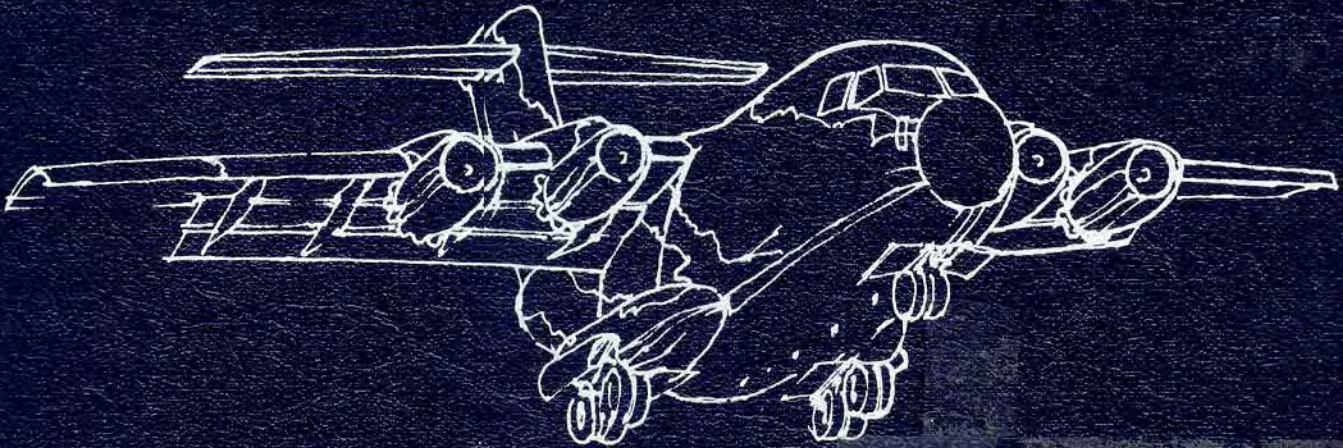
REPORT NO MDC J6005

YC-15 FLIGHT MANUAL



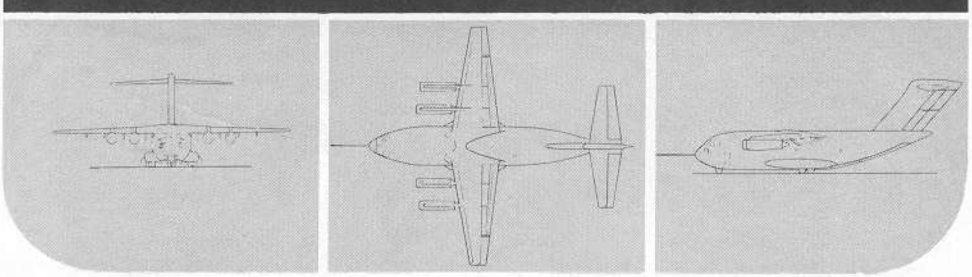
DOUGLAS AIRCRAFT COMPANY

MCDONNELL DOUGLAS CORPORATION

UTILITY FLIGHT MANUAL

McDonnell Douglas
Advanced Medium STOL Transport

YC-15



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INTRODUCTION

SCOPE

This manual contains necessary information for safe and efficient operation of the YC-15 aircraft. These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operation procedures. Your flying experience is recognized, and therefore, basic flight principles are avoided.

SOUND JUDGMENT

Instructions in this manual are for a crew inexperienced in the operation of this airplane. This manual provides the best possible operating instructions under most circumstances, but is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS

The flight manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance must be obtained from the applicable authority before any operation is attempted which is not specifically covered in this manual and/or flight test cards.

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 personnel injury or loss of life if not carefully followed.

CAUTION Operating procedures, techniques, etc., which will results in damage to equipment if not carefully followed.

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

USE OF CAPITAL LETTERS AND ABBREVIATIONS

In Section I of this manual, where most of the description material is located, placarded nomenclature (e.g., L CSD, MASTER WARNING) and switch positions are capitalized and abbreviated.

USE OF PARENTHESIS IN ELECTRICAL BUS DESCRIPTIONS

In section I of this manual the source of electrical power and circuit breakers are noted for each light, switch or valve. The following sentence illustrates the use of parenthesis in section I. The HYD QTY indicators are powered by the AC buses #1 and 2 (#3 and 4) indicators receive 28VAC, single power from the LEFT (RIGHT) AC bus through the HYDRAULIC QUANTITY, SYS 1 and SYS 2 (SYS 3 and SYS 4) circuit breakers (L:M-15-16 and R:Y-15-16 respectively) on the EPC panel. Read the sentence omitting the parenthesis except CB's. This will show #1 and 2 systems. Now read the items in the parenthesis and ignore the items preceeding them. This will show correctly for #3 and 4 systems.

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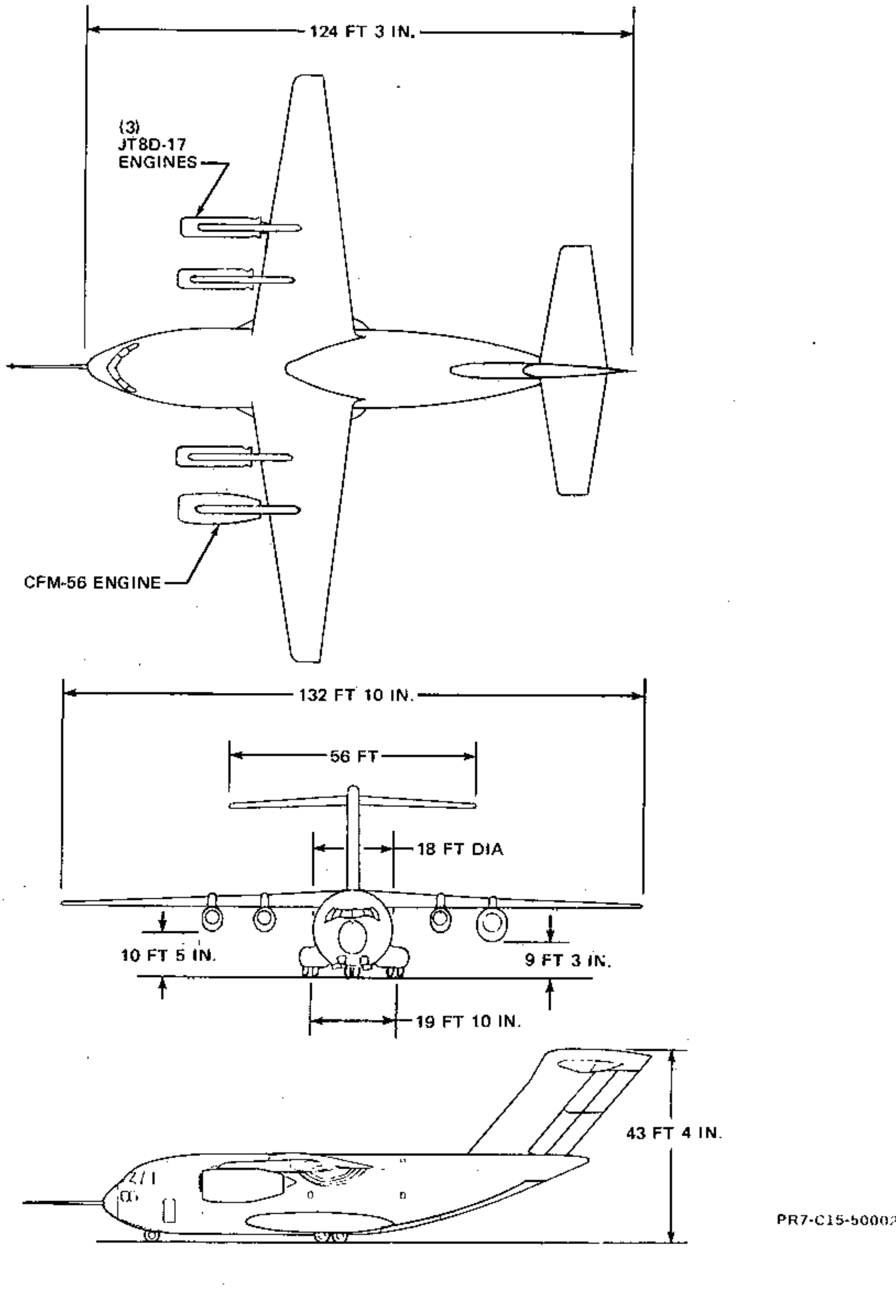

Figure 1-1

AIRCRAFT DIMENSIONS

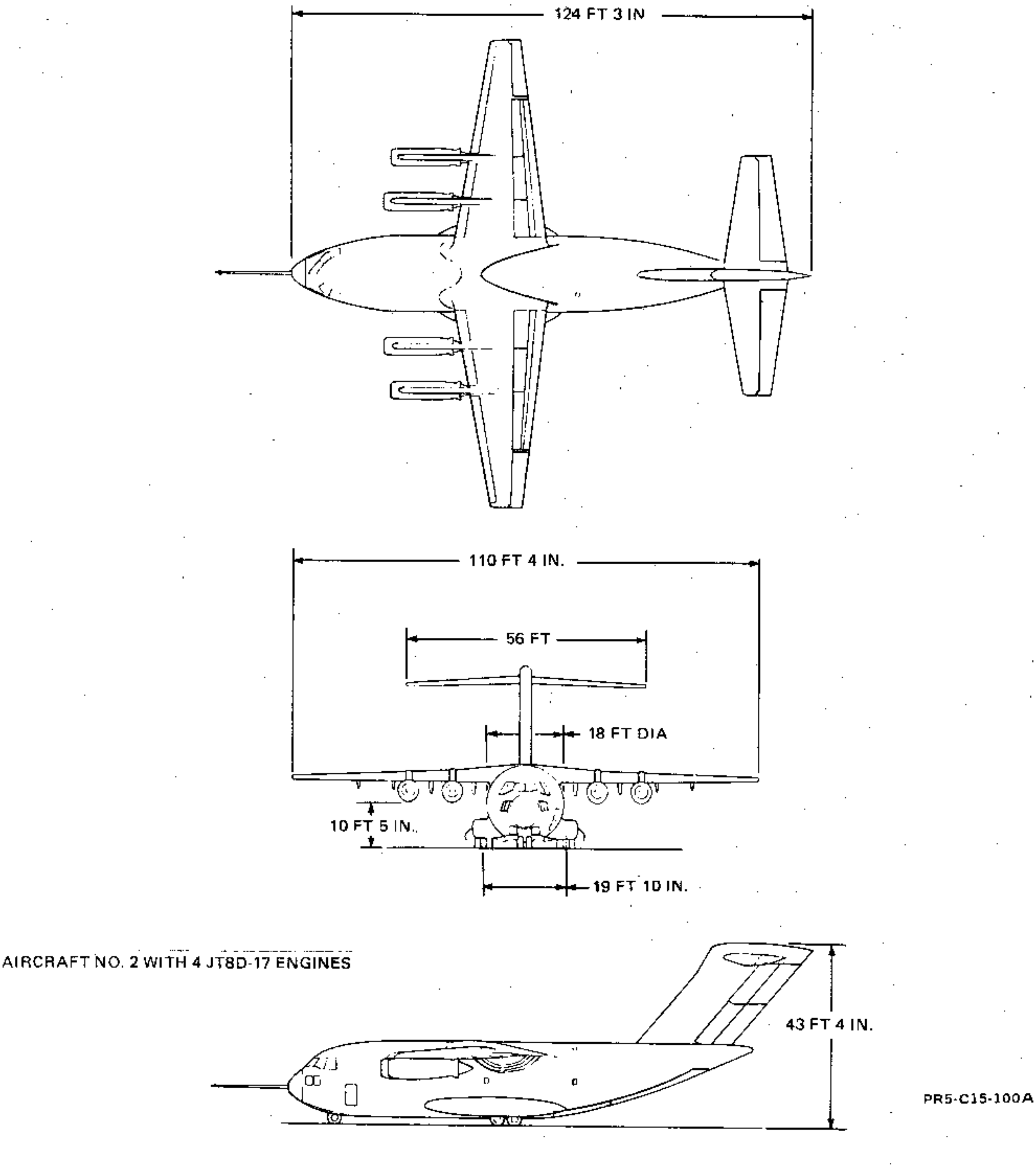

Figure 1-1A

PILOTS STATION

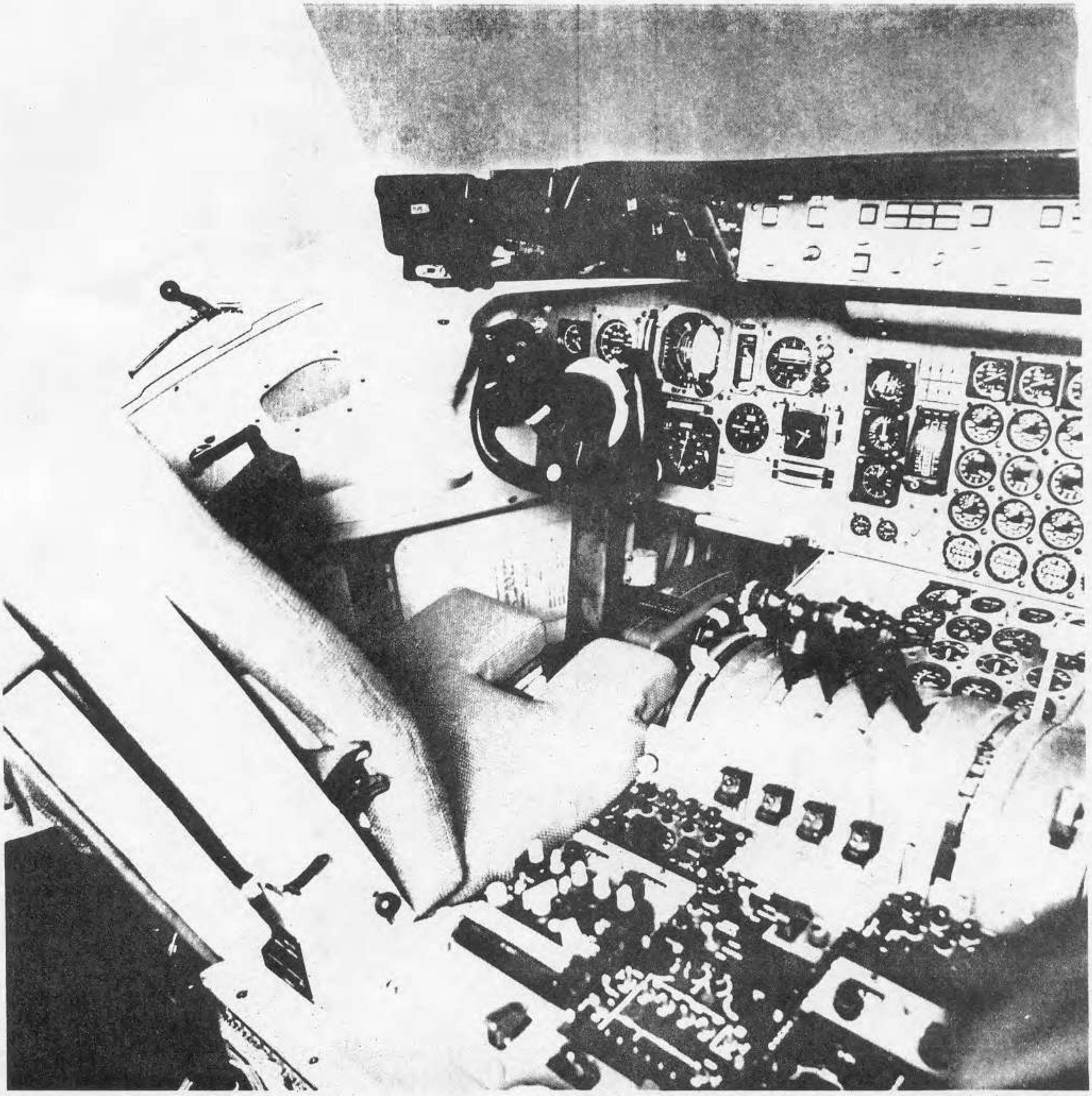

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Figure 1-2

COPILOTS STATION

Figure 1-3

OVERHEAD AND GLARESHIELD

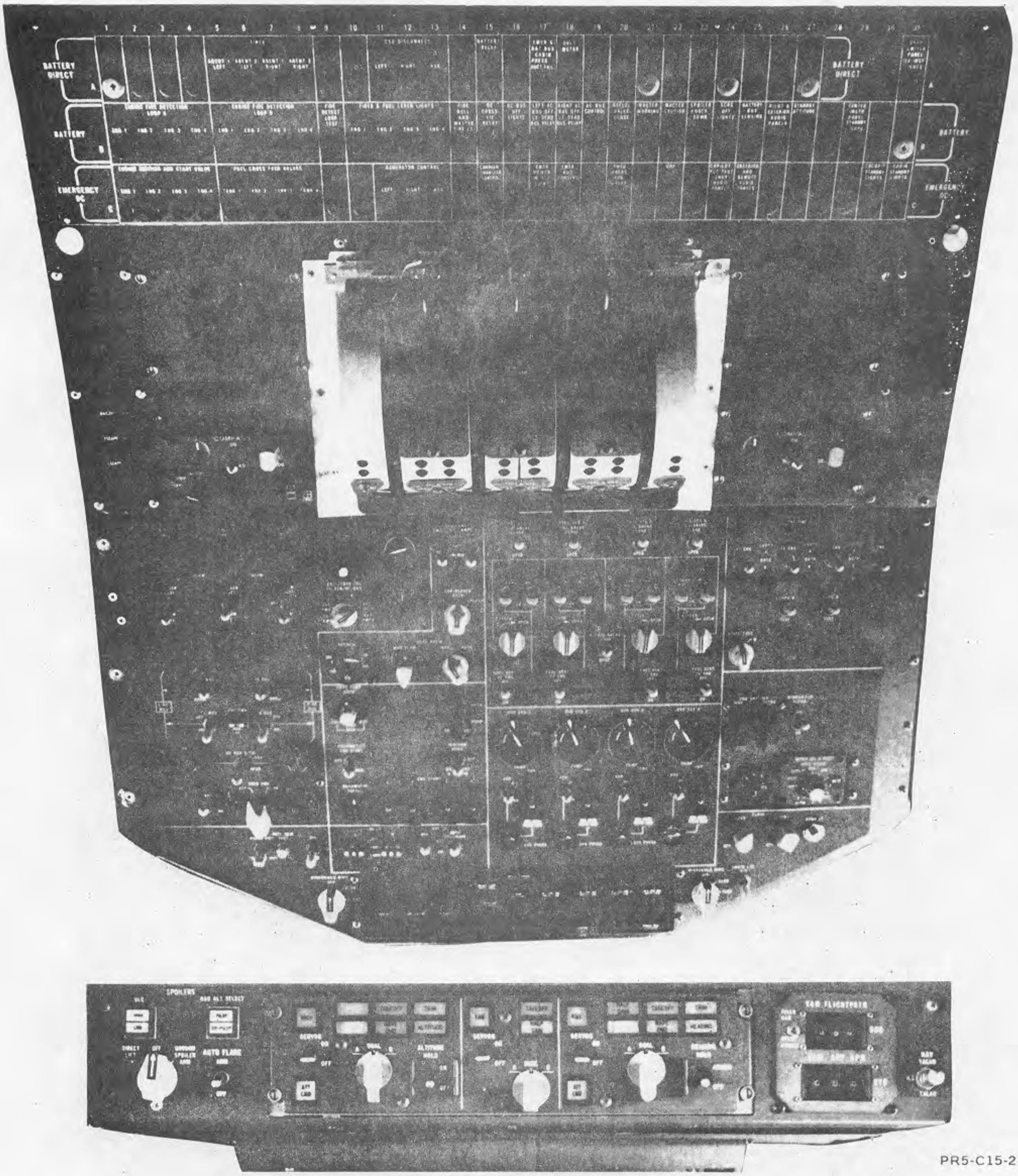

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Figure 1-4

FTE STATION

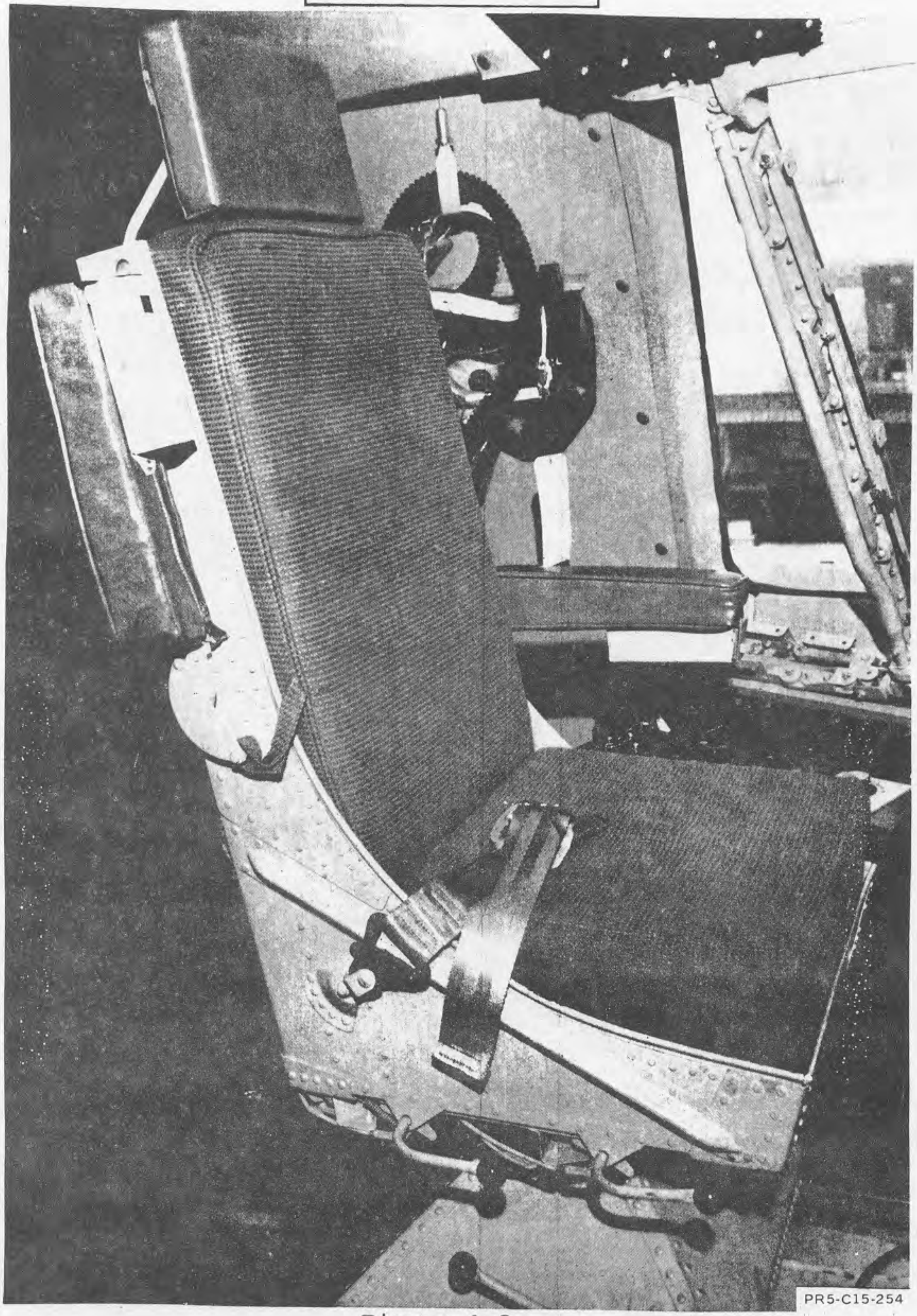

Figure 1-5

ACM STATION

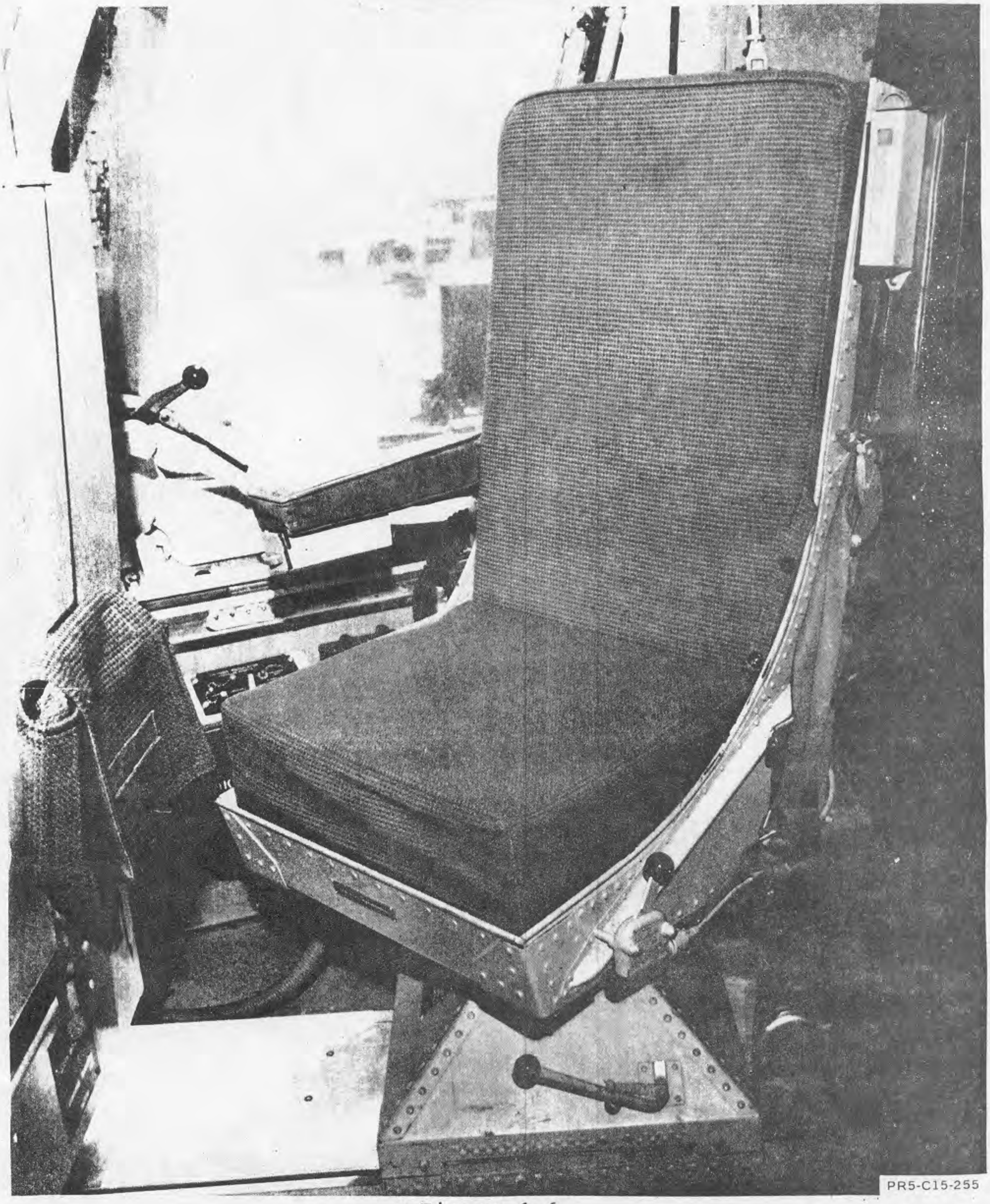

Figure 1-6

SECTION I

DESCRIPTION AND OPERATION

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THE AIRCRAFT

The McDonnell Douglas YC-15 is a prototype Advanced Medium STOL Transport (AMST) aircraft. It is an all metal, highwing, widebody, T-tail aircraft employing the Externally Blown Flap (EBF) highlift concept. The normal crew is a pilot, copilot and flight test engineer. Features of the aircraft are:

Full-scale geometric, aerodynamic and dynamic similarity to the projected production aircraft.

A fully-powered flight control system with stability and control augmentation to enhance flying qualities, especially during STOL operations.

The capability to accept and discharge cargo and troops.

Special flight test equipment including a nose boom, data acquisition system and crew emergency escape chute.

Aircraft Dimensions

Exterior dimensions and ground clearance are shown in Figures 1-1 and 1-1A. Turning radius is shown in Figure 2-2.

Aircraft Gross Weight

The maximum takeoff gross weight of the YC-15 aircraft is 216,680 pounds and the maximum landing gross weight is 190,965 pounds. STOL maximum weight using a 2,000 foot runway is 154,560 pounds. For additional weight information refer to Section V.

Interior Arrangement

The aircraft interior is designed to accommodate a test flight crew of three plus an ACM, flight test equipment, ballast (if required), and test ADS equipment as shown in FO-2 and FO-3.

Flight Crew

Accommodations are provided for a flight crew consisting of a pilot (figure 1-2), copilot (figure 1-3) and flight test engineer (figure 1-5). When flight tests dictate, an additional crewmember and/or loadmaster may be assigned. A seat is provided in the flight compartment to accommodate the ACM (figure 1-6).

ENGINES

The aircraft is powered by four Pratt and Whitney JT8D-17 turbofan engines (figure 1-7). The JT8D-17 is a twin-spool, axial flow, forward fan type engine of moderate bypass ratio. Each engine is equipped with a hydraulic thrust reverser system.

The engine nacelles are supported from wing pylons by an overhead mount system. The nacelles are isolated from the wing by a firewall within the pylon. To achieve necessary nacelle compartmentation, a fire seal is installed aft of the rear engine mount and provides separation of the accessory compartment from the reverser section. The other fire seal is the nose cowl bulkhead.

The low speed rotor, designated N1, consists of two fan stages and four compressor stages which are driven by three low pressure turbine stages (#2, 3 and 4). The high speed rotor, designated N2 consists of seven high pressure compressor stages and is driven by one high pressure turbine stage (#1).

The combustion section of the engine contains nine burner chambers. Fuel nozzles at the front of the chambers spray fuel for rapid mixing with air prior to combustion. Ignitor plugs in the No. 4 and No. 7 burner chambers provide initial ignition of the fuel-air mixture. When combustion occurs, the flame propagation tubes carry combustion to all chambers. Combustion will continue until the fuel flow is interrupted or a malfunction occurs.

Air enters the engine through a fixed inlet which incorporates a thick lower lip to provide good flow at a high angle of attack during high lift STOL operation. An annular fan duct is used to deliver the fan discharge rearward to mix with the primary exhaust downstream of the low pressure turbine.

The exhaust gas is directed through a daisy nozzle which has ten identical lobes arranged around a large plug centerbody. This nozzle arrangement promotes good mixing of the exhaust gas with freestream air to cool, slow down and spread the exhaust wake over a large span of the flap.

Each engine has a starting circuit, a throttle and reverser lever, and fuel lever. The instrument panels contain indicators for fuel flow, EGT, RPM and Engine Pressure Ratio.

The accessory gearbox provides mounting pads for the hydraulic pump, the pneumatic starter, the N2 tachometer generator, the fuel pump and the fuel control. On engines 2, 3 and 4 a constant speed drive (CSD) with a 40 KVA generator is installed. Engine 3 has provisions for bleeding 8th & 13th stage air for air conditioning.

Engine Thrust

Thrust, as such, cannot be measured directly on an installed turbofan engine. Since RPM has no fundamental relationship to thrust on the JT8D engine, it should not be used as a primary measure of thrust being developed. Some engine variable, such as turbine discharge pressure or engine pressure ratio, both of which vary proportionally with thrust, must be employed as an indication of the propulsive force that the engine is developing. On the JT8D engine, engine pressure ratio (EPR) is used as the primary indicator of developed engine thrust and for setting desired thrust. The JT8D-17 engine is flat rated to 84°F. Below 84°F, the engine operating at sea level develops 16,000 pounds of thrust. Above 84°F, thrust decreases with increasing temperature. The amount of thrust developed is reflected on the engine pressure ratio (EPR) indicators.

Engine Flat Rating

Turbojet and turbofan engines are usually "part-throttle" engines; that is, Takeoff Thrust is obtained at throttle settings below full-throttle position. "Part-throttle" engines are also referred to as being flat rated, due to the shape of the Takeoff Thrust Curves used for such engines. The primary purpose of the flat-rated engine is to provide constant thrust over a wide ambient temperature range. What is actually meant by the term "flat rating" is perhaps best described by comparing takeoff thrust settings on military "full-throttle" engines with the "part-throttle" engines.

The "full-throttle" engine is adjusted under Sea Level standard conditions to produce full rated thrust with the throttle in full forward position. Ambient temperature changes occuring with the throttle in full forward position will cause thrust level changes. Temperatures rising above the S.L. Std. 15°C will result in proportional thrust decrease, while at temperatures below standard, thrust will increase, exceeding the rated level (figure 1-8).

For maximum reliability, better hot day performance, and economy of operation, turbojet and turbofan engines are operated at the more conservative "part-throttle" positions, thus in effect making them "flat rated". A flat rated engine is adjusted under sea level standard conditions to produce full rated thrust with the throttle at less than full forward position. When ambient temperature rises above the S.L. Std. 15°C, rated thrust can still be maintained up to a given temperature increase by advancing the throttle. The amount of throttle advance available to keep the thrust level "flat rated" is determined by engine operating temperature limits.

As an example, the takeoff thrust of the Pratt and Whitney JT8D-17 turbofan engine is flat rated to sea level standard day (15°C) plus 14°C, =29°C (84°F), at which point thrust becomes EGT limited (figure 1-8). Any further increase in ambient temperature will result in proportional decrease of thrust.

At ambient temperatures below S.L. Std., the thrust is held by partial throttle to the same maximum value as for a hot day. In this manner a flat rated engine can produce a constant rated thrust over a wide range of ambient temperatures without overworking the engine.

Determining Required Thrust

Thrust curves and charts are used to determine the required engine pressure ratio (EPR) for any desired engine rating at prevailing ambient temperature and barometric pressure. Takeoff thrust is limited by time, engine speed and exhaust gas temperature (EGT). Maximum continuous thrust is limited by EGT.

NOTE

The aforementioned ratings are related to a specified value of thrust, not - as is sometimes interpreted - to a maximum value of RPM and/or EGT. The limitations of RPM and EGT are physical limitations within which an engine should develop the appropriate thrust rating.

Engine Rated Takeoff Thrust

Takeoff thrust is the maximum thrust approved for takeoff operation. For the JT8D-17 engine the specified rating is the maximum thrust available at or below 84°F ambient temperature. The rating is time limited to five minutes or less. The rating is established by setting the throttle to obtain the predetermined EPR value for the prevailing altitude and temperature conditions. Since this rating is less than the full-throttle thrust capability of the engine, it is important that takeoff thrust setting parameters are accurately determined and set to insure compliance with takeoff thrust rating limitations. The takeoff thrust rating is to be used for takeoff and go around.

Engine Rated Maximum Continuous Thrust

Maximum continuous thrust is the maximum thrust approved for continuous use. Maximum continuous thrust is authorized for emergency use at the discretion of the pilot, and for climb operations. The rating is selected by setting the throttle to obtain the predetermined EPR value for the prevailing altitude and total air temperature.

Engine Cooling

The nacelle ventilation system is designed to provide adequate cooling of engine and accessories and to prevent accumulation of combustible vapors.

Engine Oil System

The engine oil system (figure 1-9) is a high-pressure, self-contained system supplying the main engine bearings and accessory drives. An oil scavenge system withdraws oil from the bearing compartments and accessories, and returns oil to the oil tank. A breather system connects the individual bearing compartments and oil tank.

The oil tank gravity feeds the main oil pump which pumps oil through the main oil filter to the system. The main oil filter bypass valve will open to bypass oil around a clogged filter. A differential pressure switch senses pressure on both sides of the filter and turns on the ENG OIL FILTER Δ P and MASTER CAUTION lights if the differential pressure is approximately 35 PSI. The pressure regulating valve will regulate the main oil pump pressure and will relieve excessive pressures. Oil then passes through the fuel/oil cooler heat exchanger to cool the engine oil; and, if the cooler becomes clogged, the fuel/oil cooler bypass valve will open to permit continuous flow of oil. Under normal conditions all oil flows through the fuel/ oil cooler without temperature regulation. The oil temperature sensor provides input for the oil temp gage on the forward section of the pedestal. The oil pressure transmitter, sensing oil pressure and engine breather pressure, supplies a pressure signal to the oil pressure indicator on the forward section of the pedestal.

The oil pressure low caution switch senses pressure of the oil delivered to the bearings. If the pressure at this point drops below approximately 35 PSI, a circuit is completed to turn on the ENG OIL PRESS LOW and MASTER CAUTION lights. Oil passes through additional screens before being metered to the bearings. From the bearings, oil drains into collection points and is pumped back to the tank by a series of scavenge pumps. The air oil separator in the engine gearbox separates the oil from the air. These oil particles are pumped back to the tank by a scavenge pump in the gearbox and the air is vented to atmosphere.

The usable oil volume in each oil tank when filled is approximately 4 US gallons. Each engine may be operated as long as oil pressure and temperature limits are not exceeded. The oil quantity should indicate a minimum of 5 quarts prior to engine start and 8 quarts after engine is stabilized at IDLE RPM.

NOTE

Static engine oil level

check should be conducted within 15 minutes after engine shutdown to obtain an accurate indication of quantity. When engines remain static for extended periods oil flows into the engine scavenge areas resulting in an erroneous low oil quantity indication.

Engine Fuel Controller System

Each engine fuel controller system (figure 1-11) is identical and independent of each other. The fuel control and engine driven pump are located at the forward right lower section of the engine gearbox. The fuel control responds to engine compressor speed (N2), compressor inlet temperature (Tt2) and burner pressure (Ps4) and will supply fuel for optimum engine operation at each throttle setting.

Two electric driven fuel pumps in each wing tank deliver fuel through the fire shutoff valve to the first stage engine driven pump. An inlet pressure switch will turn on the PRESS LOW and MASTER CAUTION lights when the supply pressure to the first stage pump drops below 5 PSI. The first stage pump normally delivers fuel through the air/fuel heat exchanger and fuel filter to the high pressure pump. If the heat exchanger is blocked, the bypass valve will open allowing fuel to the high pressure pump. If the first stage pump is damaged, a bypass valve will open allowing unfiltered fuel to the high pressure pump. A FUEL HEAT switch on the pilots' overhead panel controls the engine 13th stage bleed air supply shutoff valve through a timer (1 minute on then off). Fuel heat is used to prevent or remove ice at the filter. The fuel temperature transmitter provides an input to the fuel temperature indicator on the flight test engineer's auxiliary panel. A differential pressure switch senses pressure on both sides of the main fuel filter and turns on the pilots' overhead switch panel FUEL FILTER PRESS DROP and MASTER CAUTION lights if differential pressure reaches approximately 5 PSI. The high pressure pump delivers fuel to the fuel control when the fuel lever is ON for proper metering to the engine.

The metered fuel flows through the flowmeter sensor and provides an input for the FUEL FLOW indicator on the center instrument panel. The fuel oil cooler utilizes fuel flow to cool engine oil. The primary fuel nozzles supply fuel to the burner cans during low power engine operation. The secondary fuel nozzles are cut in as a function of primary nozzle pressure drop to supply the necessary flow.

Engine Ignition System

Each engine has two ignition systems, one high energy DC powered 20 joule, and one low energy AC powered 4 joule system. The high energy system services both ignitors on each engine. The low energy system services one ignitor on each engine. When one ignition system is in use, the other ignition system for that engine is interrupted. Both ignition systems route electrical power to an ignition exciter, located on the left side of each engine. The exciter transforms the respective electrical power to a high voltage oscillating current which fires across the gaps of the ignitor plugs. The low energy system is used for continuous operation of the ignitor plugs. It also enhances the longevity of the plugs. The high energy is used for ground starting and instantaneous high power to the ignitor plugs in the event of a flame out.

Engine Ignition Switch

The engine IGNITION switch (figure 1-12) is a three-position lever lock switch which controls the operation of the engine fuel ignitor plugs in Nos. 4 and 7 burner cans.

The OVRD (override) position provides 20-joule DC energy to both ignitors in all engines, bypassing the ENG START control switches. The OVRD position diminishes probability of engine flame out in adverse weather, during takeoff or turbulence penetration. Normal duty cycle is 2 minutes on and 3 minutes off, 2 minutes on and 23 minutes off. The OFF position interrupts all energy to both ignitors in all engines. The GND START & CONTIN (continuous) position provides 20-joule DC high energy to both ignitors when the ENG START switch is on and the fuel lever for that engine is placed ON. When the ENG START switch is OFF, the FUEL lever is ON, and the IGNITION switch is GND START & CONTIN, the 4-joule AC low energy system services the ignitor plug in the No. 7 burner can of the respective engine.

The 20-joule DC high energy ignition systems receive 28-VDC power from the DC EMERGENCY BUS through the ENGINE IGNITION AND START VALVE, ENG 1, 2, 3 and 4 circuit breakers (C-1, -2, -3, -4) on the pilots' overhead panel.

The 4-joule AC low energy ignition systems receive 115-VAC, single-phase power from the AC buses. #1 and 2 are powered by the LEFT AC bus through the CONTINUOUS IGNITION, ENG 1 and ENG 2 circuit breakers (P-10, -11) on the EPC panel. #3 and 4 are powered by the RIGHT AC bus through the CONTINUOUS IGNITION, ENG 3 and ENG 4 circuit breakers (AA-10, -11) on the EPC panel.

Engine Starting System

Each engine is equipped with a starting system consisting of a pneumatic starter, starter control valve, pneumatic ducting and the starting and ignition control circuits. All engines may be started by using an external pneumatic power source. Engines 1, 2 and 4 may also be started using Engine 3 bleed air as an internal pneumatic source after Engine 3 is operating. However, Engine 3 must be started using an external pneumatic source.

The pneumatic-driven turbine starter accelerates the N2 compressor to starting speed and also aids engine acceleration after light-off until self-sustaining speed is reached. An electrically controlled, pneumatically actuated starter valve on each engine controls each engine's starter.

Engine Start Switches

Four ENG START switches (figure 1-12), located in the pilots' overhead panel, are of the two-position spring-loaded OFF type. In addition to completing the electrical circuits to the ignition switch (refer to Ignition System), holding an engine start switch in the ON position opens the starter valve for the respective engine. When the starter valve opens, its ENG START VALVE OPEN light comes on in the pilots' annunciator panel. Starter valve opening can also be determined by observing a drop in pneumatic pressure as indicated on the pneumatic pressure indicator. The ENG START valves receive 28 VDC power from the DC EMERGENCY bus through the ENGINE IGNITION and START VALVE, ENG 1, 2, 3, 4 circuit breakers (C-1, -2, -3, -4) on the pilots' overhead panel.

Engine Start Valve Open Light

Four green ENG START VALVE OPEN lights (figure 1-12) are located in the pilots' annunciator panel. An ENG START VALVE OPEN light comes on when the respective engine starter valve opens. The lights receive 28 VDC power from the DC buses. Lights #1 and 2 are powered by the LEFT DC bus through the ENGINE START VALVE OPEN LIGHTS, ENG 1 and ENG 2 circuit breakers (V-7, -8) on the EPC panel. Lights #3 and 4 are powered by the RIGHT DC bus through the ENGINE START VALVE OPEN LIGHTS, ENG 3 and ENG 4 circuit breakers (AF-7, -8) on the EPC panel.

Engine Starting, Normal

The pneumatic starter drives the engine for ground starts. The pneumatic manifold is connected to the engine starter valve on Engines 1, 2, 4 and to the pressure regulator valve on #3 engine. Moving the PNEUMATIC switch to ENG START opens the pressure regulator valve allowing air to Engine #3 starter valve. In addition, it closes the air conditioning flow valve preventing the possibility of contamination in the air conditioning system. A minimum pneumatic pressure of 36 PSI is required for ground start. Holding the ENG START switch ON, opens the pneumatic starter valve supplying air to the starter. On the pilots' annunciator panel, the respective ENG START VALVE OPEN light comes on when the valve opens approximately 5°.

CAUTION

If your finger slips off the START switch, do not re-engage the starter. Wait until N2 rotation is zero before attempting another start.

The ENG START switches should not be used inflight as damage to the starter/engine may occur.

Moving the FUEL lever to ON (between 15 and 20%, N2 RPM) completes the ignition circuits. Releasing the ENG START switch (between 30 and 40% N2 RPM) closes the starter valve, turning off the related ENG START VALVE OPEN light. Moving the IGNITION switch to OFF de-energizes the ignition circuits. Refer to Section V for starter limitations.

Fuel Levers

Four FUEL levers (figure 1-15) are located on the aft portion of the throttle pedestal. Fuel is shutoff at the fuel controller until the respective FUEL lever is moved to the ON position. The FUEL LEVER pushrod must be pressed to unlock the lever prior to actuation of the lever to ON or OFF position. Each lever is cable connected to its respective engine fuel control shutoff valve. The ON position opens the valve to supply fuel to the applicable engine. Movement of each lever also controls engine ignition when the ignition switch is in GND START & CONTIN position. As the lever is moved to the OFF position, the fuel is shut off first then ignition.

Engine Thrust Reverser System

Each engine is equipped with a thrust reverser system (figure 1-13) installed in the aft section of the engine nacelle. Reverse thrust is equal to approximately 35% of engine forward thrust. The system consists basically of an interfering ring, translating cascades, control valve, actuating mechanism, control and indicating circuits and indicators.

The interfering ring has the cascade and daisy nozzle attached. This entire unit is movable forward and aft and is positioned by four hydraulic actuators. When the interfering ring, cascade and daisy nozzle are in the forward position (forward thrust), the engine exhausts through the passageway between the daisy nozzle and the engine centerbody. This nozzle disperses the engine exhaust in a fan pattern for externally blown flaps. When this unit moves aft (reverse thrust), the interfering ring blocks the passageway, exposes the cascades so that engine exhaust can be directed through the cascades in an upward and forward direction.

The thrust reverser system is designed for two position operation only: stowed (forward thrust) or extended (reverse thrust). Transition from forward to reverse, and visa versa is accomplished by the throttle piggyback lever movement. Hydraulic power for each engine thrust reverser is supplied by the hydraulic system of the respective engine through an electrical and mechanical valve. These two valves provide redundant protection against inadvertent reverser deployment. Movement of the reverser lever to reverse idle detent actuates a switch which opens the electrically operated valve and mechanically positions the second valve.

Throttle cross-shaft angle stops are installed to limit reverse thrust inflight and on the ground. The stops are in the ground mode with the landing gear selector in DOWN position. The ground stops are set to limit reverse thrust to maximum continuous thrust (MCT) or less during ground operation. When the landing gear selector is placed in the UP position, the stops shift to the flight mode. The flight stops are set to limit reverse thrust to approximately 40% thrust (1.4 EPR) in flight to insure operation below the reverser actuator structural limits.

CAUTION

> Engine limitations could be exceeded if the stops were not properly adjusted. Do not exceed MCT on the ground or 1.4 EPR in flight.

Thrust Reverser Hydraulic Pressure Lights

Four amber THRUST REV PRESS lights (figure 1-13), one for each thrust reverser hydraulic system, are located in the overhead annunciator panel. A light comes on when the respective thrust reverser electric valve is open pressurizing the system up to the manual valve. The THRUST REV PRESS light circuits receive 28 VDC power from the DC buses. The LEFT DC bus powers lights #1 and 4 through the ENGINE THRUST REVERSE PRESS LIGHT, ENG 1 and ENG 4 circuit breakers (V-11, -12) on the EPC panel. The RIGHT DC bus powers lights #2 and 3 through the ENGINE THRUST REVERSE PRESS LIGHT, ENG 2 and ENG 3 circuit breakers (AF-11, -12) on the EPC panel.

Thrust Reverser Not Locked Lights

Four amber THR REV NOT LKD lights (figure 1-13), one for each thrust reverser, are located on the pilots' center instrument panel. A light comes on when any one of the locks of the related actuators are not in the locked position. The lights receive 28 VDC power from the DC buses. The LEFT DC bus powers lights #1 and 4 through the ENGINE THRUST REVERSE INDICATION, ENG 1 and ENG 4 circuit breakers (U-11, -12) on the EPC panel. The RIGHT DC bus powers lights #2 and 3 through the ENGINE THRUST REVERSE INDICATION, ENG 2 and ENG 3 circuit breakers (AE-11, -12) on the EPC panel.

Thrust Reverser Extended Lights

Four green THR REV EXTD lights (figure 1-13), one for each thrust reverser, are located on the pilots' center instrument panel. When the reverser is fully extended a limit switch in each thrust reverser closes to complete a circuit to the related light. The lights receive 28 VDC power from the DC buses. The LEFT DC bus powers lights #1 and 4 through the ENGINE THRUST REVERSE INDICATION, ENG 1 and ENG 4 circuit breakers (U-11, -12) on the EPC panel. The RIGHT DC bus powers lights #2 and 3 through the ENGINE THRUST REVERSE INDICATION, ENG 2 and ENG 3 circuit breakers (AE-11, -12) on the EPC panel.

Reverse Do Not Use Caution Light

An amber flight REVERSER DO NOT USE caution light (Figure 1-13), located on the pilots' center instrument panel, provides a means of monitoring the thrust reverser flight stops. The REVERSER DO NOT USE light comes on when the reverser flight stops are not in the correct flight position. The light receives 28 VDC power from the RIGHT DC bus through the ENGINE THRUST REVERSER LIMITER LIGHTS circuit breaker (AF-9).

CAUTION

If the REVERSER DO NOT USE light is on in flight, the pilot should limit reverse thrust to near idle since the design strength of the reverser actuators may be exceeded at high reverse thrust.

Reverser Limited Caution Light

An amber flight REVERSER LIMITED light (Figure 1-13), located on the pilots' center instrument panel, provides a means of alerting the pilots of limited reverse thrust for landing. The REVERSER LIMITED light comes on when the thrust reverser flight stops have not retracted and the landing gear is down. The stops limit the amount of thrust available on landing. The REVERSER LIMITED light receives 28 VDC power from the RIGHT DC bus through the ENGINE THRUST REVERSER LIMITER LIGHTS circuit breaker (AF-9).

CAUTION

If the REVERSER LIMITED light is on, thrust reverser will be limited to approximately reverse idle.

The circuit logic uses gear handle operation to actuate the flight thrust reverser stops and gear position to activate the caution lights.

Thrust Reverser Operation

When the throttle piggyback lever is placed in the reverse idle position, two signals are transmitted to the reverser control valve. A cable rotates the selector cam in the reverser control valve and an electrical signal supplies electrical power to the inlet valve solenoid to open the control valve to hydraulic pressure. At this time the hydraulic pressure switch signals the THRUST REV PRESS light to come on. Simultaneously the hydraulic pressure will extend the thrust reverser in the following sequence:

1. An interlock in the thrust reverser control valve prevents throttle movement up and aft of reverse idle.

2. Hydraulic pressure is directed to unlock the reverse actuators in sequence. As the lock of the first actuator opens, its indicator switch signals the THR REV NOT LKD light to come on.

3. When the actuators are unlocked, hydraulic pressure is directed to a thrust reverser control valve which directs pressure to extend the actuators to effect reverse thrust.

4. When the actuators are within an inch of the extended position, the mechanical throttle interlock is removed to permit piggyback lever movement to the thrust reverser limit stops.

5. When the actuators have fully extended, the feedback strikes the deploy position switch resulting in de-energizing the solenoid, shuts off the hydraulic pressure and turns on the THRUST REV EXT light. The reverser is held in position by air loads.

CAUTION

> Advancing the throttle from forward flight idle, while thrust reversers are stowing may cause the thrust reversers to stop in an intermediate position. Verify that all thrust reverser lights are off prior to advancing the throttles.

When the piggyback lever is moved down and forward out of reverse thrust, the preceding sequence is reversed. The actuators retract and are locked in position by the actuator locks, and hydraulic pressure is vented from the system.

Throttles

One set of four throttles are quadrant mounted on the pedestal. Each throttle is cable connected to its respective engine fuel control unit to regulate engine thrust. When throttles #1 or 2 are advanced and DLC is selected and flaps are in takeoff position the takeoff warning horn will sound intermittently. When any throttle is retarded to approximately IDLE position and the landing gear is not down, the landing gear warning horn will sound. On top of each throttle is the thrust reverser lever (piggyback style). The throttle must be moved to IDLE position before the reverse lever can be moved aft for reverse thrust. On the outboard of #1 and #4 throttles is a Direct Lift Control (DLC) thumb switch which permits DLC operation by either pilot. A takeoff/go-around button is installed on #2 throttle. When pressed it will electrically retract the spoilers.

Engine Instruments

Engine Pressure Ratio (EPR) Indicators

Engine Pressure Ratio (EPR) indicators (figure 1-14) are located on the pilots' center instrument panel. The EPR indicator shows the ratio of low pressure turbine exit total pressure to engine inlet total pressure. Each engine is equipped with an EPR transmitter which consists of a pressure ratio sensor that is connected with pressure sensing probes located in the engine inlet and in the low pressure turbine exit. It computes the ratio and transmits the EPR signal to the indicator. Each indicator is equipped with a pointer, digital readout window and a marker. The marker and digital readout are set by the set knob in the face of the indicator. The EPR indicators receive 115 VAC, single phase power from the AC buses. The LEFT AC bus powers #1 and 2 through the ENGINE PRESSURE RATIO, ENG 1 and ENG 2 circuit breakers (N-10, -11) on the EPC panel. The RIGHT AC bus powers #3 and 4 through the ENGINE PRESSURE RATIO, ENG 3 and ENG 4 circuit breakers (Z-10, -11) on the EPC panel.

N1 and N2 Tachometers

Engine N1 and N2 RPM indicators (figure 1-14), located on the pilots' center instrument panel, indicate the speed of the fan (N1) and the compressor (N2). The indicators monitor the speeds of the individual engines. Each RPM indicator has two dials. The small dial is graduated in 1% increments from 0 to 9. The large dial is calibrated in 2% increments marked every 10% from 0 to 100. The N1 and N2 tachometer systems are self- power generating and do not require aircraft power.

Engine Exhaust Gas Temperature (EGT) Indicators

The exhaust temperature indicators (figure 1-14), located on the pilots' instrument panel, indicates the exhaust gas temperatures. Each indicator is calibrated in 20° increments from 0 to 860°C and is marked every 100°C. The EGT indicators are self-power generating and do not require aircraft power.

Fuel Flow Indicators

Fuel flow indicators (figure 1-14) are located on the pilots' center instrument panel and show the engine fuel flow rate (1000 pounds per hour). The indicators are graduated in 200 pound increments from 0 to 12,000 and are marked every 1000 pounds. The pointers are colored orange. A digital readout window shows the total amount of fuel used by its related engine. One FUEL USED RESET toggle switch is used to reset all four of the FUEL USED readout windows. The fuel flow indicating system receives 115 VAC, single phase power from the AC buses. The LEFT AC bus Power #1 and 2 through the FUEL FLOW, ENG 1 and ENG 2 circuit breakers (N-7, -8) on the EPC panel. The RIGHT AC bus Powers #3 and 4 through the FUEL FLOW, ENG 4 circuit breakers (Z-7, -8) on the EPC panel.

Oil Pressure Indicators

On the pedestal, center forward section, are the engine oil pressure indicators (figure 1-14). Each oil pressure indicator is calibrated from 0 to 100 pounds per square inch with graduations every 5 pounds and marks every 20 pounds. The indicators transmit oil pressure in the distribution lines after the main oil filter. The oil pressure indicators are powered by 28 VAC. The LEFT AC bus powers #1 and 2 through the ENGINE OIL PRESSURE, ENG 1 and ENG 2 circuit breakers (M-10, -11) on the EPC panel. The RIGHT AC bus powers #3 and 4 through the ENGINE OIL PRESSURE, ENG 3 and ENG 4 circuit breakers (Y-10, -11) on the EPC panel.

Oil Temperature Indicators

Each of the four oil temperature indicators (figure 1-14) is calibrated in 2° increments marked every 20°C from 0 to 170°C. The indicators show oil temperature that has passed through the fuel/oil cooler. The oil temperature system is powered by 28 VDC. The LEFT DC bus supplies #1 and 2 through the ENGINE OIL TEMP INDICATOR, ENG 1 and ENG 2 circuit breakers (T-7, -8) on the EPC panel. The RIGHT DC bus powers #3 and 4 through the ENGINE OIL TEMP INDICATOR, ENG 3 and ENG 4 circuit breakers (AD-7, -8) on the EPC panel.

Oil Quantity Indicators

The four oil quantity indicators (figure 1-14) show the quantity of usable oil in the tank. Each indicator is graduated in quarts from 0 to 18 quarts with numerals every 4 quarts. The oil quantity indicating system is powered by 28 VDC. The LEFT DC bus supplies #1 and 2 through the ENGINE OIL QTY INDICATOR, ENG 1 and ENG 2 circuit breakers (U-7, -8) on the EPC panel. The RIGHT DC bus powers #3 and 4 through the ENGINE OIL QTY INDICATOR, ENG 3 and 4 circuit breakers (AE-7, -8) on the EPC panel.

Oil Pressure Low Caution Lights

Four amber ENG OIL PRESS LOW lights (figure 1-9), one for each engine, are located on the overhead annunciator panel. A light and the MASTER CAUTION lights come on when the oil pressure in the distribution system decreases below approximately 35 PSI and goes out when the pressure increases above 35 PSI. The OIL PRESSURE LOW caution lights received 28 VDC from the DC buses. The LEFT DC bus powers #1 and 2 through the ENGINE OIL LOW PRESSURE LIGHT, ENG 1 and ENG 2 circuit breakers (T-9, -10) on the EPC panel. The RIGHT DC bus powers #3 and 4 through the ENGINE OIL LOW PRESSURE LIGHT, ENG 3 and ENG 4 circuit breakers (AD-9, -10) on the EPC panel.

Oil Filter ΔP Caution Lights

Four amber ENG OIL FILTER ΔP lights (figure 1-9), one for each engine, are located on the overhead annunciator panel. A light and the MASTER CAUTION lights come on when the pressure differential between the inlet and outlet sides of the main oil filter exceeds 35 PSI and goes out when the differential pressure decreases below 35 PSI. The ENG OIL FILTER ΔP light receives 28 VDC from the DC buses. The LEFT DC bus powers #1 and 2 through the ENGINE OIL FILTER ΔP LIGHT, ENG 1 and ENG 2 circuit breakers (U-9, -10) on the EPC panel. The RIGHT DC bus powers #3 and 4 through the ENGINE OIL FILTER ΔP LIGHT, ENG 3 and ENG 4 circuit breakers (AE-9, -10) on the EPC panel.

Total Air Temperature Versus EPR Indicator

A Total Air Temperature (TAT) versus Engine Pressure Ratio (EPR) indicator (figure 1-10), located on the center instrument panel, indicates allowable EPR for the existing total air temperature. The pressure ratio limits on these scales do not make allowances for engine airbleed or anti-ice loss. Maximum continuous thrust (MCT) EPR scale for the JT8D-17 engine ratings apply at all temperatures and altitudes.

STATIC TAKEOFF/GO-AROUND WINDOW - The left Static Takeoff/Go-Around Window displays the static takeoff (STA-TO) white engine pressure ratio scale. Also the yellow pressure altitude EPR limitation scale when NORM is selected.

MAXIMUM CONTINUOUS THRUST WINDOW - The right window displays the maximum continuous thrust (MCT) engine pressure ratio scale.

TOTAL AIR TEMPERATURE POINTERS - The total air temperature (mechanically bussed together) pointers receive inputs from the right TAT probe and move vertically on the fixed TAT air temperature scale.

SELECTOR knob - A three position selector knob allows selection of three sets of scales for Static T.O. and MCT. NORM is a general format; EDW is for EDWARDS AFB and YUMA is for YUMA.

ENGINE FIRE DETECTION SYSTEM

The fire detection system detects overheating or a fire condition in the engine nacelle and alerts the crew by a visual and/or aural indication. The system is dual with two separate fire- sensing element loops and an individual amplifier control unit for each fire detection area. The detection system in each fire area is capable of detecting a fire condition with one sensing element loop ground faulted or open. When the sensing loops are subjected to heat, the resistance to ground of the loops is decreased; and, when a preset value of resistance is reached, the amplifier control unit completes the electrical circuit to the fire warning indicating components. Normally both sensing element loops in an area must be grounded or must attain the fire condition resistance value before a fire warning indication or aural warning is produced. One fire sensing loop in an area will provide adequate fire detection for normal flight. System integrity and operation may be checked by simultaneous actuation of the two test switches which will simulate a fire condition and will cause all fire warning indicators to be energized on a properly operating fire detection system. All fire warning indications will terminate when the fire condition ceases or when the integrity test is terminated by releasing the test switches.

Engine Loops Select Switches

The ENGINE LOOPS select switches (figure 1-15) are located in the overhead panel. Each ENG LOOPS select switch, one for each engine, are three- position, lever lock type switches which select the detection loops designated A, loops designated B, or BOTH loops (A and B). The switches are normally in BOTH position but may be in A or B position to perform integrity tests or to isolate a malfunctioning detection circuit so that fire detection operation will be maintained in an area where a fire detector circuit has been analyzed as open or ground faulted by an integrity check. All LOOPS select switches receive 28 VDC power from the BAT bus through the ENGINE FIRE DETECTION, LOOP A and LOOP B, ENG 1, 2, 3 and 4 circuit breakers (B-1, -2, -3, -4, -5, -6, -7, -8) on the pilots' overhead panel.

Loop A and Loop B Lights

The LOOP A and LOOP B lights (figure 1-15) are turned on by a signal from the applicable fire detection loops or from a test circuit. If the related LOOPS switches are in A or B position, only the A or B lights will come on. If all LOOPS switches are in BOTH position, all LOOPS lights (A and B) will come on. A loop signal will turn on the respective loop light. All LOOP lights receive 28 VDC power from the BAT bus through the ENGINE FIRE DETECTION, LOOP A and LOOP B, ENG 1, 2, 3 and 4 circuit breakers (B-1, -2, -3, -4, -5, -6, -7, -8) on the pilots' overhead panel.

Engine Fire Shutoff Handles Lights

Four engine fire shutoff handles (figure 1-15), located in the overhead panel, have integral warning lights. When a fire condition is sensed in an engine area or the test circuits are tested, the related ENG FIRE shutoff handle lights and the master ENG FIRE light comes on, the fire warning bell rings, the applicable engine LOOP A and LOOP B lights and the related fuel lever caution lights will come on. The ENG FIRE shutoff handle warning lights receive 28 VDC power from the BAT bus through the FIREX & FUEL LEVER LIGHTS, ENG 1, 2, 3, 4 circuit breakers (B-10, -11, -12, -13) on the pilots' overhead panel.

Engine Fire Warning Light and Bell

A red master ENGINE FIRE warning light (figure 1-15) is located on the left side of the pilot's glareshield. When a signal from the engine fire detection circuits or the test circuits is received, the ENGINE FIRE warning light will come on and the engine fire warning bell will ring, if an ENG FIRE shutoff handle is in the normal stowed (up) position. The engine fire warning bell can be silenced and the ENGINE FIRE warning light extinguished by pressing the ENGINE FIRE warning switch/light or actuating the related ENG FIRE shutoff handle. The ENGINE FIRE warning light and bell receive 28 VDC power from the BAT bus through the FIRE BELL and MASTER FIRE LT circuit breaker (B-14) on the pilots' overhead panel.

Fuel Lever Caution Lights

Two amber caution lights (figure 1-15), located in each fuel lever, will come on for each of the following:

1. An engine fire signal.
2. An engine is shut down with the ENG FIRE shutoff handle and no fire signal is present with the fuel lever in ON.
3. The engine fire detection system is tested.

The lights will go off when:

1. The engine fire signal ceases (overheat condition is gone).
2. The ENG FIRE shutoff handle has been pulled and there is

no engine fire and the FUEL LEVER is placed in OFF.

3. The engine fire detection system test is terminated.

The fuel lever caution lights receive 28 VDC power from the BAT bus through the FIREX & FUEL LEVER LIGHTS, ENG 1, ENG 2, ENG 3, ENG 4 circuit breakers (B-10, -11, -12, -13) on the pilots' overhead circuit breaker panel.

Loops A Test and Loops B Test Switches

The LOOPS A TEST and LOOPS B TEST are two position switches (figure 1-15) that are spring-loaded to up and momentary in TEST. The switches are located on the pilots' overhead panel. The left switch (LOOPS A TEST) tests fire detector A loops, and the right switch (LOOPS B TEST) tests fire detector B loops. When both test switches are held down, a circuit is completed for each fire detection area through the entire length of both sensing loops detector elements in each area and then to ground, which simulates a fire condition. This condition actuates the fire relays in the amplifier control units and completes the fire warning indicating circuits.

When the LOOPS select switches on the ENG FIRE DETECT SYS panel are in BOTH position, both LOOPS A TEST and LOOPS B TEST switches must held down to produce fire warning indications and to ring the engine fire warning bell. The following lights will come on: all red ENG FIRE shutoff handles, red master ENGINE FIRE warning light, all amber fuel lever caution lights, and all amber LOOP A and LOOP B lights. If only one switch is held down only the lights on the engine fire detection system panel for the selected LOOP A or LOOP B light will come on. When one or more LOOPS select switches are in either A or B position and both test switches are held down, all flight compartment red fire warning lights come on and the fire warning bell will ring, but the non- selected LOOP A or LOOP B lights will not come on. To produce all cockpit red fire warning indications and cause the fire warning bell to ring when only one test switch is held down, all LOOPS select switches on the engine fire detector system panel must be placed in the same loop position as the test switch being used.

Fire Detection System Test

Operational Test Procedure

1. Apply electrical system power and check that the applicable circuit breakers are in.

NOTE

Only battery bus power is required for this test. However, if AC power is available set up the electrical panel to utilize it.

2. Verify that all four ENG LOOP selector switches are in BOTH. All LOOP A and LOOP B lights should be off.

3. Simultaneously hold down both LOOPS A and LOOPS B TEST switches.

4. Check that the lights in all ENG FIRE shutoff handles, all LOOP A and LOOP B, master ENGINE FIRE warning, all fuel lever caution lights come on, and that the fire bell rings.

NOTE

If only one test switch is held down, only the respective LOOP A or LOOP B lights will come on.

5. Press and release the master ENGINE FIRE warning light.

6. Check that the fire warning bell stops ringing and the master ENGINE FIRE light goes off.

7. Release both LOOPS A and LOOPS B TEST switches.

8. Check that all fire warning indications terminate.

If during Step 4 all lights did not come on and/or bell did not ring, identify the engine LOOP A or LOOP B light that did not come on and continue test as follows:

9. Isolate inoperative LOOP A or LOOP B circuit by placing applicable LOOPS select switch in operational loop position. Maximum of one loop detection area may be isolated.

10. Repeat Steps 3 through 8. During Step 4 lights should come on except the isolated LOOP A or LOOP B light to indicate a normal test. If test is normal, continue operation. If fire warning indications are not produced after isolating malfunctioning fire detection loop or loops, system requires maintenance.

NOTE

During normal operation if one sensing element loop or detection circuit ground faults, the respective LOOP A or LOOP B light will come on, but the red fire warning lights will not come on and/or the fire warning bell will not sound.

Engine Loop Circuits Fire Detection Fault

Test Procedure Inflight or On Ground

If during flight or ground operation an ENG LOOP A or LOOP B light comes on but the red ENG FIRE warning light in the respective ENG FIRE shutoff handle does not come on and/or the master ENGINE FIRE warning light and/or the bell does not ring, proceed as follows:

1. Place applicable ENG LOOPS select switch in the position opposite from LOOP (A or B) light that came on.

2. Hold down LOOPS (A or B) TEST switch associated with loop position selected on ENG LOOPS select switch.

If red warning lights in applicable ENG FIRE shutoff handle come on and/or master ENGINE FIRE warning light comes on and/or bell rings, release test switch, leave LOOPS select switch in selected position, and continue operation.

If red warning lights in applicable ENG FIRE shutoff handle do not come on and bell does not ring when test switch is held, an open circuit in the tested loop is indicated and the LOOP A or B light that came on must be assumed to be a fire warning. Release the test switch, place the ENG LOOPS select switch to the position corresponding to the LOOP (A or B) light that came on and follow engine fire procedures (refer to EMERGENCY PROCEDURES, Section

III).

ENGINE FIRE EXTINGUISHER SYSTEM

The engine fire extinguishing system (figure 1-16) consists of two identical systems one for engines 1 and 2 and the other for engines 3 and 4 and cannot be interconnected. Each system consists of two fire extinguishing agent containers, distribution lines, and control circuits. The extinguishing agent of a selected container is dispensed to the required area by operating the ENG FIRE shutoff handle for that area.

Each of the four fire extinguishing agent containers, two in each wing, has two electrically controlled discharge heads. Both containers in the left wing have one head for Engine 1 and one for Engine 2. Both containers in the right wing have one head for Engine 3 and one for Engine 4. Each container has a pressure gage that can be viewed through an inspection panel under each wing about 2 feet outboard of Engines 1 and 4. Each container is loaded with 10.0 pounds of agent, is charged with nitrogen, provides one extinguishing shot and cannot be recharged while installed in the aircraft.

NOTE

> The engine fire extinguishing system uses Bromotrifluoromethane (BrCF3) as an extinguishing agent. This agent is a non-volatile, colorless, heavy liquid with an odor resembling chloroform. It can be harmful to humans after prolonged contact in vapor or liquid form. It should be handled with caution.

Engine Fire Shutoff Handle

Each ENG FIRE shutoff handle (figure 1-14) provides fire warning indication and fire extinguishing control for the respective engine. Pulling the respective ENG FIRE handle down will trip the generator control relay, shut off engine fuel and hydraulic pumps supply. Rotating a handle clockwise, or CCW, will discharge the fire extinguishing agent from #1 or #2 container for the related engine.

OIL SUPPLY SYSTEM

Each engine is provided with an integral non pressure regulated oil supply system. A gravity filled tank with a total capacity of 5.5 gallons and usable quantity of 4.0 gallons is installed. A sight level gage (windows) show the full and low levels. For oil servicing see Figure 1-102.

— TR-10 —

TEMPORARY REVISION X

SECTION I (DESCRIPTION AND OPERATION)

1. Page 1 - 018

After the "Engine Fire Shutoff Handle" and prior to the "OIL SUPPLY SYSTEM" paragraphs, add the following:

ENGINE FAILURE DETECTION SYSTEM.

An engine failure detection system is installed in Aircraft 2. The system provides visual and aural annunciation to alert the pilots' of an engine failure. The engine failure detection system utilizes the thrust management system, engine EPR's, Master Caution system, a horn and two engine fail lights. The engine fail signal is generated within the thrust management system when an engine EPR decreases 0.2 EPR below the mid-value EPR. This signal then turns on the MASTER CAUTION and ENGINE FAIL lights and energizes the caution horn. The system is armed when the mid-value EPR is 1.2 or more and there are no thrust reversers deployed. There is no ON-OFF switch for the system. The system is enabled-disabled by 28 VDC from the LEFT DC bus through the ENGINE FAILURE DETECT circuit breaker (K-7) on the EPC panel.

ENGINE FAIL LIGHTS.

Two amber ENGINE FAIL lights (flashing), one located on each pilot's glareshield, alerts the pilots to an engine failure.

ENGINE FAIL HORN.

A small horn is mounted near the pilot's instrument panel eyeball air outlet. The signal that turns on the ENGINE FAIL lights also powers the horn.

When the system is armed and an engine EPR decreases 0.2 EPR below the mid-value EPR, the MASTER CAUTION lights come on, the Amber ENGINE FAIL lights come on flashing, and the caution horn sounds intermittently.

To cancel the lights and horn, press the Master Caution light. This also disarms the system. The system can only be re-armed by returning the affected EPR to within 0.2 EPR of the other engines.

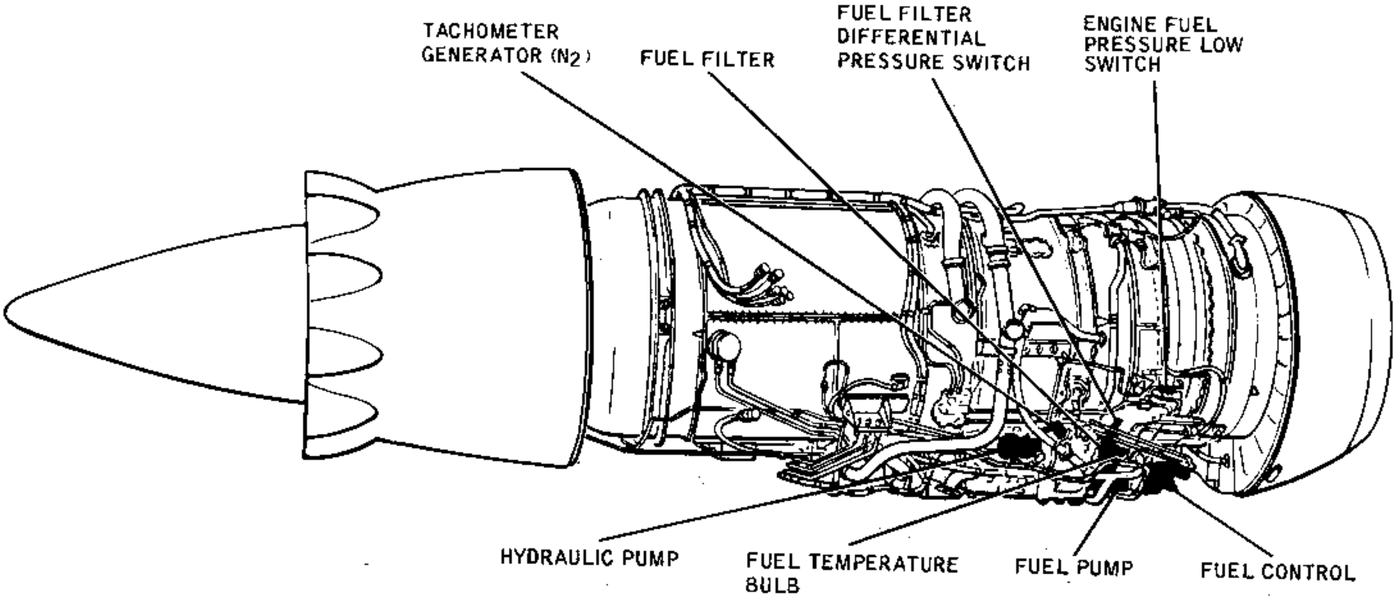
The system can be tested as follows:

1. Set all 4 EPR's to 1.2 or more.
2. Retard one throttle so EPR is less than 1.2, MASTER CAUTION, ENGINE FAIL lights should come on and caution horn should sound.
3. Momentarily press MASTER CAUTION light. Lights and horn should go off.

NOTE

Advancing the throttle until the EPR is equal to or more than the other EPR's will rearm the system.

JT8D-17 TURBOFAN ENGINE



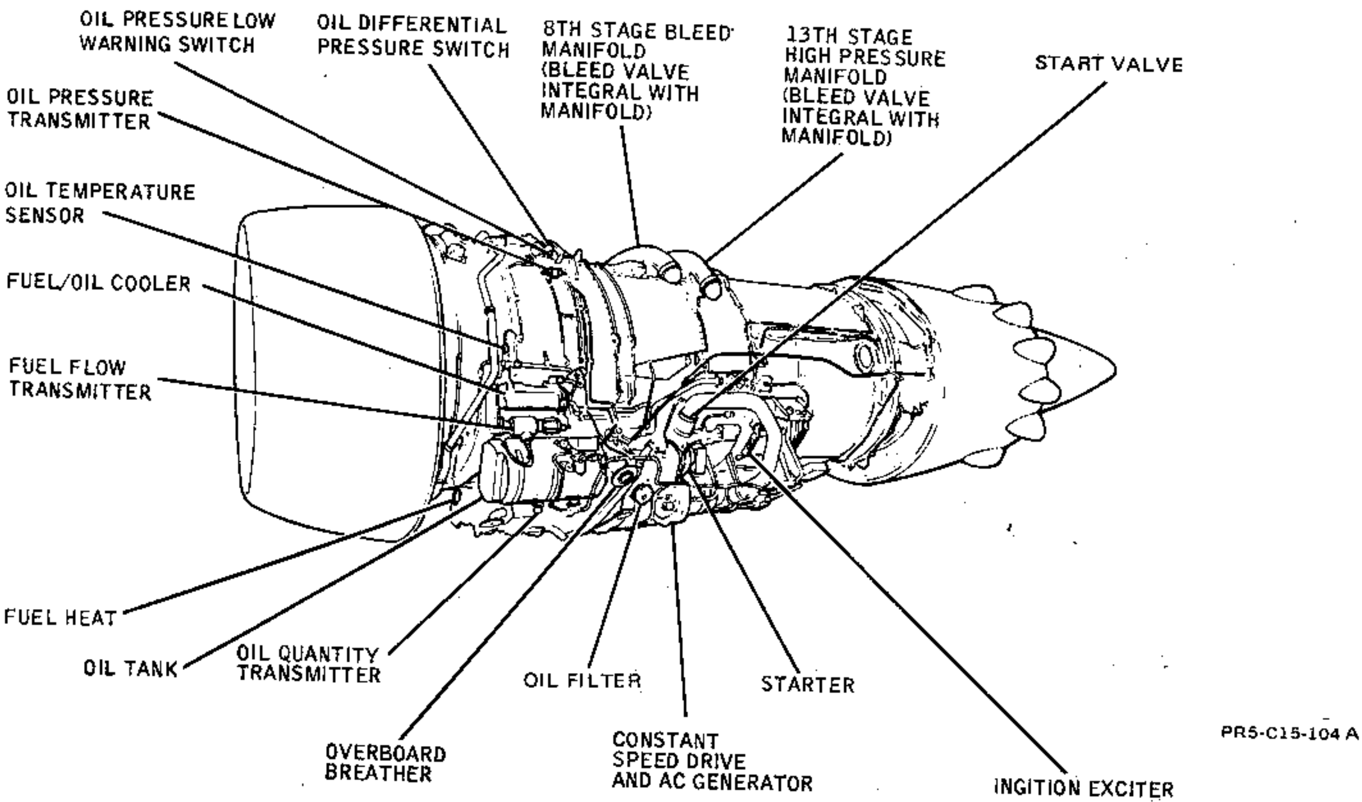


Figure 1-7

FLAT RATED vs FULL THROTTLE ENGINE

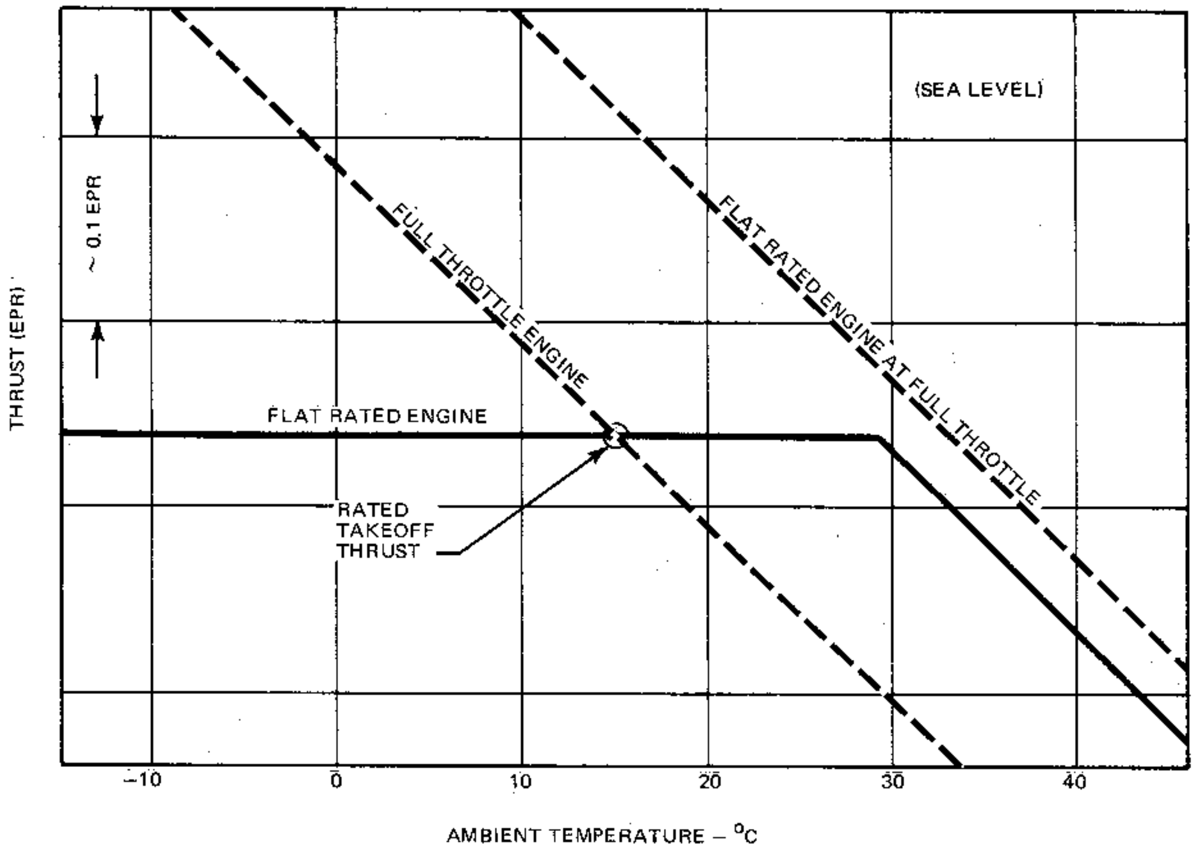


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Figure 1-8

ENGINE OIL SYSTEM

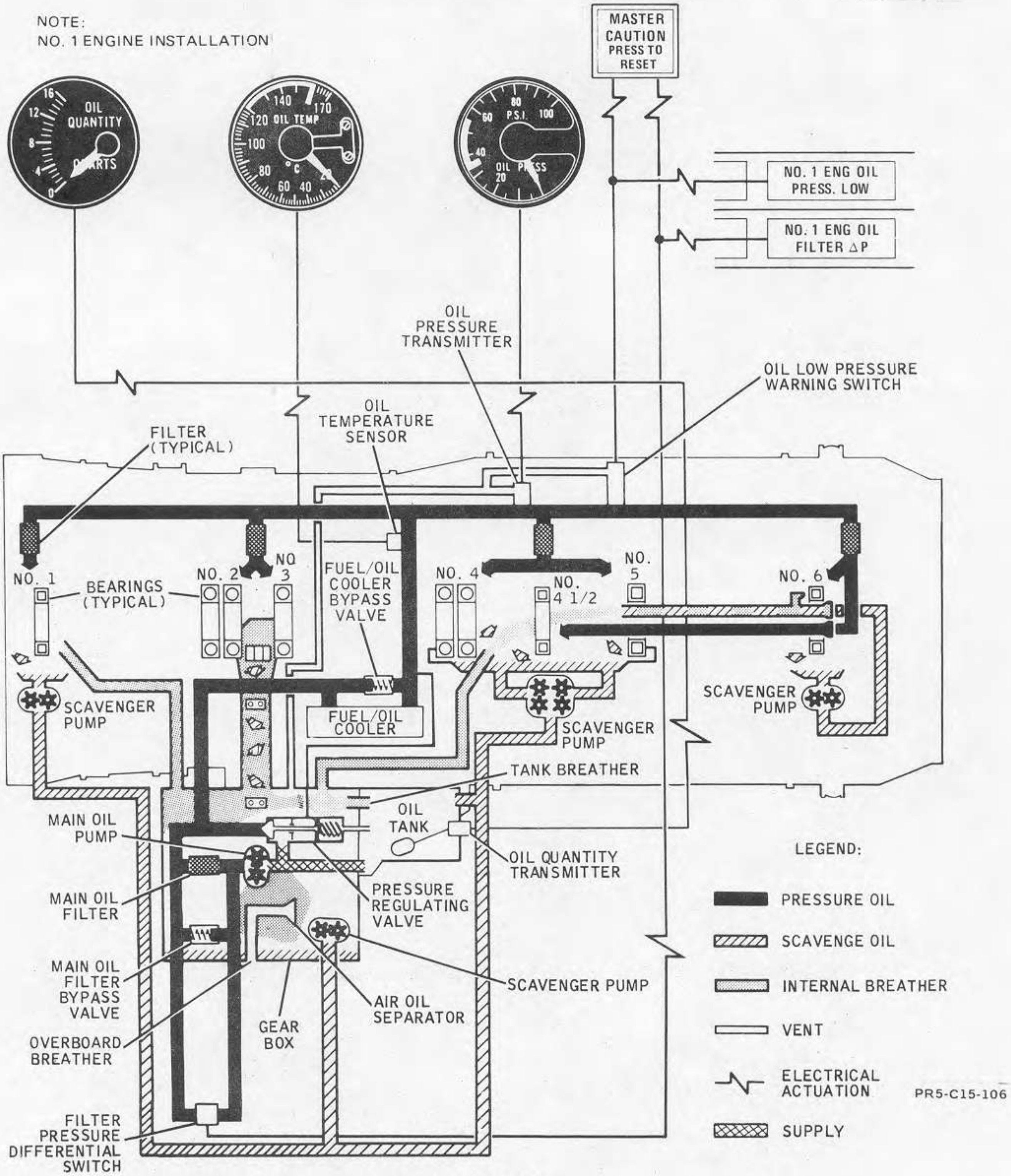

Figure 1-9

ENGINE TOTAL AIR TEMPERATURE vs EPR INDICATOR

NOTES:
1. PRESSURE RATIO LIMITS ON THESE SCALES DO NOT MAKE ALLOWANCES FOR AIR BLEED AND ENGINE ANTI-ICE PROTECTION LOSS.
2. MAXIMUM CONTINUOUS THRUST (MCT) EPR SETTINGS DISPLAYED ON THE TAT Vs INDICATOR FOR THE JT8D-17 ENGINE RATINGS APPLY AT ALL TEMPERATURES AND ALTITUDES.

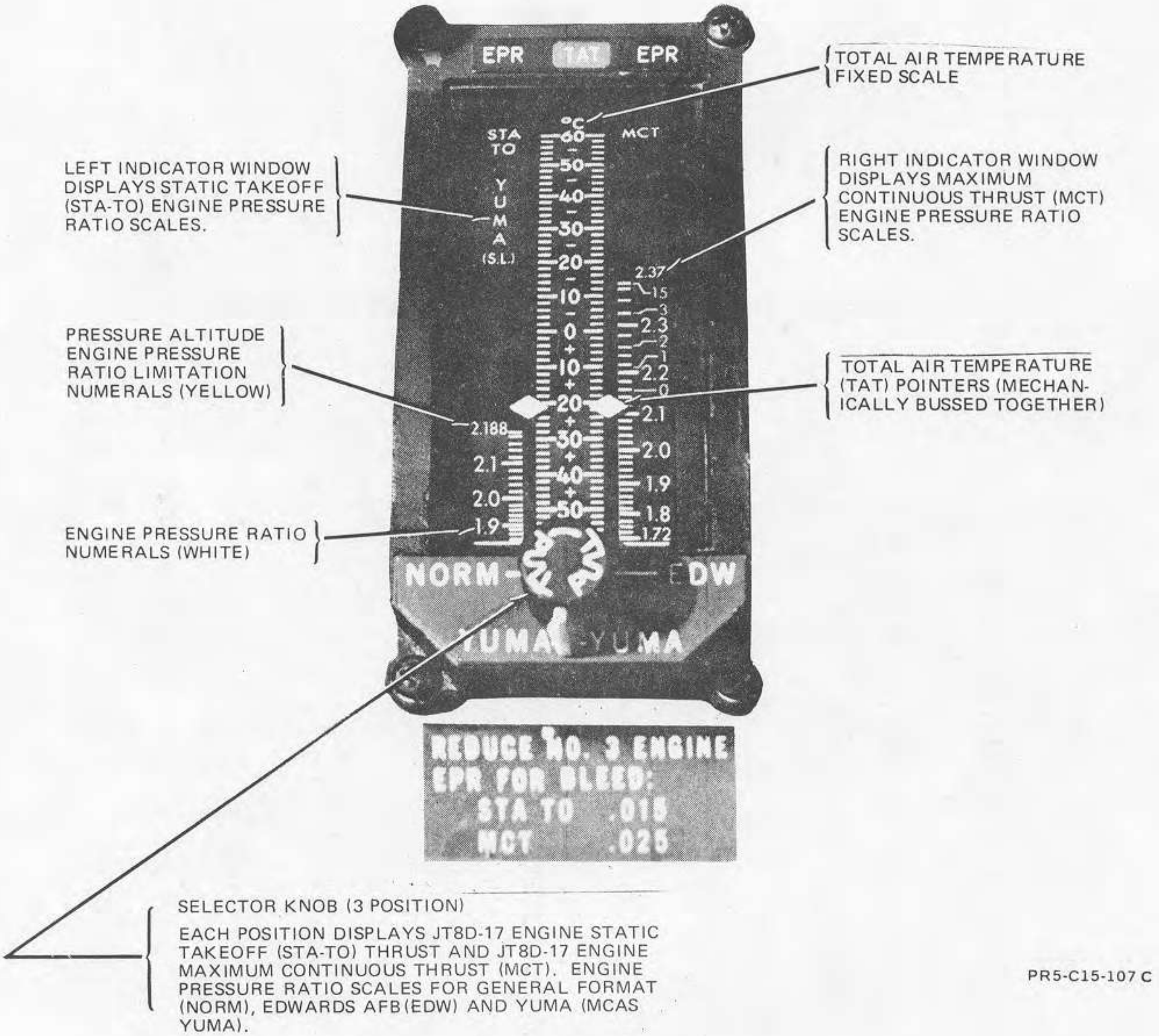

Figure 1-10

ENGINE FUEL SYSTEM

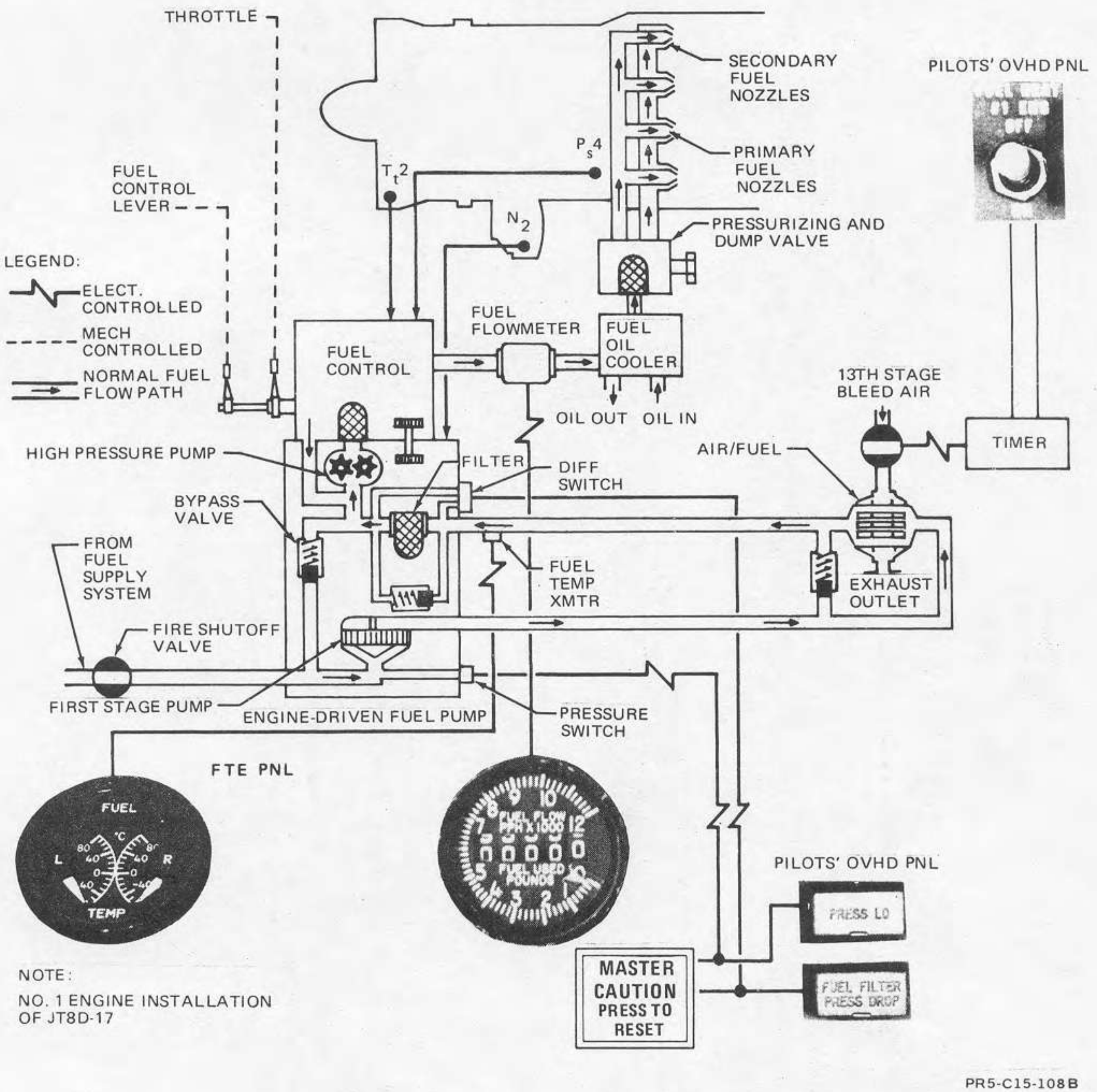

Figure 1-11

ENGINE CONTROL PANEL AND INDICATORS

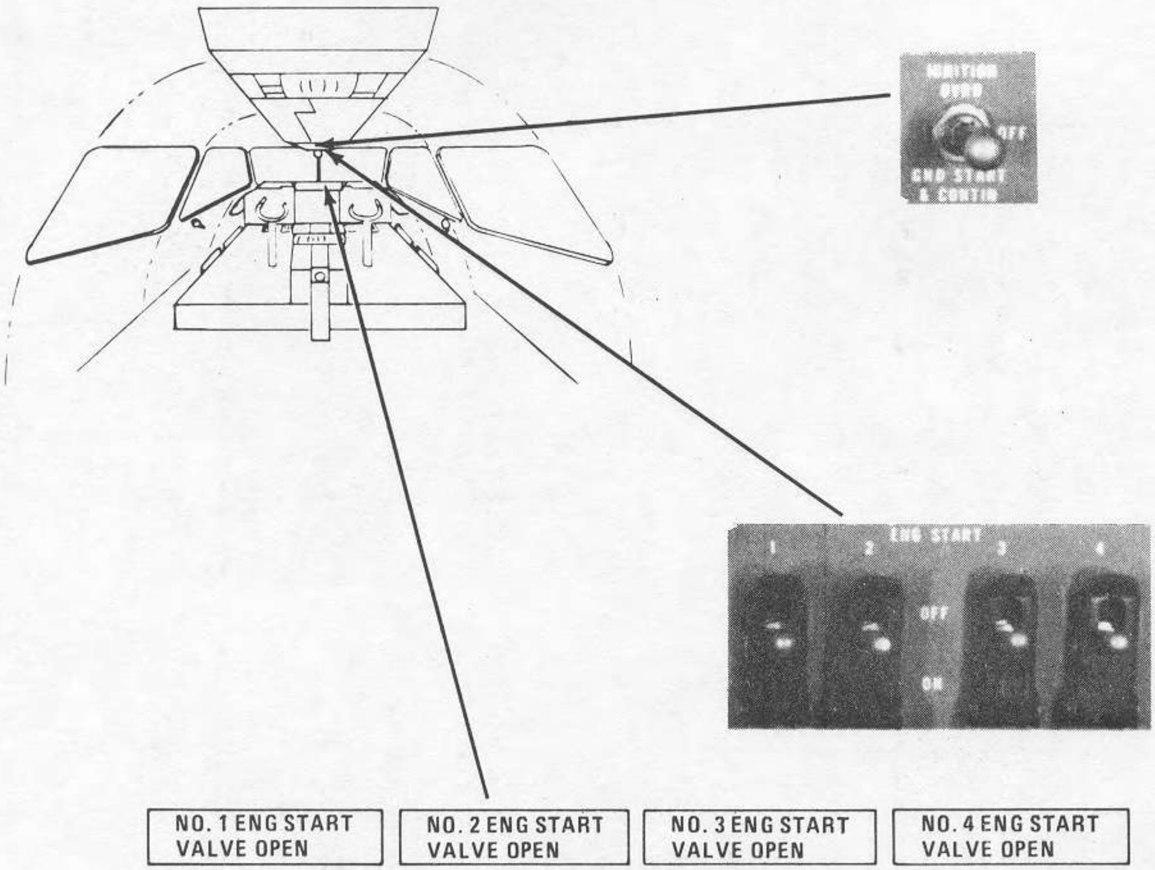

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Figure 1-12

REVERSE THRUST SYSTEM

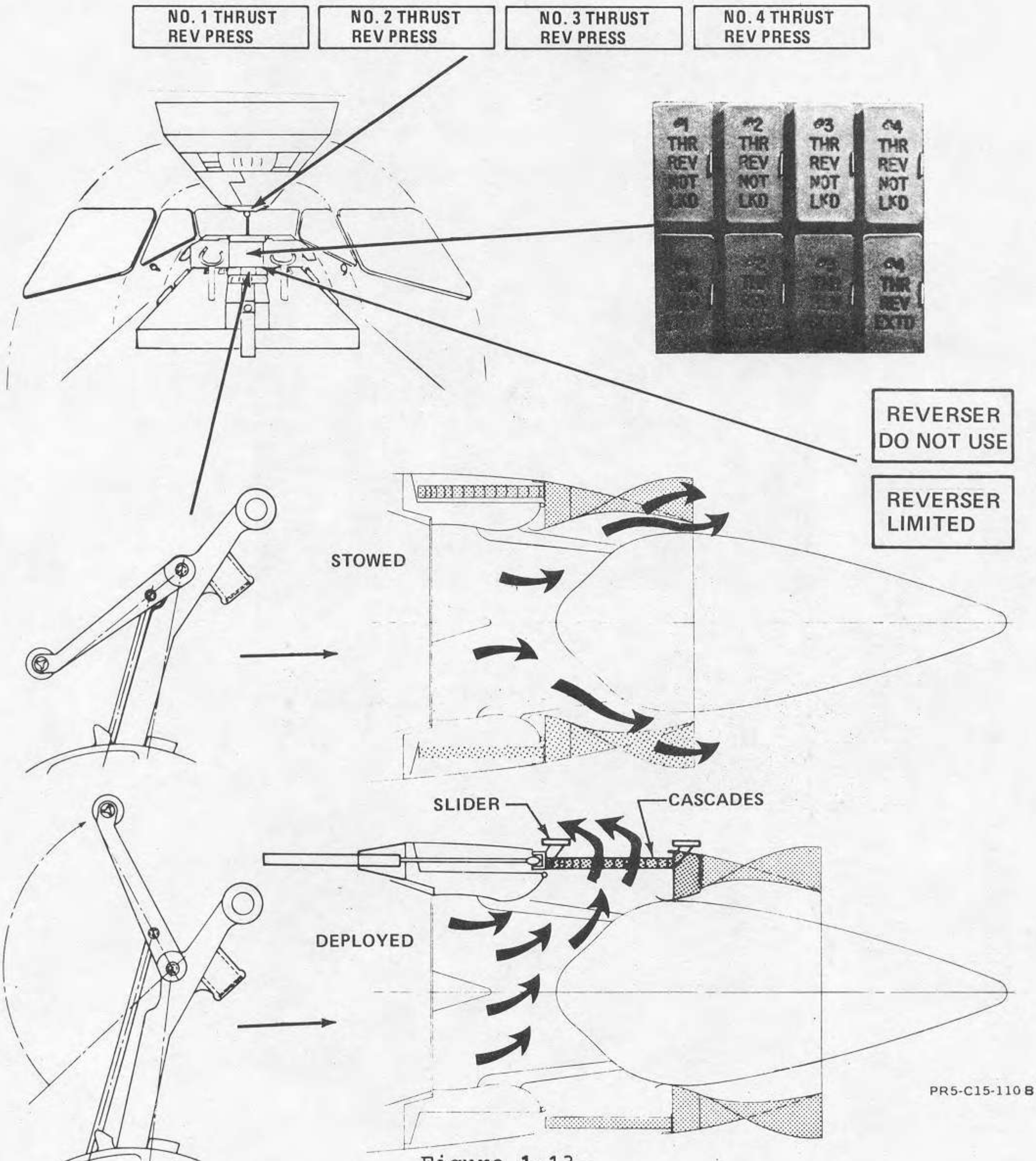

Figure 1-13

ENGINE INSTRUMENTS

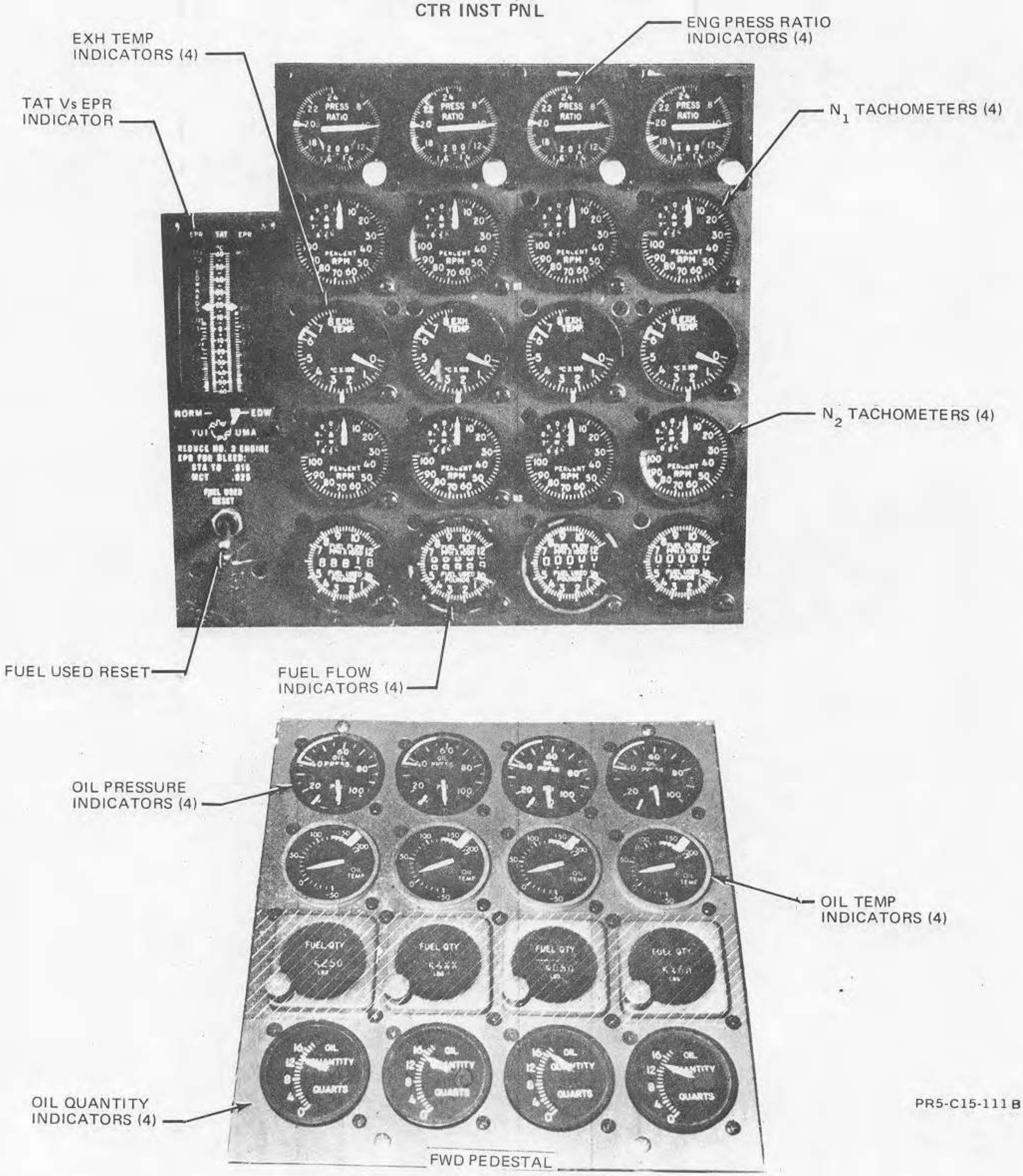

Figure 1-14

ENGINE FIRE DETECTION SYSTEM CONTROLS AND INDICATORS

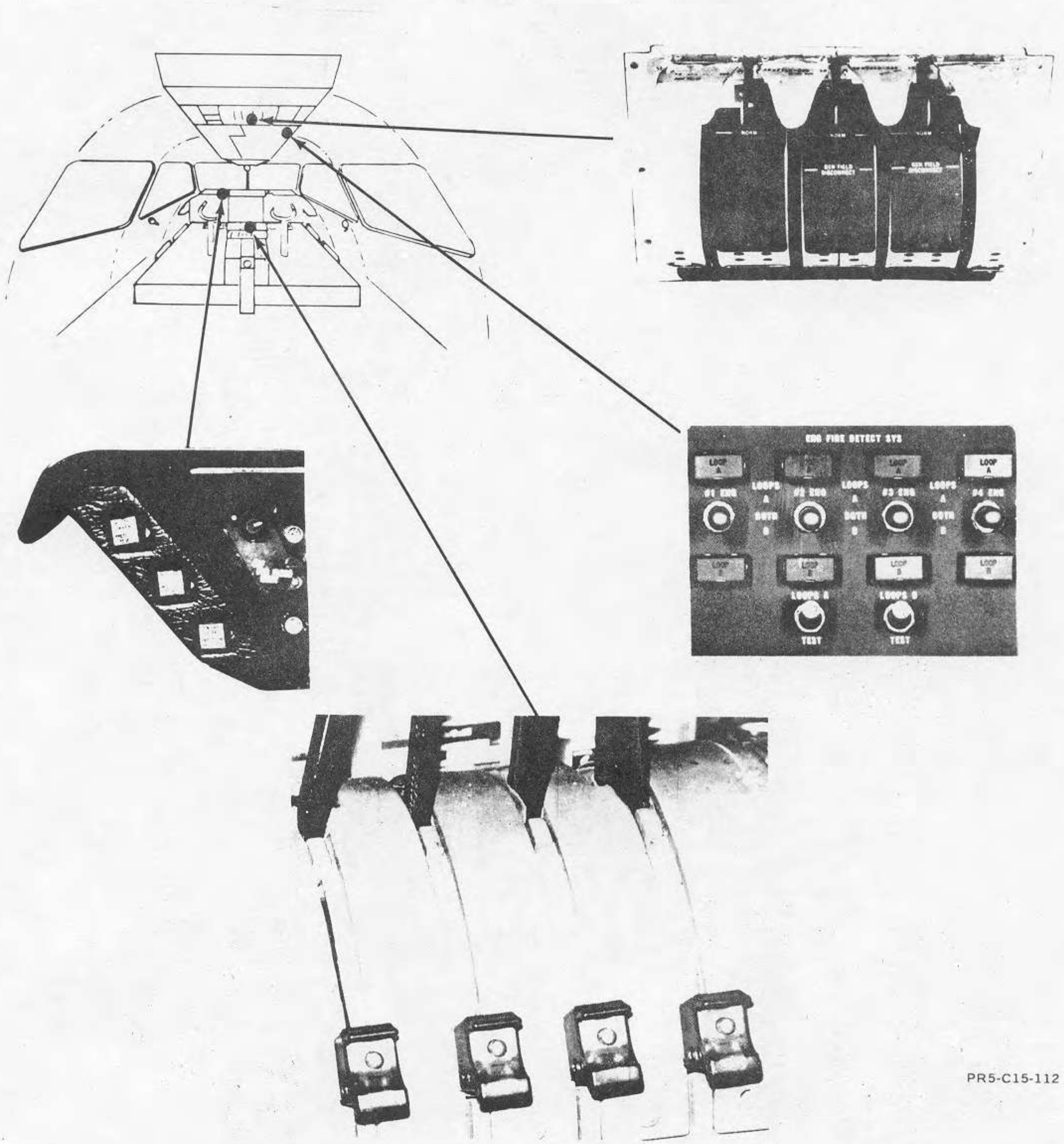

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Figure 1-15

FIRE EXTINGUISHER SYSTEM

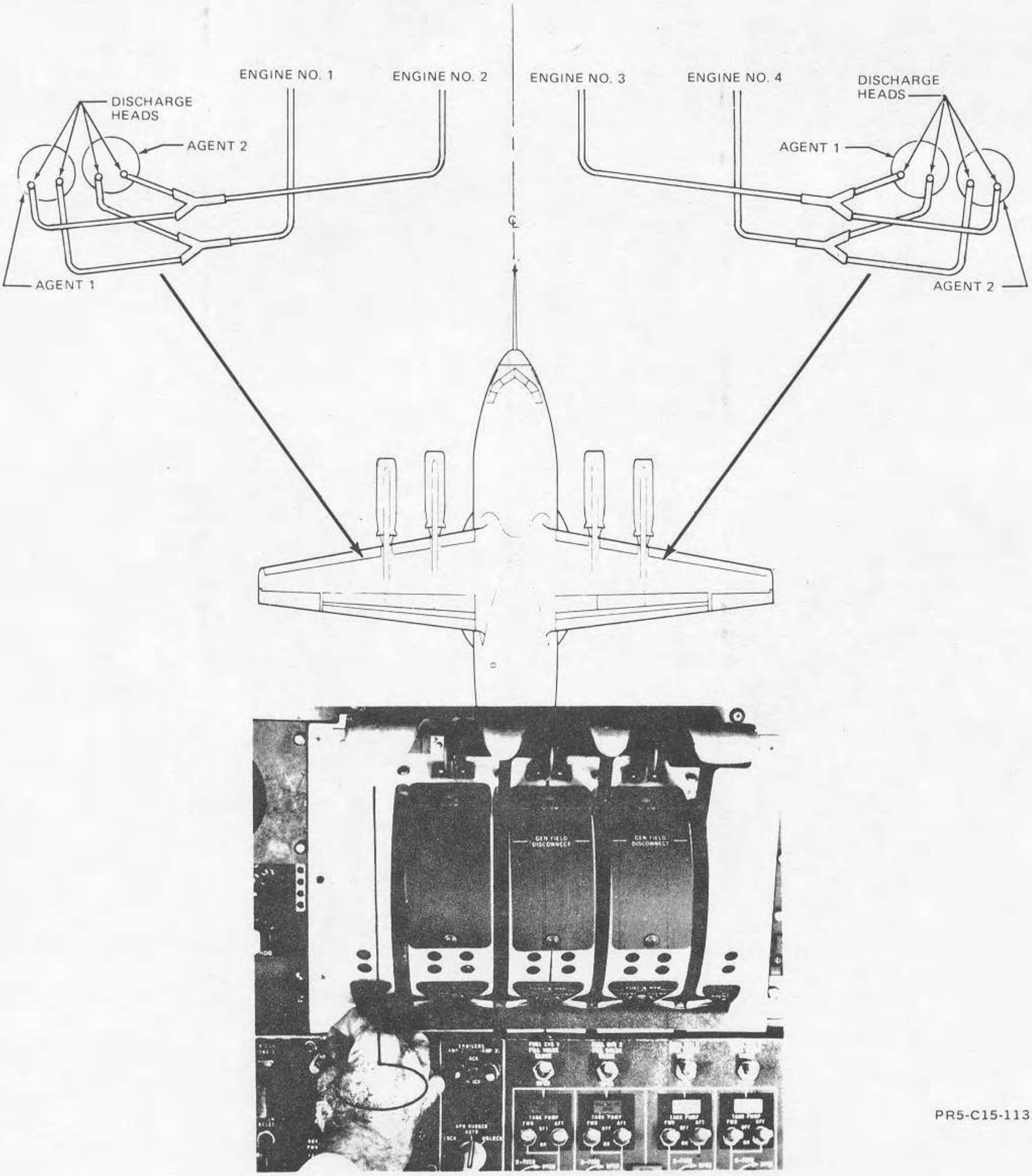


Figure 1-16

FUEL SUPPLY SYSTEM

The fuel supply system is designed to provide uninterrupted fuel flow under all conditions and attitudes encountered in normal operations. The system permits servicing the wing and fuselage tanks utilizing the crossfeed manifold from a single point in the right wheel pod. The aircraft is refueled using the cockpit controls. Each wing tank may also be serviced by gravity feed at fill points on the top of each wing.

Fuel Tanks, Wing

In Aircraft #1, the four integral wing tanks outboard of the fuselage, #1 and 4 - 2900 gallons, #2 and 3 - 2700 gallons, have a total capacity of 11,200 gallons (75,700 pounds at 6.76 pounds per gallon).
In Aircraft #2, the four integral wing tanks (Figure 1-17), outboard of the fuselage; #1 - 2,200 gallons, #2 - 1,800 gallons, #3 - 1,800 gallons, #4 - 2,200 gallons, have a total usable capacity of 8,000 U.S. gallons (54,080 pounds at 6.76 pounds per gallon).

A sump drain is located at the lowest inboard point of each wing tank. The dry centerwing bay sump drain is located at the centerline of the aircraft and is routed through a sight level gage located on the right side of the fuselage. A drain valve is installed to permit draining of this gage. The fuel couplings located in the dry centerwing bay are shrouded and drained through a line into the right wheel pod and overboard. The single point fueling adapter leakage line is teed into this line.

Fuel Tank Vent System

The left wing tanks (#1 and 2) are vented through a piping system to a vent box located in the right wing. The right tanks (#3 and 4) are vented in a similar manner but to the left wing. An overflow standpipe drip-free outlet on the wing lower surface is installed in each vent box.

The vent lines are sized to prevent excessive tank pressure during all operating conditions of the aircraft. Vent lines will flow fuel overboard at maximum fill rate and not overpressure the wing structure.

Fuel Boost Pumps

Each wing tank has two AC boost pumps (FWD and AFT) (figure 1-17) installed at the inboard end of the tank. The inboard end of each tank acts as a fuel reservoir, with flapper-type flow baffles to maintain fuel around the boost pumps for all normal aircraft attitudes and maneuvers. Each boost pump has adequate flow to supply two engines at takeoff rated thrust. All boost pumps are identical and are interchangeable. The forward (FWD) boost pumps receive 115 VAC, 3-phase power from the LEFT AC bus through the FUEL BOOST PUMPS, TANK 1, 2, 3, 4 FWD circuit breakers (N-1, -2, -3, -4 and P-etc. and R-etc.) on the EPC panel. The AFT BOOST PUMPS receive 115 VAC, 3-phase power from the RIGHT AC bus through the FUEL BOOST PUMPS, TANK (1, 2, 3, 4) AFT circuit breakers (Z-1, -2, -3, -4 and AA-etc. and AB-etc.) on the EPC panel.

Fuel Feed

Each wing tank feeds directly to the related engine. The tank-to-engine fuel feedlines are interconnected by a crossfeed manifold with electrically operated crossfeed shutoff valves so that any engine may be fed fuel from any tank. The engines will operate on suction feed from the related tank. An ENG FIRE shutoff handle actuates a guillotine-type fuel tank fire shutoff valve which is installed in each engine fuel feedline on the wing front spar.

Fuel System Controls and Indicators

The fuel system controls and indicators required for normal operation and refueling of the aircraft are in the pilots' overhead panel, annunciator panel, the center instrument panel the pedestal and on each fuselage fuel tank.

Fuel System Fill Valve Switches

Each FUEL SYS FILL VALVE switch (figure 1-18) controls the operation of the fill valve connected to the crossfeed manifold. The green FILL VALVE OPEN light (figure 1-16) comes on when its related fill valve opens. When the aircraft is on the ground, each switch is solenoid held in the OPEN position. AIRCRAFT 1 in flight, the solenoid is deactivated and the switch must be held in the OPEN position except when either fuselage TANK PUMP switch is ON. AIRCRAFT 2 in flight, the solenoid is activated when the AERIAL REFUELING MASTER or either fuselage TANK PUMP switch is ON. When the tank is full the high level shutoff switch will close the fill valve and the switch will go to close. Fill valves #1 and 2 (#3 and 4) and FILL VALVE OPEN lights #1 and 2 (#3 and 4) receive 28 VDC power from the LEFT (RIGHT) DC bus through the FUEL FILL VALVES TANK 1 and TANK 2 (TANK 3 and TANK 4) circuit breakers (T-1, -2 and AD-1, -2 respectively) and the FUEL FILL VALVE OPEN LIGHTS TANK 1 and TANK 2 (TANK 3 and TANK 4) circuit breakers (U-1, -2 and AE-1, -2 respectively) on the EPC panel.

Fuel Tank Pump Switches

The tank pump switches (figure 1-18) control the operation of the fuel boost pumps. Each tank supply system contains two fuel boost pumps controlled by the switches placarded FWD or AFT. Each FWD (AFT) boost pump switch receives 115 VAC single-phase power from the LEFT (RIGHT) AC bus through the FUEL PUMP CONTROL TANK 1, 2, 3, 4 FWD (AFT) circuit breakers (N-5, P-5, R-5, R-6 and Z-5, AA-5, AB-5, AB-6 respectively) on the EPC panel.

Fuel Crossfeed Selectors and Indicators

The X-FEED selectors (figure 1-18) control the operation of the crossfeed valves. There are four crossfeed selectors, one for each tank. When a selector is placed horizontally (the white line in the selector aligns with the white fuel line) the valve opens to route fuel from the related tank to the crossfeed manifold which allows crossfeed operation or fuel transfer. An amber X-FEED DISAGREE light, one for each selector, will monitor the positions of the valve and selector. When the selector and valve agree, the X-FEED DISAGREE light will be off. The fuel crossfeed valves are powered by the DC EMERGENCY bus through the FUEL CROSSFEED VALVES TANK 1, 2, 3, 4 circuit breakers (C-5, -6, -7, -8) on the pilots' overhead panel. The #1 and 2 (#3 and 4) X-FEED DISAGREE lights receive 28 VDC power from the LEFT (RIGHT) DC bus through the FUEL CROSSFEED VALVE DISAGREE LIGHTS circuit breakers (V-1, -2 and AF-1, -2 respectively) on the EPC panel.

Refuel Valve and Light

The REFUEL VALVE switch (figure 1-18) controls the operation of the refuel valve on the right rear spar aft of #3 tank. When this switch is placed in OPEN, the refuel valve opens, the amber REFUEL VALVE OPEN light (figure 1-16) and the MASTER CAUTION lights come on, allowing fuel from the refuel adapter (SPR) to enter the refueling piping which joins the crossfeed manifold. The REFUEL VALVE open operation and REFUEL VALVE OPEN light is powered by the LEFT DC bus through REFUEL VALVE circuit breaker (T-3) and the REFUEL VALVE OPEN LIGHT circuit breaker (T-4) on the EPC panel. The REFUEL VALVE close operation is powered by the BAT BUS through the REFUEL VALVE CLOSE circuit breaker (B-20) on the pilots' overhead panel.

Pressure Low Lights

Low engine inlet fuel pressure is monitored by the related amber PRESS LOW caution light (figure 1-18) on the fuel panel. When the fuel pressure is less than 5 PSI, the related PRESS LOW light and the MASTER CAUTION lights will come on. The #1 and 2 (#3 and 4) fuel PRESS LOW lights are powered by the LEFT (RIGHT) DC bus through the ENGINE FUEL PRESS LOW LIGHT, ENG 1 and ENG 2 (ENG 3 and ENG 4) circuit breakers (U-5, -6 and AE-5, -6 respectively) on the EPC panel.

Fuel Heat Switches

Four FUEL HEAT switches (figure 1-11), one for each engine, are located on the pilots' overhead panel. Each switch controls the respective engine 13th stage bleed air valve which directs hot air through the engine air/fuel heat exchanger. Placing a switch in the momentary ON position energizes a timer for one minute, which electrically opens the respective bleed air valve. The FUEL HEAT switches ENG #1 and 2 (#3 and 4) receives 115 VAC, single phase power from the LEFT (RIGHT) AC BUS through the FUEL HEAT, ENG 1 and ENG 2 (ENG 3 and ENG 4) circuit breakers (R-7, -8 and AB-7, -8 respectively) on the EPC panel.

Fuel Filter Pressure Drop Lights

If a fuel filter becomes clogged or restricted, the related amber FUEL FILTER PRESS DROP caution light (figure 1-11) and the MASTER CAUTION lights come on. The lights for Engines 1 and 2 (3 and 4) are powered by the LEFT (RIGHT) DC BUS through the ENGINE FUEL FILTER PRESS DROP LIGHT ENG 1 and ENG 2 (ENG 3 and ENG 4) circuit breakers (V-5, -6 and AF-5, -6 respectively) on the EPC panel.

Fire Shutoff Handles

Four ENG FIRE shutoff handles (figure 1-15), one for each engine, are located in the pilots' overhead panel. Each handle is cable connected to its respective engine fuel line fire shutoff valve at the wing front spar. When a handle is pulled down the fuel fire shutoff valve closes, stopping fuel to the respective engine.

Fuel Quantity Indicators

Capacitance-type probes in each fuel tank provide input signals to the respective FUEL QTY indicator (figure 1-19) located on the pilots forward pedestal.

All indicators are digital readout type. A test button on each indicator is used to test the system. When the button is pressed, the fuel quantity indicator will decrease toward zero, also the total fuel quantity indicator will show a decrease. When released, the indicators will return to the pretest value. The system is calibrated, based on a fuel density of 6.76 pounds per gallon and indicates fuel in pounds. The fuel quantity indicators receive 115 VAC, single phase power from the AC buses. Indicators #1 and 2 (#3 and 4) are powered by the LEFT (RIGHT) AC Bus through the FUEL QUANTITY, TANK 1 and TANK 2 (TANK 3 and TANK 4) circuit breakers (P-7, -8 and AA-7, -8 respectively) on the EPC panel.

A combination TOTAL FUEL QTY and GROSS WEIGHT indicator (figure 1-19), located on the center instrument panel, is connected to the individual wing fuel tank indicators. It does not include fuselage tank fuel. It consists of a stationary inner dial calibrated from E to F in 1/4 increments. A pointer indicates the sum of the individual quantities on this dial. Also the sum is displayed in the digital window. The moveable outside dial is graduated in thousands of pounds and is rotated to set the zero fuel weight adjacent to E on the inside dial. When the aircraft is fueled, the pointer will indicate the gross weight on the outside dial and the quarters of fuel on the inside dial. The total fuel quantity indicator receives 115 VAC, single phase power from the LEFT AC bus through the FUEL QUANTITY TOTALIZER circuit breaker (P-6) on the EPC panel.

NOTE

The TOTAL FUEL QTY indicator will reflect errors of any and all individual FUEL QTY indicators that are malfunctioning. The operative FUEL QTY indicator may be used with the FUEL FLOW indicators to determine the amount of fuel remaining.

Fuel Temperature Indicators

The aircraft has two dual FUEL TEMP indicators (figure 1-19), one for Engines 1 and 2, and the other for Engines 3 and 4, located on the flight test engineer's panel. Each indicates fuel temperature in degrees centigrade of the respective engine on scales graduated in 10°C increments from -60 to +80°C. Each engine has a fuel temperature probe located in the fuel line prior to the filter and fuel control unit which signals the respective pointer on the indicator. Due to the location of the fuel temperature probe, the indicated fuel temperature is approximately 10° higher than the fuel in the tank. The FUEL TEMP indicators receive 28 VDC power from the DC buses. The LEFT (RIGHT) DC Bus powers #1 and 2 (#3 and 4) through the ENGINE FUEL TEMP INDICATOR, ENG 1 and ENG 2 (ENG 3 and ENG 4) circuit breakers (T-5, -6 and AD-5, -6 respectively) on the EPC panel.

Fuel System, Fuselage

A fuselage fuel system can be installed in the aircraft. The system consists of two 1800 gallon tanks, fueling manifold, fill valves, vent manifold, boost pumps, controls and indicators.

Fuel Tank, Fuselage

Two 1800 gallon tanks, mounted side by side on cradles, can be installed in the cargo area. These tanks are secured in place by the -4A Dual Rail Cargo Handling System. A combination refueling and fuel manifold provides a means of refueling the tanks and using the fuel from the tanks. For refueling, fuel flow is from the SPR to the tank fill valves (figure 1-17). For fuel usage, fuel flow is from the tanks through the same manifold through the refuel valve into the wing tank refueling manifold. Each tank has one fill valve; controls are on the tank fuel fill control panel. The fuselage tanks are vented through one vent valve to the wing tanks vent manifold.

Fuel Tank Pump Switches, Fuselage

Two (ON-OFF) TANK PUMP switches (figure 1-19), located on the forward pedestal, control the tank boost pumps in the respective tank. The left (right) switch receives 28 VDC power from the LEFT (RIGHT) DC bus through the FUEL PUMP CONTROL FUSELAGE LEFT (RIGHT) circuit breaker (V-3 and AD-3 respectively).

Fuel Tank Empty Light, Fuselage

Two amber TANK EMPTY lights (figure 1-19), located on the forward pedestal, alert the pilots that the respective fuselage tank is empty. When fuel pressure is less than 8 PSI, the TANK EMPTY light comes on. Both TANK EMPTY lights receive 28 VDC power from the RIGHT DC bus through the FUEL TANK EMPTY LIGHT FUSELAGE circuit breaker (AE-3).

Fuel Controls and Indicators, Fuselage Tank

There are three fuselage tank control panels, one on each fuselage tank and one on the pilots' forward pedestal. The fuselage tank control panels are used to fuel the fuselage tanks. The pilots' pedestal fuselage control panel is the primary control for using the fuel.

Fuel Quantity Indicators, Fuselage

Probes in each tank provide input signals to the respective FUEL QUANTITY indicator (figure 1-19) located on the pilots' forward pedestal. An INDICATOR TEST button is used to test the system. When the button is pressed, the fuel quantity indicator will decrease toward zero. The left (right) FUEL QUANTITY indicator receives 115 VAC single phase power from the LEFT (RIGHT) AC bus through the FUEL QUANTITY FUSELAGE TANK LEFT (RIGHT) circuit breaker (N-6 and Z-6 respectively).

NOTE

> Fuselage fuel is not indicated on the totalizer. If fuselage fuel is aboard, set the outer bezel to indicate present gross weight adjacent to the totalizer pointer. The pointer will then indicate the existing gross weight as long as fuselage fuel is not used. When the fuselage tanks are empty, set zero fuel weight adjacent to the "E" on the inner scale. While the fuselage fuel is being transferred, disregard the outer bezel reading.

Fuel System Operation and Management

Fuel normally feeds from each wing tank to its respective engine. Crossfeed operation permits operating any engine from any tank. Transfer operation permits the transfer of fuel from one wing tank to another.

NOTE

Before or after engine start, all fuel boost pumps may be individually checked to verify pump operation.

Fuel Usage

1. Fuel X-FEED selectors (4) - CLOSED.
2. Start engines with both boost pumps in each wing tank ON, "PRESS LOW" lights (4) should be off.
3. For takeoff, verify both boost pumps are ON in each wing tank.
4. REFUEL VALVE OPEN switch - CLOSED.

   REFUEL VALVE OPEN light should be OFF.
5. Continue flight with both boost pumps on.

Crossfeed Operation

1. Check that both boost pumps are ON in the supplying tank.
2. Rotate the desired X-FEED selectors (clockwise) to OPEN (one for the supply and one for receiving). The X-FEED DISAGREE lights should flicker on then off when the valves open.
3. Turn off both boost pump switches for the ENG which is receiving X-FEED fuel. Monitor the fuel gages.
4. When crossfeed operation is no longer desired, turn on both boost pumps in the ENG/TANK receiving fuel. PRESS LOW light may flicker on then off once.
5. Rotate the desired X-FEED selectors (counterclockwise) to the closed position. The X-FEED DISAGREE lights should flicker on then off when the valves close.

Fuel Transfer Operation

1. Check that both boost pumps are ON in the supplying tank.
2. Rotate (clockwise) the supplying tank X-FEED selector to OPEN. The X-FEED DISAGREE light should come on and go off when the valve opens.
3. Hold the desired (RECEIVING tank) FUEL FILL VALVE switch to the OPEN position. The related FILL VALVE OPEN light should come on when the valve opens.
4. Monitor the fuel quantity indicators.
5. When the desired amount of fuel has been transferred, release the FUEL FILL VALVE switch. The related FILL VALVE OPEN light will go off when the valve closes.
6. Rotate (counterclockwise) the supplying tank X-FEED selector to CLOSE. The X-FEED DISAGREE light should come on and go off when the valve closes.

Fuel Transfer Operation, Fuselage Tank

1. Check that wing tank fuel supply system is normal.
2. Turn ON the desired TANK PUMP switch(es)
3. Open the REFUEL VALVE. The

REFUEL VALVE OPEN light should come on.

4. Place the desired (Receiving Tank) FUEL SYS FILL VALVE switch to OPEN. The FILL VALVE OPEN light should come on when the valve opens.

NOTE

The fill valve switches will remain in OPEN, when either or both fuselage TANK PUMP switches is ON. Also in aircraft 2 the Aerial Refueling Master switch in ON will do the same thing.

5. Monitor the fuel quantity indicators.

6. When the desired amount of fuel has been transferred or the TANK EMPTY light is ON, place the FILL VALVE switches in CLOSE. The related FILL VALVE OPEN light will go off when the fill valve closes.

Fuel Heat Operation

Fuel heat may be used to prevent or remove ice at the engine fuel filter, fuel control and fuel lines. Fuel heat should be turned on if FUEL FILTER PRESS DROP light comes on.

NOTE

Fuel heat should be turned on for 1 minute just prior to takeoff if the indicated fuel temperature is 10°C or below.

Fuel heat should not be used during takeoff to ensure that engine thrust is not diminished by unnecessary extraction of engine bleed air.

Fuel heat should be turned on any time within 10 minutes after the FUEL FILTER PRESS DROP light comes on.

Do not exceed oil temperature limitations by excessive use of fuel heat.

If the FUEL FILTER PRESS DROP light comes on when the fuel temperature is above 15°C, the cause may be due to fuel filter clogging by solid contami--nents other than ice. Continued engine operation is permissible if engine oil temperature is maintained within normal limits.

1. Place the FUEL HEAT switches in ON and release.

NOTE

If the fuel heat timer fails and causes continuous heat to be applied, fuel heat may be disconnected by pulling the applicable circuit breaker on the LEFT or RIGHT AC bus FUEL HEAT (R-7, -8) or (AB-7, -8) on EPC panel.

2. If FUEL FILTER PRESS DROP light does not go off and fuel temperature is below 15°C, repeat Step 1.

Single-Point Ground Refueling

The controls and indicators for fueling are located on the pilots' overhead panel and the pedestal. Pressure fueling is normally accomplished with electrical power. Fuel flow, through the single point fuel adapter (figure 1-17), is directed through the Refuel Valve into the crossfeed manifold to each wing tank fuel system fill valve. Fuel fill shutoff float switches, provided in each wing tank, automatically close the respective fuel fill valve when the wing tank is full. When the tanks are being fueled to less than maximum capacity, the fuel valves must be closed individually, when the desired fuel quantity in each wing tank is attained. Fuselage fuel tank fuel flow through the SPR, figure 1-17 , is directed through the fuselage tank manifold to each tank fill valve. The fill valves are controlled by switches on the fuselage fuel fill control panel.

CAUTION

Refueling is restricted until the brake temperatures are 205°C or less. (Below flash point of JP-5).

Gravity Fueling

The wing fuel tanks can be gravity fueled through the overwing fill cap on the top of each wing tank.

Aerial Refueling System (Aircraft #2 only)

The aerial refueling system provides a means of refueling tanks from a boom-type tanker aircraft. Fuel is transferred from the tanker boom through a receptacle located on top of the aircraft above the flight test engineer's station (fuselage station 310, centerline of aircraft). Fuel from the receptacle flows through an isolation valve to the crossfeed manifold and into the aircraft tanks through the fill valves. The aerial refueling system consists of a universal air refueling receptacle slipway installation, fuel lines controls and indicators.

Universal Air Refueling Receptacle Slipway Installation

This installation provides a standard refueling package for USAF aircraft. It consists of a hydraulically actuated slipway door, fuel receptacle, lights and housing structure. When the door is closed, the receptacle is covered. When the door is opened, the door moves forward and down forming a slipway for guiding the boom into the receptacle. Also two lights come on for illumination.

Aerial Refueling Control Panel

An aerial REFUELING CONTROL panel (figure 1-20), located on the 422 bulkhead, provides a means of controlling the system. It consists of the following:

Refuel Master Switch

A guarded, two position (ON-OFF) REFUEL MASTER switch (figure 1-20) provides electrical power for the aerial refueling operation. When in ON, #1 hydraulic system pressure is ported to the manifold control valve. Also, the left and right receptacle lights come on.

Manual Release Control Handle

A MANUAL RELEASE CONTROL HANDLE (figure 1-20), located above the aerial refueling control panel, provides a means of opening and closing the slipway door. Rotating (CCW) to unlock and pulling the handle, unlatches the door and hydraulically opens the slipway door. Pushing the handle closes the slipway door then rotating (CW) the handle locks the door.

Isolation Valve Switch

A two position (OPEN-CLOSE) ISOLATION VALVE switch (figure 1-20), located on the AERIAL REFUELING CONTROL panel, provides a means of controlling the isolation valve. When in OPEN, the valve is open allowing fuel to enter the fuel crossfeed manifold. When in CLOSE, the valve is closed isolating the crossfeed manifold from the receptacle.

Drain Valve Selector Switch

A two position (OPEN-CLOSE) DRAIN VALVE switch (figure 1-20), located on the AIR REFUEL CONTROL panel, provides a means of draining the fuel trapped in the line between the receptacle and isolation valve into tank #2. It normally takes 5 minutes to drain this line.

Aerial Refueling Disconnect Switch

Two aerial refueling disconnect pushbutton type switches (figure 1-20), installed on the outboard horn of each pilot's control wheel, provides a means of disconnecting the boom from the receptacle. When pressed, the latching mechanism unlatches allowing the boom to be withdrawn from the receptacle.

Door Not Locked Light

An amber DOOR NOT LOCKED light (figure 1-20), located on the AERIAL REFUELING CONTROL panel, comes on when the slipway door is unlocked. The DOOR NOT LOCKED light receives 28 VDC power from the LEFT DC bus through the AIR REFUEL CONTROL circuit breaker (U-3).

Ready Light

Two blue READY lights (figure 1-20), one located on the AERIAL REFUELING CONTROL panel and the other on the pilots' overhead panel, signals the crew that the slipway door is down and latched, signifying that the door is in position for the boom. The READY lights receive 28 VDC power from the LEFT DC bus through the AIR REFUEL CONTROL circuit breaker (U-3).

Latched Lights

Two green LATCHED lights (figure 1-20), one located on the AERIAL REFUELING CONTROL panel and the other on the pilots' overhead panel, signals the crew that the boom is latched in the receptacle. This latching mechanism is automatic. When the green LATCHED lights come on, the blue READY lights should go off. The LATCHED lights receive 28 VDC power from the LEFT DC bus through the AIR REFUEL CONTROL circuit breaker (U-3).

Isolation Valves Open Light

An amber ISOLATION VALVE OPEN light (figure 1-20), located on the AERIAL REFUELING CONTROL panel, provides a means of monitoring the isolation valve. When on, the isolation valve is open. When off, the valve is closed. The ISOLATION VALVE OPEN light receives 28 VDC power from the LEFT DC bus through the AIR REFUEL VALVES circuit breaker (U-4).

Drain Valve Open Light

An amber DRAIN VALVE OPEN light (figure 1-20), located on the AERIAL REFUELING CONTROL panel, provides a means of monitoring the drain valve. When on, it signifies that the drain valve is open. When off, the valve is closed. The DRAIN VALVE OPEN light receives 28

VDC power from the LEFT DC bus through the AIR REFUEL VALVES circuit breaker (U-4).

Air Refuel Valve Open Light

An amber AIR REFUEL VALVE OPEN light (figure 1-20), located in the fuel panel on the pilots' overhead panel, provides a means for the pilots to monitor the position of the isolation valve. When either the isolation valve or drain valve is open, the AIR REFUEL VALVE OPEN light and the MASTER CAUTION lights come on. The AIR REFUEL VALVE OPEN light receives 28 VDC from the LEFT DC bus through the AIR REFUEL VALVES circuit breaker (U-4).

Disconnect Light

An amber DISCONNECT light (figure 1-20), located on the pilots' overhead panel, signals the pilots when the toggle latch is disconnected from the boom. When the A/R disconnect button is pressed, the toggle latch disconnects from the boom, the LATCHED light goes out and the DISCONNECT light comes on. It will remain on as long as the disconnect button is held. Releasing the disconnect button, causes the DISCONNECT light to go off and the READY light to come on. The DISCONNECT light will also come on when the pressure in the refueling manifold becomes excessive causing the toggle latch to disconnect from the boom. The DISCONNECT light receives 28 VDC power from the LEFT DC bus through the AIR REFUEL CONTROL circuit breaker (U-3).

Aerial Refueling Operation

Use only the minimum electrical equipment and systems necessary to safely accomplish refueling and return to base in the event of damage or failure which would result in fuel vapor in the flight compartment.

Prior to initiating Aerial Refueling Operations: Rotate the IFF MASTER selector switch to STBY; open the LANDING GEAR WARNING (V-16) circuit breaker; turn off the Radar Beacon and HF radio.

When the tanker and receiver aircraft have rendezvoused; communication has been established; and when cleared for aerial refueling, proceed as follows:

1. Check that all the fuel circuit breakers are closed.

   Air Refuel Control: U-3
   Air Refuel Valve: U-4
   Fuel Cross Feed Valves: C-5, -6, -7, -8
   Fuel Cross Feed Disagree Lts: V-1, -2, AF-1, -2
   Fuel Fill Valves: T-1, -2, AD-1, -2
   Fuel Fill Valves Open Lts: U-1, -2, AE-1, -2
   Refuel Valve: T-3
   Refuel Valve Open Lt: T-4
   Refuel Valve Close: B-20
   Fuel Quantity: P-7, -8, AA-7, -8

2. Check that SCAS ENGAGE circuit breaker (F-10) is closed:

   NOTE

   The aerial refueling system will not operate when the SCAS ENGAGE circuit breaker is open.

3. Check that all X-FEED valve selectors (4) are closed. X-FEED DISAGREE lights (4) are off.

4. Place REFUEL MASTER switch (located on bulkhead at station 422) in ON. This turns on the slipway white illumination lights and arms the ground REFUEL VALVE switch.

5. Rotate (CCW) and pull out MANUAL RELEASE CONTROL HANDLE then rotate (CW) to lock handle out. This opens the slipway doors.

CAUTION

Do not operate when refueling boom is latched because it could damage the slipway doors.

The aircraft should be in the PRE CONTRACT position.

6. Press and release the AR button (placarded single SCAS disconnect), located on outboard horn of each control wheel. The amber DISCONNECT light should go off and the blue READY lights should come on.

NOTE

During Aerial Refueling Operation, do not use single SCAS.

If in single SCAS operation and the AR disconnect button is pressed, it will also disconnect the SCAS as this button has a dual function.

The aircraft should be in the CONTACT position.

If refueling is desired:

7. Place ISOLATION VALVE switch in OPEN. These amber lights come on: ISOLATION VALVE OPEN and AIR REFUEL VALVE OPEN.

The system is now ready for contact (wet or dry).

NOTE

When connected, the blue READY lights go off and the green LATCHED lights comes on. Notify the tanker NOT to transfer fuel until requested by receiver.

8. Place the desired FILL VALVE switches in OPEN. The respective green FILL VALVE OPEN light should come on.

After contact, the aircraft should be flown to the REFUELING POSITION.

9. Request the tanker to commence normal fuel transfer. (Normal rate is approximately 3800 ppm – 55 PSI with two tanker pumps).

10. Monitor the fuel quantity. When any tank quantity indicates 10,000 pounds, place #1 and 4 (outboard tanks) FILL VALVE switches in CLOSE, one a time. When Tank #2 and 3 (inboard tanks) quantity indicates 11,500 pounds maximum, place the respective FILL VALVE switch in CLOSE. The associated FILL VALVE OPEN light should go off.

NOTE

If any FILL VALVE OPEN light does not go off, place the Isolation valve switch in CLOSE and discontinue the refueling.

As the other inboard tank quantity approaches 11,000 pounds, place #1 and 4 FILL VALVE switches in OPEN. When the inboard quantity indicates 11,500 pounds, place the respective inboard FILL VALVE switch in CLOSE. The associated FILL VALVE OPEN light should go off. As each outboard tank quantity approaches 14,000 pounds maximum, place the respective FILL VALVE switch in CLOSE. The associated FILL VALVE OPEN light should go off.

CAUTION

Closing two ore more FILL VALVES simultaneously could cause a disconnect.

If the fuselage tanks are to be refueled, proceed as follows:

a. Place REFUEL VALVE switch in OPEN. The amber REFUEL VALVE OPEN ligh should come on. This allows fuel into the fuselage tank manifold. Open the control box cover (located in the left rear corner of each tank). Tanks may be refueled individually or simultaneously. Place MASTER switch in ON. This should turn on the light for illumination. Rotate LEVEL CONTROL VALVE switch to OPEN. The fill valve is open and the fuselage tank can now be refueled. When the fuel quantity indicates 11,000 pounds maximum, rotate the LEVEL CONTROL VALVE to CLOSE.

NOTE

If the fill valve does not close, fuel cannot be transferred from the fuselage tank.

To terminate refueling if the fill valve does not close, rotate the manual shut-off valve to CLOSE. Manual shut-off valve is painted red and located on top of each fuselage tank.

In order to use fuel from the tank, this manual shut-off valve must be rotated to OPEN.

f. Refuel the other fuselage tank in a like manner.

g. Place the REFUEL VALVE switch in CLOSE. The amber REFUEL VALVE OPEN light goes off. This isolates the fuselage tanks from the refuel/ crossfeed manifold.

When a disconnect is desired:

11. Press the AR disconnect button twice. First it disconnects the boom and the DISCONNECT light comes on. Second press, the DISCONNECT light goes off and the blue READY lights come on.

NOTE

Pause a short time between presses to permit the boom to actually disconnect from the receptacle.

The system is ready for another contact, go to action

8 after connected or to terminate refueling proceed:

12. Place the ISOIATICN VALVE switch in CLOSE. The ISOLATION VALVE OPEN and AIR REFUEL VALVE OPEN lights should go off.

13. Place the DRAIN VALVE switch in OPEN. The amber DRAIN VALVE OPEN light should come on.

NOTES

It takes approx-mately 5 minutes to drain this line (into tank #2).

The AIR REFUEL VALVE OPEN light comes on, alert-ing the pilots that a valve is still open in the AERIAL REFUEL manifold.

14. Unlock by rotating (CCW) the MANUAL RELESE CONTROL HANDLE, push in and lock it in by rotating (CW). The READY lights should go off. This retracts the receptacle and closes the slipway doors.

15. Place the DRAIN VALVE switch in CLOSE. The DRAIN VALVE OPEN and AIR REFUEL VALVE OPEN lights should go OFF.

16. Place the REFUEL MASTER switch in off. All the refueling lights should be off.

NOTE

When the DRAIN VALVE switch is ON and the REFUEL MASTER switch is OFF, the MASTER CAUTION lights will come on.

17. Rotate the IFF MASTER selector switch to NORM. Close the LANDING GEAR WARNING (V-16) circuit breaker. As desired, turn on the Radar Beacon and HF radio.

FUEL SYSTEM

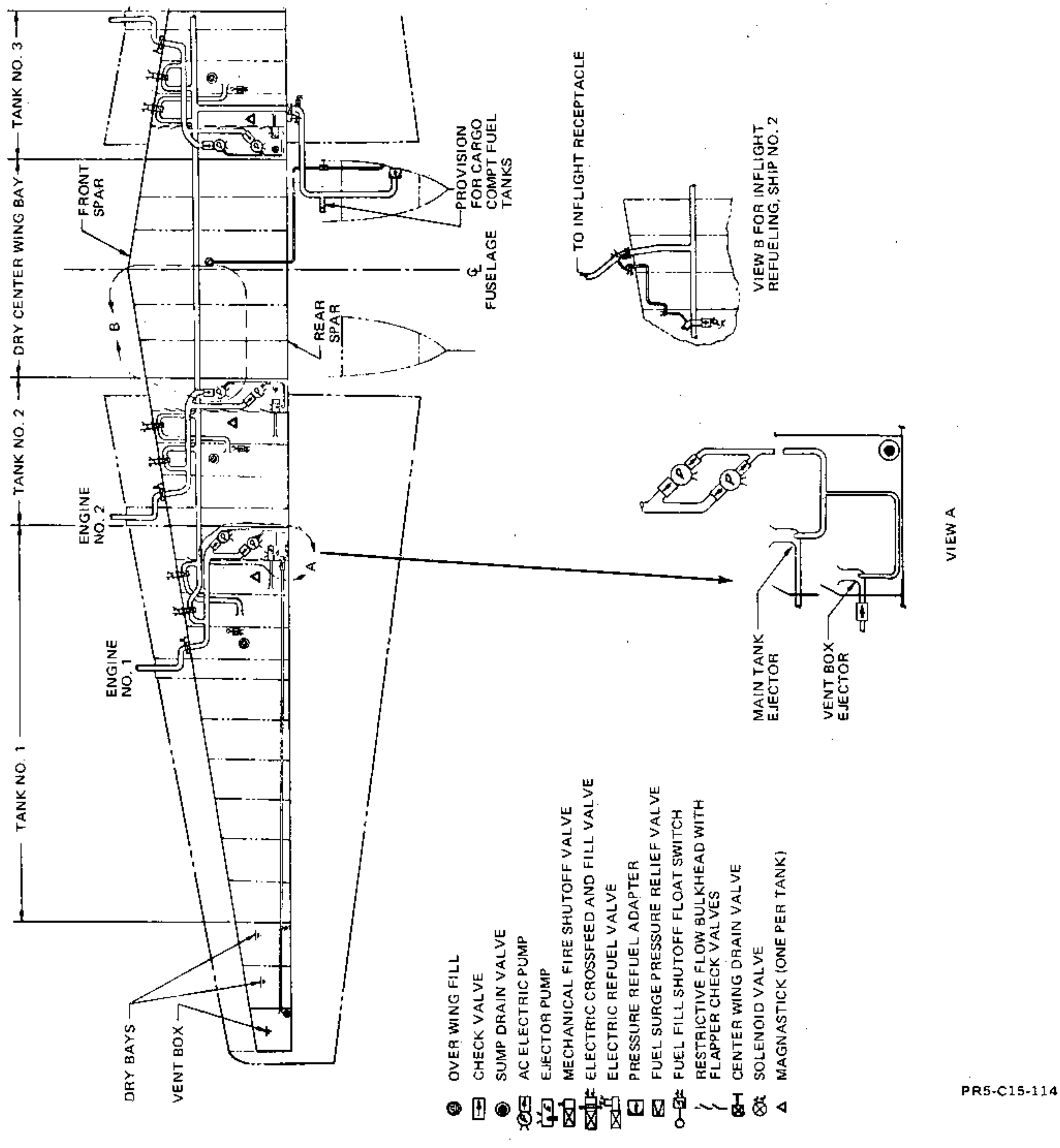
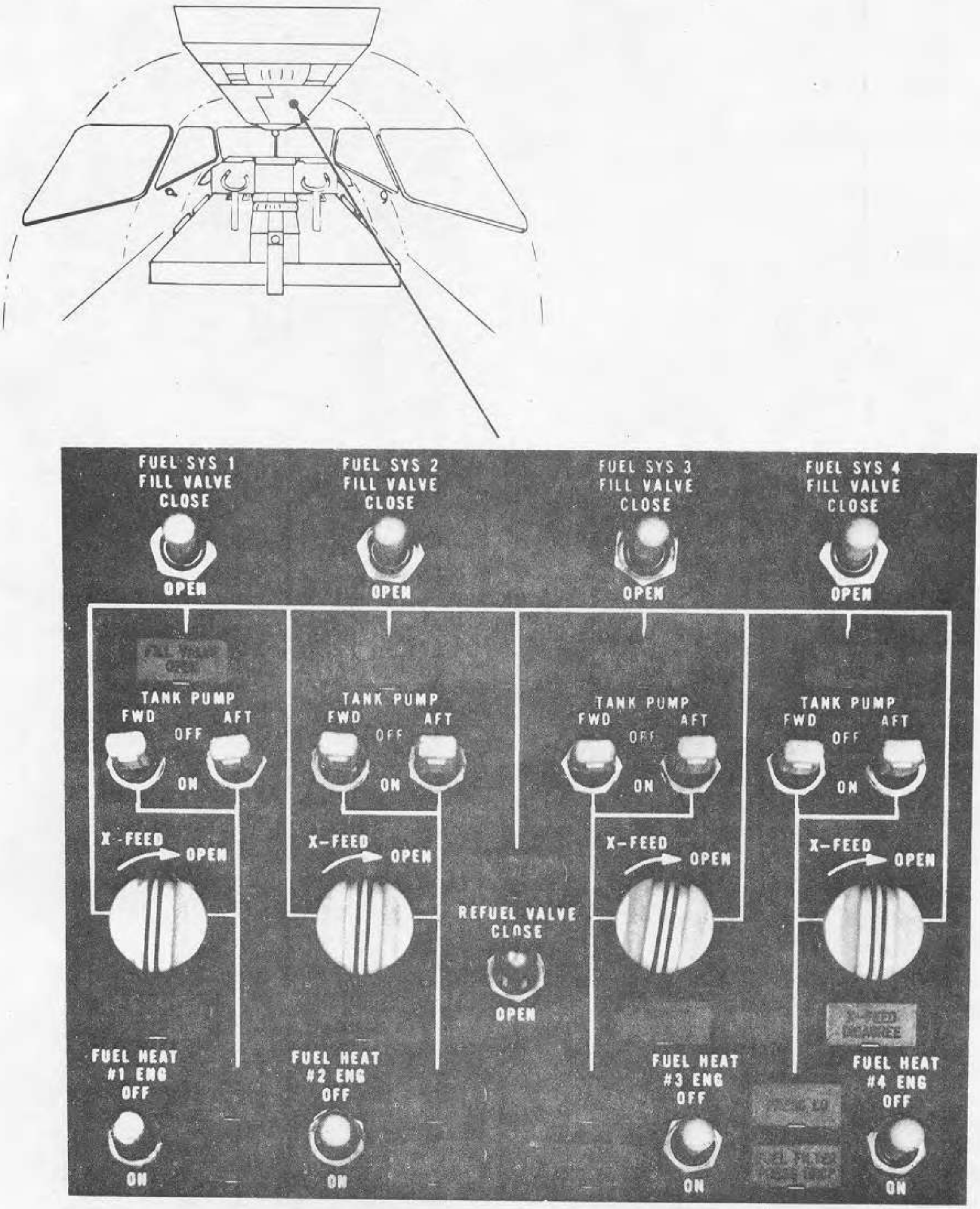


Figure 1-17

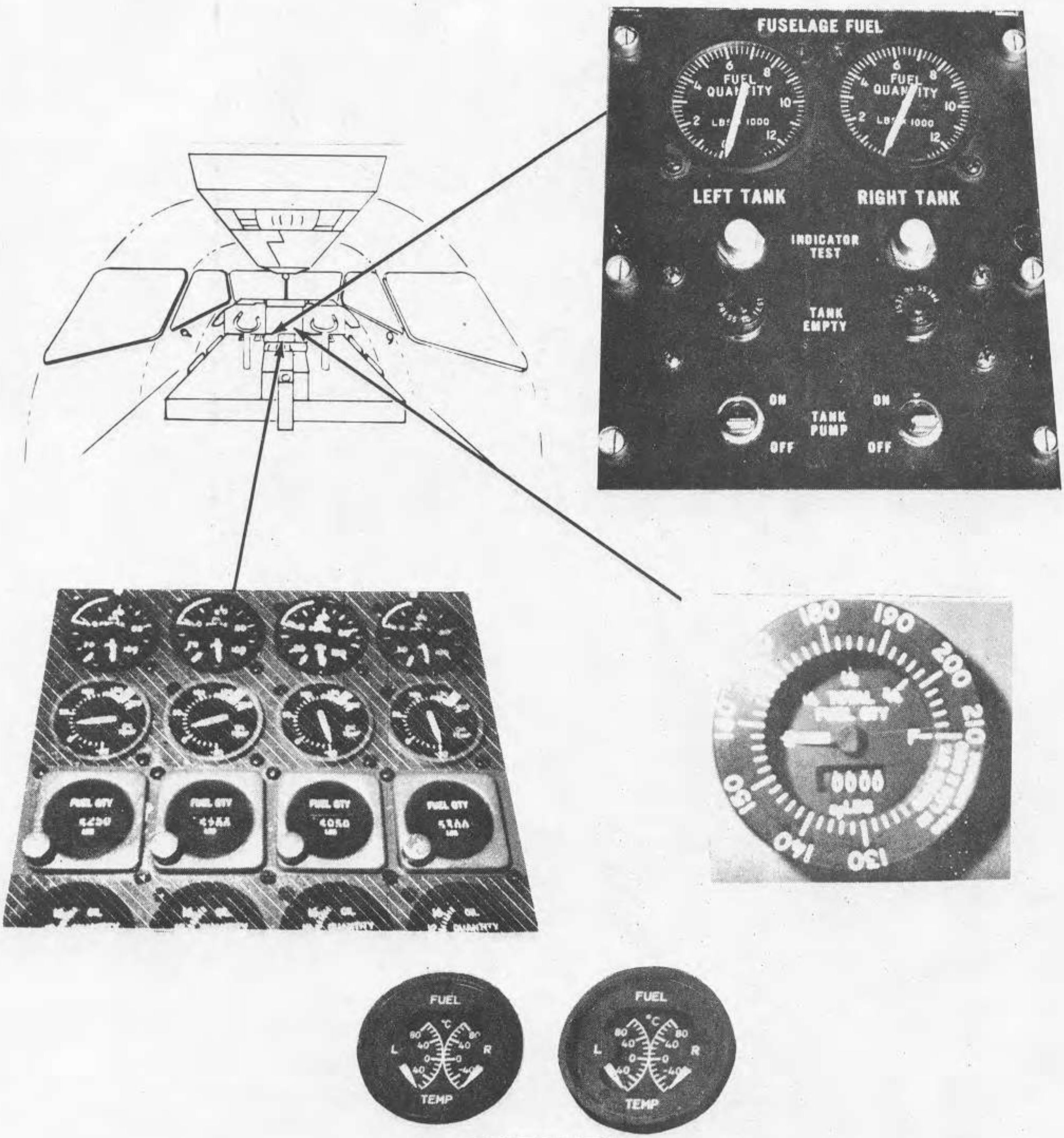
FUEL SYSTEM CONTROLS AND INDICATORS



PR5-C15-115

Figure 1-18

FUEL QUANTITY CONTROLS AND INDICATORS



FLT TEST ENG PNL

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Figure 1-19

AERIAL REFUELING CONTROLS AND INDICATORS

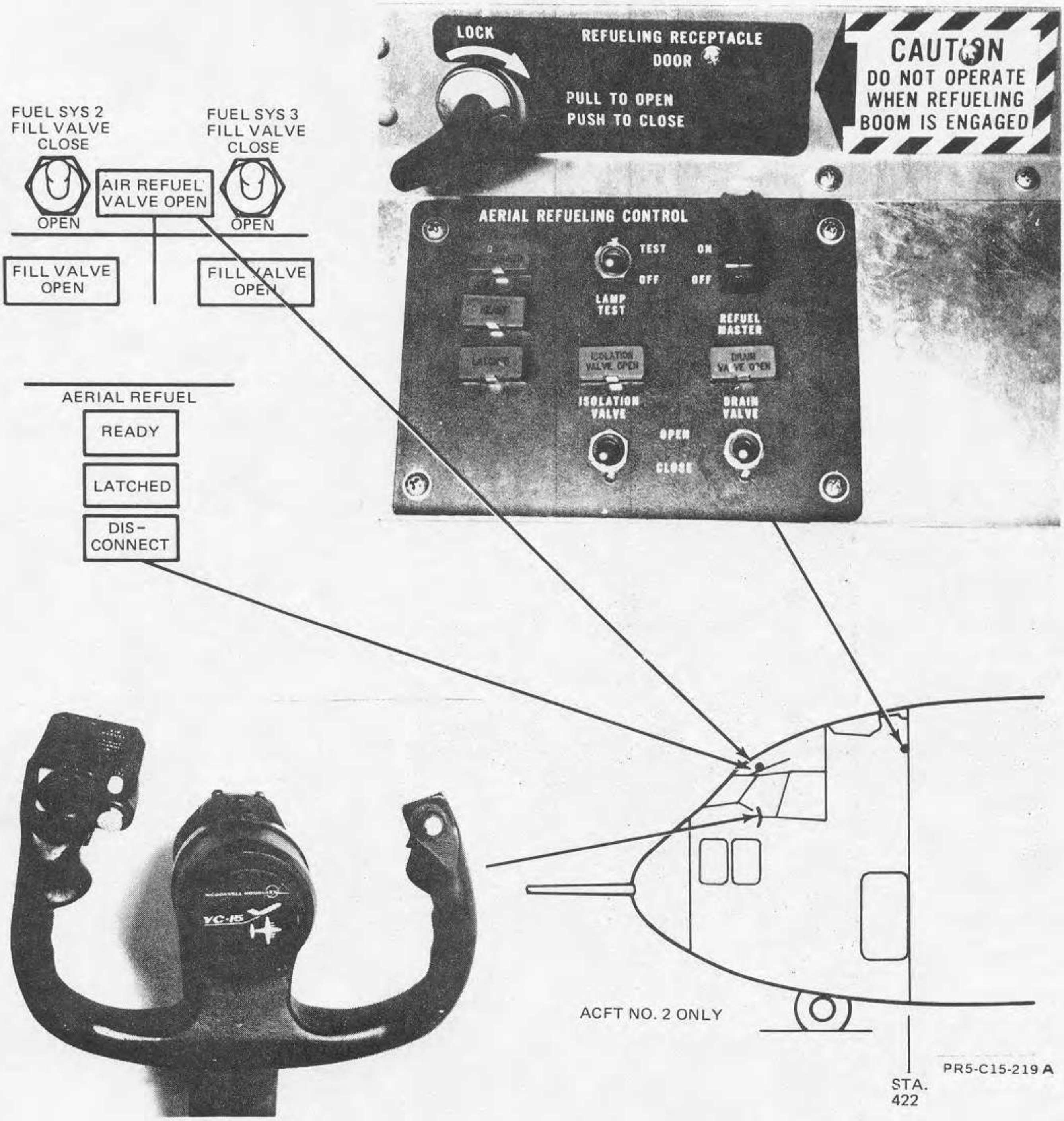

Figure 1-20

PNEUMATIC POWER SUPPLY SYSTEM

The pneumatic system provides pressurized air from Engine #3 for engine starting and for operation of the air conditioning system (figure 1-21). There are nine functional components which control and monitor the pneumatic system:

- Pressure Regulator Valve
- Augmentation Valve
- 8th Stage Check Valve
- Flow Control Valve
- 600°F Sensor
- #3 PYLON DUCT FAIL Light
- DUCT FAIL Light
- Pneumatic Pressure Sensor
- Pneumatic Switch

For ground operation and engine starting, pneumatic pressure is supplied by external pneumatic source or by an operating Engine 3. A ground pneumatic connector is located in the right wheel pod. This connector supplies pneumatic pressure to the interconnecting manifold between the pressure regulator valve and flow control valve.

NOTE

> Before attempting to start engine 3, the PNEUMATIC switch must be in ENG START.

Inflight, pneumatic pressure is supplied by the 8th and/or 13th stage compressor of Engine 3. There are no provisions for pneumatics from the other engines.

Pressure Regulator Valve

The pressure regulator valve is mounted in Engine #3 pylon, just downstream of the 8th and 13th stage bleed lines intersection. It will reduce any upstream supplied pressure to 27 PSIG and will shutoff all flow when the PNEUMATIC switch is placed in the OFF position. There is a solenoid operated valve in the downstream pressure sense line of this valve which, when energized by placing the PNEUMATIC switch in the ENG START position, will release all pressure in this sense line and cause the regulator valve to go full open. This will permit a free flow of air through the valve in either direction. The pressure regulator valve is powered by the DC EMER BUS through a PNEU PRESS REG VALVE circuit breaker (C-20) on the pilots' overhead panel.

Augmentation Valve

The augmentation valve allows flow of 13th stage bleed air when the 8th stage compressor will not meet the demands of the air conditioning unit. For air conditioning operation, the augmentation valve will remain closed when 8th stage pressure is above 18 PSI. If 8th stage pressure is below this point, the augmentation valve will open and regulate the flow of 13th stage bleed air to maintain 18 PSI. Automatic control of the augmentation valve for air conditioning operation occurs when the PNEUMATIC switch is in the AIR COND position. The augmentation valve is powered from the LEFT DC BUS through the AIR COND FLOW CONTROL & AUG VALVES circuit breaker (T-19) on the EPC panel.

8th Stage Check Valve

A check valve in the 8th stage line prevents reverse flow when the pressure downstream of the check valve is higher than the 8th stage.

Flow Control Valve

The flow control valve is mounted

in the right wheel pod, just upstream of the bleed air connection to the air conditioning unit. It normally controls the flow of air into the air conditioning unit and acts as a shutoff valve when the pneumatic switch is placed in either the OFF or ENG START positions. The flow control valve receives 28 VDC power from the LEFT DC bus through the AIR COND FLOW CONTROL & AUG VALVES circuit breaker (T-19).

600°F Sensor

A sensor (figure 1-21) is installed in the pneumatic manifold downstream of Engine #3 pressure regulator valve. This sensor will illuminate the amber AIR COND SPLY TEMP HIGH light, on the overhead annunciator panel and the MASTER CAUTION lights should the bleed air temperature reach 600°F. The AIR COND SPLY TEMP HIGH light receives 28 VDC power from the LEFT DC bus through the AIR COND SUPPLY HIGH TEMP LIGHT circuit breaker (T-18) on the EPC panel.

#3 Pylon Duct Fail Warning Light

A red #3 PYLON DUCT FAIL warning light (figure 1-23), located in the overhead annunciator panel, alerts the pilots of pylon duct failure. When the pylon pressure exceeds approximately 4 PSIG, the pylon pressure relief door opens and turns on the #3 PYLON DUCT FAIL and MASTER WARNING lights. The #3 PYLON DUCT FAIL light receives 28 VDC power from the LEFT DC bus through the #3 PYLON DUCT FAIL circuit breaker (U-18).

DUCT FAIL Light

A red DUCT FAIL warning light (figure 1-21), located in the overhead annunciator panel, warns the pilot of a pneumatic duct failure. Sensors, located in the leading edge of the wings, sense temperature and will turn on the DUCT FAIL light and MASTER WARNING light when the temperature exceeds approximately 126°C and closes the pressure regulator valve. The DUCT FAIL light receives 28 VAC power from the BATTERY DIRECT bus through the EMER & BATT BUS OFF/CABIN PRESS/DUCT FAIL LTS circuit breaker (A-17).

Pneumatic Switch

The PNEUMATIC switch (figure 1-23), located on the pilots' overhead panel, is a three-position switch (ENG START, OFF, and AIR COND). The ENG START position is lever locked to prevent inadvertent selection of this position.

The ENG START position closes the air conditioning flow control valve and augmentation valve and locks the pressure regulator valve full open, permitting bleed air to flow backwards through the pressure regulator valve for Engine 3 starting. Once Engine #3 is operating, this switch position allows 8th stage bleed air in the crossfeed manifold from Engine 3 without pressure reduction by the regulator valve. This allows the manifold pressure to be raised (Engine 3 throttle increase) to the required pressure to start the other engines. The OFF position closes the air conditioning flow control valve, augmentation valve and the pressure regulator valve. The AIR COND position opens the flow control valve, the pressure regulator valve and arms the augmentation valve to modulate to maintain 18 PSI in the manifold whenever the 8th stage bleed air pressure decreases below 18 PSI. The pneumatic system receives 28 VDC from the DC buses.

Pneumatic Pressure Indicator

The PNEU PRESS (Pneumatic Pressure) indicator (figure 1-23), located in the pilots' overhead panel, indicates the pneumatic pressure in the crossfeed manifold. The indicator is calibrated from 0 to 100 PSI pressure with graduation every 10 PSI and numbers every 20 PSI. The system receives 28 VAC power from the LEFT AC BUS through the PNEU PRESS IND circuit breaker (M-19) on the EPC panel.

AIR CONDITIONING SYSTEM

The aircraft has one air conditioning system designed for ground or inflight operation (figure 1-22). It consists of one air cycle refrigeration unit, water separator, ducting for distributing the conditioned air, temperature control valve, and associated controls and indicators for controlling and monitoring the system. A ground condition air connector is located in the right wheel pod. The connector can supply preconditioned air directly into the conditioned air distribution system. Conditioned air in excess of what is required for the cockpit is dumped into the cargo area with no attempt made to obtain selective distribution in this area.

Hot bleed air from Engine 3 passes through a pressure regulator valve set for approximately 27 PSI and an air conditioning flow control valve. Part of the air supply is ducted to the temperature control valve which provides the heated air portion of the system. The remaining air is routed through a heat exchanger and turbine for cooling. The turbine drives a fan in the ram air ducting. This fan ensures a flow of air through the heat exchanger when there is no ram airflow. From the turbine the cold air enters a water separator which removes entrained water and the cold air goes from there into the fuselage. Modulation of the temperature control valve determines the amount of hot air to be mixed with the cold air to provide the desired conditioned air temperature. The temperature control valve is normally automatically controlled to respond to temperature requirements selected by the pilots. The automatic temperature system is designed to provide temperature selection for the flight compartment through a range of from 65 to 80°F. The valve may be manually controlled through flight compartment switching.

Cockpit Temp Control Selector

The CKPT TEMP control (figure 1-23), located on the pilots' overhead panel, provides automatic or manual control of the temperature in the flight compartment. The AUTO (automatic temperature control) range extends from a detent at 8 o'clock position to a detent at 4 o'clock position. These positions correspond to temperatures of 65 and 80°F respectively. Positioning of the selector between these points will vary the cockpit temperature accordingly. When the SELECTOR is rotated beyond the detent positions, toward the MAN range, the selector becomes spring-loaded to the STOP position at the bottom of the control. Rotation from the STOP position toward HOT or COLD will move the air conditioning temperature control valve toward the open or closed position and vary the cockpit temperature accordingly. Releasing the selector to STOP will stop the valve in its present position. The air conditioning systems receive 115 VAC, single phase power from the LEFT AC bus through the AIR COND TEMP CONTROL AUTO (N-19) and AIR COND PACK CONTROL circuit breaker (P-19). Also, 28 VDC power from the LEFT DC bus through the AIR COND TEMP CONTROL AUTO (U-19) and AIR COND TEMP CONTROL MANUAL circuit breaker (V-19) on the EPC panel.

Air Condition Supply Temperature High Caution Light

Refer to 600°F sensor in Pneumatics.

Avionics Rack Cooling

Avionics rack cooling is closely related to flight compartment ventilation as the same air is used in a series flow path to accomplish these various functions. The flight compartment conditioned air is exhausted from the bottom edge of both down view windows and from behind the pilots' instrument panels and the pedestal through ducting to the distributing systems in the avionics rack by a continuously operating fan in the avionics distribution duct. The avionics rack fan receives 115 VAC, three phase power from the LEFT AC BUS through the AVIONICS RACK FAN circuit breakers (N-18, P-18, R-18) on the EPC panel.

NOTE

When the temperature is extremely warm, a physical check of the avionic racks cooling must be made. If the air is not flowing, the avionics load must be reduced.

Electrical Power Center Cooling

Flight compartment conditioned air is drawn into the electrical power center panel and circulated through the panel by two EPC fans. One fan (alternate fan) receives 115 VAC, single phase power from the RIGHT (LEFT) AC BUS through the EPC FAN (ALTN) circuit breaker (AB-18 and R-19 respectively).

Air Conditioning System Operation

The aircraft air conditioning system is controlled from the flight compartment by either pilot.

Air conditioning using Engine 3 bleed air while inflight or on the ground is accomplished as follows:

1. Place the PNEUMATIC switch in AIR COND position.
2. Rotate the CKPT TEMP selector in the AUTO range to the desired temperature.

Air conditioning using an external pneumatic power source.

NOTE

LEFT AC and DC must be powered to operate the controls.

1. Contact ground crewman to connect external pneumatics to ground pneumatic connector. PNEU PRESS indicator should indicate at least 18 PSI.
2. Place the PNEUMATIC switch in the AIR COND position.
3. Rotate the CKPT TEMP selector in the AUTO range to the desired temperature.

Air conditioning using external conditioned air.

1. Contact ground crewman to connect external conditioned air to the ground conditioned air connector.

PRESSURIZATION SYSTEM

Pressurization is obtained by having a continuous flow of conditioned air into the fuselage and restricting the outflow so as to back pressure the fuselage to the desired pressurization level (figure 1-24). The pressurization control system is essentially a controller and manual control valve mounted in the pedestal in the cockpit and pneumatically connected to two outflow valves mounted on the skin of the aircraft under the cargo floor. Any isobaric altitude from -1000 feet to 10,000 feet and cabin change rate from 50 to 2000 feet per minute may be selected on the controller. The two outflow valves, as signaled by the controller, maintain cabin pressure to up to a maximum cabin to ambient differential of 7 PSID. The manual valve will permit direct control of the outflow valves for rapid depressurization, repressurization and continuous control of the system should a malfunction occur in the controller. Cabin altitude, cabin to ambient pressure differential and pressure rate of change are displayed to the flight crew. Positive and negative pressure relief is accomplished by the two outflow valves. An altitude warning is installed to signal the flight crew if cabin altitude goes to 9,750 ±250 feet.

When the aircraft is on the ground, a small fan is energized to provide a flow of air through a venturi, which in turn provides a suction on the outflow valves to hold them full open. When in the flight mode, the fan is de-energized which allows the outflow valves to close and respond to signals from the controller. The fan receives 115 VAC single phase power from the LEFT AC bus through the CABIN PRESS VENTURI circuit breaker (AB-19) on the EPC panel.

Cabin Pressure Controller

A cabin pressure controller (figure 1-25) is located on the forward right side of the pedestal. The RATE control knob on the left selects the desired cabin change rate. The white dot and index, when aligned produces a cabin change rate of 300 feet per minute down to 500 feet per minute up. When in MIN, the cabin change rate is 50 ft/min. When in MAX, the cabin change rate is 2000 ft/min. The CABIN ALT control knob on the right is used to set the desired cabin altitude on the dial. With maximum differential pressure and aircraft altitude of approximately 16,000 feet, the cabin altitude will be sea level. Prior to landing, the cabin altitude should be set to the destination airport elevation so that the cabin altitude will equal the airport elevation upon landing.

Cabin Altimeter and Differential Indicator

A combined cabin altimeter and differential pressure indicator (figure 1-25) provides comparative indications of cabin altitude and differential pressure. The short pointer indicates cabin altitude on the inner dial while the long pointer indicates the difference in PSI between cabin pressure and atmosphere on the outer dial.

Cabin Altitude Rate Indicator

A cabin rate of climb indicator, VERTICAL SPEED (figure 1-25), indicates the rate of cabin climb or descent. The indicator is calibrated from 100 to 2,000 feet per minute climb or descent.

Cabin Altitude Manual Control

With the control knob rotated full CW to the stop, the manual mode is disabled allowing the controller to function automatically. When the CABIN ALT MANUAL knob is rotated toward the UP position, the automatic controller is bypassed and permits manual control of the cabin altitude.

Cabin Pressure Valve Switch

The CABIN PRESS VALVE switch (figure 1-25), located on the pilots' overhead panel, is a two position switch (NORM - OPEN). The switch is guarded in the NORM position. The NORM position allows the pressurization system to operate normally. The OPEN position energizes a small fan to provide a flow of air through a venturi, which in turn provides a suction on the outflow valves to hold them full open preventing aircraft pressurization. This switch may be used to ensure the aircraft is depressurized. The CABIN PRESS VALVE switch receives 115 VAC single phase power from the RIGHT AC bus through the CABIN PRESS VENTURI circuit breaker (AB-19).

Cabin Pressurization Warning Light

The red CABIN PRESS warning light (figure 1-25), located on the overhead annunciator panel, and MASTER WARNING lights come on when the cabin altitude reaches an altitude of approximately 9,750 feet ±250 feet. The light is actuated by a differential pressure switch in the EPC. The switch and light receives 28 VDC power from the BATTERY DIRECT bus through the EMER & BATT BUS/CABIN PRESS/DUCT FAIL LTS circuit breaker (A-17) on the pilots' overhead circuit breaker panel.

Cabin Pressurization Operation

A controlled flow of compressed air from the pneumatic system passes through the air conditioning system to pressurize the aircraft. The selected pressurization level is made possible by regulating the escape of compressed air through the outflow valves. The cabin air outflow valves are automatically controlled by the cabin pressure control system to maintain 7 PSI normal maximum differential pressure.

Normal Operation:

Prior to Start -

To ensure pressurization after takeoff, proceed as follows:

1. Check that the CABIN PRESS VALVE switch is in NORM.

2. Set the cabin pressure control pointer to the airport elevation.

3. Set the rate knob to the dot.

4. Verify the cabin altitude manual control knob is fully CW to the stop.

After Takeoff -

1. Cross check the indicators to ensure the aircraft is pressurizing.

During Flight -

1. Periodically check cabin differential pressure during all phases of flight.

NOTE

In the normal automatic operating range and with sea level selected on the controller, the cabin altitude should be sea level when the aircraft altitude is 16,000 feet or below.

Descent -

1. Set the destination airport elevation on the cabin pressure controller with the cabin altitude knob.

2. Verify rate knob is in DOT position.

3. Check rate of descent approximately 300 fpm.

PNEUMATIC SYSTEM

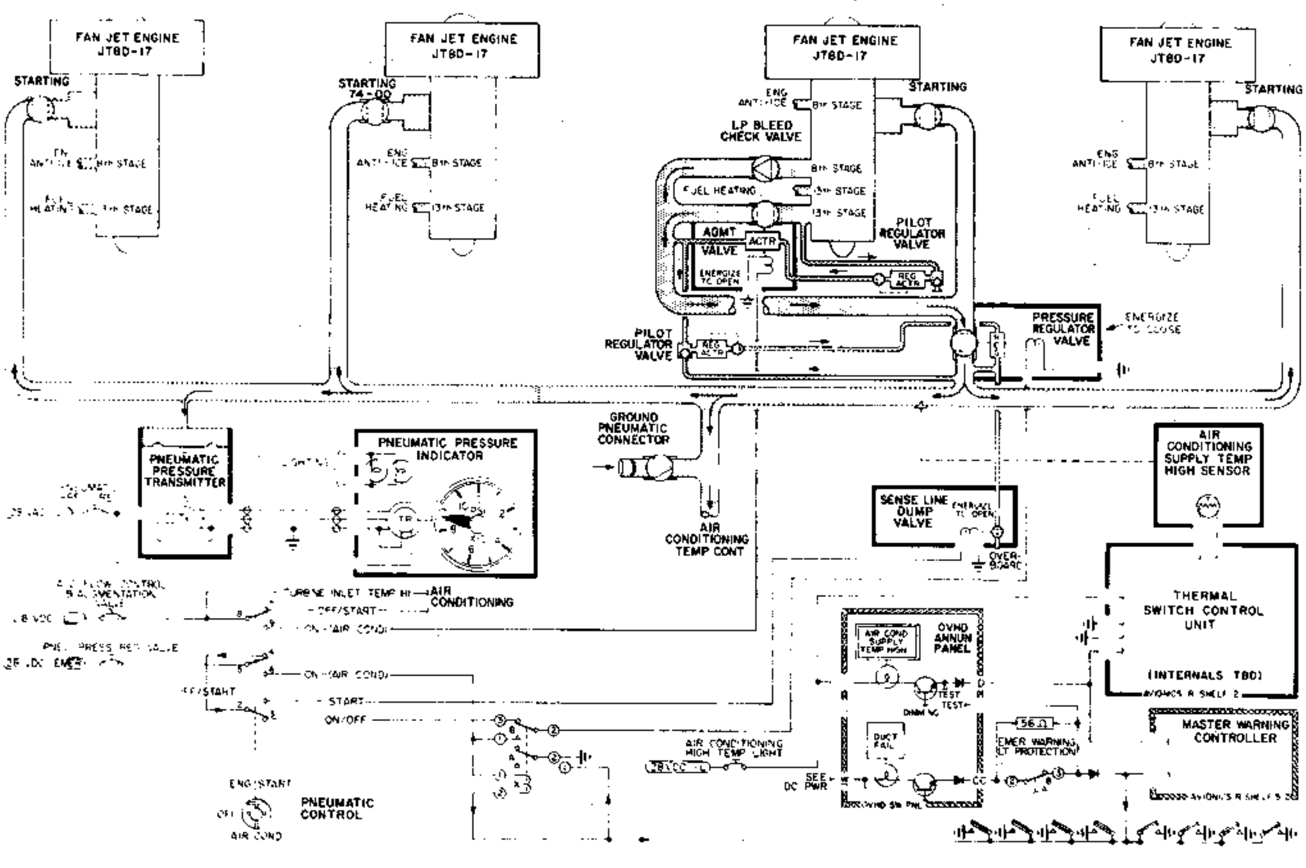

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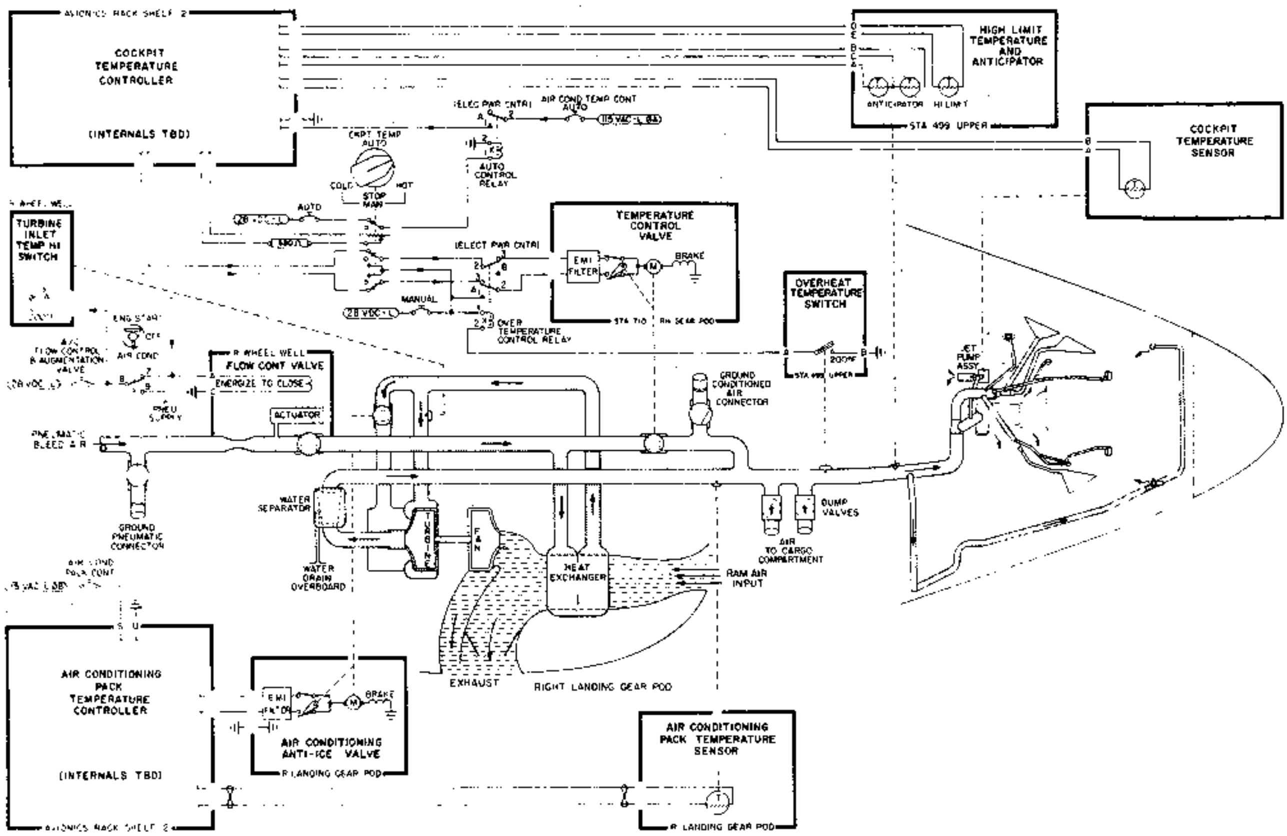
Figure 1-21

AIR CONDITIONING SYSTEM

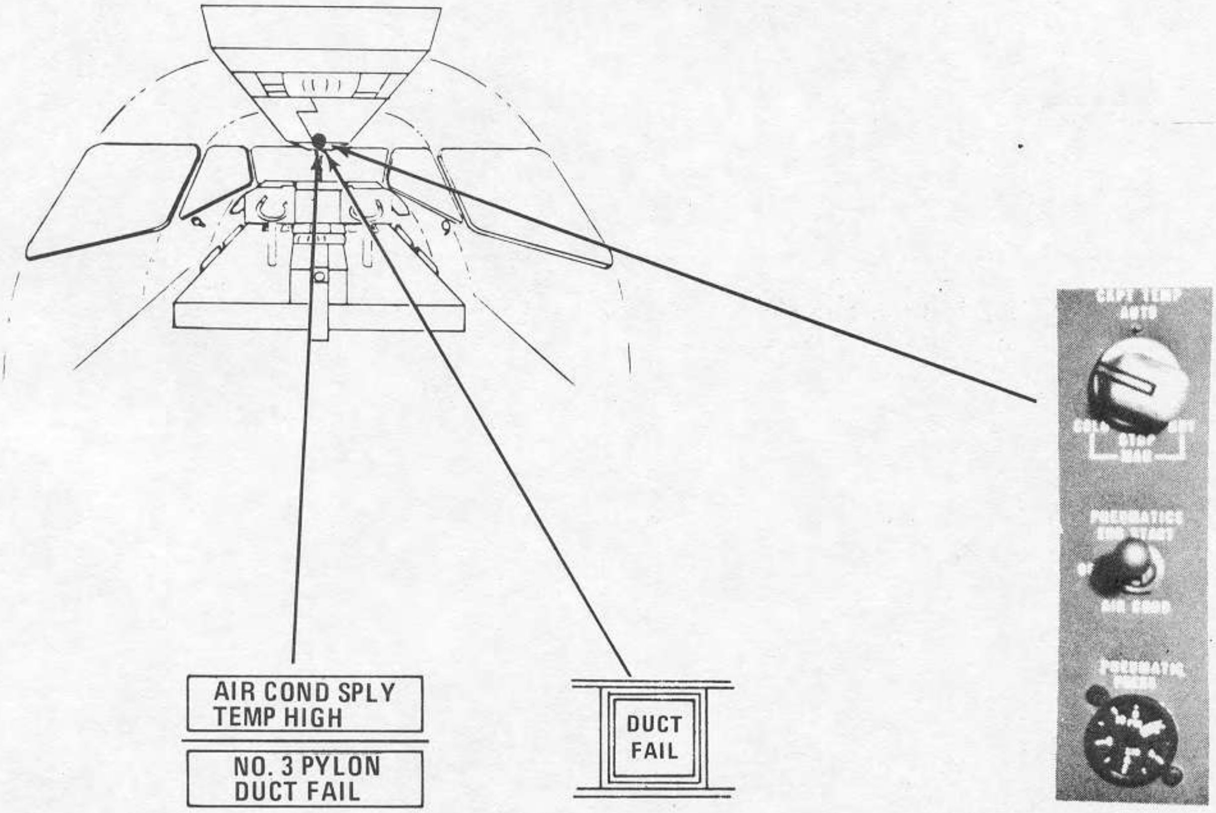
SYSTEM SCHEMATIC



PR5-C15-243

Figure 1-22

PNEUMATIC AND AIR CONDITIONING CONTROLS AND INDICATORS



PR5-C15-118A

Figure 1-23

PRESSURIZATION SYSTEM

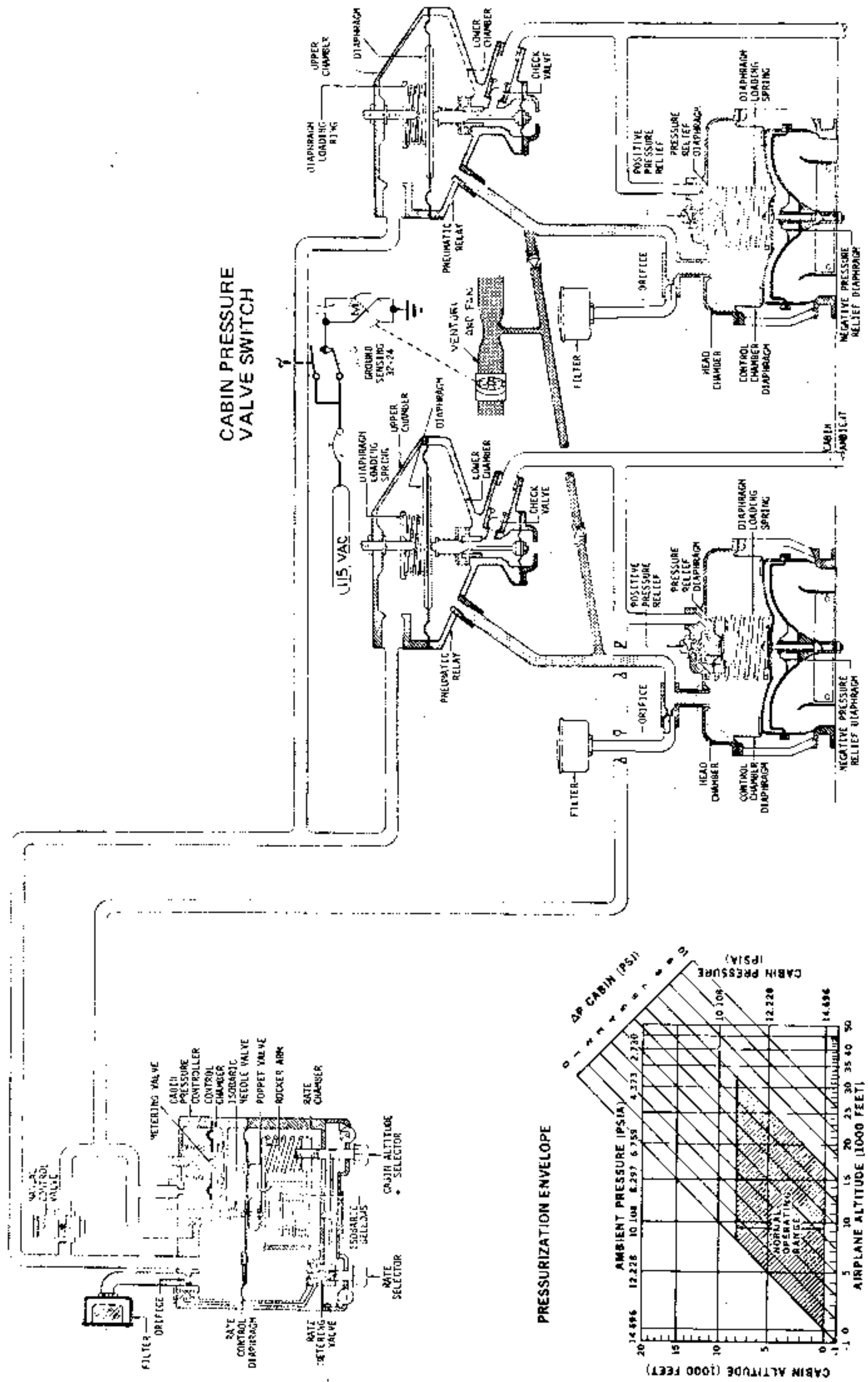


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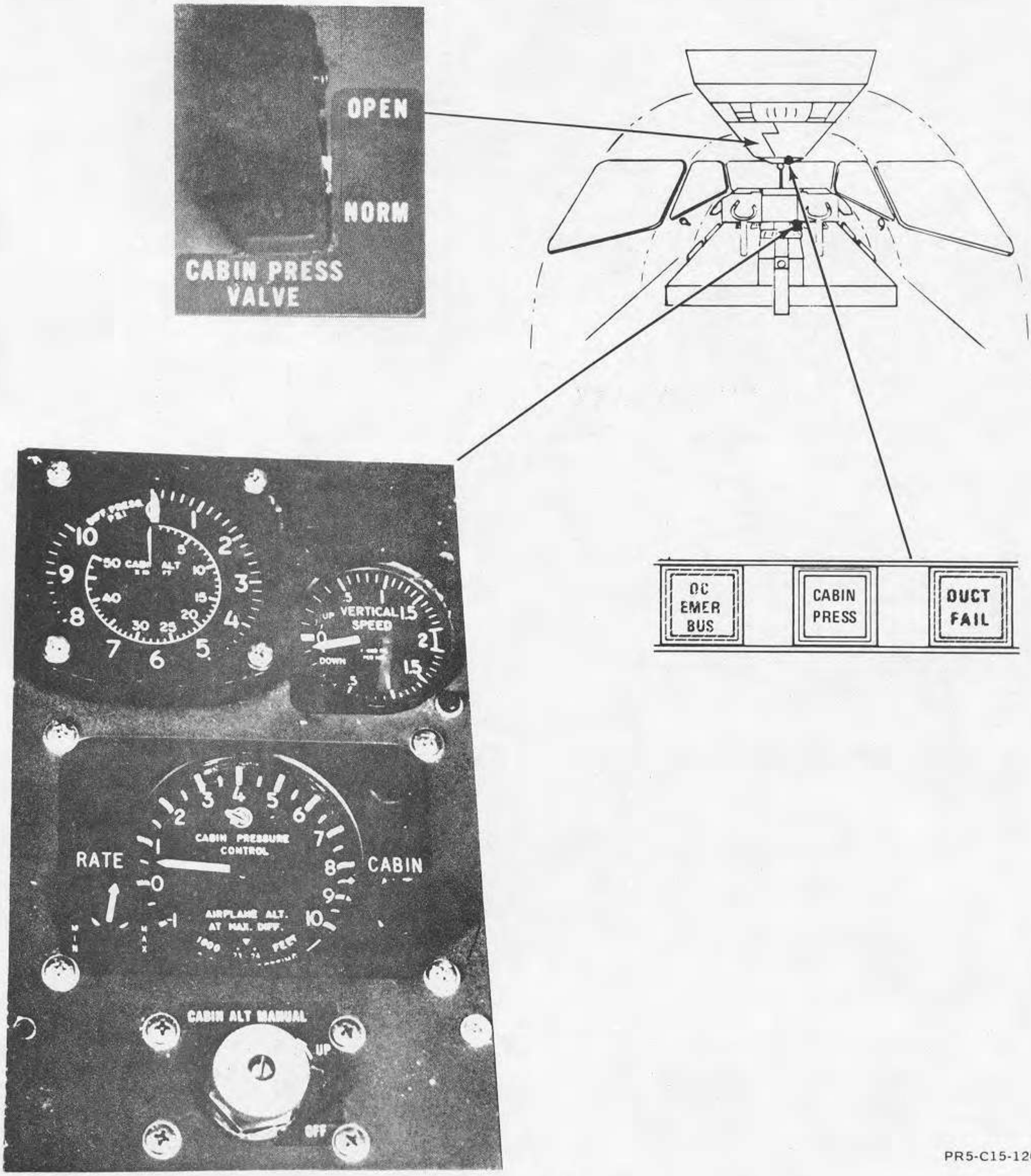
Figure 1-24

CABIN PRESSURE CONTROLS AND INDICATORS



PR5-C15-120B

Figure 1-25

WINDSHIELD RAIN REMOVAL SYSTEM

The windshield rain removal system consists of two electrically powered, two speed windshield wipers, control units and switches.

Windshield Wiper Selectors

Two WINDSHLD WIPE selectors (Figure 1-26), one for the pilot and one for the copilot, are located on the pilots' overhead panel. Each selector turns on and controls the speed of the wiper on the respective windshield.

The OFF position stops the motor and drives the wiper to the parked position out of view. The windshield wiper system receives 28 VDC power from the DC buses. The pilot's (copilot's) system receives power from the LEFT (RIGHT) DC bus through the LEFT (RIGHT) WSHLD WIPER CONTROL (U-17 and AE-17 respectively) and LEFT (RIGHT) WSHLD WIPER MOTOR circuit breaker (T-17 and AD-17 respectively) on the EPC panel.

Rain Removal Operation

To operate the windshield wipers, proceed as follows:

1. Windshield wiper selector - rotate to desired speed.

NOTE

Do not operate the windshield wipers on a dry windshield. The force applied to the wiper blade causes unecessary wear of the blades and scores the windshield.

ANTI-ICING AND DEFOGGING SYSTEM

The YC-15 is not designed for flight in icing conditions, however, it does employ hot air and electrical resistance heating for anti-icing and defogging. Heated air for thermal anti-icing of the engine compressor guide vanes and bullet is supplied by the 8th stage bleed air. Each engine furnishes its own bleed air and cannot be anti-iced from another engine.

Electrical resistance vinyl coated panels provide heat for defogging the pilots' windshields. Electrical resistance elements are used for anti-icing the pitot/static tubes, beta vanes, TAT probe and alpha vanes.

Engine Anti-icing Switches

The guarded INBD and OUTBD ENG ANTI-ICE switches (Figure 1-27) are located in the pilots' overhead panel. The switches when placed in ON, open the respective engine anti-ice shutoff valves, admitting 8th stage bleed air to the compressor guide vanes and bullet. The INBD (OUTBD) ENG ANTI-ICE switch receives 115 VAC, single phase power from the LEFT (RIGHT) AC bus through the ENGINE ANTI-ICE, ENG 2 and ENG 3 (ENG 1 and ENG 4) circuit breakers (R-10, -11 and AB-10, -11 respectively) on the EPC panel.

CAUTION

YC-15 will not intentionally be flown during or in icing conditions which would require anti-ice.

Engine Anti-ice Abnormal Operation

When icing conditions cannot be

avoided, proceed as follows:

1. Continuous ignition-------ON

NOTE

The low energy ignition system should provide adequate ignition protection in all phases of flight. However, if use of the high energy override position is desired, the duty cycles are as follows: ignition OVRD switch ON maximum of 2 minutes, 3 minutes OFF, 2 minutes ON and 23 minutes OFF.

2. ENG ANTI-ICE switch - INBD - ON; OUTBD - ON

NOTE

Turn on one ENG ANTI-ICE switch at a time and wait until the engines are stablized before turning on the other ENG ANTI-ICE switch.

Windshield Defogging System

Defogging of the two flight compartment windshields is accomplished from electrical resistance coated vinyl pane within the glass assemblies. When the WINDSHIELD DEFOG switch (Figure 1-27) is in ON, the system is automatically controlled. Sensing elements in the windshield panels regulate the defogging temperature. The operating temperature of the defogging system is approximately 90°F.

The windshield's defog system receives 115 VAC, single phase power from the LEFT and RIGHT AC buses through the respective LEFT WSHLD DEFOG and RIGHT WSHLD DEFOG circuit breakers (N-17; Z-17) on the EPC panel.

Pitot/Static Anti-icing System

The pitot/static system is electrically anti-iced (figure 1-28). To prevent a possible overheat of the test probes, the ground sensing relays (ground mode) shifts the source of input voltage to a lower voltage on certain probes and de-energizes the TAT probes. The anti-icing system consists of heating elements, indicators, controls and circuitry. The heating elements receive electrical power as follows:

1. LEFT AC bus

   a. Pilot Pitot Static (R-16)
   b. Aux 1 Pitot Static (R-15)
   c. Alpha 1 (P-16)
   d. Alpha 1/Beta 1 (M-16)
   e. TAT 1/Beta 1 (P-15)

2. RIGHT AC bus

   a. Copilot Pitot Static (AB-16)
   b. Aux 2 Pitot Static (AB-15)
   c. Alpha 2 (AA-16)
   d. Alpha 2/Beta 2 (Y-20)
   e. TAT 2 /Beta 2 (AA-15)

A system description follows:

METER SELECTOR AND HEAT PITOT STATIC SELECTOR. An eleven position rotary switch (Figure 1-27), located on the pilots' overhead panel, provides a means of energizing the heaters and monitoring the current to the selected heater. In the ground mode and the selector is rotated to any position other than OFF, all the heaters except TAT will be energized.

HEATER CURRENT METER. A HTR CUR (Heater Current) meter (figure 1-27), adjacent to the selector, provides a means of monitoring the current to the selected heater.

Pitot Heater Inoperative Caution Light

A PITOT HEAT INOP light (Figure 1-27), located in the overhead annunciator panel, cautions of a failure of the heater system. When the selector is in OFF, the light will be on. When the selector is in any position other than OFF and one or more monitored heaters (PILOT, COPILOT, AUX 1 and AUX 2) are inoperative, the PITOT HEAT INOP light will come on. This signal also turns on the MASTER CAUTION lights. The light receives 28 VDC power from the RIGHT DC bus through the PITOT HEAT MONITOR circuit breaker (AD-15).

Pitot Heat Normal Operation

When heat is desired, the selector must be in any position other than off.

1. Rotate the METER SEL & HEAT selector to monitor desired heater. The HTR CUR meter will indicate the current flow for that selected heater.

NOTE

When TAT 1 or 2 positions are selected with the aircraft on the ground, the HTR CUR will indicate zero because the TAT probes are not heated on the ground.

WINDSHIELD WIPER CONTROLS

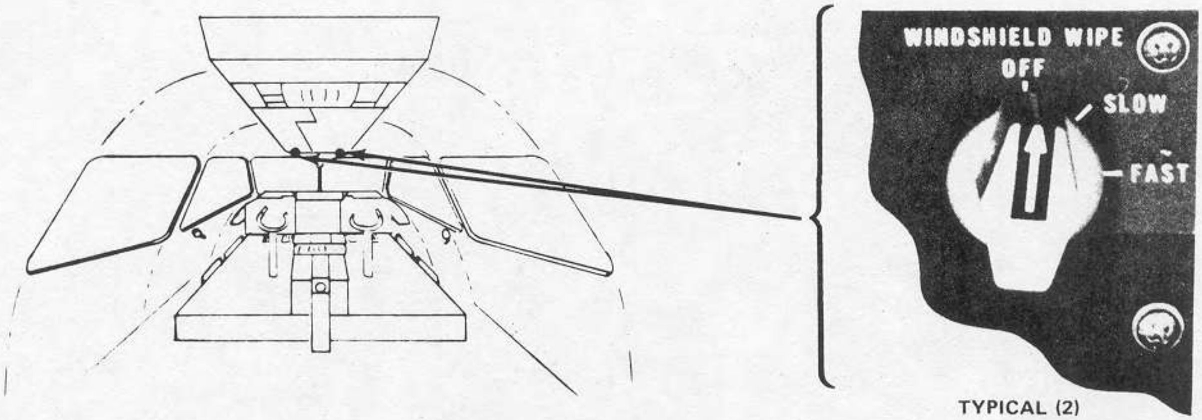


Figure 1-26

ANTI-ICING AND DE-ICING CONTROLS AND INDICATORS

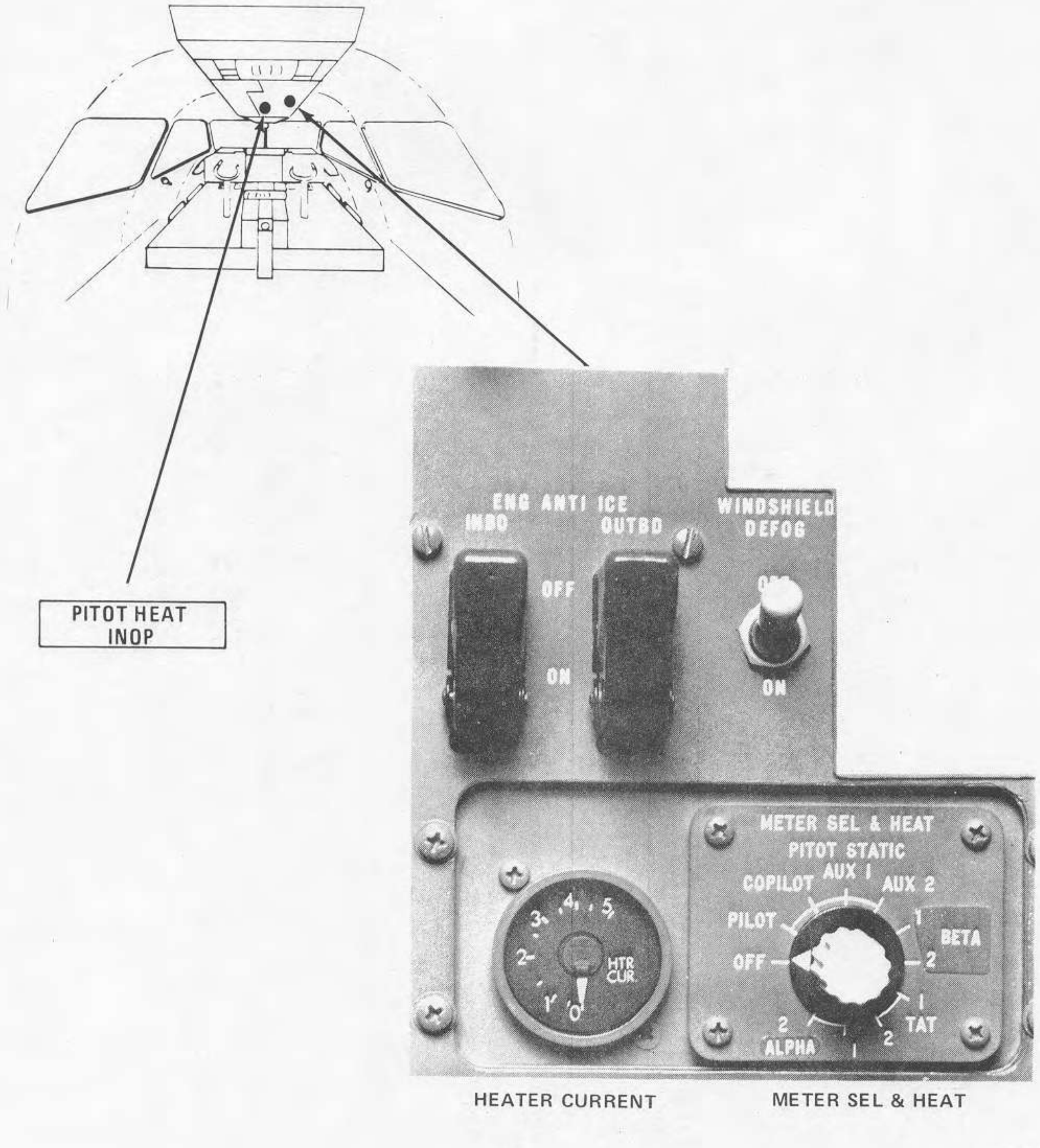


Figure 1-27

PITOT STATIC HEATER SYSTEM

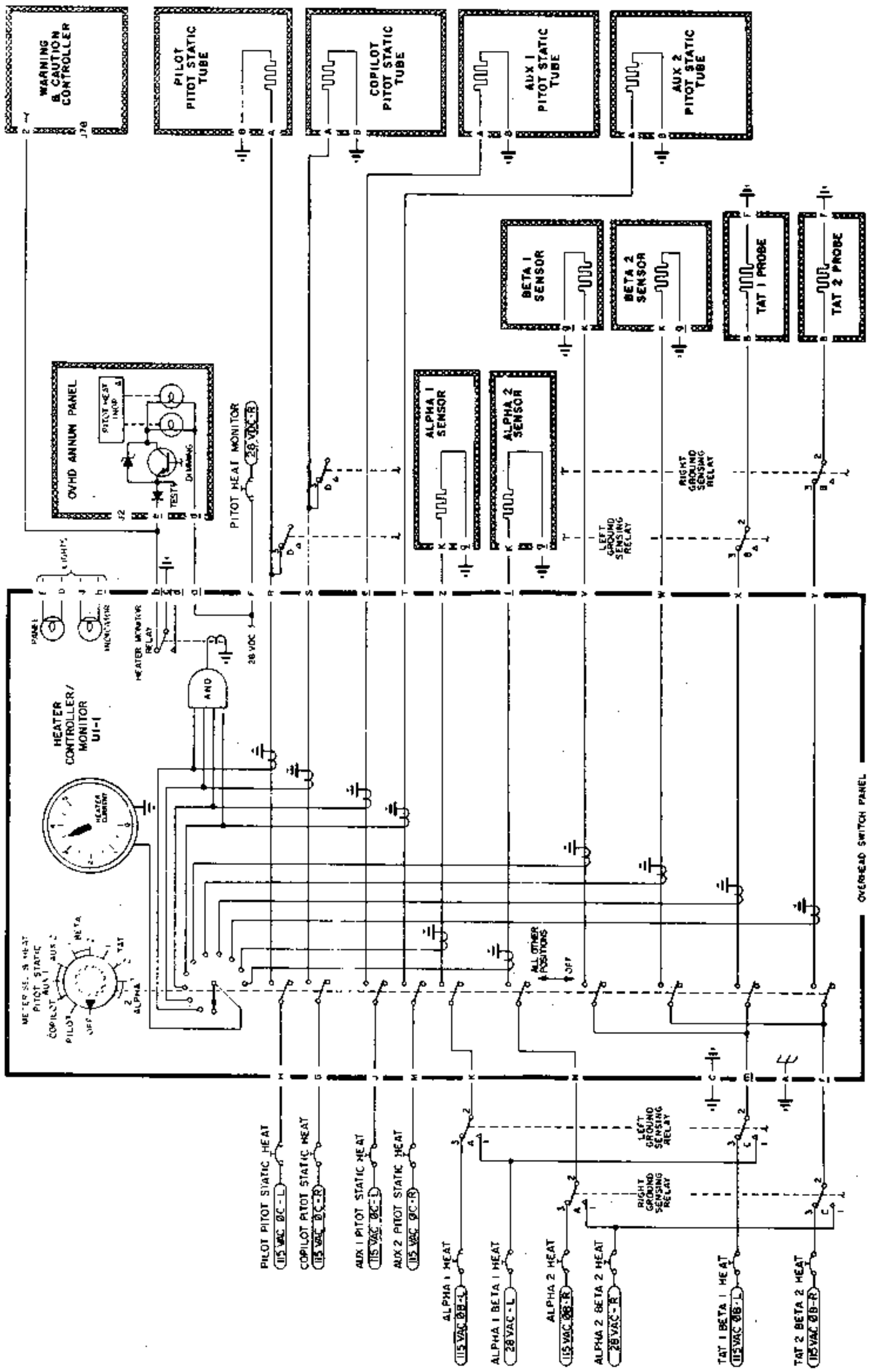


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Figure 1-28

HYDRAULIC POWER SUPPLY SYSTEM

The aircraft has four completely independent, parallel, continuously operating hydraulic systems (figure 1-29) using Skydrol fluid. They are designated by the respective engine from which they receive their power via the engine driven pump, i.e., #1 engine supplies #1 system, #2 engine supplies #2 system and etc. There are no provisions for routing the hydraulic fluid from one system to another. Each system consists of an engine driven pump and electric auxiliary pump, reservoir, filters, valves, manifolds, and controls and indicating circuits.

Engine Driven Hydraulic Pump

The four engine driven hydraulic pumps are variable displacement, piston type pumps capable of providing continuous hydraulic flow at a rate of 32 GPM and hydraulic pressure up to 3000 PSI. A solenoid-operated unloading valve with a blocking valve is incorporated in the pump to shut off all pump output when the pump is depressurized by the ENG PUMP switches on the hydraulic control panel. The ENG PUMP switches receive 28 VDC from the DC buses.

Electrically Driven Auxiliary Hydraulic Pump

Each hydraulic system has an electrically driven hydraulic pump located in the wheel pods: 1 & 2, left; 3 & 4, right. The pump can supply hydraulic fluid continuously at the rate of 6 GPM and hydraulic pressure of 3000 PSI. The pump can be used for preflight and maintenance with the engine inoperative, and as a flight backup. The auxiliary pumps are protected from overheat damage by a thermal protection circuit that disconnects electrical power from the pump when normal operating temperatures are exceeded. Each auxiliary pump is controlled by the AUX switch on the pilots' overhead panel.

Aux pumps 1 and 2 receive 115 VAC, 3 phase power through the AUX PUMP 1 (AH-7, AJ-7, AK-7) and AUX HYD PUMP 2 circuit breakers (AH-8, AJ-8, AK-8) on the EPC panel.

Aux pumps 3 and 4 receive 115 VAC, three phase power through the AUX HYD PUMP 3 (AL-7, AM-7, AN-7) and AUX HYD PUMP 4 circuit breakers (AL-8, AM-8, AN-8) on the EPC panel.

The hydraulic systems supplies pressure and pressure distribution as shown in FO-4 and FO-5.

Hydraulic System Reservoir

The four hydraulic system reservoirs are mounted on the fuselage interior wall. #1 is left forward, #2 left aft, #3 right aft and #4 right forward. Each reservoir supplies hydraulic fluid to its own system exclusively and has a fluid capacity of 12 gallons. Hydraulic fluid from the reservoir is ported to the supply lines through an ENG FIRE shutoff valve to the engine driven hydraulic pump. The reservoir utilizes a system pressure of 3000 PSI in a piston and diaphragm assembly to maintain a pressure head of approximately 60 PSI on the hydraulic fluid. This pressure ensures a positive flow of fluid to the pump.

A sight glass on the reservoir is used to check excessive air accumulation in the reservoir. To bleed off excessive air, a pushbutton type bleed valve, drain line and plastic container are provided. A fluid quantity transmitter, located at each reservoir, transmits information to the applicable hydraulic quantity indicator.

Reservoir Drain Valve

A manually operated drain valve is located in the bottom of each reservoir and provides for complete draining of the low pressure fluid chamber.

Reservoir Relief Valve

The reservoir relief valve is located in each system auxiliary pump suction/supply line in the wheel pods. This system prevents reservoir damage from overfilling and minimizes hydraulic fluid spillage by routing fluid overboard. The relief flow is 25 GPM at approximately 125 PSI.

Balanced Relief and Depressurization Valve

The balanced relief and depressurization valve is a combination priority and integral pushbutton bypass valve. It is mounted adjacent to its respective system accumulator which are located in the wheel pods. When the hydraulic pressure source is shut down, the priority valve maintains partial accumulator pressure on the reservoir, preventing pump cavitation upon restart. When the accumulator and/or reservoir needs to be drained, the pushbutton depressurization valve speeds up depletion rate. The valve is spring-loaded to the closed position.

Hydraulic System Filters

Filters are installed in the engine driven hydraulic pump pressure and case drain lines, in the electrically driven auxiliary hydraulic pump pressure line and in the hydraulic system return line up stream of the reservoir. Each filter has a red button indicator to show an overload condition of the filter element. When the filter becomes overloaded, causing a differential of approximately 120 PSI across the pressure and return filters, 30 PSI across the case drain filter, the red button will pop out on the filter head. The pump manifold filter assembly for each system is mounted on its resepctive engine. The system filter assembly is located near its respective reservoir. The electric driven auxiliary pump filters are located in the respective wheel pods.

Hydraulic System Accumulators

One spherical accumulator for each hydraulic system is located in the respective wheel pods, #1 and 2 left, #3 and 4 right. Each accumulator has a capacity of 130 cubic inches at 3000 PSI. An air pressure gage on each accumulator provides a means for checking initial air charging pressure of 1000 PSI.

Ground Service Hydraulic Connectors

Each hydraulic system has an adapter for ground service installed in the wheel pods, #1 and 2 left, #3 and 4 right. The connectors are available for maintenance checkout and normal servicing of system hydraulic fluid.

Fire Shutoff Valves

When the engine fire shutoff handles are pulled, a cable actuated shutoff valve closes, shutting off hydraulic suction/supply flow to the engine driven hydraulic pump on the respective engine. Each system's valve is located on the wing front spar adjacent to the related engine pylon.

Hydraulic Quantity Indicators

The four HYD QTY indicators (figure 1-30), one for each system, are located on the pilots' overhead panel to show the quantity of fluid in the respective reservoirs. A little "V", adjacent to the numeral 4, is the low quantity mark for preflight. The HYD QTY indicators are powered by the AC buses. #1 and 2 (3 and 4) indicators receive 28 VAC, single phase power from the LEFT (RIGHT) AC bus through the HYDRAULIC QUANTITY, SYS 1 and SYS 2 (SYS 3 and SYS 4) circuit breakers (M-15, -16 and Y-15, -16 respectively) on the EPC panel.

NOTE

> In the event of an electrical failure, the related HYD SYS QTY indicator will tend to remain in the last powered position.

Auxiliary Hydraulic Pump Switches

The AUX PUMP switches (figure 1-30), one for each system, located on the pilots' overhead panel, control the respective auxiliary pumps. When ON, the pump will operate at 3000 PSI output. When OFF, the pump is depressurized. The AUX PUMP switches are normally in the OFF position. Each switch receives 115 VAC, single phase power from the GEN buses. Aux pump switches 1 and 2 (3 and 4) are powered by the LEFT (RIGHT) GEN bus through the AUX HYD PUMP CONT 1 and 2 (3 and 4) circuit breakers (AH-3, -4 and AL-3, -4 respectively) on the EPC panel.

Engine Hydraulic Pump Switches

The four ENG PUMP guarded switches (figure 1-30), one for each system, located on the pilots' overhead panel, control engine driven hydraulic pump operation. When ON, the engine driven hydraulic pump will operate at approximately 3000 PSI. When OFF, the pump is depressurized; the only circulation of fluid will be for pump lubrication. The ENG PUMP switches receive 28 VDC power from the DC buses. Switches #1 and 2 (3 and 4) are powered by the LEFT (RIGHT) DC bus through the ENGINE HYDRAULIC PUMP CONTROL, ENG 1 and ENG 2 (ENG 3 and ENG 4) circuit breakers (T-13, -14 and AD-13, -14 respectively) on the EPC panel.

NOTE

> In the event of an electrical failure, the respective engine driven pumps will operate regardless of switch position.

Hydraulic Pressure Low Lights

Four amber ENG PUMP PRESS LOW lights (figure 1-30), one for each system located on the pilots' overhead panel, and the MASTER CAUTION lights come on when the respective engine driven pump output is less than approximately 1800 PSI. The light will go off when the pump output pressure is more than 2200 PSI. The ENG PUMP PRESS LOW lights receive 28 VDC from the DC buses. The lights for Pumps 1 and 2 (3 and 4) are powered by the LEFT (RIGHT) DC bus through the ENGINE HYD PUMP LOW

PRESS LIGHT, ENG 1 and ENG 2 (ENG 3 and ENG 4) circuit breakers (U-13, -14 and AE-13, -14 respectively) on the EPC panel.

Hydraulic System Pressure Indicators

The four HYD pressure indicators (figure 1-30), one for each system, located on the pilots' overhead panel show the pressure existing in the hydraulic pressure line. The HYD pressure indicators receive 28 VAC, single phase power, from the AC buses. HYD pressure indicators for #1 and 2 (3 and 4) system are powered by the LEFT (RIGHT) AC bus through the HYDRAULIC PRESSURE, SYS 1 and SYS 2 (SYS 3 and SYS 4) circuit breakers (M-17, -18 and Y-17, -18 respectively) on the EPC panel.

NOTE

In the event of an electrical failure, the related HYD SYS PRESS indicators will tend to remain in the last powered position.

Hydraulic Temperature Caution Lights

The four amber HYD SYS TEMP HI lights (figure 1-30), one for each system, located in the overhead annunciator panel and the MASTER CAUTION lights come on when the temperature of the fluid in the respective engine driven pump manifold exceeds approximately 120°C. The light is actuated by a temperature switch located in the engine driven pump manifold assembly. The HYD SYS TEMP HI lights receive 28 VDC from the DC buses. The #1 and #2 HYD SYS TEMP HI (#3 and #4 HYD SYS TEMP HI) lights are powered by the LEFT (RIGHT) DC bus through the HYDRAULIC SYS HIGH TEMP LIGHT, SYS 1 and SYS 2 (SYS 3 and SYS 4) circuit breakers (V-13, -14 and AF-13, -14 respectively) on the EPC panel.

Hydraulic Quantity Low Light

One amber HYD QTY LOW light (figure 1-30), located on the overhead annunciator panel, and MASTER CAUTION lights come on when one or more hydraulic system reservoir(s) quantity is less than 1 gallon. The HYD QTY LOW light receives 28 VDC power from the LEFT DC bus through the HYD QTY LOW LIGHT circuit breaker (U-15) on the EPC panel.

Hydraulic System Operation

Prior to Start

To ensure hydraulic fluid is available for the engine driven pumps and hydraulic pressure for the brakes, proceed as follows:

1. Verify that electrical AC and DC buses are powered.
2. Place AUX PUMP switch for System #1 in ON and check for normal conditions, i.e., quantity above the little V, pressure approximately 3000 PSI, HYD QTY LOW and #1 HYD SYS TEMP HI lights are off.
3. Check the FWD BRAKE pressure indicator shows normal pressure.
4. Verify that the parking brake is set.

NOTE

Hydraulic Systems #1 and 4 power the brake system. When the parking brake handle is in PARK position, it is not necessary to cycle the brake pedals to reset them on re-applying hydraulic pressure.

5. Place AUX PUMP switches #2, 3 and 4 in ON, one at a time. Check for normal indications.

NOTE

The ENG PUMP PRESS LOW lights should be on because the engine driven hydraulic pumps are static.

This action charges the accumulators and reservoirs and will preclude the possibility of engine driven pump cavitation on engine start.

6. When hydraulic pressure is no longer required, place AUX PUMP switches in OFF.

7. Verify that all ENG PUMP switches are ON.

During Engine Start

1. The ENG PUMP PRESS LOW lights will go off during engine operation.

After Engine Start

1. Check for normal indications, i.e., quantity, pressure, ENG PUMP PRESS LOW, HYD QTY LOW, HYD SYS TEMP HI lights off.

During Flight

1. In the event of an engine driven hydraulic pump failure, the AUX PUMP may be used to pressurize the hydraulic system provided there is hydraulic fluid in the system.

CAUTION

If required, turn on only one AUX PUMP on the same side of the aircraft. If both pumps on one side are used, it may cause an electrical overload.

LANDING GEAR SYSTEM

The landing gear is a fully retractable tricycle type. The nose gear consists of a dual wheel unit and incorporates hydraulic steering and retracts forward into the fuselage. The main gear consists of two four wheel bogie type assemblies which retract into pods on each side of the aircraft. The landing gears are electrically controlled and hydraulically operated, using pressure from aircraft hydraulic system No. 1. In the event of electrical failure, the hydraulic part of the system can be manually controlled to extend or retract the gears. In the event of hydraulic system failure, the gear can be manually extended.

Nose Gear

The nose gear is locked in the extended position by over-center linkage actuated by a spring-loaded hydraulic bungee cylinder (figure 1-31).

Nose Gear Doors

The nose gear enclosure consists of two forward doors and two aft doors mechanically operated by movement of the nose gear during extension and retraction.

Nose Landing Gear Emergency Uplock Release Handle

A "T" shaped yellow handle (figure 3-4), located on the aft face of the avionics rack near the crew entrance stairs, provides a means of mechanically unlocking the nose gear, when hydraulic and electrical power is not available, permitting the gear to free fall.

Main Gear

Each main gear is locked in the extended position by a spring-loaded downlock actuator which latches the locks in place (figure 1-32). In flight, each main gear is locked in the UP position by its respective up-lock hook. Each system consists of a selector valve actuator, down-lock actuator, door lock actuator, door lock selector valve, down-lock selector valve, up-lock release actuator and an actuating cylinder which are powered by aircraft hydraulic system #1 for normal retraction and extension. Normal retraction or extension time for the main gear is 8-12 seconds.

Main Landing Gear Doors

Each main gear pod has two doors which completely enclose the gear when retracted. Door operation is accomplished by mechanical linkage. During normal cruise condition the gear doors are locked up by an over-center locking mechanism.

Ground Sense Relays

The left and right ground sense relays provide an electrical means of establishing a ground or flight mode of operation for various systems. Two switches (gear compressed and gear extended) are located on each main gear. The gear compressed switch and gear extended switch are actuated by compression or extension of the respective strut which energizes or de-energizes ground sense relays to establish ground or flight mode for various systems as follows:

1. Left ground sense relays:

   a. Air Data
   b. Fuel Fill (2)
   c. Pitch SCAS
   d. Roll SCAS
   e. Spoilers (Ground)
   f. Probe Heat
   g. Landing Gear Handle Down Lock
   h. Anti-skid

2. Right Ground Sense Relays:

   a. Air Data
   b. Fuel Fill (2)
   c. Pitch SCAS
   d. Roll SCAS
   e. Probe Heat
   f. Spoiler Auto-flare
   g. Cargo Door/Ramp Control
   h. Pressure Venturi
   i. Landing Gear Handle Down Lock
   j. Anti-skid

The ground sense relays are powered by the DC buses. The left (right) ground sense relays receive 28VDC from the LEFT (RIGHT) DC bus through the LEFT (RIGHT) GROUND SENSE RELAYS circuit breaker (V-15 and AF-15 respectively) on the EPC panel.

Main Landing Gear Door Uplock Latch Emergency Release Handles

A handle (figure 3-4) is provided for emergency manual release of the associated main landing gear door uplock latch. Each handle is located aft and below the main gear inspection window. The "T" handle must be pulled to release the door uplock latch before the main landing gear uplock release handle is pulled, so that the landing gear doors will open when the gear free falls.

Main Landing Gear Emergency Uplock Release Handles

A "T" shaped handle (figure 3-4), located below each main gear inspection window, provides a means of mechanically releasing the respective gear uplock, permitting the gear to free fall.

Main Landing Gear Emergency Down-Lock Engage Handles

An emergency down-lock engage handle (figure 3-4) is provided for each main gear. The lever type handles are located aft and below the main landing gear inspection windows. Operating an emergency down-lock engage handle mechanically moves the associated gear to the downlock position. Safety pins, which can be installed in flight are provided to mechanically safety-lock each gear in the down position. Access to the safety pin installation point is accomplished by removing the related inspection window after the aircraft is depressurized.

Selector Valves Manual Controls

Manual override buttons (figure 1-35) are provided on each of the landing gear system selector valves. The buttons provide a means of manually controlling landing gear retraction and extension. The nose gear selector valve is located on the left side of the cargo compartment aft of the crew entry door. The selector valves, main gear down, main gear actuating and main gear down-lock, are located on the left side of the cargo compartment adjacent to the wheel pod.

Landing Gear Controls and Indicators

A two-position (UP-DN) landing gear handle (figure 1-34), located on the pilots' right instrument panel, controls gear retraction and extension. Placing the handle to UP energizes three solenoid operated selector valves, opening valves to apply hydraulic system 1 pressure simultaneously to the down-lock, gear actuating and uplock cylinders of the left and right main gears and to the uplock cylinder, down-lock bungee, and gear actuating cylinder to the nose gear. As soon as the main gear is up and locked, a circuit is completed to energize the up solenoid of the main gear door selector valve, causing the main gear doors to lock closed. Placing the handle to DN similarly energizes the three solenoid-operated selector valves, opening the valves to port fluid in such a manner as to reverse the UP procedure. The landing gear control circuits receive 28 VDC power from the RIGHT DC bus through the LANDING GEAR CONTROL circuit breaker (AD-16) on the EPC panel.

Landing Gear Handle Lock Release

An electrical solenoid-operated locking mechanism prevents movement of the landing gear handle from DN position until the main landing gear struts are fully extended after takeoff.

A landing gear handle lock release (figure 1-34), located adjacent to the handle, can be used to release the handle after takeoff, in case of an electrical malfunction.

Landing Gear Indication

Three flag type position indicators (figure 1-34), located above the landing gear handle, show the position of each landing gear. A miniature tire flag indicates gear down and locked, an UP flag indicates gear up and locked, and a black and yellow diagonally-striped flag indicates the gear is in an intermediate position. Limit switches, actuated by movement of the landing gear to the down and locked and up and locked positions, control the position indicator. The indicators receive 28 VDC power from the RIGHT DC bus through the LANDING GEAR POSITION IND circuit breaker (AE-16) on the EPC panel.

Bogie Position Indicator

Two flag type position indicators (figure 1-34) one for each main gear bogie are located just above the landing gear indicators. A miniature tire flag indicates the correct bogie position for landing. A black and yellow diagonally-striped flag indicates the bogie is not in the landing position. The black and yellow flags will always be in view when the aircraft is on the ground because of bogie position. The bogie position indicators receive 28 VDC power from the RIGHT DC bus through the BOGIE POSITION IND circuit breaker (AF-16) on the EPC panel.

Landing Gear Unsafe Warning Lights

Two landing gear unsafe warning lights are installed inside the clear plastic knob on the landing gear handle (figure 1-34). These lights come on when any of the following conditions exists:

1. Gear handle down:

   a. The landing gear is not down and locked.

   b. The bogies are not in a landing position.

2. Gear handle up:

   a. The landing gear is not up and locked.

   b. The main gear doors are unlocked.

The landing gear warning lights receive 28 VDC power from the LEFT DC bus through the LANDING GEAR WARNING circuit breaker (V-16) on the EPC panel.

Landing Gear Warning Horn

A warning horn, located in the flight compartment, sounds when these conditions exists:

1. Any engine throttle is retarded to near idle while the landing gear is not down and locked.

2. The flap/slat handle is moved to the LANDING range and the landing gear is not down and locked.

The warning horn system receives 28 VDC from the LEFT DC bus through the LANDING GEAR WARNING circuit breaker (V-16) on the EPC panel.

Horn Silence Buttons

Two push type HORN SILENCE buttons (figure 1-34), one located below the landing gear handle and the other on the right-side of the pedestal, are provided for silencing the warning horn if it has been actuated as a result of an engine throttle being retarded. These buttons do not silence the horn if it has been actuated as a result of the flap/slat handle being moved to the landing range. When a HORN SILENCE button has been pressed, advancing a throttle past the point which actuated the horn re-arms the warning circuits for that throttle.

Landing Gear Handle Light Test Switch

A HANDLE LIGHT TEST pushbutton (figure 1-34), located below the landing gear handle, provides a means of checking the landing gear handle warning lights. Pressing the button will cause the lights to come on.

Nose Gear Uplock Test Button

A nose gear uplock test button (figure 1-34), located on the copilots instrument panel, provides a means of verifying that the nose gear is up and locked. When pressed and held, the "up" hydraulic pressure is released and allows the nose gear to rest on its up lock. Releasing the test button allows the "up" hydraulic pressure to return to the nose gear. The system receives 28VDC from the RIGHT DC Bus through the LANDING GEAR CONTROL circuit breaker (AD-16) on the EPC panel.

Tail Wheel

A tail wheel, located in the ramp, is used as a tail skid to prevent or limit structural damage if test maneuvers cause the aft fuselage to strike the ground.

Landing Gear Operation -

Retraction, Systems Normal -

1. Place the landing gear handle in UP position. Gear handle red lights should come on.

   Gear and bogie position indicators should be black and yellow stripes.

2. After the retraction cycle is complete (8 to 12 seconds), gear handle light should be off. Gear position indicators should be UP. Bogie position indicators should remain black and yellow stripes.

Extension, Systems Normal -

1. Place the landing gear handle in DN position.

   Gear handle red lights should come on.

   Gear and bogie position indicators should be black and yellow stripes.

2. After the extension cycle is complete (15 seconds maximum).

   Bogie position indicators should show wheels.

   Gear position indicators should show wheels.

   Gear handle red lights should be off.

Retraction of Landing Gear, Unable

1. Check landling gear control circuit breaker (AD-16).

2. The gear handle lock release button, located adjacent to the landing gear handle, may be operated in an attempt to raise the gear if deemed necessary or appropriate.

NOTE

For routine operation of the YC-15, if there is a gear malfunction and the landing gear is down, leave it down, observe gear placard speed and land after suitable visual checks have been completed.

Extension of Landing Gear, Loss of Electrical Power

To extend the landing gear when the electrical solenoids on the selector valve are de-energized (failure inoperative solenoids), proceed as follows:

1. Check hydraulic system #1 is normal.
2. Place the landing gear handle in DN position.
3. Establish communications with crewmembers in the cargo compartment.
4. At the command of the aircraft commander: Depress and hold the DOWN side of nose gear selector valve.
5. Visually inspect that nosegear is down.
6. Depress the UNLOCK side of the MLG DOOR LOCK selector valve.
7. Depress and hold the DOWN side side of the MLG selector valve. Release when gear is down.
8. Depress the LOCK side of MLG DOWN-LOCK selector valve.

   If electrical power is available for landing gear position indications (LANDING GEAR POSITION IND circuit breaker AE-16), check that gear indicates down.

Emergency Free Fall of Landing Gear: Refer to Section III Emergency Procedures.

Nosewheel Steering System

The nosewheel steering system (figure 1-36) is hydraulically actuated and mechanically controlled by the pilot with the rudder pedals. The nosewheel steering system consists of a control valve, bypass valve, actuating cylinders mechanically linked to the steering control cable system and powered by hydraulic System #1 through the nose gear control valve. The steering cylinders function as shimmy dampers. A follow-up differential mechanism transfers the cable system action to the steering system hydraulic control valve. The ground shift mechanism positions the steering mechanism to operate from rudder pedals when the nose gear strut is compressed (ground mode), and locks out the steering system when the strut is extended (flight mode).

Nosewheel Steering Selector Handle

A NOSE WHL STEERING handle (figure 1-36), located to the left of the throttles, has two positions TAKEOFF & LAND and TAXI. When the handle is in the TAKEOFF & LAND (forward) position, rudder pedal movement will provide a maximum nose-wheel angle of 12° either side of center. Placing the handle in TAXI (aft) position shifts the rudder pedal movement to provide a maximum nose-wheel angle of 61° either side of center.

NOTE

During takeoff roll there is no annunciation that the NOSE WHL STEERING handle is in the TAXI position. Nosewheel steering will be too sensitive if the NOSE WHL STEERING handle is in TAXI during takeoff or landing.

Nosewheel Steering Bypass Valve

A bypass valve (figure 1-36), located on the nosegear strut, is incorporated in the nosewheel steering system and permits towing (approximately ±50°) without disconnecting the torque links. It is a manually operated valve, spring-loaded to NORMAL position, pinned in BYPASS position. The torque links are also provided with quick-disconnect pins to allow separation of the links.

When the torque links are disconnected using the quick-disconnect pins, the nose gear can be turned 360° without damage to the gear.

CAUTION

During preflight inspection verify that the bypass is in normal and the torque links are connected.

Brake Systems

There are two completely independent hydraulic brake systems (figure 1-37) designated FWD (powered by Hydraulic System #1) and AFT (powered by Hydraulic System #4). Each system has an accumulator, dual brake control valve, two anti-skid control valves, multiple disc brakes, a parking brake shutoff valve, a brake pressure indicator and brake temperature indicators. Mechanical controls common to both brake systems are the brake pedals and linkage.

Each main gear wheel is equipped with a disc-type power brake. The forward main gear wheel brakes are powered by hydraulic system #1 and the aft main gear wheel brakes are powered by hydraulic system #4. Each main gear wheel has three fuse plugs. These fuse plugs will yield and deflate a tire to prevent dangerous pressure buildup resulting from an overheated brake. The fuse yields from heat but will not prevent overinflation when servicing a tire.

The MLG wheels are also braked automatically upon gear retraction to stop wheel spin up. This is accomplished hydraulically by porting pressure from the MLG selector valve to a retract wheel anti-spin cylinder attached to linkage connector to both dual brake valves. With the landing gear handle UP, gear up pressure retracts this cylinder, allowing minimal brake pressure application to each MLG wheel. Brake pressure is released when the gear is up and locked.

Brake System Pressure Indicators

Two brake pressure indicators (figure 1-38), located on the center instrument panel, indicate pressure available for brake operation from either aircraft hydraulic system #1 or 4, or the forward or aft brake system accumulators. The indicators are graduated in 250 psi increments from 0 to 4,250, with numerals at 1, 2, 3 and 4 designating 1000 PSI increment increase. The pressure transmitter is downstream of the check valve. The BRAKE pressure indicators are powered by the AC buses. The FWD (aft) indicator receives 28 VAC, single phase power from the LEFT (RIGHT) AC bus through the BRAKE PRESS IND FWD (AFT) circuit breaker (M-14, Y-14) on the EPC panel.

Normal Brake Controls

The hydraulic brakes are actuated

by depressing the toe section of the hinged rudder pedals, the hydraulic pressure applied to the brakes being in proportion to the pedal pressure applied.

Parking Brake Handle

The brakes can be locked by using the PARK BRAKE handle on the left side of the pedestal (figure 1-38). The parking brakes are set by depressing the brake pedals, pulling the PARK BRAKE handle aft, and then releasing the brake pedals. This action closes the parking brake shut off valve. The parking brake shutoff valve also closes when the Anti-Skid switch is in OFF. Releasing the parking brake will not open the valves in this condition. The Anti-skid switch must be placed in ARM to open the parking brake shut off valve. The parking brakes are released by depressing the brake pedals. The handle will automatically return to the forward position.

Park Brake Light

An amber PARK brake light (figure 1-38) is located on the pedestal aft of the PARK BRAKE handle. When the anti-skid switch is ARM and the parking brake is set and both parking brake shutoff valves are closed, the PARK light will come on. The PARK brake light receives 28 VDC power from the LEFT DC bus through the ANTI-SKID TEST circuit breaker (T-15) on the EPC panel. The parking brake valves receive 115 VAC, single phase power from the LEFT AC bus through the PARK BRAKE VALVE circuit breaker (P-14).

Brake Temperature Indicators

A brake temperature indicator (figure A2-3), selector and test switch, located on the flight test engineer's panel, is flight test equipment. Refer to Appendix II.

Anti-skid System

A fail safe anti-skid brake control system is installed to provide maximum braking efficiency for all types of runway conditions, mismatched tires, unequal tire inflation pressure and to prevent locking of the braked wheels in the event excess brake pressure is metered by the pilot during any phase of ground operation above 10 knots.

The anti-skid system provides a means of metering the pressure at each brake to permit maximum efficiency while preventing a skid condition of any wheel. The system is electrically controlled and has a touchdown wheel protection circuit that prevents braking action before wheel spin up.

The anti-skid system consists of an ANTI-SKID arming switch, a TEST button, a PAVED RWY - UNPAVED RWY switch, control box, four dual control valves, eight wheel speed transducers and four annunciator panel lights.

When the anti-skid system is in operation, the wheel speed transducers (one for each main gear wheel) transmit wheel speed information to the control box. The control box in turn, uses this wheel speed input to control the operation of the anti-skid control valves. These valves modulate wheel braking pressure to prevent a skid. The anti-skid control valves can only modulate pressure received from the brake control valves as a result of pilot input at the pedals. The anti-skid control valves can never permit the application of more braking pressure than called for by the pilot input. When taxi speed is below approximately 8 knots, the anti-skid system reverts to manual braking.

Anti-skid Switch

The ANTI-SKID switch (figure 1-38) located in the pilots' overhead panel has OFF and ARM positions. When in OFF, the system is disarmed and braking pressure is manually controlled by pilot application of the brake pedals. Automatic skid protection is not available. When in ARM, the anti-skid system is armed. Automatic skid protection, locked wheel protection on landing and manual reversion is available. The ANTI-SKID, OFF - ARM switch receives 115 VAC, single phase power from the AC buses. The forward (aft) anti-skid control system is powered by the LEFT (RIGHT) AC bus through the ANTI-SKID CONTROL, FWD (AFT) circuit breaker (N-15 and Z-15 respectively) on the EPC panel.

Anti-skid Circuit Test Button

An ANTI-SKID TEST button (figure 1-38), located adjacent to the anti-skid OFF-ARM switch, provides a means of testing the integrity of the system. The anti-skid switch must be in ARM position and all annunicator lights off. The system may be tested with the parking brake set or released. A satisfactory test is indicated if all the anti-skid fail lights come on when the TEST button is pressed and held and if all the lights go off when the button is released. The ANTI-SKID TEST button receives 28 VDC from the LEFT DC bus through the ANTI-SKID TEST circuit breaker (T-15) on the EPC panel.

Anti-skid Paved-Unpaved Runway Switch

A two position, PAVED-UNPAVED, RUNWAY switch (figure 1-38) is located adjacent to the TEST button. This switch selects the skid detection threshold to provide optimum braking when operating from either a paved or unpaved runway.

Anti-Skid Failure Light

An overhead annunciator panel failure indicating light is provided for each pair of main gear wheels. The lights are labeled ANTI-SKID L INBD FAIL; ANTI-SKID L OUTBD FAIL; ANTI-SKID R INBD FAIL; and ANTI-SKID R OUTBD FAIL (figure 1-38).

When the anti-skid switch is in OFF, the four anti-skid fail lights remain on to indicate the system is inoperative. When the switch is placed to ARM, the anti-skid system is armed and the four anti-skid fail lights should go off, indicating that the system is operational. If any anti-skid light remains on, or comes on later, it indicates that the anti-skid protection for that pair of wheels is inoperative. The anti-skid fail lights receive 28 VDC power from the LEFT DC bus through the ANTI-SKID TEST circuit breaker (T-15) on the EPC panel.

HYDRAULIC SYSTEM BLOCK DIAGRAM

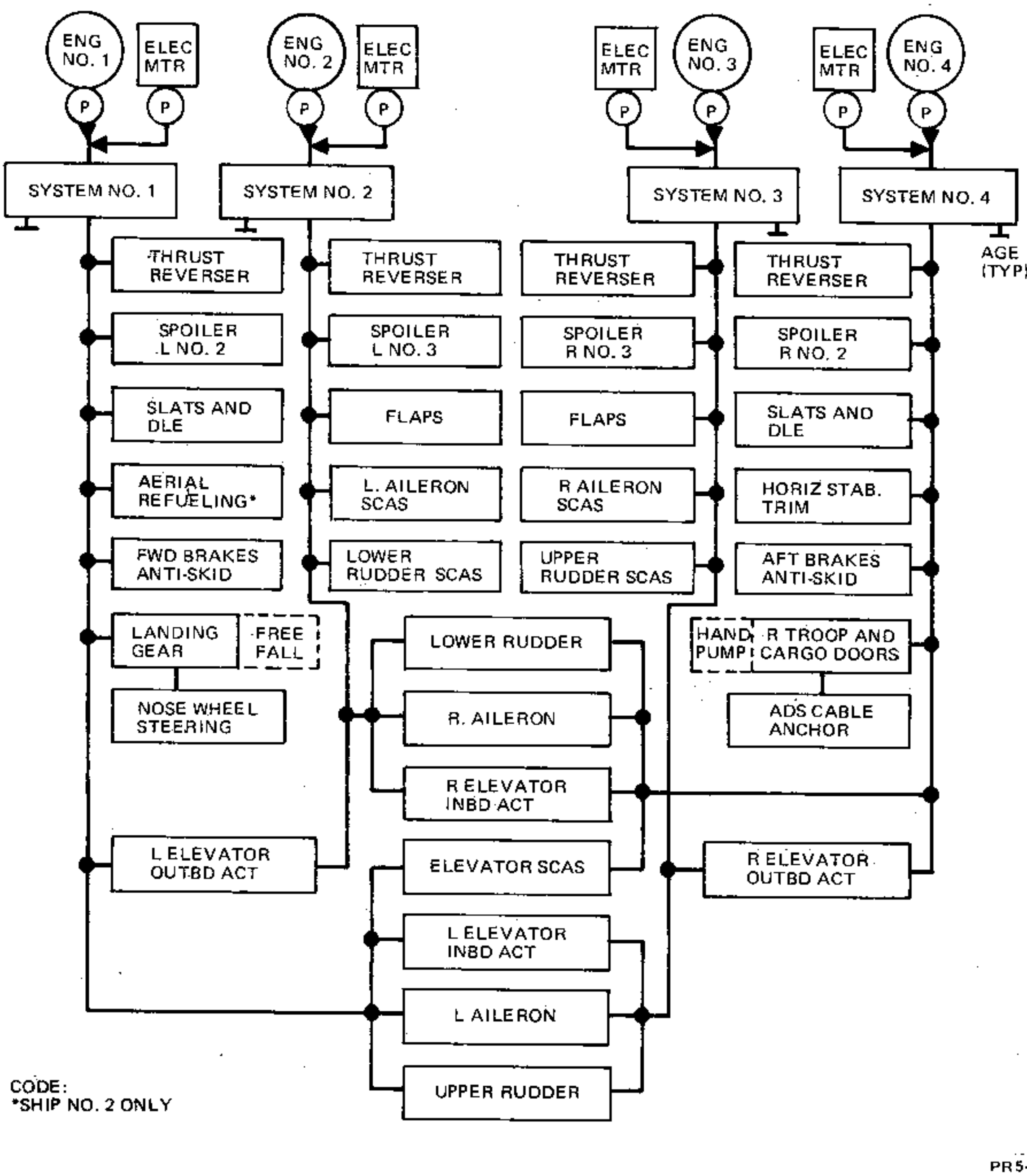
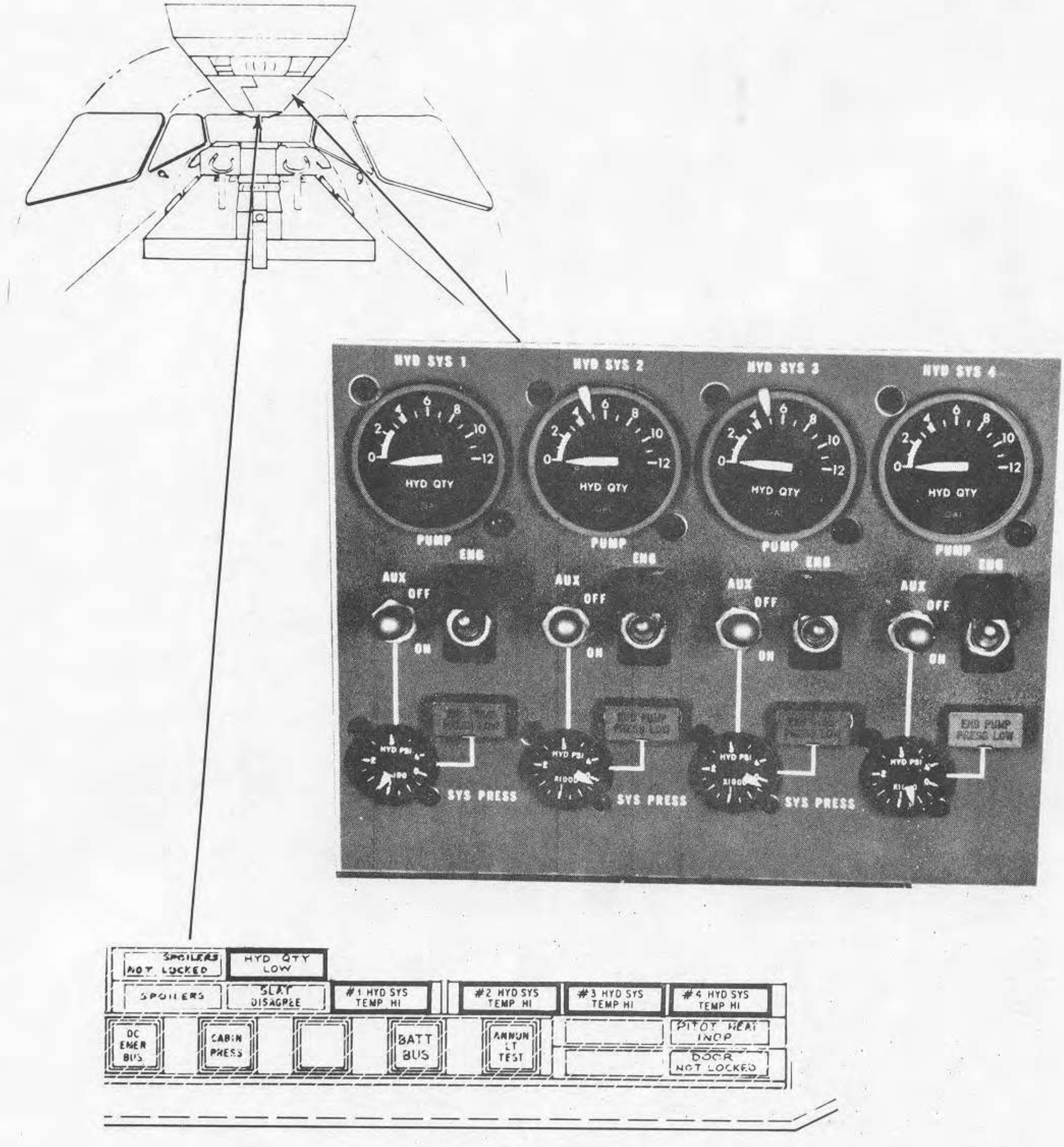


Figure 1-29

HYDRAULIC SYSTEM CONTROLS AND INDICATORS



PR5-C15-125

Figure 1-30

NOSE LANDING GEAR

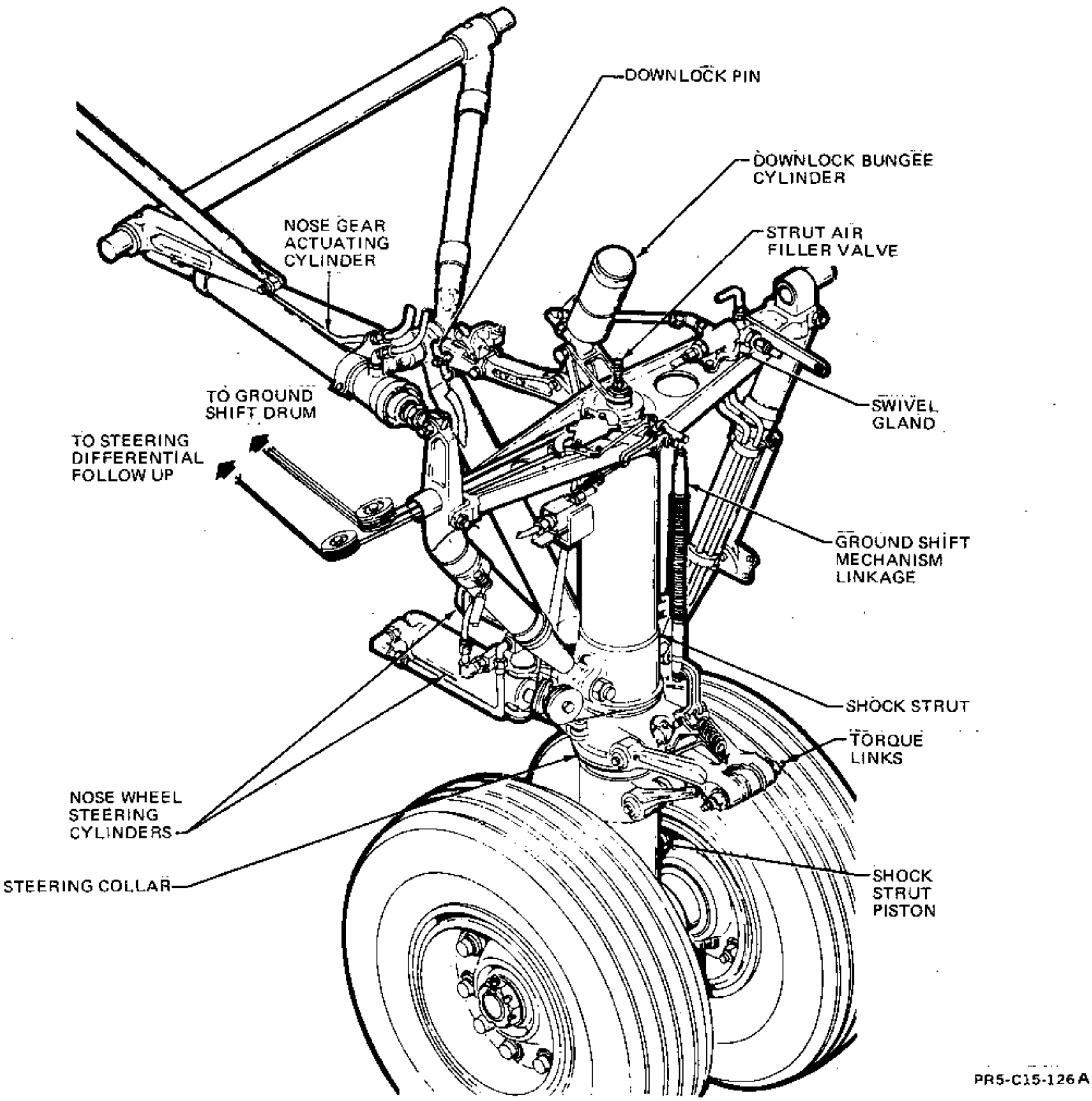


Figure 1-31

MAIN LANDING GEAR

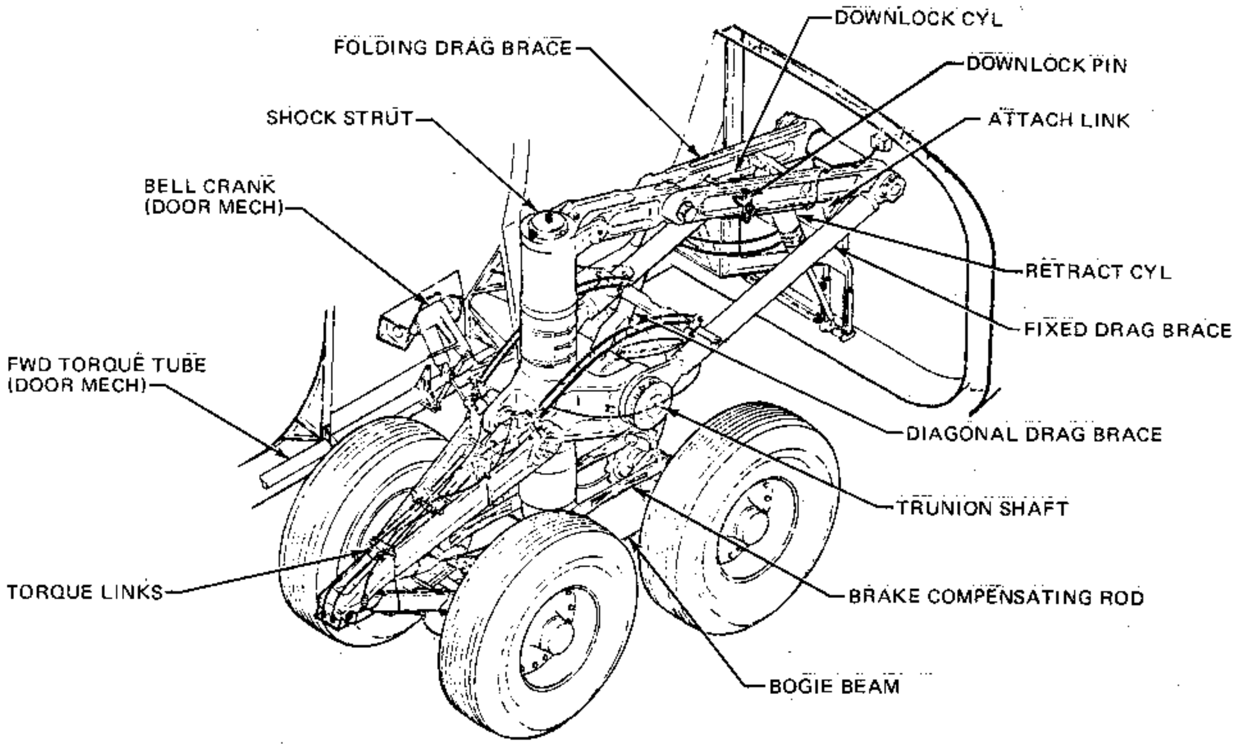


Figure 1-32

LANDING GEAR SYSTEMS

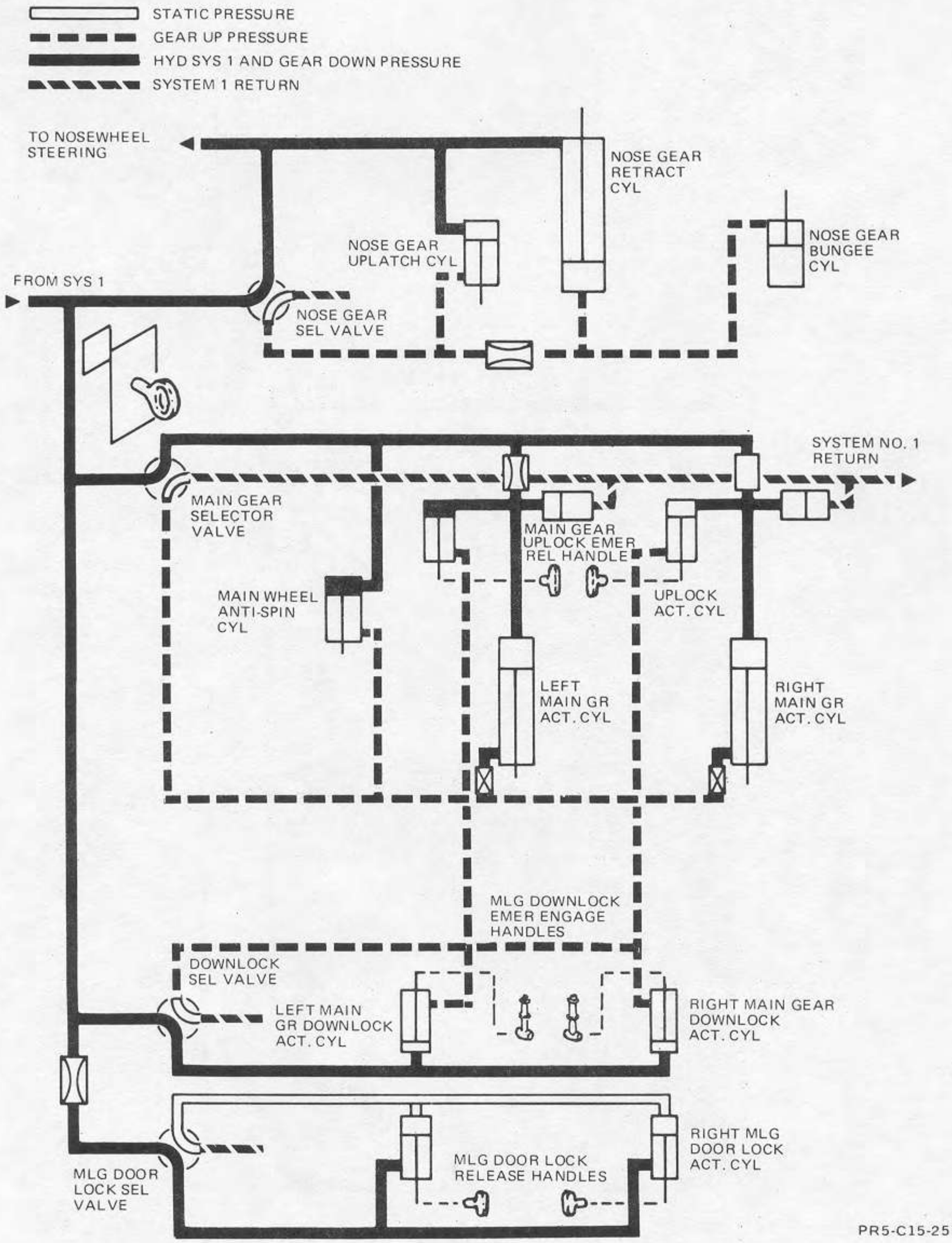


Figure 1-33

LANDING GEAR INDICATORS AND CONTROL PANEL

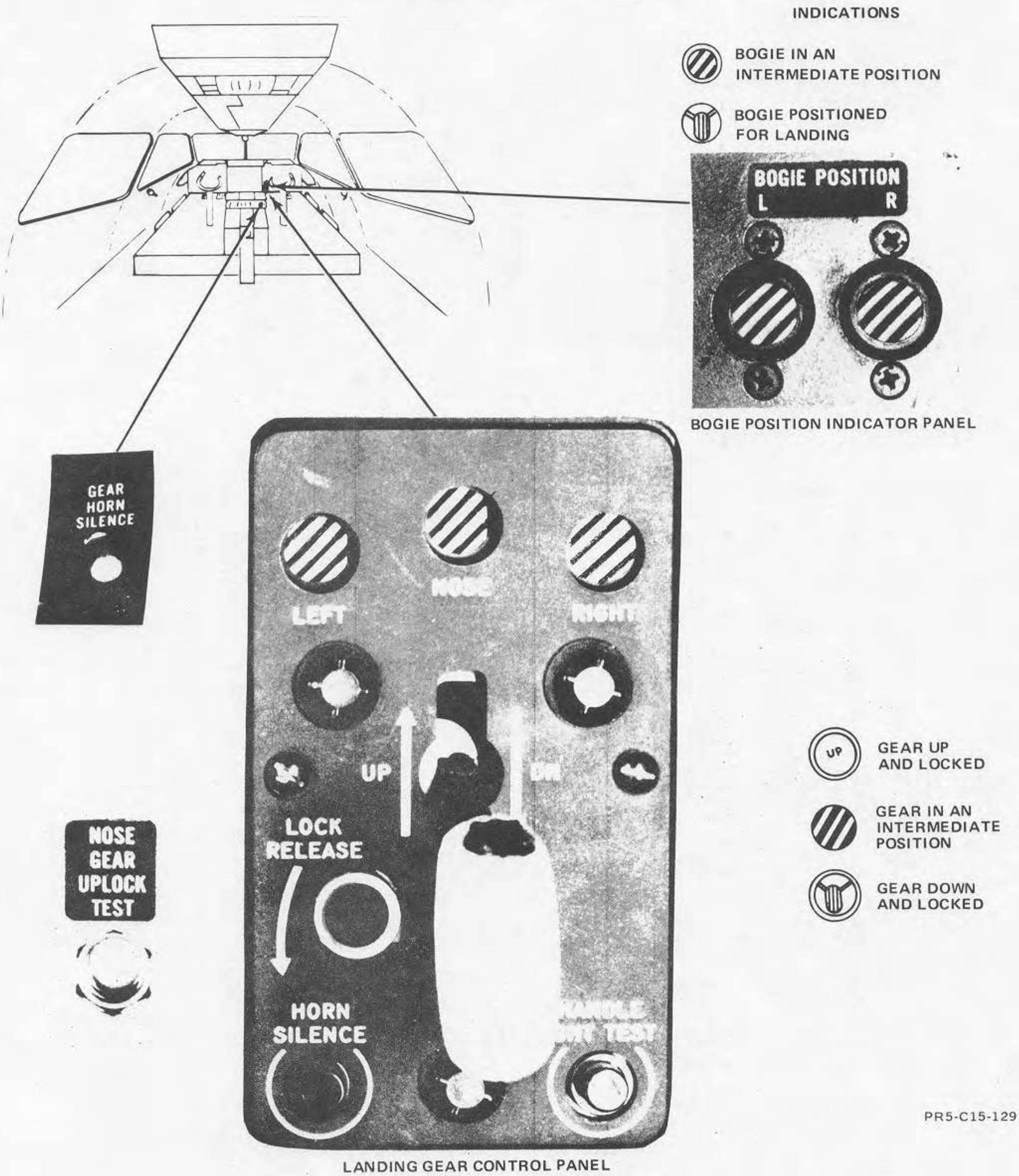


Figure 1-34

LANDING GEAR MANUAL CONTROLS

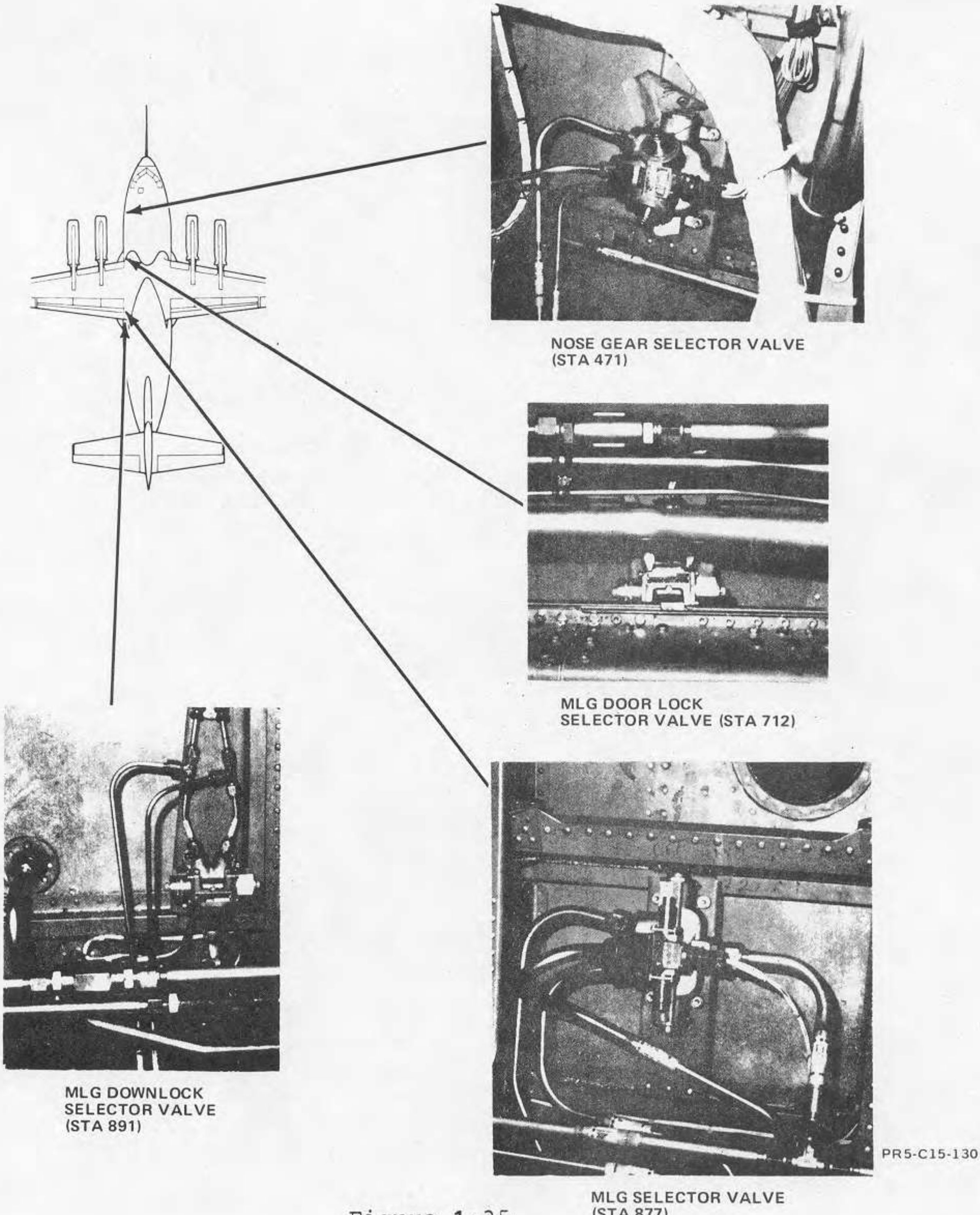
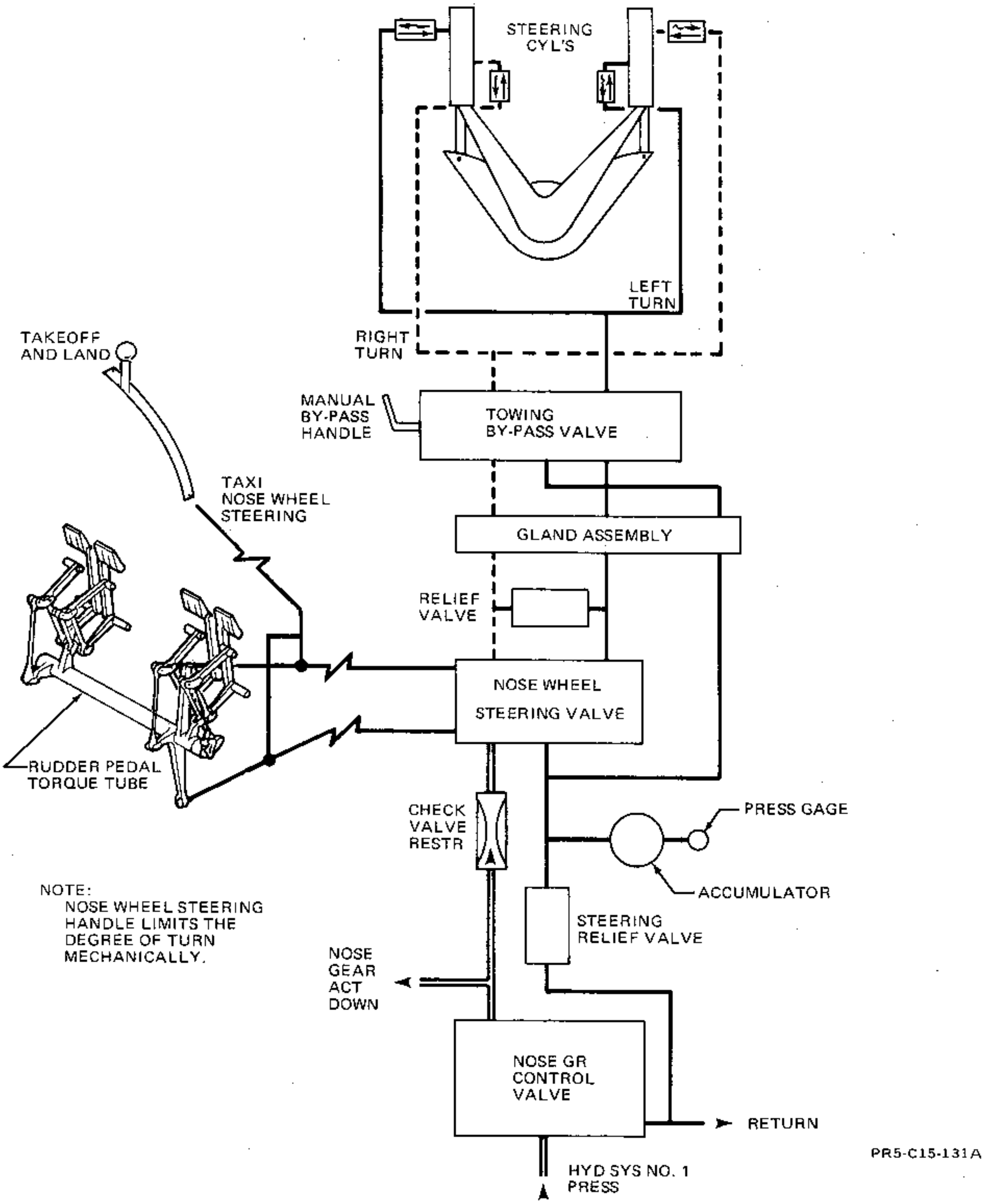


Figure 1-35

NOSE WHEEL STEERING



NOTE:
NOSE WHEEL STEERING HANDLE LIMITS THE DEGREE OF TURN MECHANICALLY.

Figure 1-36

BRAKE SYSTEM

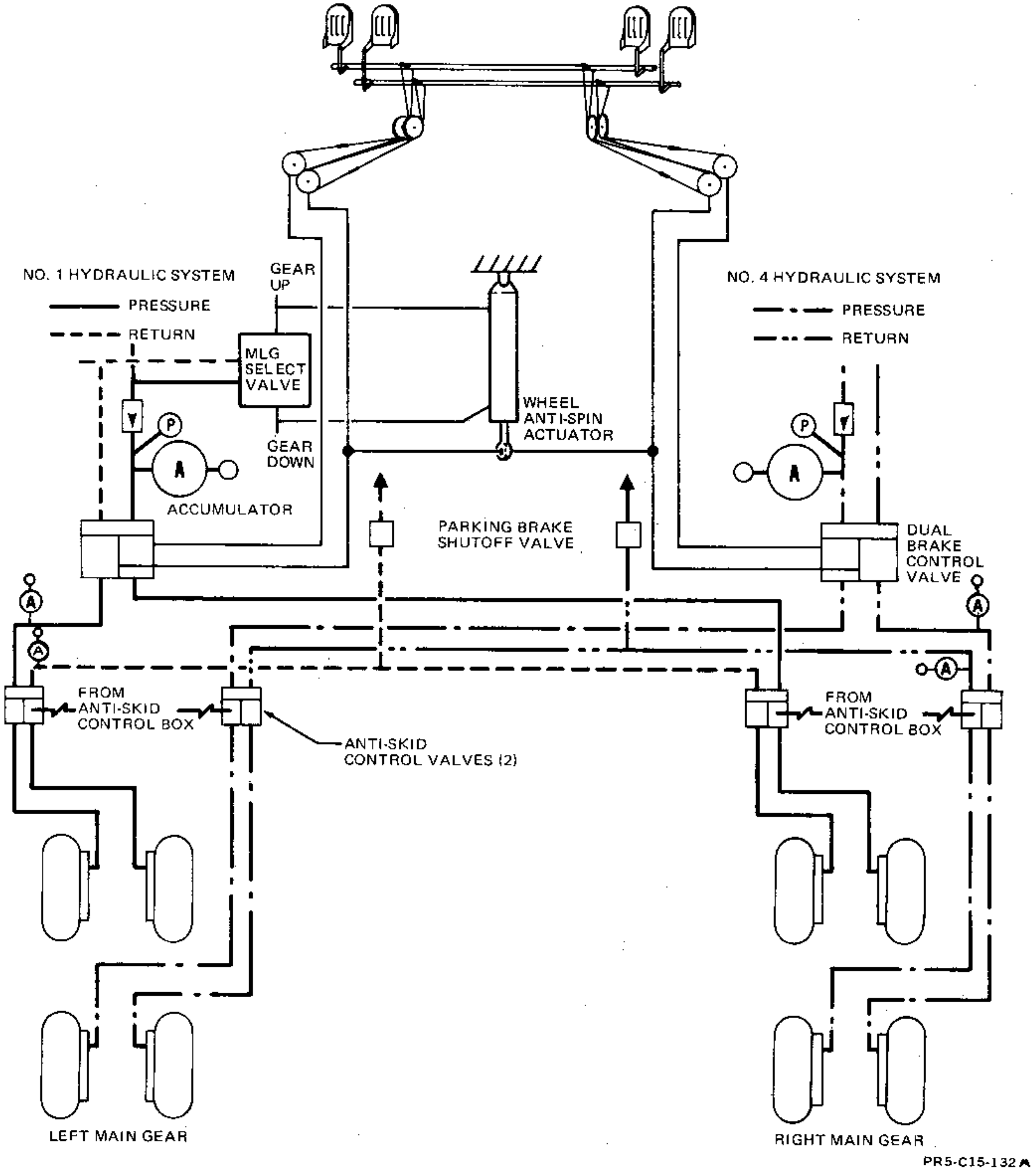


Figure 1-37

BRAKE CONTROLS AND INDICATORS

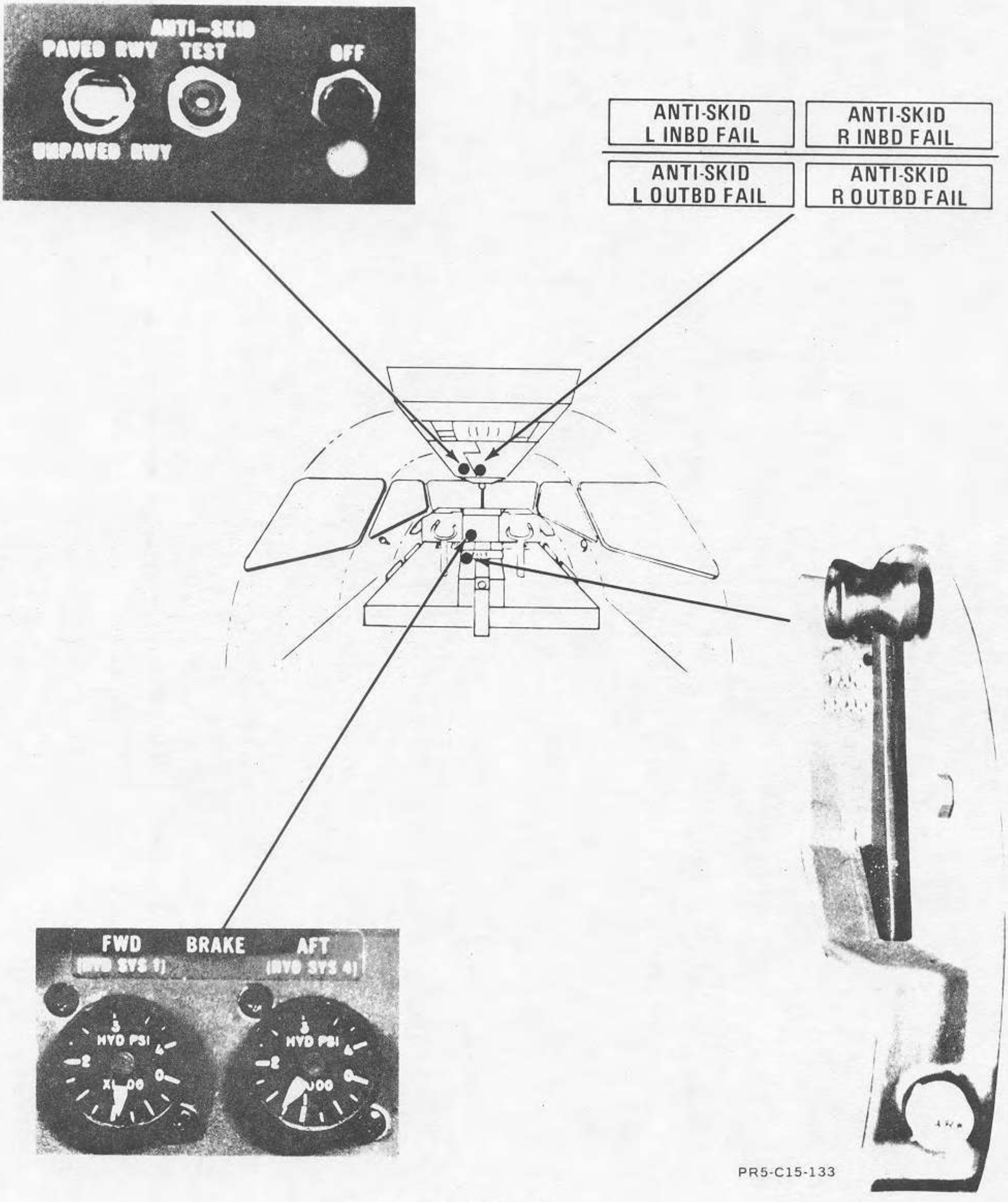


Figure 1-38

WING FLAPS, DROOP LEADING EDGE FLAPS AND SLATS SYSTEM

The wing flaps (figure 1-39) are double-slotted, high lift, externally blown type that extend aft and down. The flaps consist of forward and aft sections on each wing, extending from the wing root to the aileron. The flaps, actuated by 5 hydraulic cylinders, normally powered by hydraulic systems #2 and 3 can be extended by either of the systems at reduced airspeed.

Flap/Slat Control Handle (Top Operation)

The flap/slat control handle (Figure 1-40), located on the right side of the throttle quadrant, has two selectable detent modes - Normal and Alternate, and provides a means of selecting slat or flap position. Selection of the desired detent mode is performed by rotating (in a horizontal plane) a white lever on the right side of the white flap handle. When the lever is flush with the flap handle (clockwise position when looking down) the normal detents are selected. When the lever is forward, away from the flap handle (counterclockwise position), the alternate detents are selected. When the flap/slat handle is aft of the FLAPS RET detent, the entire handle must be raised to permit rotation of the detent lever. The normal mode utilizes the UP/RET, 0/EXT, 14°/EXT, 23°/EXT,33°/EXT and 45°/EXT flap detents. The flap/slat handle can be lifted out of any detent and repositioned. A detent at 23°/EXT is the go-around detent and insures a pause when selecting flaps.

When the alternate detent mode is selected, the teeth of the dog and the teeth of the detent channel are aligned which permits flap setting increments of approximately 1° between 10 to 18° and 28 to 45° flap. The flap/slat control handle positions control valves that control pressure from Hydraulic Systems No. 2 and 3 for extension or retraction of the flaps. A follow up cable system linked to the flap surfaces, moves with the flaps to close the control valves. When the flaps reach the position selected by the flap control handle, the follow up cable system will have fully closed the control valves, stopping further flap movement. The flap extension rate is 2°/second. The retraction rate is 3°/second to 24° and 2°/second from 24° to 0°.

Flap Position Indicator

The flap position indicator (figure 1-40), located on the center instrument panel, contains dual superimposed pointers and a dial that is graduated in degrees of flap travel. Each flap is linked to a separate flap position transmitter that operates one of the dual pointers. The pointers respond to flap movement rather than flap/slat control handle movement and will normally move in unison. The flap position indicator receives 28 VAC single phase power from the LEFT and RIGHT AC buses through the respective FLAP POSITION LEFT and RIGHT circuit breakers (D-18 and H-18) on the EPC panel.

Leading Edge Slats and Droop Leading Edge Flaps

In Aircraft #1, all of the leading edge devices are slats.

In Aircraft #2 the slats and droop leading edge (DLE) flaps are high lift devices located on the wing leading edge. The 3 segments outboard of #1 and 4 engine are slats. The segments inboard of the slats are DLE flaps. The difference between slats and DLE flaps are the shape and method of movement.

The inboard DLE flaps, between engine and fuselage, are driven by closed loop cable systems from a central drive mechanism. The outboard DLE flaps, between engines, are slaved to their respective inboard DLE flap through a closed loop cable system. The track mounted slats are driven by the same DLE flap control drive mechanism. The drive mechanism consists of a pair of hydraulic actuating cylinders linked to a cable drum from which separately rigged closed cable loops extend to each inboard DLE flap and each slat segment. Hydraulic system #1 and 4 power the drive mechanism. One hydraulic system will fully extend the DLE flaps and slats at a reduced airspeed. The DLE flaps and slats have two positions, retracted or extended.

Flap/Slat Control Handle (Slat Operation)

The DLE flaps and slats are extended when the FLAP/SLAT control handle is moved from the SLAT OPR RET detent to the EXT detent. DLE flaps and slats will remain extended for all flap settings between RET and 45°. The DLE flaps and slats are retracted when the flap/slat handle is moved down and forward through the FLAP OPR RET gate to the SLAT OPR RET detent. DLE flaps and slats extension time is approximately 5 seconds and retraction time is approximately 11 seconds.

Slat Disagree Caution Light

An amber SLAT DISAGREE light (figure 1-40), located in the overhead annunciator panel, comes on to indicate slat position disagreement with the position selected by the flap/slat handle. Position sensing switches in each wing, and at the flap handle, will cause the light to come on if either wing slats do not match the position selected by the flap/slat control handle. The SLAT DISAGREE light will remain on during slat movement. When the SLAT DISAGREE light comes on and remains on for 15 seconds or more, the Master Caution lights come on to alert the pilots to the slat disagreement. The light receives 28 VDC power from the RIGHT DC bus through the SLAT DISAGREE LIGHT circuit breaker (K-18) on the EPC panel.

Slat Extend Light

A green SLAT EXTEND light (figure 1-40), located in the pilots' center instrument panel, comes on when both inboard slats reach the fully extended position. The light receives 28 VDC power from the LEFT DC bus through the SLAT EXTEND LIGHT circuit breaker (F-18).

WING SPOILER CONTROL SYSTEM

Four electrically controlled hydraulically actuated wing spoilers (figure 1-39) provide a means of varying the wing lift. With the Flap/Slat handle out of the SLAT RET position, the modes of operation are symmetrical (DLC and ground spoilers) and asymmetrical (roll control). When a symmetrical mode is selected, spoilers 2 and 3 L&R are operable. When spoilers are extended symmetrically (DLC or ground spoilers), roll control spoilers move from the symmetrical position (Figure 1-42). This feature maintains roll control during simultaneous operation of both modes. With the loss of electrical power, the affected spoilers (L&R) will fail safe to the retracted position.

When the flaps extend, the spoilers mechanically droop to provide an optimum aerodynamic wing, thus producing a new spoiler neutral position. This new position is not displayed on the spoiler position indicators.

Spoiler Mode Selector Switch

In Aircraft #1, a three-position (DIRECT LIFT CONT-OFF-RTO SPOILER ARM) rotary SPOILER selector switch (figure 1-41), located on the left side of the glareshield panel, provides a means of selecting the spoiler mode. It is spring loaded to the center OFF position and solenoid held in the other positions. When in DIRECT LIFT CONT (control), the DLC system will be energized allowing the spoilers to extend upon DLC thumb switch activation and provide ground spoilers for landing upon engine reversing. When in RTO SPOILER ARM, the spoiler system provides ground spoiler extension for a rejected takeoff upon engine reversing. When in OFF, the symmetrical spoiler system is not activated. The spoiler mode selector solenoid receives 28VDC from the BAT Bus through the SPOILER KNOCKDOWN circuit breaker (B-23).

In Aircraft #2, a three-position (LAND-OFF-TAKEOFF) rotary GROUND SPOILERS mode selector switch (Figure 1-41), located on the left side of the glareshield, provides a means of selecting the ground spoiler modes. It is spring loaded to the center OFF position and solenoid held in the other positions and is automatically reset to OFF as follows from:
either position by pressing TOGA switch;
LAND position by advancing the throttles and retracting the flap to the Takeoff range;
TAKEOFF position by landing gear retraction.
When in LAND, the spoiler system provides ground spoiler extension on landing automatically (wheel spin-up). If wheel spin-up is inoperative, the spoilers will extend with symmetric thrust reverse lever actuation. When in OFF, the ground spoiler system is de-energized. When in TAKEOFF, the spoiler system provide ground spoiler extension for a rejected takeoff upon symmetric thrust reverse lever actuation.

Land Spoilers Switch/Light (Aircraft #1)

A LAND spoilers switch/light (figure 1-41), located on the left side of the glareshield panel, provides a means of arming the landing spoilers or annunciating a system malfunction. It is a press to energize and press to de-energize. When pressed and the system is operational, the green ARMED integral light will come on. If a system malfunction occurs, the amber DO NOT USE integral light will come on. The LANDING spoiler switch/light receives 28VDC power from the RIGHT DC bus through the GROUND SPOILER CONTROL circuit breaker (K-15) on the EPC panel.

High-Low DLC Authority Switch/Light (Aircraft #1)

This switch/light is deactivated.

DLC Selector Switch (Aircraft #2)

A two position (AUTO-OFF) lever lock toggle switch (Figure 1-41), located on the left side of the glareshield, provides a means of selecting DLC. When in AUTO and flaps in the landing range, the DLC system is armed and the spoilers will extend by aft thumbswitch operation. When in OFF, the DLC system is disarmed.

DLC Throttle Thumb Switch

Two DLC thumb switches (figure 1-41), located on the outboard side of #1 and 4 throttles, provide a means of operating spoilers from the neutral position. Both are spring-loaded to the retract position. When the system is armed and the switch is held in an aft position, the spoilers will extend 20° (TEU) from their neutral position. Releasing the switch allows the spoilers to retract. The DLC thumb switches receive 28 VDC power from the LEFT and RIGHT DC buses through the SPOILER COMMANDS AMPL 2 and SPOILER COMMANDS AMPL 1 & 3 circuit breakers (F-23 and K-22, respectively).

Ground Spoiler System

The four control spoilers are operated symmetrically in the ground mode to spoil lift and thereby increase wheel braking efficiency. The spoiler effectiveness is greater at higher speeds, so their primary value is for stopping with low flap angles and high gross weights such as a rejected takeoff or heavy weight landing.

The ground spoiler modes are manual and automatic. In Aircraft #1, the manual mode is armed when the SPOILER mode selector switch is in either DIRECT LIFT CONT or RTO SPOILER ARM. When at least one symmetrical pair of thrust reverse levers are actuated with weight on the main landing gear, the spoilers will extend 60° (TEU) from their neutral position. In Aircraft #1, the automatic mode is armed by the LAND spoilers switch/light. The spoilers will automatically extend (60°TEU) when the green ARMED LAND spoilers switch/light is ON, the flaps are in the landing range (33 to 45°) and the forward main wheels spin up (Right Inboard and Outboard or Left Inboard and Outboard or Right and Left Inboard or Right and Left Outboard).

In this ground spoiler mode, the spoilers will operate differentially in response to pilot roll control inputs. The direct lift control and ground spoiler function receive 28VDC power from the LEFT and RIGHT DC Buses through the SPOILER ARM AMPL 2, SPOILER ARM AMPL 3 circuit breakers (F-24 and K-24 respectively).

In Aircraft #2, the manual mode is armed when the GROUND SPOILERS mode selector switch is in TAKEOFF, weight on the main gear and flaps in the takeoff range. When at least one symmetrical pair of thrust reverse levers are actuated, the spoilers will extend 60°TEU for a rejected takeoff. The automatic mode is armed when the selector is in LAND, the gear handle is down and the slats are extended (not in the UP/RET position). When the wheels spin-up on landing, the spoilers will extend 60°TEU. The automatic ground spoilers are inhibited with one or more wheel spin-up signals and one of the following: (a) cargo door/ramp open/not locked or mode selector in (b) TAKEOFF or (c) OFF.

Spoiler Amplifier Switches

Two, three-position (LOCK, AUTO, UNLOCK) SPOILERS AMP 3 and 2 switches (Figure 1-41), located on the pilots' overhead panel, provide a backup means of controlling spoiler operation. When in LOCK, the corresponding spoilers are locked in a faired or retracted position. When in AUTO, the corresponding spoilers operate in conjunction with the flap/slat handle (e.g., When the slats are retracted, the spoilers are locked faired. When the slats are extended, the spoilers operate according to the mode selected.). AUTO is the normal position. When in UNLOCK, the spoilers are unlocked regardless of flap/slat handle position. The SPOILERS AMP 2 switch receives 28 VDC power from the LEFT DC bus through the SPOILER LOCK AMPL 2 circuit breaker (F-22). The SPOILER AMP 3 switch receives 28 VDC power from the RIGHT DC bus through the SPOILER LOCK AMPL 3 circuit breaker (K-21).

Spoilers Locked Caution Light

An amber SPOILERS LOCKED caution light (figure 1-41), located in the overhead annunciator panel, alerts the pilot of a spoilers locked condition. This light comes on when the slat handle is extended and the spoilers are locked. The MASTER CAUTION lights come on also. The SPOILERS LOCKED light receives 28 VDC power from the LEFT DC bus through SPOILER ANNUN LIGHTS circuit breaker (F-20).

Spoilers Not Locked Caution Light

An amber SPOILERS NOT LOCKED light (figure 1-41), located in the overhead annunciator panel, alerts the pilots of a spoiler not locked condition. This light comes on when the slat handle is retracted and the spoilers are not locked. The MASTER CAUTION lights come on also. The SPOILERS NOT LOCKED light receives 28 VDC power from the LEFT DC bus through the SPOILER ANNUN LIGHTS circuit breaker (F-20).

Spoilers Caution Light

An amber SPOILERS light (Figure 1-41), located in the overhead annunciator panel, alerts the pilots of an incorrect spoiler selection and flap position.

In Aircraft #1, this light and the MASTER CAUTION lights will come on when the SPOILER SELECTOR switch is in DIRECT LIFT CONT and the flap handle is set to less than 28°.

In Aircraft #2, this light and the MASTER CAUTION lights will come on whenever one of the following conditions exists: (a) selector in LAND and less than 4 spin-up signals for more than 7 seconds; (b) selector in LAND and Auto Ground Spoiler inhibit relay activated; (c) selector in TAKEOFF and flaps extended more then 28° and test switch in other than OFF position.

If the SPOILERS light comes on, do not use spoilers. Verify that the GROUND SPOILERS mode selector and DLC switch are in the OFF position. The SPOILERS light receives 28 VDC power from the LEFT DC bus through the SPOILER ANNUN LIGHTS circuit breaker (F-20).

STALL WARNING SYSTEM

Two independent stall warning systems are installed. The system warns of an impending stall by activating a stick shaker mounted at the base of the pilot's and copilot's control columns. The stall warning system is implemented by computation within the CADCs which receive engine pressure ratio (EPR) inputs, angle of attack sensors inputs and slat position inputs. Incoming signals are compared with programmed values. When these values are exceeded, the stick shaker will operate.

A supplemental stall recognition system (SSRS) is installed to provide additional stall recognition during excursions beyond stick-shaker in those landing flap configurations where no natural stall characteristics have been observed at high thrust settings. The system consists of a stall recognition tone generator and dual horns. The generator uses CADC outputs to activate the horns.

The angle of attack sensors (1 and 2) receive 28 VAC from the LEFT and RIGHT AC buses through the ANGLE OF ATTACK 1 and 2 circuit breakers (D-9 and H-9, respectively).

STALL TEST SWITCH. A rotary three position switch, (figure 1-43) located on the pilots' overhead panel, provides a means of testing the stall warning system when the aircraft is in the ground mode. When held in L (left), CADC 1, AOA sensor 1 and the stick shaker will be tested. When held in R (right), CADC 2, AOA sensor 2 and the stick shaker will be tested. With the slats extended, the SSRS horns will sound also. The system can only be tested on the ground. The STALL TEST switch is spring loaded to the neutral position.

FLIGHT TEST DISCONNECT BUTTON. A push-pull button (figure 1-43), located on the pilot's control wheel (inboard horn), provides a means of stopping the stick shaker under certain conditions. When pulled out, the integral light comes on and the button is inoperative. When pressed in, the light goes off and the flight test disconnect select switch affects the stick shaker.

FLIGHT TEST DISCONNECT SELECT SWITCH - A two position DISC SELECT switch (figure 1-43) located on the pilot's instrument panel, provides a means of selecting the mode of operation of the stick shaker. When in FLUTTER VANE, pressing the pilot's flight test disconnect button, will not affect the stick shaker operation. When in STICK SHAKER, pressing the pilot's flight test disconnect button, will turn off the integral light and deactivate the stick shaker.

Stall Warning System Test

To test the system proceed as follows:

1. Verify the CADC-1 and 2, AOA sensors 1 and 2 and stick shaker have electrical power.

2. Rotate and hold the STALL TEST switch in L (left).

3. Check that the stick shaker activates.

NOTE

If the slats are extended, the SSRS horns will sound.

4. Release the STALL TEST switch and the stick shaker will stop.

5. Repeat Steps 1, 2, 3 and 4 in the R (right) position.

When the stall warning disconnect system test is desired, proceed as follows:

1. On the pilots' instrument panel, check that the DISC SELECT switch is in FLUTTER VANE.

2. Perform Steps 1, 2 and 3 from above.

3. On the pilot's control wheel, press the flight test disconnect button. Observe the integral light goes off and the stick shaker is not affected.

4. Release the STALL TEST switch.

5. Place the DISC SWITCH in STICK SHAKER.

6. Rotate and hold the STALL TEST switch to R. Stick shaker should not operate.

7. Pull the flight test disconnect button out. Stick shaker should operate and integral light comes on.

8. Release the STALL TEST switch.

9. Place the DISC SELECT switch in FLUTTER VANE.

FLIGHT CONTROL SYSTEM

The flight control system consists of primary and secondary flight controls. The primary flight controls are ailerons, elevators, rudders, horizontal stabilizer and wing spoilers. The secondary flight controls are wing leading edge flaps and slats and trailing edge flaps. The flight controls are hydraulically actuated (refer to figure 1-44). Hydraulic power is arranged to provide control effectiveness in roll, pitch and yaw with any one of the four independent hydraulic systems operating normally. Windmilling engines provide sufficient hydraulic power to control the aircraft in the event of an all-engine flame out at speed above TBD. Primary controls are full-power with load feel springs tailored to provide desired pilot control forces. Pilot control inputs are mechanically transmitted to the appropriate surface control valves except spoilers. The control valves direct hydraulic pressure to the actuator. An automatic flight control system is integrated with the basic mechanical flight control system to provide stability and control augmentation (SCAS). Manual and automatic trim is provided to zero pilot control forces and long term SCAS commands. The secondary flight controls are designed to provide powered lift and short takeoff and landing capability.

Roll Control System

Primary roll control is provided by conventional ailerons. With the slats extended, the two outboard spoilers (L&R) augment roll control for slow speed flight. The aileron control system is shown in Figure 1-46. Maximum aileron movement corresponding to 75° control wheel rotation in either direction is 30° TEU or TED.

Aileron Position Indicator

An AIL (aileron) position indicator (figure 1-45), located on the pilot's instrument panel, provide a means of monitoring aileron position. This is flight test equipment and is described in Appendix II.

Roll/Pitch Trim System

There are two modes of roll trim: Manual trim is provided by two trim switches. When a trim switch is operated the control surfaces are moved without pilot's control wheel rotation. Maximum aileron trim is 15°. With the slats extended, the lateral control spoilers assist in lateral trim. A detrim mechanism allows 5° of aileron trim before spoiler extension occurs. This is the spoiler dead band position. The maximum spoiler extension on one side (asymmetrical mode) is 20° or ± 10° from neutral on both sides (symmetrical mode). Automatic lateral trim is provided by Stability and Control Augmentation System (SCAS).

Roll Trim Switches

Two, four-position roll/pitch trim switches (figure 1-45), located on the outboard grip of each pilot's control wheel, provide a means of trimming in the roll axis. These are combination roll/pitch trim switches. When moved sideways the roll trim system is activated and when moved up or down, the pitch trim system is activated. The roll/pitch trim switches receive 28 VDC power from the RIGHT DC bus through the CONTROL WHEEL TRIM circuit breaker (K-20).

Roll Trim Selector Switch

A red guarded two-position (NORM-ALTN) ROLL TRIM switch (figure 1-45), located on the aft pedestal, provides a means of de-energizing the control wheel roll trim switches and automatic SCAS roll trim or ALTN ROLL TRIM. When in NORM, the pilot's control wheel trim switches and SCAS trim are operable. When in ALTN, the ALTN ROLL TRIM switch is enabled and the pilot's trim switches and SCAS trim is de-energized.

Alternate Roll Trim Switch

A three position (LWD, neutral, RWD) ALTN (alternate) ROLL TRIM switch (figure 1-45), located on the aft end of the control pedestal, provides an alternate means of trimming the roll axis when the ROLL TRIM switch is in ALTN position. The switch is momentary in LWD (left wing down) and RWD (right wing down) and is spring loaded to neutral. The ALTN ROLL TRIM switch receives 28 VDC from the RIGHT DC bus through the CONTROL WHEEL TRIM circuit breaker (K-20).

Aileron Trim Position Indicator

An AIL TRIM position indicator (figure 1-45), located on the pilots' instrument panels, provides a means of monitoring aileron trim. This is flight test equipment and is described in Appendix II.

Directional Control System

Directional control is provided by a two segment upper and lower rudder. Each forward rudder segment is powered by two independent hydraulic systems (figure 1-44). The aft segment is hinged to the forward segment and is mechanically bussed to deflect in the same direction as the forward segment to provide a highly effective airfoil. As a function of airspeed, the upper rudder is automatically unlocked and locked (faired). A manual override is provided which enables the pilot to control the upper rudder lockout system. The maximum upper and lower rudder deflection is approximately 26° for the forward segments and an additional 26° for the aft segments. At airspeeds above approximately 140 knots the upper rudder is locked in a faired position. Rudder trim is provided by mechanical means to reposition the rudder neutral position.

Upper Rudder Mode Selector Switch

A rotary UPR RUDDER three position (LOCK, AUTO, UNLOCK) selector switch (figure 1-47), located on the overhead panel, provides a means of selecting the operating mode. When in AUTO, the system provides automatic rudder lock-unlock control as a function of airspeed. When in LOCK, the automatic system is disabled and the rudder lockout actuator will lock the upper rudder in a faired position. When in UNLOCK, the upper rudder will be unlocked regardless of airspeed.

Upper Rudder Not Locked Light

A green UPPER RUDDER NOT LOCKED light (figure 1-47), located in the overhead annunciator panel, signals the pilots that the upper rudder is unlocked. This light comes on when the upper rudder lockout mechanism is in the unlock position. The UPPER RUDDER NOT LOCKED light receives 28 VDC from the RIGHT DC bus through the UPPER RUDDER LOCK IND circuit breaker (K-19).

Upper Rudder Lock Disagree Caution Light

An amber UPPER RUDDER LOCK DISAGREE light (figure 1-47), located in the overhead annunciator panel, and the MASTER CAUTION lights come on to alert the pilots of a disagreement between the desired and actual rudder lockout mechanism position. The UPPER RUDDER LOCK DISAGREE light receives 28 VDC from the RIGHT DC bus through the UPPER RUDDER LOCK IND circuit breaker (K-19).

Rudder Trim Control Knob

A rudder trim control knob (figure 1-47), located on the aft end of the pedestal, provides a means of mechanically repositioning the neutral point of the load feel springs which in turn repositions, the forward segment of the rudders. When the upper rudder is locked, the upper rudder lockout mechanism prevents the upper rudder from being trimmed. The knob may be pulled outward to give a larger radius when turning. The indicator is marked in 10 Units NOSE Left or Right. 10 is equivalent to 100% trim; 5:50% etc. The maximum authority of rudder trim is approximately 14° of rudder deflection.

Rudder Position Indicator

A rudder position indicator (figure 1-47) is located on the pilot's instrument panel. This is flight test equipment and is described in APPENDIX II.

Longitudinal Control System

Longitudinal control is provided by two elevators hinged at the rear of the horizontal stabilizer. Pitch trim is provided by a movable horizontal stabilizer. The elevators are hydraulically powered by four tandem actuators (figure 1-44). Elevator authority is changed by an elevator ratio changer when airspeed changes. Maximum elevator travel below 135 knots is 35° TEU and 25° TED. As airspeed increases, the allowable elevator deflection gradually decreases. When the airspeed is 295 knots or more the total elevator authority is reduced by 50%. When the flaps extend more than 20°, the elevator neutral position changes gradually with flap extension. At 40° or more flap extension, the elevator neutral position is 12° TEU.

Elevator Ratio System

An elevator ratio system provides a means to regulate the elevator surface travel as the function of column force applied in accordance with airspeed. In conjunction with variable load feel, it also maintains a near constant force per load factor throughout the flight envelope. The elevator ratio system consists of two programmers, one actuator with two motors driving a differential gear train, controls and indicators. The system's two channels are redundant. In the event one fails, the remaining channel continues to operate without performance degradation. Elevator Ratio System 1 (2) receives 115 VAC, single phase power from the LEFT (RIGHT) AC bus through the ELEV RATIO CHANGE 1 (2) circuit breaker (E-16 and J-16, respectively). Elevator Ratio System 1 (2) receives 28 VDC power from the LEFT (RIGHT) DC bus through the ELEV RATIO CHANGE 1 (2) circuit breaker (F-16 and K-16, respectively).

Elevator Ratio Selector Switch

A rotary ELEV RATIO two-position MAN (manual) AUTO (automatic) selector switch (figure 1-48), located on the pilots' overhead panel, provides a means of selecting the operating mode. When in AUTO, the system provides automatic elevator ratio control in accordance with the pre-determined schedule as a function of airspeed. When in MAN, the automatic mode is deactivated and the manual mode is activated. The manual position is to be used only if the auto system is inoperative.

Manual Slew Switch

A momentary five-position rotary MAN (manual) SLEW switch (figure 1-48), located on the pilots' overhead panel, provides manual positioning of the Elevator Ratio System (ERS) actuator to agree with the aircraft's airspeed. The dots represent redundant motors and not a rate change. Holding the switch in DECR (decrease) provides manual electrical control of one of two electrical motors to decrease the reference airspeed indications and ERS load feed. Holding the switch at the other dot, performs the same function but with the other motor. Holding the switch in INCR (increase), performs the same functions as decrease position except in the increase direction.

Elevator Ratio Reference IAS Indicator

An ELEV (elevator) RATIO REF (reference) IAS (indicated airspeed) indicator (figure 1-48), located on the pilots' overhead panel, provides a means of monitoring the reference IAS. When in AUTO mode, the pointer will approximate the aircraft's speed, providing proper maneuvering control force gradient throughout the flight envelope. When in MAN, the pilot manually changes the pointer to match the aircraft's airspeed to provide the proper feel on the control column. The ELEV RATIO REF IAS indicator receives 28 VAC single phase power from the LEFT AC bus through the ELEV RATIO IND circuit breaker (D-16).

Elevator Ratio Channel Inoperative Light

A green ELEV RATIO CHANNEL INOP light (figure 1-48) is located in the overhead annunciator panel. When on, it signifies the system is no longer monitored. The system should not be adversely affected.

The ELEV RATIO CHANNEL INOP light receives 28 VDC power from the LEFT DC bus through the ELEV RATIO INOP & SELECT LIGHTS circuit breaker (F-17).

Select Elevator Ratio Manual Caution Light

An amber SELECT ELEV RATIO MAN light (figure 1-48), located in the overhead annunciator panel, alerts the pilots of a dual channel failure which prevents automatic operation or that the elevator selector switch is in MAN position. The MASTER CAUTION lights will come on also. The SELECT ELEV RATIO MAN light receives 28 VDC power from the LEFT DC bus through the ELEV RATIO INOP & SELECT LIGHTS circuit breaker (F-17).

Elevator Position Indicator

Two elevator position indicators (figure 1-48), located on each pilot's instrument panel, provides a means of monitoring the elevator position. This is flight test equipment and is described in Appendix II.

Pitch Trim System

A movable horizontal stabilizer provides pitch trim (figure 1-49). The stabilizer is attached to a pivot point and trim is accomplished through angular rotation of the stabilizer about this point. Horizontal stabilizer movement is accomplished by a screwjack actuator which utilizes primarily a hydraulic motor-brake-gear assembly or alternately an electric motor for actuation. Pitch trim has two modes: automatic (SCAS) and manual. Refer to SCAS description for auto pitch trim. Primary manual trim is accomplished by pilots' control wheel trim switches. The trim rate changes as a function of airspeed to provide an optimal trim rate throughout the flight envelope. Full trim authority is 6° aircraft nose up (trailing edge up, TEU) and 7° aircraft nose down (trailing edge down, TED). The stabilizer has three trim rates: two primary and one alternate. The primary trim rate is .5°/sec when airspeed is less than 255 knots or .1°/sec when airspeed is more than 255 knots. The alternate trim rate is .07°/sec regardless of air speed.

Roll/Pitch Trim Switches

Two, four-position primary roll/pitch trim switches (figure 1-49) are located on the outboard grips of each pilot's control wheel. These are combination roll/pitch trim switches. When moved sideways the roll trim system is activated and when moved up and down the pitch trim system is activated. The switches are recessed to provide a guard against inadvertent operation. The circuitry is designed so that opposing signals from the pilot and copilot cancel each other. Actuation of either switch in the desired direction (up and down) causes the primary trim system (hydraulic motor-brake) to move the stabilizer at the primary fast or slow rate. The pilots' pitch trim switches receive 28 VDC power from the RIGHT DC bus through the CONTROL WHEEL TRIM circuit breaker (K-20).

Alternate Pitch Trim Switches

Two ALTN (alternate) PITCH TRIM switches (figure 1-49) are located on the throttle control pedestal. These switches must be operated simultaneously to provide power for the alternate electric trim motor-brake assembly. Actuation of the switches in the desired direction (for and aft) causes the alternate trim system to move the stabilizer at the alternate trim rate. The alternate trim motor-brake assembly receives 115 VAC 3-phase power from the LEFT AC bus through the ALTN PITCH TRIM circuit breakers (N-20, P-20, R-20). The alternate pitch trim switches are powered by the LEFT DC bus through the ALTN PITCH TRIM CONT & BRAKE circuit breaker (T-20).

Manual Pitch Trim Handles

Two manual pitch trim handles (figure 1-49), located on the left side of the pilots' control pedestal, provide direct mechanical control of the horizontal stabilizer primary trim hydraulic supply and control valves. The handles must be moved simultaneously to provide hydraulic power for the hydraulic motor-brake-gear assembly. The left handle operates the control valve and the right one the supply valve. Actuation of these handles in the desired direction (fore and aft) causes the primary trim system to move the stabilizer at the primary fast or slow rate. The hydraulic trim motor will continue to run as long as the handles are held out of the spring-loaded neutral position. The pitch trim handles can override any other pitch trim signals.

Pitch Trim Disconnect Switch

A red, guarded two-position NORM-DISC (Disconnect) PITCH TRIM switch (figure 1-49), located on the pilots' control pedestal, provides a means of disconnecting the electrical controls to the pitch trim systems. It does not affect the manual pitch trim handles operation. When in NORM, the electrical controls of the primary and alternate trim systems operate normally. When in DISC (disconnect), the primary pitch trim, alternate pitch trim and SCAS pitch trim systems are de-energized.

Horizontal Stabilizer Position Indicator

Two horizontal stabilizer indicators (figure 1-49), locate on each pilot's instrument panel, provides a means of monitoring the stabilizer. The HORIZ indicator is graduated in units and marked 0 and 5. To the left of 0 is aircraft nose down (AND) and to the right of 0 is aircraft nose up (ANU).

This is flight test equipment and is described in Appendix II.

Radio Altimeter Select Switch Light

Inoperative in Aircraft.

Flare Arm Selector Switch

Inoperative in Aircraft.

Flare Annunications

The D.H. signal of the selected radio altimeter causes the D.H. light to come on.

The YC-15 Stability and Control Augmentation System is used to provide improved stability and aircraft response to pilot control inputs about all three axes-pitch, roll and yaw. The SCAS operates with 50% control authority. Each axis has two channels packaged in a single chassis with separate sensors providing inputs for individual computation circuits in each channel. Basic references are obtained from dual sensors consisting of accelerometers, rate gyros, pilot control force sensors and digital air data computers.

Dual electro-hydraulic SCAS actuators operate in series with the primary flight control system throughtout the entire flight regime of the aircraft. Each SCAS axis may be selected and engaged independent of another axis by its corresponding servo switch on its control panel. Dual channels in each axis operating into duplex servos, along with comparative monitoring, result in a fail-passive system with fault isolation.

In Aircraft #1, there are six modes of operation:

a. Takeoff,

b. Rate Command/Attitude Hold, and CWS

c. Attitude Command,

d. CWS

e. Heading Hold, and

f. Altitude Hold.

In Aircraft #2 additional modes are (a) Flight Director in Pitch and Roll axis and (b) Automatic in Roll only.

Rate Command and CWS are the basic mode and are engaged automatically after takeoff with SCAS on or when selecting SCAS on inflight. Attitude Command is a priority mode inflight. It's selection, with the ATT CMD switch/light, overrides any other mode. TAKEOFF is the only mode available on the ground and reverts to Rate Command and CWS automatically after takeoff. Heading Hold and Altitude Hold are similar to conventional autopilot modes. In addition to the "manual" trim available with conventional trim switches, SCAS features "automatic" trim and "reference" trim in pitch. Automatic trim requires no pilot action and operates to relieve steady state SCAS control inputs by trimming the horizontal stabilizer to null servo commands. This action restores the SCAS to full authority about a new trim condition. Reference trim is operative in the Pitch Attitude Command and Attitude Hold modes and permits the pilot to reposition the attitude established at mode engagement through use of the wheel trim switches, i.e. trimming the reference attitude.

SCAS Pitch Axis

The pitch SCAS has four basic modes: 1, Takeoff (Boost); 2, Rate Command/Attitude Hold; 3, Attitude Command and 4, Altitude Hold.

The takeoff mode functions when the main gear strut is compressed. This system acts as a boost to reduce pilot forces during takeoff rotation and in addition provides pitch-rate damping. Manual stabilizer trim is operable in the takeoff mode. After liftoff, the takeoff (boost) mode remains active until the column force is reduced to less than 3 pounds (threshold force). At which time, automatic switching to the Rate Command/Attitude Hold occurs.

The Pitch Rate Command/Attitude Hold Mode provides pitch rate proportional to pilot force. The overall gain in Rate Command is varied to provide a maneuvering force gradient of 24 lb/g at speeds above 100 KTAS. Below 100 KTAS, the pitch response is 0.42 deg/sec/lb. When the column force is less than the threshold value, the attitude is held constant at the value existing when the force is released. Manual stabilizer trim is inoperative in the Pitch Rate Command Mode. However, when the column force is less than 3 lb, reference pitch attitude trim capability via the wheel mounted trim switch is available to make small variations in the reference pitch attitude without applying column force. An automatic trim follow-up system operates in pitch rate command. This system retrims the stabilizer whenever the SCAS elevator command exceeds 2° for longer than one second.

Pitch rate is generated in turns by the coupling of bank angle and yaw rate. The pitch rate gyro signal is compensated to eliminate this coupling such that the commanded pitch rate or attitude hold will not be affected by banking. This compensation (Q comp) is provided in all pitch SCAS modes.

The Attitude Command Mode may be selected at any time but is normally selected for transitions from cruise to landing approach. When the column force is less than 3 lb, the system holds the attitude constant. When a column force greater than 3 lb is applied, the pitch attitude changes proportional to force (0.5 deg/lb). When the force is released, the pitch attitude returns to the value existing prior to the force application (assuming no pilot trim inputs). In the Pitch Attitude Command Mode, there is no manual stabilizer trim but reference pitch attitude trim is available. Trim switch operation varies the pitch or "reference" attitude for zero column force. The automatic pitch trim follow-up (stabilizer) operates in the Attitude Command Mode only when the column force is less than 3 lb.

In order to select the Altitude Hold Mode, the pitch SCAS must be in the Rate Command/Attitude Hold Mode. The SCAS will hold the altitude existing when Altitude Hold is selected. When the control force exceeds 10 lb, the Altitude Hold Mode will cut off and must be reselected if it is still desired. While in the Altitude Hold Mode, the wheel mounted pitch trim switch is not functional. Automatic follow-up trim (stabilizer) does operate in this mode when the column force is less than 3 lb.

The SCAS PITCH Control panel contains the following:

SCAS Pitch Servo Control Switch

A SCAS pitch servo control switch (figure 1-51), located in the SCAS pitch control panel on the glareshield, has two positions (ON-OFF) and is solenoid held in ON position. The switch will not remain in the ON position until all the appropriate system interlocks are satisfied for safe operation. When in ON, the SCAS PITCH is engaged. The pitch servo control switch receives 28 VDC power from the LEFT DC bus through the SCAS ENGAGE circuit breaker (F-10).

SCAS Pitch Channel Selector Switch

A three position (A-DUAL-B) pitch channel rotary selector switch (figure 1-51), located in the pitch control panel, provides a means of selecting channels for the pitch axis. This feature is primarily provided for channel fault isolation in the event of a single channel failure which would cause the pitch servo control lever to drop off and prevent dual channel operation. DUAL is the normal position of this switch.

SCAS Altitude Hold Switch

A two position (ON-OFF) ALTITUDE HOLD switch (figure 1-51), located in the pitch control panel, provides a means of engaging and disengaging the altitude hold mode of the pitch axis. The only time that altitude hold becomes operational is when the pitch is in rate command. The ALTITUDE HOLD switch will remain in ON when each of these condition exists:

1. When pilot(s) force is less than 10 pounds.

2. When the flaps are extended less than 28°.

3. When in RATE COMMAND mode.

SCAS Pitch Attitude Command Switch/light

A green ATT CMD (attitude command) switch/light (figure 1-51), located in the pitch control panel, provides a means of selecting and annunciating the Attitude Command mode. When the switch/light is pressed, the SCAS pitch goes to Attitude Command mode and the ATT CMD light should come on. The ATT CMD light receives 28 VDC power from the LEFT DC bus through the PITCH SCAS circuit breaker (F-11).

SCAS PITCH Warning light

A red PITCH warning light (figure 1-51), located in the SCAS PITCH control panel, warns the pilots of a SCAS PITCH disengagement. The PITCH light comes on steady when the pitch servo switch is placed in OFF or when a SCAS PITCH failure occurs. The light may be turned off by momentarily pressing the switch/light or placing the pitch servo switch in ON. The PITCH light receives 28 VDC power from the BATTERY bus through the SCAS OFF LIGHTS circuit breaker (B-24) on the overhead circuit breaker panel.

SCAS Pitch Trim advisory light

An amber TRIM advisory light (figure 1-51), located in the pitch control panel, provides monitoring of the pitch trim system. When on, this light signifies that pitch trim is required for excessive period of time. The TRIM light receives 28 VDC power for the LEFT DC bus through the PITCH SCAS circuit breaker (F-11).

Pitch TAKEOFF advisory light

A green TAKEOFF light (figure 1-51), located in the SCAS PITCH control panel, annunicates that the SCAS pitch is in the TAKEOFF mode. The aircraft must be on the ground (both main gear strut compressed switches engaged) and the pitch servo switch ON. The TAKEOFF light receives 28 VDC power from the LEFT DC bus through the PITCH SCAS circuit breaker (F-11).

SCAS Pitch Rate Command Advisory light

A green RATE CMD (command) light (figure 1-51), located in the pitch control panel, provides a means of monitoring the Rate Command mode. The RATE CMD light receives 28 VDC power from the LEFT DC bus through the PITCH SCAS circuit breaker (F-11).

SCAS Pitch Altitude advisory/caution light

A green/amber ALT HOLD advisory/caution light (figure 1-51), located in the pitch control panel, provides a means of monitoring the Altitude Hold mode. When the green light is on, it signifies that the pitch axis is in the Altitude Hold mode. When the Altitude Hold mode is disengaged, the amber light will flash. Pressing the switch/light turns off the light. The ALT HOLD light receives 28 VDC power from the LEFT DC bus through the PITCH SCAS circuit breaker (F-11).

SCAS ROLL Axis

The Roll SCAS has three basic modes: 1. Takeofff; 2. CWS; and 3. Heading Hold. As in pitch, the Takeoff Mode in roll operates as a boost system to reduce forces and provides additional roll rate damping when the gear is compressed. Manual lateral trim is operable in every mode. After liftoff, the roll SCAS automatically switches to the CWS Mode.

CWS provides roll rate proportional to pilot wheel force. At low speeds (below 200 kts), the overall gain is set to provide a roll rate of 2.27 deg/sec/lb. Above 200 KTS, the gains are scheduled to match the basic aircraft, increasing linearly from 2.27 deg/sec/lb to 4.52 deg/sec/lb at 400 kts. When the wheel force is less than 3 lb (threshold force), the bank angle is held constant.

The Heading Hold Mode may be selected any time during flight when CWS is engaged. While in this mode, the pilot can maneuver as normal. When the bank angle is reduced to less than 3 degrees and the wheel is centered, the heading hold will activate and attempt to hold the existing heading.

The SCAS ROLL control panel contains the following:

SCAS ROLL Servo Control Switch

A SCAS roll servo control switch (figure 1-52), located in the SCAS roll control panel on the glareshield, has two positions (ON-OFF) and is solenoid held in ON position. The switch will not remain in the ON position until all the appropriate system interlocks are satisfied for safe operation. When in ON, the SCAS roll is engaged. The roll servo control switch receives 28 VDC power from the LEFT DC bus through the SCAS ENGAGE circuit breaker (F-10).

SCAS Roll Channel Selector Switch

A three position (A-DUAL-B) roll channel selector switch (figure 1-52), located in roll control panel, provides a means of selecting channels for the roll axis. The feature is primarily provided for channel fault isolation which would cause the roll servo control switch to drop off and prevent dual channel operation. DUAL is the normal position of this switch.

SCAS Roll Heading Hold Switch

A two position (ARMED-OFF) HEADING HOLD switch (figure 1-52), located in the roll control panel, provides a means of arming the Heading Hold mode. The heading hold switch may be placed in ARM when in CWS. The switch must be placed in OFF as there is no automatic disengage function.

SCAS ROLL Warning Light

A red ROLL warning light (figure 1-52), located in the SCAS roll control panel, warns the pilots of a SCAS roll disengagement. The ROLL light comes on steady when the roll servo control switch is placed in OFF or when a SCAS roll failure occurs. The light may be turned off by momentarily pressing the switch/light or placing the roll servo control switch in ON. The ROLL light receives 28 VDC power from the BATTERY Bus through the SCAS OFF LIGHTS circuit breaker (B-24).

Roll Half Gain Advisory Light

An amber HALF GAIN light (figure 1-52), located in the roll control panel, alerts the pilots when one of the two hydraulic systems pressure is low and the SCAS has reverted to single aileron surface operation; however the system will remain engaged and operational. The roll HALF GAIN light receives 28 VDC power from the LEFT DC bus through the ROLL SCAS circuit breaker (F-12).

SCAS Roll Takeoff Advisory Light

A green TAKEOFF light (figure 1-52), located in roll control panel, annunicates that the SCAS roll is in the TAKEOFF mode. The aircraft must be on the ground (both maingear strut compressed switches engaged) and the roll servo control switch ON. The TAKEOFF light receives 28 VDC power from the LEFT DC bus through the ROLL SCAS circuit breaker (F-12).

SCAS Roll CWS Advisory Light

A green CWS light (figure 1-52), located in the roll control panel, provides a means of monitoring the control wheel steering mode. The CWS is the basic roll mode and this light should be on unless some other mode is selected. The CWS light receives 28 VDC power from the LEFT DC bus through the ROLL SCAS circuit breaker (F-12).

SCAS Roll Trim Advisory Light

An amber TRIM advisory light (figure 1-52), located in the roll control panel, provides monitoring of the roll trim system. When on, this light signifies that roll trim is required for excessive period of time. The TRIM light receives 28 VDC power from the LEFT DC bus through the ROLL SCAS circuit breaker (F-12).

SCAS Roll Heading Advisory Light

A green HEADING light (figure 1-52), located in the roll control panel, provides a means of monitoring the Heading Hold mode. When on, it signifies that the roll axis is in the Heading Hold mode. The HEADING light receives 28 VDC power from the LEFT DC bus through the ROLL SCAS circuit breaker (F-12).

SCAS YAW Axis

The yaw axis stability and control augmentation system provides Dutch-roll damping, turn coordination, and suppression of transients due to engine failure. The yaw SCAS utilizes sideslip angle and sideslip angle rate; the latter signal being synthesized from roll attitude and yaw rate. The command feature of the yaw SCAS allows the pilot to command sideslip angle proportional to rudder pedal force (0.33 deg/lb). In order to eliminate rudder SCAS hardovers and excessive weathercocking during ground operation, the yaw SCAS does not operate when the main gear is compressed.

Manual trim is always available in the yaw axis. Trim operation simply recenters the zero force rudder pedal position.

The SCAS YAW control panel contains the following:

SCAS YAW Servo Control Switch

A SCAS YAW servo control switch (figure 1-53), located in the SCAS yaw control panel, has two positions (ON-OFF) and is solenoid held in ON position. The switch will not remain in the ON position until all the appropriate system interlocks are satisfied for safe operation. When on, the SCAS YAW is engaged. The yaw servo control switch receives 28 VDC power from the LEFT DC bus through the SCAS ENGAGE circuit breaker (F-10).

SCAS Yaw Channel Selector Switch

A three position (A-DUAL-B) yaw channel selector switch (figure 1-53), located in the yaw control panel, provides a means of selecting channel for the yaw axis. This feature is primarily provided for channel fault isolation which would cause the yaw servo control switch to drop off and prevent dual channel operation. DUAL is the normal position of this switch.

SCAS YAW Turbulance Switch/Light

A green TURB switch/light (figure 1-53), located in the yaw control panel, provides a means of selecting and annunciating the turbulance mode. This mode is inhibited on the ground by the takeoff mode but may be preselected on the ground. If preselected, dual annunciation is normal (TURB and TAKEOFF). When in the flight mode the takeoff mode is deenergized and only the TURB light will be on. The TURB switch/light receives 28VDC from the LEFT DC bus through the YAW SCAS circuit breaker (F-13).

SCAS YAW Warning Light

A red YAW warning light (figure 1-53), located in the yaw control panel, warns the pilot of a SCAS YAW disengagement. The YAW light comes on steady when the yaw servo control switch is placed in OFF or when a SCAS YAW failure occurs. The light may be turned off by momentarily pressing the switch/light or placing the yaw servo control switch in ON. The YAW light receives 28 VDC power from the BATTERY BUS through the SCAS OFF LIGHTS circuit breaker (B-24).

SCAS Takeoff Advisory Light

A green TAKEOFF light (figure 1-53), located in the yaw control panel, annunciates that the SCAS yaw is in the TAKEOFF mode. The aircraft must be on the ground (both main gear strut compressed switches engaged) and the zero servo control switch ON. The TAKEOFF light receives 28 VDC power from the LEFT DC bus through the YAW SCAS circuit breaker (F-13).

SCAS YAW Half Gain Advisory Light

An amber HALF GAIN light (figure 1-53), located on the yaw control panel, alerts the pilots when one of the two hydraulic system pressure is low and the SCAS has reverted to single control surface operation (airspeed below 140 KTS); however the system will remain engaged and operational. The yaw HALF GAIN light receives 28 VDC power from the LEFT DC bus through the YAW SCAS circuit breaker (F-13).

SCAS Trim Summary

The following tables are a summary of the various trims in the various SCAS modes.

PITCH

MODE	WHEEL TRIM	AUTO TRIM
TAKEOFF	YES (1)	NO

TEMPORARY REVISION X

SECTION I (DESCRIPTION AND OPERATION)

2. Page 1-104 Rev. 003 24 Jan. 1977

Delete the "SCAS YAW Turbulance Switch/Light" paragraph.

3. Page 1-105 Rev. 003 24 Jan. 1977

Under "ROLL" paragraph make the following pen and ink changes:

~~ATT CMD~~	~~NO~~	~~YES~~
CWS ~~RATE CMD~~	YES (1) ~~(2) (3)~~	No ~~YES~~
HDG HOLD	yes (1) ~~NO~~	No ~~YES~~

ATT CMD	YES (2)	YES (3)
RATE CMD	YES (2) (3)	YES
ALT HOLD	NO	YES (3)

ROLL

MODE	WHEEL TRIM	AUTO TRIM
TAKEOFF	YES (1)	NO
~~ATT CMD~~	~~NO~~	~~YES~~
CWS ~~RATE CMD~~	YES (1) ~~(2) (3)~~	No ~~YES~~
HDG HOLD	yes (1) ~~NO~~	No ~~YES~~

(1) Wheel trim switches control trim actuator directly, i.e., manual trim.
(2) Wheel trim switches control SCAS Reference trim which in turn operates the trim actuator, i.e., reference trim.
(3) Trim is not operative with pilot force more than 3 pounds.

FLIGHT CONTROL SURFACES

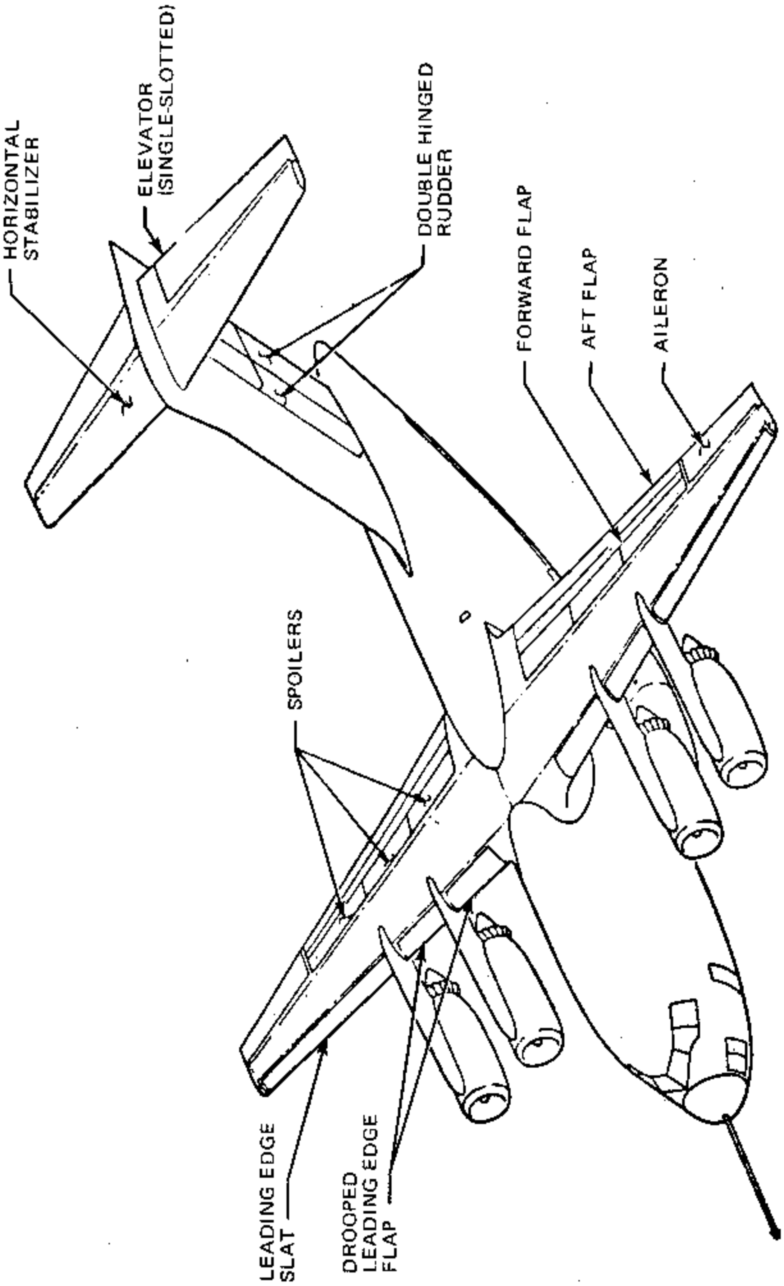
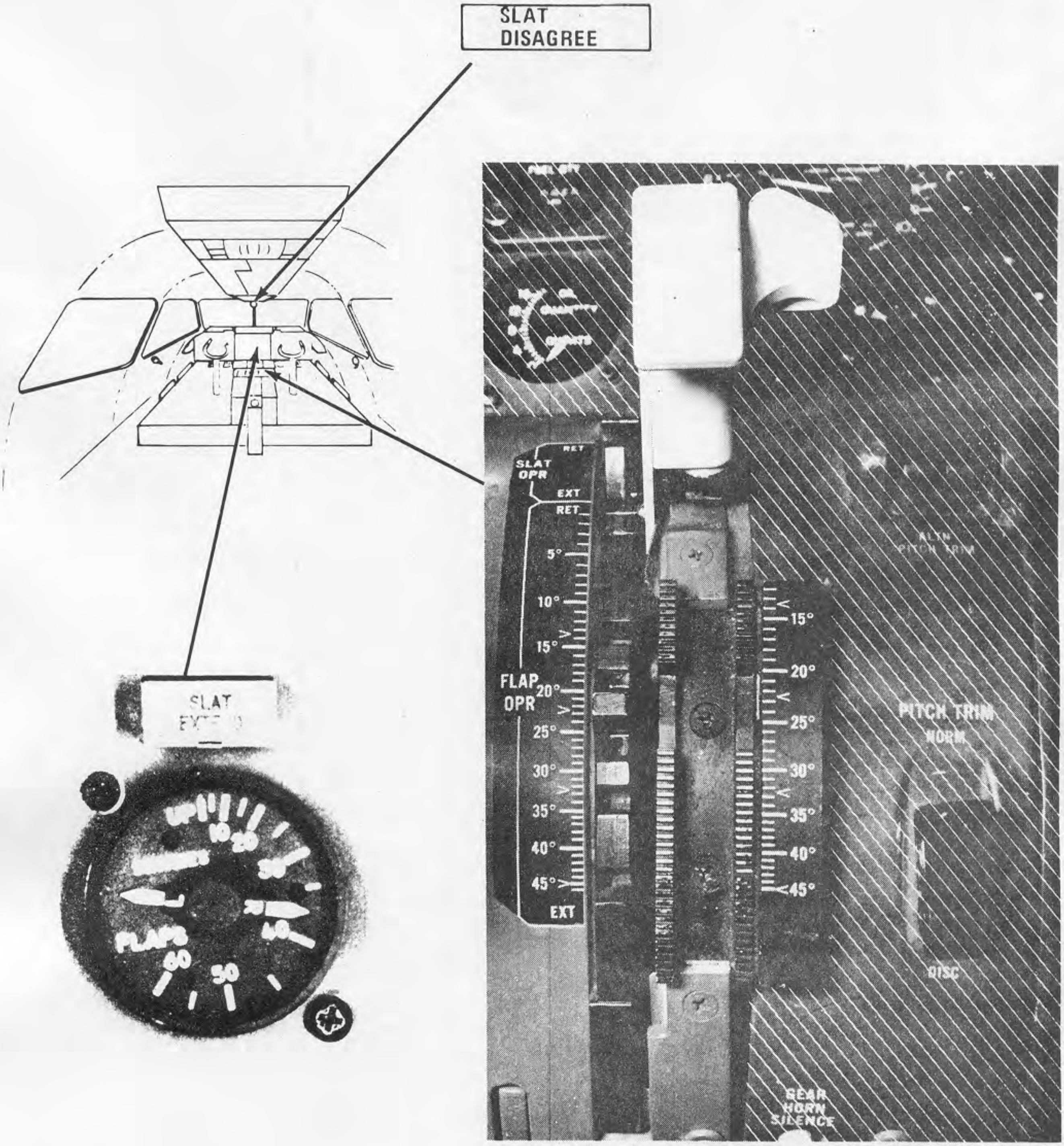


Figure 1-39

FLAPS AND SLATS CONTROLS AND INDICATORS



PR5-C15-135 A

Figure 1-40

SPOILER CONTROLS AND INDICATORS

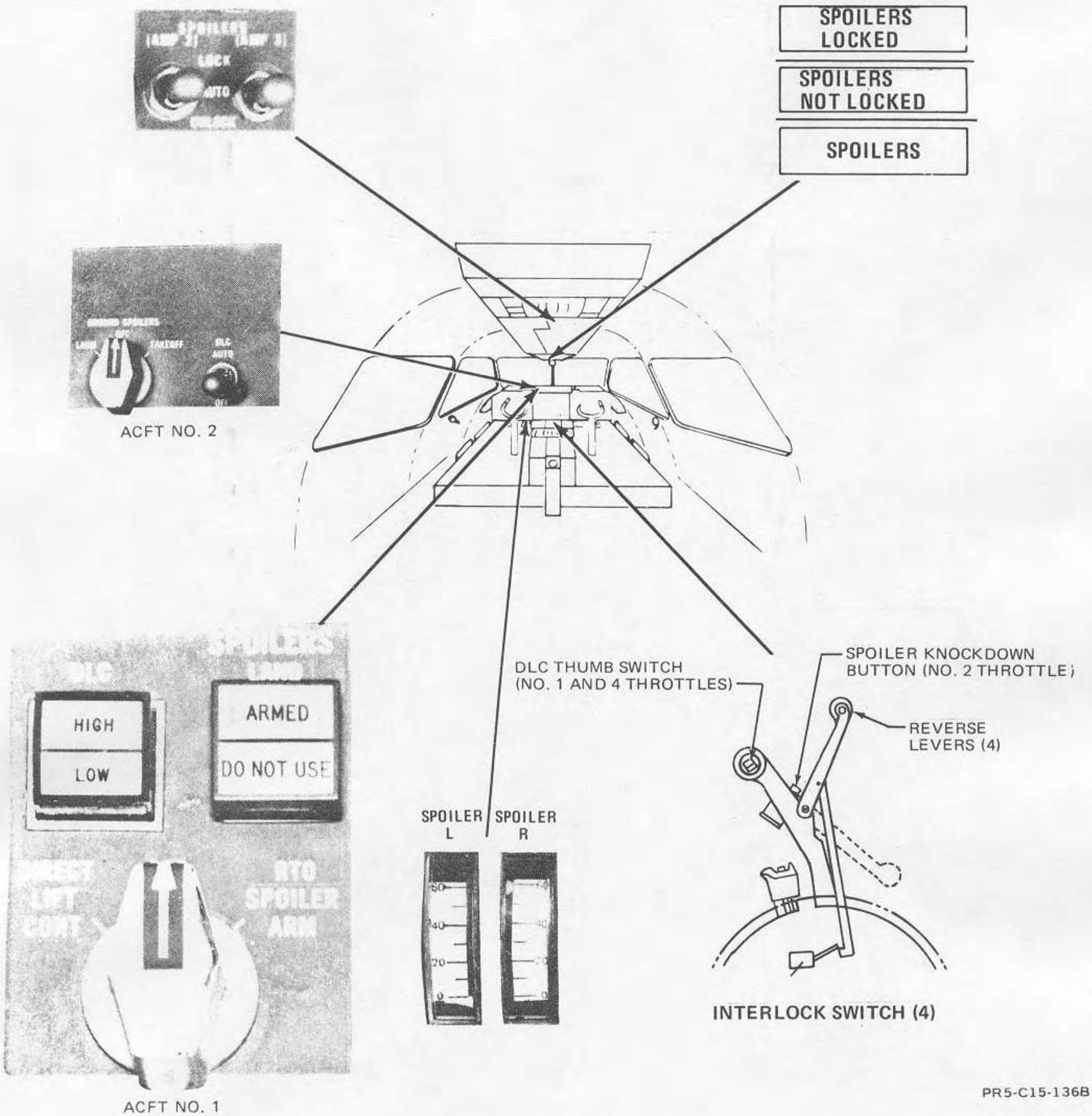
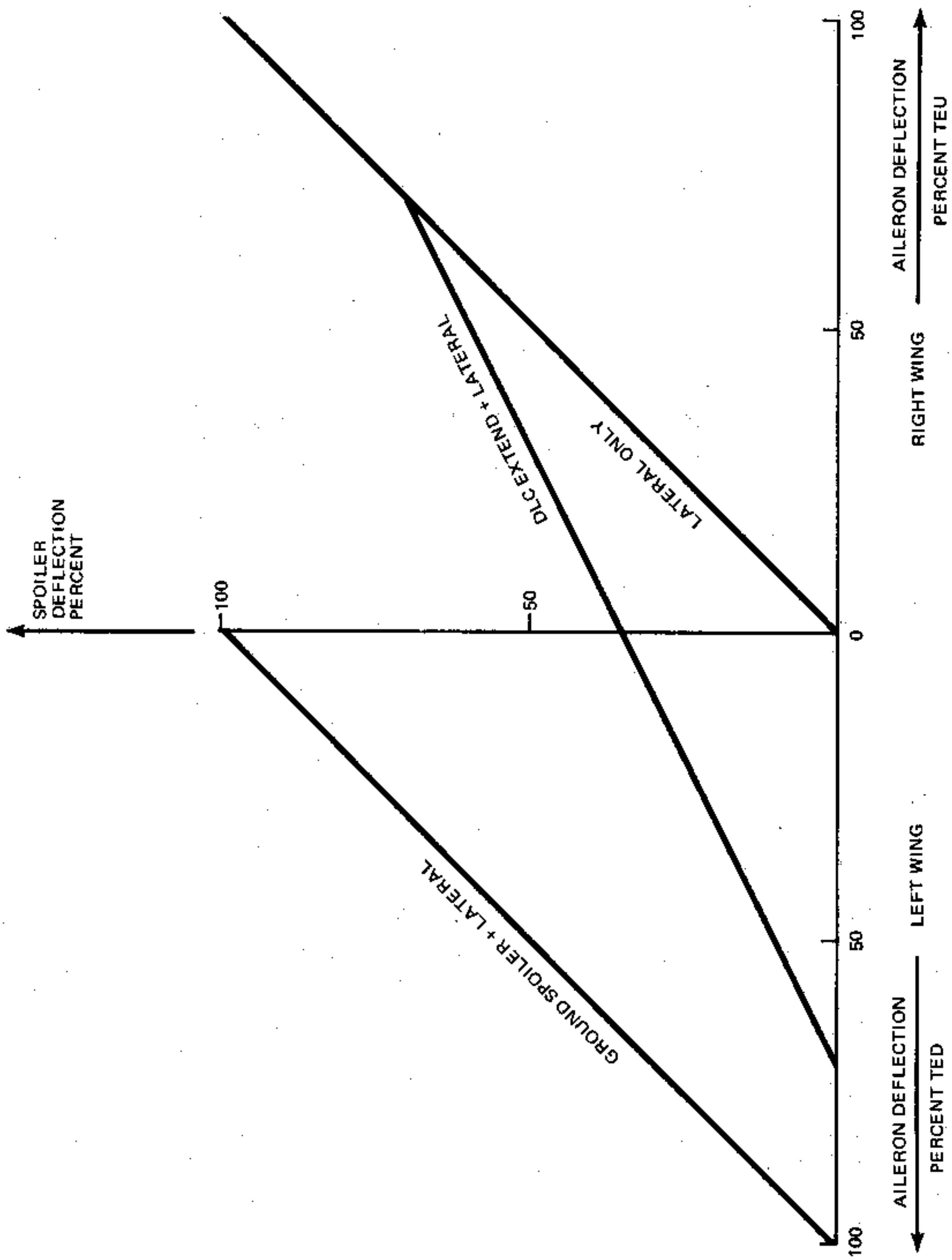


Figure 1-41

SPOILER VERSUS AILERON TRAVEL



PR5-C15-137B

Figure 1-42

STALL SYSTEM CONTROLS

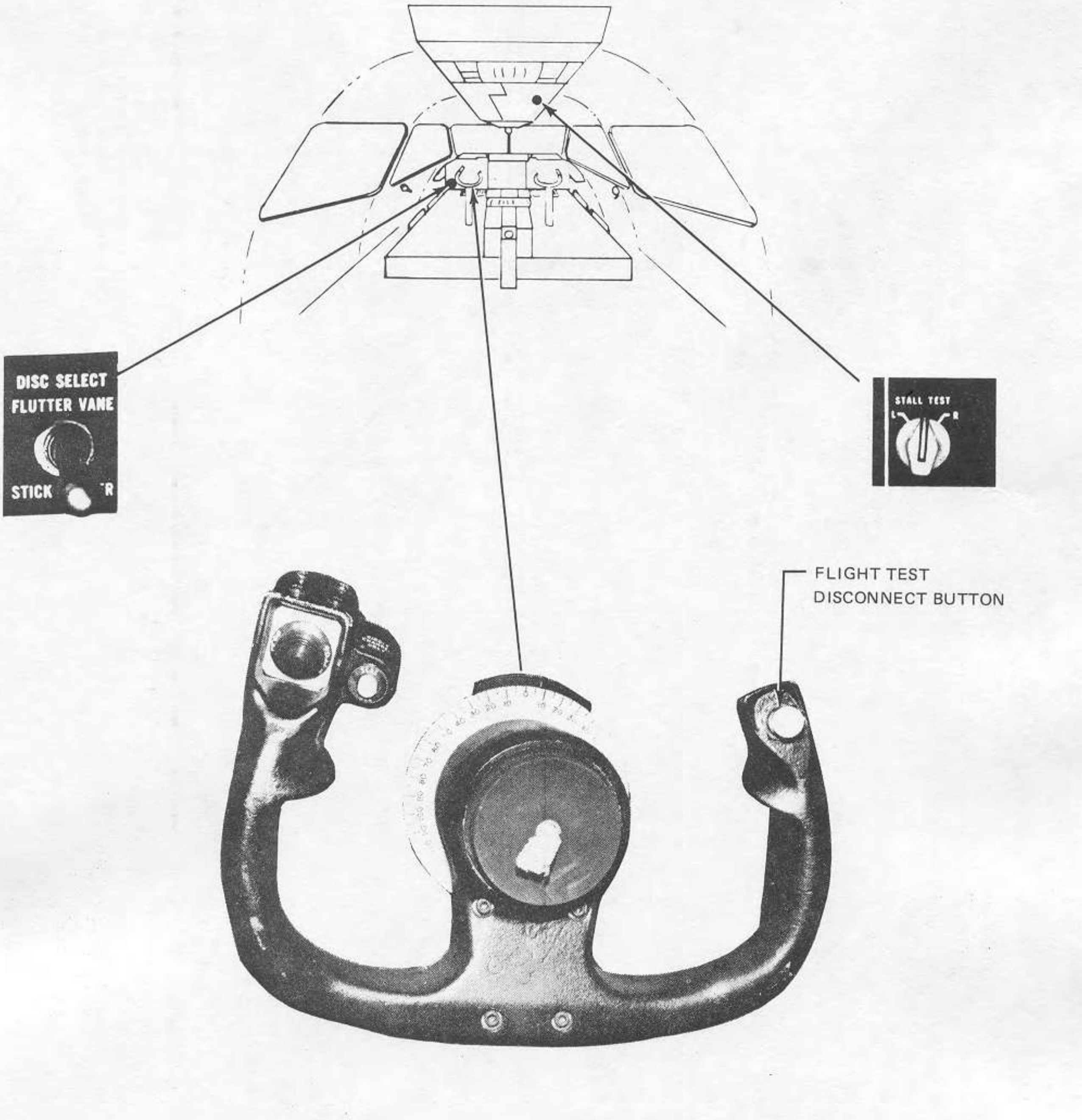


Figure 1-43

FLIGHT CONTROL HYDRAULIC SYSTEM ARRANGEMENT

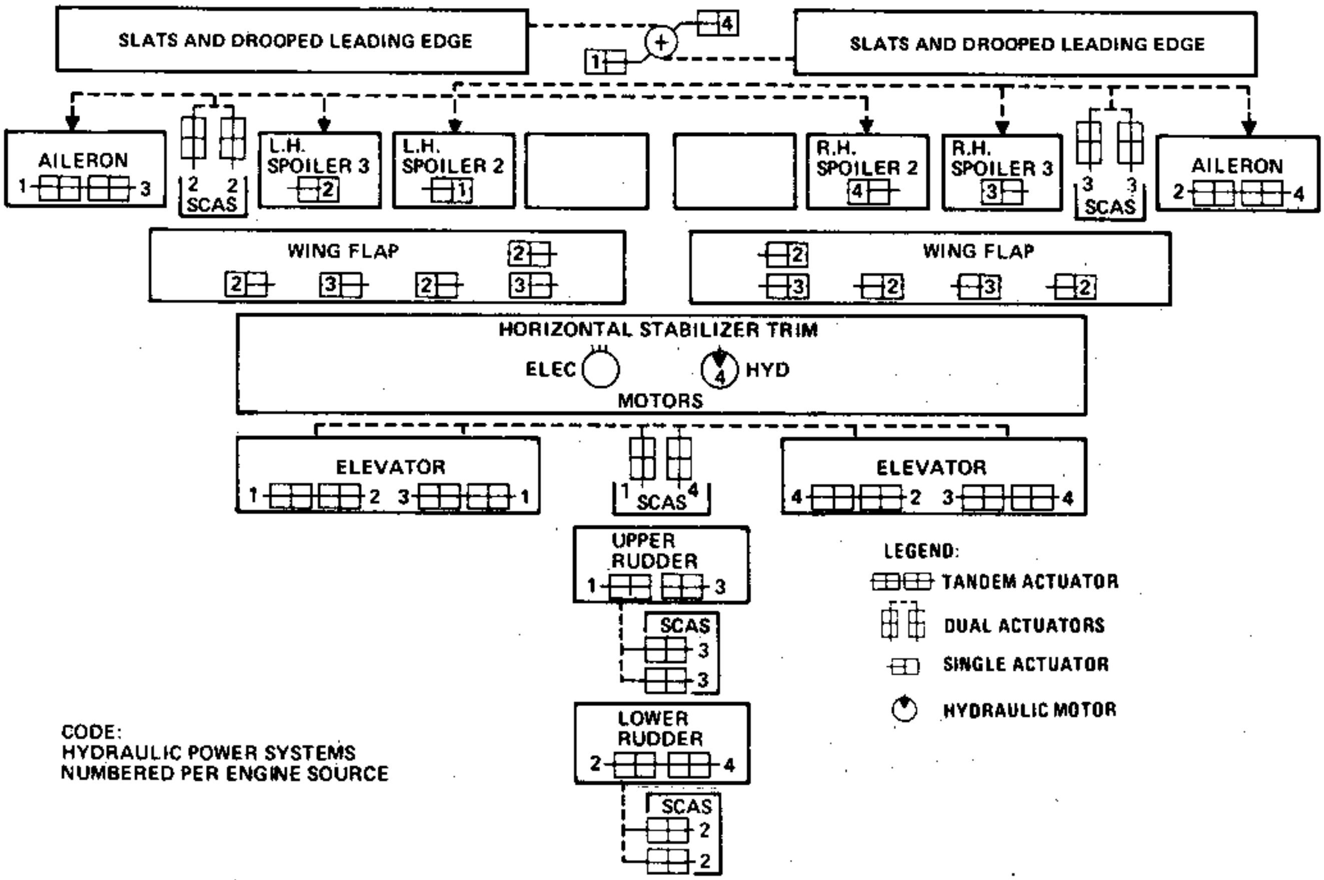


Figure 1-44

AILERON AND ROLL CONTROLS AND INDICATORS

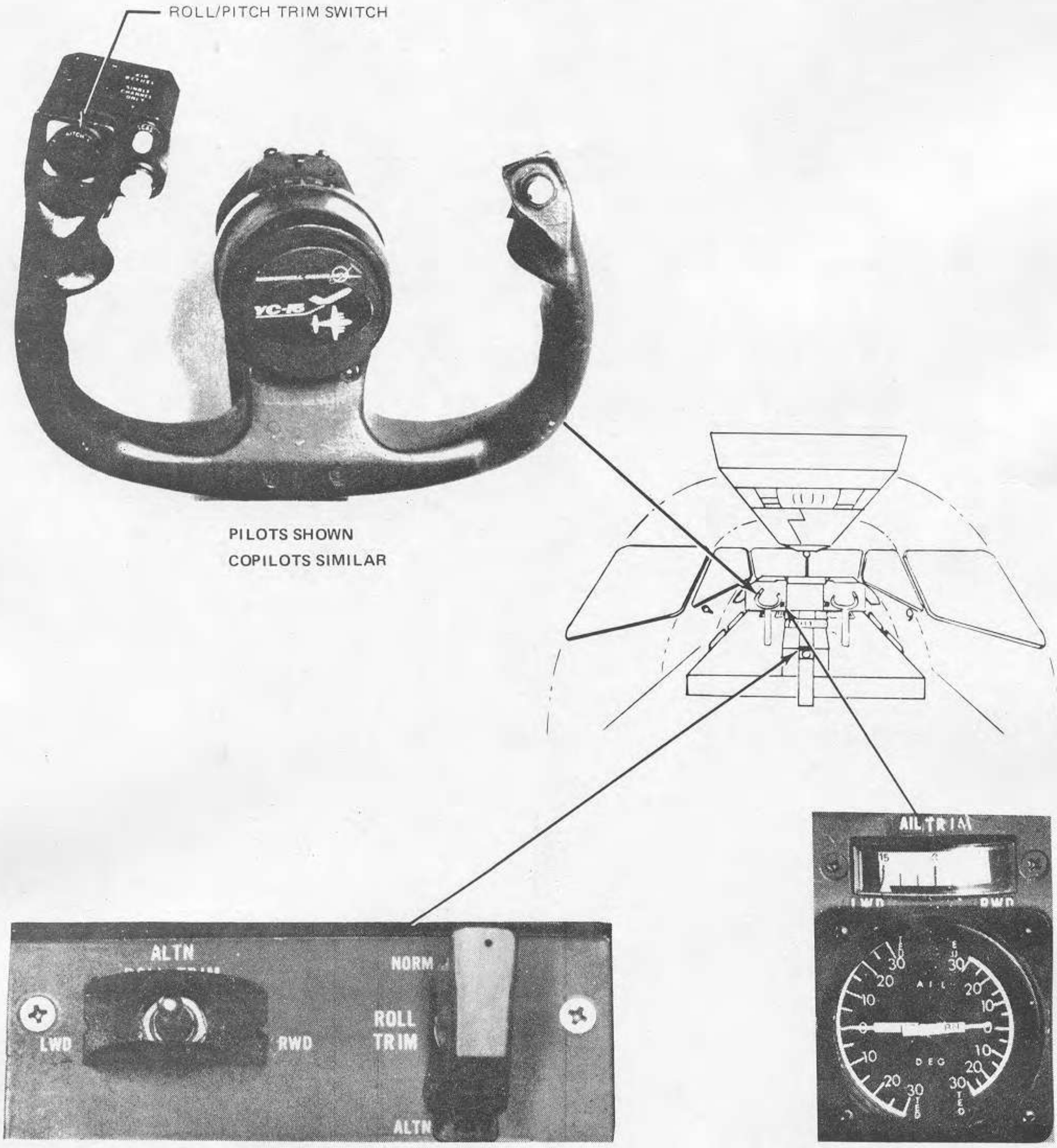


Figure 1-45

AILERON MECHANICAL CONTROL

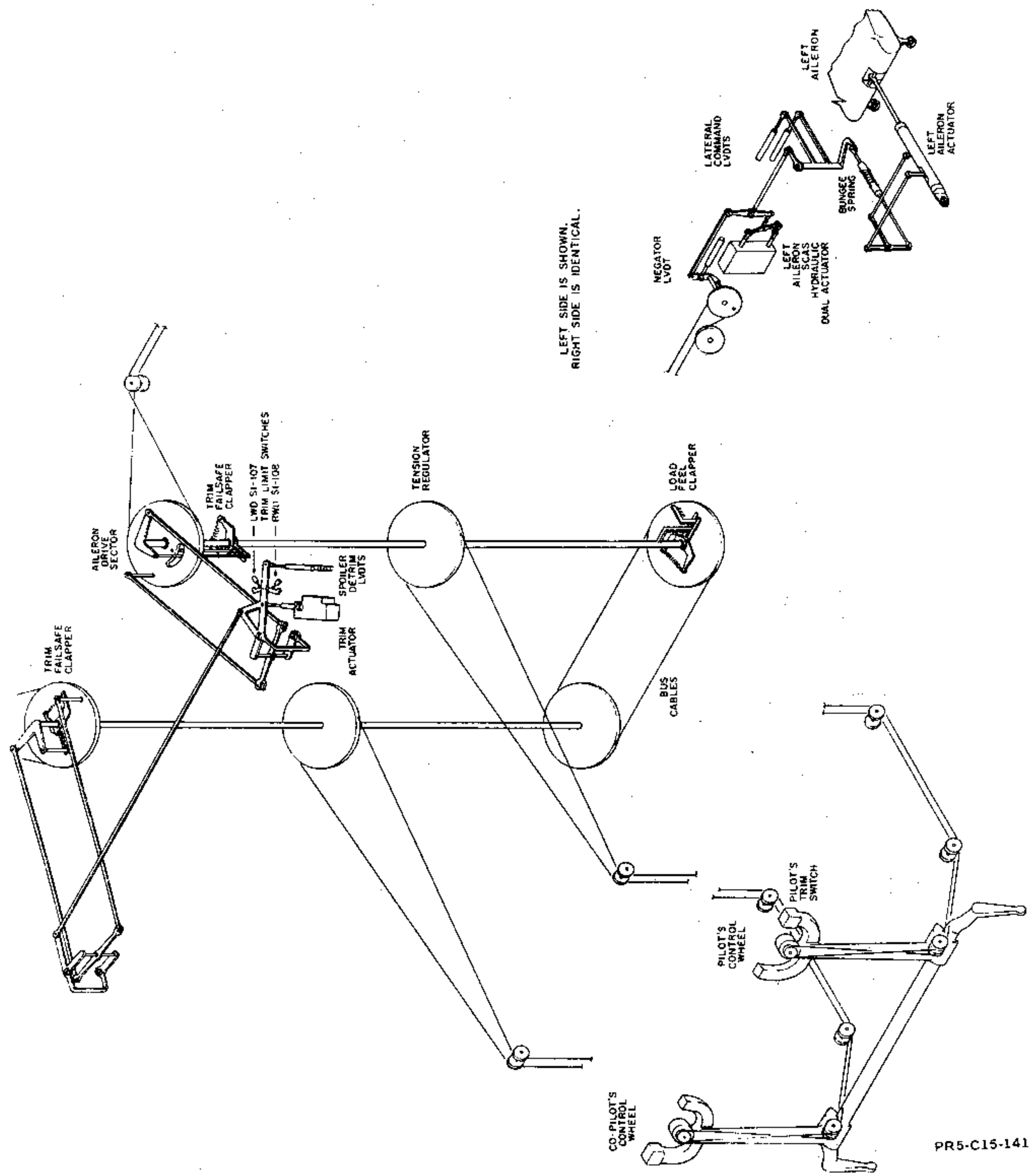
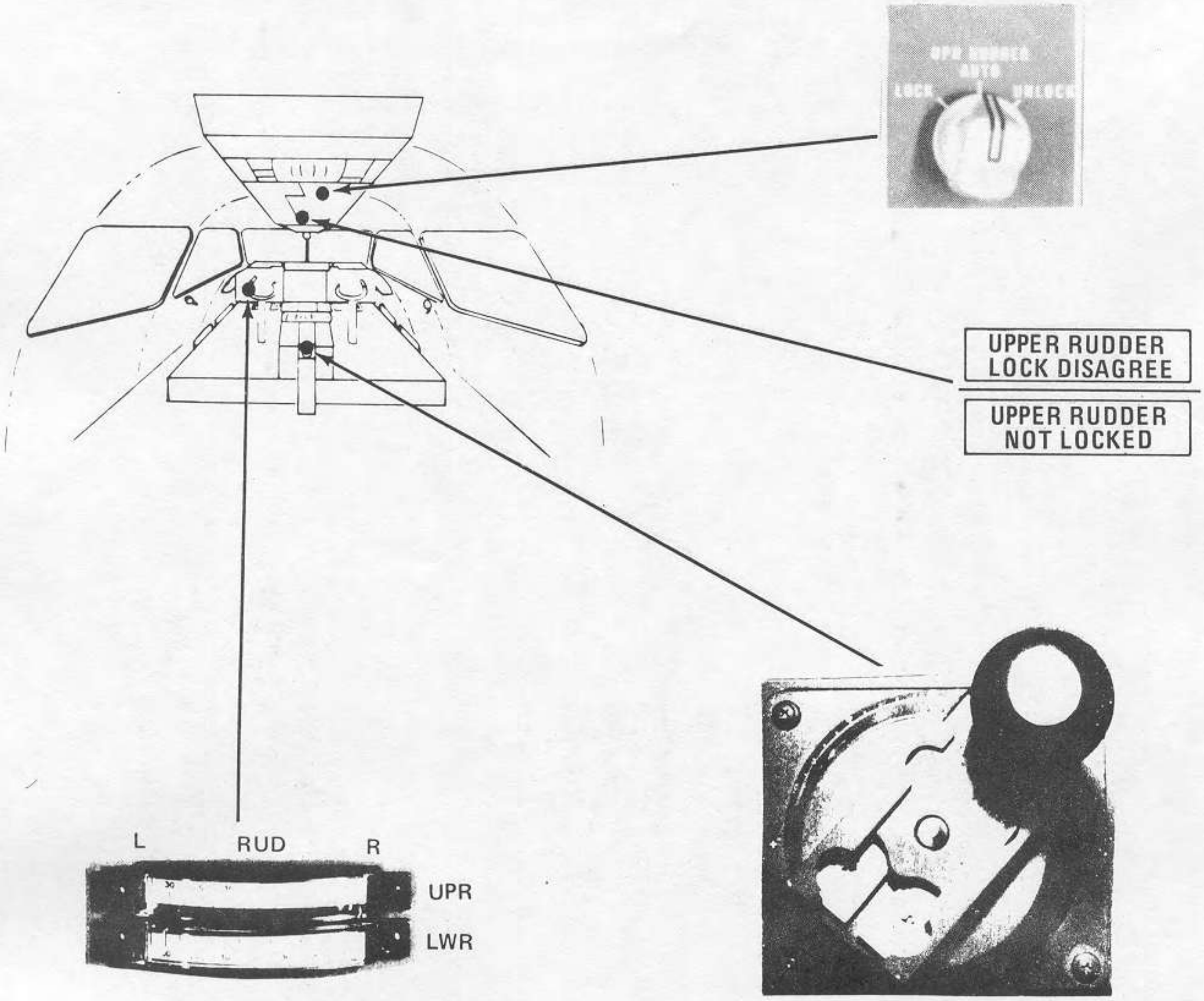


Figure 1-46

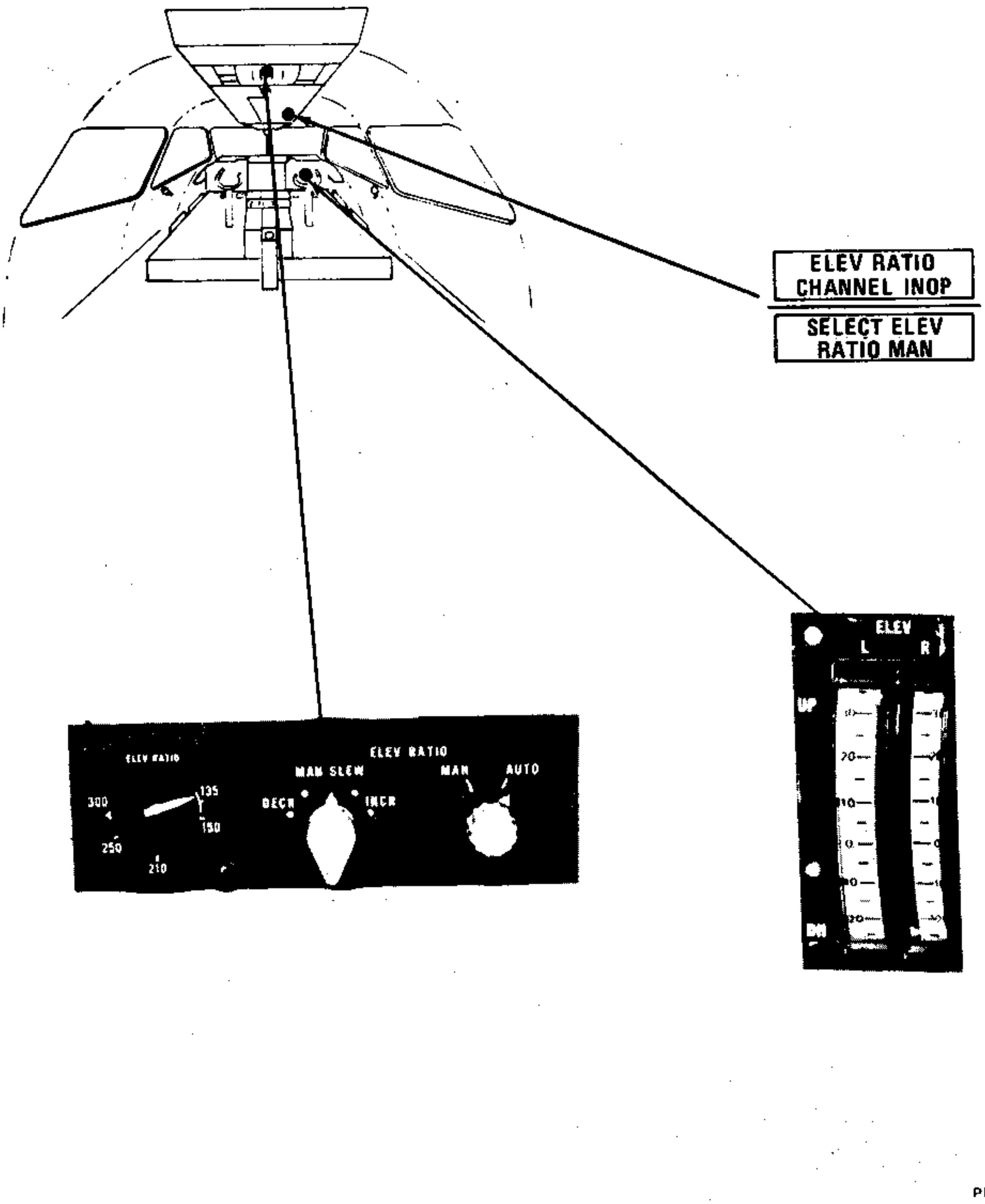
RUDDER CONTROLS AND INDICATORS



PR5-C15-142 A

Figure 1-47

ELEVATOR RATIO CONTROLS AND INDICATORS



PR5-C15-143B

Figure 1-48

PITCH TRIM CONTROLS AND INDICATORS

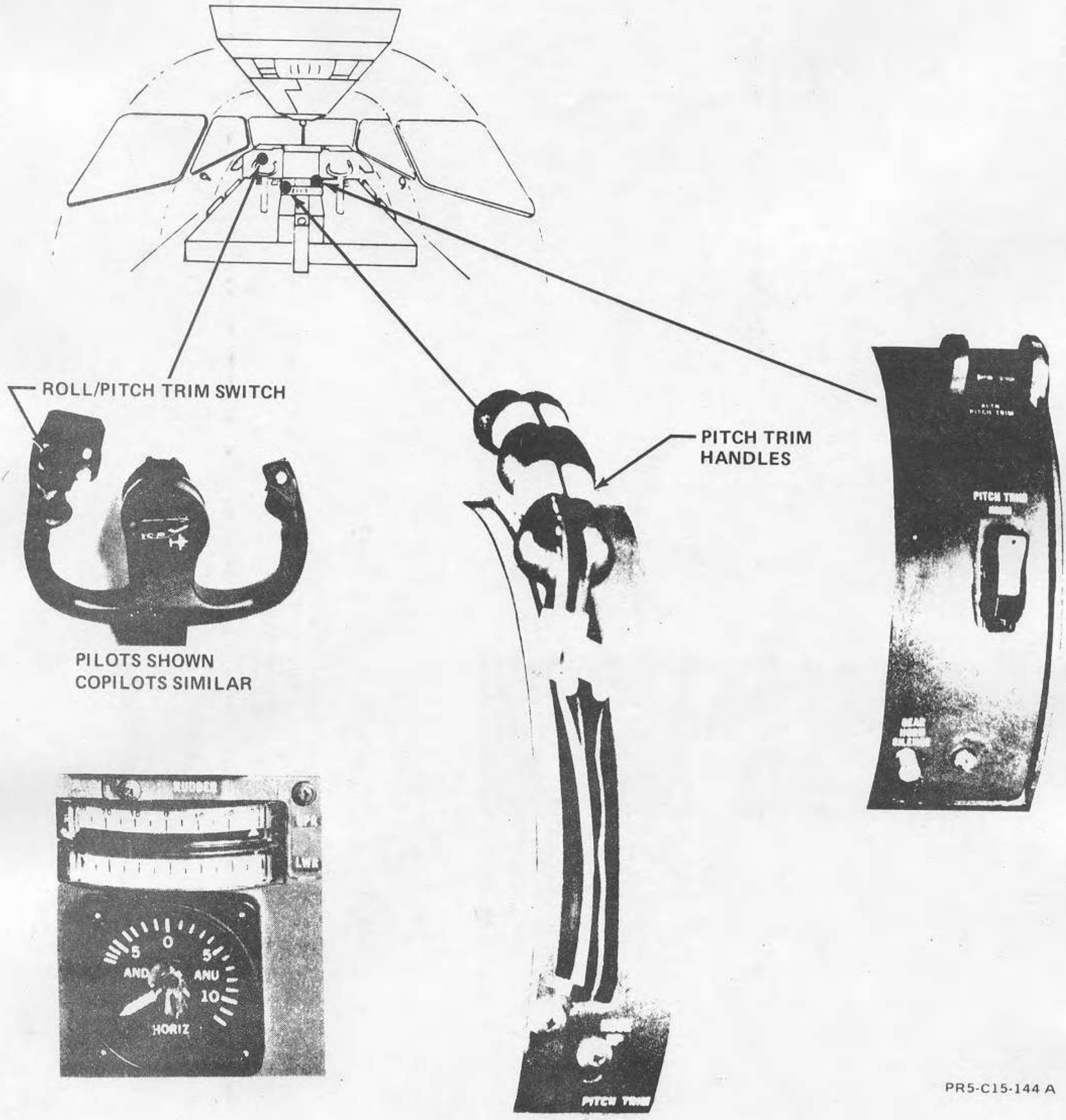
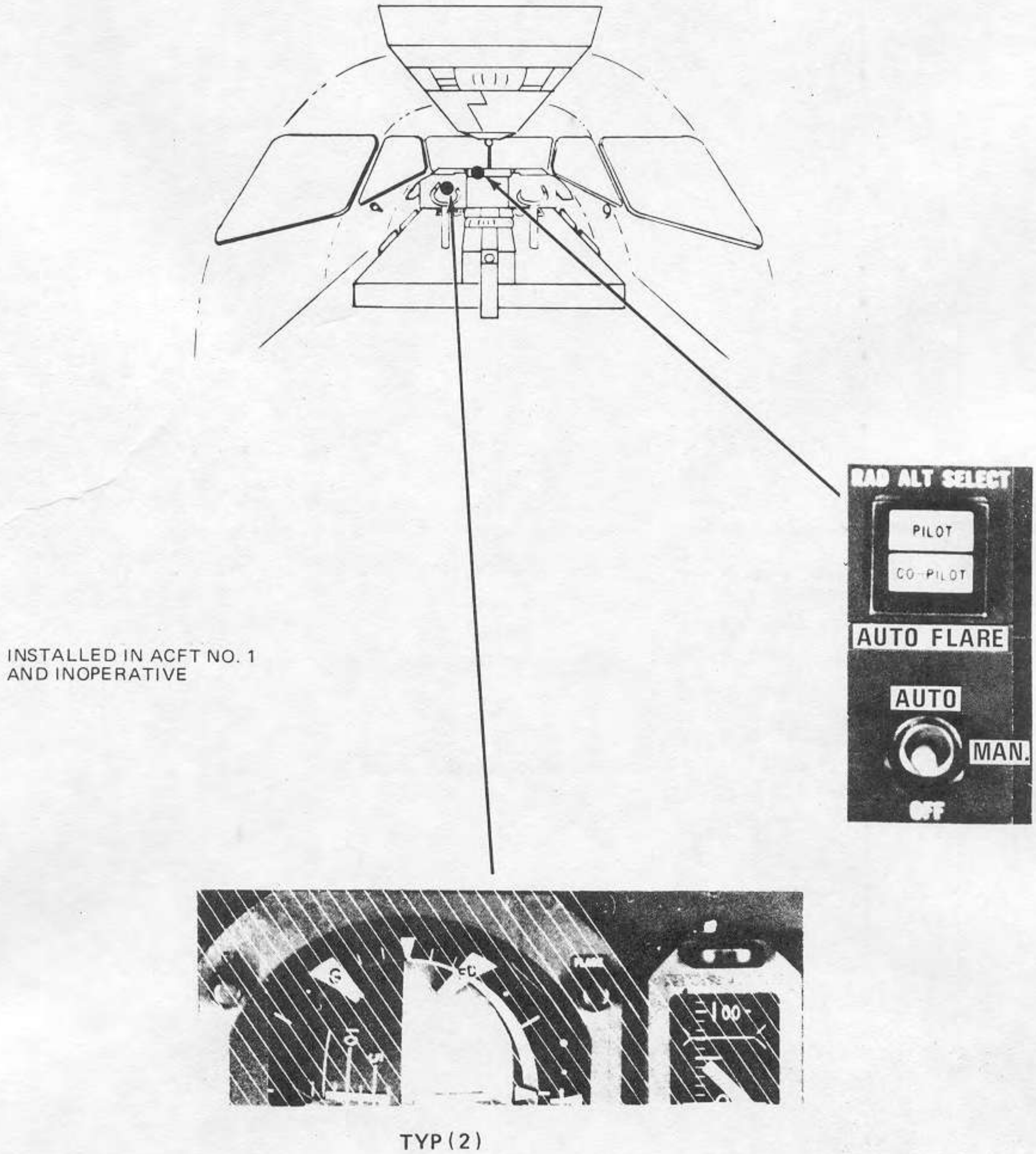


Figure 1-49

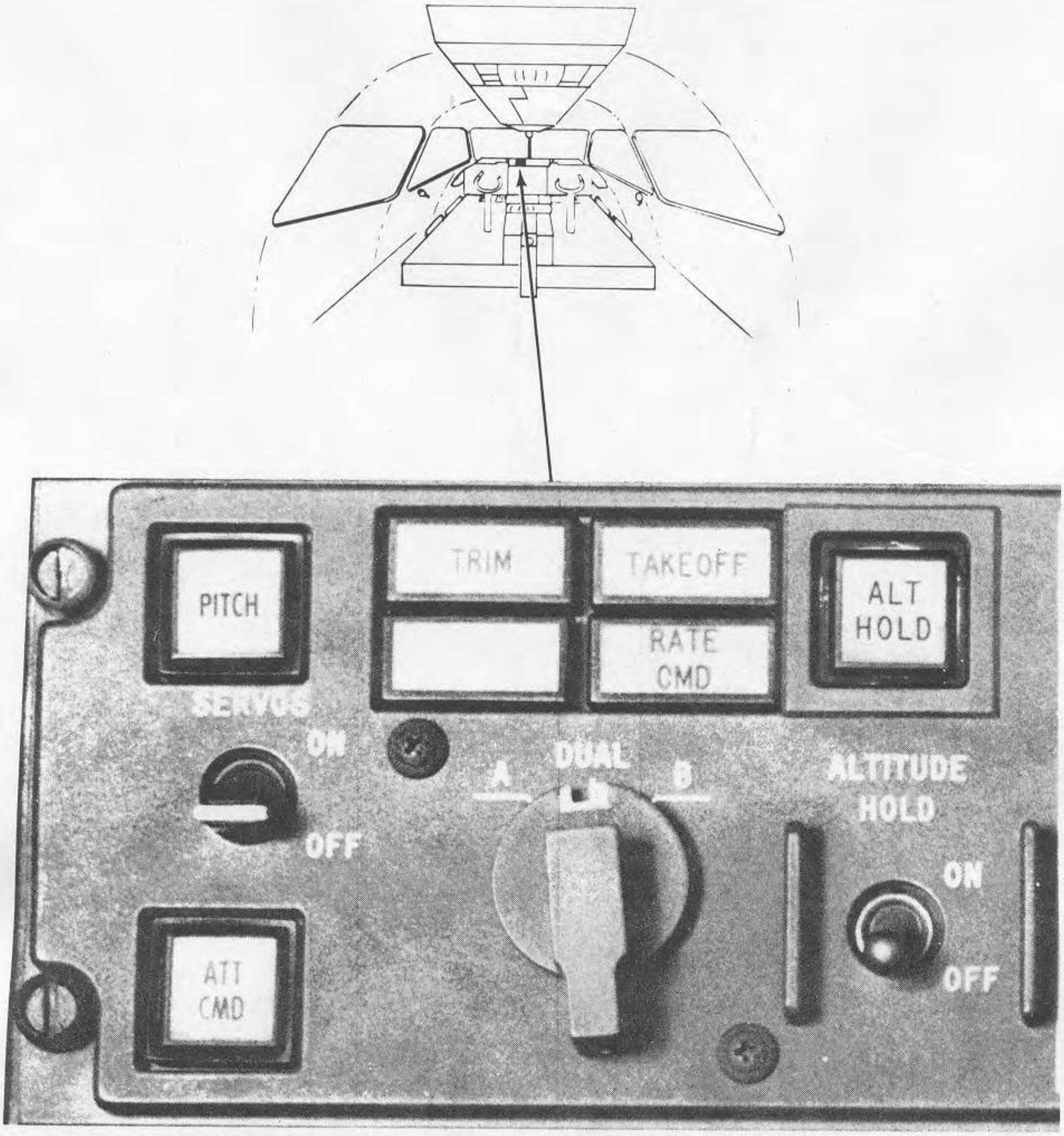
AUTOFLARE CONTROLS AND INDICATORS



PR5-C15-145C

Figure 1-50

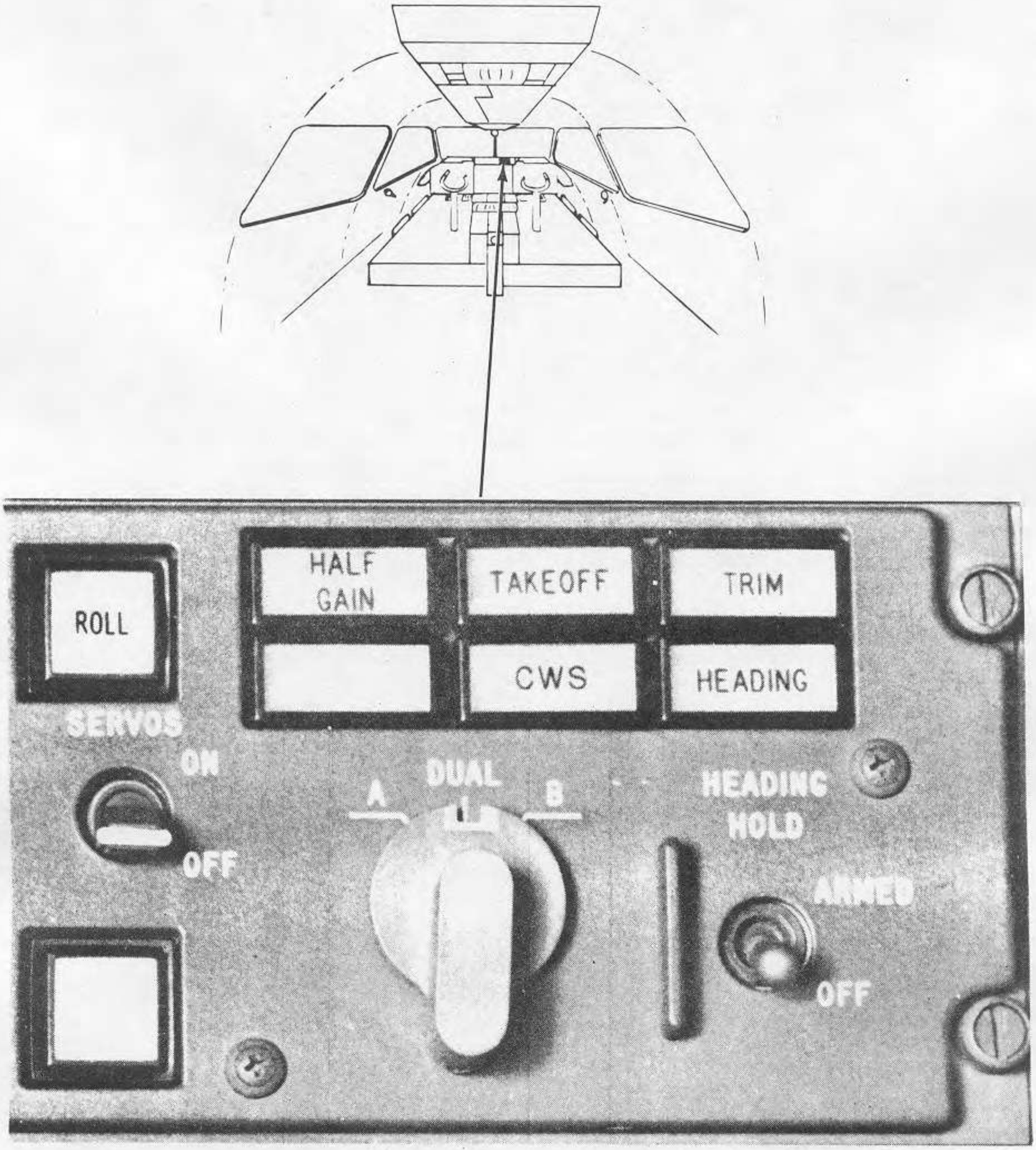
SCAS CONTROL PANEL – PITCH



PR5-C15-146A

Figure 1-51

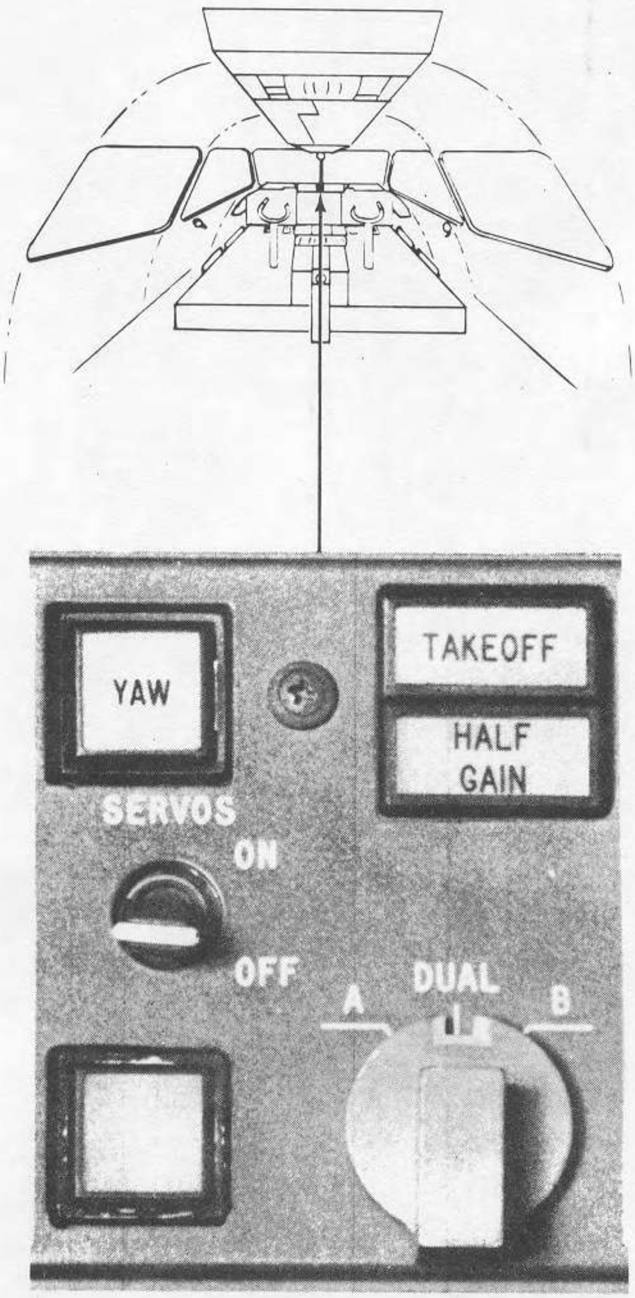
SCAS CONTROL PANEL – ROLL



PR5-C15-147A

Figure 1-52

SCAS CONTROL PANEL – YAW



PR5-C15-148A

Figure 1-53

ELECTRICAL POWER SUPPLY SYSTEM

The YC-15 electrical power system is a split bus sytem (FO-6 and 7). Electrical power is normally supplied by alternating current generators mounted on Engines 2 and 3 (figure 1-54) through a Constant Speed Drive (CSD). A third generator on Engine 4 provides an auxiliary electrical power source. These AC generators provide 120/208 volt, 3-phase, 400 Hz power to the generator buses for distribution. Any two generators will supply normal electrical power. Four transformer- rectifiers convert 115 VAC power to 28 VDC power for control circuits, lighting and other load devices. Two step down transformers reduce 115 VAC power to 28 VAC power for instrumentation. Two series connected nickel-cadmium batteries provide emergency DC power for engine fire protection, necessary lights and communications equipment. The batteries are rated at 14 volts, 35 ampere-hours.

The aircraft electrical circuits can also be energized from an external 115/200 volt, 3-phase 400 Hz power supply through a ground receptacle and external power relay.

AC Power Supply System

AC Generators

The AC generators (FO-6) are 3-phase, brushless, rated at 120/208 VAC, 400 Hz with a maximum continuous output of 40 KVA. The voltage output of each generator is controlled by a solid state voltage regulator. The regulators are set to maintain approximately 115 volts at the generator buses. The generator control panels, one for each generator, contain the necessary components for control and fault protection of each generator system. Overvoltage, under- voltage, underfrequency, differential current protection, and improper phase sequence are sensed by the control circuits and relays within the control panel, and the generator relays trip when any such malfunctions occur. Fault protection circuits are provided with a time delay to prevent tripping of the generator relays during transient conditions, such as momentary overload. Once a relay is tripped, the generator control switch must be placed in the RESET position and then in the ON (NORM for AUX GEN) position to place the affected generator back on the corresponding bus.

CAUTION

Normally, a generator should be reset only once for a given fault. If a fault trips the generator after reset, the fault should be located and corrected before attempting to place the generator on its bus again.

Constant Speed Drive

Each engine driven generator is connected to the engine through a CSD (FO-6) that maintains the output speed of the generator at a constant 6,000 rpm. The CSD is a gear-differential type, with a variable hydraulic pump powering a constant speed hydraulic motor for rpm control. The governing and control mechanisms adjust the output from the pump to the motor to compensate for varying engine speed and variation of load on the generator. The resulting constant output speed to the generator maintains the frequency output of the generator at approximately 400 Hz for all operating conditions. The CSD can be disconnected from the engine by an electromechanical switch controlled from the pilots' overhead switch panel. Once disengaged, the CSD cannot be re-engaged in flight.

NOTE

The CSD should not be disconnected when the engine N2 rpm is less than 25 percent.

Electrical System Fault Protection

A fault protection system is provided for the following fault conditions:

1. Short circuits and grounds.
2. Open circuits in generating system.
3. Overvoltage and undervoltage.
4. Underfrequency.
5. Incorrect phase sequence from generators or external power source.
6. Open circuits, short circuits, and malfunctions in control equipment.

The fault protection circuits sense and isolate an existing fault condition before it can damage the overall generating system or its loads. It is capable of distinguishing between normal transient conditions and actual fault conditions, and will automatically take the required corrective action for these faults. This corrective action will be visually indicated to the flight crew by instruments or annunciator lights. The flight crew must evaluate the visual indications to determine any crew action to be taken.

Differential Current

If a differential current is detected between the generator and distribution point, the differential protection relay will trip the generator control relay, which opens the generator field circuit, and trips the generator relay which isolates the generator from the electrical system.

Overvoltage

Each generator's monitoring circuitry and overvoltage relay protect the system by sensing voltage and when an overvoltage occurs the respective generator control relay is tripped. This action opens the power relay which, in turn, trips the generator relay, thereby isolating the generator from the system.

Undervoltage

An undervoltage relay and monitoring circuitry for each generator sense the lowest of the 3-phase voltages on the generator side of the generator relay. When an undervoltage is sensed, 3 time delay circuits are activated which determine whether undervoltage was caused by a generator fault or a bus fault. If the voltage does not return to normal within approximately 6 to 8 seconds, a generator fault is indicated and the generator is removed from the system. If the voltage recovers within this time, the time delays reset and the generator continues to operate. If under- voltage was caused by a bus fault, the undervoltage protection system will remove the generator from the system.

Underfrequency

There is one underfrequency relay for each generator. During engine start, when generator frequency reaches approximately 380 Hz, the relays complete a circuit for closing the generator relay. When generator frequency drops to approximately 375 Hz, a time delay circuit is activated and if the frequency fails to recover in approximately 1 seconds, the power ready relay is de-energized which trips the generator relay isolating the generator from the system.

Overspeed

If the CSD attempts to operate at overspeed, the CSD governor setting is automatically reduced by hydraulic means so that the CSD will run at underspeed. Thus, the underfrequency relay for the affected generator will also operate to trip the generator relay for an overspeed condition.

Dead Bus Relay

There is one dead bus relay and dead bus slave relay for each AC bus. The main purpose of the relays is to prevent connecting a second power source to a bus already receiving power, and thus avoiding two sources on a bus.

Phase Sequence Relays

There is one phase sequence relay for each engine driven generator, and the external power source. These relays prevent application of electrical power of incorrect phase sequence to the buses.

AC Power Distribution System

AC Generator Buses

The AC power distribution system (FO-6) is divided into two separate systems operating independently of each other. The left (Eng. 2) and right (Eng. 3) AC generators supply power, through the left and right generator relays, directly to the respective generator buses for distribution. Power from the auxiliary (Eng. 4) generator may be routed to either the left or right generator bus, but not both, and only when the respective generator is not operating. This is accomplished using the Auxiliary Power L BUS and R BUS switches on the electrical power panel on the pilots' overhead switch panel. In normal operation, the auxiliary power L BUS and R BUS switches will be in NORM and if either the left or right generator is shut down for any reason other than a fault on that generator bus, the respective auxiliary power relay will automatically transfer the auxiliary generator to the affected bus. In the event both the left and right generators are shut down, the left generator bus has preference and will be powered by the auxiliary generator. Should a generator become inoperative due to a fault on its own bus, the auxiliary power relay will also trip open to protect the auxiliary generator from the faulty bus. The auxiliary power bus switch to the faulty bus would then be placed to OFF and the aux gen "Reset" to maintain a ready backup for the operating bus.

Power from the external power receptacle may be routed to either or to both left and right generator buses when an engine driven generator is not supplying power to the bus. There is a priority control of AC power to the left and right generator buses. The respective engine driven generators have first priority, the auxiliary generator is next (but prefers the left generator bus when given a choice), and the external power is lowest. That is, if the AUX generator is supplying power to a bus, and an engine driven generator is placed on the bus, the AUX generator will automatically be removed from the bus. If external power is supplying power to a bus, and either the AUX, L or R generator is placed on the bus, external power will automatically be removed from the bus and the oncoming generator will assume the load for that bus. If external power is supplying both buses and AUX power is available, when both auxiliary power bus switches are placed to NORM, external power will automatically be removed from the left bus and the auxiliary generator will assume the load for that bus. The right bus will remain on external power.

The left generator bus supplies 115 VAC power directly to #1 and 2 auxiliary hydraulic pumps and pump controls, L1 and L2 transformer rectifiers, flight test instrumentation, the battery charger, the left static line retraction winch, and left AC bus sensing, in addition to supplying power to the left AC bus. The right generator bus supplies 115 VAC power directly to #3 and 4 auxiliary hydraulic pumps and pump controls, R1 and R2 transformer rectifiers, flight test instrumentation, the right static line retraction winch, and right AC bus sensing, in addition to supplying power to the right AC bus.

AC Buses

The left and right AC buses receive 115 VAC 3 phase power from the left and right generator buses through the LEFT and RIGHT AC BUS FEED circuit breakers (AH-12, AJ-12, AK-12 and AL-12, AM-12, AN-12) respectively. The LEFT and RIGHT AC Buses furnish 115 VAC power for all 115-VAC loads on the aircraft which are not supplied power directly from the generator buses.

The left and right 28 VAC buses receive power from the left and right 28 VAC transformers. The transformers receive 115 VAC single phase power from the LEFT AC BUS and RIGHT AC BUS through the 28 VAC XFMR, LEFT and RIGHT circuit breakers (N-24, Z-24). The 28 VAC buses provide power for basic navigational and flight test (LEFT 28 VAC BUS) instru- tation.

AC Electrical System
Controls and Indicators

Controls and indicators for the operation of the AC electrical system are located on the electrical power control panel on the pilots' overhead switch panel. The electrical power control panel provides the controls and indicators for selecting the power source for delivery to the left and right AC buses and for monitoring the selected AC and DC power supply and distribution system.

Left, Aux and Right
Constant Speed Drive (CSD)
Disconnect Switches

The L CSD, AUX CSD and R CSD switches (figure 1-55) are guarded momentary contact switches and provide the capability of disconnecting a malfunctioning CSD from the engine. The DISC position disconnects the CSD from the engine driven pad through an electromechanical switch. The disconnect switches receive 28 VAC power from the BATTERY DIRECT BUS through the CSD DISCONNECT - LEFT, RIGHT and AUX circuit breakers (A-11, -12, -13). A CSD should not be disconnected if the engine N2 rpm is below 25 percent. Once disengaged, the CSD cannot be re-engaged in flight.

CAUTION

> Ensure that the CSD switch to be actuated is for the malfunctioning CSD. CSD disconnect action is irrevocable and the CSD cannot be re-engaged inflight. Disconnecting the wrong CSD could result in loss of electrical power from more than one engine generator.

Left and Right Generator Switches

The L GEN and R GEN switches (figure 1-55) are three-position switches with positions ON, OFF, and RESET. The normal position of these switches is ON. The ON position is lever locked to prevent inadvertent de-selection of this position. This connects the AC generator to the AC power distribution through the generator relay provided all protection control circuits have been satisfied. The RESET (momentary) position resets the generator control circuits. The OFF position disconnects the AC generator from the AC power distribution through the generator relay.

Auxiliary Generator Switch

The AUX GEN switch (figure 1-55) is a two-position switch with positions NORM and RESET. The RESET (momentary) position resets the auxiliary generator control circuit. The NORM position is for all other normal operation.

AC Generator Load Meter

The AC LOAD meters (figure 1-55) indicate the load that the associated generator is delivering to the generator bus for distribution. The meters indicate from 0.0 to 1.5 with 1.0 indicating 100 percent generator rated capacity. Normal indication would be between 0.0 and 1.0.

NOTE

> Generator overload ratings for short time operation are: 1.5 for 5 minutes or 2.0 for 5 seconds.

Auxiliary Power Left and Right Bus Switches

The auxiliary power L BUS and R BUS switches (figure 1-55) on the electrical power control panel are two-position, lever lock type switches with positions NORM and OFF. These switches are normally in the NORM position. This position will allow the auxiliary generator to power either the left or right generator bus under certain conditions. The OFF position of the switches isolates the auxiliary generator from the buses. The left and right green AUX PWR IN USE lights, located adjacent to each switch, indicate that the power source selected is connected to the respective bus. The indicating lights receive 28 VDC power from the EMERGENCY DC BUS through the GENERATOR CONTROL-AUX circuit breaker (C-13).

AUX Power Available Light

The green AUX PWR AVAIL light (figure 1-55) on the electrical power control panel indicates that the AUX generator is operating and electrical power is available for distribution to the left or right generator bus. The AUX PWR AVAIL light receives 28 VDC power from the EMERGENCY DC BUS through the GENERATOR CONTROL-AUX circuit breaker (C-13).

External Power Left and Right Bus Switches

The EXT PWR L BUS and R BUS switches (figure 1-55) on the electrical power control panel are two-position ON and OFF switches. The switches select external power as a power source for delivery to the respective left and/or right generator bus. The external power relays receive 28 VDC open power from the BATTERY BUS through the AC BUS CONTROL circuit breaker (B-19). The close power comes from the bus control panel.

External Power Available Light

The green EXT PWR AVAIL light (figure 1-55) on the electrical power control panel indicates that external electrical power is connected, available and suitable (phase sequence only) for distribution as required to the left and right generator buses. The light receives 28 VDC power from the external AC power through a small transformer rectifier located in the BUS CONTROL PANEL.

Volt Frequency Selector

The VOLT/FREQ SELector (figure 1-55) is a multi-position selector that selects the power source to be read on the AC VOLTS meter, the FREQuency meter, and the DC VOLTS/AMPS meter. When placed in either the L or R position, the AC voltage and frequency and the DC bus voltage for the selected source will be read on the respective meters. In the EXT PWR or AUX PWR position, AC voltage and frequency for the selected source are read on the respective meters and the DC meter indicates zero. The BAT VOLTS poition provides a battery voltage reading on the DC VOLTS/AMPS meter, and the BAT AMPS position provides charge or discharge current reading on the DC VOLTS/AMPS meter.

AC Voltmeter and Frequency Meter

The AC voltmeter and frequency meter (figure 1-55) indicate output voltage and frequency of the generators or external power as selected by the VOLT/FREQ SELector. Normal operating range of the generators is 115V ±3 volts and 400 Hz ±4 Hz. The AC voltmeter and frequency meter receive the output voltage and frequency of the generator through the RIGHT, LEFT or AUX AC VOLTMETER circuit breakers, as applicable. The circuit breakers are located within the electrical power center (EPC) and are not readily accessible to the flight crew.

AC Electrical System Caution Lights (Overhead Annunciator Panel)

The MASTER CAUTION lights (figure 1-56) come on with each of the following annunciator caution lights:

1. The amber AUX, L and R CSD OIL PRESS LOW caution lights come on when the respective CSD oil pressure drops below a safe level. The L CSD OIL PRESS LOW light receives 28 VDC power from the LEFT DC BUS through the LEFT CSD OIL LOW PRESS LIGHT circuit breaker (U-24). The AUX and R CSD OIL PRESS LOW lights receive power from the RIGHT DC BUS through the AUX and RIGHT CSD OIL LOW PRESS LIGHT circuit breakers

(AE-23, -24), respectively.

2. The amber AUX, L and R CSD OIL TEMP HI caution lights come on when the respective CSD oil temperature exceeds normal operating limits. The L CSD OIL TEMP HI light receives 28 VDC power from the LEFT DC BUS through the LEFT CSD OIL HIGH TEMP LIGHT circuit breaker (V-24). The AUX and R CSD OIL TEMP HI lights receive power from the RIGHT DC BUS through the AUX and RIGHT CSD OIL HIGH TEMP LIGHT circuit breakers (AF-23, -24), respectively.

3. The amber L and R GEN OFF caution lights indicate that the respective generator relay is open and the generator is disconnected from its bus. The lights receive 28 VDC power from the EMERGENCY DC BUS through the GENERATOR CONTROL - LEFT and RIGHT circuit breakers (C-11, -12), respectively.

4. The amber AUX GEN OFF caution light will come on when: (1) the aux gen is inoperative and electrical power is not available (the AUX PWR AVAIL light will be OFF in this case); or (2) the AUX GEN is operative, electrical power is available and the AUX PWR, L BUS and R BUS switches are both in the OFF position (the AUX PWR AVAIL light will be ON in this case). The light receives 28 VDC power from the EMERGENCY DC BUS through the GENERATOR CONTROL - AUX circuit breaker (C-13).

5. The amber L and R AC BUS OFF caution lights indicate that the respective left or right AC generator bus is not energized. The lights receive 28 VDC power from the BATTERY BUS through the LEFT and RIGHT AC BUS OFF LT/DEAD BUS RELAY circuit beakers (B-17, -18), respectively.

Direct Current (DC) Electrical System

The 28 VDC electrical system (FO-7) like that of the AC electrical system has left and right systems that function separately. Power is supplied to the LEFT DC system from the LEFT GEN BUS through two transformer rectifiers operating in parallel. The RIGHT DC system receives power from the RIGHT GEN BUS through two other transformer rectifiers operating in parallel. The DC systems have a manual crosstie switch to connect the left and right DC systems to a common source in the event of a failure in one of the systems. Two 14 volt nickel-cadmium batteries are connected in series to supply 28 VDC power to the BATTERY DIRECT BUS and, if the BAT switch is ON, to the BATTERY BUS when neither DC bus is powered. With the EMER PWR switch in the ON position, the batteries will also power the EMERGENCY DC BUS.

DC Power Distribution

Left and Right DC Buses

The LEFT DC BUS receives 28 VDC power from the left No. 1 and 2 transformer rectifiers which are connected in parallel and receive 115 VAC, 3 phase power from the LEFT GEN BUS through the XFMR RECT, L1 and L2 circuit breakers (AH-9, -10; AJ-9, -10; AK-9, -10), respectively. The RIGHT DC BUS receives 28 VDC power from the right No. 1 and 2 transformer rectifiers which are connected in parallel and receive 115 VAC, 3 phase power through the XFMR RECT, R1 and R2 circuit breakers (AL-9,

-10; AM-9, -10; AN-9, -10), respectively. In the event of loss of power to either DC bus, the bus can be powered from the opposite DC bus through the DC bus crosstie relay. The relay is controlled by the manually operated DC BUS X TIE switch. This switch is normally in the OPEN position and must be manually closed for crosstieing. The relay is powered by the BATTERY BUS through the DC CROSS TIE RELAY circuit breaker (B-15).

Reverse Current Relays

Each transformer rectifier is connected to its DC BUS through a normally closed reverse current relay which opens in the event of a transformer-rectifier fault. The relays are not accessible in flight and, if tripped, must be manually reset on the ground.

Battery Direct Bus

The BATTERY DIRECT BUS provides 28 VDC power for the firex system, CSD disconnects, EMER & BATT BUS/CABIN PRESS/DUCT FAIL lights and voltmeter. The bus also provides control power for the BATTERY RELAY through the BATTERY RELAY circuit breaker (A-15). Loss of power to this relay will not allow the batteries to power the BATTERY BUS. The BATTERY DIRECT BUS is powered at all times from the two series connected 14 volt batteries.

Battery Bus

The BATTERY BUS (FO-7) provides 28 VDC power for the engine fire detection system and warning, the DC CROSSTIE RELAY, the DC BUS OFF, AC BUS OFF, MASTER WARNING, MASTER CAUTION, SCAS OFF and CENTER INSTR PANEL LIGHTS, REFUEL VALVE CLOSE, standby attitude indicator, pilots audio panel, and SPOILER KNOCKDOWN. The BATTERY BUS receives 28 VDC power from the battery through the battery relay when the BAT switch is in the ON position and neither of the DC buses is energized. If either (or both) DC bus(es) is(are) energized, the BATTERY BUS will be powered by the DC bus(es) through the BATTERY BUS FEED circuit breakers (AP-12, AR-12) independent of the BAT switch position.

Emergency DC Bus

The EMERGENCY DC BUS (FO-7) provides 28 VDC power for emergency loads such as the standby lighting and communication equipment. The EMERGENCY DC BUS is normally powered from the LEFT DC BUS through the DC emergency power transfer relay, the EMER BUS FEED circuit breaker (AP-11), and the OFF position of the EMER PWR switch. In the event of loss of power to the LEFT DC BUS, DC emergency power transfer relay automatically transfers the power source to the RIGHT DC BUS through the EMER BUS FEED circuit breaker (AR-11). In the event of loss of power to both LEFT and RIGHT DC BUSES, the EMERGENCY DC BUS can be powered from the batteries by placing the EMER PWR switch in the ON position. Fully charged batteries will provide emergency power to essential loads for a minimum of 60 minutes.

DC Electrical System Controls and Indicators

Battery Switch

The BAT switch (figure 1-57) is a two position switch with positions OFF and ON. The ON position of the BAT switch actuates the battery relay and connects the BATTERY BUS to the batteries if the LEFT and RIGHT DC BUSes are de-energized. With the BAT switch ON and the

LEFT and/or RIGHT DC BUS and LEFT GEN BUS energized, the battery relay automatically connects the battery charger to the battery. The battery charger receives 115 VAC, 3 phase power from the LEFT GEN BUS through the BATTERY CHARGER circuit breaker located above the LEFT GEN BUS circuit breaker panel in the EPC panel. In the OFF position the battery charger is disconnected from the batteries and the BATTERY BUS cannot be powered directly from the batteries.

DC Bus Crosstie Switch

The DC BUS X TIE switch (figure 1-57) is a two position switch with positions CLOSE and OPEN. The DC system is normally operated with the switch in the OPEN position which isolates the LEFT DC BUS and RIGHT DC BUS. The CLOSE position connects the LEFT DC BUS and RIGHT DC BUS through the DC bus crosstie relay allowing any combination of transformer rectifiers to power both DC buses.

Emergency Power Switch

The EMER PWR switch (figure 1-57) is a two position OFF and ON switch. OFF is the normal position. When the switch is in OFF position, the emergency DC bus is powered by the normal DC power distribution system. When the EMER PWR switch is in ON position, power for the EMERGENCY DC BUS is supplied from the batteries.

Emergency Power In Use Light

The white EMER PWR IN USE light (figure 1-57) will come on when the EMER PWR switch is in the ON position and the EMERGENCY DC BUS is powered. The EMER PWR IN USE light receives 28 VDC power from the EMERGENCY DC BUS through the EMER POWER IN USE LIGHT circuit breaker (C-17).

DC Loadmeters

The left and right DC LOAD meters (figure 1-57) indicate the load the respective transformer-rectifier is delivering to the distribution system. Loadmeters are dual indicating with separate scales for each transformer rectifier. The indicators are calibrated from 0.0 to 1.5 with 1.0 indicating 100 percent of transformer-rectifier rated capacity.

DC Volt/Ammeter

The DC VOLTS/AMPS meter (figure 1-57) is calibrated in both volts and amperes and indicates the charge or discharge current of the battery with the selector switch in the BAT AMPS position, battery voltage with the selector switch in the BAT VOLTS position or LEFT or RIGHT DC BUS voltage with the selector switch in the L or R position. Input for battery amperage is received from the battery shunt through the BATTERY AMMETER and VOLT/AMP circuit breakers located in the avionics rack. The left or right DC bus voltmeter receives 28 VDC power from the LEFT DC BUS and RIGHT DC BUS through the LEFT and RIGHT DC BUS SENSE & VOLTMETER circuit breakers (T-24, AD-24), respectively. Battery voltage indication receives 28VDC power from the BATTERY DIRECT bus through the VOLTMETER circuit breaker (A-18).

DC Electrical System Caution and Warning Lts (Overhead Annunciator Panel)

The amber L and R DC BUS OFF caution lights (figure 1-58) indicate that the respective DC bus is not powered. The lights receive 28 VDC power from the BATTERY BUS through the DC BUS OFF LIGHTS circuit breaker (B-16). The MASTER CAUTION lights come on with a DC BUS OFF caution light.

The red DC EMER BUS warning light (figure 1-58) indicates that the EMERGENCY DC BUS is not powered. The red BATT BUS warning light (figure 1-58) warns the pilots that the BATTERY BUS is not powered. These lights receive 28 VDC power from the BATTERY DIRECT BUS through the EMER & BAT BUS/CABIN PRESS/DUCT FAIL LTS circuit breaker (A-17). The MASTER WARNING lights come on simultaneously with the DC EMER BUS and/or the BATT BUS warning lights.

Circuit Breakers

The load circuit breakers on the BATTERY DIRECT, BATTERY and EMERGENCY DC buses (figure 1-60) are located on the pilots' overhead circuit breaker panel. The remaining load circuit breakers for both AC and DC are located on the forward face of the Electrical Power Center (EPC) (figure 1-59). These circuit breakers are installed on three panels: upper, lower and generator bus (figures 1-61 through 1-66). The upper panel contains four sections. The LEFT and RIGHT AVIONICS sections contain the avionics circuit breakers on the LEFT and RIGHT AC and DC buses, grouped together for convenience. The remaining two sections contain the circuit breakers on the LEFT AC buses and the LEFT DC bus. The lower panel contains circuit breakers on the RIGHT AC buses and the RIGHT DC bus. The generator bus panel contains circuit breakers on the LEFT GEN BUS, the RIGHT GEN BUS and the EMER and BATTERY BUS FEED circuit breakers on the LEFT and RIGHT DC BUS(es). The AUX AC voltage and frequency meter circuit breaker is located in the EPC behind the generator bus panel. The circuit breakers for the left and right generator voltage and frequency meters are also located behind the generator bus panel but on the aft side of the EPC. Four INSTRUMENT LIGHT circuit breakers are located on the center pedestal forward of the throttle quadrant and an OVHD SWITCH PANEL 5V INST LIGHTS circuit breaker is located on the pilots' overhead circuit breaker panel. One BATTERY DIRECT BUS FEED, one BATTERY BUS FEED, one battery voltmeter, and one battery ammeter circuit breakers are located at the battery in the lower outboard section of the avionics rack. Two (four in aircraft #2) cabin lighting circuit breakers are located on the Station 607 Electrical Disconnect Panels. One breaker is installed on the left and the other on the right panel. Eleven circuit breakers are located at the external power receptacle; six EXTERNAL POWER primary circuit breakers, three sensing circuit breakers and two DC circuit breakers.

Electrical Power Normal Operation

Using external power to energize all buses:

1. All circuit breakers checked and closed (some may be open and collared).

2. Place BAT switch in ON. The DC EMER BUS, L and R DC BUS OFF, and L and R AC BUS OFF lights should be on. Reset the MASTER WARNING and MASTER CAUTION lights.

3. Verify EMER PWR selector in

OFF and EMER PWR IN USE light is OFF.

4. Verify the DC BUS X TIE switch is in OPEN.

5. Verify the EXT PWR, L BUS and R BUS switches are in OFF.

6. Verify the AUX PWR, L and R BUS switches are in NORM.

7. When ground connects external power supply to the external power receptacle, the EXT PWR AVAIL light should come on.

8. Rotate the VOLT/FREQ SEL to EXT PWR and check the voltage and frequency are normal.

CAUTION

If voltage and/or frequency are not normal, do not apply external electrical power to aircraft. Applying could cause equipment damage.

9. Place EXT PWR, L BUS and R BUS switches (one at a time) in ON. Observe L and R AC BUS OFF, L and R DC BUS OFF and the DC EMER BUS lights go off. Check that the DC LOADMETERS indicate a normal load.

Using the generators to energize all buses (when engines are started 3, 4, 2 and 1):

1. Complete "using external power to energize all buses" procedure to power all buses.

2. Verify CSD (L, AUX, R) guards are closed and safetied.

3. Verify L and R GEN switches in ON and the AUX GEN switch in NORM. (AC loadmeters should indicate 0.)

4. Verify AUX PWR (L BUS and R BUS) switches in NORM. Both AUX PWR IN USE and AUX PWR AVAIL lights should be off.

5. Rotate VOLT/FREQ SEL selector to AC GEN/DC BUS R position.

6. Start Engine 3. As N2 RPM increases, the R CSD OIL PRESS LOW light on the overhead annunciator panel should go off. Check the AC VOLTS and FREQ indicators in the pilots' overhead panel. When the engine is stabilized, the normal indications are 115 ±3 volts and 400 ±4 Hz.

7. Observe the R GEN OFF annunciator light is off.

8. Check the right AC LOAD meter indicates a normal load.

9. Check the DC LOAD meters. All should continue to indicate a load.

NOTE

If R GEN OFF annunciator light does not go off, check the voltage, frequency and AC loadmeter for normal indication. If the generator indications are not normal, reset the generator. Place the R GEN switch to momentary RESET (up) position and back to ON. The voltage, frequency and loadmeters (AC and DC) should indicate normally. The R GEN OFF light should go off.

10. Rotate the VOLT/FREQ SEL selector to AUX PWR position.

11. Start Engine 4. As N2 RPM increases the AUX CSD OIL PRESS LOW annunciator light should go off. Check the AC VOLTS and FREQ indicators. When the engine is stabilized, the normal indications are 115 ±3 volts and 400 ±4 Hz.

12. Observe the AUX GEN OFF annunciator light is off.

13. Observe AUX PWR AVAIL light comes on. Check that the left AUX PWR IN USE light comes on. The aux AC LOAD meter and DC loadmeters should indicate a normal load. At this time, the right generator is powering the right system and the aux generator (Engine 4) is powering the left system.

NOTE

If AUX GEN OFF annunciator light does not go off, check the voltage, frequency and AC LOAD meter for normal indications. If the generator indications are not normal, reset the generator. Place the AUX GEN switch to momentary RESET (up) position and back to NORM. The voltage, frequency and AC loadmeter should indicate normally. The AUX GEN OFF light should go off.

14. External power is no longer being used. Place EXT PWR (L BUS and R BUS) switches, one at a time, to OFF. Notify ground to disconnect external power.

15. Rotate the VOLT/FREQ SEL selector to AC GEN/DC BUS L position. Start Engine 2. As N2 RPM increases, the L CSD OIL PRESS LOW annunciator light should go off. Check the AC VOLTS and FREQ indicators. When the engine is stabilized at idle, the normal indications are the same as the right and aux generators.

16. Observe the L GEN OFF annunciator light is off.

17. Check the left AC LOAD meter indicates a normal load and the DC LOAD meters continue to indicate a load.

NOTE

If L GEN OFF annunciator light does not go off, check the voltage, frequency and AC loadmeter for normal indication. If the generator indications are not normal, reset the generator. Place the L GEN switch to momentary RESET (up) position and back to ON. The voltage, frequency and loadmeters (AC and DC) should indicate normally. The L GEN OFF light should go off.

18. Check the left AUX PWR IN USE light goes off and the aux AC LOAD meter indicates a zero load. However, the AUX PWR AVAIL light remains on.

19. Start Engine 1 (Engine 1 does not have a generator).

20. Place R GEN switch in OFF. Observe the R GEN OFF light comes on.

21. Check the right AUX PWR IN USE light comes on. The aux AC LOAD should indicate a load and the right AC LOAD meter should indicate zero. Also the

DC LOAD meters should continue to indicate a load.

NOTE

By starting engines in this order, it checks the automatic electrical bus priority system, (i.e., (1) L or R GEN; (2) AUX GEN; (3) EXT PWR).

22. Place the R GEN switch in ON. Observe the R GEN OFF light goes off.

23. Check the right AUX PWR IN USE light goes off. The right AC LOAD meter indicates a load and the aux AC LOAD meter indicates zero. All the DC LOAD meters should continue to indicate a load.

ELECTRICAL POWER SYSTEM

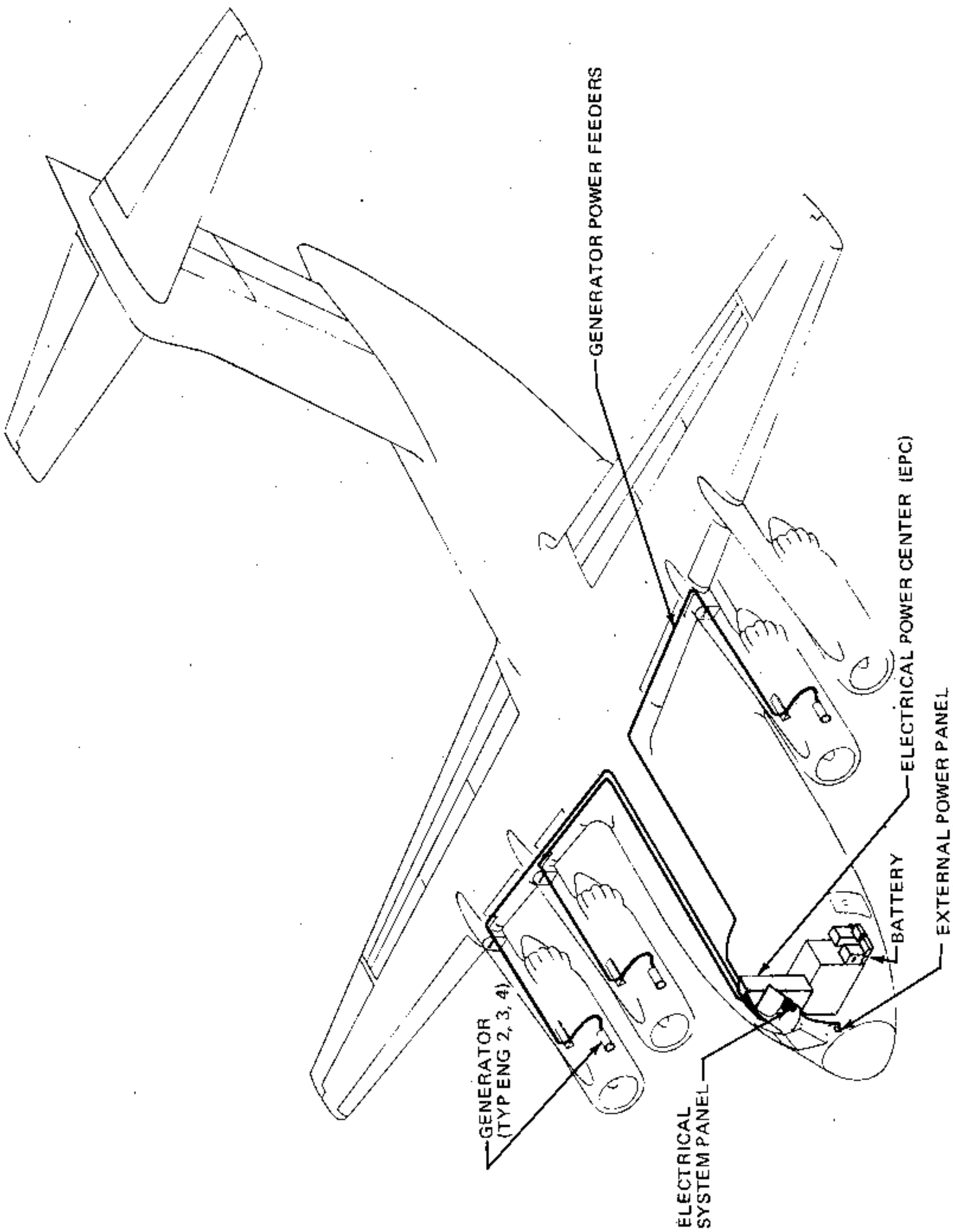
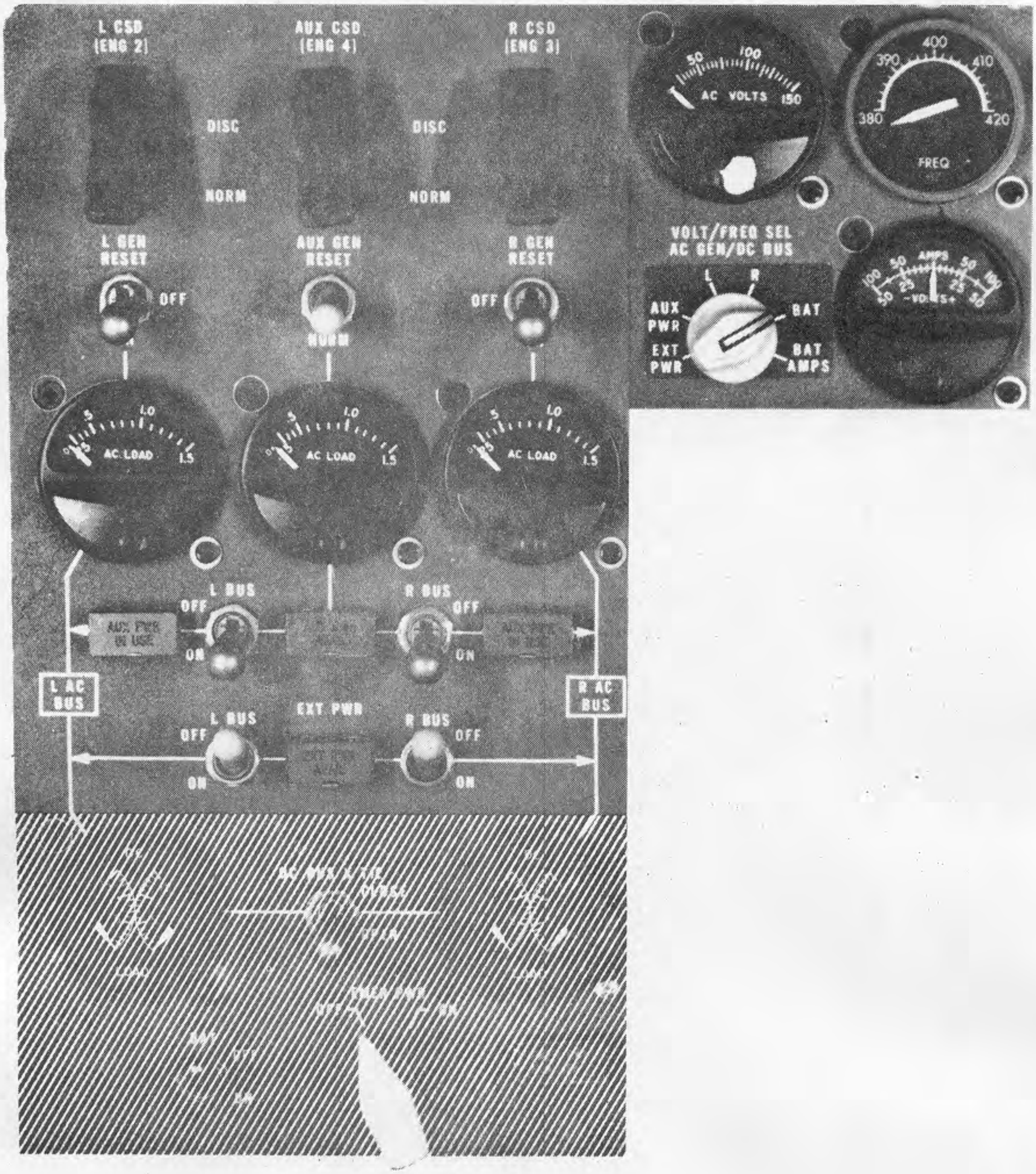


Figure 1-54

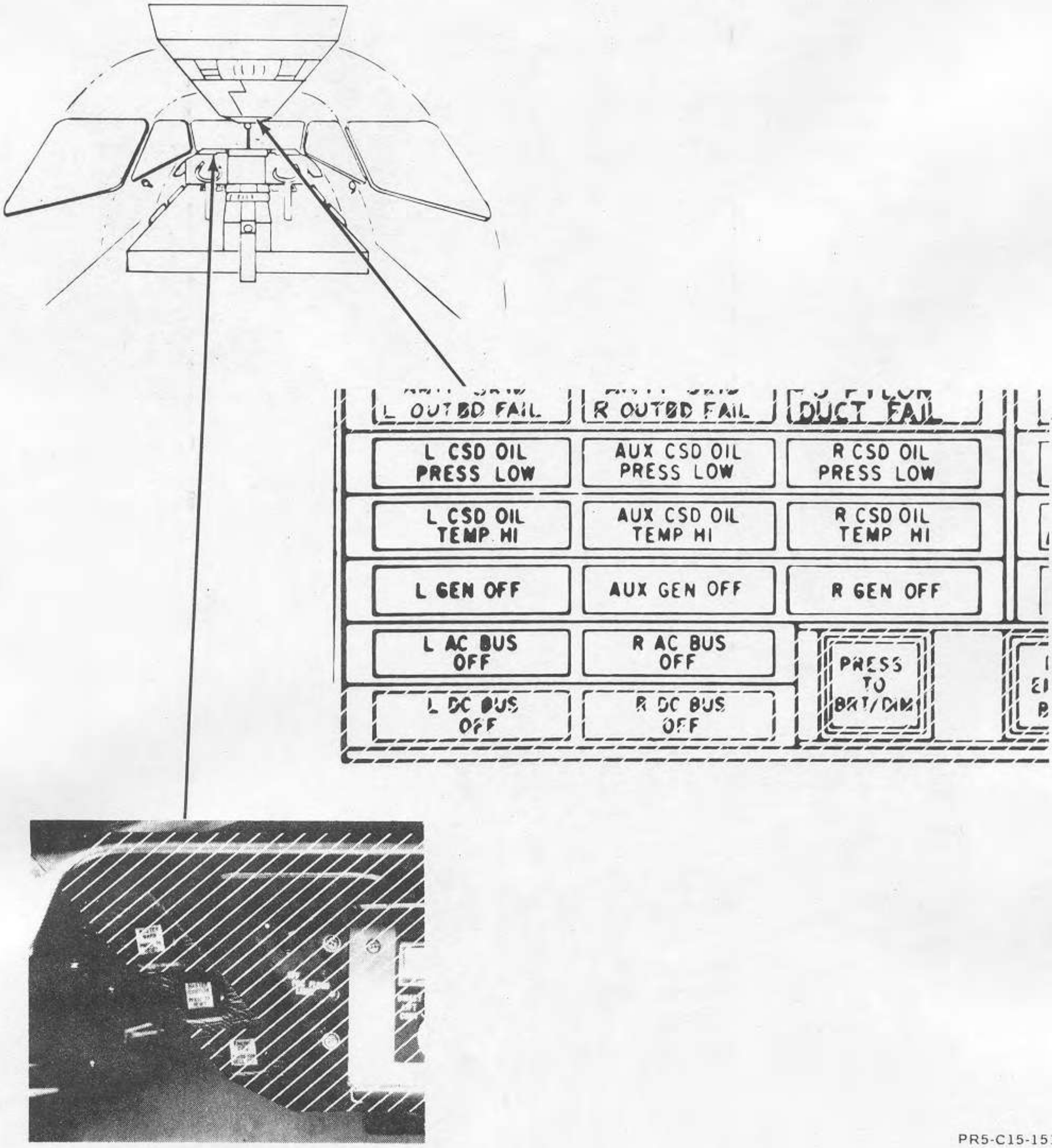
A.C. CONTROL PANEL ELECTRICAL POWER SYSTEM



PR5-C15-150 A

Figure 1-55

A.C. CAUTION LIGHTS



PR5-C15-151

Figure 1-56

D.C. CONTROL PANEL ELECTRICAL POWER SYSTEM

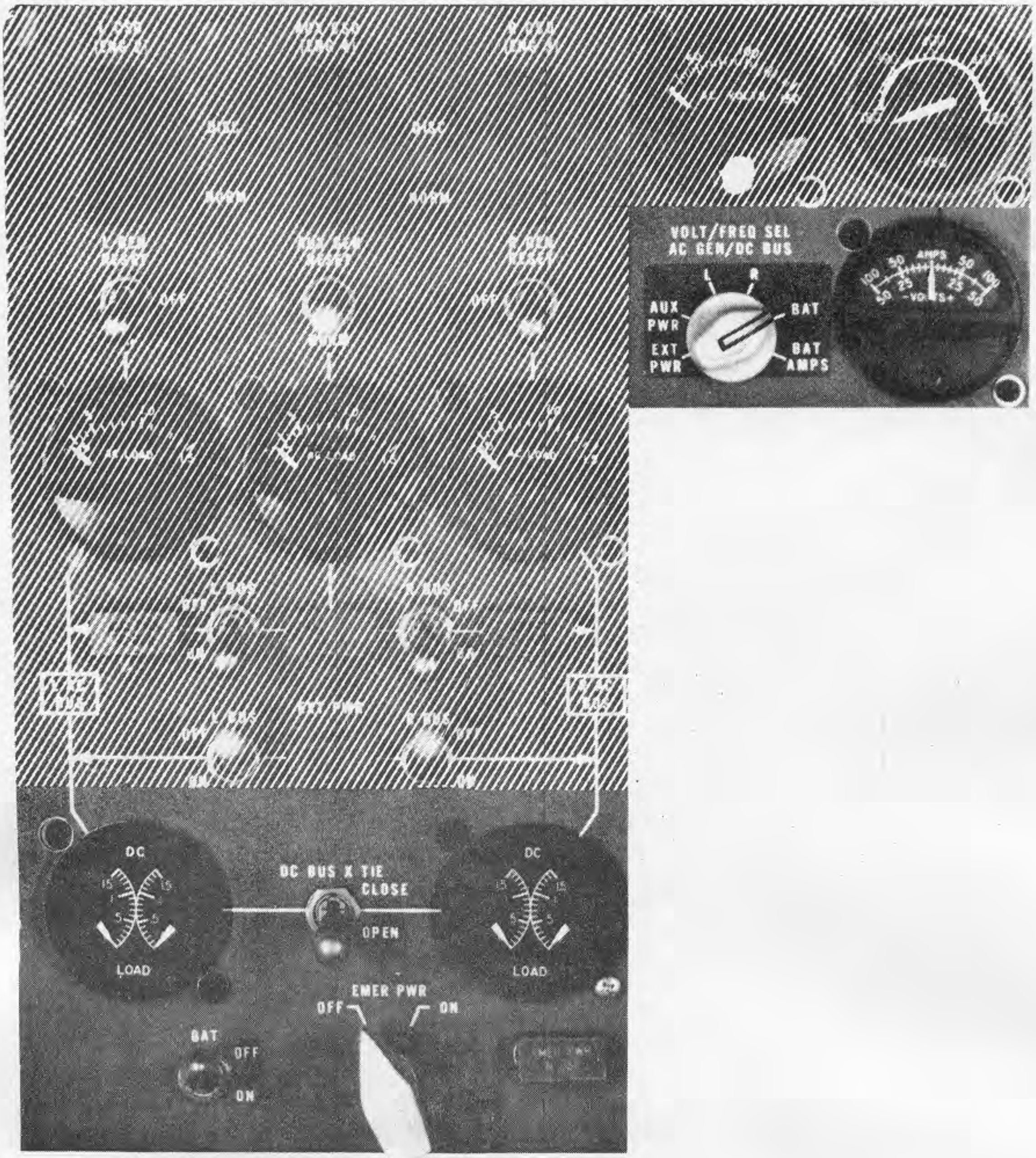


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Figure 1-57

D.C. CAUTION AND WARNING LIGHTS

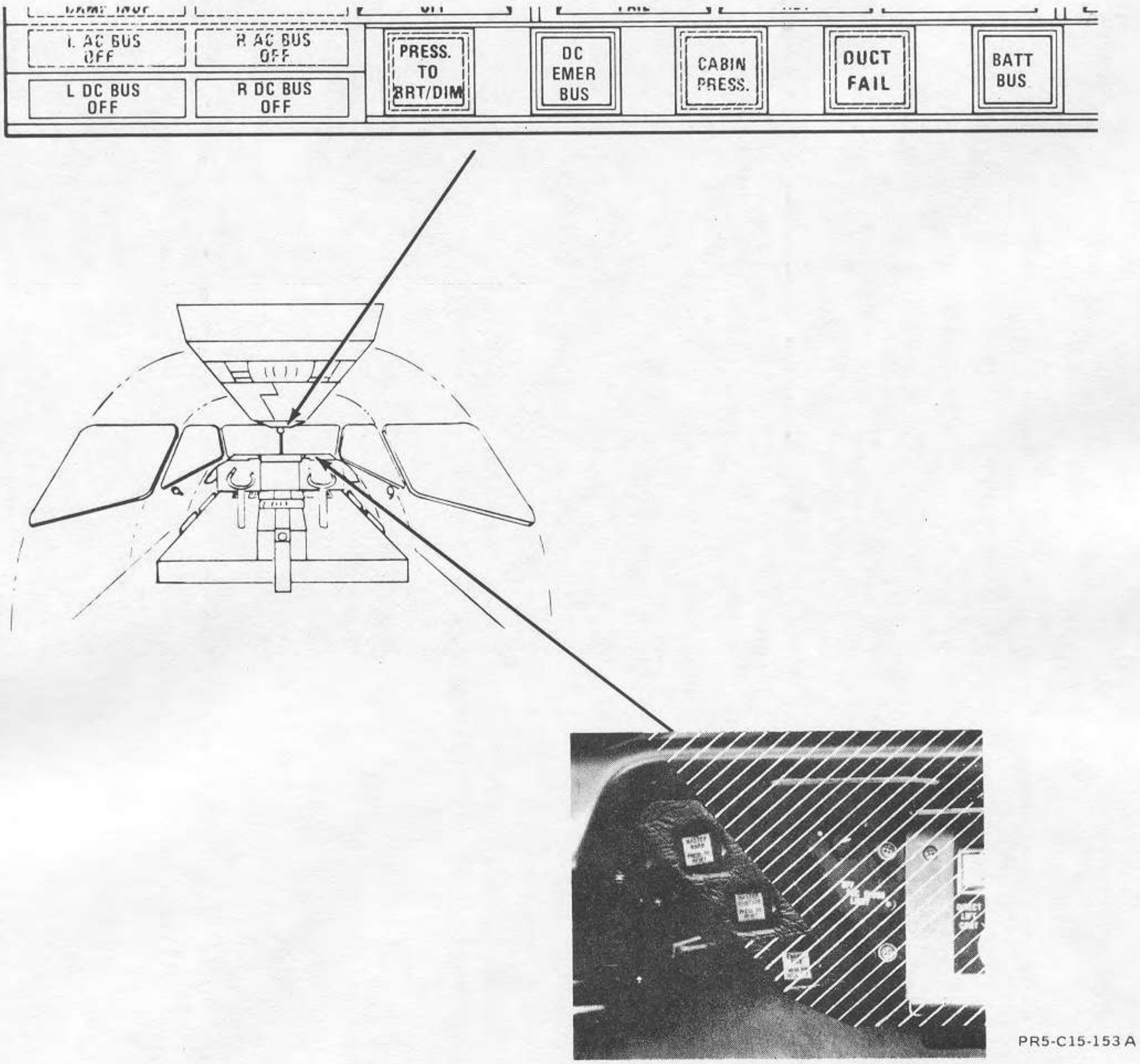

Figure 1-58

CIRCUIT BREAKERS – ELECTRICAL POWER CENTER (EPC)

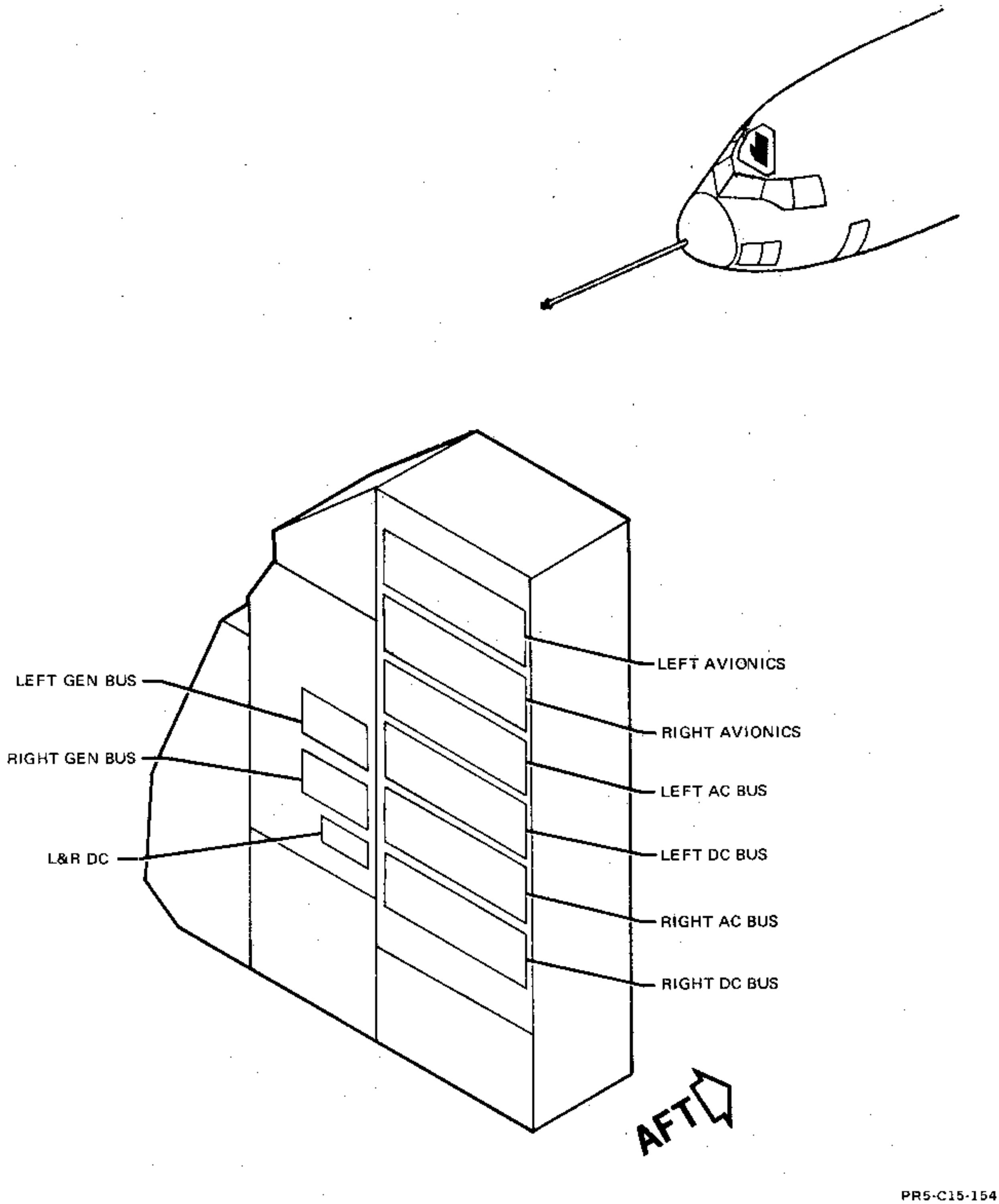

Figure 1-59

CIRCUIT BREAKERS – OVERHEAD PANEL

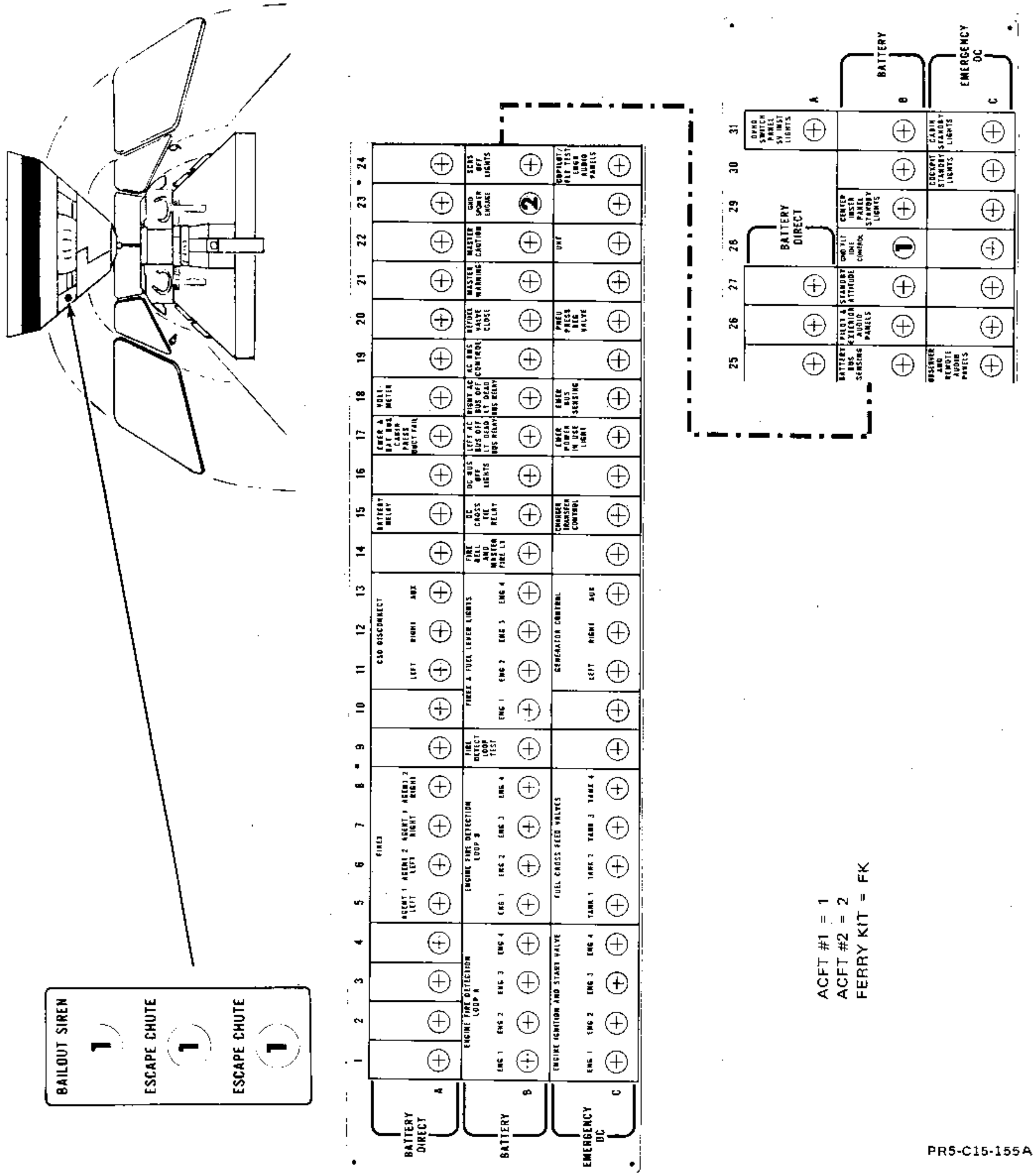

Figure 1-60

CIRCUIT BREAKERS — LEFT AND RIGHT AVIONICS

ACFT #1 = 1
ACFT #2 = 2
FERRY KIT = FK

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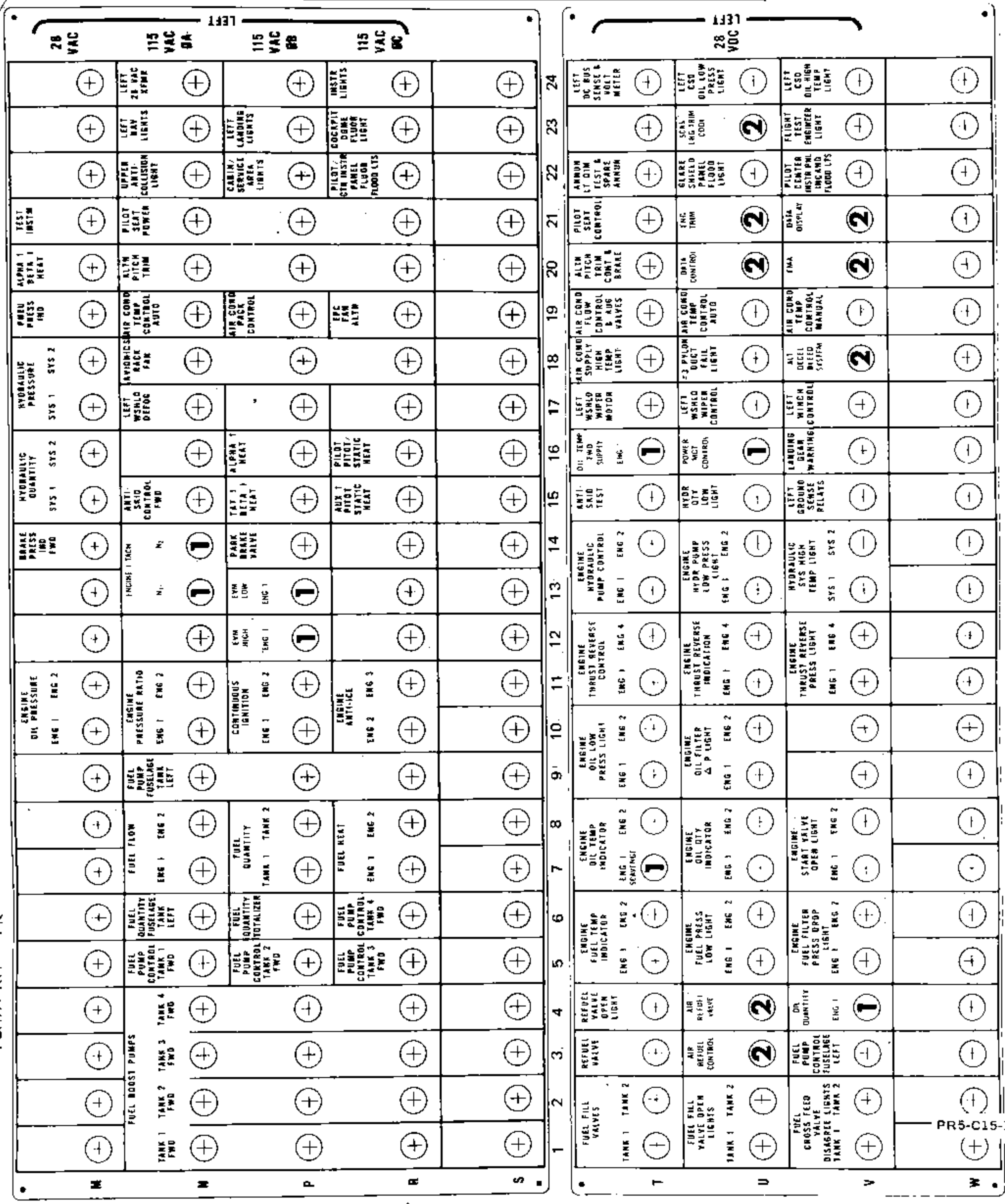
Figure 1-61

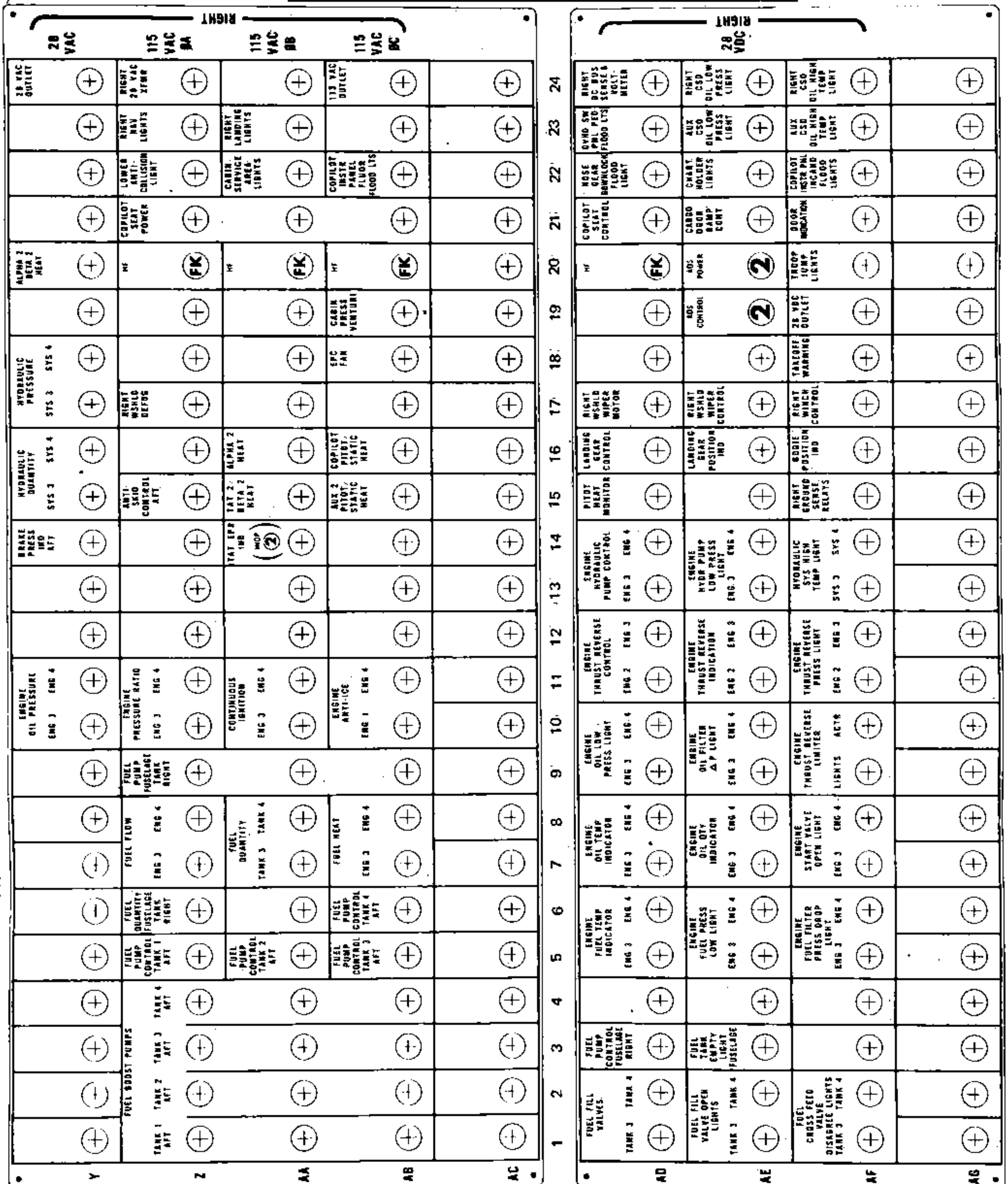
CIRCUIT BREAKERS – LEFT BUSES



ACFT #1 = 1
ACFT #2 = 2
FERRY KIT = FK

Figure 1-62

CIRCUIT BREAKERS — RIGHT BUSES



ACFT #1 = 1
ACFT #2 = 2
FERRY KIT = FK

Figure 1-63

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CIRCUIT BREAKERS – GEN BUSES

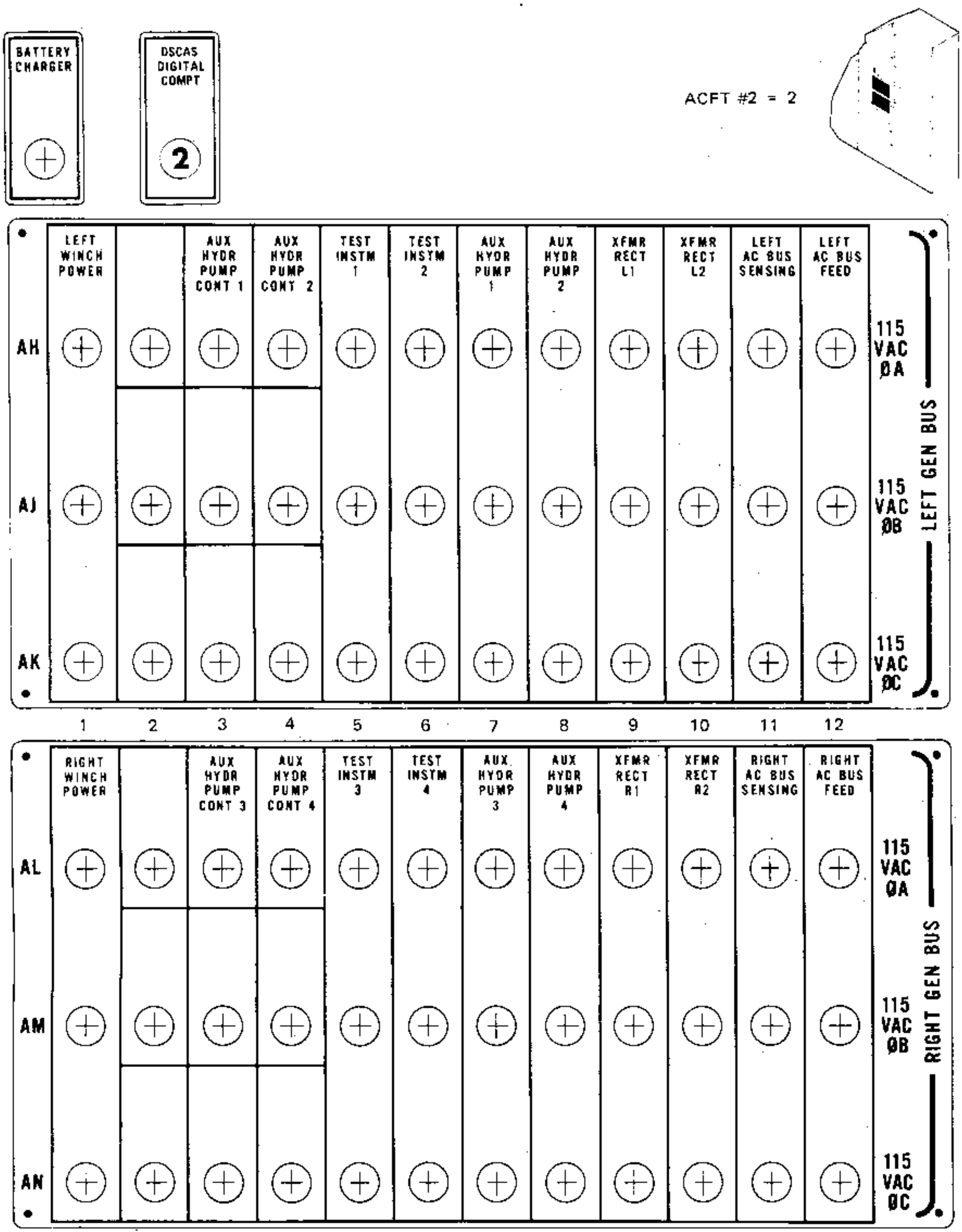

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Figure 1-64

CIRCUIT BREAKERS – BUS FEED

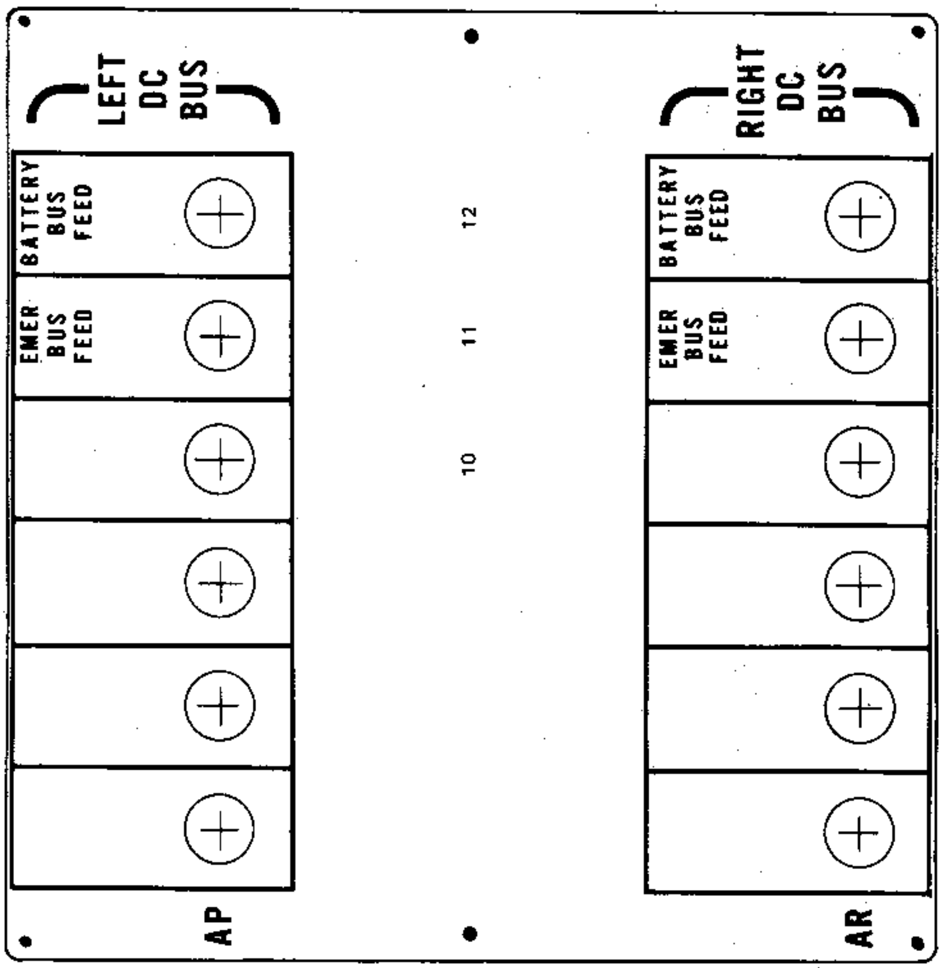

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Figure 1-65

CIRCUIT BREAKERS – BATTERY

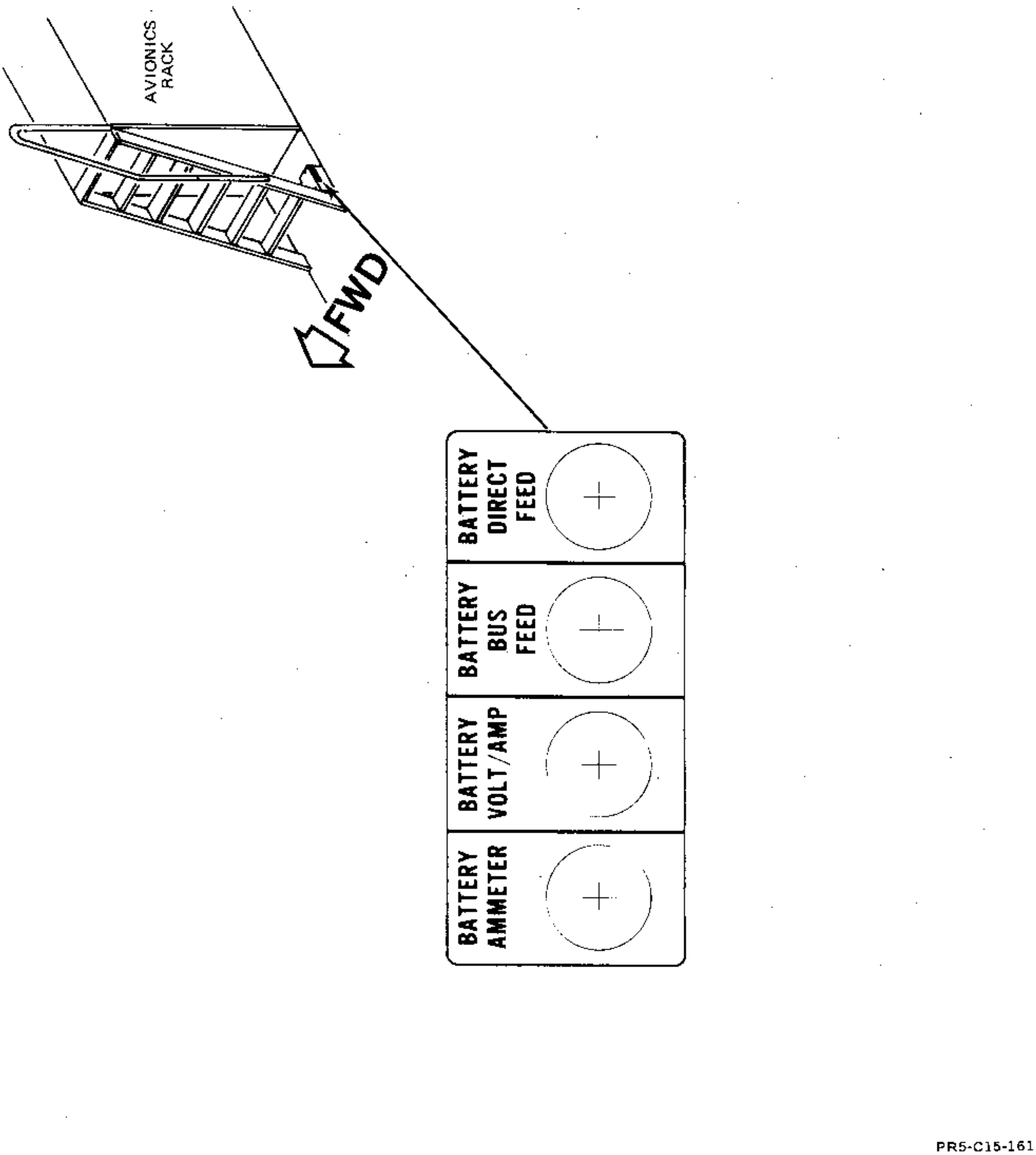


Figure 1-66

PITOT/STATIC SYSTEMS

The pitot-static system consists of four electrically anti-iced pitot-static tubes, two on each side of the forward fuselage, with related pressure tubing (Figure 1-67). The system provides pitot and/or static air pressure for the operation of the central air data computers, standby airspeed, altimeter and cabin altitude differential pressure indicator.

CENTRAL AIR DATA COMPUTER (CADC) SYSTEMS

Two digital CADCs, #1 and #2, are installed in the aircraft.

The pilot's pitot/static probe (Figure 1-67), located on the forward upper left fuselage, supplies pitot pressure for CADC #1. The pilot's and AUX-1 probe, located on the forward lower right fuselage, supply static pressure for CADC #1.

The copilot's pitot/static probe (Figure 1-67), located on the forward upper right fuselage, supplies pitot pressure for CADC #2. The copilot's and AUX-2 probe, located on the forward lower left fuselage, supplies static pressure to CADC #2. Refer to Figure 1-67 for computer inputs and outputs.

CADC #1 (#2) receives 115 VAC, single phase power from the LEFT (RIGHT) AC bus through the AIR DATA CMPTR 1 (2) circuit breaker (E-9 and J-9 respectively), 28 VDC from the LEFT (RIGHT) DC bus through the AIR DATA CMPTR 1 (2) circuit breaker (F-9 and H-9 respectively).

Flight Test Air Data Computers

Two flight test air data computers are installed to provide airspeed data from the boom and trailing cone to the pilots' mach airspeed indicator for test purpose. Refer to Appendix II for details.

NOTE

The flight test trailing CONE installation has no provisions for anti-icing.

Airspeed Selector Switch

A three-position rotary AIRSPEED selector (Figure 1-68), located on the pilots' instrument panel, provides a means of selecting the source of airspeed data. When in ACFT, CADC #1 supplies airspeed information to the pilots' mach/airspeed indicator. When in CONE, the trailing cone DADC supplies airspeed information to the pilots' MACH/AS indicator. When in BOOM, the boom DADC supplies airspeed information to the pilots' MACH/AS indicator.

INSTRUMENTS

An integrated flight instrument system is installed in both the pilot's and copilot's instrument panel (FO-1). The system consists of mach-airspeed indicator, Attitude Director Indicator (ADI), Horizontal Situation Indicator (HSI), radio altimeter indicator, altimeter and vertical speed indicator.

Mach Airspeed Indicators

A flight test electric MACH-AIRSPEED indicator (figure 1-68) is installed in the pilot's instrument panel. It has three sources of airspeed data which can be selected by the AIRSPEED selector (refer to Figures 1-67 and 1-68). The pilot's MACH-AIRSPEED indicator receives 28 VAC power from the LEFT AC bus through the PILOT MACH AIRSPEED IND circuit breaker (D-5). The indicator has a MACH window, AIRSPEED window, pointer and numbers by 10s through 90. A red OFF flag appears in the respective window if: electrical power is lost or data is unusable.

The MACH window is a digital readout for MACH. The AIRSPEED window is a digital readout for airspeed. The pointer indicates one knot through a hundred. One complete revolution is 100 knots.

An electric MACH-AIRSPEED indicator (figure 1-68), located on the copilot's instrument panel, receives data only from CADC #2. The copilot's MACH-AIRSPEED indicator receives 28 VAC power from the RIGHT AC bus through the COPILOT MACH AIRSPEED IND circuit breaker (H-5). It consists of the follows:

MACH WINDOW - Indicates the mach number. The minimum mach number is .150.

OFF FLAG - Appears when the MACH data is unusable or an electrical failure occurs.

A/S FLAG - Appears when the AIRSPEED data is unusable or an electrical failure occurs.

AIRSPEED REFERENCE BUGS - Movable pointers normally used to alert the pilot to selected airspeed; e.q., V1, Vr, V2.

SPEED INDEX BUG - It is inoperative in this aircraft.

AIRSPEED POINTER - Indicates computed airspeed.

Vmo POINTER - Indicates maximum operating airspeed as related to altitude. When system fails, the pointer goes to 257 knots.

Attitude Director Indicator (ADI)

The ADIs are located on the pilot's and copilot's instrument panels. The primary function of the ADI's is to provide aircraft attitude reference.

The pilot's and copilot's Attitude Director Indicators (ADIs) are identical (figure 1-69). The pilot's ADI receives input from Vertical Gyro #1 and the copilot's ADI from Vertical Gyro #2. Vertical Gyro #1 receives 115 VAC and 28 VAC from the LEFT AC bus through the VG 1 and ATTITUDE 1 circuit breakers (E-7 and D-8, respectively). The pilot's ADI receives 28 VAC power from the LEFT AC bus through the PILOT ADI circuit breaker (D-7). Vertical Gyro #2 and the copilot's ADI receive power from the RIGHT AC bus through the VG 2, ATTITUDE 2 and COPILOT ADI circuit breakers (J-7, H-8 and H-7, respectively). A description of the ADI follows:

GO-AROUND LIGHT(GA) (Aircraft #2 Only) - Comes on when GA mode is selected with the Takeoff/Go-Around (TO/GA) Switch on the throttles with the flight director engaged.

GYRO WARNING FLAG (G) - Appears for TEST and to indicate that the gyro information is unusable and for certain failure conditions.

FLIGHT DIRECTOR WARNING FLAG (FD) - In Aircraft #1, it is inoperative and is in view when electrical power is off. In Aircraft #2, it appears when the FD information is unusable.

D.H. LIGHT - Comes on when the D.H. selected on the respective Radio Altimeter is reached.

ROLL AND PITCH STEERING BARS - Are

inoperative in Aircraft #1 and are out of view at all times. In Aircraft #2, they indicate the respective steer commands when valid signals are received. Also used in the Go-Around mode.

ROLL POINTER - Indicates the degree of bank. When electrical power is lost, a 90° bank is indicated.

HORIZON BAR - Provides a horizon position reference relative to the aircraft symbol.

GLIDE SLOPE INDICATOR - The indicator displays glide slope deviation information.

GLIDE SLOPE WARNING FLAG (GS) - Glide slope flag appears when glide slope information is unusable.

RADIO ALTITUDE DISPLAY - Indicates radio altitude (below 200 feet).

EXPANDED LOCALIZER DISPLAY - Displays expanded localizer deviation information.

TURN AND SLIP INDICATOR - Displays the turn and slip condition of the aircraft.

PITCH TRIM KNOB - Inoperative in this aircraft.

SLOW FAST INDICATOR - In Aircraft #2, it appears when the airspeed is within 11 knots of the selected VAM approach speed.

TEST BUTTON - Press to test button. When pressed, the blue-brown sphere indicates a 10° climb and 20° right bank and G flag appears.

AIRCRAFT SYMBOL - Indicates the position of the aircraft in relation to the horizon bar.

AIRCRAFT DOT - Indicates the center of the aircraft.

Radio Altimeter System

A radio altimeter system is installed to provide an accurate indication of aircraft altitude above the ground. It is a part of the integrated low approach and landing system. The system provides aural as well as visual altitude information. The system can alert the pilots of the flare height for STOL operations. When the aircraft is 2,500 feet above ground level, a 2-3 second tone will sound. When the aircraft is descending and within 50-100 feet above the selected D.H. a tone will start and build up until D.H. is reached, at which time it silences. Also the D.H. lights will come on. This gives the pilots visual and aural altitude information. The radio altimeter receives 115 VAC single phase power from the LEFT AC bus through the RADIO ALTM circuit breaker (E-6).

RADIO ALTIMETER INDICATOR - Two indicators (figure 1-70), located on the pilot's and copilot's instrument panel, display altitude in 10 foot increments between 0 and 500 feet and 50 foot increments between 500 and 2500 feet.

SET/TEST KNOB - A SET/TEST adjustment knob is used to set the decision height or flare height.

D.H. SET WINDOW - A digital readout of the desired decision height when the SET/TEST knob is rotated.

DECISION HEIGHT (D.H.) BAR - A reference bar is positioned to the desired decision height (D.H.) or flare height when the SET/TEST knob is rotated.

ALTITUDE REFERENCE BAR - A fixed bar which indicates current altitude above the ground.

ALTITUDE SCALE - The altitude is displayed on a veritical tape that moves. When the aircraft is on the ground the 0 should be under the altitude reference bar.

DECISION HEIGHT (D.H.) LIGHT - An amber press-to-reset DH (decision height) light comes on when the aircraft descends below the selected D.H.

WARNING FLAG - A red and white barber-pole warning flag comes into view during a test, whenever the system is malfunctioning or electrical power is lost.

Radio Altimeter D.H. Lights and Tone Test

To perform a functional test proceed as follows:

1. Verify that electrical power is on the aircraft.
2. Position the circuit breakers as follows:

   Pilot Audio Panel (C-23) closed;
   Copilot/Flt Test Engr Audio Panels (C-24) closed;
   Left and Right Ground Sense Relays (V-15 and AF-15) open
3. On the pilot's radio altimeter, rotate (CW) the SET/TEST knob until 40 (feet) is in the D.H. set window. The salmon D.H. bar will move to indicate 40 on the altitude scale.
4. The pilot's D.H. light should come on.
5. Press and hold the SET/TEST knob.
6. Observe the following indications:

   Altitude scale starts moving to 250 (feet)

   Barber pole warning flag comes in view

   As the altitude scale passes 40 the D.H. light should go off.

   The ADI radio altitude display is out of view.
7. Release the SET/TEST knob. Warning flag goes out of view. As the altitude scale indicates 140 to 90 a tone will start and build up until 40 is reached at which time it silences. Also the D.H. lights will come on.
8. On the pilot's radio altimeter, rotate the SET/TEST knob to set 0 in the D.H. set window. The D.H. bar will move the zero. The D.H. light should go off.
9. Close the LEFT and RIGHT GROUND SENSE RELAYS circuit breakers (V-15 and AF-15).

Altimeters

The pilot's and copilot's altimeters (figure 1-71) are identical and receive their inputs from CADC #1 and 2, respectively. The altimeters receive 28 VAC power from the AC buses. The LEFT (RIGHT) AC bus powers the pilot's (copilot's) altimeter through the PILOT (COPILOT) ALTM circuit breaker (D-6 and H-6 respectively).

DIGITAL WINDOW - Indicates the entire altitude from 0 to 50,000 feet. The right two-digit drum is numbered in 20 foot increments. The 0 position of the 10 thousands drum is green from sea level to 10,000 feet.

OFF WARNING FLAG - The digital window also displays an OFF warning failure flag when the altitude information is unusable or with altimeter internal power supply failure.

NEGATIVE WARNING FLAG (NEG) - The digital readout displays a NEG altitude flag when the altitude is below sea level.

MILLIBARS/INCHES OF MERCURY WINDOW - Indicates the selected barometric pressure in MB (millibars) and IN HG (inches of mercury).

REFERENCE MARKER KNOB - Used to set the altitude reference marker as desired.

BAROMETER SET KNOB - A BARO set knob is pressed and rotated to change the barometric pressure values in the MB/IN HG window. Changing the value in one window will change the value of the other window.

ALTITUDE POINTER - Makes a complete revolution for each 1,000 feet of altitude.

Vertical Speed Indicators

The pilot's and copilot's vertical speed indicators (figure 1-71) are identical and receive their inputs from CADC #1 and 2, respectively. The indicators receive 28 VAC power from the AC buses. The LEFT (RIGHT) AC bus powers the pilot's (copilot's) vertical speed indicator through the PILOT VERT SPEED IND circuit breaker (D-11 and H-11 respectively).

VERTICAL SPEED POINTER - Indicates vertical speed in 1000 feet per minute.

OFF FLAG - Appears when the vertical speed information is unusable or the indicator electrical power supply failure.

Horizontal Situation Indicators (HSI)

The Horizontal Situation Indicators (HSIs) (figure 1-72) are the primary means of monitoring the aircraft heading. The pilot's HSI receives heading information from Compass #1 and the copilot's from Compass #2. The pilot's (copilot's) heading system receives 115 VAC and 28 VAC power from the LEFT (RIGHT) AC bus through two PILOT (COPILOT) HSI HEADING circuit breakers (E-10 and D-10, J-10 and H-10 respectively). HSI's also display TACAN bearing and distance, ILS localizer and glideslope deviation, and TALAR information. A description follows:

HEADING WARNING FLAG - The red flag appears when the heading information is unusable.

HEADING MARKER - A movable white bug which indicates selected heading.

RANGE INDICATOR AND WARNING FLAG - Continuously provides digital readout of nautical miles slant range to the selected TACAN or VORTAC facility. A black flag will mask the mileage when the range information is unusable.

BEARING POINTER NO 2 - The green pointer is inoperative and postioned at the lower lubberline. When an ADF is installed and a valid signal is received, the green pointer will indicate relative bearing to the selected station.

GLIDE SLOPE INDICATOR - The white indicator represents glide slope position relative to the aircraft.

GLIDE SLOPE WARNING FLAG (GSL) - The red flag appears when the glide slope information is unusable.

HEADING SET KNOB - When rotated, the heading set bug will move and provides a reference for headings.

COURSE DEVIATION INDICATOR - Indicates the position and relative bearing of the pilot's selected TACAN course, center of localizer, or center of TALAR beam, relative to the aircraft.

AIRCRAFT SYMBOL - Indicates aircraft's position in relation to course.

TO-FROM INDICATOR - A white indicator points to or from the selected Tacan/VORTAC facility.

COURSE SET KNOB - It is used to set the desired course. The course arrow and course select window will indicate this selected course. The pilots' knob is operable and functions with the CDI. The copilots' will not effect the CDI.

NAVIGATION RECEIVER FLAG - A red and white flag appears when the selected TALAR or TACAN or ILS information is unusable. When TACAN, ILS or TALAR is selected and the information is usuable the No. 1 appears in the pilot's and copilot's HSI.

BEARING POINTER No. 1 - The red pointer continuously indicates the bearing to a selected and usuable TACAN or VORTAC facility. When VOR radio is installed, the pilot's red pointer indicates TACAN and the copilot's indicates VOR.

COURSE SELECT WINDOW - Provides a digital readout of the selected course.

COURSE ARROW - When the course set knob is rotated, the course arrow will move and indicate on the compass card the selected course and should be the same as the course select window display.

Pictorial Display Indicator

In aircraft #2, a pictorial display indicator (PDI) (figure 1-73) is installed on the copilots' instrument panel. It provides a means of monitoring the INS information. It consists of the following:

Alert light - a blue alert light comes on steady 2 minutes before a waypoint is reached and then flashes 30 seconds before a waypoint is reached.

Amber light is inoperative.

Selected track arrow (head) - indicates the desired track between two waypoints. When waypoints are not entered in the INS, the arrow will drift toward true heading.

Crosstrack Deviation Indicator - displays deviation information between desired track and actual track (cross track error).

Actual track pointer - indicates the actual track being flown between two waypoints. The angle between the pointer and true north is the drift angle.

Aircraft symbol - indicates fore and aft position of aircraft.

Compass card - indicates true heading under the upper lubber line.

Standby Altimeter

A barometric bellows type standby altimeter (figure 1-73) is located on the center instrument panel. The dial is numbered every 100 feet with a graduation mark every 20 feet. Three pointers indicate hundreds (the long one); thousands (the middle length); and ten thousands (the thin one). A barometric set knob is provided to set the barometric pressure, from 28.20 to 31.00 IN HG. When rotating this knob, the altitude pointers and pressure window will make a corresponding change. The standby altimeter static pressure sources are AUX 1 and pilot's pitot/static probes.

Standby Airspeed Indicator

The standby airspeed indicator (figure 1-73), located on the center instrument panel, displays the aircraft's airspeed as determined from the AUX 1 pitot/static probe. To determine airspeed a multiplication factor of 100 must be used. The dial is numbered .6, 1, 1.5, 2 with marks every 10 knots to 200 kts then with marks every 50 knots.

Standby Attitude Indicator

An electric standby attitude indicator (figure 1-73), located on the center instrument panel provides an emergency attitude reference. The indicator receives 28 VDC power from the BATTERY DC bus through the STANDBY ATTITUDE circuit breaker (B-27). A caging/pitch trim knob provides a means of, (1) erecting the gyro in pitch and roll, and (2) adjusting the attitude sphere up or down for pitch reference.

Standby Compass

An alcohol (whiskey) standby compass swings down from the forward edge of the overhead panel into the pilots view. When stowed the compass will be out of view.

Visual Approach Monitor (VAM) System

A visual approach monitor (VAM) (figure 1-74) system is installed to provide the pilot(s) with a head-up display of approach path and speed information. The projected images consist of a speed deviation indication, a vertical pitch-stabilized approach angle scale in degrees, a horizontal flight path bar and a FLARE annunciator. The system allows the pilot(s) to establish and maintain a preselected flight path and airspeed to a touchdown point while maintaining a constant view of the landing site. In Aircraft #2, the VAM also provides Go-Around guidance in pitch. The Visual Approach Monitor system is a non-radiating aircraft contained system and does not require ground facilities. The VAM system receives 115 VAC power from the LEFT AC bus through the VISUAL APPROACH MONITOR circuit breaker (E-14). The system consists of a computer, indicators and a control panel. A system description follows:

VAM DISPLAY INDICATOR - Two VAM indicators, located in the pilot's and copilot's glareshield, provide a display for each pilot. When in use, the VAM information is projected directly in front of the pilot(s). When not in use, the indicator may be stowed into the glareshield.

SPEED DEVIATION INDICATOR AND SCALE - The speed deviation indicator displays the aircraft speed relative to the preselected

VAM airspeed. When the amber "F" symbol intensity increases, it signifies the aircraft is 5 knots or more fast. When the green symbol is the brightest, the aircraft is on the selected speed. When the red "S" symbol is the brightest, the aircraft is 5 knots or more slow. When the airspeed error is greater than 11 knots, the F-S symbols will go off. The speed deviation indicator is a non-moving display; however, the moving illusion is produced as the symbols' intensity changes.

FLIGHT PATH BAR - A horizontal flight path bar, locked in roll to aircraft attitude and gyro stabilized in pitch, projected across indicator, provides visual cues to maneuver the aircraft to maintain the selected flight path.

FLIGHT PATH SCALE - A vertical scale in degrees, projected on the right side of the indicator, shows the angular position of the aircraft relative to points on the ground. The flight path bar and the flight path scale together will indicate the deviation between the aircraft flight path and the selected glide path.

GO-AROUND DISPLAY - In Aircraft #2, the go-around display (figure 1-74) provides two vertical target scales on the left and right sides of the VAM display, each comprised of two chevron symbols and a circular target. The horizontal flight path bar now a pitch steering command bar and, if kept centered on the circular targets, will provide go-around guidance. The letters GA are annunciated in the display when the go-around mode is selected with the throttle-mounted TO/GA switch.

VAM CONTROL PANEL - A VAM control panel, located on the copilot's side of the glareshield panel, is used to control the system. The mode of operation is controlled by the FIXED BAR - DELTA GAMMA switch. When in FIXED BAR, the flight path-bar is stabilized in the pitch position selected on the flight path selector and indicated on the VAM flight path scale. When in DELTA GAMMA, the flight path bar is computer controlled to provide for an asymptotic capture of the selected flight path and corrections for maintaining it.

VAM FLIGHT PATH SELECTORS - The selectors consist of two in-line edgewise-mounted thumbwheels which select flight path angle, allowing 2.0 to 9.9 degrees. The left thumbwheel is for degrees and the right thumbwheel is for tenths of degrees.

VAM APPROACH SPEED SELECTORS - The VAM APP SPD selectors consists of three in-line edgewise-mounted thumbwheels which indicate the desired approach airspeed. The left thumbwheel selects 0 to 1 for hundreds. The middle selector is tens of knots (0 to 9). The right wheel is for units of knots (0 to 9). These selectors allow selection of 001 to 199 knots. This speed selection controls the VAM speed deviation indicator. In Aircraft #2, it also controls the slow-fast indicator in the ADI.

VAM Operation Modes

FIXED BAR MODE - When operating in the FIXED BAR mode, the VAM flight path bar is gyro stabilized in pitch to maintain the selected flight path as indicated by intersection of the bar and the flight path vertical scale. The aircraft is maneuvered to superimpose and maintain the flight path (fixed) bar over the desired touchdown point. Relative motion between the flight path (fixed) bar and the desired touchdown point is interpreted by the pilot as approach path deviations. When the flight path bar goes high, the aircraft is high; when the bar goes low, the aircraft is low.

DELTA GAMMA MODE - When operating in the DELTA GAMMA mode, the VAM flight path bar is computer controlled to provide guidance for an asymptotic capture and maintenance of the selected flight path. When the aircraft is in level flight, the flight path bar will not indicate the selected flight path. However, as the pilot initiates a descent, the flight path bar will present pitch steering commands such that if the pilot maintains the bar superimposed on the desired touchdown point, the aircraft will fly an asymptotic approach to the selected flight path.

VAM Normal Operation

1. Determine the flight path angle and airspeed.

2. Grasp the VAM indicator handle and pull up to the detent. This turns on the system.

NOTE

The handles are placarded PULL UP TO USE - PUSH TO STOW. If the indicator is blank or dim, thumb the intensity control wheel, on the face of the indicator, to the desired intensity.

3. On the VAM control panel, place the FIXED BAR - DELTA GAMMA switch in the desired mode.

4. Thumb the VAM FLIGHT PATH selector to the desired flight path.

5. Thumb the VAM APP SPD selectors to the desired approach speed.

NOTE

The horizontal flight path bar and vertical scale should be in view. The speed deviation symbols will not be in view until the airspeed deviation is less than 11 knots.

6. When the aircraft is on speed and on selected flight path, the green speed symbol will be on bright and the flight path bar will intersect the touchdown point on the runway.

7. Fly the aircraft to maintain this airspeed and flight path. Maneuver the aircraft as required to maintain the flight path on the touchdown point.

VAM Go-Around Operations (Aircraft #2)

1. Momentarily press the TO/GA button.

2. Maneuver the aircraft (pitch axis) to maintain the horizontal flight path bar centered on the target circles. The VAM presents the same go-around guidance as the ADI FD.

PITOT STATIC AND AIR DATA SYSTEM

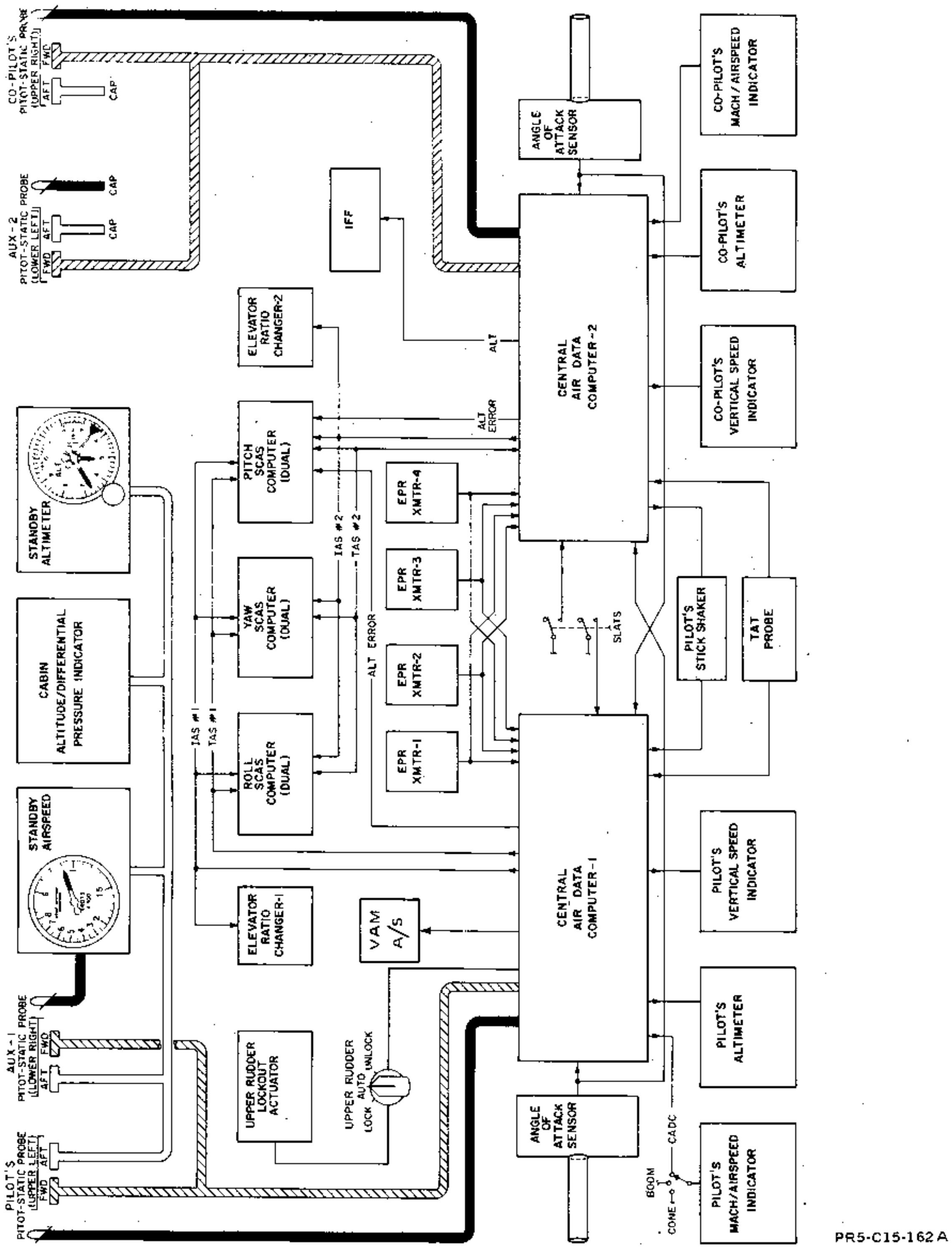
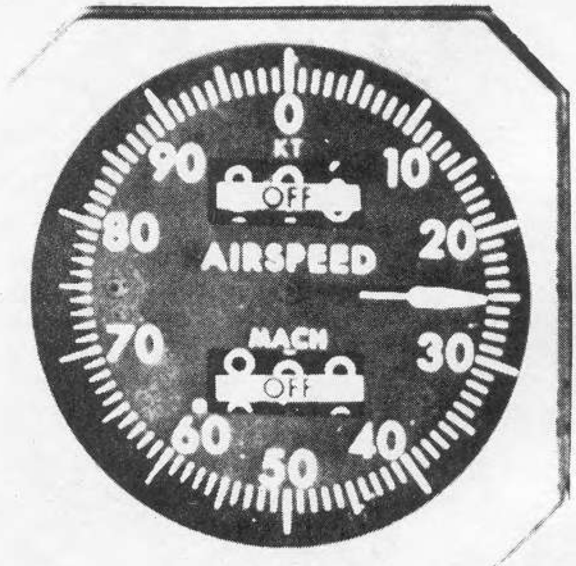
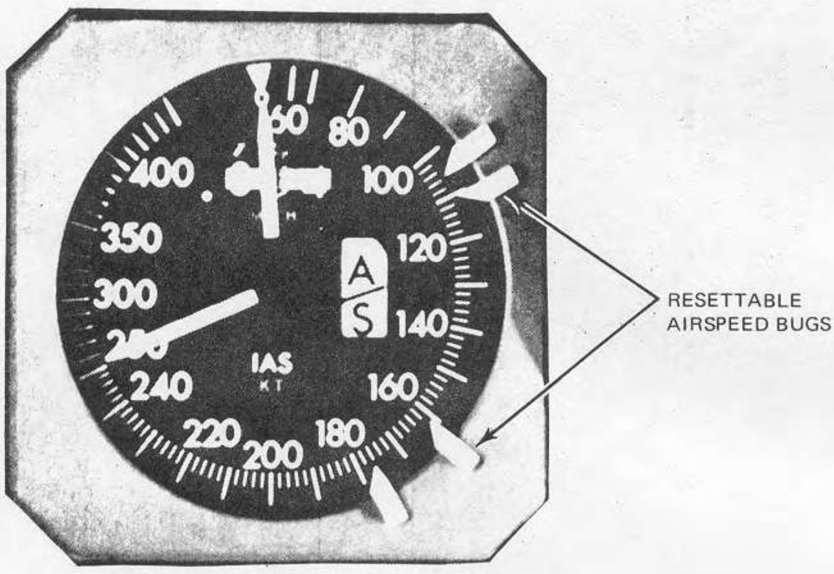


Figure 1-67

AIRSPEED INDICATORS



PILOT



COPILOT

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Figure 1-68

ATTITUDE DIRECTOR INDICATOR

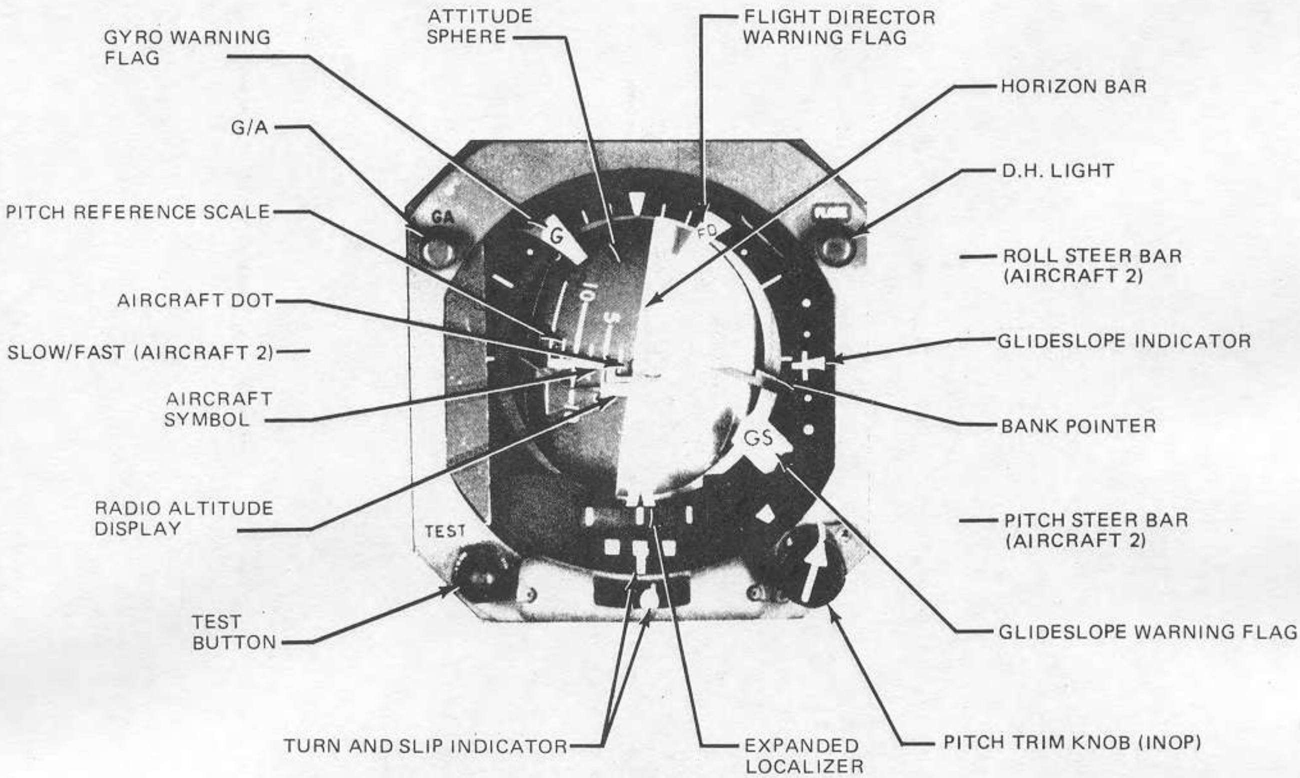


Figure 1-69

RADIO ALTIMETER

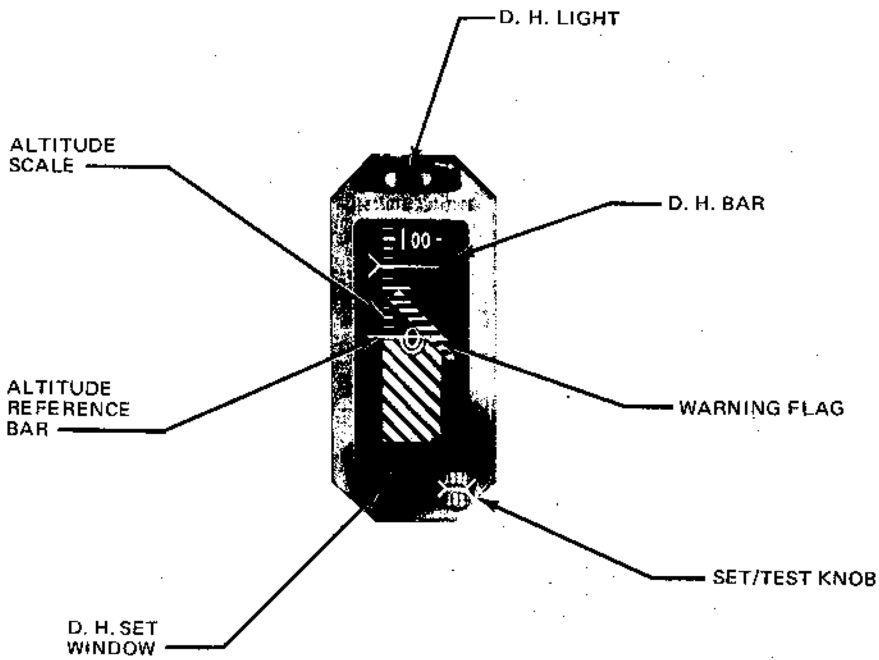
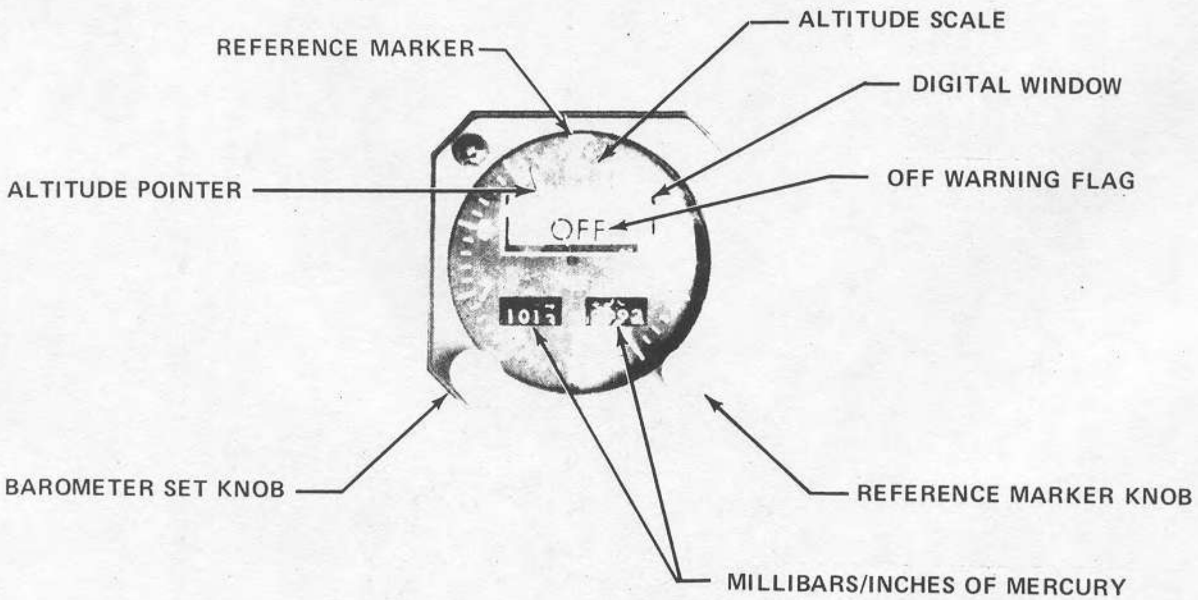


Figure 1-70

ALTIMETER



VERTICAL SPEED INDICATOR

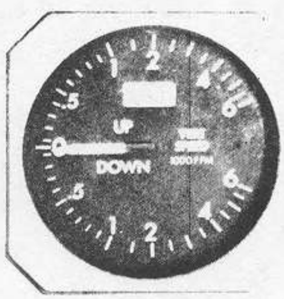


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Figure 1-71

HORIZONTAL SITUATION INDICATOR

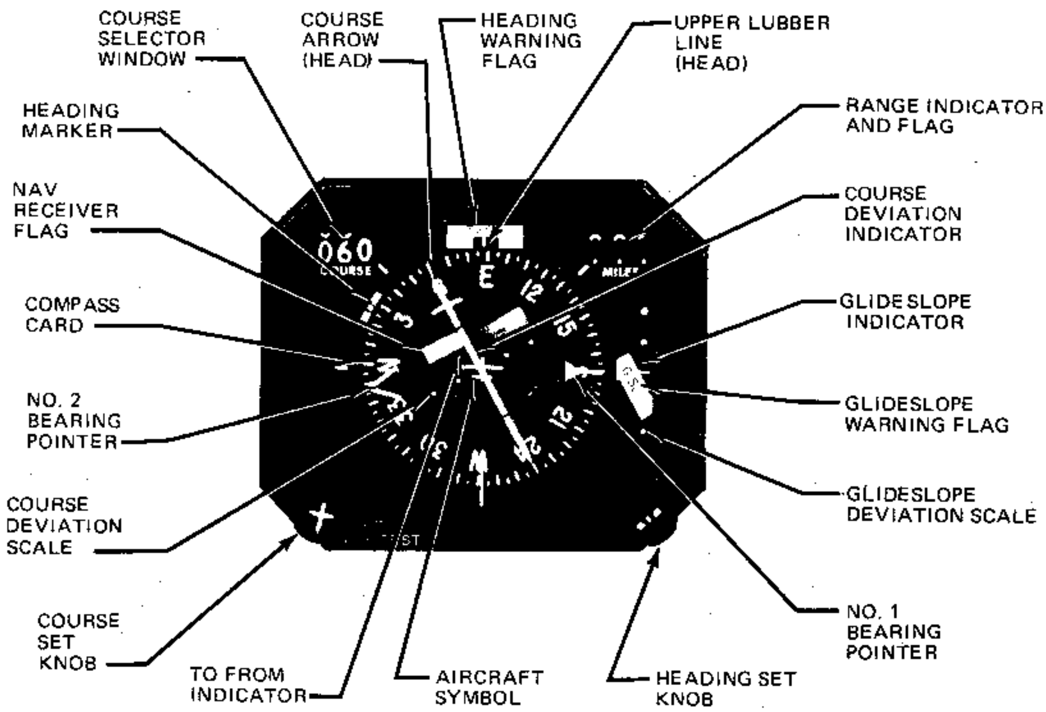

Figure 1-72

STANDBY INSTRUMENTS

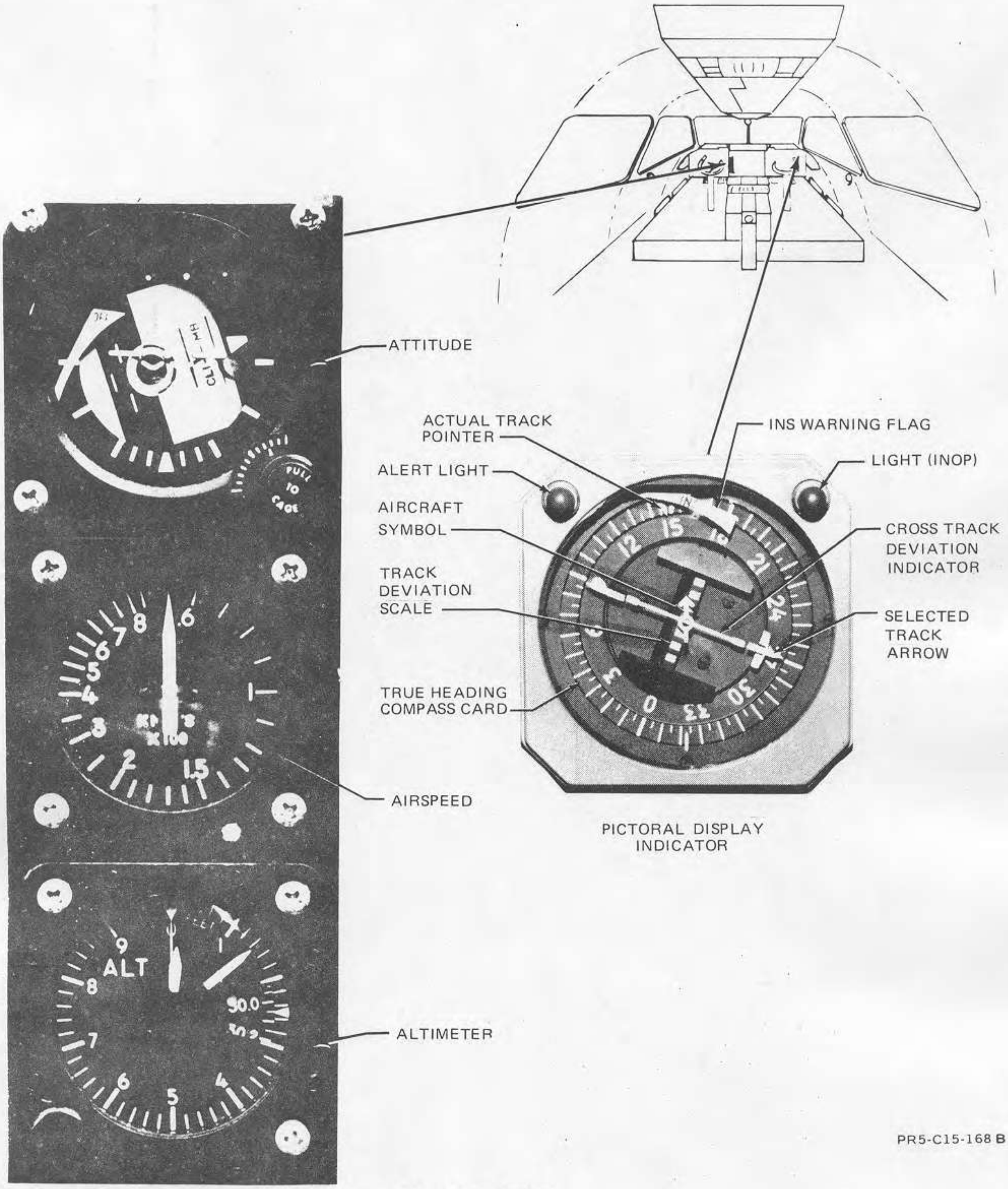

Figure 1-73

VISUAL APPROACH MONITOR (VAM)

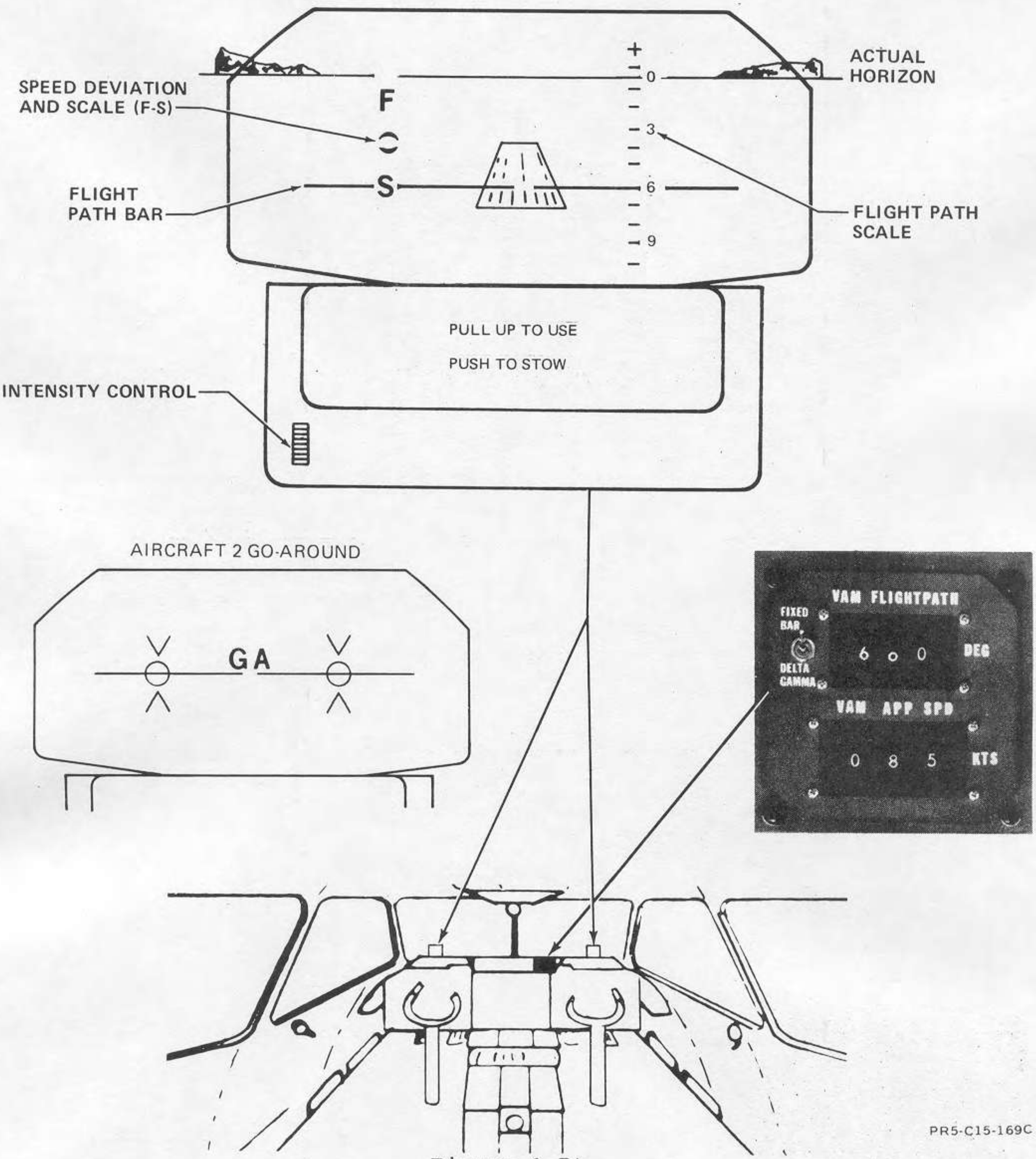

Figure 1-74

FD AND DSCAS INDICATORS

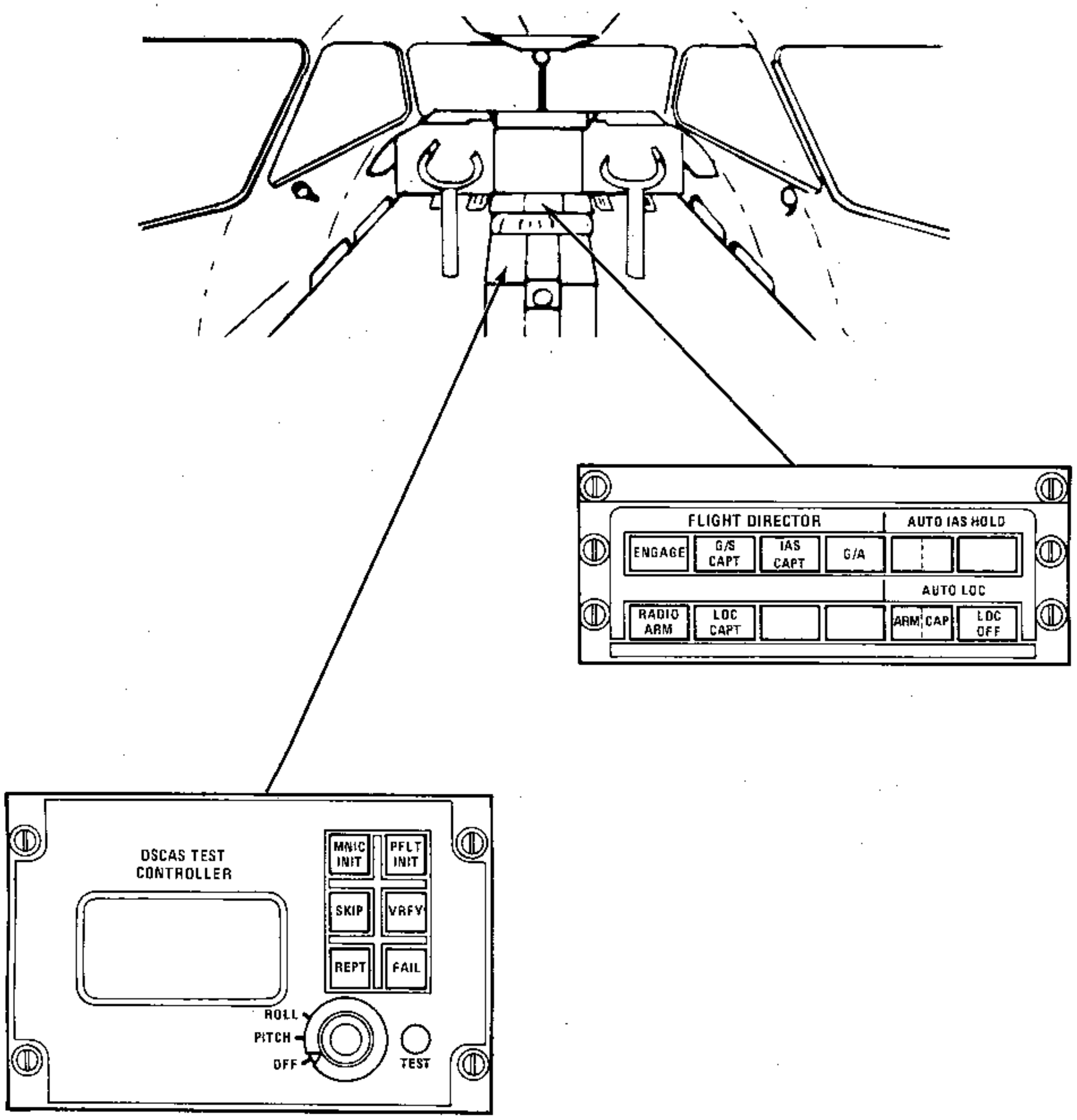

Figure 1-74A

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CONTROL WHEEL

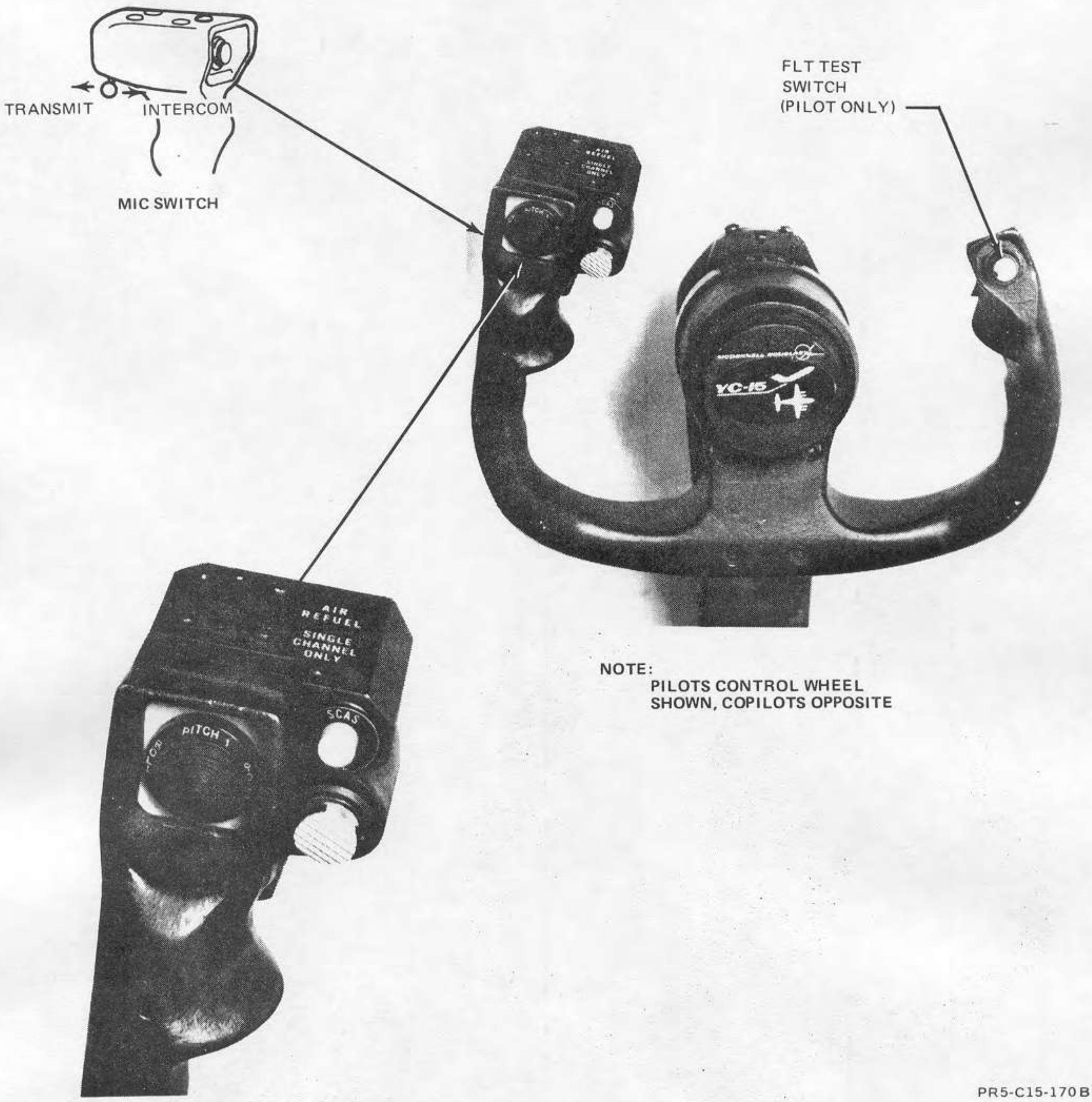
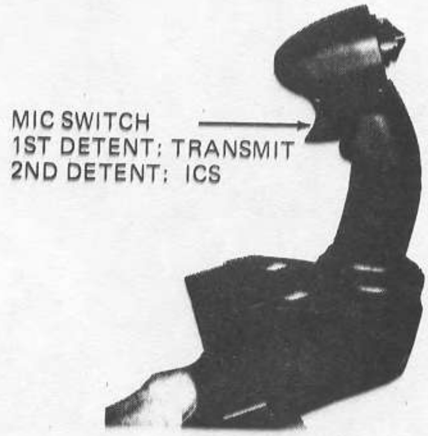
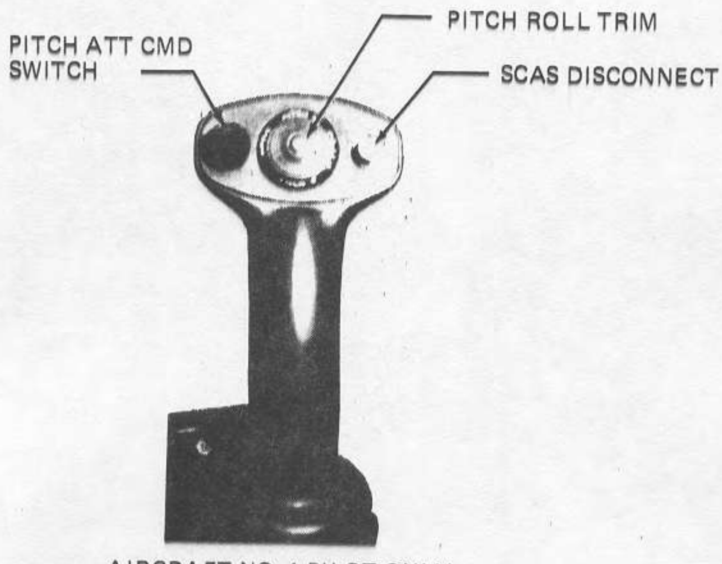


Figure 1-75

CONTROL STICK





AIRCRAFT NO. 1 PILOT ONLY

Figure 1-75A

PR7-C15-50115

COMMUNICATIONS SYSTEMS

The communications and associated electronic equipment consists of radios and communication equipment to provide aircraft-to-aircraft and aircraft-to-ground, intra-aircraft and telemetry signals for test data.

Flight Compartment Intercommunication System

The flight compartment intercommunication system (ICS) provides facilities for voice communication between the flight compartment and the remote control panels through the flight test engineer's auxiliary intercommunication control panel. The pilot's control panel receives 28 VDC power from the BATTERY bus through the PILOT & EXTERIOR AUDIO PANELS circuit breaker (B-26) on the pilots' overhead panel. The copilot's and flight test engineer's panels receive 28 VDC EMERGENCY DC power through the COPILOT/FLT ENGR AUDIO PANELS circuit breaker (C-24). The remote control panels receive 28 VDC EMERGENCY DC bus power through the OBSERVER AND REMOTE AUDIO PANELS circuit breaker (C-25).

Microphone Switches

A three position switch (figure 1-75) is located on the outboard horn of the pilot's and copilot's control wheel. The switches are spring-loaded to the center position. When the switch is pulled aft and held, the pilot or copilot can transmit to other intercom stations, regardless of his intercom control panel microphone selector position. When the switch is pushed forward and held, the operator can transmit on whatever is selected on the intercom control panel by the microphone selector. These switches serve as the boom or oxygen mask mic switches when the respective jack is inserted into the jackbox (figure 1-76). The flight test engineer's mic switch is an integral part of his mic and headset cable assembly.

Intercommunication Control Panels

Four intercommunication control panels (figure 1-76) located at the pilot's, copilot's and two at the flight test engineer's stations, provide a means of monitoring the audio systems. Each panel consists of; eight individual volume switches, a rotary microphone selector, master volume control, hot microphone push-pull switch and a momentary call button. The controls are described as follows:

VOLUME CONTROL SWITCHES. These push-pull switches are two position (pull on, push off). When a switch has been pulled (ON), it can be rotated to set the volume level of the audio system being monitored. The push-pull switches provide connection to the following:

Interphone	TACAN
UHF Radio	ILS
VHF Radio #1	Marker Beacon
VHF Radio #2	Hot Mic

MICROPHONE SELECTOR SWITCH. The rotary selector switch on three control panels (pilot, copilot, FTE) can be set to the following positions for transmissions.

INT	Interphone
UHF	UHF Radio
VHF 1	VHF Radio #1
VHF 2	VHF Radio #2

HOT MICROPHONE (HOT MIC) SWITCH. The hot microphone switch permits direct transmission without pressing the normal microphone switch. Two push-pull switches (LISTEN and TALK) on the control panel operate the hot microphone mode. When the TALK switch is pulled (ON), that station may transmit without depressing a microphone button. When the LISTEN button is pulled (ON) and rotated for audio level, the hot mic function may be monitored. When the hot mic function is not desired, the LISTEN and TALK switches should be pushed in (OFF).

VOLUME CONTROL. A rotary VOL (volume) control is a master control for all signals passing through the control panel.

CALL BUTTON. When the CALL button is pressed and held, the station initiating the call will be heard over the other stations.

Auxiliary Intercommunication Control Panel

Another control panel is installed fwd of the flight test engineer's control panel (figure A2-3) provides a means of distributing radio communications and hot mic audio to the remote stations for flight test personnel. The flight test engineer can select lines and adjust volume when requested by the test crew.

Interphone Remote Control Panel

Six interphone remote control panels (figure 1-76) located throughout the aircraft provide a means of communicating to various stations (figure 1-77) in the aircraft. Each panel consists of capped CALL button and a VOL (volume) control. When the CALL button is pressed and held, the station initiating the call will be heard over the other stations. The volume control is used to adjust the volume at that station.

UHF Command Radio (ARC-150)

One UHF communication system is installed to provide aircraft-to-aircraft and aircraft-to-ground communication. The system consists of a combined receiver/transmitter unit-control panel and a blade antenna. Frequency range is from 225 to 399.95 MHz. The UHF radio receives 28 VDC power from the EMER DC BUS through the UHF circuit breaker (C-22) on the pilots' overhead panel. A UHF control panel integral to the T/R unit (figure 1-78), located on the pilots' pedestal, provides a means for operating the UHF radio. The controls are described as follows:

MODE SELECTOR. A rotary mode selector turns on the radio and selects the type of operation. When in MAIN, the main receiver and transmitter are turned on. When in BOTH, the main receiver and transmitter is operational and the guard receiver is turned on to monitor guard frequency. The ADF position is inoperative since direction finding equipment is not installed.

FREQUENCY MODE SELECTOR SWITCH. The frequency mode selector switch selects the method of controlling the frequency of the main receiver and transmitter. When the selector switch is in PRESET, it allows selection of 20 preset channels with the rotary channel selector. When in GUARD, the main receiver and transmitter are automatically tuned to the guard frequency. When in MANUAL, it allows frequency selection with five frequency knobs. The selected frequency is displayed in the window immediately above each knob.

CHANNEL SELECTOR SWITCH. The

channel selector switch allows selection of 20 preset channels which are displayed in the PRESET window above the selector.

VOLUME CONTROL KNOB. The rotary VOLUME control knob is inoperative in this aircraft.

SQUELCH CONTROL SWITCH - An ON-OFF squelch switch provides a means to reduce ambient noise. When in OFF, the squelch circuit is opened allowing ambient noise to be heard. When in ON, the normal position, the receiver is returned to its normal squelch level.

TONE PUSHBUTTON - The momentary TONE pushbutton is used to produce a tone-modulated transmitter signal.

VHF Command Radio (RT-43A)

Two complete VHF communication systems are installed. Each system consists of a receiver-transmitter unit, control panel and a blade type antenna. Frequency range is from 116 to 149.95 MHz. The VHF radios are powered by 28 VDC buses. VHF 1 receives LEFT DC bus power through the VHF COMM 1 circuit breaker (F-1) and VHF 2 through the VHF COMM 2 circuit breaker (K-2) on the EPC panel. Two VHF control panels (figure 1-78), located on the pilots' pedestal provides a means of operating the VHF radios. These controls are described as follows:

FREQUENCY SELECTOR KNOBS. On each VHF COMM control panel are two sets of two stacked knobs. The left set controls the left frequency window and the right set the right window. The first digit is set at 1 (100 MHz). Each large outer knob controls the second and third digits in the frequency window (tens and units). Each small inner knob controls the fourth and fifth digits (tenths and hundredths).

FREQUENCY WINDOWS. Two frequency windows are on each VHF COMM control panel and provide a means of monitoring the frequency selected.

FREQUENCY SELECTED LIGHT. A light above each frequency window, when on, indicates which frequency is selected.

TRANSFER SWITCH. A two position TFR (transfer) switch allows the pilots' to use either of the selected frequencies. When the switch is toward the window, the frequency selected light will be on and the frequency in the window can be used.

Scrambler System

A scrambler system is installed in the aircraft to provide a means to scramble and unscramble VHF transmissions. The system consists of a scramble unit and control switch. The scrambler unit is inserted into VHF 1 common transmitter and audio cables. A two position, SCRAMBLE-CLEAR (figure 1-78) switch, is located on the VHF control panel. When in SCRAMBLE, the normal position, all VHF 1 transmissions will be scrambled. When in CLEAR, VHF 1 transmission will be in the clear.

UHF and VHF Command Radio Operation

1. When UHF (VHF) is desired, pull (ON) the UHF (VHF) volume control knob. Rotate it clockwise to increase the volume.

NOTE

If there is no indication of

sound, rotate the ICS master VOL control clockwise to increase.

2. Rotate the microphone selector to UHF (VHF 1 or VHF 2).

3. For UHF operation -

   a. Rotate the UHF mode selector to BOTH. This turns on the set and provides a monitor for guard channel.

   b. Place the frequency mode selector in the desired mode (preset, manual, guard).

   c. Select the desired frequency.

      (1) If in PRESET, rotate the channel selector to the desired channel #.

      (2) If in MANUAL, rotate each frequency control knob to set the desired frequency in the windows.

      (3) If in GUARD, the main transmitter and receiver are set to guard channel frequency.

4. For VHF operation -

   a. Rotate the frequency control knobs until the desired frequency is in each window.

   b. Place the TFR switch toward the window. The little light above the window should be on.

5. To transmit (UHF or VHF) -

   a. Using boom mike; push the microphone switch, on the control wheel, forward and talk.

   b. Using hand mike; just press button and talk.

NOTE

When using VHF 1 the scrambler system is in operating. When a message is to be sent in the clear, place the SCRAMBLE switch in CLEAR.

   c. Using oxygen mask mike, push the microphone switch forward and talk.

Hot Mic Operation

1. Pull (ON) the TALK control knob.

2. Pull (ON) and rotate LISTEN knob to desired volume.

3. Check that microphone selector is in desired position - normally in INT (interphone). It is not necessary to press a transmitter button.

Ferring Communications/ Navigation Kit

A Ferry Communications/Navigation will be installed for long range flights. When installed, it will consist of the following: One INS, one ADF radio, one VOR radio, one H.F. radio and one Radar Beacon. Additionally there will be two placards installed one below each HSI as follows:

Pilot's

Red Pointer TACAN #1
Green Pointer ADF #2

Copilot's

Red Pointer VOR #1
Green Pointer ADF #2

Inertial Navigation System (INS)

An independent Inertial Navigation System (LTN-72), if installed, is for backup of the LTN-51 for overseas flights. The controls (MSU and CDU) are located on the auxiliary pedestal inboard of the FTE's seat. The description and operation are similiar to the LTN-51 that is installed in the aircraft.

NOTE

There are no indications in the Pilots' instrument panels for this INS (Is not wired to the PDI).

Automatic Direction Finder (Collins-60)

One Automatic Direction Finder (ADF) system, if installed, is to provide relative bearings to a ground facility (NDB, commercial radio station, LOM, etc.).

The ADF control panel is located on the FTE's auxiliary pedestal and contains the following:

FUNCTION SELECTOR KNOB - A stacked three position rotary selector knob marked OFF, ANT and ADF is used to turn on - off and select the mode of operation. When in OFF, the radio is inoperative. When in ANT, the system is a radio receiver (audio only) between 190 KHz and 1749 KHz. When in ADF, the system is a receiver (audio) and provides relative bearings (visual) to a ground facility.

GAIN CONTROL KNOB - A rotary knob stacked on top of the function selector knob is used to control the volume of the set. Rotation CW increases and CCW decreases volume.

FREQUENCY SELECTOR KNOB - Three stacked rotary knobs are rotated to select the desirec radio frequency.

FREQUENCY WINDOW - A frequency window in the control panel provides a means of monitoring the selected frequency.

TEST BUTTON - A spring loaded to off, TEST button provides a means of testing the ADF system. When pressed and held, both HSI's No. 2 bearing pointers (green) display a test indication.

TONE SWITCH - A two position toggle, TONE-OFF, switch provides a means of obtaining a BFO for tuning the selected station. When held in TONE a BFO is energized and a 1,000 Hz tone is audible for tuning.

ADF Normal Operation

To place the ADF system in normal operation, proceed as follows:

1. Rotate the function selector knob to ANT.

2. Select the desired frequency in window.

NOTE

If desired, utilize the TONE switch for fine tuning of the station.

3. Adjust the GAIN control knob to the desired audio level and identify the station. When in ANT, the pilots' HSI's #2 bearing pointer (green) will

indicate either 090 or 270 (horizontal position).

4. Rotate the function selector knob to ADF.

5. On the pilots' HSI's, the #2 bearing pointer (green) should indicate the station's bearing.

6. If an ADF test is desired:

   a. Press and hold the TEST button. On the pilots' HSI's, the #2 bearing pointer (green) should turn 90° CW from the station bearing. 1000Hz tone is audible. Release the TEST button and the #2 bearing pointer should return to the pre-test display.

VOR System (51 RV 1)

One VOR navigation system is installed to provide indication of bearing to a selected VOR or VORTAC ground facility located within line of sight distance of up to 300 nautical miles.

VOR control panel is located on the FTE's auxiliary pedestal and contains the following:

FUNCTION SELECTOR SWITCH - A three position, rotary selector switch marked OFF, PWR and TEST is used to turn on/off and test the set. When in OFF, the set is inoperative. When in PWR (power), the system will determine bearing from the aircraft to the selected ground station. When held in TEST, the system will indicate test indications.

FREQUENCY SELECTOR KNOBS - Two stacked rotary knobs are rotated to select the desired VOR frequency. ILS is inoperative in this set.

FREQUENCY WINDOW - A frequency window in the control panel provides a means of adjusting the audio level of the set. Rotating the knob CW will increase the volume.

VOR System Normal Operation

To place the VOR system in normal operation, proceed as follows:

1. Rotate the function selector to PWR.

2. Select the desired VOR frequency in the window.

3. Adjust the volume as desired and identify the VOR station.

4. Place the NAV selector switch in VOR. The green VOR light should come on.

5. Observe that the copilot's HSI bearing pointer #1 (red) indicates toward the station.

NOTE

To check the CDI and bearing pointer, rotate the course set knob until the CDI centers. The course selector window readout and the respective VOR bearing pointer should indicate approximately the same.

6. If a test of the VOR system is desired:

   a. Hold the function selector in TEST. Select 360° (or 180°) in the course selector window. Observe that the copilot's HSI #1 bearing pointer (red) indicates 180° (360°) and

HSI TO/FROM indicators show FROM(TO). When the test is completed, release the function selector to PWR. The indications would return to the pre-test display.

HF Liaison Radio (AN/ARC-123)

If installed, the H.F. Liaison Radio transceiver provides two way voice communications in the 2 to 30 MHz frequency range. The set is capable of single side band (SSB) or amplitude modulation (AME).

A control panel is located on the FTE's auxiliary pedestal. These controls are described as follows:

SQUELCH CONTROL KNOB - This rotary knob provides a means to reduce ambient and radio generated noise. When the knob is rotated full CW (maximum position) all signals will be heard (no squelch). The control is normally adjusted from full CW to CCW until the station cannot be heard. Then rotate CW until the station can be heard. Readjustment may be required if the same station is used over a long period of time.

VOLUME CONTROL KNOB - When operating in the SSB mode, rotate the VOLUME control knob fully CW and adjust the volume with the RF GAIN control knob. When operating in the AME, adjust the VOLUME control knob to the desired audio level.

FREQUENCY SELECTOR KNOBS - Six rotary frequency selector knobs provide a means of selecting the desired frequency.

FREQUENCY WINDOWS - Six frequency windows are on the control panel and provide a means of monitoring the selected frequency.

MODE SELECTOR SWITCH - A four position, rotary selector switch marked OFF, SSB, AME, and FSK is used to turn on the set and select the mode of operation. When in OFF, all electrical power is removed from the radio. When in SSB (single side band, upper), the mode of operation is upper sideband and suppresses the carrier. When in AME (amplitude modulated equivalent), the mode of operation is AM. This is done by the upper sideband and carrier usage to provide a signal which is equivalent of an AM signal. FSK (frequency shift keying) mode is inoperative in this aircraft.

RF GAIN CONTROL KNOB - This rotary knob provides a means of eliminating distortion. Rotating the knob CCW may reduce the distortion. When in SSB mode, volume may be adjusted by the RF GAIN knob. When in AME mode, rotate the knob fully CW and adjust volume with the VOLUME control knob.

NOISE BLANK CONTROL KNOB - This rotary knob provides a means of blanking out certain types of noise (pulse-type and ECM etc). The NOISE BLANK control knob is normally left in the full CCW position. When noise is heard, slowly rotate the control knob CW until the noise is no longer heard. If this action has no effect, return the NOISE BLANK knob to its fully CCW position.

H.F. COOLING CONTROL SWITCH - A two position (OVERRIDE - NORMAL) guarded toggle switch, located on the FTE's auxiliary panel, provides a means of using the H.F. radio when the air conditioning cooling system has malfunctioned. When in NORMAL, the H.F. radio is in normal operation. When in OVERRIDE, it will allow H.F.

operations until the automatic thermal system disables the radio.

HF COOLING OFF light - An amber COOLING OFF light, located on the FTE's auxiliary panel, advises the crew that the cooling air for the HF radio has malfunctioned. When on, it also disables the H.F. radio.

H.F. RADIO Normal Operation

To place the HF radio in normal operation, proceed as follows:

1. Rotate the MODE SELECTOR switch to SSB position.

NOTE

When aircraft is on the ground and no cooling air, the H.F. COOLING control switch should be in OVERRIDE and the amber HF COOLING OFF light should be on.

2. Select the desired frequency with the frequency selector knobs.

NOTE

The frequency windows reflect the frequency in MHz. The normal civilian frequencies are in KHz therefore 3144 KHz would be 3.1440 in the windows.

3. Press and hold the mic button. A tone will sound while the radio is sequencing and when the tone stops, the radio is ready for operation. Release mic button.

NOTE

While transmitting, a sidetone should be audible.

4. If there is no sidetone, momentarily rotate the 10 MHz frequency knob off frequency then track to the desired frequency. Then when transmitting a sidetone should be heard.

NOTE

Only try this procedure once to get a sidetone. Then select another frequency.

5. For AME operation, rotate the MODE SELECTOR switch to AME position. Then transmit normally.

If the amber COOLING OFF LIGHT is on and H.F. radio operation is desired:

1. Lift the guard and place the HF COOLING switch in OVERRIDE.

2. Transmit the message.

NOTE

Since there is no cooling for the set, make all transmission of a short duration.

When the set overheats, an autothermal shutdown system will disable the set. After a cooling period, the set may be used again.

Radar Beacon

A Radar Beacon system, if installed, is to assist in aircraft identification and vectoring to the tanker aircraft.

The control is located on the copilots' overhead panel. It consists of a two position (ON - OFF) lever-lock RADAR BEACON switch. When in OFF, the beacon is inoperative. When in ON, the system will function as a transponder to another radar beacon. When it will transmit a dual blip with a spacing of 4 seconds (4 NM spread on the 30 mile range).

NAVIGATION SYSTEMS

Navigation and radio navigation systems include the following:

1. Gyrosyn compass system.
2. TACAN system (AN/ARN-84V).
3. ILS (Instrument Landing System) (AN/ARN-108).
4. TALAR (Tactical Landing Approach Radar) system (AN/ARN-97).
5. IFF (Identification Friend or Foe) system (AN/APX-72).
6. INS (Inertial Navigation System) (LTN-51).

Gyrosyn Compass System

Two independent compass systems are installed in the aircraft. Flux valves, in the wings of the aircraft, sense direction of the earth's magnetic field and transmit a magnetic heading signal through a magnetic compensator and compass coupler which compares with the directional gyro heading. After comparing, adjusting and amplifying, the signal is sent to the horizontal situation indicator (HSI). Compass #1 (#2) system receives 115 VAC single-phase power from the LEFT (RIGHT) AC bus through the COMPASS-1 (-2) circuit breaker (E-8 and J-8 respectively) on the EPC panel.

COMPASS CONTROL PANEL. Two compass control panels (figure 1-79), located on the pilots' overhead switch panel, provide a means of setting each individual compass. The synchronization indicator shows the deviation between the flux valve and the HSI compass card. The COMPASS control switch has DG and SLAVED positions. When in DG, it permits the respective HSI compass card to act as a free directional gyro controlled heading indicator. When in SLAVED, the HSI compass card is slaved to the flux valve and the synchronization indicator should be aligned. The SET HDG knob permits manual resynchronization of the gyro with the flux valve when in SLAVED, or selection of a compass heading when in DG. The SET HDG knob is spring-loaded to center (zero rate change) and marked on either side for slow or fast rate compass slew.

Navigation Selector Switch

A three position lever-lock NAV selector switch (figure 1-79), located on the right side of the glareshield panel, provides a means of selecting the navigation signals to be displayed in the HSI's. Regardless of switch position, the TACAN bearing pointer and range indicator will be operating in both HSI's. When in TACAN, the CDI will display selected course deviation information in both HSI's. When in ILS, ILS glideslope and localizer information will be displayed in both pilots' ADI's and HSI's. When in TALAR, TALAR glideslope and localizer information is displayed. The NAV switch receives 28 VDC power from the LEFT DC bus through the NAV SWITCH UNIT circuit breaker (F-7) on the EPC panel.

TACAN System (AN/ARN-84V)

One TACAN navigation system is installed to provide indication of bearing and distance to a selected TACAN surface beacon or VORTAC facility or aircraft-to-aircraft located within line-of-sight distance of up to 300 nautical miles. The system consists of a transmitter-receiver unit, two blade type antennas, control panel and NAV selector switch. The TACAN system receives 28 VDC power from the LEFT DC bus through the TACAN circuit breaker (F-2) on the EPC panel.

TACAN CONTROL PANEL. The TACAN control panel (figure 1-79), located on the pedestal, contains the following:

FUNCTION SELECTOR. A four-position, rotary function selector marked OFF, REC, T/R and A/A and is used to turn on the set and select the mode of operation. When in OFF, the system is inoperative. When in REC (receive), the system will determine bearing from the aircraft to the selected ground station. When in T/R (transmit/receive), both bearing and range information are available. When in A/A (aircraft-to-aircraft), only range information between aircraft is available.

CHANNEL SELECTOR KNOBS. Two channel selector knobs are rotated to select any one of the 126 channels. The left knob, when rotated, selects the hundreds and tens digits and the right knob selects the units digits. The selected channel appears in the channel selector window.

MODE SWITCH. The mode switch is used to select the X or Y group of frequency channels. The X-mode is the standard mode of operation and contains 126 channels. When X-mode is selected an X appears after the channel frequency. The Y mode provides 126 additional channels for planned TACAN expansion and is currently inoperative.

VOLUME CONTROLS. The rotary VOL (volume control) knob is inoperative in this aircraft.

TEST PUSHBUTTON. A TEST pushbutton is used to test the TACAN system.

TACAN Advisory Light

A green TACAN light (figure 1-79), located on both pilot's instrument panels adjacent to the HSI, comes on when the NAV selector switch is in TACAN. The TACAN lights receive 28 VDC power from the LEFT DC bus through the TACAN circuit breaker (F-2).

TACAN Test Procedure

To test the TACAN proceed as follows:

NOTE

Pilot's and Copilot's compasses should agree. If not, sync them.

1. Rotate the function selector to T/R.
2. On the glareshield panel, place the NAV selector switch in TACAN.
3. On the HSI's, rotate the course selector knob to 180°. The course window should show 180.
4. On the TACAN control panel, press (momentarily) the TEST button.

5. On the HSI's, the bearing pointer should read 180° ±2° and the MILES window should read 000. The course deviation indicator will center. The NAV FAIL warning flag will be out of view.

NOTE

After a short duration, the HSI's will show the pretest display.

TACAN System Normal Operation

To place the TACAN system in normal operation, proceed as follows:

1. Verify the X/Y mode switch is in X mode.
2. Rotate the function selector to T/R.
3. Select the desired channel with the channel selector knobs.

NOTE

The channel number will appear in the channel selector window followed by an X.

4. Pull up and rotate TACAN volume knob, on ICS panel, to desired level.
5. Place NAV selector, on glareshield panel, in TACAN. Each TACAN light should come on. When the selected TACAN or VORTAC facility is locked on, the HSI bearing pointer and miles window will indicate the bearing and milage.

TACAN Aircraft-to-Aircraft Operation

To place the TACAN in A/A operation, proceed as follows:

1. Establish communications with other aircraft.
2. Verify (both aircraft) the X/Y mode switch is in the same mode (either both in X or both in Y).
3. Rotate the function selector to A/A (both aircraft).
4. In one aircraft, select the desired channel with the channel select knob. Notify the other aircraft what channel you have selected.
5. The other aircraft must select a channel that is 63 channels apart from the first aircraft's channel.

NOTE

For A/A operation, there are 63 paired channels that will work; therefore, the aircraft channels must be 63 apart. (e.g., One aircraft channel 6X-other aircraft 69X).

6. When locked on, the HSI range indicator will show the distance between the aircraft.

Instrument Landing System (ILS) (AN/ARN108)

One ILS is installed to provide an instrument landing capability. It consists of a receiver (localizer, glideslope and marker beacon), control panel and antennas. The ILS receives 28 VDC from the LEFT

DC bus through the ILS and MARKER BEACON circuit breakers (F-5, F-6) on the EPC panel.

ILS Control Panel

The ILS control panel (figure 1-79), is located on the pilots' pedestal, and contains the following:

OFF-PWR SWITCH. The left outer knurled knob is the ON-OFF power switch for the ILS system.

FREQUENCY SELECTORS. The two blade type knobs select the desired frequency. The left knob selects units of MHz (1-9) and the right knob selects odd tenths and hundredths of MHz (0.10, 0.15, 0.30, etc.). The frequency selected will appear in the frequency window. When an ILS frequency is selected on the panel, the glideslope receiver is turned on and automatically switches to the appropriate glideslope frequency which is paired with the selected localizer frequency.

VOLUME CONTROL. The right outer knurled knob placarded VOL is inoperative in this aircraft. ILS volume is controlled by the respective volume controls (ILS, MKR BCN) on the ICS panel.

ILS Advisory Light

A green ILS light (figure 1-79), located on both pilots' instrument panel adjacent to the HSI's, comes on when the NAV selector switch is in ILS. The ILS lights receive 28 VDC power from the LEFT DC bus through the ILS circuit breaker (F-5).

ILS Normal Operation

To place the ILS in normal operation, proceed as follows:

1. Rotate the OFF-PWR switch to PWR.

2. Using the frequency selectors, select the desired ILS frequency.

NOTE

Normal ILS frequencies are 108.1 to 111.95 with odd tenths of MHz (109.10, 108.35, etc.).

3. Pull up and rotate ILS volume knob, on ICS panel, to desired audio level.

4. Place NAV selector, on glareshield panel, in ILS. The ILS lights, beside each HSI, will come on. When the selected ILS is receivable, each pilot's ADI and HSI should show glideslope and localizer information.

Marker Beacon Annunciator Lights

The instrument landing systems provides aural and visual indication when the aircraft is in range of a marker beacon transmitter. Visual indication is provided by indicator lights (figure 1-79) on the pilot's and copilot's instrument panels. An indicator light comes on when the aircraft is over airway (white), outer marker (blue) or middle marker (amber). Aural signals are received through the intercom system when the MKR BCN volume switch on the intercommunication panel (figure 1-76) is pulled (ON). The marker beacon receives 28 VDC power from the LEFT DC bus through the MARKER BEACON circuit breaker (F-6).

Tactical Landing Approach Radar (TALAR) System (AN/APN97)

One TALAR system is installed to provide an instrument landing capability for STOL operations. The system consists of a ground transmitter, a receiver with antenna, and control and indicating circuitry. The TALAR system receives 28 VAC power from the LEFT DC bus through the TALAR circuit breaker (F-4) on the EPC panel. The ground transmitter is portable and is normally positioned approximately 100 feet right of the runway and 500 feet from the threshold. The transmitter is single channel and is very short range. There are no ON-OFF, VOLUME and frequency controls in the aircraft.

Regularly used navigation aids have the necessary accuracy to guide an aircraft well within the TALAR I.P.

Holding patterns are conducted in the same manner as on an ILS inbound (front course). When flying outbound from the holding fix, no useable signal information is displayed on the HSI's, since the aircraft antenna is facing away from the ground transmitter.

Although the system is based on line-of-sight transmission, preferred altitudes for intercept are in the range of 1000 to 3000 feet at distances between 5 and 10 NM from the transmitter (end of runway) and 1500 to 5000 feet at greater distance.

Intercepts should be made at 45° or less to the runway heading. The aircraft receiver receives signals from the ground transmitter, and provides glideslope and localizer deviation signals similar to ILS display on both pilots' instruments.

TALAR Advisory Light

A green TALAR light (figure 1-79), located on the pilots' instrument panel adjacent to the HSI, comes on when the NAV selector switch is in TALAR. The TALAR light receives 28 VDC power from the LEFT DC bus through the TALAR circuit breaker (F-4).

TALAR Normal Operation

1. Verify that there is a TALAR available at the airfield of intended landing.

2. Place the NAV selector switch in TALAR. The TALAR lights should be on. When the aircraft is within range, 32 NM in clear weather or 10 NM in rainy weather and in position, each pilot's ADI and HSI should show glideslope and localizer information.

IFF (APX-72)

The APX-72 IFF radar identification system provides automatic radar identification of the aircraft when interrogated by surface or airborne radar sets. The system enables friendly aircraft to identify themselves apart from other aircraft and provides a means of transmitting a special coded emergency reply signal.

An automatic altitude reporting function of the transponder, using CADC altitude inputs, automatically transmits this altitude when interrogated. The system includes a receiver-transmitter, a test set, a control panel and two blade type antenna, one on top and one on the bottom of the aircraft. The IFF system receives 28 VDC power from the RIGHT DC and 115 VAC single phase power from the RIGHT AC through the IFF circuit breakers (K-1 and J-1 respectively).

IFF Control Panel

The IFF control panel (figure 1-80), located on the pilot's pedestal provides controls and indicators for the various functions of the IFF radar system. Functions of the controls and indicators are as follows:

MASTER SELECTOR SWITCH. The five-position rotary MASTER switch allows selection of the functions OFF, STBY, LOW, NORM and EMER. When in OFF, all power is removed from the system. When in STBY (standby), operating power is applied; however, the set will not transmit a reply to interrogations until one of the modes (LOW, NORM or EMER) is selected. When in LOW, the receiver sensitivity is decreased to reduce the clutter on the ground controller scopes. When in NORM, the receiver is returned to normal sensitivity for enroute operations outside of terminal areas. When in EMER (emergency), the system transmits an emergency reply when interrogated. A detent in the MASTER switch prevents selection of EMER or OFF unless the selector is pulled up and rotated.

IDENTIFICATION-OUT-MIC SWITCH. A three-position toggle switch, IDENT-OUT-MIC, controls the identification function. When held in IDENT, the system sends coded replies selected by MODE 1 or MODE 3/A code selectors. MODE C is not affected. When in OUT, the IDENT function is disabled. When in MIC, identification replies are activated by keying the microphone switch, provided UHF is selected.

MODE ENABLE AND TEST SWITCHES. MODE 1, MODE 2 and MODE 3/A each have a three-position toggle switch. When in OUT, the mode is disabled. When in ON, the mode function is enabled. When held in TEST, the TEST light will come on to indicate proper operation of the set. The TEST position is spring-loaded to return to ON position.

MODE C ALTITUDE REPORTING ENABLE AND TEST SWITCH. This switch is the same as the other MODE switches. When in OUT, the mode is disabled. When in ON, the CADC pressure altitude inputs provide automatic altitude reporting and the set transmits the altitude in 100 feet increments when interrogated. TEST position is same as other enable switches.

MODE 1 SELECTORS. These selectors consist of two in-line edgewise-mounted thumb wheels and are continuously rotatable with no stops. The left wheel has eight positions numbered 0 through 7 consecutively. The right wheel numbering is 0 through 3 which appears twice, once on each half of the drum.

MODE 2 SELECTORS. The code selectors for MODE 2 are on the face of the R/T unit. Normally they are preset by ground crewmen and are not set during flight.

MODE 3/A SELECTORS. These code selectors consist of four in-line edgewise-mounted thumb wheels and are continuocusly rotatable with no stops which allows code groups from 0000 through 7777.

MODE REPLY SELF-TEST LIGHT. A green TEST light is provided to indicate satisfactory operation of the set for self-test of Modes 1, 2, 3/A and C. In normal operation, the light will indicate proper response to interrogation.

MODE 4 is inoperative in the aircraft.

RADIATION TEST-MONITOR-ENABLE SWITCH. A three-position toggle switch, RAD TEST-OUT-MON, controls the radiation test and monitor functions of the system. When held in RAD TEST, the test mode is energized for maintenance testing. The switch is spring-loaded to OUT when released. When in MON (monitor), the monitor circuits are enabled and the self-test REPLY light comes on when the set sends a reply to interrogations in all modes.

IFF Test

To test the IFF before flight or inflight proceed as follows:

1. Rotate the MASTER switch to STBY. Allow the set to warm up at least 80 seconds.
2. Verify the IDENT-OUT-MIC switch is in OUT.
3. Verify the RAD TEST-OUT-MON switch is in OUT.
4. Thumb MODE 1 and MODE 3/A selectors to set any desired code in the windows.

NOTE

Do not set 7700 or 3100 in MODE 3/A.

5. Rotate MASTER switch to LOW or NORM as desired.

   When performing the following tests, the TEST light will come on if the mode being tested is operating properly.

6. Place and hold the M-1 (mode 1) enable and test switch in TEST. The TEST light should come on.
7. Release M-1 switch and TEST light should go off.
8. Repeat steps 6 and 7 for MODE 2, MODE 3/A and MODE C.
9. Rotate MASTER switch to STBY.

IFF Normal Operation

To place the IFF in operation:

1. Rotate the MASTER switch to STBY. Allow the set to warm up at least 80 seconds.
2. Verify the IDENT-OUT-MIC switch is in OUT.
3. Verify the RAD TEST-OUT-MON switch is in OUT.
4. Thumb the mode selectors (1, 3/A) as required. Mode 2 cannot be set from the flight compartment.
5. Place the M-1, M-2 M-3/A and M-C enable switches as required.
6. Rotate the MASTER switch to LOW or NORM.

NOTE

LOW is normally used in a terminal area and NORM is used enroute or else as directed.

7. To turn off the IFF system, pull up and rotate (CCW) the MASTER switch to OFF.

IFF Emergency Operation

1. Pull up and rotate (CW) the MASTER switch to EMER.

2. Select mode 3A to 7700

Inertial Navigation System (INS)

The Litton (LTN-51) inertial navigation system (INS) continuously computes horizontal navigation data and senses aircraft attitude displacement in pitch, roll and yaw from a vertical and horizontal reference (accelerometers and gyro compass for flight test equipment). The INS system receives 28 VAC and 115 VAC single phase power from the RIGHT AC bus through the following circuit breakers: INS ATTITUDE (H-2); INS HEADING PLATFORM (H-3); INS NAV (H-4); INS (J-3); and INS HEATER (J-4).

The INS consists of five units; the mode selector unit (MSU), the control display unit (CDU), a signal conditioning unit (SCU), the inertial navigation unit (INU), and the battery unit. The INU and battery unit are not involved in operation procedures.

The relationship between navigation data provided by the INS is illustrated in Figure 1-81. The INS furnishes its own numerical display of navigation data and indicates its own operating status.

Signal Conditioning Unit

The SCU converts altitude and true airspeed and vertical velocities into a format that can be utilized for flight test data.

Inertial Navigation Unit

The INU consists basically of a precision gyro stabilized inertial platform and a digital computer. All INS attitude and navigation information is determined in the INU.

Battery Unit

The battery unit provides auxiliary DC power to turn on the INS and to supply power to sustain INS operation for 15 to 30 minutes should the electrical power be interrupted.

Mode Selector Unit

The Mode Selector Unit (MSU) (figure 1-82), located in the pilots' overhead panel, provides a means of selecting the INS modes of operation and monitoring the INS. It consists of a function selector and indicating lights.

MODE FUNCTION SELECTOR SWITCH. A five-position rotary function selector switch (OFF, STBY, ALIGN, NAV and ATT REF) turns on the INS and selects the type of operation. The functions are as follows:

OFF — Power removed from the inertial navigation system (INS).

STBY — Power is applied to the system. INS display test can be performed and present position coordinates inserted. Automatic alignment sequence starts after present position is inserted and temperature stabilization and gyro run up are initiated.

ALIGN — Alignment continues. When alignment is completed the READY NAV light will come on.

NOTE

Alignment can only be accomplished when airplane is on the ground in a static position.

Aircraft must not be moved after present position has been entered, during alignment, and prior to moving mode selector to the NAV position.

NAV The normal INS operating mode. (Mode selector has a positive lock in the NAV position and must be pulled out to rotate to another position).

NOTE

If the selector is moved out of the NAV position, the INS must be realigned on the ground with the aircraft in a static position before moving the mode selector back to the NAV position.

ATT REF Selection of this position will result in a loss of navigation capability and CDU numerical displays will be blank. Only pitch, roll attitude and platform heading data will be available for flight test instrumentation.

READY NAV ANNUNCIATOR (GREEN). Comes on when the INS has completed alignment and is ready for navigating.

BATT ANNUNCIATOR (RED). Comes on when backup power is less than the minimum required to operate the INS. Must be pressed to turn off the light when power is restored or will remain on as long as sufficient power to light the annunciator lamp is available.

Control Display Unit

The Control Display Unit (CDU) (figure 1-82), located on the pilots' pedestal contains controls, indicators and displays for manually inserting information into INS and for displaying navigation information and system status. A description of the CDU follows:

DISPLAY SELECTOR SWITCH. A nine-position rotary switch selects the desired function and display of the INS. The position and functions are as follows:

TEST The CDU may be tested by setting the display selector to TEST. All segments of the numerical displays and the from/to waypoint displays illuminate. Also the ALERT, BAT, WARN lights, degree, decimal and minute symbols come on.

NOTE

This display test may be performed with the mode selector in STBY, ALIGN or NAV positions without affecting either alignment or navigation computation.

DSR TK STS This position provides multi functions:

a. Monitors alignment progress with mode selector in STBY or ALIGN. High numbers (90, 80, etc.) indicates that alignment has just begun and low number (02, 01) indicates it is nearing completion.

b. Displays desired track with mode selector in NAV. The DSR TRK (desired track) is the great circle path connecting the departure and destination positions or two waypoints referenced to true north.

c. Displays vertical velocity in right numerical display with mode selector in NAV and AUTO- MAN-RMT selector in AUTO. The R or L preceeding the readout indicates UP or DOWN. The numerals indicate feet per second with the last digit signifying tenths of feet. Vertical velocity will be blanked whenever ADS WARN or SCU VALID discrete is invalid.

d. Displays received altitude in the right numerical display with mode selector in NAV and AUTO-MAN-RMT selector in RMT. Pressure altitude is from the CADC to the INU.

WIND a. Displays wind direction (degrees true) and speed (knots). Displays are valid only if true airspeed exceeds 40 knots.

b. Displays true airspeed in the right numerical display with mode selector in NAV and AUTO-MAN-RMT selector in RMT. True airspeed will be blanked whenever ADS WARN or SCU VALID discrete is invalid.

NOTE

Received true airspeed is total airspeed and contains vertical as well as horizontal components.

DIS/ TIME — Displays distance (as measured between present position and the next selected waypoint) and time, based on present ground speed along the desired track.

WPT — Displays latitude and longitude of up to nine stored waypoints corresponding to the digit on the WPT selector.

POS — Displays present position in degrees of latitude and longitude.

XTK/ TKE — Displays cross track distance (XTK) in miles and track angle error (TKE) in degrees. The R or L preceding the read- out indicates that the aircraft track is to the right or left of the desired track or the desired track angle.

HDG DA — Displays aircraft's true heading (HDG) and drift angle (DA). The R or L preceding the drift angle readout indicates the aircraft's track is to the right or left of the aircraft heading.

TK GS — Displays track angle (TK) and ground speed (GS).

AUTO-MAN-RMT SELECTOR SWITCH. A three-position rotary switch selects the method of data entry and waypoint sequencing. The positions and functions are:

AUTO	Track leg changes automatically.
MAN	Enables operator to manually initiate track changes.
RMT	(Remote) Allows call up distance between waypoints other than the active leg.

WAYPOINT SELECTOR SWITCH. An in-line, edgewise-mounted thumb wheel is continuously rotatable with no stops. The wheel has ten numbered positions, 0 through 9 consecutively. Allows selection of the waypoint (1 through 9) for insertion or selects stored waypoint to be displayed.

FROM/TO WAYPOINT DISPLAY. An illuminated display provides visual indications of the FROM (left side) and TO (right side) of the track leg. A track leg change is accomplished by changing the waypoints.

LIGHTS DIM CONTROL SWITCH. An in-line, edgewise-mounted thumb wheel provides dimming of the CDU integral lights.

NUMERICAL DATA DISPLAYS. The left and right numerical displays are composed of lights which indicate numbers, decimal points, degree symbols, left and right directions, and latitude or longitude. Depending on the position of the display selector switch, the indications are as follows:

Left	Right
Latitude	Longitude
Wind Direction	Wind Speed
Dist to Go	Time
Cross Tk Dist	Tk-angle Error
Track Angle	Ground Speed
True Heading	Drift Angle
Desired Track	Status Check
Test	Test

ANNUNCIATOR LIGHTS. Three lights are installed to warn and caution the user of various functions of the INS. The lights and functions are as follows: ALERT light (amber) comes on steady two minutes before a waypoint is reached and then flashes 30 seconds before a waypoint must be manually changed.

BATT light (amber) comes on when the INS is operating on backup (battery) power.

WARN (red) light comes on steady when a system malfunctions. During the align mode, it comes on flashing to indicate, (1) an incorrect position latitude is inserted or (2) an INS alignment failure has occurred.

DATA KEYBOARD. The data keyboard consists of ten alphanumeric keys (0 through 9) which provide a means of entering and monitoring present position, waypoints and from/to waypoints into the CDU displays that are to be inserted into the INS. The keys 2, 4, 6, 8 have letters on them which are used to signify latitude and longitude. A CLEAR key provides a means of clearing the displays before the data is inserted into the INU.

HOLD pushbutton is a green momentary switch/light. When the HOLD pushbutton is pressed and released, the light comes on, the CDU numerical displays freeze the present position and the INS computer continues normal operation. When the HOLD pushbutton is pressed and released the second time, the light goes off, the displays return to normal operation, immediately showing a continuously updated present position.

INSERT pushbutton is an amber momentary switch/light. When data has been entered in the CDU, the INSERT amber light will come on. When the INSERT button is pressed and released, the light goes off, the data is transferred from the CDU and is inserted into the INS and the displays normally go blank.

TK CHG (track change) pushbutton is a green momentary switch/light. When pressed and released, the light comes on and allows entering and monitoring of manual waypoints.

Preflight Procedures

Preflight operations include turn on, warmup, inserting information required for alignment and flight, and verifying proper operation (give it electricity, test it, tell it where is is, align it).

INS Start Up

1. On the MSU, verify the mode selector switch is in OFF.

2. On the CDU, rotate the AUTO/MAN/RMT switch to MAN.

3. On the CDU, rotate the display selector switch to POS.

4. On the MSU, rotate the mode selector switch to STBY.

NOTE

When in STBY, power is applied to the INS. Sequence will not start if the battery pack is dead.

5. Check that the left numerical display is all zeroes, degrees, decimals and N symbol. The from/to display is 01 or 00. The right numerical display is 100538.

Display Test

The display test tells the pilots the CDU numerical displays, from/to display and annunciators are operating correctly. The test can be performed with the mode selector in STBY, ALIGN or NAV.

1. Perform the steps in INS startup.

2. On the CDU, rotate the display selector switch to TEST.

3. Check for the following indications:

   a. Left and right numerical displays are degree signs, decimal points, arc-minute signs, NS and EW and all numeral 8's.

   b. From/To display is all numeral 8's.

   c. Amber ALERT, amber BATT and red WARN annunciators are on.

NOTE

If all lights are off, thumb the DIM switch forward until the desired intensity level is reached.

Present Position Entry

The aircraft's present position must be entered into the INS digital computer before the INS can be aligned.

1. On the MSU, verify the mode selector switch is in STBY.

2. On the CDU, rotate the display selector switch to POS.

3. To start LATITUDE entry procedures:

   a. On the data keyboard, press the 2N key (Northern hemisphere). The INSERT pushbutton light comes on.

   b. Left numerical displays blanks and N; the right displays blanks.

   c. Starting with the most significant number, enter latitude to the nearest tenth of a minute by pressing the corresponding keys on the data keyboard. As each key is pressed, the corresponding digit is displayed on the left numerical display as the least significant digit, and that each preceding digit moves one place to the left.

   d. Check the left display is the correct latitude, then press the INSERT pushbutton. Check that the INSERT light goes off signifying that the latitude data is inserted into the digital computer.

   e. Check that latitude on left display, which is data computer, is within 0.1 arc-minute and that the right numerical display is all zeroes and an E.

   f. If left display is incorrect, repeat steps 3a through 3e.

   CAUTION

   If present position latitude is inserted incorrectly the INS will determine, during calculations performed later in the alignment sequence, that the error exists, flash the WARN annunciator, and stop the self-alignment sequence. The INS START UP and PRESENT POSITION ENTRY procedures must be repeated resulting in a delay of 10 to 15 minutes.

   g. If left display is correct, proceed with step 4.

4. To start LONGITUDE entry procedure:

   a. On the data keyboard, press the 4W key (West longitude). The INSERT pushbutton light comes on.

   b. Left numerical display latitude and right displays blanks and a W.

   c. Enter longitude in the same manner as latitude.

   d. Check the right display is the correct LONGITUDE, then press the INSERT pushbutton. Check that INSERT light goes off signifying that longitude data is inserted into the computer.

   e. Check that the longitude (right display) is correct within 0.1 arc-minute.

   f. If right display is incorrect, repeat steps 4a through 4e.

5. Check that left and right numerical displays are correct.

6. On the MSU, rotate the mode selector to ALIGN.

NOTE

Alignment can only be accomplished when aircraft is on the ground in a static condition. The aircraft must not be moved until alignment is completed and the mode selector switch placed in NAV.

Waypoint Position Entry

Waypoints are enroute fixes and are entered at latitude and longitude positions. Up to nine waypoints can be entered in the INS during the self-alignment sequence while the aircraft is on the ground or in the NAV mode in flight. Waypoints cannot be entered until the present position has been entered. Once entered, waypoints will remain in the INS until new waypoints are entered. When the mode selector switch is rotated to OFF, all waypoints are automatically cleared.

1. Perform the present position entry procedures.

2. On the CDU, rotate the mode selector switch to WPT (waypoint).

3. Thumb the waypoint selector switch until #1 is in window.

NOTE

Waypoint 0 is an automatic function that is reserved for establishing a track from the aircraft's present position, and cannot be used to enter waypoints.

4. Enter the first enroute waypoint latitude and longitude in a similar manner as entering present position.

5. Check that the left and right displays show the first waypoint's latitude and longitude.

6. Thumb the waypoint selector switch to #2 and enter waypoint 2 latitude and longitude in a similar manner.

7. Now enter the remaining waypoint's.

Status Check

This check tells the pilots if the INS is operational. If it is not, it displays numbers which indicates to the pilot as to what his actions are toward the INS. This check can be performed with the mode selector switch in STBY or ALIGN.

1. Perform the present position entry procedure.

2. Rotate the display selector switch to DSR TK/STS (desired track/status).

3. Observe the left numerical display is blank. The right display shows 90 and then starts counting down by tens until 40 is reached and then by ones until 02.

NOTE

After the status number decreases

to 02, the READY NAV light should come on.

4. On the MSU, check the READY NAV light is on.

5. During the Before Taxi Checklist, rotate the mode selector switch to NAV. The READY NAV light should go off.

CAUTION

If system is taken out of NAV, it must be realigned on the ground with the aircraft in a static position before switching back to NAV.

NOTE

Do not pull mode selector when switching to NAV. This prevents overshoot to ATT REF which destroys alignment. If ATT REF is selected, alignment must be restarted by rotating mode selector to OFF and to STBY and re-inserting present position.

Initial Track Selection Procedure

The initial track selection is the direct great-circle route between the aircraft's present position and waypoint 1.

1. On MSU, verify mode selector is in NAV.

2. On the CDU, verify the AUTO/MAN/RMT switch is in MAN.

3. Press the TK CHG pushbutton. The TK CHG and INSERT pushbuttons lights will come on. The from/to display will go blank.

4. On the data keyboard, press the 0 key. In the from/to display, the left side will show 0 and right blank. Press the 1 key. The display should show 01.

NOTE

Initial track selection may be initiated on the ground or inflight.

5. Press the INSERT pushbutton. The TK CHG and INSERT pushbutton lights should go off. This signifies that the data has entered the computer and initial track selection has been initiated.

Attitude Reference Procedure

When the navigation mode is not required and only pitch, roll and platform heading outputs for flight test data are required, the INS can be operated in the attitude reference mode.

1. On the MSU, pull out and rotate the mode selector to ATT REF. On the CDU, the displays will go blank and the CDU WARN annunciator should be off.

CAUTION

On the ground: The aircraft should be static or taxiing at a constant speed and steady heading before selecting ATT REF. After selecting ATT REF, this initial condition must be maintained for 3 minutes. In flight: Fly the aircraft wings level at constant airspeed for 3 minutes.

TAXIING - With the display selector switch in TK/GS (track/ground speed) and the mode selector switch in NAV and the aircraft on the ground, the right numerical display shows ground speed. The left display shows track angle.

Inflight Procedures

The terms automatic and manual apply only to track selection. When in NAV mode, the INS provides the same navigation data regardless of the AUTO/MAN/RMT switch position (AUTO or MAN). During automatic operation (switch in AUTO), the INS navigates through each preset waypoint in sequence and automatically changes the track at each waypoint. During manual operation, the INS navigates from waypoint to waypoint, but the pilct must change the track at each waypoint.

Inflight warnings and Cautions:

1. CDU WARN annunciator on. The INS is malfunctioning and may not be providing accurate data. In flight, rotate the MSU selector to ATT REF.

2. CDU BATT annunciator ON. The INS is using the battery pack for DC power. The battery pack is good for approximately 15 to 30 minutes. When battery voltage gets low, the INS WILL AUTOMATICALLY SHUT OFF.

3. MSU BATT annunciator ON. The battery pack voltage is too low, the INS has automatically shut down and the CDU WARN annunciator will come on.

4. Do not rotate the mode selector out of NAV unless an INS malfunction occurs. If you do, NAV mode cannot be reinstated in flight.

Inflight Manual Procedures

Inflight manual operating procedures include track change at waypoint, track change from present position, waypoint bypassing and waypoint position change. Description of the procedures follow:

Track Change at Waypoint

Two minutes prior to the waypoint, the ALERT annunciator comes on steady. One-half minute prior to waypoint the ALERT annunciator flashes and it will continue to flash until pilot makes a track change.

NOTE

The ALERT light operates above 150 knots ground speed.

1. Rotate the AUTO-MAN-RMT switch to MAN.

NOTE

The display and WPT (waypoint) selector switches positions do not affect the procedure; however, the display selector switch determines what the numerical displays show.

2. Press the TK CHG pushbutton.

3. Check the TK CHG and INSERT pushbuttons lights come on. The from/to display blanks.

4. On the data keyboard, press the # key for approaching waypoint. Press the waypoint # key next in sequence (e.g., aircraft is approaching waypoint 2 and the next waypoint is 3, then press #2 key first then #3 key).

5. Check from/to display is 2 3.

6. Press INSERT pushbutton. Observe TK CHG, INSERT and ALERT lights go off. From/To display is 2 3.

7. Rotate the display selector switch to DSR TK/STS. The left numerical display shows the desired track. Check that it is reasonable.

Track Change from Present Position

1. Rotate the AUTO-MAN-RMT switch to MAN.

NOTE

The display and WPT (waypoint) selector switches position do not affect this procedure; however, the display selector switch determines what the numerical displays show.

2. Press the TK CHG pushbutton.

3. Check the TK CHG and INSERT pushbuttons lights come on and from/to display blanks.

4. Press the 0 key and then the desired waypoint # key.

5. Check the from/to display is 0 - desired #.

6. Press the INSERT pushbutton. Observe the TK CHG and INSERT pushbuttons lights go off. The from/to display is 0 - desired #.

7. Rotate the display selector switch to DSR TK/STS. The left numerical display shows the desired track. Check that it is reasonable.

Waypoint Bypass Procedures

The pilot may bypass waypoints by a track change; (1) from present position, or (2) from a waypoint. If the aircraft is approaching a waypoint and the next waypoint in sequence is to be bypassed, refer to track change from waypoint procedure. If the waypoint to be bypassed is the next waypoint, refer to track change from present position procedure.

Waypoint Position Change Procedure

The pilot can change the coordinates of waypoints by using the waypoint position entry procedure. Enter future waypoints sequentially starting with 1 and continuing through the last number used.

Inflight Automatic Operation

In automatic operation (the AUTO-MAN-RMT switch in AUTO), the change to the next sequential track at each waypoint is performed automatically by the INS. Two minutes prior to each waypoint, the ALERT light comes on and goes off when the track change is made. The from/to display automatically changes to show the new waypoint numbers.

NOTE

The ALERT light operates above 150 knots ground speed.

Data Display Selection

The left and right numerical displays will show the desired data when the data display selector switch is rotated to the desired position. The INS operation is not affected. This switch only changes the numerical displays.

Distance Between Waypoints PROCEDURE

The distance between any two waypoints can be obtained by the following:

1. Rotate the AUTO/MAN/RMT switch to RMT. Observe the from/to display is flashing.

2. Rotate the data display selector switch to DIS/TIME. Observe the left numerical display is 0000, and the right numerical display continues to show time to next waypoint on present track.

3. Press TK CHG pushbutton.

4. Check the TK CHG and INSERT pushbutton lights come on and from/to display blanks.

5. On data keyboard, press the # keys corresponding to the two selected waypoints.

6. Check from/to display is the desired waypoints.

7. Press INSERT pushbutton. Observe TK CHG and INSERT pushbuttons lights go OFF.

8. The left numerical display is the distance in nautical miles between the selected waypoints. The right display still continues to show time to next waypoint on present track.

9. Rotate the AUTO/MAN/RMT switch to AUTO or MAN. Check the left numerical display is the distance and from/to display are for present track.

Postflight Procedures

After a flight the INS may be left in NAV mode if:

1. The landing is an intermediate stop and another flight will be flown.

2. INS accuracy during flight is within 1.5 NM/hour.

If these conditions are not met, shut down the INS and realignment will be required prior to the next flight.

CAUTION

If normal aircraft electrical power or external electrical power is not available, shut down the INS. When the INS shifts to its battery pack, INS operation will deplete a battery pack in 15-30 minutes.

Shutdown Procedure

1. Pull out and rotate the mode selector to OFF.

2. On the CDU, the displays are blank, annunciators and pushbuttons are OFF.

Flight Director System
(Aircraft #2)

A Flight Director (FD) system is installed in Aircraft #2 to provide headdown guidance during a precision instrument approach. The system consists of a control panel, test panel and incorporates the pilot's ADIs and VAMs. This FD system has two operational modes: Approach and Go-Around. The ADI only is used during ILS and TALAR approaches; However during Go-Around the ADI and VAMs are utilized.

The Flight Director system requires an operative radio altimeter for approaches and will operate with or without SCAS. There is no provision for ground testing.

Flight Director Control
Panel

The flight director control panel (figure 1-74A), located on the pilots' pedestal provides controls and indicators for the various functions of the flight director as follows:

ENGAGE Switch/Light - The press-to-engage/press to-disengage (green) ENGAGE switch is used to engage (arm) the flight director for all three operational modes and to disengaged it. For flight director guidance on approach, ILS or TALAR must be selected with the navigation selector switch and the flight director engaged. For go-around guidance, the flight director may be engaged with the navigation selector switch in any position and the FD engaged.

RADIO ARM LIGHT(amber) - Comes on to indicate that the flight director system is armed for ILS or TALAR LOC and/or G/S capture. When on, the flight director is engaged and remains on until both LOC and G/S have captured.

LOC CAPT light(green) - Comes on to indicate localizer capture. This may be confirmed by the appearance of the roll steer bar on both ADI's. At this time, if the roll SCAS had been engaged and in Heading Hold modes, heading hold would disengaged.

G/S CAPT light(green) - Comes on to indicate glideslope capture. This may be confirmed by the appearance of the pitch or path steer bar on both ADI's. At this time, if the pitch SCAS had been engaged and in the Altitude Hold Mode, Altitude Hold would disengage.

IAS CAPT light(green) - Comes on to indicate that the slow-fast indicator on the ADI is active. This occurs when the airspeed comes to within 5 knots of the approach speed set on the VAM control panel.

G/A LIGHT(green) - Comes on to indicate that the go-around mode of the flight director has been selected with the TakeOff/Go-Around (TO/GA) button on the throttles. The G/A lights on the ADI's will simultaneously come on at this time.

The ADI is described earlier in this section. It's functions that pertain to the flight director system are the pitch(path) and roll steer bars, the slow-fast indicator and the go-around light. Both ADI's present identical flight director information as selected with the navigation selector switch.

PITCH(PATH) STEER BAR - In the ILS or TALAR approach mode, the pitch steer bar comes into view at G/S CAPT and presents glideslope or path deviation. The pitch steer bar atuomatically biases from view at 50 feet radio altitude in the approach mode. In the go-around mode, the pitch steer bar presents pitch guidance to 15 degrees ANU.

ROLL STEER BAR - In the ILS or TALAR approach modes, the roll steer bar comes into view at LOC CAPT and presents localizer deviation. The roll steer bar automatically biases from view at 50 feet radio altitude during a TALAR approach and with weight on wheels during an ILS approcah. The logic behind this is beyond the comprehension of mere mortals. In the go-around mode, the roll steer bar commands Heading Hold.

SLOW-FAST Indicator - Biased from view until the aircraft speed corresponds to the approach speed selected on the VAM control panel. The full scale range of the slow-fast scale is TBD Knots.

Flight Director Normal Operation, ILS or TALAR

To utilize the flight director system for ILS or TALAR approach guidance procced as follows:

1. Place the navigation selector switch in ILS or TALAR position as desired.

If ILS is desired:

2. Select an ILS frequency on the ILS control panel.

NOTE

> There is no ON-OFF/ Frequency switch for the TALAR. With the selector in TALAR and aircraft is within range the ADI's will indicate TALAR information.

3. Select the desired approach speed on the VAM control panel.

4. Set the correct inbound course on the HSI's.

5. Momentarily press the FD ENGAGE switch/light. The ENGAGE and RADIO ARM light should come on.

6. Maneuver the aircraft o intercept the localizer using the raw data. At localizer capture, the roll steer command bar will come into view, LOC CAPT light comes on, and the roll SCAS Heading Hold mode (if engaged) will disengage.

7. Proceed inbound on the localizer until glideslope capture. The G/S CAPT light comes on, the pitch steer bar comes into view, the RADIO ARM light goes off and pitch SCAS Altitude Hold (if engaged) will disengage.

8. As the aircraft speed approaches the selected approach speed, the slow-fast indicator comes into view and the IAS CAPT light comes on.

9. At 50 feet radio altitude the pitch(path) steer bar will bias from view. During TALAR operation, the roll steer bar will also bias from view at 50 feet. During ILS operation, the roll steer bar will bias from view at weight on wheels.

Flight Director Normal Operation, Go-Around

1. Momentarily press the flight director ENGAGE switch to arm the go-around mode.

2. Momentarily press the TO/GA button.

   The G/A lights come on (on both ADI's and on the FD control panel).

3. The pitch steer bar gives pitch guidance for go-around rotation to 15 degrees pitch attitude. The roll steer bar gives Heading Hold guidance.

4. The VAM approach display will be replaced with the G/A display (figure 1-74). The horizontal flight path bar becomes, in effect, a pitch steer command bar and presents the same information as the ADI FD pitch steer bar.

5. Momentarily press the FD ENGAGE switch/light to remove the G/A display in the VAM and FD.

NOTE

The ENGAGE and RADIO ARM lights should come on. The system returns to the Approach Mode.

Auto-Loc (Autopilot) System (Aircraft #2)

In addition to the SCAS pilot relief modes of Heading Hold and Altitude Hold, common to both aircraft, which could be considered autopilot modes; Aircraft #2 has included a split-axis approach mode for use with ILS or TALAR localizer only. In this autopilot mode of the roll SCAS, the SCAS will automatically capture and track the desired localizer while the pilot manually controls glideslope deviation and airspeed.

Autopilot Control Panel - The autopilot control panel (figure 1-74A), located on the pilot's pedestal, provides controls and annunciations for use of the LOC-only autopilot mode of the roll SCAS.

AUTO IAS HOLD - Inoperative in this aircraft.

AUTO LOC ARM-CAP - The amber ARM switch/light is a press-to-engage/ press-to-disengage switch/light. The green CAP light is part of the same switch and comes on at localizer capture when the ARM light goes off.

LOC OFF LIGHT - The press-to-reset flashing amber LOC OFF light comes on when the previously captured localizer mode has disengaged. This will intentionally occur at 100 feet radio altitude on an ILS approach and at 300 feet radio altitude on a TALAR approach. The roll SCAS will revert to CWS mode at this time.

Auto-LOC (Autopilot) Normal Procedures

1. Engage roll SCAS.

2. Place the navigation selector switch in the ILS or TALAR position, as desired.

If ILS is desired:

3. Select a valid ILS frequency on the ILS control panel.

NOTE

There is no ON-OFF/ FREQUENCY switch for the TALAR.

4. Select the correct inbound course of the Pilot's HSI.

5. Momentarily press the Auto Loc ARM switch. The amber ARM light should come on.

6. Maneuver the aircraft to intercept the localizer using raw data. At localizer capture, the ARM light goes off and the green CAP light comes on. The roll SCAS will automatically complete the localizer intercept and commence localizer tracking until 100 feet radio altitude for ILS (300 feet for TALAR) at which time the roll SCAS will revert to the CWS Mode.

INTERCOM PANELS

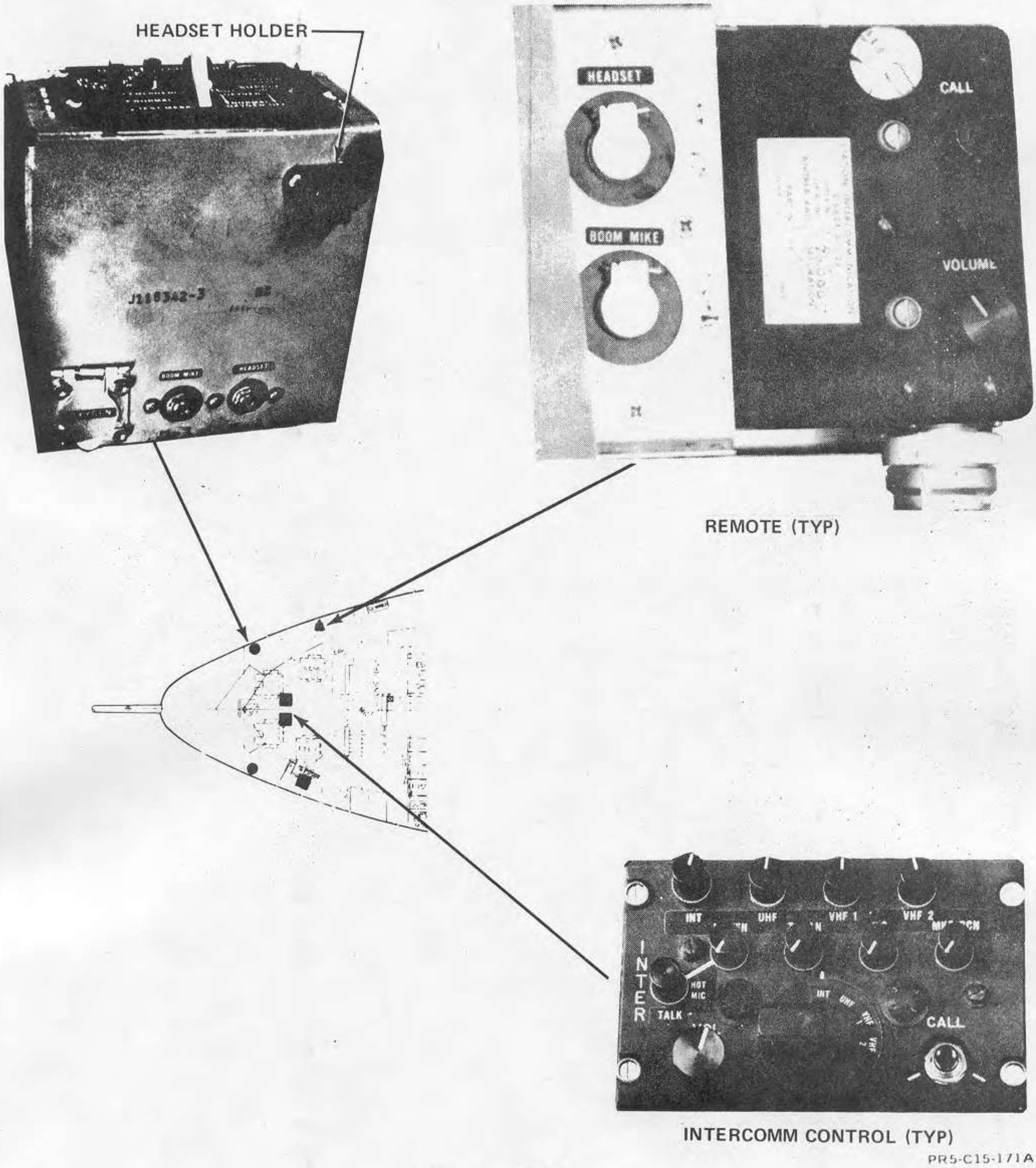
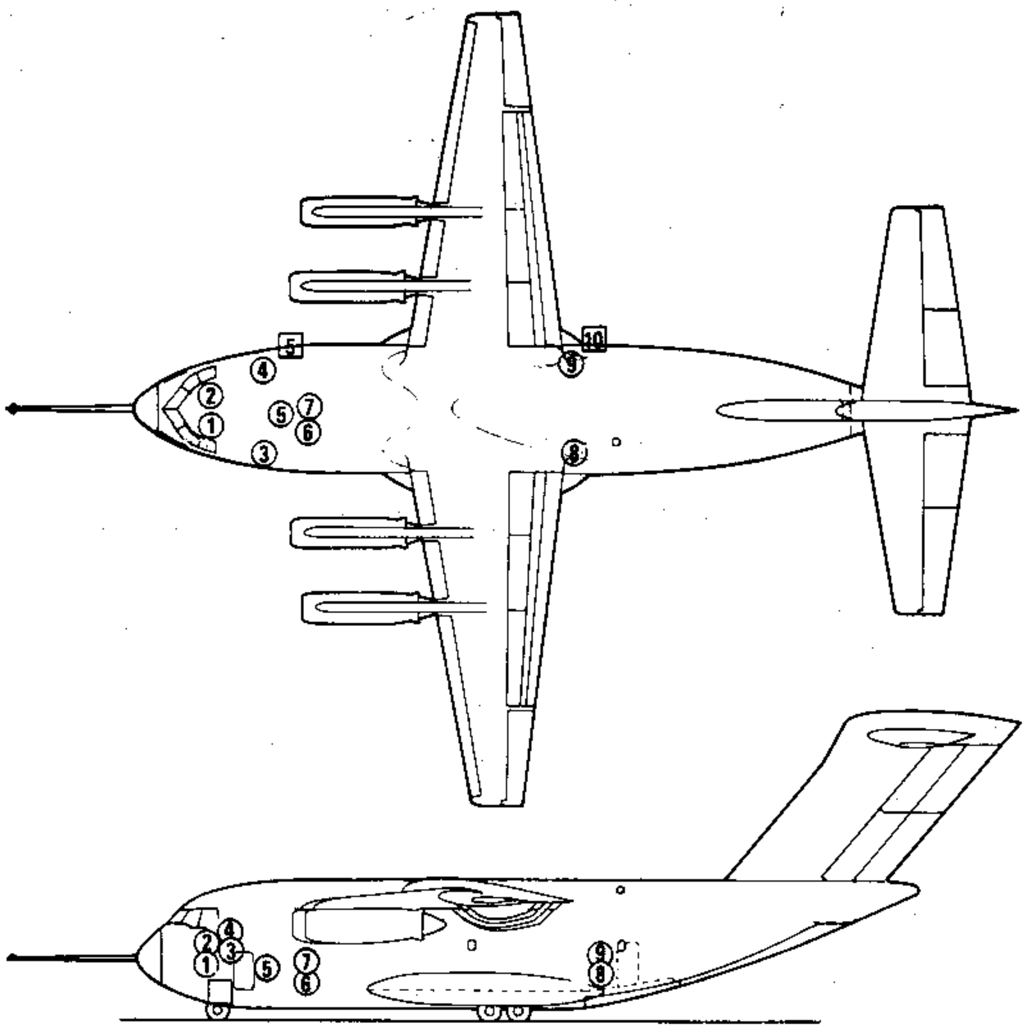


Figure 1-76

INTERPHONE JACK RECEPTACLE LOCATIONS

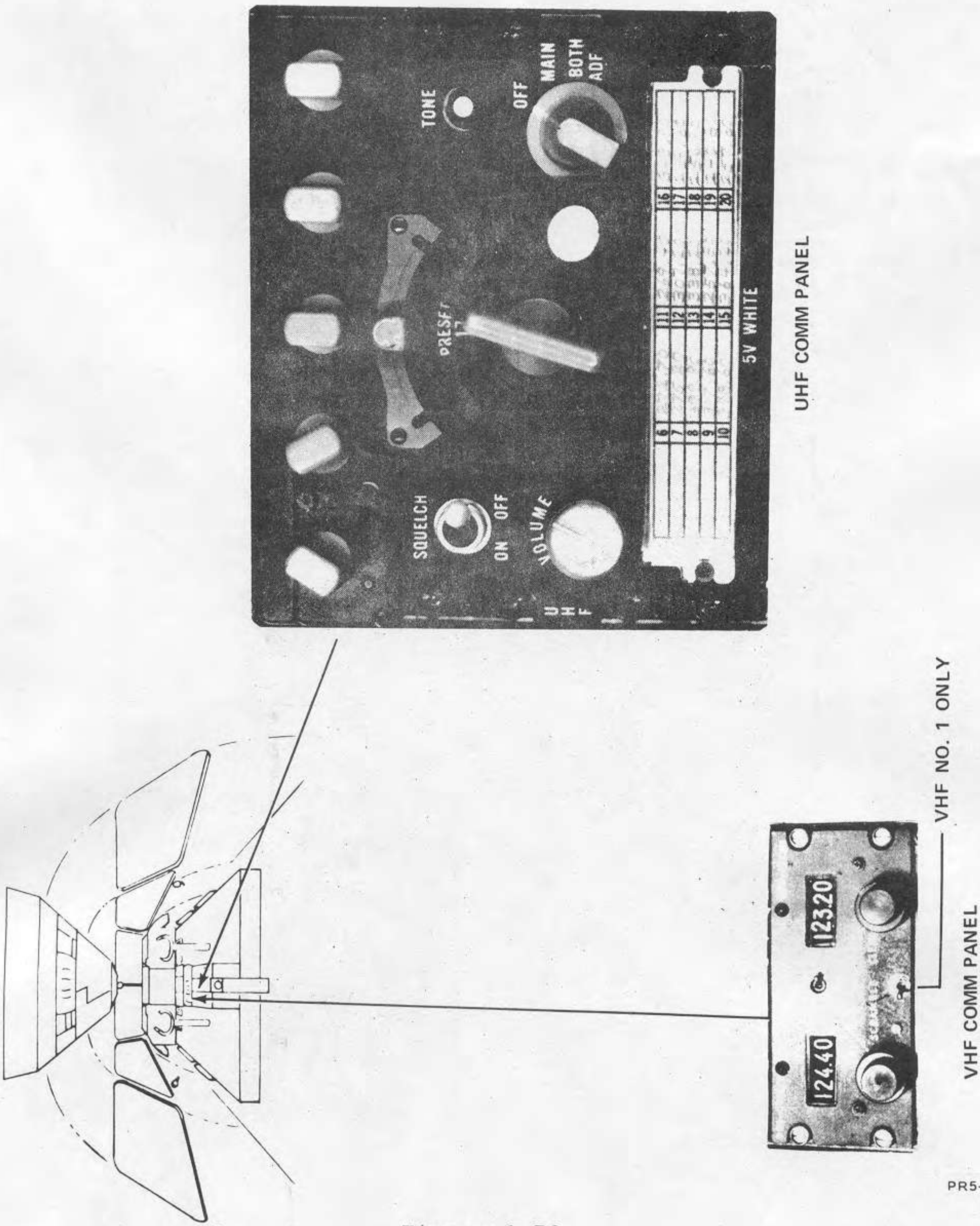


STATION	①	PILOT		(CONTROL SET)
STATION	②	CO-PILOT		(CONTROL SET)
STATION	③	FLT TEST ENGINEER		(CONTROL SET)
STATION	④	ACM		(REMOTE SET)
POSITION	[5]	EXTERNAL ELECTRICAL		(HEADSET AND MIC ONLY)
STATION	⑤	EXTERNAL – NOSE		(REMOTE SET)
STATION	⑥	FLT DEV DIGITAL	NO. 1	(REMOTE SET)
STATION	⑦	DATA SYSTEM	NO. 2	(REMOTE SET)
STATION	⑧	CARGO DOOR		(REMOTE SET)
STATION	⑨	TROOP DOOR		(REMOTE SET)
STATION	[10]	EXTERNAL GND REFUEL		(REMOTE SET)

PR5-C15-172A

Figure 1-77

COMM PANELS



PR5-C15-173B

Figure 1-78

NAV CONTROLS AND INDICATORS

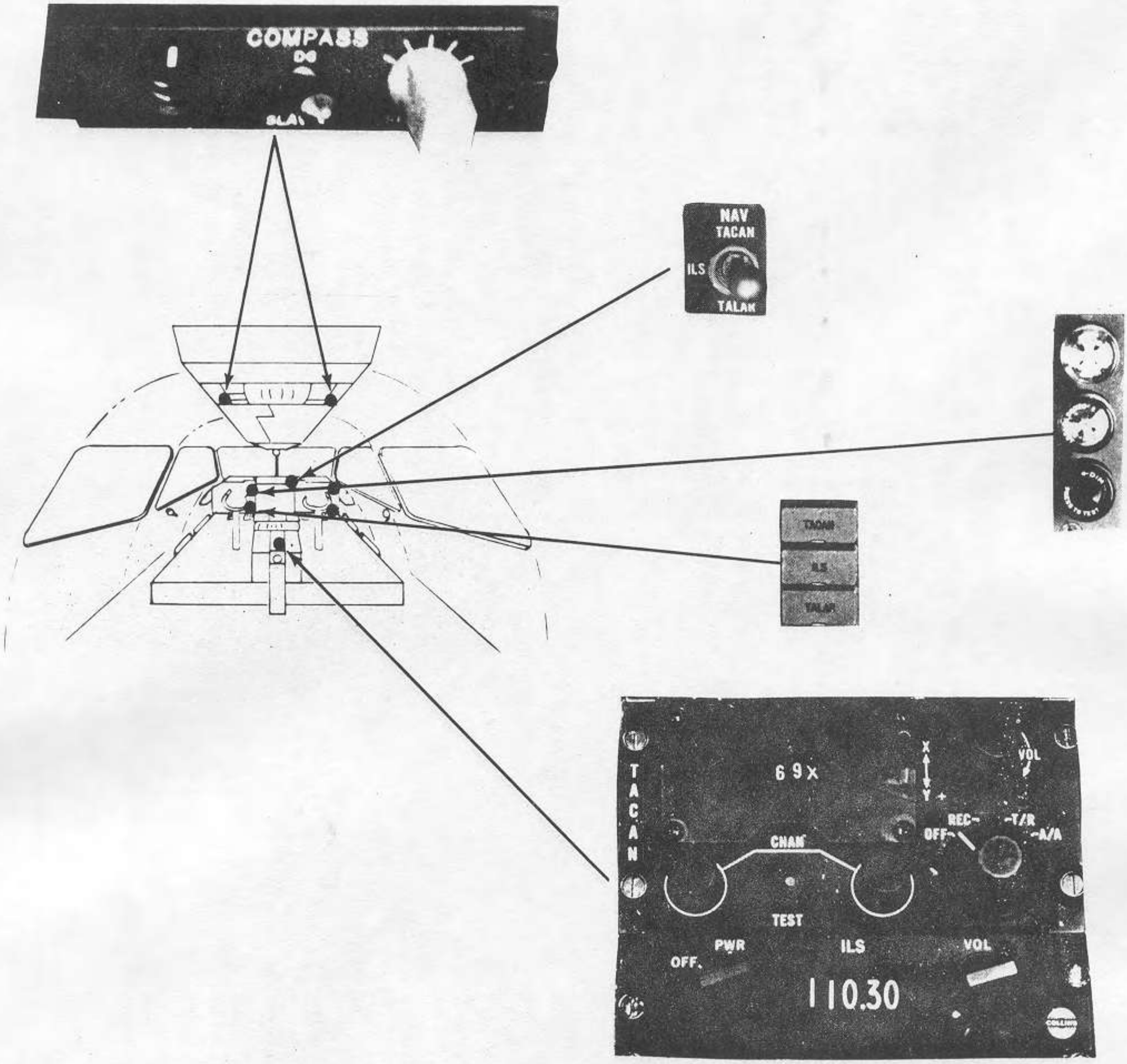


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Figure 1-79

IFF RADAR CONTROLS (APX-72)

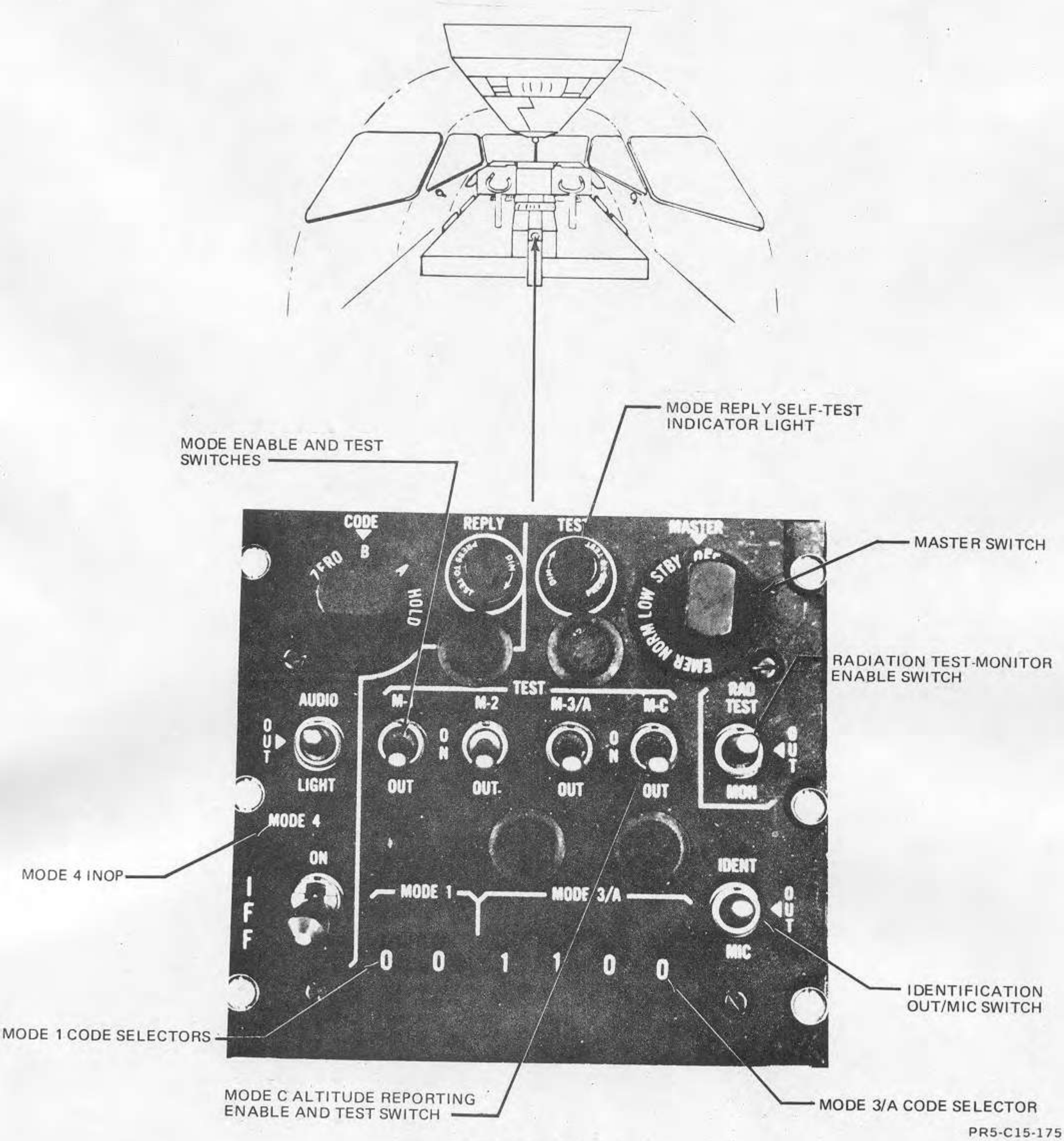
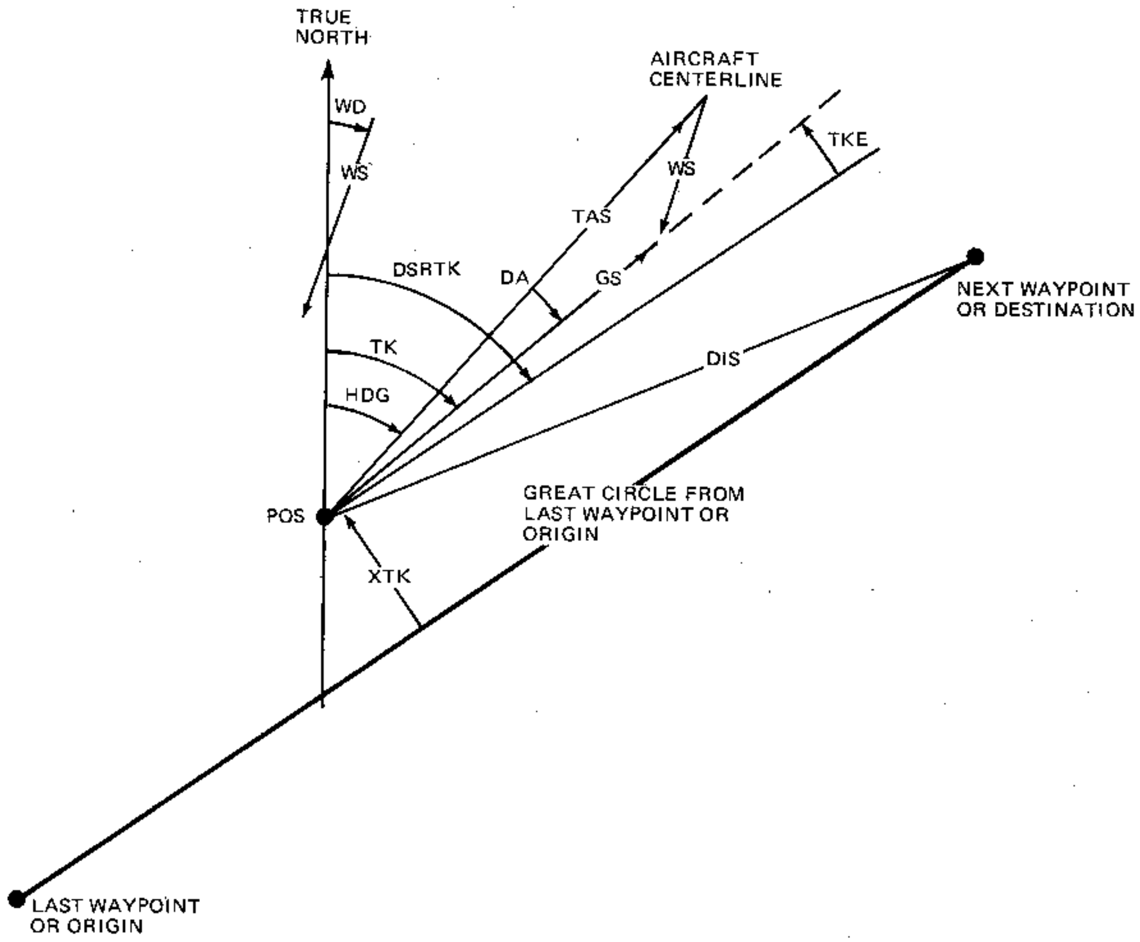


Figure 1-80

NAVIGATION DATA RELATIONSHIP



LEGEND:

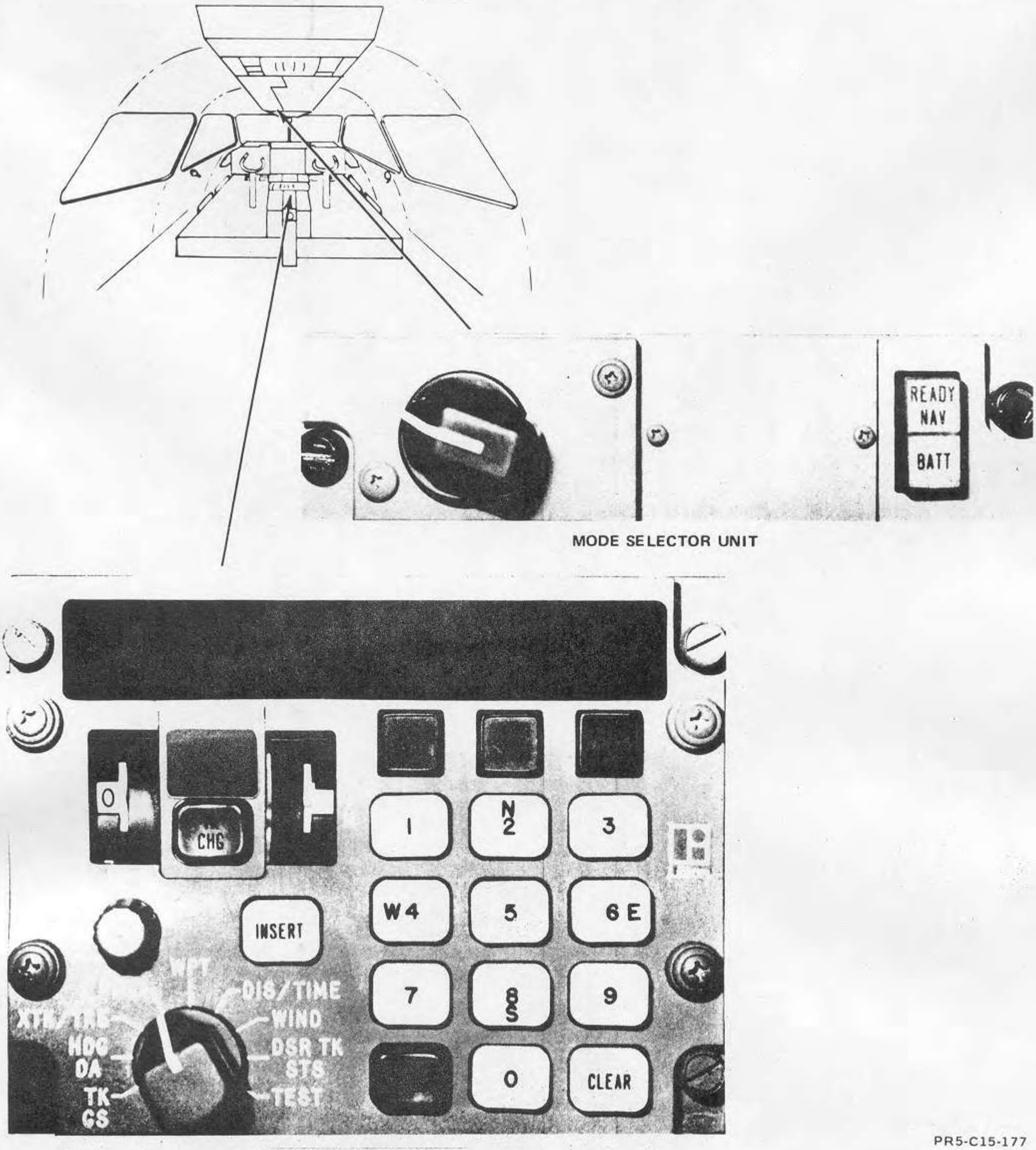
HDG ...... TRUE HEADING
TAS....... TRUE AIRSPEED
WS .... WIND SPEED
WD....... WIND DIRECTION ANGLE
TK. ...... GROUND TRACK ANGLE
GS........ GROUND SPEED
DA........DRIFT ANGLE
DSRTK.... DESIRED TRACK ANGLE
XTK ...... CROSS TRACK DISTANCE
TKE.......TRACK ANGLE ERROR
POS ...... PRESENT POSITION
DIS .... GREAT CIRCLE DISTANCE FROM POS
TO NEXT WAYPOINT OR DESTINATION

TIME EQUAL TO $\frac{DIS}{GS} \times 60$

PR5-C15-176

Figure 1-81

INS CONTROLS AND INDICATOR



MODE SELECTOR UNIT

CONTROL DISPLAY UNIT

Figure 1-82

CREW ENTRANCE DOOR

The crew entrance door provides access to the forward cargo area and the flight compartment. The door is on the forward left side of the fuselage and opens out and downward. The door assembly basically consists of a latching mechanism, telescoping support strut, crank and cable assembly, locking latches, steps and indicating circuit.

Door Exterior Latch-Uplatch Handle

A latch-unlatch handle (figure 1-83), located on the forward edge of the door outside, provides a means of latching-unlatching the door from outside the aircraft. There are two handles labeled PULL and PUSH. Pushing the PUSH handle first, allows access to the PULL handle. Pulling the PULL handle will unlock the door and it will open by gravity.

WARNING

Do not pull this handle until aircraft is de-pressurized.

Door Interior Latch-Unlatch Lever

A latch-unlatch lever (figure 1-83), located on the forward side of the steps, provides a means to latch and unlatch the door from inside the aircraft. When the door is closed and the lever is moved up, eight bayonet-type latches lock the door against a rubber seal installed around the perimeter of the door jam. This latching mechanism is attached to the flush mounted door exterior latch-unlatch handle.

Crank and Cable Assembly

A crank and cable assembly (figure 1-83), located just aft of the door jam, provides a means of closing the door from inside. The cable is attached to the forward edge of the door and acts as a counter-balance for the door.

Telescoping Support Strut

A telescoping support strut (figure 1-83) is attached to the forward corner of the door to provide support for the door in the fully open position. Also it limits the door travel. It may also be used as a handrail by personnel. When the door is closed, one section of the support strut retracts into itself for convenient storage.

Door Locking Latches

There are eight bayonet-type door locking latches (figure 1-83), four on each side of the door. When the latching lever is moved up, all eight bayonet latches move toward their respective door jam latches. When the latch lever is fully up, a red stripe on each bayonet latch will line up with the centerline of its stationary latch. A quick glance can verify that each bayonet latch is in place.

Door Caution Lights

The DOOR NOT LOCKED light (figure 1-86), located on the overhead annunciator panel, the CREW L FWD light, located on the flight test engineer's panel and the MASTER CAUTION lights should come on when the crew entrance door is not locked. The lights receive 28 VDC power from the RIGHT DC bus through the DOOR INDICATION circuit breaker (AF-21) on the EPC panel.

Crew Entrance Door - Normal

Operation

To open from outside:

1. Verify that the aircraft is depressurized.

NOTE

Aircraft depressurization will be confirmed by voice communication with flight crew or by observing an open clearview window, troop jump door or cargo ramp and door.

2. Push in the PUSH handle for access to the PULL handle.

3. Hold door with other hand and then pull up on PULL handle and ease the door to open position.

WARNING

Door will open by gravity and could cause personnel injury when pull lever is pulled if door is not held closed.

To close from outside:

1. Lift and hold door to closed position.

2. Push down and in on PULL handle until it is flush with skin.

To open from inside:

1. Verify aircraft is depressurized.

2. Check with outside that there are no obstructions.

3. Take a firm grip on the crank and pull the latch-unlatch lever inboard and down.

4. With a cranking motion, open the door until it stops.

NOTE

Do not try to ride the door to the open position.

To close from inside:

1. With a cranking motion, close the door until it stops.

2. Pull the latch-unlatch lever up and outboard until it stops.

3. Check that each bayonet latch red line is aligned with the centerline of the stationary latch.

NOTE

The door caution light switch is located below the aft #2 stationary latch and if the bayonet latch is not fully extended the DOOR NOT LOCKED CREW L FWD and MASTER CAUTION lights will be on.

Troop Jump Door

A paratroop jump door is located on the aft right side of the fuselage. This door can be used in flight or ground operation. The door has six manual latches and is actuated by a hydraulic cylinder attached to a hinged and mechanically linked jump platform attached to the door. The troop jump door assembly basically consists of a door hinged at the forward edge, platform, hydraulic actuating cylinder, hydraulic hand pump, controls and indicating circuit.

The door can be manually opened on the ground for emergency exiting, however, hydraulic power is required for closing. Normally, the door is powered by aircraft hydraulic system 4 (figure 1-87). When system 4 is depressurized, a hand pump can be utilized for opening and closing.

Door Interior Latching Lever

A latch-unlatch lever (figure 1-84), located on the upper center of the door, provides a means to latch and unlatch the door from inside the aircraft. When the door is closed and the lever is moved down, six bayonet type latches on the trailing edge of the door extend into the door sill and locks the door. This latching mechanism is also attached to a flush mounted outside handle. The latching mechanism has a detent in the open position which prevents the lever from being blown toward the closed position.

Door Exterior Latch - Unlock Handle

A latch-unlatch handle (figure 1-84), located on the bottom edge of the door outside, provides a means of of latching-unlatching the door from the outside. There are two handles labled PUSH and PULL. Pushing the PUSH handle first, allows access to the PULL handle. Pulling the PULL handle will unlock the door.

Jump Platform

A jump platform (figure 1-84) is hinged at the door jamb and is mechanically linked to the door. When the door is closed the platform will rotate up and inward giving clearance for the closing door. When the door is open, the platform rotates down and outward to act as a base for personnel to stand on.

Door Hydraulic Hand Pump

A hydraulic hand pump (figure 1-85), located forward of troop door, provides a means of pressurizing the door hydraulic cylinder for opening and closing the door when there is no electrical or hydraulic power.

Troop Door Control Panel

A troop door control panel (figure 1-85) is located just forward of the troop door. It consists of a hydraulic pressure indicator, a placard for hand pump troop door operation and a two position selector lever, CLOSE - OPEN. The hydraulic pressure indicator requires no electrical power for operation. It shows the hydraulic pressure in the troop door hydraulic system and does not necessarily reflect aircraft hydraulic system #4 pressure (figure 1-85). The selector lever provides a means of selecting the desired position of the door.

Door Shutoff Valve Control

A door isolation shutoff valve control switch (figure 1-85), located forward of the door and troop door control panel, provides a means of isolating the troop door hydraulic system from aircraft hydraulic system. The valve is electrically operated but can be overridden manually when electrical power is lost. The valve solenoid receives 28 VDC power from the RIGHT DC bus through the CARGO DOOR/RAMP CONT circuit breaker (AE-21) on the EPC panel.

TEMPORARY REVISION XI

SECTION I (DESCRIPTION AND OPERATION)

1. Page 1-207, Rev. 003 24 Jan. 1977

   a. Under "Troop Door Normal Operation Aircraft Inflight paragraph 1 CAUTION" add the following paragraph:

      Do not open the Troop Jump Door unless the Cargo Door Manual Control Lever is in CLOSE position or Cargo Door is already open.

   b. Under paragraph 7:

      Delete the NOTE and pen in the word CAUTION.

      Pen in the word NOTE as the title of the second paragraph.

Door Caution Lights

The DOOR NOT LOCKED light (figure 1-86) located on the overhead annunciator panel, and TRP R AFT (troop right aft) light, located on the flight test engineer's panel, and the MASTER CAUTION lights should come on when the troop door is not latched. The lights receive 28 VDC power from the RIGHT DC bus through the DOOR INDICATION circuit breaker (AF-21) on the EPC panel.

Troop Door Normal Operation

Aircraft Inflight:

Prior to door operation, establish communications with flight compartment.

1. Verify that aircraft is depressurized and airspeed is below troop jump door limiting airspeed.

CAUTION

Do not open troop door if aircraft is pressurized or if door open limiting airspeed is exceeded. ← TR-11-

NOTE

Aircraft depressurization will be confirmed by voice communication with flight crew.

2. Place CONT PNL SELECT switch, located in forward CARGO DOOR/RAMP CONTROL panel on escape chute structure, in AFT position.

3. Verify troop door lever is in CLOSE.

4. Place HYD PRESS switch, located in aft CARGO DOOR/RAMP CONTROL panel, in ON position.

5. Check hydraulic pressure indicator, located in troop door control panel, is in normal operating range. Pressure should be 2700 PSI or more.

6. When ADS static line is required, pull out the ADS static line cable anchor support and pin it in the extended position.

7. Rotate the latch-unlatch lever, located in the upper center of the door, aft and up. Check that each bayonet latch is free of its stationary latch.

~~NOTE~~ CAUTION

If the Troop Jump Door and Cargo door/ramp are to be opened, open the cargo door/ramp first. TR-11

NOTE

As the door unlocks, the pilot's DOOR NOT LOCKED and MASTER CAUTION lights and flight test engineer's TRP R AFT light should come on.

8. Rotate the TROOP DOOR VALVE lever, located on the troop door control panel, to the OPEN position.

Door Closing:

1. Verify that the latch-unlatch lever is still in the unlatched position.

CAUTION

Do not close the troop door unless

the lever is in the unlatched position. If it is any other position, one or more bayonet latches could damage the door jamb.

2. When clearance is received, rotate the TROOP DOOR VALVE lever to the CLOSED position. When the door is closed, leave the lever in the CLOSED position.

3. Rotate the latch-unlatch lever down to the LATCHED position. Check that each bayonet latch red line is aligned with the centerline of its stationary latch.

NOTE

The door caution light switch is located below the #2 stationary latch and if the bayonet latch is not fully extended, the DOOF NOT LOCKED, TRP R AFT and MASTER CAUTION lights will be on.

4. Place the HYD PRESS switch in OFF position.

5. If ADS static line was used, stow and pin the ADS static line cable anchor support.

6. Place the CONT PNL SELECT switch, located in forward CARGO DOOR/RAMP CONTROL panel in OFF position.

Troop Door Operation with Hydraulic System #4 Depressurized

Prior to door operation, establish communications with flight compartment.

1. If electrical power (RIGHT DC bus):

   a. is available - verify the PANEL SELECTOR switch, located in forward CARGO DOOF/RAMP CONTROL panel on escape chute structure, is in AFT position. Place HYD PRESS switch, located in aft CARGO DOOR/RAMP CONTROL panel, in ON position.

   b. is not available - select the OPEN position of the door ISOLATION SHUTOFF VALVE, located forward of the troop door control panel.

2. When ADS static line is required, pull down the ADS static line cable anchor support and pin in the extended position.

3. Verify that aircraft is depressurized.

CAUTION

Do not open troop door if aircraft is pressurized or if door open limiting airspeed is exceeded.

4. Rotate the latch-unlatch lever aft and up. Check that each bayonet latch is free of its stationary latch.

5. Rotate the TROOP DOOR VALVE lever to OPEN position.

6. Using the hydraulic hand pump, pump the door open. When the

door is fully open, the hydraulic pressure should build up to 3000 PSI or more.

NOTES

When the door is opening and the hand pump is used, the hydraulic pressure indication will fluctuate.

If electrical power is available, the door caution lights will operate normally. If electrical power is not available the lights will remain off.

Door Closing:

1. Verify that the latch-unlatch lever is still in the unlatched position.

CAUTION

Do not close the troop door unless the lever is in the unlatched position. If it is any other position, one or more bayonet latches could damage the door jamb.

2. When clearance is received, rotate the TROOP DOOR VALVE lever to CLOSED position.

3. Using the hand pump, pump the door closed. When the door is fully closed, the hydraulic pressure should build up to 3000 PSI or more.

4. Rotate the latch-unlatch lever down and forward to the latched position. Check that each bayonet latch red line is aligned with the centerline of its stationary latch.

5. If electrical power:

   a. is available, place HYD PRESS switch in OFF position.

   b. is not available, select the CLOSED position of the ISOLATION SHUTOFF VALVE.

6. If ADS static line was used, stow and pin the ADS static line cable anchor support.

7. Place the PANEL SELECTOR switch in OFF.

Troop Door Operation Without Hydraulic and/or Electrical Power

When conditions exist that require opening the troop door without hydraulic and/or electrical power provide as follows:

1. Verify that the aircraft is depressurized.

2. Rotate the latch-unlatch lever aft and up.

3. Rotate the TROOP DOOR VALVE lever to the OPEN position.

4. Push the door open.

NOTE

Hydraulic power is required to close the door. The door caution lights will be inoperative if the RIGHT DC bus is without power.

CARGO DOOR AND RAMP SYSTEM

The cargo door and ramp, providing

entry for wheeled vehicles and large loads, are used for load exiting during aerial delivery system operations. The cargo door and ramp assembly consist basically of cargo door, ramp, ramp toes, anti-tipover struts, hydraulic actuating cylinders, locks - mechanical and hydraulic, cargo door uplock emergency release handle, hydraulic hand pump, controls and indicating circuits.

The door and ramp are normally hydraulically operated through aircraft hydraulic system #4 (figure 1-88). Also the hydraulic pressure can be supplied by a hand pump using the aircraft hydraulic system #4 fluid.

Control of the system is either electrical or manual. Automatic sequencing of the control valve is accomplished electrically. A switch controls both cargo door and ramp operation in the correct sequence. The electrical control system has two panels; forward, located on the left side of the emergency escape chute structure; and aft, located forward of the troop door. The manual controls are located above the aft electrical control panel.

Cargo Door

The cargo door (figure 1-88), located aft of the ramp, is hinged at the aft end, permitting the door to open inward and upward, providing a large opening for loading and unloading of cargo or equipment. Latch hooks along each side encounter latch assemblies on the side of the door jamb and firmly secure the door by engaging the latch hooks when the door is closed. The cargo door is normally controlled by the cargo door/ramp controls.

Ramp

The ramp (figure 1-90), located at the aft end of the cargo deck, is hinged at the forward end, permitting the ramp to open outward and downward providing a means for loading and unloading cargo or equipment during ground and inflight operations. Tiedown fittings, roller conveyor trays, and LAPES towplates are included in the ramp. The ramp is opened and closed hydraulically by an actuator at each aft outboard side. Stowable telescoping aerial delivery system links are included to assist in supporting and limiting the ramp travel in the aerial delivery (cargo floor level) position.

The ramp is provided with a hydraulically powered latch system with six latches to a side, to lock the ramp in a closed position. The two sides (latching system) are not mechanically bused together and each side is interlocked with a vent door in the ramp skin which prevents aircraft pressurization if the ramp latches are not locked.

Toes

For ground operations the aft end of the ramp has two ramp toes (figure 1-88) installed which fold down when the ramp is lowered to provide a continuous surface from the ground to the cargo floor. This permits driving vehicles directly into the main cargo compartment. When the ramp is closed, the toes fold up into the aircraft (aircraft #1 mechanically; #2 hydraulically). For aerial delivery system operation the toes are removed and stowed in the aircraft.

Stabilization Struts
(Aircraft #2 Only)

Two stabilization struts, one located in the aft end of each wheel pod, provides a means of preventing the aircraft from tipping over when cargo is being loaded. An access door is provided to pull the strut aft and down into position. An instruction placard is mounted on the strut giving detailed operating instructions:

To extend: Close silver knob valve fully. Place strut in vertical position. Depress blue (lock) lever and allow cylinder to extend to ground.

To retract: Open silver knob (bypass) valve 1-1/2 turns. Push cylinder up to lock.

To stow: Lock cylinder in retracted position. Open silver knob (bypass) valve to stop. Rotate cylinder to horizontal position. Push forward on cylinder until its in the aircraft. Close and secure access door.

Aerial Delivery System (ADS) Links

Stowable slotted aerial delivery system links are attached to each side of the ramp just aft of the actuating cylinder. The ADS links, when attached, will limit the ramp position level with the cargo deck and help support the ramp for air drop operation. A ramp position light switch is installed on the left ADS link to activate when the ramp is in the airdrop position (the ADS links are extended to their limits).

Cargo Ramp Manual Control Knob

The ramp manual control rotary selector knob (figure 1-89) is located above the TROOP DOOR CONTROL panel and the AFT CARGO DOOR/RAMP CONTROL panel. It may be set to any of 6 numbered positions: 1. (uplock); 2. (lower); 3N. (neutral); 4. (raise); 5. (lock); and 6N. (neutral). These settings of the knob manually position the system valves which control flow, supplied either from the hand pump or aircraft hydraulic system #4, to and from the ramp uplock and ramp actuating cylinders. The following table lists the knob selection and the actions.

Position	Action
1 (Uplock)	Hydraulic pressure is directed to the up-side of the ramp actuating cylinders to raise the ramp off of the uplocks; while pressure is directed to the unlock side of the ramp uplock cylinders to unlatch the ramp uplocks.
2 (Lower)	Hydraulic pressure is directed to the down side of the ramp actuating cylinders to lower the ramp.
3 (Neutral)	A neutral position.
4 (Raise)	Hydraulic pressure is directed to the upside of the ramp actuating cylinders to raise the ramp.
5 (Lock)	Hydraulic pressure is directed to the lock

	side of the ramp uplock cylinder to lock the ramp in the closed position.
6 (Neutral)	A neutral position. Leave in this position when not in use for proper electrical automatic sequencing.

Cargo Door Manual Control Lever

TR-11

The cargo door manual control lever (figure 1-89), located adjacent to the cargo ramp manual control knob, has three positions: OPEN-NEUT-CLOSE. When the lever is placed in OPEN position, hydraulic pressure is directed to the four door down latch cylinders and to the upside of the cargo door actuating cylinder. Simultaneously, pressure extends the uplatch actuating cylinders locking the door up when it is fully open. The cargo door uplock latches are spring-loaded to the locked position if hydraulic system pressure should fail. When the door lever is placed in the NEUTRAL position, hydraulic pressure is shut off from the door system and must be left in this position for proper electrical control operation. When the lever is placed in CLOSE position, hydraulic pressure is directed to uplatch actuating cylinders and unlocks the latches. When the uplock latches are open, a mechanical sequencing check valve permits pressure to the down side of door actuating cylinder. Simultaneously pressure is directed to the down side of the door actuating cylinders. When the door is fully closed, the down locks are triggered over center, locking the door closed.

TR-11

Cargo Door Uplock Emergency Release Handle

A cargo door uplock emergency release handle (figure 1-89), located aft of the cargo manual control panel, provides a means of closing the cargo door in an emergency. When pulled, it mechanically unlocks the uplocks.

Troop Door and Cargo Door/Ramp Hydraulic Hand Pump

A hydraulic hand pump (figure 1-89), located just below the TROOP DOOR control panel, provides an alternate pressure source to operate the TROOP DOOR and CARGO DOOR/RAMP in an emergency or if hydraulic system #4 is not pressurized.

Troop Door and Cargo Door/Ramp Hydraulic Shutoff Valve

A hydraulic shutoff valve (figure 1-89), located forward of the cargo ramp manual control panel, provides a means is isolating the troop door and cargo door/ramp hydraulic system from aircraft hydraulic system #4. This valve is normally operated by the HYD PRESS switches; however, it can be manually moved to OPEN or CLOSE position when electrical power is not available.

Cargo Door and Ramp Electrical Controls and Indicators

There are two CARGO DOOR/RAMP CONTROL panels (figure 1-89), designated FWD and AFT. The FWD control panel is located on the emergency escape chute structure and should be used during air drop operations. The AFT control panel is located just forward of the TROOP DOOR and may be used for both flight and ground operations.

Control Panel Selector

TEMPORARY REVISION XI

SECTION I (DESCRIPTION AND OPERATION)

2. Page 1-212 Rev. 001 15 Aug 1975

   a. Under "Cargo Door Manual Control Lever", after "OPEN-NEUT-CLOSE", add the following sentence:

      This lever should always be left in the CLOSE position except when operating the Cargo Door/Ramp.

   b. Delete the word "left" in the 21st line of the paragraph.

Switch

A three position CONT PNL SELECT switch (figure 1-89) located on the forward CARGO DOOR RAMP CONTROL panel, provides a means of selecting the panel, FWD or AFT, from which to control the door and ramp. When in FWD, the forward control panel switches are energized. The OFF position disables the electrical control system. When in AFT, the control is shifted to the aft control panel. The CONT PNL SELECT switch receives 28 VDC power from the RIGHT DC bus through the CARGO DOOR/RAMP CONT circuit breaker (AE-21).

Hydraulic Pressure Switches

Two HYD PRESS switches (figure 1-89), one on the forward panel and one on the aft panel, have two positions, ON-OFF. The ON position opens the isolation shutoff valve. This allows aircraft hydraulic system 4 to pressurize the door/ramp system. The OFF position closes the isolation shutoff valve, isolating the cargo door/ramp hydraulic system from aircraft hydraulic system 4. These switches are in series with the CONT PNL SELECT switch. The CONT PNL SELECT switch must be in the desired position in order for the respective HYD PRESS and DOOR/RAMP switches to function.

Door/Ramp Control Switches

Two DOOR/RAMP control switches (figure 1-89), one located on the forward control panel and one located on the aft control panel, have three positions, OPEN-OFF-CLOSE. When the switch is in OPEN, the cargo door control valve is energized directing hydraulic pressure to the door down latch cylinders, while pressurizing the up side of the cargo door actuating cylinder. Simultaneously, pressure extends the uplatch actuating cylinders locking the door when it is fully up.

Then the switches located on the uplock are activated, energizing the ramp position and ramp uplock control valves simultaneously. This directs hydraulic pressure to the upside of ramp actuating cylinders and to the unlock side of the ramp uplock actuating cylinders until the uplock is unlatched. Another set of switches are then actuated on ramp unlocking and energize the ramp position valve to direct hydraulic pressure to the down side of the ramp actuating cylinder, lowering the ramp and extending the attached toes. When the panel mounted control switch is in OFF, the hydraulic pressure is shut off and the electrical sequencing circuits are de-energized. When the panel mounted control switch is in CLOSE, the reverse action of the OPEN position will occur.

Cargo Door/Ramp Not Locked Caution Light

An amber DOOR/RAMP NOT LOCKED caution light (figure 1-89), located on the forward control panel, comes on when either the cargo door and/or ramp are not locked. It also turns on the flight test engineer's CARGO or RAMP light, as applicable, and the pilots' annunciator panel DOOR NOT LOCKED and MASTER CAUTION lights. This light circuitry is powered by 28 VDC RIGHT DC bus through the DOOR INDICATION circuit breaker (AF-21).

Air Drop Position Light

The green AIR DROP POSITION light (figure 1-89), located on the forward control panel, comes on when the ramp is in the air drop position. When ADS links are attached to the ramp, the ramp's extension is limited to the cargo floor level position for aerial delivery. When the ramp extends to links limit, a switch is activated to illuminate the AIR DROP POSITION light.

Cargo Door Not Locked
Caution Light

An amber DOOR NOT LOCKED light (figure 1-89), located on the aft control panel, comes on when the cargo door is not locked. It also turns on the forward panel DOOR/RAMP NOT LOCKED, flight test engineer's CARGO, pilots' annunciator DOOR NOT LOCKED and MASTER CAUTION lights.

Cargo Door Up and Locked
Position Light

A green cargo DOOR UP AND LOCKED light (figure 1-89), located on the aft control panel, comes on when the door is fully up and locked.

Cargo Ramp Not Locked
Caution Light

An amber RAMP NOT LOCKED light (figure 1-89), located on the aft control panel, comes on when the ramp is not fully locked. Two limit switches, located on either side of the ramp latch torque tubes, will turn on this light if both are not activated. Also the flight test engineer's RAMP and pilot's annunciator DOOR NOT LOCKED and MASTER CAUTION lights will come on.

Cargo Door/Ramp Normal
Operation

Aircraft on ground. Electrical and hydraulic power is available.

Opening Door and Ramp:

1. Verify that area is clear.

2. Verify that hydraulic system 4 is pressurized (pilots' hydraulic pressure indicator).

3. On forward CARGO DOOR/RAMP CONTROL panel, place the PANEL SELECTOR switch in AFT position.

4. Verify that both ADS static line cable anchor supports are pinned in stowed position.

NOTE

When ADS static line cable anchor supports are NOT pinned in the stowed position, the CARGO DOOR/RAMP CONTROL panels are electrically inoperative on the ground.

5. Place the HYD PRESS switch, on aft panel, in ON position. Check hydraulic pressure indicator is in normal operating range (2700 PSI min).

6. Disconnect the ADS links by removing the pip pin and bolt. This allows the ramp to fully open.

TR-11

8 7. Hold DOOR/RAMP switch in OPEN position.

NOTE

The DOOR NOT LOCKED light should come on. When door is fully open, the DOOR UP AND LOCKED should come on. The RAMP NOT LOCKED light should come on.

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SECTION I (DESCRIPTION AND OPERATION)

3. Page 1-214 Rev. 001 15 Aug 1975

   a. Add the following new step at the end of step 6:

      7. Place the Cargo Door Manual Control Lever in NEUTRAL position.

   b. Renumber the old step 7 to 8.

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SECTION I (DESCRIPTION AND OPERATION)

4. Page 1-215 Rev. 002 20 Feb 1976

   a. Remember step 8 to 9.

   b. Under "Closing Ramp and Door (Aircraft on Ground)", add the following new step at the end of step 5:

      6. Place the Cargo Door Manual Control Lever in CLOSE position.

   c. Renumber step 6 to 7 and 7 to 8.

8. When the ramp is down, release the DOOR/RAMP switch. The toes should be extended and resting on the ground.

NOTE

As the ramp opens, the toes will rotate aft and downward.

Closing Ramp and Door (Aircraft on Ground)

1. Verify that area is clear.

2. Verify that CONT PNL SELECT switch on forward panel is in AFT position.

3. Verify that HYD PRESS switch, on AFT panel, is in ON position.

4. Hold DOOR/RAMP switch in CLOSE position. The ramp should start to close and the toes should start to pivot up and inward.

CAUTION

When the ramp is closing, check that the ADS links are free and do not hang up and damage the ramp structurally.

NOTE

When the ramp is closed, the RAMP NOT LOCKED light should go off. When door unlocks, the DOOR UP AND LOCKED light should go OFF. When door is fully closed, the DOOR NOT LOCKED light should go off.

5. When the door is closed, release the DOOR/RAMP switch.

6. Place the HYD PRESS switch in OFF position.

7. Place the CONT PNL SELECT switch on the forward panel in OFF.

Aircraft in flight. Electrical and hydraulic power available.

Opening Door and Ramp:

1. Establish communications with crew.

2. Select the desired control panel.

   a. For forward control panel usage, place the CONT PNL SELECT switch in FWD position.

   b. For aft control panel usage, place the CONT PNL SELECT switch in AFT position.

3. If static lines are required, remove ADS cable anchor pins. Check that anchor arms are not obstructed.

4. Verify that both ADS links are connected to aft end of ramp.

5. Detach, remove and stow the toes.

6. Verify that aircraft is depressurized and airspeed is below cargo door/ramp limiting airspeed.

CAUTION

Do not open cargo door/ramp if air-

craft is pressuri-
zed or if door
open limiting air-
speed is exceeded.

7. Verify that the DOOR/RAMP switch is OFF.

8. Place the HYD PRESS switch in ON position.

9. Check hydraulic pressure indicator, troop door control panel, shows 2700 PSI or more.

TR-11

11 ~~10.~~ Place the DOOR/RAMP switch in OPEN position:

   a. At the forward control panel.

   NOTES

   When the door opens, the DOOR/RAMP NOT LOCKED light should come on.

   The ADS links limit the travel of the ramp. When the ramp extends to the limit, a switch on the left link turns on the AIR DROP POSITION light.

   b. At the aft control panel.

   NOTE

   The DOOR NOT LOCKED, DOOR UP AND LOCKED and RAMP NOT LOCKED lights should come on.

When the ramp extends to the ADS links limit, release the switch. On the forward panel the AIR DROP POSITION light should come on.

CAUTION

When heavy loads are dropped, using aft panel only, hold switch in OPEN during the drop to prevent possible buffeting and load ejection reaction.

Closing Ramp and Door (Aircraft in Flight)

1. When clearance is received and door/ramp area is clear, hold the DOOR/RAMP switch in CLOSE position.

   a. At the forward control panel, when the AIR DROP POSITION and DOOR/RAMP NOT LOCKED lights go off, release the DOOR/RAMP switch to OFF.

   b. At the aft control panel when the DOOR UP AND LOCKED, DOOR NOT LOCKED and RAMP NOT LOCKED lights go off, release the DOOR/RAMP switch.

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3 ~~2.~~ Place the HYD PRESS switch in OFF.

4 ~~3.~~ Re-install the toes.

5 ~~4.~~ At the forward control panel, place the CONT PNL SELECT switch in OFF.

Manual Operation of the Cargo Door and Ramp with the Hand Pump

An instruction plate, located forward of the troop door, is for hand pump operation of the ramp and cargo door. To open the cargo door and lower the ramp using the hand pump, proceed as follows:

1. If possible, establish communications.

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SECTION I (DESCRIPTION AND OPERATION)

5. Page 1-216 Rev. 000 15 Aug 1975

a. Add the following new step at the end of step 9:

10. Place the Cargo Door Manual Lever in the NEUTRAL position.

b. Remember step 10 to 11.

c. Under "Closing Ramp and Door (Aircraft in Flight), add the following new step at the end of step 1:

2. Place the Cargo Door Manual Control Lever in the CLOSE position.

d. Renumber step 2 to 3, 3 to 4 and 4 to 5.

TEMPORARY REVISION XI

SECTION I (DESCRIPTION AND OPERATION)

6. Page 1-217 Rev. 000 01 June 1975

Under the "To close the cargo door and raise the ramp using the hand pump, proceed as follows", paragraph step 5:

Delete the word "Place" and add the word Leave. Delete the word "NEUTRAL" and add the words CLOSE position.

2. Verify that area is clear.

3. Rotate the isolation shutoff valve lever, located adjacent to upper manual control panel, to the OPEN position.

4. Verify that the toes are installed.

CAUTION

Verify that the ADS cable anchor supports are stowed and pinned. If not, cargo door opening could cause damage.

5. Disconnect the ADS links.

6. Place the cargo door control lever to OPEN. Use the hand pump until the door is up and locked.

NOTE

If electricity is available, the indication lights should function normally.

7. Place the cargo door control lever to NEUTRAL.

8. Break the safety wire from the ramp manual control knob.

9. Rotate the ramp manual control knob to Position 1. Use the hand pump until the pressure indicator shows at least 2700 PSI and all the ramp locks are visibly disengaged.

10. Rotate the ramp manual control knob to Position 2. Use the hand pump until the ramp is down and the pressure indicator shows at least 600 PSI.

11. Rotate the ramp manual control knob to Position 3 and leave it there while loading and unloading:

CAUTION

Do not use the ramp for loading or unloading when the hand pump pressure indicator shows less than 600 PSI. Serious damage may result if the locking action of the ramp cylinders is lost because of insufficient hydraulic pressure.

To close the cargo door and raise the ramp using the hand pump, proceed as follows:

1. Rotate the ramp manual control knob to Position 4. Use the hand pump until the ramp is closed.

2. Rotate the ramp manual control knob to Position 5. Use the hand pump until the pressure indicator shows at least 2700 PSI and all the ramp locks are visibly engaged.

3. Rotate the ramp manual control valve to Position 6 and leave it there.

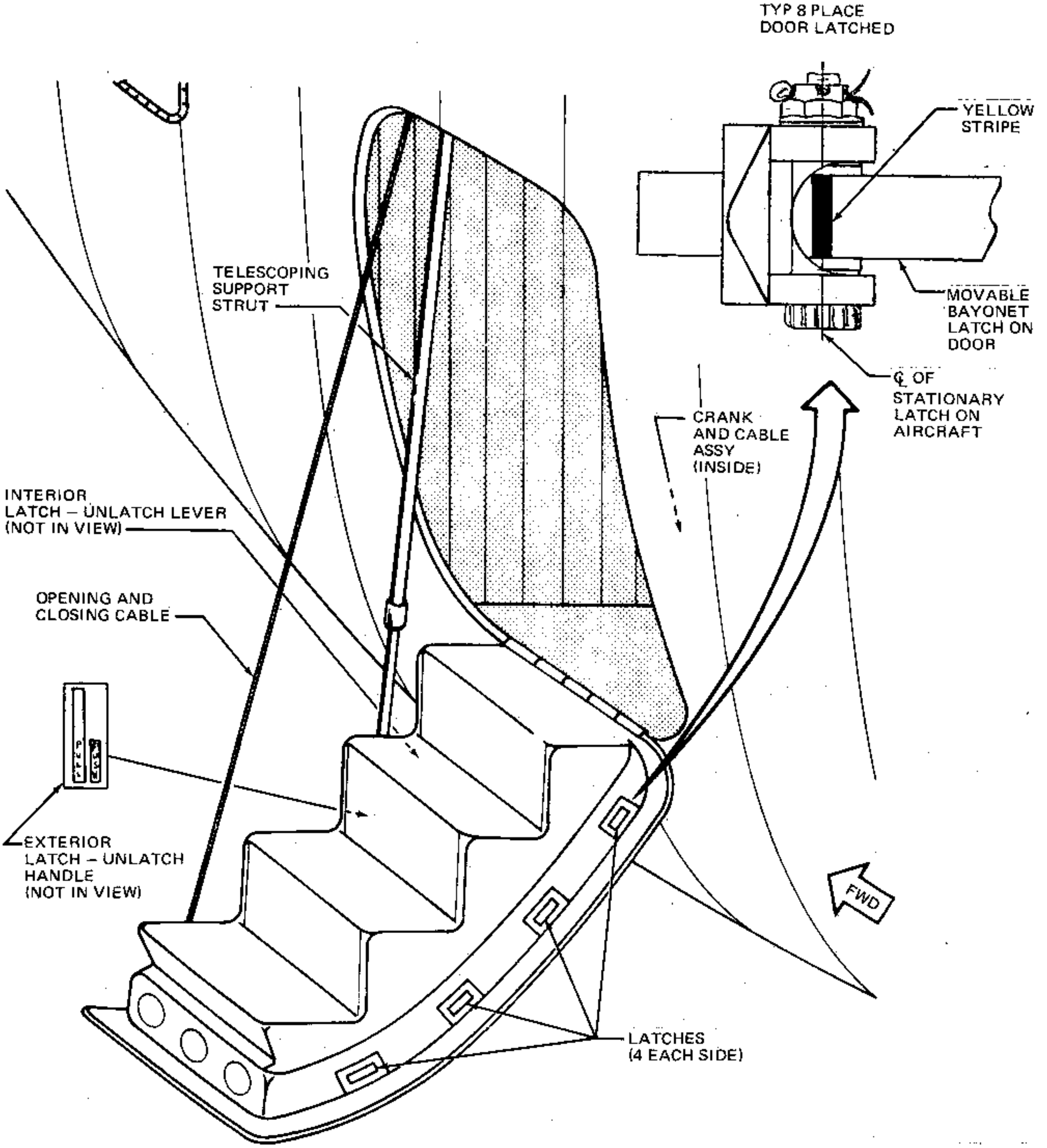
4. Place the cargo door control lever to CLOSE. Use hand pump until the door is closed and the latches are visibly locked.

5. Leave ~~Place~~ cargo door control lever in ~~NEUTRAL~~, CLOSE position.

6. If desired, re-attach the ADS links.

7. Rotate the isolation shutoff valve lever to CLOSE position.

CREW ENTRANCE DOOR



1

Figure 1-83

TROOP JUMP DOOR

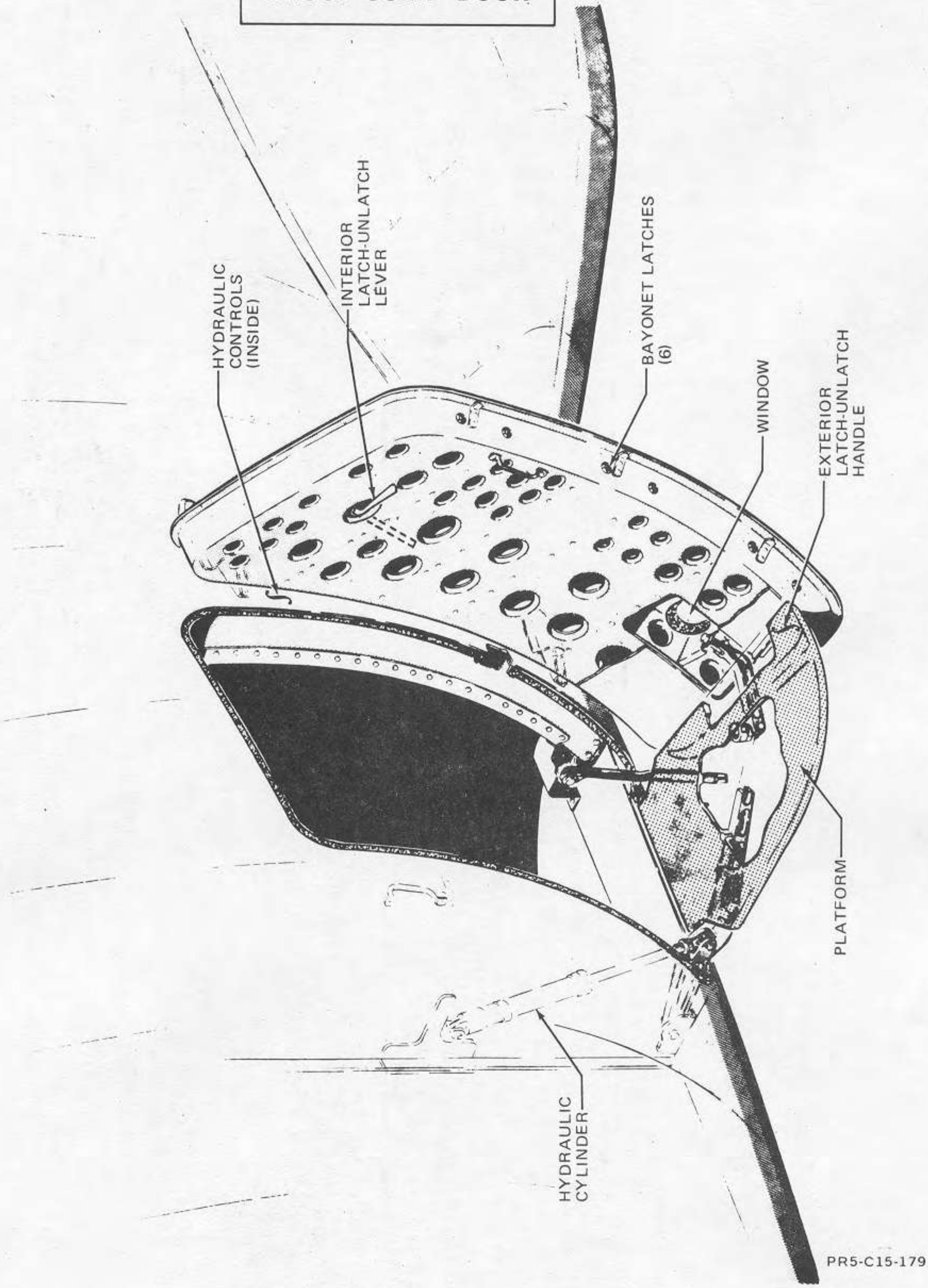


Figure 1-84

TROOP JUMP DOOR CONTROLS

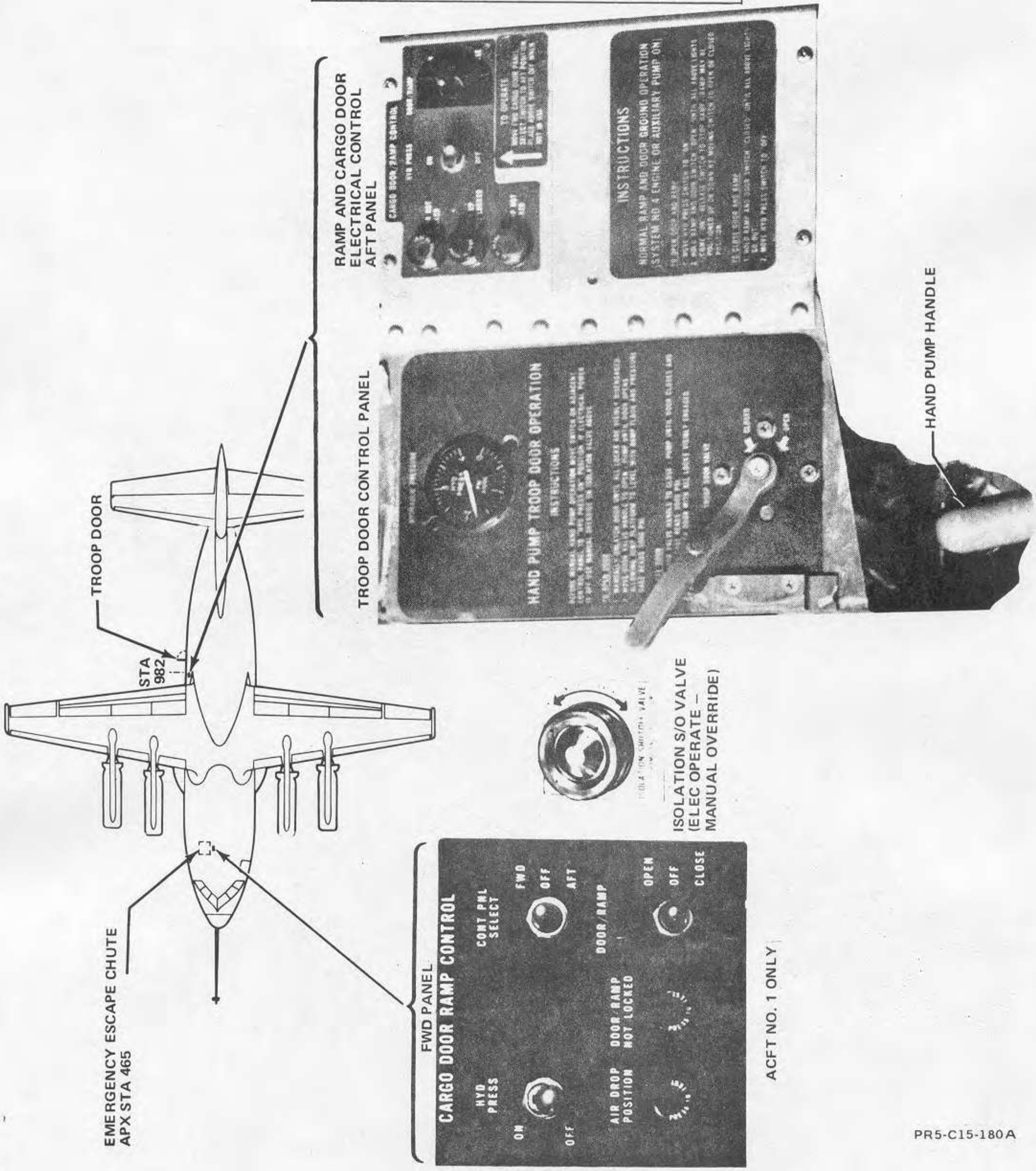


Figure 1-85

DOOR INDICATING LIGHTS

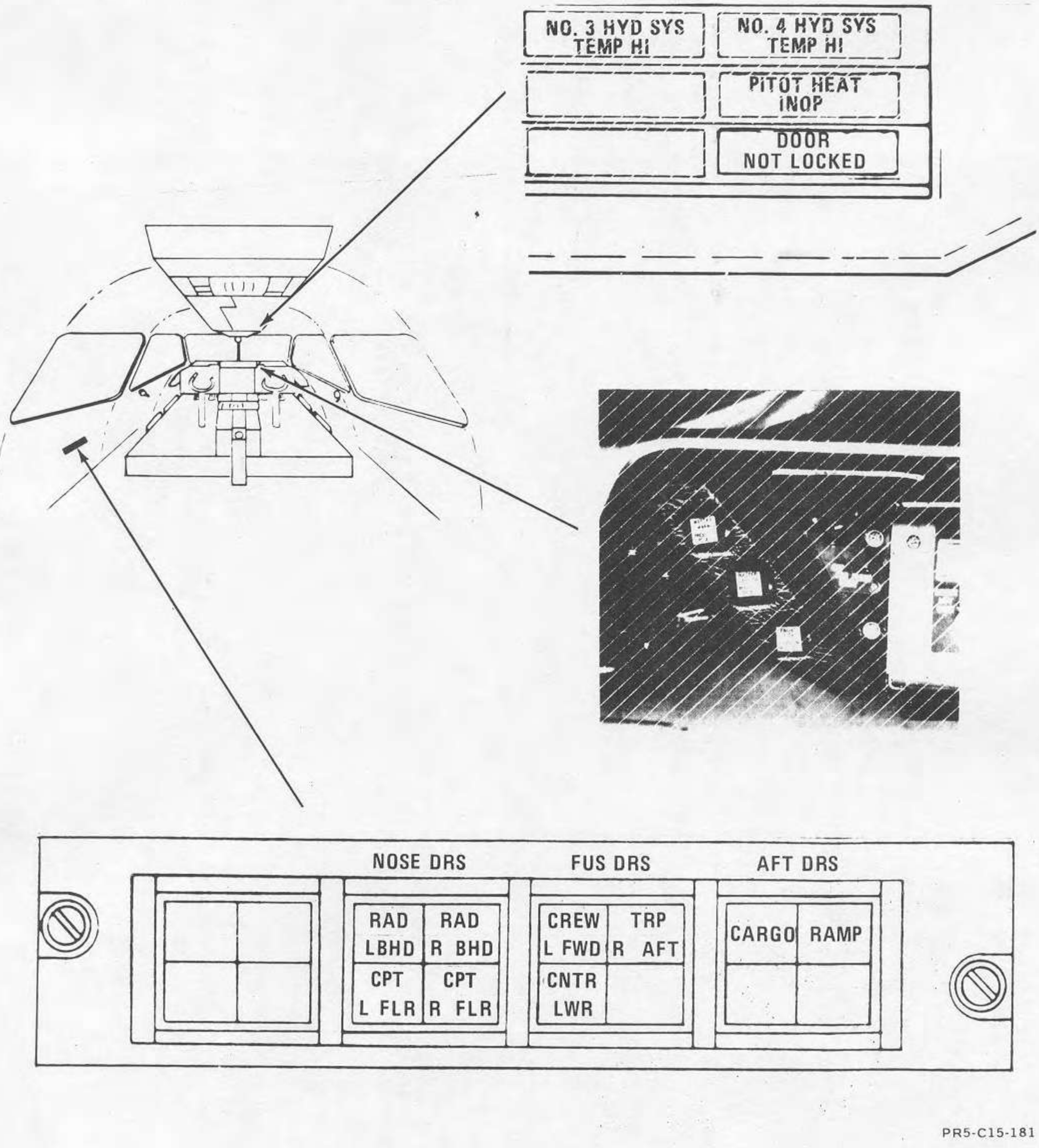


Figure 1-86

TROOP DOOR HYDRAULIC SYSTEM

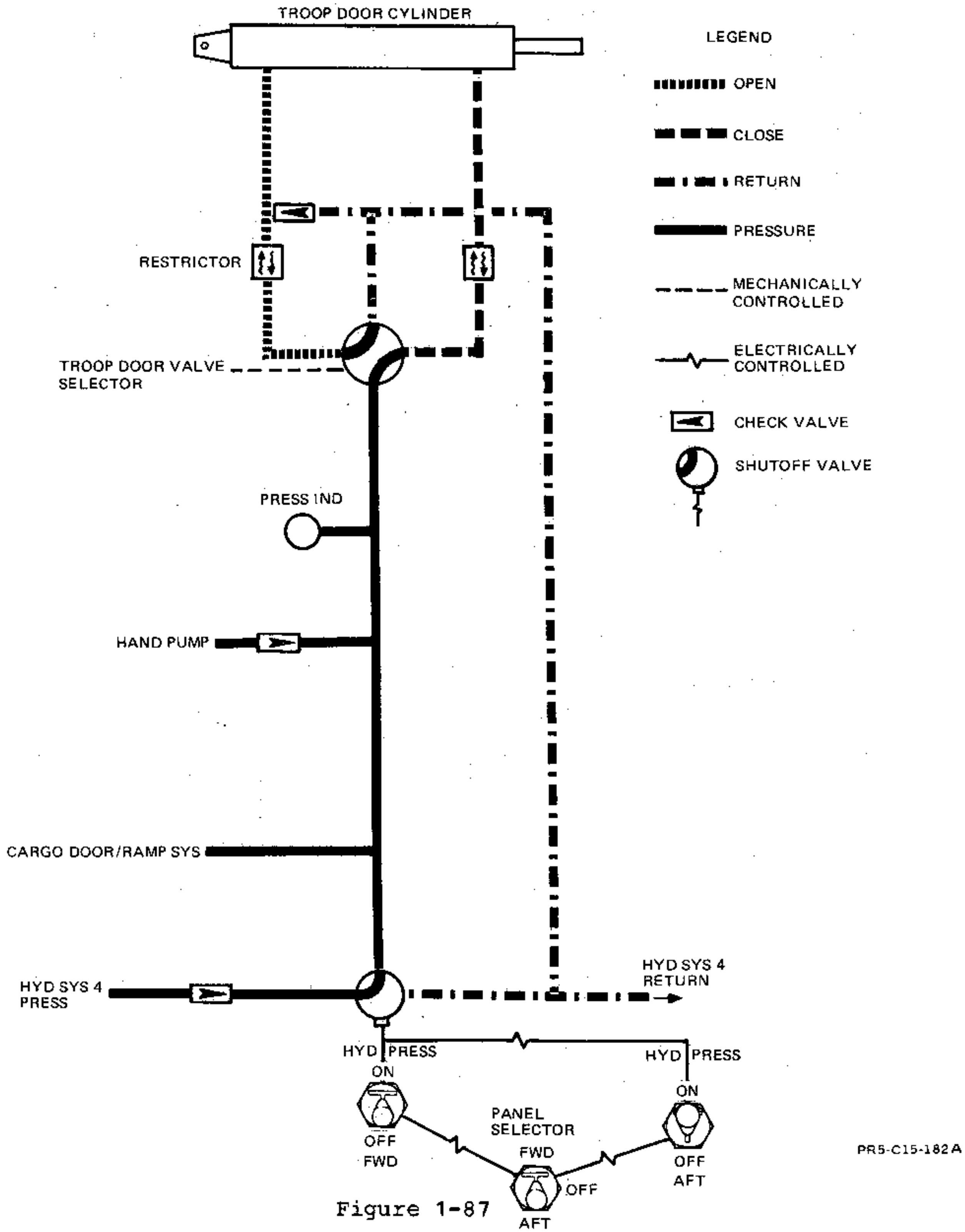


Figure 1-87

CARGO DOOR AND RAMP

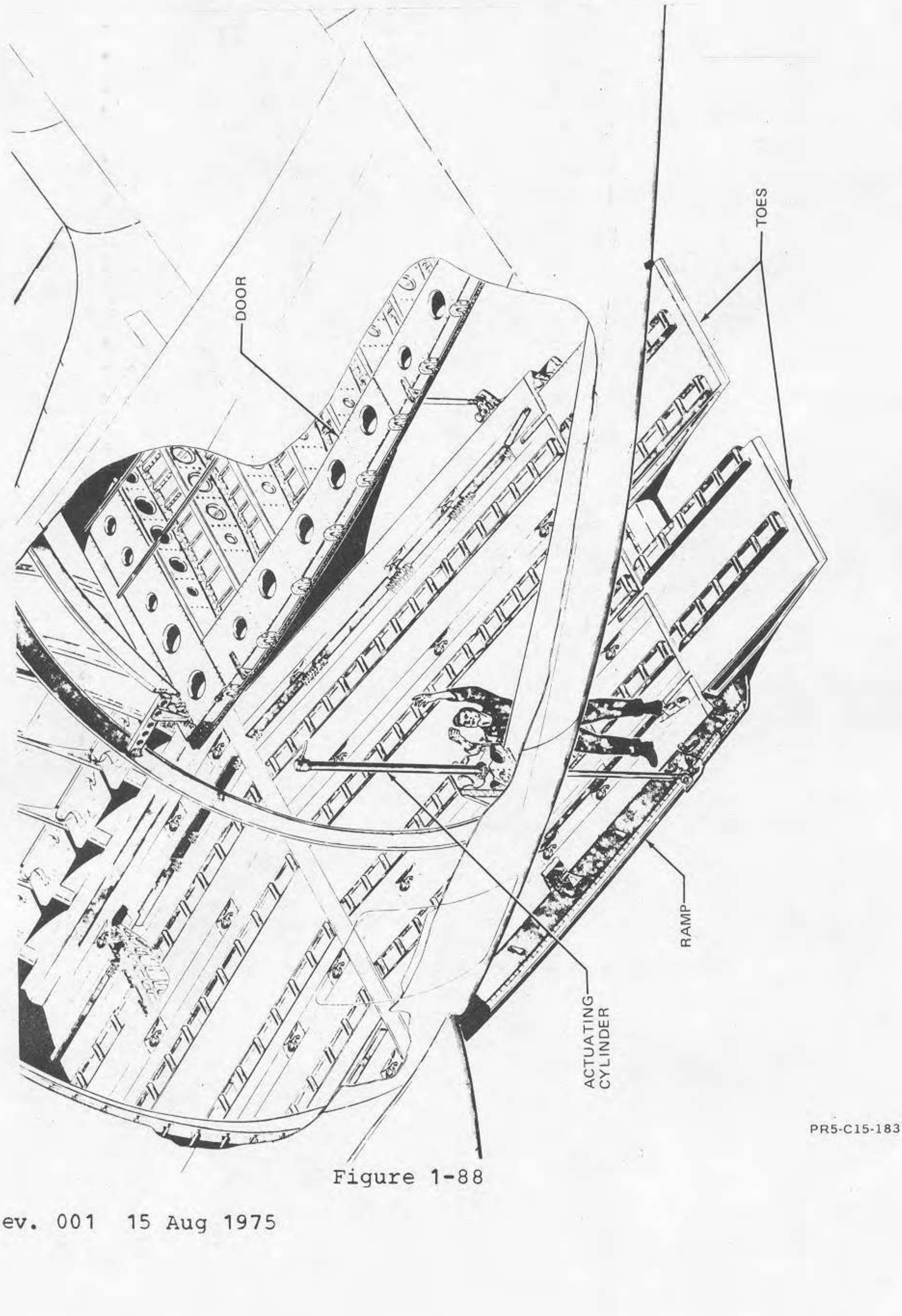


Figure 1-88

SECTION I (DESCRIPTION AND OPERATION)

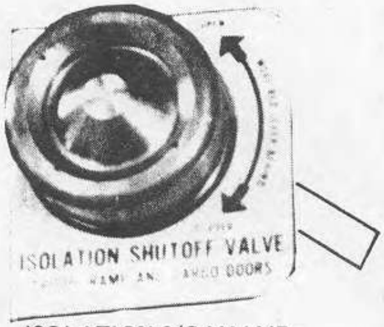
7. Page 1-225 Rev. 001 15 Aug 1977 Figure 1-89

In the open space of the figure, add the following title:

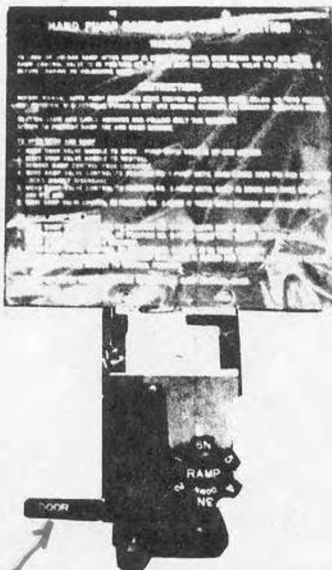
CARGO DOOR MANUAL CONTROL LEVER

and an arrow pointing to the lever that is labeled DOOR.

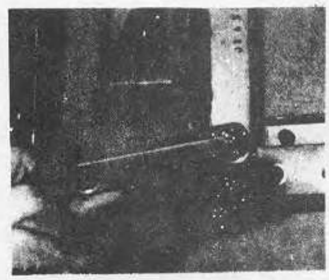
CARGO DOOR AND RAMP CONTROLS



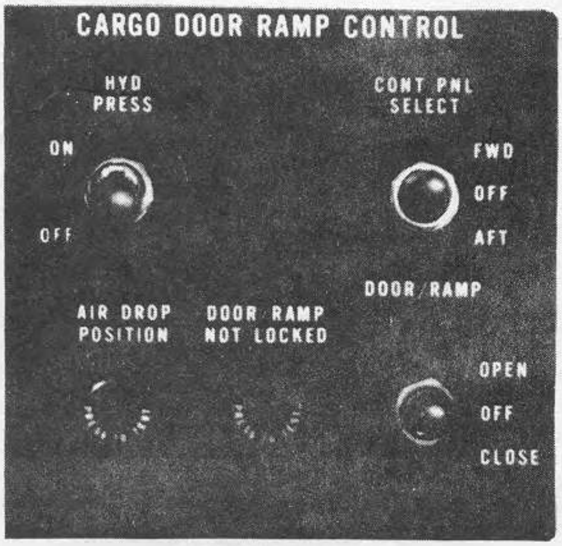
ISOLATION S/O VALVE
(ELECT. OPERATE – MANUAL OVERRIDE)



CARGO DOOR MANUAL CONTROL LEVER

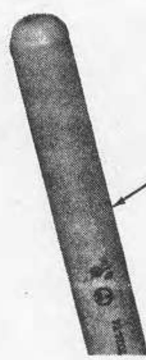


CARGO DOOR UPLOCK EMERGENCY RELEASE HANDLE



FORWARD PANEL

RAMP AND CARGO DOOR ELECTRICAL CONTROL AFT PANEL



HAND PUMP HANDLE

PR5-C15-184A

Figure 1-89

TROOP AND CARGO DOORS/RAMP ADS CABLE ANCHOR SYSTEM

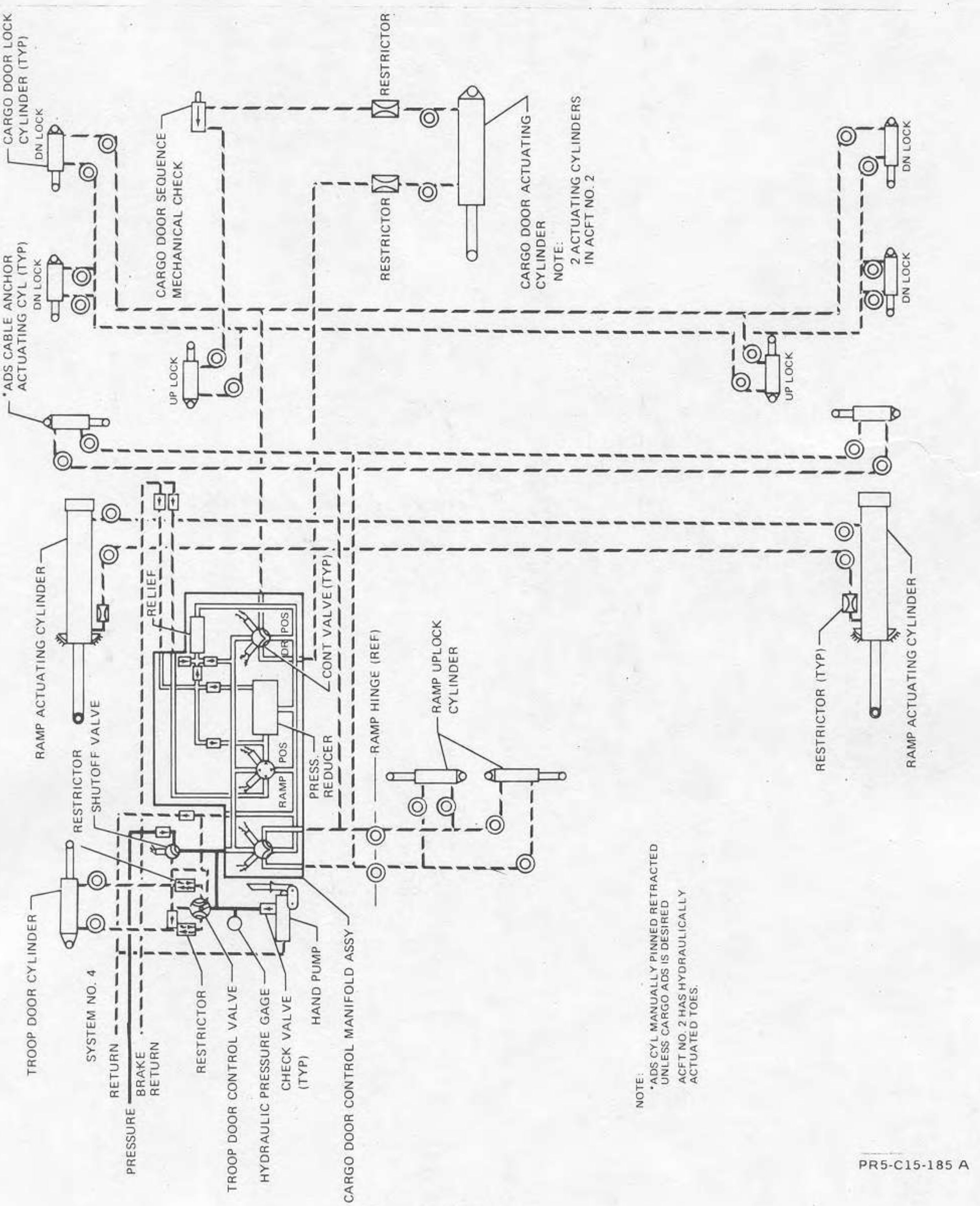


Figure 1-90

DUAL RAIL CARGO HANDLING SYSTEM

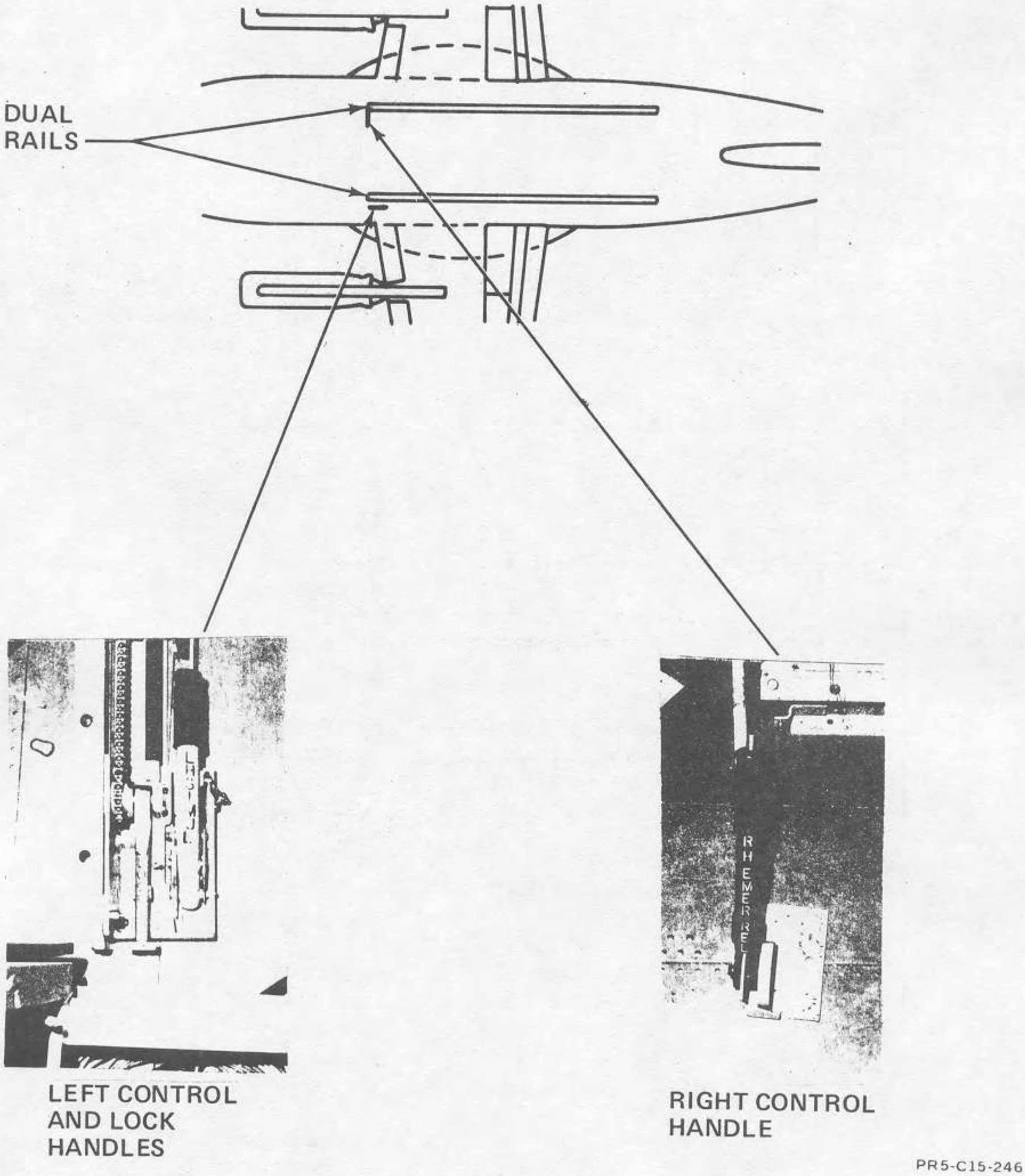


Figure 1-91

AERIAL DELIVERY SYSTEM (ADS) AND CARGO HANDLING

Dual Rail Cargo Handling System (A/A32H-4A)

The dual rail cargo handling system provides the YC-15 aircraft with the capability to safely secure ballast for test configurations, to safely handle equipment for aerial delivery tests and to evaluate handling of palletized cargo. The system consists of outboard restraint rail assemblies and intermediate conveyor frame assemblies. The outboard restraint rails provide vertical restraint and lateral guidance for ballast or pallets, while rollers in the conveyor frame assemblies give vertical support and facilitate transfer fore and aft during loading-unloading. Fore and aft restraint is provided by mechanical detent locks in the rail assemblies. Two sets of controls actuate the locking and release mechanisms. One set actuates the left mechanism, and one sets the right mechanism.

Outboard Restraint Rail Assemblies

The outboard restraint rail assemblies (figure 1-91) are installed on the left and right sides of the cargo floor to guide a 463L series pallet and includes the detent latch assemblies.

Conveyor Frame Assemblies

The system includes roller conveyors which are located between the outboard restraint rail assemblies and installed on the cargo floor to facilitate loading and unloading of ballast and/or pallets. They are also installed on the cargo ramp.

Right Detent Latches

There are variable restraint detent latches mounted on the right rails. Each latch provides a constant forward restraining force of 20,000 pounds and a variable aft restraining force to 4,000 pounds. An adjusting bolt and load indicator are provided on each latch to adjust for the desired spring tension. When the aft force exerted against the detent exceeds the preset valve, the detent will disengage and remain disengaged. A lockout pin is provided to keep the detent in the fully retracted and locked out position.

Left Detent Latches

The left detent latches are similiar to the right latches except the aft restraining force is 10,000 pounds.

Left Master Control

The left master control device (figure 1-91) consists of the SIMUL OPEN control, and LOCK-UNLOCK sequence control handles. The actuation of the left master control, subject to the mode selected, will provide the following operation.

1. Engages and locks all left detent latches sequentially, starting at the foremost latch.
2. Unlocks and disengages all left detent latches simultaneously.
3. Unlocks and disengages all left detent latches sequentially, starting at the aft most latch.
4. Retain detent latches in an unlocked position until relocked.

SIMUL OPEN Control Handle

The left SIMUL OPEN control handle (figure 1-91) is a four- position spring-loaded device which controls the actuation of the detent latches that have been locked by the LOCK-UNLOCK sequence handle. The four positions are as follows:

1. Stowed Position - Full down and locked position which locks all the latches simultaneously.
2. Operation Position - automatically attained by removing the quick release pin on the housing assembly.
3. Aft Restraint Release Position - aft restraint is removed but forward restraint is still in effect.
4. Simultaneous Position - full forward extended position. Both forward and aft restraint is removed from the detent.

LOCK-UNLOCK Sequence Control Handle

The lock-unlock sequence control handle drives the draw bar fore and aft. The draw bar in turn drives the bellcrank forward and aft. Within the latch, the draw bar is closed in the bypass mechanism. The purpose of the bypass mechanism is two-fold:

1. It provides a means of detecting a malfunctioning latch.

CAUTION

Do not force SEQ LOCK handle in any direction.

NOTE

If the detent hook does not fully engage about the aft restraint pin, the SEQ LOCK handle will not operate past the latch. This indicates that a latch is malfunctioning.

2. It provides a means of bypassing a malfunctioning latch.

Right Master Control

The right master control (figure 1-91) is installed at the forward most section of the conveyor and rail and toward the center of the cargo floor. The master control is actuated by the red RH EMER REL handle. This handle is a four-position mechanical device that acts upon the right detent latches as follows:

1. CHECK, first position, is the full down position. This position is used after loading to ensure all right detents are properly engaged in the pallet or platform indents.

   NOTE

   The right master control cannot be placed in CHECK position if any right detent latch is pinned out.

2. NORM, second position, is the normal or locked position. This position locks the right detent latches to provide both forward and aft restraint.
3. EMER, third position, provides a means of disengaging the

right detent latches if they do not automatically disengage during airdrop operations. The aft restraint is removed, however the forward restraint is still applied.

4. LOAD, fourth position, is the full up position. This position is used for loading and unloading because it releases all the fore and aft restraining forces.

Dual Rail Cargo Handling System Operation

1. Check the rails and rollers for security

2. LH SIMUL handle (left side)------STOWED,, pin installed

3. SEQ LOCK Handle------RATCHET TO ALL UNLOCKED (Check that all latches are retracted)

4. SEQ LOCK Handle------RATCHET TO ALL DETENTS EXTENDED (Check that Drum counter is opposite #7) STOWED LOCK UP

5. Detent Locks-------LOCKED (Hook engaged around aft restraint. Emergency release arm and bellcrank has no metal to metal contact, locks not in bypass.)

6. SIMUL Handle------REMOVE PIN (Move to aft restraint release position) check detents full for aft movement

7. SIMUL Handle------Full forward position (Check all detents reracted)

8. SIMUL Handle------DOWN, PIN INSTALLED, DETENTS extended.

9. SEQ Handle------RATCHET, to all detents retracted for loading

10. Right Locks-------Checked (pressure set .50 place all lockout pins in storage hole

11. Right EMER Release Handle and Adj---------Serviceable, connected and secured

12. Right EMER Release Handle------NORMAL position then to CHECK position, ensure handle remains in CHECK

13. Right EMER Release Handle------NORMAL position. Check release spacer between roller on all locks

14. Right EMER Release Handle------EMER position, detents free fore and aft movement

15. Right EMER Release Handle------LOAD position. All detents retracted.

The aircraft is ready for loading ballast or pallets. To secure the load proceed as follows:

1. Check that load is in correct

2. Right EMER Release Handle------NORM position All detent should lock.

3. SEQ LOCK Handle------DOWN, unlock

4. SIMUL Handle------STOWED

5. SEQ LOCK handle------DOWN, LOCKED

CAUTION

Do not force any handles into position. Move the pallets, cargo then attempt to put handles in correct position.

LIGHTING SYSTEMS

Exterior Lights

The exterior group of aircraft lights (FO-8) consists of 2 landing lights, 2 taxi lights, 4 navigation lights, 2 anti-collision lights, 2 hi-intensity strobe lights, 2 main gear position lights and 1 nose gear downlock light. All of the controls except the main gear position inspection light are on the pilots' overhead panel.

Landing and Taxi Lights

A landing light and taxi light (FO-8) are mounted on the forward inside edge of each outboard main landing gear door. The upper light is the taxi light and the lower one the landing light. The left (right) landing and taxi lights receive 115 VAC, single phase power from the LEFT (RIGHT) AC bus through the LEFT (RIGHT) LANDING LIGHTS circuit breakers (P-23 and AA-23, respectively).

Navigation Lights

The navigation lighting system consists of four lights (FO-8). A red light is installed on the left wing tip. A green light is installed on the right wing tip. Two white lights installed on the trailing edge of the wing between the flaps and aileron serve as tail-lights. The left (right) navigation and tail lights receives 115 VAC single phase power from the LEFT (RIGHT) AC bus through the LEFT (RIGHT) NAV LIGHTS circuit breakers (N-23 and Z-23, respectively).

Hi-Intensity Strobe Lights

An hi-intensity white strobe light is installed on each wing tip adjacent to the navigation light. The hi-intensity strobe lights receive 115VAC, single phase power from the LEFT AC bus through the UPPER ANTI-COLLISION LIGHT circuit breaker (N-22).

Anti-collision Lights

The aircraft is equipped with two white strobe lights (FO-8) which serve as anti-collision lights. One is mounted on the top of the fuselage and the other on the bottom. The top (bottom) anti-collision light receives 115 VAC, single phase power from the LEFT (RIGHT) AC bus through the UPPER (LOWER) ANTI-COLLISION LIGHT circuit breakers (N-22 and Z-22, respectively).

Nose Gear Downlock Flood Light

A nose gear downlock flood light is installed in the nose wheel well to provide a means of illuminating the mechanical downlock. The light receives 28 VDC power from the RIGHT DC bus through the NOSE GEAR DOWNLOCK FLOOD LIGHT circuit breaker (AD-22).

Main Landing Gear Position Inspection Lights

One main landing gear position inspection light is installed in each wheel pod to illuminate the gear mechanical downlock. The left (right) lights receive power from the LEFT (RIGHT) AC bus through the CABIN/SERVICE AREA LIGHTS circuit breaker (P-22 and AA-22, respectively).

Landing Light and Taxi Light Switches

Two, three position (LAND-TAXI-OFF) L and R switches (figure 1-92), located on the pilots' overhead LDG LT panel, control the lights. The landing gear handle must be in the DOWN position in order for these switches to function.

Exterior Light Switches

Two, two position (ON-OFF) NAV and ANTI-COLLISION switches (figure 1-92), located on the pilots' overhead EXT LT panel, control the lights. When the NAV switch is in ON, all four navigation lights come on. When the ANTI-COLLISION switch is in ON, both anti-collision lights and both hi intensity strobe lights come on.

Nose Gear Downlock Flood Light Switch

A two position (ON-OFF) NOSE GEAR DOWN LOCK FLOOD LT switch (figure 1-92), located on the upper section of the pilots' overhead panel, controls the light.

Main Landing Gear Position Inspection Light Switch

Two, two position (ON-OFF) GEAR POS INSPECT LT switches (figure 1-92) are located in the cargo area near the landing gear viewing window, one on the left and one on the right.

Interior Lights

The interior group of aircraft lights (figure 1-93) consists of instrument, flood, chart holder, cargo area illumination, troop jump lights and standby lighting. The pilots' instrument panel flood lights provide fluorescent and incandescent lighting. The instruments are also integrally lighted. The cargo area is illuminated by 10 incandescent lamps. Standby lighting is provided for the instruments and at the crew entrance door, escape chute, and troop door. Adjacent to the troop door are red and green troop jump lights.

Pilots' Instrument Panel Lights Control Knobs

Two dual concentric INSTR PNL FLOOD LT knobs (figure 1-92), located on the outboard side of each pilot's instrument panel, control the respective lighting. The large outer knob is an ON/OFF switch and controls the intensity of the fluorescent lights. The smaller, inner knob controls the incandescent lights. The pilot's and center (copilot's) fluorescent light receives 115 VAC power, single phase from the LEFT (RIGHT) AC bus through the PILOT/CTR (COPILOT) INST PANEL FLUOR FLOOD LTS circuit breakers (R-22, AB-22 respectively). The pilot's and center (copilot's) incandescent flood lights receive 28VDC power from the LEFT (RIGHT) DC bus through the PILOT/CENTER (COPILOT) INST PNL INCAND FLOOD LTS circuit breakers (V-22, AF-22, respectively).

Instrument Lights Switch

A two position (ON-OFF) INSTR LTS switch (figure 1-92), located on the pilot's overhead panel, controls the integral lighting of the instruments and panels. The lights receive 115 VAC, single phase power from the LEFT AC bus through the INSTR LIGHTS circuit breaker (R-24).

Flood Light Switches

A rotary OVHD FLOOD LT and rotary PED FLOOD LT on/off switch and intensity control (figure 1-92), located on the pilots' overhead FLOOD LT panel, are used to turn on/off the lights and control the intensity as desired. These lights receive 28 VDC power through the OVHD SW PNL/PED FLOOD LTS circuit breaker (AD-23).

Dome Light Button

DOME light ON-OFF push button switches, one located on the pilots' overhead panel and one on the light assembly, operate the fluorescent dome light on the ceiling. The light receives 115 VAC single phase power from the LEFT AC bus through the COCKPIT DOME FLUOR LIGHT circuit breaker (R-23).

Chart Holder Light Switch

A rotary type switch is installed on the top of each control wheel and and provides ON-OFF and intensity control of the incandescent illumination of approach charts. The lights receive 28 VDC power from the RIGHT DC bus through the CHART HOLDER LIGHTS circuit breaker (AE-22).

Glareshield Panel Flood Light Switch

A rotary GS (glareshield) PANEL FLOOD LT switch (figure 1-92), located on the pilot's side of the glareshield, provides ON-OFF and intensity control of the incandescent glareshield flood lights. These lights receive 28 VDC power from the LEFT DC bus through the GLARESHIELD PANEL FLOOD LIGHT circuit breaker (U-22).

Flight Test Engineer Light Switches

A push button and rotary switch, located above the flight test engineer's panel, provides ON-OFF and intensity control of the incandescent illumination for his panel. The light receives 28 VDC power from the LEFT DC bus through the FLIGHT TEST ENGINEER LIGHT circuit breaker (V-23).

Cargo Area Flood Lights

There are no switches to turn on and off the various cargo area lights. Whenever the electrical buses are powered, the lights will be on. The area flood lights receive 115 VAC single phase power from the LEFT and RIGHT AC buses through the CABIN/SERVICE AREA LIGHTS circuit breakers (P-22 and AA-22, respectively).

Standby Lighting

When the EMER PWR (emergency

power) switch (figure 1-57), located on the pilots' overhead panel, is rotated to ON (With the BAT switch ON), the pilots' standby instrument, crew entrance door, escape chute and troop door lights come on. The lights receive 28 VDC power from the EMERGENCY DC bus through the COCKPIT STANDBY LIGHTS and CABIN STANDBY LIGHTS circuit breakers (C-30 and C-31). The center instrument panel lights receive 28VDC power from the BATTERY bus through the CENTER INSTR PANEL STANDBY LIGHTS circuit breaker (B-29).

CREW OXYGEN SYSTEM

Oxygen for the flight crew is supplied from a high pressure cylinder. There is one portable walk-around bottle located adjacent to the crew cylinder with mask attached. The system (figure 1-94) basically consists of a cylinder, overpressure blowout disc, shutoff valve, pressure regulator, pressure indicator, distribution lines, and oxygen regulators (4).

Oxygen Cylinder

One oxygen cylinder (figure 1-94), located in the flight compartment aft of the flight test engineer's seat-attached to the bulkhead, has a 111 cubic foot capacity at 1850 PSI. It is the only source of oxygen for the system.

Overpressure Disc

The overpressure blowout disc (figure 1-94), located on the left side of the aircraft, provides a means of discharging the oxygen supply overboard when the cylinder pressure builds excessively.

Shutoff Valve

The manual shutoff valve (figure 1-94), attached to the cylinder provides a means of isolating the oxygen supply from the system in the event of a fire or leak.

Supply Pressure Indicator

The supply pressure indicator (figure 1-94), located on the shutoff valve, shows the oxygen cylinder supply pressure at all times, whether the shutoff valve is open or closed.

Supply Pressure Regulator Valve

The supply pressure regulator valve (figure 1-94), attached to the shutoff valve, provides a means of automatically regulating the supply line pressure throughout the distribution lines.

Oxygen Regulator

Four oxygen diluter-demand regulators (figure 1-95), one at each crew station, provide the capability of obtaining oxygen on demand. Each regulator incorporates three levers to control regulator operation, a flow indicator and a pressure indicator. Attached to each regulator is a four foot extension hose with a quick-disconnect oxygen mask hose fitting.

OXYGEN SUPPLY LEVER. A manual, two-position ON-OFF supply lever, is located at the lower right corner of the regulator. It provides a means of turning on or off the oxygen supply to the regulator.

DILUTER LEVER. The two position, 100% OXYGEN and NORMAL OXYGEN, diluter lever on the regulator may be used to provide correct oxygen requirements for normal body needs at all altitudes. When in 100% OXYGEN, the regulator supplies only pure oxygen without air dilution to the mask. When in NORMAL OXYGEN, normal air/oxygen dilution characteristics of the regulator are maintained. When the flight compartment altitude is greater than 28,000 feet undiluted, pressure oxygen is automatically delivered to the mask.

EMERGENCY LEVER. The three position, EMERGENCY-NORMAL-TEST, lever is located on the left side of the regulator. When in EMERGENCY, pure oxygen is supplied to the mask at continuous positive pressure. When in NORMAL, oxygen flow is controlled automatically by the regulator. When held in TEST position, oxygen is supplied at positive pressure for testing the hose assembly and mask.

FLOW INDICATOR. The visual blinker flow indicator on the regulator is a slide-and-window device which, during normal use of the oxygen masks, shows oxygen flow by blinking white and black with the breathing cycle of the user. The white blinker is out of view when there is no oxygen flow.

PRESSURE INDICATOR. A regulated oxygen pressure indicator on the regulator is a dial-type instrument which shows oxygen supply line pressure at the regulator in pounds per square inch.

Oxygen Masks

There are no oxygen masks installed in the aircraft. Each crewmember is issued a MBU S/P oxygen mark as his personal equipment.

Crew Oxygen Normal Operation

1. Verify that the shutoff valve is OPEN.
2. Check that the regulator pressure indicator shows approximately in the normal range.
3. Verify that the emergency lever, on the regulator, is in NORMAL.

WARNING

The emergency lever should remain in the center, normal, position except when emergency or test is desired. If left in emergency and system is on, the oxygen will flow continuously until the cylinder is empty.

4. Verify that the diluter lever, on the regulator, is in 100%.
5. Verify that the SUPPLY lever on the regulator is saftied ON.

WARNING

There are two types of regulators which look identical that can be installed. One type shuts off all flow to the mask when the SUPPLY lever is in OFF. The other allows cockpit air flow to the mask when in OFF. This could cause anoxia when the cockpit altitude is 12,000 feet or more. This regulator is identified by a red mark on it.

6. Don mask and breathe normally.
7. When oxygen is no longer

required, remove and stow mask.

Cargo Area Oxygen

Portable oxygen bottles with masks are installed in racks as follows: three at F.S. 700 left and two at F.S. 980 right.

EMERGENCY EQUIPMENT

There are two emergency equipment panels (Figure 1-96) installed in each aircraft. In Aircraft #1, one panel is on the mezzanine. In Aircraft #2, one panel is at F.S. 525, right side. In both aircraft the other panel is in the cargo area, left side F.S. 950.

Flight Compartment Escape Ropes

Two escape ropes (figure 3-3), one over each pilot's clearview window, provide a means of emergency egress when the aircraft is on the ground. The ropes are coiled in a container when stowed. One end of each line is secured to the aircraft stucture. When used for emergency escape (figure 3-1), the free end of the lines are extended through the open clearview windows in the flight compartment.

Crash Ax and hatchet

A crush ax and hatchet (Figure 1-96) are located on each emergency equipment panel

Portable Fire Extinguishers

There are two fire extinguishers located on each emergency panel, One dry extinguisher and one CO2.

First Aid Packet

One first aid packet is located on forward emergency equipment panel.

Emergency Tool Box

In Aircraft #1, an emergency tool box is located on forward emergency equipment panel.

Life Raft

In Aircraft #1, one 7 man life raft is located on the mezzanine aft of the emergency equipment panel.

In Aircraft #2, the 7 man life raft is located in the cargo compartment, F.S. 760, right side.

Oxygen (Cargo Compartment)

Oxygen for additional crewmembers is provided in both aircraft with portable oxygen cylinders. In Aircraft #2, two storage high pressure cylinders (111 cu ft) and refill manifold with two outlets, located on the left side of the cargo compartment F.S. 1000, provides a means of refilling the low pressure portable oxygen cylinders.

In Aircraft #1, racks for three 96 cu inch cylinders are located at F.S. 820, right side.

In Aircraft #2, provisions for portable oxygen is as follows:

a. 12-280 cu inch low pressure cylinders at F.S. 1000 on the left side and 6 on the right side.

b. One 96 cu inch high pressure cylinder on the aft emergency panel.

Parachute and Crash Helment Racks

Racks for crew parachutes and crash helments are installed in both aircraft, located as follows:

a. #1 - on the mezzanine;

b. #2 - cargo compartment, right side F.S. 760.

WARNING SYSTEMS

Master Warning and Caution System

The master warning and master caution system (figure 1-97) consists of a red MASTER WARNING and an amber MASTER CAUTION light on the glareshield near each pilot's instruments and an overhead annunciator panel with color-coded lenses. The red warning lights and certain amber caution lights on the annunciator panel are connected in parallel with respective MASTER WARNING and MASTER CAUTION lights and will come on to warn the pilots of critical malfunctions or emergency conditions within aircraft systems. The remainder of the amber caution lights and all of the green advisory lights are not connected to the master warning and master caution systems, but provide pertinent information on the status or condition of specific aircraft systems.

Overhead Warning and Caution Annunciator Panel

The overhead warning and caution annunciator panel (figure 1-97), located on the overhead panel, contains color-code indicator lights, with legends, to advise the pilots of certain malfunctions or conditions within the aircraft systems. The legends on the color-coded light lenses indicate the specific nature of the malfunction or condition. The red warning lights indicate conditions, involving aircraft safety, that require immediate action. The amber caution lights indicate conditions that require corrective action. The green advisory lights indicate that a system is on or in operation. The MASTER CAUTION lights will come on simultaneously with certain critical amber caution lights. The MASTER WARNING lights will come on with all red warning lights. The annunciator panel red warning lights and caution lights will stay on until the emergency or malfunction is corrected. The green advisory lights will stay on until the corresponding system is off or ceases to operate.

Master Warning and Caution Lights

The MASTER WARNING and MASTER CAUTION lights (figure 1-97) are located on the glareshield directly in front of the pilot and copilot. The MASTER WARNING lights come on simultaneously with the annunciator panel red warning lights to warn of conditions that require immediate action. The MASTER CAUTION lights come on with certain annunciator panel amber caution lights to indicate malfunctions or conditions that require corrective action. The master warning and master caution light circuit are reset (lights turned off) by pressing momentarily either pilots applicable MASTER WARNING or MASTER CAUTION switch/ light. The MASTER WARNING and MASTER CAUTION lights are powered by the BAT bus through the MASTER WARNING and MASTER CAUTION circuit breakers (B-21 and B-22 respectively) on the overhead circuit breaker panel. In addition the EMER & BAT BUS CABIN PRESS/DUCT FAIL LTS (A-17) and ANNUN LT DIM TEST & SPARE ANNUN (T-22) circuit breakers must be closed in order for the Master Warning and Caution System to function.

NOTE

The MASTER WARNING and MASTER CAUTION lights should be reset immediately after determining which light or lights caused the applicable MASTER WARNING or MASTER CAUTION lights to come on. This action resets the master warning and master caution light circuit to alert the pilots of any additional lights coming on.

Annunciator Lights Test Switch

The ANNUN LT TEST switch (figure 1-97) is a momentary contact switch that tests the integrity of all annunciator panel lights, overhead panel lights (except EMER PWR IN USE, EXT PWR AVAIL and fire warning & detection lights), glareshield lights, pilots' instrument panel lights (except MKR BCN and gear handle lights), and the MASTER CAUTION and MASTER WARNING lights. Press switch for all lights to come on for testing, and release to turn all lights off.

Annunciator Lights Bright/ Dim Switch

The PRESS TO BRT/DIM switch (figure 1-97) dims all the annunciator panel, overhead panel glareshield and instrument panel lights. They will remain dimmed until the switch is pressed again.

Takeoff-Go-around Warning Horn

A takeoff-go-around warning horn provides a means of alerting the pilots that the spoiler selector is not in the correct configuration during takeoff or go-around. On takeoff, when throttles #1 or #2 are advanced and the Spoiler selector switch is in DLC and the flaps in the takeoff range, the spoiler selector switch will to to OFF. This alerts the pilots that the Spoiler selector switch is in the wrong position. On a go-around, the horn would also sound signifying that the spoiler selector switch is in an incorrect position. The takeoff warning horn receives 28VDC power from the RIGHT DC bus through the TAKEOFF WARNING circuit breaker (AF-18).

GROUND PROXIMITY WARNING SYSTEM (AIRCRAFT #2 ONLY)

A ground proximity warning system (GPWS) is installed to provide aural and visual warnings of four unsafe flight conditions (MODES) relative to the terrain between 2450 feet and 50 feet radio altitude. It is automatically deactivated above 2450 feet and below 50 feet radio altitude. Also, a fifth mode provides aural and visual warnings, when on an ILS approach, of an inadvertent descent below the glideslope between 1000 feet and 50 feet radio altitude. The GPWS is silent during normal flight operations and does not require any pilot inputs. If a warning is activated, it does require corrective action by the pilot; pull up and establishment of a climb until warning ceases or bringing the aircraft back toward the glideslope, if that was the cause of the warning. The GPWS consists of a computer, speaker and indicators. A Ground Proximity Warning panel (Figure 1-98 Sheet 1), located on the pilots' overhead panel, contains the following:

Flap Position Override Switch

A guarded two-position (NORM-OFF) FLAP POSITION OVERRIDE switch (Figure 1-98 Sheet 1) provides a means of disconnecting the flap position logic into the computer.

Glideslope Inhibit Switch

A guarded two-position (NORM-OFF) GLIDESLOPE INHIBIT switch (Figure 1-98 Sheet 1) provides a means of inhibiting the glideslope logic into the GPWS computer.

Ground Proximity Test Button

A ground proximity TEST button (Figure 1-98 Sheet 1) provides a means of testing the GPWS. When pressed, the GPWS will test both aurally and visually.

Ground Proximity Warning Fail Light

A red GND PROX WARN FAIL light (Figure 1-98 Sheet 1) comes on when the system has failed or is tested. The GND PROX WARN FAIL light receives 28 VDC power from the RIGHT DC bus through the GPWS LTS circuit breaker (K-6).

Pull Up Lights

Two red PULL UP lights (Figure 1-50), located on glareshield, one in front of each pilot, warns the pilots of unsafe flight paths into terrain. Both PULL UP lights receive 28 VDC power from the RIGHT DC bus through the GPWS LTS circuit breaker (K-6).

The warning causes and indications are as follows:

Mode 1: Figure 1-98, Sheet 2
Mode 2: Figure 1-98, Sheet 3
Mode 3: Figure 1-98, Sheet 4
Mode 4: Figure 1-98, Sheet 5
Mode 5: Figure 1-98, Sheet 6

GPWS Test

On the Ground:

a. Press and hold TEST button for at least 2 seconds

b. Voices - "Whoop-whoop pull up" and "Glideslope"

c. Lights - PULL UP and GND PROX WARN FAIL

In flight test only when altitude is above 1000 feet.

SEATS

Pilots' Seats

The pilots' seats (figure 1-99) have electrical and mechanical controls for forward and aft, lateral and vertical position adjustments. Each seat has a thigh support cushion adjustment, recline and armrest positioning. Both seats are equipped with seatbelts and dual harnesses with inertia reels. The seats are additionally equipped with a crotch belt. Each seat has a position indicator for ready reference. If the electrical control power or power of a seat is lost, full movement of the seat is possible through manual operation.

CAUTION

Do not lift vertical control unless seat is occupied.

The compression spring used to move the seat in the vertical plane is very strong and when released manually, with seat unoccupied, the seat may move rapidly enough to injure the unsuspecting user. In addition, the residual energy generated at the peak of travel can damage the mechanism.

Seat Power Switch

Each seat has an ON-OFF power switch (figure 1-99), located on the inboard side of the seat, which controls electrical power to the seat. The pilots' power switch receives 28 VDC power from the LEFT DC bus through the PILOT SEAT CONTROL circuit breaker (T-21) on the EPC panel. The copilot's switch receives 28 VDC power from the RIGHT DC bus through the COPILOT SEAT CONTROL circuit breaker (AD-21).

Seat Exit Button

Each seat has an EXIT button (figure 1-99), located on the inboard side of the seat which provides a means of positioning the seat to facilitate exit and entrance. When the EXIT button is pressed and held, the electric motors move the seat aft and outboard to the stops. The seat will travel to full aft position then over to full outboard position and then stop even though the button is held depressed. The seat will remain in position, if the button is released prior to it reaching the stops. The pilot's seat motor receives 115 VAC, 3 phase power from the LEFT AC bus through the PILOT SEAT POWER circuit breakers (N-21, P-21 and R-21) on the EPC panel. The copilot's seat motor receives 115 VAC, 3 phase power from the RIGHT AC bus through the COPILOT SEAT POWER circuit breaker (Z-21, AA-21, AB-21).

Seat Power Control Handle

A four position handle (figure 1-99), located on the inboard side of the seat, has FWD, AFT, UP and DOWN positions and is spring-loaded to the center position. Placing the handle to any position will move the seat in the direction of the handle movement. When the handle is released the seat will remain in place. When the seat is in full aft and outboard position, placing the handle in FWD position will move the seat full inboard first then forward.

Seat Forward and Aft Manual Control Handle

A forward and aft control handle (figure 1-99) located on the inboard side of each seat, provides forward and aft seat manual adjustment. When the seat is in the full aft and outboard position, raising the "H" handle will allow seat movement to full inboard and then forward. Releasing the handle locks the seat in position.

Seat Vertical Manual Control Handle

A vertical control handle (figure 1-99), located on the inboard side of each seat, provides vertical seat manual adjustment. Releasing the "V" handle locks the seat in position.

Seat Recline Manual Control Handle

A RECLINE control handle (figure 1-99), located on the inboard side of each seat, provides manual adjustment of the seat back from upright to recline position.

Thigh Support Control Handle

A thigh support control handle (figure 1-99), located on the inboard side of each seat, provides a means of giving additional support to the thighs. cushion will raise additionally. To return the cushion to the stowed position, push down on the leading edge.

Armrest Control

The armrests can be adjusted to various positions. An armrest control button (figure 1-99), located under the forward tip of each armrest, provides a means of adjusting the armrest. The inboard armrests of each seat when in the vertical position can be rotated behind the seat-back to provide additional access space.

Shoulder Harness Lock Lever

A two position (lock - unlock) shoulder harness reel lock lever is located below the inboard armrest on each seat frame. Pulling up on the lock lever unlocks the reel, and reel harness cable will extend to allow occupant to lean forward. When the lock lever is in locked position (down), the reel harness cable is locked so that occupant is prevented from leaning any further forward.

Seat Position Indicator

A seat position indicator (figure 1-99), located on the inboard side of each seat, provides a means of actually determining the position of the seat. When the seat is adjusted, vertical and horizontal numbered scales show numbers under an index mark in the position indicator window. When a seat is properly positioned, the pilot has a ready reference for future seat adjustment.

Flight Test Engineer's and Additional Crewmember's Seats

The flight test engineer's and additional crewmember's seats (figure 1-100) are installed on tracks and provide forward and aft, vertical and full-swivel position adjustments. Each seat is equipped with an adjustable and removable headrest, a safety belt, and should harness. The armrest of each seat can be pivoted and stowed to a position parallel to the seat back.

Seat Fore and Aft Adjustment Levers

Fore and aft movement of the seat is accomplished by pulling up on either lever (figure 1-100) located on both sides of the pedestal. This action unlocks the seat allowing the seat to full fore and aft on the seat tracks. When the lever is released, the seat will lock in the selected position. It is not necessary to pull up on both handles simultaneously in order to unlock the seat.

Seat Swivel Control Lever

A lever (figure 1-100), located on the forward right side of the seat frame, is pulled up to allow full-swivel of the seat. When the lever is release, the seat locks in the desired position.

Seat Vertical Adjustment Lever

Vertical movement of the seat is accomplished by pulling up on a lever (figure 1-100) located below the right armrest on the aft side of the seat frame. This action unlocks the seat support parts allowing up and down adjustment of the seat.

Shoulder Harness Lock Lever

A two position (lock - unlock)

shoulder harness inertia reel lock lever (figure 1-100) is located below the left armrest on the seat frame. Pulling aft on the lock lever unlocks the inertia reel, and reel harness cable will extend to allow the occupant to lean forward. If a forward "g" force is encountered while the reel is unlocked, it will lock and remain locked until the lever is moved forward to the locked position and then returned to the unlocked position. When the lock lever is in the locked position, the reel harness cable is manually locked so that the occupant is prevented from leaning forward.

Windows

Pefer to figure 1-101 and 1-102.

LIGHT CONTROLS

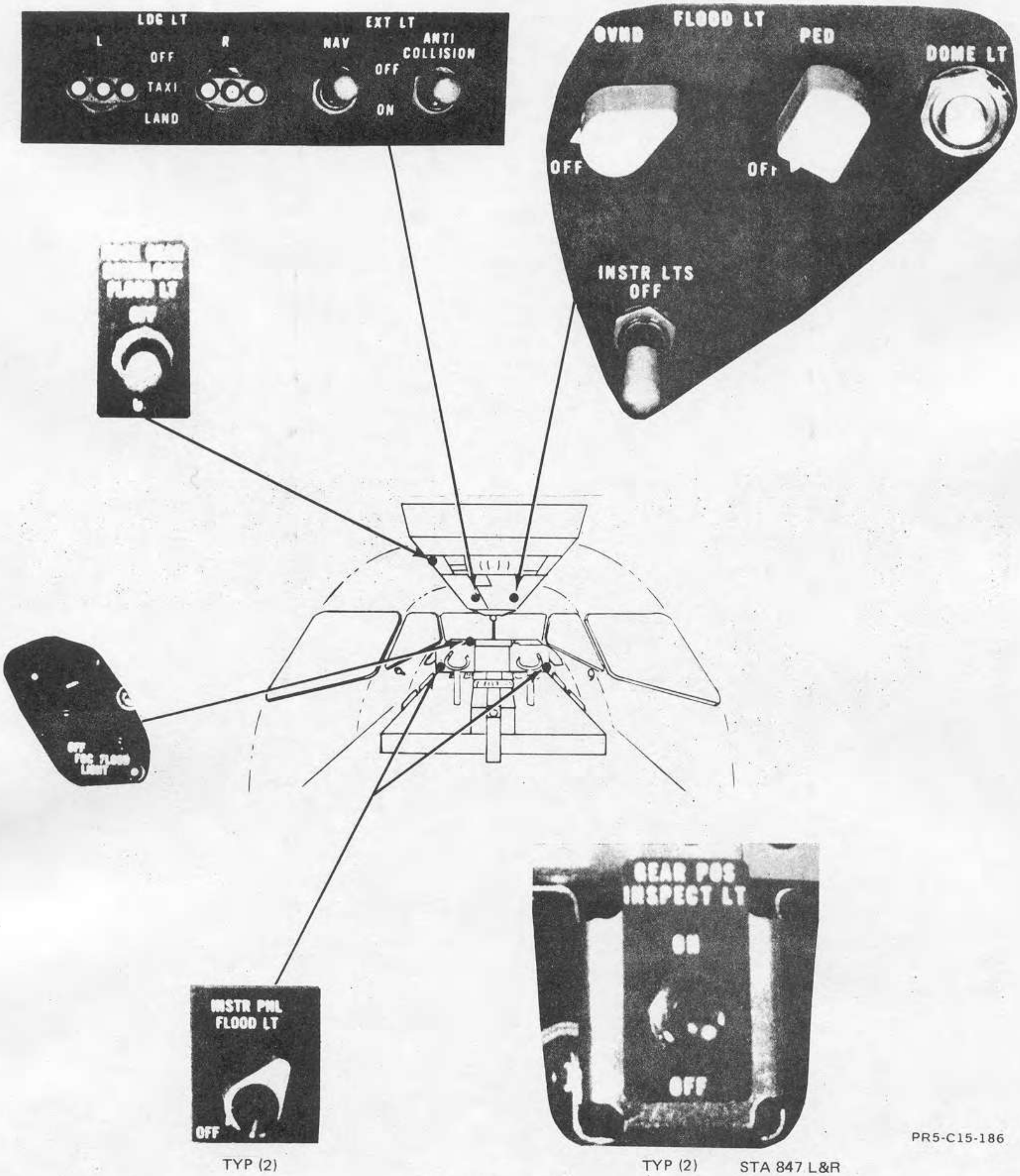
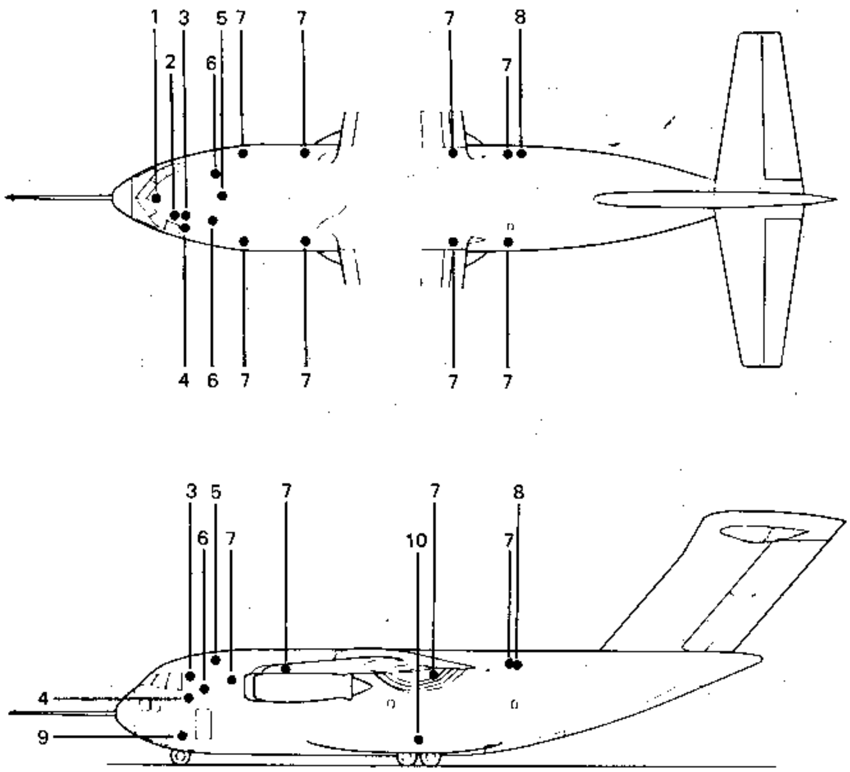


Figure 1-92

INTERIOR LIGHTS LOCATIONS



1. PILOTS' STATION
   INST PANEL LTS
   INST PANEL FLOOD LTS
   OVHD PANEL LTS
   OVHD PANEL FLOOD LTS
   PEDESTAL LTS
   PEDESTAL FLOOD LTS
   DOME LT
   GLARESHIELD FLOOD LT
   CHART HOLDER LTS
2. FLIGHT TEST ENGINEERS' STATION
   INST PANEL FLOOD LTS

3. & 4. CREW ENTRANCE AND STAIRWAY LT (STANDBY)
5. ESCAPE CHUTE STANDBY LT
6. AVIONICS RACK LTS
7. CARGO ILLUMINATION LTS
8. TROOP DOOR STANDBY LTS
   TROOP JUMP LTS
9. NOSE GEAR DOWNLOCK LT
10. MAIN GEAR POS INSPECT LTS (L AND R)

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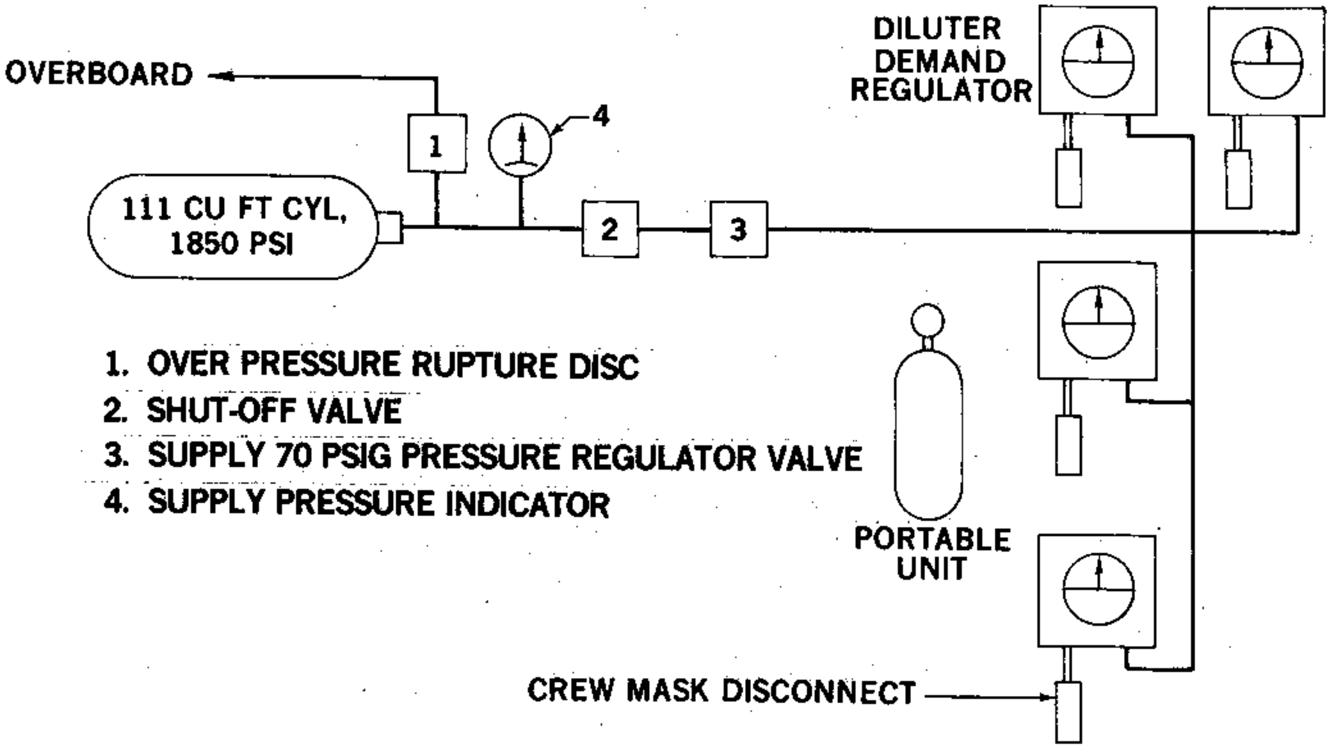
Figure 1-93

CREW OXYGEN SYSTEM



PR5-C15-188 A

Figure 1-94

OXYGEN REGULATOR

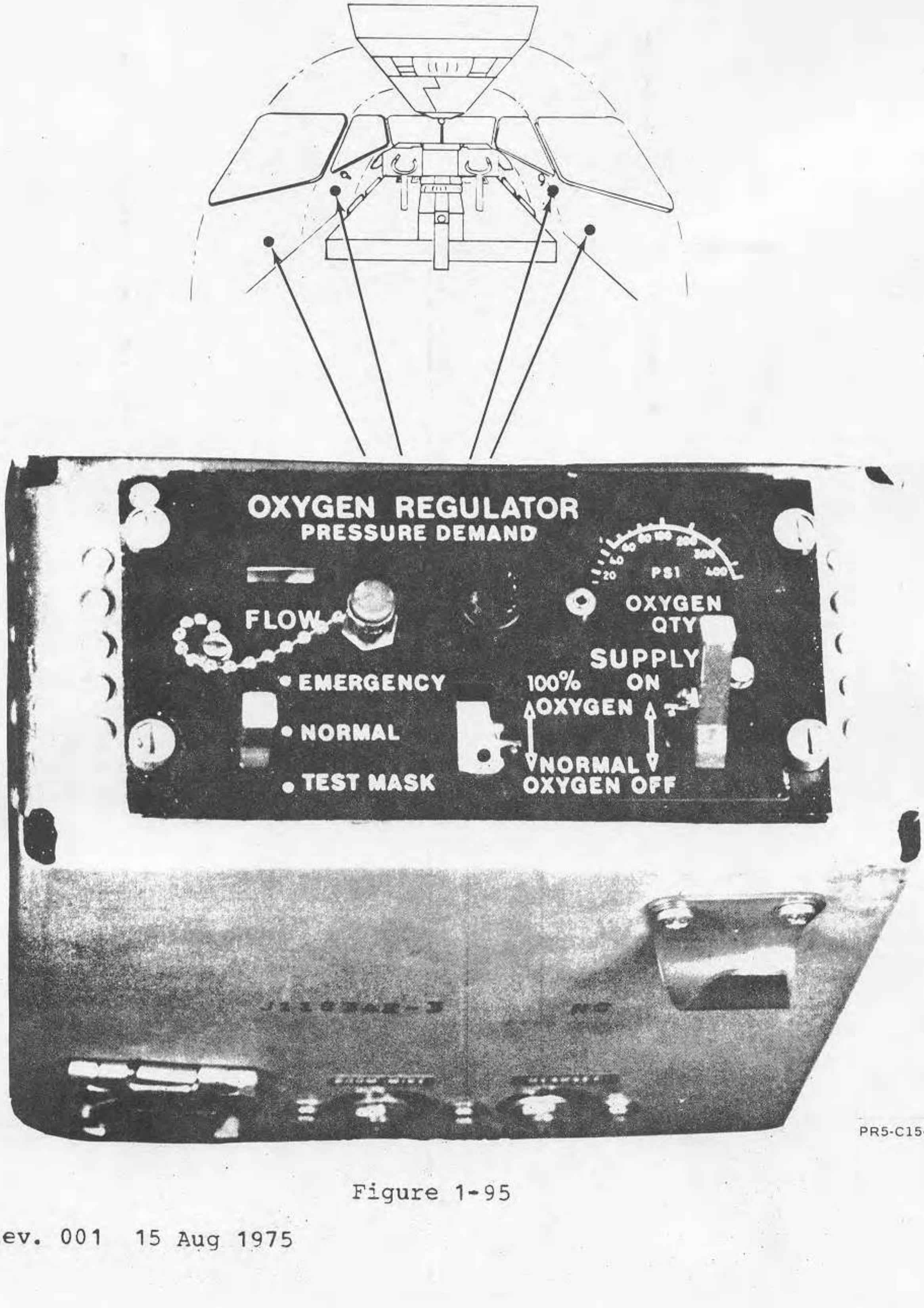
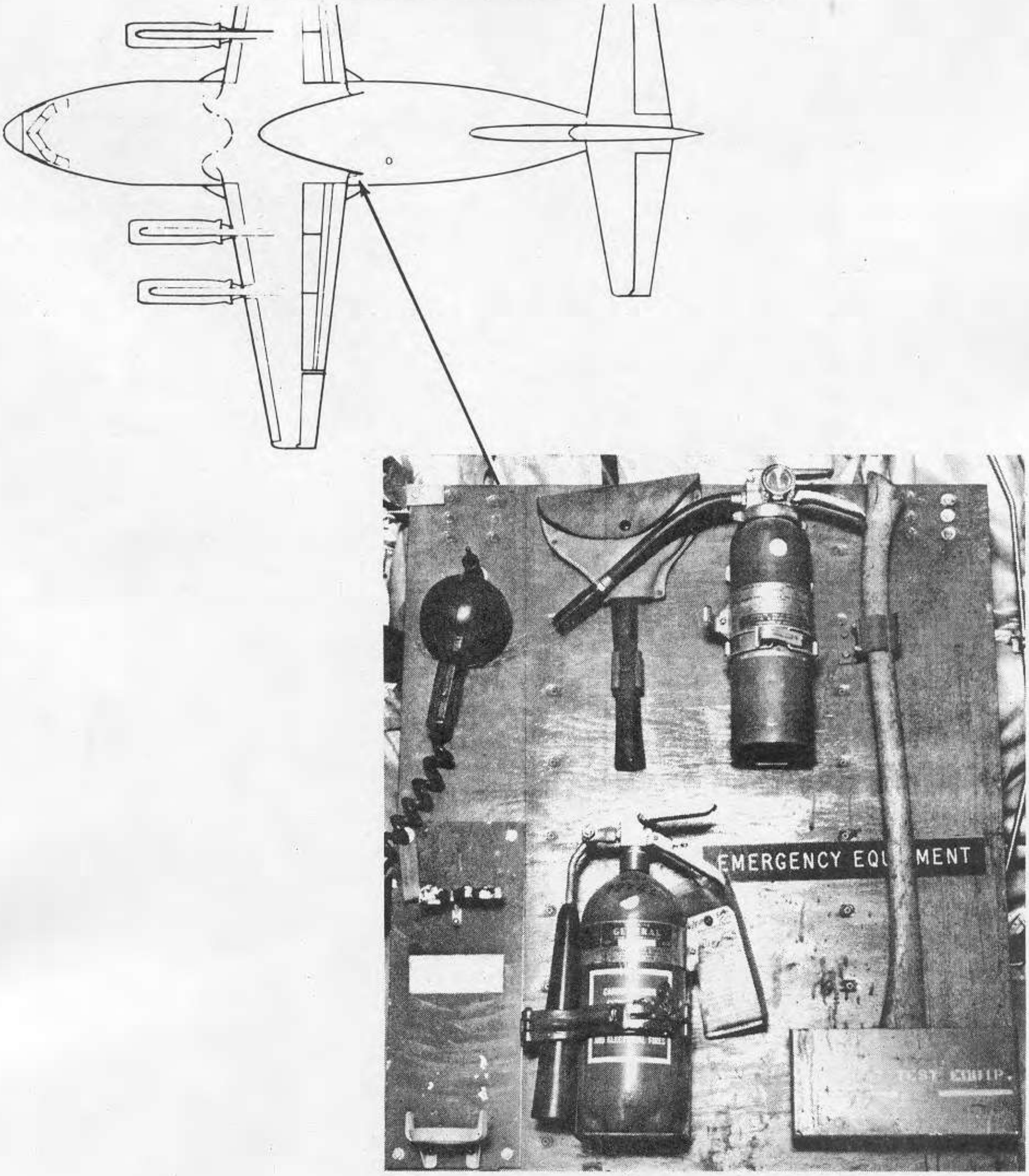


Figure 1-95

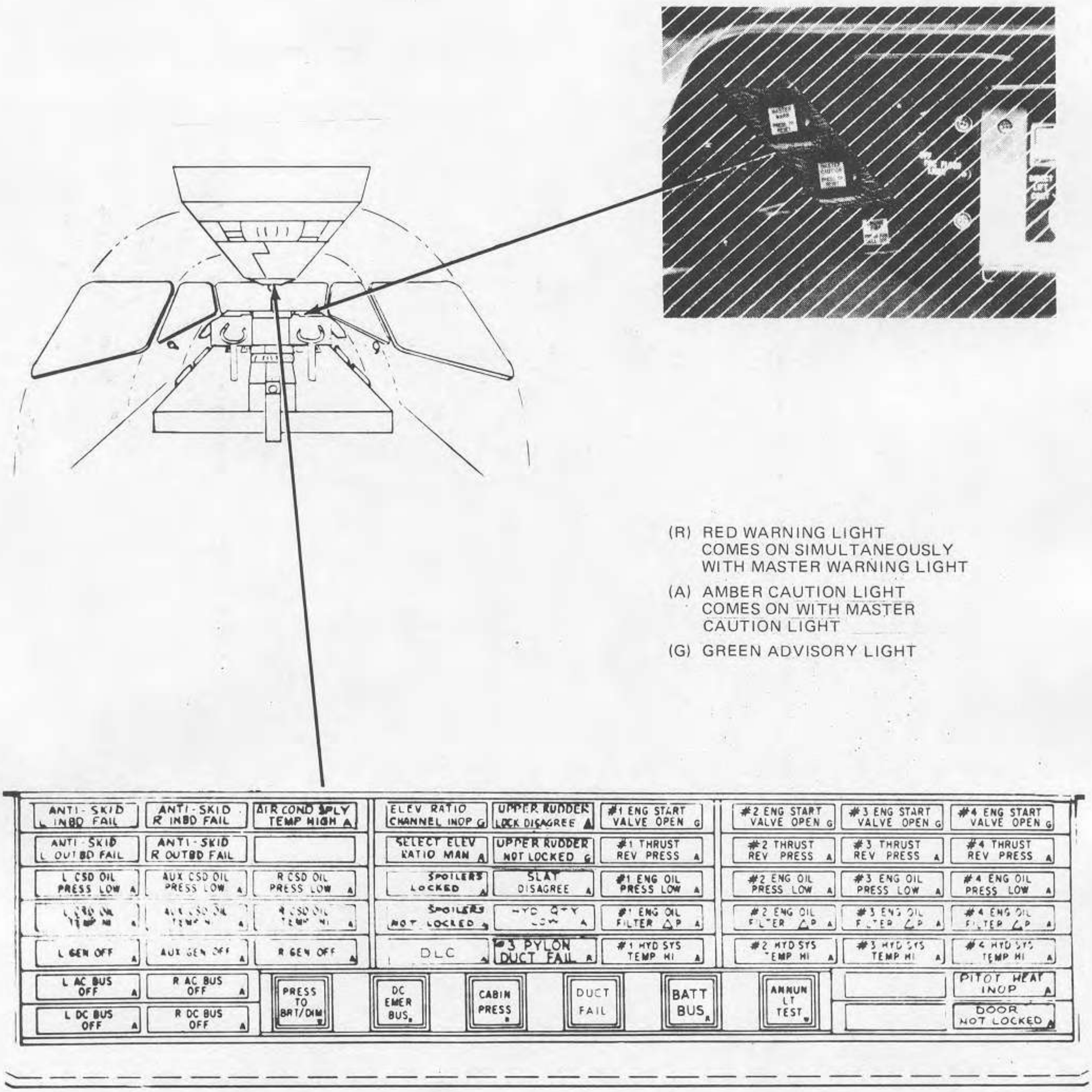
EMERGENCY EQUIPMENT PANEL



PR7-C15-50003

Figure 1-96

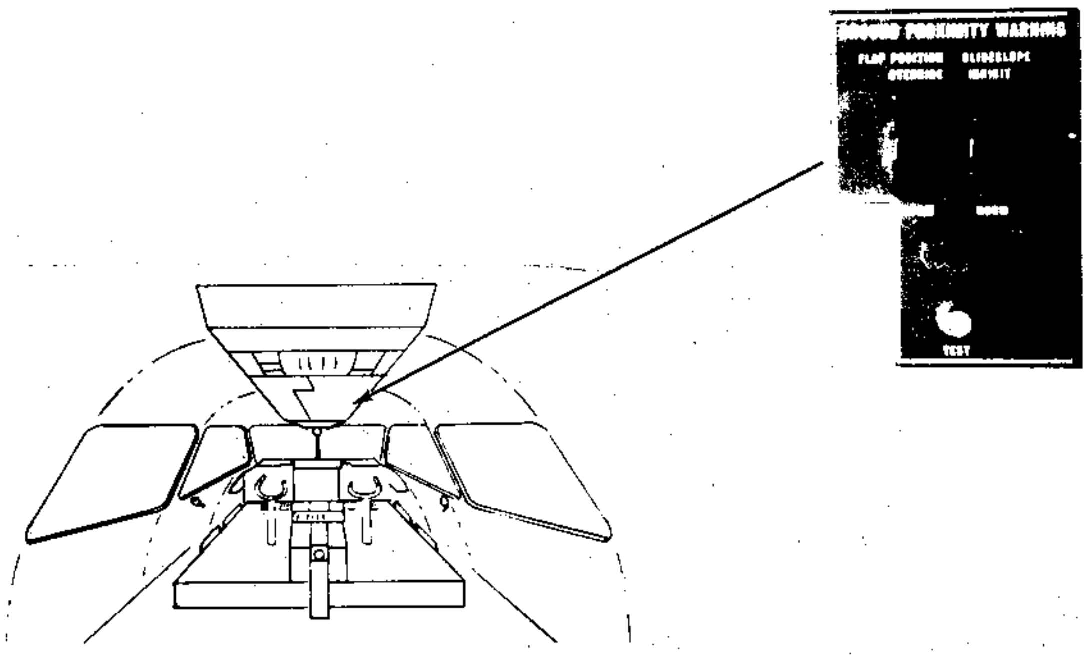
MASTER WARNING AND CAUTION SYSTEM



PR5-C15-190 B

Figure 1-97

GROUND PROXIMITY WARNING SYSTEM CONTROLS AND INDICATORS



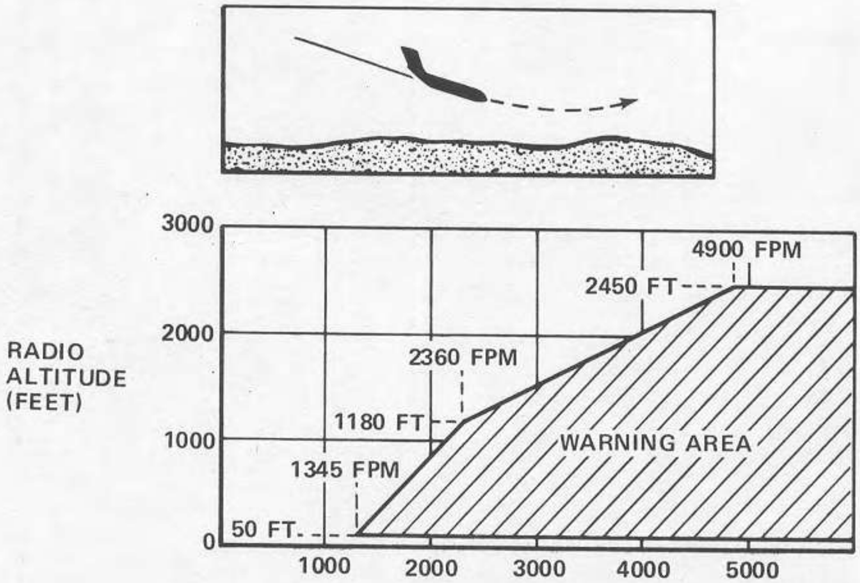
NOTE: AIRCRAFT NO. 2 ONLY

PR5-C15-199

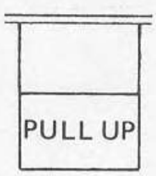
Figure 1-98, Sheet 1

GROUND PROXIMITY WARNING SYSTEM

MODE 1: EXCESSIVE RATES OF DESCENT WITH RESPECT TO TERRAIN



- This mode provides warning if barometric rate of descent is excessive between 2,450 feet AGL and 50 feet AGL. The rate of descent that triggers the warning varies with radio altitude as shown on the chart above. For radio altitudes between 2,450 feet and 1,180 feet, the system is designed to provide a nominal 30-second warning time prior to predicted terrain impact. Below 1,180 feet radio altitude, the warning time is decreased to prevent nuisance warnings during normal terminal operations. This mode is applicable to all aircraft configurations and is functional at all times between 2,450 feet and 50 feet AGL.



TYP (2)

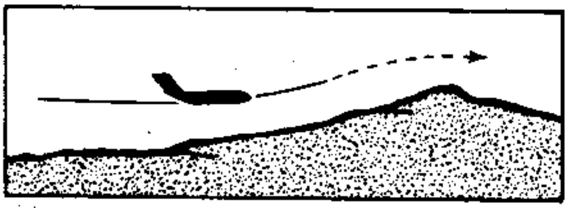
"WHOOP-WHOOP PULL UP"

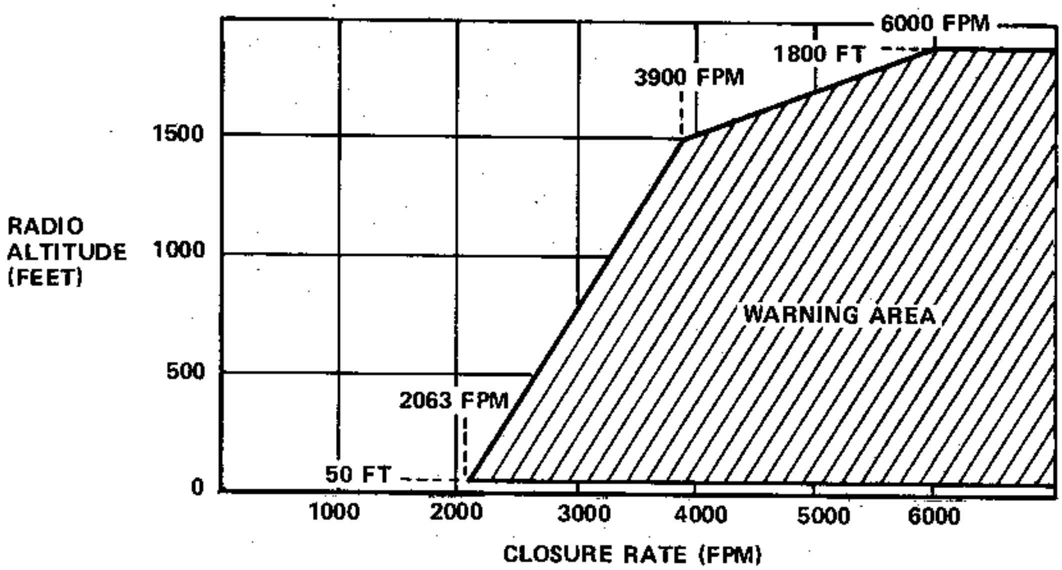
PR5-C15-247 A

Figure 1-98, Sheet 2

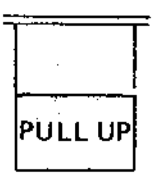
GROUND PROXIMITY WARNING SYSTEM

MODE 2: EXCESSIVE CLOSURE RATE TO TERRAIN





- This mode provides warning if the GPWS computed rate of closure with terrain exceeds the limits shown on the chart above. The closure rate that triggers the warning varies with radio altitude. This mode is partially desensitized when the Flap Lever is set to the normal landing configuration to avoid false warnings during landing approaches.



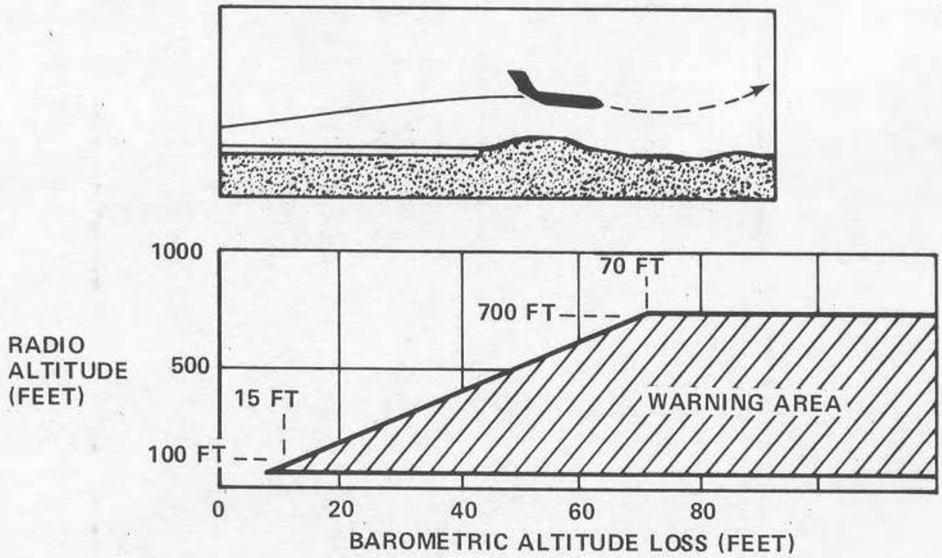
TYP (2)
"WHOOP-WHOOP PULL UP"

PR5-C15-248 A

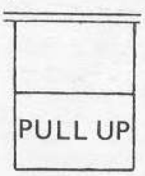
Figure 1-98, Sheet 3

GROUND PROXIMITY WARNING SYSTEM

MODE 3: LOSS OF ALTITUDE BELOW 700 FEET AGL DURING TAKEOFF OR GO-AROUND



- This mode provides warning when a barometric altitude loss occurs prior to reaching 700 feet AGL during takeoff or go-around. The altitude loss required to trigger a warning varies with the existing radio altitude at the point where the barometric altitude loss first occurs; e.g., at 100 feet AGL, 15 feet of barometric altitude loss will cause a warning – at 700 feet AGL, 70 feet of loss will cause a warning. As the aircraft climbs through 700 feet AGL, Mode 3 is canceled.



TYP (2)

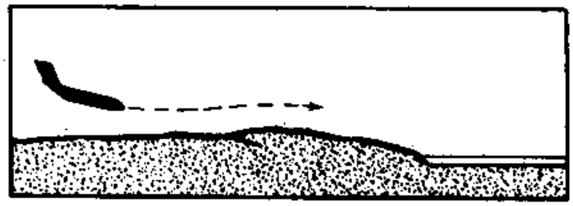
"WHOOP-WHOOP PULL UP"

PR5-C15-249 A

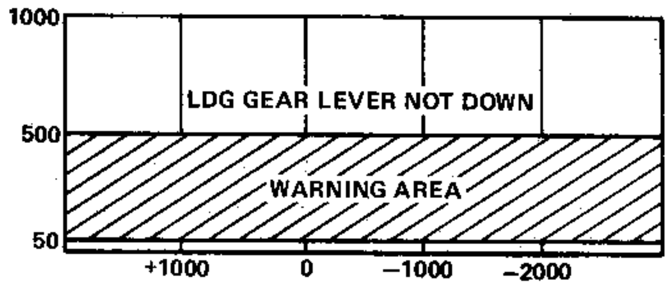
Figure 1-98, Sheet 4

GROUND PROXIMITY WARNING SYSTEM

MODE 4 A/B: INADVERTENT PROXIMITY TO TERRAIN DURING APPROACH

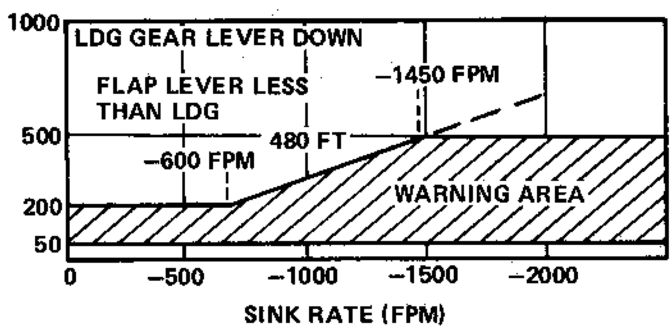


SUB-MODE 4A:

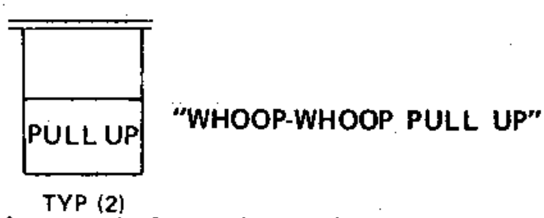


- Sub-mode 4A provides a warning if the aircraft descends through 500 feet AGL with the Landing Gear Lever not DOWN. The aircraft must have been above 700 feet AGL to cancel Mode 3 in order for Sub-Mode 4A to be active.

SUB-MODE 4B:



- Sub-mode 4B provides a warning if the Landing Gear Lever is DOWN but the Flap Lever is set to less than landing position. This warning is a function of radio altitude and barometric rate of descent as shown on the chart above. However, if the aircraft descends below 200 feet AGL with the Flap Lever set to less than landing position, the warning will occur regardless of the rate of descent.

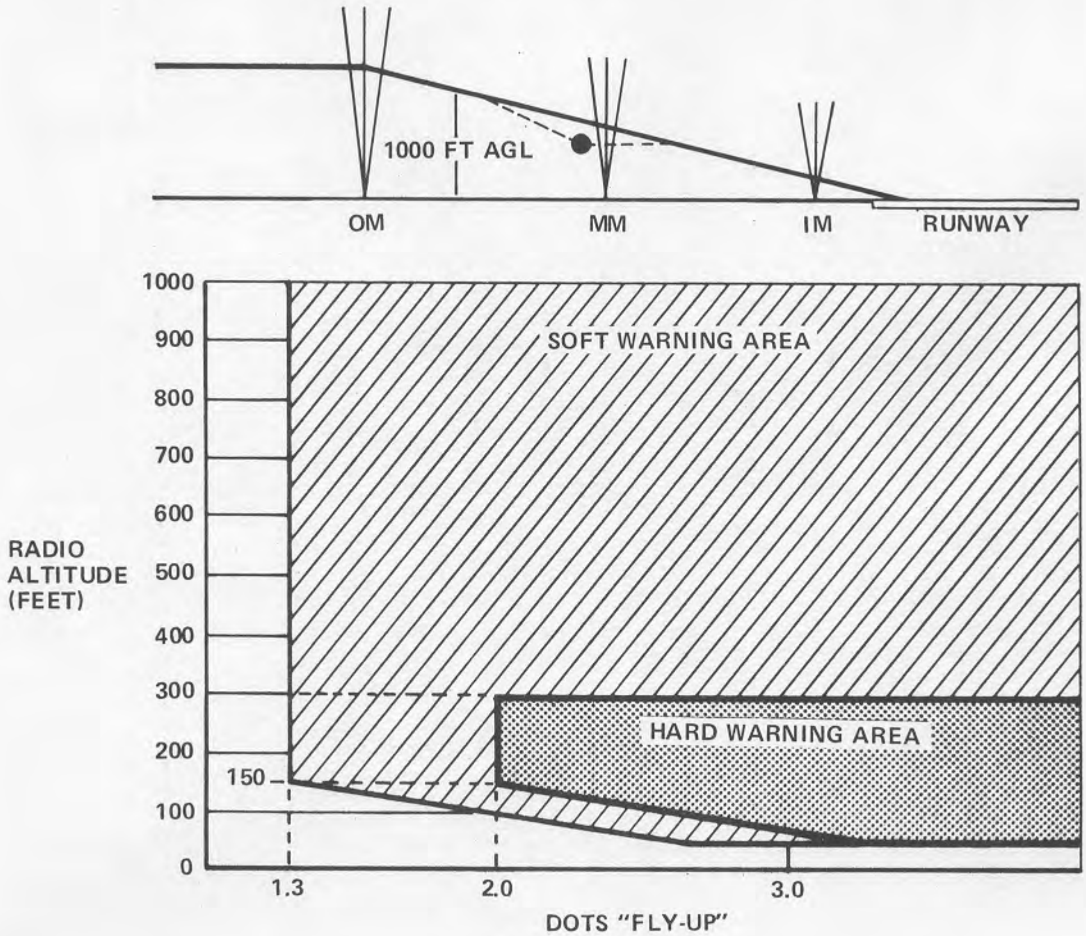


PR5-C15-250A

Figure 1-98, Sheet 5

GROUND PROXIMITY WARNING SYSTEM

MODE 5: INADVERTENT DESCENT BELOW GLIDESLOPE



- This mode is automatically armed when an ILS frequency is selected on the ILS receiver. The mode is active between 1,000 feet AGL and 50 feet AGL. The amount of deviation below the glideslope (as indicated by the "fly up" indication) necessary to trigger a warning varies with radio altitude as shown on the chart above. Below 150 feet AGL, the amount of deviation required is increased to eliminate nuisance warnings which could be caused by large deviation signals resulting from close proximity to the glideslope transmitter.

  The "hard warning" area depicts the area wherein the repetition rate and amplitude of the "GLIDESLOPE" aural warning are increased.

  All other modes function independently of Mode 5. A "PULL UP" warning (Modes 1 through 4) always has priority over a "GLIDESLOPE" warning. If it is desired to deliberately descend below the glideslope, Mode 5 can be canceled.

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Figure 1-98, Sheet 6

PILOTS SEATS

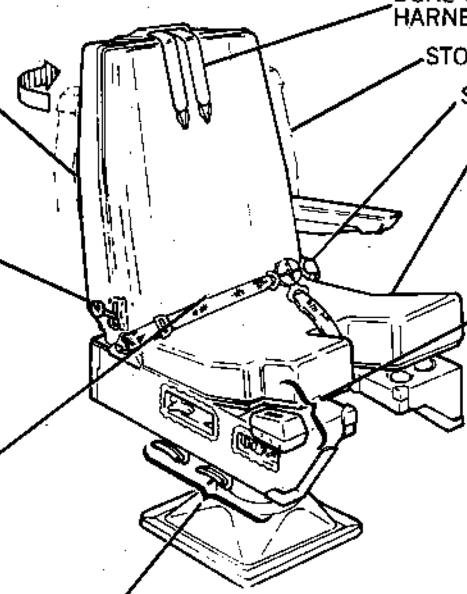
- Lumbar Support

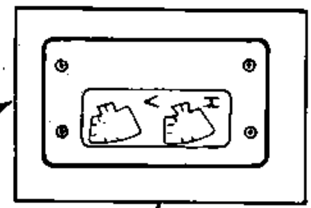
  Insert fingers and pull forward to desired thickness. Move ends up or down to fit small of back. To release, insert fingers in handhold and press inward on release handle.

- Shoulder harness control lever down position locks harness up position unlocks harness

- Armrest Release (2)

  Flush fingertip control on bottom of armrest releases lock to permit adjustment. The inboard armrest may be swiveled around behind seat back from stowed position to provide additional space for entering or leaving seat.





- Seat Position Indicator

  Horizontal and vertical index scales indicate seat position. Indicator light on when seat power switch is in ON position.

PILOT'S SEAT
(COPILOT'S SEAT OPPOSITE)

- Power Control Handle

  Placing the four-position handle to FWD, AFT, UP, or DOWN position will move seat in direction of handle movement. When seat is in full outboard and aft position (for exit), placing handle in FWD position will first move the seat inboard then forward.

  Handle is spring-loaded to the center position.

- Power Switch

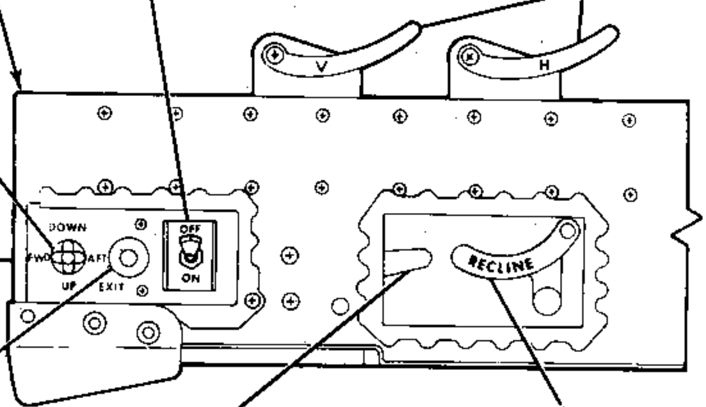
  ON/OFF switch controls power to seat.

- Manual Vertical/Horizontal Control Handles

  Raising handles releases seat position locks for manual adjustment.

- Seat Controls

  Shown upsidedown for clarity.



- EXIT Control Button

  When pushed the button operates the electric motor to move the seat aft and outboard for exit from cockpit. Seat must be moved full aft before it can be moved outboard.

- Thigh Support Control

  Raising control releases thigh support for manual adjustment.

- RECLINE Control Handle

  Raising the RECLINE control releases seatback lock for manual adjustment from upright to recline position.

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Figure 1-99

FLIGHT TEST ENGINEER'S AND ACM'S SEATS

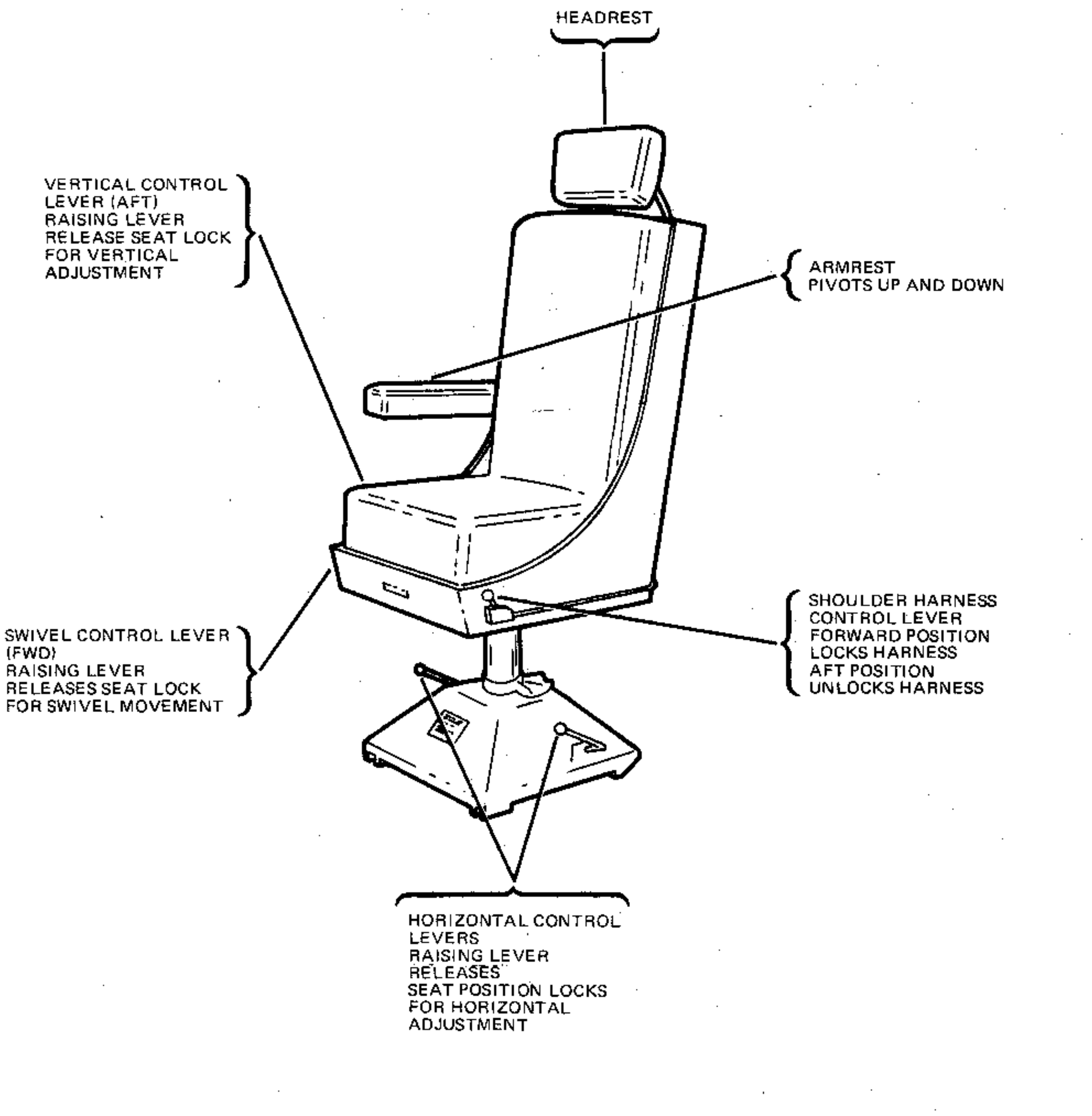


Figure 1-100

YC-15 WINDOWS

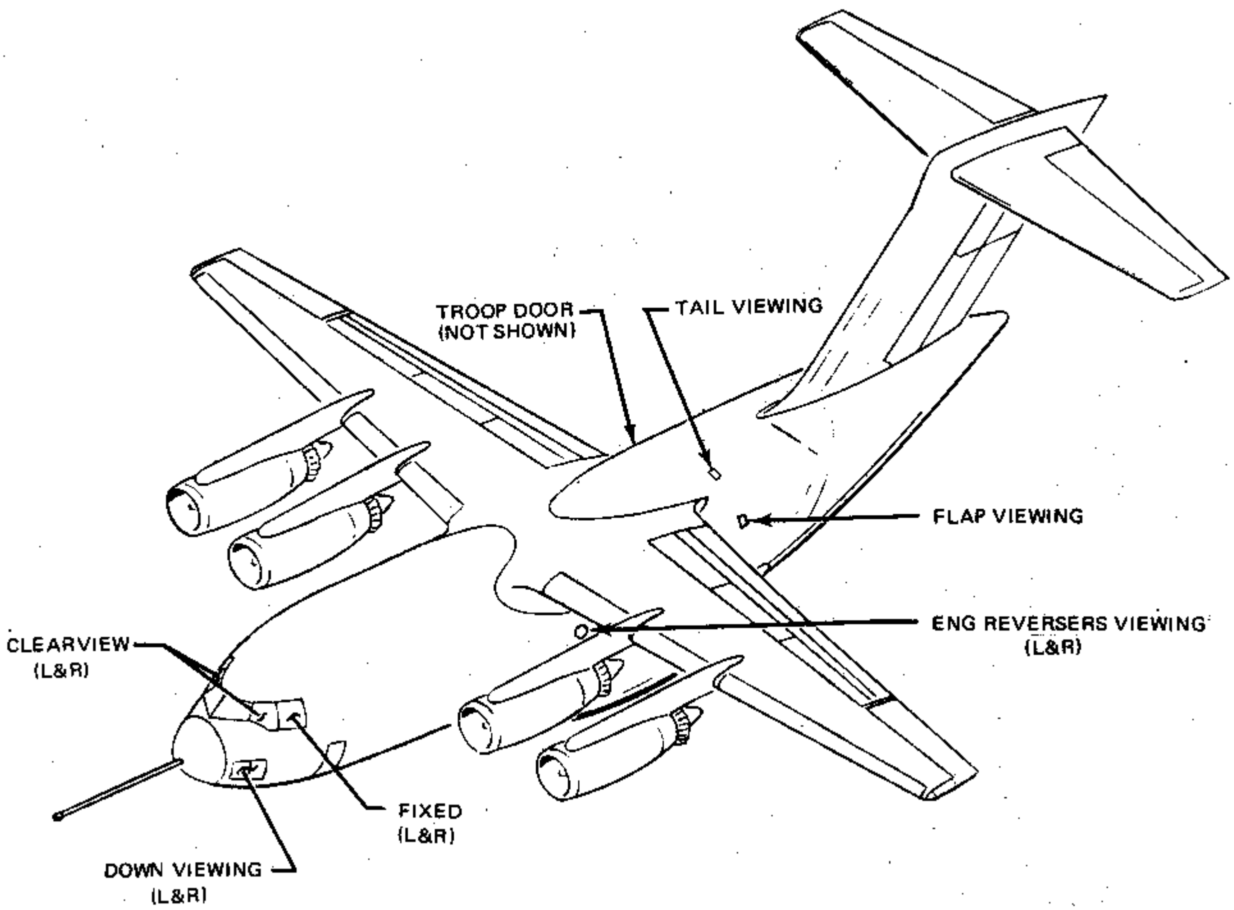


Figure 1-101

CLEARVIEW WINDOW (Left window shown, Right window opposite)

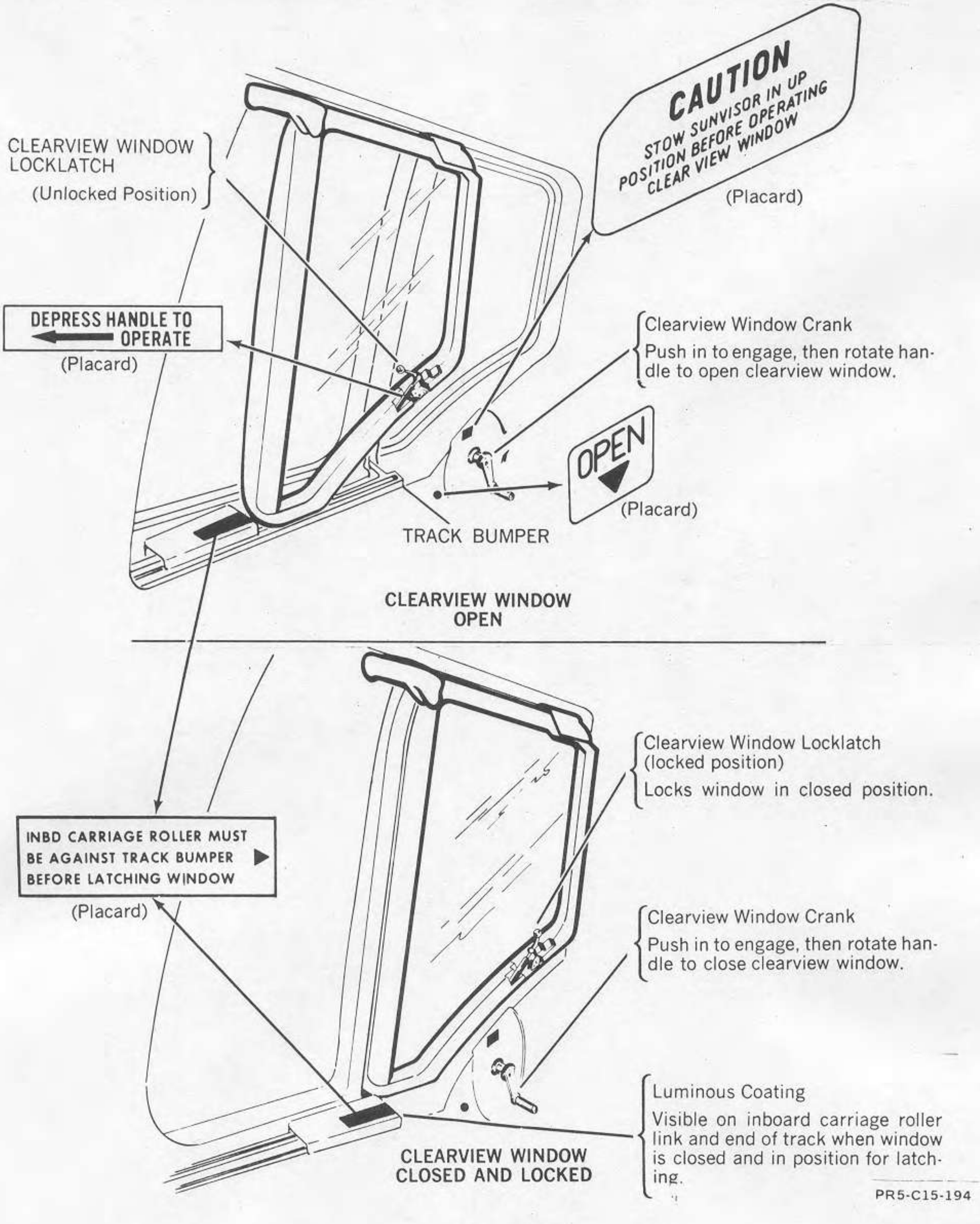
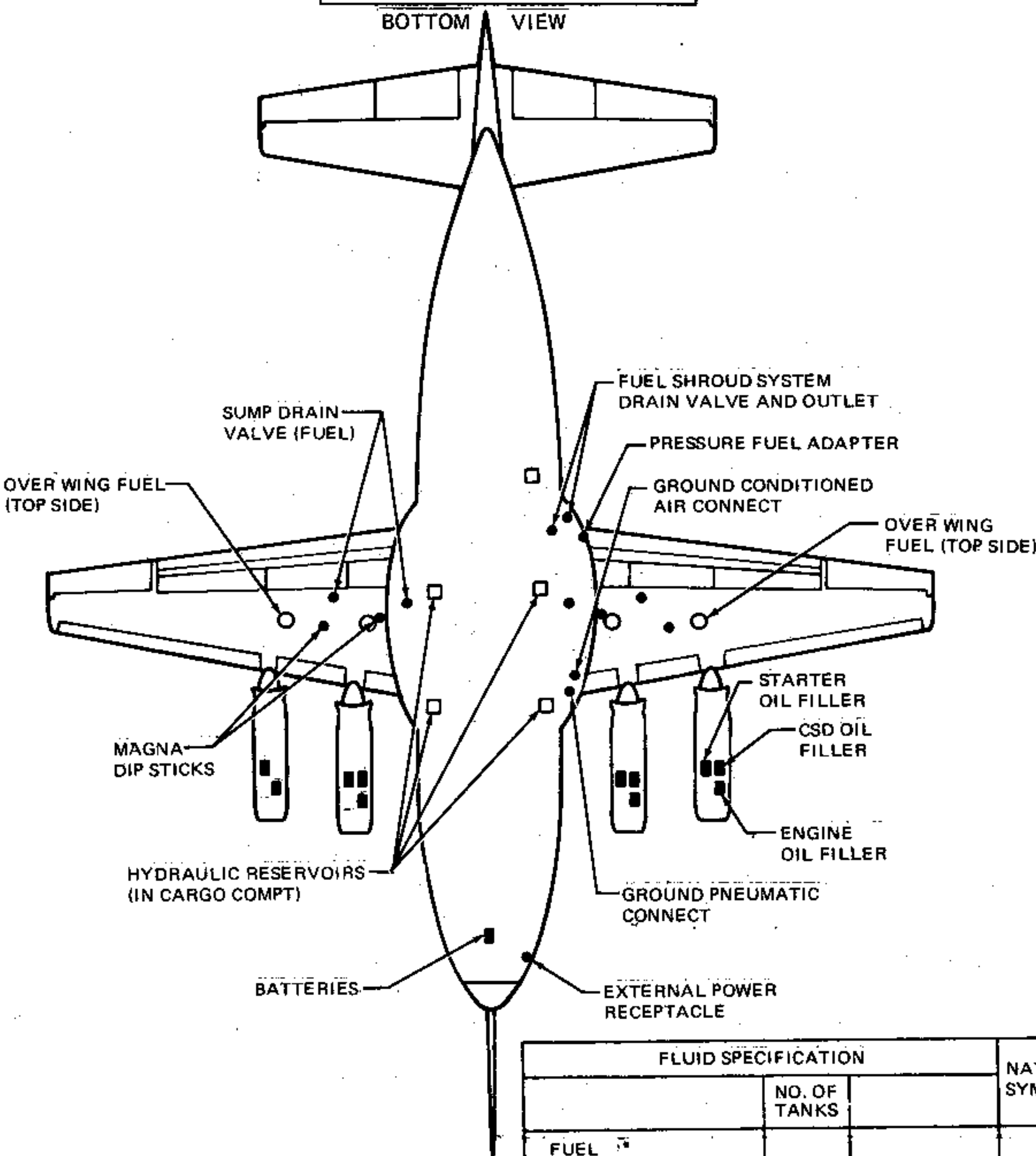


Figure 1-102

SERVICING DIAGRAM



FLUID SPECIFICATION	NO. OF TANKS		NATO SYMBOL
FUEL * WING FUSE	4 2	MIL-J5624 JP-5	F-44
ENGINE OIL	4	MOBIL JET NO. I	NONE
CSD OIL	3	MOBIL JET NO. II	NONE
HYDRAULIC FLUID	4	SKYDROL 500	NONE
OXYGEN	1	MIL-0-27210 TYPE II	NONE

* SEE SECTION V FOR ALTERNATE FUELS

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Figure 1-103

SECTION II

NORMAL PROCEDURES

TABLE OF CONTENTS

PREPARATION FOR FLIGHT

Checklists

The flight manual contains only amplified checklists. The abbreviated checklists have been issued as separate booklets. Line items in the amplified and abbreviated checklists are identical in arrangement and item number.

When a checklist item is followed by a crew position designation, i.e., (P), (CP), (FTE), that crewmember takes the action and if the action is in quotation marks, he reports that action to the person reading the checklist. If the action is not in quotes, he completes the action and remains silent. Beginning with the Before Takeoff Checklist, and all subsequent checklists, if an action item is not in quotes, and the copilot is not designated for action, he observes that the action as indicated on the checklist, has been completed. If the action has not been completed as designated, that item becomes a challenge item that requires a response from the pilot. Emergency checklist actions will be initiated only when the pilot calls for a specific checklist. The copilot normally will be responsible for reading the pilot's checklist.

For clarity, this section will include only normal procedures applicable to the pilot and copilot. For duties of other crewmembers refer to Section IV. The following crew identifying codes are used throughtout the checklists:

- P Pilot
- CP Copilot
- FTE Flight Test Engineer
- LM Loadmaster

Flight Restrictions and Limitations

Applicable flight restrictions will be found in the Interim Flight Restrictions (IFRs) and/or the Structural Placards manual and noted on test cards where applicable. Additional aircraft and systems limitations are contained in Section V of this manual and the FTE's Handbook.

Flight Planning

A preflight briefing will be conducted prior to each flight. The flight card package will be presented by the FTE and all tests will be reviewed in detail. In addition, a review and coordination of special requirements such as laser, TALAR, wind kit and runway support, chase, etc., will be conducted. After reviewing and checking the forms, the pilot in command will sign the "Accepted for Flight" block of the preflight form.

The completed and approved "Ship's Papers" will be turned in to Quality Assurance. Refer to the FTE's Handbook for necessary performance data.

Takeoff and Landing Data

Prior to takeoff, the TOLD (Takeoff Landing Data) card will be completed by the FTE and reviewed by the pilots. Information necessary to complete TOLD card is contained in the FTE Handbook.

Weight and Balance

Note the aircraft weight and balance as submitted by the FTE at the preflight briefing. Section IV contains a description of the FTE's duties with regard to weight and balance computations and briefings.

Entrance to Aircraft

Crew entrance is gained through the crew entrance door.

WARNING

Do not open door until aircraft is depressurized. When unlocking, hold door to prevent possible injury if door should fall down.

NOTE

Aircraft depressurization will be confirmed by voice communication with flight crew or by observing an open: clearview window, troop jump door or cargo ramp and/or door.

PREFLIGHT CHECKS

The pilot in command shall verify with the maintenance crew chief that the aircraft is in flight status and has been serviced with the proper amounts and grades of fuel, oil, and oxygen. It is the responsibility of the pilot to determine that the preflight inspection has been performed.

NOTE

The flight crew inspection procedures outlined in this section are predicated on the assumption that maintenance personnel have completed all the requirements for preflight inspection. Duplicate inspection and operational checks of systems by flight crewmembers have been eliminated, except for certain items required in the interest of flying safety.

Exterior Inspection

During exterior inspection (figure 2-1), the aircraft will be checked for evidence of damage, leaks, security of inspection plates, access doors, and attachments. In order to perform this inspection, the flaps should be fully extended. Check installation of equipment and for presence of foreign matter in airscoops, ducts, inlets, and outlets. Refer to Section VII for adverse weather operation.

1. Nosewheel Well - CHECKED

   Downlock installed
   Hydraulic lines for security and leakage
   Uplock hook and roller for security or damage
   Check that emergency nosegear release cable is attached and in the pully
   Steering mechanism and linkage for security and hydraulic leaks and position of bypass handle
   Gear actuating cylinder for leakage
   Strut for proper extension, cleanliness and leakage
   Tires for excessive wear, cuts, cracks and inflation
   Electrical wiring for chafing or damage
   Doors and actuating arms for condition and security
   Check wheel access panels installed

2. Nose Area and Boom - CHECKED

   Radome for damage and security
   Pitot tubes for alignment,

covers removed, no obstruction or discoloration
Boom cover removed, no damage
Windows for cracks or crazing

3. Fuselage (Side and Underside) Nose to Wing - CHECKED
Access panels for security
Skin for obvious damage and fasteners for security
Pitot tubes for alignment, covers removed, no obstructions or discoloration
Antennas and underside of fuselage for obvious damage

4. Right Wheel Pod and Center Fuselage - CHECKED
Air conditioning inlet cover removed
Taxi and landing lights for cracks and security
Doors and actuating arms for condition and security
Tires for excessive wear, cuts, cracks and inflation
Brakes for evidence of overheating and leakage
Uplocks for damage
Check that the emergency main gear release cable is attached and in the pully
Downlock pin installed
Hydraulic lines for security and leakage
Strut for proper extension against placard value, cleanliness and leakage
Aux pumps 4 and 3 for security and condition
Single point refueling door security
Skin for damage
Anti-collision light for damage

5. Right Wing Lower Surface and Flaps - CHECKED

Doors and access panels for security
Skin for obvious damage and leaks
Flaps for obvious damage

6. #3 and 4 Engine Nacelles - CHECKED

DLE flaps for obvious damage
#3 engine inlet cover removed and exhaust clear.
Nacelle for obvious damage, leaks and access panels security
Reversers stowed
#4 engine same

7. Right Wing - CHECKED

Slat condition and security
Skin for obvious damage and leaks
Wing and tail lights intact

8. Aft Fuselage and Tail - CHECKED

Skin for obvious damage
Troop door condition
Cargo door/ramp seals and general condition
Tail wheel checked for proper inflation
Vertical stabilizer and rudder for damage or leakage
Horizontal stabilizer for damage and leakage
Elevators for damage

9. Left Wing - CHECKED

Same as right wing

10. #1 and 2 Engine Nacelles - CHECKED

Same as #3 and 4

11. Left Wing Lower Surface and Flaps - CHECKED

Same as right wing

12. Left Wheel Pod and Center Fuselage - CHECKED

Same as right wheel pod

TEMPORARY REVISION XI

SECTION II (NORMAL PROCEDURES)

1. Page 2-005 Rev. 003 24 Jan 1977

   Under step 2 add the following sentence after "Verify ISOLATION SHUTOFF VALVE manual red lever is in CLOSED":

   Verify Cargo Door Manual Control Lever is in CLOSE position.

13. Fuselage (Side and Underside) - CHECKED

Same as right side and Pressure relief valve openings clear and static ports are clear.
Oxygen blowout disc in place

Interior Inspection

The interior inspection (figure 2-1) will normally be accomplished by a flight crewmember.

1. From Crew Entrance to Ramp

   a. Crew entrance door, check seal, mechanism condition and bayonet latches

   b. Flight test equipment - CHECKED & STOWED & PROPERLY RESTRAINED
   FTE and/or LM verify all flight test equipment necessary for this flight is aboard and stowed. Electrical power is on. Tape recorder loaded and spare tape available.

   c. At FWD CARGO DOOR RAMP CONTROL panel, check HYD PRESS and CONT PNL SELECT switches are OFF

   d. Emergency equipment - ABOARD & STOWED
   Check that fire extinguishers and oxygen cylinders are aboard and stowed.

   e. Cabin ballast - STOWED
   If cabin ballast is aboard, check that it is stowed.

   f. Fuselage tank
   Installed - check security and leakage

   Not Installed - check security of vent, fuel lines and wiring

   g. Left fuselage
   Obvious damage and leaks
   Hydraulic systems #1 and 2 reservoirs Landing gear safety pin and red pry bar installed

2. Troop and Cargo Door/Ramp - CHECKED

At AFT CARGO DOOR/RAMP CONTROL panel, verify HYD PRESS switches OFF
Verify ISOLATION SHUTOFF VALVE manual red lever is in CLOSED
TR-11
Check for obvious damage and leaks
Check troop jump door for security and leaks

3. Right Fuselage - CHECKED

Check for obvious damage and leaks
Landing gear safety pin stowed
Hydraulic systems #3 and 4 reservoirs
Check that the fuel sight gage is empty

4. Avionics Area - CHECKED

Check for area security, units connected and air flowing from the piccolo tubes

CAUTION

If there is no airflow, notify crewchief.

Check battery for security and battery circuit breakers closed

5. Escape Chute Area - CHECKED

If installed, verify that the porti-potty is secured
Aircraft #2 only, check the LAPES control handle is in

SAFE and pinned
Check that ADS handle and cable are stowed

6. Oxygen Cylinders - CHECKED

   Verify the portable oxygen cylinders (if aboard) are charged to approximately 1,800 PSI and properly stowed

7. Fire Extinguishers - STOWED

   Verify the portable fire extinguishers in cargo area are charged and properly stowed

8. Escape Chute Pin - INSTALLED

   If installed

9. Bolt Cutter - STOWED

   If installed

10. Escape Chute Switches - OFF (CP)

    If installed

11. Flight Compartment Emergency Equipment - ABOARD & STOWED

    Verify that the fire extinguishers, oxygen bottles, and smoke goggles are aboard and stowed.

12. Circuit Breakers - "SET" (CP,P)

    Check that the circuit breakers on the overhead panel, EPC and pilot's lights are closed. If any circuit breaker is guarded open verify with maintenance crew chief that it is correct for flight.

BEFORE STARTING ENGINES

During the Before Starting Engines and Starting Engines checklists, the ground crew will maintain contact with the pilot on the interphone system.

1. Escape Chute Switches - "SAFETIED" (CP)

   If installed, check that the DEPLOY and ARM escape chute switch guards are down and safetied.

2. Oxygen Regulator - "SET" (all)

   Check that the switches are "NORMAL", "100% OXYGEN" and that each SUPPLY lever is saftied in "ON". Check the supply pressure indicator shows sufficient oxygen for the flight.

3. Bailout Siren - "TESTED" (P,LM)

   If installed, hold the bailout siren switch in ON and listen for the bailout siren. Release the switch and the siren should silence. This indicates the battery is connected and the Battery Direct Bus is powered.

4. Rudder Trim - "ZEROED" (P)

   If desired, rotate the rudder trim knob and check for freedom of movement.

5. Fuel Levers - "OFF" (P)

   Verify that all the fuel levers are latched in OFF.

6. Throttles - "IDLE" (P)

7. Flap/Slat Handle - "SET" (P,CP)

   The handle should agree with the actual position of the flaps.

8. Gear Handle - "DOWN" (CP)

9. Spoiler Mode Selector Switch - "OFF" (P)

10. Inoperative Components - PLACARDED (CP,P)

Verify that any components that are inoperative are placarded. Verify with maintenance crew chief and FTE that all components required for flight are operative.

11. Battery - "ON" (P)

12. Electrical System - "SET/CHECKED" (P)

a. CSD switches - NORM & GUARDED

b. L & R GEN switches - ON AUX GEN switch - NORM

c. AC LOAD meters - ZERO

d. AUX PWR IN USE and AUX PWR AVAIL lights - OFF

e. AUX PWR L & R BUS switches - NORM

f. DC BUS X-TIE switch - OPEN

g. Connect external power to aircraft, EXT PWR AVAIL light - ON
This light on signifies that external power is suitable for the aircraft.

h. VOLT/FREQ SEL - EXT PWR
Check that voltage and frequency are normal.

i. EXT PWR L BUS switch - ON
EXT PWR R BUS switch - ON
Check that AC and DC BUS OFF lights go off, indicating that buses are powered.

j. VOLT/FREQ selector switch - BAT VOLTS
When the battery is charging, the voltmeter pointer will be pulsing.

13. Emergency Power - "OFF" (P)

The white EMER PWR IN USE light should be off.

In aircraft #2, the AERIAL REFUEL lights should be off

14. Anti-skid - "CHECKED" (P)

Anti-skid system may be tested without hydraulic pressure and regardless of the position of the parking brakes: Normal position is PAVED RWY and ARM. Wheel chocks shall be in place during anti-skid system test.

a. Runway selector in UNPAVED RWY

b. Anti-skid switch - ARM

c. ANTI-SKID FAIL lights should be OFF

d. Press and hold TEST button

e. ALL ANTI-SKID FAIL lights should come on. If one or more fail lights do not come on, it indicates an anti-skid malfunction.

f. Release TEST button

g. All ANTI-SKID light should go off

NOTE

If the anti-skid system fails to test properly, notify maintenance. The aircraft should not be released for normal flight tests with the anti-skid system inoperative.

h. Retest in PAVED RWY position

15. INS, Mode Selector - "STBY" (P)

If installed, include LTN-72 operation.

NOTE

If INS has been operating prior to crew arrival, MSU could be in ALIGN.

16. Flight Control Selectors - "CHECKED" (P)

a. SPOILERS, AMP 2 and AMP 3 switches - AUTO
With the flap/slat handle in SLAT RET, the SPOILERS LOCKED and SPOILERS NOT LOCKED annunciators should be off. Place either switch in UNLOCK and the SPOILERS NOT LOCKED light should come on. With the flap/slat handle in SLAT EXT, placing either switch in LOCK, causes the SPOILERS LOCKED light to come on. Reselect AUTO.

b. UPR RUDDER selector - AUTO
The UPPER RUDDER NOT LOCKED annunciator should be on. Place the selector in LOCK and the UPPER RUDDER NOT LOCKED light goes off and the UPPER RUDDER LOCK DISAGREE light comes on. Reselect AUTO.

c. ELEV RATIO selector - AUTO
The ELEV RATIO REF IAS should be in lower white band (135 knots). If a test is desired proceed as follows:

(1) Rotate the ELEV RATIO selector to MAN.
The ELEV RATIO CHANNEL INOP and SELECT ELEV RATIO MAN and MASTER CAUTION lights should come ON. Do not reset MASTER CAUTION lights.

(2) Rotate and hold MAN SLEW Selector (CW) to first INCR dot.
Observe the REF IAS pointer increases.

(3) Rotate and hold the MAN SLEW selector (CCW) to second DECR dot. Observe the REF IAS pointer decreases.

(4) Release the selector and observe the pointer remains stationary.

(5) Rotate the ELEV RATIO selector to AUTO.
Observe the ELEV RATIO CHANNEL INOP and SELECT ELEV RATIO MAN and MASTER CAUTION lights go off and the pointer returns to the lower white band (135 Knots).

17. Cabin Press Valve - NORM (P)

18. Pneumatics - "AIR COND" (P)

If desired, air condition the flight compartment as follows:

a. Contact ground crewman to plug in pneumatics.

b. Pneumatic pressure 18 PSI or more.

c. Pneumatic switch - AIR COND.

19. Ignition - "OFF" (P)

All four ENG START switches should be guarded to OFF.

20. Landing and Exterior Lights - "AS REQUIRED" (P)

21. Fire Shutoff Handles - "STOWED" (P)

22. Fuel System - "CHECKED" (P)

a. Fuel system fill valve switches - CLOSED

b. FILL VALVE OPEN lights - OFF
Aircraft #2 only - AIR REFUEL VALVE OPEN light - OFF

c. TANK PUMP (FWD and AFT) switches - OFF

d. X-FEED selectors - CLOSED

e. X-FEED DISAGREE lights - OFF

f. REFUEL VALVE OPEN light - OFF

g. REFUEL VALVE switch - CLOSED

h. FUEL HEAT switches - OFF

i. PRESS LOW lights - ON
If any PRESS LOW light(s) is not on, bleed pressure from manifold into tank(s) before proceeding.

j. FUEL FILTER PRESS DROP lights - OFF

k. Check fuel pump operation by placing each FWD tank pump switch ON one at a time and noting that applicable PRESS LOW lights go off.

l. Place each AFT tank pump switch ON.

NOTE

If desired, pumps may be turned on prior to exterior inspection to permit leak check.

23. Hydraulic System - "CHECKED" (P)

a. Place AUX PUMP switches ON, one at a time and note that applicable HYD SYS PRESS is approximately 3000 PSI.

b. Check HYD QTY indicates above minimum quantity mark (V) and HYD QTY LOW light is off.

c. Verify each ENG PUMP switch is ON.

NOTE

HYD SYS 1 and 4 pressurize the aircraft's wheel brake system.

d. Place each AUX PUMP switch OFF.

NOTE

If desired the aux pumps may be placed on for exterior inspection to permit leak check.

24. Compasses - "SLAVED" (P, CP)

The compass switches should be in SLAVED and indices aligned.

25. Fire Detectors - "CHECKED" (CP)

a. ENG LOOPS selectors - BOTH

b. LOOP A and LOOP B lights - OFF

c. Simultaneously place and hold LOOPS A and LOOPS B TEST switches in TEST. The fire shutoff handle lights, fire detector LOOP A and LOOP B lights, master ENGINE FIRE light, fuel lever lights will come on and the fire warning bell will sound.

d. Press the master ENGINE FIRE light to silence the bell.

e. Release the TEST switches to turn off all the lights.

NOTE

If an invalid test is noted, refer to SECTION I for details on single loop operation.

26. Stall Warning - "CHECKED" (CP)

Check the left system by placing STALL TEST selector in L position. Stick shaker should operate. Release and test in R position.

NOTE

If the slats are extended, the SSRS horns will sound during the test.

27. Ground Proximity Warning - CHECKED (aircraft #2 only)

Test the system by pressing and holding the GROUND PROXIMITY WARNING TEST button. Both glareshield PULL UP lights and the GND PROX WARN FAIL light comes on. "Pull up" and "Glideslope" aural warnings sound.

28. Engine Anti-Ice - "OFF" (CP)

29. Windshield Defog - "ON" (CP)

30. Pitot, Static and Probe Heaters - "CHECKED" (CP)

Select all positions of METER SEL & HEAT switch and check meter reading to indicate normal circuit. PITOT HEAT INOP light should go off. Select PILOT at completion of check. In normal operation heaters are turned on when selector is moved from OFF position, except TAT 1 & 2 probes are not heated during ground operation.

31. Windshield Wipers - "OFF" (P, CP)

Pilot and copilot windshield wiper selectors should be in OFF.

32. Annunciator panel - "CHECKED" (CP)

Press and hold ANNUN LT TEST switch and check that all the annunciator panel lights come on, blank positions will have amber dashes, and that the MASTER WARNING and MASTER CAUTION lights come on. If desired, momentarily press BRT/DIM switch and all lights should dim. Release ANNUN LT TEST switch.

33. Time of Day - "CHECKED" (CP)

Check that the glareshield digital clock is correct and counting. If it isn't, inform the FTE.

34. Flight Instruments - "CHECKED" (P,CP)

    Scan the flight instruments from left to right. h dot; CG; Force; Alpha; Elev; Ail Trim; Spoil. L & R; Ail; RUD position; and HORIZ (stabilizer) indicators. If installed, verify that the airspeed Source Selector agrees with the Flight Test Card.

35. Center Instrument Panel - "CHECKED" (P)

    Standby flight instruments normal - set altimeter setting; reverser lights all off; engine instruments normal.

    If installed in Aircraft #2, check the Thrust Rating Indicator and test it if desired.

36. TAT-EPR Indicator - "SET" (P)

    Set the TAT-EPF indicator in NORM for sea level; EDW at Edwards AFB; or YUMA at Yuma.

37. EPRs - "SET" (P)

38. Fuel Used - "NOTED" (P)

    Before zeroing the fuel used indicator, check with FTE.

    Hold the FUEL USED switch in RESET until the FUEL USED digital readouts indicate zero.

39. Fuel Quantitiy - "STATE QTY" (P)

    Check the fuel sheet and verify that correct fuel quantity is aboard and wing tank fuel equals the totalizer.

40. Fuel Totalizer - "SET" (CP)

41. Landing Gear Lights - "CHECKED" (CP)

    Check that the gear handle is down and red lights are off. Press to test the Handle lights.

42. Cabin Pressurization - "SET" (CP)

    Rotate the CABIN ALT control knob until the pointer indicates the takeoff field elevation on the scale. Check that the RATE knob indices are aligned. Verify that the CAB ALT MANUAL knob is full CW to the stop. Verify that CABIN PRESS VALVE switch is in NORM.

43. Parking Brakes - "SET" (P)

    Check that the parking brake handle is aft and the PARK light is on.

    NOTE

    There is sufficient pressure in the brake accumulators to set the parking brakes.

44. Pitch Trim - "NORM" (P,CP)

    On the pedestal, check that the PITCH TRIM DISC switch is in NORM and guarded.

    NOTE

    The pilots' control wheel and ALTN pitch trim switches are disconnected, when in DISC.

45. INS, CDU - "TEST/PRESENT POS/ALIGN" (CP)

Refer to Section I for INS detail instructions.

If installed, include LTN-72 operation.

NOTE

Do not move aircraft as long as the MSU selector is in "ALIGN".

46. Radios, Nav Aids and IFF - "SET/STBY" (P,CP)

If installed, check that the ADF, VOR, HF Radio and Radar Beacon are as desired.

47. Before Start Checklist - "COMPLETED" (CP)

STARTING ENGINES

1. Pneumatics - "ENG START" (P)

2. Pneumatic Pressure - "CHECKED" (P)

Pneumatic pressure gage should be checked to determine that pneumatic pressure of 36 PSI at sea level (subtact 1 PSI per 1000 feet increase in pressure altitude) is available for engine starting.

Refer to Appendix III for CFM56 and IV for 209 starting pressures.

3. Ignition - "GROUND START AND CONTINUOUS" (P)

The GND START & CONTIN position of ignition switch will make high energy ignition available through ON positions of engine start switches and fuel levers. As soon as start switch is released, low energy continuous ignition will be operating.

4. Anti-collision Lights - "ON" (P)

Turn anti-collision light ON as indication that engines are about to be started or are operating.

NOTE

The wing tip strobe lights will come also.

5. Start Clearance - "CLEAR TO START ENGINES" (CP/LM)

Refer to Appendix III for CFM56 starting procedure.

For JT8D engines, copilot ensures that area is clear to start engines, and assures that fire guard is in position. Fire guard will observe engine start and maintain contact with flight crew on interphone or visually. Upon receiving clearance to start, the pilot will start #3 engine then 4, 2 and 1 using the following procedures:

a. Start switch - ON (HOLD)

CAUTION

If start switch is accidently disengaged, discontinue start and wait until N2 rotation has ceased. Engaging starter while rotor is turning will damage starter drive gear train. Discontinue start if starter duty cycle, engine starting or operating limits are exceeded.

b. ENG START VALVE OPEN light - ON

If ENG START VALVE OPEN light remains off and no rotation is noted, refer to paragraph START VALVE MALFUNCTION.

c. N2 RPM - ROTATION CHECKED

NOTE

If no N2 rotation, check N1 tachometer. If N1 rotation is confirmed, continue start, using 5% N1 RPM for fuel ON and start switch OFF between 12 & 20% N1 RPM.

d. Oil pressure - CHECKED FOR RISE

If no oil pressure is indicated by 20% N2, discontinue start and investigate.

e. N1 RPM - ROTATION CHECKED

If no N1 indication, discontinue start (possible N1 rotor seizure). Confirm N1 rotation with ground crew. If N1 rotation is normal proceed with normal start using N2 and remaining engine indications.

f. Fuel levers - ON BETWEEN 15 & 20% N2 RPM

g. Fuel flow - CHECKED APPROX 800 to 1100 PPH

CAUTION

A starting fuel flow indication of 1100 PPH or more is an indication of a possible hot start. EGT should be closely monitored.

h. EGT - RISING

If EGT does not rise within 20 seconds after fuel ON, discontinue start and proceed with UNSATISFACTORY START and/or CLEAR ENGINE procedure.

i. Start switch - RELEASE BETWEEN 30 & 40% N2 RPM

j. ENG START VALVE OPEN light - CHECKED OFF

CAUTION

ENG START VALVE OPEN light goes off to indicate that start valve has closed. Prolonged operation with start valve open will damage the starter.

If light remains ON, refer to STARTER VALVE MALFUNCTION procedure.

k. Start #4, 2 and 1 engines using normal start procedure.

6. Starting Engines Checklist - "Completed"

When engine operation has stabilized, check instructions and complete remaining items of starting engines checklist.

Starter Valve Malfunction

If the start valve fails to open or remains open after engine stabilizes at idle, shut down engine and notify the crew chief.

Unsatisfactory Start

a. Fuel Lever - OFF

b. If starter is still engaged, continue rotation for 10 to 15 seconds to clear engine of fuel.

c. Start switch - OFF

d. Ignition - OFF

NOTE

Determine cause of malfunction. Proceed with clear engine procedure before attempting restart.

Clear Engine Procedure

a. Throttle - IDLE

b. Fuel lever - OFF

c. N2 RPM - Check rotation ceased

d. Ignition - OFF

e. Start switch - ON (hold 20 seconds)

CAUTION

Do not exceed starter duty cycle of 1 minute on, 30 seconds OFF; 1 minute ON, 1 minute OFF.

AFTER START

1. Hydraulic Systems - "CHECKED" (CP)

Verify each ENG PUMP switch is ON. The ENG PUMP PRESS LOW, HYD TEMP HI and HYD QTY LOW lights should be off. Check that hydraulic pressures indicate approximately 3000 PSI.

2. External Equip - "REMOVED" (CP/LM)

Copilot/LM will ensure removal of all external power and AGE.

3. Pneumatics - "AIR COND" (P)

4. Cargo Compartment - SECURE (FTE/LM)

Verifies that doors are closed and compartment is secure.

5. Gear Pins - "4 IN VIEW" (P)

The ground crewman should remove the pins and walk around in front of the aircraft and hold pins up for pilot to view.

6. Doors - "CLOSED, LIGHTS OFF" (CP, FTE)

7. Overhead Panel - "CHECKED" (P)

All amber lights off.

NOTE

UPPER RUDDER LOCK DISAGREE light will be on when the slats are retracted.

8. INS Mode Selector - "NAV" (P)

Include LTN-72, if installed.

9. Flight Controls and Test Instrumentation - "CHECKED" (ALL)

Conduct the flight control rollout checks and the flight test instrumentation checks in accordance with the flight test cards.

NOTE

Nosewheel steering should in TAKEOFF & LAND to reduc scrubbing the nosewheels. Confirm ground crewmen are clear of flap areas prior to lowering the flaps.

10. Nosewheel Steering - "TAXI" (P)

11. After Start Checklist - "COMPLETED" (CP)

Taxi

Thrust requirement for taxi depend on type and condition of ramp and aircraft gross weight. Maintain directional control with nose wheel steering in TAXI position. Cockpit visibility can be enhanced, when taxiing in congested areas, by opening the clearview windows. Directional reversals of 180 degrees on 81 foot-wide runways can be accomplished in a continuous taxi turn using full-throw rudder pedal steering. Taxi speed can be controlled by brakes and/or reverse thrust.

Reverse Taxi

The technique for backing up the aircraft and stopping without use of brakes is accomplished by selecting reverse thrust. Modulation of the inboard reverse levers controls backup speed. Upward flow of reversed exhaust causes no surface disturbance. Use nosewheel steering to maintain directional control during reverse taxiing.

Reverse thrust may be used up to the ground reverse thrust stops; however, do not exceed maximum continuous thrust.

NOTE

If a compressor stall occurs while backing the aircraft, it does not require any pilot action to prevent engine damage.

TAXI

This checklist may be performed while taxiing in uncongested areas.

1. Brakes - "CHECKED" (P,FTE)

   Pilot will check operational pressure. FTE will check each brake temperature.

2. TAT-EPR/TCI/N1 Indicator - "CHECKED (P)

   If a temperature change requires resetting of the EPR/TCI/N1 reference, pilot should direct copilot to make the necessary change.

3. Trim - "SET FOR TAKEOFF" (P,CP)

   Check that stabilizer, aileron and rudder trim are set for takeoff.

4. COMM/NAV Radios - "SET" (CP,P)

   Copilot brief on COMM radios he plans to use and notifies pilot if any change occurs. Pilot will brief NAV radio set up and select desired NAV AID with NAV SELECTOR switch. The pilot and copilot will select HOT MIC.

5. VAM - "SET" (CP)

   Copilot will set the emergency return airspeed in the VAM APP SPD window.

6. SCAS - "SET" (CP)

   The copilot will verify that the SCAS is set as desired, e.g., OFF, TAKEOFF, or as specified on TEST CARD.

7. Escape Chute Pin - "As Req'd" (FTE)

This is a checklist item if the escape chute is installed.

When the crew is not wearing parachutes, the escape chute pin may remain in position at the discretion of the aircraft commander.

8. Seat Belts and Harness - "FASTENED" (ALL)

If LM is aboard, he will go forward to flight compartment and be seated in the ACM seat.

BEFORE TAKEOFF

1. TOLD - "REVIEWED" (P,CP)

The pilot and copilot will review TOLD card for appropriate trim and flap settings and takeoff, departure and emergency return airspeeds.

2. Crew Briefing - "COMPLETED" (P)

NOTE

For convenience, the crew briefing may be accomplished prior to this point at the pilot's discretion.

Pilot briefing will include, but not be limited to, the following: flap setting, V1, VR and V2 speeds, NAV radios set up, significant departure instructions, restrictions including hazardous terrain; emergency return intentions; any deviations from normal procedures and takoff test procedures.

3. IFF - "AS REQUIRED" (CP)

4. Flaps - "STATE SETTING" P,CP)

Set flaps as required for takeoff and check position indicators. Slats should be extended. Check that the SLAT EXTEND light is on, and SLAT DISAGREE light is off.

NOTE

While the slats are in transit the SLAT DISAGREE light will be on.

5. Spoiler Mode Selector Switch - TAKEOFF (CP)

In Aircraft #2, the copilot rotates the GROUND SPOILERS selector switch to the TAKEOFF position.

In Aircraft #1, the copilot rotates the SPOILERS selector switch to the RTO SPOILER ARM position.

Either of these positions arms the spoilers for automatic extension in a rejected takeoff when symmetrical reverse levers are actuated.

6. Annunciator Panel - "CHECKED" (CP)

All lights should be off except the green UPPER RUDDER NOT LOCKED light which should be on.

7. Nosewheel Steering - "TAKEOFF" (P)

Place the nosewheel steering lever in TAKEOFF & LAND position. This reduces the nosewheel travel from 61° to

12° either side of center.

8. Airspeed Source Sel - "CHECKED" (P)

   If installed.

9. Before takeoff checklist - "COMPLETED" (CP)

TAKEOFF

The following paragraphs discuss rolling takeoff and standing takeoff procedures. To obtain takeoff performance data, the vast majority of the takeoffs performed during the test program will be standing takeoffs. The terms CTOL (conventional takeoff and landing) and STOL (short takeoff and landing) are performance oriented, not procedure oriented. For the YC-15, the STOL performance design goal has been defined as operation from a 2000 foot long runway. The procedure to accomplish this performance, however, is not unique, nor is the takeoff procedure different for various takeoff flap settings, which will result in different values of thrust induced (powered) lift during the takeoff roll. Thus, the terms CTOL and STOL are not applicable to YC-15 takeoff procedures.

TAKEOFF, ROLLING

If a rolling takeoff is desired, the following procedures may be used provided aircraft performance is not critical.

1. Complete the BEFORE TAKEOFF checklist prior to taxiing into takeoff position. The nose wheel steering may be left in TAXI until lineup is complete.

2. Taxi onto the runway and as the aircraft is aligned with the runway, select TAKEOFF & LAND on the nosewheel steering and advance power to takeoff EPR. Throttles must be set by 50 knots. From this point continue with the standing takeoff procedure.

TAKEOFF, STANDING

The standing takeoff technique is:

1. While holding brakes, the pilot will advance throttles to takeoff EPR. Should the aircraft start to move with brakes on, release the brakes smoothly and continue advancing power to takeoff EPR.

NOTE

Advance the throttles slowly so that RPM and EPR do not lag the throttle position.

2. Release brakes and smoothly advance the throttles so as to assure takeoff thrust EPR is obtained by 50 knots. The pilot will advance the throttles toward takeoff EPR setting, the copilot will backup the throttles and make final adjustments as necessary. The pilot will maintain primary control of the throttles until reaching GO speed (V1).

NOTE

Full throttle will normall not be required to achieve computed EPR for takeoff. If full throttle is required, discontinue takeof and request maintenance verification prior to proceeding.

If an engine fails to

reach takeoff EPR, the takeoff will be discontinued.

3. The pilot will use nosewheel steering to maintain directional control during the takeoff roll.

4. At 50 knots, the copilot will call "50 knots" and the pilot will verify that his airspeed indicator is in agreement with the copilot's.

5. If a condition arises before GO speed is reached which would make the takeoff unsafe, the crewmembers observing the condition will state "REJECT" on the interphone and the takeoff will be aborted.

6. Upon reaching GO speed, the copilot will state "GO" on the interphone. Upon reaching rotation speed the copilot will state "ROTATE". If "GO" and "ROTATE" speeds are equal, the copilot will state "ROTATE".

7. At rotation speed, smoothly apply back pressure and establish a pitch attitude of 15 degrees. Liftoff will occur during the rotation. The copilot will monitor the throttles and power at this time and insure that they do not creep during the climb.

8. If an engine fails after "GO" speed, the takeoff procedure and rotation attitude remain the same as the all-engine takeoff.

AFTER TAKEOFF, CLIMB

After takeoff, maintain a pitch attitude of 15 degrees. When a positive rate of climb is indicated and upon the pilot's command, the copilot will retract the landing gear. Accelerate in the climb, at takeoff EPR, to the flap retract speed. It is not necessary to change the pitch attitude during flap or slat retraction. Do not retract the flaps/slats prior ro reaching TBD feet AGL. Do not retract the flaps and slats simultaneously, but in sequence.

Use of takeoff EPR is permitted for 5 minutes use, however MCT EPR is normally set after slat retraction.

If an immediate maneuvering turn is required after takeoff, maintain a 14°/EXT configuration in the turn and do not exceed maneuvering angle-of-attack, approximately 14 degrees.

If SCAS was engaged for the takeoff, it will automatically switch to rate command/attitude hold in pitch when the control column is released to detent. During liftoff, the roll axis will automatically switch to CWS.

Do not call for this checklist until the flaps and slats are retracted and other cockpit duties will not interfere with accomplishment. Items on this checklist may be accomplished as directed by the pilot and the checklist used as a clean-up reference. This checklist is not required if the aircraft is to remain in the traffic pattern.

1. Landing Gear - "UP" (CP)

NOTE

At this time if control column force is released the pitch SCAS will change to rate command from takeoff. The roll changes to rate command from takeoff on actuation of ground sense relays.

Nosegear Uplock Test

Observe that IAS is below 200Kts. Press and hold the NOSEGEAR UPLOCK TEST button. Check that the nosegear does not free fall. Release UPLOCK TEST button.

2. Flaps - "RETRACTED" (CP)

   Flap retraction speed is V2 plus (Flap setting) KIAS.

3. Slats - "RETRACTED/LIGHTS OFF" (CP)

   Slat retraction speed is Flap retraction speed plus 2 times the first two numbers of takeoff weight.

4. Spoiler Mode Selector Switch - "OFF" (P)

   CAUTION

   If the spoiler mode selector switch is not OFF, the spoilers will extend:

   a. Spoiler ampl switches in UNLOCK and reverse thrust levers actuated.
   b. Spoiler ampl switches in AUTO, slats extended and reverse thrust levers actuated.

5. Airspeed Source Selector - "SET" (P)

   If installed, select the air speed source as required by the Test Card. If required, extend the trailing cone.

6. Annunciator Panel - "CHECKED" (CP)

   NOTE

   As speed increases above 140 knots, the green UPPER RUDDER NOT LOCKED light should go off.

7. After Takeoff Checklist - "COMPLETED" (CP)

Descent Enroute

Enroute descents are accomplished by retarding throttles with landing gear up and flaps and slats retracted. Maintain 0.76 MACH until 350 KIAS. This descent schedule is for preliminary use prior to envelope expansion including flutter clearance and maximum range performance testing.

CAUTION

When conditions indicate a likelihood of encountering turbulence, reduce airspeed to 265 KIAS or 0.70 MACH, whichever is lower.

Descent Penetration

In flight, the inboard thrust reversers may be deployed at airspeeds up to 350 knots/mach 0.76 and may be used in descent, however, do not exceed 350 knots/mach 0.76 (VH/MH).

NOTE

If only one reverser dedeploys, the aircraft has a tendency to roll wing down toward the deployed reverser during maneuvering flight.

CAUTION

When reverse thrust is

used for descent and the spoiler mode selector switch is not in OFF, the spoiler will extend: a. with the spoiler ampl switches in unlock or b. with the spoiler ampl switches in AUTO and slat extended.

Advancing the throttles from forward flight idle, while thrust reversers are stowing may cause the thrust reversers to stop in an intermediate position. Verify that all thrust reverser lights are off prior to advancing the throttles.

Descent

The copilot should obtain the station altimeter, weather, winds, temperature and runway conditions prior to arrival in the destination traffic area. The FTE will compute the landing speeds and complete the TOLD card based on anticipated landing weight and the weather information. For approach speed during gusty wind conditions, add one half (1/2) the reported gust increment (in knots), not to exceed 5 knots, to the computed VLand speed.

1. Cabin Pressurization - "SET" (CP)

   Rotate the CABIN ALT knob until the CABIN PRESSURE CONTROL pointer indicates the destination field elevation. The RATE knob indices should be aligned.

2. TOLD - "RECEIVED" (P,CP,FTE)

3. Anti-skid - "SET" (P)

   Pilot check that the anti-skid switch is in ARM and the runway condition switch is in the desired position.

4. Nosewheel Steering - "SET" (CP)

   Check that the nosewheel steering handle is in the TAKEOFF & LAND position.

5. Radio Altimeters - "SET" (P,CP)

   Rotate the SET/TEST knob until the desired height indicates in the window.

6. Altimeters - "SET" (P,CP)

   WARNING

   Altimeters will be set to station pressure (QNH) when cleared to descent through the transition level.

7. Brake Pressures - "CHECKED" (CP)

8. Flight Test Equipment Configuration - "SET" (FTE)

9. Seat Belts and Harnesses - "FASTENED" (P,CP,FTE)

10. Cargo Compartment - "SECURE" (LM)

11. Airspeed Source Selector - "SET" (P)

   If installed, rotate airspeed source selector switch to position as required by Test Card.

   NOTE

   If the selector is is either BOOM or CONE, there may be a difference in airspeed between the pilot's and copilot's airspeed indicators.

12. Trailing Cone - "Retracted" (FTE)

If installed

13. Nav Aids - SET AND CHECKED (P,CP)

Pilot briefs copilot on desired NAV setup and the copilot then notifies pilot when configured as requested. The pilot and copilot will select HOT MIC.

14. VAM - SET (CP)

Set the desired flight path angle in the FLIGHT PATH windows. Set the desired airspeed in the APP SPD windows. Notify pilot. Pilot and copilot pull VAM display into position, as desired.

15. Crew Briefing - "COMPLETED" (P)

The pilot will brief on landing data, type of approach, missed approach intentions, hazardous terrain, comm and nav radio set up and test requirements.

NOTE

The pilot may complete the crew briefing prior to initiating the Descent Checklist.

16. Descent Checklist - "COMPLETED" (CP)

NOTE

Descent Checklist is not completed until QNH is set in altimeters.

BEFORE LANDING/TRAFFIC PATTERN

1. DLC - "AUTO" (P)

Place the DLC switch in AUTO.

2. Landing Gear - "DOWN" (CP)

Place the gear handle in DOWN. While gear is in transit: gear handle red lights on, gear and bogie position indicators - show baberpole. When gear is down and locked: off, gear and bogie position indications show tire and wheel symbol.

3. Flaps/Slats - "STATE SETTING/EXT" (CP)

Check that the flaps are in the commanded position and the slats are extended and notify the pilot.

4. SCAS Panel - "SET" (CP)

Check that the desired SCAS configuration for landing is set.

5. Spoiler Mode Selector Switch - "LAND" (P)

Aircraft #1:

Press the LAND spoiler switch/light until ARMED is illuminated.

Aircraft #2:

Rotate the spoiler mode selector switch to the LAND position.

NOTE

In Aircraft #1, with the spoiler mode selector switch to DIRECT LIFT CONT or RTO SPOILER ARM, the spoilers will extend during the landing roll when two symmetrical thrust reverse levers are actuated. With the LAND spoiler switch/light ARMED on, the spoilers will extend automatically on wheel-spin up.

In Aircraft #2, with the spoiler mode selector switch in LAND, the spoilers will extend automatically on wheel spin-up.

6. Go-Around EPR 1N, Bugs - SET (CP)

   If installed, set the EPR and N1 bugs to the calculated GA EPR or N1 for the present conditions.

7. Annunciator Panel - "CHECKED" (CP)

   All lights should be off except the green UPPER RUDDER NOT LOCKED light which should be on.

8. Before Landing Checklist - "COMPLETED" (CP)

GO-AROUND

A go-around may be initiated at any position during the approach phase at the discretion of the pilot in command.

NOTE

Refer to Emergency Procedures - Section III for Go-Around with one engine inoperative.

When a go-around is to be conducted proceed as follows:

1. Announce - "GO-AROUND FLAPS" (P)

   The pilot will clearly state his intention to go-around on the interphone (hot mic). Copilot places the flap control handle 2 detents less than the flap setting (i.e., if 45° had been selected, then move the handle to 23° detent; or if flaps were set at 33° then 14° would be the correct detent; or 23° then 0°/EXT is correct).

2. Throttles (All) - TAKEOFF (P)

   While announcing "Go-Around", the pilot will simultaneously advance all four throttles toward Takeoff power. Do not refine engine power settings. Maintain wings level and approach pitch attitude.

3. Flaps 33° or Less - "CLEAR TO ROTATE" (CP)

   Copilot verifies that flaps are retracting and announces "ROTATE" as the flap indicator passes 33°. If the flaps were initially at 33° or less, copilot verifies that the flaps are retracting and announces "ROTATE". Copilot now refines throttle settings to takeoff power.

4. Aircraft - ROTATE (P)

   When the copilot announces "ROTATE", the pilot rotates at normal takeoff rotation rate to 15° pitch attitude.

NOTE

Do not exceed the stick shaker angle of attack.

5. Announce - "POSITIVE RATE OF CLIMB" (CP)

   When the copilot affirms the aircraft has a positive rate of climb, he will notify the pilot.

6. Landing Gear - "UP" (P)

   When directed by the pilot, the copilot will retract the landing gear.

Climb procedures could be initiated and an AFTER TAKEOFF, CLIMB or BEFORE LANDING, TRAFFIC PATTERN checklist could be called for.

APPROACH AND LANDING

There are two general categories of normal landings, conventional (CTOL) and short takeoff and landing (STOL).

CTOL

APPROACH - Conventional approaches are flown when operating at CTOL weights or in a normal jet traffic pattern. CTOL approaches are flown at 23 or 33 degrees flap extension depending on aircraft gross weight or desired traffic pattern airspeeds at flight path angles up to 3.5 degrees. The relationship between speed and attitude existing at STOL approach speeds that provides good airspeed control does not exist at these higher speeds. Greater pilot attention is required to maintain the desired approach speed and flight path angle.

LANDING - The aircraft is landed at the approach airspeed and pitch attitude (no flare). Positive ground effect becomes apparent at approximately 100 feet AGL, and a slight thrust reduction is necessary to land at the desired touchdown point. Excessive thrust reduction may result in higher than normal touchdown sink speed and too little thrust reduction will result in float.

STOL

APPROACH - The degree of powered lift is a function of flap extension and thrust. As the flaps are extended, drag and lift increase. The optimum relationship of flap angle and engine thrust is a function of gross weight, altitude, temperature, wind, flight path angle, and landing distance available.

STOL approaches are flown at 33 or 45 degree flap extension based primarily on gross weight and wind considerations at approach flight paths greater than 3.5 degrees. Generally, 4.5 degrees for STOL gross weights above 152,000 lbs and 6.0 degrees for STOL gross weights less than 152,000 lbs. Lower approach angles are used with higher weights to avoid excessive sink rates.

Thrust is the primary control of flight path angle and pitch attitude is the primary control of airspeed. DLC is used for small or short term flight path and wind gust corrections. The VAM should be set for the desired flight path angle and approach speed and will provide flight path accuracy of approximately ±0.5 degrees. When established on final approach, adjust the pitch attitude to maintain the desired speed and thrust to maintain the desired flight path. During the approach, angle of attack and vertical speed are primary indications of desired performance.

The aircraft should be stabilized on the desired flight path by 200 feet AGL. On a stabilized approach, the pitch attitude will be between 0 and 4 degrees depending on gross weight with an angle of attack of 8 to 12 degrees boom or 5 to 9 degrees aircraft system. Long term approach vertical speed should not exceed 1000 FPM with the exception of the upper segment of a two (2) segment approach. Vertical speeds in excess of 1000 FPM below 100 feet AGL should be arrested immediately with application of thrust. Approach thrust should not be reduced below 1.2 EPR due to the acceleration characteristics of turbofan engines.

LANDING - The aircraft is landed at the approach airspeed and pitch attitude (no flare). Thrust is not normally retarded until after touchdown. If a float is encountered, thrust should be reduced slightly. Excessive thrust reduction will result in higher than nominal touchdown sink rates. Nominal touchdown sink rates are approximately 8 FPS.

CAUTION

Do not rotate the aircraft during the landing maneuver. A pitch attitude of 8.5 degrees ANU in combination with a touchdown sink rate of 12.5 FPS will result in aft fuselage cargo ramp contact with the runway.

The ground spoilers may extend in one of two ways:

a. Aircraft #2, GROUND SPOILERS in LAND or Aircraft #1 with LANDING spoilers ARMED and wheel spinup. The following pairs of the forward 4 wheels cause spinup: Right Inboard and Outboard; Left Inboard & Outboard; Right & Left Inboard; Right & Left Outboard.

b. With weight on the main landing gear and two symmetric reverser levers placed in idle reverse.

When the reversers are extended, the four green thrust reverser extend (THR REV EXTD) lights will come on, the reverse interlock will retract and full reverse thrust is available. Reverse thrust may be applied as required to maximum continuous thrust. Thrust reversers may be operated until the aircraft comes to a complete stop.

Brake application will activate the antiskid action providing maximum wheel braking effectiveness without tire skidding. When the aircraft has slowed to taxi speed, the turning radius can be decreased by placing the nosewheel steering selector handle in TAXI.

OPERATIONAL CONSIDERATIONS DURING APPROACH AND LANDING

WINDS

Awareness of wind effects is important to achieve the desired performance during STOL approaches and landings. At STOL approach speeds the effects of winds are greater and compensation is required to obtain and maintain the desired flight path angle.

The actual wind encountered during the approach is frequently different than reported due to time lapse, height of the reported wind or wind shear. The INS (LTN-51) displayed winds are an excellent indication of approach wind conditions and any differences between INS wind and the reported wind should alert the pilot to wind variations during the approach.

For approach parameters associated with wind conditions refer to figure 2-7.

HEADWINDS - Headwinds decrease ground speed, air mass flight path angle and vertical speed and requires increased thrust or speed to maintain a given geometric flight path angle. Headwind considerations are based on an engine failure on final approach and the thrust available. At the maximum STOL weight for the existing temperature and pressure altitude a 45°flap, 6 degree STOL approach can be conducted 4 engine or continued with 3 engine headwinds up to 15 knots.

NOTE

> For approach speed with headwind components less than 5 knots and more than 15 knots, add 5 knots to the computed VLand speed.

With headwinds greater than 15 knots, a 6 degree STOL approach with 33 flaps can be flown with the same performance as a no-wind, 45 flap approach with increased three-engine thrust margins and is the recommended technique.
For approach speed during gusty wind conditions, add one half the reported gust increment (in knots), not to exceed 5 knots, to the computed VLand speed.

CROSSWINDS - Satisfactory CTOL and STOL landing characteristics have been demonstrated in all SCAS and landing flap configurations and with simulated engine failures with a crosswind component in excess of 30 knots.

Approach crab angles are considerably higher at STOL speeds than for the same wind conditions at CTOL speeds. The aircraft should be aligned with the runway at approximately 100 ft AGL with the sideslip technique. At the crosswind limits (30 knots) approximately 5 degrees of aileron and 50% rudder will be required to maintain runway track.

TAIL WINDS - Tail winds increase ground speed, air mass flight path angle and vertical speed and require less thrust to maintain a given geometric flight path. Tail wind considerations are based on touchdown sink rates. Tail winds of up to 10 knots will not result in touchdown sink rates in excess of the landing gear limits.

If operational necessity requires an approach and landing with a tail wind in excess of 10 knots and runway stopping distance is adequate, the approach flight path angle should be decreased so that the stabilized vertical speed on approach is not over 1000 FPM.

WIND SHEAR - Wind shear is a change in wind direction and/or velocity. Studies have identified wind boundary layer effects showing winds shearing out close to the ground. At STOL approach speeds, relatively small wind shears of 5 to 10 knots affect aircraft performance that would not be noticed in CTOL operations.

HEADWIND SHEAR/DECREASING HEADWIND - In a headwind shear or decreasing headwind the airspeed will decrease then slowly increase, flight path angle and sink rate will increase. Correct for the wind/shear effect by increasing thrust to regain the desired flight path. If pilot reaction is slow or inadequate thrust is set, a short landing at higher than nominal sink speeds will result.

TAILWIND SHEAR/DECREASING TAILWIND - In a tail wind shear or decreasing tailwind, the airspeed will increase then decrease, flight path angle and sink rate will decrease. Correct for the wind/shear effect with DLC or thrust to regain the desired flight path.

NOTE

> Under shearing wind conditions do not chase airspeed, maintain pitch attitude and correct glide path errors with thrust and DLC.

GROUND EFFECT

Positive ground effects are apparent in all landing flap configurations. During CTOL approaches, positive ground effect is evident as high as 100 feet AGL and during STOL approaches as high as 50 feet AGL, and remains positive until touchdown. During CTOL approaches, the aircraft will float at the approach thrust level. During STOL approaches, the positive ground effect will decrease approach sink rates at a constant pitch attitude and thrust level.

HIGH AMBIENT TEMPERATURE

At high ambient temperature (90°F and greater) conditions, runway temperatures are considerably higher than the reported ambient temperature. As the aircraft enters ground effect the increase in temperature will result in decreased thrust, an increase in sink rate and a steeper flight path angle. An increase in thrust is required to maintain nominal sink speed at touchdown. A thrust reduction of .05 EPR will increase sink rate by 1 FPS.

TOUCH & GO/STOP & GO

If a touch and go or stop and go landing is desired, accomplish the following after touchdown and before go.

1. Flaps - "TAKEOFF" (CP)

   The pilot will call for "Flaps Takeoff." The copilot will retract the flaps to the takeoff position and notify the pilot.

2. Trim - "SET" (CP)

3. TOGA - "PRESS" (P)

   Pilot presses the TAKEOFF/GO AROUND button. This ensures the SPOILER mode selector switch goes to OFF, and knocks down the spoilers.

4. Spoiler Mode Selector Switch - "OFF" (CP)

   Check that the spoiler mode selector switch is in OFF.

5. Touch and Go Checklist - "COMPLETED" (CP)

TAXI BACK

If a taxi back takeoff is desired, complete the Before Takeoff Checklist.

AFTER LANDING

This checklist may be accomplished after taxiing clear of the runway or prior to clearing the runway after the aircraft has slowed to taxi speed and when good judgement dictates that the check can be accomplished safely.

1. Nosewheel Steering - "TAXI" (P)

2. Flaps - "RETRACTED" (CP)

3. Spoiler Mode Selector Switch - "OFF" (P)

4. Landing and Taxi Lights - "AS REQUIRED" (CP)

5. IFF - "STANDBY" (CP)

6. Cargo Door/Ramp - "AS REQUIRED" (P,L/M)

7. After Landing Checklist - "COMPLETED" (CP)

If another takeoff is to be accomplished refer to Before Takeoff Checklist.

ENGINE SHUTDOWN (GROUND)

1. Parking Brakes - "SET" (P)

   PARK light should come on, signifying that the park brake shutoff valves are closed and the brakes should hold for at least 8 hours.

2. Escape Chute Pin - "INSTALLED" (FTE)

   If the escape chute is installed.

3. External Power - "ON" (CP)

   Contact ground and have external pneumatics and electrical power plugged in.

4. INS - "AS REQUIRED" (CP,FTE)

   Include LTN-72, if installed.

5. Flaps/Slats - "45°/EXT" (CP)

6. Fuel Levers - "OFF" (P)

NOTE

Engines #1 and 2 could be shutdown while awaiting external electrical power to be plugged in.

7. Anti-collision Lights - "OFF" (P)

8. Engine Shutdown Checklist - "COMPLETED" (CP)

BEFORE LEAVING AIRCRAFT

This checklist may be accomplished by either pilot.

NOTE

Before crew entrance door is opened, check that the aircraft is depressurized by voice communication with flight crew or by observing an open: clearview window, troop jump door or cargo ramp/door.

1. Windshield Defog - "OFF" (CP)

2. Pitot Heat - "OFF" (CP)

3. Fuel Tank Pumps - "OFF" (CP)

4. Ignition - "OFF" (CP)

5. Pneumatics - "AS REQUIRED" (CP)

   Unless air conditioning system is to be used turn system off.

6. External Electrical Power - "AS REQUIRED" - (CP)

7. External Power L & R Bus Switches - AS REQUIRED (CP)

8. Aircraft - "CHOCKED" (GC)

9. Parking Brakes - "OFF" (P)

10. Radios/IFF - "OFF" (CP)

    FTE include the ferry kit, if installed.

11. Interior and Exterior Lights - "AS REQUIRED" (P,CP)

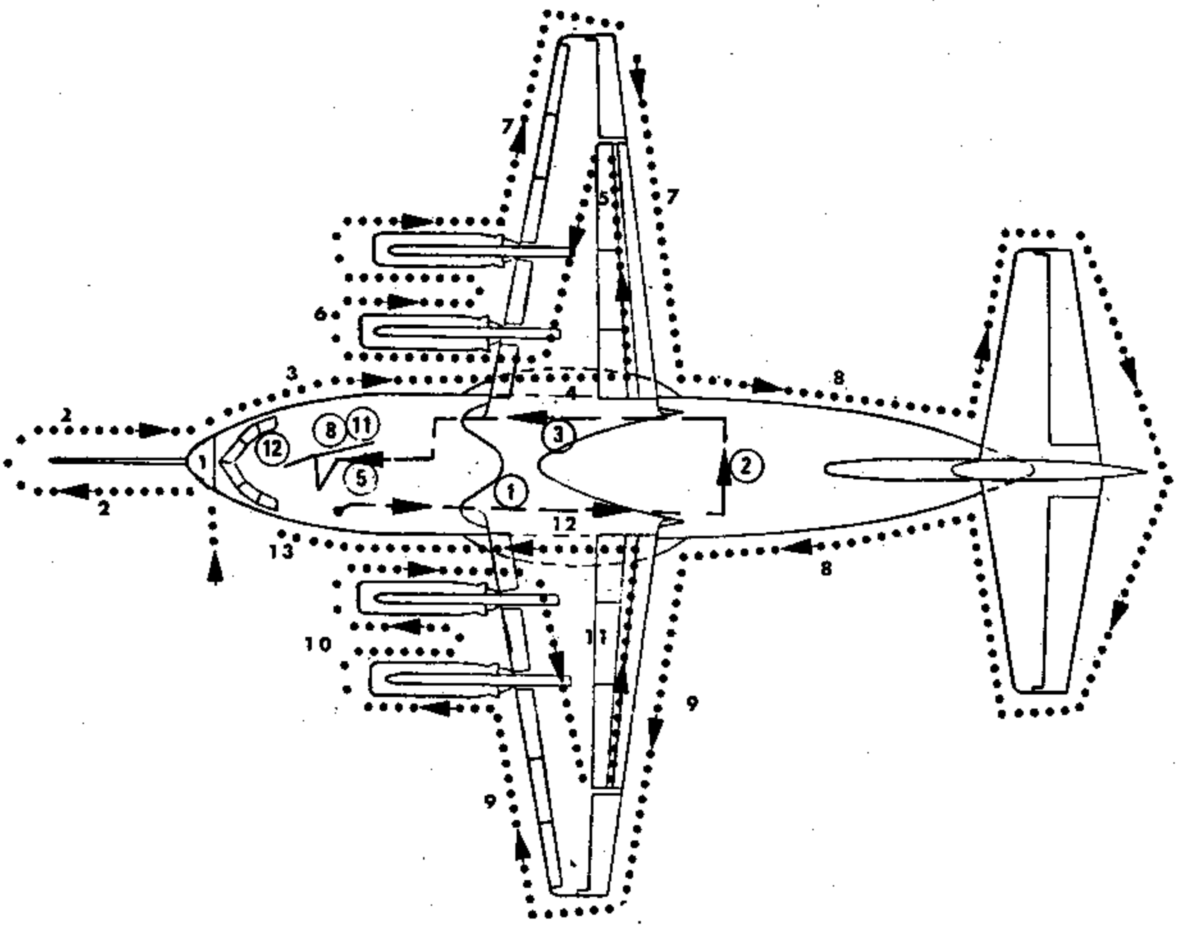
12. Flight Test Equipment Configuration - "CHECKED" (FTE)

13. Battery - AS REQUIRED (CP)

    The battery switch should remain on while external power is plugged in.

14. Before Leaving Aircraft Checklist - COMPLETED (CP)

EXTERIOR/INTERIOR INSPECTION



EXTERIOR INSP

1. NOSE WHEEL WELL
2. NOSE AREA AND BOOM
3. FUSELAGE (SIDE AND UNDERSIDE) NOSE TO WING
4. RT WHEEL POD AND CTR FUSE.
5. RT WING LOWER SURFACE AND FLAPS
6. 3 AND 4 ENGINE NACELLES
7. RT WING
8. AFT FUSE. AND TAIL
9. LEFT WING
10. 1 AND 2 ENGINE NACELLES
11. LEFT WING LWR SURFACE AND FLAPS
12. LEFT WHEEL POD AND CTR FUSE.
13. FUSE., SIDE AND UNDERSIDE

INTERIOR INSP

(1) THROUGH (12)

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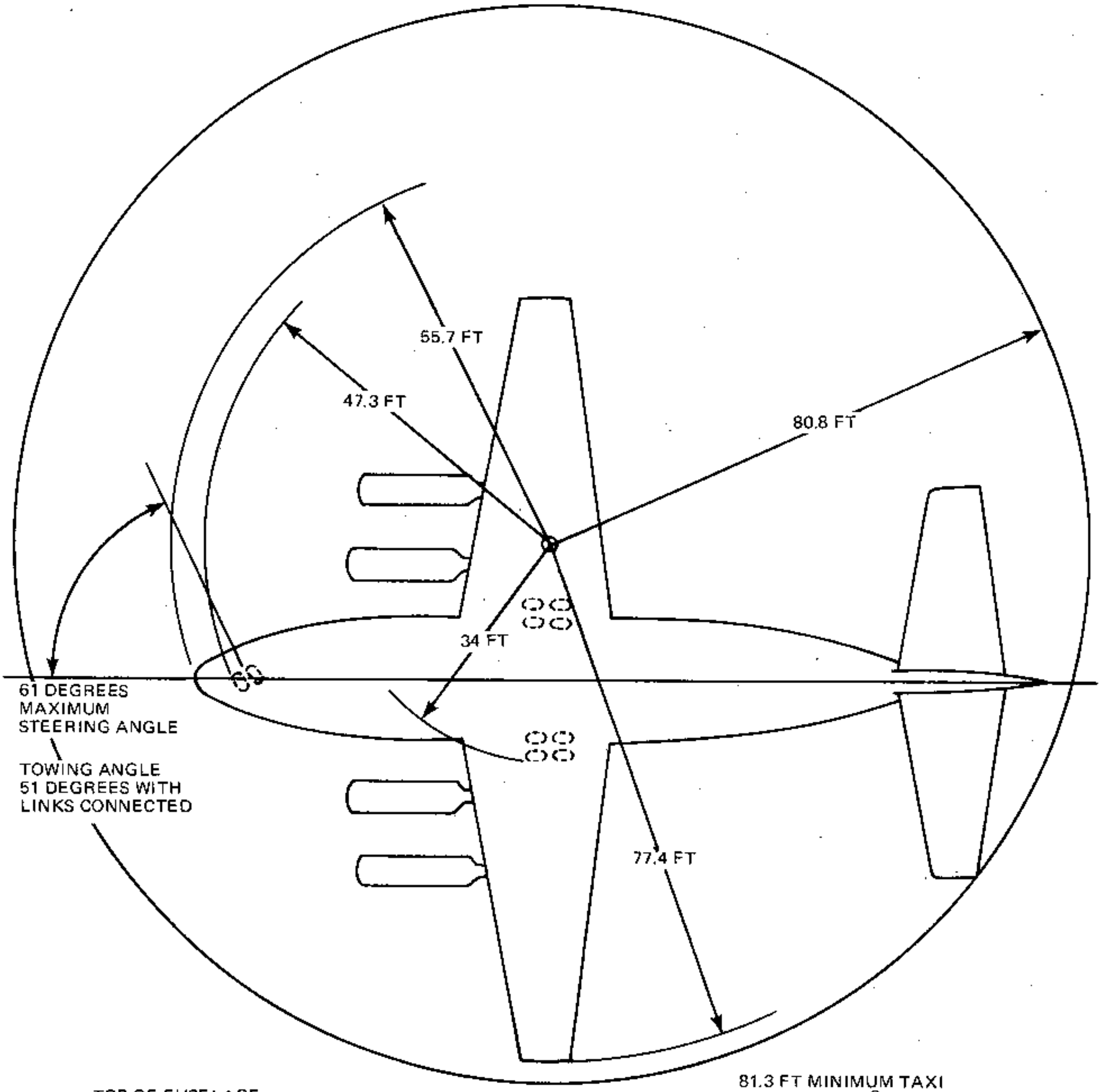
Figure 2-1

MINIMUM TURNING RADIUS AND GROUND CLEARANCE



TOP OF FUSELAGE
(VHF ANTENNA) . . . . 21 FT 0 IN.

VERTICAL STABILIZER . . . . 43 FT 4 IN.

MINIMUM GROUND CLEARANCE
BOTTOM OF FUSELAGE
UHF ANTENNA . . . . 10 IN.

PR5-C15-197

Figure 2-2

TAKEOFF TURNING PERFORMANCE

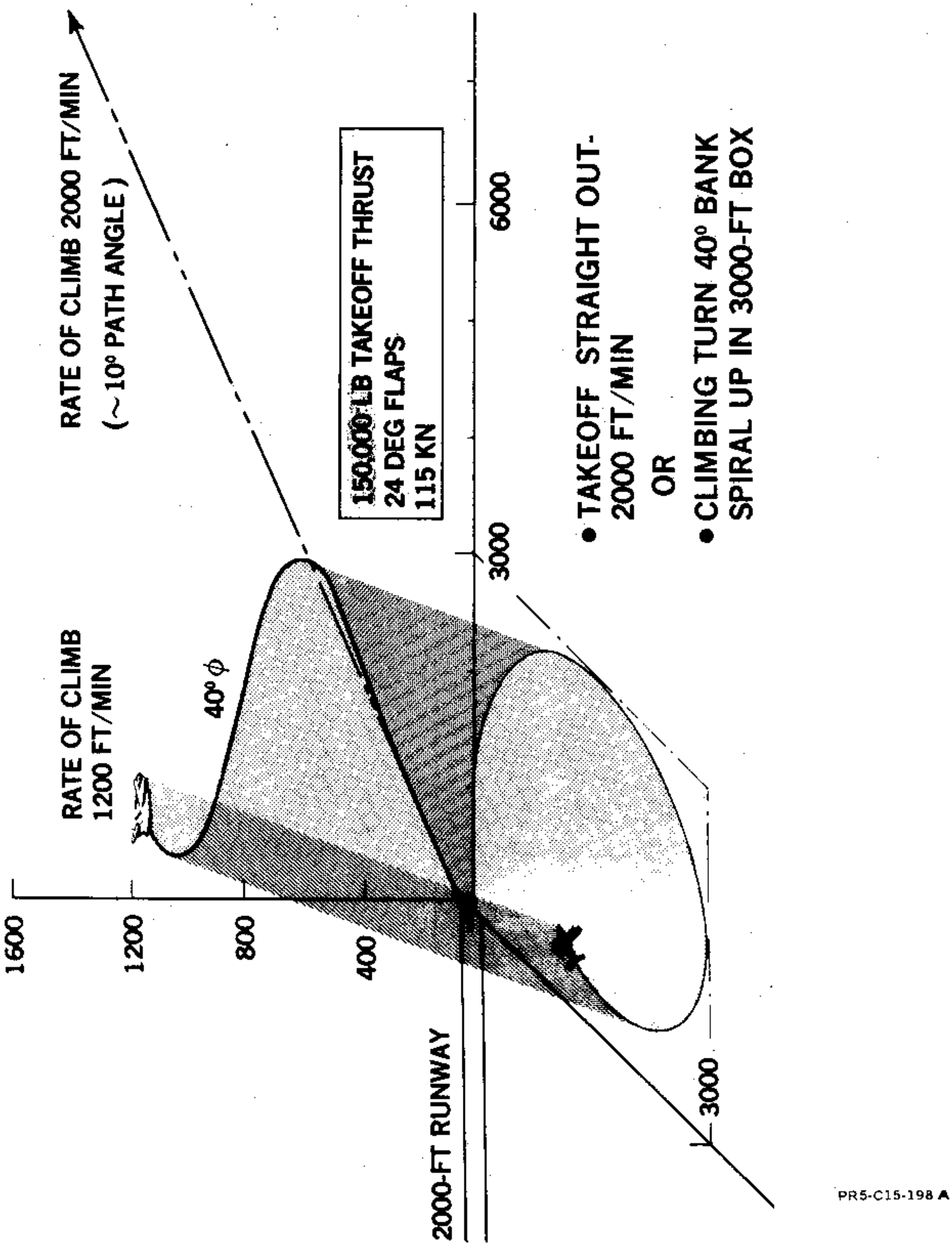


Figure 2-3

NORMAL TAKEOFF – TYPICAL

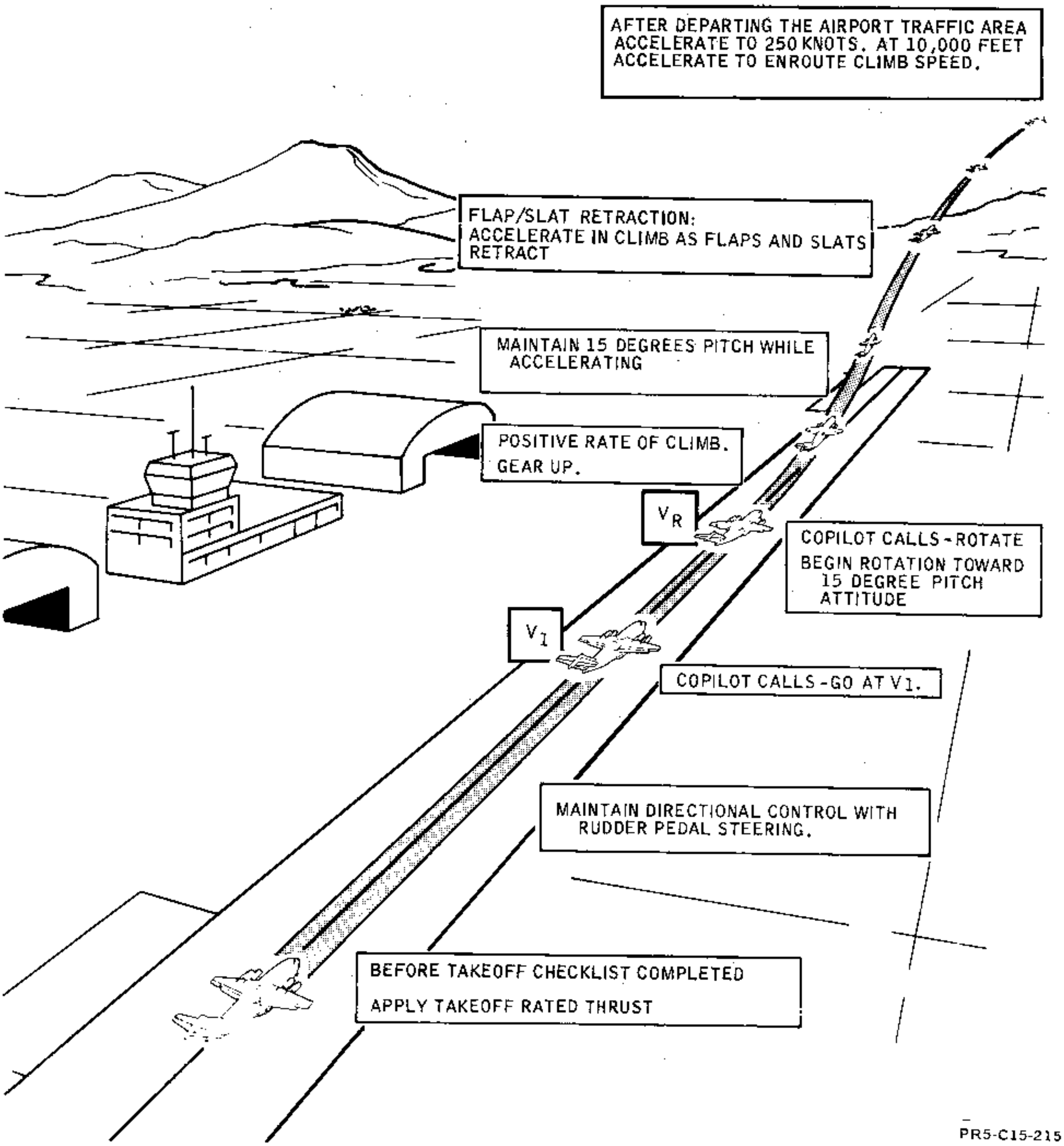


Figure 2-4

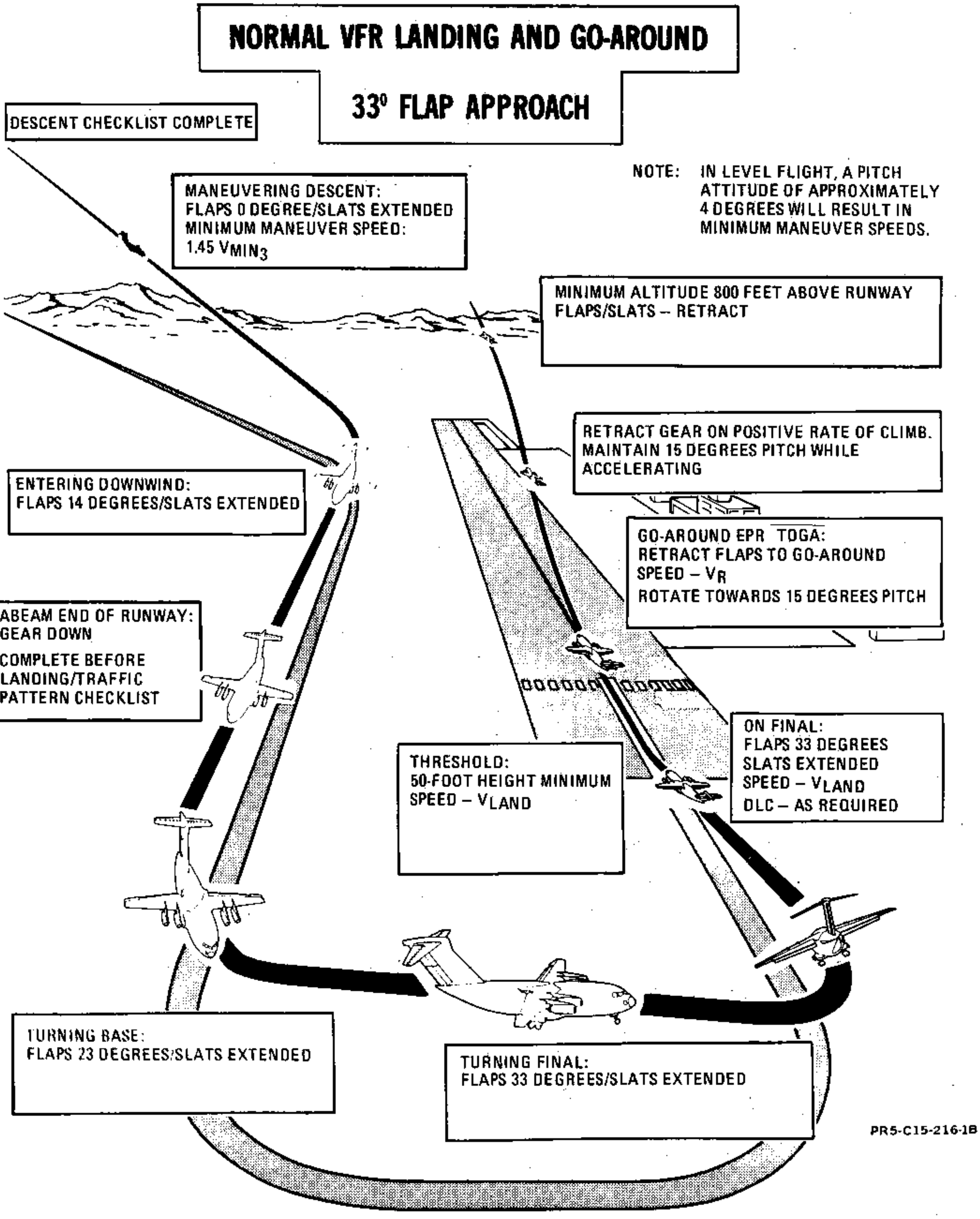

NORMAL VFR LANDING AND GO-AROUND
33° FLAP APPROACH
DESCENT CHECKLIST COMPLETE
MANEUVERING DESCENT:
FLAPS 0 DEGREE/SLATS EXTENDED
MINIMUM MANEUVER SPEED:
1.45 VMIN3
NOTE: IN LEVEL FLIGHT, A PITCH ATTITUDE OF APPROXIMATELY 4 DEGREES WILL RESULT IN MINIMUM MANEUVER SPEEDS.
MINIMUM ALTITUDE 800 FEET ABOVE RUNWAY
FLAPS/SLATS – RETRACT
RETRACT GEAR ON POSITIVE RATE OF CLIMB.
MAINTAIN 15 DEGREES PITCH WHILE ACCELERATING
ENTERING DOWNWIND:
FLAPS 14 DEGREES/SLATS EXTENDED
GO-AROUND EPR TOGA:
RETRACT FLAPS TO GO-AROUND SPEED – VR
ROTATE TOWARDS 15 DEGREES PITCH
ABEAM END OF RUNWAY:
GEAR DOWN
COMPLETE BEFORE LANDING/TRAFFIC PATTERN CHECKLIST
ON FINAL:
FLAPS 33 DEGREES
SLATS EXTENDED
SPEED – VLAND
DLC – AS REQUIRED
THRESHOLD:
50-FOOT HEIGHT MINIMUM
SPEED – VLAND
TURNING BASE:
FLAPS 23 DEGREES/SLATS EXTENDED
TURNING FINAL:
FLAPS 33 DEGREES/SLATS EXTENDED
PR5-C15-216-1B

Figure 2-5

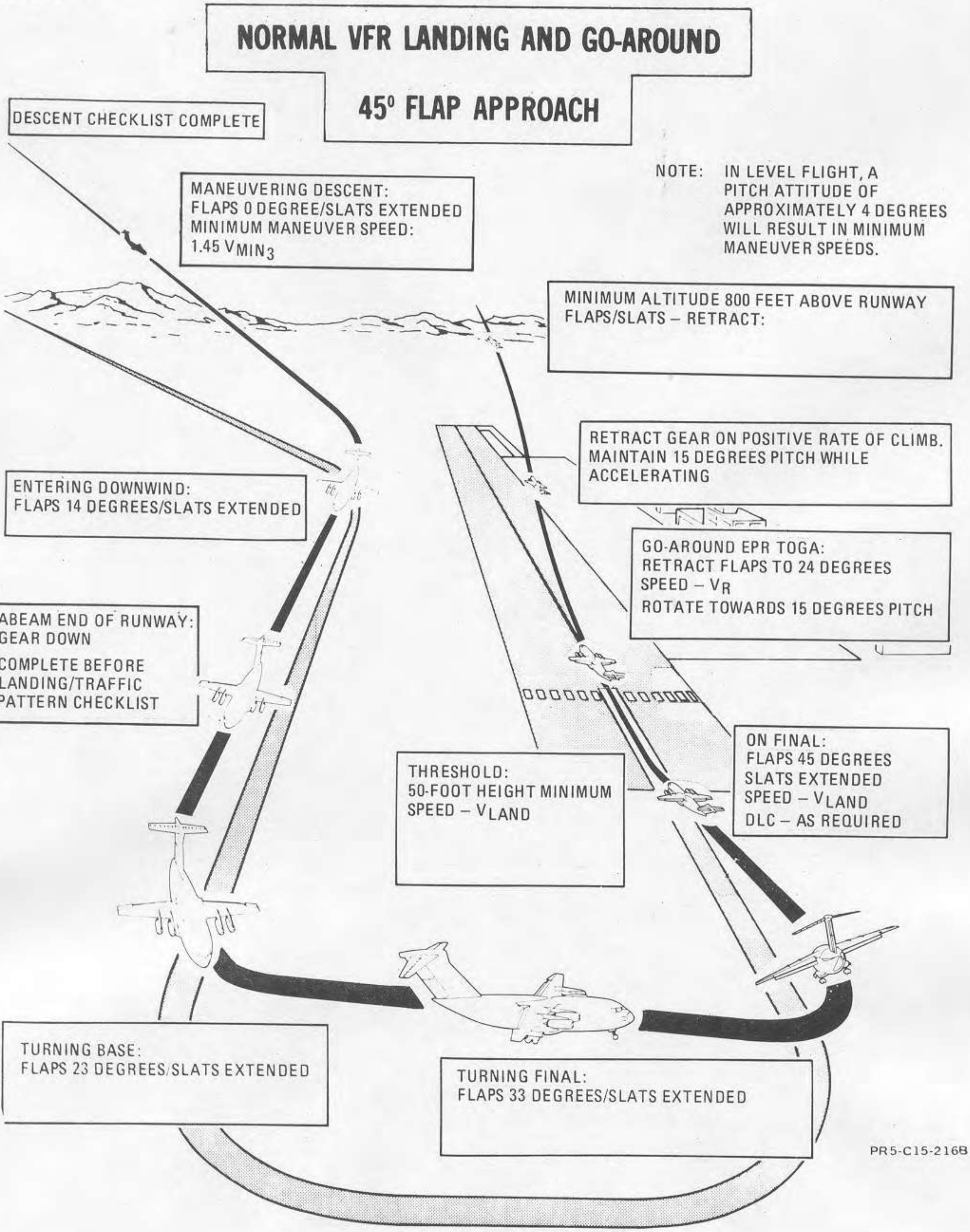

NORMAL VFR LANDING AND GO-AROUND
45° FLAP APPROACH
DESCENT CHECKLIST COMPLETE
MANEUVERING DESCENT:
FLAPS 0 DEGREE/SLATS EXTENDED
MINIMUM MANEUVER SPEED:
1.45 VMIN3
NOTE: IN LEVEL FLIGHT, A PITCH ATTITUDE OF APPROXIMATELY 4 DEGREES WILL RESULT IN MINIMUM MANEUVER SPEEDS.
MINIMUM ALTITUDE 800 FEET ABOVE RUNWAY
FLAPS/SLATS – RETRACT:
RETRACT GEAR ON POSITIVE RATE OF CLIMB.
MAINTAIN 15 DEGREES PITCH WHILE ACCELERATING
ENTERING DOWNWIND:
FLAPS 14 DEGREES/SLATS EXTENDED
GO-AROUND EPR TOGA:
RETRACT FLAPS TO 24 DEGREES
SPEED – VR
ROTATE TOWARDS 15 DEGREES PITCH
ABEAM END OF RUNWAY:
GEAR DOWN
COMPLETE BEFORE LANDING/TRAFFIC PATTERN CHECKLIST
ON FINAL:
FLAPS 45 DEGREES
SLATS EXTENDED
SPEED – VLAND
DLC – AS REQUIRED
THRESHOLD:
50-FOOT HEIGHT MINIMUM
SPEED – VLAND
TURNING BASE:
FLAPS 23 DEGREES/SLATS EXTENDED
TURNING FINAL:
FLAPS 33 DEGREES/SLATS EXTENDED
PR5-C15-216B

Figure 2-6

APPROACH PARAMETERS ASSOCIATED WITH WIND CONDITIONS

WINDS	PITCH ATTITUDE		AIR MASS FLIGHT PATH	SPEED	IAS	THRUST
	SCAS ON	SCAS OFF				
CONSTANT TAILWIND	NO CHANGE(1)	NO CHANGE(1)	INCREASED	INCREASED	V_{app}	REDUCED
CONSTANT HEADWIND	NO CHANGE(2)	NO CHANGE(2)	DECREASED	DECREASED	V_{app}	INCREASED
SHEARING TAILWIND	NO CHANGE	INC AT SHEAR	WILL DECREASE (4)	WILL DECREASE	WILL INC THEN DEC TO V_{app} (3 & 4)	REDUCE THEN INCREASE
SHEARING HEADWIND	NO CHANGE	DEC AT SHEAR	WILL INCREASE (4)	WILL INCREASE	WILL DEC THEN INC TO V_{app} (3 & 4)	INCREASE THEN REDUCE

(1) PITCH ATTITUDE WILL BE DECREASED OVER NO WIND CONDITIONS.
(2) PITCH ATTITUDE WILL BE INCREASED OVER NO WIND CONDITIONS.
(3) BELOW 100 FT AGL AIRSPEED WILL NOT HAVE TIME TO RETURN TO V_{app}.
(4) IF THE WIND SHEAR IS SLOW, THE V_{app} SPEED WILL NOT CHANGE AND THE CHANGE TO AIR MASS FLIGHT PATH WILL BE OPPOSITE THAT OF A RAPID SHEAR.

PR7-C15-50132

Figure 2-7

SECTION III

EMERGENCY PROCEDURES

TABLE OF CONTENTS

SECTION III

EMERGENCY PROCEDURES

TABLE OF CONTENTS

INTRODUCTION

This section contains procedures to be used when an emergency is encountered. These procedures are based on best information available and will be refined during the flight test program. Systems emergencies, particularly engine systems, are generally well defined.

Critical items which are capitalized and underlined should be committed to memory. Noncritical items are actions that contribute to an orderly sequence of events. Checklist sequences should normally apply as written, however, unusual circumstances or multiple failures may dictate some variations. In all cases, safety of flight is the paramount concern.

Throughout this section the words "affected engine", "related pump", "applicable switch" will not be used in the checklist. It is assumed that the pilots will know which item is affected and will operate the correct unit.

Since it is standard procedure to reset a MASTER WARNING and MASTER CAUTION light after the cause is determined, in this section the action to reset the lights will not be included in the checklist.

In the event that fire, smoke or noxious fumes are encountered inflight, or with a loss of pressurization at altitudes above 10,000 feet MSL, all crew members will don oxygen/smoke masks (as appropriate), select 100% oxygen, establish communication, contact and ensure that all other crew members are aware of the situation and requirement for oxygen/smoke masks.

GENERAL EMERGENCY PROCEDURES

Emergency Signals

For immediate bailout, the pilot will sound the warning siren and transmit "BAILOUT, BAILOUT, BAILOUT" over the intercom.

Crew Coordination

An emergency requires the coordinated effort of each crewmember to correct the condition. Emergency checklist items will normally be called for and accomplished in sequence. However, peculiar circumstances or multiple failures may require modification of published procedures. Safety of flight is the deciding factor.

An emergency situation may be compounded by premature actions taken before the indications are thoroughly analyzed. Emergency procedures, underlined text included, should be accomplished only after the crewmember has positively identified the malfunctioning system and considered what affect his actions will have on aircraft performance. Chase aircraft and data center ("X-RAY") should be kept advised of the test aircraft's status and emergency procedures accomplished.

After the pilot and copilot complete the underlined items and the pilot calls for the emergency checklist, the copilot will silently review the underlined text items for the pilot, call out any that were missed, and complete the remaining items by using challenge and response when tasks are to be performed by the pilot.

A crewmember noting an engine fire or failure should announce location over the interphone.

EXCEPTION: During takeoff, if a condition occurs before GO speed is reached which would make the takeoff unsafe, the crewmember observing the condition will call "REJECT" on the interphone and the takeoff will be aborted. The pilot will silence the ENG FIRE bell after identification.

MINIMUM CONTROL SPEEDS

Ground - 60 Kts

Air (Flaps 23°) - 84 Kts

ENGINE SEPARATION/SEVERE DAMAGE

A fire warning may or may not appear with severe engine damage or engine separation.

Emergency Equipment, Miscellaneous

Refer to FO-2 and 3 and Figure 1-6.

GROUND OPERATION EMERGENCIES

ENGINE FIRE ON THE GROUND

If an engine fire is reported or if fire is observed while the aircraft is on the ground, proceed as follows:

1. Fire Shutoff Handle-"PULLED" (P)

2. Agent-------"DISCHARGED" (P)

An additional bottle of fire agent is available. If fire persists as indicated by fire warning lights remaining on for 30 seconds, discharge remaining bottle of fire agent.

3. Fuel Lever-----------OFF (P)

4. Parking Brake--------SET (P)

5. Ground and Crew/ Tower--------NOTIFIED (P/CP)

Pilot will notify ground and crew of the emergency. Copilot will notify the tower by relaying the nature of the emergency and aircraft number and location.

If fire still persists:

6. Throttles (All)-----IDLE (P)

7. Fuel Levers (All)----OFF (P)

8. Ignition-------------OFF (P)

9. Battery--------------OFF (P)

10. Crew-------EVACUATE AIRCRAFT

EMERGENCY EVACUATION ON GROUND

If a condition arises which warrants emergency evacuation of the aircraft on the ground, proceed as follows:

a. The pilot will turn on the BAILOUT SIREN (if installed).

b. The pilot will direct the flight compartment crew to abandon the aircraft and the FTE will relay that command to the cargo crew, if necessary.

c. Use the appropriate egress routes depicted in figure 3-1.

Emergency Exits and Entrance

Refer to Figure 3-1.

TAKEOFF EMERGENCIES

ENGINE FAILURE/FIRE, TAKEOFF CONTINUED - GENERAL

If an engine failure/fire occurs after passing GO speed, the takeoff should be continued. Control with an engine failure on take-off is conventional. The airplane is flown as it would be with all engines operating: leveling the wings with lateral control and controlling heading with the rudder. Although there is sufficient control to balance maximum three-engine thrust asymmetries to speeds below the three-engine stall speed, care should be exercised to maintain speed because control does become more critical at low speeds. Performance data generated by analysis indicates that gear drag is not critical to three-engine takeoff performance. Therefore, the gear may be retained in takeoff configuration during climb and checklist procedures, at the pilot's discretion.

CAUTION

> Advancing the throttles beyond takeoff-rated EPR can result in overspeed and possible engine failure.

ENGINE FLAMEOUT, TAKEOFF CONTINUED

1. <u>Ignition</u>----------<u>"OVRD"</u> (P)

Maintain control and continue takeoff using normal procedures. The ENGINE SHUTDOWN CHECKLIST may be deferred, at the pilot's discretion, until reaching a safe altitude.

2. Refer to ENGINE SHUTDOWN Checklist.

ENGINE FAILURE/FIRE, TAKEOFF CONTINUED

At the pilot's discretion, these checklist procedures may be delayed until the takeoff is completed and the aircraft is at a safe altitude.

1. <u>Throttle</u>----------<u>"IDLE"</u> (P)

If fire indications go off when the throttle is retarded, engine operation may be continued at idle during an emergency return and landing. If fire indications remain on, proceed with this procedure.

2. <u>Fire Shutoff Handle</u>-<u>"PULLED"</u> (CP)

The pilot will state which fire handle the copilot is to pull.

3. <u>Agent</u>------<u>"DISCHARGED"</u> (CP)

If fire indications continue for 30 seconds more, discharge remaining agent.

4. Refer to ENGINE SHUTDOWN Checklist.

ABORT PROCEDURES

During an aborted takeoff, it is desireable to apply forward pressure on the control column increasing nosewheel steering effectiveness. The pilot will concentrate his effort on maintaining directional control while stopping the aircraft on the remaining runway, using the following procedure:

1. Throttles---------------IDLE
2. Brakes-----------AS REQUIRED
3. Reverse Thrust---AS REQUIRED

Apply reverse thrust as required within limits of directional control and runway conditions. Power applications up to maximum continuous thrust are permissible if conditions warrant.

CONTROL CHARACTERISTICS

AFTER LOSS OF AN ENGINE

If an engine fails during the takeoff ground roll, the aircraft will yaw and bank toward the dead engine. If failure occurs prior to decision speed, the initial aircraft response will diminish as the engines are retarded to idle, and the engine reverse levers are placed in the reverse idle detent.

The pilot should anticipate failure of the affected engine reverser to deploy due to engine or associated hydraulic system failure. Failure to deploy will be annunciated by an amber THR REV UNLKD LIGHT and the green THR REV EXT light not on. In addition, the reverser lever will be restrained at the idle reverse detent position.

Full allowable reverse thrust on the remaining engines will be controllable with effective nosewheel steering. On runway surfaces which reduce nosewheel steering effectiveness, high reverse thrust should be applied symmetrically.

CAUTION

Loss of No. 1 engine will result in loss of nosewheel steering.

If engine failure occurs after V1, the aircraft will yaw and bank toward the failed engine. Full rudder will provide a minimum control speed well below decision speed.

Aileron deflection will compensate for the lift asymmetry and augment directional control. Rotation at VR should be in the same manner as for a normal four engine takeoff.

NOTE

Takeoff procedures are predicated on loss of any engine. Takeoff rotation is to 15 degree pitch attitude. With all engines operating the aircraft will lift off as the nose attitude passes through approximately 10 degrees. With an engine failed, lift off will occur at approximately thirteen degrees nose up attitude.

CAUTION

Premature or over-rotation may result in contact of the wheel mounted on the ramp and delayed lift off.

As the aircraft lifts off and SCAS switches to the initial climb modes, the yaw SCAS in BETA command will hold zero yaw rate and near zero sideslip.

The additional rudder pedal deflection to hold the "ball" centered can be trimmed out with the manual rudder trim knob.

NOTE

Failure of No. 1 engine may result in loss of:

L Spoiler No. 2 (approximately 25% LWD rolling moment)

Nose Wheel Steering

Forward Brakes and anti-skid.

Landing Gear Retraction (free fall extension required)

Failure of No. 2 engine may result in loss of:

Spoiler L No. 3 (approximately 25% LWD rolling moment)

L Aileron SCAS (half gain)

Lower rudder SCAS (half YAW SCAS)

Failure of No. 3 engine may result in loss of:

Spoiler R No. 3 (approximately 25% RWD rolling moment)

R Aileron SCAS (half gain)

Upper Rudder SCAS (half YAW SCAS)

Failure of No. 4 engine may result in loss of:

Spoiler R No. 2 (approximately 25% RWD rolling moment)

Horizontal Stabilizer Trim (altn electric trim available)

Aft Brakes

Troop and Cargo/Ramp Doors

Loss of either forward or aft brakes does not affect directional controllability of the aircraft.

INFLIGHT EMERGENCIES

ENGINE FAILURE/FIRE INFLIGHT

If an engine failure/fire occurs which requires immediate shutdown, use this checklist. Engine shutdowns made to prevent damage or avoid failure should be made using the ENGINE SHUTDOWN checklist. Verify that the affected engine has been correctly identified. All items refer to the affected engine.

NOTE

A fire warning may or may not appear with severe engine damage or engine separation.

1. Throttle----------"IDLE" (P)
2. Fire Shutoff Handle-"PULLED" (CP)
3. Agent------"DISCHARGED" (CP)

If fire indications continue for 30 seconds, discharge the remaining agent.

4. Fuel Lever----------OFF (CP)
5. Fuel Tank Pumps-----OFF (CP)

Fuel tank pumps and fuel crossfeed may be used as required.

6. Eng Hydraulic Pump--OFF (CP)

Check hydraulic system quantity. If normal, auxiliary hydraulic pump may be used as required.

7. Generator------------OFF (P)
8. Engine Failure/Fire Checklist-------"COMPLETED" (CP)

ENGINE SHUTDOWN

1. Throttle-----------IDLE (CP)
2. Fuel Lever----------OFF (CP)
3. Fuel Tank Pumps-----OFF (CP)
4. Aux Hydraulic Pump---ON (CP)

Check hydraulic quantity. If normal, place respective AUX PUMP switch ON and verify system pressure.

5. Generator-----------OFF (P)

Verify that the aux generator has taken the load of the inoperative generator. Confirm that electrical loads are within limits.

6. Engine Shutdown Checklist-------"COMPLETED" (CP)

NOTE

If fuel crossfeed operation is required, the affected engine tank pumps may be used.

AIRSTART (ENGINE RESTART)

The engine start envelope (figure 3-5) shows the altitude and speed envelope in which windmilling airstarts should normally be successful.

1. Throttle-----------IDLE (CP)

2. Fuel Lever----------OFF (CP)

3. Fire Shutoff Handle---STOWED (CP)

4. Fuel Tank Pumps------ON (CP)

5. Airspeed ------WITHIN LIMITS (per Fig. 3-5)

6. RPM (N1 and N2)---INDICATING

CAUTION

The ENG START switches should not be used inflight as damage to the starter/engine may occur.

7. Oil Pressure------INDICATING

8. Ignition----------"OVRD" (P)

Duty cycle for override position is: 2 Min. ON, 3 Min. OFF, 2 Min. ON, 23 Min. OFF.

9. Fuel Lever----------"ON" (P)

NOTE

If EGT and RPM do not rise within 20 seconds after the fuel lever has been place in the ON position, discontinue airstart. Shutdown engine in accordance with ENGINE SHUTDOWN checklist.

After successful airstart:

10. Engine Instruments---CHECKED (P, CP)

Check the engine generator (if applicable) is on the line, voltage and frequency are normal and AC load distribution is normal.

11. Ignition----AS REQUIRED (CP)

12. Hydraulic System-----CHECKED (CP)

13. Airstart Checklist-------"COMPLETED" (CP)

FOUR ENGINE FLAMEOUT

A simultaneous loss of all four engines is improbable except for fuel starvation or possibly during operation at unusual attitudes as in a spin or deep stall condition. Complete electrical failure at high altitude resulting in the loss of all fuel tank pumps should not result in flameout. In the event of loss of all engines in a controlled flight condition, proceed as follows:

1. Airspeed-------------150 Kts

Maintain 150 Knots to provide

sufficient windmill RPM for hydraulic power and for airstart. Minimize control inputs and maneuvering.

2. Emergency Power-------ON (P)

3. Ignition------------OVRD (P)

4. Throttles-----------IDLE (P)

5. Fuel Tank Pumps--ALL ON (CP)

6. Fuel Crossfeeds----OPEN (CP)

NOTE

Step 6 will have no effect until an engine with a generator restarts.

When an operative engine generator is on-line, restart remaining engines using AIRSTART checklist.

7. Land--------------AT NEAREST SUITABLE AIRPORT

BAILOUT PROCEDURE

If possible reduce airspeed to less than 200 knots and descend to an altitude where supplemental oxygen is not required. Depressurize the aircraft. Consider alternate exits. To use the escape chute in Aircraft #1 proceed as follows:

a. Give the bailout warning over ICS and sound the bailout siren.

b. Place the ARM escape chute switch in ARM. Both amber lights should come on.

c. Place the DEPLOY escape chute switch in DEPLOY.

NOTE

A 3 second time delay is incorporated in the door opening sequence after the deploy switch is in DEPLOY.

If the escape chute interior door (Iron grate) is not open, use the secondary escape chute Arm & Deploy switches.

If the secondary switches do not work, pull the door release handle or "T" handle to manually open the doors.

If these handles do not work, use the bolt cutter stowed on the right side of the escape chute, to cut the long bolt or cable.

d. Crew Evacuate the aircraft.

NOTE

Wear a helmet, exit feet first with arms folded.

In Aircraft #2 TBD

CARGO AREA FIRE

Any crewmember discovering a fire will immediately notify the pilot of the nature and origin of the fire. Proceed as follows:

1. Crew-----------"ALERTED" (P)

Notify crew of nature of emergency.

2. Oxygen/Smoke Masks--------"ON/100%" (ALL)

Pilot shall direct all crewmembers to don oxygen/smoke masks (as appropriate) and select 100 percent oxygen on their regulators. Those using walk-around/portable oxygen bottles should select 100% on the bottle regulator.

As directed by the pilot, all crewmembers not engaged in control of the aircraft shall proceed to fight the fire. The flight test engineer will maintain liaison with the pilot.

3. Pressurization--DEPRESSURIZE (P,CP)

NOTE

To eliminate smoke and fumes, refer to SMOKE AND FUME ELIMINATION checklist, as required.

4. Descend------AS REQUIRED (P)

Descend and land at the nearest suitable airport as soon as practical

5. Cargo Area Fire Checklist-------"COMPLETED" (CP)

ELECTRICAL FIRE

If a fire is determined to be of electrical origin, perform the following procedure attempting to isolate the faulty circuit:

1. Oxygen Masks---ON/100% (ALL)

2. DC Bus X Tie--------OPEN (P)

3. R Aux Pwr-------------OFF (P)

4. R GEN-----------------OFF (P)

If smoke/fire stop, checklist complete (refer to F0-6 and F0-7 for items affected with dead buses).

If smoke/fire continues, proceed:

5. R GEN-----------------ON (P)

6. R Aux Pwr-----------NORM (P)

7. L Aux Pwr-------------OFF (P)

8. L GEN-----------------OFF (P)

NOTE

With the LEFT AC bus dead, the avionics fan will stop and the air distribution for the instruments will stop. This could cause an increase of smoke and/or fumes in the cockpit.

If smoke/fire stops, checklist complete (refer to F0-6 and -7 for items affected with dead buses).

If smoke/fire continues, proceed:

9. L GEN-----------------ON (P)

10. L Aux Pwr switch----NORM (P)

11. EMER BUS FEED (L&R) CB's--------------OPEN (FTE)

Circuit breakers are on the EPC below the GEN BUS CP panel (AP-11 and AR-11).

If smoke/fire stops, checklist complete (refer to F0-7 for items affected with dead EMER BUS).

If smoke/fire continues, proceed:

12. EMER BUS FEED (L&R) CB's-------------CLOSE (FTE)

13. BATTERY BUS FEED (3) CB's--------------OPEN (FTE)

Circuit breakers are on EPC below the GEN BUS CB panel (AP-12 and AR-12 and one CB under the stairway beside the battery).

If the smoke/fire stops, checklist complete: (refer to F0-7 for items affected with dead BATTERY BUS).

If the smoke/fire continues, proceed:

14. BATTERY BUS FEED (3) CB's--------------CLOSE (FTE)

15. BATTERY DIRECT FEED CB-----------OPEN (FTE)

circuit breaker is under the stairway beside the battery.

If smoke/fire stops, checklist complete.

WING FIRE

The wing is not visible from the flight compartment seats. If a wing fire is reported, the pilot shall attempt to determine its exact location and any indications of structural damage.

If the fire cannot be extinguished, land as soon as possible, using forced landing or ditching procedures, abandon the aircraft. Increasing airspeed above 250 knots may aid in extinguishing the fire. The pilot should minimize maneuvering loads due to possible structural failure.

1. Fuel X---Feeds (ALL)--CLOSED (CP)

2. Fuel Tank Pumps-----OFF (CP) (Affected Wing)

3. Generator(s)---------OFF (P) (Affected Wing)

4. Pneumatics-----------OFF (P)

5. Hydraulics------CHECKED, OFF (CP)

Check hydraulic system quantities for fluid loss. Turn off hydraulic pumps for any system in affected wing that shows fluid loss.

If the fire extinguishes, perform the following:

6. Generator(s)---------ON (CP)

Turn generators on only after determining that they did not cause the fire.

7. Pneumatics-----AIR COND (CP)

Reinstate pressurization only after determining that bleed air was not the cause of the fire.

8. Land-----AS SOON AS POSSIBLE

Minimize maneuvering and landing loads, make a CTOL approach using small flap settings; do not use DLC or ground spoilers; minimize use of thrust reversers.

AIR CONDITIONING SMOKE

This procedure will be used to eliminate smoke and fumes emanating from the engine bleed system or the air conditioning unit.

1. Oxygen Masks-"ON/100%" (ALL)

2. Pneumatics----------OFF (CP)

Check the PNEU PRESS indicator for zero pressure reading.

NOTE

Turning off the pneumatics will result in loss of cabin pressurization.

3. Descend------AS REQUIRED (P)

If the smoke or fumes persist and the PNEU PRESS gauge does not drop to zero pressure.

4. Engine #3-------SHUTDOWN (P)

Refer to ENGINE SHUTDOWN Checklist Return to base.

If the smoke or fumes have stopped entering the cabin, leave the pneumatics off, descend to an altitude not requiring oxygen and return to base. Pesidual smoke and fumes may be eliminated from the cabin by opening the clearview windows. Refer to SMOKE AND FUME ELIMINATION checklist.

SMOKE AND FUME ELIMINATION

1. Oxygen Masks-ON/100% (ALL)

The pilot shall direct all crewmembers to don oxygen mask and smoke goggles or use smoke mask (as applicable) and to select 100 percent on their oxygen regulators. The smoke masks may be purged after donning by momentarily holding the oxygen regulator EMERGENCY LEVER in the TEST position.

2. Crew Comm--ESTABLISHED (ALL)

3. Pressure---DEPRESSURIZE (CP)
After the aircraft is depressurized, place the CABIN VALVE switch in OPEN.

4. Configuration----SET (CP/LM)
If Smoke is in the flight compartment proceed:

This procedure is designed to provide the flight crew visibility inside and outside the flight compartment adequate for control of the aircraft and visual emergency landing.

5. Reduce the airspeed to 200 knots or less.

6. Open the clearview window and flight compartment door.

NOTE

The clearview window could be opened at 250 knots however the noise level is very high. The windows will not open with the aircraft pressurized.

7. Maintain an airspeed to reduce flight compartment noise levels with the clearview window open and still retain adequate maneuvering margin.

NOTE

If the cargo door/ramp is open with a clear-view window open, the flow of air through the flight compartment will be greatly increased.

If Smoke is in the Cargo Compartment proceed:

8. Reduce the airspeed to approximately 150 knots, and the altitude as necessary for unpressurized flight.

9. Extend enough flaps to maintain a safe airspeed and then open the cargo door/ramp and troop jump door.

NOTE

Troop jump door open limitation is 150 knots. Cargo door/ramp open limitation is 200 knots.

With a gross weight above 206,000 pounds do not open the troop door because the maneuvering speed is greater than the door opening speed. With grossweights less than 206,000 pounds, extend the flaps in accordance with the structual limitations.

RAPID LOSS OF PRESSURIZATION

The aircraft is pressurized with bleed air from #3 engine controlled by the PNEUMATICS switch and the air conditioning and pressurization unit. Rapid loss of pressurization could be caused by:

a. #3 engine flameout/failure.

b. Duct failure, in the engine pylon or wing.

c. Cabin pressure controller failure.

d. Ramp/door/excape chute open.

e. Fuselage structural failure.

Procedures to be followed will be determined by the crew's assessment of the most probable cause of the depressurization.

a. Oxygen Masks---ON/100% (ALL)

b. If the pressurization loss is the result of #3 engine failure or flameout, descend to an altitude not requiring oxygen. If the engine cannot be restarted, place the PNEUMATICS switch off.

c. If the pressurization loss is the result of a duct failure as evidenced by the MASTER WARNING light, and applicable duct fail light coming on, refer to the #3 PYLON DUCT FAILURE or DUCT FAILURE checklist,as applicable.

d. If the pressurization loss is the result of a pressure controller failure, verify that the PNEUMATICS switch is on and attempt to regain pressurization thru manual operation of the cabin pressure controller. If manual operation is not successful, place the PNEUMATIC switch off and descend to an altitude not requiring oxygen.

e. If the pressurization loss is the result of a ramp/door open condition as evidenced by the MASTER CAUTION lights and DOOR NOT LOCKED annunciation or if it is the result of structural failure, place the PNEUMATICS switch off. Descend to an altitude not requiring oxygen.

#3 PYLON DUCT FAILURE

A bleed air overpressure condition in the #3 Pylon Duct is evidenced by the #3 PYLON DUCT FAIL light and MASTER WARNING lights coming on. Proceed as follows:

1. Pneumatics---------"OFF" (P)

NOTE

The PNEU PRESS indicator should decrease to zero. This action shuts off the source of pressurization and cabin altitude will increase.

2. ENGINE #3-----"SHUTDOWN" (P)

Refer to ENGINE SHUTDOWN checklist

3. Descend to an altitude not requiring oxygen and land as soon as practical.

DUCT FAILURE

An overtemp condition in the wing leading edge caused by a airconditioning and pressurization duct failure is evidenced by the DUCT FAIL light and MASTER WARNING lights coming on. Proceed as follows:

1. Pneumatics---------"OFF" (P)

NOTE

The PNEU PRESS indicator should decrease to zero. This DUCT FAIL light on also signals the pressure regulator valve to close shutting off bleed air and cabin altitude will increase.

2. Descend to an altitude not requiring oxygen and land as soon as practical.

3. Pneu Press--CHECKED ZERO (P)

4. DUCT FAIL light------OFF (P)

If the PNEU PRESS indicator is zero and the DUCT FAIL light is off, #3 engine may be operated normally. Monitor the PNEU PRESS indicator during descent and landing. Checklist complete.

If the PNEU PRESS indicator is not zero, or the light is not off after 30 seconds,

5. Engine #3-------SHUTDOWN (P)

Refer to ENGINE SHUTDOWN Checklist.

CAUTION

Prolonged operation with the DUCT FAIL light on could result in structural damage to the wing due to exposure to high temperatures.

EMERGENCY DESCENT

A high-rate descent from altitude may be necessitated by such emergencies as loss of cabin pressure, structural failure or fire. The cause of the emergency must be considered before attempting a high-rate descent. For instance, if a cabin pressure loss is due to structural failure, a maximum rate descent may be more serious than operating unpressurized at altitude. The pilot must consider the emergency, and modify the descent accordingly. To accomplish a maximum rate descent, proceed as follows:

1. Crew-------------ALERTED (P)

2. Pressurization------SET (CP)

If the pressurization is malfunctioning in AUTO, use manual.

3. Throttles---IDLE REVERSE (P)

NOTE

Reverse power may be used up to inflight thrust reverse stops; but do not exceed 1.4 EPR.

4. Airspeed------350K/.76 M MAX

5. IFF---------------EMER (CP)
Mode 3A-7700

6. Traffic (TEST) Control---------------ADVISE

ENGINE THRUST REVERSER JAMMED

A thrust reverser jams in a partially or fully deployed position and stowing of the reverser is desired. Proceed:

1. Shutdown the engine.

2. Attempt to stow the thrust reverser using the appropriate auxiliary hydraulic pump.

   2a. If thrust reverser stows (all thrust reverser lights off), restart engine. Do not use reverser.

2b. If thrust reverser does not stow, continue with engine shutdown.

NOTE

If #3 thrust reverser is jammed in a partially or fully deployed position, consider the operational situation as pressurization and air conditioning will be lost when engine #3 is shutdown.

DOOR OPEN CAUTION, INFLIGHT

If a door opens inflight as evidenced by the DOOR NOT LOCKED light, MASTER CAUTION lights, and applicable light on FTE panel, proceed as follows:

1. Pressurization--------REDUCE (CP)

Reduce the pressurization until the DOOR NOT LOCKED light goes off. Continue flight in a status that will maintain the light off. Advise all crewmembers stationed in the cargo area to put on parachutes and exercise caution when working in the area near the malfunctioning door.

LANDING EMERGENCIES

FORCED LANDING

The following procedures are applicable to a landing with gear retracted or a forced landing at any place other than a prepared landing area. Landing gear should be extended for a forced landing on unprepared surface. Approach and landing should be accomplished utilizing conventional speeds and flap/slat configuration for a nominal three degree approach path. Complete the FORCED LANDING CHECKLIST. If time permits and if the situation warrants, a clearview window may be opened inflight to preclude jammed window preventing crew egress.

1. Crew-------------ALERTED (P)

Direct crew to prepare for forced landing. Brief on procedures to be followed during and immediately following landing.

2. Pneumatics----------OFF (CP)

3. Pressurization--DEPRESSURIZE (CP)

When forced landing is imminent:

4. Gear (if possible)-DOWN (CP)

Copilot will extend gear at pilot's command. If a gear up landing is to be made, open the LANDING GEAR WARNING circuit breaker (V-16).

5. Flaps/Slats--"STATE SETTING" (CP)

Pilot will direct copilot to set final flaps.

6. Spoilers------------OFF (CP)

7. Fuel Tank Pumps-----OFF (CP)

8. Final Warning-----------"BRACE FOR IMPACT" (P)

After touchdown:

9. Fire Shutoff Handles (4)----"PULLED" (CP)

10. Battery-------------OFF (CP)

11. Crew-------EVACUATE AIRCRAFT

DITCHING

Refer to FORCED LANDING CHECKLIST. Ditch with gear UP, clearview windows CLOSED.

LANDING WITH ONE OR MORE ENGINES INOPERATIVE

Sufficient control exists in all configurations to balance maximum thrust asymmetries associated with one inoperative engine to below the corresponding full-thrust three-engine stall speed. It is possible to maintain course with the wings level to below the stall speed. The asymmetric thrust control procedure simply consists of leveling the wings with the ailerons and using the rudder as necessary to control heading.

SCAS operation will tend to mask engine failures so the first manifestation of an engine failure during a STOL approach may be the resulting increased sink rate and glide path angle accompanied by a slight rolling and yawing motion into the failed engine. Positive DLC and increased thrust should be applied in the normal course of events even before the engine failure is recognized as such. The approach can be continued with the same speed and flap deflection if the aircraft is not low or slow; however, if the speed gets low or the aircraft falls below the intended flight path a go-around should be initiated immediately. Refer to Go-Around with engine failed.

THREE ENGINE APPROACH AND LANDING

In the event of an actual failure of an engine during the prototype test program, the flight will be terminated and it is recommended that the aircraft will be returned for a conventional 23 degree flap, 3 degree approach and landing. In the event #1 hydraulic system is inoperative and strong or gusty crosswinds exist, the pilot should consider use of a lakebeed or runway into the wind as appropriate (no nosewheel steering).

TWO ENGINE APPROACH AND LANDING

Landing with different combinations of engines requires consideration of those components and systems that are inoperative. In general, all control surfaces will have half of the hinge moment capability with two engines inoperative.

All three axes of SCAS will be affected with dual engine failure since aux hydraulic pumps are not capable of handling all the anticipated hydraulic power demands. Loss of engines 2 and 3 or 3 and 4 (generators) will result in loss of RIGHT AC bus. Loss of engines 2 and 4 (generators) will result in loss of LEFT AC bus.

Two-engine out landings will be made with flaps retracted and slats extended, if operable. Using the main runway or a lakebed runway, the minimum speed on final approach should be the 0°/Ext landing speed greater than 130 KIAS in Ship 1 or greater than 150 KIAS in Ship 2. With slats retracted, add 20 knots to the slats extended approach speed.

Unlock the upper rudder prior to the approach and minimize roll, sideslip and aileron usage during the approach.

Proceed as follows if unable to restart engines:

1. ENGINE SHUTDOWN Checklist (as appropriate)-"COMPLETED" (CP)

2. DC X-TIE---------CLOSED (CP)

3. Aux Hydraulic Pumps,

affected engines-----ON (CP)

NOTE

If engines 2 and 3 are inoperative, #3 aux hyd pump will be inoperative. If engine 2 and 4 are inoperative, #1 and 2 aux hyd pumps are inoperative. If engine 3 and 4 are inoperative, aux hyd pumps #3 and 4 are inoperative.

4. Landing gear-----"DOWN" (CP)

5. Slats--------"Extended" (CP)

6. Upper Rudder------Unlock (P)

Check slat extend light, if not on, check slat disagree annunciator light. If both are off and no abnormal lateral trim is noted perform visual check. Fly a no-slat no-flap pattern.

If the slats will not extend, add 20 knots to the above approach speeds.

7. Touchdown and Roll Out

a. Reverse Thrust--------As Required

Place all reverse levers to the reverse idle interlock. Only those reversers with hydraulic power will be operable. Apply reverse thrust symmetrically.

b. Brakes-------------APPLY

Either hydraulic system 1 or 4 will provide full braking capability. Avoid rapid or heavy anti-skid cycling by a steady pedal pressure and a smooth deceleration.

c. Directional Control---------maintain

In the event of loss of hydraulic system 1, directional control can be maintained by rudder and appropriate wheel braking. Banking will assist in maintaining directional control.

GO AROUND WITH ONE OR MORE ENGINES INOPERATIVE - ENGINE FAILURE ON APPROACH

The control surfaces are designed to provide a no-wind, rudder only, ground minimum control speed of 63 knots, a three engine minimum control speed in takeoff-go-around and landing configuration of 73 knots.

NOTE

Engines will not be shutoff to practice engine out approaches. An engine at 1.1 EPR will provide suitable simulation without the risks associated with additional unplanned failures.

When conducting a simulated engine inoperative approach (inop engine at idle RPM), actual failure of another engine can result in an excessive sink rate during the recovery until the idling engine spools up to takeoff RPM. The most critical condition would be an engine failure on the same side as the simulated failure (i.e., 2 out on one side).

Since altitude loss and an increase in sink speed can be significantly reduced by a reduction in engine spool up time, the idling engine minimum EPR will be 1.1 below 300 feet AGL. This limitation which may be waived during specific tests, will reduce the resks without adversely affecting evaluation or training.

NOTE

Maintaining the idling engine EPR of 1.1 will reduce the spool up time 50%. The effects on the flight path are comparable to a light windshear of 5 knots.

GO-AROUND WITH ENGINE FAILED

For a simulated engine inoperative go-around the pilot will retard the desired throttle to approximately 1.1 EPR.

When a go-around with an engine inoperative/engine failure on approach is to be conducted proceed as follows:

1. Announce---"Go Around FLAPS" (P)

Copilot places the flap control handle to 2 detents less than the flap setting (i.e., if 45° had been selected, then move handle to 23° detent; or if flaps were set at 33° then 14° would be the correct detent; or 23° then 0°/EXT is correct).

2. Throttles (All)----"TAKEOFF" (P)

While announcing "go-around", the pilot will simultaneously advance all four throttles toward takeoff power. Do not refine engine power setting. Maintain wings level and approach pitch attitude.

3. Flaps 33° or less-"CLEAR TO ROTATE" (CP)

Copilot verifies that flaps are retracting and announce "ROTATE" as flap indication passes 33°. If the flaps were initially at 33° or less, copilot verifies that the flaps are retracting and announces "Rotate". Copilot now refines throttle settings to takeoff power.

4. Aircraft----------ROTATE (P)

When the copilot announces "rotate", the pilot rotates at normal takeoff rotation rate to 15° pitch attitude.

NOTE

Do not exceed stick shaker angle-of-attack.

5. Announce------"POSITIVE RATE OF CLIMB" (CP)

When the copilot affirms the aircraft has a positive rate of climb, he will notify the pilot.

6. Landing gear--------"UP" (P)

When directed by the pilot, the copilot will place the landing gear control handle in the up position.

NOTE

If #1 engine has failed (actual or simulated), the #1 auxiliary hydraulic pump must be ON in order to retract the landing gear.

Perform the appropriate clean up procedures on the failed engine, refer to ENGINE FAILURE/FIRE emergency procedures. For a simulated engine failure, restore the engine to normal conditions. Climb procedures could be initiated and AFTER TAKEOFF, CLIMB or BEFORE LANDING, TRAFFIC PATTERN checklist could be called for.

NOTE

Both pilots identify the failed engine. The pilot will fly the aircraft and the copilot will perform the checklist at the command of the pilot.

If go around is initiated less than 200 feet above the runway, anticipate touchdown during the go-around maneuver.

APPROACH CONTINUED WITH ENGINE FAILED

Continue the approach at the pitch attitude required to maintain approach airspeed and thrust as required to maintain the desired flight path.

Do not retard throttles during the landing maneauver below that EPR required for approach. On touchdown; throttles to idle and reverse and brake normally.

LANDING GEAR EMERGENCY EXTENSION PROCEDURE

If the gear cannot be extended normally, proceed as follows:

1. Airspeed---200K or BELOW (P)

2. Gear----------------DOWN (CP)

NOTE

If the gear handle is jammed in the up position, open LANDING GEAR CONTROL circuit breaker (AD-16). This EMERGENCY EXTENSION procedure will extend the gear regardless of gear handle position.

3. Press-----DEPRESSURIZED (CP)

4. Cargo Area Comm----ESTABLISH

5. Nose Gear Emergency Extension Handle--------PULL

The nose gear emergency extension handle is located on the upper left corner of the avionics rack adjacent to the flight compartment stairs (figure 3-4).

NOTE

This will position the nose gear selector valve so as to allow hydraulic pressure for nose/wheel steering. (Refer to FORCED LANDING CHECKLIST).

6. Placards (FS 875 L&R)------------READ

   a. Step 1 (Pull Yellow Handle #1 FS 723 L & R)------------PULLED

   b. Step 2 (Pull Yellow Handle #2 FS 840 L & R)------------PULLED

   c. Step 3 (Red Lever FS 880 L & R)--ACTIVATED

7. Viewing Windows (FS 870 L & R)----------OPEN

CAUTION

Aircraft must be depressurized before attempting to open viewing windows.

8. Gear Pins (L&R)----INSTALLED

If gear pins cannot be inserted, use red pry bar (figure 3-6), located adjacent to the left viewing window, to apply leverage to the downlock overcenter link until pins can be inserted.

LANDING WITH NOSE GEAR RETRACTED

If the nose landing gear cannot be extended, a landing on the main landing gear can be made and the nose lowered onto the runway as speed decreased. Smooth nose contact with the runway is of primary importance.

If time permits, the part of the runway where nose touchdown is planned should be foamed. Directional control on the unfoamed portion of the runway may be maintained with rudder and/or brakes. Brake effectiveness may diminish on the foamed runway surface and asymmetric reverse thrust may be used with caution for added directional control. Proceed as follows:

a. Complete Before Landing Checklist.

b. Perform a CTOL approach for landing.

c. Gear----------------DOWN

d. Spoilers-----------ARMED

e. Brake Pressure---CHECKED

After touchdown, the pilot should:

f. Smoothly fly the nose to the runway.

g. Upon nose contact, select idle reverse thrust on all engines.

h. Use braking to maintain directional control. If braking becomes ineffective, asymmetric reverse thrust may be used with caution for directional control.

LANDING WITH BOTH MAIN GEAR RETRACTED

If both main gear fail to extend, land with the nose gear extended and flap extension that will permit an approach (2-3 degrees) in a near level attitude. If time permits, the runway should be foamed. Maintain directional control with rudder and nose wheel steering, and hold wings level with aileron. When the aircraft stops (or just prior to stopping) shutdown all engines and turn the battery switch off. Evacuate the aircraft.

NOTE

There may not be time to assess whether discharge of fire agent is required. Since no harm results from agent discharge apply the rule; when in doubt, discharge the agent.

LANDING WITH ONE MAIN GEAR RETRACTED

If any main landing gear cannot be extended, using normal and emergency procedures, land with the remaining gear extended. Touchdown holding the wing up on the failed landing gear side. As speed decreases, the aircraft will settle onto the pod of the retracted gear. Maintain directional control with rudder, nosewheel steering and brakes. Time permitting, the runway should be foamed with a strip of foam off centerline on the side of the failed gear. Strive to maintain the nose gear and good main gear out of the foam.

NOTE

Heavy braking on the good gear could pull the failed gear out of the foam. The prime concern is to perform the flare, touchdown and roll out smoothly holding the wings level as long as possible and then stopping in the shortest distance consistent with maintaining directional control. Using this technique will limit damage to the pod doors and fairing.

BRAKE SYSTEM FAILURE

If either or both BRAKE PRESSURE indicators (FWD and AFT) shows a loss of system pressure with the gear handle down, proceed as follows:

If both indicators show a loss of system pressure, turn antiskid off to prevent rapid depletion of brake accumulator pressure. Use manual braking, do not pump brakes, apply smooth and steady brake pedal pressure. Use reverse thrust as required to stop the aircraft.

NOTE

If both hydraulic systems are inoperative and cannot be restored, fully charged brake accumulators will provide approximately 5 brake applications.

ANTI-SKID SYSTEM FAILURE

If one or more ANTISKID FAIL caution lights come on during approach, proceed as follows: Stop at any item that causes all antiskid caution lights to go off.

1. Anti-skid------------ARM (P)

NOTE

Check the antiskid control circuit breakers are closed (N-15, Z-15, T-15).

2. Antiskid---CYCLE OFF/ARM (P)

3. Runway Cond-----SELECT OTHER RUNWAY CONDITION (Paved/Unpaved) (P)

If lights remain on:

4. Antiskid-------------ARM (P)

5. Brakes----USE MANUAL BRAKING TECHNIQUES

6. Reverse Thrust---AS REQUIRED

JAMMED STABILIZER APPROACH AND LANDING

If the horizontal stabilizer becomes jammed special care must be taken particularly at lower speeds. Pitch change effectiveness of stabilizer is twice that of the elevator. If the stabilizer jams in cruise flight, plan a convential low angle approach with partial flaps.

NOTE

With pitch SCAS ON, a jammed stabilizer will probably be noticed first by an amber TRIM light on the pitch SCAS control panel. Disengaging pitch SCAS will result in a pitch transient proportional to the out-of-trim condition. This pitch transient can be minimized by changing speed. Note the elevator position in hands-off flight with SCAS on. If the elevator is up, increase speed. Conversely, if the elevator is down, decrease speed. Changing speed until the amber TRIM light goes off will approxmate a hands-off SCAS-off trim condition.

SCAS authority is capable of masking stabilizer mistrim. However, to minimize the effects of mistrim, SCAS disengagements, etc., landings should be conducted with flaps extended no greater than 35 degrees. The pilot should monitor stabilizer and elevator positions realizing that the stabilizer is mistrimmed one degree for every two degrees of elevator position from trim.

Perform a normal three degree landing approach with 35 degrees of flaps. Monitor elevator position and anticipate pitch transients in event of a SCAS disconnect. As speed is decreased the mistrim will require up elevator and a disconnect transient will be nose down.

NO FLAP LANDING

Inability to lower the flaps could be due to loss of hydraulic systems 2 and 3 or a jammed mechanical control component. If the slats can be extended, extend them for landing. If the slat cannot be extended, do not extend the flaps. Inability to extend the slats could be due to the loss of hydraulic systems 1 and 4. The effects of dual hydraulic failures should be reviewed thoroughly prior to landing.

The pilot should fly an extended pattern that will permit reduced control inputs and straight and level flight for landing gear extension.

Procedures for no-flap landings are the same with or without slats extended. Although slats reduce power-off stall speed approximately 20 knots (150,000 pounds gross weight), the higher nose-up attitude required to take advantage of the lower speed will result in tail first contact on touchdown. Slats should be extended if operable, for the increased maneuver margin, however, flaps retracted, slats retracted speeds should be used.

Fly final approach speed plus 20 knots on base leg.

a. Landing gear should be extended before approach is started.

b. Set up on a long straight final approach.

c. Reduce airspeed to final approach speed prior to 1000 feet above the ground. Deceleration will be slow due to reduced drag configuration.

d. The speeds for a no flap landing have been selected to provide proper attitude. Body angles in excess of eleven degrees may result in tail contact with runway.

e. Do not attempt to make a smooth landing by holding off.

f. Upon touchdown, lower the nose and apply brakes and reverse thrust.

DLC SYSTEM INOPERATIVE

With the Direct Lift Control (DLC) spoiler system inoperative, a normal STOL or CTOL approach and landing can be accomplished. Check that the SPOILER AMPLIFIER circuit breakers (J-23, -24, E-24) are closed. If open, reset once and re-attempt DLC operation. If closed or will not reset, set SPOILER mode selector switch to OFF for approach and landing. Ground spoilers will not be available for landing.

SCAS DISCONNECT DURING APPROACH/LANDING

The failure of one or more SCAS axes during an approach to landing is important only insofar as the pilot must rapidly adjust to changed handling qualities in the affected axes. Aircraft performance is not affected.

Attitiude changes must be anticipated and control inputs kept small. If a particular SCAS axis is malfunctioning, it would be preferable to fly the entire approach with it OFF or in SINGLE SCAS rather than risk a disconnect during the final stages of the landing. In any SCAS failure mode, a 5 to 10 knots speed increase from nominal STOL approach speeds will enhance the aircraft's handling qualitites and reduce pilot workload by increasing natural aerodynamic damping. The basic problem is not the SCAS-off handling qualities, per se, but rather the change in handling qualities associated with a SCAS disconnect while the pilot's attention is directed toward the external landing environment.

PITCH SCAS FAILURE DURING STOL APPROACH

The effects of failure of the Pitch SCAS during approach will be most noticeable with DLC operation and thrust changes. Do not try to fly too tightly in pitch control. Accept small pitch disturbances without much correction. Monitor airspeed trends, not minor deviations. Anticipate thrust corrections and operate throttles smoothly.

During a go-around, thrust increases will cause nose-down pitching moments, flap retraction will cause nose-up pitching moments.

YAW SCAS FAILURE DURING STOL APPROACH

Failure of the Yaw SCAS during approach would result in loss of yaw damping, turn coordination and Beta command. The most prominent effect will be the easily excited Dutch Roll As with the Pitch SCAS disconnect case, anticipation of control inputs and acceptance of minor deviations without correction are the keys to success. With Roll SCAS operative, the Yaw SCAS disconnect is a minor problem, easily handled without significant increase in pilot workload. With Roll SCAS inoperative, loss of the Yaw SCAS results in changes in handling qualities. In this case, yaw oscillations should be minimized by the pilot and roll control inputs kept small and smooth to minimize Dutch Roll excitation.

SYSTEM MALFUNCTIONS

ANNUNCIATOR INDICATIONS

Refer to figure 3-7, sheets 1 through 7.

ENGINE OIL SYSTEM MALFUNCTION

During start, if no rise in oil pressure is indicated, discontinue the start. If the OIL PRESS LOW light stays on after start, check oil pressure. If oil pressure is below 40 psi, SHUTDOWN ENGINE and correct malfunction; if oil pressure is above 40 psi, advance throttle to 75 percent N2 rpm. If oil pressure is normal, operation may be continued. Proceed as follows for oil system malfunctions inflight.

OIL QUANTITY INCREASING OR DECREASING

If the oil quantity increases above normal level, observe oil pressure and fuel flow. SHUTDOWN ENGINE if oil pressure exceeds 55 psi with increasing oil quantity.

If the oil quantity decreases, observe oil pressure and temperature. Anticipate engine oil pump cavitation condition or oil pressure loss. If fluctuation of oil pressure is observed, reduce thrust; and if oil pressure loss is experienced, SHUTDOWN ENGINE.

OIL TEMPERATURE HIGH

The oil temperature limit is 130°C for continuous operation and 165°C for transient operation. During transient operation, the oil temperature may exceed 130°C for a period of not more than 15 minutes. If these limits are approached, increasing thrust will provide higher fuel flows to improve oil cooling until lower fuel flows are capable of maintaining oil temperature within limits.

OIL PRESSURE LOW

If oil pressure indication is below 40 psi but above 35 psi, check oil quantity and temperature. If temperature and quantity are normal, operation is permissible at reduced thrust as required to sustain flight.

Inflight, oil pressure is below 35 psi and the ENG OIL PRESS LOW caution light is not on, proceed as follows:

a. Recycle affected ENGINE OIL PRESSURE circuit breakers (M-10, -11, Y-10, -11).
b. Test annunciator panel.
c. Monitor oil temperature and oil quantity for abnormal indications.
d. If oil temperature and quantity are normal and oil pressure warning light does not come on, assume faulty pressure gage.
e. Correct cause of low pressure indication prior to next takeoff.

If at anytime the oil pressure is below 35 psi and the ENG OIL PRESS LOW caution light is on, SHUTDOWN ENGINE.

OIL PRESSURE HIGH

If oil pressure is above 55 psi reduce thrust as required to sustain flight. If oil pressure is above 55 psi and oil quantity increases above normal range, SHUTDOWN ENGINE.

OIL FILTER CLOGGING

If the ENGINE OIL FILTER ΔP light comes on, reduce thrust. If the light goes off, continue flight at reduced thrust setting at or below thrust necessary to keep the light off. If light remains on at reduced thrust, SHUTDOWN ENGINE or reduce the throttle setting to the minimum thrust required to sustain flight until a landing can be made.

ELECTRICAL POWER SYSTEM MALFUNCTIONS

GENERATOR POWER LOSS

With a complete loss of generator power, the BATTERY BUS and BATTERY DIRECT BUS remain powered. The instrument fail flags will be in view. The following are operable:

- Standby instruments (gyro, airspeed, altimeter)
- Center instrument panel floodlights
- MASTER WARNING lights
- MASTER CAUTION lights
- Engine fire detection, indication and warning
- Escape chute
- Bailout siren
- AC and DC BUS OFF lights
- SCAS off lights
- DC EMER BUS off warning light
- BATT BUS off warning light
- Pilot's ICS panel
- DC X-TIE
- Spoiler Knockdown
- AGENT DISCHARGE

CSD DISCONNECT
CABIN PRESS Warning light
DUCT FAIL Warning light

Proceed as follows:

1. Emergency Power-------ON (P)

EMER PWR IN USE light should come on, DC EMER BUS light should go off. The additional following are now operable:

- Engine ignition (4)
- Fuel crossfeed valves (4)
- Generator control (3)
- Pneumatic pressure regulator valve
- UHF
- Remaining ICS panels
- Cockpit and cabin standby lights

2. VOLT/FREQ SEL----BAT AMP (P)

3. L/R GEN---------RESET/ON (P)

4. AUX GEN-------RESET/NORM (P)

NOTE

If any one generator is restored, reduce electrical loads to minimum required for flight.

If one of the generators can not be restored, the batteries, if fully charged, will provide emergency DC power for 60 minutes. Minimize use of UHF communications. Do not predicate operations on the use of fuel crossfeed.

5. Land at the nearest suitable airport.

EMERGENCY DC BUS LOSS

Loss of power to the EMERGENCY DC BUS will be indicated by the MASTER WARNING lights and the DC EMER BUS warning light coming on. Proceed as follows:

1. EMER BUS FEED Circuit Breaker (AP-11, AR-11)-----CHECK

Check EMER BUS FEED circuit breakers (AP-11, AR-11). If the circuit breakers have opened, reset the altn EMER BUS FEED circuit breaker (AP-11) one time only.

CAUTION

If circuit breaker opens again, or will not close, do not place the EMER PWR switch on, as a DC emergency bus fault possibly exists.

If the circuit breakers are closed, proceed as follows:

2. EMER PWR switch-----------ON

With the EMER PWR switch on, the EMERGENCY DC BUS is powered directly from the batteries through the BAT/DIRECT BUS FEED circuit breaker.

3. LAND at the nearest suitable airport

NOTE

The batteries, if charged, will provide emergency DC power for 60 minutes. Minimize use of UHF communications. Do not predicate operations on the use of fuel crossfeed.

BATTERY BUS LOSS

If the Battery Bus fails as indicated by the BATT BUS light on and certain equipment is inoperative, proceed as follows:

NOTE

When the Battery Bus has failed, the following are inoperative: ENGINE FIRE DETECTION, INDICATION AND WARNING SYSTEM: DC BUS OFF LT; MASTER WARNING and MASTER CAUTION lights; Pilot's ICS panel; and Standby Attitude.

1. Battery Bus Sensing C.B. - ----------------(B-25) CHECK

2. Battery-------------------ON

3. ANNUN LT TEST-----------TEST

If the MASTER WARNING and MASTER CAUTION lights come on during test, then the BATT BUS light is a false indication. Monitor the electrical system and continue flight. CHECKLIST COMPLETE.

If the MASTER WARNING and MASTER CAUTION lights remain OFF during the test, then the Battery Bus is actually dead, so proceed as follows:

4. EMER PWR------------------ON
EMER PWR IN USE light should come on.

5. If Battery Bus is powered proceed to Step 7.

6. If battery Bus is not powered, proceed to Step 9.

7. Cycle the following CB's: CHARGER/TRANSFER CONTROL (C-15); BATTERY CHARGER (EPC pnl) and LEFT & RIGHT BATTERY BUS FEED (EPC pnl).

8. EMER PWR-OFF
If the Battery Bus is powered, continue. End of Checklist.

If Battery Bus is not powered, reselect emergency power. Land ASAP, checklist completed.

9. Cycle the following CB's: BATTERY RELAY (A-15), CHARGER/TRANSFER CONTROL (C-15), BATTERY CHARGER (EPC pnl); LEFT & RIGHT BATTERY BUS FEED (EPC pnl) and BATTERY BUS FEED (adjacent to battery).

10. EMER PWR-----------------OFF

If the Battery Bus is powered, checklist complete.

If the Battery Bus is not powered, land ASAP, checklist completed.

CSD HIGH OIL OUTLET TEMPERATURE

High CSD oil outlet temperature is indicated by the MASTER CAUTION lights and the applicable CSD OIL TEMP HI light coming on.

1. Generator----------------OFF

If the CSD OIL TEMP HI light remains on for one minute after placing the applicable GEN switch OFF, proceed as follows:

2. CSD---------------------DISC

Disconnect malfunctioning CSD by placing applicable CSD switch to the DISC (disconnect) position and hold for at least 3 seconds.

CAUTION

Make certain that the CSD switch to be actuated is for the malfunctioning CSD. CSD disconnect action is irrevocable. CSD cannot be reengaged inflight. A CSD should not be disconnected if the engine N2 RPM is below 25 percent.

3. AC Voltage-------VERIFY ZERO

Verify that the CSD has been disconnected by placing VOLT/FREQ selector switch in applicable AUX PWR or L or R, AC GEN/DC BUS position.

Check that the AC voltage pointer goes to the extreme left side of the AC VOLTS scale. The applicable CSD OIL PRESS LOW caution light should come on.

CSD LOW OIL PRESSURE

Low CSD oil pressure is indicated by the MASTER CAUTION lights and the applicable CSD OIL PRESS LOW light coming on. Proceed as follows:

1. Generator----------------OFF

2. CSD----------------------DISC

3. AC Voltage-------VERIFY ZERO

Refer to CSD high oil temperature procedure for amplification and cautions regarding CSD disconnect procedures.

FLIGHT CONTROL SYSTEMS MALFUNCTIONS

NOTE (EIRT)

If a rudder cable breaks, the pilot's and copilot's rudder pedal will remain synchronized; however, rudder control is lost in one direction and rudder pedal centering is inoperative.

RUDDER LOCK MALFUNCTION

A Rudder Lock failure is evidenced by the UPPER RUDDER LOCK DISAGREE and MASTER CAUTION lights on.

The upper rudder is automatically "locked" above 140 KIAS and "unlocked" below 140 KIAS. The electric signal to lock or unlock the upper rudder is from CADC #1 (LEFT BUS). The UPPER RUDDER LOCK DISAGREE light will come on 1, with slats retracted and upper rudder not locked or 2, flap handle in the landing range and the rudder not unlocked.

The UPR RUDDER switch operates the same actuator to lock and unlock the upper rudder as the CADC #1 automatic signal.

a. If airspeed is above 140 kts and Flap/Slat handle is Retracted and the UPPER RUDDER NOT LOCKED light is on, proceed as follows:

1. UPR RUDDER switch-------LOCK

2. UPPER RUDDER LOCK DISAGREE light---------------OFF (approximately 15 seconds)

3. UPPER RUDDER NOT LOCKED light----------------OFF

When the rudder pedals are moved, the upper rudder position indicator will remain centered.

If UPPER RUDDER LOCK DISAGREE light remains on, reduce speed, observe side slip limits, discontinue test and perform a normal approach and landing.

b. If the airspeed is below 140 kts and the flap/slat handle is in the landing range and the UPPER RUDDER NOT LOCKED light is off, proceed as follows:

1. UPR RUDDER switch-----UNLOCK

2. UPPER RUDDER LOCK DISAGREE light---------------OFF (approximately 15 seconds)

3. UPPER RUDDER NOT

LOCKED light-----------------OFF

Upper and lower rudder indicators shows same response with rudder pedal movement.

If UPPER RUDDER LOCK DISAGREE light remains on, assume an actuator failure. Fly a normal flaps 33 degree approach.

NOTE

Sufficient rudder exists to execute a go-around with the upper rudder locked and/or only one hydraulic system powering the lower rudder.

SPOILER SYSTEM MALFUNCTION

Spoiler system malfunctions can be grouped into two categories, Extension/Retraction malfunctions and Spoiler Lock malfunctions.

If the spoiler selector switch is in DLC or RTO SPOILER ARM and:

a. Uncommanded spoiler extension occurs: Press the TOGA switch on the #2 throttle and verify that the spoiler selector switches to OFF. Continue flight with spoilers off.

SPOILERS NOT LOCKED

This amber annunciator light will come on when the slats are retracted and the spoilers are not locked (any one of six spoiler amplifier "lock" relays not energized).

Proceed as follows:

1. Spoiler Amp 3 and Spoiler Amp 2 switches------LOCK

Check SPOILERS NOT LOCKED annunciator light goes off.

If the SPOILERS NOT LOCKED LIGHT remains on check circuit breakers LATERAL SPOILER LOCK AMPL 2 (F-22) and LATERAL SPOILER LOCK AMPL 3 (K-21). If the circuit breakers will not reset, the annunciator will remain on.

2. Airspeed--Less than 235 KIAS

If the spoilers cannot be locked maintain speed below 235 KIAS, discontinue the test and return for maintenance corrective action. Make a normal approach with DLC.

NOTE

The SPOILER NOT LOCKED annunciator light will remain on with the flap/slat handle in the slat retracted position.

SPOILER LOCKED

This amber annunciator light will come on if the spoilers are "locked" and the flap/slat handle is out of the slat retract position. Proceed as follows:

1. Spoiler Amp 3 or Spoiler Amp 2 SW-----UNLOCKED

Check SPOILERS LOCKED light goes off.

If the annunciator light remains on, pull circuit breaker F-22 amplifier 2 or K-21 amplifier 3.

NOTE

Pulling the circuit breaker removes electric power from the lock relays which must be energized to hold the spoilers locked.

ROLL TRIM LOSS

Roll trim is electrically controlled and actuated by manual operation of the wheel trim switches or automatically by the ROLL SCAS. If an amber TRIM light comes on the ROLL SCAS panel (SCAS on) or if the aircraft fails to respond to wheel trim inputs, proceed as follows:

a. Check circuit breaker, K-20. If the breaker is open, attempt to reset it.

b. If the breaker is closed, or will not reset, select alternate roll trim (ALTN) and trim the aircraft with the ALTN ROLL TRIM switch.

c. If both the NORM and ALTN roll trim are inoperative, continue flight SCAS off holding the out of trim roll control forces or select ROLL SCAS on.

STABILIZER RUNAWAY

An electrical or hydraulic malfunction that results in a runaway stabilizer may not be noticed until the amber trim light on the pitch SCAS control panel comes ON. Should this light not be noticed and the stabilizer runs away during cruise, the SCAS authority may be exceeded in which case the aircraft will nose up or nose down in the out of trim condition.

CAUTION

Should the aircraft nose move up or down with SCAS on, an amber pitch trim light ON and no control column input, the pilot should assume full SCAS authority elevator control input is present.

Do not disengage SCAS until the pitch trim guarded override switch has been placed in DISC (disconnect) and the stabilizer returned to trim (amber light off). The manual trim levers ("suitcase handles") would normally be used.

SCAS disconnect with a trim light on will result in a transient proportional to the mistrim conditions. Pitch SCAS servo disconnect is a "hand-on" wheel operation.

To correct for a runaway stabilizer trim:

a. Pitch trim guarded override switch----DISC (Disconnect)

b. Operate manual trim to return stabilizer to trim position. Amber trim light------------OFF

instruct co-pilot to operate manual as required to keep amber trim light off and/or stabilizer elevator mistrim within limits. Anticipate speed and configuration changes as to minimize large rapid trim changes.

SCAS MALFUNCTIONS

SCAS HALF-GAIN OPERATION

The ROLL and YAW SCAS axes are each powered by two hydraulic systems (2 & 3). Failure of one of these hydraulic systems or a mechanical jam of a SCAS actuator in either the ROLL or YAW axis will cause the appropriate amber HALF-GAIN light on the SCAS control panel to come on. This indicates that though the SCAS circuitry is active, the actuator is not responding.

SCAS CHANNEL FAILURE

The dual-channel fail-passive SCAS axes are internally monitored and protected against hardover signals and channel disagreement in the event of component or sensor failure. When engaged in DUAL, SCAS malfunctions resulting in hardover signals or other channel disagreement will cause the servo engage lever to drop to OFF in the failed axis and the red annunciator light (PITCH, YAW, ROLL) to come on. If the pilot elects to operate single channel, proceed as follows:

a. Channel selector to A or B. Prior to selection of a single channel, the cockpit instruments should be checked for warning flags, etc, in an effort to determine which channel is operative. If the channel failure was the result of SCAS axis component or sensor malfunction, that channel should not stay engaged when selected.

CAUTION

If the SCAS disengagement was the result of a channel disagreement, as in a hardover signal, when the single failed channel is selected on it may engage, resulting in a hardover signal when the servo engage lever is placed ON. Caution should be exercised when engaging single channel SCAS if the possibility exists of engaging the failed channel.

b. If the selected channel will not stay engaged, it is the failed channel. Select other channel and continue operations in single-channel SCAS observing current limitations on such operation.

SCAS SINGLE CHANNEL HARDOVER

If a SCAS axis is operative in Channel A or B, the fail passive protection is not available. Failure of the selected channel could result in a "hardover" signal to the flight control surface. The control surface hardover is limited to 1/4 the normal control authority for the flight condition and will not, in itself, result in excessive structural loads. In the event of a SCAS single channel hardover, proceed as follows:

1. Regain control of the aircraft prior to disconnecting SCAS. Sufficient control authority exists to permit any SCAS hardover to be overpowered and the aircraft returned to initial flight conditions.

2. When in controlled flight, disconnect the failed SCAS axis by using the wheel mounted SINGLE SCAS DISC button (figure 1-71). Simultaneously release the overpower forces to zero to prevent structural loads in the opposite direction as the hardover.

FLAP SYSTEM MALFUNCTION

If flap asymmetry exceeds three degrees during retraction or extension a dual mechanical follow-up mechanism stops the flaps. There is no caution annunciation. It is incumbent on the copilot to check that the flaps move to the selected position whenever the selector is repositioned. Should the flaps stop at an intermediate position and differ by three degrees indicating flap malfunction proceed as follows:

1. Flap Handle---RETURN TO LAST POSITION OF FLAP SYMMETRY

2. Land at the nearest suitable airport.

   Observe appropriate speeds for the existing flap position.

NOTE

It is recommended that the flaps be left in the last position of symmetry.

SLAT SYSTEM MALFUNCTION

Slat disagree light ON, proceed as follows:

1. Slat Handle---RETURN TO LAST POSITION OF SLAT SYMMETRY

If the slat disagree light remains on and visual check affirms slat asymmetry, land with flap retracted. Use no flap procedure for landing. Full slat asymmetry requires TBD (EST) degrees of aileron control at 150,000 pound gross weight, no-slat/no-flap landing speed.

RUDDER TRIM LOSS

The rudder trim is mechanical. Rotation of the rudder knob drives a closed loop cable system to the rudder load feel mechanism. If the rudder trim mechanism fails, the pilot/copilot must hold the out of trim forces. Rudder authority is not affected. The rudder can be moved full travel with force varying proportional to the out of trim condition (approximately 5 lbs/unit of mistrim).

NOTE

Rudder trim loss could be due to jammed rudder pedals. If the rudder pedals become jammed, the nosewheel steering will also be jammed. On the ground, the nosewheel will steer to the position commanded by the rudder pedal.

FUEL SYSTEM MALFUNCTIONS

FUEL TANK PUMP INOPERATIVE

If fuel pressure is lost as indicated by a PRESS LOW light and and MASTER CAUTION lights on, proceed as follows:

NOTE

Failure of a single fuel tank pump, while the other respective fuel tank pump operating will not cause the related PRESS LOW light to come on.

Check engine performance. If its normal - monitor and continue to suspect a pressure sensor indicator. If its not normal for the conditions - refer to Cross Feed operation in Section I.

NOTE

Maintain wing to wing fuel balance within lateral balance limits.

FUEL CROSSFEED DISAGREE LIGHT ON

The X-FEED DISAGREE light on indicates that the valve position does not agree with the selector switch position.

1. X-Feed Valve CB's------CHECK (C-5, -6, 07, -8)

If the light remains on and the X-FEED selector switch is in OPEN, the X-FEED valve is closed. Place the selector switch in CLOSED and light should go off. Continue operations in the tank to engine fuel configuration.

If the light remains on and the X-FEED selector switch is in CLOSE, the X-FEED valve is open and the X-FEED manifold is pressurized. Monitor and manage the fuel as required to maintain lateral balance limits.

FUEL FILTER CLOGGING

A clogged or restricted fuel filter, as evidenced by the respective FUEL FILTER PRESS DROP light and MASTER CAUTION lights coming on, may result from either foreign objects or ice at the filter. If the FUEL TEMP (gauges on the FTE's panel) is high, the restriction is probably foreign material, as in contaminated fuel. If the fuel temperature is low, suspect icing and activate the momentary FUEL HEAT switch. Verify operation by monitoring the FUEL TEMP gauges. The fuel heat is timed at 60 seconds. If this heat application causes the FUEL FILTER PRESS DROP light to go off, fuel icing is confirmed. Use FUEL HEAT as necessary, monitor engine oil temperature limits.

AIR CONDITIONING SYSTEM MANUAL OPERATION

In the event the cabin pressure controller fails to automatically maintain selected cabin pressure schedule as evidenced by:

a. Excessive pressure resulting in pressure relief valve operation, or

b. Loss of cabin pressure, proceed as follows:

Use the CAB ALT MANUAL control knob to control the cabin differential pressure. Rotate the control knob counter-clockwise off the stop and adjust cabin rate as desired.

HYDRAULIC SYSTEM MALFUNCTIONS

HYDRAULIC FLUID LOSS

If the loss of hydraulic fluid is experienced as indicated by decreasing or low quantity indication, and/or HYD QTY LOW light and MASTER CAUTION lights on, for the affected system, attempt to isolate source of leakage, to prevent further fluid loss as follows:

1. Eng Hyd Pump-------------OFF

2. Aux Hyd Pump-------------OFF

3. Hyd Quantity-----------CHECK

NOTE

In the cargo compartment observing the affected system reservoir's plunger, you can determine how much fluid remains. (e.g., the higher the plunger, the more fluid.)

If the loss of fluid stops:

4. Aux Hyd Pump--------------ON

5. Monitor System.

If the loss of fluid continues:

6. Shutdown the affected engine, if not in a critical phase of flight.

NOTE

Shutting down the engine

could prevent damage to the engine driven hydraulic pump and/or engine.

HYDRAULIC PRESSURE LOSS

With complete loss of pressure from a system as indicated by low pressure indication, and/or ENG PUMP PRESS LOW ligh and MASTER CAUTION lights on, for the affected system, proceed as follows:

1. Eng Hyd Pump-------------OFF

NOTE

ENG PUMP PRESS LOW light will be on with engine pump switch OFF.

2. Hyd Quantity-----------CHECK

If quantity is normal:

3. Aux Hyd Pump--------------ON

4. Monitor affected system for normal indications (ENG PUMP PRESS LOW light will still be on even though pressure is normal)

If quantity is low or decreasing refer to HYDRAULIC FLUID LOSS Emergency procedure.

HYDRAULIC SYSTEM TEMPERATURE HIGH

If a system temperature increases as evidenced by a HYD SYS TEMP HI light and MASTER CAUTION lights on, for the affected system, proceed as follows:

1. Eng Hyd Pump-------------OFF

2. Monitor system while cooling (approx. 15 min.)

NOTE

TEMP HI sensor is in the engine-driven hydraulic pump case drain return line to reservoir. It actually indicates the condition of the pump.

3. In the cargo compartment, feel the external surface of affected system reservoir and compare with other reservoirs and check light:

If light goes off and reservoir temperatures are approximately equal:

4. AUX HYD PUMP--------------ON
Monitor system for normal indications.

If light remains on or reservoir temperature is higher than others:

5. Normal engine operation, hyd pump off. May be continued at pilot's discretion.

EMERGENCY EXITS AND ENTRANCES

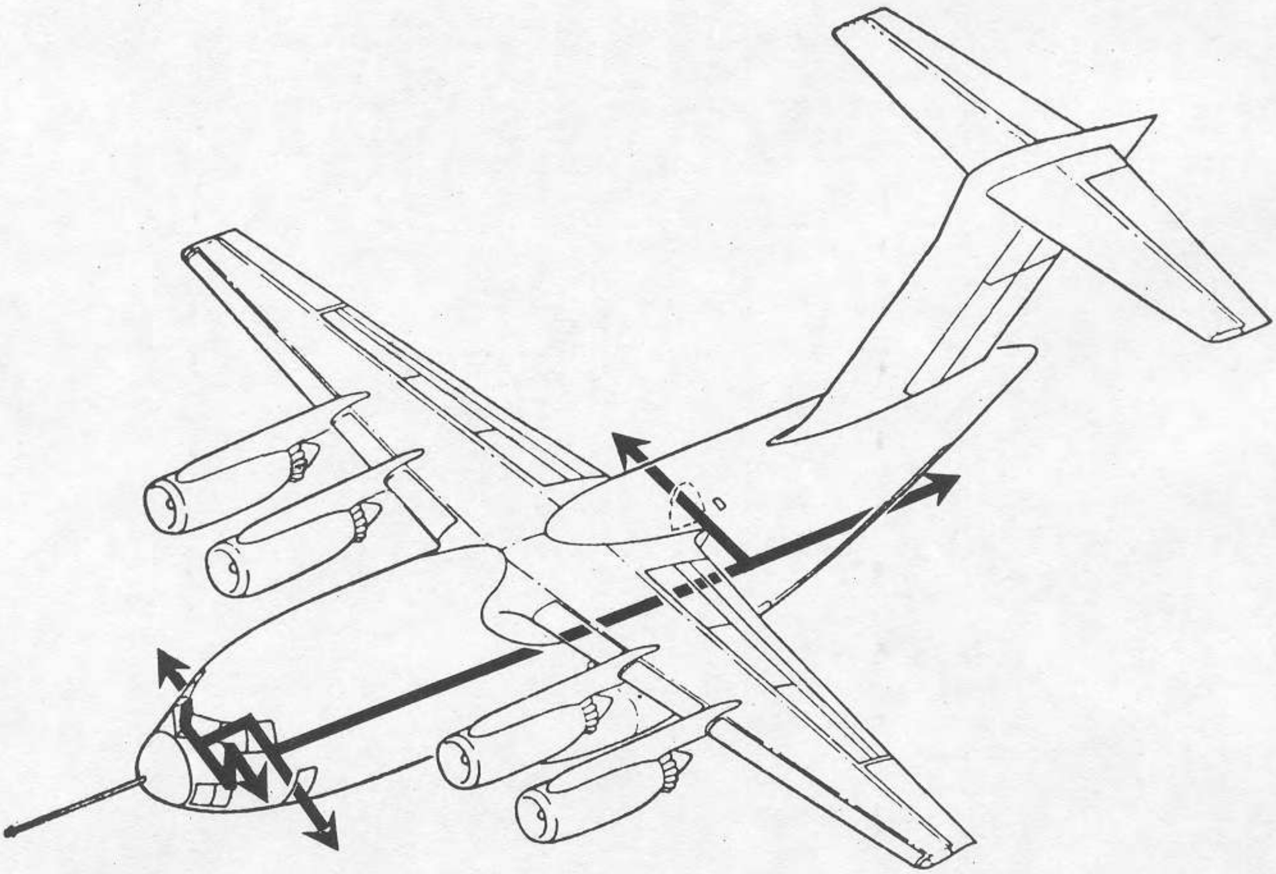
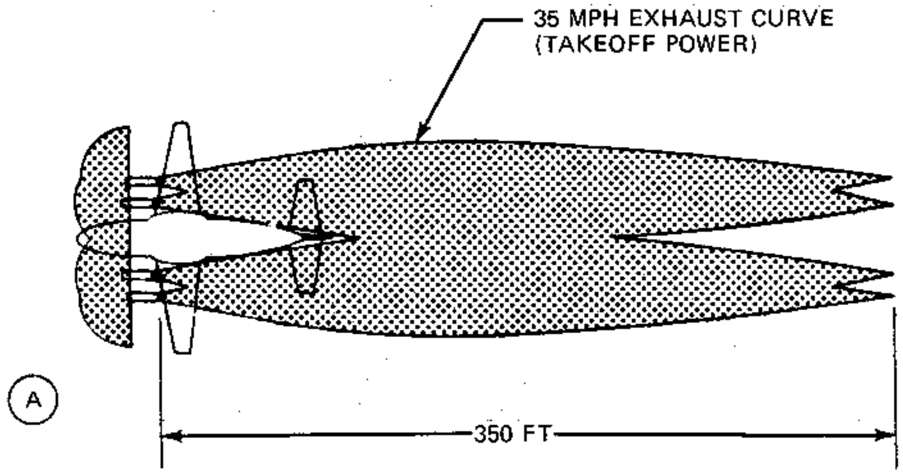


Figure 3-1

ENGINE DANGER AREAS

CURVES SHOWN WITH NO FLAPS



View Looking Up at Bottom of Airplane

(A) 25-ft Radius

Idle Power (Not Critical)

Takeoff Power

Note: Crosswinds will have considerable effect on contours.

PR5-C15-253

Figure 3-2

ESCAPE ROPES

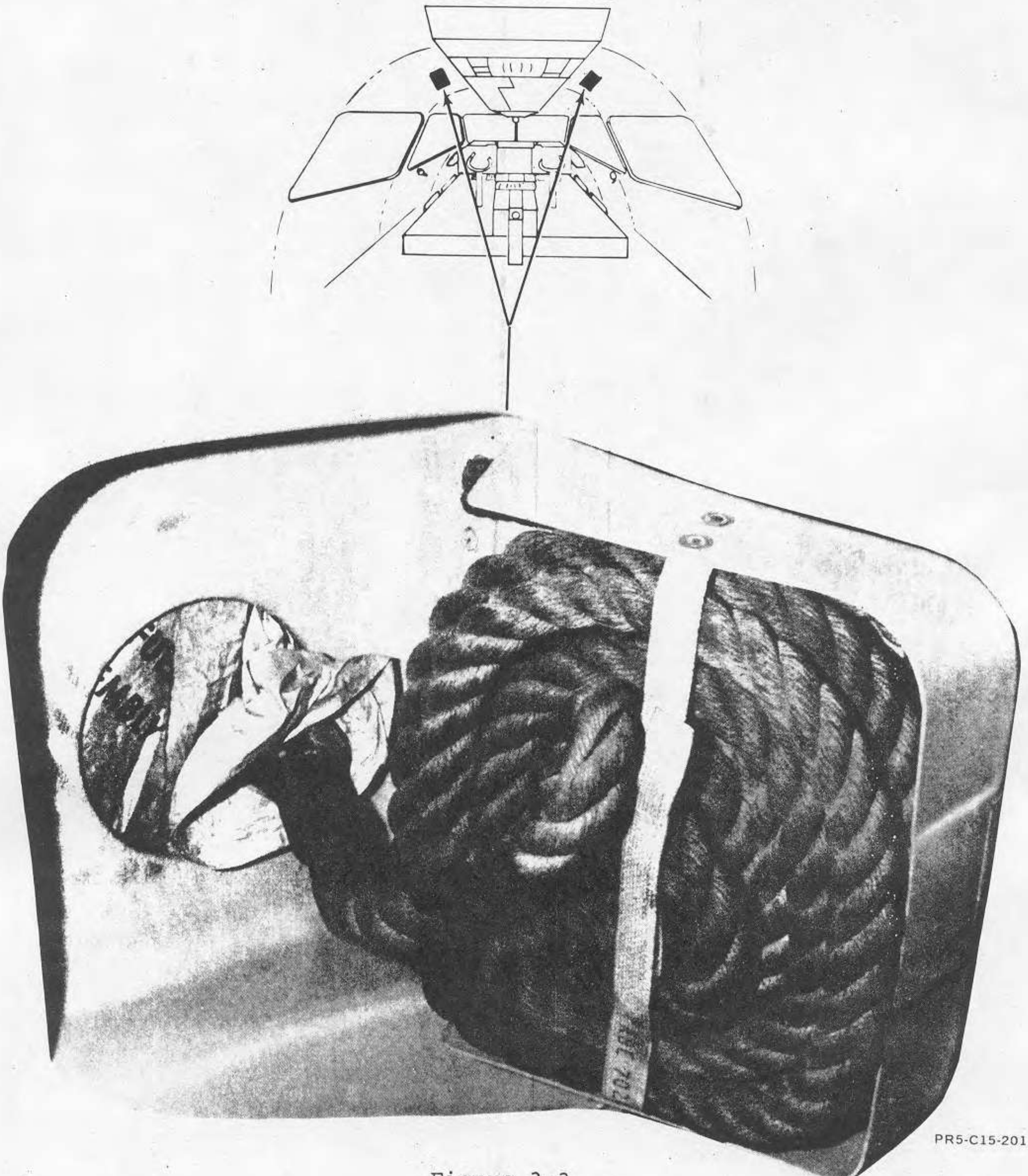
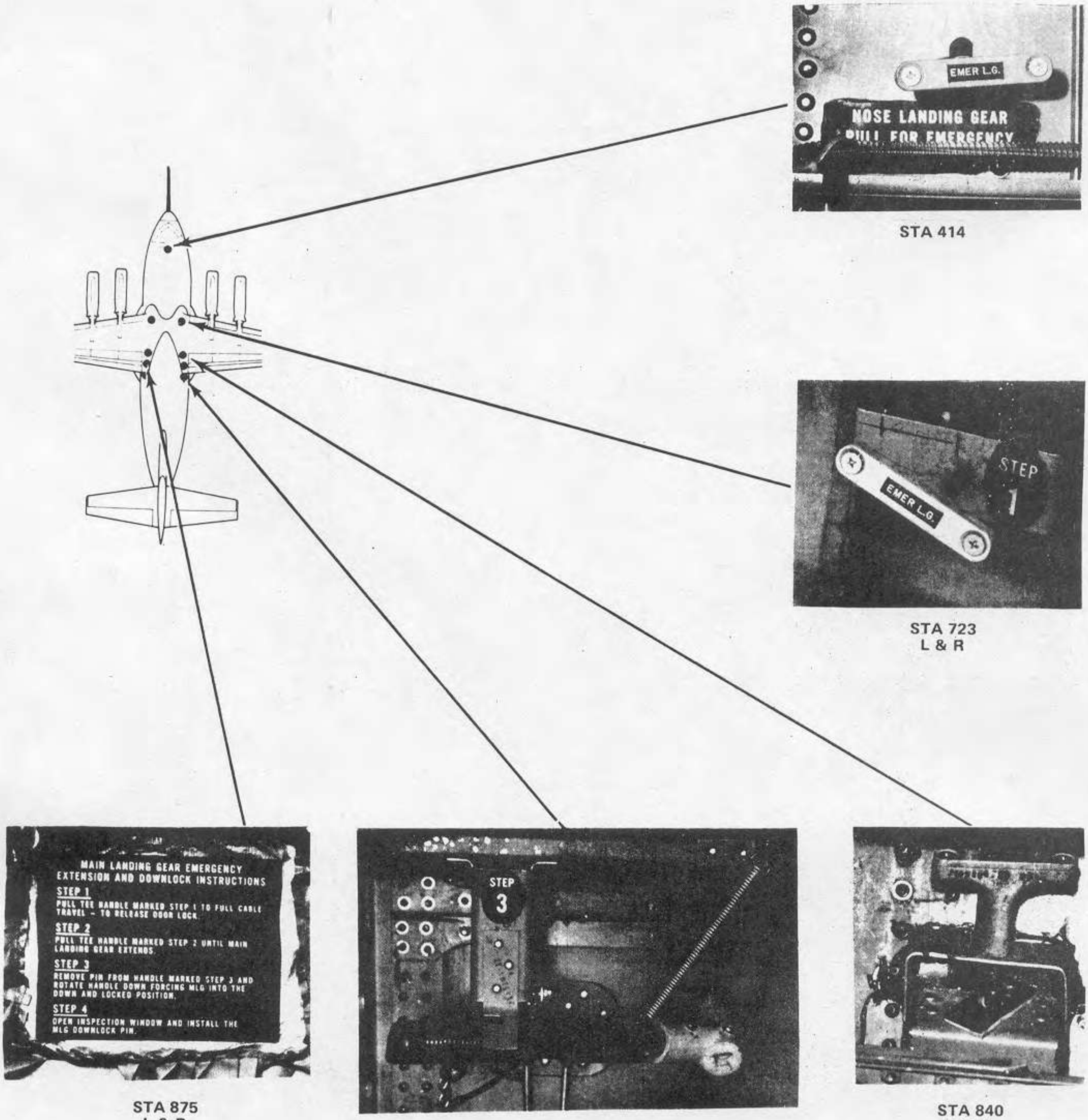


Figure 3-3

LANDING GEAR EMERGENCY CONTROLS



STA 414

STA 723
L & R

STA 875
L & R

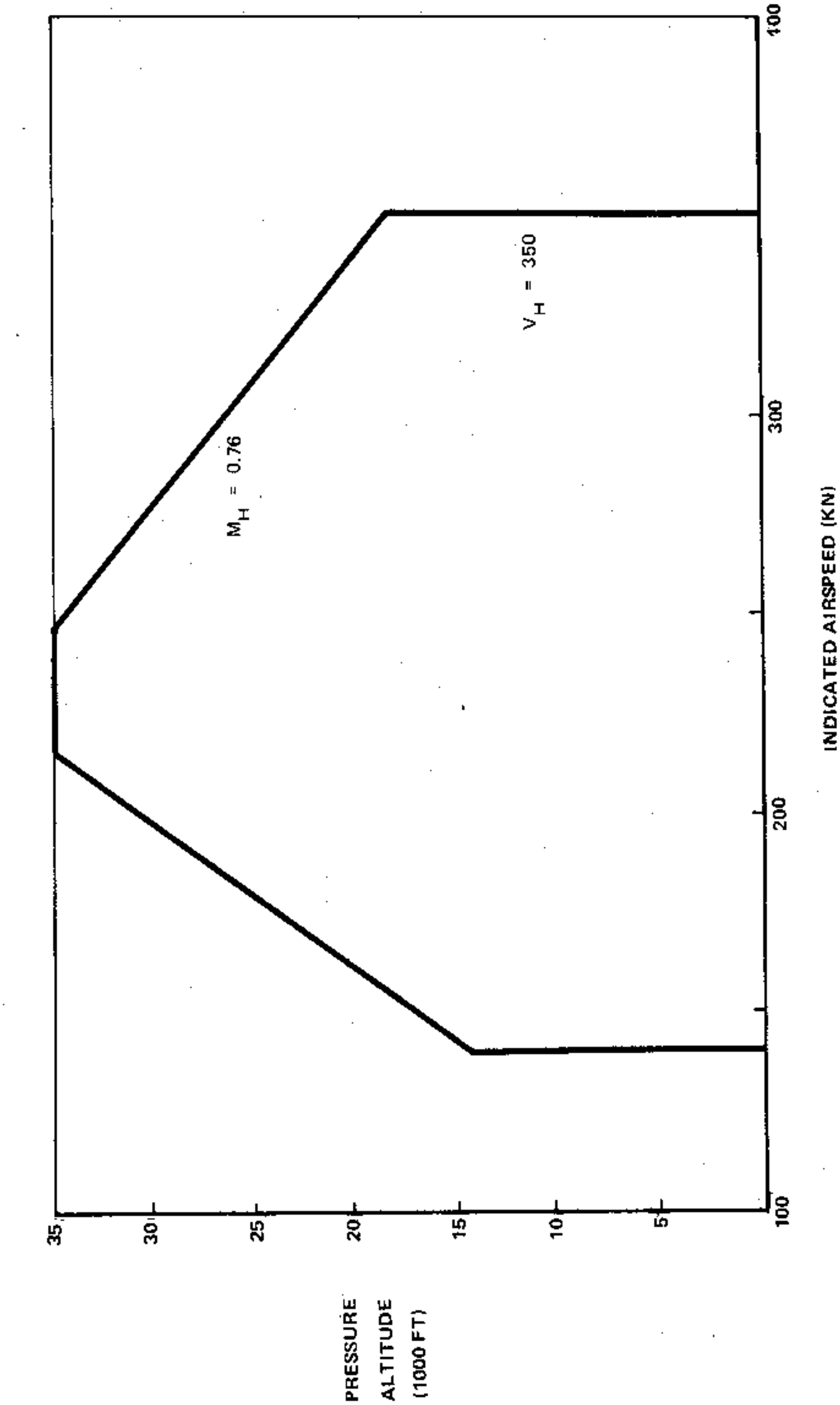
STA 880
L & R

STA 840
L & R

PR5-C15-202

Figure 3-4

ENGINE START ENVELOPE



PR5-C15-217

Figure 3-5

MAIN LANDING VIEWING WINDOW AND PRY BAR

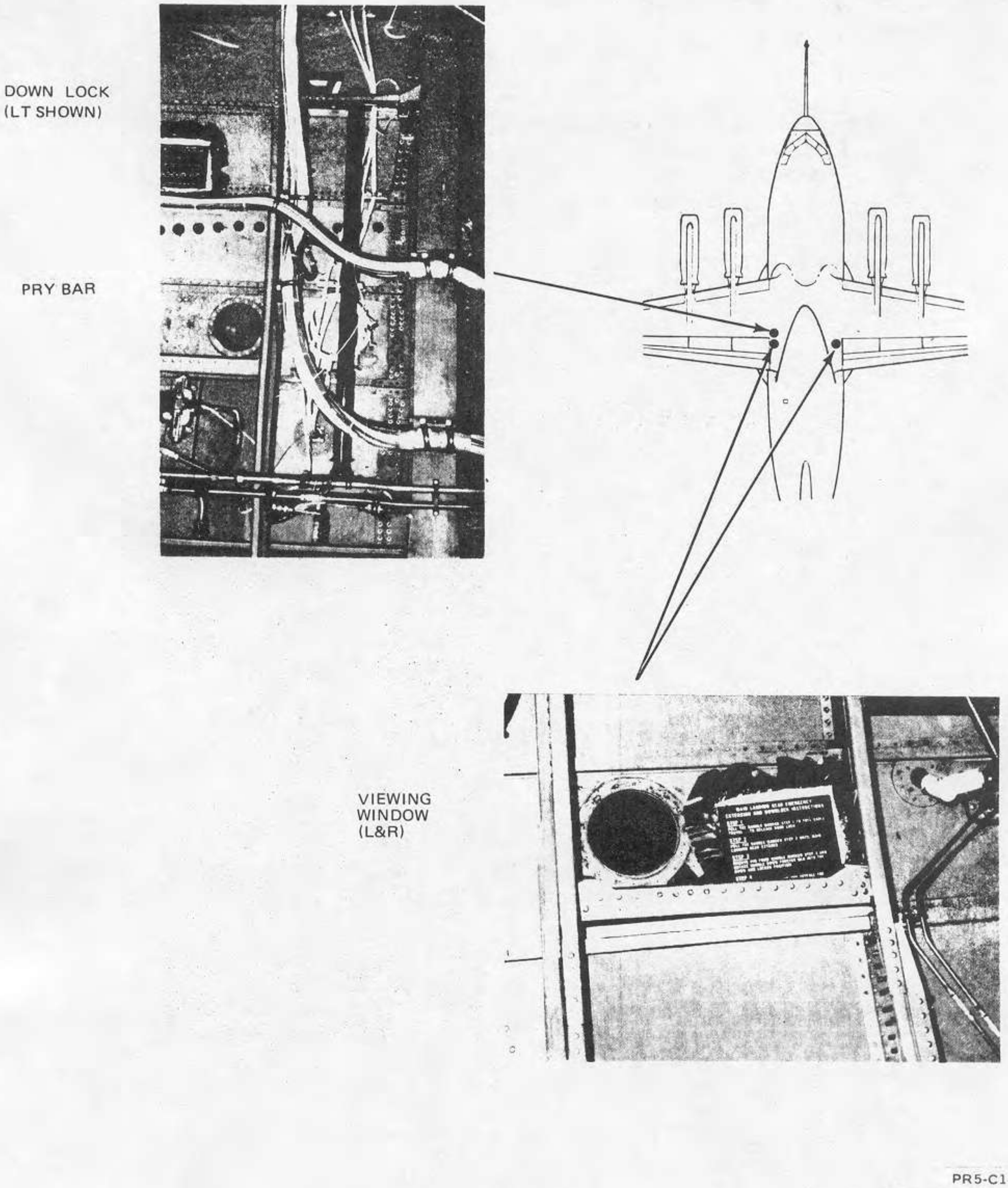


Figure 3-6

ANNUNCIATOR INDICATIONS

The following chart indicates the callouts for the Master Warning and Caution System annunciator panel and miscellaneous caution and advisory lights and the pilot's response. Actions indicated in the pilot's response column do not consider multiple malfunctions that may involve more than one system or subsystem.

NOTE

Whenever the MASTER WARNING or MASTER CAUTION lights come on, the light must be pressed to reset the system for subsequent malfunction indications. The light on the annunciator or system panel will remain on until the condition causing the light to come on has been corrected.

Figure 3-7, Sheet 1

ANNUNCIATOR INDICATIONS

NOTE

Annunciator lights shown in order of appearance on annunciator panel. Duplicate lights for systems one through four are not shown.

LIGHT	CONDITION	USUAL PILOT RESPONSE
MASTER WARNING (MW)	Malfunction in system monitored by master warning logic.	Check annunciator panel for indicator. Push to reset master warning system.
MASTER CAUTION (MC)	Malfunction in system monitored by master caution logic.	Check annunciator and system panels for indication. Push to reset master caution system.
ENG FIRE	Fire/Overheat condition sensed in engine area or system test.	Check fire shutoff handles/fuel control levers for engine fire identification.
ANTI-SKID (L-R) INBD FAIL ANTI-SKID (L-R) OUTBD FAIL	Malfunction of anti-skid system for specific wheel indicated. (Lights will be on when ANTI-SKID switch is in the OFF position.)	Check that the ANTI-SKID switch is in ARM position. Recycle system and PAVED-UNPAVED RUNWAY switch. Check control circuit breakers N-15, Z-15, T-15.
(L-AUX-R) CSD OIL PRESS LOW (MC)	Respective CSD oil pressure is below safe operating level.	Switch respective generator OFF, disconnect CSD.
(L-AUX-R) CSD OIL TEMP HI (MC)	Respective CSD oil outlet temperature exceeds normal operating limits.	Switch respective generator OFF. If TEMP HI light remains on for one minute, disconnect CSD.
(L-R) GEN OFF (MC)	Loss of power from respective generator.	RESET then OFF. Check voltage and frequency. If normal, generator ON.
AUX GEN OFF (MC)	1. Aux generator inoperative, or 2. Aux generator operative, and both (L-R) AUX PWR switches are off.	RESET. Check AUX PWR NORM.
(L-R) AC BUS OFF (MC)	Power not being supplied to respective AC bus or AC BUS SENSE circuit breaker open.	Check generator switch ON and respective loadmeter. Check (L-R) AC BUS SENSING CB's (AH, AJ, AK, AL, AM, AN-11).

Figure 3-7, Sheet 2

ANNUNCIATOR INDICATIONS

LIGHT	CONDITION	USUAL PILOT RESPONSE
(L-R) DC BUS OFF (MC)	Power not being supplied to respective DC bus or DC BUS SENSE circuit breaker open.	Check DC loadmeters to determine condition of buses. Check transformer-rectifier circuit breakers (AH, AJ, AK, AL, AM, AN-9, and -10) and DC BUS SENSE CB's (T-24, AD-24).
AIR COND SUPPLY TEMP HIGH (MC)	Air conditioning pneumatic supply temperature exceeds 600°F (augmentation valve malfunction).	Switch pneumatics OFF.
NO. 3 PYLON DUCT FAIL (MW)	Internal pylon pressure exceeds normal limits and relief door is open.	Switch pneumatics OFF and SHUTDOWN NO. 3 ENGINE.
ELEV RATIO CHANNEL INOP	Failure of one of two channels. No adverse affect. Automatic system monitoring inoperative.	Advisory
SELECT ELEV RATIO MAN (MC)	Either dual channel failure or switch is positioned in MAN.	Check switch position. If dual channel failure exists, select MAN.
SPOILERS LOCKED (MC)	Spoilers remain locked with slats extended.	Select spoiler amp switch to UNLOCK. If light remains on, open circuit breakers F-22 or K-21.
SPOILERS NOT LOCKED (MC)	Spoilers remain unlocked with slats retracted.	Select spoiler amp switch to LOCK. If light remains on, check CB's F-22 and K-21, reduce airspeed to maintain less than 235 KIAS.
DLC (MC)	DLC selected when flaps are not in landing position.	Check flap and DLC selections.
UPPER RUDDER LOCK DISAGREE (MC)	Disagreement between desired and actual position of rudder lock and slat handle moved to extend (retract) above (below) 140 KIAS.	Above 140 KIAS, UPR RUDDER switch to LOCK. Check light off. Below 140 KIAS, UPR RUDDER switch to UNLOCK. Check light off.
UPPER RUDDER NOT LOCKED	Upper rudder is not locked.	Normal below 140 KIAS. Above 140 KIAS, UPR RUDDER switch to LOCK. Check light off.

Figure 3-7, Sheet 3

ANNUNCIATOR INDICATIONS

LIGHT	CONDITION	USUAL PILOT RESPONSE
HYD QTY LOW (MC)	One or more hydraulic reservoir(s) quantity is less than one gallon.	Check hydraulic quantities. Shutoff pumps in affected system. If fluid loss continues, SHUTDOWN ENGINE.
SLAT DISAGREE (MC)	Disagreement between slat position and control handle position. (15-second delay on MASTER CAUTION light.)	Reposition slat control handle to last position of slat symmetry. If slat asymmetry remains, observe slat extended airspeed limit and land with zero flaps.
NO. 1 ENGINE START VALVE OPEN (typical 4 places)	Respective engine pneumatic starter is open 5 degrees or more.	Normal for starting. If light stays on after start, SHUTDOWN ENGINE.
NO. 1 THRUST REV PRESS (MC) (typical 4 places)	1. Respective thrust reverser selected and electric valve open. (No MASTER CAUTION.)	1. Normal for thrust reversing.
	2. Respective reverser electric valve open without selection (with MASTER CAUTION).	2. Select idle power, check reverser lever stowed.
NO. 1 ENG OIL PRESS LOW (MC) (typical 4 places)	Respective engine oil pressure is below approximately 35 psi.	Check oil pressure. If below 35 psi, SHUTDOWN ENGINE. If between 35 and 40 psi, check temperature and quantity. If normal, continue ops at reduced thrust. If abnormal, SHUTDOWN ENGINE.
NO. 1 ENG OIL FILTER ΔP (MC) (typical 4 places)	Differential pressure across main oil filter is 35 psi or above.	Reduce thrust. If light goes off, continue ops at reduced thrust. If light remains on, SHUTDOWN ENGINE.
NO. 1 HYD SYS TEMP HI (MC) (typical 4 places)	Respective engine driven pump manifold temperature exceeds approximately 120°C.	Shut down respective system. After cooling, system may be turned on, but monitor for indications of malfunction.
PITOT HEAT INOP (MC)	Failure of one or more of the PILOT, COPILOT, AUX 1 or AUX 2 pitot heaters.	Normal when system is off. Advisory for failure mode.

Figure 3-7, Sheet 4

ANNUNCIATOR INDICATIONS

LIGHT	CONDITION	USUAL PILOT RESPONSE
DOOR NOT LOCKED (MC)	One or more aircraft doors is not locked (specific door annunciated on FTE panel).	Normal for door operation. If abnormal indication occurs, reduce pressurization DP. Remain clear of suspect door inflight.
DC EMER BUS (MW)	Power not being supplied to DC Emergency Bus or EMER BUS SENSING circuit breaker (C-18) open.	Check EMER BUS FEED CB's (AP-11, AR-11) and EMER BUS SENSING CB (C-18). If not open, select EMER PWR on. If bus feed breakers open, reset AP-11 one time only.
CABIN PRESS (MW)	Cabin altitude exceeds approximately 10,000 feet.	Check pressurization on. If gradual climb, verify pneumatics on, attempt manual operation. If rapid loss, check for duct failure indications, door open or erratic operation of NO. 3 engine. Descend to altitude not requiring oxygen.
DUCT FAIL (MW)	Temperature (internal) of wing leading edge area exceeds approximately 126°C.	Turn off pneumatics. Verify zero pneumatic pressure and light off. If not, SHUTDOWN NO. 3 ENGINE.
BATT BUS (MW)	Power not being supplied to Battery Bus or BATTERY BUS SENSING circuit breaker (B-25) open.	Check BATTERY BUS SENSING CB (B-25). Check battery on and test annunciator lights. If test fails, select EMER PWR on. If battery bus still dead, land ASAP.
	MISCELLANEOUS SYSTEM ANNUNCIATORS	
LOOP (A-B)	Respective engine fire sensing loop activated by fire/overheat condition or by system test.	If LOOPS (A-B) selector switch is in BOTH and one loop light comes on, verify system continuity.
AIR REFUEL VALVE OPEN (MC) (Acft No. 2 only)	Air refueling isolation valve and/or drain valve open.	Advisory
FILL VALVE OPEN	Respective fuel tank fill valve open.	Advisory
REFUEL VALVE OPEN (MC)	Refuel valve open (ground operation).	Advisory

Figure 3-7, Sheet 5

ANNUNCIATOR INDICATIONS

LIGHT	CONDITION	USUAL PILOT RESPONSE
X-FEED DISAGREE	Disagreement between crossfeed selector and valve position.	Normal during transit. If steady light occurs, check X-FEED VALVE CB's (C-5, 6, 7, 8). If CB not open, match selector with valve position. Monitor fuel balance if X-feed open.
PRESS LOW (MC)	Low inlet supply pressure to respective engine driven fuel pump.	Check applicable wing fuel tank pumps on. Check fuel pump circuit breakers (N-5, P-5, R-5, R-6, Z-5, AA-5, AB-5 and AB-6). Use crossfeed if necessary.
FUEL FILTER PRESS DROP (MC)	Respective engine fuel filter clogging. Suspect ice if fuel temperature low.	Check fuel temperature. Use fuel heat as necessary, monitor oil temperature limits.
ENG PUMP PRESS LOW (MC)	Respective engine driven pump output is less than approximately 1800 psi. (Light goes out at approximately 2200 psi.)	Check pressure and quantity gages. If quantity is normal but pressure is low, turn on respective aux pump and monitor system operation.
NO. 1 THR REV NOT LKD (typical 4 places)	Respective thrust reverser actuator lock not in locked position.	Normal during use. If abnormal, check that reverser lever is full down. Cycle reverser as necessary.
NO. 1 THR REV EXTD (typical 4 places)	Respective thrust reverser is fully extended.	Normal during use. If abnormal, reduce airspeed and position throttle and thrust reverser lever to forward idle thrust.
REVERSER LMTR INOP	The reverser flight stops are not in the correct flight position.	Inflight, manually limit reverse thrust to near idle.
REVERSER LIMITED	The reverser flight stops have not retracted and landing gear is down.	Reverser operation will be limited to approximately idle. Advisory
SLAT EXTEND	Both inboard slats fully extended.	Advisory
TACAN	NAV selector switch is in TACAN. HSI course and MILES are TACAN.	Advisory
ILS	NAV selector switch is in ILS. HSI course is ILS LOC, MILES is TACAN DME.	Advisory

Figure 3-7, Sheet 6

ANNUNCIATOR INDICATIONS

LIGHT	CONDITION	USUAL PILOT RESPONSE
TALAR	NAV selector switch is in TALAR. HSI course is TALAR LOC, MILES is TACAN DME.	Advisory
FLARE (lights on glareshield, ADI's and legend in VAM displays)	Indicates decision height on selected radio altimeter has been reached, with autoflare armed.	Secondary decision height (DH) indications. Pilot should manually retract DLC and flare.
FIRE SHUTOFF HANDLE LIGHTS (four places)	Fire/Overheat condition sensed in respective engine area or system test.	Carry out appropriate engine fire procedures.
FUEL LEVER CAUTION LIGHTS (four places)	1. An engine fire/overheat signal. 2. An engine shutdown with the fire shutoff handle and the fuel lever on. 3. System test	Advisory that respective engine fuel lever is on with a fire signal present or with the fire shutoff handle pulled.

Figure 3-7, Sheet 7

SECTION IV

CREW DUTIES

TABLE OF CONTENTS

INTRODUCTION

This section contains only those duties and procedures that are in addition to the Normal Procedures, Section II and Emergency Procedures, Section III. The duties listed in this section are only a part of those that may be required of the crewmembers. Crewmembers are responsible for operation of the equipment pertaining to their duties covered in other sections of the book in order that the mission may be carried out safely and with dispatch.

INTERPHONE PROCEDURES AND PHRASEOLOGY

Use of the interphone in the flight compartment will be at the pilot's discretion. Circumstances will dictate when the transmission of verbal instructions and/or responses are best satisfied with or without the use of interphone. To implement standard interphone procedures and phraseology, the following will be used during ground and flight operation.

Nomenclature

In the interest of standardization of crewmember identification, the following terms will be used:

1. Pilot: The occupant of the left seat in the cockpit, regardless of his position on the crew.

2. Copilot: The occupant of the right seat in the cockpit, regardless of his position on the crew.

NOTE

Frequently, during training, the instructor pilot or the pilot in command will occupy the right seat; regardless, he will be referred to as copilot.

3. Flight Test Engineer: The crewmember seated at the flight test engineer's station.

4. Additional Crew Member (ACM) The crewmember seated at the ACM station.

5. Loadmaster (L/M): The crewmember designated to accomplish loadmaster duties. If the cargo compartment is not being utilized for testing and evaluation, a loadmaster will not be designated.

Identification

The crewmember or position being called will be identified first, followed by the identification of the crewmember making the call. For example: "Loadmaster from copilot".

Sequence

Crewmembers will always state the unit to be actuated first, and then follow with the action to be taken, for example: "Gear - UP; Flaps - RETRACT".

Terminology

In the interest of clarity and comprehension, the terminology contained in this publication will be used as applicable.

Acknowledgement

Prior to execution, every command will be repeated by the receiver to ensure understanding of the transmission. An exception to the above rule may be made during the final approach on a GCA let down; here, the pilot may direct the other crewmembers not to acknowledge his commands in order to prevent interphone transmissions. After initial contact has been established, it is not necessary during subsequent transmission (in the same conversation) to identify the crewmember being called.

Hot Mic Procedure

The use of HOT MIC, TALK and LISTEN will be coordinated by the pilot.

Hot mic will be used for takeoff and landing. The following procedures apply:

1. HOT MIC will be selected from "before takeoff" checklist to "after takeoff, climb" checklist and from the "before landing" checklist to the "after landing" check list.

2. Both pilots should have their HOT MIC, TALK and LISTEN buttons pulled out. The crew, other than the pilot and copilot, will use normal interphone procedures during this portion of the flight.

PILOT IN COMMAND

The pilot in command shall be designated on the flight test card. He shall be in command of the aircraft regardless of his crew station. He is responsible for proper inspection, preparation and for the safe and orderly conduct of the flight.

COPILOT

The copilot will assist the pilot as directed to accomplish the assigned flight. He must be thoroughly familiar with the Emergency Procedures as they pertain to the aircraft and to his duties relative to the briefed flight test cards.

FLIGHT TEST ENGINEER

The flight test engineer will perform inspections as required and report to the pilot the condition of the flight test equipment as it pertains to the flight. He will brief the crew on the Flight Test Cards for each flight. He will complete the TOLD card and brief the pilots. He will present the current weight and balance for the specific test flight. Weight and balance changes to be experienced during the flight, such as aerial delivery tests, as well as any flight conditons which approach the current weight and balance limits will be briefed prior to flight. In-flight, weight and balance configuration will be monitored and shifts of ballast or cargo as required to maintain test CG limits will be directed by him. He will operate and monitor various test systems to ensure the successful completion of the flight. He must be thoroughly familiar with the Emergency Procedures as they pertain to the aircraft and to his duties.

ADDITIONAL CREWMEMBER

The ACM will assist the crew with their duties and perform inspections as required as it pertains to the flight. In-flight, he will assist the crew as directed and perform the specific duties as assigned to the flight.

LOADMASTER

The loadmaster is responsible for the knowledge of and proper use of load equipment, the tiedown and restraint mechanism, cargo/troop aerial delivery systems, the cargo door and ramp system operation. He will be in the cargo compartment during the test and evaluaton of compartment airflow, parachute tow, simulated personnel air drop, heavy equipment extraction, LAPES, CDS and at other times as directed. Refer to McDonnell Douglas YC-15 Cargo/Troop Aerial Delivery Evaluation document for detail instructions and loadmaster duties. He must be thoroughly familiar with the Emergency Procedures as they pertain to the aircraft and his duties.

MINIMUM FLIGHT TEST CREW

Pilot, Copilot and Flight Test Engineer and additional crewmembers as required to complete the designated flight test.

SECTION V

OPERATING LIMITATIONS

TABLE OF CONTENTS

INTRODUCTION

This section contains design limitations on the basic aircraft and JT8D-17 engines (except where noted) that must be observed for safe and efficient operation of the engines and aircraft, however, until the aircraft envelope is expanded to these limits the Interim Flight Restrictions (IFR) apply. These limitations should be studied closely and if they are exceeded it should be noted on the appropriate form along with time interval and actual instrument reading.

MINIMUM FLIGHT TEST CREW REQUIREMENT

The minimum flight test crew will consist of a pilot, copilot and flight test engineer.

INSTRUMENT MARKINGS

(Refer to figure 5-5).

STARTING LIMITATIONS

Starter Duty Cycle is one minute ON, 30 seconds OFF, one minute ON and one minute OFF. The cycle may be repeated as often as required.

Exhaust Gas Temperature: if the exhaust gas temperature increases to 550°C (momentary), discontinue start and record hot start on appropriate form. An overtemperature inspection must be accomplished before a restart is attempted.

ENGINE LIMITATIONS

(Refer to Figure 5-1.)

ENGINE RATINGS AND THROTTLE SETTINGS

(Refer to Section I Engine Ratings.)

ENGINE OIL PRESSURE LIMITS

(Refer to Figure 5-1.)

ENGINE IGNITION

The normal duty cycle for the override (OVRD) position is 2 minutes ON, 3 minutes OFF, 2 minutes ON and 23 minutes OFF.

FUEL GRADE AND LIMITS

(Refer to Figure 5-1.)

FUEL MANAGEMENT AND LOADING

Each fuel tank feeds directly to the related engine. The tank-to-engine fuel feedlines are interconnected by a crossfeed manifold with electrically operated crossfeed shutoff valves so that any engine may be fed from any tank. The engines will suction feed from their related tank.

WARNING

Engine fuel starvation could occur when lateral acceleration is greater than one ball in the turn and slip indicator for a sustained time. X-FEED operation to all engines whenever this lateral acceleration is continued for more than 4 minutes duration will preclude this fuel starvation. Before terminating X-FEED operation, the aircraft must be flown equal to or less than cruise power without lateral acceleration for a minimum of 15 minutes.

All fuel boost pumps should be ON for all flight conditions, irregardless of the fact that one boost pump is capable of supplying two engines at takeoff rated power.

Fuel tanks should be fueled in the following order: inboards, outboards then fuselage tanks (when installed).

FUEL HEAT

Whenever the fuel temperature is 10°C or below, move the fuel heat switch for the affected engine momentarily to ON position. Positioning the fuel heat switch to the ON position energizes a one minute timer which electrically opens the respective bleed air valve.

WARNING

To ensure maximum performance in the event of engine failure, do not use fuel heat during takeoff. Fuel heat utilizes 13th stage bleed air and results in thrust loss of operating engine.

THRUST REVERSERS

In flight, only inboard thrust reversers may be used. Do not exceed 350 knots/mach 0.76. Reverse power may be used up to the inflight thrust reverse stops but do not exceed 1.4 EPR. Before stowing reversers, reduce airspeed to 300 knots or below.

NOTE

The reversers may not stow at speed greater than 330 knots. In flight thrust reversers may be used up to VL/ML in an emergency.

Ground operations, reverse thrust may be used up to the ground reverse stops, but do not exceed maximum continuous thrust (MCT).

WEIGHT LIMITATIONS

The weight limitations when used in conjunction with the other limitations in this section will maintain the loads imposed on the airplane to 80 percent of the design load levels.

BASIC WEIGHTS POUNDS

Operating Empty Weight
(No Test Equipment)
Aircraft 1--(CFM-56)----116,269
Aircraft 2--(JT8D-17)---105,902
Aircraft 2--(-209)------106,807

Operating Empty Weight
(With Test Equipment)
Aircraft 1--(CFM-56)----127,865
Aircraft 2--(JT8D-17)---115,185
Aircraft 2--(-209)------112,439

Maximum Fuel Capacity
Aircraft 1---------------75,700
Aircraft 2---------------54,700
(at 6.76 pounds per gallon)

STOL MODE - 2.4g CRUISE

Maximum Takeoff
and Landing (14 FPS)
Aircraft 1--(CFM-56)----154,568
Aircraft 2--(JT8D-17)---154,568
Aircraft 2--(-209)------154,568
(12 FPS)

Maximum Zero Fuel
Aircraft 1--(CFM-56)----143,270
Aircraft 2--(JT8D-17)---133,000
Aircraft 2--(-209)------133,807

CTOL MODE - CRUISE

Maximum Takeoff----------216,680

Maximum Landing (6 FPS)--216,680

Maximum Landing (10 FPS)-190,965

Maximum Zero Fuel
Aircraft 1--(CFM-56)----178,270
Aircraft 2--(JT8D-17)---168,000
Aircraft 2--(-209)------168,807

MAXIMUM LATERAL UNBALANCE

Maximum asymmetrical fuel loading between wings for takeoff, inflight and landing configuration should not exceed 2000 pounds; including an engine inoperative operation.

CENTER OF GRAVITY LIMITATIONS

The location of the center of gravity for any gross weight configuration, determined from the ballast request form and the weight and balance data, must fall within the weight and balance center of gravity envelope (figure 5-2).

WIND GUST LIMITATION

The aircraft has been designed to withstand 70 knot gusts from any direction in the horizontal plane.

PRESSURIZATION LIMITATIONS

Max Allowable Differential Pres------------------7.15 PSID

Maximum Emergency Pressure Relief----7.15 PSID(+)

Max Allowable Negative Pres-------0.8 PSID(-)

ELECTRICAL LIMITATIONS

(Refer to Figure 5-3.)

STRUCTURAL DESIGN AND OPERATING SPEEDS

(Refer to Figure 5-4).

Configuration A/S MACH

Slats/DLE--------235 KEAS, .50 M

14° Flaps--------200 KEAS, .40 M

23° Flaps--------190 KEAS, .40 M

33° Flaps--------156 KEAS, .40 M

45° Flaps--------116 KEAS, .40 M

Landing Gear Extended--------200 KEAS, .50 M

Landing Gear Operation-------200 KEAS, .40 M

Troop Jump Door Operation/Open--150 KEAS, .40 M

Ramp/Cargo Door Operation-------200 KEAS, .44 M (Toes Removed)

Ramp Only Open/------VH-----MH Operation (Cargo Door Latched Closed, Toes Removed)

Aerial Delivery, Clean-----------200 KEAS, .50 M

Aerial Delivery, 20°-35° Flaps---130 KEAS, .40 M

Aerial Delivery, Flaps 33°-------100 KEAS, .40 M

Clearview Window Operation--------------250 KEAS

Spoilers-Lateral Control---------235 KEAS, .50 M

Spoilers - DLC----------200 KEAS

Spoilers, Ground, Inflight Extension-----180 KEAS

The aircraft may be flown to VL/ML except when hydraulic System #1 or 3 is inoperative and cannot be reinstated, then 350 knots/Mach 0.76 (VH/MH) is the limiting airspeed.

THRUST REVERSER LIMITS A/S MACH

Maximum Deploying
or Deployed---350 knots 0.76

Maximum
Stowing-------300 knots

ENGINE OIL MINIMUM QUANTITY:

Prior to
engine start-------------5 qts.

Engine stabilized
at idle------------------8 qts.

Engine may be operated as long as oil pressure and temperature limits are not exceeded.

MANEUVER LOAD LIMITS

These maneuver load limitations represent 80 percent of design load factors.

CONFIG	WEIGHT	g	MAX V
Clean	154,568	+1.8/0.2	VH
	154,568	+2.4/0.0	VH
Flaps/Slats Extended	All	+1.6/0.2	VLF
Aerial Delivery	All	+1.6/0.2	---

TIRE SPEED LIMITATION

225 MPH (195 knots) on paved surface at recommended pressure.

TIRE PRESSURES

	Rwy Cond	PSI
Nose -	Paved	112
	Unprepared	80
Main -	Paved	145
	Unprepared	90

FUSE PLUG TEMPERATURE

200°C (390°F)

BRAKE TEMPERATURE

Maximum brake temperature for 100% (Rejected Takeoff) capability: CTOL no reverse thrust 190°C. Reverse thrust; CTOL 307°C; STOL 363°C.

ENGINE OPERATING LIMITS

OPERATING CONDITIONS	OPERATING LIMITS					
	TIME LIMIT	MAX EGT (°C)	MIN OIL[1] PRESS. (PSIG)	OIL[2] TEMP (°C)	THRUST SL (STD)	MAX ROTOR SPEEDS
TAKEOFF	5 MINUTES	650	40	130	16,000[3]	N_1 N_2
MCT	CONTINUOUS	610	35	130		8,795 RPM = 102.4% 12,245 RPM = 100%
IDLE	CONTINUOUS	480/420[5]	35	130	–	
STARTING	MOMENTARY	550/650[4]	35	130	–	
ACCEL	2 MINUTES	660	35	130	–	

(1) NORMAL OIL PRESSURE IS 40-55 PSIG. PRESSURES BETWEEN 35-40 PSIG ARE PERMISSIBLE FOR SUSTAINING FLIGHT AT REDUCED POWER SETTINGS; PRESSURES BELOW 35 PSIG ARE UNSAFE AND THE ENGINE WILL BE SHUT DOWN.

(2) OIL TEMPERATURE IN EXCESS OF 130°C, BUT NOT OVER 165°C, IS ALLOWED FOR A MAXIMUM OF 15 MINUTES.

(3) TAKEOFF RATED THRUST OF THE JT8D-17 ENGINE IS AVAILABLE UP TO AN AMBIENT TEMPERATURE OF 29°C (84°F).

(4) MAXIMUM 550°C FOR GROUND AND 650°C FOR INFLIGHT STARTS. THESE TEMPERATURES ARE LIMITED TO MOMENTARY FOR STARTING. IF MAXIMUM ALLOWABLE STARTING EGT IS EXCEEDED, THE ENGINE SHALL BE SHUT DOWN AND INSPECTED.

(5) 480°C APPLIES WHEN AIRBLEED OR POWER EXTRACTION IS BEING USED. WHEN NO EXTRACTION IS USED, 420°C APPLIES.

FUEL GRADE AND LIMITS

FUEL TYPE	GRADE	NATO SYMBOL	U.S. MIL SPEC	SPECIFIC GRAVITY (MAX-MIN AT 60°F)	MINIMUM FUEL TEMPERATURE (°C)
WIDE CUT TURBINE FUEL	JP-4	F-40	MIL-J-5624	0.802 – 0.721	–54[1]
	COMMERCIAL JET B			0.802 – 0.751	–45
KEROSENE	JP-5	F-44	MIL-J-5624	0.845 – 0.788	–42
	JP-5B	F-42		0.845 – 0.788	–34
	COMMERCIAL JET A-1	F-34		0.829 – 0.775	–44
	COMMERCIAL JET A	F-30		0.829 – 0.775	–34

(1) AVOID FLYING AT ALTITUDES WHERE INDICATED FUEL TEMPERATURE IS LESS THAN THE MINIMUM.

[illegible]

Figure 5-1

WEIGHT AND BALANCE LIMIT

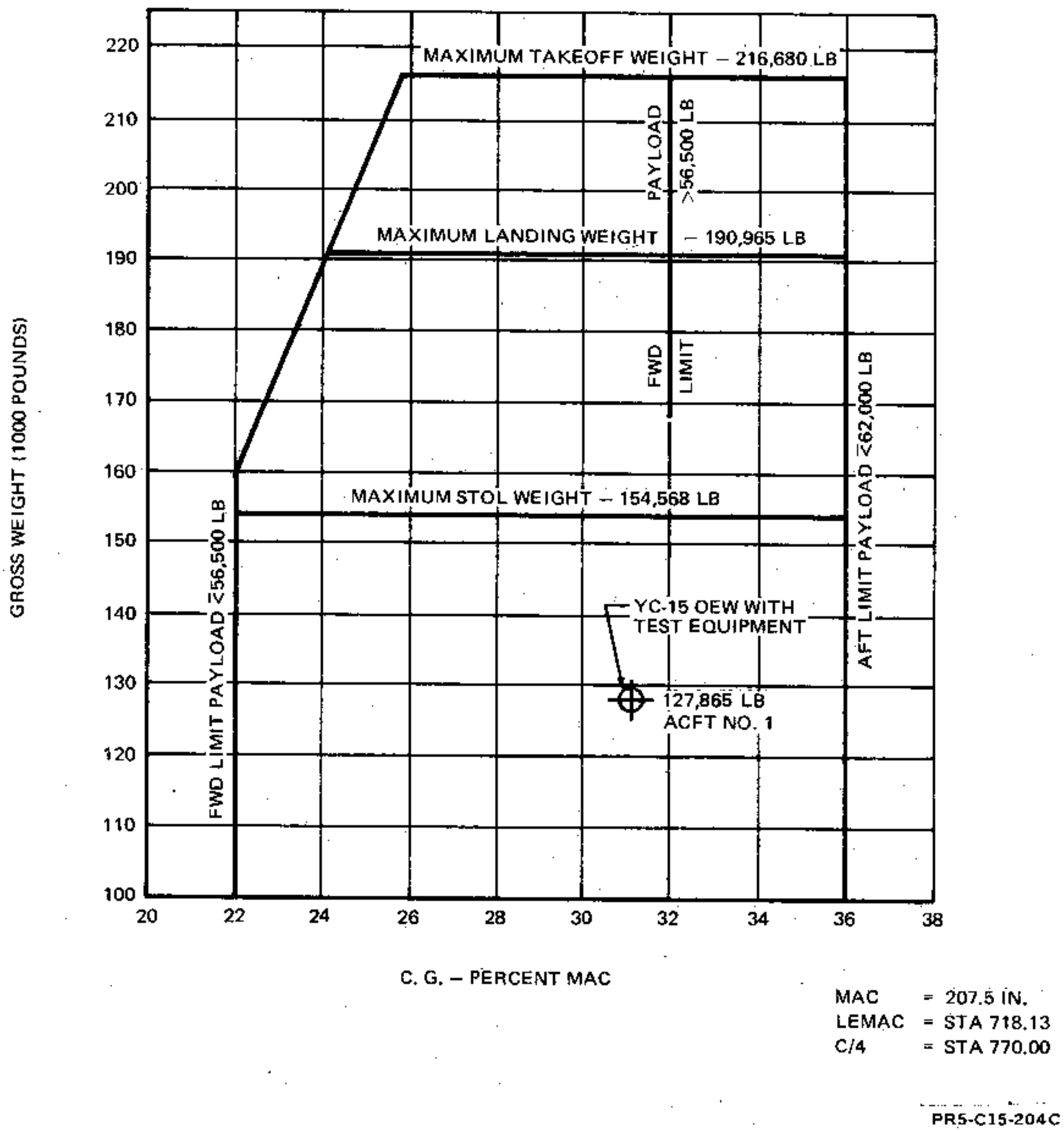


Figure 5-2

ELECTRICAL LIMITATIONS

GENERAL

THE VALUES SHOWN IN THE NORMAL COLUMN ARE NORMAL OPERATING RANGES. INDICATIONS OUTSIDE THE NORMAL RANGE INDICATE POSSIBLE SYSTEM ABNORMALITIES.

LIMITS SHOWN IN THE ALLOWABLE COLUMN SHOULD NOT BE EXCEEDED, AND SUSTAINED OPERATION AT THESE LIMITS IS NOT RECOMMENDED.

CAUTION

ANY CONDITION THAT CAUSES ANY INDICATION IN ALLOWABLE COLUMN, OTHER THAN WITHIN NORMAL RANGE, SHOULD BE CORRECTED AT EARLIEST OPPORTUNITY.

CONDITION OR ITEM		NORMAL MINIMUM	NORMAL MAXIMUM	ALLOWABLE MINIMUM	ALLOWABLE MAXIMUM
DC LOADMETERS	ALL	MAXIMUM DIFFERENCE BETWEEN THE TWO INDICATIONS SHOULD NOT EXCEED 0.3		0	1.0
RIGHT OR LEFT DC BUS		24 VDC	28 VDC	22 VDC	30 VDC
ENGINE GENERATORS	VOLTAGE FREQUENCY	112 VAC 396 Hz	118 VAC 404 Hz	107 VAC 380 Hz	123 VAC 420 Hz
EXTERNAL POWER	VOLTAGE FREQUENCY	112 VAC 396 Hz	118 VAC 404 Hz	107 VAC 380 Hz	123 VAC 420 Hz
AC LOADMETERS OF OPERATING GENERATORS NOTE: GENERATOR OVERLOAD RATINGS FOR SHORT TIME OPERATION ARE: a. 1.5 FOR 5 MINUTES b. THE OVERLOAD RATING OF THE GENERATOR IS 2.0 FOR 5 SECONDS		OVER 0	UNDER 1.0	0	1.0
BATTERY VOLTAGE					
a. NO OTHER POWER AIRCRAFT NO LOAD ON BATTERY		NOT LESS THAN 27 VOLTS		NOT LESS THAN 27 VOLTS	
b. BATTERY CHARGING NOTE: BATTERY VOLTAGE MAY BE FLUCTUATING, DEPENDING ON MODE OF OPERATION OF THE BATTERY CHARGER		30 VOLTS NOTE: BATTERY CHARGING VOLTAGES AT AMBIENT TEMPERATURE OF 70°F.	33 VOLTS	26 VOLTS NOTE: ALLOWABLE BATTERY CHARGING VOLTAGES AT AMBIENT TEMPERATURE EXTREMES OF 165 TO 0°F.	39 VOLTS
c. EMERGENCY POWER SWITCH IN ON POSITION		NOT LESS THAN 26 VOLTS		NOT LESS THAN 22 VOLTS	
BATTERY AMPERES					
a. BATTERY CHARGING		0 AMPERES	65 AMPERES		
b. EMERGENCY POWER SWITCH IN ON POSITION			−35 AMPERES		

PR5-C15-205 B

Figure 5-3

STRUCTURAL DESIGN AND OPERATING SPEEDS

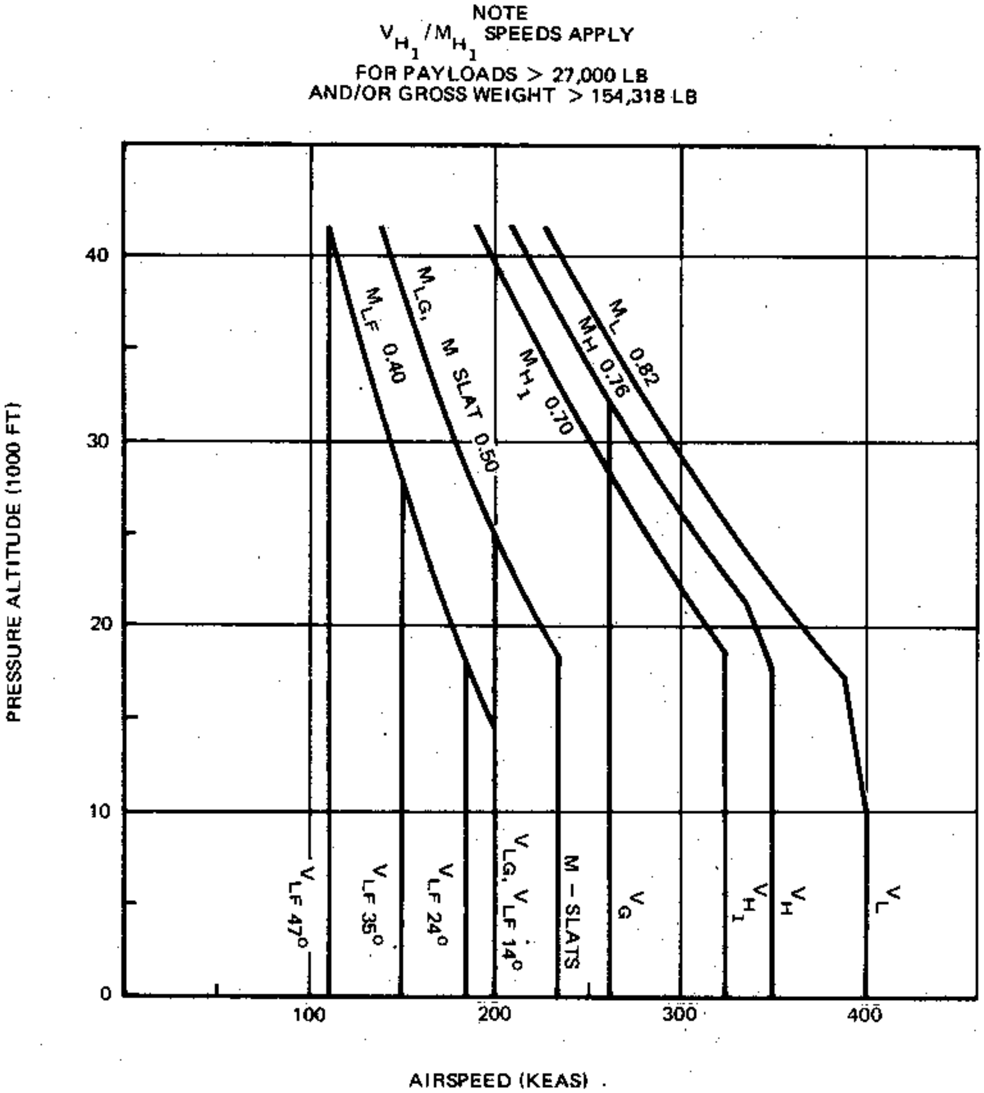
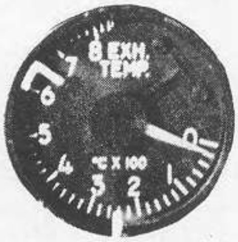


Figure 5-4

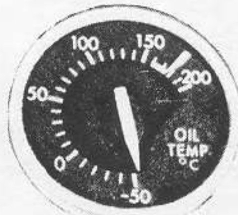
INSTRUMENT LIMIT MARKINGS

ENGINE



ENGINE EXHAUST TEMPERATURE INDICATOR

- 610° TO 650°C – CAUTION
- 660° – MAXIMUM

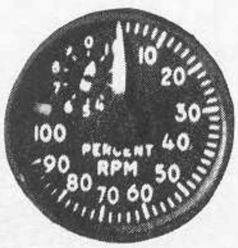


ENGINE OIL-TEMPERATURE INDICATOR

- 130° TO 165°C – CAUTION
- 180°C – MAXIMUM

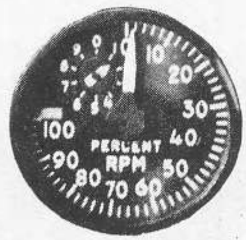
ENGINE OIL PRESSURE INDICATOR

- 40 TO 55 PSI – NORMAL
- 35 TO 40 PSI – CAUTION
- 35 PSI – MINIMUM



ENGINE TACHOMETER N_1

- 102.4% – MAXIMUM



ENGINE TACHOMETER N_2

- 100.0% – MAXIMUM

FREQUENCY METER

- 380 TO 396 – CAUTION
- 404 TO 420 Htz – CAUTION

PR5-C15-208A

Figure 5-5

SECTION VI

FLIGHT CHARACTERISTICS

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STALLS

Normal Stall and Recovery

Stall Characteristics - SCAS OFF

There is generally no aerodynamic stall warning in the YC-15. Buffet onset, when it occurs, is usually coincident with the stall. Power-off stalls are characterized by light buffet, G-break or slight wing heaviness or by some combination of these characteristics. Power-on stalls occur at higher pitch attitudes and angles of attack, but have essentially the same characteristics as power-off stalls except with full landing flaps where boom angles of attack in excess of 35 degrees have been achieved at maximum continuous thrust without defining a stall condition or observing any stall characteristics. There is no strong tendency for wing drop (outboard wing stall) nor loss of lateral control at the stall. Stability with respect to angle of attack varies from slightly positive to slightly negative with center-of-gravity variation. No appreciable pitch-up or pitch-down occurs at or near the stall. There is no loss of longitudinal or directional control at the stall. There is no dihedral effect at stall angles of attack.

Stall Characteristics - SCAS ON

The SCAS tends to minimize the intensity of stall characteristics but does not alter them significantly. Pitch Rate Command causes the aircraft to behave as through it were neutrally stable, thus enhancing slightly the stall characteristics where the basic aircraft exhibits mild angle of attack instability at aft CG, degrading slighly the characteristics where the basic airplane has a natural G-break and nose drop at stall. Pitch Attitude Command generally enhances the stall entry characteristics by creating the effect of strongly positive longitudinal static stability. Roll SCAS (CWS) and Yaw SCAS (TURB) have their greatest effect during stall recovery by damping the directional excursions occasionally experienced in the basic aircraft. At no time does the SCAS mask the basic aircraft's stall characteristics, but it can delay recognition of those characteristics because of its minimizing effects.

Stall Recognition

The aircraft's flight controls are extremely effective at and beyond stall angles of attack, so the pilot always has positive control of the aircraft's attitude. This excellent control response could be detrimental though in that the plane "feels good", i.e., responds briskly to control inputs, right up to and beyond the stall. There is no mushiness of the controls, no lack of aircraft response and seldom any buffet, so stick shakers are installed as stall warning devices. At stick shaker, the aircraft is approximately 10 degrees from stall angle of attack. Stall recovery procedures should be initiated at stick shaker onset. At this point, the indicated airspeed does not appear alarmingly low and simply adding thrust is usually all that is required to reduce the angle of attack below the stick shaker threshold. If the angle of attack continues to be increased, either the aircraft will stall or the SSRS will activate first. The SSRS is designed to augment the aircraft's natural stall recognition characteristics or, in a few cases, to substitute as the primary stall recognition characteristic where no natural characteristics exist or have been defined. At SSRS actuation, the indicated airspeed may still not appear alarmingly low but at these angles of attack, the angle of attack can increase 3 to 5 degrees for each one knot decrease in airspeed. If stall entry has progressed to the point of actual stall/SSRS, considerable altitude may be lost during the recovery, particularly in the landing flap configurations and the pilot must execute positive receovery procedures. In the interests of simplicity and safety, this stall receovery procedure will normally be initiated at stick shaker onset.

Stall Recovery

Stall recovery is normally initiated at stick shaker. Stall angle of attack increased with thrust so application of thrust and nose down elevator is particularly effective in stall prevention and receovery. The normal stall receovery and prevention procedure consists of:

a. Throttles to MCT - Thrust tends to cause a nose down pitching moment in the aircraft as well as increasing the stall angle of attack.

b. Reduce Angle of Attack - Simultaneously lower the aircraft nose to achieve a true alpha of 7-9° (10-12° boom alpha) while leveling the wings. This may require a push force of up to 40 or 50 pounds, depending on configuration, SCAS and maximum alpha attained prior to recovery. Maintain target angle of attack throughout recovery.

c. Reset Flaps as Required - If flaps are less than 23°, maintain configuration. If flaps are greater than 23°, select 23° configuration and verify flap retraction.

d. Pullout at Recovery Angle of Attack - A full stall with landing flaps can result in a -10 to -20 degree pitch attitude to decrease alpha to 7-9° true and a sink rate of 3000+ FPM. Airspeed will increase rapidly as the nose is lowered and flaps are retracted. DISREGARD IT except for flap limit speeds. ANGLE OF ATTACK IS THE SOLE INDICATION OF STALL RECOVERY PROGRESS. Rotate at a rate that will maintain the desired recovery alpha until a positive rate of climb is achieved. Do not overcontrol the aircraft in an attempt to immediately correct attitude deviations. The flight controls are extremely effective and large lateral-directional control inputs at stall or during recovery should be avoided, particularly SCAS off. During stall, the pilot has full control of aircraft attitude but has temporarily lost control of the aircraft's flight path. The angle of attack recovery method permits the pilot to quickly regain control of that flight path and recover with minimum altitude loss. This recovery technique is trivial in cruise configurations and generally so in recoveries from stick shaker onset. But, it is critically important in the landing flap configuration where initiated at high angles of attack and low altitude.

To Summarize:

a. SELECT MAX POWER
b. LOWER THE NOSE TO REDUCE ALPHA TO TARGET
c. RESET FLAPS AS REQUIRED
d. RECOVER ON TARGET ALPHA
e. DON'T OVERCONTROL

Deep Stalls

Although there should be no difficulty in preventing locked-in deep stalls by normal stall recovery and prevention procedure, deep stalls are possible. Deep stalls are characterized by excessive sink rates at relatively low air speeds and flat pitch attitudes (angles of attack around 45 degrees).

Positive deep stall recovery can be accomplished by the following technique:

a. Retard throttles - at very high angles of attack thrust tends to cause a nose-up pitching moment in contrast to the nose-down moment at normal stall conditions.

b. Retract flaps to at least the Go-Around Gate (23°) - to increase available nose-down control.

c. Turn SCAS off - to provide positive control of all surfaces.

d. Apply full nose-down elevator.

If this procedure does not provide prompt recovery and sufficient altitude exists, initiate a pitching oscillation by alternate nose- down and nose-up elevator to build up sufficient nose down angular momentun to accomplish recovery. Remember, however, that angular motions in response to controls will be faily sluggish.

Another potential deep stall recovery consists of building up large roll oscillations in which angle of attack is traded for sideslip angle. This is a last resort, however, because it may not be possible to build up sufficiently large, rapid roll oscillations in such a large airplane at the low speeds involved.

SPINS

Spins are a prohibited maneuver and will not be tested during the flight test program. If a spin is entered inadvertently, it is anticipated that a normal recovery for multi-engine aircraft will be effective:

a. Release all control forces.

b. Reduce power to idle.

c. Turn SCAS off.

d. Slats extended and flaps retracted.

e. Apply full rudder against the spin direction and hold until rotation stops. Hold elevators and ailerons neutral.

f.--When rotation stops, hold forward elevator control and rapidly return rudder to neutral.

g. Perform dive recovery.

APPENDIX II

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DIGITAL DATA SYSTEM

The Douglas Digital Data System (DDS) is the primary method of data acquisition on the YC-15. Aircraft #1 has two systems and Aircraft #2 has one system. Each system simultaneously receives more than 400 inputs from various sources throughout the aircraft. All inputs are coded and recorded on an onboard magetic tape. If required, one system may also be transmitted by telemetry (TM) to a ground station which provides "real time" monitoring and analysis by ground based personnel. DDS parameters may also be monitored onboard in data system "counts". The digital data system basically consists of a data system console, analog and digital patch panels, displays (time and data), two TM transmitters and antennas, controls and associated circuitry.

Data System Console

The data system console (Figure A2-1), located in the left forward cargo area, consists of electronic module racks and a magnetic tape recorder. The forward rack contains a display module, two signal conditioning units and a digitizer. An aft rack on aircraft #1 contains a display module, signal conditioning units and digitizer for the second data system which is identical in appearance to the forward rack shown. The display module (Figure A2-2) contains a four digit data readout (3 numbers and + or - sign), a data channel selector and a six digit time readout. The data channel selector permits selection of any data channel on the respective data system for display. The selected channel is displayed in "counts" on the data readout. A calibration curve is required to translate "counts" into engineering units (e.g., PSI, feet, degrees, pounds, etc.). Two momentary pushbuttons are located below the data readout. Pressing the ZERO pushbutton will cause the data readout to indicate all zeroes. Pressing the LAMP pushbutton will test the data readout lamps and should indicate a plus sign and three eights (+888). A two position toggle switch labeled 1 SPS and RUN is also located below the CHAN SEL. The 1 SPS position allows the data readout to update only once per second. The RUN position will allow the display to update at the same rate at which the DDS is operating (the maximum DDS update rate is 400 samples per second). The time readout shows the DDS time of day (TOD) reference in hours, minutes and seconds using the 24 hour clock. The signal conditioning units receive analog voltage inputs from various instrumentation devices such as strain gages, accelerometers, thermocouples, surface position potentiometers, etc. These volgate input signals are converted within the signal conditioning units to voltage levels compatible with the digitizer. The digitizer receives these conditioned analog inputs and converts them to digital signals. It also receives direct digital inputs from various digital instrumentation devices such as the digital air data computers (DADC). The digitizer then arranges these data into a serial digital output for recording on the magnetic tape, transmission to the ground station and display on the onboard readouts. The magetic tape recorder is mounted on top of the second module rack. The rack contains a tape control module, a 5 volt power supply for strain gage instrumentation, a logic drawer (DDS remote control panel) and a time code generator.

DDS Analog and Digital Patch Panels

The patch panels are located outboard of the data system console on the cargo compartment sidewall. There are five panel sections; four large analog panels and a smaller digital panel. All instrumentation wiring to be recorded on the DDS is terminated at these patch panels. Wiring for each DDS channel is then connected or "patched" on these panels to the desired parameters recorded on the DDS.

DDS Displays

Two DDS display units are located in the flight compartment and one for each system on the data system console, discussed previously. One flight compartment display is located on the pilot's seat back for use by the flight test engineer and the other is located on the center of the glareshield. The FTE's display consists of a data readout, a data channel selector and a time readout. Its use is identical to the data system console display. The glareshield display, however, consists of a data readout and a time readout only. The data readout on this display is slaved to the FTE's and shows identical and simultaneous readings. For Aircraft #1, the FTE may select either of the data systems for display on the flight compartment readouts.

Telemetry System

Two redundant telemetry (TM) transmitters and antennas (Figure A2-8) are installed on the aircraft. The upper unit is located on the ceiling of the forward cargo area and the lower unit is located below the cargo floor in the aft cargo area. The two TM antennas are mounted on the fuselage exterior near their respective transmitters. The TM transmitters are controlled through the TM section of the flight test engineer's control panel. On Aircraft #1, either one of the two data systems may be transmitted when selected by the FTE.

Digital Data System FTE Control Panel

The primary data system control is at the flight test engineer's control panel (Figure A2-3) located below the pilot's fixed window. This panel is used for control and monitoring of the DDS, the magnetic tape recorder and the TM system. The control panel consists of the following:

Master Run Switch

The MASTER run switch may be set to three positions: OFF (lever lock), STDBY and RUN. In the OFF position, all data recorders and cameras must be operated locally and the DDS will continue to display data and time but will not record onboard. In the STDBY position, auxiliary data recorders and cameras are optional and the DDS and the DDS magnetic tape operate at a fixed sample rate of 10 SPS (samples per second). In the RUN position all recorders and cameras which are ARMed operate at selected rates and the DDS and the DDS magnetic tape operate at the SAMPLE RATE selected by the FTE.

Correlate Switch

The CORREL switch is a momentary switch/light which when pressed its integral light comes on and initiates a correlation (event) mark in the DDS.

NOTE

When the PHOTOSCOPE CORRELATION system is ARMed on the FTE panel, the CORREL switch will actuate the manual photoscope correlation on the DDS and the photoscope window lights. A 1000 Hz tone will also be actuated if selected to a radio with the TONE SELECT switch on the FTE panel.

Calibrate Switch

The CALIB switch is a momentary switch/light which when pressed the integral light comes on and initiates a data calibration cycle on the DDS.

Sample Rate Pushbuttons

The SAMPLE RATE select pushbuttons consist of six mechanically ganged pushbutton switches labeled 10, INOP, 50, 100, 200 and 400 (SPS). When the desired sample rate pushbutton is pressed, the button will go on and remain on to indicate the switch is engaged. When the MASTER switch is selected to RUN, the DDS will sample data at the selected rate and the DDS tape will run at the appropriate speed.

Tape Monitor Indicator

The TAPE MONITOR indicator displays the speed at which the DDS is operating in samples per second and also, the following tape status messages: TAPE BREAK, END OF TAPE, REWIND, FAST FWD and STOP.

Tape Remaining Indicator

The TAPE REMAINING indicator is labeled E, 1/4, 1/2, 3/4 and F. It provides a visual indication of DDS tape remaining.

System Status Annunciators

The SYS 1 OK/SYS 2 OK annunciator will come on when the respective DDS is recording in normal operation. The NO DATA 1/NO DATA 2 annunciator will come on and the respective SYS 1 OK/SYS 2 OK annunciator will go off when the DDS is not recording properly. The last annunciator, OT1A, OT1B, OT2A and OT2B will come on to indicate an overtemperature (OT) in the respective signal conditioning unit and the SYS 1 OK/SYS 2 OK annunciator will go off.

Control Switch

The CONTROL switch is a dual action switch/light; FTE and REMOTE. When pressed the integral light will come on either FTE or REMOTE. When FTE is on, it provides control of the DDS from the FTE control panel. When REMOTE is on, it transfers DDS control to the data system console in the cargo area. In REMOTE, it can be used by ground maintenance or the FTE when changing DDS tapes inflight.

Telemetry Control Section

The telemetry (TM) control section provides a means of controlling and monitoring the TM trnasmitters. The XMTR PWR (transmitter power) switch/light is an ON-OFF switch. When pressed, the integral light will come on. When ON is on, both TM transmitters are energized. When OT (overtemperature) is on, both TM transmitters have been automatically de-energized. The DATA XMIT (data transmit) switch is a dual action switch/light; SYS 1 and SYS 2 (SYS 2 lens is blank on Aircraft No 2). When pressed, the integral light will come on either SYS 1 or SYS 2 (Blank on

A/C 2) to indicate the data system being transmitted. Aircraft No. 2 should be selected to SYS 1 at all times the TM system is ON.

NOTE

Clearance from the appropriate ground station must be obtained prior to actuation of the TM transmitters to avoid conflict with other aircraft utilizing the system.

Display Selector Switch (Aircraft No. 1 Only)

The DISPLAY selector switch located on the left side of the FTE control panel is a dual action switch/light; SYS 2 and SYS 1. When pressed, the integral light will come on either SYS 2 or SYS 1 to indicate the data system selected for display on the cockpit date readouts.

FLIGHT TEST EQUIPMENT ELECTRICAL POWER

Electrical power for flight test instrumentation and miscellaneous flight test items is distributed through the flight test Main Power Center (MPC) (Figure A2-4) located in the left forward cargo area. The MPC receives electrical power from the aircraft LEFT and RIGHT GEN busses and the LEFT 28 VAC bus. The LEFT GEN BUS provides 115 VAC, 3 phase power to the MPC through the TEST INSTM-2 circuit breakers (AH-, AJ- and AK-6). This input powers a transformer rectifier to supply 28 VDC power for flight test equipment. The TEST INSTM-1 circuit breakers (AH-, Aj- and AK-5) on the LEFT GEN BUS are provisions for future use and should be open and collared. The RIGHT GEN BUS provides 115 VAC, 3 phase power to the MPC through the TEST INSTM-3 circuit breakers (AL-, AM- and AN-5) for 115 VAC powered flight test equipment. The TEST INSTM-4 circuit breakers (AL-, AM- and AN-6) are provisions for future use and should be open and collared. The LEFT 28 VAC bus supplies 26 VAC, single phase power to the MPC through the TEST INSTM circuit breaker (M-21) for the 26 VAC powered flight test equipment. Figure A2-4 shows a typical flight test main power center panel, however, flight test electrical wiring and circuit breaker titles and locations are subject to change. The appropriate aircraft instrumentation engineer should be consulted for correct information on the flight test electrical systems.

FLIGHT TEST AIRSPEED/ ALTITUDE SYSTEMS

The YC-15 is equipped with two flight test airspeed/altitude systems: a BOOM system and a trailing CONE system. The 18 foot boom has instrument installations that tend to minimize the aircraft bow wave effect on the following: angle of sideslip. Pitot and static pressure readings from the boom are sent to an Air Data Computer (ADC) located near the FTE's station. This ADC provides boom airspeed, altitude, mach number, total (pitot) pressure, and static pressure to the DDS. The pilot may select the BOOM airspeed system with the AIRSPEED source selector located on the lower left portion of the pilot's instrument panel. The BOOM position of the AIRSPEED selector provides boom airspeed and mach number to the pilot's indicator.

NOTE

The copilot's instruments are not affected by the position of the AIRSPEED source selector.

The trailing CONE airspeed/altitude system, normally referred to as the CONE system, uses a fuselage mounted pitot probe (Figure A2-8) located below the cockpit and slightly right of the fuselage centerline. The pitot is connected to the cone system ADC located in a flight test module rack in the left forward cargo area by Nylaflo tubing. The static ports are located on a stainless steel sleeve which is trailed approximately 100 feet or more behind the aircraft on a length of Nylaflo tubing extended from the tip of the vertical stabilizer (Figure A2-8). A fiberglass cone is attached to the end of the tubing, several feet aft of the static sleeve, to keep the Nylaflo taut and stable. The tubing is routed through the vertical stabilizer and into the fuselage to a motor driven reel which allows the static sleeve/cone assembly to be retracted to a shorter length (approximately 15 feet) for takeoff and landing. The Nylaflo is connected at the center of the reel to a leak proof swivel joint which is connected through another length of tubing to the cone system ADC. The cone system is used to provide a static pressure source which is far enough removed from the aircraft to minimize the influence of the aircraft wake on the pressure measurement. Thus, the cone system provides for accurate altitude measurements and a reliable static pressure for airspeed computation. The cone airspeed, altitude and mach number are recorded on the DDS and airspeed and mach may be selected by the pilot using the CONE position of the AIRSPEED source selector.

NOTE

The trailcone must be fully extended to provide accurate airspeed, altitude and mach number.

ESCAPE CHUTE

The emergency escape chute provides an emergency exit for the flight crew. The chute is located in the right forward cargo area and extends from the mezzanine to an escape door in the bottom of the fuselage. The escape chute system basically consists of the chute structure, a grated interior door, an exterior door, a windscreen, a bailout siren, deployment systems, controls and indicator circuitry.

The escape chute interior door (Figure A2-5) is aft hinged opening up and aft. The door is grated to allow airflow through the chute when the exterior door is ejected if the aircraft is pressurized. The door is spring loaded to the open position and latched closed. This latch has two manual release handles and an automatic timer/release mechanism. A plywood box is built around the upper edge of the chute to serve as a seat for the door and a protective enclosure for the latching mechanism. One latch release handle is a pull lever recessed into the forward side of the plywood enclosure and the other is a pull T-handle recessed into the right side of the enclosure. The automatic timer/release mechanism is located in the forward section of the plywood enclosure and is attached by a cable to the latching mechanism. The time actuator is attached by a cable to the windscreen. Viewing ports are provided to observe the timer and the cable attach points. The timer setting should be three seconds. When the escape chute is actuated, the exterior door will jettison and the windscreen will slide into place, pulling the timer actuating cable. After the three second delay, to permit depressurization, the timer will pull the latch release cable and the interior door will spring open.

The escape chute exterior door is held in place by the door cable. The door cable is attached to the center of the door and runs the length of the chute up through the interior door. A cutable bolt on the upper end of the cable is attached to bracket mounted to the top of the door. The bolt is held through the bracket by a spearation nut which contains two explosive cartridges for redundancy. When the escape chute is electrically actuated, the cartridges are detonated to fracture the nut and release the door cable. The exterior door then opens downward into the slip stream and free falls clear of the aircraft.

The windscreen is U-shaped and mounted on slide rails to the forward side of the escape chute with the open side facing aft. It is spring loaded to extend 48 inches into the windstream and held retracted by the exterior door. When the exterior door is released, the windscreen will slide into place forcing the exterior door away from the aircraft and actuating the interior door timer. Two cables are attached to the windscreen and the ends are stowed on the top forward edge of the plywood enclosure around the upper end of the chute. These cables are used to retract the windscreen using a manually operated winch stowed on the mezzanine.

Prior to landing with the escape chute deployed, the windscreen must be retracted to prevent structural damage to the aircraft.

Escape Chute Control Panels

The ESCAPE CHUTE primary control panel (Figure A2-6), located on the pedestal, consists of ARM, DEPLOY and BAILOUT SIREN switches and two amber arm lights. The ARM and DEPLOY switches are guarded and safety wired in OFF. When the ARM switch is in the ARM position, power is supplied to the DEPLOY switch and both amber arm lights will come on. When the deploy switch is in the DEPLOY position, the circuit is completed to the explosive cartridges initiating escape chute deployment and actuates the bailout siren, located in the forward cargo area. The BAILOUT SIREN switch may be used to test the siren without deploying the escape chute. Electrical power is supplied to the switches, lights, siren and explosive cartridges by the BATTERY DIRECT BUS through the BAILOUT SIREN and two ESCAPE CHUTE circuit breakers located left of the ENG FIRE handles on the pilots' overhead switch panel.

An escape chute secondary control panel (Figure A2-6), located on the right aft side of the control cable enclosure aft of the flight compartment door, consists of a guarded ARM swtich and a guarded DEPLOY switch and actuating the deploy switch then completes the circuit to the explosive cartridge. Power is supplied to those switches from an escape chute battery pack located adjacent to the switches.

An escape chute manual deployment capability is provided in the event that both the primary and secondary electrical systems fail to operate. A pair of bolt cutters are mounted on the right side of the plywood enclousre (Figure A2-5) and are used to cut the bolt which holds the exterior door in place. As the exterior door falls and the windscreen slides into position, the interior door timer is actuated and in three seconds the interior door will open.

WARNING

After cutting the bolt, immediately remove yourself and the bolt cutters clear of the arc of the interior door which will spring open in three seconds.

When the escape chute is deployed and the interior door timer does not automatically unlatch the door, the T-handle or lever release handle may be used to manually unlatch the door.

Emergency Escape Chute Operation

(Refer to Section 3, Emergency Procedures Bailout.)

Windscreen Retraction Winch Operation

NOTE

Airspeed envelope for windscreen retraction will be determined early in the flight test program.

1. Establish communications with the flight compartment.
2. Close and latch escape chute interior door.
3. Unstow winch.

CAUTION

Winch weighs 84 pounds. Lift with care.

4. Slide winch onto forward upper edge of interior door.
5. Unstow one of the windscreen cables on the forward edge of the plywood enclosure.
6. Attach cable to winch hub.
7. Slowly crank winch to take up cable and retract windscreen.
8. Verify visually through grates in door that windscreen is fully retracted.
9. Verify latch on winch is secure.

FLIGHT TEST HYDRAULIC SYSTEM FAIL VALVE

An electic hydraulic shutoff (FAIL) valve is installed in #3 Hydraulic System left wing flap actuators down line. The valve is controlled from the FTE's panel by a HYD FAIL VLV - FLAPS DN SYS 3 switch (Figure A2-7). The switch is two position, FAIL and NORM, and guarded in the NORM (valve open) position. A red indicator light, adjacent to the switch, comes on when the switch is selected to FAIL and the valve has been driven closed. The valve will be utilized during flight testing to evaluate wing flap operation on a single hydraulic system. The fail valve system will be deactivated in the normal position except when planned flight tests requiring use of the fail valve are to be conducted.

LASER REFLECTOR

The laser reflectors are a self-contained semi-cylinder attached to the top of the wheel pods, one unit on each pod (Figure A2-8). The units are used to reflect the laser signal from the mobile automatic laser tracking (MALT) system which provides aircraft space positioning data for takeoff and landing performance tests.

FLIGHT COMPARTMENT FLIGHT TEST EQUIPMENT

Pilots' Instrument Panel

The pilot's and copilot's instrument panels (FO-1) contain a number of indicators and switches for use during flight test operation. All flight test indicators, except for the pilot's airspeed, receive electrical power through the flight test main power center.

Flight Test Airspeed/Mach Indicator

A flight test airspeed indicator is installed in place of a production indicator on the pilot's instrument panel. The test indicator provides an expanded airspeed scale for better readability. Digital readouts of airspeed and mach number are also provided.

C.G. Normal Indicator

The C.G NORMAL indicator on the pilot's instrument panel is electrical and shows the normal load factor in G's being exerted on a test accelerometer located near the aircraft's center of gravity.

Pilot's Force Indicator

A FORCE indicator, located on the pilot's instrument panel, provides a visual means of monitoring the force in pounds applied by the pilot to his wheel, column or rudder pedals. The pointer will deflect either right or left of zero according to the pilot inputs. Since there is only one indicator and three axes, selector pushbuttons are installed on the FTE's panel. When a pushbutton is pressed (aileron, rudder or elevator), and the pilot applies a force in the selected axis, the force will be displayed.

Angle of Attack Indicator

The ANGLE OF ATTACK indicators on the pilot's and copilot's instrument panels show the aircraft angle of attack, in degrees, measured by the flight test boom alpha vane.

Horizontal Stabilizer Position Indicator

The HORIZ STAB T.E. POS (horizontal stabilizer trailing edge position) indicators on the Pilot's and copilot's instrument panels show the position of the horizontal stabilizer trailing edge, in degrees, measured by a flight test potentiometer.

Elevator Position Indicator

The ELEV L and R (elevator left and right) indicators on the pilot's and copilot's instrument panels show the position of each elevator, in degrees, measured by a flight test potentiometer on each elevator.

Sideslip Indicator

The SIDESLIP L and R (left and right) indicators on the pilot's and copilot's instrument panels show the aircraft's angle of sideslip, in degrees, measured by the flight test boom sideslip vane.

Spoiler Position Indicators

The SPOIL L and SPOIL R (spoiler left and spoiler right) indicators on the pilot's panel show the average deflection, in degrees, of the two left outboard spoilers and the two right outboard spoilers, respectively. The spoiler positions are measured by flight test potentiometers.

Aileron Trim Indicator

The AIL TRIM indicator on the pilot's instrument panel shows the lateral trim setting in degrees of aileron deflection.

Aileron Position Indicator

The AIL L and R (aileron left and right) indicator on the pilot's instrument panel shows the position, in degrees, of the left and right ailerons, respectively, measured by flight test autosyns.

Rudder Position Indicator

The RUD UPR and LWR (Rudder upper and lower) indicators on the pilot's instrument panel show the position, in degrees, of the upper and lower rudder forward segments, respectively. The positions are measured by flight test potentiometers.

Flight Test Airspeed Source System Selector

The AIRSPEED source selector on the pilot's instrument panel is used to select the airspeed system for display on the pilot's airspeed indicator. It does not affect the copilot's airspeed indicator. The ACFT position selects the normal aircraft system. The CONE position selects the flight test trail cone system. The BOOM position selects the flight test boom system.

Disconnect Selector Switch

The DISC SELECT switch on the pilot's instrument panel is a two position lever lock type with positions FLUTTER VANE and STICK SHAKER. When the DISC SELECT switch is in the STICK SHAKER position the stall warning stick shaker will operate normally when the thumb disconnect switch is pulled out and pushing in the thumb switch will deactivate the stick shaker. The stick shaker disconnect is used by the pilot during preplanned flight test slow speed maneuvers to remove the distraction of the stick shaker. The FLUTTER VANE position of the DISC SELECT switch is a provision for future flight test installations and is not functional at this time. If the FLUTTER VANE position is selected, the stick shaker will operate normally and will not be affected by the position of the thumb switch. This switch is used to select the function of the thumb disconnect switch located on the inboard horn of the pilot's control wheel. The thumb disconnect switch is a two position push/pull type switch with an integral light. When the thumb switch is pulled out, the selected system is active and the integral light in the thumb switch will be on. When the thumb switch is pressed, the selected system will be deactivated and the thumb switch light will be out.

Mechanical Accelerometer

An ACCELERATION G UNITS indicator is installed on the copilot's instrument panel. This is a mechanical accelerometer and indicates the load factor in Gs.

Glareshield

A digital data system data and time readout is located on the center of the glareshield. Refer to Digital Data System paragraphs this section.

Flight Test Engineer's Panel

The flight test engineer's (FTE) panel is located below the pilot's window (Figure A2-7). The FTE panel consists of three adjacent panel units. The forward unit is a data control panel which basically consists of the DDS controls and indicators, the force select buttons for the pilot's force indicator, cockpit and auxiliary camera controls, auxiliary data recorder controls, a photoscope correlation panel and door warning lights. The center panel unit consists of the audio panel for the FTE station, the audio mixer panel for the remote interphone stations, fuel temperature indicators, a hydraulic fail valve control switch and indicator light, a radio selector switch for the phtoscope correlaticn tone, the brake temperature indicator and the brake selector switch for the temperature indicator. The aft panel unit consists of the oxygen regulator head for the FTE station and the FTE mic and headset jacks. The flight test engineer's panel is subject to change during the flight test program to accomodate instrumentation requirements. The aircraft FTE may be consulted for current configuration and operation of the panel.

Flight Test Engineer's Data and Time Display Panel

A digital data system data and time display panel is located on the pilot's seat back. Refer to Digital Data System this section for details.

Cockpit Camera

A 35mm cockpit camera is located on the upper aft cockpit bulkhead left of the door opening. The camera is aimed at and focused on the pilots' instrument panel. The COCKPIT CAMERA control module is located on the FTE's panel. The camera frame rate is selectable from 1 frame per 10 seconds standby to 1, 2 or 5 frames per second.

DATA SYSTEM CONSOLE

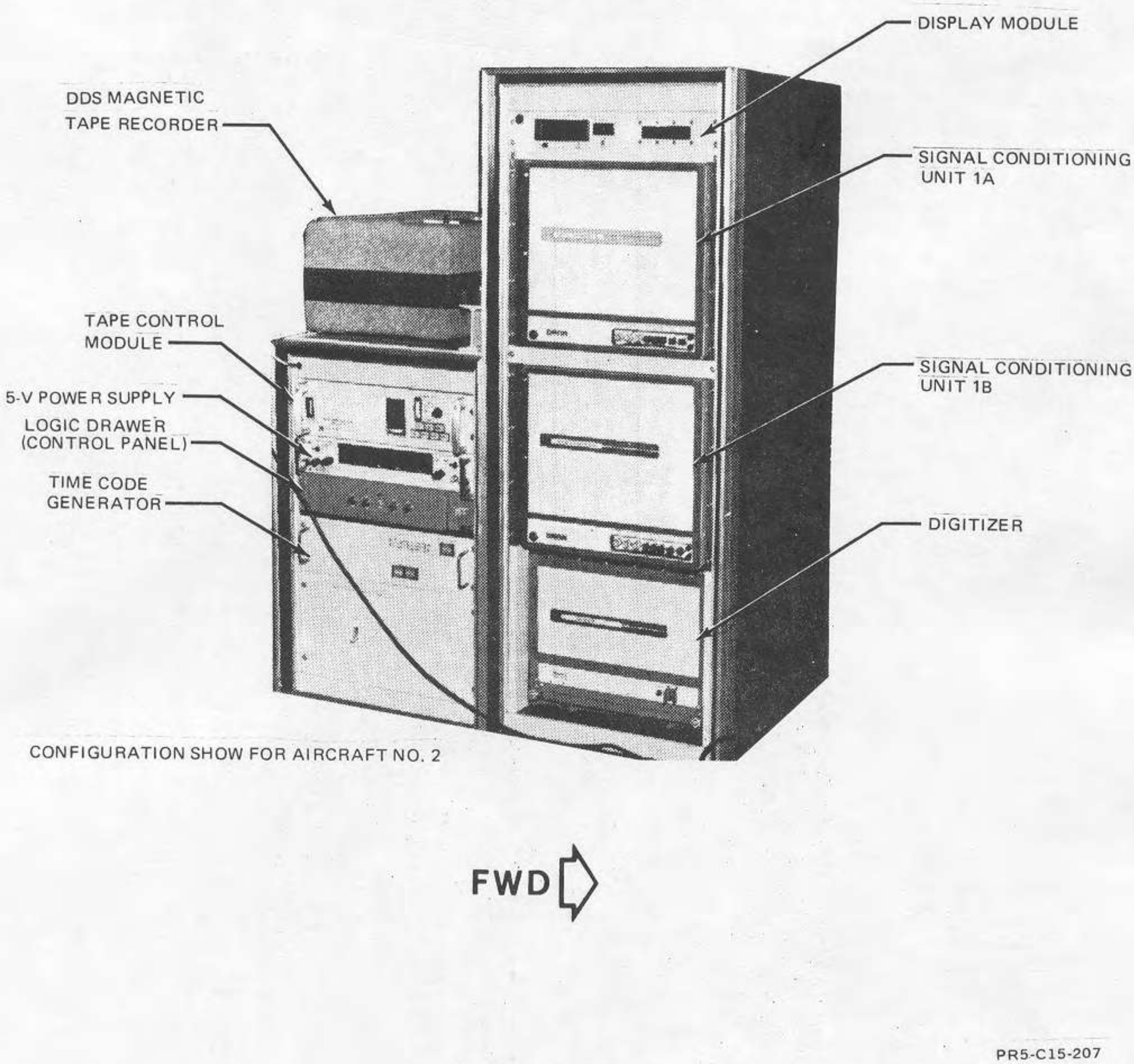
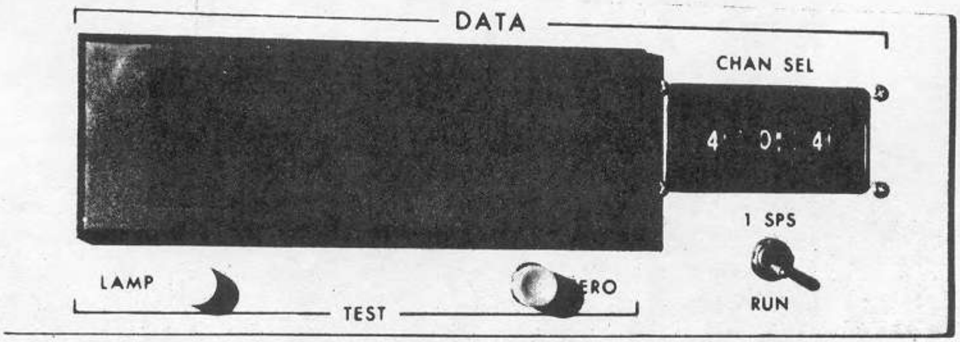
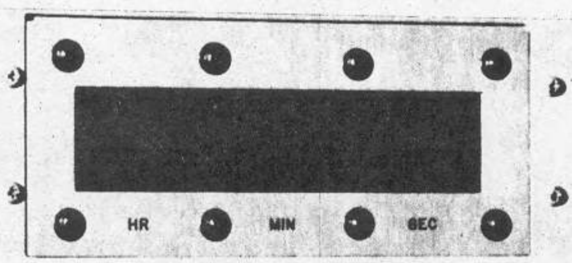


Figure A2-1

DDS DATA AND TIME DISPLAY



DATA READOUT



TIME READOUT

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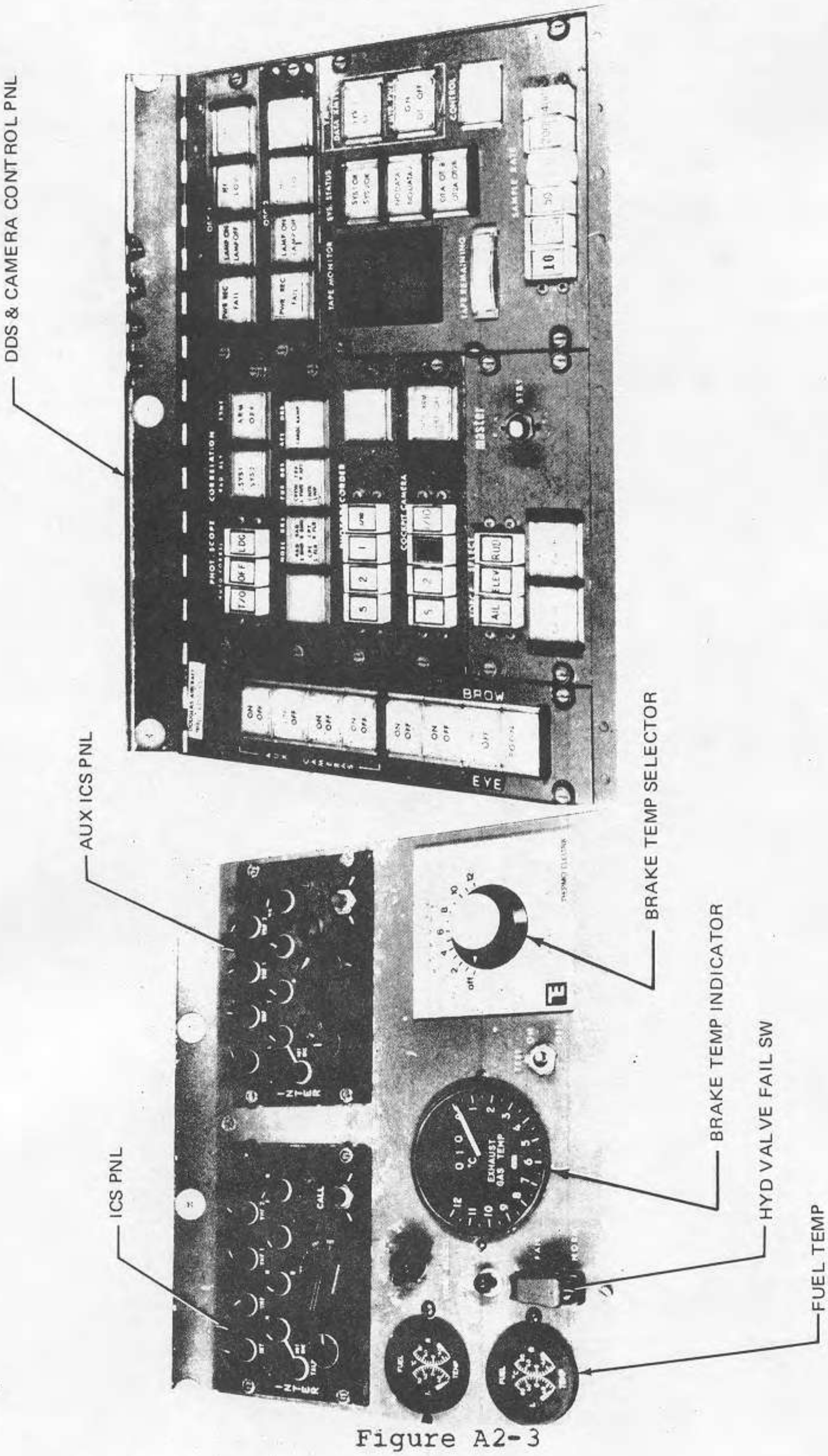
Figure A2-2

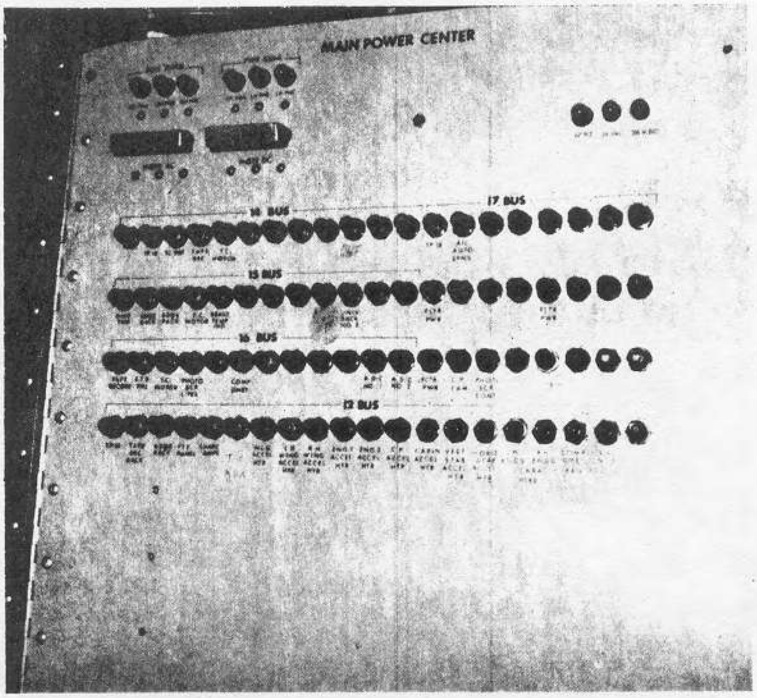
FLIGHT TEST ENGINEERS PANEL



PR5-C15-103 A

Figure A2-3

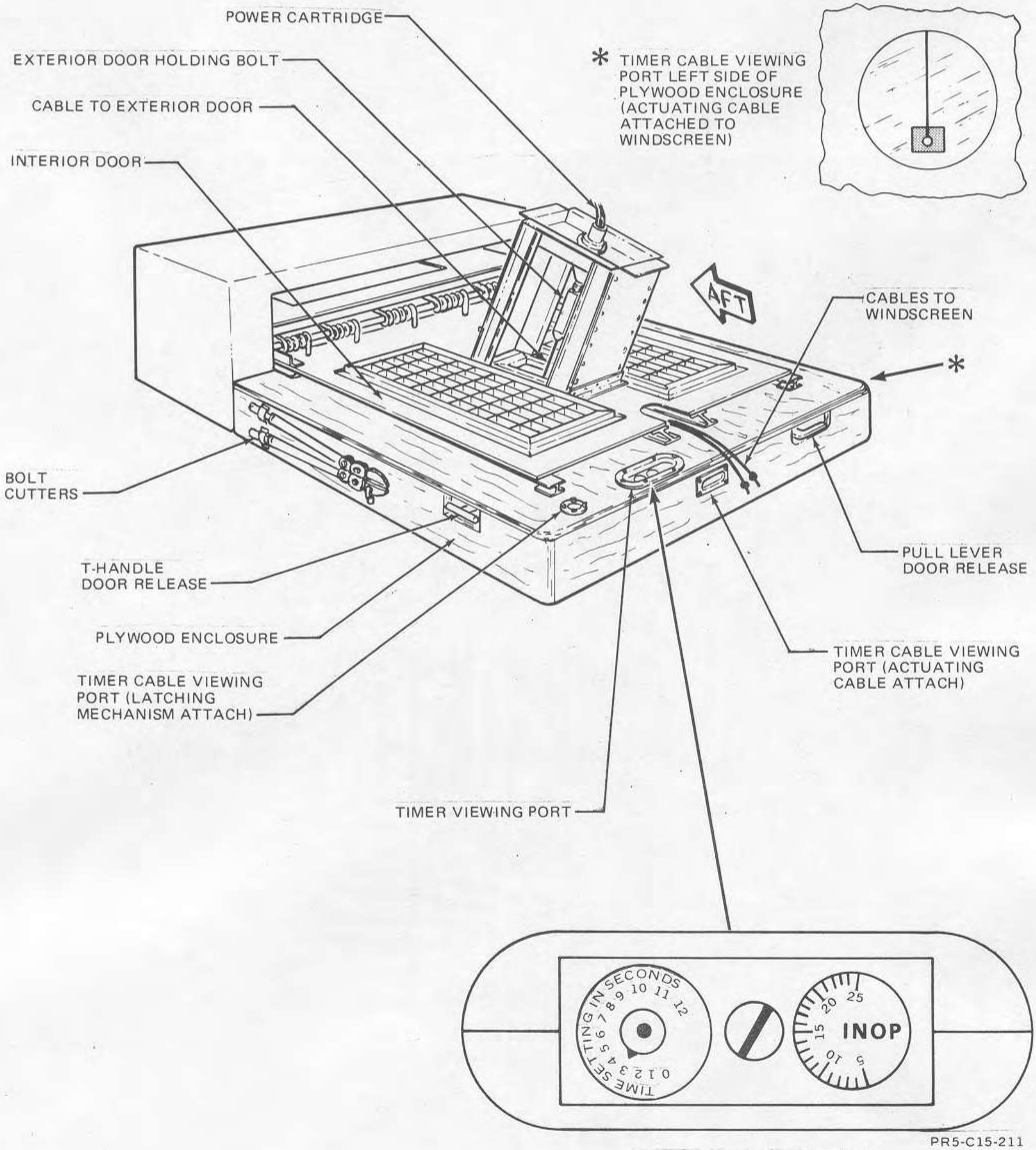
FLIGHT TEST – MAIN POWER CENTER



PR5-C15-210

Figure A2-4

EMERGENCY ESCAPE CHUTE (MEZZANINE VIEW)



TIMER/RELEASE MECHANISM

Figure A2-5

EMERGENCY ESCAPE CHUTE CONTROLS

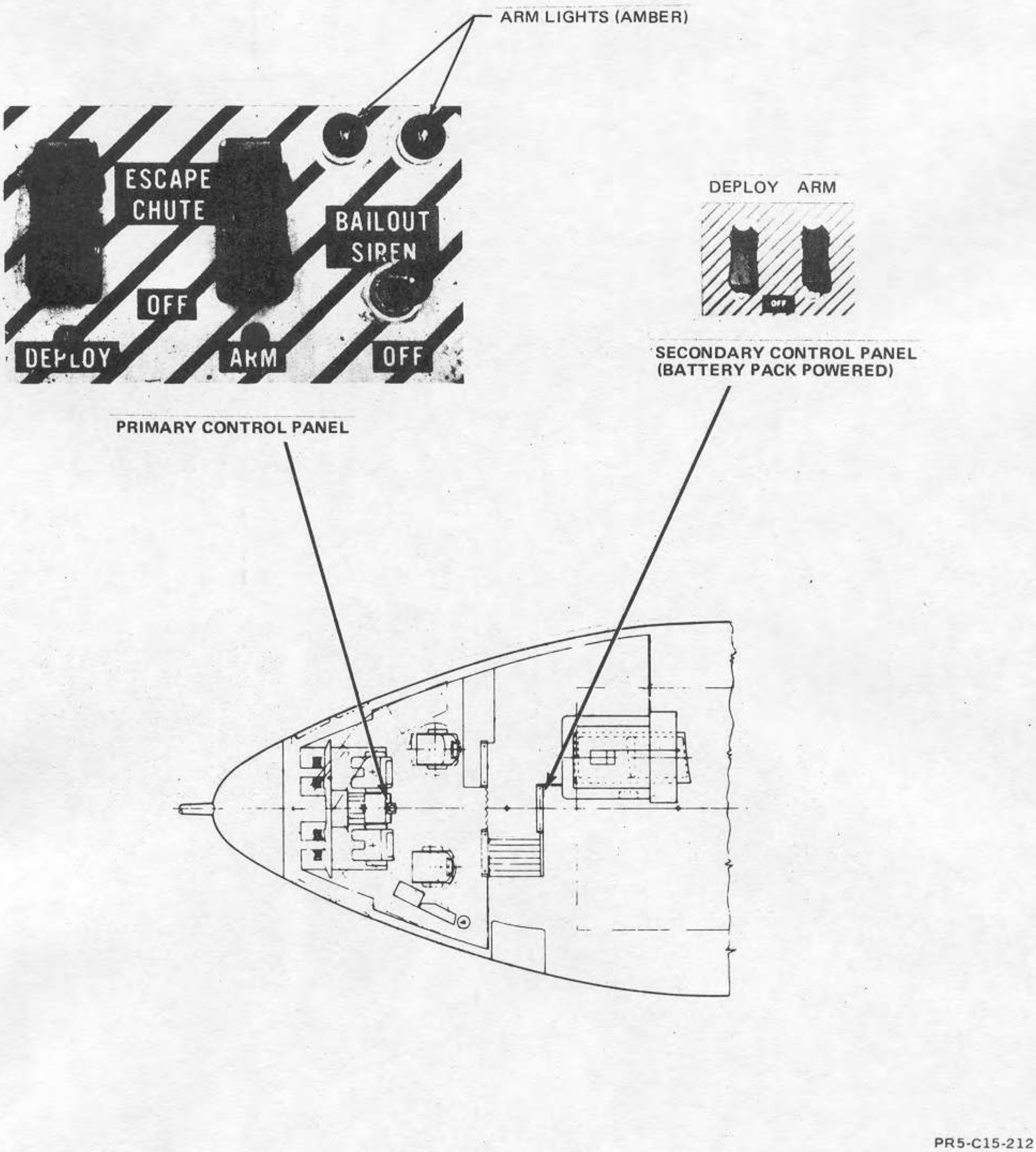
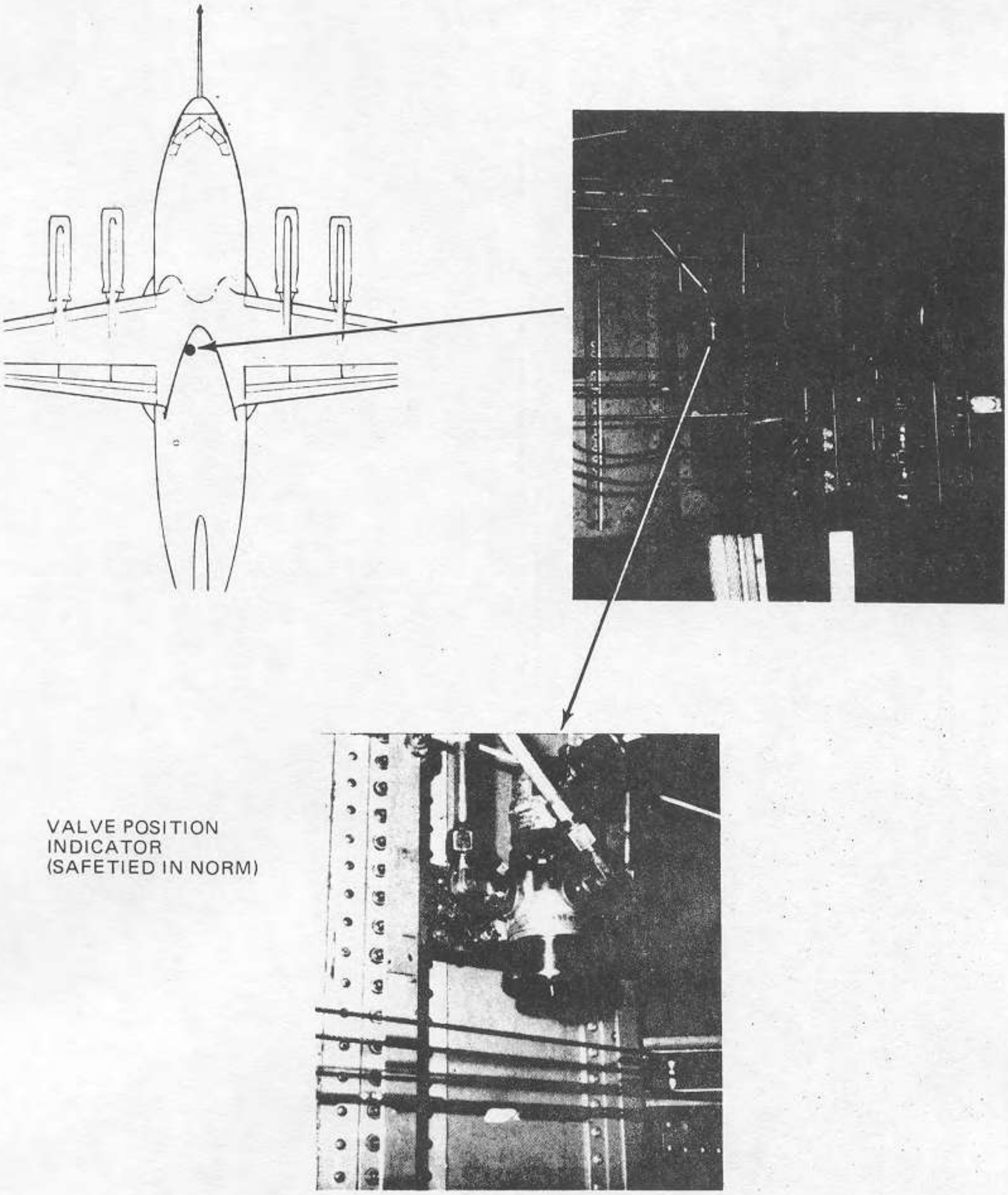


Figure A2-6

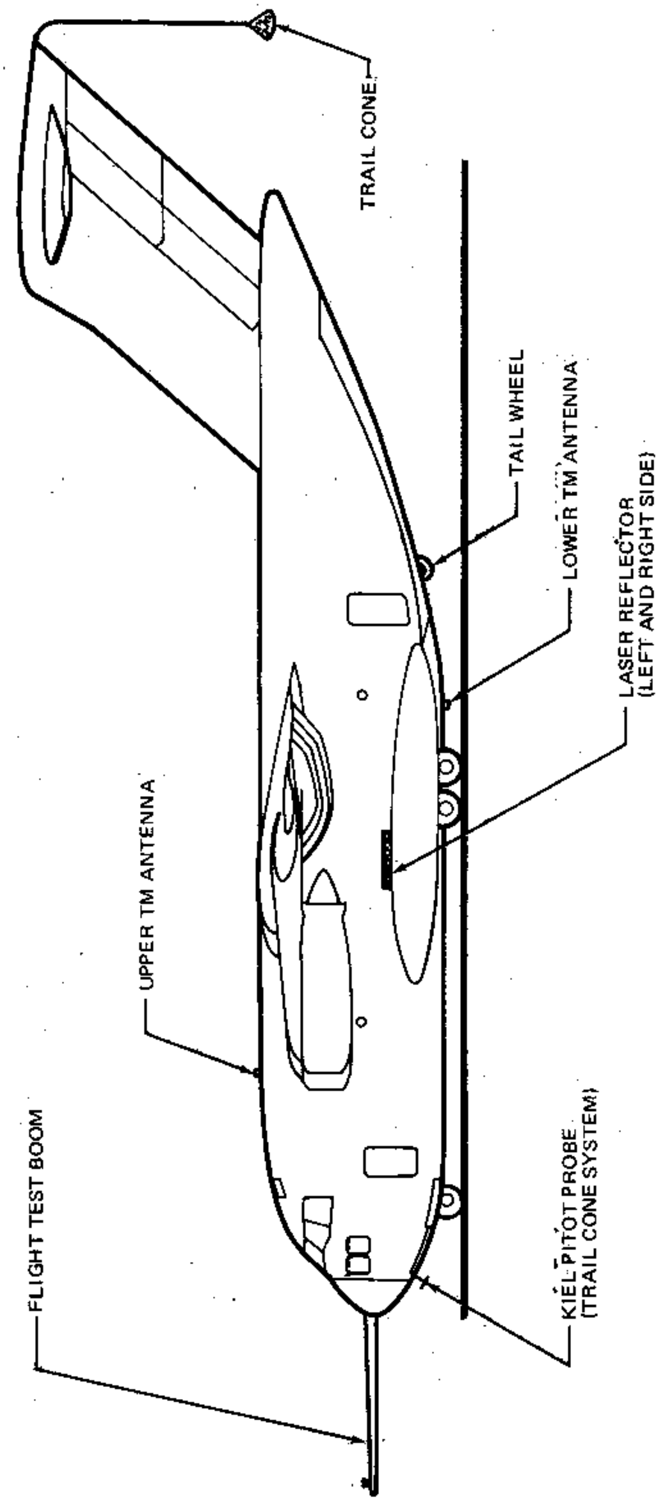
FLIGHT TEST HYDRAULIC SYSTEM FAIL VALVE



PR5-C15-213

Figure A2-7

FLIGHT TEST EXTERNAL INSTALLATIONS



PR5-C15-214

Figure A2-8

APPENDIX III

TABLE OF CONTENTS

DESCRIPTION AND OPERATION

CFM-56 ENGINE (AIRCRAFT #1 Only)

A CFM-56 Engine is installed on the No. 1 engine pod. It is a dual rotor, variable stator, axial flow, high-bypass-ratio turbofan engine. The engine accessory is located near the forward position of the fan case and is driven through a series of shafts from the high speed rotor.

The engine nacelle is supported from the wing pylon by an overhead mount system. The nacelle is isolated from the wing by a firewall made up of the lower surface of the pylon. To achieve necessary nacelle compartmentation, a fire seal is installed aft of the rear engine mount. The other fire seal is the nose cowl bulkhead. The low speed rotor (fan), designated N1, consists of one full diameter, single-stage fan and a smaller diameter, three-stage booster for the core engine flow. The fan and booster are mounted on a common internal concentric shaft driven by the low-pressure turbine. The high speed rotor (core), designated N2, is a nine-stage axial flow component. The first three stators and inlet guide vanes (IGV) are variable.

The combustion section of the engine contains a combustor (annular ring), low pressure fuel injectors and dual ignitors for redundancy.

Air enters the engine through a fixed inlet. A bifurcated fan duct is used to deliver the fan discharge air rearward to mix with the primary exhaust downstream of the low pressure turbine.

The primary exhaust gas is directed through a daisy nozzle which has twelve identical lobes arranged around a large plug centerbody. This nozzle arrangement promotes good mixing of exhaust gas with air to cool, slow down and spread the exhaust wake over a large span of the flap.

The engine has a starting circuit, throttle (power lever) and fuel lever. The instrument panels contains indicators for oil quantity and pressure, scavenge oil temperature, fuel flow, RPM, EGT and Power Lever Angle (PLA). Additionally, the FTE's panel contains fuel temperature, supply oil temperature and Engine Vibration Monitor (EVM) and Low Pressure Turbine (LPT) aft cavity temperature indicators.

Engine and aircraft accessories (Figure 3A-1) are mounted on the transfer and accessory gear boxes located on the lower fan casing. Plug-in accessory drive units with quick attach/detach flanges provide mounts for the hydraulic pump, pneumatic starter, N2 tachmometer generator, fuel pump and fuel control.

The engine control system (Figure 3A-2) consists of a hydromechanical core speed (N2) control, a compressor inlet temperature sensor (TT25), compressor discharge pressure sensor, an electronic power management control, hydraulic motor and actuators for variable bypass valves (VBV), variable stator vane (VSV) actuators, a control alternator, a fan speed sensor (N1), a fan inlet temperature sensor (TT12), and a fan inlet static pressure sensor (PS12).

The hydromechanical N2 speed control operates to provide N2 control in response to power lever (throttle) input as modified by engine control variables. The control automatically adjusts the compressor variable stator vanes (VSV) and the variable bypass valves (VBV) by position control of their actuators.

Engine power can be set and maintained automatically and manually.

a. Automatically: Power Management Control (PMC) switch in ACTIVATE and setting the power lever (throttle) to the desired PLA which gives the desired N1.

b. Manually: PMC switch in DEACTIVATE and setting the power lever to obtain the desired N1.

The PMC operates from power delivered by the control alternator and functions to set the N1 by overriding the hydromechanical N2 control in the downward direction only. Automatic calculation and setting of the N1 is achieved by sensing fan inlet temperature and static pressure levels and computing the N1 required to satisfy the throttle input demand.

Takeoff thrust is the maximum thrust approved for takeoff operation. For the CFM-56 engine, the specified rating is the maximum thrust available (21,200 pounds installed) at or below 76°F ambient temperature. The rating is time limited to five minutes or less. The rating is established by adjusting the throttle to the desired PLA to obtain the predetermined N1 for the prevailing altitude and temperature conditions. Since this rating is less than the full throttle thrust capability of the engine, it is important that takeoff thrust setting parameters are accurately determined and set to insure compliance with takeoff thrust ratings.

CFM-56 Engine Oil System

The engine oil system (Figure 3A-3) is a medium-pressure, self-contained system supplying the engine main bearings, gear boxes and lube module. An oil scavenge system withdraws oil from the bearing compartments (forward and aft) and accessories, and returns oil to the oil tank.

The oil tank suction feeds the main oil pump which pumps oil through the main oil filter to the system. The main oil filter anti-clogging bypass valve will open to bypass oil around a clogged filter. A differential pressure switch senses pressure on both sides of the filter and a red indicator becomes visible when the differential pressure exceeds approximately 14.5 PSI. The supply oil temperature sensor on the lube module provides input for the SUPPLY OIL TEMP indicator on the FTE's instrument panel. The oil pressure transmitter supplies a pressure signal to the OIL PRESS indicator on the forward section of the pedestal. The oil pressure low caution switch senses pressure of the oil delivered to the main bearings. If the pressure at this point drops below 13.5 PSI, a circuit is completed to turn on the #1 ENG OIL PRESS LOW and MASTER CAUTION lights. Oil then passes to the engine main bearings (forward and aft), the gear boxes and accessories.

Oil drains from the bearings and gear boxes and is pumped by a series of four scavenge pumps through the fuel/oil heat exchanger to the tank. A scavenge oil temperature sensor provides input for the SCAVENGE OIL TEMP indicator on the forward section of the pedestal.

The usable oil in the oil tank when filled is approximately 4.5 U.S. gallons. Each engine may be operated as long as oil pressure and temperature limits are not exceeded. The oil quantity should indicate a minimum of 8.5 quarts prior to engine start. The oil tank quantity will decrease approximately 3 quarts during engine operation due to "gulping".

NOTE

Static engine oil level check should be conducted within 30 minutes after shutdown to obtain an accurate indication of quantity.

CFM-56 Engine Ignition System

The engine has two independent ignition systems, both 15 joules. Both systems route electrical power to an ignition exciter, located on the side of the engine. The exciter transforms the electrical power to a high voltage oscillating current which fires across the gaps of the ignitors. One ignitor system is used for ground starting, the other for continuous and both for override.

Engine Ignition Switch

The engine IGNITION switch (Figure 1-12) is utilized for all four engines and controls the operation of the two ignitors.

The OVRD (override) position provides 15 joule DC energy to both ignitors in the engine, bypassing the ENG START control switch. The OVRD position diminishes probability of engine flame out in adverse weather, during takeoff or turbulence penetration. The OFF position interrupts all energy to both ignitors. The GND START & CONTIN (continuous) position provides 15 joule DC power to one ignitor when the ENG START switch is ON and the fuel lever for that engine is placed ON. When the ENG START switch is OFF, the fuel lever is ON, and the IGNITION switch is GND START & CONTIN, the other ignitor is energized. The ignition system receives 115 VAC, single-phase power from the LEFT AC bus through the CONTINUOUS IGNITION ENG 1 circuit breaker (P-10) on the EPC panel.

CFM-56 Engine Starting System

The engine is equipped with a starting system consisting of a pneumatic starter, starter control valve, pneumatic ducting and the starting and ignition control circuits. The engine may be started by using an external pneumatic power source or #3 engine bleed air.

NOTE

The external pneumatic source must be plugged into the pneumatic adapter under the CFM-56 fan cowl door. The normal pneumatic receptical cannot be used.

The pneumatic-driven turbine starter accelerates the N2 compressor to starting speed and also aids engine acceleration after combustion until self-sustaining speed is reached. An electricall controlled, pneumatically actuated starter valve controls the starter.

CFM-56 Engine Start Switch

The ENG START switch (Figure 1-12), located in the pilots' overhead panel, is of the two-position spring-loaded OFF type. In addition to completing the electrical circuits to the ignition switch (refer to CFM-56 Engine Ignition System), holding an engine start switch in the ON position opens the starter valve for the engine.

When the starter valves opens, the green #1 ENG START VALVE OPEN light comes on in the pilots' annunciator panel. Starter valve opening can also be determined by observing a drop in pneumatic pressure as indicated on the pneumatic pressure indicator. The engine start valve receives 28 VDC power from the DC EMERGENCY bus through the ENGINE IGNITION and START VALVE ENG 1 circuit breaker (C-1) on the pilots' overhead panel.

CFM-56 Engine Start Valve Open Light

A green #1 ENG START VAIVE OPEN light (Figure 1-12) is located in the pilots' annunciator panel. The #1 ENG START VALVE OPEN light comes on when the engine start valve opens. The light receives 28 VDC power from the LEFT DC bus through the START VALVE OPEN LIGHTS, ENG 1 circuit breaker (V-7) on the EPC panel.

CFM-56 Engine Thrust Reverser System

There are no provisions in the YC-15 aircraft for the installation of a thrust reverser on the CFM-56 engine.

CFM-56 Engine Instruments

CFM-56 Power Lever Angle Indicator

CFM-56 Power Lever Angle (PLA) indicator (Figure 3A-4) is located on the pilot's center instrument panel. The PLA indicator shows the relative position of the throttle input to the Power Management Control.

CFM-56 N1 and N2 Indicators

Engine N1 and N2 RPM indicators (Figure 3A-4), located on the pilot's center instrument panel, indicate the speed of the fan (N1) and the core (N2). Each indicator has an analog and digital readout. The analog dial is graduated in 5% increments marked every 20% from 0 to 120. The digital readout window shows the % RPM to 0.1 of 1%. In the event of an electrical failure, a red OFF flag will cover the window. The indicators receive 115 VAC single phase power from the LEFT AC bus throught the ENGINE 1 TACH N1 and N2 circuit breakers (N-13, -14) on the EPC panel.

CFM-56 Exhaust Gas Temperature (EGT) Indicator

The exhaust temperature indicator is located on the pilot's center instrument panel and indicates the exhaust gas temperatures. The indicator is calibrated in 20° increments numbered every 200° from 0 to 1000°C. The EGT indicator is self-power generating and does not require aircraft power.

CFM-56 Fuel Flow Indicator

A fuel flow indicator (Figure 3A-4) is located on the pilot's center instrument panel and shows the engine fuel flow rate (1000 pounds per hour). The indicator is graduated in 200 pound increments with numerals every 1000 pounds from 0 to 12,000. A digital readout window shows the total amount of fuel used. In the event of an electrical failure, the pointer and readout remains in the last powered position. The fuel flow indicating system receives 115 VAC single phase power from the LEFT AC bus through the FUEL FLOW ENG 1 circuit breaker (N-7) on the EPC panel.

CFM-56 Oil Pressure Indicator

An OIL PRESS indicator (Figure 3A-3) is located on the forward center pedestal. It is calibrated in 10 pound increments with numerals every 20 pounds from 0 to 80 pounds. The indicator shows oil pressure prior to the engine bearings. In the event of an electrical failure, the pointer will go off scale low end. The OIL PRESS indicator receives 28 VAC power from the LEFT AC bus through the ENGINE OIL PRESSURE ENG 1 circuit breaker (M-10) on the EPC panel.

CFM-56 Oil Temperature Indicators

A SCAVENGE OIL TEMP indicator (Figure 3A-3), located on the forward center pedestal, is calibrated in 5° increments numbered every 50° from -50 to 200°C. The indicator shows the temperature of the oil that has passed through the engine and is returning to the aft scavenge oil pump. In the event of an electrical failure, the pointer goes off scale low end. The SCAVENGE OIL TEMP indicator receives 28 VDC from the LEFT DC bus through the ENGINE OIL TEMP INDICATOR ENG 1 SCAVENGE circuit breaker (T-7) on the EPC panel.

A SUPPLY OIL TEMP indicator (Figure 3A-3), located on the FTE's instrument panel, is calibrated in 5° increments numbered every 50° from -50 to 200°C. The indicator shows the temperature of the oil that has passed through the main oil pump, filter, and check valve assembly prior to the engine bearings. In the event of an electrical failure, the pointer will go off scale low end. The SUPPLY OIL TEMP indicator receives 28 VDC from the LEFT DC bus through the OIL TEMP FWD SUPPLY ENG 1 circuit breaker (T-16) on the EPC panel.

CFM-56 Oil Quantity Indicator

An oil quantity indicator (Figure 3A-3), located on the forward center pedestal, shows the quantity of useable oil in the tank. The indicator is calibrated every 2 quarts with numerals as noted. In the event of an electrical failure the pointer will go off scale low end. The system is powered by 28 VDC from the LEFT DC bus through the OIL QUANTITY ENG 1 circuit breaker (V-4) on the EPC panel.

CFM-56 Oil Pressure Low Caution Light

An amber #1 ENG OIL PRESS LOW light is located on the overhead annunciator panel. The oil pressure low caution switch senses pressure of the oil delivered to the bearings. If the pressure at this point drops below approximately 14.5 PSI, a circuit is completed to turn on the #1 ENG OIL PRESS LOW and MASTER CAUTION lights. When the pressure exceeds 14.5 PSI the lights will go off. The system is powered by 28 VDC from the LEFT DC bus through the ENGINE OIL LOW PRESS LIGHT, ENG 1 circuit breaker (T-9) on the EPC panel.

CFM-56 Engine Vibration Monitor System

An engine vibration monitor system (EVM), figure 3A-5, is installed to provide a visual indication in the flight compartment of engine vibration. The system consists of vertical accelerometers (installation on engine main bearings #1, 2, & 5), signal conditioner, velocity indicators and a test button. The transducers on the engine main bearings send a signal to the signal conditioner which filters, splits and amplifies it. The corresponding signal is sent to either EVM HIGH or LOW indicator and the respective pointer will indicate the vibration.

CFM-56 EVM Indicators

Two identical EVM indicators (figure 3A-5) are installed on the FTE's instrument panel, one for HIGH frequency vibration and the other for LOW. Each indicator has three vertical scales labeled 1, 2, and 5, with marks from 0 to 10 and numerals every 2 marks. The EVM system receives 115 VAC single phase power from the LEFT AC bus through EVM HIGH ENG 1 and EVM LOW ENG 1 CIRCUIT BREAKERS (P-12, -13) on the EPC panel.

CFM-56 EVM Test Button

An EVM Test button (figure 3A-5), located on the FTE's instrument panel, provides a means of testing the EVM system. When pressed and held, all six pointers will indicate 6 units. When released the pointers will return to a pretest position.

CFM-56 ENGINE FIRE DETECTION SYSTEM

The fire detection system detects overheating or a fire condition in the engine nacelle and alerts the crew by a visual and/or aural indication. The system is dual with three separate fire-sensing element loops and an individual amplifier control unit for the core fire detection area. There is an upper and lower dual loop detector in the core area and one in the fan area (Figure 3A-6). The fan detector system (LOOP A & LOOP B) is connected to the respective core system (LOOP A and LOOP B). In the event of a fire it will only indicate Engine 1 and will not deferentiate between fan and core. Test and operation is controlled by Engine 1 switches and lights.

CFM-56 FIRE EXTINGUISHER SYSTEM

The CFM-56 engine has an identical system as the JT8D engine plus two additional fire extinguishing agent containers mounted in the lower fan cowl (Figure 3A-6). The extinguishing agent of a selected container (No. 1 or 2) is dispensed to Engine 1 when ENG 1 FIRE shutoff handle is actuated.

NOTE

> The engine fire extinguising system used Bromotrifluromethane (BrCF3) as an extinguishing agent and could be harmful to humans after prolonged contact (vapor or liquid).

CFM-56 Engine Oil Sump Overtemperature Warning System

An engine oil sump overtemperature system is installed in Aircraft 1 for the CFM-56 engine. The system provides visual indication when the engine internal oil temperature exceeds a predetermined value. It signifies an overtemperature and not an engine fire. The system consists of a low pressure turbine cavity discharge temperature sensor, a warning light in the overhead panel, a temperature indicator on the FTE's panel, and utilizes the MASTER WARNING system. There is no ON-OFF switch for this system. When the annunciator panel is tested, the engine oil sump overtemperature warning light is also tested. A description follows:

#1 Engine Oil Sump Overtemperature Light

A red #1 ENG OIL SUMP OVERTEMP light, located in the pilots' overhead annunciator panel, comes on when the temperature in the LPT cavity is 1200°F or more. The light receives 28 VDC power from the BAT bus through the ENG 1 OIL SUMP OVERTEMP circuit breaker (B-31) on the pilots' overhead circuit breaker panel.

Satisfactory operation of the engine oil sump overtemperature warning light is considered mandatory for flight.

Low Pressure Turbine Cavity Discharge Temperature Indicator

A rectangular oil temperature indicator, located on the FTE's panel, provides a means of monitoring the Low Pressure Turbine (LPT) cavity discharge temperature. There are two scales on the indicator. The upper scale is graduated in degrees Fahrenheit and the lower one in Celius. A 1200°F red mark is superimposed on the scale to designate the temperature at which the #1 ENG OIL SUMP OVERTEMP light come on.

If the LPT cavity discharge temperature reaches approximately 1200°F, the #1 ENG OIL SUMP OVERTEMP, MASTER WARNING and No. 1 fuel lever lights will come on. Proceed:

NOTE

The engine fire bell and light do not come on.

Shutdown the engine immediately.

1. Throttle - IDLE (P)
2. Fire Shutoff Handle - PULLED (P)

CAUTION

Do not discharge the agent unless there is evidence of an engine fire.

3. Fuel Lever - OFF (CP)

NOTE

The light in the fuel lever should go off.

4. Fuel Tank Pumps - OFF (CP)
5. Engine Hydraulic Pump - OFF (CP)

Check hydraulic system quantity. If normal, the auxiliary hydraulic pump may be used as required.

NOTE

If #1 engine is shutdown, the auxiliary hydraulic pump is required to operate the landing gear and nose wheel steering.

CFM-56 NORMAL PROCEDURES

Before Start Checklist - "COMPLETED" (P)

CFM-56 ENGINE STARTING

1. Pneumatic - "ENG START" (P)

2. Pneumatic Pressure - "25-55 PSI" (P)

   Pneumatic pressure gage should be checked to determine that pneumatic pressure is 25-55 PSI.

   NOTE

   Optimum engine acceleration to idle RPM and lowest EGT peak is obtained with starter pressures of 33 PSI or more.

3. Ignition - "GROUND START AND CONTINUOUS" (P)

   The GND START and CONTIN position of ignition switch will make high energy ignition available through ON position of engine start switch and fuel lever. As soon as start switch is released, the other high energy ignition system will be operating.

4. Anti-collision Lights - "ON" (P)

   Turn anti-collision light ON as indication that engines are about to be start or are operating.

   NOTE

   The wing tip strobe lights will come on also.

5. Power Management Control - "ACTIVATE" (P)

6. Start Clearance - "CLEAR TO START ENGINES" (CP/LM)

   Copilot ensures that area is clear to start the engine, and assures that fire guard is in position. Fire guard will observe engine start and maintain contact with flight crew on interphone or visually. Upon receiving clearance to start, the pilot will start No. 1 using the following procedures:

   CAUTION

   The following limits apply for starting:
   tailwind - 20 knots or more
   crosswind - 30 knots or more

   a. Start swtich - ON(HOLD)

      CAUTION

      If start switch is accidently disengaged, discontinue start and wait until N2 rotation has ceased. Then another attempt to start may be accomplished. Engaging starter while rotor speed is more than 10% could damage the starter drive gear train. Discontinue start if starter duty cycle, engine starting or engine operating limits are exceeded.

   b. ENG START VALVE OPEN light - ON

      If ENG START VALVE OPEN light remains off and no rotation is noted, abort the start.

   c. N2 RPM - ROTATION CHECKED

      If there is no N2 rotation, discontinue the start and investigate.

   d. Oil Pressure - CHECKED FOR

RISE

Positive oil pressure must be indicated by the time the engine has accelerated to stabilized ground idle. If not discontinue start and investigate.

e. N1 RPM - ROTATION CHECKED

If no N1 indication, discontinue start (possible N1 rotor seizure). Confirm N1 rotation with ground crew. If N1 rotation is normal proceed with normal start using N2 and remaining engine indications.

NOTE

Maximum allowable N2 is 80% RPM.

f. Fuel Lever - ON at 15% N2 RPM

g. Fuel Flow - CHECKED APPROX 450 PPH

CAUTION

A starting fuel flow indication of 500 PPH before combustion is an indication of possible hot start. Be prepared to abort the start if a rapid EGT rise occurs, approaching starting limits.

NOTE

If the start is aborted, motor the engine with fuel lever OFF for 60 seconds and use the CLEAR ENGINE procedure.

h. EGT - RISING

If EGT does not rise within 15 seconds aft[illegible] fuel ON, discontinue start, motor engine with fuel OFF for 60 seconds and proceed with CLEAR ENGINE procedure.

i. Start Switch - RELEASE at 52% ±1 N2 RPM

j. ENG START VALVE OPEN light - CHECKED OFF

CAUTION

ENG START VALVE OPEN light goes off to indicate that start valve has closed. Prolonged operation with start valve open will damage the starter.

If light remains ON or the start valve fails to open or remains open after engi[illegible] stabilizes at idle, shutdo[illegible] engine and notify the crew chief. The starter valve for the YC-15 flight test program will not contain the manual override feature.

When engine operation has stabilized, check instructions and complete remaining items of starting engines checklist.

NOTE

The engine normally stabilized at ground idle within 40-45 seconds at SLS conditions.

As a normal procedure, the engine shall be operated for 5 minutes at ground idle after engine start prior to advancing power.

If it is desired to make rap[illegible] accelerations to an engine power setting above 50% N1 following the 5 minute period at ground idle, the following additional warmup is required provided the engine has been shutdown for longer than one hour:

a. five (5) minutes at flight idle, (35% N1) or,

b. two (2) minutes at 41% N1 or,

c. one (1) minute at 50% N1.

The above portion of the warmup procedure, after 5 minutes at ground idle, is not required if a slow acceleration in the order of 25 to 30 seconds is made to takeoff power.

Starting Engines Checklist - "Completed"

CFM-56 Start Abort Procedure

a. Fuel Lever - "OFF" (P)

b. Start switch - "RELEASE" (P)

c. Ignition - "OFF" (P)

d. EGT - MONITOR (P)

NOTE

If EGT does not decrease, motor the engine for 60 seconds using the CLEAR ENGINE procedure.

CFM-56 Clear Engine Procedure

a Throttle - IDLE

b. Fuel lever - OFF

c. N2 RPM - Check rotation less than 10%

NOTE

If practicable, wait until N2 rotation has ceased prior engaging starter.

d. Ignition - OFF

e. Start switch - ON (hold 60 seconds)

CAUTION

Maximum continuous starter duty cycle is 3 minutes. Cool starter for 30 seconds per minute of duty cycle. After 2 consecutive 3 minute duty cycle, cool the starter for 10 minutes prior to each subsequent 3 minute duty cycle.

CFM-56 EMERGENCY PROCEDURES

CFM-56 AIRSTART (ENGINE RESTART)

The estimated engine start envelope (Figure 3A-8) shows altitude and speed envelope in which airstarts should normally be successful.

1. Throttle-----------IDLE (CP)

2. Fuel Lever----------OFF (CP)

3. Fire Shutoff Handle-----------STOWED (CP)

4. Fuel Tank Pumps-------ON (CP)

5. Airspeed-------WITHIN LIMITS (per Figure 3A-8)

6. RPM (N1 and N2)---CHECK (CP)

If N2 is less than 10% RPM and sta proceed:

#1 Start Switch--ON(Hold) (P)

NOTE

Hold the starter switch until the N2 RPM is greater than 15% before proceeding. Do not release starter switch now.

If N2 is greater than 15% RPM, proceed:

CAUTION

Airstarts without start assist should not be atempted if N2 RPM is less than 10%.

NOTE

Engine starter can be engaged in flight any time the engine is stabilized at windmilling speed.

7. Ignition----------"OVRD" (P)

8. #1 Fuel Lever---------ON (P)

NOTE

Combustion should occur within 2-3 seconds. If EGT does not rise within 15 seconds after the fuel lever has been placed in ON, discontinue airstart by returning fuel lever to OFF. Windmill the engine for 30 seconds before attempting another airstart.

If a starter assist start:

Start Switch---------RELEASE (at 52% N2)

When engine stabilizes at Flight Idle N2:

9. Oil Pressure----CHECK/LT OFF (CP)

10. Engine Instruments---CHECKED (P,CP)

NOTE

Engine should be stabilized at flight idle for 2 minutes prior to the advancing the throttle.

11. Ignition----AS REQUIRED (CP)

12. Hydraulic System-----CHECKED (CP)

13. Airstart Checklist---"COMPLETED" (CP)

CFM-56 ENGINE SHUTDOWN (Voluntary)

1. Throttle-----------IDLE (CP)

2. Idle RPM for minimum of 5 minutes

NOTE

Gradual power reduction to flight idle during shutdown promotes thermal stabilization before fuel shutoff.

3. Fuel Lever----------OFF (CP)

4. Aux Hydraulic Pump---ON (CP)

Check hydraulic quantity. If normal, place #1 AUX PUMP switch in on and verify system pressure.

5. Engine Shutdown Checklist-----COMPLETED (CP)

The following indications are symptoms of serious engine malfunction or impending failure.

1. Engine vibration increase.

2. Compressor stalls (repeated or

uncontrollable)

3. Loss of thrust

4. Variation in engine parameters also one to another (during steady state operations).

5. Oil pressure increase or decrease of 30 psig or more (during steady state operation).

6. Engine oil pressure below 13.5 psig.

CAUTION (EIRT)

Avoid bird environment whenever practicable.

CFM-56 ENGINE SHUTDOWN (GROUND)

NOTE

Idle RPM for minimum of 5 minutes prior to shutdown.

1. Parking Brakes - "SET" (P)

2. Escape Chute Pins - "INSTALLED" (FTE)

   In Aircraft #1, install pin.

3. External Power - "ON" (P)

4. INS - "AS REQUIRED" (CP, FTE)

5. Flaps/Slats - "45°/EXT" (CP)

6. Fuel Levers - "OFF" (P)

CFM-56 Engine Abnormal Conditions

CFM-56 NO START

If there is NO rise in EGT within 15 seconds after the fuel lever is placed in ON, discontinue the start.

Before attempting a second start, motor the engine for 60 seconds. Use the override ignition system for the second start attempt.

If a third start attempt fails, do not attempt another start.

CFM-56 HOT START

A hot start is indicated by an abnormally rapid EGT rate of rise after combustion. If the start is NOT discontinued, the EGT will exceed the limits. By monitoring fuel flow and EGT, a hot start can be anticipated and discontinued before the limits are exceeded.

Hot start and/or overtemperature should be recorded and maintenance notified.

CFM-56 HUNG START

A hung start is indicated by combustion followed by an abnormally slow RPM acceleration and stabilized below idle RPM. A hung start could be the result of a lean or rich fuel scheduling and/or a rotating compressor stall. If a hung start cannot be overcome, discontinue start and investigate.

If fuel flow prior to combustion was less than 285 PPH, or N2 RPM was below 15%, a successfuly start is not likely.

CFM-56 N1(FAN) and N2 (CORE) OVERSPEED

If N1 or N2 exceeds the limits, retard the throttle. Record the maximum speed and duration.

CFM-56 ENGINE STALLS

A stall may be indicated by varying degrees of abnormal engine noises, fluctuating parameters, adverse throttle response, and/or high EGT or rapid EGT rise.

If an engine stall is encountered, proceed:

1. Retard the throttle.

Verify that the EGT and N2 RPM decrease.

2. Slowly advance the throttle to determine if a stall will reoccur. Check that the RPM follows throttle movement.

If a stall does reoccur, repeat Steps 1 and 2. If stall cannot be cleared, shutdown the engine.

If stall does not reoccur, proceed:

3. Advance the throttle to a thrust level below that at which the stall occured and operate at this level.

CAUTION

Continued operation of the engine which stalls must be done with extreme care to prevent structural damage to the engine.

CFM-56 N1(FAN) ROTOR SEIZED

If there is NO N1 rotation.

1. Operate N2 at ground idle speed for 30 seconds then shutdown the engine.

2. When N2 is zero, attempt a restart and monitor N1(fan). If there is no N1 rotation within 30 seconds, shutdown the engine and investigate.

CAUTION

Do not exceed ground idle limitations until normal N1 rotation and operation is confirmed.

CFM-56 ENGINE EMERGENCIES

These emergencies are similiar to the JT8D-17 engine emergencies and are presented in Section III Emergency Procedures.

CFM-56 OPERATING LIMITATIONS

CFM-56 STARTING LIMITATIONS

The maximum continuous starter duty cycle is three (3) minutes. Cool starter 30 seconds for every minute of duty cycle (i.e., cool 1-1/2 minutes for each 3 minute cycle). After two (2) consecutive three (3) minute duty cycles, cool 10 minutes prior to each immediate subsequent three (3) minute duty cycle (i.e., 3 minutes ON - 1.5 minute cool - 3 minutes ON - 10 minutes cool).
For starting EGT limits refer to igure 3A-9.

CFM-56 ENGINE LIMITATIONS

(Refer to Figures 3A-10, 3A-11, 3A-12, and 3A-13.)

CFM-56 ENGINE OIL PRESSURE LIMITS

(Refer to Figure 3A-9 and 3A-14.)

CFM-56 ENGINE IGNITION

The engine ignition system may be used continuously.

THRUST REVERSERS

With the CFM-56 installed, only inboard thrust reversers may be used in flight. Do not exceed 350 knots/mach 0.76. Reverse power may be used up to the inflight thrust reverse stops but do not exceed 1.4 EPR. Before stowing reversers, reduce airspeed to 300 knots or below.

NOTE

The reversers may not stow at speed greater than 330 knots. In flight thrust reversers may be used up to VL/ML in an emergency.

Ground operations, reverse thrust may be used up to the ground reverse stops, but do not exceed maximum continuous thrust (MCT).

CFM-56 ENGINE OIL QUANTITY

Prior to engine start 8.5 qts. The oil tank quantity will decrease by approximately 3 quarts during engine operation due to "gulping".

CFM-56 OIL PRESSURE

Use caution when operating the engine with oil pressure outside of the normal pressure range.

Do not operate the engine when the oil pressure is below 13.5 psig.

CFM-56 SCAVENGE OIL TEMPERATURE

If the scavenge oil temperature rises above 160°C, throttle back and observe the oil temperature. Oil temperature between 160-170 is limited to four minutes. record in logbook.

CFM-56 ACCESSORIES LOCATION

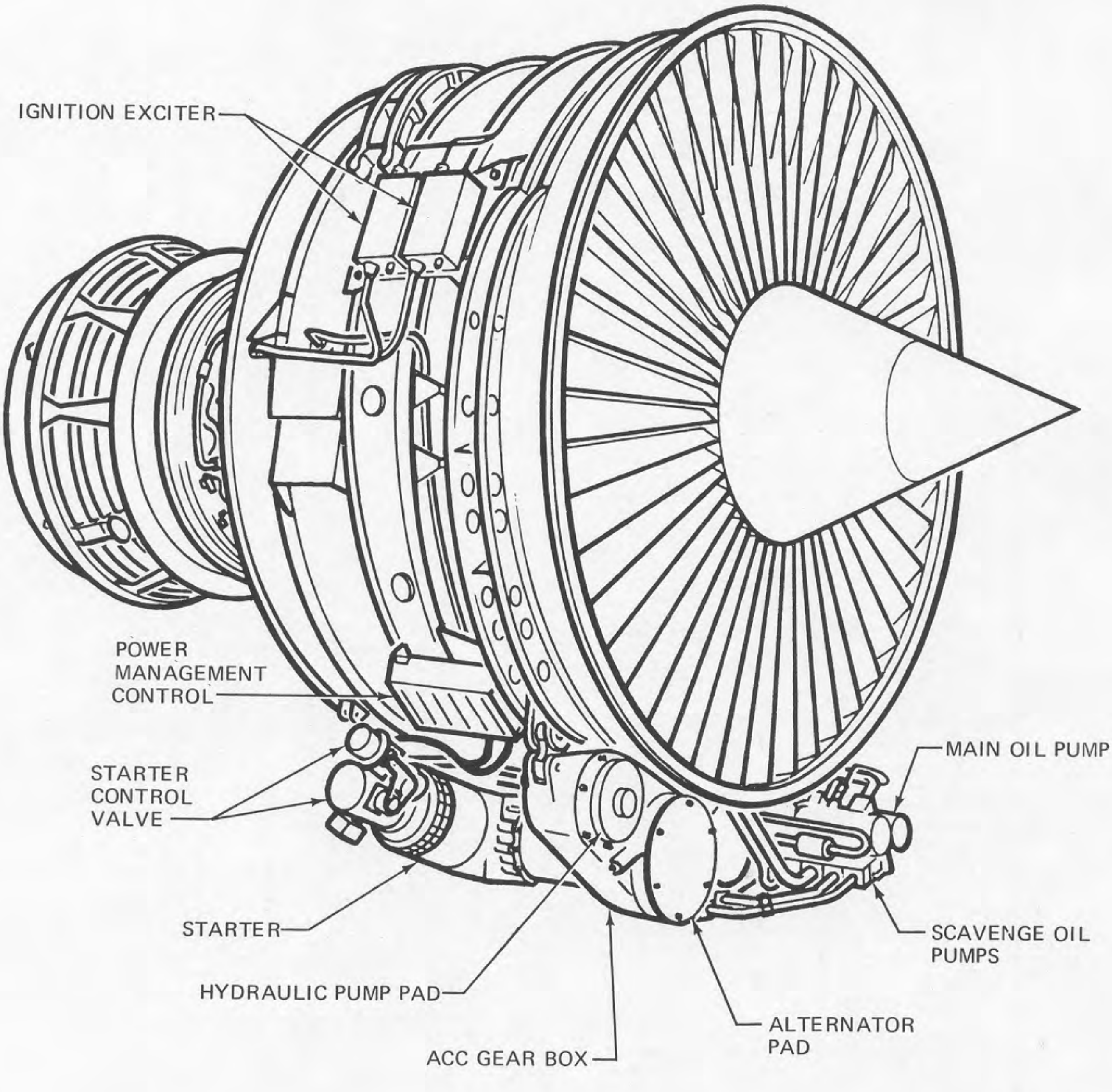


Figure 3A-1

PR7-C15-50009

CFM-56 FUEL SYSTEM SCHEMATIC

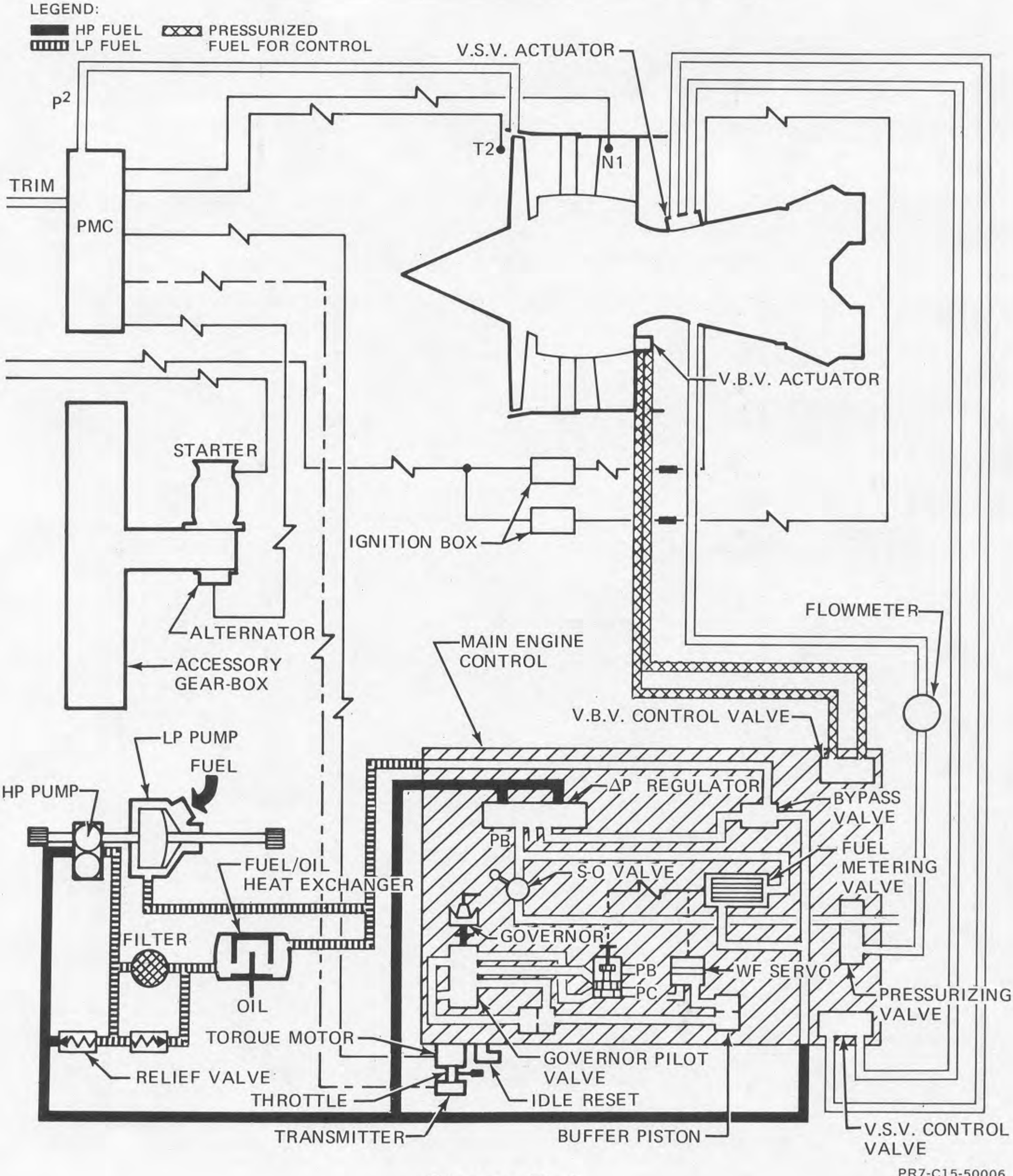


Figure 3A-2

CFM-56 ENGINE OIL SYSTEM

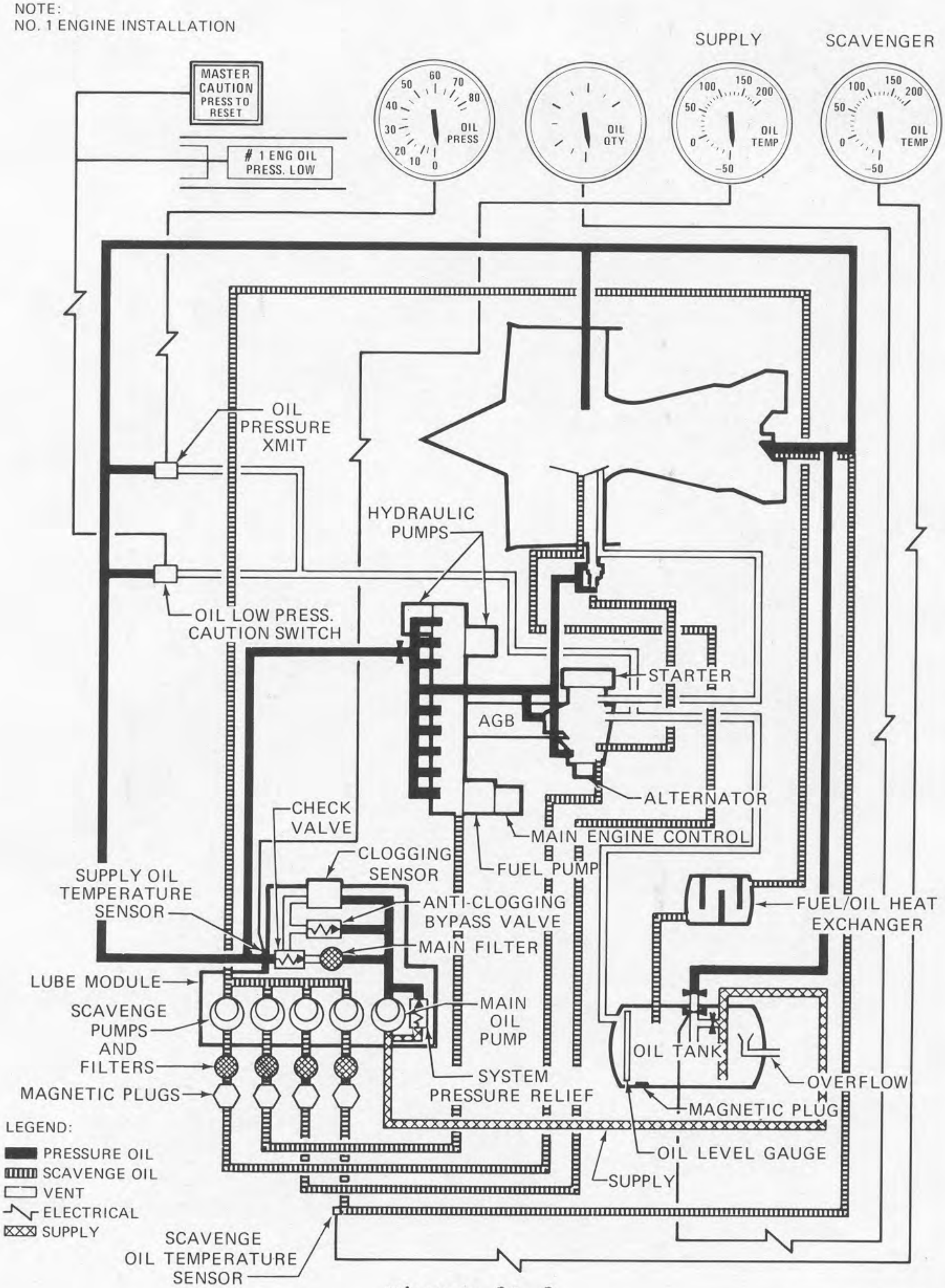


Figure 3A-3

PR7-C15-50000

CFM-56 ENGINE INSTRUMENTS

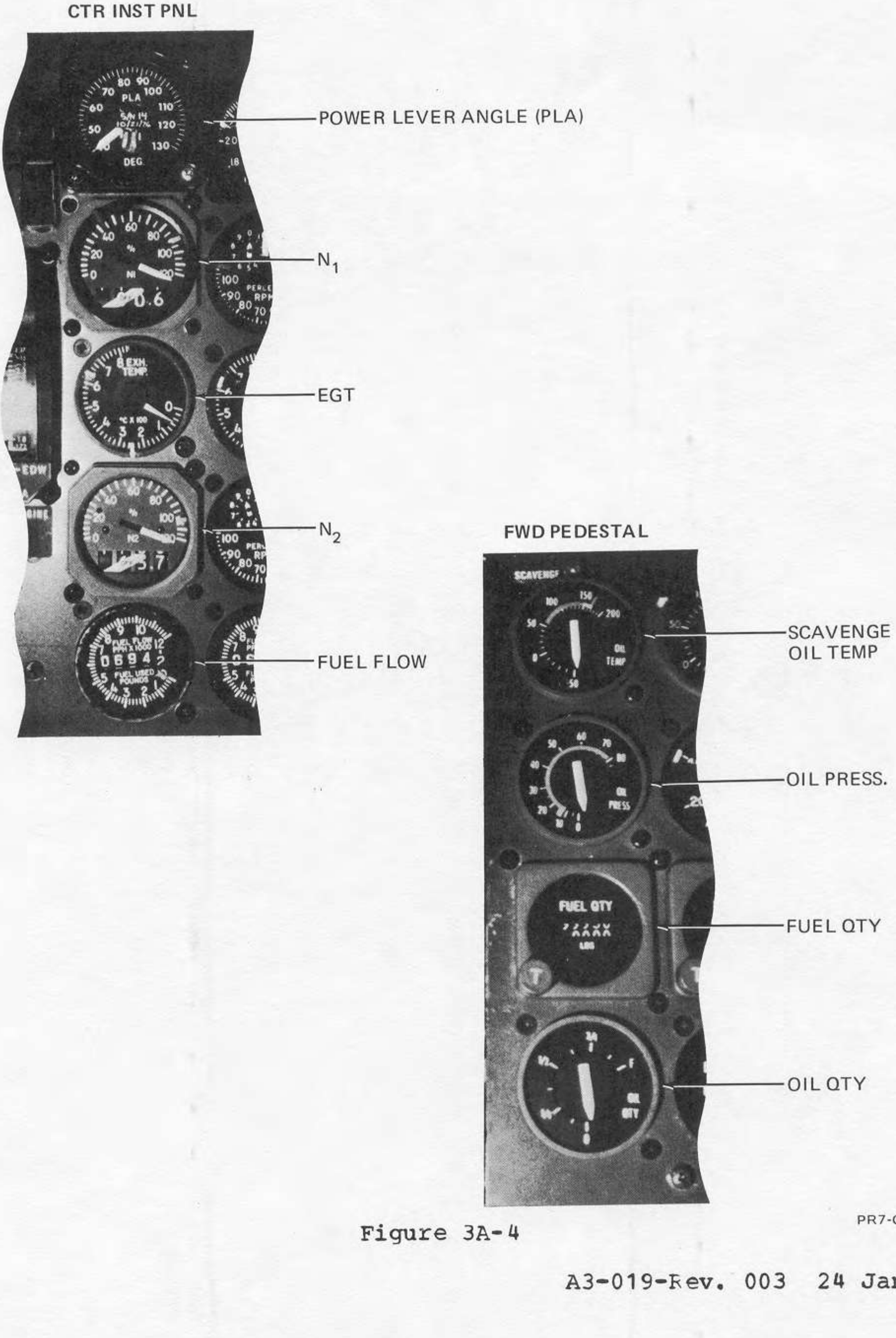
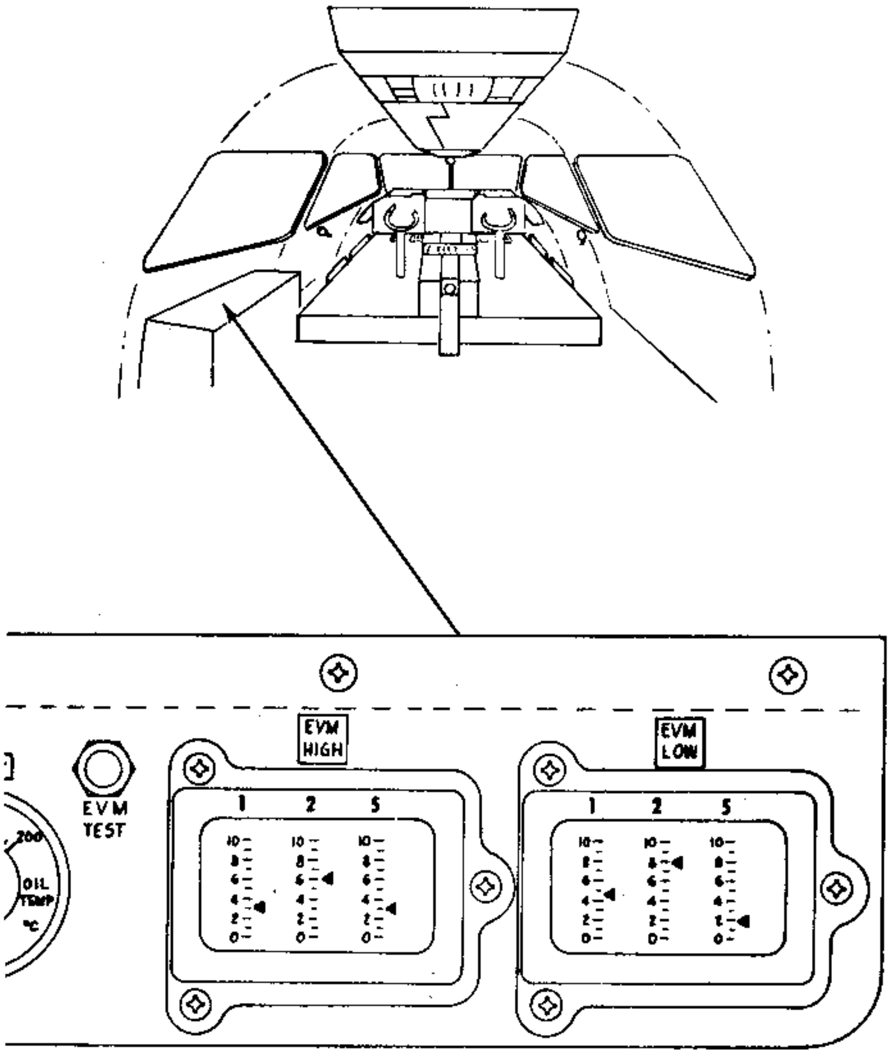


Figure 3A-4

ENGINE VIBRATION MONITOR



VIEW LOOKING DOWN ON AFT PORTION OF FLIGHT TEST ENGR PANEL

PR7-C15-50133

Figure 3A-5

CFM-56 FIRE EXTINGUISHER AND DETECTION SYSTEMS

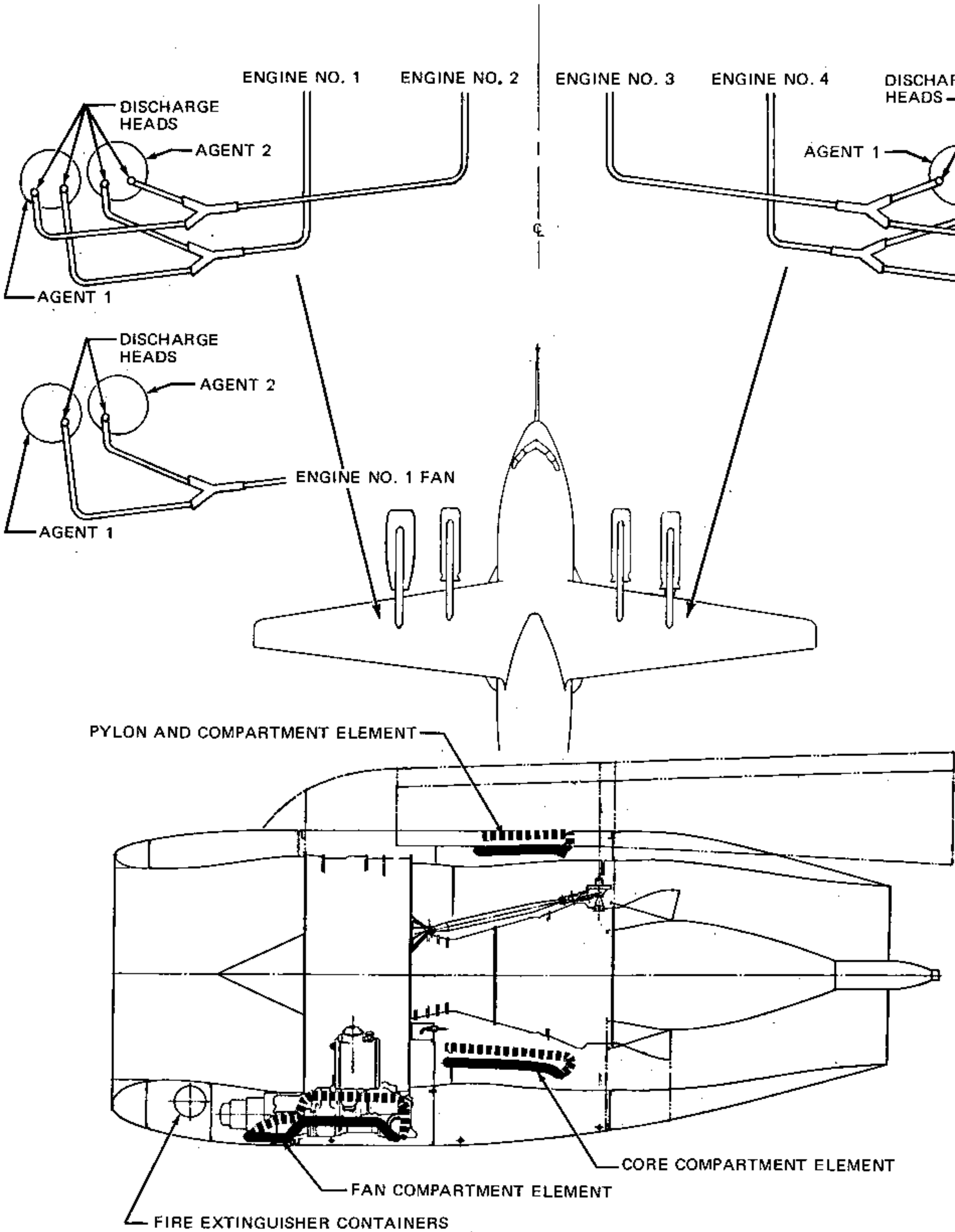
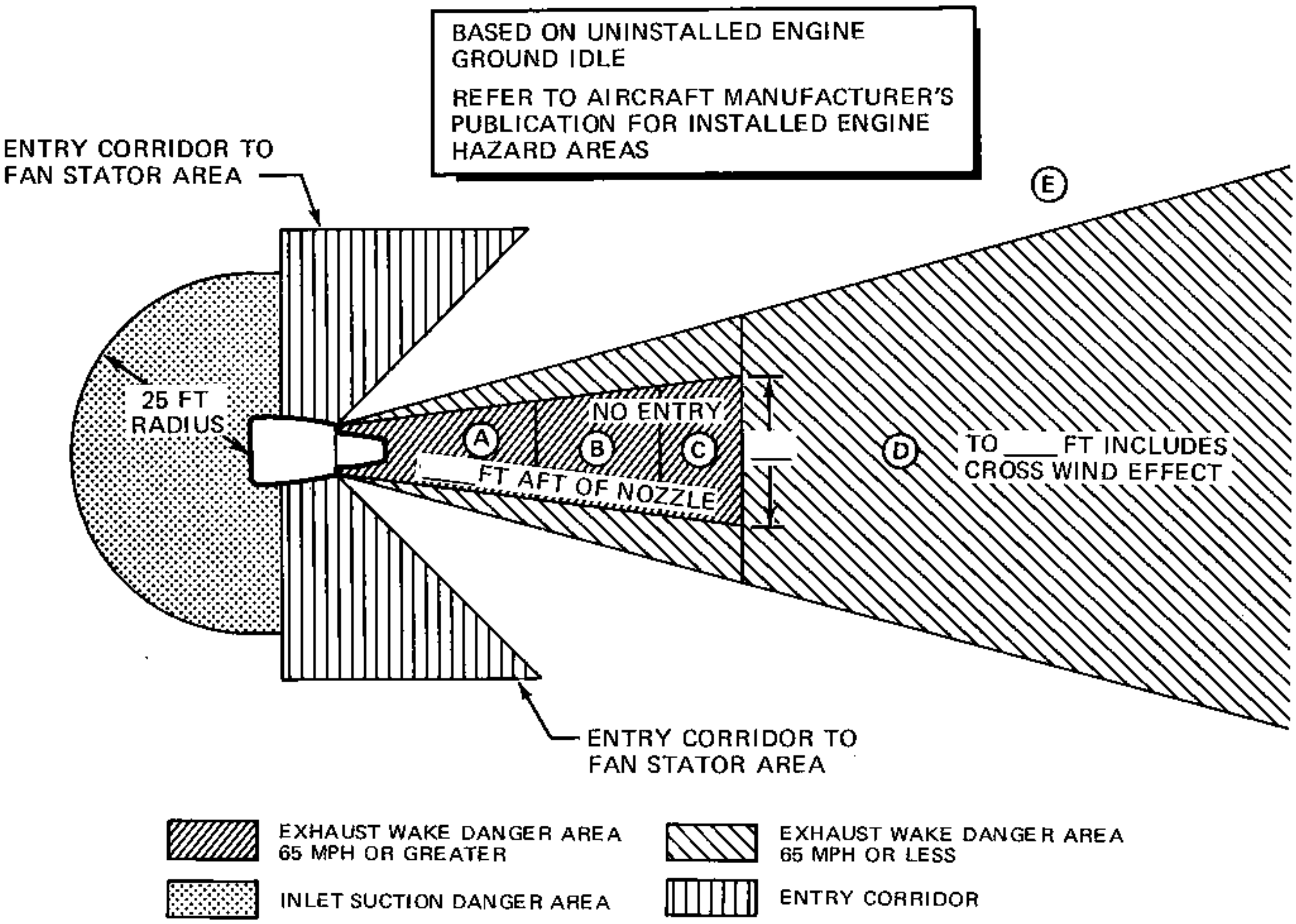


Figure 3A-6

CFM-56 ENGINE DANGER AREAS

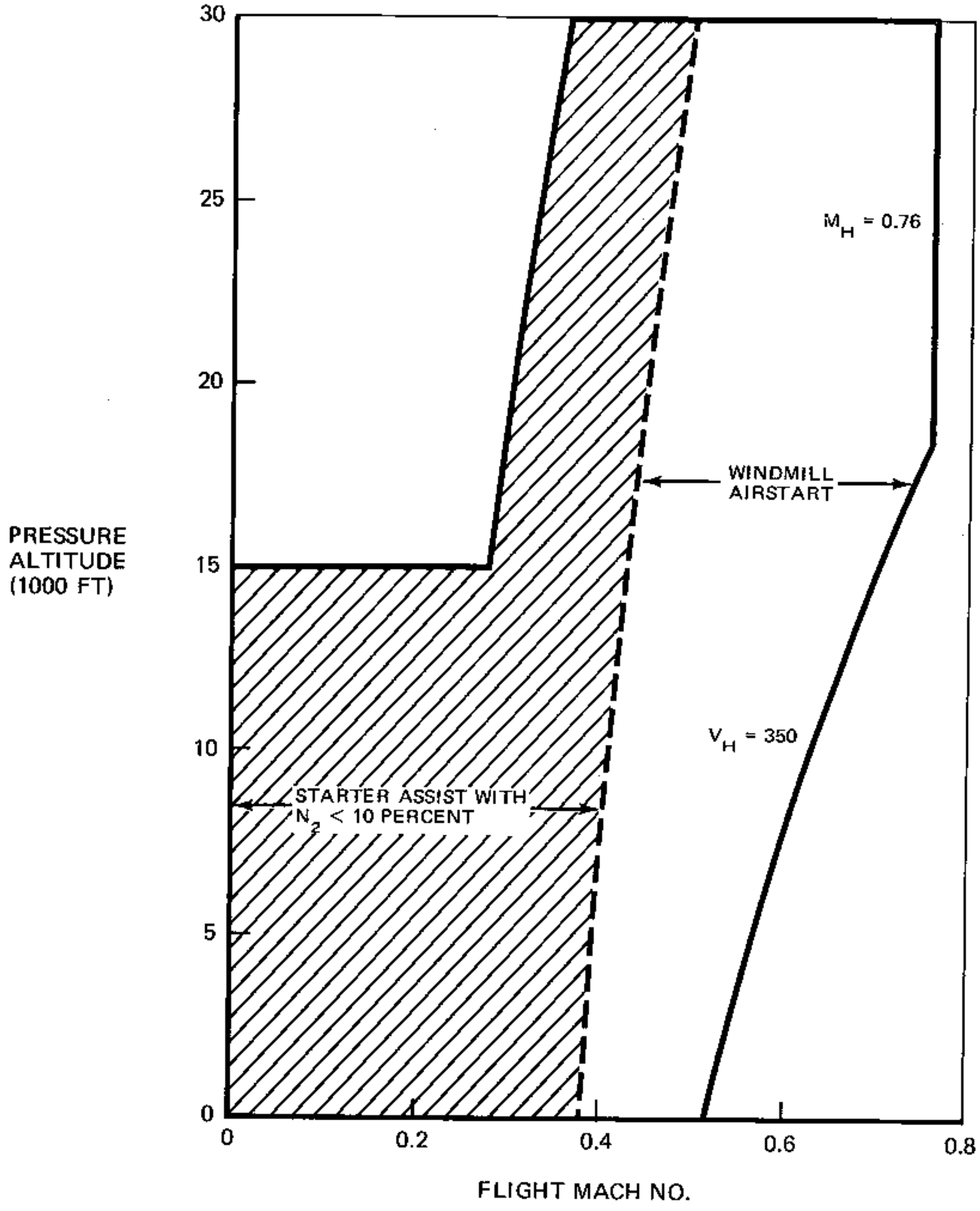


AREA	APPROX WIND VELOCITY (MPH)	POSSIBLE EFFECTS WITHIN DANGER ZONE BASED ON "RADIOLOGICAL DEFENSE" VOLUME II ARMED FORCES SPECIAL WEAPONS PROJECT, NOV 1951
A	210 TO 145	A MAN STANDING WILL BE PICKED UP AND THROWN.
B	145 TO 105	A MAN STANDING FACE-ON WILL BE PICKED UP AND THROWN; DAMAGE NEARING TOTAL DESTRUCTION TO LIGHT INDUSTRIAL BUILDINGS OR RIGID STEEL FRAMING; CORRUGATED STEEL STRUCTURES LESS SEVERELY
C	105 TO 65	MODERATE DAMAGE TO LIGHT INDUSTRIAL BUILDINGS AND TRANSPORT-TYPE AIRCRAFT
D	65 TO 20	LIGHT TO MODERATE DAMAGE TO TRANSPORT-TYPE AIRCRAFT
E	<20	BEYOND DANGER AREA

PR7-C15-50007

Figure 3A-7

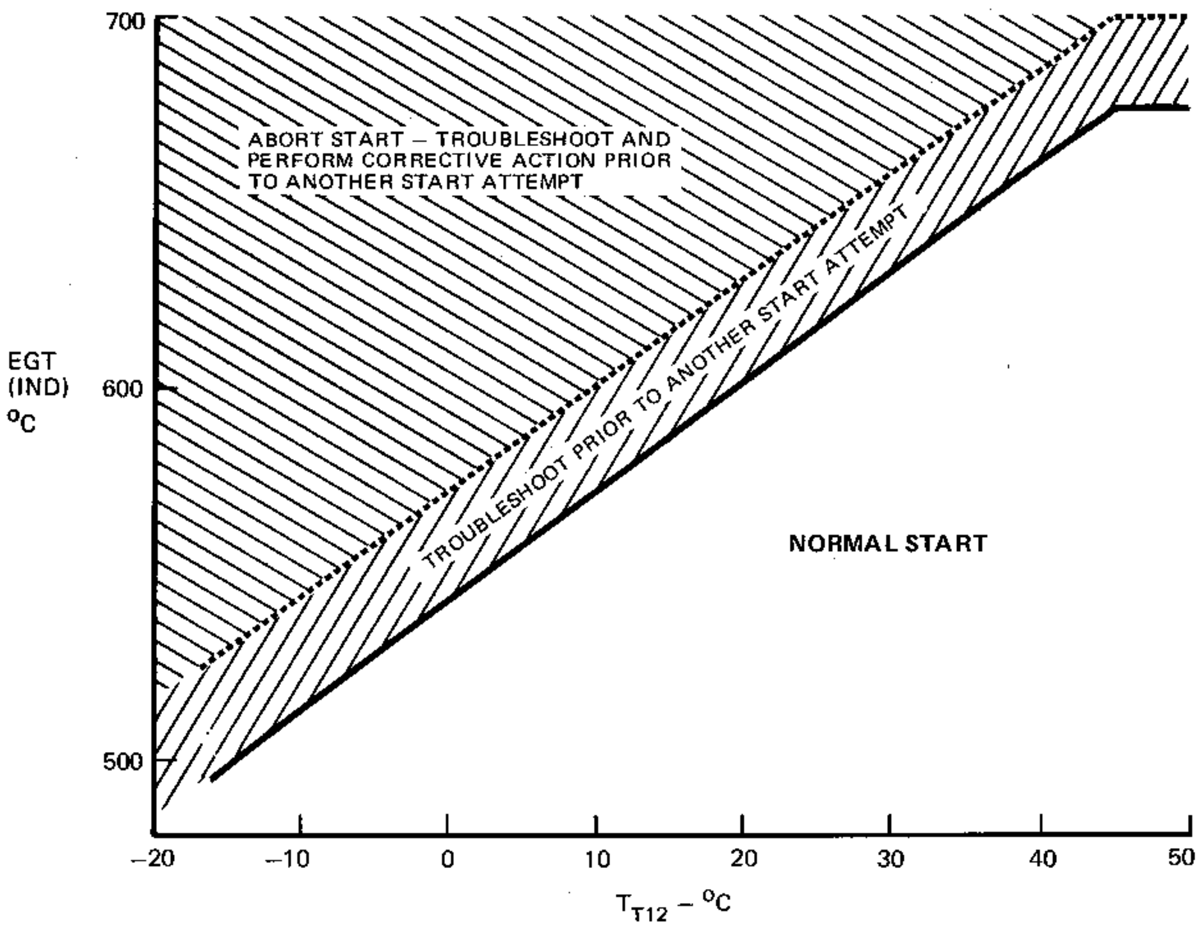
CFM-56 ENGINE START ENVELOPE



PR7-C15-50008

Figure 3A-8

CFM-56 EGT LIMITS, STARTING



PR7-C15-50127

Figure 3A-9

CFM-56 ENGINE OPERATING LIMITS

OPERATING CONDITIONS	OPERATING LIMITS						
	DURATION MINUTES	MAX EGT °C	OIL PRESS. PSIG	OIL TEMP °C	THRUST POUNDS (1)	MAX ROTOR SPEEDS (%)	
						N_1	N_2
TAKEOFF (FLAT-RATED TO SL STD + 9.5°C)	5 MINUTES	(3)	15 TO 90 NORMAL (4)	150 SUPPLY 160 SCAVEN	21,200	93	101.5
MAX CONT (FLAT-RATED TO SL STD + 10°C)	CONTINUOUS	(3)	15 TO 90 NORMAL (4)	150 SUPPLY 160 SCAVEN	19,410	93	101.5
MAX CLIMB (FLAT-RATED TO SL STD + 10°C)	CONTINUOUS		15 TO 90 NORMAL (4)	150 SUPPLY 160 SCAVEN	19,410	93	101.5
FLIGHT IDLE	CONTINUOUS	–	(4)	150 SUPPLY 160 SCAVEN	2,750	–	F.3A-11
GROUND IDLE	CONTINUOUS	–	(4)	150 SUPPLY 160 SCAVEN	890	–	F.3A-10
STARTING	–	(2)	–	–	–	–	–

THRUST (1) – REPRESENTS YC-15 INLET AND MIXED FLOW EXHAUST, WITH CYLINDRICAL NOZZLE

EGT CURVES (2) – STARTING – SEE FIGURE 3A-9

(3) – TAKEOFF 10-20°C IS 600°C WITH EACH 10° INCREMENT OF INCREASED TEMPERATURE ADD 10° TO THE BASIC EGT LIMIT (i.e., 20-30°C = 610°) SEE FIGURE 3A-11. WITH EACH 10° INCREMENT OF DECREASED TEMPERATURE SUBTRACT 10° FROM THE BASE EGT LIMIT (i.e., 0-10° = 590°C).

– MAXIMUM CONTINUOUS LIMITS – SEE FIGURE 3A-11

OIL PRESSURE – FULL-SCALE PRESSURE SURGES MAY OCCUR DURING COLD SOAK, SUBZERO TEMPERATURE STARTS. COLD-START BYPASS VALVE OPENS AT 300 PSI (SEE FIGURE 3A-13).

– UNDER EXTREME COLD CONDITIONS, WITH BOTH OIL AND FUEL AT LOW TEMPERATURE, THE OIL PRESSURE COULD EXCEED 90 PSI AT RATED CORE ENGINE SPEED. UNDER THESE CONDITIONS THE HIGH OIL PRESSURE IS ACCEPTABLE.

– FLIGHT AND GROUND IDLE NORMAL OIL PRESSURE IS 15 PSI OR ABOVE. LESS THAN 13.5 PSI DURING IDLE OPERATION REQUIRES ENGINE SHUTDOWN.

(4) – SEE FIGURE 3A-13 – OIL PRESSURE VERSUS CORE ENGINE SPEED

OIL TEMPERATURE – TRANSIENT TEMPERATURES UP TO 170°C MAXIMUM ARE LIMITED TO 4 MINUTES.

OUT OF LIMIT OPERATIONS – DURATION AND EXTENT OF ANY OPERATIONS BEYOND THE STATED LIMITS SHOULD BE RECORDED IN THE AIRCRAFT LOG AND APPROPRIATE CORRECTIVE ACTION SHOULD BE TAKEN.

PR7-C15-50131

Figure 3A-10

CFM-56 EGT LIMITS, TAKEOFF AND MCT

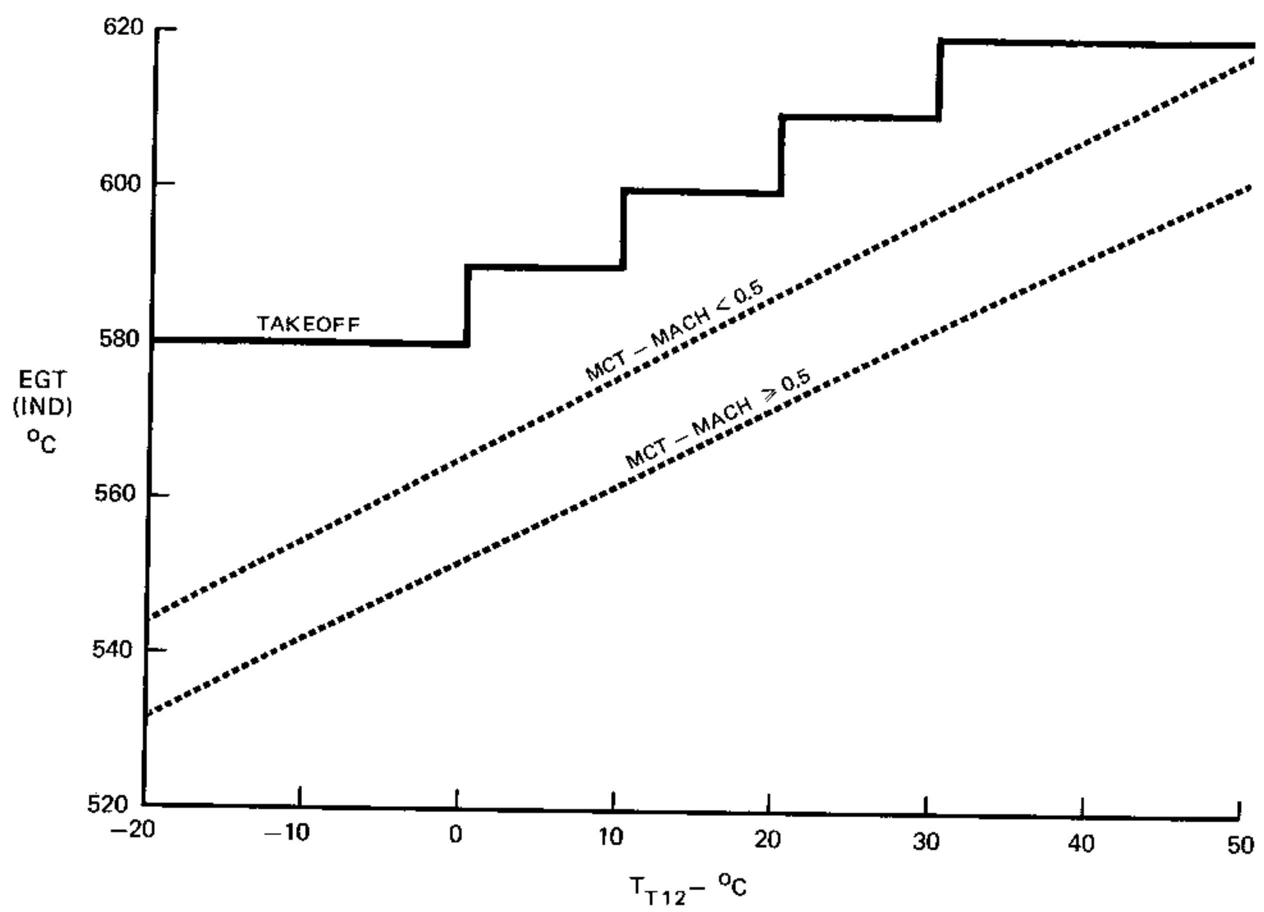


Figure 3A-11

PR7-C15-50158

CFM-56 GROUND IDLE SPEEDS

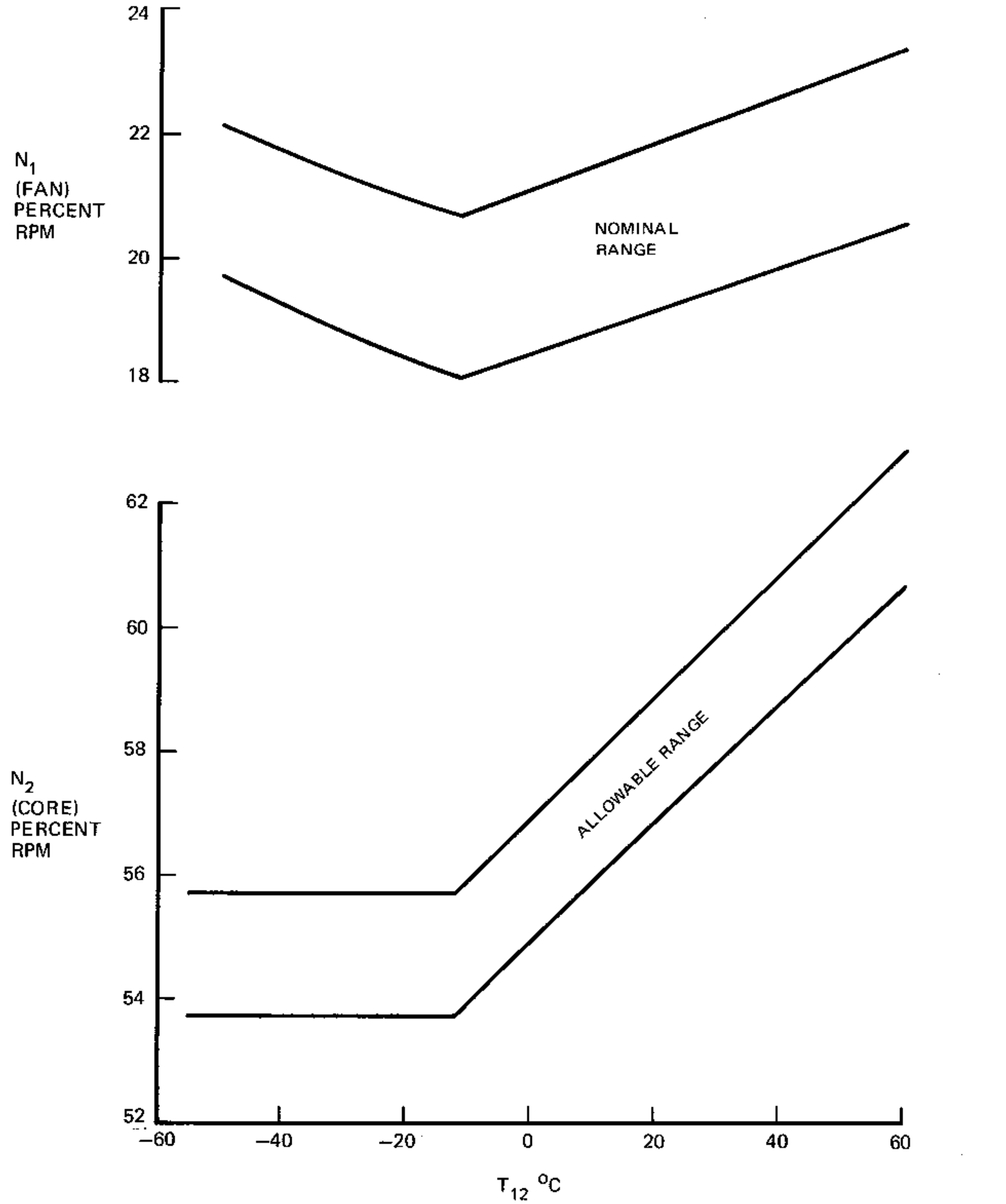


Figure 3A-12

CFM-56 FLIGHT IDLE SPEEDS

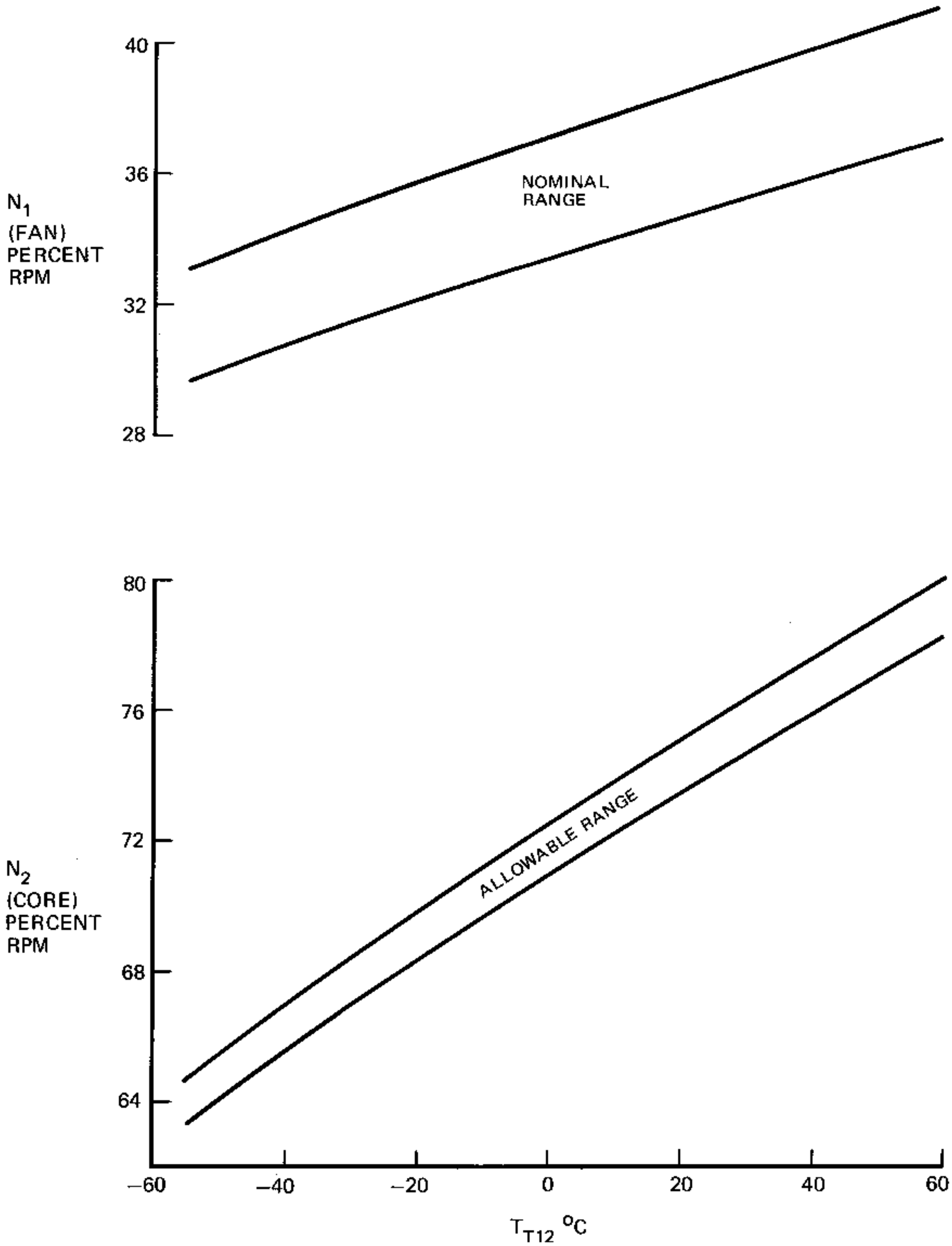


Figure 3A-13

CFM-56 OIL PRESSURE VERSUS N² SPEED

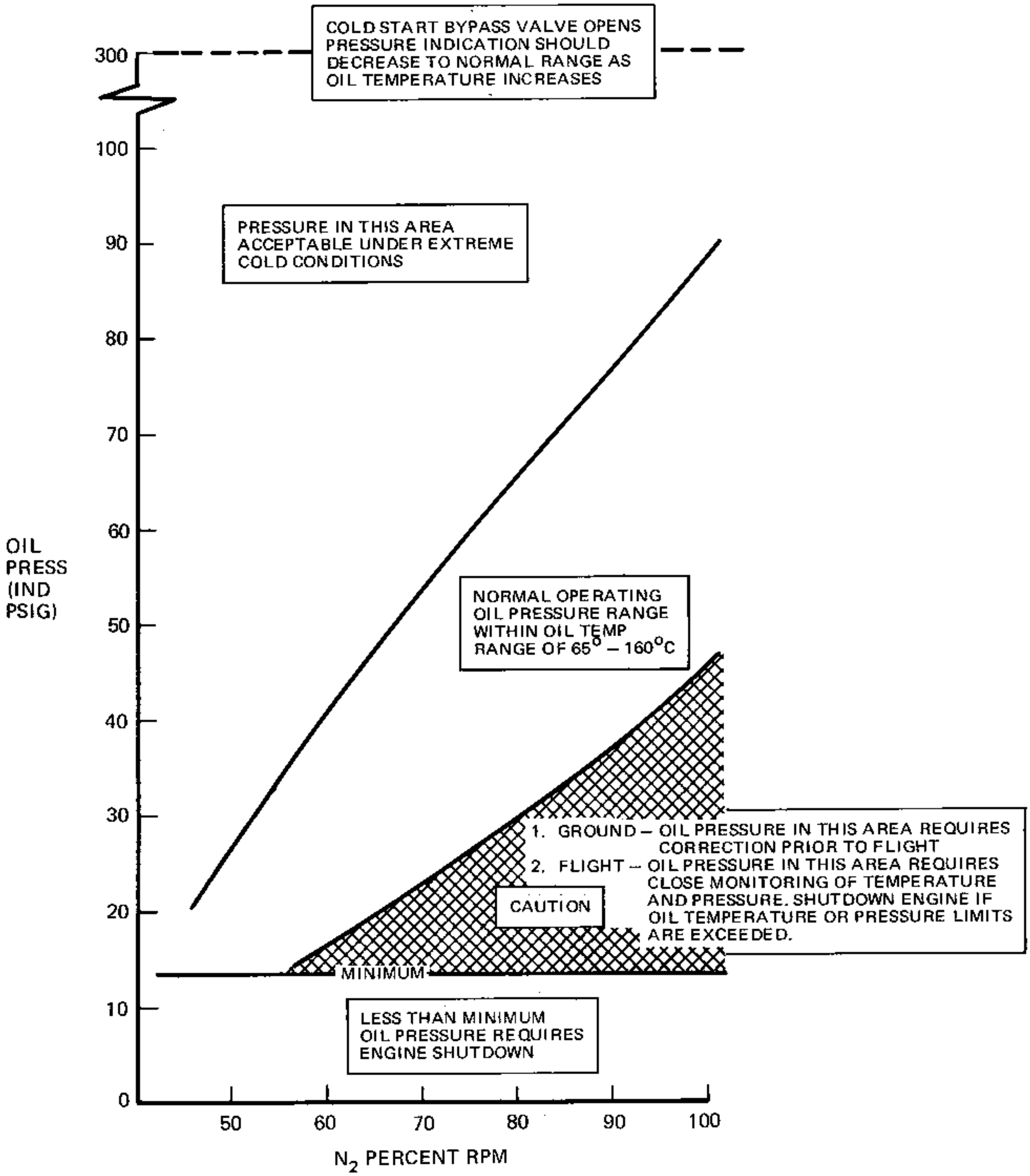


Figure 3A-14

APPENDIX IV

TABLE OF CONTENTS

DESCRIPTION AND OPERATION

JT8D-209 ENGINE (Aircraft 2 Only)

A Pratt and Whitney JT8D-209 turbofan engine is installed on Aircraft 2, number 1 engine pod. The JT8D-209 was derived from the JT8D-9 engine. This engine was designed to improve thrust capability, lower fuel consumption and reduce noise without affecting reliability and maintainability. It has a single stage fan, six low-pressure compressor stages, and seven high-pressure compressor stages. The uncooled, single stage, high-pressure turbine from the JT8D-9 has been retained. The low-pressure turbine has been completely redesigned to increase efficiency and to provide the torque carrying capability required by the new, larger diameter fan. The fan ducts have also been completely redesigned to incorporate acoustic treatment throughout the fan flowpath.

The engine is mounted in the JT8D-17 engine pod and required a new pylon, nose cowl and bullet and access doors.

The combustion chambers, fuel nozzles and ignition system are similiar to the JT8D-9 engine.

The exhaust system is a long duct, mixed flow configuration with forced mixed flow. The mechanical mixer is a nine-lobe daisy around a large centerbody. The four upper lobes have a lesser area to minimize heat impingement on the lower wing surface. This nozzle arrangement promotes good mixing of the exhaust gas with air to cool, slow down and spread the exhaust wake over a large span of the flaps.

The engine has a starting circuit, a throttle and reverse lever (disconnected). The pilots' instrument panels contain indicators for EPR, N1, N2, EGT and fuel flow. On the FTE's panel are indicators for the Engine Vibration Monitor System (EVM) and the Flight Mode Annunciator (FMA).

The accessory gearbox provides mounting pads for the: hydraulic pump, pneumatic starter, N2 tachometer generator, fuel pump and fuel control.

The JT8D-209 engine is flat rated to 84°F. Below 84°F, the engine operating at sea level develops 18,000 pounds of thrust. Above 84°F thrust decreases with increasing temperature. The amount of thrust developed is reflected on the EPR indicator and the FMA.

Refer to Section I (Description and Operation) for descriptions of the following items:

a. Engine Cooling

b. Engine Oil System

c. Engine Fuel Controller System

d. Engine Ignition System

e. Engine Ignition Switch

f. Engine Starting System

g. Engine start Switch

h. Engine Start Valve Open Light

i. Engine Starting, Normal

j. Fuel Lever

k. Engine Instruments

l. Engine Fire Detection System

m. Engine Fire Extinguisher System

n. Engine Oil Supply System.

Engine Thrust Reverser System - There is no thrust reverser system on the JT8D-209 engine, however thrust reverser cascades are simulated on one side of the exhaust fairing for the purpose of conducting flight tests.

Throttle - The throttle is the basic YC-15 throttle except that the reverser lever is disconnected and wired down.

JT8D-209 ENGINE VIBRATION MONITOR SYSTEM

An Engine Vibration Monitor System (EVM) (Figure 4A-1), located on the FTE's panel, provides a means of continuously monitoring the JT8D-209 engine compressor and turbine vibration. The system consists of engine mounted accelerometers, an amplifier/ controllers, two indicators and a Press-to-Test button. There is no ON-OFF switch for this system. The system is powered by the LEFT DC Bus through the ENG 1 VIB MONITOR CPRSR (V-9) and TURB (V-10) circuit breakers on the EPC panel.

If a system test is desired:

a. Press and hold the TEST button.

b. Observe that the pointers indicate a minimum of 3 units.

c. Release the TEST button and the pointers should return to a pretest display.

THRUST MANAGEMENT SYSTEM

A Thrust Management System (TMS) (Figure 4A-2) is installed in Aircraft 2 for use with the JT8D-209 engine, and provides a means of controlling and monitoring engine thrust. The TMS consists of a Data Adapter/Electronic Control Unit, an 1819B digital computer, Thrust Rating Indicator (TRI), Flight Mode Annunciator (FMA), four throttle servo actuators, annunciator light and switch.

The system provides continuous internal test and monitoring to verify the reliability of the computations and selected engine trim commands to provide symmetrical thrust output of the engines. It also computes and displays the value of the EPR LIMIT for each of the flight conditions from engine coefficients, altitude and temperature. The system limits the computed EPR LIMIT output value to 2.40 EPR maximum.

The controls and indicators descriptions are as follows:

JT8D-Engine Trim Servos Panel

An ENGINE TRIM SERVOS control and indication panel (Figure 4A-3), located on the glareshield panel, provides a means of controlling and monitoring the system. The panel contains the following:

FUNCTION MODE SELECTOR SWITCH - is a solenoid held two position (ENGAGE-DISENGAGE) switch that controls the TMS. When in ENGAGE, the TMS is energized. When in DISENGAGE, the system is disabled.

ENGINE TRIM Switch/Light has a dual function. When the mode selector switch is in ENGAGE and the system is operable, the ENG TRIM light comes on GREEN. When the system fails, the ENG TRIM green light goes off and then flashes AMBER. Simultaneously the mode selector switch repositions to OFF. Also when the function switch is placed in DISENGAGE, the

ENG TRIM light flashes amber. Pressing the flashing amber light turns it OFF.

TRIM LIMIT Light - comes on amber to alert the pilots that one or more throttle servo actuators is at the trim limit.

Manual Sync Switch

MANUAL SYNC Switch (Figure 4A-3), located on the FTE's panel, provides a means of synchronizing the servo actuators to the null position. This switch is only operable when the TMS ENGINE TRIM SERVO function mode selector switch is in DISENGAGE.

Engine Trim Test Switch

The ENG TRIM test switch (Figure 4A-3), located on the FTE's panel, has two positions, momentary TEST and NORM. This switch is inhibited in flight. When the ENG TRIM switch is momentarily placed in TEST, an automatic test sequence is initiated so that the LRU failures can be identified.

EPR Limit Switch

The EPR LIMIT Switch (Figure 4A-3), located on the FTE's panel, is a momentary three-position, center OFF type. When held in ENG-1, the parameters of the -209 engine equivalent -17 EPR limit will be displayed in the FMA. When held in ENG 3, the parameters of the -17 engine will be displayed.

Flight Mode Annunciator

A Flight Mode Annunciator (Figure 4A-3), located on the FTE's panel, displays appropriate messages during preflight checks and also during flight. The intensity of the FMA is controlled by a DISPLAY BRIGHTNESS rotary knob.

Thrust Rating Indicator

A Thrust Rating Indicator (TRI) (Figure 4A-3), located on the pilots' center instrument panel, provides a means of selecting, displaying and monitoring the EPR mode. A Ram Air Temperature window displays the current RAT. The ENGINE TRIM SERVOS function mode selector switch will effectively turn on and off the TRI. The TRI receives 28 VDC power from the LEFT DC Bus through the RAT THRUST RATING IND (E-19) circuit breaker on the EPR panel. A description of the TRI follows:

RAT °C - window displays the current RAT in numerals with the word "plus" or "minus" preceeding the digital readout.

EPR LIM - digital readout window displays the selected EPR Limit.

EPR Mode Selector Switch/Lights - Four mode selector switch/lights (T.O., GA, MCT, CL) provide a means of selecting the EPR mode. When T.O. is momentarily pressed, its integral blue light comes on and the EPR LIM window displays the maximum EPR allowable for TAKEOFF. GA is go-around, MCT is Maximum Continuous Thrust and CL is Climb.

TEST Button - Provides a means of testing the system. It is only operable on the ground.

If the TRI is to be tested, proceed:

a. Check that the ENGINE TRIM SERVOS function mode selector switch is in ENGAGE.

b. Press and hold the TEST button.

c. The RAT window should display PLUS 12 ± 2.

d. The EPR LIM window should display 2.11.

e. The blue NO MODE light should come on.

f. Release the TEST button.

g. Observe that the -

1. RAT window shows Ambient Temperature,

2. EPR LIM window shows 2.00,

3. The blue NO MODE light is ON, and,

4. Flag is in view.

NOTE

These indications will remain until an EPR mode is selected.

There are two operational modes: Limit and Trim. The LIMIT MODE becomes functional when the Function Mode Selector Switch is in ENGAGE and for:

1. TAKEOFF with the -

a. T.O. mode selected on the TRI and

b. TOGA button on the throttle pressed.

2. GO-AROUND with the -

a. Gear down or flaps in landing range and

b. GA mode selected on the TRI and,

c. TOGA button on the throttle pressed.

For a Touch and Go the aircraft must be on the ground for less than 20 seconds in order to revert from Trim Mode to Limit Mode when the TOGA button is pressed. If the aircraft is on the ground more than 20 second, the system must be disengaged, re-engaged, T.O. and TOGA switches pressed.

In the LIMIT MODE, the system shall maintain engine EPR at the level determined by the selected limits (T.O. or GA) on the TRI for the JT8D-17 engines. The maximum allowable EPR limit for the TMS is 2.4 EPR.

The LIMIT MODE ceases to be operational when the system is disengaged or a thrust rating other than T.O. or GA is selected on the TRI.

The TRIM MODE becomes operational when the function mode selector switch is in ENGAGE, aircraft is in flight, and either MCT or CL thrust mode is selected on the TRI. The TRIM MODE equalizes all four engine EPR levels to the commanded EPR derived from the mid-value EPR.

Whenever the servo actuator commands exceed the authority limit, power is removed and LIMIT is displayed in the FMA if the error is greater than .01 EPR for 3 seconds. The servo actuators are recentered (synchronized) whenever the function mode selector switch is placed from DISENGAGE to ENGAGE. They do not synchronize when DISENGAGED. This is done with the MANUAL SYNC switch. Control power to the servo actuators is removed when:

1. Engine EPR is less than 1.2.

2. Airspeed is more than 60 knots and in T.O. mode.

3. Actuators have exceeded their limits.

4. System failure occurs.

During TRIM MODE, the commanded EPR is limited to the selected computed EPR on the TRI. During throttle pilot inputs, the TMS will not permit overshoots greater than .01 EPR.

The TRIM MODE ceases to be operational when the LIMIT MODE is selected.

JT8D-209 NORMAL PROCEDURES

Before Start Checklist - "COMPLETED" (CP)

JT8D-209 STARTING ENGINE

1. Pneumatics - "ENG START" (P)

2. Pneumatic Pressure - "CHECKED" (P)

   Pneumatic pressure gage should be checked to determine that a minimum pneumatic pressure of 36 PSI at sea level (subtract 1 PSI per 1000 feet increase in pressure altitude) is available for engine starting.

3. Ignition - "GROUND START AND CONTINUOUS" (P)

   The GND START & CONTIN position of ignition switch will make high energy ignition available through ON positions of engine start switches and fuel levers. As soon as start switch is released, low energy continuous ignition will be operating.

4. Anti-collision Lights - "ON" (P)

   Turn anti-collision light ON as indication that engines are about to be started or are operating.

NOTE

The wing tip strobe lights will come also.

5. Start Clearance - "CLEAR TO START ENGINES" (CP/LM)

   For the JT8D-209 engine, copilot ensures that area is clear to to start engines, and assures that fire guard is in position. Fire guard will observe engine start and maintain contact with flight crew on interphone or visually. Upon receiving clearance to start, the pilot will start #1 engine using the following procedures:

   a. Start switch - ON (HOLD)

      CAUTION

      If start switch is accidently disengaged, discontinue start and wait until N2 rotation has ceased. Engaging starter while rotor is turning will damage starter drive gear train. Discontinue start if starter duty cycle, engine starting or operating limits are exceeded.

   b. ENG START VALVE OPEN light - ON

      If ENG START VALVE OPEN light remains off and no rotation is noted, refer to paragraph START VALVE MALFUNCTION.

   c. N2 RPM - ROTATION CHECKED

      NOTE

      If no N2 rotation, check

N1 tachometer. If N1 rotation is confirmed, continue start, using TBD N1 RPM for fuel ON and start switch OFF TBD N1 RPM.

d. Oil pressure - CHECKED FOR RISE

If no oil pressure is indicated by 20% N2, discontinue start and investigate.

e. N1 RPM - ROTATION CHECKED

If no N1 indication, discontinue start (possible N1 rotor seizure). Confirm N1 rotation with ground crew. If N1 rotation is normal proceed with normal start using N2 and remaining engine indications.

f. Fuel levers - ON at 20% N2 RPM

g. Fuel flow - CHECKED APPROX 800 to 1000 PPH

CAUTION

A starting fuel flow indication of 1100 PPH or more is an indication of a possible hot start. EGT should be closely monitored.

h. EGT - RISING

If EGT does not rise within 20 seconds after fuel ON, discontinue start and proceed with UNSATISFACTORY START and/or CLEAR ENGINE procedure.

i. Start switch - RELEASE at 35% N2 RPM

j. ENG START VALVE OPEN light - CHECKED OFF

CAUTION

ENG START VALVE OPEN light goes off to indicate that start valve has closed. Prolonged operation with start valve open will damage the starter.

If light remains ON, refer to STARTER VALVE MALFUNCTION procedure.

6. Starting Engines Checklist - "Completed"

When engine operation has stabilized, check instructions and complete remaining items of starting engines checklist.

JT8D-209 Starter Valve Malfunction

If the start valve fails to open or remains open after engine stabilizes at idle, shut down engine and notify the crew chief.

JT8D-209 Unsatisfactory Start

If the engine starts unsatisfactorily, proceed:

1. Fuel Lever - OFF (P)
2. If starter is still engaged, continue rotation for 10 to 15 seconds to clear engine of fuel.
3. Start switch - OFF (P)
4. Ignition - OFF (CP)

NOTE

Determine cause

of malfunction. Proceed with clear engine procedure before attempting restart.

JT8D-209 Clear Engine Procedure

If the engine needs to be cleared, proceed:

1. Throttle - IDLE (P)

2. Fuel lever - OFF (P)

3. N2 RPM - Check rotation ceased

4. Ignition - OFF (CP)

5. Start switch - ON (hold 20 seconds) (P)

CAUTION

Do not exceed starter duty cycle of 1 minute on, 30 seconds OFF; 1 minute ON, 1 minute OFF.

JT8D-209 EMERGENCY PROCEDURES

JT8D-209 AIRSTART (ENGINE RESTART)

The engine start envelope (figure 4A-4) shows the altitude and speed envelope in which windmilling airstarts should normally be successful.

1. Throttle-----------IDLE (CP)

2. Fuel Lever----------OFF (CP)

3. Fire Shutoff Handle---STOWED (CP)

4. Fuel Tank Pumps------ON (CP)

5. Airspeed ------WITHIN LIMITS (per Fig. 4A-4)

6. RPM (N1 and N2)---INDICATING

CAUTION

The ENG START switches should not be used in-flight as damage to the starter/engine may occur.

7. Oil Pressure------INDICATING

8. Ignition----------"OVRD" (P)

Duty cycle for override position is: 2 Min. ON, 3 Min. OFF, 2 Min. ON, 23 Min. OFF.

9. Fuel Lever----------"ON" (P)

NOTE

If EGT and RPM do not rise within 20 seconds after the fuel lever has been place in the ON position, discontinue airstart. Shutdown engine in accordance with ENGINE SHUTDOWN checklist.

After successful airstart:

10. Engine Instruments---CHECKED (P, CP)

Check the engine generator (if applicable) is on the line, voltage and frequency are normal and AC load distribution is normal.

11. Ignition----AS REQUIRED (CP)

12. Hydraulic System-----CHECKED (CP)

13. Airstart Checklist-------"COMPLETED" (CP)

JT8D-209 SYSTEM MALFUNCTION

JT8D-209 OIL TEMPERATURE HIGH

The oil temperature limit is 139°C for continuous operation and 177°C for transient operation. During transient operation, the oil temperature may exceed 139°C for a period of not more than 15 minutes. If these limits are approached, increasing thrust will provide higher fuel flows to improve oil cooling until lower fuel flows are capable of maintaining oil temperature within limits.

JT8D-209 OPERATING LIMITATIONS

This portion of the Flight Manual contains the design limitations on the JT8D-209 engine that must be observed for safe and efficient engine operation.

JT8D-209 INSTRUMENT MARKINGS

TBD

JT8D-209 STARTING LIMITATIONS

Starter Duty Cycle is one minute ON, 30 seconds OFF, one minute ON and one minute OFF. The cycle may be repeated as often as required.

Exhaust Gas Temperature: if the exhaust gas temperature increases to 510°C (momentary), discontinue start and record hot start on appropriate form. An overtemperature inspection must be accomplished before a restart is attempted.

JT8D-209 ENGINE LIMITATIONS

(Refer to Figure 4A-5.)

JT8D-209 ENGINE OIL PRESSURE LIMITS

(Refer to Figure 4A-5.)

THRUST REVERSERS

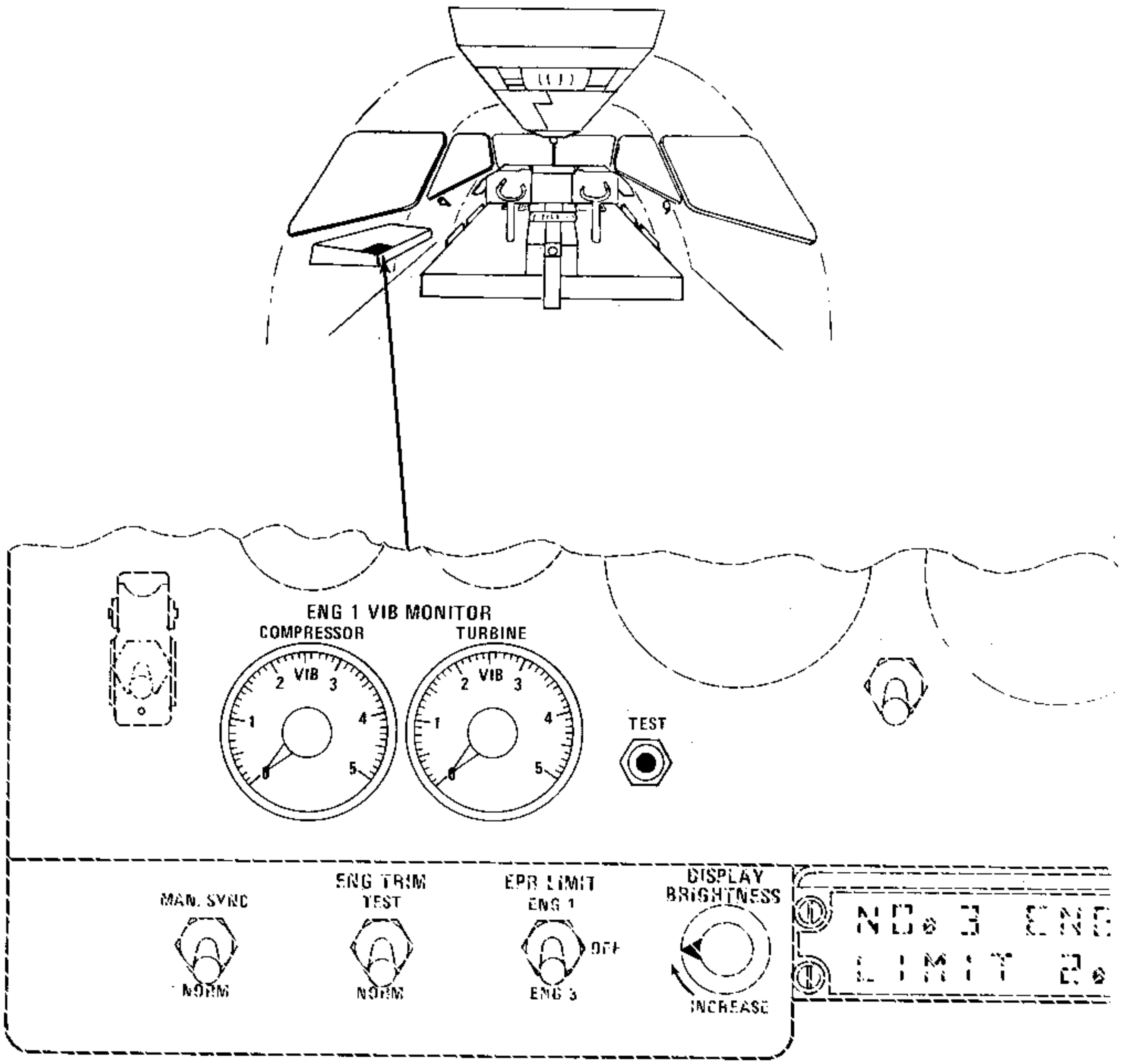
With JT8D-209 installed, only inboard thrust reversers may be used inflight. Do not exceed 350 knots/mach 0.76. Reverse power may be used up to the inflight thrust reverse stops but do not exceed 1.4 EPR. Before stowing reversers, reduce airspeed to 300 knots or below.

NOTE

The reversers may not stow at speed greater than 330 knots. In flight thrust reversers may be used up to VL/ML in an emergency.

Ground operations, reverse thrust may be used up to the ground reverse stops, but do not exceed aximum continuous thrust (MCT).

JT8D-209 ENGINE VIBRATION MONITOR

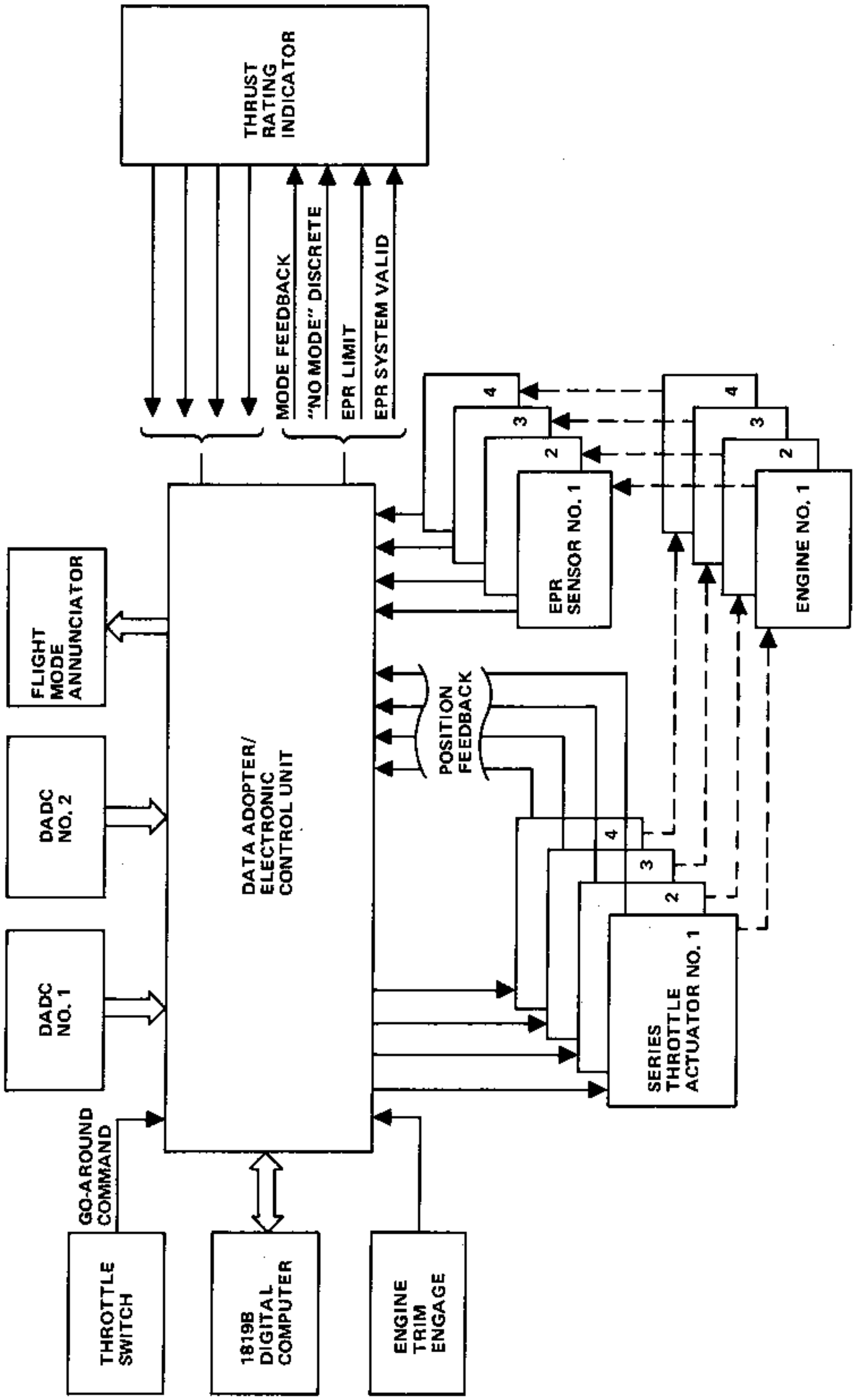


VIEW LOOKING DOWN ON AFT PORTION OF FLIGHT TEST ENGINEER'S PANEL

Figure 4A-1

PR7-C15-50154

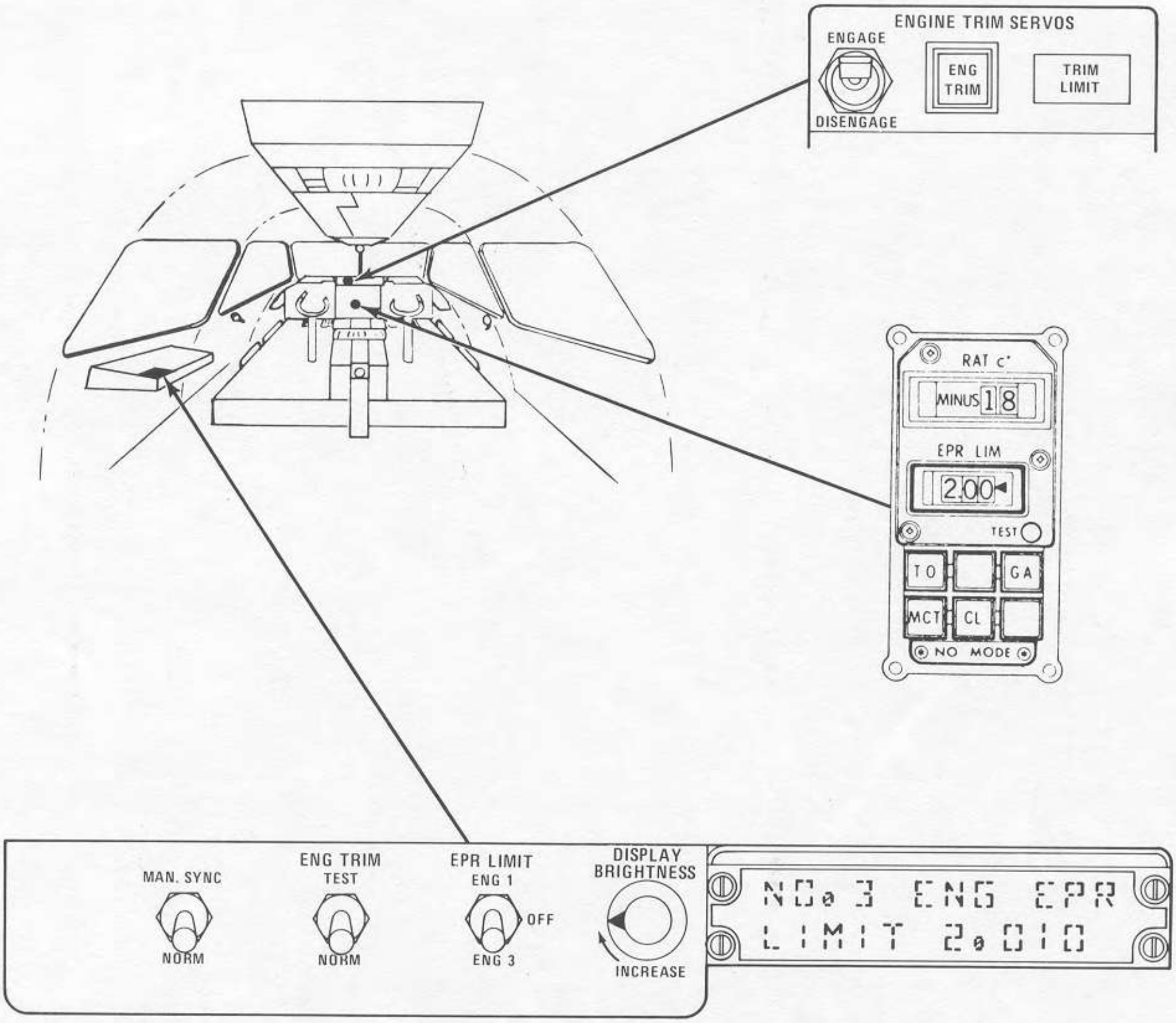
THRUST MANAGEMENT SYSTEM BLOCK DIAGRAM



PR7-C15-50156

Figure 4A-2

THRUST MANAGEMENT SYSTEM CONTROLS AND INDICATORS



AIRCRAFT 2 ONLY

Figure 4A-3

PR7-C15-50153

JT8D-209 ENGINE START ENVELOPE ESTIMATED

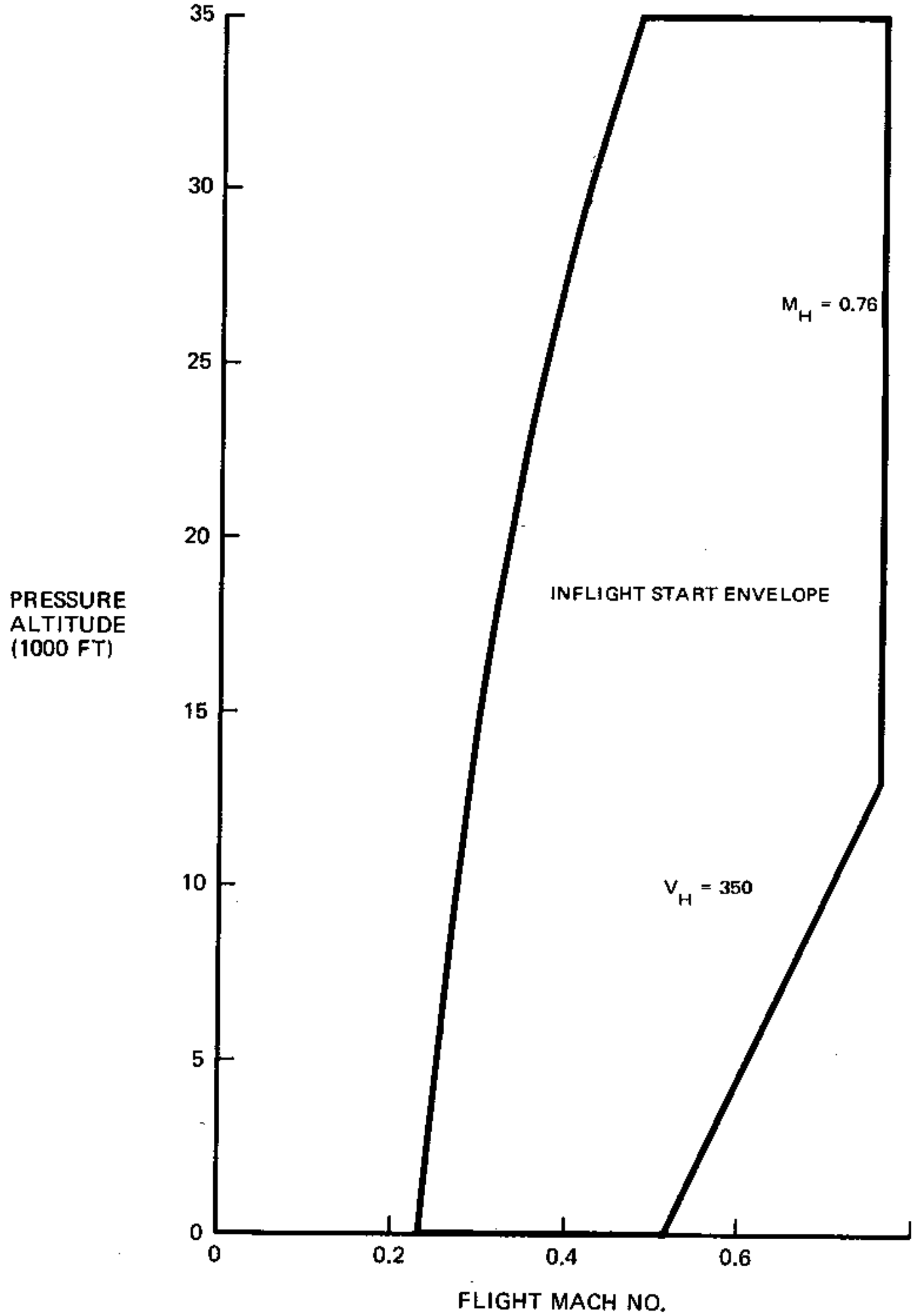


Figure 4A-4

PR7-C15-50155

JT8D-209 ENGINE OPERATING LIMITS

OPERATING CONDITIONS	OPERATING LIMITS					
	TIME LIMIT	MAX EGT (°C)	OIL[1] PRESS. (PSIG)	OIL[2] TEMP (°C)	THRUST SL (STD)	MAX ROTOR SPEEDS
TAKEOFF	5 MINUTES	515	40-55	139	18,000[3]	N_1 N_2
MCT	CONTINUOUS	475				8044 RPM = 97.8% 12,250 RPM = 100%
IDLE	CONTINUOUS	420[5]				
STARTING	MOMENTARY	510[4]				
ACCEL	2 MINUTES	515				

[1] PRESSURES BETWEEN 35-40 PSIG ARE PERMISSIBLE FOR SUSTAINING FLIGHT AT REDUCED POWER SETTINGS; PRESSURES BELOW 35 PSIG ARE UNSAFE AND THE ENGINE WILL BE SHUT DOWN.

[2] OIL TEMPERATURE IN EXCESS OF 139°C, BUT NOT OVER 177°C, IS ALLOWED FOR A MAXIMUM OF 15 MINUTES.

[3] TAKEOFF RATED THRUST OF THE JT8D-209 ENGINE IS AVAILABLE UP TO AN AMBIENT TEMPERATURE OF 29°C (84°F).

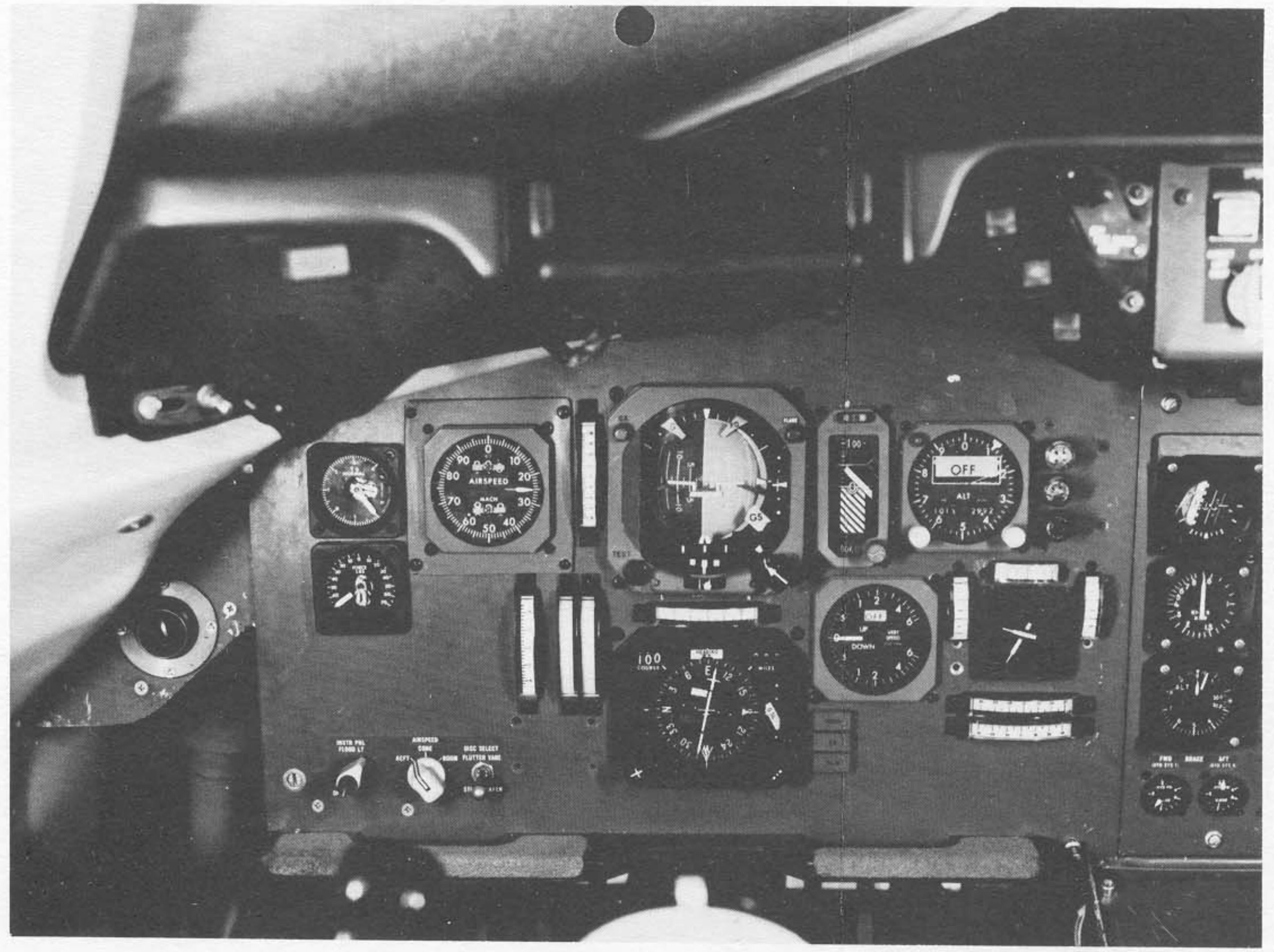
[4] THIS TEMPERATURE IS LIMITED TO MOMENTARY FOR STARTING. IF MAXIMUM ALLOWABLE STARTING EGT IS EXCEEDED, THE ENGINE SHALL BE SHUT DOWN AND INSPECTED.

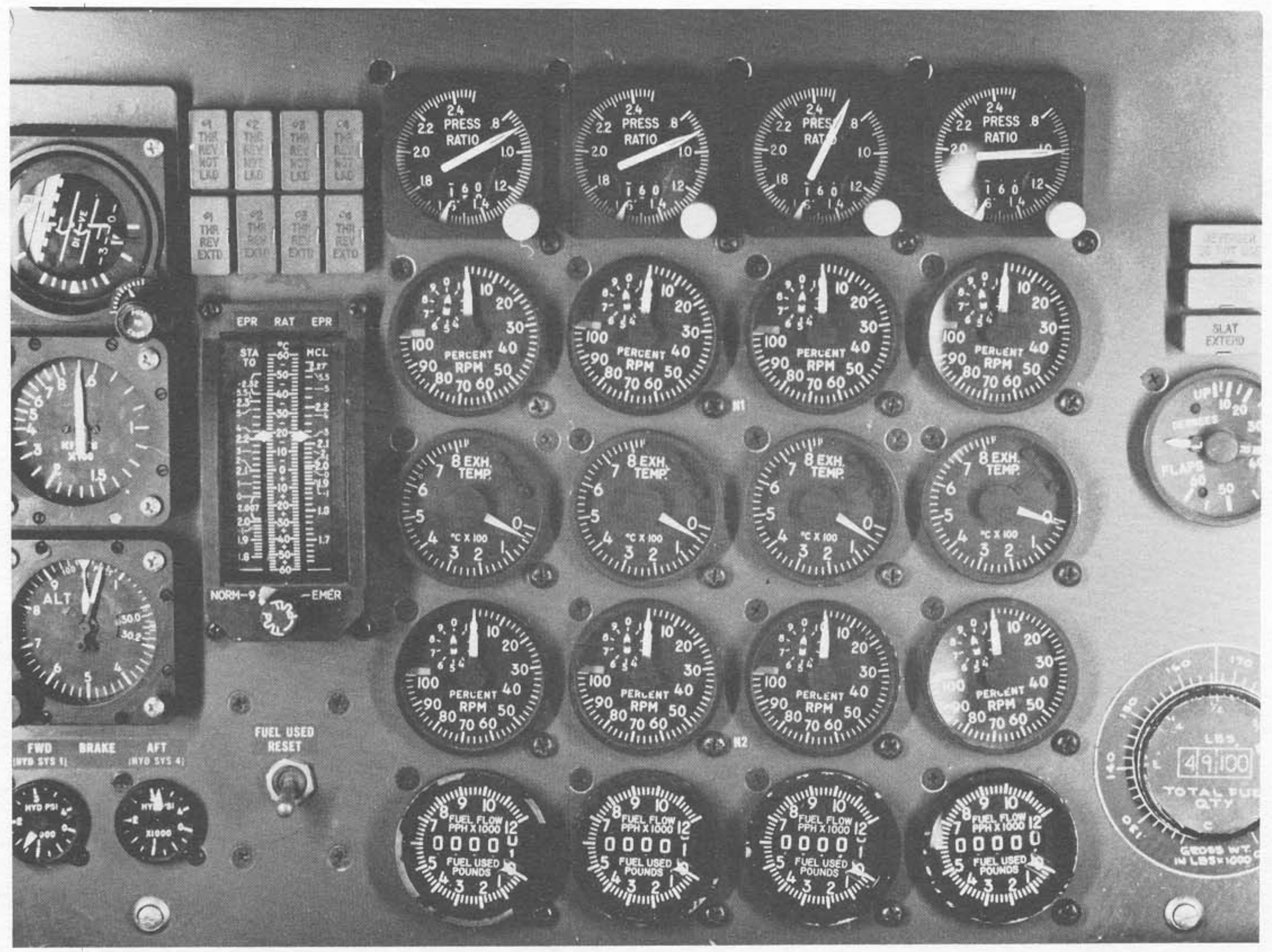
[5] 420°C APPLIES WHEN NO AIRBLEED OR POWER EXTRACTION IS BEING USED. WHEN EXTRACTION IS USED, 480°C APPLIES.

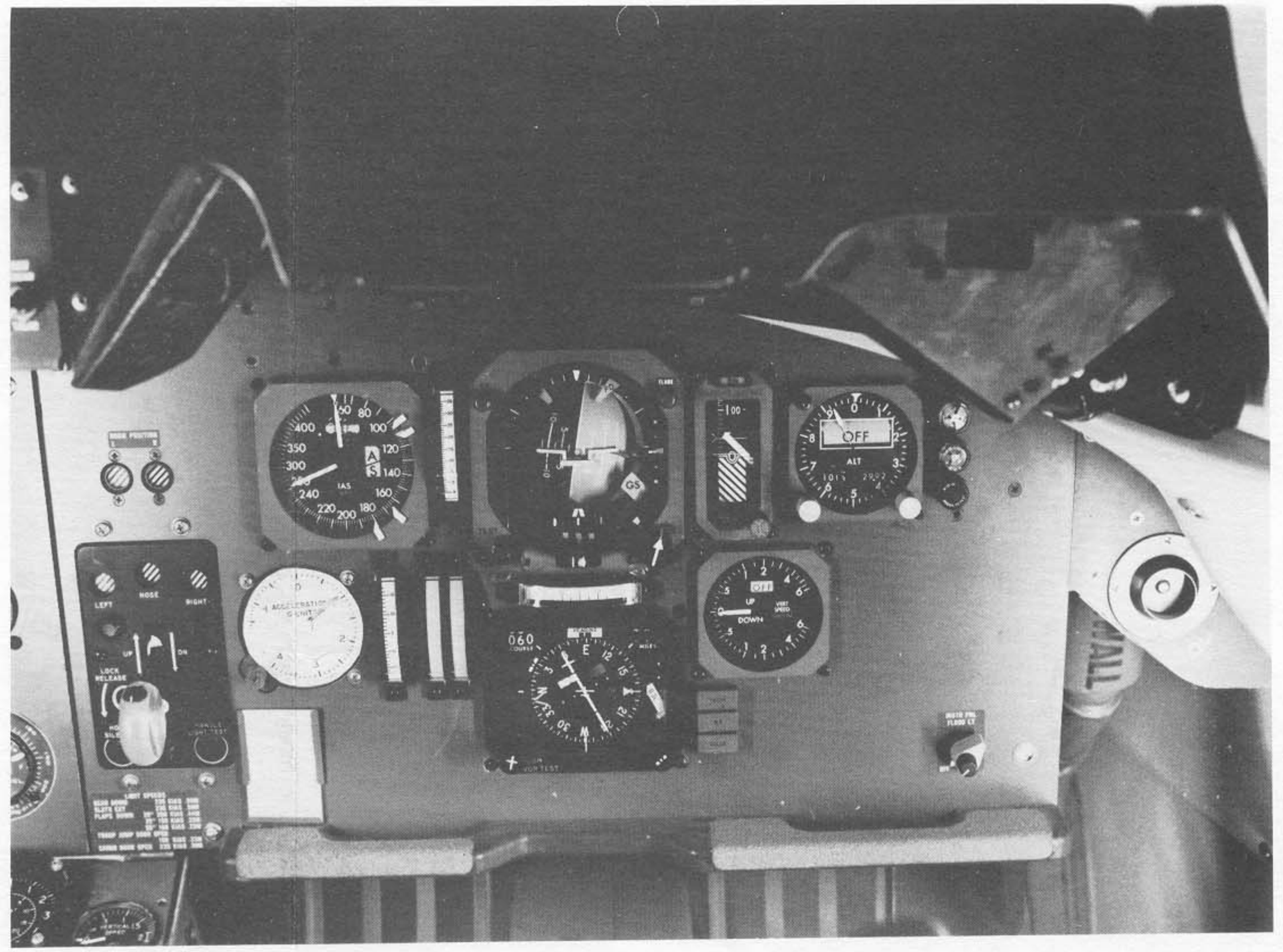
Figure 4A-5

PR7-C15-50157

ALPHABETICAL INDEX

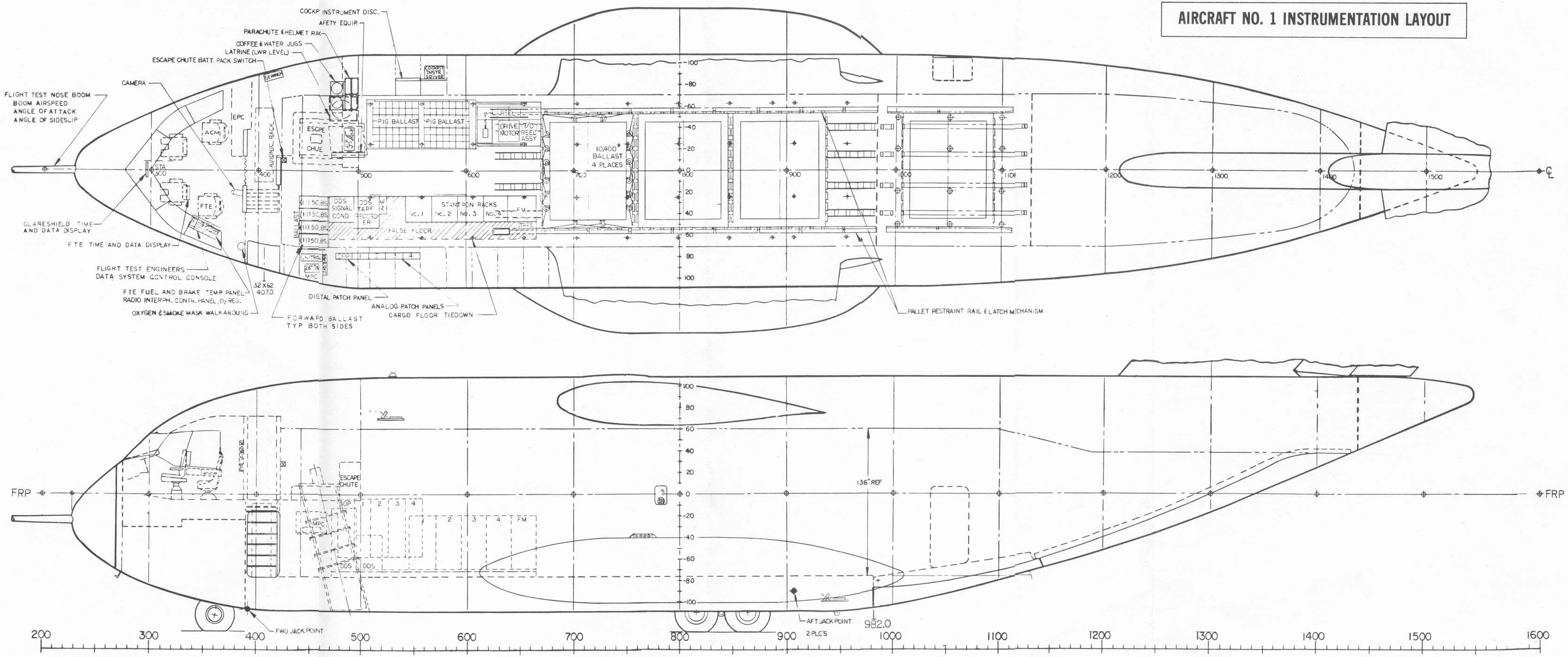






FOLDOUT NO. 1

AIRCRAFT NO. 1 INSTRUMENTATION LAYOUT



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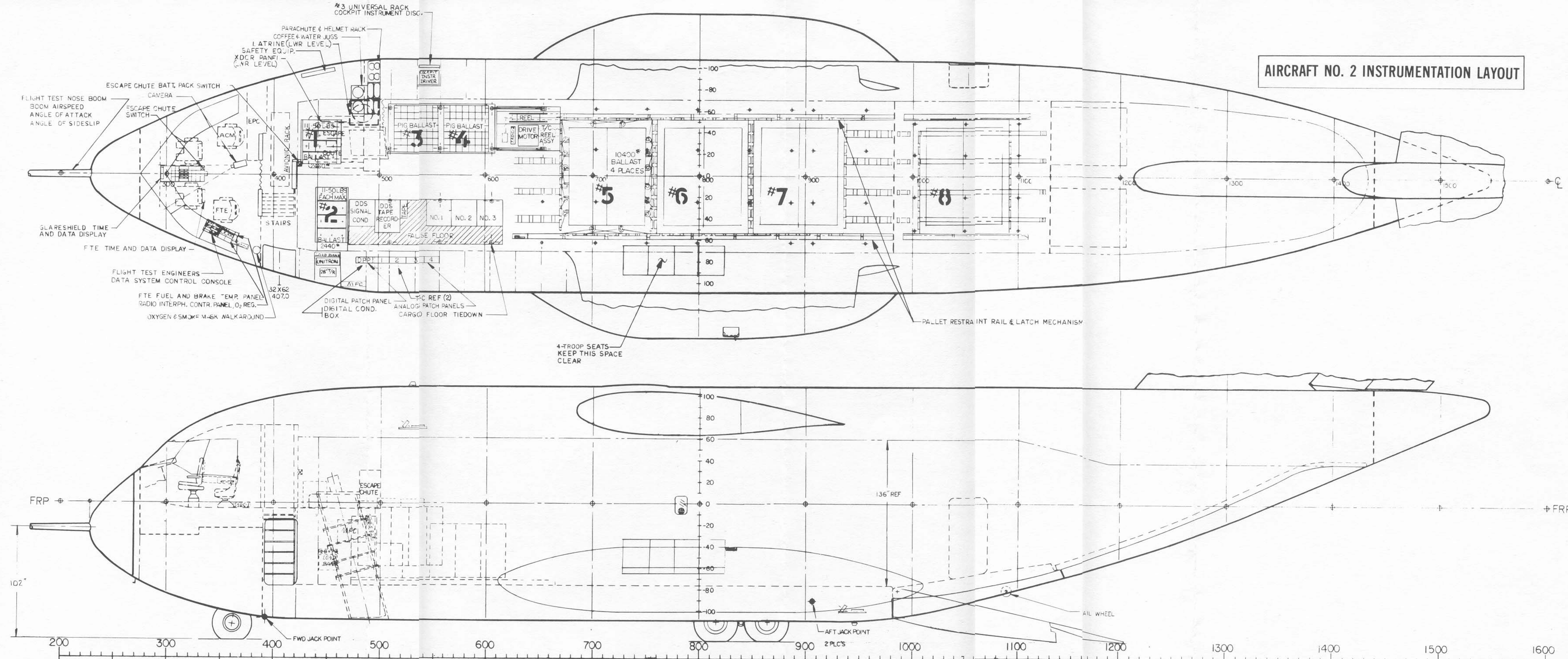
AIRCRAFT NO. 2 INSTRUMENTATION LAYOUT



HYDRAULIC POWER 1 – 2

FOLDOUT NO. 4

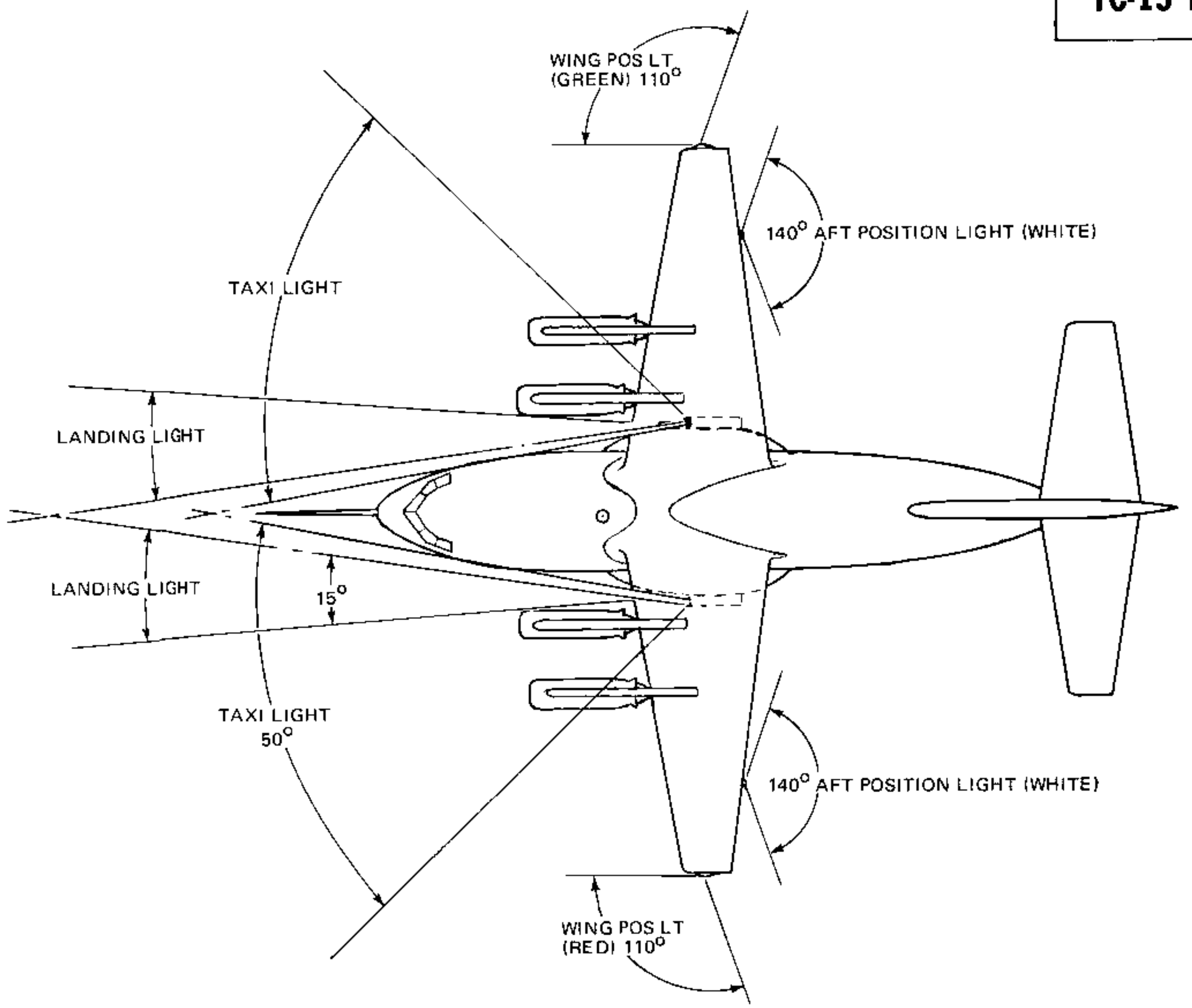
HYDRAULIC POWER 3 – 4

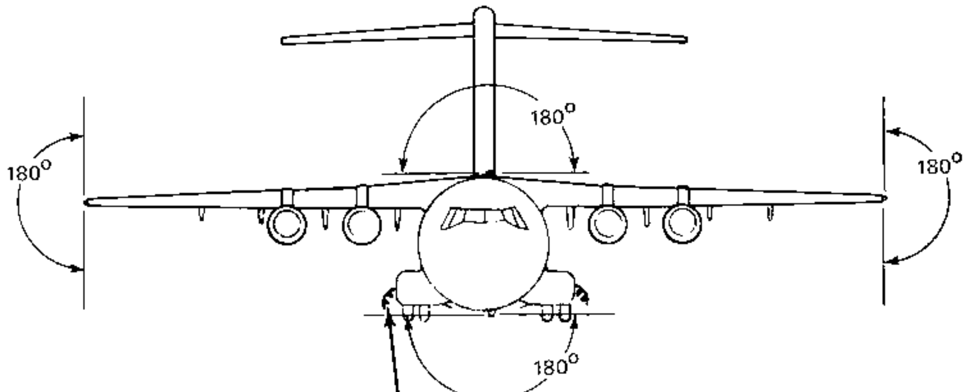
AC POWER DISTRIBUTION

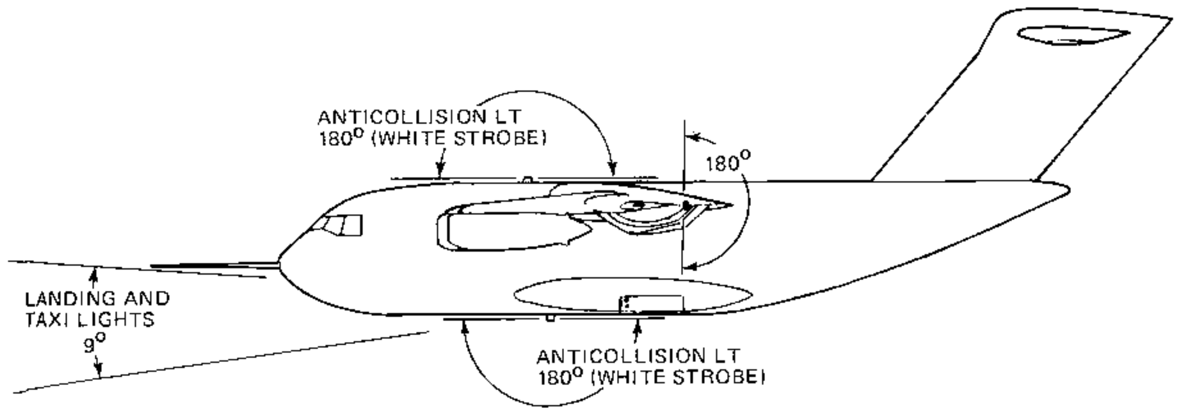
FOLDOUT NO. 6

DC POWER DISTRIBUTION

YC-15 EXTERIOR LIGHTING







FOLDOUT NO. 8