flight manual

USAF SERIES
AC-130A AIRPLANE

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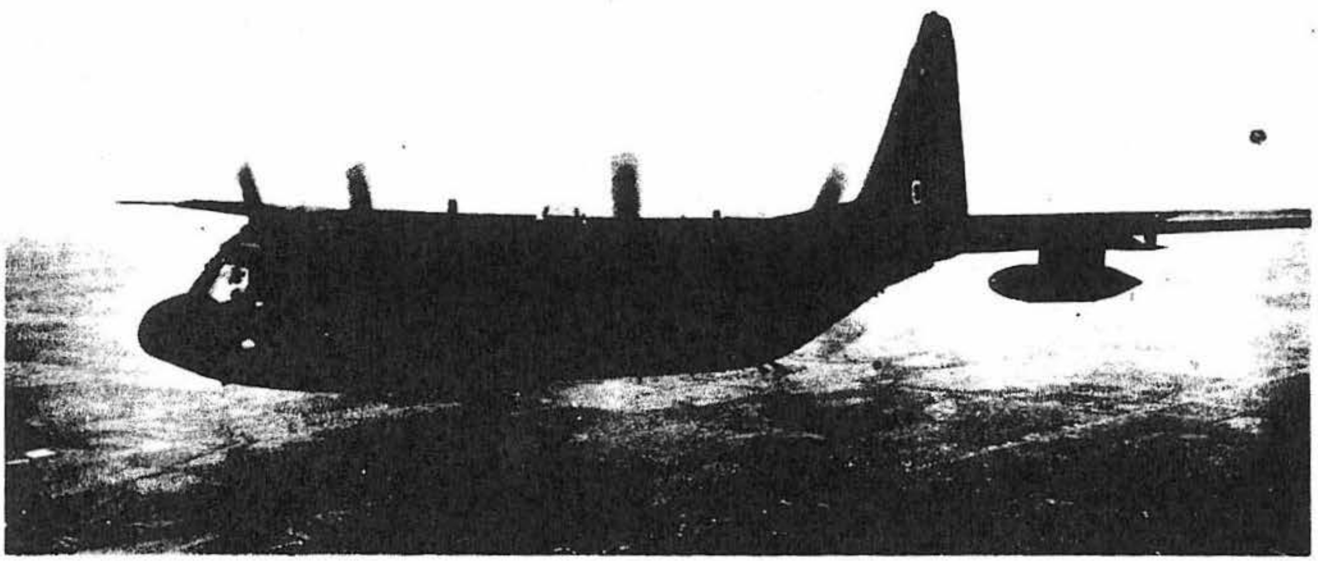

THIS PUBLICATION IS INCOMPLETE WITHOUT T.O.'s 1C-130(A)A-1-1 AND T.O. 1C-130(A)A-1-2

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS PUBLICATION TO THE ATTENTION OF ALL AFFECTED PERSONNEL.

This publication replaces TO 1C-130(A)A-1 dated 1 April 1975 and incorporates Operation Supplement TO 1C-130(A)A-1S-8 dated 21 July 1975 and Safety Supplement TO 1C-130(A)A-1SS-18 dated 5 January 1977.

Refer to Index, T. O. 0-1-1-3, for the current status of Flight Manuals, Safety/Operational Supplements and Flight Crew Checklists.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE.

1 APRIL 1977

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Total number of pages in this manual is 688 consisting of the following:

Zero in this column indicates an original page.

TIME COMPLIANCE TECHNICAL ORDERS

The following Time Compliance Technical Orders have been incorporated in this manual or in outstanding Safety Supplements:

Number	Title
T.O. 1C-130-702	Permanent Closure of Forward Cargo Door Opening
T.O. 1C-130A-694	Deactivation of GTC Compartment Fireye Dector System
T.O. 1C-130-688	Redesign of MLG Shelf Bracket Installation
T.O. 1C-130-822	Installation of FM622A VHF-FM Radio and KY-8 Speech Incryption Capability
T.O. 1C-130-831	Installation of Aircraft Fuel Cell Explosion Suppression
T.O. 1C-130A-648	Installation of Transistorized Torqmeters
T.O. 1C-130A-788	Installation of Pylon Tanks
T.O. 1C-130A-659	Installation of TACAN AN/ARN-21
T.O. 1C-130-759	Installation of Nose Wheel Inspection Panel and Window
T.O. 1C-130A-569	Installation of Hydraulic Inline Pressure Filters
T.O. 1C-130-699	Modification of QEC to Incorporate Transistorized Temperature Datum Control Amplifier System
T.O. 1C-130-838	Installation of AIMS Equipment
T.O. 1C-130A-793	Installation of Multiple UHF Antenna System AN/ARQ-23 Radio Set and AN/APN-147, AN/ASN-35 Doppler Radar and Radar Computer
T.O. 1C-130-784	Installation of Automatic Emergency Lighting System
T.O. 1C-130-743	Installation of Hytrol Mark II Anti-Skid Brake System
T.O. 1C-130-764	Incorporation of Provisions for Emergency Extension and Rigging of MLG
T.O. 1C-130-740	Retrofit Replacement of NLG Drag Strut and Retraction Mechanism
T.O. 1C-130-554	Installation of Collins VHF101
T.O. 1C-130A-600	Installation of Alarm System
T.O. 1C-130A-544	Installation of Master Fire Warning Light
T.O. 1C-130-794	Installation of Check Valves in Brake System Return Lines
T.O. 1C-130-821	Rework of NLG Drag Strut Actuator
T.O. 1C-130-823	Readjustment of NLG Drag Strut Actuator
T.O. 1C-130A-753	Installation of MA-1 Accelerometer
T.O. 1C-130-824	Installation of Lower Anti-Collision Light
T.O. 1C-130(A)E-501	Installation of Intervalometer for the LAU-74 Flare Launcher, AC-130A, AC-130E Aircraft
T.O. 1C-130(A)E-502	Installation of ALE-20 Flare Ejector Set, AC-130A, AC-130E Aircraft
T.O. 1C-130(A)A-518	Modify AN/APR-26 System to Provide Audio Signal and Install Additional Antenna, AC-130A Aircraft

TIME COMPLIANCE TECHNICAL ORDERS (Con t)

T.O. 1C-130(A)A-521	Provide Alternate Pitch Signal From LTN-51 Inertial Platform to Auto-Pilot, AC-130A Aircraft
T.O. 1C-130(A)A-522	Provide Power Supply Spike Supression for AN/ARN-92 Computer, AC-130A Aircraft
T.O. 1C-130(A)A-523	Install Active Television (GLINT), AC-130A Aircraft
T.O. 1C-130(A)A-524	Install AN/AAD-7 Infrared System Water Separator, AC-130A Aircraft
T.O. 1C-130(A)A-525	Modify Oxygen System, AC-130A Aircraft
T.O. 1C-130(A)A-526	Install External Call Switch at Right Scanner Position, AC-130A Aircraft
T.O. 1C-130(A)A-530	Provide VHF-AM to Cargo Compartment Intercom Station, AC-130A Aircraft
T.O. 1C-130(A)A-532	Relocate Portable Oxygen Bottles, AC-130A Aircraft
T.O. 1C-130(A)A-533	Correction of Tacan and Other EMI Problems, AC-130A Aircraft
T.O. 1C-130(A)A-534	Installation of Improved Radar Warning Capability, AC-130A Aircraft

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SCOPE.

This manual contains the necessary information for safe and efficient operation of the AC-130A. These instructions provide you with a general knowledge of the airplane, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized; therefore, basic flight principles are avoided.

SOUND JUDGEMENT.

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 it is a poor substitute for sound judgement. 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 (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from the Flight Manual Manager before any questionable operation is attempted which is not specifically permitted in this manual.

HOW TO BE ASSURED OF HAVING LATEST DATA.

Refer to T.O. 0-1-1-3, its monthly supplement, and the latest safety or operational supplement flyleaf.

STANDARDIZATION AND ARRANGEMENT.

Standardization assures that the scope and arrangement of all Flight Manuals are identical. The manual is divided into nine fairly independent sections to simplify reading it straight through or using it as a reference manual.

USE OF WORDS SHALL, WILL, AND MAY.

The following definitions apply to words "shall," "will," and "may" found throughout the manual:

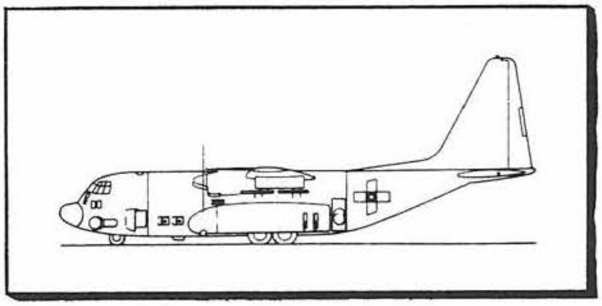
Shall and Will - Used to indicate a mandatory requirement.

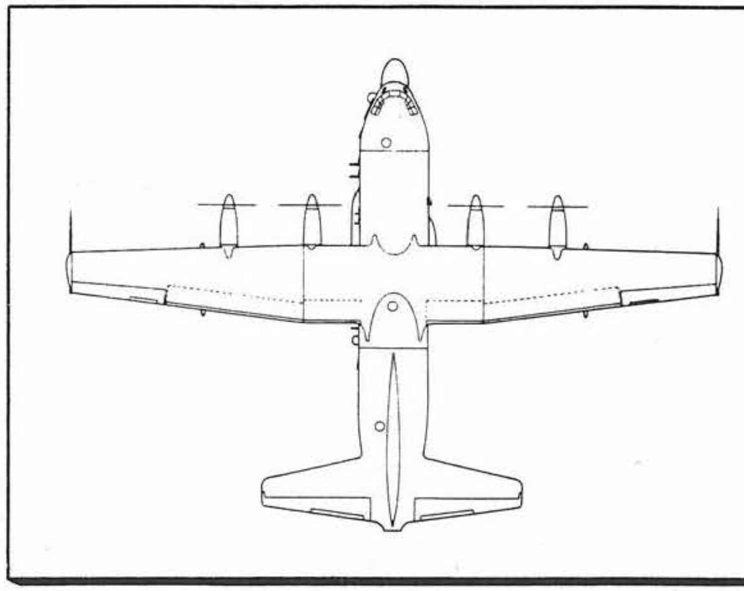
May Indicates an acceptable or suggested means of accomplishment.

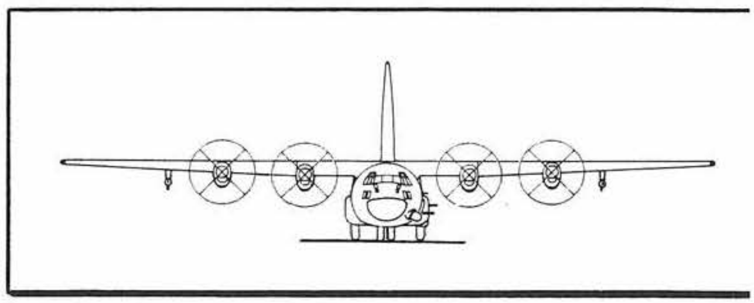
YOUR RESPONSIBILITY - TO LET US KNOW.

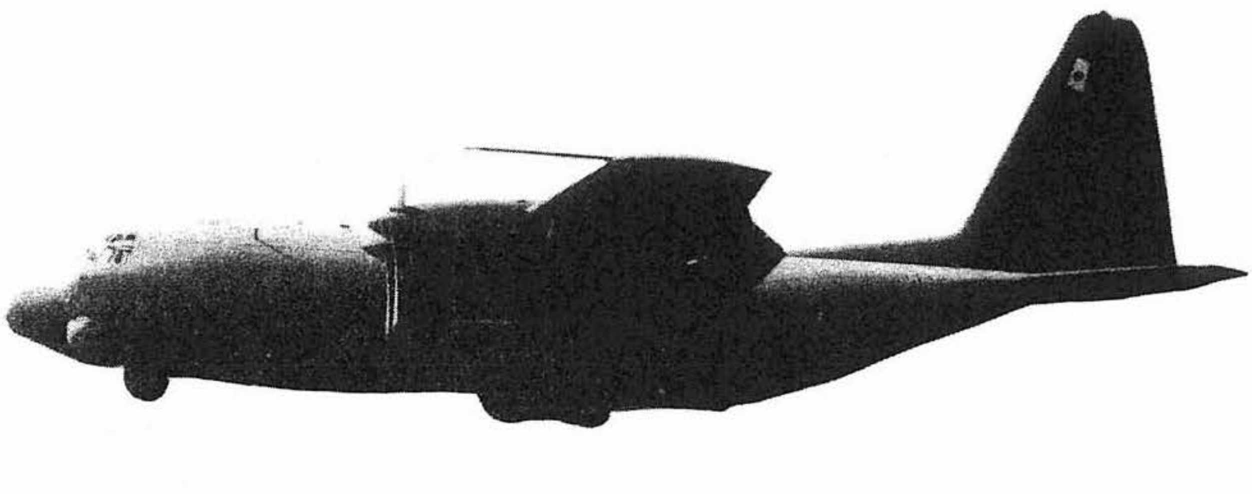
Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through your Command Headquarters to Warner Robins Air Logistics Center, Robins AFB, Georgia, 31098 ATTN: MMSRE.

the airplane









SECTION I

description

Table of Contents

THE AIRPLANE.

The Lockheed AC-130A is an all-metal, high-wing, long-range, land-based monoplane. The fuselage is divided into the cargo compartment and the flight station. It can be fully pressurized and air conditioned, both in flight and on the ground. The mission of the airplane is to operate as an aerial gunship. The AC-130A can be used on landing strips such as those usually found in advance base operations.

INTERIOR ARRANGEMENT.

The fuselage is divided into the cargo compartment and the flight station. It may be fully pressurized (for ferry configuration) and air conditioned both in flight and on the ground.

PROPULSION.

Power is supplied by four Allison turboprop, constant-speed engines. Each engine drives a 3-blade Aeroproducts electrohydraulic, constant-speed propeller having full feathering and reversible pitch.

AIRPLANE DIMENSIONS.

The principal dimensions of the airplane are:

Wing Span	132 feet 7 inches
Length	97 feet 9 inches
Height	38 feet 4 inches
Stabilizer Span	52 feet 8 inches
Maximum Gross Weight	124,200 pounds

(For complete Weight information, see Section V.)

Cargo Compartment Dimensions:

Length	41 feet
Width	10 feet 3 inches
Height	9 feet

CREW.

The flight deck and cargo compartment provide for a crew of fourteen. Four crew members are located on the flight deck and ten in the cargo compartment.

The four flight deck crew members include the pilot, copilot, navigator, and flight engineer.

The ten cargo compartment crew members include a fire control officer (FCO), and infrared operator (IR), an electronic warfare officer (EWO), television operator (TV), five weapons mechanics (WM), and an illuminator operator (IO).

An operator's booth, installed on the right side of the cargo compartment, houses the FCO, IR operator, EWO, and TV operator.

The IO is stationed on the cargo ramp as an aft scanner. Five weapons mechanics man the gun stations (20mm, 7.62mm, and 40mm).

ENGINES.

The airplane is powered by four Allison T56-A-9 turboprop engines, which develop approximately 3,750 ESHP, 10% of which is jet thrust. The basic engine consists of two major assemblies - a power section and a reduction gear assembly - which are attached to each other by an extension shaft assembly and two supporting struts. Fuel, starting, ignition, control, and oil systems are provided with the engine.

POWER SECTION.

The power section of the engine is composed of a single-entry, 14-stage, axial-flow compressor; a set of six combustion chambers of the through-flow type; and a 4-stage turbine. Mounted on the power section are an accessories drive assembly and components of the engine fuel, ignition, and control systems. Acceleration bleed valves are installed at the 5th and 10th compressor stages and a starting bleed is installed at the 14th stage to unload the compressor to facilitate engine starting. A manifold is installed at the diffuser to bleed air from the compressor for airplane pneumatic systems. Anti-icing systems are provided to prevent accumulation of ice in the engine inlet air duct. Inlet air enters the compressor through a scoop and duct below the compressor and is progressively compressed through the 14 stages of the compressor. The compressed air (at approximately 125 PSI, 600°F) flows through a diffuser into the combustion section. Fuel is introduced in the combustion chambers and burned to increase the temperature and thereby the energy of gases. The gases expand through the turbine, causing it to rotate and drive the compressor, propeller, and accessories. Gases, after expanding through the turbine, flow out through a tailpipe.

EXTENSION SHAFT ASSEMBLY.

The extension shaft assembly consists of two concentric shafts and torquemeter components. The inner shaft transmits power from the power section to the reduction gear. The outer shaft serves as a reference so that the torsional deflection of the loaded inner shaft can be detected by magnetic pickups of a torque indicating system.

REDUCTION GEAR ASSEMBLY.

The reduction gear assembly contains a reduction gear train, a propeller brake, an engine negative torque control system, and a safety coupling. Mounted on the accessory drive pads are the engine starter, a DC generator, a hydraulic pump, an oil pump, a tachometer generator and an AC generator on each of the inboard engines. The reduction gear has an independent dry-sump oil system. The reduction gear train is in two stages, providing an overall reduction of 13.6 to 1 between engine speed (13,820 RPM) and propeller shaft speed (1,016 RPM). The propeller brake, engine negative torque control system, and safety coupling are described in following paragraphs.

Propeller Brake.

The friction-cone type propeller brake acts on the first stage of reduction gearing. During engine operation, it is held disengaged by oil pressure. As engine speed is reduced and oil pressure drops, the braking surfaces are brought into contact by spring force to help slow the propeller to a stop. To keep the brake from dragging during engine starting, starter drive torque is applied through helical splines on the starter shaft and the starter gear on the outer brake member to disengage the brake. The brake also engages to stop reverse rotation of the propeller.

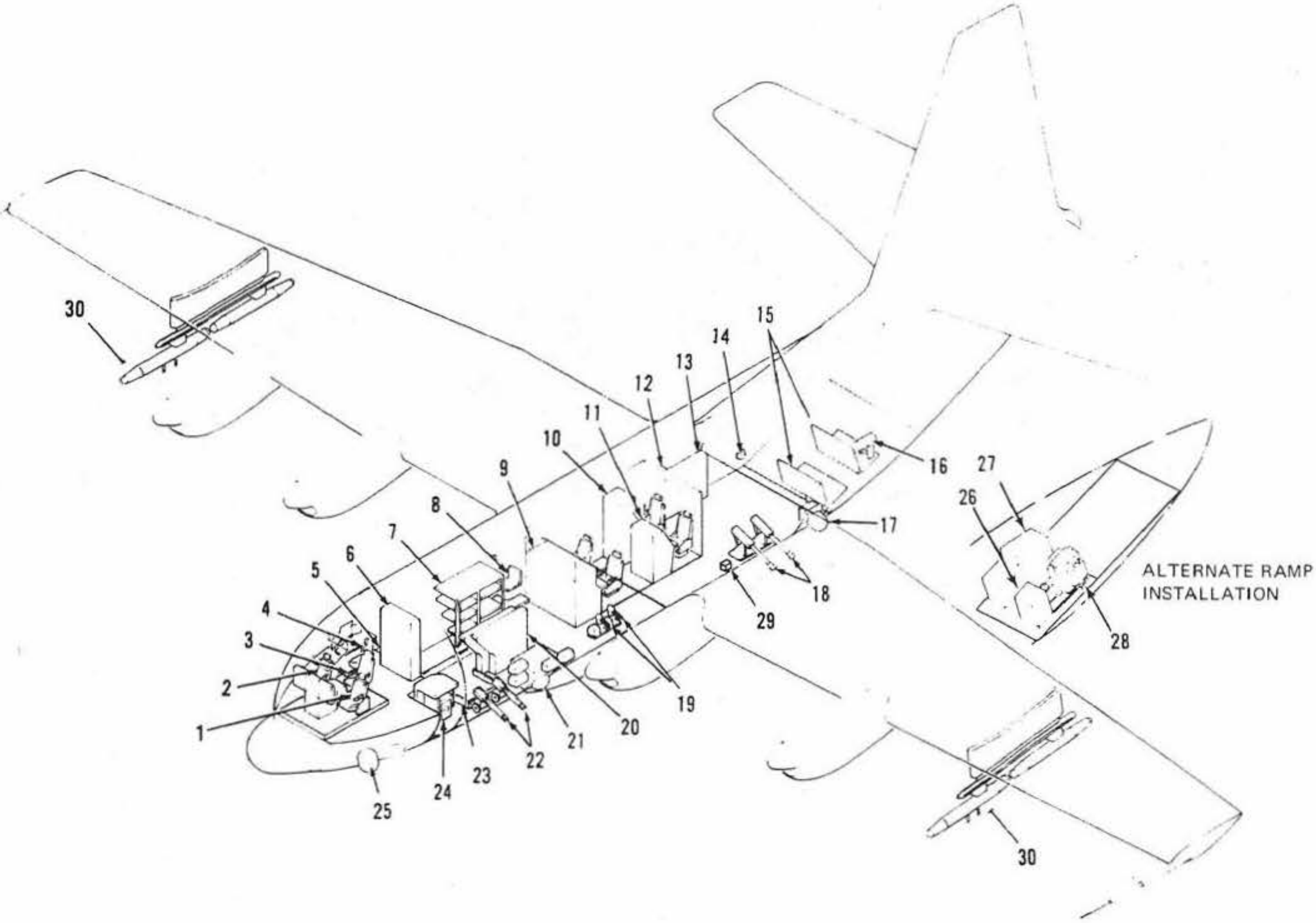
Safety Coupling.

The safety coupling is provided to decouple the power section from the reduction gear if negative torque applied to the reduction gear exceeds approximately 6,000 inch-pounds, a value much higher than that required to operate the engine negative torque control (ENTC) system. Because of its higher setting, the safety coupling backs up the ENTC system to reduce drag until the propeller can be feathered.

ENGINE FUEL AND CONTROL SYSTEM.

In a turboprop engine (figure 1-7) the turbine extracts the maximum amount of energy from the gas stream. This is done to drive not only the compressor and the accessories but also the propeller. Since most of the gas stream energy is absorbed by the turbine, the jet action, while still effective, is reduced considerably. A reduction gear is used because the turning speed of the power unit is too high for use with a propeller. In flight, the engine operates at a constant speed which is maintained by the governing action of the propeller. Power changes are made by changing fuel flow and propeller blade angle rather than engine speed. An increase in fuel flow causes an increase in turbine inlet temperature and a corresponding increase in

general arrangement



1. PILOT
2. COPILOT
3. FLIGHT ENGINEER
4. NAVIGATOR
5. GALLEY
6. MAIN POWER DISTRIBUTION BOX
7. ELECTRONIC RACK
8. SCANNER
9. IR AND EWO CONSOLE
10. TV CONSOLE
11. FIRE CONTROL CONSOLE
12. ELECTRONIC SHELF
13. 40MM AMMUNITION RACK
14. URINAL
15. RAMP CRASH SEATS
16. 2KW ILLUMINATOR
17. AN/APQ-150 BEACON TRACKER
18. 40MM CANNON
19. 7.62MM MINIGUNS
20. 20MM AMMUNITION
21. IR DETECTING SET
22. 20MM CANNON
23. BRASS TROUGH
24. TV/LASER PLATFORM
25. BLACK CROW ANTENNA
26. ILLUMINATOR CONTROL
27. FLARE LAUNCHER
28. 40KW ILLUMINATOR
29. ALE-20 DISPENSER (2 PLACES)
30. ECM PODS (WHEN INSTALLED)

Figure 1-1

flight station forward

(typical)

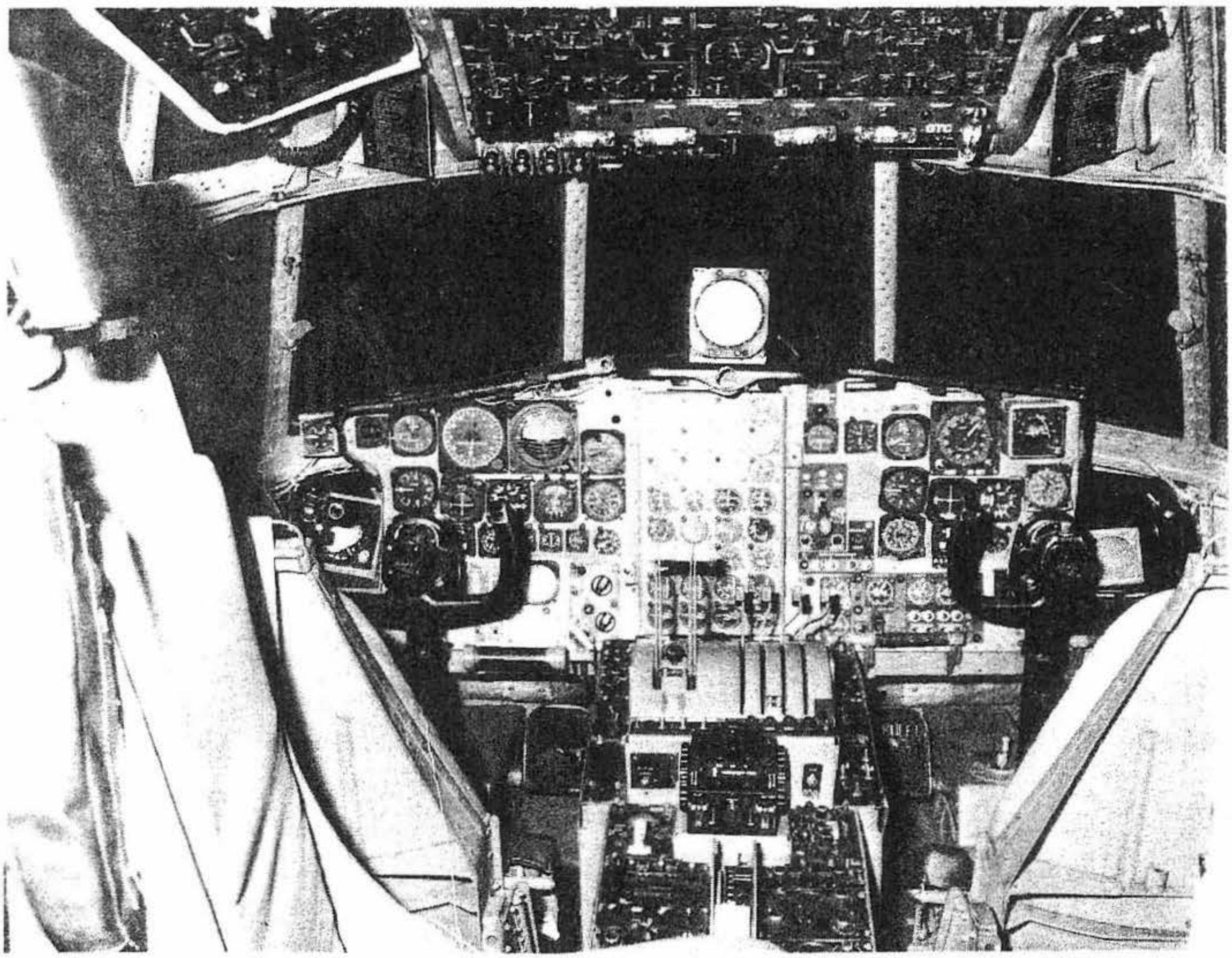


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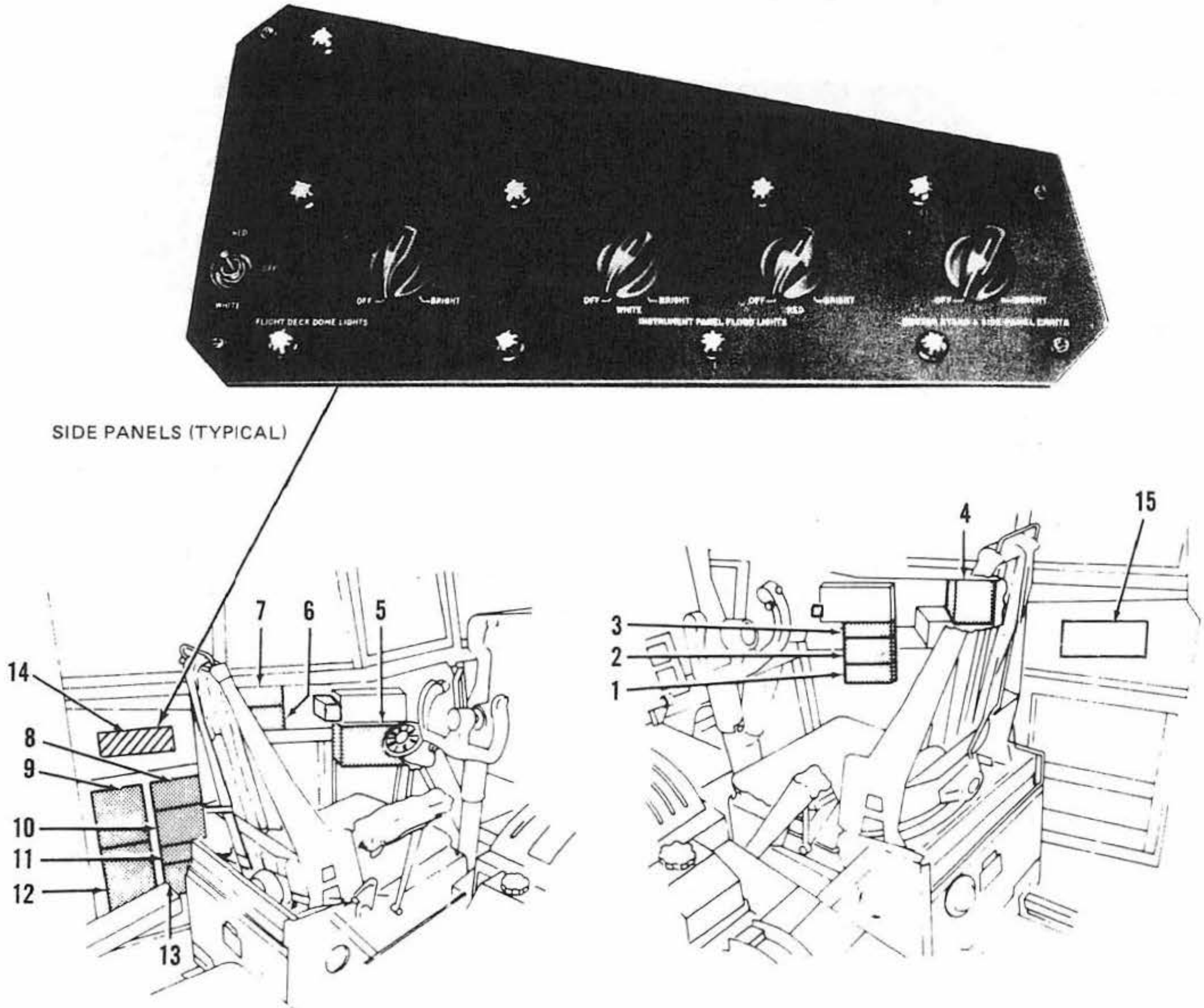
Figure 1-2.

pilot's auxiliary control panel



1. CONTROL PANEL, C-7213/ARC
2. CONTROL UNIT, UHF 2
3. ANTENNA SELECTOR, UHF 2
4. CONTROL, FM 2
5. PILOT'S SENSOR ANGLE DISPLAY PANEL
6. AUTOPILOT GYRO SELECTOR PANEL
7. OXYGEN REGULATOR
8. GUN STATUS PANEL
9. GUNSIGHT CONTROL PANEL
10. GUN STATUS LIGHT CONTROL PANEL
11. GUN SIGHT TEST PANEL
12. BORESIGHT ADJUST PANEL
13. PILOT'S SLADS LIGHT CONTROL
14. PILOT'S AUXILIARY CONTROL PANEL
15. COPILOT'S AUXILIARY CONTROL PANEL

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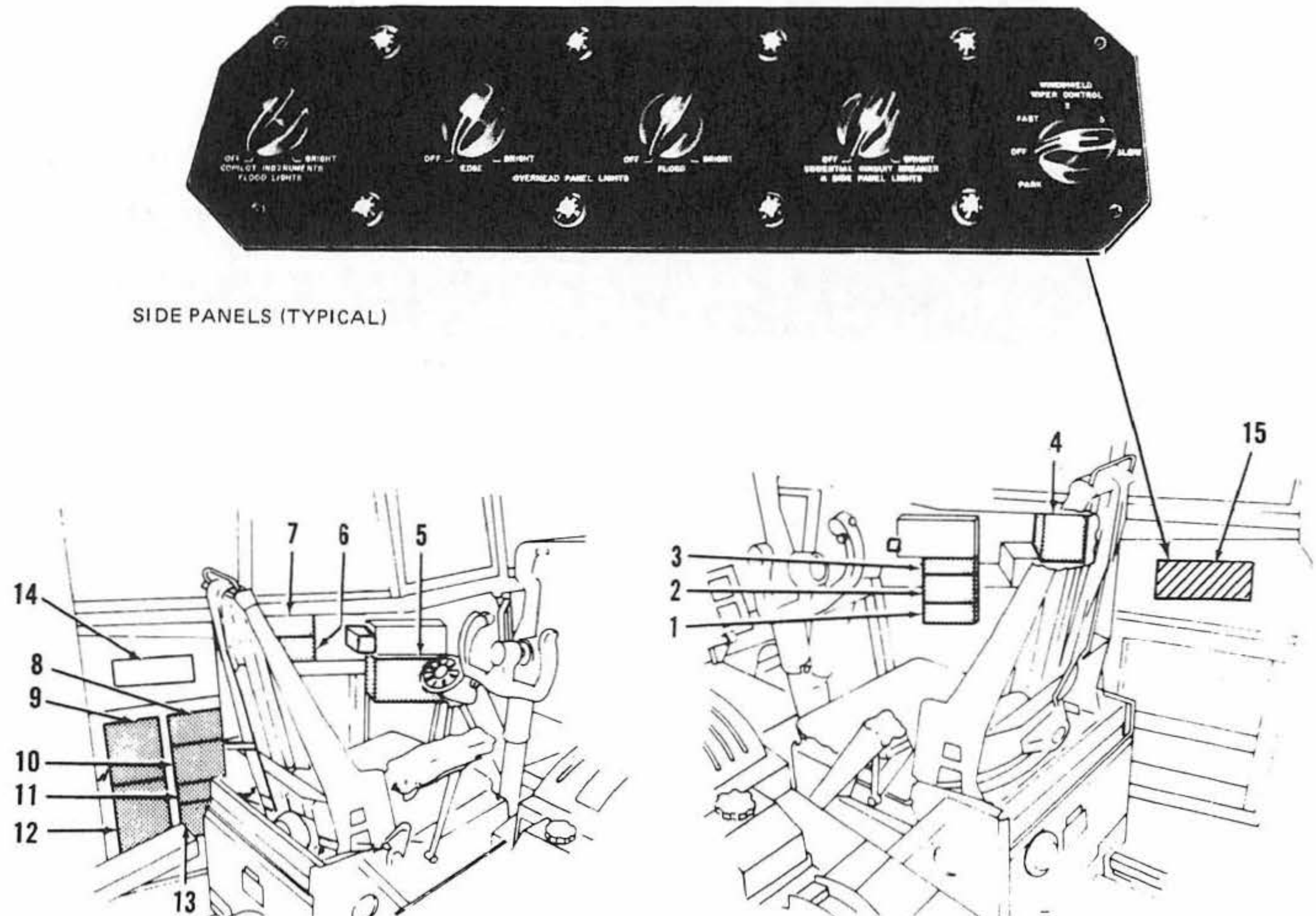
Figure 1-3.

copilot's auxiliary control panel



1. CONTROL PANEL, C-7213/ARC
2. CONTROL UNIT, UHF 2
3. ANTENNA SELECTOR, UHF 2
4. CONTROL, FM 2
5. PILOT'S SENSOR ANGLE DISPLAY PANEL
6. AUTOPILOT GYRO SELECTOR PANEL
7. OXYGEN REGULATOR
8. GUN STATUS PANEL
9. GUNSIGHT CONTROL PANEL
10. GUN STATUS LIGHT CONTROL PANEL
11. GUN SIGHT TEST PANEL
12. BORESIGHT ADJUST PANEL
13. PILOT'S SLADS LIGHT CONTROL
14. PILOT'S AUXILIARY CONTROL PANEL
15. COPILOT'S AUXILIARY CONTROL PANEL

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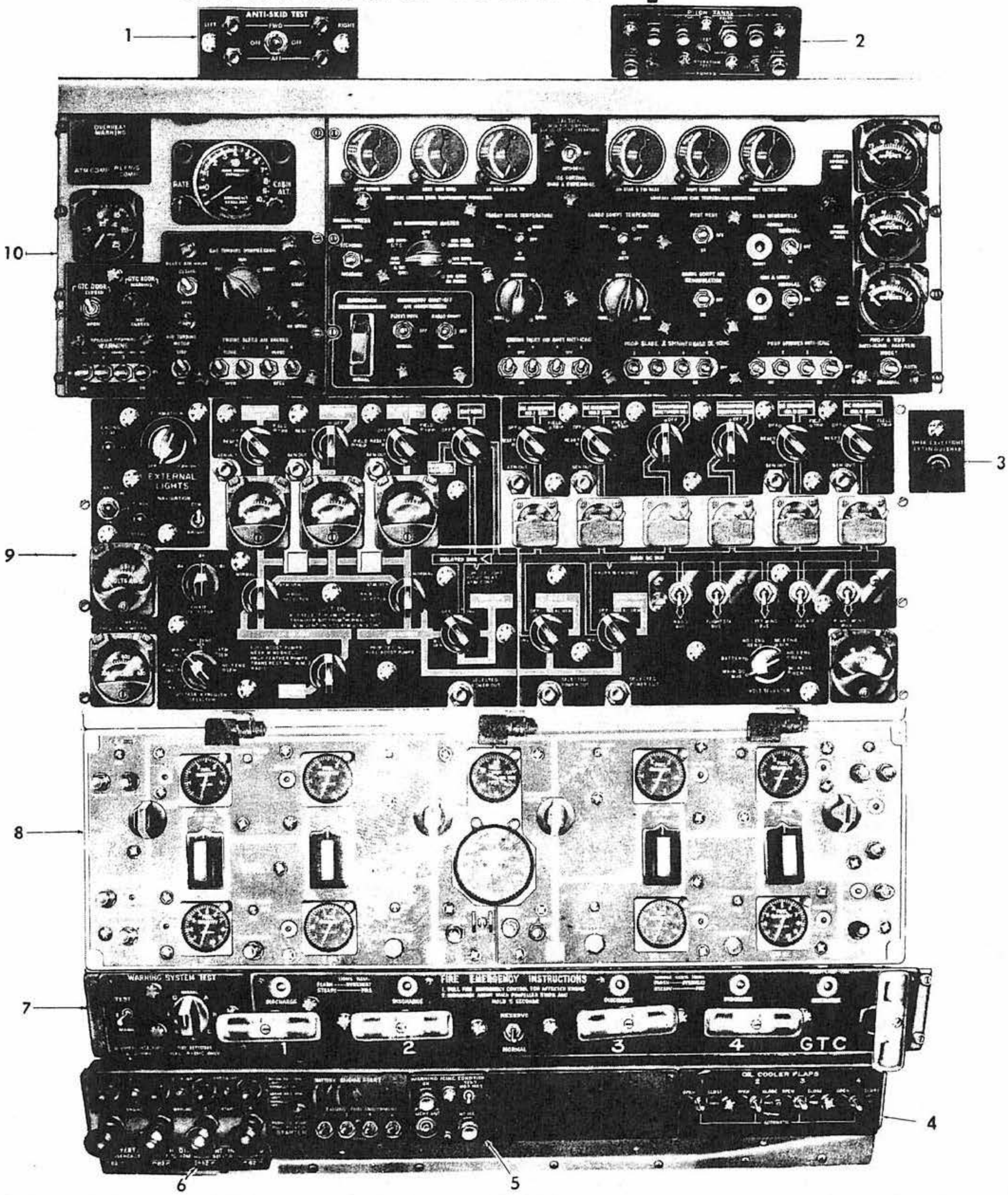
Figure 1-4.

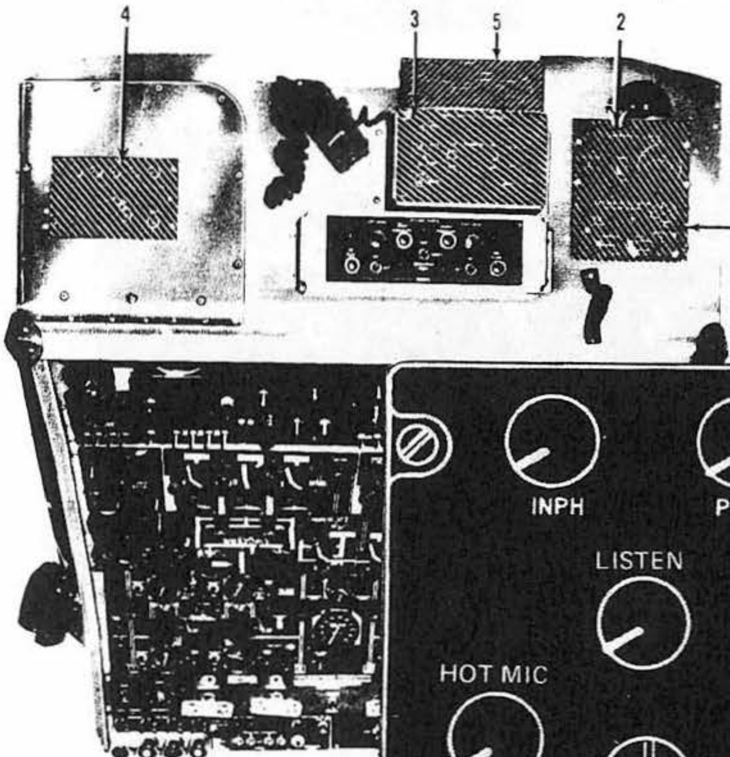
overhead control panel

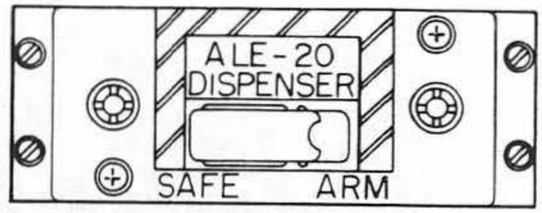


1. ANTI-SKID TEST PANEL (SOME AIRPLANES)
2. PYLON TANK PANEL
3. EMERGENCY EXIT LIGHT EXTINGUISH SWITCH PANEL
4. OIL COOLER FLAPS SWITCH PANEL
5. ICE DETECTION PANEL
6. ENGINE STARTING PANEL
7. FIRE EMERGENCY CONTROL PANEL
8. FUEL CONTROL PANEL
9. ELECTRICAL CONTROL PANEL
10. AIR CONDITIONING CONTROL PANEL

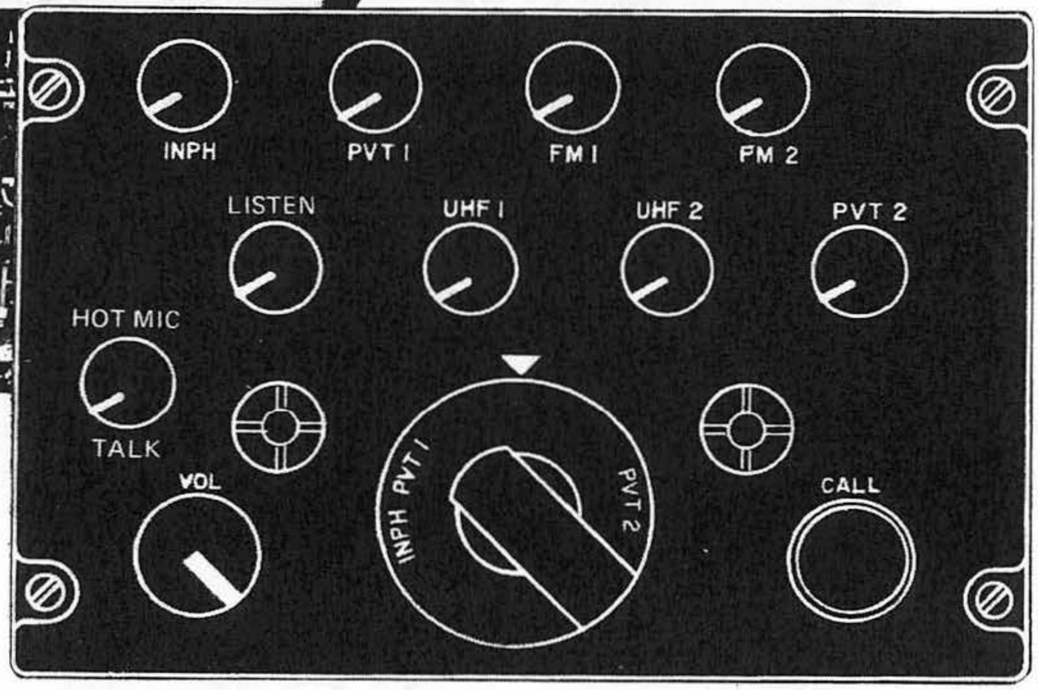
Figure 1-5. (Sheet 1 of 3)

overhead control panel
(TYPICAL)

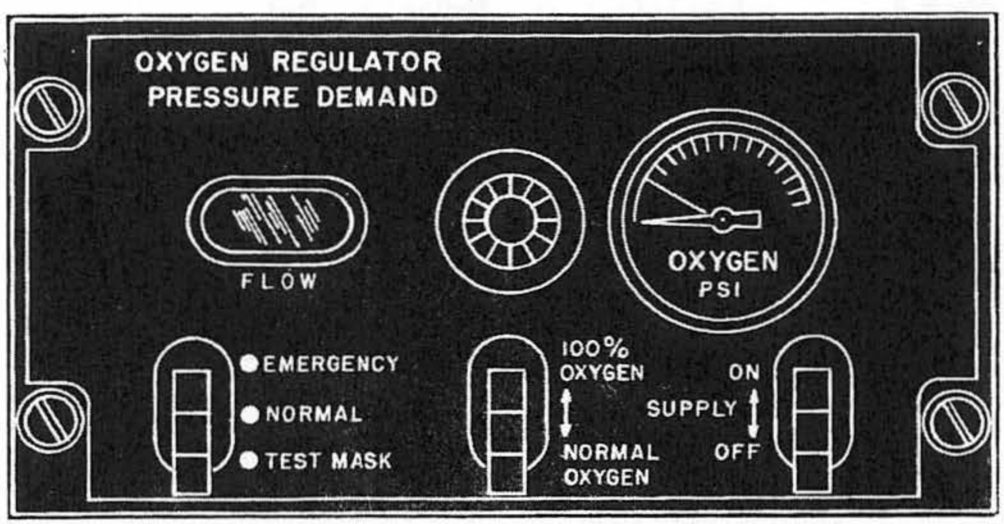




5. ALE-20 DISPENSER ARMING PANEL



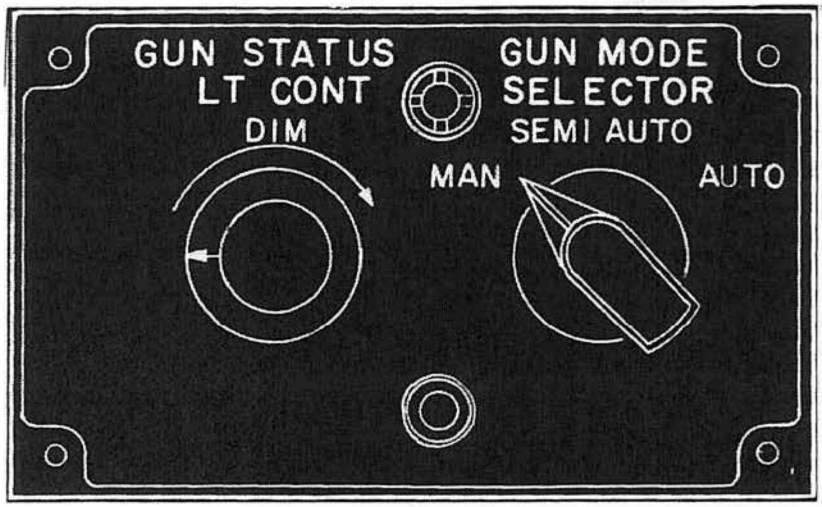
2. INTERPHONE CONTROL



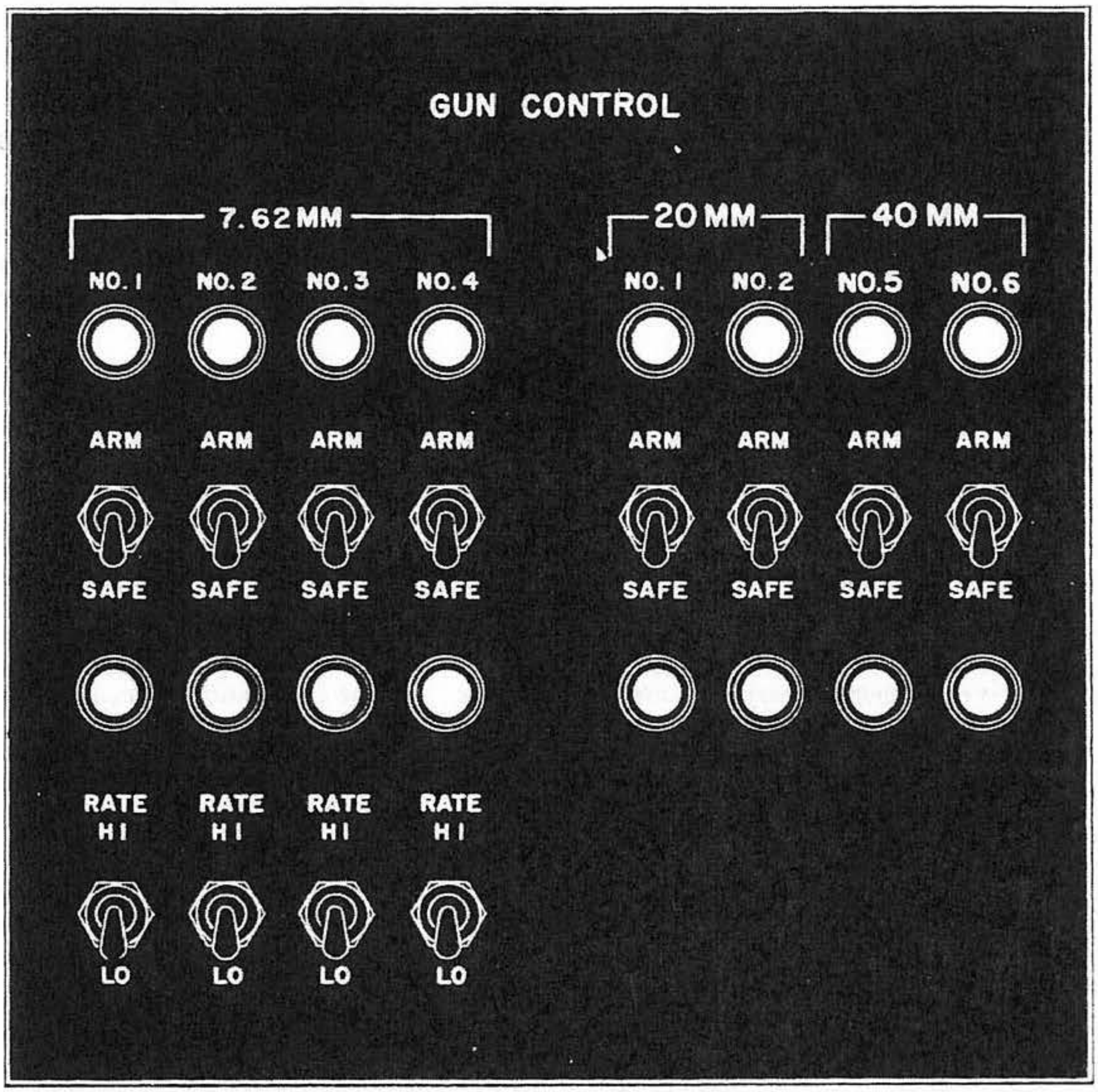
1. OXYGEN REGULATOR

Figure 1-5. (Sheet 2 of 3)

overhead control panel (cont) (typical)

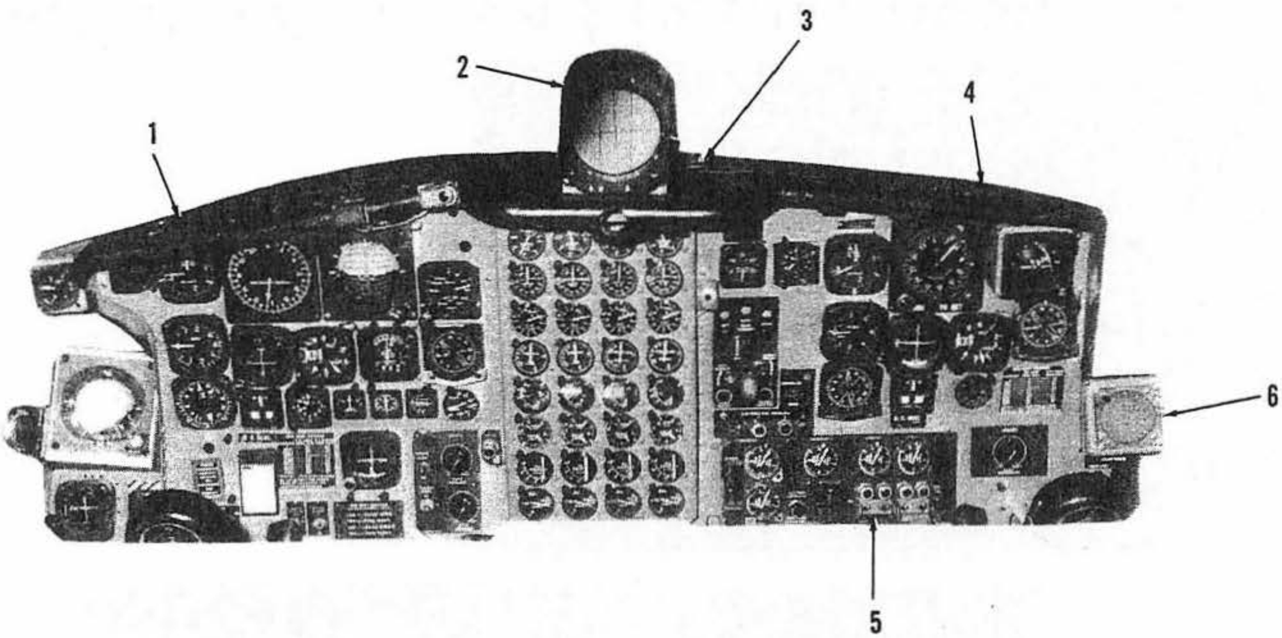


3. GUN MODE AND LIGHTING CONTROL



4. GUN CONTROL PANEL

Figure 1-5. (Sheet 3 of 3)



main instrument panel typical

1. PILOT'S INSTRUMENT PANEL
2. AN/APN-59 INDICATOR
3. ENGINE INSTRUMENT PANEL
4. COPILOT'S INSTRUMENT PANEL
5. HYDRAULIC CONTROL PANEL
6. AN/ALR-46 INDICATOR

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Figure 1-6.

energy available at the turbine. The turbine absorbs more energy and transmits it to the propeller in the form of torque. In order to maintain governing speed, the propeller increases blade angle to absorb the increased torque. Hence, the engine is unique in that an advance of the throttle (in the flight range) will produce an immediate power response. Turbine inlet temperature is a very important factor in the control of the engine. It is directly related to fuel flow and consequently to power produced. It is also limited because of the strength and durability of the combustion and turbine section materials. The control system schedules fuel flow to produce specific turbine inlet temperatures and to limit those temperatures so that the temperature tolerances of combustion and turbine section materials are not exceeded. The fuel system consists of fuel filters, a fuel pump, a hydro-mechanical fuel control in series with an electronic temperature datum control system, and six fuel nozzles. Operating with the fuel system is the ignition system, the starting fuel enrichment system, the bleed air system, and the propeller. Changes in power settings are effected by the throttle which is connected to the fuel control and the propeller through a mechanical coordinator. During ground operation, changes in throttle position mechanically affect both the fuel flow and the propeller blade angle. In flight, changes in throttle position affect fuel flow only, the propeller governor maintaining constant engine speed. The hydro-mechanical fuel control, which is part of the basic fuel system, senses engine inlet air temperature and pressure, rpm, and power lever position and varies fuel flow accordingly. The electronic temperature datum (TD) control system senses turbine inlet temperature and throttle position and makes any necessary changes in the fuel flow from the fuel control before it reaches the fuel nozzles. The TD system compensates for minor variables not sensed by the hydro-mechanical fuel control and for mechanical tolerances within the fuel control itself. By means of switches the TD system can be positioned to NULL or locked and the engine will operate on the basic hydro-mechanical system alone. With the TD system in AUTO, automatic overtemperature protection is provided throughout the operating range and automatic temperature scheduling is provided when the throttle is in the range of 65 to 90 degrees. When the TD system is in NULL, the automatic functions of temperature limiting and temperature scheduling must be accomplished manually by adjustment of the throttle.

T56-A-9 ENGINE

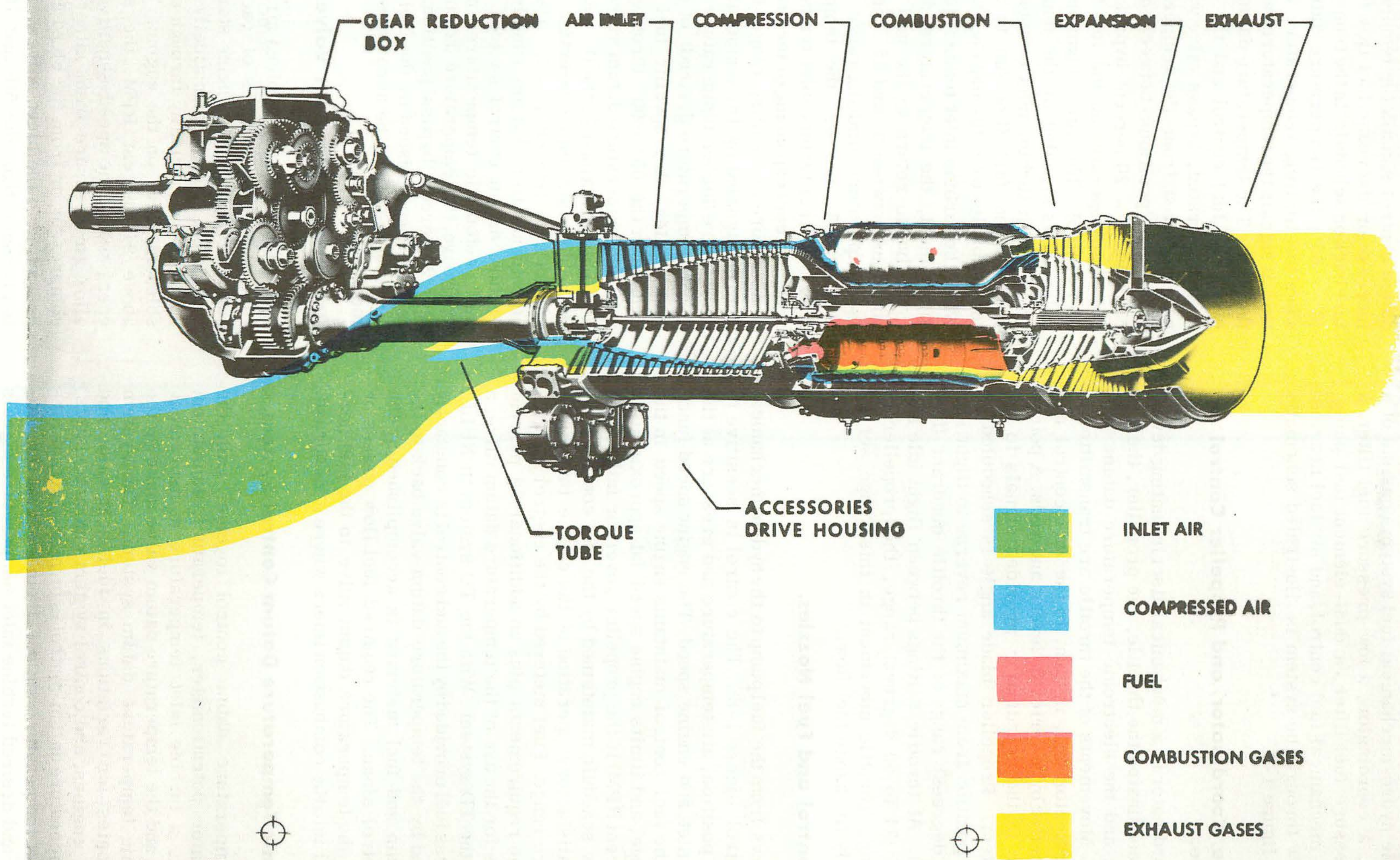


Figure 1-7.

Basic Hydro-Mechanical Fuel System.

The basic hydro-mechanical fuel system consists of a throttle, a coordinator, a low-pressure fuel filter, a high-pressure fuel filter, a dual-element fuel pump, a hydro-mechanical fuel control, and six fuel nozzles. Fuel flow through the system is illustrated schematically in figure 1-8.

Throttle, Coordinator, and Propeller Control Linkage.

The coordinator is a mechanical discriminating device which coordinates the throttle, the propeller, the fuel control, and the electronic temperature datum (TD) system. Movements of the throttle are transmitted to the coordinator and, in turn, to the fuel control and the propeller by a series of levers and rods. A potentiometer in the coordinator provides signals to the TD system. Propeller blade angle is scheduled by throttle position from maximum reverse to flight idle (0 to 34 degrees) range of the throttle quadrant (figure 1-9). At throttle settings between flight idle and take-off (34 to 90 degrees) range, the propeller is governing. Throttle movement in this range serves primarily to change fuel flow.

Fuel Control and Fuel Nozzles.

Fuel flows from the fuel pump to the hydro-mechanical fuel control (figure 1-8). The control is sensitive to throttle position, air temperature and pressure at the engine inlet, and engine speed. The engine speed function of the fuel control maintains engine speed in the taxi range, and limits engine speed (at approximately 104 percent RPM) if the propeller governor fails. The fuel flow schedule maintained by the fuel control provides satisfactory operation of the engine throughout its entire range. Fuel metered by the control is equal to engine requirements plus an additional 20 percent which is for the use of the temperature datum valve, a part of the TD system. With the TD system in NULL, the excess fuel provided by the fuel control is constantly bypassed by the temperature datum valve back to the fuel pump and fuel metering is accomplished by the fuel control alone. The required fuel flow passes on through the temperature datum valve to the fuel nozzles and into the combustion liners where it is burned.

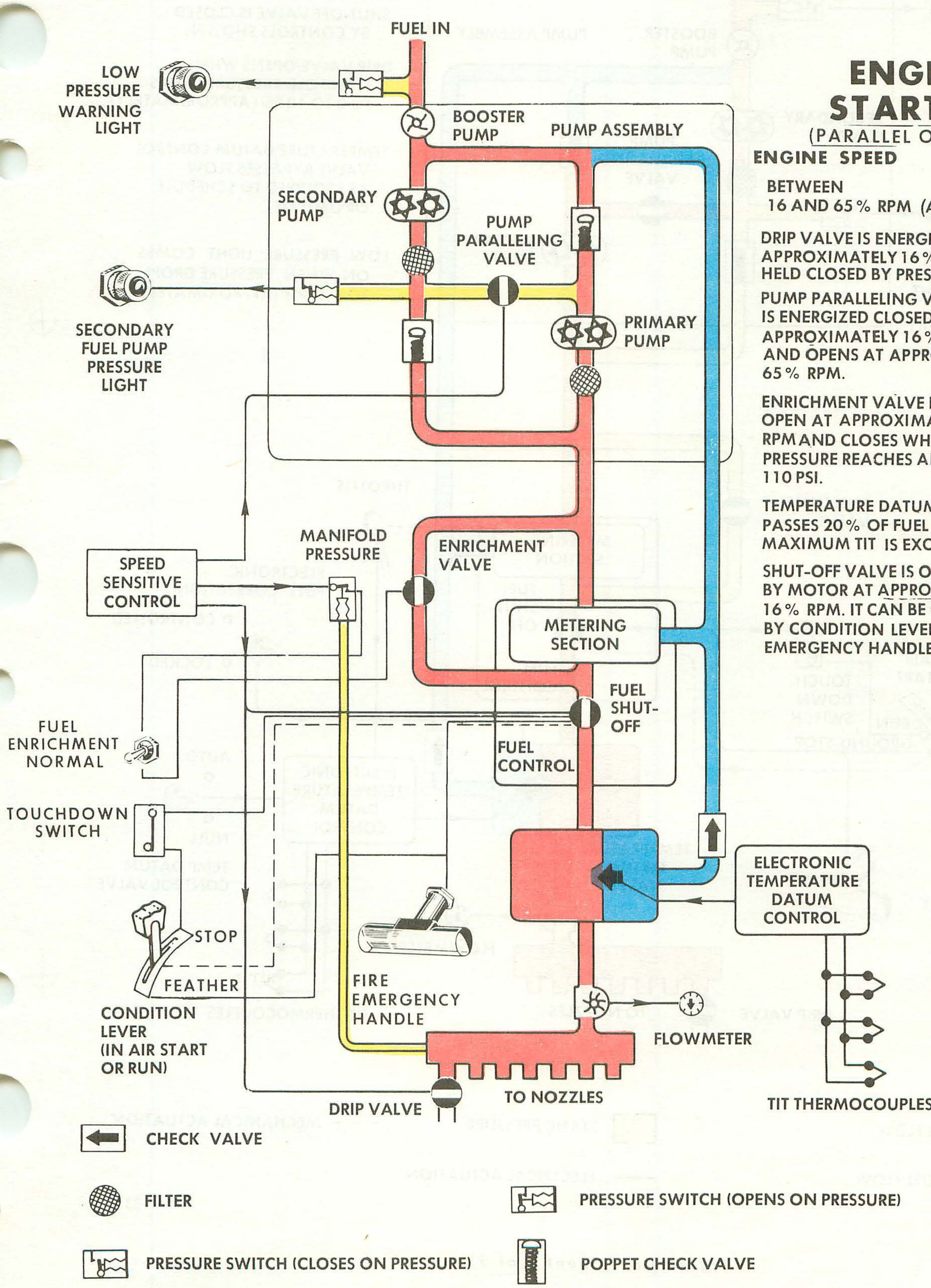
Electronic Temperature Datum Control System.

The temperature datum control together with the coordinator potentiometer, temperature adjustment network, a turbine inlet temperature measurement system, and the temperature datum valve make up the electronic temperature datum system. The system compensates for variations in fuel heat value and density, engines, and control system characteristics. The temperature datum control is furnished actual turbine inlet temperature signals from a set of thermocouples and desired turbine inlet temperature signals by the throttle through the coordinator potentiometer and the temperature adjustment network. The control compares the actual and the desired turbine inlet temperature signals. In the temperature controlling range (65° - 90°), if there is a difference, the temperature datum control signals the temperature datum valve to increase or decrease fuel flow to bring the temperature back on schedule. In the temperature limiting range (0° - 65°) the temperature datum control acts only when the limiting temperature is exceeded at which time it signals the temperature datum valve to decrease fuel flow. The temperature datum valve is located between the fuel control and the fuel nozzles. It is a motor-operated, bypass valve which responds to signals received from the temperature datum control. In throttle positions between 0° and 65° the valve remains in a 20 percent bypass or null position and the engine operates on the fuel flow scheduled by the fuel control. The valve remains in the null position unless it is signaled by the temperature datum control to limit turbine inlet temperature. The valve then reduces the fuel flow (up to 50% of required fuel) to the nozzles by returning the excess to the fuel pump. When the turbine inlet temperature lowers to the desired level, the temperature datum control signals the valve to return to the null position. In throttle positions between 0° and 65° the control system is in the temperature limiting range. In throttle positions between 65° and 90° the temperature datum valve acts to control turbine inlet temperature to preselected schedule corresponding to throttle position; this is the temperature controlling range. In this range the valve may be signaled by the temperature datum control to allow more (higher temperature desired) or allow less (lower temperature desired) of the fuel to flow to the fuel nozzles. Any specific fuel flow trim correction applied in the 65° - 90° throttle range can be locked into the temperature datum valve while above 65° and will be maintained in the 0° - 65° range by the use of the electronic fuel correction switch located at the copilot's instrument panel. Also, the TD system can be returned to null at any time by the use of the temperature datum control switch. When the switch is in null, automatic temperature limiting circuits are inoperative, the temperature datum valve remains in the null (20 percent bypass) position, and all fuel metering is then accomplished by the fuel control. Temperature limiting then must be accomplished by throttle adjustment.

Acceleration Bleed Air Valves Control System.

The eight acceleration bleed air valves on the 5th and 10th compressor stages of each engine are opened automatically during engine starting to facilitate acceleration. The pneumatically actuated valves are controlled electrically through control of a three-way solenoid valve on the engine. When engine speed is above 94 percent RPM, the solenoid valve is de-energized by the speed-sensitive control and opens to allow air pressure from either the 14th stage of the compressor or from the bleed air system manifold to be applied to the bleed valves. This air, being higher in pressure than the 5th and 10th stage compressor air, drives the bleed valves closed. When engine speed is below 94 percent RPM, the solenoid valve is closed, venting the high pressure air, and the bleed

engine fuel flow



ENGINE STARTING

(PARALLEL OPERATION)

ENGINE SPEED

BETWEEN 16 AND 65 % RPM (APPROXIMATELY)

DRIP VALVE IS ENERGIZED CLOSED AT APPROXIMATELY 16 % RPM AND IS HELD CLOSED BY PRESSURE.

PUMP PARALLELING VALVE IS ENERGIZED CLOSED AT APPROXIMATELY 16 % RPM AND OPENS AT APPROXIMATELY 65 % RPM.

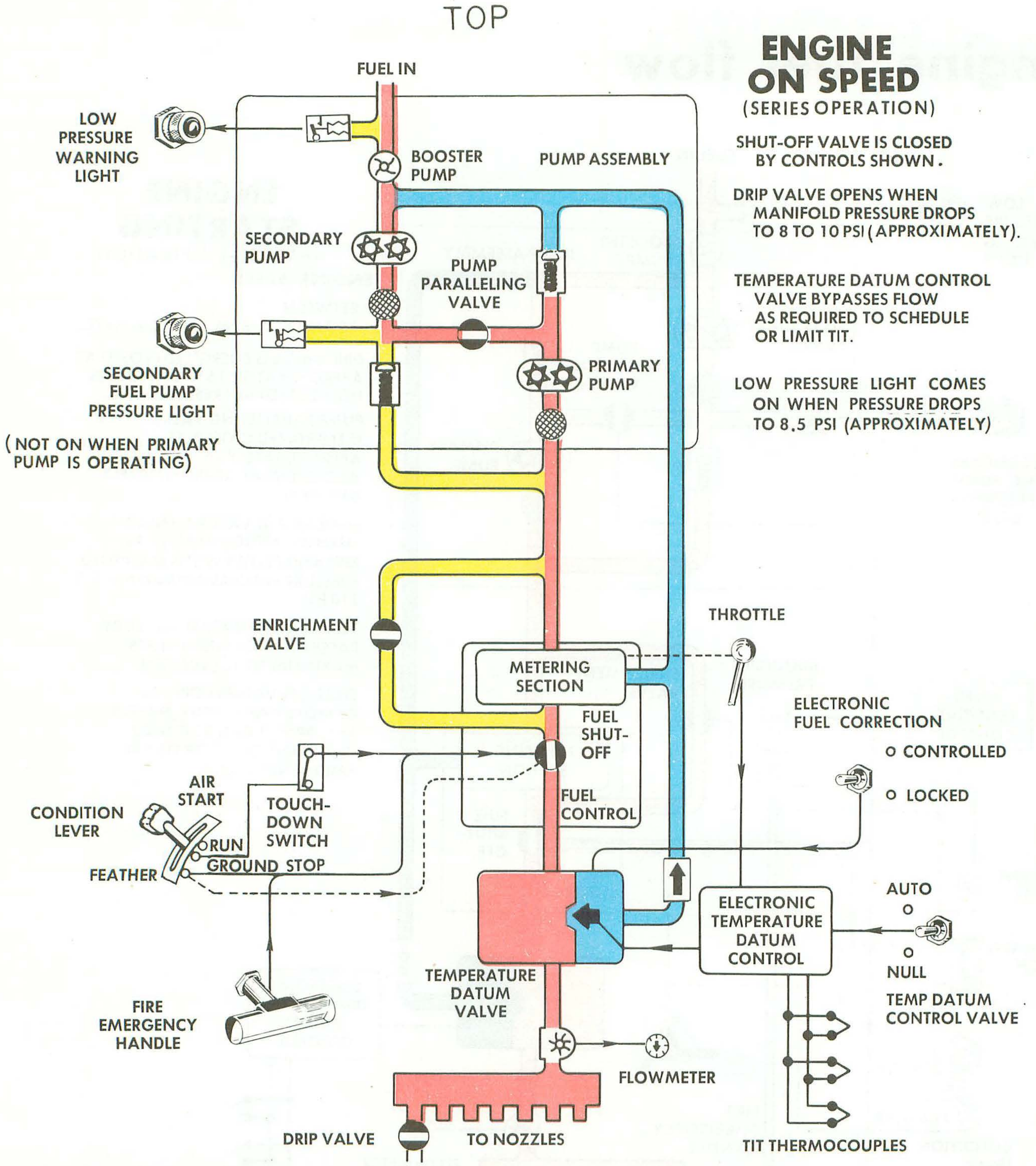
ENRICHMENT VALVE IS ENERGIZED OPEN AT APPROXIMATELY 16 % RPM AND CLOSES WHEN MANIFOLD PRESSURE REACHES APPROXIMATELY 110 PSI.

TEMPERATURE DATUM VALVE BY-PASSES 20 % OF FUEL UNLESS MAXIMUM TIT IS EXCEEDED.

SHUT-OFF VALVE IS OPENED BY MOTOR AT APPROXIMATELY 16 % RPM. IT CAN BE CLOSED BY CONDITION LEVER OR FIRE EMERGENCY HANDLE.

130A-1-33-010-1

Figure 1-8. (Sheet 1 of 2)



MAIN FUEL FLOW

BY-PASS FUEL FLOW

STATIC PRESSURE

ELECTRICAL ACTUATION

MECHANICAL ACTUATION

130A-1-33-010-2

Figure 1-8. (Sheet 2 of 2)

throttle quadrant

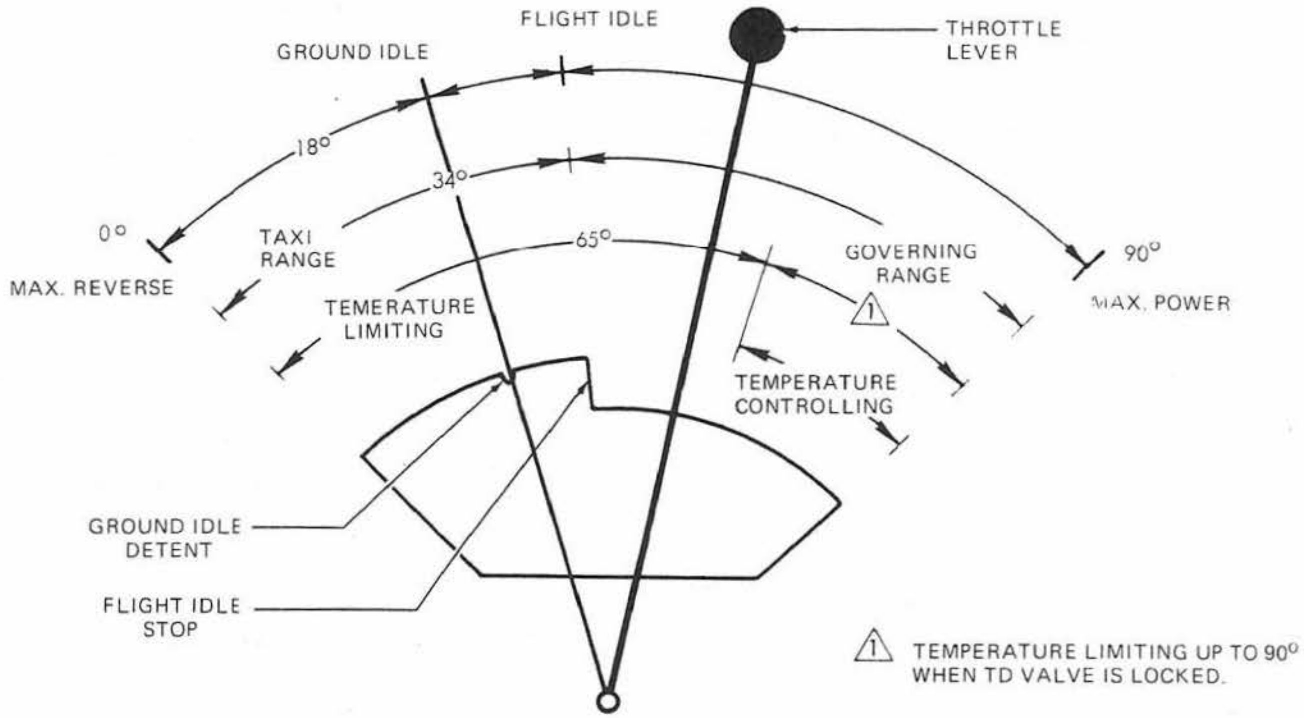


Figure 1-9.

valves are opened by pressure of air in the 5th and 10th stages of the compressor. If the engine is shut down by using the fire emergency handle, no DC power is applied to the solenoid valve during the shutdown and the valve will remain open allowing air from the other three engines to flow from the main bleed manifold through a double ball check valve to the affected engine holding the compressor bleeds closed. If a start is attempted and the bleed valves are not open, the TIT may exceed the limits or the compressor may stall.

Diffuser Bleed Valve.

The 14th stage bleed air valve reduces airflow to the combustion liners at the beginning of the starting cycle to assist in lightoff. It closes automatically at 33 percent RPM engine speed.

Starting Fuel Enrichment System.

The engine fuel enrichment switches (figure 1-14), located on the engine starting panel, are toggle switches with NORMAL and OFF positions. In NORMAL, each switch allows the engine fuel enrichment valve to be controlled by the speed-sensitive control and manifold pressure switch during starting. The OFF position is provided to permit deactivating the fuel enrichment system for any engine. The enrichment system consists of a bypass line in which is mounted a solenoid valve controlled by the speed-sensitive control and a manifold pressure switch. The valve is opened by the speed-sensitive control, through the ignition relay, when engine speed reaches 16 percent RPM during starting. While open, it allows pump discharge fuel to flow around the metering section of the fuel control to add to the metered flow from the fuel control. After fuel pressure in the manifold reaches approximately 110 PSI (gage), the manifold pressure switch opens to deenergize the valve, which then closes.

STARTING SYSTEM.

An air turbine starter drives the engine for ground starts. The starter consists of a turbine unit, a reduction gear section, and a clutch to engage the starter turbine to the starter reduction gearing. A regulator valve at the turbine inlet is opened by energizing a solenoid on the valve to allow airflow into the starter turbine. The solenoid is energized by closing a ground start switch at the flight station; and is deenergized, causing the regulator valve to close, when centrifugal cutout switches in the starter are operated at starter cutout speed. Air for driving the starter can be supplied from an external source, the gas turbine compressor, or an operating engine. The air is supplied from the bleed air system through an engine bleed air valve. When opened, the bleed air valve allows air to flow into the nacelle duct leading to the starter regulator valve. (See Section V for starter limits.)

IGNITION SYSTEM.

The ignition system is a high-voltage, condenser-discharge type, consisting of an exciter, two igniters, and control components. The system is controlled by the speed-sensitive control through the ignition relay which turns it on at approximately 16 percent RPM and turns it off at approximately 65 percent RPM during starting.

ENGINE CONTROLS.

Throttles.

The throttles (figure 1-10) are quadrant-mounted on the flight control pedestal. Throttle movement controls engine operation by positioning propeller controls and by positioning controls to select the rate of engine fuel flow. Throttle movements are transmitted through mechanical linkage to an engine-mounted coordinator, and all references to throttle travel are given in degrees of coordinator movement. The coordinator transmits the movements through mechanical linkage to the propeller and to the engine fuel control, and it also actuates switches and a potentiometer which affect electronic temperature datum control system operation. Each throttle has two distinct ranges of movement - taxi and flight (governing). They are not marked, but are separated by a cam step (see figure 1-9). Both ranges are used for ground operation, but the taxi range is not used in flight. In the taxi range, the throttle position selects a propeller blade angle and a corresponding rate of fuel flow. In the flight (governing) range, throttle position selects a rate of fuel flow to produce a scheduled turbine inlet temperature, and the propeller governor controls propeller blade angle. The throttles have four marked positions, which are the following:

MAX REVERSE - (0 degrees travel) gives maximum reverse thrust with engine power approximately 60 percent of take-off power.

GROUND IDLE - (18 degrees travel) is a detent position. This is the ground starting position at which blade angle is set for minimum thrust and the fuel control for minimum fuel flow.

FLIGHT IDLE - (34 degrees travel) is the transition point between the taxi and flight (governing) ranges. A step in the quadrant limits aft travel of the throttle at this position until the throttle is lifted.

TAKE-OFF - (90 degrees travel) is the full-power position.

The throttle quadrant is also divided into two unmarked ranges with respect to control of the electronic temperature datum control system. The crossover point is at 65 degrees throttle travel, at which point the switches in the coordinator are actuated. Below this point, the electronic temperature datum control system is limiting turbine inlet temperature. Above this point, it is controlling turbine inlet temperature.

Throttle Friction Knob.

A friction knob (figure 1-10) on the throttle quadrant adjusts the amount of force applied to the throttles to prevent creepage or accidental movement.

CAUTION

Excessive force applied to the friction knob can cause breakage of parts which might jam the throttles.

Engine Condition Levers.

Four pedestal-mounted condition levers (figure 1-10) are primarily controls for engine starting and stopping and propeller feathering and unfeathering. They actuate both mechanical linkages and switches which provide electrical control. Each lever has four marked positions, which are the following:

RUN is a detent position. At this position, the lever closes a switch which places engine fuel and ignition systems under control of the speed-sensitive control. For engines No. 2 and No. 3, the ice detection system is energized.

AIR START is a position attained by holding the lever forward against spring tension. In this position, the lever closes the same switch closed by placing the lever at RUN, and in addition closes a switch which causes the propeller feathering pump to operate.

GROUND STOP is a detent position. In this position, the lever actuates a switch which causes the fuel shutoff valve on the engine fuel control to close only if the airplane is on the ground, and the landing gear touchdown switches are closed. The switch also closes the nacelle preheat control circuit and the ENTC test circuits for the engine, making these systems operable.

FEATHER is a detent position. When the lever is pulled toward this position, mechanical linkages transmit the motion to the engine-mounted coordinator and from the coordinator to the propeller and to the shutoff valve on the engine fuel control. Switches are also actuated by the lever as it is pulled aft. The results of moving the lever to FEATHER are the following:

The propeller receives a feather signal mechanically.

The fuel shutoff valve on the engine fuel control is closed both mechanically and electrically.

The propeller feathering pump is turned on.

The nacelle preheat system remains operable.

control pedestal typical

1. FLARE DISPENSER MASTER ARMING SWITCH
2. VHF NAVIGATION PANEL
3. INSTRUMENT SELECT PANEL
4. TACAN CONTROL PANEL
5. NO. 2 LIASON RADIO CONTROL PANEL
6. COPILOT'S INTERCOMMUNICATION CONTROL PANEL
7. ENGINE CONDITION LEVERS
8. COPILOT'S MIC TRANSFER PANEL
9. LANDING LIGHTS CONTROL PANEL
10. ELECTRONIC PROP GOVERNOR AND ENTC TEST PANEL
11. AUTO-PILOT CONTROLLER
12. COMPASS CONTROLLER (2 AXIS)
13. VHF CONTROL PANEL
14. NO. 2 RADIO COMPASS CONTROL PANEL
15. FLAP LEVER
16. NO. 1 RADIO COMPASS CONTROL PANEL
17. MASTER ARM SWITCH
18. INBOARD GENERATOR CONTROL SWITCH
19. TEMP DATUM CONTROL VALVE SWITCHES
20. ANTENNA SELECTOR, UHF 1
21. FLAP CONTROL PANEL
22. NO. 1 UHF COMMAND CONTROL PANEL
23. AUTO-PILOT CONTROL PANEL
24. TRIM TAB CONTROL PANEL
25. ELEVATOR TAB SELECTOR SWITCH
26. THROTTLE FRICTION KNOB
27. PILOT'S MIC TRANSFER PANEL
28. PILOT'S INTERCOMMUNICATION CONTROL PANEL
29. THROTTLES

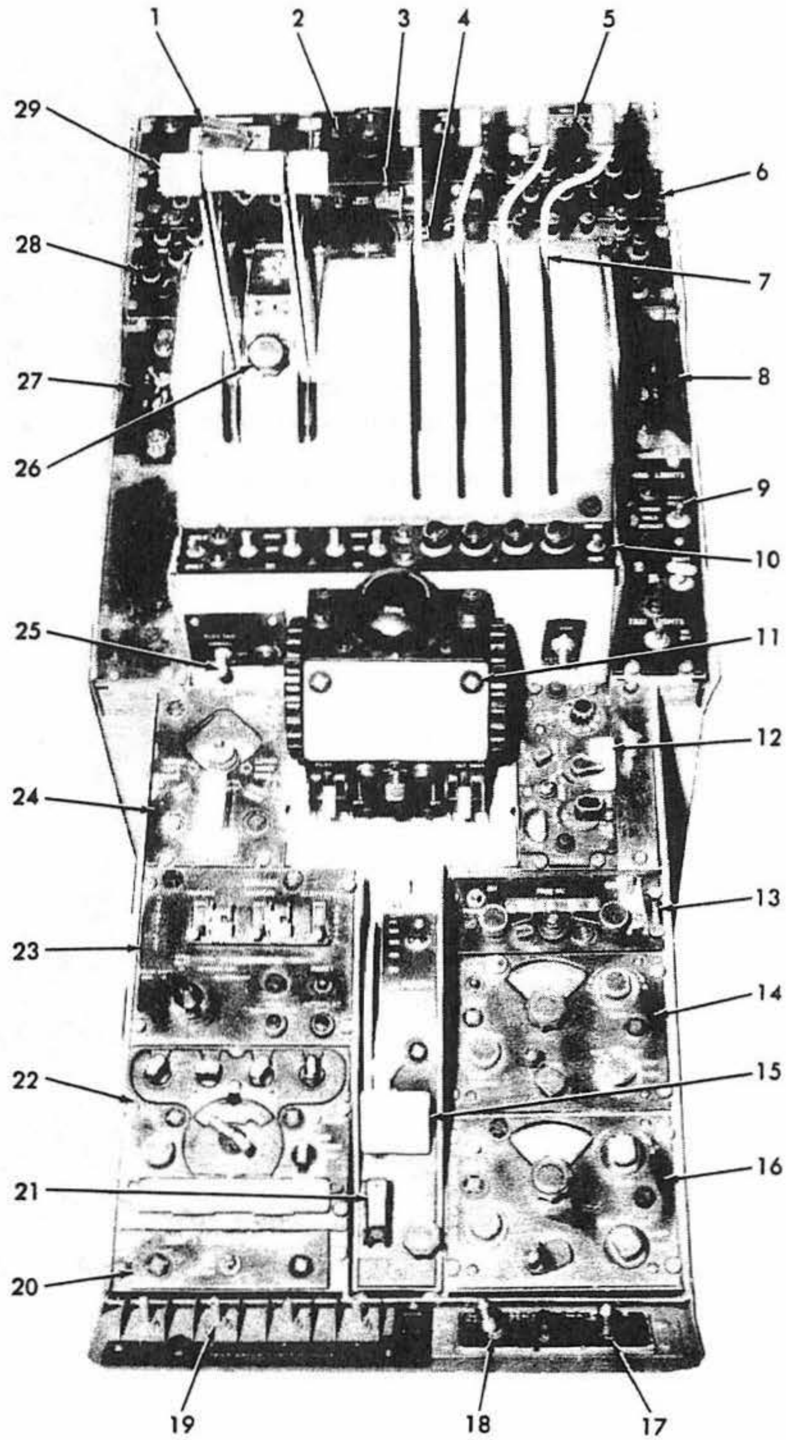


Figure 1-10.

control pedestal

AIRPLANES MODIFIED BY T.O. 1C-130-838

1. UHF COMMAND CONTROL PANEL
2. IFF ANTENNA SWITCH AND CAUTION LIGHT PANEL
3. IFF TRANSPONDER CONTROL PANEL

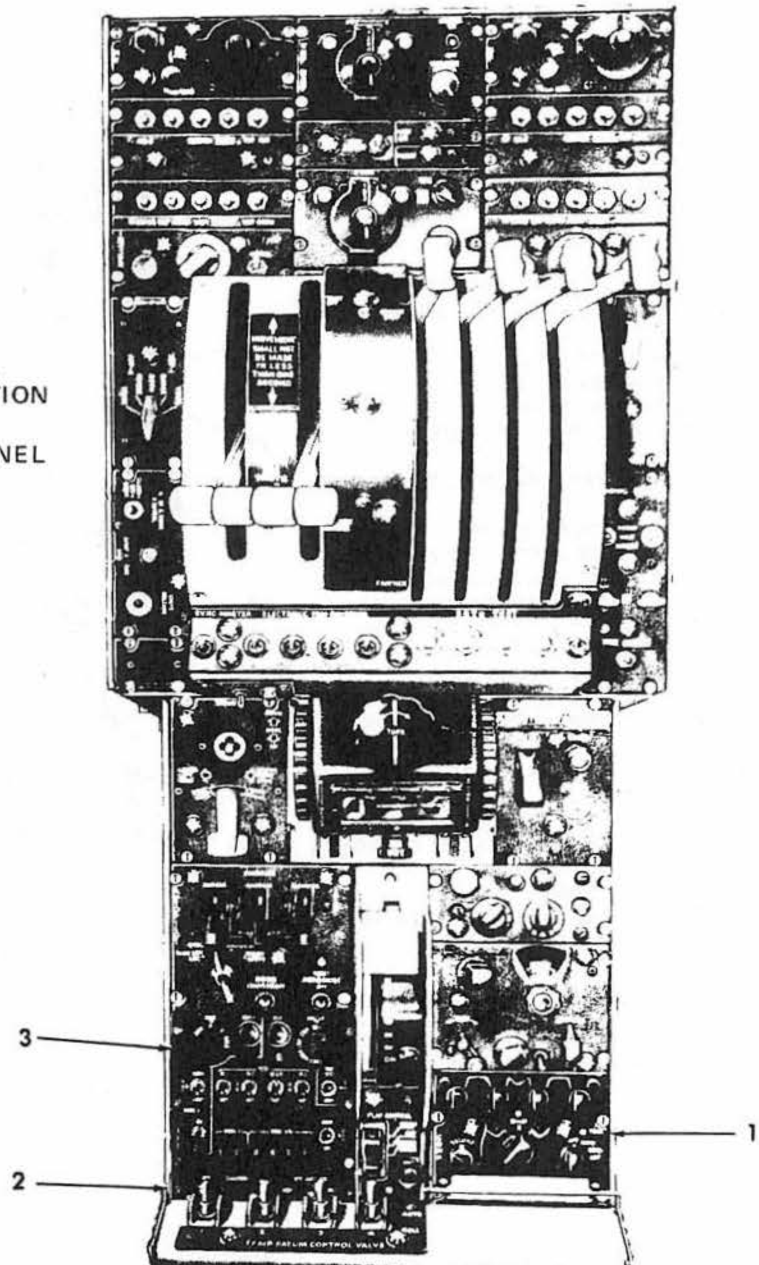


Figure 1-11.

CAUTION

When pulling the condition lever to FEATHER, pull it smoothly through the GROUND STOP position all the way to the detent, without stopping at any midpoint, to assure that the propeller is fully feathered when the engine fuel is shut off. If the lever is left at a midposition, it is possible to cause engine decoupling if the ENTC system fails.

TD (Temp Datum) Control Valve Switches.

Four temperature datum control valve switches (figure 1-12) are mounted on a control panel at the aft end of the flight control pedestal. Each switch has AUTO and NULL positions. The switch positions are used as follows:

The AUTO position permits normal operation of the electronic temperature datum control system by applying single-phase AC power to the amplifier through an engine fuel and temperature control circuit breaker on the main AC distribution panel. The TD valve brake is unlocked after the amplifier warms up (30 seconds).

The NULL position of these switches is used to deactivate the control systems when erratic fuel scheduling is suspected or when the engines are not operating. The NULL position removes AC power from the TD control amplifier, and applies DC power, through the null circuit breaker on the copilot's circuit breaker panel, to the TD valve brake to unlock it. Receiving no control signals, the TD valve returns to its null position so that it does not correct the fuel flow according to turbine inlet temperature.

Electronic Fuel Correction Switch and Lights.

Note

On aircraft modified by TCTO 1C-130-699 the fuel correction lights may illuminate any time the battery switch is turned on.

The electronic fuel correction switch and amber lights (figure 1-13) are located on the copilot's instrument panel. The switch, which has CONTROLLED and LOCKED positions, controls the brakes on all four temperature datum valves. With the switch at CONTROLLED position, the brakes are unlocked and the valves are controlled by the electronic control systems to provide temperature limiting or controlling, depending on throttle position. The lights are on while the throttles are in temperature-limiting range (below 65 degrees) and go out when the throttles are advanced to the temperature-controlling range (above 65 degrees) if the control systems are functioning normally. While the throttles are in temperature-controlling range, the valves may be at some "put" or "take" position, depending on what fuel flow correction is necessary to maintain a selected turbine inlet temperature. If the electronic fuel correction switch is then positioned at LOCKED, the TD valves are locked at whatever positions they are in at the time. The TD valves remain locked and the fuel correction lights remain out through all throttle movements, unless an over-temperature condition is sensed by the amplifier. If the engine throttle is in the temperature-limiting

temperature datum control valve switch panel

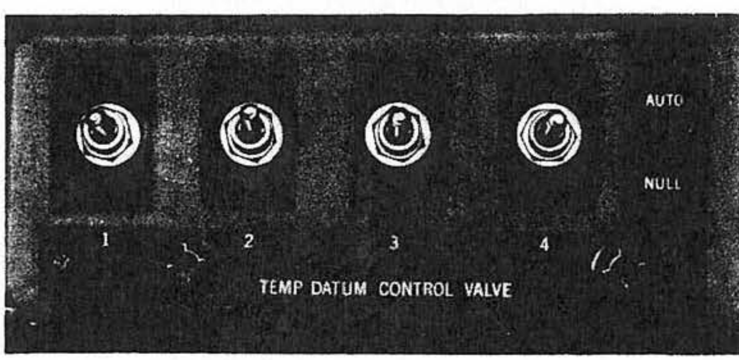


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Figure 1-12.

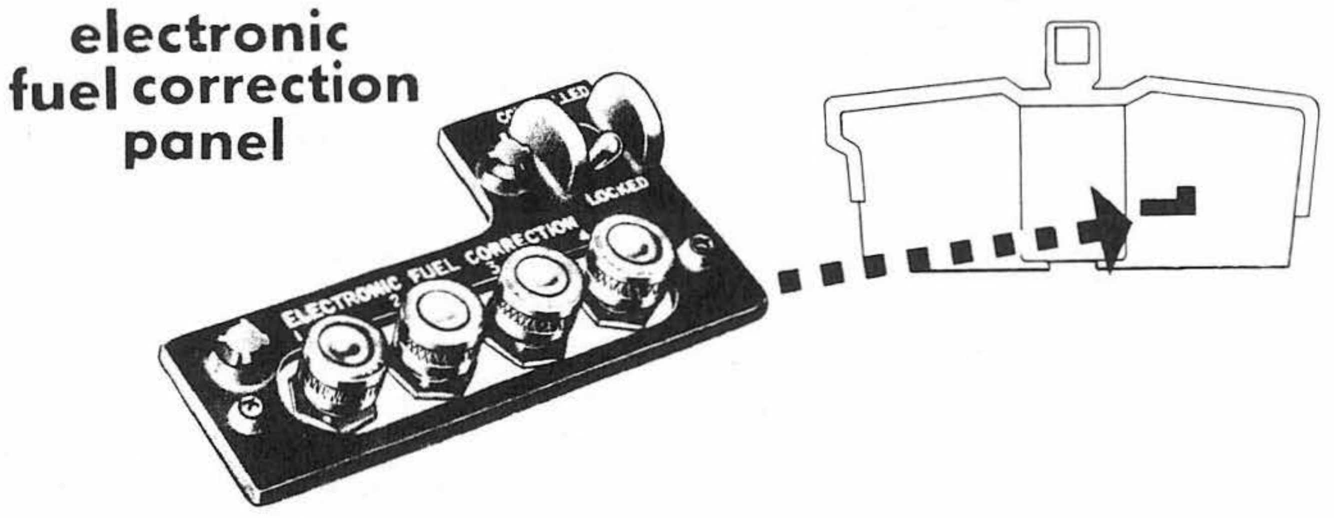


Figure 1-13.

range (below 65 degrees) and an over-temperature condition exists, the TD valve for the particular engine will unlock and open to a "take" position regardless of the electronic fuel correction switch position. If a valve is unlocked by its control system to correct an over-temperature condition, the fuel correction light for that engine illuminates to indicate that the valve is unlocked and the system will continue to operate in a temperature limiting mode.

Note

The electronic correction switch locks the correct fuel setting of the TD valve only when it is positioned at LOCKED while the throttles are in the temperature controlling range, the TD control valve switch is in the AUTO position, and the fuel correction lights are out. Locking the valves permits all the engine fuel controls to maintain more equal power distribution during formation flying and landing.

Starting Control System.

The starting control system automatically controls fuel flow, ignition, and compressor unloading during ground and air starts. DC power for the control circuits is supplied from the flight station bus through the engine start control circuit breakers on the flight station distribution panel and from the propeller and engine bus through the engine fuel and ignition control circuit breakers on the copilot's circuit breaker panel. Provisions are made for using the battery to energize these circuits when all the air output of the gas turbine compressor is required to drive the starter. The automatic control of the starting control system is a speed-sensitive control, which is engine-driven and contains three centrifugal speed switches. These switches perform the following functions:

On acceleration to 16 percent RPM - The motor-driven fuel shutoff valve in the engine fuel control is opened. The ignition relay is energized and completes circuits to:

a. Energize the ignition exciter.

b. Close the engine fuel pump paralleling valve.

c. Open the fuel enrichment valve.

d. Close the manifold drip valve.

e. If battery engine start is accomplished, battery engine start holding circuit is energized (if battery switch is in BATTERY position only).

On acceleration to 65 percent RPM - The ignition relay is de-energized, causing the following:

a. Ignition system is turned off.

b. Fuel pump paralleling valve opens to return pumps to series operation.

c. Manifold drip valve is de-energized. (It is then held closed by manifold pressure.)

d. ATM is turned on if battery-engine start is used.

e. Deenergizes the battery engine start holding circuit. (If battery switch is in BATTERY position only.)

On acceleration to 94 percent RPM - electronic temperature datum control system is switched from start limiting to normal limiting and the three-way solenoid valve is deenergized through the speed-sensitive control to allow 14th stage bleed air pressure to force the 5th and 10th stage compressor bleed valves closed and the engine start control circuit is deenergized.

On deceleration to 94 percent RPM - the three-way solenoid valve is energized to allow 5th and 10th stage valves to open, and electronic temperature datum control system is switched to start limiting and engine start control circuit is energized by the speed-sensitive control. (See Section V for limits.)

Engine Ground Start Switches.

The engine ground start switches (figure 1-14) are located on the engine starting panel on the overhead control panel. Each switch is used to open the starter air regulator valve to permit operation of the starter. A red light in the switch glows as long as the switch is held in. When the engine accelerates to starter cut-out speed, speed switches in the starter are actuated to cause the regulator valve to close and the switch to be released, causing the light to be extinguished. The switch can be disengaged manually at any time to discontinue starter operation. Power is supplied to the switches from the flight station DC bus.

Note

The red light in the starter switch does not necessarily indicate that the starter is energized.

Battery-Engine Start Switch.

The battery-engine start switch (figure 1-14) is located on the engine starting panel. The switch is used when starting the first engine on days of low air density. If the switch is not used, the gas turbine compressor may not supply enough air to drive the starter and air turbine motor at the same time if air density is low because of high temperature or altitude. Closing the switch causes the relays to energize and turn off the air turbine motor, and allows current to flow from the battery through a reverse-current relay to the main DC bus. When the voltage output of the engine-driven generator exceeds battery voltage, the generator is connected to the main bus. The higher bus voltage then causes the relays of the battery engine start circuit to be deactuated, and the reverse current relay resumes its normal function of preventing current flow from battery to bus. Power for the battery-engine start switch is obtained from the isolated DC bus through the GTC control circuit breaker on the main power distribution box

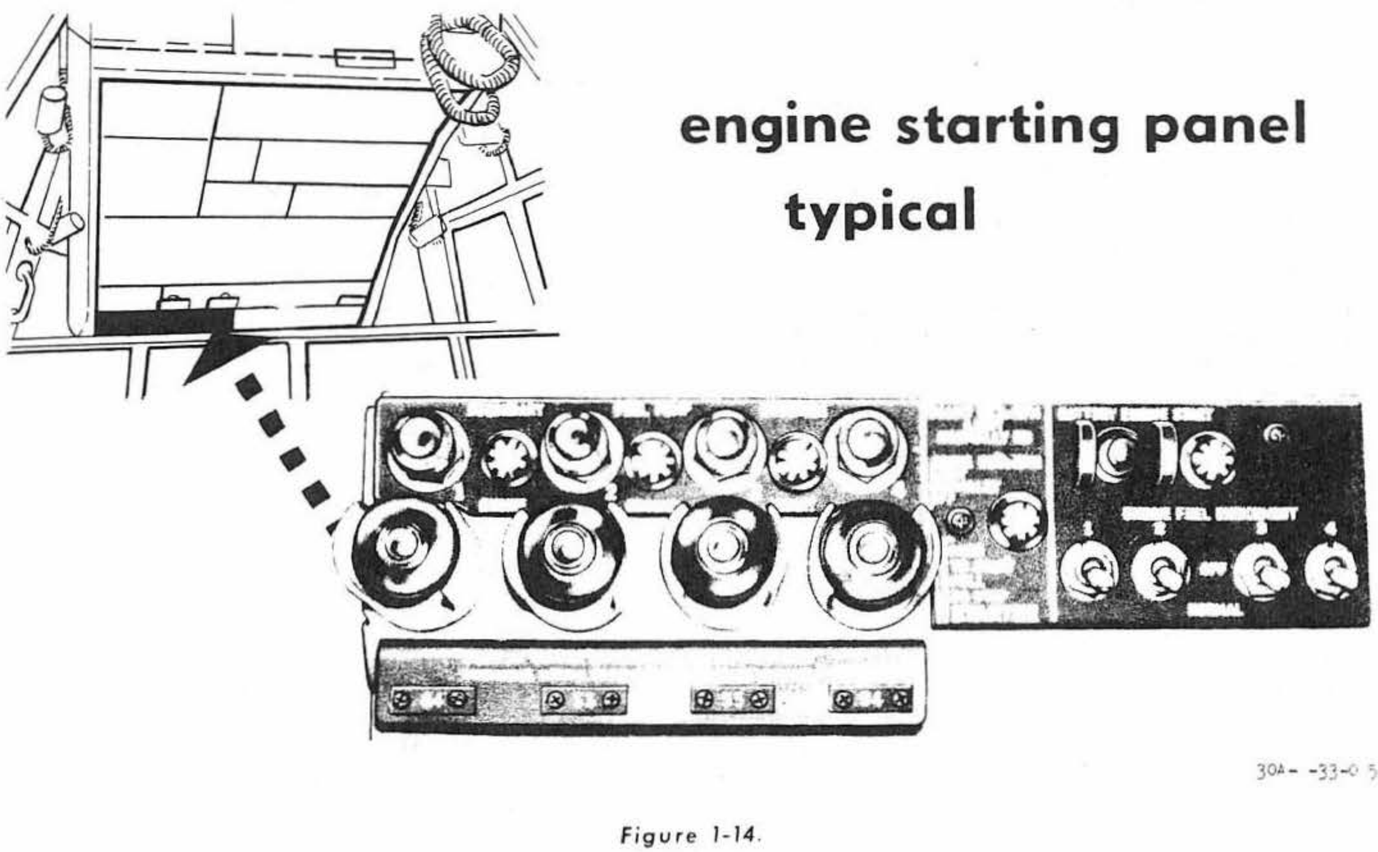


Figure 1-14.

Engine Fuel Enrichment Switches.

The engine fuel enrichment switches (figure 1-14) are located on the engine starting panel. They are toggle switches with NORMAL and OFF positions. In NORMAL, each switch allows the engine fuel enrichment valve to be controlled by the speed-sensitive control and manifold pressure switch during starting. The OFF position is provided to permit deactivating the fuel enrichment system for any engine. Power is supplied to the switches from the flight station bus through the engine starting control circuit breakers.

Engine Bleed Air Valve Switches.

The engine bleed air valve switches are located on the gas turbine compressor control panel on the overhead panel. They are toggle switches with OPEN and CLOSED positions. Each switch controls a motor-driven bleed air valve in the engine nacelle. When the valve is opened, it allows bleed air to flow from the bleed air system manifold to the starter valve, the nacelle preheat valve, and the inlet air scoop anti-icing valve; or, if the engine is running, it allows air to flow from the 14th compressor stage of the engine to the bleed air system. The valve is closed when necessary to prevent air flow from the engine to the bleed air system or from the bleed air system to the nacelle ducts. Power is supplied to the switches from the propeller and engine DC bus.

ENTC Test Switch and Lights.

The ENTC test switch and lights (figure 1-16) are located at the aft end of the flight control pedestal. The switch has NORMAL and TEST positions. When positioned at TEST, it applies DC power to a test circuit, providing for testing the ENTC system for any engine. If an engine is then shut down by the procedure described in Section II, propeller momentum tends to drive the engine after engine fuel flow is shut off. If the ENTC system is functioning, it signals the propeller to increase blade angle; and the No. 1 blade trips a switch as it increases angle. The switch turns on the test light, which is controlled by a holding circuit after it is originally lighted, for the engine to indicate that the negative torque signal has caused the blade angle increase. The ENTC disabling system is deactivated during the test by a relay. Power is supplied to the test system from the fuselage DC bus.

Engine Fire Emergency Control Handles.

The fire emergency control handles (figure 1-57) are located on the overhead control panel. Each handle contains overheat warning lights and fire detection warning lights. Normal position of the handles is in. Refer to FIRE EXTINGUISHER SYSTEM in this section for additional information on the fire emergency control handles.

ENGINE INSTRUMENTS.

Torquemeters.

Each of the four torquemeters (figure 1-15 indicates torque in inch-pounds, and can indicate either positive or negative torque. When reading positive torque, the indicator hands are read together. When reading negative torque, the small indicator must be read in reverse. The difference between 1,000 and the small indicator hand reading is the indicated negative torque. (Example: with the large indicator hand showing -1,000 and the small indicator hand reading 800, the negative torque is -1,200.) The indicated torque is detected at the extension shaft between the engine power section and reduction gear assembly. Each torquemeter system uses both 115-volt, single-phase, and 26-volt, AC power supplied through circuit breakers and fuses on the main AC distribution panel. On airplanes modified by T.O. 1C-130A-648 (which have a transistorized system), 115-volt, single-phase, AC power is used.

Tachometers.

Each of the four tachometers (figure 1-15) indicates engine speed in percent of normal engine RPM. Normal RPM (100 percent) equals 13,820 engine rpm. A vernier dial on each indicator makes it possible to read to the nearest percent. The tachometers are self-powered.

TIT (Turbine Inlet Temperature) Indicators.

Each of the TIT indicators (figure 1-15) indicates temperature sensed by thermocouples in the engine turbine inlet casing. Each indicator contains a vernier scale which registers temperature in degrees centigrade. Single-phase, 115-volt power for the indicator systems is supplied through circuit breakers on the main AC distribution panel. A test switch (figure 1-15) on the panel next to the indicators is provided for testing indicator operation. Power for operation of the test system is supplied through the DC fire detector test relay circuit breaker on the flight station distribution panel.

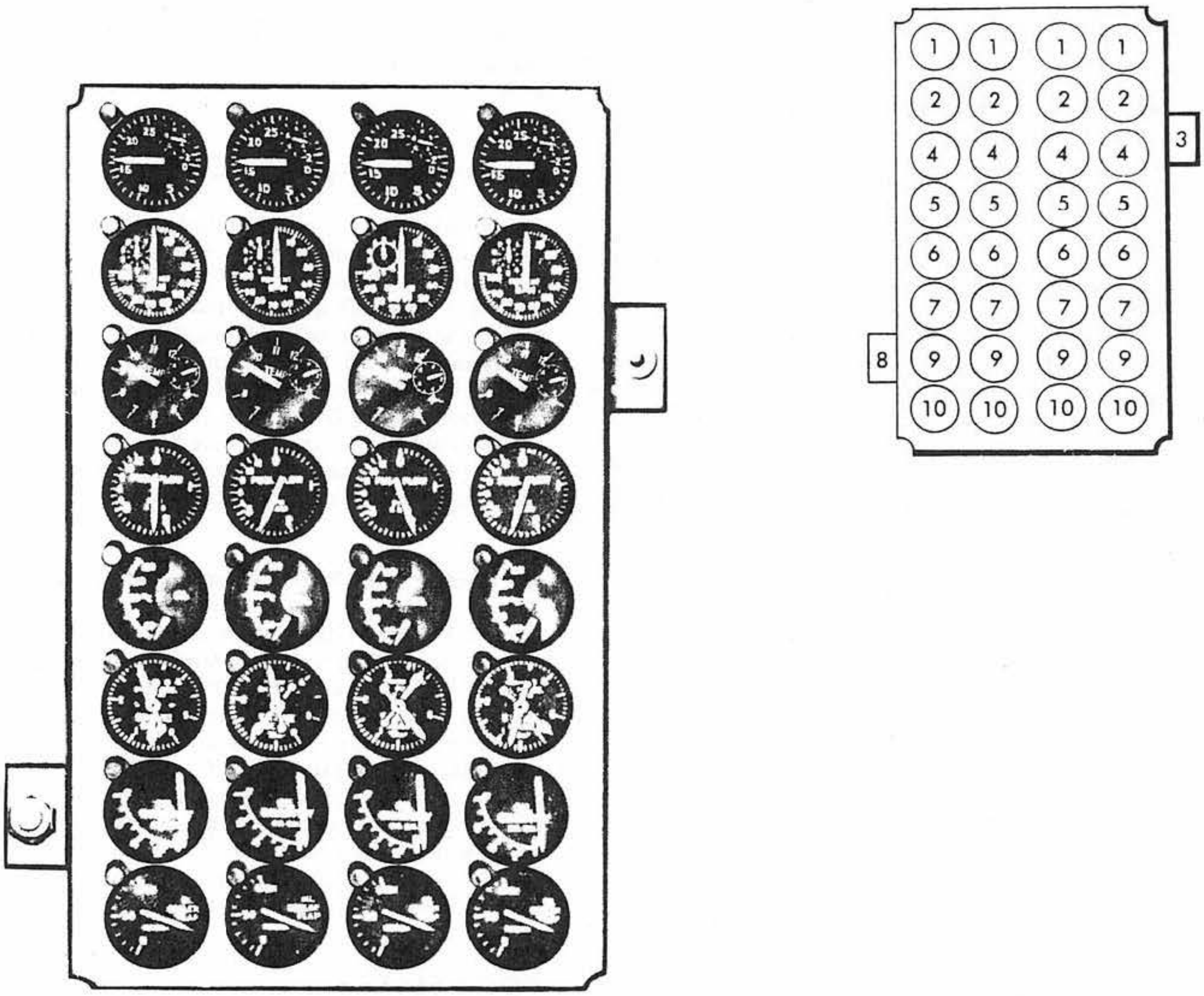
Fuel Flow Gages.

Each of the four fuel flow gages (figure 1-15) indicates flow in pounds per hour. Flow is measured at the point where it enters the manifold on the engine. Single-phase, 26-volt power is supplied to the indicator systems through fuses on the main AC distribution panel.

Fuel Pressure Warning Lights.

Four fuel pressure warning lights (figure 1-21) are located on the fuel control panel. On some earlier airplanes, they are labeled PRESS. WARN; on all other airplanes, they are labeled LOW PRESS. Each light

engine instrument panel



1. TORQUEMETER
2. TACHOMETER
3. TURBINE INLET TEMPERATURE INDICATOR TEST SWITCH
4. TURBINE INLET TEMPERATURE INDICATOR
5. FUEL FLOW GAGE
6. OIL TEMPERATURE GAGE
7. OIL PRESSURE GAGE
8. LOW OIL QUANTITY WARNING LIGHT
9. OIL QUANTITY GAGE
10. OIL COOLER FLAP POSITION INDICATOR

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Figure 1-15.

is turned on by a pressure switch when fuel supply pressure at the point where fuel enters the engine pump falls below approximately 8.5 PSI. When on, a light indicates a possible booster pump failure, valve failure, fuel line failure, or a malfunctioning pressure switch. The lights are energized by DC power supplied through a circuit breaker on the flight station distribution panel.

Secondary Fuel Pump Pressure Lights.

Four secondary fuel pump pressure lights (figure 1-14) are located on the engine starting panel. Each light is controlled by a pressure switch on the engine fuel pump and filter assembly. The light is normally on while the two gear pumps in the assembly are operating in parallel during engine starting (16 percent to 65 percent RPM). The light also illuminates at any other time if the pump paralleling valve is not open or if the primary gear pump fails. If the light does not illuminate during starting, either the pump paralleling valve has not closed or the secondary pump has failed. The four lights are energized by DC power supplied through a circuit breaker on the flight station distribution panel.

Oil Temperature Gages.

The four oil temperature gages (figure 1-15) indicate oil temperature in the oil inlet lines. The DC, electrical-resistance type indicators receive power through an oil temperature indicator circuit breaker on the flight station distribution panel.

Oil Pressure Gages.

Four dual oil pressure gages (figure 1-15) register oil pressure for both the engine power sections and reduction gears. The rear pointer on each indicator shows reduction gear oil pressure; and the front pointer indicates power section oil pressure. Single-phase, 26-volt AC power for the indicator systems is supplied through fuses on the main AC distribution panel.

Note

On some airplanes a fluctuation of engine oil pressure (power section and gear section) may be experienced during movement of the flight controls. This is due to vibrations caused by the hydraulic in-line pressure filter which is connected to a common support with the engine and gear section oil pressure transmitter. This engine oil pressure fluctuation will also be dependent upon shock mounting of the oil pressure transmitter on some airplanes. See Section V for oil pressure fluctuation limits.

Oil Quantity Gages.

Four oil quantity gages (figure 1-15), one for each engine oil system, are located on the engine instrument panel. Each instrument is calibrated from E (empty) to F (full) in increments of 2 gallons each. The indicators are energized by 28-volt DC power through the engine oil quantity eng 1, eng 2, eng 3, and eng 4 circuit breakers on the copilot's circuit breaker panel.

Low Oil Quantity Warning Light.

A low oil quantity warning light (figure 1-15) is located on the engine instrument panel to the left of the oil quantity indicators. The light is electrically connected to each oil quantity indicator transmitter and will glow when an oil tank quantity level drops to approximately 3.25 gallons in 8-gallon tanks and 4.0 gallons in 10-gallon tanks. The light will be energized only on the first engine to have a low oil quantity. The warning light is energized by 28-volt DC power through the engine oil quantity lights circuit breaker on the copilot's circuit breaker panel.

Oil Cooler Flap Position Indicators.

Four oil cooler flap position indicators (figure 1-15), one for each engine oil system, are located on the engine instrument panel. The indicators are electrically connected to position transmitters that are geared to the oil cooler flap door actuators. The indicator dials, calibrated from 0 to OPEN in increments of 10 percent, indicate the precent of opening of cooler flap doors. The indicators are energized by 28-volt DC power through the oil cooler flap No. 1, 2, 3, and 4 circuit breakers from the rh and lh wing buses in the main power distribution box.

PROPELLERS.

Each engine drives an Aeroproducts, three-blade, electro-hydraulic, full-feathering, reversible-pitch propeller. This propeller is capable of operating either as a controllable-pitch propeller for engine starting and taxi operations or as a constant-speed unit for ground or flight operation. The propeller assembly consists of hub, blades, regulator, master gear assembly, feather pump and reservoir, and spinner. With each propeller, an electronic governor system is provided as a control system component. The electronic governor system supplements the hydraulic governing of the propeller to help stabilize constant-speed governing and to make synchronization of propellers possible. The propeller regulator is the blade angle control unit of the propeller. It contains control components and pumps of a hydraulic system, which is completely contained within the propeller assembly. The regulator controls the flow and pressure of hydraulic fluid which drives torque units in the hub. The torque units position the blades. The electric motor-driven feather pump supplies hydraulic pressure for changing blade angle while the propeller is stationary and to assist in feathering and unfeathering when the gear pumps in the regulator are driven too slowly to produce sufficient pressure. The master gear assembly synchronizes the angles of the three blades. A low-pitch stop and a pitch lock are also incorporated in the assembly as safety devices. The low-pitch stop prevents the blades from turning to an angle less than flight idle angle unless the taxi range of operation is selected by throttle position. The pitch lock consists of a spring-loaded ring with teeth which engage teeth on the master gear when the engine overspeeds, to prevent the blades from being turned in a decreased-pitch direction. The ring is forced to disengage from the master gear by hydraulic pressure applied through a pitch lock control valve when the propeller is turning at normal speeds. When the engine overspeeds to approximately 104 percent RPM, the pitch lock control valve is actuated by centrifugal force, allowing the hydraulic pressure to vent. This allows the spring-loaded ring to engage the master gear. When pitch lock is suspected, verification may be made by slowly advancing or retarding the throttle. RPM will follow throttle movement if this condition exists. Electrical anti-icing and de-icing elements are installed on each propeller.

Note

The pitchlock is mechanically cammed out below 10° blade angle or above 50° blade angle.

HYDRAULIC CONSTANT-SPEED GOVERNING SYSTEM.

The constant-speed governing system is an integral part of the propeller regulator. A constant-speed governor in the regulator controls the flow of hydraulic fluid to and from the blade torque units to position the blades. A speed-sensitive piston in the governor reacts to centrifugal force and positions a distributor valve piston in the governor assembly to port hydraulic pressure to the torque units. The centrifugal force is opposed by an adjustable governor spring so that the speed-sensitive piston is in a neutral position when the propeller is turning at normal speed. When an off-speed condition occurs, the piston is displaced from neutral; and the governor ports fluid to and from the torque units so that they change blade angle as required to correct the off-speed condition. When propeller speed is at normal, the governor closes its ports so that hydraulic pressure holds the torque units in position. While in governing operation, the propeller has the capability of varying blade angle between flight idle to full feather angles.

ELECTRONIC PROPELLER GOVERNING SYSTEM.

The electronic propeller governing systems provide for acceleration-sensitive stabilizing of each propeller and synchronization of the four propellers. Each electronic governing system consists of an electronic governor under the flight station, and engine-driven signal alternator, and a solenoid valve in the propeller regulator. Control circuits are also provided to interconnect the governing systems for synchronizing the propellers. The electronic governors use 115-volt, unregulated AC power supplied through circuit breakers on the main AC distribution panel.

Acceleration-Sensitive Stabilizing System.

The acceleration-sensitive stabilizing system supplements the action of the hydraulic constant-speed governing system in the propeller regulator to further stabilize engine speed control. The hydraulic constant-speed governor senses the magnitude of engine speed change and corrects blade angle accordingly. The stabilizing system senses both magnitude and rate of speed change; and because it is sensitive to rate of change, it can oppose and dampen the changes sensed. The stabilizer circuits in the electronic governor sense speed change from the magnitude and frequency of the output of the engine-driven signal alternator. While engine speed is changing, the system produces an electrical signal to control the solenoid valve in the regulator. The solenoid valve ports hydraulic fluid to and from the torque units which drive the blades. Since the valve may add to or subtract from the fluid flow provided by the constant-speed governor, the valve and governor work together in correcting a change in engine speed. The solenoid valve functions while the speed is changing to oppose the change, and the governor functions while the off-speed condition exists to return the speed to normal. The maximum amount of fluid which can be ported by the valve is limited so that loss of the stabilizing system does not adversely affect propeller operation.

Synchronizing System.

Components of the electronic governing system are also used for control of propeller synchronization. Either the No. 1 or No. 2 propeller may be selected as the master. When in synchronizing operation, the signal output of the engine-driven alternator on the master engine is applied to synchronizing circuits in the electronic governor for each slave propeller. This signal serves as the reference speed signal for the synchronizing circuits. The actual speed signal output of each slave engine alternator is compared with the signal output of the master engine alternator. If there is a difference between the speeds of the master engine and slave engines, the electronic governors of the slave engines accordingly adjust their signal output which is being fed to the solenoid valve in each slave propeller regulator. The valves are operated as required to change blade angle until the out-of-sync condition is corrected. Response of the synchronizing circuits is much slower than response of the stabilizing circuits of the electronic governor; therefore, only a prolonged out-of-sync condition results in a blade angle change. In the event that the selected master engine is shut down and the other master is not selected, the RPM of the slave engines will drop a maximum of two percent. DC power for operation of the synchronizing system switching relays is supplied through a master engine selector circuit breaker on the copilot's circuit breaker panel.

TAXI-RANGE CONTROL SYSTEM.

For taxi-range operation, propeller blade angle is selected by positioning the throttle between FLIGHT IDLE and REVERSE. Since engine speed is almost constant for ground operation, changing blade angle either increases or decreases thrust as necessary to control taxi speeds. The speed-sensitive piston in the constant-speed governor in the propeller regulator is positioned by mechanical linkage in the taxi range rather than by centrifugal force as in the flight range, to control the flow of hydraulic fluid to and from torque units to effect blade angle changes. A control lever on the propeller regulator is linked through the engine control coordinator to the throttle, and its position corresponds to throttle position. When the lever moves, the motion is transmitted through a carriage in the regulator to reposition the speed-sensitive piston in the governor. The governor then ports hydraulic fluid to the torque units to drive blades to the selected position. As the blades turn, a feedback shaft driven by the propeller master gear drives a carriage which returns the speed-sensitive piston toward its neutral position and the blades are stopped and held at the selected angle. When the throttle is above FLIGHT IDLE, the control linkage is moved away from the speed-sensitive piston in the governor so that it can be positioned by centrifugal force, and constant-speed governing is in effect.

CONDITION LEVER FEATHERING AND UNFEATHERING.

Feathering of a propeller may be controlled by the engine condition lever. Movement of the condition lever to FEATHER causes the engine control coordinator to disengage the throttle control linkage and to transmit the motion of the condition lever to the control lever on the propeller regulator. As a result, the speed-sensitive piston in the constant-speed governor is set to its full increase-pitch position, and it is held in that position by the control mechanism. The electric motor-driven feather pump is turned on during the feather cycle. The motor supplies hydraulic pressure and flow through the constant-speed governor to the blade torque units to drive the blades to the feather stops after the output of pumps in the propeller regulator falls off when propeller rotation is reduced to approximately six percent RPM. A timing relay cuts off the feather pump to prevent continuous operation after the blades reach feather angle. During unfeathering in flight, the feather pump is energized when the engine condition lever is held in AIR START. The speed-sensitive piston in the constant-speed governor is released from control by the engine condition lever, and it is forced to its decrease-pitch position by the governor spring. Hydraulic fluid from the feather pump then flows through the governor to the torque units to drive the blades in a decrease-pitch direction. Releasing the condition lever to run will stop the feathering pump. The output of pumps in the regulator is sufficient at 10 percent RPM to continue the decrease of blade angle. As engine speed increases, the constant-speed governor in the propeller assumes control of blade angle to maintain 100 percent engine RPM. Three-phase AC power for operation of the propeller feather pumps is supplied through feather pump motor circuit breakers on the main AC distribution panel. Power for control of the pumps is supplied from the prop and engine 28-volt, DC bus through feather motor control circuit breakers on the copilot's circuit breaker panel.

ENTC (ENGINE NEGATIVE TORQUE CONTROL) SYSTEM.

Note

> Very high windmilling drag upon sudden loss of turbine power is a problem in propjet aircraft operation. High windmilling drag results when the compressor absorbs a great amount of power. If a power failure is experienced in flight at high speed, the engine starts to slow down; and the propeller, sensing RPM, reduces blade angle and drives the compressor, trying to bring it up to speed. A sudden reversal of propeller thrust could result in high structural loads on the tail of the airplane and loss of directional control. To protect the airplane, two safety devices are provided: the negative torque control system, which increases blade angle of the propeller, and the safety coupling, which can decouple the propeller and reduction gear from the power section of the engine upon failure of the power section.

The engine negative torque control system provides a mechanical signal to limit negative torque. Negative torque is encountered when the propeller attempts to drive the engine. If not relieved, this condition creates a great amount of drag, causing the airplane to yaw. The ENTC system consists of an actuating mechanism housed partly within the reduction gear assembly and partly in a signal assembly on the nose of the reduction gear case. It operates when a negative torque is applied to the ring gear. The ring gear then moves forward against springs as a result of a torque reaction generated by helical splines. In moving forward the ring gear pushes a plunger through the nose of the gearbox. The plunger pushes against a cam in the signal assembly to actuate control linkage connected to an NTS lever on the propeller regulator. When a negative torque signal is transmitted to the propeller, the propeller increases blade angle to relieve the condition. If the negative torque is sufficiently reduced, the signal mechanism returns to normal. Engine torque may decrease to the negative torque signal range in flight during FLIGHT IDLE, low-speed conditions and can be relieved by advancing the throttle on the affected engine.

Note

The ENTC signal does not commit the propeller to feather.

ENTC (ENGINE NEGATIVE TORQUE CONTROL) DISABLING SYSTEM.

A disabling system is provided to deactivate the engine negative torque control system for an engine when the throttle is retarded below FLIGHT IDLE. The system prevents an ENTC signal in the ground handling range, and the ENTC signal on one or more engines while the propellers are moving towards full reverse blade angle. This will cause positive thrust on some propellers and negative thrust on others resulting in control problems. When the solenoid is energized, it rotates the cam in the signal assembly. While the cam is thus rotated, negative torque signals are not transmitted to the propeller. The lockout solenoid is energized by DC power supplied through an ENTC lockout solenoid circuit breaker on the copilot's circuit breaker panel. The solenoid cannot be energized if the engine throttle is in governing range or if the ENTC test switch is in TEST position.

Note

While the throttle is forward of FLIGHT IDLE, the ENTC system functions normally.

FIRE EMERGENCY CONTROL HANDLE FEATHERING SYSTEM.

An emergency feathering system is provided to feather a propeller when the fire emergency handle for the engine is pulled. An emergency feathering solenoid on the engine reduction gear is linked to the engine negative torque signal linkage and, when energized, drives the NTS lever on the propeller regulator to its feather position. The constant-speed governor in the propeller regulator is thus set for increase pitch in the same way that it is actuated as a result of a negative torque signal. At the same time that the feather solenoid is energized, the feather pump is turned on to provide hydraulic pressure to drive the propeller blades all the way to the feather stops after internal pump pressure drops off. The electric feather pump is turned off by a timer relay to prevent continuous operation of the pump after the blades reach feather angle. Power for energizing the feather solenoid and feather pump control circuit is supplied from the prop and engine DC bus through emergency feather solenoid and emergency feather timer circuit breakers on the copilot's circuit breaker panel.

FLIGHT-IDLE SOLENOID STOP.

The flight idle solenoid stop is a safety device which prevents the control lever on the propeller regulator from moving into the ground operating range if the control linkage becomes disconnected or broken while in flight. If control linkages for the propeller become disconnected or broken while in flight, this control lever could creep into its ground operation range and affect propeller governor operation in a way that would cause the blades to turn to a low angle or reverse. This could cause uncontrollable overspeed and severe yaw. The solenoid stop prevents this by stopping the lever when it reaches its flight idle position; therefore, the propeller could govern normally with control linkage disconnected and can be feathered by operation of the fire emergency control handle. The solenoid stop is energized and retracts as a result of operation of a throttle-actuated switch to permit taxi-range operation of the propeller. In case of electrical failure or other malfunction, the solenoid stop can be overridden for ground operation by sharply pulling the throttle through the stop. Power for operation of the solenoids is supplied from the prop and engine DC bus through flight idle stop solenoid circuit breakers on the copilot's breaker panel.

PROPELLER CONTROLS.

All propeller controls are located on the flight control pedestal. The throttles and engine condition levers affect both propeller and engine operation. Only their effect on propeller operation is discussed here; their effect on engine operation is discussed under ENGINES in this section.

Throttles.

Each throttle (figure 1-10) is mechanically linked through an engine control coordinator to a control lever on the corresponding propeller regulator. When the throttle is in the governing range, between FLIGHT IDLE and TAKE-OFF positions, this control lever moves with the throttle but the internal linkage is withdrawn from the speed-sensitive piston in the propeller governor and does not affect propeller governing. When the throttle is in the taxi range, any movement of the throttle is transmitted by the control lever on the propeller regulator to the speed-sensitive piston in the propeller governor to select a new blade angle. The low pitch stop in the propeller master gear assembly is withdrawn when the throttle is lifted into taxi range and allows blades to turn to lower angles. Blade angle decreases as the throttle is moved aft, and the maximum negative angle is reached when the throttle is AT MAXIMUM REVERSE. Approximate minimum thrust angle is obtained when the throttle is at GROUND IDLE. A throttle also actuates switches when it is moved from the governing range to the taxi range. One of these switches opens a DC relay circuit to prevent transmission of control signals from the electronic governor to the solenoid valve in the propeller regulator during ground operation. A second switch closes a circuit to energize the flight idle solenoid stop, which then releases the control lever on the propeller regulator so that the throttle can be pulled into taxi range. A third switch closes a circuit to energize the lockout solenoid in the engine negative torque control disabling system. The engine negative torque control system is thus disabled for the landing roll after touchdown.

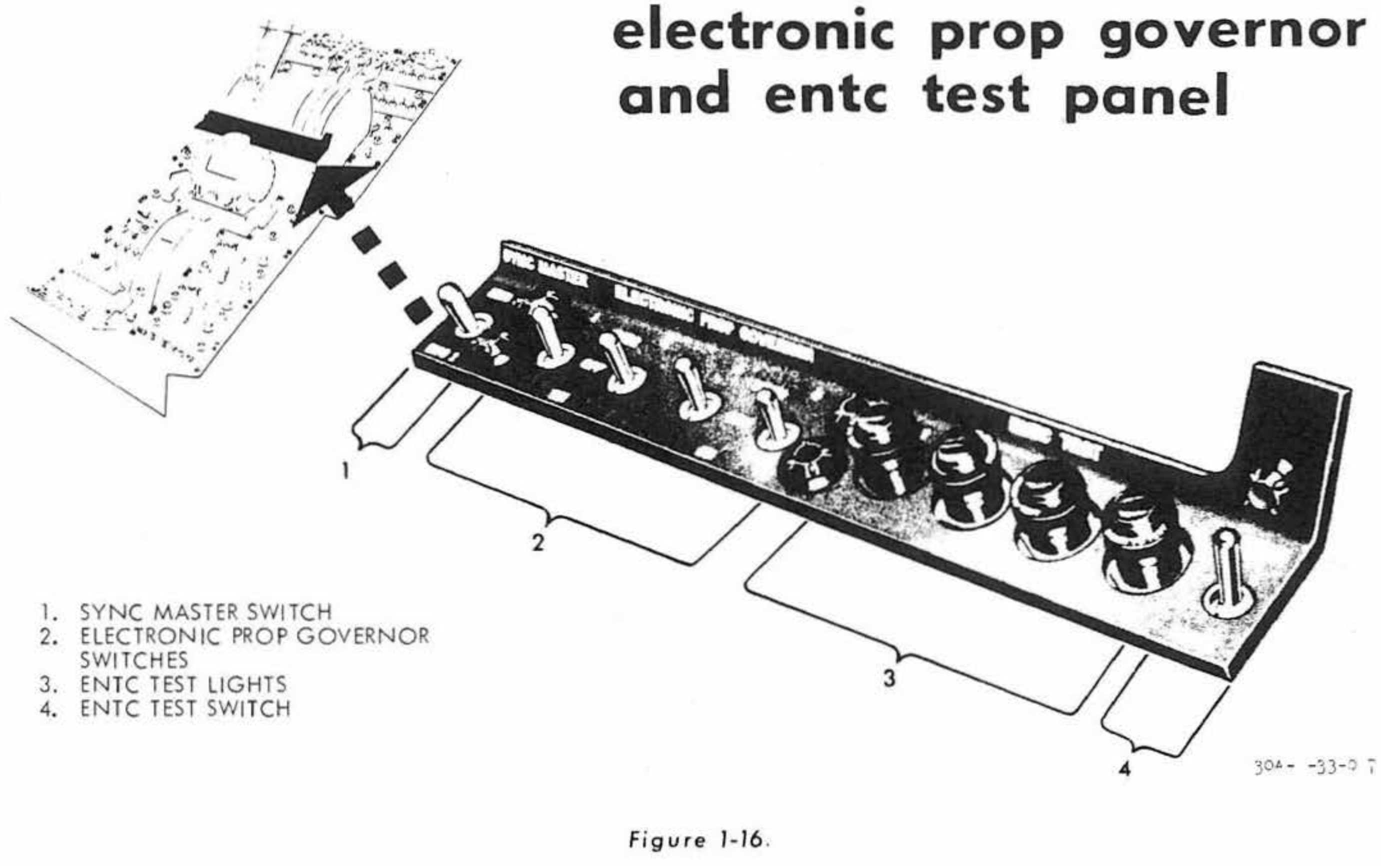
Engine Condition Levers.

Insofar as propeller control is concerned, the engine condition levers (figure 1-10) serve as feathering and unfeathering controls. Each lever is mechanically linked to the engine control coordinator, which transmits the motion of the lever only when it is moved to FEATHER position. When pulled to FEATHER, the condition lever also actuates switches to turn on the electric feather pump on the propeller. As a result of pulling the condition lever to FEATHER, the propeller is feathered as described under NORMAL FEATHERING AND UNFEATHERING. If the engine condition lever is pushed forward from FEATHER position, the feather pump timer is reset, and the feather pump can then be turned on again by pulling the condition lever back to FEATHER. While the engine condition lever is in FEATHER, it also actuates a switch which disables the propeller electronic governing system. For unfeathering, the engine condition lever is held in AIR START position. A switch is then actuated to turn on the propeller feather pump, and the pump continues operating as long as the lever is held in position. In AIR START position, the lever also operates a switch which cuts out the propeller electronic governor system. When the condition lever is in GROUND STOP or RUN position, the propeller is controlled normally; and the lever has no effect on its operation.

Electronic Prop Governor Switches.

The electronic prop governor switches (figure 1-16) are located on a panel on the flight control pedestal. Each switch has ON, OFF, and SYNC positions. When a switch is in ON position, it turns on the acceleration-sensitive stabilizing system for the propeller if the throttle is in governing range and the condition lever is at GROUND STOP or RUN. If the switch is at OFF, the electronic governing circuit continues to operate as long as AC power is available, but its output signals are not transmitted to the solenoid valve in the propeller regulator. The propeller will govern at constant speed with the hydraulic governor

electronic prop governor and entc test panel



1. SYNC MASTER SWITCH
2. ELECTRONIC PROP GOVERNOR SWITCHES
3. ENTC TEST LIGHTS
4. ENTC TEST SWITCH

Figure 1-16.

alone. Flight may be continued with the switch in OFF position without the benefits of electronic governing. If a switch is positioned at SYNC, the electronic governor for the propeller retains its stabilizing control and also switches in synchronizing circuits which control synchronization of the propeller to a master. The master propeller operates with acceleration-sensitive stabilizing only, regardless of whether its electronic governor switch is at ON or SYNC. Power to the switches is supplied from the prop and engine bus through the feather motor control circuit breakers.

Synch Master Switch.

The sync master switch (figure 1-16) is on the same panel with the electronic prop governor switches. It has ENG. 1 and ENG. 2 positions, and is used to select either engine No. 1 or No. 2 as the master when propellers are to be synchronized. Electronic governor switches for the other propellers must be in SYNC if the propellers are to be synchronized to the master. Slave engines will synchronize to the selected master while the electronic governor switch for the master engine is in any position.

OIL SYSTEM.

Independent oil systems, one for each engine, supply lubrication to the engine gearboxes and power sections. An oil tank is located in each nacelle above the engine and has an 8-gallon usable oil capacity, plus an additional 2-gallon expansion air space. On some airplanes, each oil tank has a capacity of 10 gallons, plus an additional 2 gallons expansion air space. The oil feeds from the tank into the gearbox and power section of the engine, where it is picked up by engine-driven pumps and driven through a heat exchanger and oil cooler back into the oil tank. Heat from the oil passing through the heat exchanger prevents ice from forming in the fuel line to the engines. Air flowing through an oil cooler duct and over the coils of the oil cooler absorbs excess heat from the oil. A thermostatic element, located in the oil tank return line, controls the oil temperature by regulating the amount of air flowing through the oil cooler duct. Refer to the general arrangement and servicing diagram for oil specifications and grades.

OIL TANK PRESSURIZATION SYSTEM.

An engine oil tank pressurizing valve controls the outflow of air which is released from the engine scavenge oil as the oil returns to the tank. This released air keeps the tank pressurized to a 3.5 psi differential at altitudes above approximately 22,000 feet. Below approximately 22,000 feet the tank is partially pressurized, while at altitudes below 10,000 feet, the tank pressurization valve vents the released air into the overboard drain.

Note

Oil tank filler caps must be securely locked for satisfactory operation of the system. An unsecure cap will cause air leakage and corresponding drop of gear box oil pressure when climbing to altitude above approximately 22,000 feet.

OIL SYSTEM CONTROLS.

Oil Cooler Flap Switches

Airflow through the oil cooler is governed by a controllable oil cooler flap which restricts the opening of the oil cooler air exit duct. Four four-position (AUTOMATIC, OPEN, CLOSE, FIXED) toggle switches are located on the engine starter control panel (figure 1-17) of the overhead control panel. These switches control the electrical circuits of the oil cooler flap actuators. When any of the four switches is in AUTOMATIC position, the position of the oil cooler flap is regulated by a thermostatic unit to cool the oil to approximately 80°C (176°F). In the OPEN or CLOSE positions (spring-loaded), the thermostat is excluded from the circuit, and the actuator is directly energized to open or close the oil cooler flap. When the switch is moved to the FIXED position, the flap actuator is deenergized and the flap will remain in the position it was in prior to moving the switch. Moving the switch to the AUTOMATIC position provides for all normal operations. OPEN, CLOSE, and FIXED positions are used to control the oil cooler flap actuator manually if the thermostatic control unit fails. The oil cooler flap switches are energized by 28-volt, DC power through oil cooler flaps No. 1, 2, 3, and 4 circuit breakers from the lh and rh wing buses in the main power distribution box.

Fire Emergency Control Handles.

Four motor-operated tank shutoff valves provide an emergency means of shutting off oil flow to the engines when the fire emergency control handles are pulled. The four valves receive 28-volt DC power from the isolated DC bus through engine 1 & 4 and engine 2 & 3 eng fire control shutoff valves air & oil circuit breakers on the main power distribution box and the engine fire control shutoff air & oil circuit breakers on the copilot's circuit breaker panel. Refer to FIRE EXTINGUISHER SYSTEM in this section for other functions of the fire emergency control handles.

FUEL SYSTEM.

The fuel system is a modified manifold flow type, incorporating a fuel crossfeed system and a single point refueling and defueling system. The system provides fuel supply for the four engines and the gas

oil cooler flaps switch panel

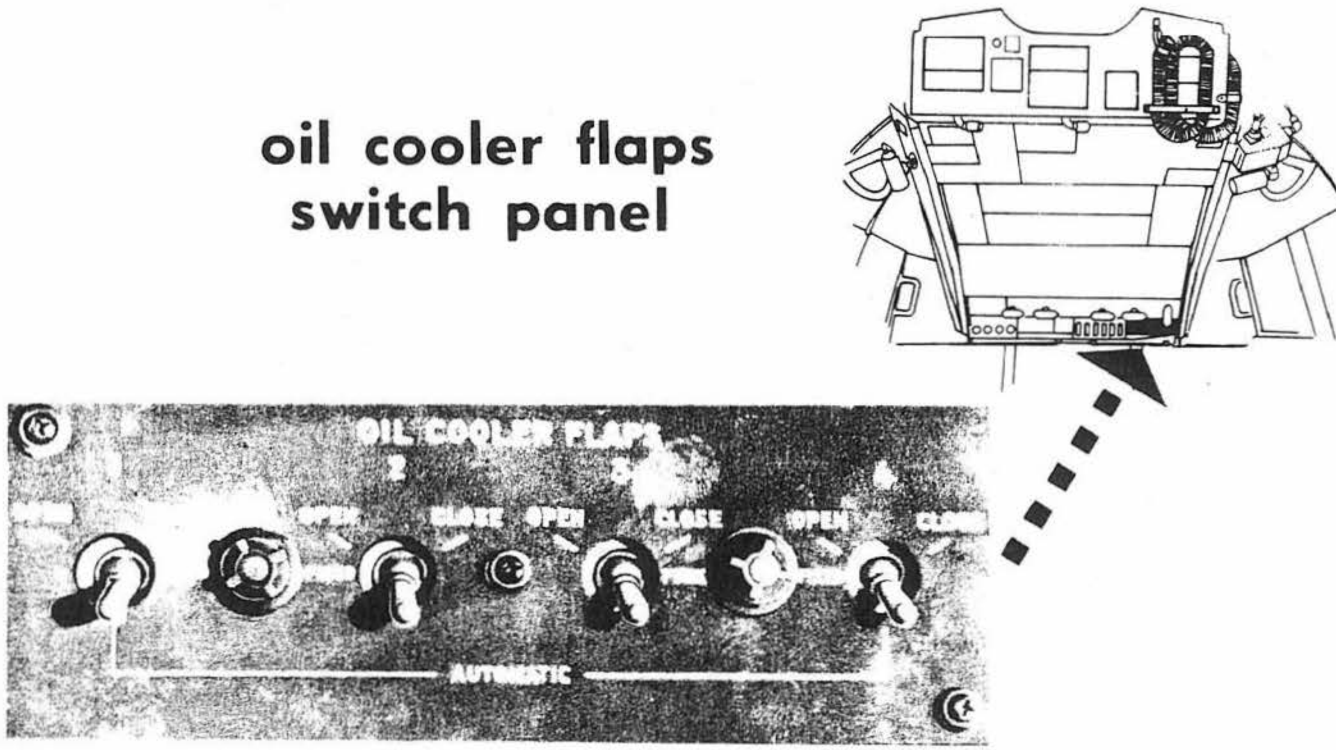


Figure 1-17.

turbine compressor. It is adaptable to a number of flow arrangements (figure 1-18 and 1-19). Plumbing, control, and indicator systems for external tanks are included in the fuel system. External pylon tanks are provided for some airplanes. The existing external system controls and indicators on the fuel control panel and the single point refueling panel are not installed and are therefore inoperative. All controls and indicators for the 450-gallon pylon tank system now in use are located on the pylon tanks fuel control panel (figure 1-21). Fuel from the pylon tanks can be pumped into only the inboard internal tanks to replenish the fuel as it is used from these tanks. Fuel used must conform to the specification and grade listed in the servicing diagram at the beginning of this section. The total usable capacity of the fuel tanks is shown in figure 1-20. For system management, see Section VII, SYSTEMS OPERATION. Airplane limitations resulting from the use of alternate fuels are discussed in Section V.

Note

> The fuel capacity will be reduced by approximately 5 percent when polyurethane foam baffles are installed. The fuel gauges will be recalibrated to reflect the fuel capacity change.

FUEL FLOW.

Fuel from internal wing tanks may be supplied directly to the engine located immediately inboard of each tank or, by means of the crossfeed manifold, to all of the engines. When sufficient fuel has been used from the inboard internal tanks the fuel pumps for both pylon tanks may be turned on to pump fuel from the pylon tanks into the inboard internal tanks through connections made in the inboard tank refuel lines (figure 1-18). The pylon tank system does not provide fuel quantity or flow gages, and a no-flow light is all that is provided to indicate when the pylon tanks are empty.

Fuel for operation of the auxiliary power plant on airplanes AF53-3129 through 55-0014 is supplied from either of the inboard internal tanks. Fuel for operation of the auxiliary power plant on airplanes AF55-0029 and up may be supplied from any tank, through the crossfeed manifold. For description of the auxiliary power plant, see AUXILIARY EQUIPMENT, Section IV.

REFUELING AND DEFUELING.

All internal fuel tanks may be refueled or defueled from a single point, ground refueling and defueling receptacle, located in the right landing gear fairing.

fuel system

NOTE

Refueling, defueling, and internal fuel transfer are only possible as ground operations. Internal fuel transfer, in the air is possible only from the pylon tanks.

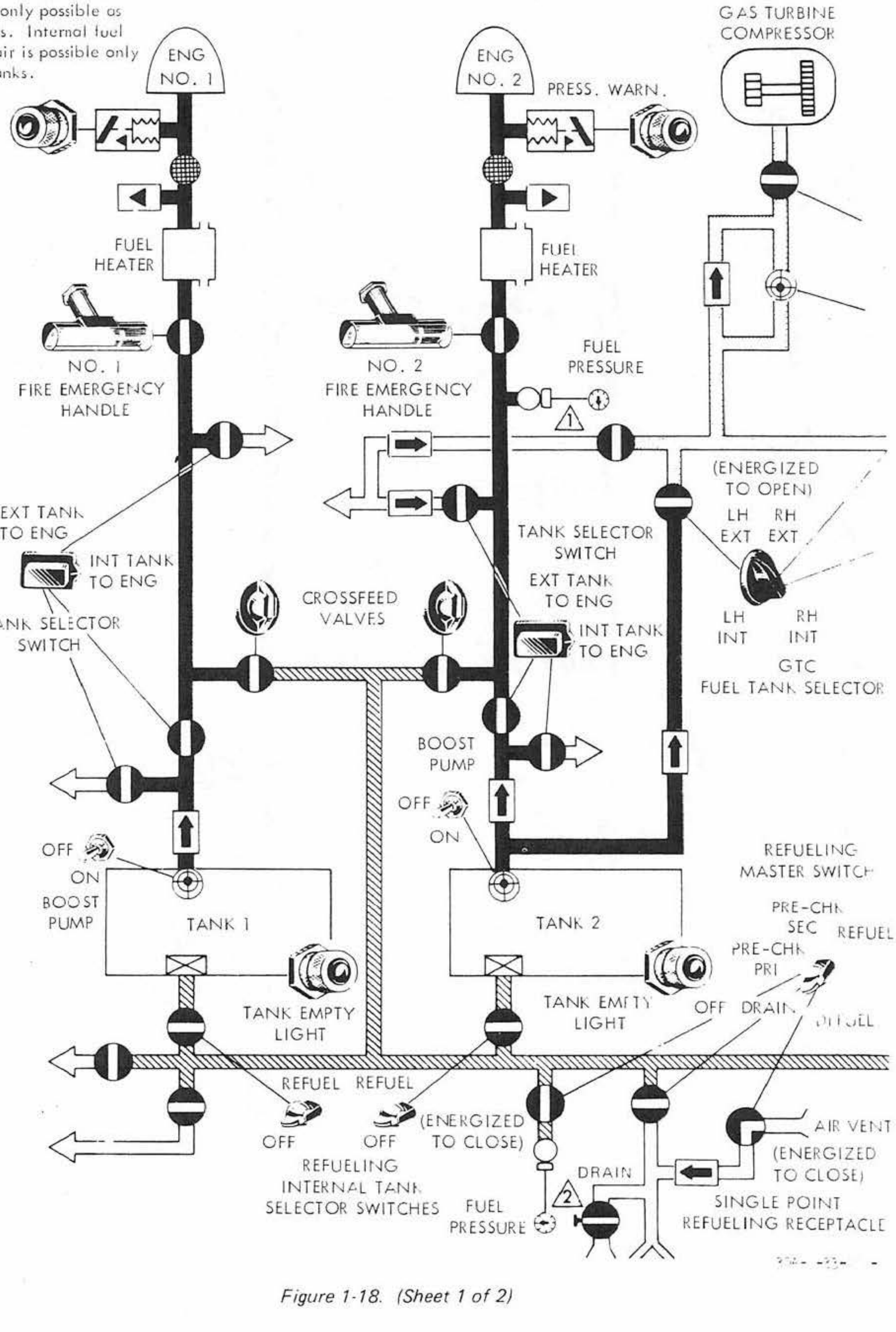


Figure 1-18. (Sheet 1 of 2)

AIRPLANES AF53-3129 THROUGH 55-0014

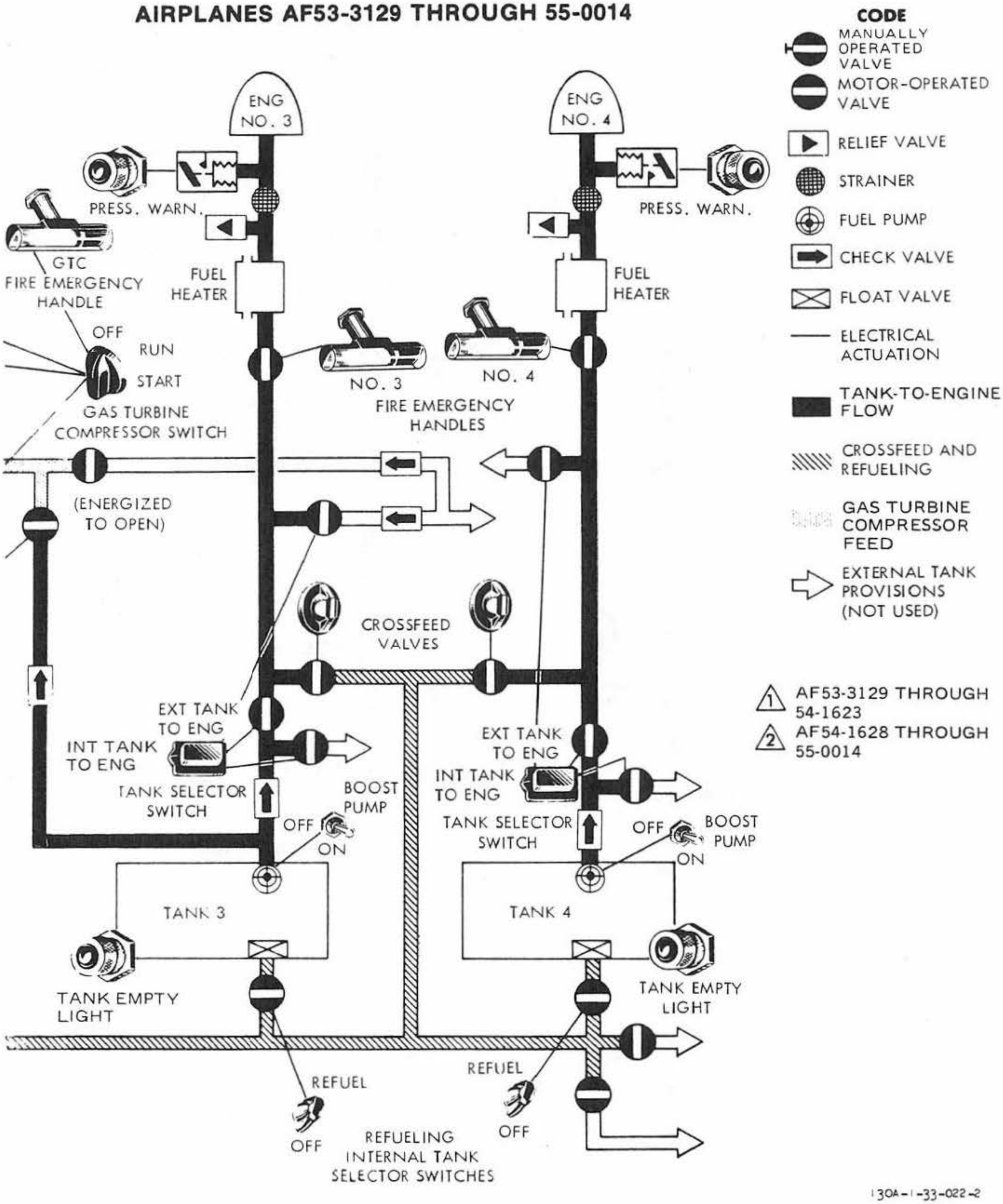


Figure 1-18. (Sheet 2 of 2)

fuel system

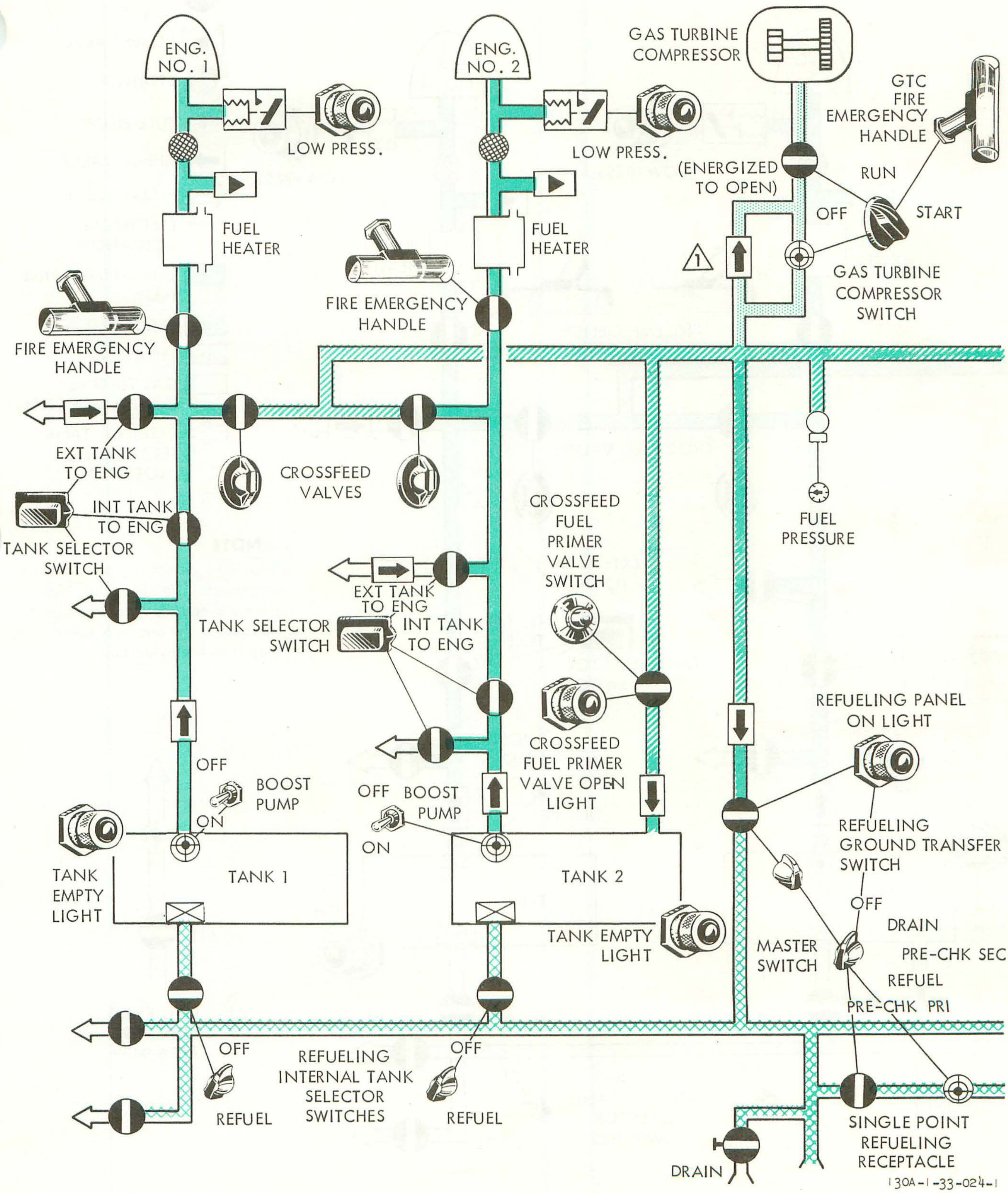
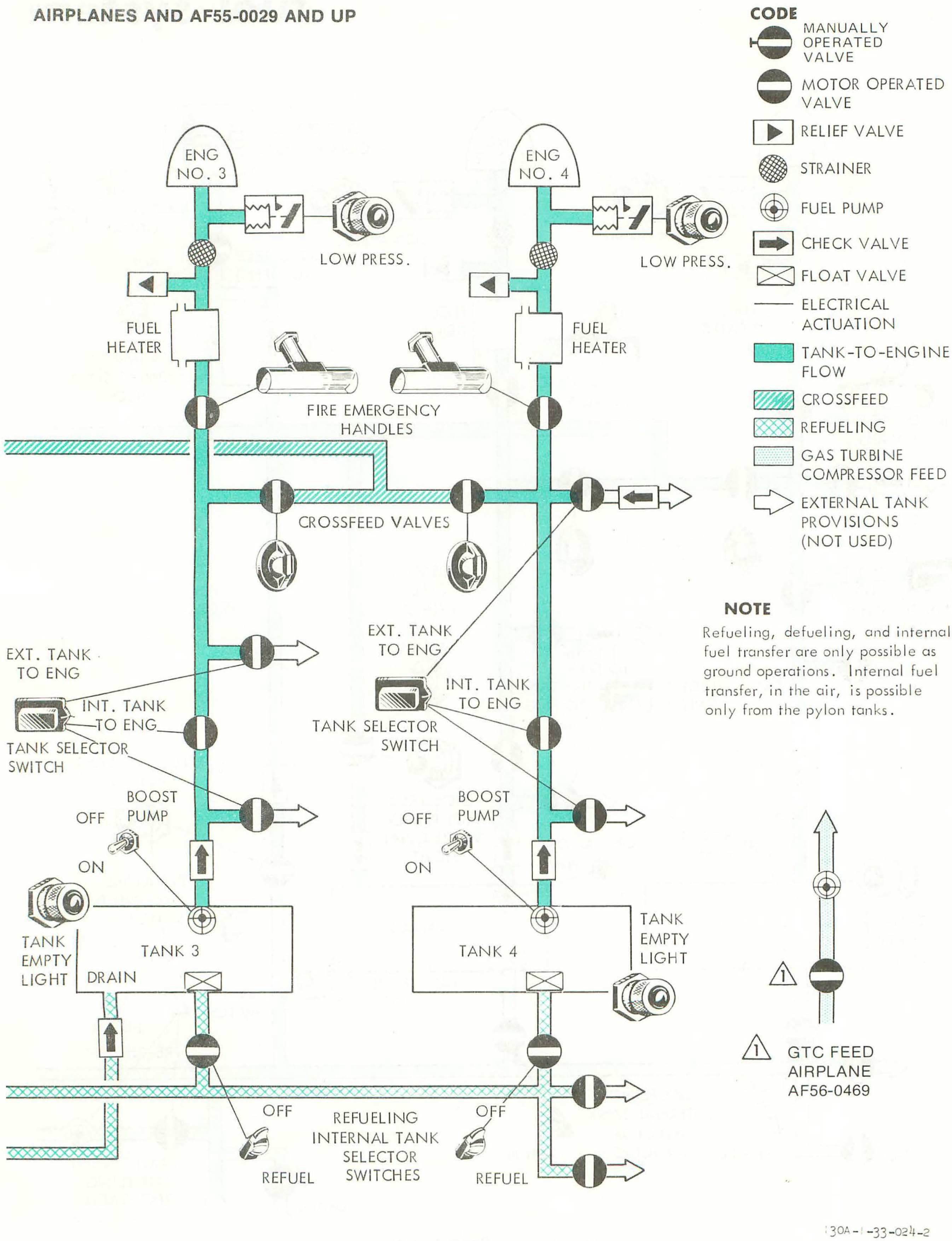


Figure 1-19. (Sheet 1 of 2)

AIRPLANES AND AF55-0029 AND UP



NOTE

Refueling, defueling, and internal fuel transfer are only possible as ground operations. Internal fuel transfer, in the air, is possible only from the pylon tanks.

Figure 1-19. (Sheet 2 of 2)

fuel quantity data table

TANK	FULLY SERVICED SINGLE POINT REFUELING		USABLE FUEL * LEVEL FLIGHT		FULLY SERVICED THROUGH INDIVIDUAL FILLER PORTS		USABLE FUEL * LEVEL FLIGHT	
	GALS	LBS	GALS	LBS	GALS	LBS	GALS	LBS
INTERNAL TANK NO. 1	1348 (1275)	8762 (8288)	1335 (1262)	8678 (8203)	1373 (1342)	8925 (8723)	1360 (1329)	8840 (8639)
PYLON TANK NO. 1					450 (428)	2925 (2782)	445 (423)	2892 (2750)
INTERNAL TANK NO. 2	1203 (1125)	7820 (7313)	1190 (1112)	7735 (7228)	1278 (1221)	8307 (7937)	1265 (1208)	8223 7852)
INTERNAL TANK NO. 3	1203 (1125)	7820 (7313)	1190 (1112)	7735 (7228)	1278 (1221)	8307 (7937)	1265 (1208)	8223 (7852)
INTERNAL TANK NO. 4	1348 (1275)	8762 (8288)	1335 (1262)	8678 (8203)	1373 (1342)	8925 (8723)	1360 (1329)	8840 (8639)
PYLON TANK NO. 2					450 (428)	2925 (2782)	445 (423)	2892 (2750)
	TOTAL USABLE		5050 (4748)	32826 (30862)	6202 (5982)	40314 (38884)	6140 (5920)	39910 (38482)
					TOTAL USABLE		6140	39910

DATA BASIS: CALCULATED, BASED ON 6.5 POUNDS PER GALLON OF JP4 FUEL FOR ICAO STANDARD DAY

* LEVEL FLIGHT AT 4° NOSE UP ATTITUDE

NOTE

VALUES IN PARENTHESES DENOTE AIRPLANES MODIFIED BY T.O. 1C-130-831.

Figure 1-20.

Fuel is routed from the single point receptacle through the refueling manifold. Each tank has a separate supply line from the manifold and each supply line has a motor-operated shutoff valve. Refueling is controlled at the single point refueling control panel, located above the refueling receptacle. As an alternate method, tanks may be fueled separately through a filter opening in the top of each tank. The pylon tanks can be fueled only through the filler port on the top of each tank, near the pylon strut.

PYLON TANKS (SOME AIRPLANES).

The addition of one 450-gallon pylon fuel tank on each wing will increase the maximum range of the airplane by approximately 325 miles for ferry and deployment missions. The weight of the airplane has been increased by 670 pounds with the pylon tanks empty, or by 6,520 pounds with the tanks filled with JP-4 fuel at a density of 6.5 pounds per gallon. The fuel from the pylon tanks is transferred into the inboard tanks by a 28-volt, DC motor-driven suction pump through connections made in the refuel line of the inboard internal tanks. Each line from a pylon tanks to an inboard fuel tank has two check valves which prevent reversal of flow from the internal tanks to the pylon tanks. Power for the fuel pumps is supplied by the main DC bus through pylon tanks circuit breakers in the main DC power distribution box. The pylon tanks are not jettisonable.

WARNING

Pylon tanks do not have foam installed and must be removed before flying combat missions.

Pylon Tank Flow Switch.

Each line from a pylon tank to an internal fuel tank is provided with a flow switch. When there is no flow through the line, this switch closes a circuit to cause a no flow indicator light on the pylon tanks fuel control panel to illuminate, provided the pylon tank pump switch remains on.

Pylon Tank Boost Pumps Relief Valve.

Each pylon tank boost pump is equipped with a relief valve, which is located on the right side of the pump. A cutaway section in the right side of each pylon leading edge assembly provides for installation of the relief valve. The valve relieves pressure at 17 PSI in the pylon tank fuel pump by allowing fuel to be recirculated within the pump when there is a fuel line stoppage or when a dual-float control valve in the internal tank is closed.

Pylon Tanks Fuel System Controls.

All controls for in-flight managing of the fuel for the pylon tanks are contained on the pylon tanks fuel control panel. None of the controls on the overhead fuel control panel have been altered, and none of the external tank provisions on this panel operate for the pylon tanks system on some airplanes.

Pylon Tanks Pump Switches.

Two pylon tanks pump switches are located on the pylon tanks fuel control panel to control the pylon tank fuel pumps. The pylon tanks pump switches close relay circuits to route 28-volt, DC power from the main DC bus to the pumps. Circuit protection is provided by the pylon tanks boost pump and the pylon tanks boost pump control circuit breakers on the main DC power distribution box.

Pylon Tanks Fuel System Indicators.

Warning lights on the pylon tanks fuel control panel give a continuous visual indication of the fuel situation in the pylon tanks. There are no individual fuel quantity gages for the pylon tanks, and the fuel in the pylon tanks is not included in the indication of total fuel quantity indicator on the fuel control panel. The amount of fuel in the pylon tanks can be computed by multiplying the pumping rate of the pumps by the length of time they have been on.

Pump On Lights.

Two pump-on press-to-test indicator lights, one for each pylon tank, are located on the pylon tanks fuel control panel. These lights illuminate when the pylon tank pumps are turned on, and they remain illuminated until the pumps are turned off.

No Flow Lights.

Two no flow press-to-test indicator lights on the pylon tanks fuel control panel, one for each pylon tank, are the only means of indicating insufficient fuel flow from the pylon tanks. When there is no fuel flow through the flow switch in the line from a pylon tank to an inboard tank, or if the flow is of insufficient rate (less than 2.5 gallons per minute), the switch closes and completes the indicator light circuit to light the corresponding tank no flow light. The two pylon tank systems are completely independent of each other: but, as the pumping rate of each pump is approximately 5.0 gallons per minute, the indicator light for each pylon tank should illuminate approximately 90 minutes after the pump is turned on. The lighting of a no flow light does not necessarily mean an empty tank, but it could mean that fuel is not flowing from the pylon tank to the inboard tank at the proper rate. The pump pressure may be tested by using the pump operation test switch on the pylon tanks fuel control panel. The no flow lights are wired in parallel with the pump-on lights and will illuminate only when the pump switches are in the ON position and the fuel flow is insufficient. Therefore, when the pumps are turned off, both the pumps on and the no flow lights circuits will be opened, and the press-to-test feature cannot be used.

Pump Operation Test Switch and Indicator Lights.

To test fuel pump operation, a pump operation test switch and two pump pressure indicator lights have been installed on the pylon tanks fuel control panel. When the switch is held in the TEST position for approximately one minute, the pylon-tanks-to-inboard-tanks fuel lines are closed at the dual float valves in the internal tanks. If the boost pumps are operating to develop proper fuel pressure (approximately 13 to 15 PSI), the pump pressure lights and the no flow lights should illuminate to indicate that no fuel is flowing. The 28-volt, DC power for the indicator lights is obtained from the main DC bus through the pylon tanks boost pump and the pylon tanks boost pump control circuit breakers on the main DC power distribution box.

INTERNAL TANKS.

There are four internal fuel tanks, one tank located outboard of each engine. The tanks are integral units of the wings, using the upper and lower surfaces as tank walls. A check valve in the supply line from each tank prevents reversal of flow during crossfeed operations. Pressure to assure fuel flow from the tanks is supplied by boost pumps. One boost pump is located in the aft inboard corner of each tank and is driven by 115/200-volt, 3-phase, AC. A scavenge pump, located in the fore section of each tank and driven by 115/200-volt, 3-phase, AC assures fuel supply to the boost pump during all operating conditions. Power for all internal tank pumps is taken from the left- and right-hand unregulated AC buses through the fuel boost pumps power internal tanks circuit breakers in the main power distribution box.

OTHER FUEL SYSTEM COMPONENTS.

Vent Valves.

Float-controlled vent valves allow escape of fuel vapors and air during single point refueling and equalize all tank and surrounding pressures during flight. Each internal fuel tank has two vent valves one near the inboard wall and the other near the outboard wall. The two vent valves of each tank are connected to a vent line, which is routed overboard outboard of the flaps.

Fuel Heaters.

A fuel heater mounted between the lower longerons of each engine nacelle, is included in each engine fuel system. The function of the fuel heaters is to prevent icing of fuel system components by transferring engine oil heat to the fuel being supplied to the engines. Temperature to which the fuel is heated is limited by a thermostatic bypass valve in the oil core.

Fuel Strainers.

A fuel strainer for each engine fuel system is located just ahead of the fire wall on each lower right nacelle longeron. Fuel flow is from the fuel heater to the fuel strainer, then to the engine. In addition to filtering, the fuel strainer acts as a water sump for removal of water from the fuel.

FUEL SYSTEM CONTROLS.

Controls for in-flight management of the fuel system are located on the fuel control panel, the pylon control panel, the auxiliary internal fuel control panel, or the auxiliary fuel transfer panel (figure 1-21).

Boost Pump Switches.

Eight fuel boost pump switches (figure 1-21) are located on the fuel control panel. Four switches control the internal tank boost pumps and scavenge pumps, and four switches are for the external tank boost pumps. The internal tank boost pump switches route three-phase, unregulated AC from the left-hand and right-hand buses to the pumps. Circuit protection is supplied by the fuel boost pumps power internal tanks circuit breakers on the main power distribution box. The external tank pump switches are not used.

Tank-Selector Switches.

Four tank-selector switches (figure 1-21), are located on the fuel control panel. These two-position (EXT. TANK TO ENG., INT. TANK TO ENG.) rotary switches route 28-volt DC from the wing buses to the external tank control valves to open or close the valves. Circuit protection is provided by the engine fuel transfer circuit breaker on early model airplanes.

Crossfeed Valve Switches.

Four crossfeed valve switches (figure 1-21) are located on the fuel control panel. These 2-position rotary switches route 28-volt DC from the wing buses to the motor-operated crossfeed valves. When the switches are placed in the crossfeed position (switch markings aligned with the fuel control panel markings), the valve motors are energized to open the valves. When the switches are placed in the off position (switch markings at right angles to the panel markings), the valve motors are energized to close the valves. In case of power failure, the valves hold the last energized position. Circuit protection is provided by the engine crossfeed valves circuit breakers in the main power distribution box.

Crossfeed Fuel Primer Valve Switch and Valve Open Light (Airplanes AF 55-0029 and Up).

A press-to-actuate crossfeed fuel primer valve switch (figure 1-21) is located on the fuel control panel. This switch, when depressed, actuates the motor-driven crossfeed fuel primer valve to the open position. This allows fuel to flow through the manifold into the No. 2 internal tank, which removes any trapped air. Releasing the switch actuates the primer valve to the closed position. A press-to-test, valve-open warning light (figure 1-21) is mounted immediately below the primer switch. This warning light glows any time the crossfeed fuel primer valve is in the open position. Thus, if the system is working normally, when the switch is depressed, the light comes on; when the switch is released, the light goes out. Failure of the light to operate in this sequence indicates a malfunction of the system. The primer valve circuit breaker is on the main DC distribution panel. Power for the light is supplied through a master warnlight breaker on the wheel well junction box.

Fire Emergency Control Handles.

Five fire emergency control handles, one for each engine and one for the gas turbine compressor, are mounted on the fire emergency control panel (figure 1-57). These control handles when pulled, route 28-volt DC power to the motor-operated engine fire wall shutoff valves and fuel control valves. The gas turbine compressor fire emergency control handle routes 28-volt

fuel control panels

MAIN FUEL CONTROL PANELS

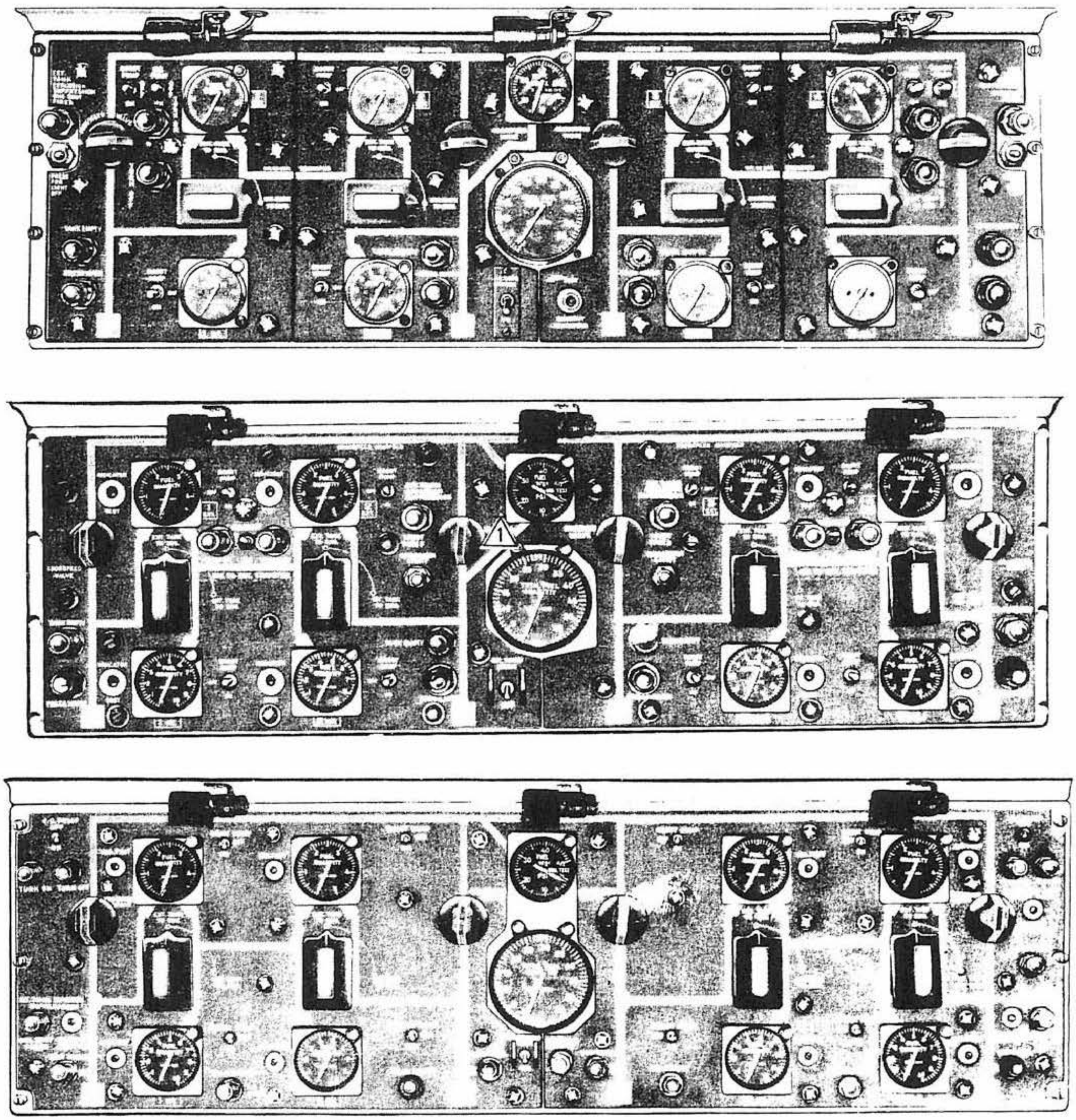


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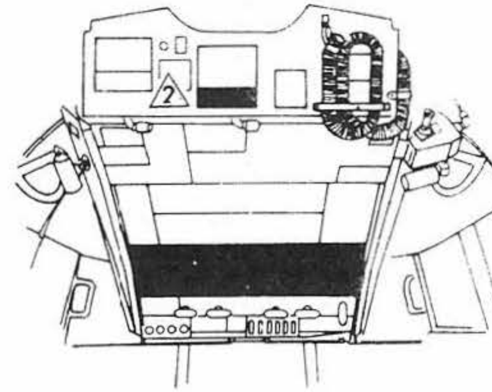
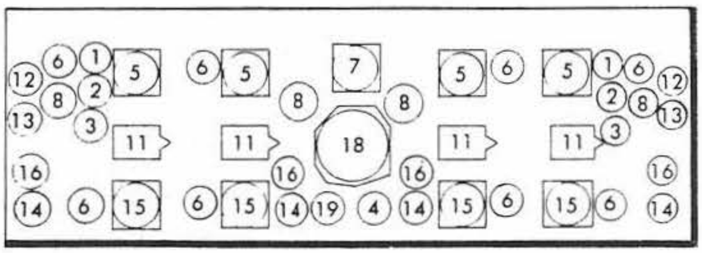
Figure 1-21. (Sheet 1 of 2)

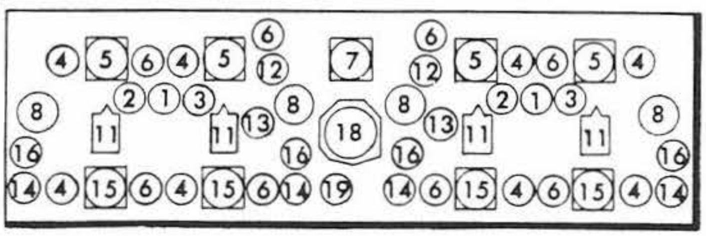
PYLON TANK FUEL CONTROL PANEL

△2

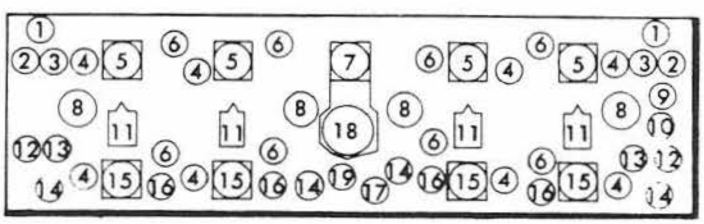




AIRPLANE AF53-3129



AIRPLANES AF54-1623 THROUGH 55-0014



AIRPLANES AF55-0029 AND UP

1. C. G. PUMP SWITCH
2. C. G. PUMP TURN ON LIGHT
3. C. G. PUMP TURN OFF LIGHT
4. FUEL QUANTITY INDICATOR TEST SWITCH
5. EXTERNAL TANK FUEL QUANTITY INDICATOR
6. BOOST PUMP SWITCH
7. FUEL PRESSURE TEST INDICATOR
8. CROSSFEED VALVE SWITCH
9. CROSSFEED FUEL PRIMER VALVE SWITCH
10. CROSSFEED FUEL PRIMER VALVE OPEN LIGHT
11. TANK-SELECTOR SWITCH
12. EXTERNAL TANK EXPLOSION SUPPRESSION ONE SHOT FIRED LIGHT
13. ONE SHOT FIRED PRESS FOR LIGHT OFF SWITCH
14. PRESSURE WARNING LIGHT
15. INTERNAL TANK FUEL QUANTITY INDICATOR
16. TANK EMPTY LIGHT
17. REFUELING PANEL ON LIGHT
18. TOTAL FUEL QUANTITY INDICATOR
19. INTERNAL TANKS PURGE SWITCH AF53-3129 AND 54-1623

△1 **AF53-3129 AND 54-1623**

△2 **AIRPLANES MODIFIED BY T.O. 1C-130A-778.**

EXTERNAL TANK PROVISIONS ON THE FUEL CONTROL PANEL WERE PROVIDED FOR A TYPE OF PYLON TANK NOT INSTALLED IN PRODUCTION. THEY ARE INOPERATIVE FOR THE PYLON TANKS PROVIDED ON AIRPLANES MODIFIED BY T.O. 1C-130A-778. ALL CONTROLS FOR THE PYLON FUEL TANKS PROVIDED ON THESE AIRPLANES ARE LOCATED ON THE PYLON TANKS FUEL CONTROL PANEL.

30A-1-33-027-2

Figure 1-21. (Sheet 2 of 2)

DC power to the motor operated gas compressor fuel supply shutoff valve. The valves will be repositioned when the fire emergency control handles are pushed in. In case of power failure, valves hold the last energized position. Circuit protection is provided by the fire wall fire control shutoff valves fuel circuit breakers on the copilot's circuit breaker panel and the GTC control circuit breaker in the main power distribution box. Other functions of the handles are described under FIRE EXTINGUISHING SYSTEM in this section.

GTC Fuel Tank Selector Switch (Airplanes AF53-3129 through AF55-0014).

A gas turbine compressor fuel tank selector switch (refer to Section IV) is provided on the gas turbine compressor control panel. The switch permits selection of either No. 2 or No. 3 fuel tank as the source of fuel for GTC operation. A solenoid-operated valve is energized open by turning the switch to LH INT or RH INT position, if the GTC control switch is in START or RUN. Power to energize the valve is supplied through the GTC control circuit breaker located on the main DC power distribution panel.

FUEL SYSTEM INDICATORS.

WARNING

Fuel quantity indicators will not be removed or changed in flight.

Quantity gages and warning lights are located on the fuel control panel to give the crew a continuous, visual indication of the status of the fuel system.

Total Fuel Quantity Indicator.

A total fuel quantity indicator (figure 1-21) is located in the center of the fuel control panel. The indicator is electrically connected to each of the fuel tank quantity gages, through a ratio assembly and power unit, and continuously shows the total fuel quantity (in pounds) in the fuel tanks. Single phase 115-volt 400-cycle regulated AC power to operate the totalizer is taken from the single-phase bus. Circuit protection is provided by the quantity totalizer circuit breaker in the main power distribution box.

Fuel Quantity Indicators and Test Switches.

Eight fuel quantity indicators (figure 1-21) are located on the fuel control panel. Each internal tank indicator is connected to a capacitance gage in one of the fuel tanks, and gives a continuous visual indication of the pounds of fuel contained in that tank. Single-phase 115-volt 400-cycle regulated AC power to operate the quantity indicators is taken from the single-phase bus. Circuit protection is supplied by the fuel quantity power units circuit breakers in the main power distribution box. A quantity indicator test switch (figure 1-26) is provided to test the quantity indicating system. The individual fuel quantity gage press-to-test switch, when depressed, grounds the power lead for that indicator, moving the pointer toward zero. The total fuel quantity pointer will detect the decrease and subtract an equal amount from the totalizer indication. Failure of a pointer to move toward zero when the press-to-test switch is actuated indicates an indicator malfunction.

Tank Empty Lights.

Four tank empty lights (figure 1-21), one for each internal fuel tank, are located on the fuel control panel. When an internal tank fuel quantity indicator pointer indicates 400 (±200) pounds, a low-level switch in the indicator turns on the light for that tank if the boost switch is on. A tank empty light is extinguished by turning OFF the fuel boost pump switch for the empty tank. Circuit protection is provided by the int. tank empty warning circuit breaker on the flight station distribution panel. On airplanes AF53-3129 through AF55-0046, the press-to-test lights can be tested only while corresponding boost pump switches are on. On airplanes AF55-0469 and up, the press-to-test lights can be tested with the boost pump switches off.

Refueling Panel On Light (Airplanes AF55-0029 and Up).

A refueling panel on light (figure 1-21) is located on the fuel control panel. The circuit to this press-to-test light is completed by either or both of the following: single point refueling master switch not off, ground transfer valve not closed. Twenty-eight-volt, DC power to operate the light is taken from the wheel well bus. Circuit protection is provided by the master warning light circuit breaker on the wheel well power junction box.

Fuel Pressure Ground Test Indicator.

A fuel press. indicator (figure 1-21) is located on the fuel control panel and is used to check out the fuel boost pumps before flight. This indicator is electrically connected to a fuel pressure transmitter. On airplanes AF53-3129 through 54-1623, the pressure transmitter measures the pressure supplied the No. 2 engine from the crossfeed manifold. On airplanes AF54-1628 and up, the transmitter measures the pressures of the crossfeed manifold. Thus, when the fuel boost pumps are turned on individually, the pressure supplied the crossfeed system by any pump is measured by the transmitter and shown by the indicator. Single-phase, 26-volt, 400-cycle AC to operate the pressure indication system is supplied by the No. 1 instrument power transformer. Circuit protection is provided by the fuel pressure indicator fuse in the main power distribution box.

Note

This instrument is for preflight reference when checking the fuel booster pumps with the engines inoperative. Readings may be used in flight to determine that the cross-feed manifold has been pressurized by the fuel boost pumps: however, gage markings are not related to inflight pressure. Inflight low pressure warning is supplied by the pressure warning lights on the fuel control panel. For description of the low pressure warning lights, see ENGINE INDICATORS in this section.

ELECTRICAL POWER SUPPLY SYSTEMS.

Three power systems are provided to operate the electrical equipment. These are: (1) A 28-volt DC system with power supplied by engine-driven DC generators, battery, external power source, and by two transformer rectifiers. (2) An unregulated AC system with power supplied by the engine-driven AC generators, external power source, or by an ATM-driven AC generator. (3) A regulated AC system with power supplied by engine-driven AC generators, inverters, external power source, and by the ATM-driven AC generator. The ATM-driven AC generator is capable of supplying AC power to the unregulated AC power system, the regulated AC power system, and to two transformer rectifiers which supply DC power to the main DC bus. Controls for all three systems are located on the overhead panel in the flight station and can be reached by the pilots and the flight engineer. Circuit breaker panels are shown in figures 1-26 through 1-33.

EXTERNAL POWER PROVISIONS.

Note

The 200/115-volt, 3-phase, 400-cycle AC external source should have a capacity of 40 KVA; its phase rotation must be A-B-C. The 28-volt DC external source should have a capacity of 400 amperes.

Both DC and unregulated AC external power receptacles are located on the left side of the fuselage just aft of the battery compartment. DC power from the external source is supplied through a relay and two current limiters to the main DC bus. Any DC electrically operated equipment on the airplane, except equipment connected to the battery bus, can be supplied from an external power source. The battery is disconnected from the DC buses when external power is being used. When an AC external power source is connected to the airplane, the power is supplied through an automatic circuit breaker relay to the left-hand main AC buses. The left-hand and right-hand main buses are tied together by another automatic circuit breaker relay so that all unregulated AC buses are energized. Interlock circuits prevent connection of the external power source to the buses in parallel with an engine-driven generator. External power is tripped off automatically, by the switch whenever a generator switch is turned on. External AC power should always be disconnected before external DC power is disconnected.

WARNING

Use of the battery engine start button, or other unapproved methods, to connect external AC power results in two unsafe conditions caused by DC power not being available to trip the external AC power relay: while disconnecting the external AC power cable, arcing to the receptacle contacts may cause a fire, and if external AC power is reconnected, power will be supplied directly to the bus, possibly causing injury to maintenance personnel.

CAUTION

External AC power is connected to all regulated AC power systems if inverter switches are turned to AC GEN positions. Make sure that the inverter switches and the related system switches are positioned as desired before connecting external power.

DIRECT-CURRENT SYSTEM.

Note

The DC system has been changed to include the addition of the pylon tanks controls and indicators. Figure 1-23 shows the addition of the pylon tanks to the main DC bus. Figure 1-28 shows the addition of the pylon tanks circuit breakers to the main DC power distribution box.

The direct current (DC) system power sources are four 400-ampere engine-driven generators, a battery, two transformer rectifiers and external power. The engine-driven generators supply normal 28-volt power for the DC system. The air-turbine-motor-driven AC generator, located above the left wheel well, is provided as an emergency source for flight operations and as an alternate for external power for ground operations. The transformer rectifiers are used to obtain DC power from the air turbine motor AC generator. The battery is an emergency source of power for the few essential circuits. It can also be used for starting the gas turbine compressor and to energize starting circuits.

dc power supply

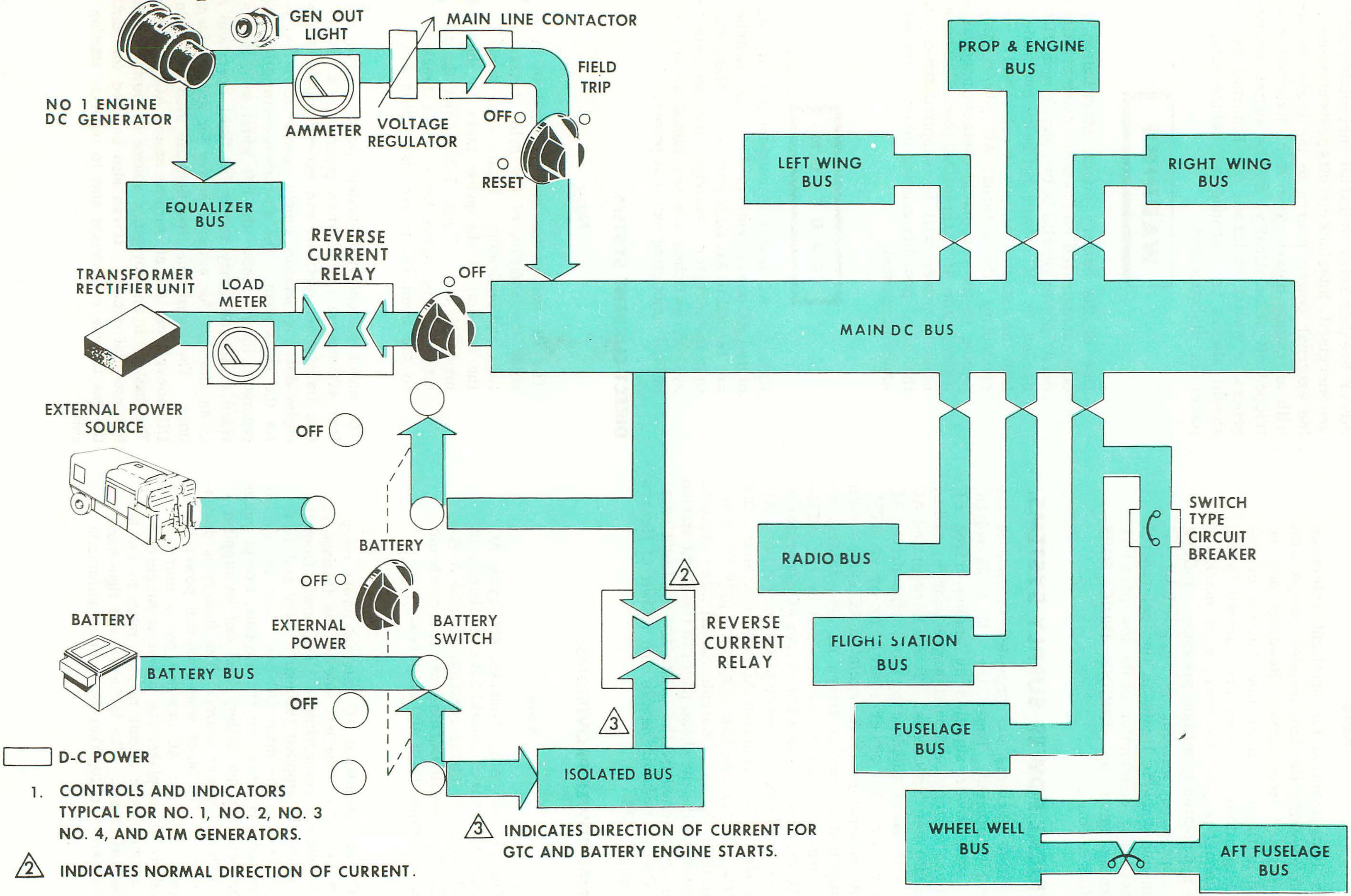


Figure 1-22.

DC Generators and Buses.

The four engine-driven generators normally supply all power to the main bus of the DC distribution system. Each generator is connected to the main bus through a main line contactor (relay). During operation, the main line contactor will automatically be opened by any overvoltage, feeder fault, or reverse current condition. The main line contactor is electrically controlled by the generator switch to connect or disconnect a generator from the distribution system. However, the automatic devices in the system will override any manual control to remove a malfunctioning generator from operation. Generator control panels completely control the operation of paralleling the generators on the main bus. Carbon pile regulators automatically regulate the voltage. An equalizer bus regulates the division of loads among the generators, balancing the load by reducing the voltage on any generator which tends to assume more than its share of the total load. The generators supply all power for the DC operated equipment in the airplane, and also supply power to operate the inverters. All loads which are considered to be of primary importance are connected to either the main DC bus, the propeller and engine bus, or the isolated bus. All other loads are supplied from auxiliary or sub-buses, which are supplied from the main DC bus through contactors (relays). The following auxiliary buses are provided: flight station, fuselage, radio, left wing, and right wing. The wheel well bus and the aft fuselage bus derive their power from the fuselage bus. Nine current limiters (one 50-ampere, six 100-ampere, one 150-ampere, and one 175-ampere) located inside the main power distribution box provide overload protection for the dc loads imposed by added mission equipment. Added circuit breakers provide overload protection for the power and control circuits of the additional avionics and armament system. Figure 1-22 and 1-23 show the DC power generation and distribution, and list the DC operated equipment which is connected to each of the buses.

Transformer-Rectifiers.

Two transformer rectifiers are connected to the main DC bus through reverse current relays. These transformer rectifiers operate in parallel with each other and the DC generators, though they do not necessarily share the load equally with DC generators. The maximum output of a transformer rectifier is 200 amperes at 28 volts. The transformer rectifier units are used on the ground when no external power is available or for emergency power in the event that an engine-driven generator fails. The transformer rectifiers are located under the flight station and are powered from the left-hand AC bus.

Battery.

A 24-volt, 36-ampere-hour battery is located in a fuselage compartment forward of the crew entrance door. The battery supplies power to the battery bus and to the isolated bus. A reverse current relay is connected between the isolated bus and the main DC bus. It normally prevents the battery from powering equipment connected to the main DC bus and permits power from the main DC bus to be used to power equipment connected to the isolated bus, and to charge the battery. During gas turbine compressor starting or battery-engine starting, reverse current relay reverses the normal current flow to allow the battery to power the main bus. Power from the battery is thus made available for operation of GTC starter or engine starting control circuits.

Direct Current System Controls.

The DC system controls, with the exception of a second manual reset lever on each generator control panel, are located on the overhead electrical control panel above the flight station. The generator control panels are located in racks under the flight station and are accessible, in flight, from the cargo department.

GENERATOR SWITCHES. Each of the generators is controlled independently by its own four-position, rotary-type switch located on the overhead electrical control panel (figure 1-24). When the switch is in the ON position (knob stripe aligned with panel stripe) the main line contactor is closed and the generator is connected to the main bus. The contactor is open when the switch is in the OFF position. The generator still continues to produce voltage. The switch is placed in the momentary FIELD TRIP position to trip the generator field relay. This removes the excitation current from the generator field and voltage generation ceases, except for residual voltage (2 or 3 volts), even though the generator armature continues to turn. The switch knob must be pulled out before the switch can be placed in the FIELD TRIP position. If the generator field relay has been tripped, it can be reset to the closed position by placing the generator switch in the momentary RESET position.

MANUAL RESET LEVER. A manual reset lever is located on each generator control panel under the flight station. This reset lever is used to manually reset a generator if the reset coil in the control box fails to operate.

BUS ISOLATION SWITCHES. A bus isolation switch for each of the auxiliary buses is located on the overhead electrical control panel (figure 1-24). The ON position of these switches energized relays, which close to connect the auxiliary buses to the main DC bus. The OFF position of the switches de-energizes the relays to disconnect the auxiliary buses from the main DC bus. These switches are primarily emergency disconnect switches for isolating an auxiliary bus from the main DC bus. They are normally left in the ON position at all times. A transparent plastic switch plate surrounds the bus switches to prevent accidental actuation.

dc power distribution

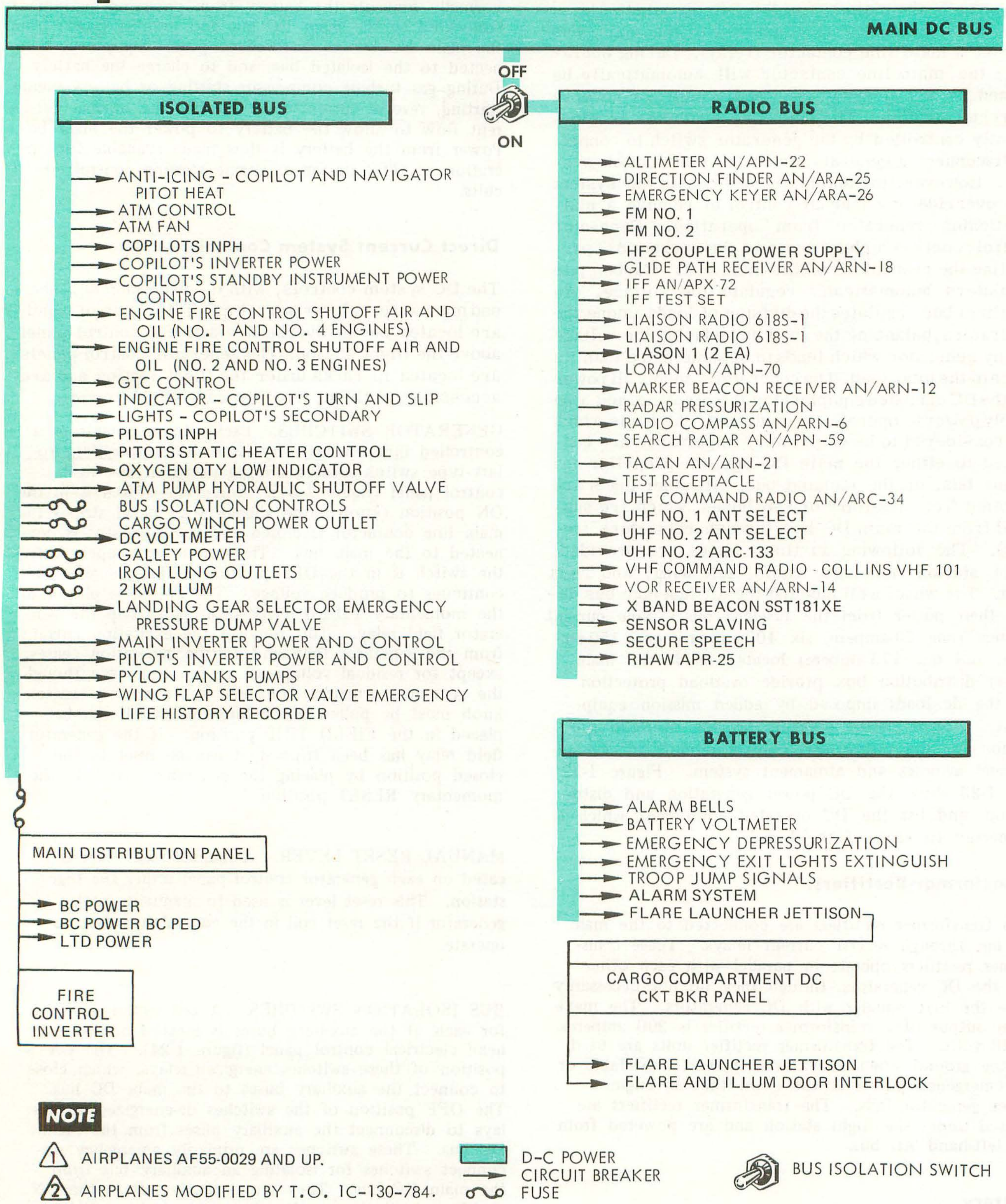


Figure 1-23. (Sheet 1 of 4)

MAIN DC BUS

OFF / ON

FLIGHT STATION BUS

- AC GENERATOR AND BUS TIE WARNING LIGHTS
- AC GENERATOR CONTROL
- AIR CONDITIONING AND PRESSURIZATION CONTROL
- ANTI-SKID CONTROL
- ANTI-SKID INOPERATIVE LIGHT
- AUTOPILOT
- DOOR SAFETY WARNING LIGHTS
- DOPPLER RADAR AN/ASN-35
- DOPPLER RADAR AN/APN-147
- ENGINE PRESSURE WARNING LIGHTS
- ENGINE SECONDARY PUMP PRESSURE LIGHTS
- ESSENTIAL CIRCUIT BREAKER AND COPILOT'S AUXILIARY PANEL LIGHTS
- EXTERIOR LIGHTS
- EXTERNAL AC POWER CONTROL
- EXTERNAL TANKS PUMP PRESSURE TEST
- FIRE DETECTOR TEST RELAY
- FLIGHT STATION AND RADIO CIRCUIT BREAKER PANELS LIGHTS
- FREE AIR TEMPERATURE INDICATOR
- FUEL CONTROL (4 ENG)
- LANDING GEAR POSITION INDICATORS
- LANDING GEAR WARNING LIGHT AND HORN
- LANDING LIGHT MOTORS
- N-1 COMPASS SYSTEMS
- NAVIGATOR'S PRIMARY AND SECONDARY INSTRUMENT LIGHTS
- NESA WINDSHIELD CONTROL
- OIL TEMPERATURE INDICATORS
- OVERHEAD PANEL PRIMARY AND SECONDARY LIGHTS
- PEDESTAL AND PILOT'S AUXILIARY PANEL LIGHTS
- PILOT'S AND ENGINE INSTRUMENTS SECONDARY LIGHTS
- PILOT'S PITOT HEAT
- POWER FAILURE LIGHTS
- SIGNAL LIGHT RECEPTACLES
- START CONTROL (4 ENG)
- TANK EMPTY WARNING LIGHTS
- THUNDERSTORM AND FLIGHT STATION UTILITY LIGHTS
- WINDSHIELD WIPERS
- PITOT STATIC HEATER CONTROL
- NO. 1 GEN AC POWER CONTROL
- NO. 4 GEN AC POWER CONTROL

OFF / ON

LH WING BUS

- ANTI-ICE SHUTOFF VALVES, NO. 1 AND NO. 2 ENGINES
- CROSSFEED VALVES, NO. 1 AND NO. 2 ENGINES
- FUEL TRANSFER, NO. 1 AND NO. 2 ENGINES
- LH LANDING LIGHT
- OIL COOLER FLAPS, NO. 1 AND NO. 2 ENGINES
- PUMP RUN-AROUND SHUTOFF VALVES, NO. 1 AND NO. 2 ENGINES

PROPELLER AND ENGINE BUS

- ATM AC GENERATOR CONTROL
- BLEED AIR SHUTOFF VALVES (4 ENG)
- DC GENERATOR CONTROL (4 ENG)
- DE-ICING TIMER - PROPELLER
- EMERGENCY FEATHER SOLENOID (4 ENG)
- ENGINE OIL QUANTITY GAGES (4 ENG)
- ENGINE OIL QUANTITY LIGHT
- FIRE EXTINGUISHER SYSTEM (4 ENG)
- FEATHER MOTOR CONTROL (4 ENG)
- FEATHER TIMER AND POWER RELAY
- FIREWALL SHUTOFF VALVES RELAYS (4 ENG)
- FLIGHT IDLE STOP SOLENOID (4 ENG)
- FUEL AND IGNITION CONTROL (4 ENG)
- FUEL SHUTOFF VALVES (4 ENG)
- HANDLE LIGHTS, OVERHEAT (4 ENG)
- HYDRAULIC SHUTOFF VALVES (4 ENG)
- NEGATIVE TORQUE CONTROL LOCK-OUT SOLENOIDS (4 ENG)
- PILOT'S ATTITUDE INDICATOR
- PILOT'S TURN AND SLIP INDICATOR
- PRIMARY INSTRUMENT LIGHTS
- SYNCH MASTER
- TEMPERATURE DATUM CORRECTION RELAY
- TEMPERATURE DATUM VALVE NULL CONTROL (4 ENG)
- UTILITY LIGHTS - PILOT AND COPILOT
- FIRE WARNING LIGHTS (4 ENG)

Figure 1-23. (Sheet 2 of 4)

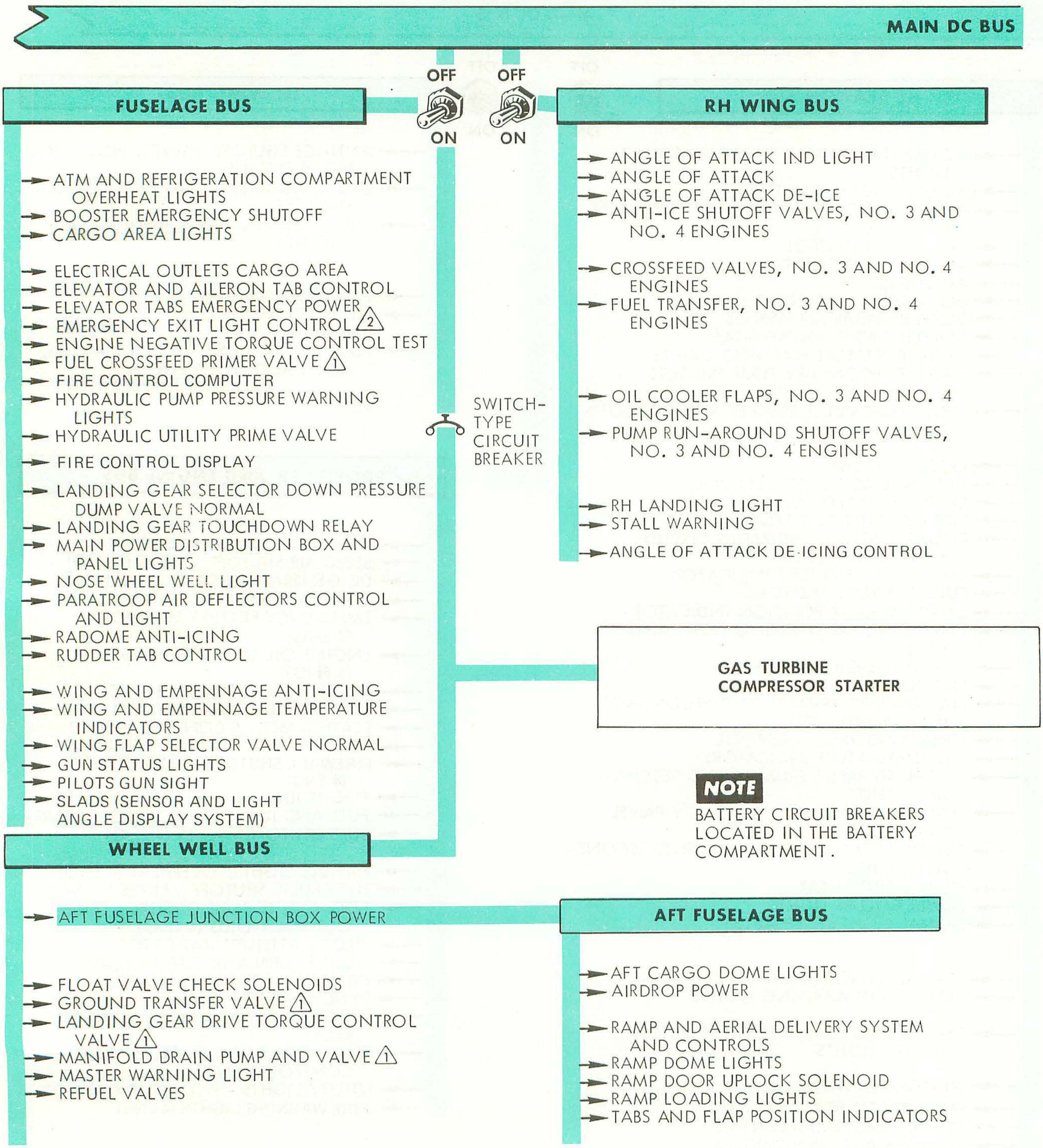


Figure 1-23. (Sheet 3 of 4)

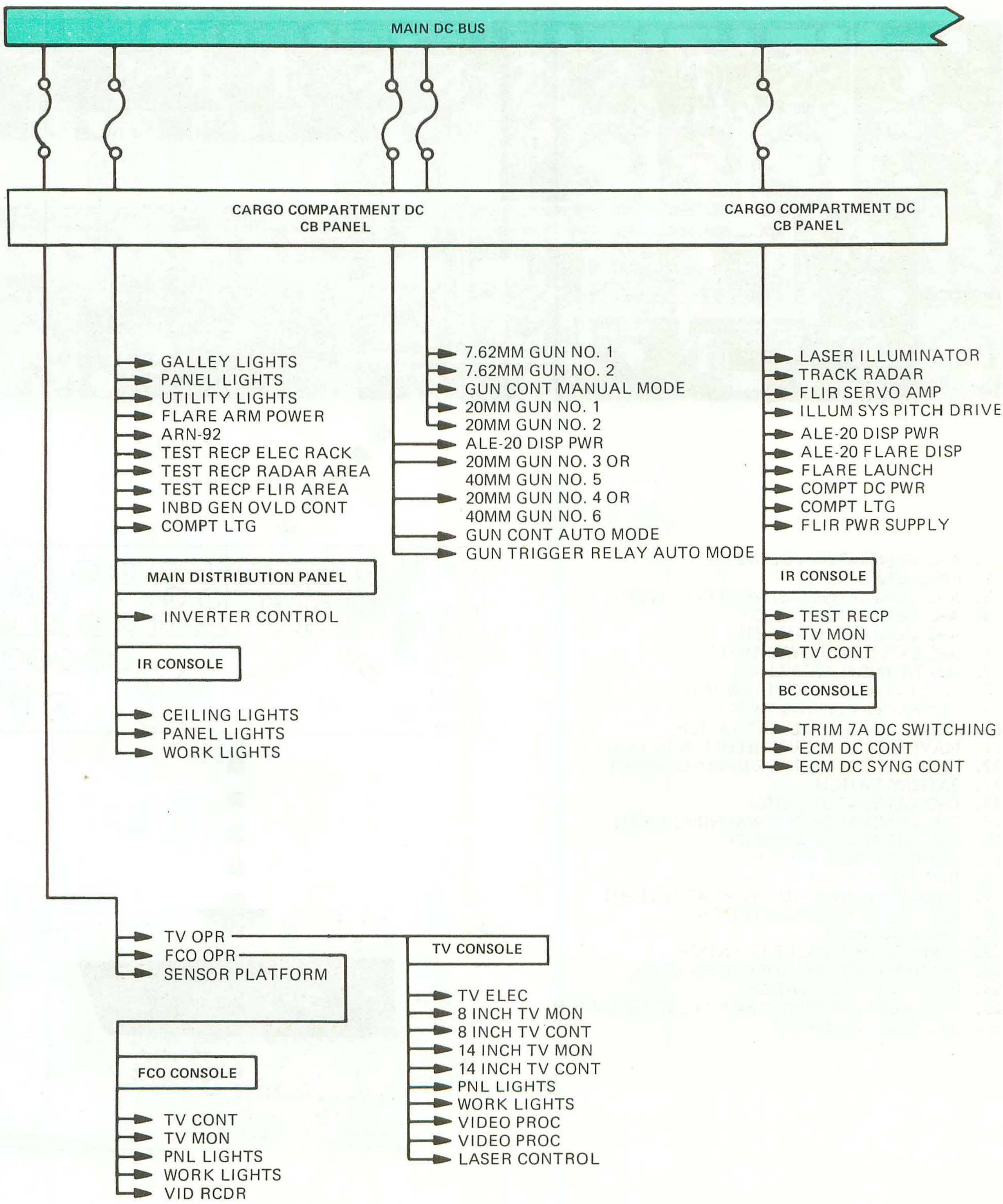
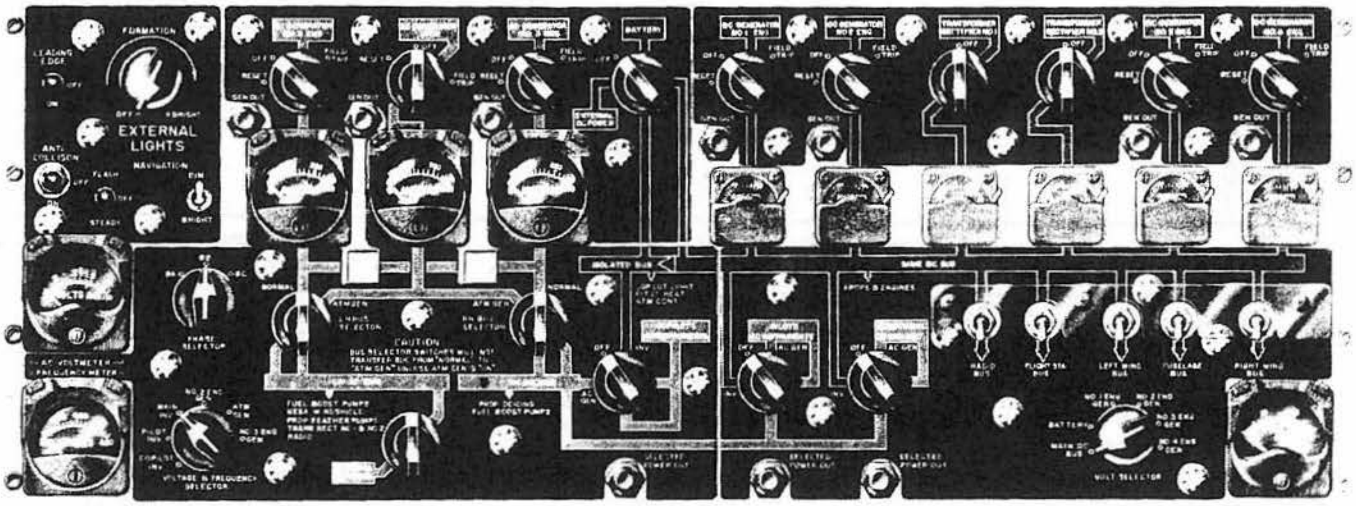
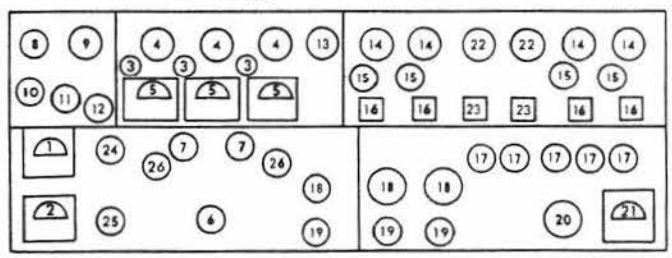


Figure 1-23. (Sheet 4 of 4)

electrical control panel





1. A-C GENERATOR VOLTMETER
2. FREQUENCY METER
3. A-C GENERATOR OUT WARNING LIGHT
4. A-C GENERATOR SWITCH
5. A-C GENERATOR AMMETER
6. A-C EXTERNAL POWER SWITCH
7. BUS TIE INDICATOR LIGHT
8. LEADING EDGE LIGHTS SWITCH
9. FORMATION LIGHTS SWITCH
10. ANTI-COLLISION LIGHT SWITCH
11. NAVIGATION LIGHTS SELECTOR SWITCH
12. NAVIGATION LIGHTS DIMMING SWITCH
13. BATTERY SWITCH
14. D-C GENERATOR SWITCH
15. D-C GENERATOR OUT WARNING LIGHT
16. D-C GENERATOR AMMETER
17. BUS ISOLATION SWITCH
18. INVERTER SWITCH
19. SELECTED POWER OUT INDICATOR LIGHT
20. VOLTMETER SELECTOR SWITCH
21. D-C VOLTMETER
22. TRANSFORMER RECTIFIER SWITCH
23. TRANSFORMER RECTIFIER LOAD METER
24. PHASE SELECTOR SWITCH
25. VOLTAGE AND FREQUENCY SELECTOR SWITCH
26. BUS SELECTOR SWITCH

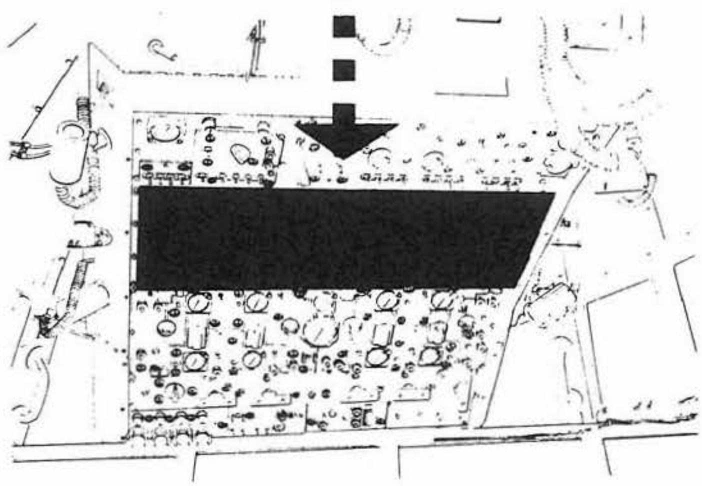
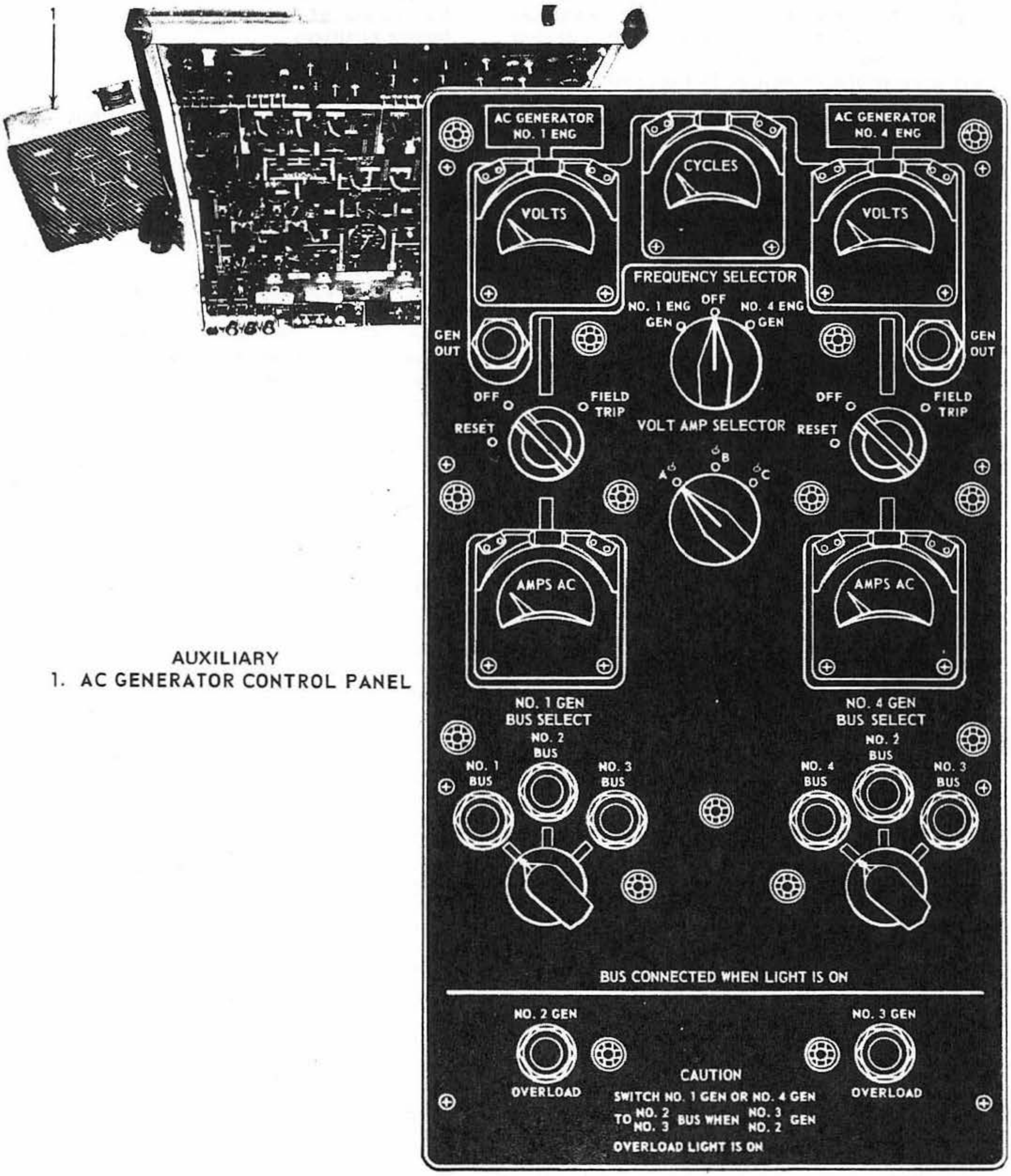


Figure 1-24. (Sheet 1 of 2)

auxiliary ac generator control panel



AUXILIARY
1. AC GENERATOR CONTROL PANEL

Figure 1-24. (Sheet 2 of 2)

DC EXTERNAL POWER SWITCH (BATTERY SWITCH). The battery switch is a three-position, rotary-type switch located on the overhead electrical control panel (figure 1-24). When the switch is in the EXTERNAL POWER position, the external power relay will close when external power is applied, to connect the external power receptacle to the main DC bus. When the switch is in the BATTERY position, the battery relay is closed and the battery is connected to the isolated bus. This position of the switch permits power to flow from the main DC bus through the reverse current cutout to charge the battery. When the switch is in the OFF position, the external power relay is opened, the external power receptacle is disconnected from the main DC bus, and the battery is disconnected from the isolated bus.

Note

A minimum battery voltage of approximately 18 volts is required to close the battery relay (the battery relay must be closed before the generators can recharge the battery).

Direct Current System Indicators.

The DC system indicators, which include individual generator-out lights and ammeters, and a common voltmeter with its accompanying selector switch, are located on the overhead electrical control panel in the flight station.

VOLTMETER AND VOLTMETER SELECTOR SWITCH. The voltmeter is located on the overhead electrical control panel (figure 1-24) and is connected to the main DC bus or generators by means of the voltmeter selector switch adjacent to the voltmeter. Individual generator voltage can be read only if the generator switch is in the OFF position. The voltmeter connects to the generator circuits on the generator side of the main line contactors. Bus voltage will be indicated on the voltmeter, regardless of the position of the voltmeter selector switch, unless the selected generator main line contactor is opened by placing the generator switch in the OFF position. When the switch is moved to the BATTERY position, battery voltage will be indicated regardless of the position of the battery switch.

GEN OUT WARNING LIGHTS. One red gen out warning light for each generator is located on the overhead electrical panel (figure 1-24). A light will illuminate any time the associated generator switch is in ON position and that generator is not connected to the main bus.

AMMETERS. Each generator is provided with an ammeter, which is located directly below the control switch for the generator (figure 1-24). The ammeters continuously indicate their respective generator loads in amperes.

LOAD METERS. Each transformer rectifier is provided with a load meter located directly below the control switch for the transformer rectifier. These load meters indicate percent of capacity of the transformer rectifiers.

REGULATED AC SYSTEM.

The regulated AC power system is divided into four separate power supply systems. They are an electronic and engine power system, a pilot's instruments power system, a copilot' instruments power system and a fire control system. Figure 1-25 shows the power sources, controls and distribution of power for the four systems. Circuit breakers for the power control circuits are located on the main distribution panel. One additional circuit breaker for the fire control system inverter is located forward of the inverter, on the outside of the electronics rack, which is positioned in front of the booth, on the right hand side of the cargo compartment.

Note

A regulated AC power system can be powered by either a generator or inverter. An unregulated AC power system can be powered only by a generator.

Electronic and Engine AC Power System.

The electronic and engine AC power system supplies single-phase, 400-cycle power for radio, radar, instruments, and other systems. The No. 3 engine generator is the primary power source, and standby power is provided by the main inverter. Since the primary power is drawn from the right-hand, C-phase bus, external AC power can be used for ground operation of systems using single-phase, 400-cycle AC power. Power for driving the main inverter is drawn from the main DC bus. Twenty-six-volt, AC power for synchro-type instruments is obtained by transforming a portion of the power supplied to the 115-volt, single-phase bus. Two instrument transformers are used for this purpose.

Pilot's AC Instrument Power System.

The pilot's AC instrument power system supplies 3-phase, 400-cycle power for the N-1 compass and pilot's attitude indicator. The primary power source for the system is the No. 3 engine generator, and a pilot inverter is provided as a standby source. Power for driving the pilot inverter is supplied from the main DC bus. Since primary power for the pilot's AC instruments is supplied through the right-hand AC bus, external AC power can be used to operate the N-1 compass and pilot's attitude indicator on the ground. The pilot's isolation transformer converts 3-phase, 115/200-volt, 400-cycle AC to 3-phase, 115-volt, 400-cycle AC to operate the pilot's AC instruments.

ac power supply and distribution unregulated

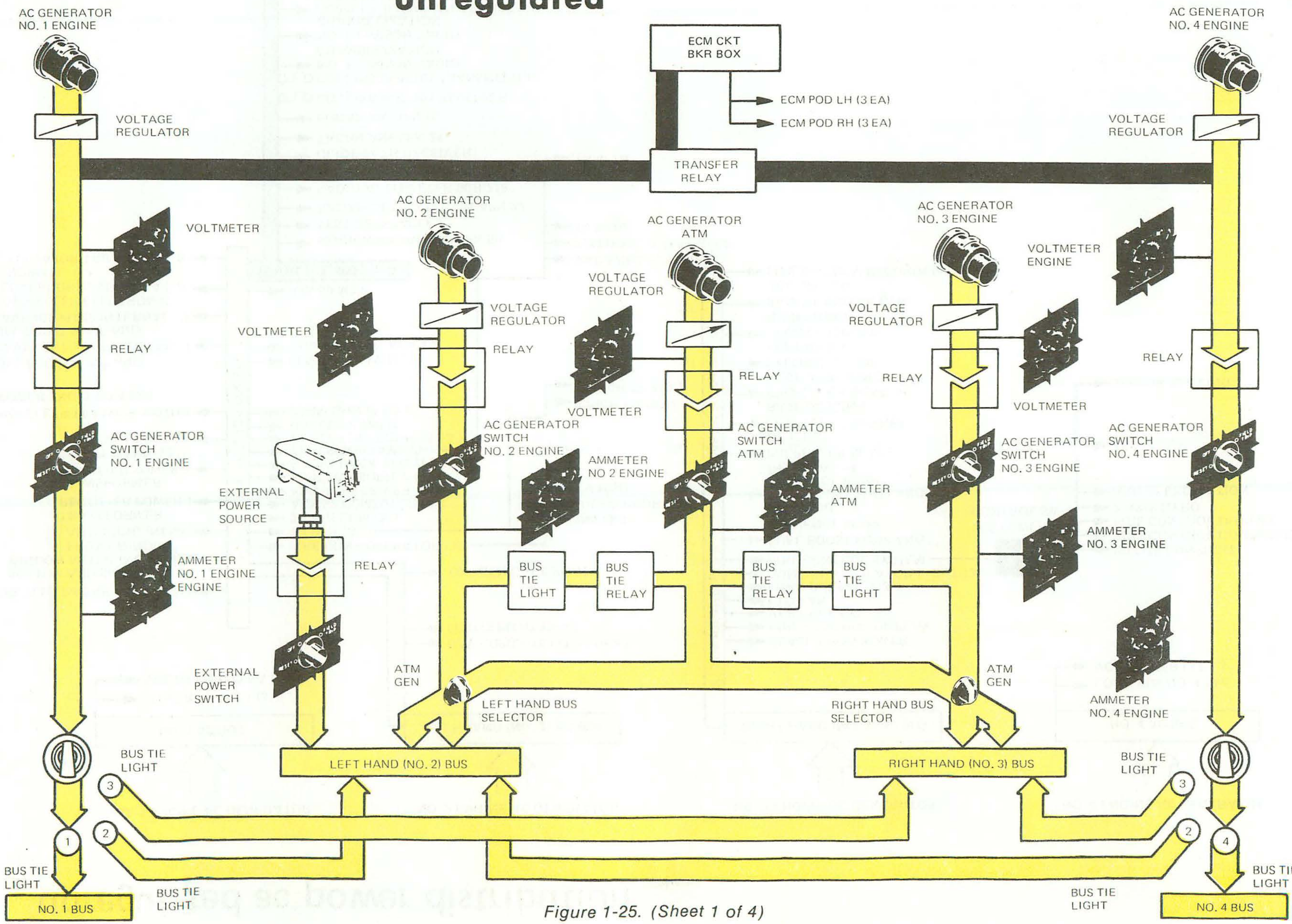


Figure 1-25. (Sheet 1 of 4)

unregulated ac power distribution

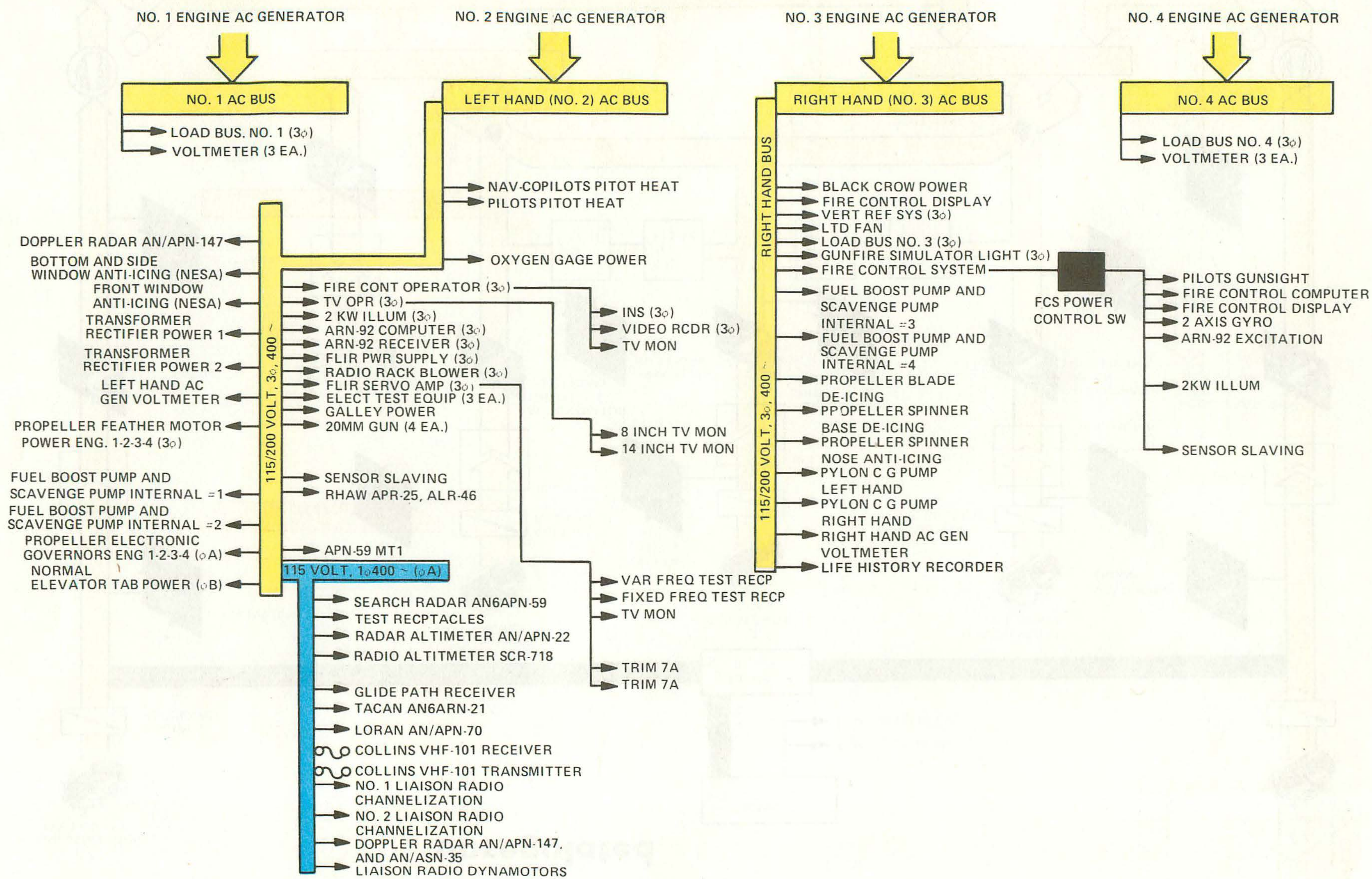


Figure 1-25. (Sheet 2 of 4)

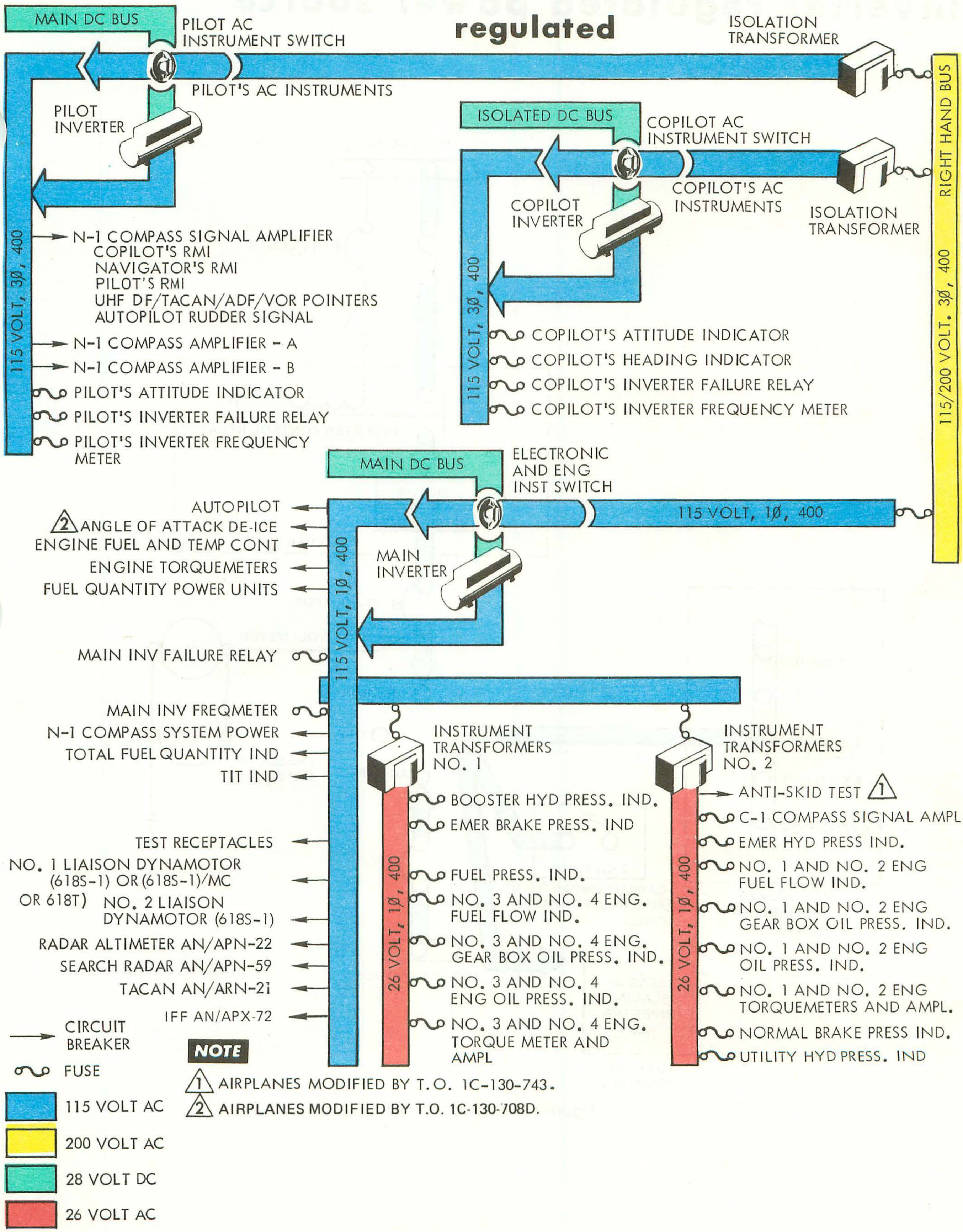


Figure 1-25. (Sheet 3 of 4)

inverter regulated power source

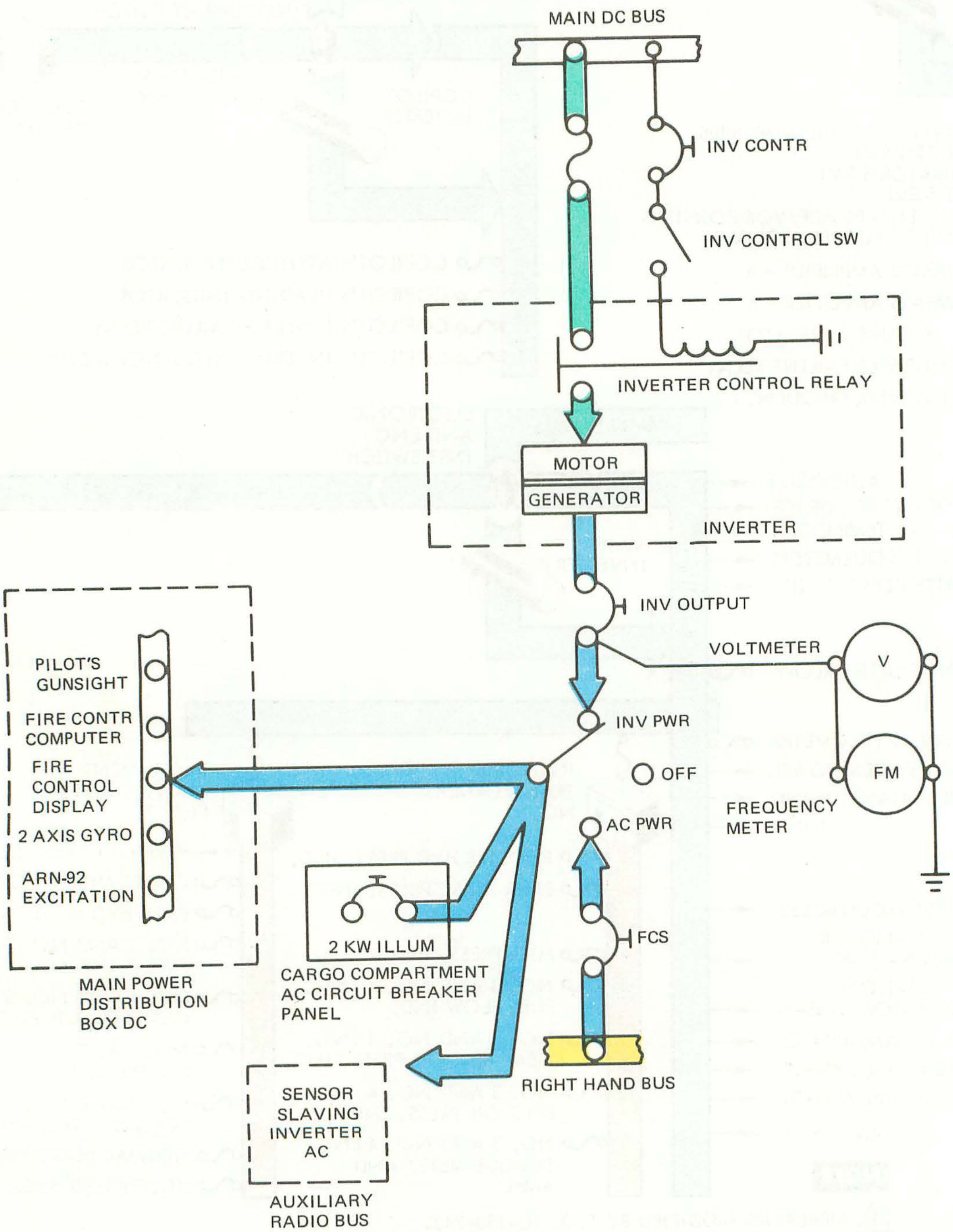
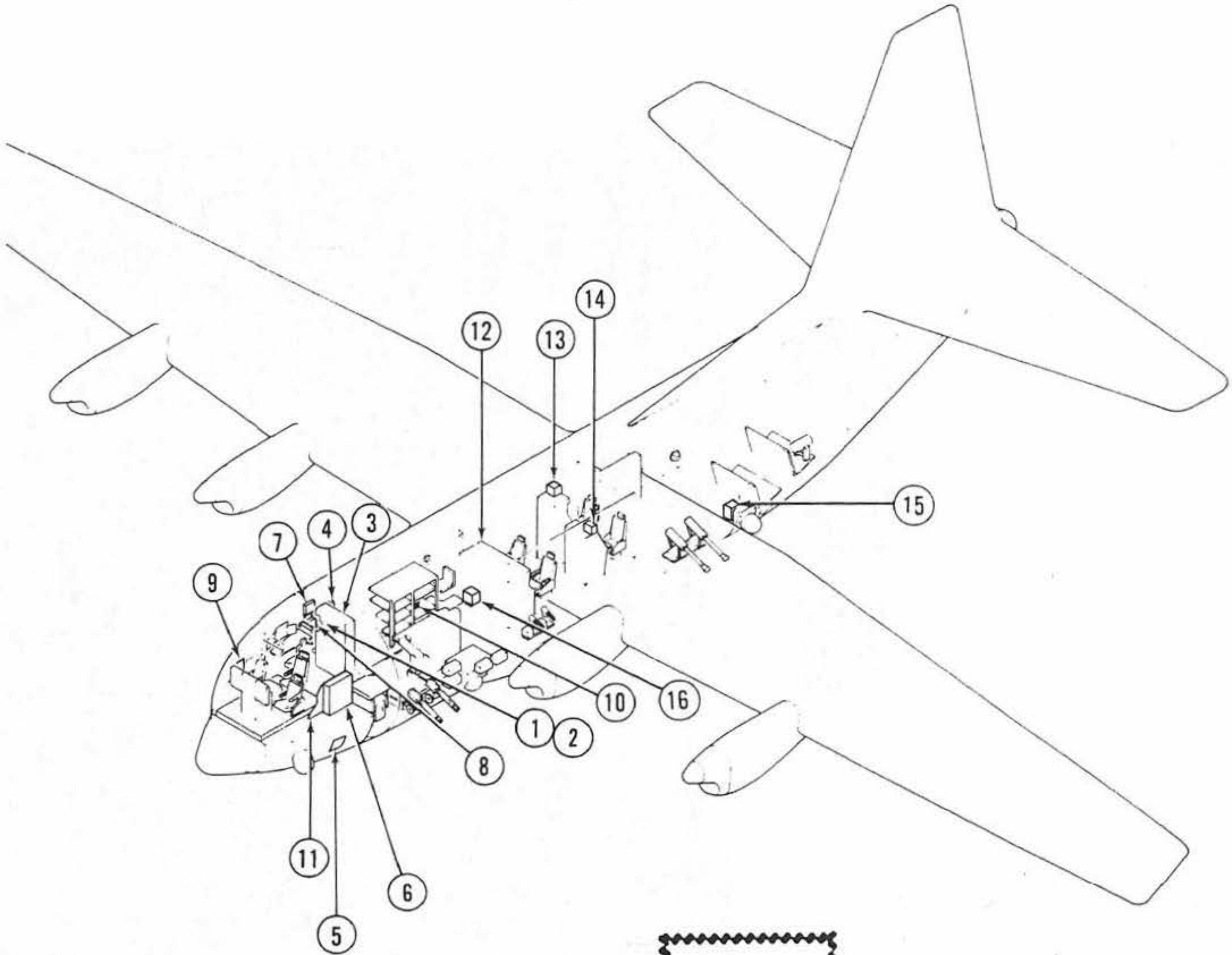


Figure 1-25. (Sheet 4 of 4)

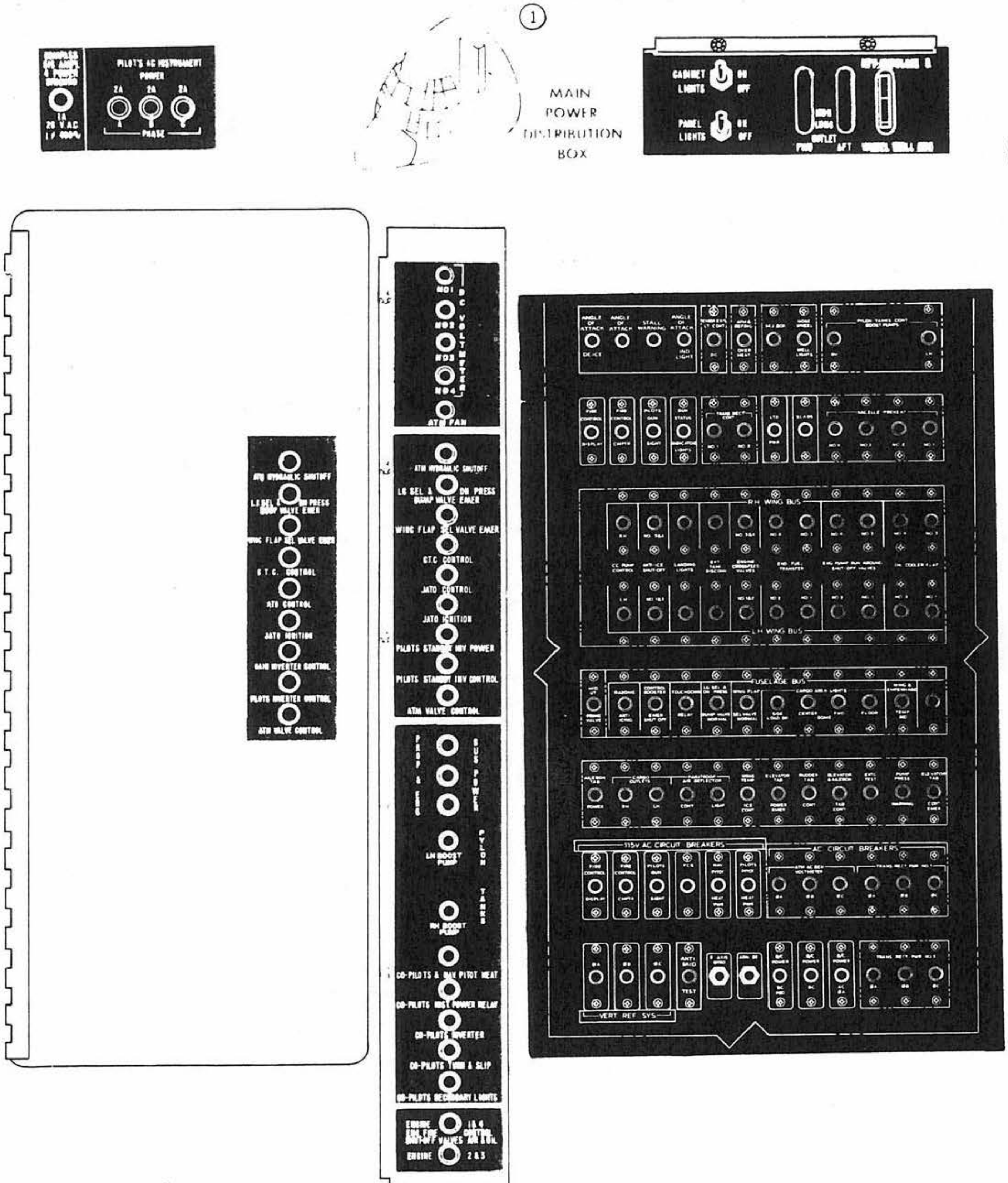
circuit breaker panels



CAUTION

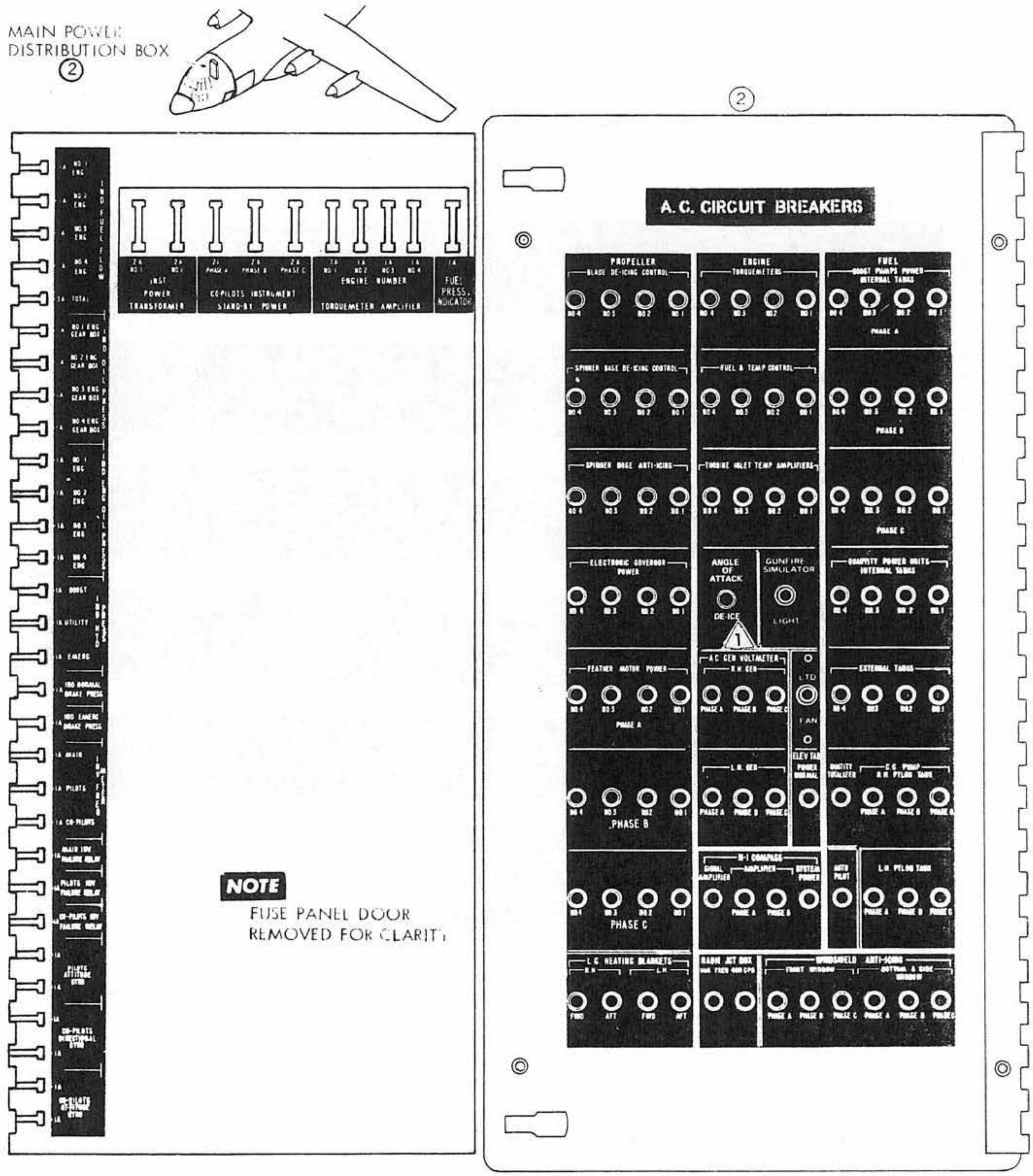
NEVER USE A CIRCUIT BREAKER AS A SWITCH. CIRCUIT BREAKERS ARE TO BE PULLED ONLY WHEN NECESSARY TO ISOLATE A SYSTEM DURING AN EMERGENCY OR FOR MAINTENANCE. DO NOT PLACE OBJECTS (PARACHUTES, HELMET BAGS, ETC) IN FRONT OF ANY CIRCUIT BREAKER PANEL

Figure 1-26.



main power distribution box dc

Figure 1-27.

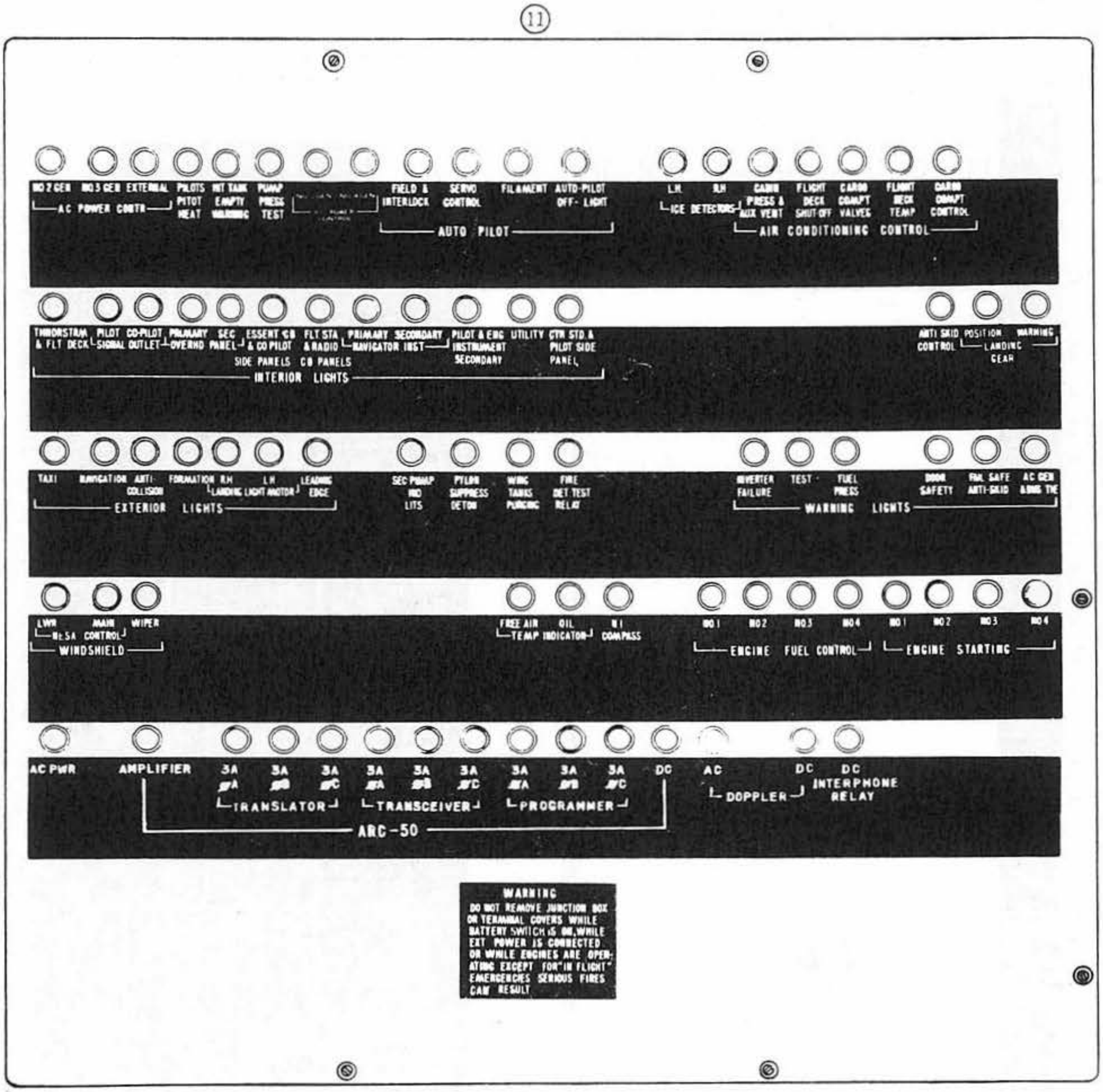


⚠1 AIRPLANES MODIFIED BY T.O. 1C-130-708D

main power distribution box ac

typical

Figure 1-28.



flight station distribution panel typical

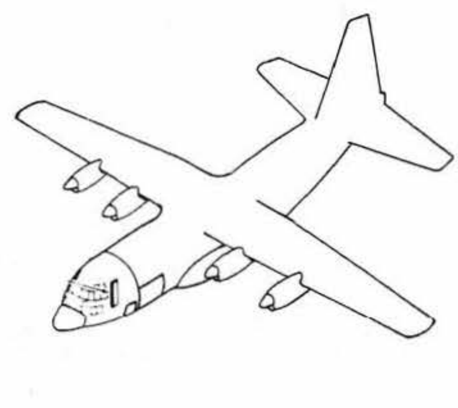


Figure 1-29.

Copilot's AC Instrument Power System.

A single 100-volt-ampere inverter supplies 115-volt, 400-cycle, 3-phase power for operation of the copilot's heading and attitude indicators. The inverter draws DC power from the isolated bus; therefore, it can be operated from the battery during emergency conditions of flight. Standby power can be supplied from the right-hand unregulated AC bus, through an isolation transformer, to operate the copilot's AC instrument. The copilot's isolation transformer converts 3-phase, 115/200-volt, 400-cycle AC to 3-phase, 115-volt, 400-cycle AC to operate the copilot's AC instruments.

FIRE CONTROL AC POWER SYSTEM. The fire control system inverter is the primary source of power for the fire control system. The aircraft system is a backup power source. The inverter is controlled by the two-position (ON-OFF) INV CON'T toggle switch located on the main power distribution box. (See Fig. 1-3.) When use of the inverter is not required, the switch should be turned OFF. Power is supplied from the main dc bus. Two meters are installed on top of the main power distribution box: one indicates inverter voltage (115 + 3 volts ac) and the other inverter frequency (380-420 Hz). A three position (AC PWR-OFF-INV PWR) FCS toggle switch, below the INV CONT switch, enables the navigator to select either the airplane power supply or the fire control inverter.

Regulated AC System Controls.

Controls for the regulated AC power system are located on the overhead electrical control panel in the flight station. The controls are three switches which act as inverter controls and power source selectors.

MAIN INVERTER SWITCH. The three-position main inverter switch (figure 1-24) has INV, AC GEN, and OFF positions. When the switch is in INV position, DC power is supplied to the main inverter, and inverter output is fed to the electronic and engine instruments circuits. With the switch in AC GEN position, the inverter is off; and generator power is supplied to the electronic and engine instrument circuits. With the switch in OFF, the circuits receive no power.

PILOT INVERTER SWITCH. The pilot inverter switch (figure 1-24) selects either the pilot inverter of the No. 3 engine generator as the source of power for the pilot's AC instruments. With the switch in INV position, DC power is supplied to the inverter from the main bus, and the inverter supplies AC power to the pilot's instruments. With the switch in AC GEN position, the inverter is off, and generator power is supplied to the instruments. With the switch in OFF, the instruments receive no power.

COPILOT INVERTER SWITCH. The copilot inverter switch (figure 1-24) selects either the copilot inverter or the No. 3 engine generator as the source of power for the copilot's AC instruments. The INV position of the switch is used to supply normal power for the copilot's system. If the switch is in the AC GEN position, the inverter is off, and the AC generator supplies power to the instruments. When the switch is in OFF, the instruments receive no power.

Regulated AC System Indicators.

Indicators for the regulated AC power system are a frequency meter, voltmeter, and selected power out lights located on the overhead electrical panel in the flight station.

FREQUENCY METER AND VOLTMETER. A frequency meter and voltmeter are provided to indicate frequency and volts of the AC generators and inverters powering the regulated systems (figure 1-24). Circuit protection is provided through circuit breakers and fuses on the main power distribution panels.

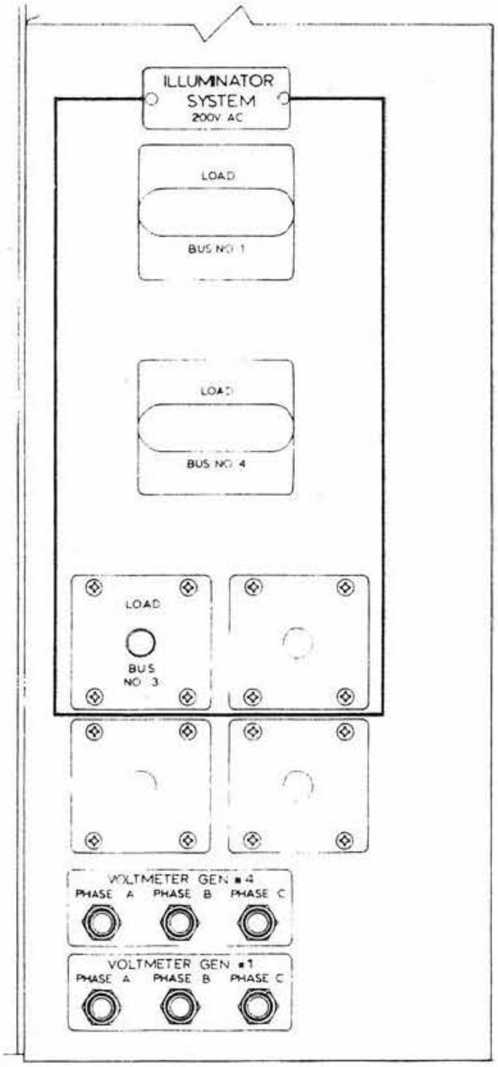
The voltage and frequency selector switch and the phase selector switch are used to connect the output of the AC generators and inverters to the frequency meter and voltmeter. When on particular power source position is selected with the voltage and frequency selector switch, the frequency and volts of that generator or inverter will be indicated. A phase, B phase, and C phase of the generator are selected by positioning the phase selector switch in the ØA, ØB, and ØC positions, respectively. The phase selector switch must be in the ØB position to read frequency or voltage of the inverters.

SELECTED POWER OUT LIGHTS. A selected power out light (figure 1-29) is located below each inverter switch. If a light illuminates, it indicates a blown inverter failure relay fuse or that no power is being supplied to the single-phase bus, pilot's instruments, or or copilot's isntruments. A light does not illuminate when the corresponding inverter switch is at OFF.

UNREGULATED AC SYSTEM.

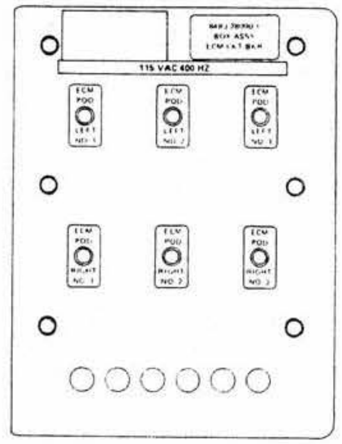
The unregulated AC power supply system supplies 115/200-volts, 3-phase power for operation of radio and rader equipment, propeller governing systems, electrical anti-icing and deicing systems, and fuel pumps. Engine-driven generators supply the required power during flight and taxiing. An external source can be used to furnish the power for ground operation and testing of systems. The engine driven generators are four 40-KVA units. The No. 2 generator supplies power to the No. 2 (left-hand) bus, and the No. 3 generator supplies power to the No. 3 (right-hand) bus. No. 1 generator supplies power to the No. 1, No. 2(left-hand), or No. 3 (right-hand) bus, as selected by a bus selector switch (Figure 1-23.) No. 4 generator supplies power to No. 2 (left-hand), No. 3 (right-hand) or No. 4 bus as selected by a bus selector switch (Fig 1-23). Circuit breaker relays, automatically controlled by the generator control system, disconnect a generator in event the output voltage or frequency is beyond limits, or if a ground fault occurs. A bus-tie relay, also controlled by the

circuit breaker panels



LOCATED AT AUXILIARY AC POWER BOX

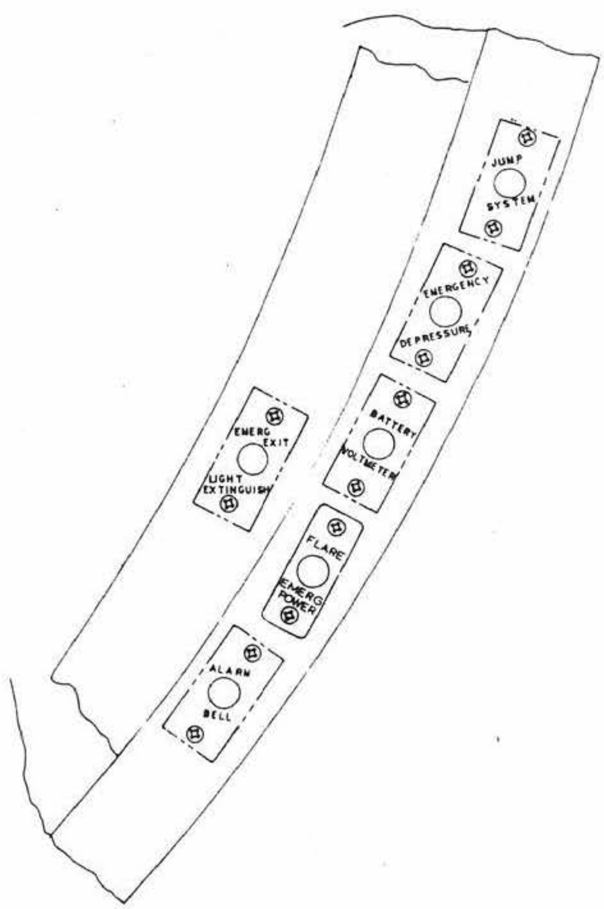
(3)



ECM CIRCUIT BREAKER BOX

(4)

(TYPICAL)



LOCATED IN BATTERY COMPARTMENT

(5)

Figure 1-30. (Sheet 1 of 5)

circuit breaker panels (cont)

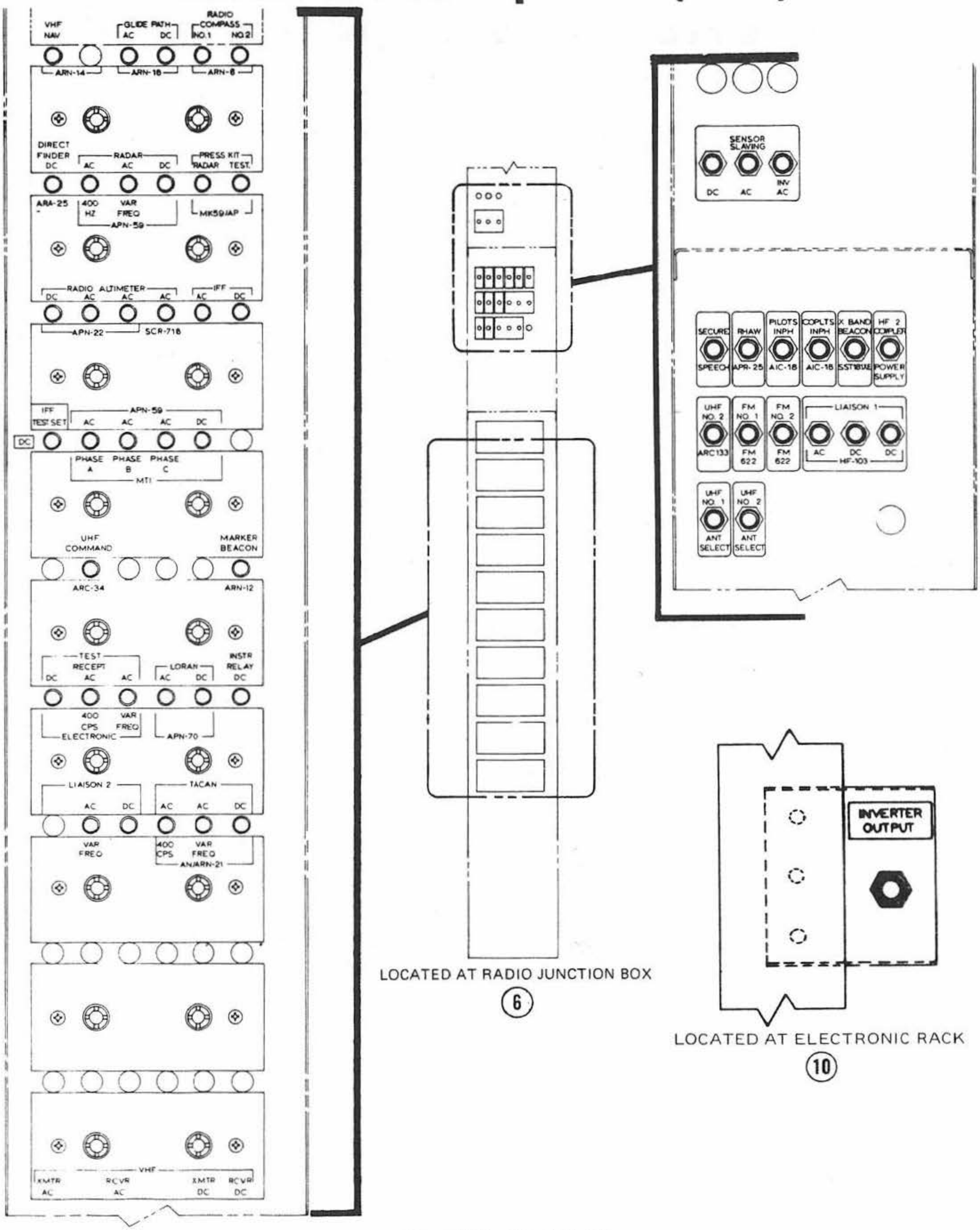
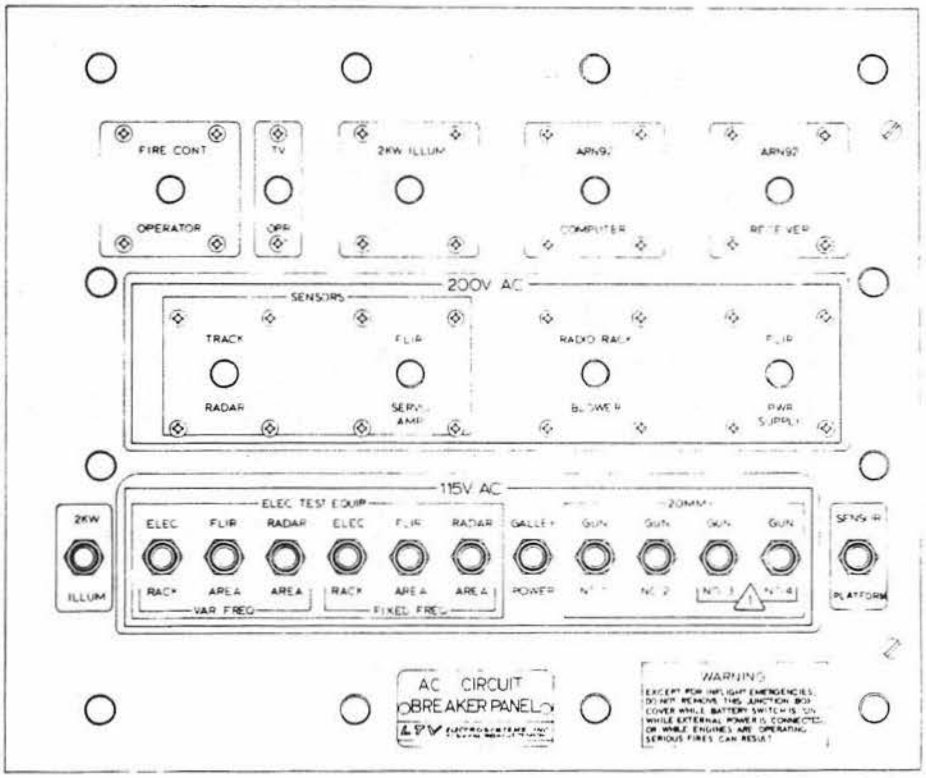


Figure 1-30. (Sheet 2 of 5)

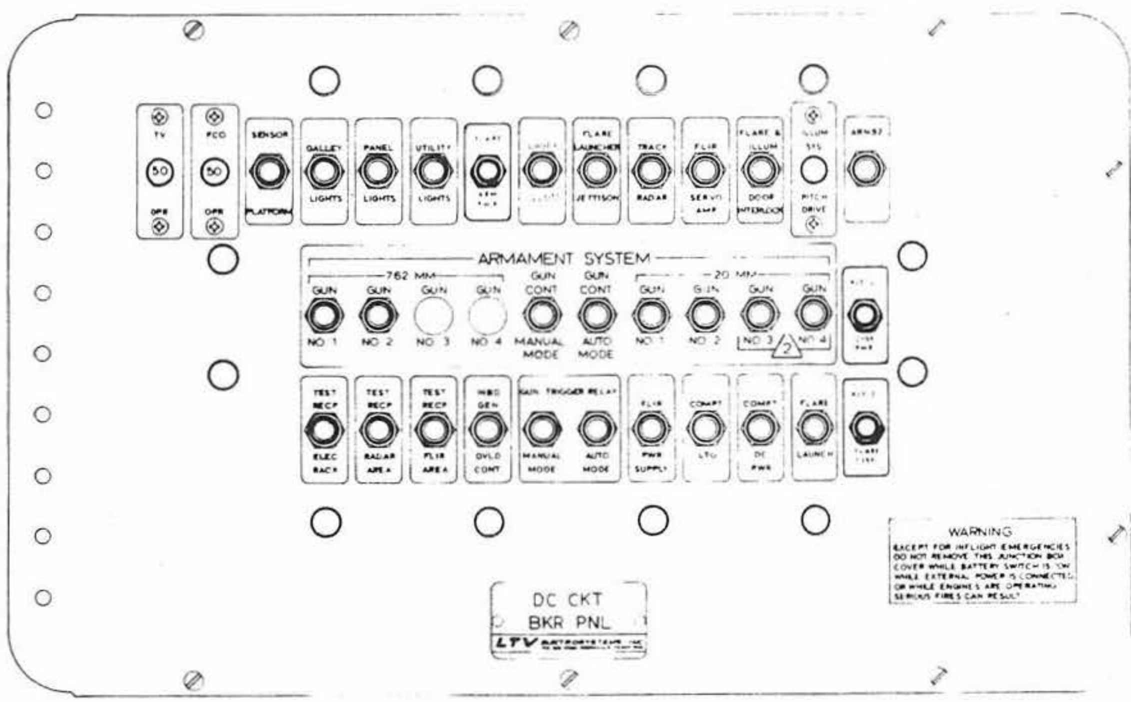
circuit breaker panels (cont)



⚠1 NOT USED IF 40MM WEAPONS ARE INSTALLED

⚠2 USED FOR 40MM WEAPONS WHEN INSTALLED

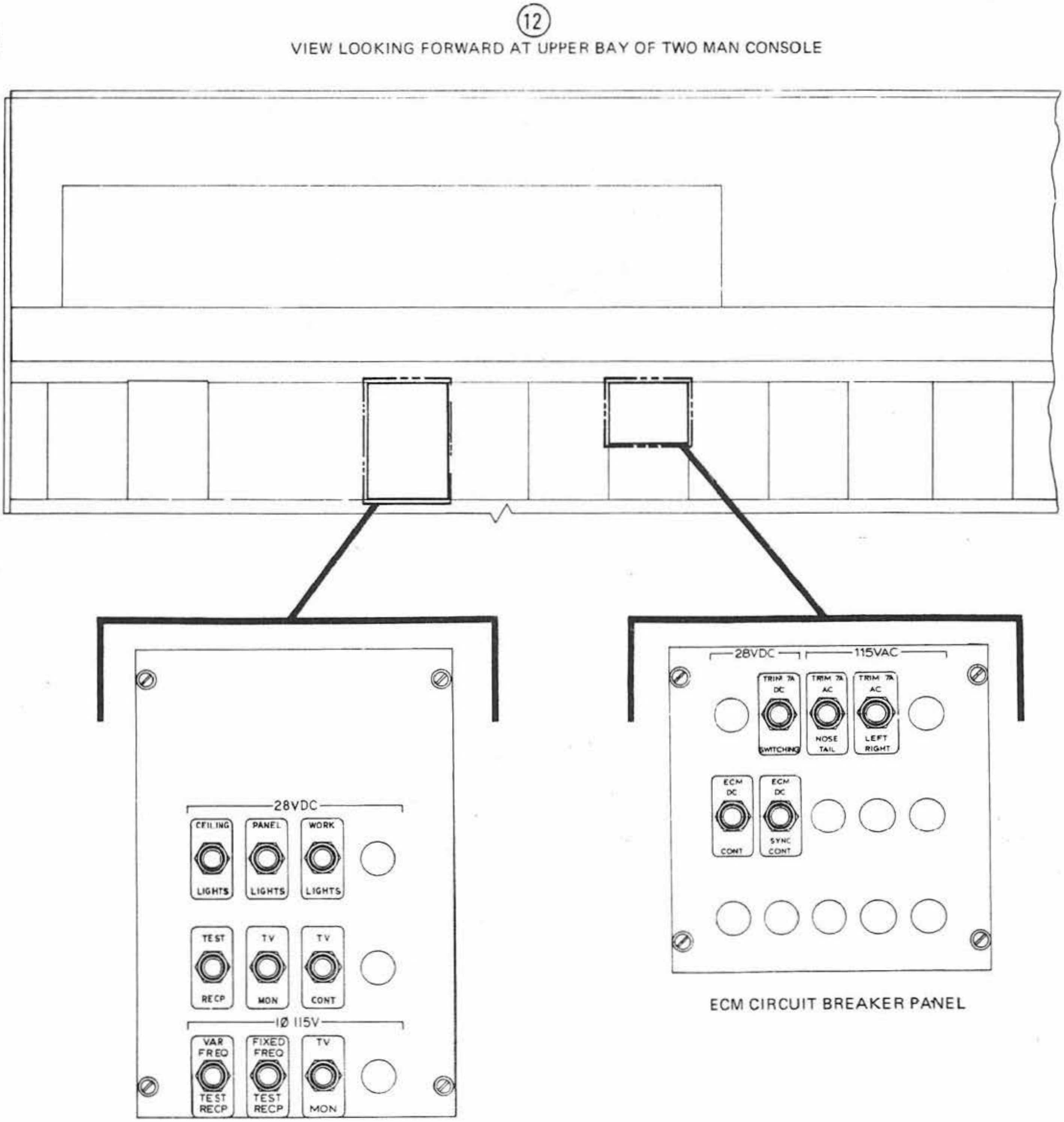
CARGO COMPARTMENT AC CIRCUIT BREAKER PANEL (7)



CARGO COMPARTMENT DC CIRCUIT BREAKER PANEL (8)

Figure 1-30. (Sheet 3 of 5)

circuit breaker panels (cont)

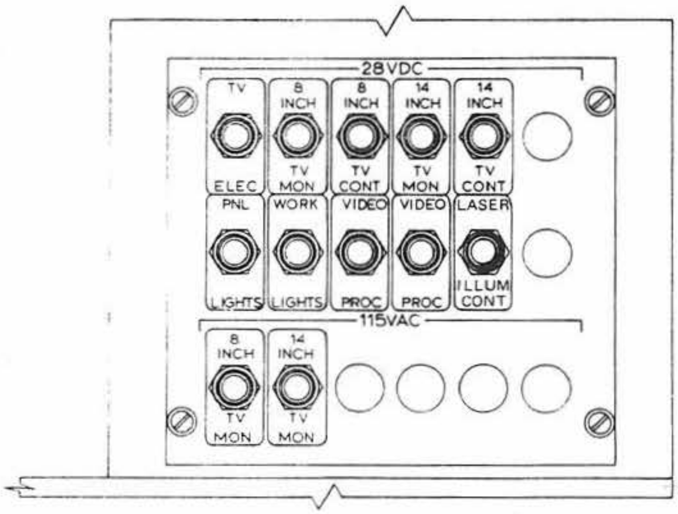


8477M27070 CIRCUIT BREAKER PANEL

ECM CIRCUIT BREAKER PANEL

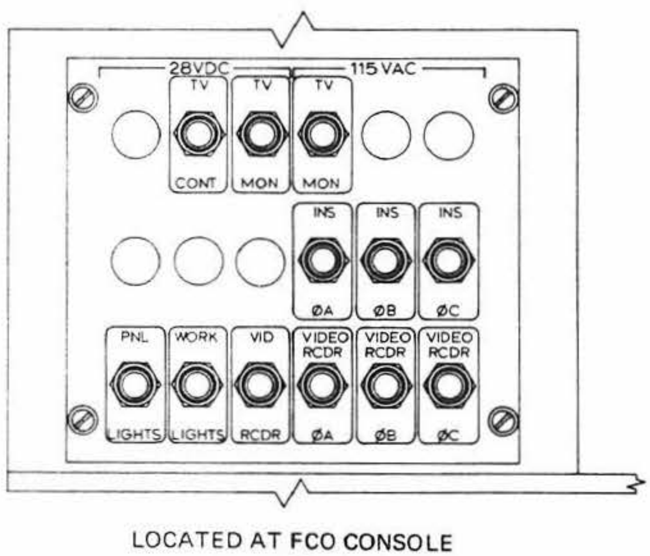
Figure 1-30. (Sheet 4 of 5)

circuit breaker panels (cont)



LOCATED AT TV CONSOLE

(13)



LOCATED AT FCO CONSOLE

(14)

Figure 1-30. (Sheet 5 of 5)

generator control systems, operates to connect the left-hand and right-hand buses together if external power is being used or if only one generator is operating. Since the generators are driven at nearly constant speed by the engines, they produce power of a nearly constant frequency of 400 cycles per sesecond. The generators are connected to the buses only when the output frequency exceeds 380 CPS. The Air turbine motor can be used during an emergency to supply power during flight and taxiing. The air turbine motor or an external power source can be used to furnish power for ground operation and testing of systems. Bus-tie relays operate to connect the left-hand and right-hand buses together if external power is being used or if only one engine-driven generator is operating. The air turbine motor generator or AC external power can be used to power the same buses as are normally powered by No. 2 and No. 3 engine-driven AC generators,

NOTE

If the No. 1 generator is lost, No. 4 generator will assume the load of the ECM equipment. In case of an emergency in the ECM equipment, it will be necessary to field trip both the No. 1 and No. 4 generators to remove power from the ECM equipment.

Air Turbine Motor Generator.

AC power for ground operation at advanced or isolated bases not equipped with ground power units is supplied by a generator driven by the air turbine motor. (Refer to Section IV for description and operation of the air turbine motor.) This generator can be connected to the left-hand and right-hand AC buses and can be used for emergency power during flight. The generator will field trip if the frequency decreases below 370 (±5) cycles per second. and it must be reset before it can be reconnected to the buses. Turn off the air turbine motor generator switch before stopping the air turbine motor to prevent generator field trips during normal shutdown. A fluctuation within the tolerance range of ± 20 cycles per second may be expected when starting the air turbine motor generator or during surge loads.

CAUTION

The ATM generator is rated at 20 KVA (57 amps per phase). However, when the generator is cooled by ram air in flight or by fan-provided air on the ground (OAT below 40° C) the output is increased to 30 KVA (83 amps per phase). Continued use of the ATM without cooling (on the ground) is not recommended. However, if use is absolutely necessary, restrict operation time to a minimum and generator load to 57 amps per phase (20 KVA).

Unregulated AC System Controls.

The AC system controls, with the exception of a manual reset lever on each generator control panel, (figure 1-24) are located on the overhead electrical control panel in the flight station. The generator control panels are located in racks under the flight station and are accessible from the cargo compartment.

GENERATOR SWITCHES. The generator switches consist of three four-position, rotary switches located on the overhead electrical control panel (figure 1-24) in the flight station. When a switch is in the ON position (knob stripe aligned with panel stripe), a relay closes contacts to connect the generator to the buses if the generator is operating normally. When the switch is placed in the OFF position, the relay disconnects the generator from its bus. If the switch is turned to FIELD TRIP, the field circuit of the generator is opened by a field relay to remove the generator excitation. No voltage is then produced by the generator. The RESET position of the switch is used to operate the field relay to its reset position after it has been tripped. The relay then closes the generator field circuit to allow the generator to build up voltage. The FIELD TRIP and RESET positions of the generator switch knob are spring-loaded. The generator switch knob must be pulled out to move it to the FIELD TRIP position.

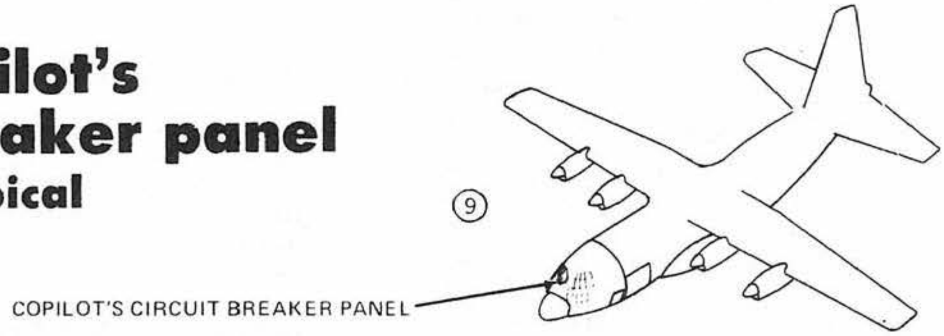
AUXILIARY AC GENERATOR CONTROL PANEL.

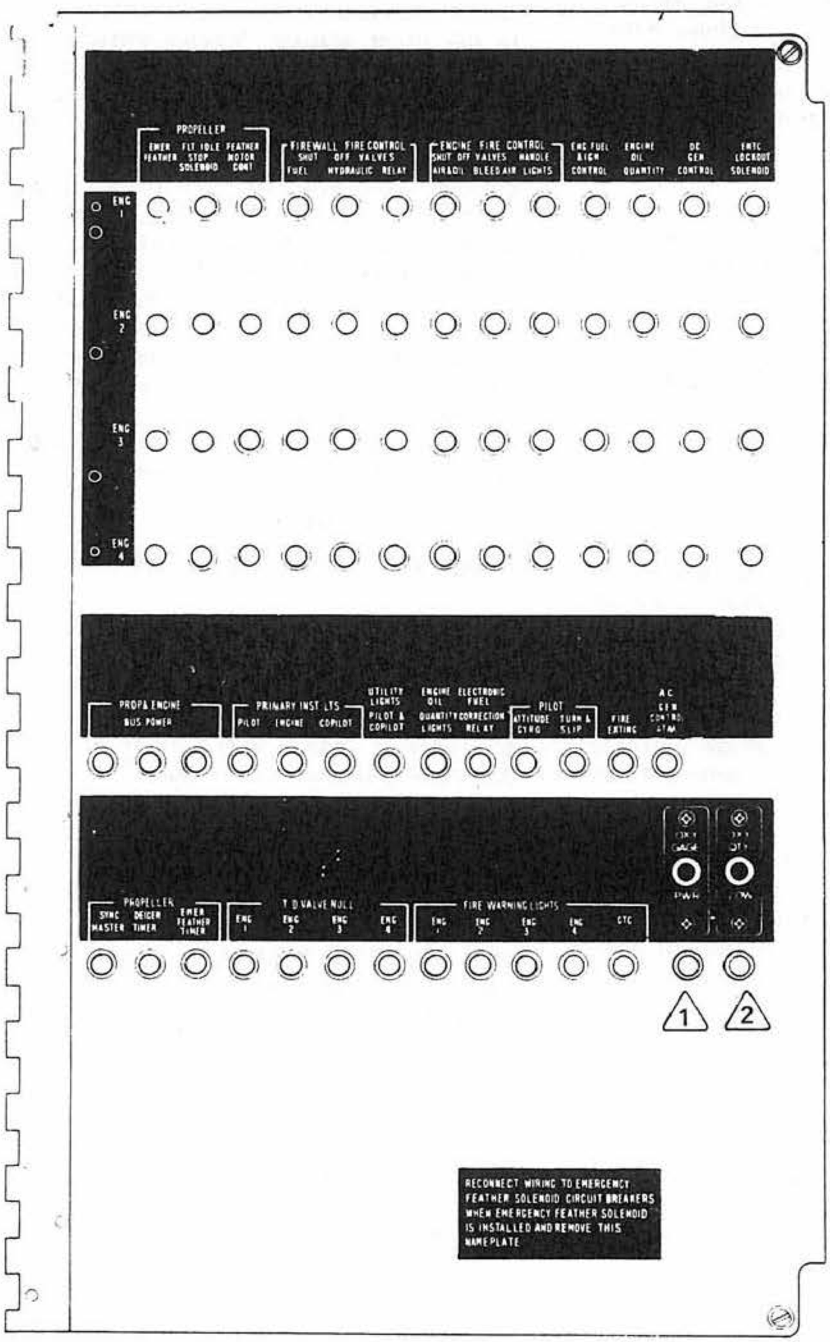
The No. 1 and No. 4 generators are controlled from a panel (figure 1-7) mounted on the left-hand side of the overhead electrical control panel. The panel contains a generator switch, voltmeter, ac ammeter, bus selector switch, and a GEN OUT indicator lamp for each generator. The panel also contains a volt-ampere selector switch and a frequency meter and a frequency selector switch. Indicator lamps are provided for generator overload and to indicate which buses are connected to the generators.

MANUAL RESET LEVER. A manual reset lever is located on each generator control panel under the flight station. This reset lever is used to manually reset a generator if the reset coil in the control box fails to operate.

BUS SELECTOR SWITCHES. Two bus selector switches (figure 1-24) are provided to select engine-driven generator power or air turbine motor generator power for the left-hand and right-hand AC buses. Any one of the three AC generators can be connected to either or both of the left-hand and right-hand buses by proper operation of the bus selector and generator control

copilot's circuit breaker panel
typical





⚠1 FROM LH AC BUS SINGLE PHASE

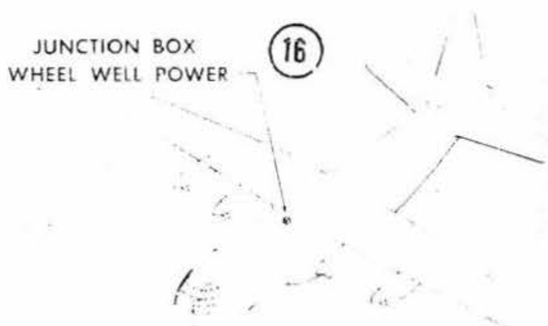
⚠2 FROM ISOLATED BUS

130A- -33-037

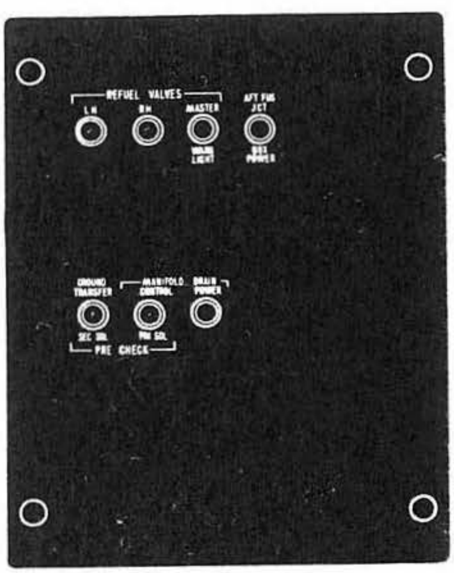
Figure 1-31.

wheel well power junction box

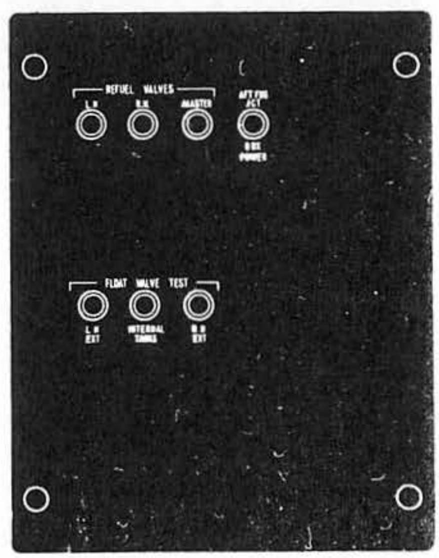
typical



AIRPLANE AF53-3129



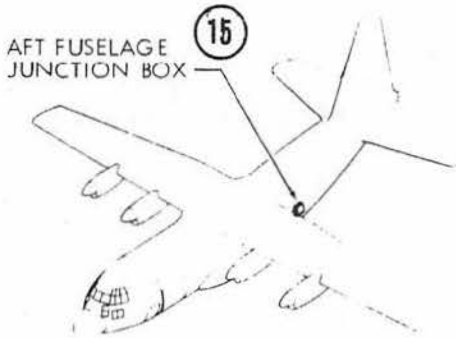
AIRPLANES AF55-0029 AND UP

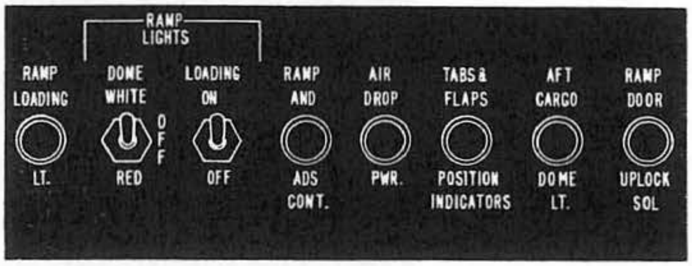


AIRPLANES AF54-1623 THROUGH 55-0014

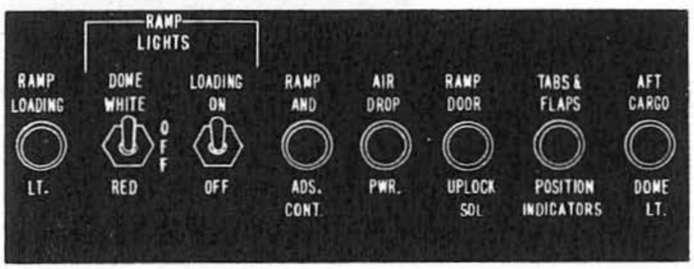
Figure 1-32

aft fuselage junction box panel

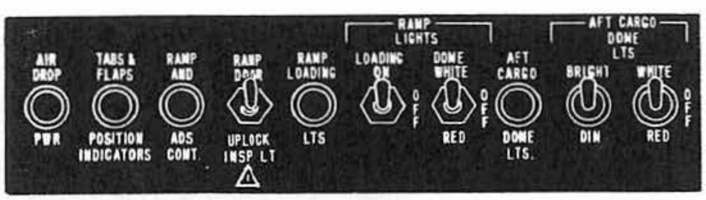




AIRPLANES AF53-3129 AND 54-1623



AIRPLANES AF54-1628



AIRPLANES AF55-0011 THROUGH 56-0509

⚠1 AIRPLANES WITH UNMODIFIED AFT CARGO DOOR UPLOCK USE "RAMP DOOR UPLOCK SOLENOID" CIRCUIT BREAKER

30A- -33-039

Figure 1-33.

switches. In the event of failure of the air turbine motor generator, and the engine-driven generators are on, the engine-driven generators will supply the buses automatically, regardless of the position of the bus selector switches. The air turbine motor generator will not supply the buses automatically if an engine-driven generator fails. When the air turbine motor generator is off, the buses will be supplied by the engine-driven generators regardless of the position of the bus selector switches.

AC EXTERNAL POWER SWITCH. A two-position AC external power switch is located on the overhead electrical control panel (figure 1-29). The OFF position of the switch disconnects external power from the AC distribution system. An override solenoid in the system will turn the switch off if any or all of the AC generator control switches are on, or if the external power plug is not in the receptacle. External power will be supplied to the left-hand and right-hand buses regardless of the position of the bus selector switches. The AC ground power relay is powered from the flight station DC bus, and DC power must be available to connect external AC power.

VOLTAGE AND FREQUENCY SELECTOR SWITCH AND PHASE SELECTOR SWITCH. The voltage and frequency selector switch and the phase selector switch are provided as a means of connecting the output of the generators and inverters to the frequency meter and voltmeter. When one particular position is selected with the voltage and frequency selector switch, the frequency and volts of that generator or inverter will be indicated. The phase selector switch is ganged to provide simultaneous amperage and voltage reading from the generators. A phase, B phase, and C phase of the generator are selected by placing the switch in the ϕA, ϕB, and ϕC positions, respectively. The phase selector switch must be in the ϕB position to read frequency or voltage on the inverters.

INBOARD GENERATOR OVERLOAD CONTROL SWITCH.

The inboard generator overload control switch is a two-position toggle switch located on the control pedestal (figure 1-8). This switch provides the pilot, copilot, or flight engineer the capability of disabling the automatic protective circuit of the inboard generators. No. 2 and No. 3 ac generators have a current sensing device incorporated in the generator output circuit. In the ON position of the overload switch, this device senses a current overload condition in either the No. 2 or No. 3 ac generators and provides the pilot with a generator overload light. Simultaneously, a control signal is sent to the illiminator system which automatically reduces the power load on the No. 3 ac generator by approximately 16 KVA. If the overload condition remains, a relay will disconnect the ac power contactor of the overloaded generator after a 30 second time delay. The generator automatic protective circuit is disabled by positioning the overload control switch to OFF.

Unregulated AC System Indicators.

Indicators for the unregulated AC power system are located in the overhead electrical control panel in the flight station (figure 1-24).

GENERATOR-OUT INDICATOR LIGHTS. Each generator is provided with a GENERATOR-OUT indicator light (figure 1-24) on the overhead electrical control panel which will illuminate when the generator control switch is in the ON position and the generator is not developing sufficient voltage.

BUS TIE INDICATOR LIGHTS. Two amber bus tie indicator lights are located on the overhead electrical control panel (figure 1-24). The left-hand bus tie light indicates when the No. 2 AC generator is supplying the right-hand bus, or when external AC power is supplying both buses. The right-hand light indicates when the No. 3 generator is supplying the left-hand bus

AMMETER. Each AC generator is provided with an ammeter (figure 1-24) located directly below the generator control switch. The ammeters continuously indicate their respective generator loads in amperes.

FREQUENCY METER AND VOLTMETER. A frequency meter and voltmeter are provided to indicate frequency and volts of the AC generators and inverters. These indicators are used in conjunction with the phase selector switch and the voltage and frequency selector switch (figure 1-24). Circuit protection is provided through circuit breakers on the main power distribution panels.

ELECTRONIC TEST RECEPTACLES.

Four electronic test receptacles are installed in the airplane. One is located on the aft end of the electronic equipment rack, one at the Electronic Warfare Officer's station, one at the IR rack, and one at the AN/APQ-150 radar rack. Power available at the various pins is shown on the unit identification plate. Input circuits are protected from overload by circuit breakers located on the cargo compartment ac and dc circuit breaker panels for the IR, EWO, and electronic rack areas; and by circuit breakers located on the circuit breaker panel located above the IR operator station.

HYDRAULIC POWER SUPPLY SYSTEMS.

A utility hydraulic system, a booster hydraulic system, and an emergency hydraulic system (figure 1-34 through 1-36), distribute hydraulic pressure to the hydraulically operated components of the airplane. The utility and booster hydraulic systems are interconnected to the extent that normal operation of the aileron, elevator and rudder booster cylinders makes use of hydraulic pressure from both sources. The utility and booster hydraulic systems concurrently actuate the dual tandem booster cylinder. The emergency hydraulic system can be used for emergency landing services and for normal or hand pump ramp operation. Normal operating pressure for the utility, booster, and emergency hydraulic systems is approximately 3,000 PSI. These systems are protected from excessive pressure by pressure-relief valves set to crack at approximately 3,400 PSI and to reseat at approximately 3,100 PSI minimum. Cylindrical accumulators, precharged with air to approximately 1,500 PSI, are connected to the hydraulic power supply systems to store reserve pressure for peak load requirements and to dampen pump ripple. A modulator, precharged with air to approximately 300 PSI, is positioned in the main landing gear brake system for anti-skid control.

Refer to the general arrangement and servicing diagram in this section for hydraulic fluid specification.

GROUND EXTERNAL HYDRAULIC CONNECTIONS.

Ground external pressure and return hydraulic connections are provided for the utility, booster, and emergency hydraulic systems. The external connections for the utility and booster systems are located slightly forward of the main landing gear door on the right side of the airplane. Those for the emergency system are located on the forward wall of the left wheel well inside the fuselage. The pressure and return connections are used for ground testing hydraulically operated airplane components.

RESERVOIR INTERFLOW CONNECTIONS.

A separate filler opening is provided for the emergency system reservoir; however, an interflow and vent connection between the utility and booster reservoirs and the emergency reservoir routes fluid back to the emergency reservoir after emergency operation of the flaps or landing gears, instead of dumping it overboard.

UTILITY HYDRAULIC SYSTEM.

The utility hydraulic system (figure 1-34), supplies pressure for one of the dual elevator booster cylinders, one piston chamber of the tandem aileron booster cylinder, one piston chamber of the tandem rubber boost cylinder, the main and nose landing gears, nose gear locks, wing flaps, steering, and brakes.

Normal operating pressure of the engine-driven pumps is approximately 3,000 PSI. As fluid leaves the supply boost pump, it passes through the fire wall shutoff valves before reaching the engine pumps. Each engine pump has an interconnect between the pump supply line and the pressure line. This interconnect contains a pump bypass valve, which permits the fluid to bypass from the pump pressure line to the pump supply line. If one engine pump becomes inoperative, the other is capable of maintaining system pressure, although operating time for the landing gear and flap systems will be longer when only one pump is operating. A check valve in each engine pump pressure line prevents loss of system pressure in the event one engine pump becomes inoperative and also provides individual pump failure warning by preventing pressure from the operating pump from actuating the low pressure switch for the failed pump. Fluid is forced under pressure from the engine pumps to a low-pressure warning switch and through the check valves in the pressure lines to the pressure transmitter, accumulator, and surface control system (ailerons, rudder, and elevators). Continuing, it passes through a surge damper to the two-speed torque-selector valve. Fluid also flows through the priority valve to the landing gear and flap systems. This priority valve permits the surface control system to obtain pressure when insufficient flow is available for the operation of all the systems. A relief valve between the pressure line and the reservoir return line permits any excess fluid to return to the reservoir in case of failure of the variable volume control on the pumps. The utility reservoir has a usable capacity of approximately 10.8 quarts.

Utility Suction Boost Pumps.

A vane type suction boost pump is connected to the utility hydraulic system. Its function is to supply fluid to the supply lines of No. 2 and No. 4 engine-driven pumps to prevent cavitation. It also provides fluid to the brake handpump system. The pump is driven by a hydraulic motor. Fluid pressure to drive the motor is furnished by a portion of the pressure supplied by the engine-driven pumps. A flow regulator meters the hydraulic fluid from the engine-driven pump to the hydraulic motor. A utility prime switch connects the emergency hydraulic system to the utility system pressure lines and the hydraulic motor of the suction boost pump.

Utility Hydraulic System Controls.

Electrically powered controls for the flow of utility hydraulic fluid are provided to operate the system or to shut it off.

UTILITY RESERVOIR DRAIN VALVE. A manually operated drain valve is located below the utility hydraulic system reservoir for drainage or bleeding of the utility hydraulic system.

utility hydraulic supply system

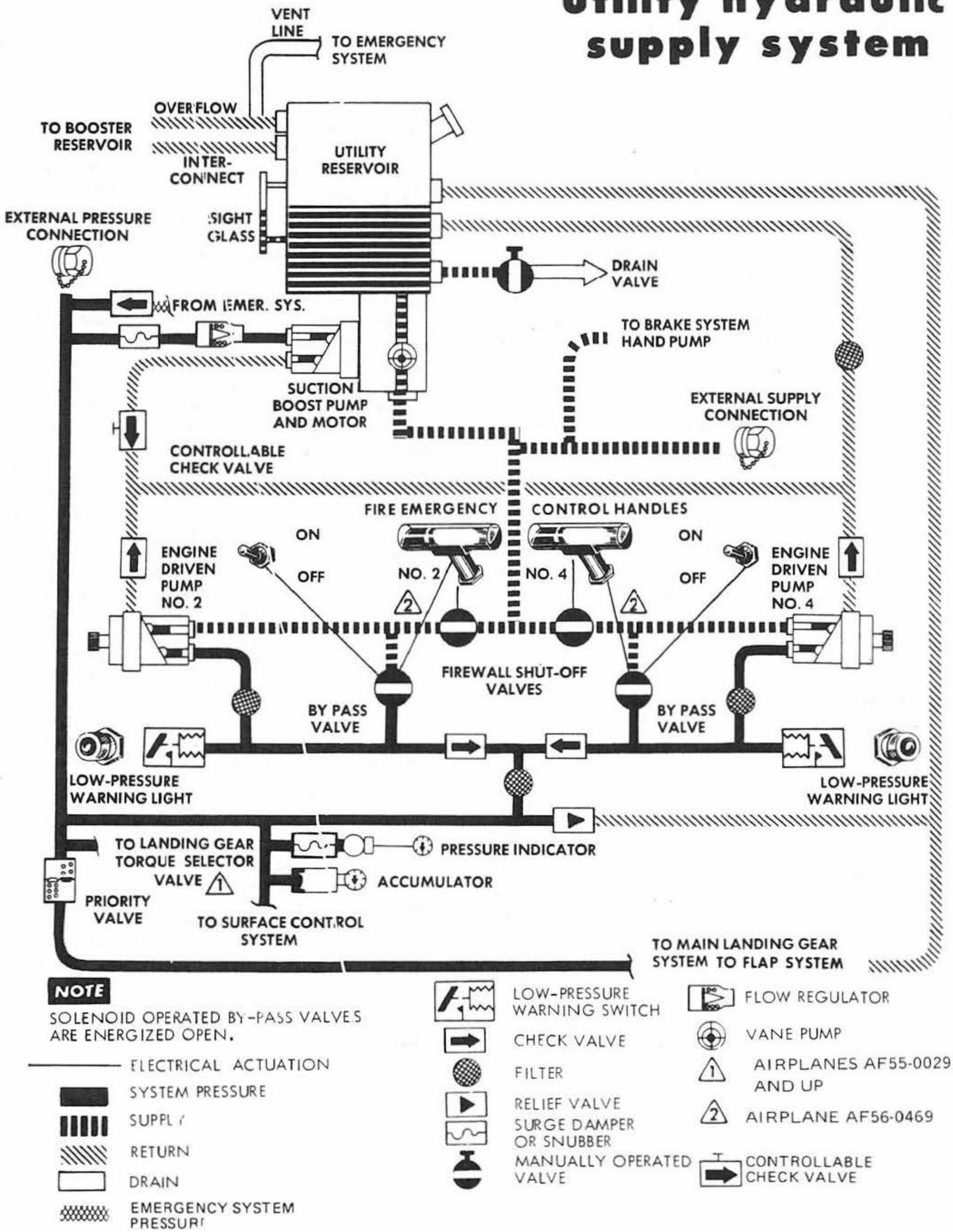


Figure 1-34.

ENGINE-DRIVEN PUMP SWITCHES. Two 2-position (ON, OFF) toggle switches (figure 1-37), engine-driven pumps utility 2 and engine-driven pumps utility 4, are located on the hydraulic control panel. They operate by means of 28-volt, DC power through the engine pump run around shutoff valves No. 2 and No. 4 circuit breakers from the rh wing and lh wing buses in the main power distribution box. They control the flow of hydraulic fluid from the engine-driven hydraulic pumps on engines No. 2 and No. 4 by opening or closing the solenoid-operated pump bypass valves. When the toggle switches are in the ON position, the pump bypass valves are closed, and the pumps supply pressure to the utility hydraulic system. When the toggle switches are in the OFF position, the pump bypass valves are energized open, and hydraulic fluid from the pumps is returned to the pump supply lines.

FIRE EMERGENCY CONTROL HANDLES. Pulling out fire emergency control handles 2 and 4 on the fire emergency control panel (figure 1-57) closes the fire wall shutoff valves mounted in the dry bay areas aft of engines No. 2 and No. 4, shutting off the flow of hydraulic fluid through the utility hydraulic system. At the same time, on airplanes AF56-0469 and up, the pump bypass valves for engines No. 2 and No. 4 are opened, returning hydraulic fluid from these pumps to the pump supply lines. See FIRE EXTINGUISHING SYSTEM in this section for other control functions of the fire emergency control handles.

Utility Hydraulic System Indicators.

Utility hydraulic system gages indicate amount and pressure of fluid in the system, and warning lights indicate lowering pressure in the system.

UTILITY PRESSURE INDICATOR. A utility hydraulic system pressure indicator (figure 1-37) is located on the copilot's instrument panel. It is a remote-indicating instrument that is connected to a pressure transmitter in the utility hydraulic system, and registers the pressure available for operation of the utility hydraulic system. The indicator is energized by 26-volt, AC power through the utility ind. hyd. press fuse in the main power distribution box.

UTILITY RESERVOIR SIGHT GLASS. A reservoir sight glass is mounted on the side of the utility hydraulic system reservoir to give a visual indication of the hydraulic fluid level in the reservoir.

ACCUMULATOR PRESSURE GAGES. A direct-reading pressure gage is attached to each of the accumulators in the utility hydraulic system to indicate the total system pressure in that portion of the system in which the accumulator is located.

PUMP PRESS. WARNING LIGHTS. Two pump press. warn. lights (figure 1-37) are located on the hydraulic control panel above the engine-driven pumps switches No. 2 and No. 4. They are energized by 28-volt, DC power from the fuselage bus through the pump press warning circuit breaker in the main power distribution box. Each light is connected to a low-pressure warning switch located in a pressure line from one of the engine-driven utility hydraulic system pumps. When pump pressure drops below approximately 1,250 PSI, the low-pressure warning switch for that pump will close, causing the warning light to glow.

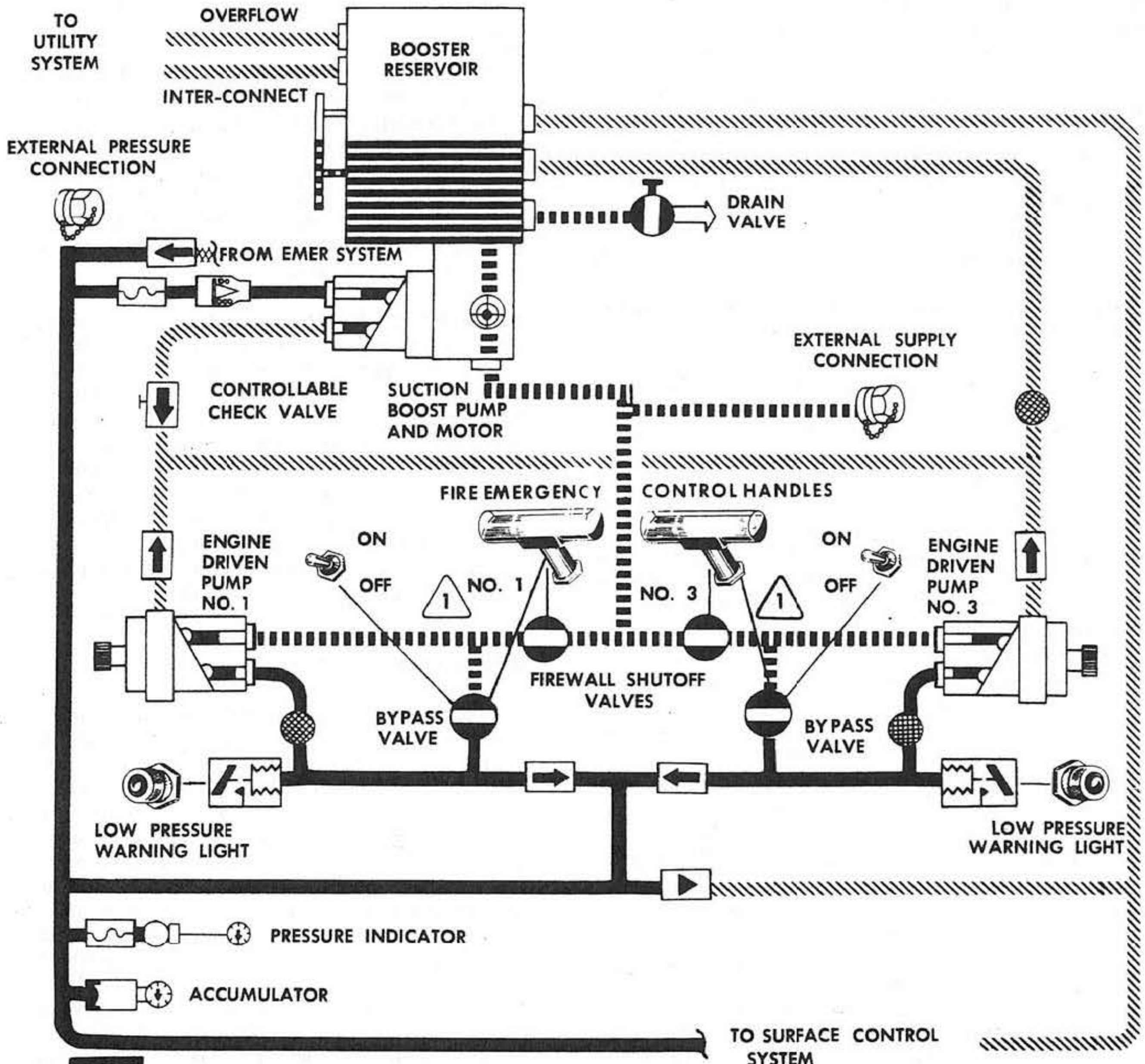
BOOSTER HYDRAULIC SYSTEM.

The booster hydraulic system (figure 1-35) supplies hydraulic pressure to the rudder booster cylinder, to one of the dual elevator booster cylinders, and to half of the tandem aileron booster cylinder. The booster hydraulic system supplies pressure to one piston chamber of the tandem rudder booster cylinder. A suction boost pump, attached to the booster reservoir, supplies hydraulic fluid to the two engine pumps. One engine pump is driven by No. 1 engine and the other by No. 3 engine. Normal operating pressure of the engine pumps is approximately 3,000 PSI. As fluid leaves the suction boost pump, it passes through firewall shutoff valves before reaching the engine pumps. Each engine pump has an interconnect between the pump supply line and the pressure line. This interconnect contains a pump bypass valve which permits the fluid to bypass from the pump pressure line to the pump supply line. If one engine pump becomes inoperative, the other is capable of maintaining system pressure. A check valve in each engine pump pressure line prevents loss of system pressure in the event either pump becomes inoperative and also provides individual pump failure warning by preventing pressure from the operating pump from actuating the low pressure switch for the failed pump. Hydraulic fluid is forced, under pressure, from the engine pumps to a low-pressure warning switch and through the check valves and surge damper valve in the pressure lines to the pressure transmitter, accumulator, and surface control system (ailerons, rudder, and elevators). A relief valve between the pressure line and the reservoir return line permits any excess fluid to return to the reservoir, should the variable-delivery controls of an engine pump fail. The booster system reservoir has a usable capacity of approximately 6 quarts.

Booster Suction Boost Pump.

A vane type suction boost pump is connected to the booster hydraulic system. Its function is to supply fluid to the supply lines of No. 1 and No. 3 engine-driven pumps to prevent cavitation. The pump is

booster hydraulic supply system



NOTE

SOLENOID OPERATED BY-PASS VALVES ARE ENERGIZED OPEN.

- ELECTRICAL ACTUATION
- SYSTEM PRESSURE
- SUPPLY
- RETURN
- DRAIN
- EMERGENCY SYSTEM PRESSURE
- LOW-PRESSURE WARNING SWITCH
- CHECK VALVE
- FILTER
- RELIEF VALVE
- SURGE DAMPER OR SNUBBER
- MANUALLY OPERATED VALVE
- FLOW REGULATOR
- VANE PUMP
- AIRPLANE AF56-0469
- CONTROLLABLE CHECK VALVE

Figure 1-35.

driven by a hydraulic motor. Fluid pressure to drive the motor is furnished from a portion of the pressure supplied by the engine-driven pumps. A flow regulator meters the hydraulic fluid from the engine-driven pump to the hydraulic motor. A utility prime switch connects the emergency hydraulic system to the booster system pressure lines and the hydraulic motor of the suction boost pump.

Booster Hydraulic System Controls.

Manual and electrically powered controls over the flow of the booster hydraulic system are provided to operate the system or to shut it off.

BOOSTER RESERVOIR DRAIN VALVE. A manually operated drain valve is located below the booster hydraulic system reservoir for drainage or bleeding of the booster hydraulic system.

ENGINE-DRIVEN PUMP SWITCHES. Two two-position (ON, OFF) toggle switches (figure 1-37), engine-driven pumps booster 1 and engine-driven pumps booster 3, are located on the hydraulic control panel. They operate by means of 28-volt, DC power from the rh wing and lh wing buses through the engine pump run around shutoff valves No. 1 and No. 3 circuit breakers in the main power distribution box. The switches labeled 1 and 3 control the flow of booster hydraulic fluid from the engine-driven hydraulic pumps on engines No. 1 and No. 3 by opening and closing the pump bypass valves. When the toggle switches are in the ON position, the solenoid-operated pump bypass valves are closed, and the pumps supply pressure to the booster hydraulic system. When the toggle switches are in the OFF position, the pump bypass valves are energized open, and hydraulic fluid from the pumps is returned to the pump supply lines.

FIRE EMERGENCY CONTROL HANDLES. Pulling out fire emergency control handles 1 and 3 on the fire emergency control panel (figure 1-57) closes the fire wall shutoff valves mounted in the dry bay areas aft of engines No. 1 and No. 3, shutting off the flow of hydraulic fluid through the booster hydraulic system. At the same time, on airplanes AF56-0469 and up, the pump bypass valves for engines No. 1 and No. 3 are opened, returning hydraulic fluid from those pumps to the pump supply lines. See FIRE EXTINGUISHING SYSTEM in this section for other functions of the fire emergency control handles.

Booster Hydraulic System Indicators.

Booster hydraulic system gages indicate the pressure of fluid in the system, and warning lights indicate lowering pressure in the system.

BOOSTER PRESSURE INDICATOR. A booster hydraulic system pressure indicator (figure 1-37) is located on the copilot's instrument panel. It is a remote-indicating instrument that is connected to a pressure transmitter in the booster hydraulic system, and registers the pressure available for operation of the booster hydraulic system. The indicator is energized by 26-volt, AC power through the boost ind. hyd. press fuse in the main power distribution box.

BOOSTER RESERVOIR SIGHT GLASS. A reservoir sight glass is mounted on the side of the booster hydraulic system reservoir to give a visual indication of the hydraulic fluid level in the reservoir.

ACCUMULATOR PRESSURE GAGES. A direct-reading pressure gage is attached to the accumulator in the booster hydraulic system to indicate the total system pressure in that portion of the system in which the accumulator is located.

PUMP PRESS. WARNING LIGHTS. Two pump press. warn. lights (figure 1-37) are located on the copilot's instrument panel above the engine-driven pump switches No. 1 and No. 3. They are energized by 28-volt, DC power from the fuselage bus through the pump press warning circuit breaker in the main power distribution box. Each light is connected to a low-pressure warning switch, located in a pressure line from one of the engine-driven booster hydraulic system pumps and activated by a drop in hydraulic pressure. When pump pressure drops below approximately 1,250 PSI, the low-pressure warning switch for that pump will close, causing the warning light to glow.

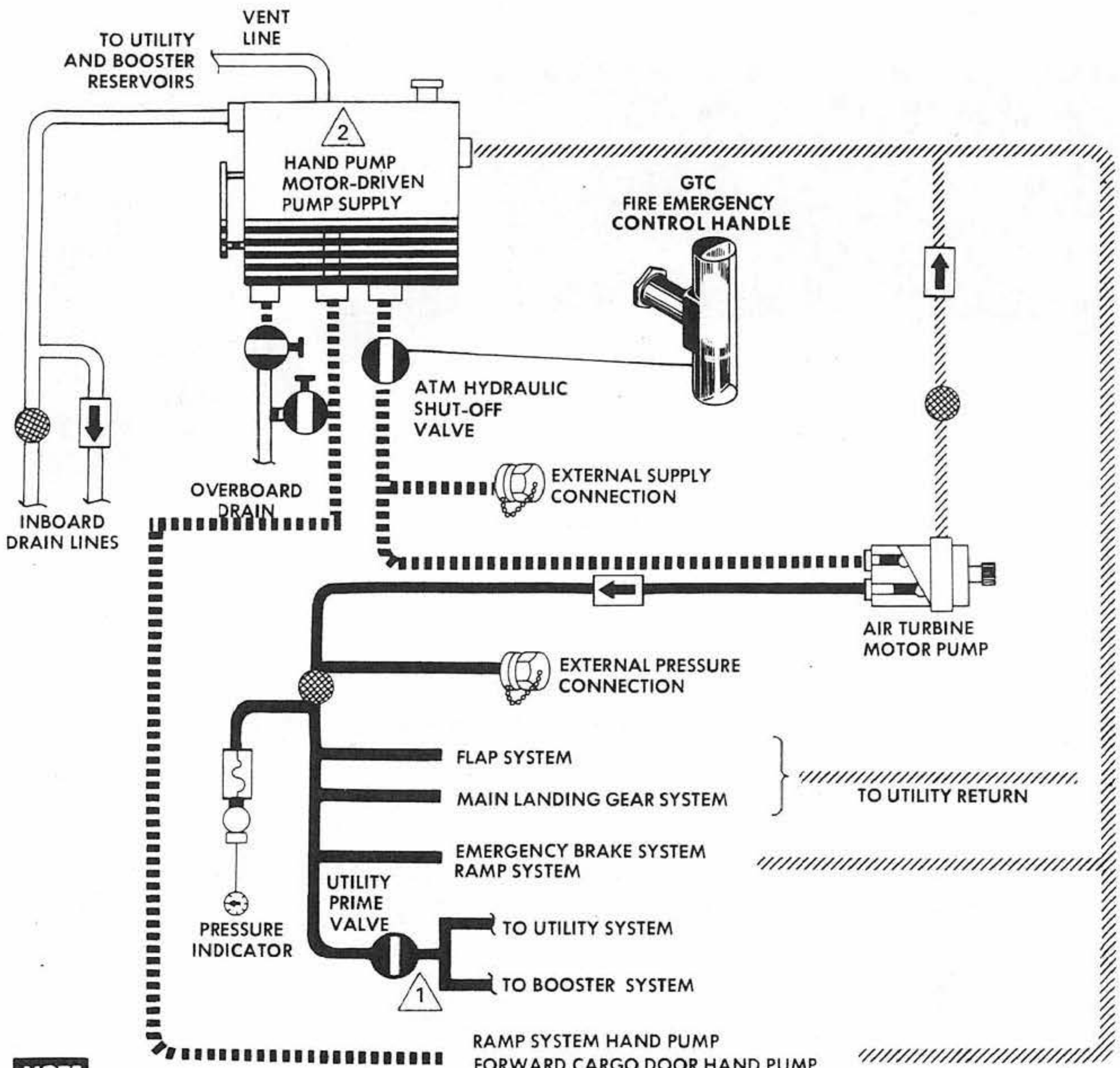
Utility Prime Switch

A prime switch for the engine-driven suction boost pump pressure lines is located on the utility prime switch panel (figure 1-37) on the copilot's instrument panel. It is a 2-position (ON, OFF) toggle switch which operates the utility prime valve to route emergency hydraulic fluid from the emergency hydraulic system to the utility and booster engine-driven pump pressure lines when the ATM is running. When the switch is in the ON position, the utility prime valve is open and emergency pressure is directed to the utility and booster pressure lines and to the hydraulically operated suction boost pump. The suction boost pumps send the fluid from the booster and utility reservoir to the suction side of the engine-driven hydraulic pumps. When the switch is OFF, the utility prime valve is closed. Circuit protection is provided by the hyd ut prime valve circuit breaker in the main power distribution box.

EMERGENCY HYDRAULIC SYSTEM.

Emergency hydraulic system pressure (figure 1-36) is provided by a variable-volume pump, driven by the air turbine motor, located in the left wheel well. The pump provides pressure for emergency operation of the brakes, emergency extension of the flaps and landing gears, and for normal operation of the ramp and ramp door system. Hydraulic fluid is supplied to

emergency hydraulic supply system



NOTE

ELECTRICALLY OPERATED SHUT-OFF VALVE IS MOTOR-OPERATED, SHOWN IN THE NORMAL POSITION

- EMERGENCY SYSTEM PRESSURE
- SUPPLY
- RETURN
- VENT, DRAIN, OR STATIC
- UTILITY PRESSURE
- SURGE DAMPER OR RESTRICTOR
- FILTER
- CHECK VALVE
- MANUALLY OPERATED VALVE
- PRESSURE REDUCER VALVE
- RELIEF VALVE
- ELECTRICAL ACTUATION

1 SOLENOID OPERATED SHUTOFF VALVE, DE-ENERGIZED CLOSED

2 STANDPIPE RETAINS APPROXIMATELY 50 CUBIC INCHES OF FLUID FOR HANDPUMP OPERATION IF RESERVOIR IS DEPLETED

Figure 1-36.

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hydraulic system control panels typical

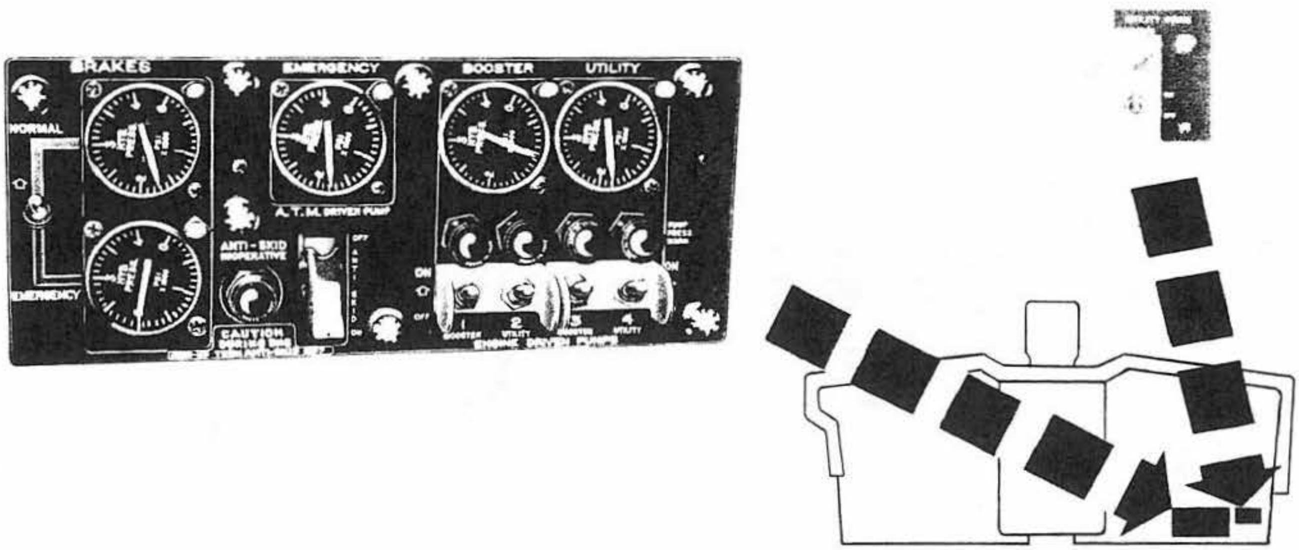


Figure 1-37

the pump from an emergency supply reservoir which is located on the forward wall of the left wheel well. This reservoir supplies fluid through the ATM hydraulic shutoff valve to the pump which is driven by the air turbine motor. This pump has a normal operating pressure of approximately 3,000 PSI. Hydraulic fluid is forced, under pressure, from this pump through a check valve to the pressure transmitter, flap system, normal ramp system, main landing gear system, and main landing gear brake system. The check valve in the pressure line from the pump prevents the return of fluid to the pump during ground test. A return line from the pump contains a check valve which prevents the back pressure from the main landing gear brake system from entering the pump. The emergency reservoir also supplies hydraulic fluid to manually operated pumps, one in the emergency ramp system and one in the forward cargo door system. The hand pump in the forward cargo door system is a double-acting cylinder pump, which is used to open and close the forward cargo door, for emergency extension of the nose landing gear. The handpump in the aft cargo door and ramp system is a double-acting cylinder pump which is used to open and close the aft cargo door and ramp. The emergency system reservoir has a usable capacity of approximately 9 gallons.

Emergency Hydraulic System Controls.

Manual and electrically powered controls over the flow of emergency hydraulic fluid are provided to operate the system or to shut it off.

EMERGENCY RESERVOIR DRAIN VALVE. A manually operated drain valve is located below the emergency hydraulic system reservoir for drainage or bleeding of the emergency hydraulic system.

FIRE EMERGENCY CONTROL HANDLE. The GTC fire emergency control handle, located on the fire emergency control panel (**figure 1-57**), **controls the** flow of hydraulic fluid to the air turbine motor pump. When pulled, it energizes the ATM hydraulic shutoff valve in the emergency hydraulic system. Energizing current is supplied from the 28-volt main DC bus through a circuit breaker on the main power distribution box. On airplanes AF54-1628 and up, the circuit is protected by the ATM hydraulic shutoff circuit breaker. On earlier airplanes, it is protected by the suction shutoff valve emer circuit breaker. For other functions, see FIRE EXTINGUISHING SYSTEM, in this section.

WARNING

After pulling the GTC fire emergency control handle, do not turn on the air turbine motor. With the ATM hydraulic shutoff valve closed, the emergency system hydraulic pump is supplied no fluid and could disintegrate.

Emergency Hydraulic System Indicators.

Emergency hydraulic system gages indicate the amount and pressure of fluid in the system.

EMERGENCY PRESSURE INDICATOR. An emergency hydraulic system pressure indicator (figure 1-36) labeled EMERGENCY A.T.M. DRIVEN PUMP, is located on the hydraulic control panel. It is a remote-indicating instrument that is connected to a pressure transmitter in the emergency hydraulic system and registers the pressure available for operation of the emergency hydraulic system. This indicator is energized by 26-volt, AC power through the emergency ind. hyd. press fuse in the main power distribution box.

EMERGENCY RESERVOIR SIGHT GLASS. A reservoir sight glass is mounted on the side of the emergency hydraulic system reservoir to give a visual indication of the hydraulic fluid level in the reservoir.

ACCUMULATOR PRESSURE GAGE. A direct-reading pressure gage is attached to the emergency hydraulic system accumulator in the brake system to indicate the total system pressure of the emergency hydraulic system.

FLIGHT CONTROLS.

The flight controls include the main surface control systems, which are aileron, rudder, and elevator systems, and tab control systems. The main surfaces are controlled by mechanical systems with hydraulic boost. The trim tabs are controlled by electrical control systems. The autopilot, when operating, controls the main surfaces and elevator trim tabs.

MAIN SURFACE CONTROL SYSTEMS.

The main surfaces, ailerons, rudder, and elevators, are controlled by mechanical control systems, consisting of cables, pushrods, bell cranks, and torque tubes. Hydraulically driven booster units provide most of the force required to move the surfaces. The booster units are driven by hydraulic pressure supplied by both the booster hydraulic system and the utility hydraulic system (figure 1-38). The provisions for using both booster and utility hydraulic system pressure for operation of booster units reduces the possibility of loss of booster units. The airplane can be controlled with the loss of booster units by the use of trim tabs and engine power, plus coordinated increased efforts of the pilot and copilot.

WARNING

Never purposely remove the hydraulic assistance from the flight controls for the purpose of simulating complete loss of boost assistance. This results in a requirement for high manual forces to move the flight controls and is an emergency condition that would probably never be experienced due to the dual hydraulic design.

Rudder Booster Assembly.

The rudder booster assembly supplements the pilot effort on the rudder pedals. A tandem actuating cylinder is furnished, operating by means of utility and booster hydraulic pressure applied concurrently. The booster assembly contains pressure-reducer valves, relief valves, and check valves. The pressure-reducer valves reduce the operating pressure to approximately 1,500 PSI, and the relief valve protects the booster assembly should the pressure-reducer valve fail. The check valves prevent the interflow of pressure between the utility and booster hydraulic systems. An autopilot servomoter is cable-rigged to the assembly to substitute for manual control during autopilot operation.

Aileron Booster Assembly.

The aileron booster assembly furnishes actuating power for operation of the left and right ailerons, which are located on the trailing edges of the left and right outer wing sections. The booster assembly has a single, tandem-type actuating cylinder that is supplied approximately 3,000-PSI pressure from both the booster and utility hydraulic systems. A partial or complete loss of hydraulic pressure in either hydraulic system results in a corresponding loss in the dual pressure chamber of the actuator, and a proportionate loss of power to operate the ailerons. In case of a complete loss of hydraulic pressure in both hydraulic systems, the ailerons can be manually operated through actuation of the control cables, but only with greatly increased pilot effort. An autopilot servomotor is cable-rigged to the aileron booster assembly to substitute for manual control during autopilot operation.

surface control system

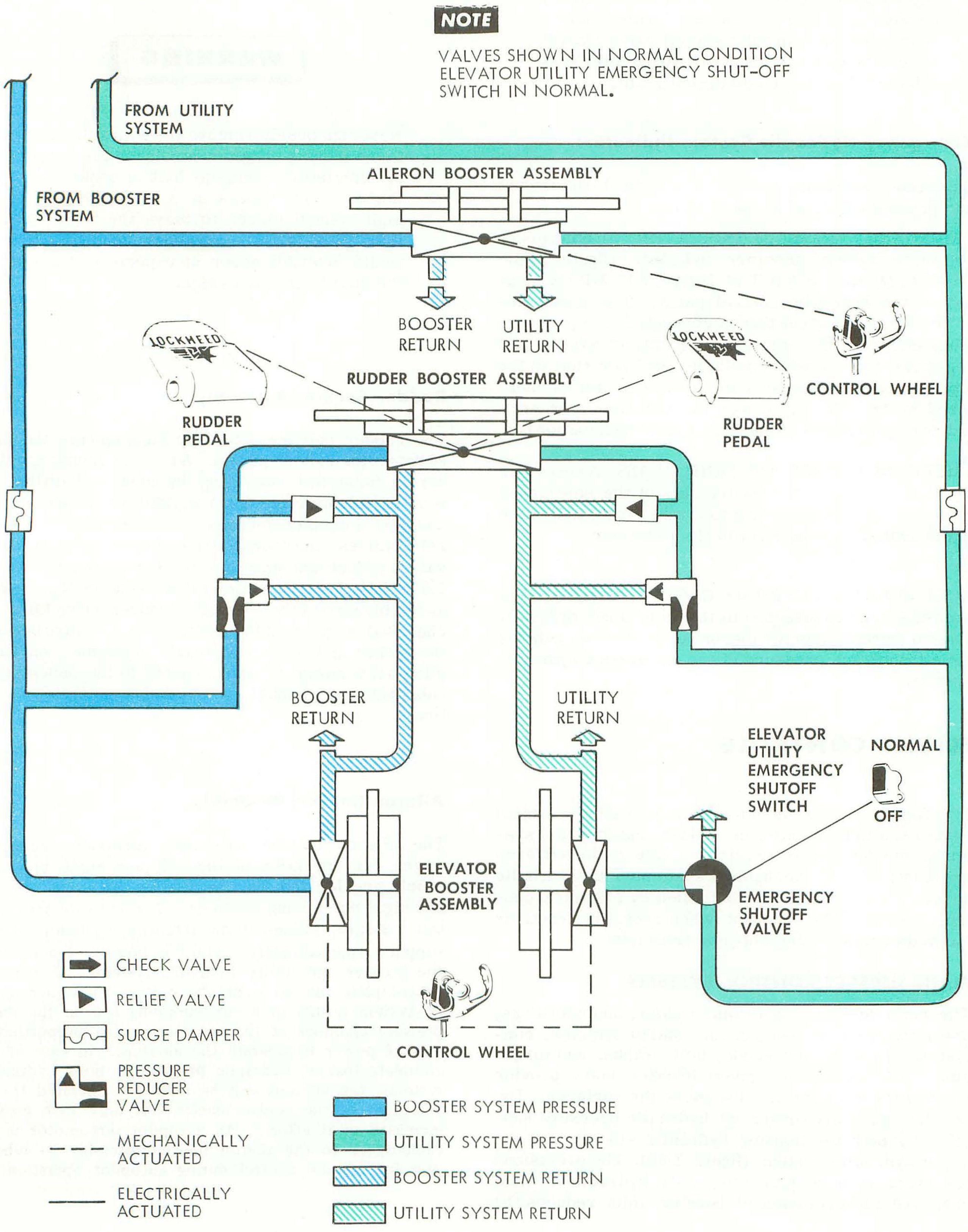
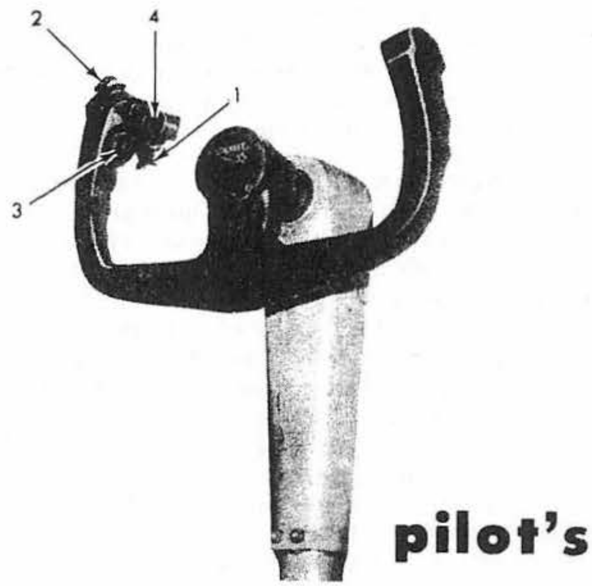


Figure 1-38.

control wheels



1. MICROPHONE BUTTON
2. ELEVATOR TAB SWITCH
3. AUTO-PILOT RELEASE BUTTON
4. TRIGGER (PILOT ONLY)

Figure 1-39.

Elevator Booster Assembly.

Two elevator booster cylinders are supplied hydraulic pressure of approximately 3,000 PSI for operation of the two elevator control surfaces, which are hinged to the horizontal stabilizer trailing edge. The booster hydraulic system supplies one booster cylinder, and the utility hydraulic system supplies the other booster cylinder. The output power of the two elevator booster cylinders is additive, and the failure of one booster cylinder would result in only half of the normal power necessary to operate the elevators. In case of a loss of pressure in both hydraulic systems, the elevator can be manually operated, but only with greatly increased pilot effort. An autopilot servomotor is cable-rigged to the elevator booster assembly, to substitute for manual control during autopilot operation.

Surface Control Systems Controls.

CONTROL COLUMNS AND WHEELS. Control columns and wheels (figure 1-39) are installed at the pilot's and copilot's stations to operate the aileron and elevator surface controls. Elevator control is gained by forward and aft movement of the control column and aileron control by rotation of the control wheel. Mechanical linkage actuates the hydraulically powered booster unit control valves and servomotors for each of these surface controls. Push rods (elevator) and a chain and cable arrangement (ailerons) connect the control column to bell cranks on torque tubes which are mounted under the flight station beneath the pilot's and copilot's seats. From there, dual sets of steel cables continue the elevator linkage as far as the pressure bulkhead at the extreme rear of the cargo compartment and the aileron linkage to the rear face of the center section wing rear beam web. From these points push rods and bell cranks pick up the motion and transmit it to the booster unit control valves and servo units.

RUDDER PEDALS AND ADJUSTMENT CRANKS. Rudder pedals for control of the rudder surface are located at the pilot's and copilot's stations. Each pair of rudder pedals can be adjusted individually by rotation of an adjustment crank located forward of each control column. The adjustment crank operates a worm gear which positions the pedals. The rudder pedals are used to operate the rudder booster when hydraulic power is available, and to operate the rudder manually when hydraulic power is not available. Toe pressure on the rudder pedals actuates the brakes during either normal or emergency braking. Actuating power is conducted by means of mechanical linkage from the rudder pedals to the booster control valve and servomotor in the same manner as from the control column to the elevator booster control mechanism, except that a single set of steel cables connects the forward torque tube to the push rods at the pressure bulkhead.

Note

Do not attempt to move the adjustment crank past the last number on the indicator. To do so may cause the adjustment gears to lock.

ELEVATOR UTILITY EMERGENCY SHUTOFF SWITCH. An elevator utility emergency shutoff switch is mounted on the control booster emergency shutoff panel (figure 1-40) located on the forward face of the flight station radio junction box. It is a 2-position (NORMAL, OFF) guarded toggle switch used to close a solenoid valve in the utility hydraulic supply line and shut off utility hydraulic system pressure to one of the booster assemblies. When the switch is in the NORMAL position, the valve is open, and the booster and utility systems supply pressure for the operation of the elevator control boosters. When the switch is in the OFF position, the valve is closed, and utility hydraulic system pressure is no longer available for operation of the elevator control boosters. Usually, the switch is safety-wired in the NORMAL position. The 28-volt, DC circuit is protected by the control booster emer shutoff circuit breaker on the fuselage bus in the main power distribution box.

TRIM TAB CONTROL SYSTEMS.

Trim tabs are provided on the control surfaces to aid in trimming the airplane during flight. Lateral trim is obtained through operation of a trim tab on the left aileron. A manually adjustable tab is located on the right aileron to compensate for any inherent unbalance about the longitudinal axis of the airplane. Longitudinal trim is obtained through operation of the trim tabs on the elevators, one trim tab on each elevator control surface. Directional trim for yaw conditions is obtained by operation of the rudder trim tab. The aileron trim tab and rudder trim tab actuators are driven by 28-volt, DC motors. The elevator trim tab actuator is driven by a phase B, variable-frequency, AC motor during normal operation and by a 28-volt, DC motor during emergency operation.

Trim Tab System Controls.

AILERON AND ELEVATOR TRIM TAB SWITCH. An aileron and elevator trim tab switch is located on the trim tab control panel of the flight control pedestal (figure 1-41). It is a recessed, five-position (NOSE UP, NOSE DOWN, off, LOWER LEFT WING, LOWER RIGHT WING) toggle switch, with all switch positions other than the off (center) position spring-loaded to return to the center position upon release of the switch. When the switch is held in the LOWER LEFT WING or LOWER RIGHT WING position, the trim tab on the left aileron control surface is actuated by a 28-volt, DC motor through the elevator and aileron tab cont. circuit breaker from the fuselage bus in the main power distribution box to trim the airplane laterally. When the switch is held in the NOSE UP or NOSE DOWN position, the elevator trim tabs are actuated by a tab motor to raise or lower the nose of the airplane. When the switch is in the off (center) position, the electric motors that actuate the trim tabs are de-energized.

ELEVATOR TAB SWITCH. An elevator tab switch (figure 1-39) is located on the outboard hand grip of each control wheel. It is a slide-type switch with NOSE UP, NOSE DOWN, and center off positions. Either of the two switches can control the tabs. When either of the two switches is in NOSE UP or NOSE DOWN position, a pair of dual relays are actuated to apply power to the elevator trim tab actuator. With the ELEVATOR TAB POWER SELECTOR SWITCH positioned to NORMAL, the elevator tabs can only be operated from the tab switch on the pilot's and copilot's control wheel. With the ELEVATOR TAB POWER SELECTOR SWITCH positioned to EMERGENCY, the elevator tabs can only be operated from the elevator tab switch located on the control pedestal. Unregulated AC power is applied to the actuator if the elevator tab power selector switch is in NORMAL. Twenty-eight volt, DC power is applied to the actuator if the power selector switch is in EMERGENCY.

ELEVATOR TAB POWER SELECTOR SWITCH. An elevator tab switch (figure 1-41) is located on the flight control pedestal. It is a three-position (NORMAL, OFF, EMERGENCY) toggle switch used to select the source of electrical power for operation of the elevator trim tabs. The NORMAL position operates the trim tabs with 115-volt, unregulated AC power when either the pilot's or copilot's elevator tab switch is actuated. The EMERGENCY position operates the trim tabs with 28-volt, DC power when the aileron and elevator trim tab switch is moved to the NOSE UP or NOSE DOWN position. When the elevator tab power selector switch is placed in the OFF position, all circuits to the elevator trim tabs are deenergized. Circuit protection is provided through an elev tab power normal circuit breaker, an elev tab power emer circuit breaker, an elev and aileron tab control circuit breaker, and an elev tab control emergency circuit breaker located in the main power distribution box. Elevator trim tabs for autopilot operation will be available only when the switch is in NORMAL position. Trim tab operation will be slower in EMERGENCY than in NORMAL.

control booster emergency shutoff panel

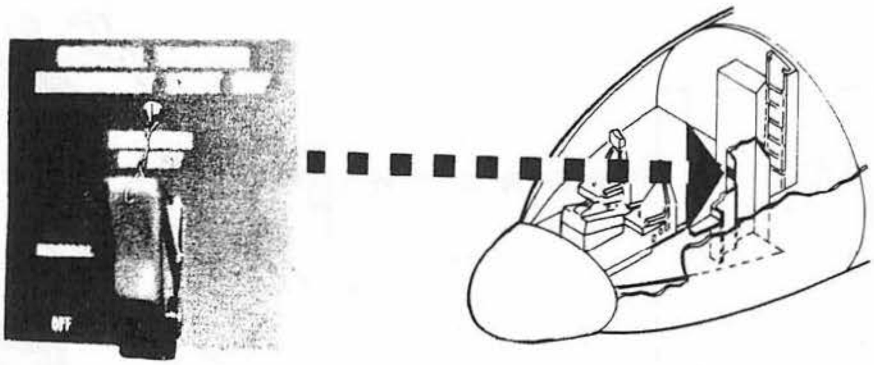


Figure 1-40.

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tabs for autopilot operation will be available only when the switch is in the NORMAL position. Trim tab operation will be slower in EMERGENCY than in NORMAL.

RUDDER TRIM TAB SWITCH. A rudder trim tab switch is located on the trim tab control panel of the flight control pedestal (figure 1-41). It is a three-position (NOSE LEFT, off, NOSE RIGHT) switch that controls operation of the 28-volt, DC rudder trim tab motor. The NOSE LEFT and NOSE RIGHT positions are spring-loaded to return to the off (center) position upon release of the control switch. When the switch is in NOSE LEFT or NOSE RIGHT position, 28-volt, DC electrical power through the rudder tab cont circuit breaker in the main power distribution box energizes the rudder trim tab motor to position the rudder trim tab and trim the airplane.

Tab Position Indicators.

Tab position indicators show the pilot the angle formed by any trim tab with its corresponding control surface and the direction in which the trim will act.

RUDDER TRIM TAB POSITION INDICATOR. A rudder trim tab position indicator is located on the pilot's instrument panel (figure 1-53). The indicator is connected to a transmitter mounted on the rudder trim tab actuator housing and indicates to the pilot the degree of rudder trim tab positioning relative to the rudder control surface. This indicator is energized by 28-volt, DC power through the tabs and flap position ind circuit breaker in the aft fuselage junction box. The indicator dial face is calibrated from 0 to L and 0 to R in increments of five degrees of rudder trim tab travel from the neutral 0 marking. The needle on the indicator shows the angle between the rudder trim tab and rudder surface and the direction in which the trim will act.

AILERON TRIM TAB POSITION INDICATOR. An aileron trim tab position indicator is located on the pilot's instrument panel (figure 1-53). This indicator is connected to a transmitter mounted on the left aileron trim tab actuator and indicates to the pilot the degree of left aileron trim tab positioning relative to the aileron control surface. This indicator is energized by 28-volt, DC power through the tabs and flaps position indicators circuit breaker in the aft fuselage junction box. The indicator dial face is calibrated from the neutral position of 0 to 20 up and 0 to 20 down in 5-degree increments of left aileron trim tab travel. The needle on the indicator shows the angle between the aileron trim tab and the left aileron surface and the direction in which the trim will act.

ELEVATOR TRIM TAB POSITION INDICATOR. An elevator trim tab position indicator is located on the pilot's instrument panel (figure 1-53). The indicator is connected to a transmitter mounted on the elevator trim tab rotary actuator housing and indicates to the pilot the degree of elevator trim tab positioning relative to the elevator control surface. This indicator is energized by 28-volt, DC power through the tabs and flaps position indicators circuit breakers in the aft fuselage junction box. The indicator dial face is calibrated from the neutral position 0 to 25 up or 25 down, in 5-degree increments of elevator trim tab travel. The needle on the indicator shows the angle between the elevator trim tabs and the corresponding elevator surface and the direction in which the trim will act.

trim tab control panel

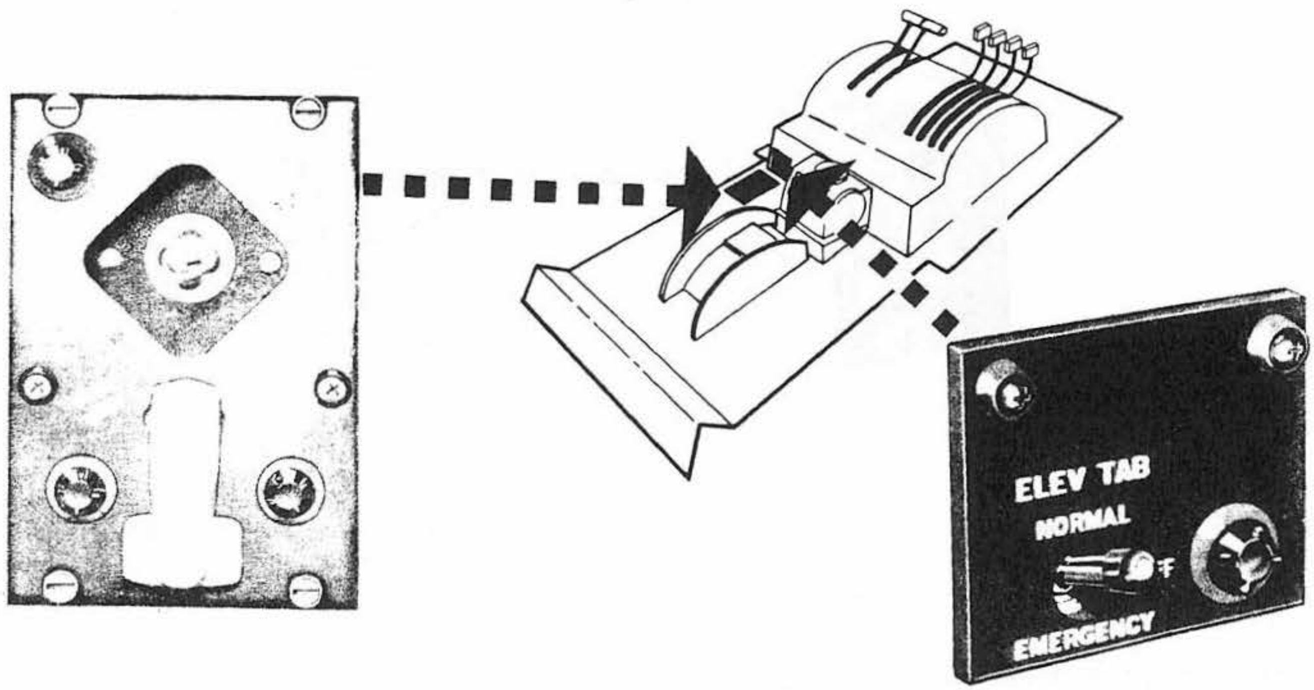


Figure 1-41.

Note

Elevator trim tab travel is controlled by limit switches set to provide approximately 6 degrees nose down and 25 degrees nose up, and by mechanical stops set to provide approximately 8 degrees nose down and 27 degrees nose up.

FLAP SYSTEM.

The airplane is equipped with four flaps, consisting of an outboard and an inboard flap in each wing. The flaps are of the Fowler high-lift type in which the flap motion is a combination of an aft movement to increase wing area and a downward tilting movement to alter the airfoil section to increase lift and drag. When 100 percent extended, the flaps form an angle of approximately 35 degrees with the wings. The flaps are operated by a reversible hydraulic motor, a cam-actuated microswitch followup mechanism, torque tubes, gearbox, and drive screw assemblies. Hydraulic pressure is directed through the priority valve and check valve to the emergency flap brake valve, thence through the wing flap selector valve, surge damper, shuttle valve and restrictor valve to the hydraulically operated flap motor, and to the return line (figure 1-42). The hydraulic motor operates the torque shaft sections extending outboard to the gearbox, which rotates ball bearing drive screws for actuation of the flaps. Disk-type, spring-loaded flap brakes hold the flaps in the selected position and prevent movement by aerodynamic loads. The brake is released by fluid pressure supplied to the system for operation of the flap drive motor. Emergency flap brakes are splined to the outer ends of the flap drive torque shaft to prevent unequal actuation of the flaps during normal extension and retraction of the flaps. Utility hydraulic system pressure is used for normal operation of the flap system, and emergency hydraulic system pressure is used for emergency extension of the flaps. The landing gear warning horn is interconnected with the flap system. When the flap lever is set at approximately 70 percent or more with the landing gear not fully extended, the landing gear warning horn will sound; it cannot be silenced.

FLAP SYSTEM CONTROLS.

Flap system controls are provided for either normal or emergency operation of the flaps, as well as provisions for manual override control of the system.

flap system

NOTE

Electrically operated, solenoid controlled valves are shown in the normal, de-energized position.

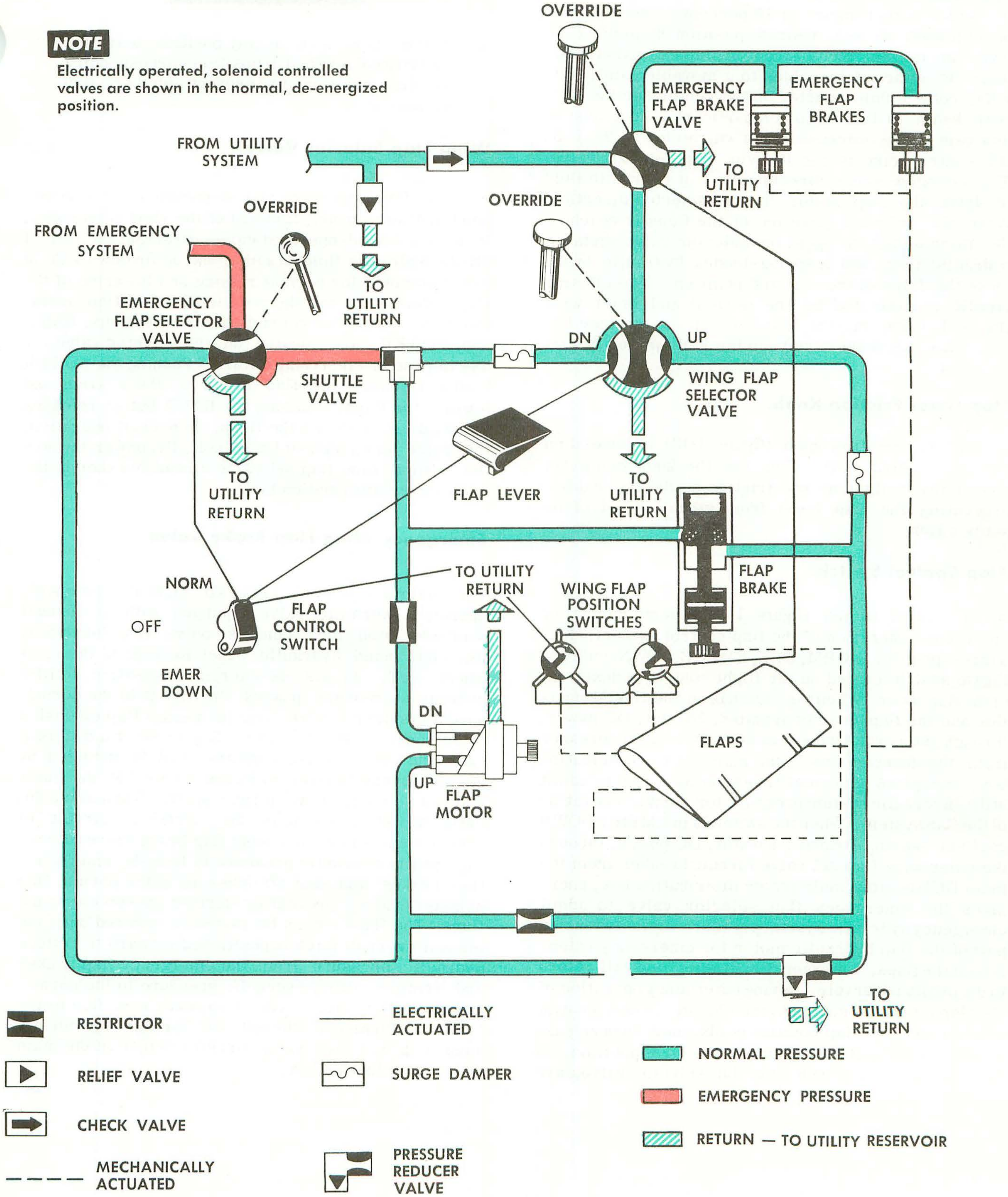


Figure 1-42.

Flap Lever.

A flap lever (figure 1-43) is located on the aft end of the flight control pedestal. It is a manually actuated control lever with the lever range calibrated from UP to DOWN in increments of 10 percent. The flaps can be extended to any desired position by placing the lever at the selected percent of flap extension. The lever is attached by cables to a movable cam inside a flap control unit mounted on the center section wing rear beam in the cargo compartment. Movement of this cam closes microswitches which close a 28-volt, DC control circuit for the wing flap selector valve. The actuated valve directs a flow of hydraulic fluid to drive the flap motor in the selected direction. When the selected position of the flaps is reached, the microswitches open, the selector valve shuts off hydraulic flow, and a spring-loaded hydraulic brake locks the flaps in the selected position. The electric circuit is protected by the normal and emer wing flap sel valve circuit breakers on the fuselage bus and main bus respectively, in the main power distribution box.

Flap Lever Friction Knob.

A flap lever friction knob (figure 1-43) is located on the flap control panel. Turning the knob clockwise mechanically tightens the friction on the flap cables, preventing the flap lever from vibrating out of its set position.

Flap Control Switch.

A flap control switch (figure 1-43) selects normal or emergency operation of the flap control system. It is a three-position (NORM, OFF, EMERG DOWN) guarded toggle switch located on the flight control pedestal aft of the flap lever. When the switch is in the NORM position and the flap lever is actuated, 28-volt, DC power, through the normal wing flap sel valve circuit breaker from the fuselage bus in the main power distribution box, energizes a normal flap selector valve to admit utility hydraulic system pressure for normal operation of the flap system. When the switch is in EMERG DOWN position (spring-loaded), 28-volt, DC power, through the emer wing flap sel valve circuit breaker from the main DC bus in the main power distribution box, energizes the emergency flap selector valve to admit emergency hydraulic system pressure to the extension port of the flap hydraulic motor for emergency extension of the flaps. Emergency hydraulic fluid will return to the utility reservoir. During emergency operation of the flaps, hold the switch in the EMERG DOWN position until the desired flap position is obtained, then release it. The switch will then spring to the OFF position. In the OFF position, both wing flap selector valves are de-energized. The flaps cannot be retracted until the utility system pressure is restored.

WARNING

If the flaps lock at any position, leave the flap control lever at a position corresponding to flap position to prevent further flap movement.

Wing Flap Selector Valve.

A wing flap selector valve is mounted on the right-hand hydraulic panel, forward of the right wheel well. It is a solenoid-operated valve, directing the flow of utility hydraulic fluid to either the up or down side of the flap motor for normal raising and lowering of the flaps, depending on the position of the flap lever. Override controls, consisting of two buttons, RAISE and LOWER, are located on the selector valve for use in case of electrical failure. Pushing the LOWER button releases the flap brake in the gearbox and lowers the flaps. Pushing the RAISE button releases the brake and raises the flaps. In normal operation, the valve is energized by 28-volt, DC power through the normal wing flap sel valve circuit breaker in the main power distribution box.

Emergency Wing Flap Brake Valve.

The emergency wing flap brake valve is a solenoid-operated hydraulic valve equipped with a manual override latch (for ground use only). It is located on the right hand hydraulic panel forward of the right wheel well. In its de-energized position, utility hydraulic pressure passes through it to the normal wing flap selector valve. During normal flap extension or retraction, should either flap move at a different rate, the out-of-phase condition will be detected by asymmetrical sensing switches located at the outer ends of the flap drive torque shaft. When actuated, these switches complete an electrical circuit to energize the emergency wing flap brake valve, directing utility hydraulic pressure to lock the emergency flap brakes and shut off pressure to the normal flap selector valve, preventing further movement of the flaps. The flaps cannot be raised or lowered until the manual override latch is positioned forward to relieve hydraulic pressure from the emergency flap brakes and restore utility hydraulic pressure to the normal flap selector valve. The emergency wing flap brake valve is furnished 28-volt DC through the normal wing flap selector valve circuit breaker in the main power distribution box.

flap control panel

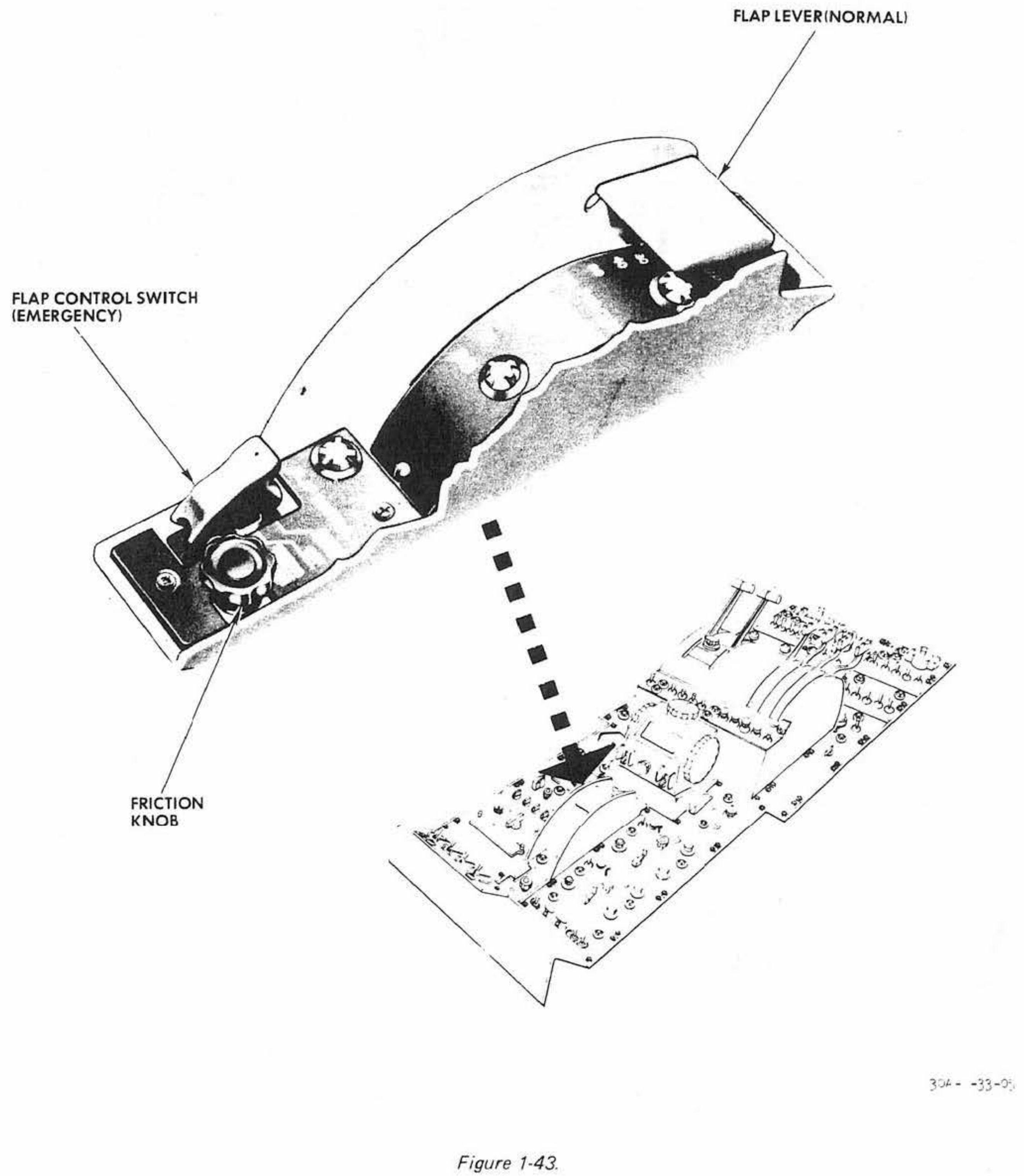


Figure 1-43.

main landing gear

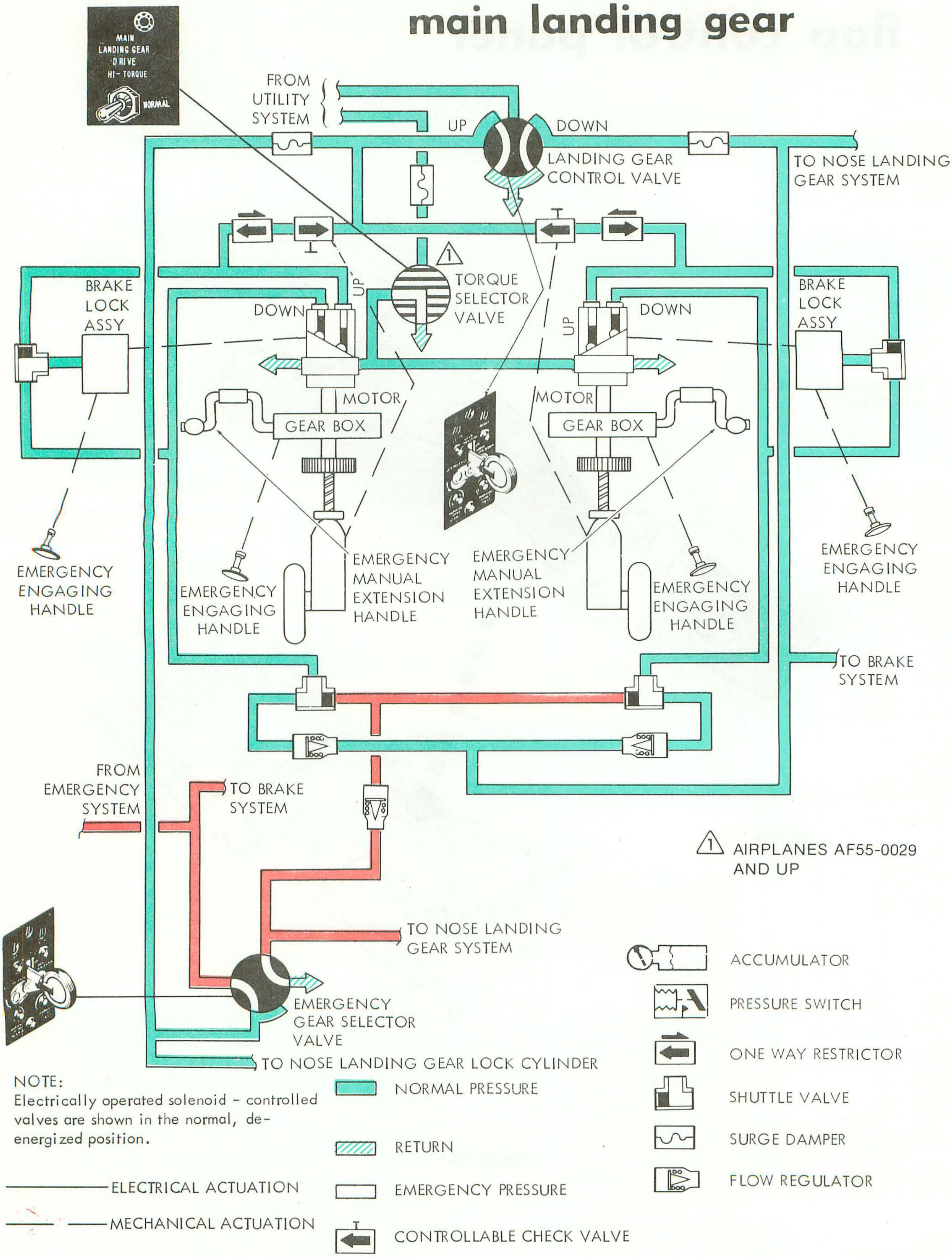


Figure 1-44.

WARNING

Asymmetrical protection by the wing flap brake valve is not provided if utility system hydraulic pressure is depleted, if emergency system pressure is being used to extend flaps, if an electrical failure occurs, or if the flap selector switch is in any position other than NORMAL.

Emergency Flap Selector Valve.

The emergency flap selector valve is a solenoid-operated hydraulic valve located on the right-hand side of the center section wing rear beam, below the flap gearbox. It is energized by 28-volt, DC power through the emer wing flap sel valve circuit breaker in the main power distribution box. It is equipped with a lever which acts as a manual override in case of electrical failure. When the flap control switch is in the EMERG DOWN position, or when the manual override lever is pulled down, the valve directs emergency hydraulic pressure to the down side of the flap motor to lower the flaps. When the flap control switch is in the NORM or OFF position, or when the override lever is in the normal position, the valve closes. The flaps cannot be raised by emergency hydraulic pressure.

Flap Position Indicator.

A flap position indicator is located on the pilot's instrument panel. The indicator is connected to a transmitter that is mounted on the flap drive control unit located on the aft face of the wing rear beam. The indicator dial is calibrated from UP to DOWN in increments of 10 percent. The indicating system is energized by 28-volt, DC power through the tabs and flaps position indicators circuit breaker in the aft fuselage junction box.

Angle of Attack/Stall Warning System Flap Compensation.

Note

All of the information pertaining to the angle of attack/stall warning system applies to airplanes modified by T. O. 1C-130-708.

A flap position transmitter is mounted on the flap drive control unit located on the aft face of the wing rear beam. The output of the calibrated flap position transmitter is applied to the circuits of the angle of attack/stall warning system to compensate for varying flap positions. The flap position transmitter is energized by the circuits of the angle of attack/stall warning system which is supplied power from the R. H. wing bus mounted in the main power distribution box.

LANDING GEAR SYSTEM.

The landing gear system includes a dual-wheel, steerable nose gear and two tandem-mounted main landing gears. Normal operation of the system is through the utility hydraulic system. The nose gear retracts forward into the nose section of the fuselage; the main landing gears retract vertically into the left and right wheel well on either side of the fuselage. In the retracted position, all landing gears are enclosed by mechanically operated flush doors. A landing gear position-indicating system gives a visual indication of the position of each gear and a visual and audible indication of an unlocked condition of the landing gear. Under normal operation, both the nose and main landing gears will retract and lock within 19 seconds and will extend and lock in 10 to 19 seconds.

MAIN LANDING GEAR.

The main landing gear system consists of four wheels, two mounted in tandem on each side of the fuselage. Each wheel has a separate strut. The landing gear actuation system is normally supplied hydraulic fluid under pressure by the utility supply system (figure 1-51). In an emergency, the emergency supply system supplies the main landing gear system. Each pair of struts is raised and lowered in vertical tracks by means of screw jacks, driven by torque shafts which are powered by the hydraulic motor through a gearbox. In airplanes AF55-0029 and up, this gearbox is equipped with a two-speed gear reduction, which doubles the torque output of the hydraulic motor when actuated by the main landing gear drive switch. Mechanical linkage between the aft main landing gear struts and the doors causes the doors to open and close as the main landing gears are extended and retracted. Manual release cables attached to the emergency engaging handles provide an alternate means of releasing the gear brake mechanism. Emergency hydraulic pressure is not available for main landing gear retraction.

NOSE LANDING GEAR.

The nose landing gear is a swinging-type gear, actuated by a hydraulic cylinder, and secured in the up and down positions by locks. The gear is normally supplied hydraulic fluid under pressure by the utility supply system; however, during an emergency it is supplied by the emergency supply system (for extension only) (figure 1-45). Hydraulic fluid from either the up or down side of the landing gear control valve flows to the nose landing gear up lock and down lock and to the nose landing gear actuating cylinder.

Fluid for the nose landing gear steering control valve and the brakes is supplied from the landing gear control valve in the down position only. A shuttle valve

nose landing gear system

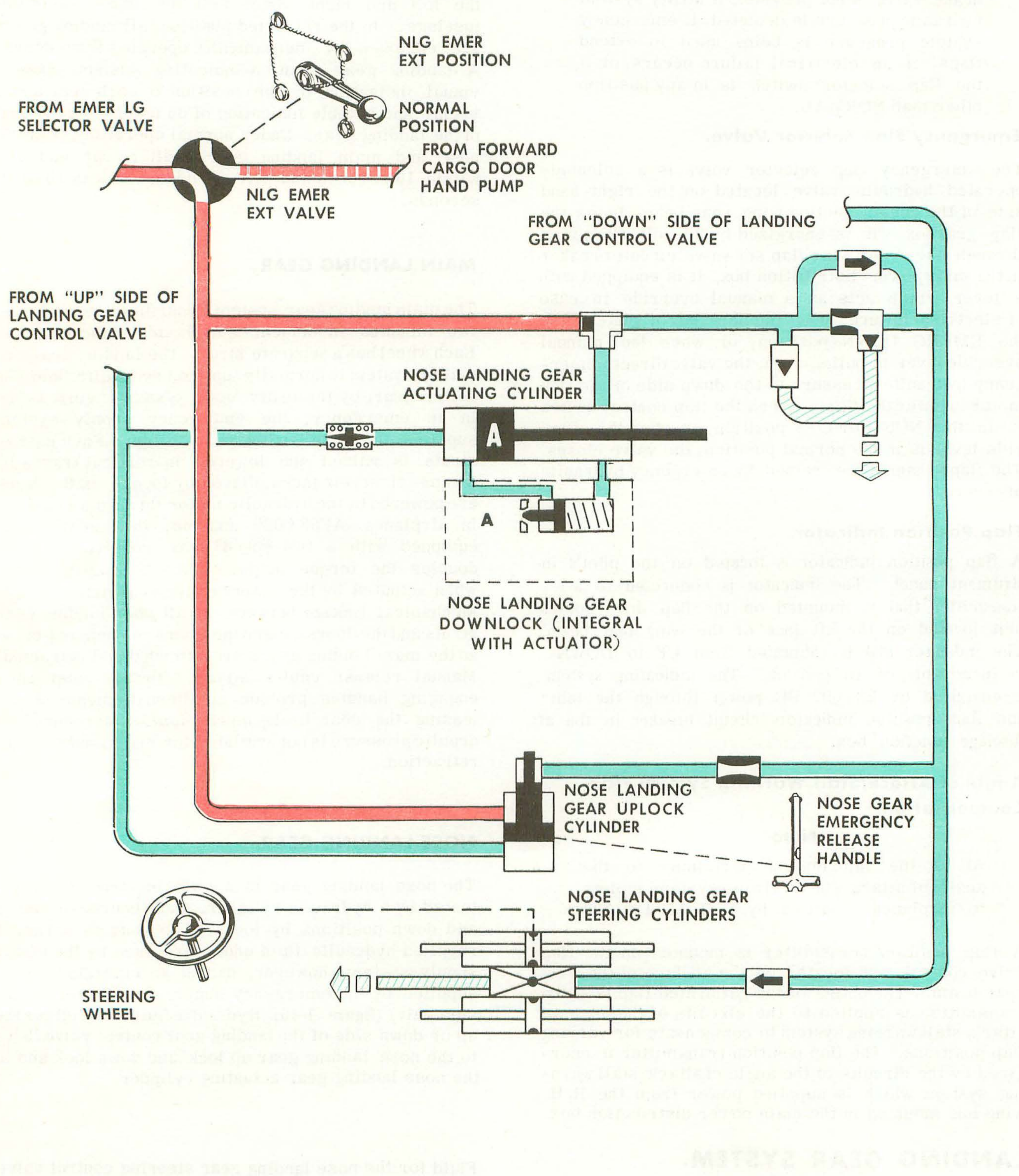


Figure 1-45.

connects the utility pressure line to the emergency pressure line and allows the emergency pressure to be used to extend the nose gear when the utility system is inoperative. The nose landing gear cannot be retracted by emergency means. A manual release cable for the nose gear uplock provides an alternate means of releasing the nose gear. The nose gear is then pumped into the down and locked position by means of a hand pump. A removable access panel and window assembly is provided, in addition to the inspection plate, in the bulkhead above the plate.

HYDRAULIC OPERATION PROVISIONS.

Hydraulic pressure for operation of the landing gear system is normally supplied by the utility hydraulic system. However, the emergency hydraulic system will supply hydraulic pressure for the extension of the landing gear in the event of a pressure failure in the utility system.

MANUAL OPERATION PROVISIONS.

An emergency method of actuating the main landing gear by mechanical means is provided by two extensions shafts, which are connected to the gearbox which drives the retraction screwjacks. One extension stub shaft is mounted on the forward wall of each main landing gear wheel well. Two glass panels are located on each of the right- and left-hand wheel well walls. These panels are used for visual inspection to determine if the main landing gear is fully extended. Manual release cables provide an emergency method of releasing the gear brake mechanisms, and engaging the manual extension and retraction mechanism. Two access panels are provided in each main landing gear wheel well sidewall, above the inspection windows. These provide access to the ball screws and vertical torque shafts, to facilitate manual extension of the gear with the emergency extension wrench in the event of a jammed gearbox.

Emergency Engaging Handles.

On airplanes AF53-3129 through AF57-0509 not modified by T.O. 1C-130A-750, one emergency engaging handle is located on the forward wall of each wheel well, just below the extension shaft of the manual landing gear retraction system. This handle operates a cable system which releases the main gear gearbox brake and door locks and engages a manually operated retraction mechanism with the torque shafts which drive the screwjacks of the main landing gear upward and downward to raise or lower the main landing gear. These handles must be pulled outward and locked by turning one-quarter turn clockwise before the landing gear can be extended or retracted manually. On airplanes AF53-3129 through 55-0014, the main landing gear retracting system is designed so that the hydraulic motor is not disconnected from the horizontal torque tube and gear box assembly when the engaging handle is pulled. On airplanes modified by T.O. 1C-130A-750, two emergency engaging handles are located on the forward wall of each wheel well, one above the other. The lower handle releases the main landing gear gearbox brake assemblies when it is pulled out and locked by turning one-quarter turn counterclockwise. The upper handles engages the manual extension system and disengages the hydraulic motor when it is pulled out and locked by turning one-quarter turn counterclockwise. (Refer to Section III for emergency procedure for these airplanes.) After each manual extension or retraction of the main landing gear, these handles must be turned one-quarter turn in the appropriate direction and released to their normal position.

Landing Gear Handcrank.

Two landing gear handcranks (refer to Section III) are provided for the manual operation of the main landing gears. One handcrank is stored in retaining clips on the forward face of the left wheel well, and the other is stored on the fuselage wall forward of the right wheel well. One end of each crank is made to fit over the protruding end of the extension stub shaft. An extension stub shaft is located on each wheel well forward wall, just above the emergency engaging handles.

Main Landing Gear Emergency F :tension Wrench.

An emergency extension wrench is provided for manual extension of the main landing gear after both the normal and emergency extension systems have failed to extend the gear. The wrench has a fixed socket on one end and a ratchet and socket on the other end. The wrench is used for manual rotation of the landing gear ball screws to extend the struts. The wrench is stowed on a sidewall litter stanchion forward of the left main landing gear wheel well.

LANDING GEAR SYSTEM CONTROLS.

The landing gear system requires several types of controls, to lower and retract the landing gears hydraulically and manually, to hold the landing gear in the down and locked position, and to silence the warning horn.

Landing Gear Lever.

A landing gear lever (figure 1-46) is located on the left side of the copilot's instrument panel. It is a three-position (UP, DOWN, EMER. DOWN) lever which directs the gear actuating mechanism to raise or lower the nose and main landing gears. When the lever is moved to the UP position, a solenoid-operated selector valve directs pressure from the utility hydraulic system to release the nose gear downlock and retract

landing gear control panels

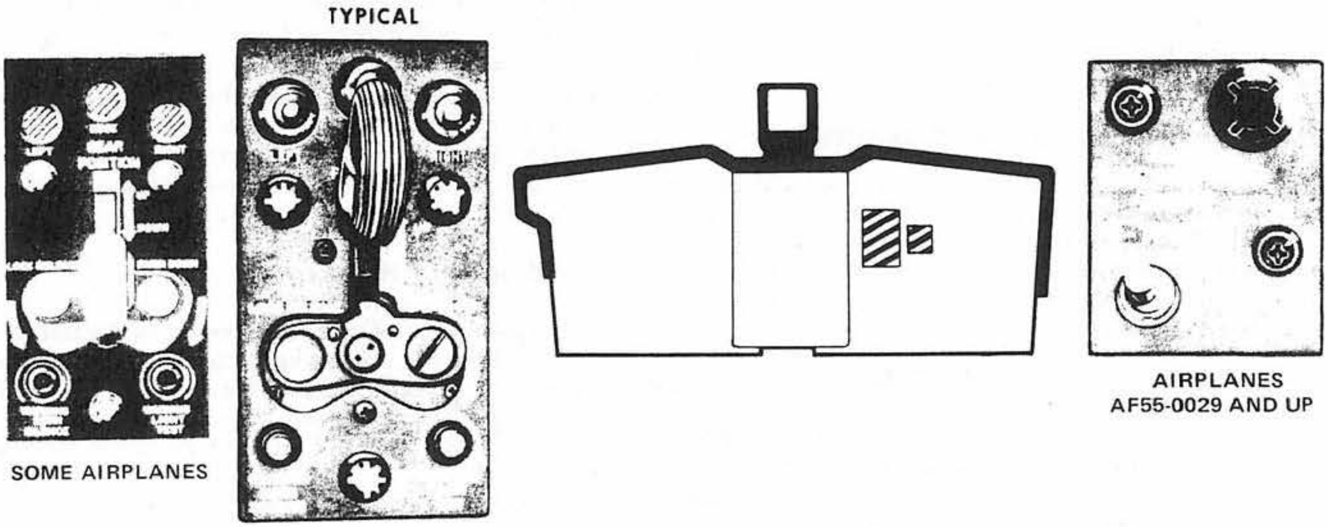


Figure 1-46.

the landing gears. When the lever is moved to the DOWN position, the nose landing gear uplock and the main landing gear retraction brakes are released, and the landing gears extend. When the lever is in the EMER. DOWN position, pressure from the emergency hydraulic system is supplied to perform the same function as utility pressure during normal extension. When the lever is in the DOWN or EMER. DOWN position, the normal landing gear selector valve is positioned to down. The valve circuit is powered by 28-volt DC through the lg sel & dn press dump valve normal and the lg sel & dn press dump valve emer circuit breakers in the main power distribution box. A mechanical locking device is engaged when the landing gear lever is moved to the DOWN position, so that the lever stays in the DOWN position until released. During take-off or in flight, the open position of the touchdown switch energizes the landing gear lever release solenoid to reduce the locking device to a simple detent. At all other times the lock release finger latch must be pulled down before landing gear lever can be moved to the UP position. When the airplane is on the ground, the main landing gear remains locked in the down position. The emer. down finger latch, on the right side of the landing gear lever, must be pulled down before the landing gear lever can be moved to the EMER. DOWN position. Emergency hydraulic pressure is not available for retraction of the main landing gears.

CAUTION

It is possible for the nose landing gear to retract when the airplane is on the ground, should the landing gear lever be inadvertently raised to the UP position.

Main Landing Gear Drive Switch (Airplanes AF55-0029 and Up).

A 2-position (HI-TORQUE, NORMAL) toggle switch (figure 1-46) is located at the right of the landing gear control panel. It is powered by 28-volt, DC current through the heating blankets and MLG speed valve circuit breaker in the wheelwell power junction box. When moved to the HI-TORQUE position, the switch actuates a solenoid-operated hydraulic valve which routes utility hydraulic pressure to each main landing gearbox to change the gear ratio from 1:1 to 2:1, thereby doubling the torque output of the gearbox. The extension and retraction times of the main landing gears are doubled.

Nose Gear Emergency Release Handle.

A nose gear emergency release handle (figure 1-47) is located below the floor of the flight station under a

nose gear emergency release handle

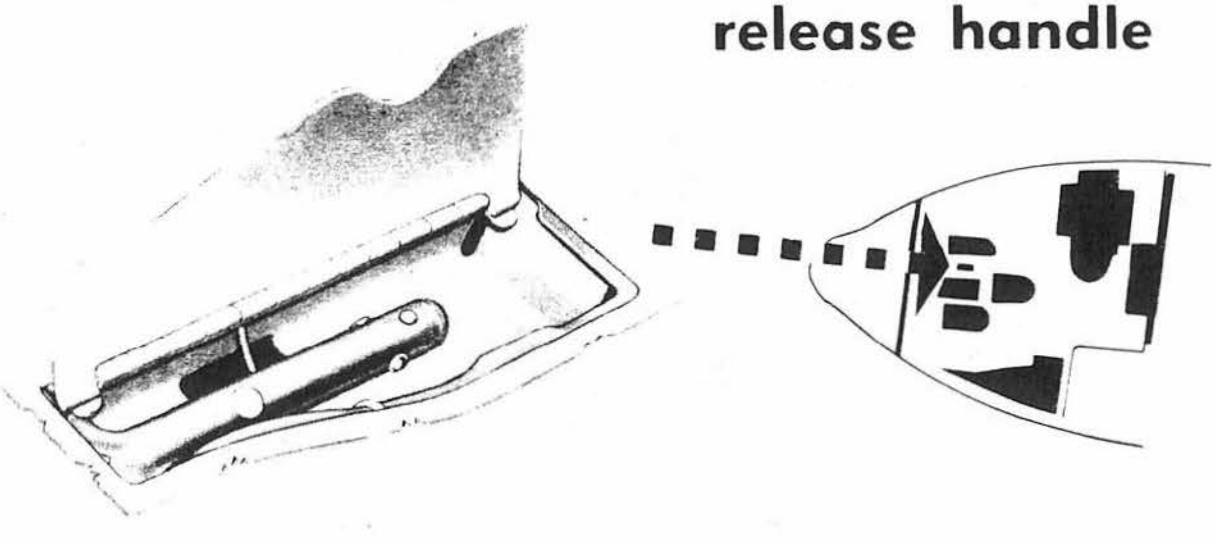


Figure 1-47.

hinged panel between the copilot's seat and the control pedestal. The handle operates a cable system which releases the nose landing gear up lock and allows the nose gear to fall free.

LANDING GEAR TOUCHDOWN SWITCH.

A touchdown switch is installed on the lower aft side of each forward main gear strut. The switches are safety devices which either prevent some airplane system from operating or permit it to operate when the airplane is on the ground, or in flight. The weight of the airplane on the gear operates these switches. The switches are wired in parallel for the ground stop functions. Therefore, either switch will affect those systems listed below. When the airplane is on the ground and the struts are compressed, the following systems are powered as indicated through the touchdown switches or through relays which are controlled through touchdown switches:

(1) Condition Lever - Ground Stop (Powered to electrically shut off fuel at the engine fuel control)

(2) Landing Gear Control Handle Lock - (De-energized)

(3) Anti-skid for Normal wheel Brakes - (Powered)

(4) Stall warning horn - (Inoperative on the ground except during test conditions) (Airplanes modified by T.O. 1C-130-708)

(5) AN/ALE-20(V) system

MAIN LANDING GEAR GROUND LOCKS.

Two main landing gear ground locks are provided for use while performing maintenance on the gear, to prevent accidental retraction of the main landing gears. The locks are installed on the hexagonal ends of the main landing gear screw assemblies, one lock on each side of the airplane. The locks are stowed in the miscellaneous equipment box aft of the flight station ladder.

NOSE LANDING GEAR GROUND LOCK

A nose landing gear ground lock (figure 1-48) is provided to prevent accidental retraction of the nose landing gear. The lock consists of a self-locking pin which is inserted through a hole in the drag strut actuator rod end. This prevents release of an internal downlock mechanism, thus securing the gear in the extended position.

LANDING GEAR SYSTEM INDICATORS.

Note

The landing gear warning horn and light operate from the same circuit. Failure of either individual landing gear warning circuits will cause the horn to remain silent and the light to remain out.

Landing gear warning signals are presented by a horn and a light. Landing gear positions are indicated by three indicators or three lights.

nose landing gear ground lock

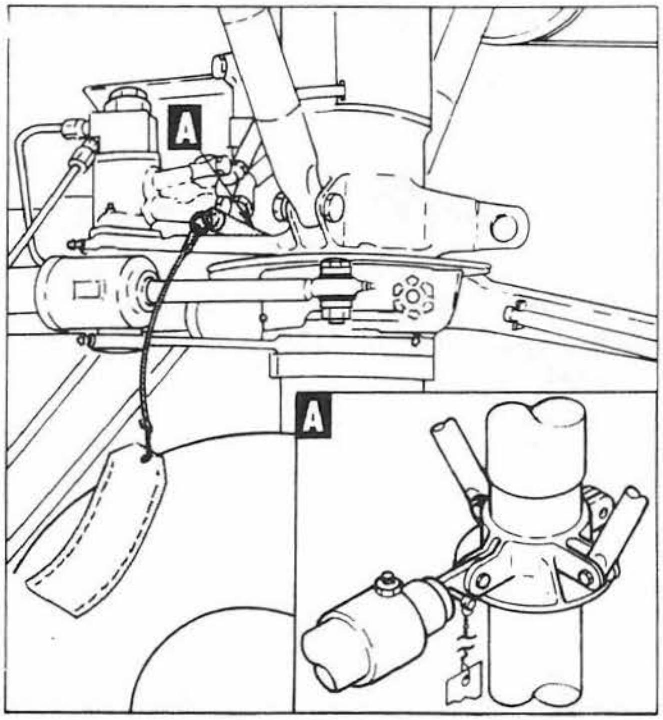


Figure 1-48.

304- -33-0

Landing Gear Warning Horn and Silence Switch.

The landing gear warning horn is located above and to the left of the pilot's seat. Two things will cause the landing gear warning horn to sound: retarding a throttle to a position five degrees forward of FLIGHT IDLE or moving the flap lever more than approximately 70 percent with the landing gear not fully extended. A warning horn silence switch (figure 1-46)is located on the landing gear control panel. It is a press-type switch, used to silence the landing gear warning horn when a throttle is retarded. It will not silence the horn when flaps are extended more than 70 percent. When the switch is pressed, the horn-silencing relay is actuated, and the warning horn electrical circuit is broken Extension and locking of the landing gears or advancement of the engine throttles will reset the horn-silencing relay, so that the horn can sound again

Note

> If an engine has been feathered, the engine throttle should be left in an advanced position so that the horn system remains active. If the throttle remains at FLIGHT IDLE after the warning horn silence switch is actuated, the horn silence relay is not reset.

The landing gear warning horn circuit is energized by 28-volt, DC power through the landing gear warning circuit breaker on the flight station distribution panel.

Landing Gear Warning Light and Warning Light Test Switch.

The landing gear warning light is connected to the landing gear retraction system and the wing flap warning switch; it will glow when the landing gear is not in a locked position or when an engine throttle is retarded to FLIGHT IDLE position, and the landing gear is not fully extended. A warning light test switch (figure 1-46) is located on the landing gear control panel. It is a press-type switch, used to test the continuity of the landing gear warning light electrical circuit. When switch is pressed, the landing gear warning light bulb in the landing gear lever handle will illuminate. Failure of the bulb to illuminate shows a defective circuit. The landing gear warning light is energized by 28-volt, DC power through the landing gear warning circuit breaker on the flight station distribution panel.

Landing Gear Position Indicators (Airplanes AF53-3129 through 55-0014).

A left main gear position indicator, a nose gear position indicator, and a right main gear position indicator are located on the landing gear control panel. These indicators give a visual indication of the position of the landing wheels. When the letters UP appear on the face of an indicator, it means that the wheel represented by that indicator is retracted and locked. When the picture of a landing gear wheel appears on the face of an indicator, it means that the landing gear wheel represented by that picture is extended and locked. Red and yellow diagonal lines on the face of an indicator mean that the landing gear wheel represented by that indicator is somewhere between the extended and retracted positions or that the indicator is inoperative. The landing gear position indicators are energized by 28-volt, DC power through the landing gear position circuit breaker on the flight station distribution panel.

Landing Gear Position Lights (Airplanes AF55-0029 and Up).

Three green landing gear position indicator lights (figure 1-46) labeled LEFT, NOSE, and RIGHT to correspond to those landing gears, are located on the landing gear control panel. They illuminate whenever the landing gears they represent are in the down and locked position. At all other times the lights are extinguished. The landing gear position indicator lights are energized by 28-volt, DC power through the landing gear position circuit breaker on the flight station distribution panel.

NOSE WHEEL STEERING SYSTEM.

The airplane is steered during taxiing by directional control of the nose wheel. The nose wheel is hydraulically actuated and governed by a steering control valve in the utility hydraulic system. The steering control valve is connected by a cable to a manually operated nose steering wheel (figure 1-45 and 1-49) located in the flight station at the left of the pilot's control column. Directional control of the nose wheel is limited by means of mechanical stops to 60-degrees right and left of center. One and one-quarter turns from center position of the nose steering wheel will turn the steering wheel to the full-left or the full-right position. Orifices in the steering cylinders provide snubbing action to dampen oscillations of the nose wheel and to prevent shimmy. Centering cams on the nose wheel strut return the nose wheel to a centered position whenever the weight of the airplane is removed from the nose wheel.

NOSE WHEEL POSITION INDICATOR.

An indicator for the nose wheel is provided on the nose wheel steering wheel column so the pilot can determine from the cockpit the actual position of the steerable nose wheel, left and right of center. The pointer on the indicator is geared so that each quarter turn of the nose wheel steering wheel moves the pointer approximately 12 degrees, thus the pointer indicates the actual position of the nose wheel.

CAUTION

To avoid damage to the nose wheels or the nose landing gear doors, the gear should not be retracted if the pointer on the nose wheel position indicator is not in the white area.

BRAKE SYSTEM.

A hydraulically operated, disk-type brake is installed on each of the four main landing gear wheels. The nose landing gear wheels do not have brakes. The brakes normally operate from utility hydraulic system pressure with an alternate supply available through the emergency hydraulic system. Hydraulic fluid is supplied to the brake system from the landing gear down-pressure line (figure 1-50). It flows through a check valve and a normal brake selector valve to the right- and left-hand brake control valves. When the fluid leaves the brake control valves, it flows through the anti-skid valves and shuttle valves to the brakes. Each of the two halves (left and right) of the brake system contains a brake control valve, an anti-skid valve, and two brake shuttle valves. The emergency system supply flows through a check valve and a surge-damper valve to an emergency brake selector valve. When the emergency brake system is actuated, fluid is directed to a pressure transmitter and to the brake control valves, then through shuttle valves directly to the brakes, bypassing the anti-skid valves. Utility or emergency system pressure is selected by manual positioning of a brake pressure selector switch.

BRAKE SYSTEM ACCUMULATORS.

Air-charged accumulators are used in both the utility and emergency hydraulic systems to provide hydraulic pressure in case of a normal pressure failure. The accumulator in the utility system is capable of supplying pressure for about two brake applications. The accumulator in the emergency system, having one-half the capacity of the utility accumulator, is capable of supplying pressure for about one brake application.

BRAKE SYSTEM MODULATOR.

On some airplanes, a brake modulator is located downstream of the one-way restrictor to supply an additional pressure source. This ensures that proper pressure is available at all times. On all other airplanes the modulator is located upstream of the brake selector valve, the restrictor is moved upstream of the brake selector valve, and a surge damper is added in place of the restrictor.

steering wheel

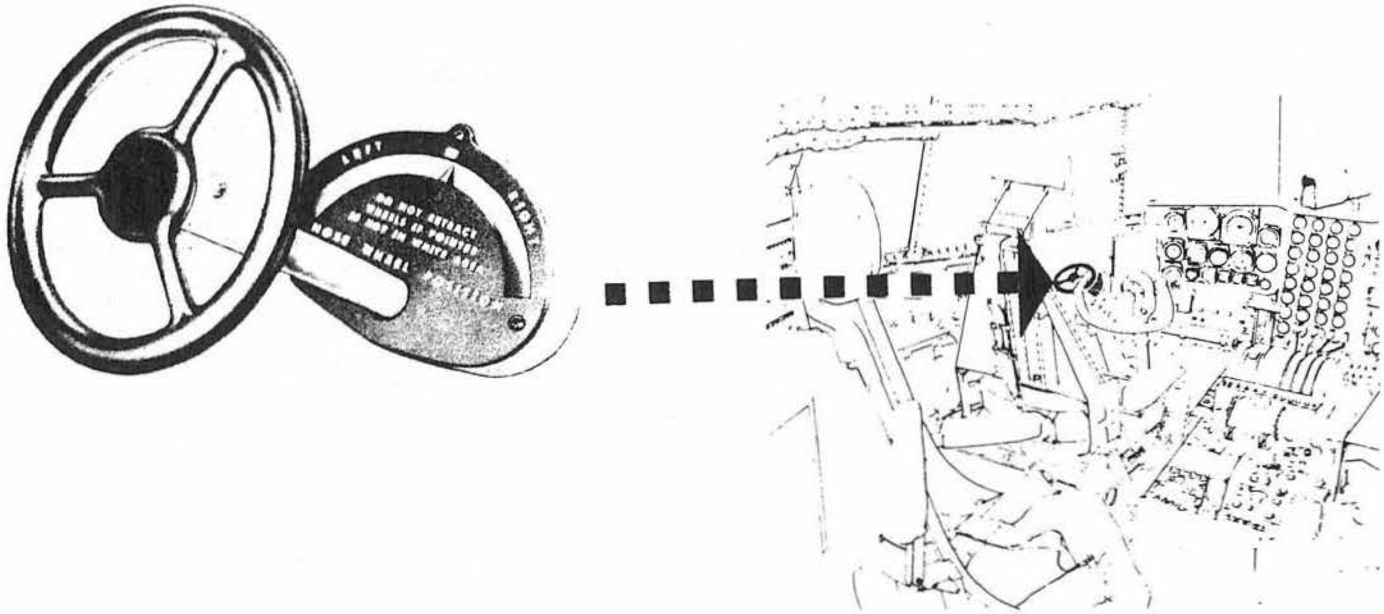


Figure 1-49.

BRAKE SYSTEM CONTROLS.

Brake Pedals.

Actuation of the brakes is through application of toe pressure on the rudder pedals at either the pilot's or copilot's stations. The amount of braking force is proportional to the force applied to the rudder pedals. Application of brake pressure before touchdown is prevented by two scissors-type main landing gear touchdown switches, one attached to each forward landing gear strut, which prevent hydraulic pressure from being applied to the brakes when the anti-skid switch is ON until the landing gear struts are compressed. When the anti-skid switch is OFF, hydraulic pressure can be applied to the brakes on the ground or in the air.

Brake Pressure Selector Switch.

A two-position (NORMAL,EMERGENCY) toggle switch (figure 1-37) located on the hydraulic control panel provides selection of either normal or emergency hydraulic pressure for applying the brakes. Move the switch to the NORMAL position to supply utility hydraulic pressure to the brakes, and to the EMERGENCY position to supply emergency hydraulic pressure to the brakes. The brake pressure selector valves are energized by 28-volt, DC power through the ATM hydraulic shutoff circuit breaker power from the main DC bus in the main power distribution box and through the anti-skid control circuit breaker on the flight station distribution panel. Both the normal brake selector valve and the emergency brake selector valve are de-energized open.

Note

> In case of electrical power failure, the de-energized valves admit both utility and emergency hydraulic system pressures to the brake system. The shuttle valves are positioned by the system supplying the greater pressure for brake application.

Brake System Pump

The brake system pump, mounted on the floor of the flight station compartment at the right of the copilot's

brake system (typical)

airplanes not modified by T.O.1C-130-743

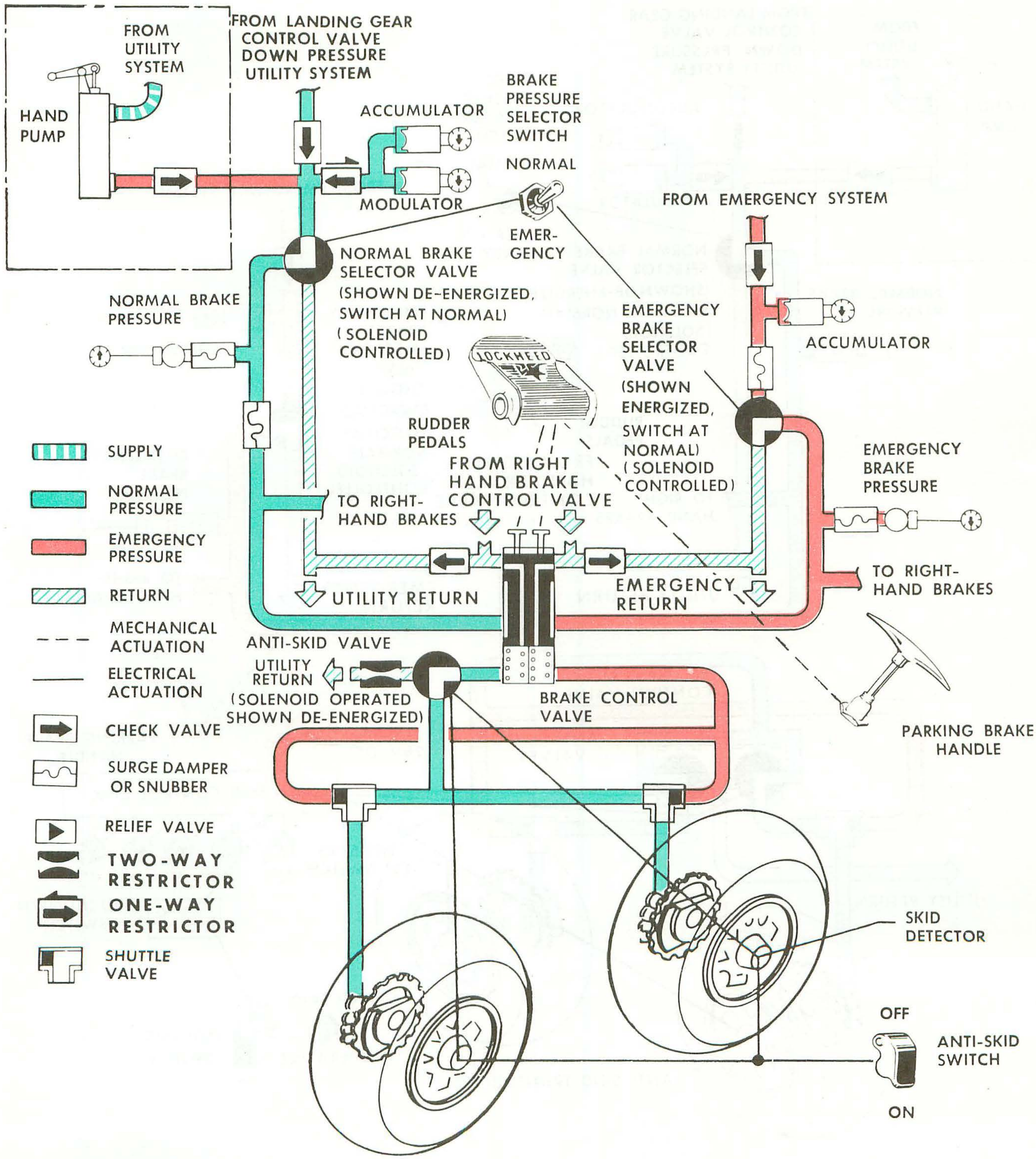


Figure 1-50. (Sheet 1 of 2)

airplanes modified by T.O.1C-130-743

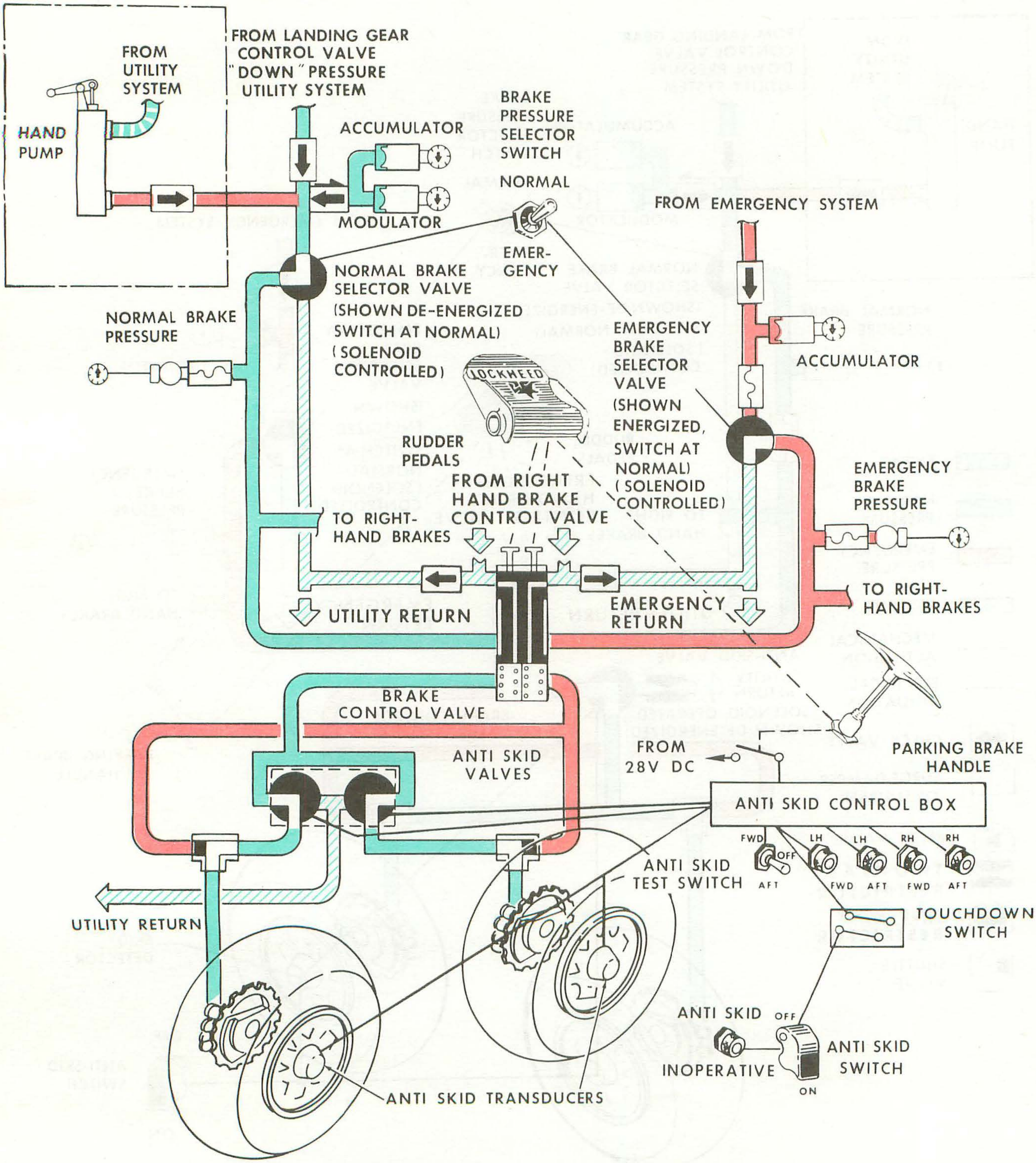
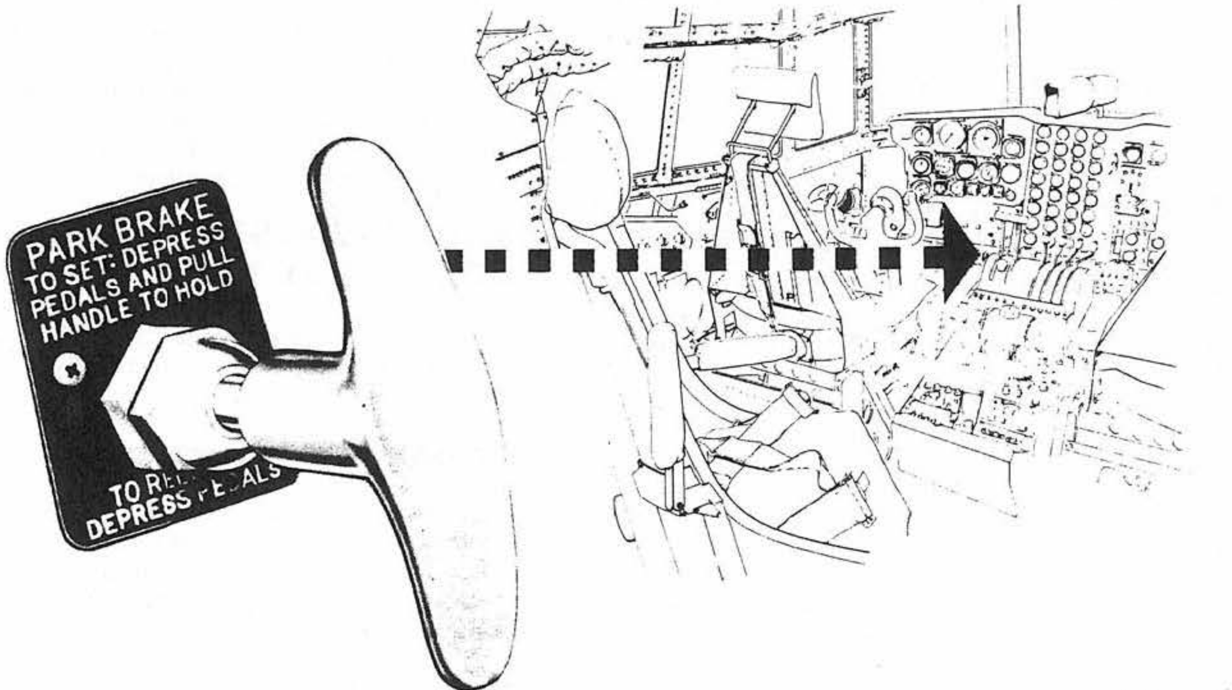


Figure 1-50. (Sheet 2 of 2)

parking brake handle



30A- -33-

Figure 1-51.

rudder pedals, is a hand-operated pump used to pressurize the brake control section of the utility hydraulic pressure system for operation of the brakes during towing operations. In cases of emergency, however, the brake hand pump may be used for brake pressure when all other means of braking have been lost. In order to have brake pressure, the brake pressure selector switch must be in the NORMAL position, anti-skid switch OFF, brakes applied, and the hand pump actuated.

Parking Brake Control Handle.

A parking brake control handle (figure 1-51) is located in front of the pilot's seat, to the right of the pilot's right-hand foot rest. The brakes are set for parking by first depressing the toe section of the rudder pedals and then pulling out the parking brake control handle. The brakes are released by again depressing the toe section of the rudder pedals. The parking brakes operate in conjunction with the pilot's and copilot's rudder pedals. On airplanes modified by T.O. 1C-130-743, setting the parking brake while the anti-skid switch is in the ON position de-energizes the anti-skid system and illuminates the anti-skid inoperative light.

BRAKE PRESSURE INDICATORS.

Utility and, on early airplanes, emergency pressure indicators (figure 1-37) are located on the hydraulic control panel at the bottom of the copilot's instrument panel. The indicators are connected to pressure transmitters in the pressure lines of the brake control system and register the hydraulic pressure available in the brake sections of both the utility and emergency hydraulic systems. The indicators are energized by 26-volt, AC power through the normal brake pressure fuse and the emergency brake pressure indicator fuse on the main power distribution box. The emergency brake pressure indicator is installed on some earlier airplanes only.

Modulator Pressure Gage (Some Airplanes).

A direct-reading pressure gage is attached to the modulator in the main landing gear brake system portion of the utility hydraulic system to indicate the total system pressure in the anti-skid portion of the main landing gear brake system.

ANTI-SKID SYSTEM (AIRPLANES NOT MODIFIED BY T.O. 1C-130-743).

The anti-skid system consists of a skid-detector unit and a brake-releasing system.

SKID-DETECTOR OPERATION.

A skid-detector unit is mounted in the axle of each main landing gear wheel. It applies control to the braking operation through two anti-skid valves only when the landing gear wheel begins to approach a skid condition. Each skid-detector unit contains a flywheel inertia mechanism and a commutator, which sense both the rate of change of speed of the wheel and also the rotational speed of the wheel. They form part of an electrical circuit which prevents landing with brakes on and releases brakes in case of a locked condition. Should the flywheel inertia mechanism continue to rotate at the speed set up by the initial landing impact while the wheel lessens its rotational speed, it means that a skid has started. The sensing of this is transmitted to the control box. The control box immediately sends an electric impulse to an anti-skid valve which releases the brakes on both wheels on that side of the airplane. It causes the brakes to operate again as soon as the wheel speed matches that of the other wheels. The system operates independently of the metered brake pressure, momentarily releasing brake pressure from the affected side of the airplane until both wheels have reached synchronous speed. The anti-skid system will not function when the brake system is operating from the emergency hydraulic system.

Anti-Skid Switch.

An anti-skid two-position (OFF, ON) guarded toggle switch (figure 1-37), is located on the hydraulic control panel. When the switch is actuated, the anti-skid system is energized by 28-volt, DC power through the anti-skid control circuit breaker from the flight station bus on the flight station distribution panel. When the switch is in the ON position, the anti-skid system is operative and becomes an integral part of the landing gear brake system. When the switch is in the OFF position, the anti-skid control system is bypassed, and the landing gear brake system operates as a standard brake system.

Anti-Skid Inoperative Light.

An anti-skid inoperative light (figure 1-37), located on the hydraulic control panel, glows whenever the anti-skid system is not operating as an integral part of the landing gear brake system. It warns the pilot that skid protection has been lost on at least one wheel. This system is energized by 28-volt, DC power through the fail-safe anti-skid warning light circuit breaker from the flight station bus on the flight station distribution panel. A functional test of the light circuit is made by pressing on the light bulb cover. Failure of the light to glow shows a defective circuit.

Note

Use of the anti-skid system after the anti-skid light has illuminated may result in uneven braking and a tendency for the airplane to swerve. The anti-skid switch should be turned to the OFF position if the anti-skid inoperative light illuminates.

ANTI-SKID SYSTEM (AIRPLANES MODIFIED BY T.O. 1C-130-743).

The anti-skid system consists of four wheel-speed transducers, an electrical control box, and two dual anti-skid valves.

ANTI-SKID SYSTEM OPERATION.

The system prevents skidding of wheels when too much brake pressure is applied during aircraft decelerations. This is done through a brake-releasing system, controlled by signals from wheel-speed transducers.

SKID-DETECTOR OPERATION.

The wheel-speed transducer unit mounted in the axle of each main landing gear wheel applies control to the braking operation through the anti-skid valves when the landing gear wheel begins to approach a skid condition. One dual anti-skid valve is located above the utility hydraulic reservoir on the forward wheel well wall, and the other is on the left-hand hydraulic panel forward of the emergency hydraulic reservoir. Each wheel-speed transducer unit contains a frequency generator which senses wheel rotational speed and wheel speed change. The transducers form part of an electrical circuit which prevents landing with brakes on, and which releases brakes in case of a locked condition. Should the wheel speed decrease rapidly, indicating approach of a skid condition, the control box sends an electric impulse to an anti-skid valve which reduces pressure to the affected brake below the pressure which caused sensing of the skid. As subsequent skids are sensed, they are electronically compared with the amount the hydraulic pressure had to be reduced to eliminate earlier skids detected. This comparison results in a more accurate determination of the minimum reduction in brake pressure required to eliminate the skid. The skid detection and control function is independent on each wheel. The skid control system will not function when the brake system is operating from the emergency hydraulic system or when the parking brakes are set.

ANTI-SKID SYSTEM CONTROLS AND INDICATORS.

Anti-Skid Switch.

An anti-skid two-position (OFF, ON) guarded toggle switch (figure 1-37) is located on the hydraulic control panel. It is energized by 28-volt dc power from the main dc bus, through the anti-skid control circuit breaker on the flight station distribution panel. When the switch is in the ON position, the anti-skid system is operative and becomes an integral part of the wheel brake system. When the switch is in the OFF position the landing gear brake system operates as a standard brake system.

Anti-Skid Inoperative Light.

An anti-skid inoperative light (figure 1-37), located on the hydraulic control panel, glows whenever the anti-skid system is not operating as an integral part of the landing gear brake system. It warns the pilot that there is a malfunction in the anti-skid system and skid protection has been lost on all wheels. This light will also illuminate when the parking brake is set. This system is energized by 28-volt dc power from the flight station dc bus, through the anti-skid fail-safe light circuit breaker on the main dc distribution circuit breaker panel. A functional test of the light circuit is made by pressing on the light bulb cover. Failure of the light to glow shows a defective circuit.

Anti-Skid Test Switch and Indicator Lights.

An anti-skid test panel (figure 1-52) is located on the aft end of the overhead control panel. The test panel contains a three-position (FWD, OFF, and AFT) anti-skid test switch and four green indicator lights identified as LH FWD, RH FWD, LH AFT, and RH AFT. When the test switch is placed in the FWD position, 26-volt, 400-cycle power obtained from the electronics and engine ac bus (through the anti-skid test circuit breaker, located on the main dc distribution panel) is applied to the anti-skid control box to simulate a skid condition. When the switch is released to the OFF position, the FWD indicator lights should illuminate momentarily. Illumination of the lights indicates that the anti-skid control box would have properly responded to an actual skid. When the test switch is placed in the AFT position and released, the AFT indicator lights should illuminate momentarily.

INSTRUMENTS.

REGULATED ALTERNATING-CURRENT INSTRUMENTS.

Regulated alternating current instruments include a heading indicator and two attitude indicators. Fuses for these instruments are in the main power distribution box.

Attitude Indicator Type B-1A.

A B-1A attitude indicator (figure 1-53) is installed on the pilot's instrument panel. A pitch trim knob is provided to adjust attitude indication. A complete clockwise rotation of the pitch trim knob will produce a nose-down indication of 10° - 20° and a complete counterclockwise rotation of the pitch trim knob will produce a nose-up indication of 5° - 10°. Attitude information is transmitted electrically from a remote vertical gyro control unit located on the upper radio rack. Although the gyro control unit compensates for turning and acceleration/deceleration errors, some error will be produced during turns of less than 40 degrees per minute or during prolonged acceleration/decelerations. The gyro control will automatically provide for correction of these errors when the airplane departs the runway, a climb error of about 1-1/2 bar widths will be normally noticed. The erection system will remove the error after acceleration ceases. The attitude indicating system is supplied 115-volt, 400-cycle, AC power from the pilot's attitude gyro fuses located in the main power distribution box. 28-volt DC power is supplied from the propeller and engine bus through a pilot attitude gyro circuit breaker located on the copilot's circuit breaker panel. A remote attitude gyro switch (figures 1-53) is mounted on the pilot's instrument panel. The switch is marked ON-OFF. The attitude indicator contains an attitude warning flag which will appear if either AC or DC power fails.

WARNING

A slight reduction in electrical power, or failure of certain components within the system will not cause the warning flag to appear even though the system is not functioning properly and or the attitude indications are reversed. Therefore, it is imperative that the attitude indicator be periodically checked with other flight instruments.

Attitude Indicator Type J-8.

A J-8 attitude indicator (figure 1-54) is installed on the copilot's instrument panel. The instrument shows aircraft attitude during all normal maneuvers. Because of the centrifugal force acting upon the erection mechanism in turns, errors in pitch and bank may be noted upon return to level flight. A pitch error will result from accelerations or decelerations. It will appear as a climb after acceleration and as a dive after deceleration. After the aircraft is returned to unaccelerated flight, the error will disappear. An

anti-skid test panel

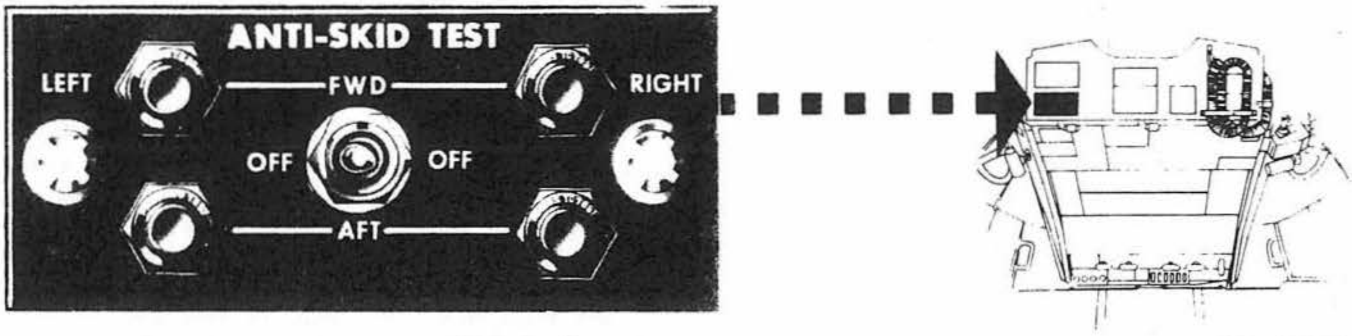


Figure 1-52.

attitude warning flag is provided within the instrument to show that the instrument is receiving insufficient 115-volt AC power from the copilot's AC instrument power system.

Heading Indicator Type C-5C.

A Type C-5C heading indicator (figure 1-54), located on the copilot's instrument panel, provides a visual indication of airplane headings during maneuvers or straight flight. The instrument is equipped with two setting knobs on the front of the indicator that provide a means of rotating either the pointer or dial, or both. By depressing and turning the dial and pointer knob, the dial can be rotated so that the pre-selected heading falls under the top index triangular marker affixed to the case. The pointer knob can then be depressed and the pointer rotated until it coincides with this heading. Any deviation of the airplane from this heading in azimuth will be reflected by the number of degrees indicated on the dial by the pointer. The indicator is also equipped with two flags. The flag marked caged is operated by the setting knobs. The caged flag appears in full view when either of the knobs is depressed, and disappears from view when both knobs are pulled out. The flag marked off provides warning of power failure in any of the three phases of the gyro motor. When power is applied and current is flowing equally in each phase, the off flag magnetically retracts. The directional gyro motor is supplied 115-volt, 400-cycle, AC power by the copilot's inverter through two copilot's directional gyro fuses located in the main power distribution box.

DIRECT-CURRENT INSTRUMENTS.

Direct-current instruments include turn-and-slip and free air temperature indicators. Circuit breakers for the turn-and-slip indicators are located in the main power distribution box and on the copilot's circuit breaker panel. Circuit breakers for the free air temperature indicators are located on the flight station distribution panel.

Turn-and-Slip Indicators.

Two turn-and-slip indicators, one on the pilot's instrument panel (figures 1-53) and the other on the copilot's instrument panel (figure 1-54), provide a reference for keeping the airplane level laterally, in maintaining straight flight, and in establishing the proper angle of bank for a given rate of turn. The turn indicator consists of a 28-volt, DC electrically driven gyro linked to a pointer.

Free Air Temperature Indicators.

Two free air temperature indicators, one on the copilot's instrument panel (figure 1-54) and the other on the navigator's instrument panel, visually indicate the temperature of the air outside of the airplane. These are 28-volt, DC electrical-resistance instruments, electrically connected to resistance bulbs mounted on each side of the airplane. The navigator's indicator is connected to a bulb on the right side; the copilot's indicator is connected to a bulb on the left side. The temperature range of the indicator is -50°C to +50°C.

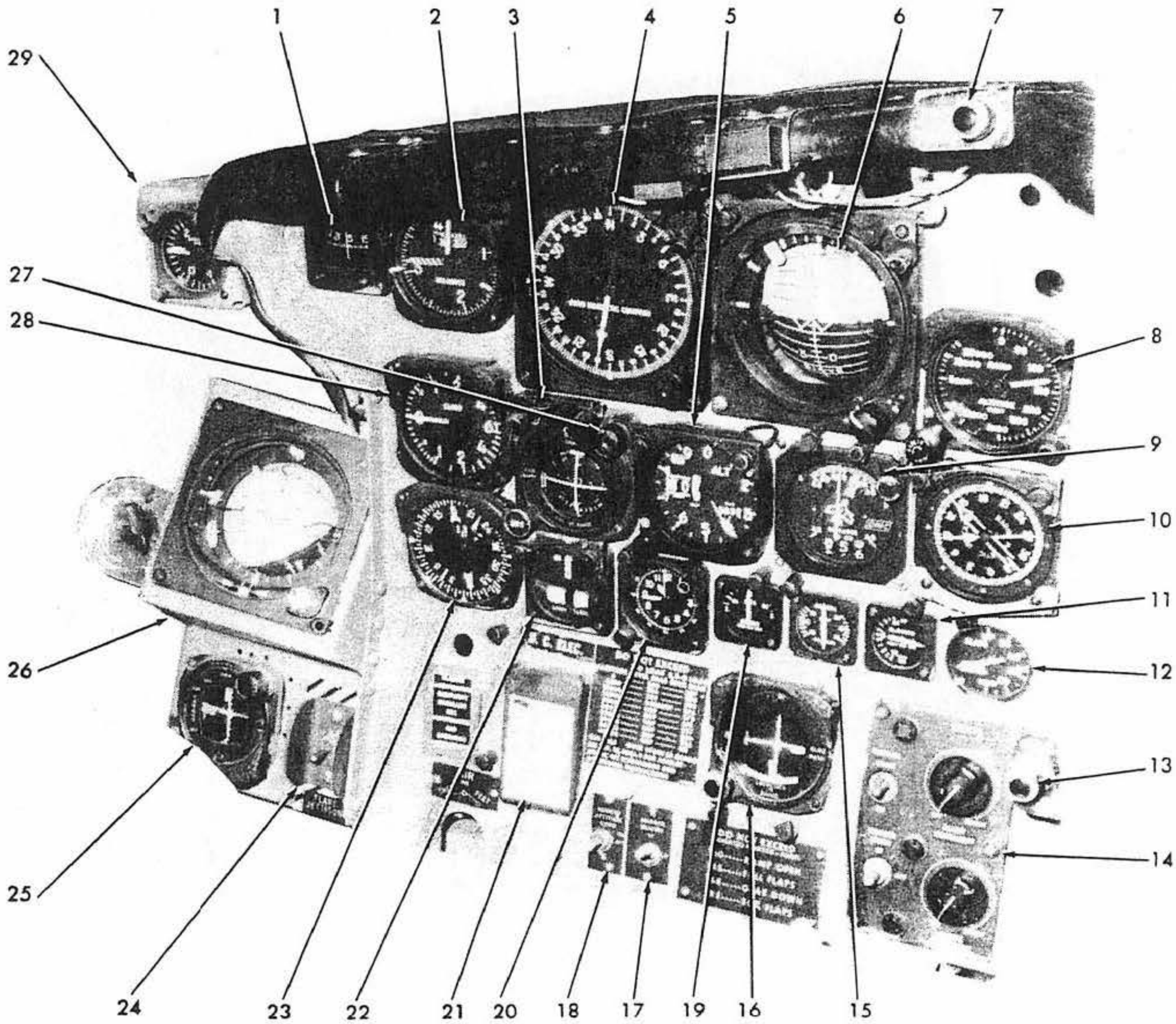
Note

> The navigator's indicator will read slightly higher than the copilot's when either the radar or radome anti-icing system is being used.

PITOT-STATIC INSTRUMENTS.

Pitot and static air pressures to operate the vertical velocity indicators, airspeed indicators and altimeters

pilot's instrument panel (TYPICAL)

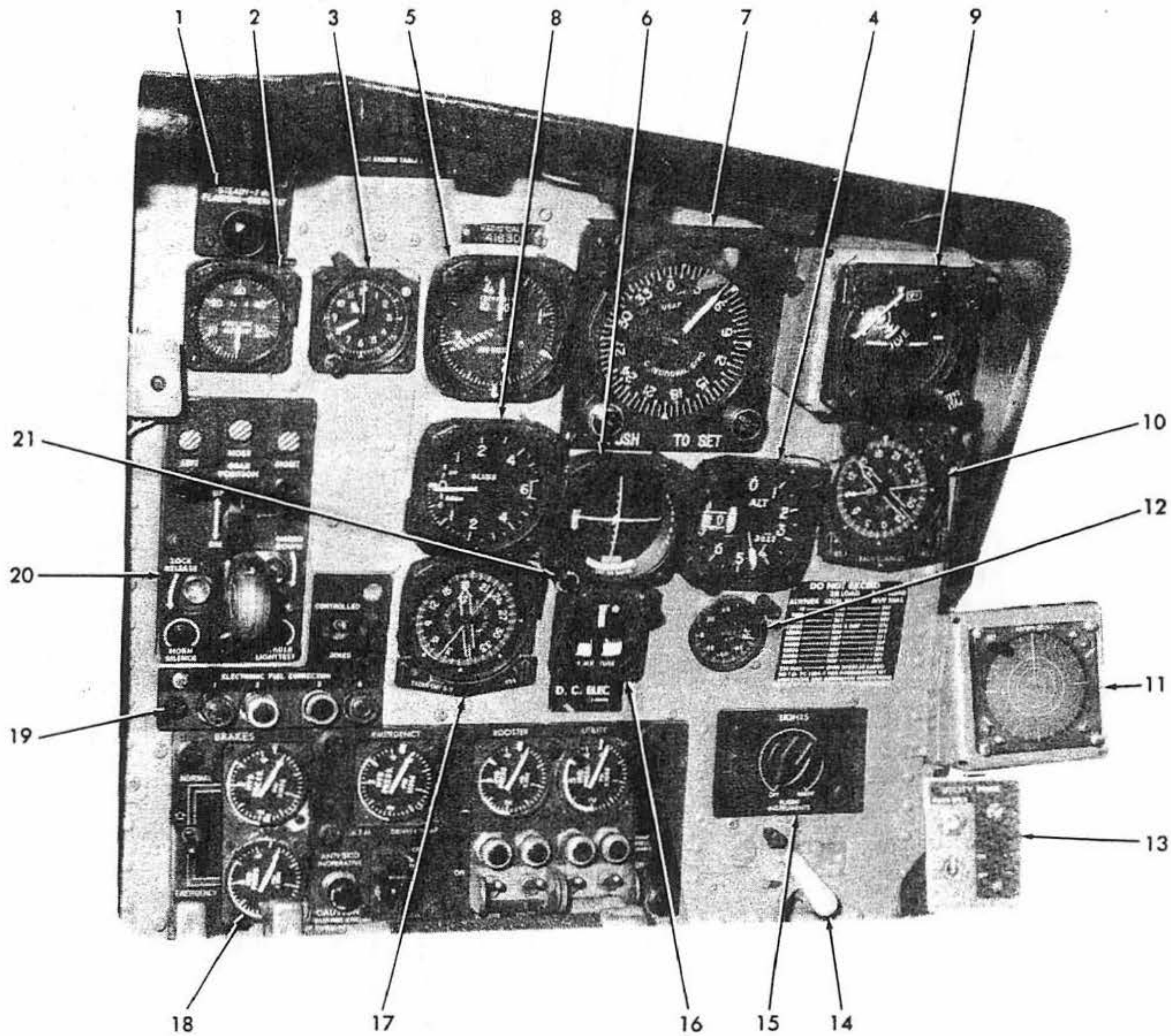


1. MAGNETIC COMPASS
2. AIRSPEED INDICATOR
3. COURSE INDICATOR
4. N-1 COMPASS REPEATER INDICATOR
5. ALTIMETER
6. ATTITUDE INDICATOR
7. DOOR WARNING LIGHT ⚠1
8. RADAR ALTIMETER
9. PILOT'S MULTIPLE INDICATOR
10. RADIO MAGNETIC INDICATOR
11. ELEVATOR TRIM TAB POSITION INDICATOR
12. WING FLAP POSITION INDICATOR
13. LOW OIL QUANTITY LIGHT
14. ENGINE AND PILOT'S INSTRUMENT LIGHT CONTROL PANEL
15. AILERON TRIM TAB POSITION INDICATOR
16. FM HOMING INDICATOR
17. MARKER BEACON SWITCH
18. REMOTE ATTITUDE GYRO SWITCH (ATTITUDE INDICATOR)
19. RUDDER TRIM TAB POSITION INDICATOR
20. CLOCK
21. COMPASS CORRECTION CARD
22. TURN AND SLIP INDICATOR
23. BEARING DISTANCE HEADING INDICATOR
24. FLARE JETTISON SWITCH
25. ID-48 STEERING INDICATOR
26. ARU-11/A ATTITUDE INDICATOR
27. MARKER BEACON LIGHT
28. VERTICAL VELOCITY INDICATOR
29. ACCELEROMETER

⚠1 DOOR WARNING LIGHT IS LOCATED ON COPILOT'S INSTRUMENT PANEL ON SOME AIRPLANES.

Figure 1-53.

copilot's instrument panel typical



1. MASTER FIRE WARNING LIGHT PANEL ⚠1
2. CABIN PRESSURE ALTITUDE INDICATOR
3. CLOCK
4. ALTIMETER
5. AIRSPEED INDICATOR
6. COURSE INDICATOR
7. HEADING INDICATOR
8. VERTICAL VELOCITY INDICATOR
9. ATTITUDE INDICATOR
10. RADIO MAGNETIC INDICATOR
11. AN/ALR 46 INDICATOR
12. FREE AIR TEMPERATURE INDICATOR
13. UTILITY PRIME SWITCH
14. AIR DIVERTER HANDLE
15. COPILOT'S INSTRUMENT LIGHT CONTROL
16. TURN AND SLIP INDICATOR
17. RADIO MAGNETIC INDICATOR
18. HYDRAULIC CONTROL PANEL
19. ELECTRONIC FUEL CORRECTION PANEL
20. LANDING GEAR CONTROL PANEL
21. MARKER BEACON LIGHT

⚠1 MASTER FIRE WARNING LIGHT PANEL IS LOCATED ON PILOT'S INSTRUMENT PANEL ON SOME AIRPLANES.

Figure 1-54.

are supplied by the pitot tubes on the forward fuselage and a static boom on each wing tip. For system schematic diagram see figure 1-55.

Vertical Velocity Indicators.

The two vertical velocity indicators, one mounted on the pilot's instrument panel (figure 1-53) and the other mounted on the copilot's instrument panel (figure 1-54), are differential-pressure-measuring instruments that indicate the rate of change in altitude of the airplane.

Airspeed Indicators.

The six airspeed indicators are instruments which use differential air pressure for determining airspeed. These indicators include one mounted on the pilot's instrument panel, one on the copilot's instrument panel, a true airspeed indicator on the navigator's instrument panel; and one airspeed indicator each on the IR, FCO, and TV operator consoles.

Altimeters.

The six altimeters are barometric-type instruments measuring variations in pressure by means of aneroid units. One altimeter is mounted on the pilot's instrument panel, one on the copilot's instrument panel, and one on the navigator's instrument panel; and one each on the IR, FCO, and TV operator consoles.

The pilot's (AAU-21/A) altimeter combines a conventional barometric altimeter and an altitude-reporting encoder in one self-contained unit. 10,000- and 1000-foot counter indicators and a 100-foot drum indicator provide a direct digital output and readout of altitude in increments of 100 feet, from -1000 to 38,000 feet. The digital output is referenced to 29.92 inches of mercury and is not affected by changes of barometric setting. A pointer repeats the indications of the 100-foot drum, and serves both as a venier for the drum and as a quick indication of the rate and sense of altitude changes. Two methods may be used to read indicated altitude on the counter-drum-pointer altimeter: (1) read the counter-drum window, without reference to the pointer, as a direct digital readout in thousands and hundreds of feet, or (2) read the thousands of feet on the two counter indicators, without referring to the drum, and then add the 100-foot pointer indication.

The pilot's (AAU-21 A) altimeter indicates pneumatic altitude referenced to barometric pressure and provides coded altitude information (Mode C) to the IFF transponder via the altitude encoder. The CODE OFF flag monitors only the encoder function of the altimeter. It does not indicate transponder condition. The AIMS altitude reporting function may be inoperative without the CODE OFF flag showing, in case of transponder failure or improper control settings. It is also possible to get a "good" Mode C test on the transponder control with the CODE OFF flag showing. Display of the CODE OFF flag indicates encoder power

pitot static schematic diagram

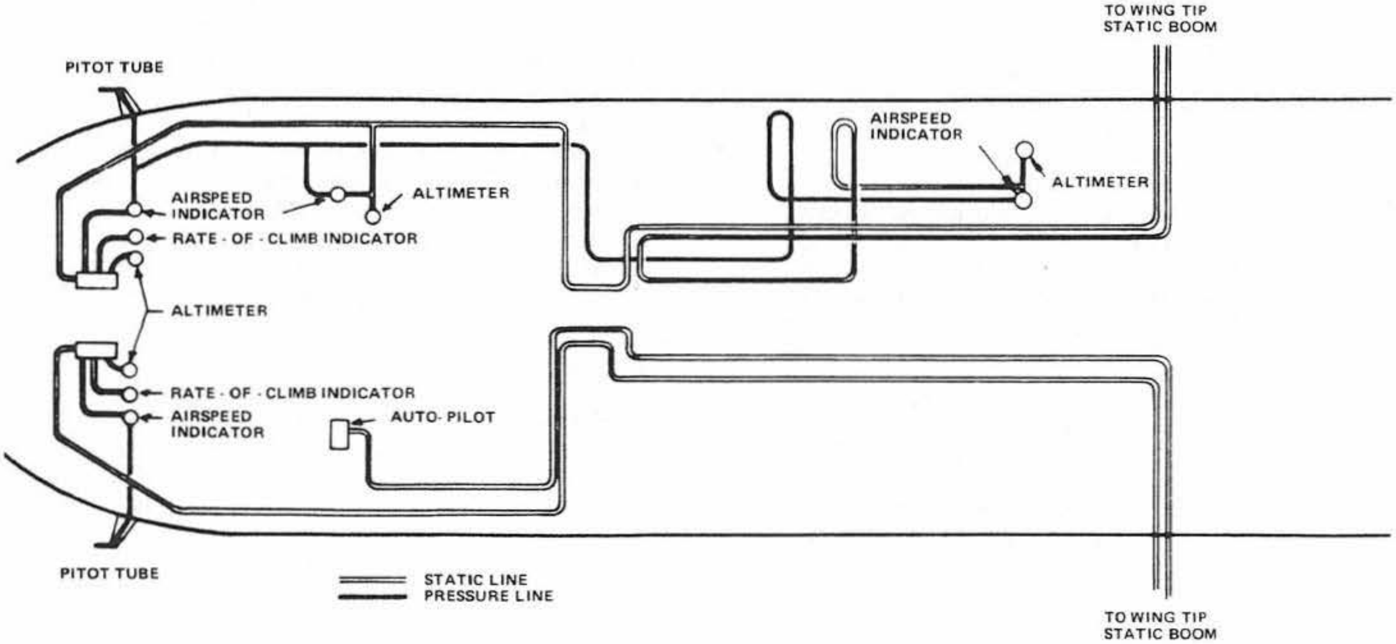


Figure 1-55.

failure or a CODE OFF flag failure. In this event, check that AC power is available and that the circuit breakers are in. If the flag is still visible, radio contact should be made with a ground radar site to determine whether the AIMS altitude reporting function is operative and the remainder of the flight should be conducted accordingly.

The altimeter setting is entered by use of a normally operated barometric set knob in the lower left front of the instrument case. The altimeter setting appears on counters in the window in the lower right of the display and has a range of settings from 28.1 to 31.0 inches of mercury.

An internal vibrator operates continuously whenever aircraft DC power is turned on. The vibrator minimizes internal mechanical friction, enabling the instrument to provide a smoother display during changing altitude conditions. Should vibrator failure occur, the altimeter will continue to function pneumatically, but a less-smooth movement of the instrument display will be evident with changes in altitude.

WARNING

If the altimeter's internal vibrator is inoperative due to either internal failure or DC power failure, the 100-foot pointer may momentarily hang up when passing through 0 (12 o'clock position). If the vibrator has failed, the 100-foot pointer hang up can be minimized by tapping the case of the altimeter. Pilots should be especially watchful for this failure when their minimum approach altitude lies within the 800 - 1000 foot part of the scale (1800 - 2000 feet, 2800 - 3000 feet, etc.), and should use any appropriate altitude back-up information available.

Note

The AAU-21/A and AAU-27/A altimeter employs a unique operating feature. The 10,000 foot and 1,000 foot counters remain in a fixed position during altitude changes while the 100 foot drum and pointer rotate continuously. When each 1,000 foot increment is nearly completed, the counter(s) abruptly index to the next correct digit making readings simpler to observe. However, the altimeter mechanism which provides this feature also causes a characteristic behavior of the pointer. This is a noticeable pause or hesitation of the pointer caused by the additional intermittent friction and inertia loads applied to the mechanism in order to turn over the counter wheel at thousand foot intervals as the pointer completes each revolution. This momentary pause is followed by a noticeable acceleration as the altimeter mechanism overcomes the counter wheel loads and rolls the dial over to the next thousand foot digit. This effect will be more pronounced at ten thousand foot intervals where both counters are turned over simultaneously. The pause occurs during the nine to one portion of the scale The pause and accelerate behavior is more pronounced at high altitudes and high rates of ascent and descent. During normal rates of descent at low altitudes the effect will be minimal.

The copilot's altimeter (AAU-27/A) is read in the same manner as the pilot's altimeter. However, the copilot's altimeter does not contain an altitude reporting encoder and, hence, no CODE-OFF window.

MISCELLANEOUS INSTRUMENTS.

Magnetic Compass.

A standard "floating card" type of magnetic compass (figures 1-53), mounted on the pilot's instrument panel, indicates the direction the plane is headed with respect to magnetic north. The N-1 gyro-stablized compass and its operation are described in NAVIGATION EQUIPMENT.

Accelerometer.

A Type MA-1 accelerometer on the pilot's instrument panel (figures 1-53) gives instantaneous as well as maximum and minimum readings of the g forces exerted on the airplane. The gage scale indicates readings of from plus 4 g's to minus 2 g's. The maximum and minimum indication needles will remain at highest readings until the PUSH TO SET button on the gage case is pushed, then they both will return to plus one g and immediately register maximum or minimum values until again reset. The accelerometer is designed for inflight use only and does not accurately measure g forces during landing. This instrument is to be used in conjunction with the information on structural limitations in Section V.

Clocks.

Five clocks are provided: One on the pilot's instrument panel, one on the copilot's instrument panel, one on the navigator's instrument panel, one at the IR operator's station, and one at the Electronic Warfare Officer's station.

EMERGENCY EQUIPMENT.

FIRE EXTINGUISHING SYSTEM.

A two-shot bromochloromethane (CB) fire extinguishing system (figure 1-56) is connected through a series of directional-flow valves to each of the four engine nacelles and to the gas turbine compressor compartment. The extinguishing agent is contained in four metal bottles mounted in the left wheel well, aft of the air turbine motor. Two bottles are discharged each time the system is actuated. A check valve prevents discharged bottles from being recharged when fresh bottles are fired. Each bottle is charged to approximately 400 PSI with nitrogen, the nitrogen acting as a propellant for the CB. Pressure gages are located on the neck of each bottle.

Fire Extinguishing System Controls.

The fire extinguishing system controls are located on the fire emergency control panel forward of the overhead electrical control panel. The fire extinguishing system control circuits use DC power supplied from the prop and engine bus.

BOTTLE SELECTOR SWITCH. A two-position (NORMAL, RESERVE) bottle selector switch (figure 1-56) is mounted on the fire emergency control panel. It transfers the release circuits from the two normal supply bottles to the two reserve supply bottles. When the extinguishing system is actuated, the switch in the normal position discharges the two normal supply bottles, and the switch in the reserve position discharges the two reserve supply bottles.

FIRE EMERGENCY CONTROL HANDLES. The five plastic fire emergency control handles (figure 1-56) are mounted on the fire emergency control panel. They operate emergency shutdown switches for the gas turbine compressor and the four engines. When an engine handle is pulled out, it closes DC circuits to operate valves which isolate the engine as follows:

a. Engine fuel flow is shut off at the fire wall and at the fuel control.

b. The engine bleed air valve is closed.

c. Engine oil flow is shut off at the tank.

d. A firewall hydraulic shutoff valve closes the suction line to the pump.

e. Hydraulic pump bypass valve is opened on airplanes AF56-0469 and up.

f. On some airplanes, generator cooling air valves are closed.

g. Engine start control circuit is de-energized.

h. Acceleration bleed valve solenoid is de-energized.

i. The fire extinguisher agent discharge control system is armed.

Pulling the engine fire emergency handle also causes feathering of the propeller.

When the GTC fire emergency control handle is pulled, the following actions occur:

a. GTC starting circuit is deactivated.

b. GTC oil shutoff valve is energized closed.

c. Holding relay is de-energized which de-energizes the bleed air valve control circuit and the GTC fuel relay.

d. GTC fuel relay being de-energized opens the circuit to de-energize the GTC boost pump and close the GTC fuel supply shutoff valve.

e. Energizes the ATM hydraulic shutoff valve closed.

f. Fire extinguisher agent discharge control system is armed.

DISCHARGE SWITCHES. Five discharge switches (figure 1-57), one for each engine and one for the gas turbine compressor compartment, are installed on the fire emergency control panel. These press-to-actuate discharge switches activate the directional-flow valves and energize the extinguishing agent release circuits. The discharge switches should not be activated until the propeller stops rotating. This insures that all fuel and hydraulic fluid valves are closed and sequenced properly, that fluid pumps come to a stop, and airflow through the nacelle is reduced. These switches are energized by 28-volt, DC power through the fire extinguishing circuit breaker from the propeller and engine bus.

Note

The fire emergency control handle must be pulled prior to the electrical circuit being completed to discharge the extinguishing agent. The corresponding discharge button, when held for five seconds, positions directional control valves, allowing the extinguishing agent to flow to the engine selected.

fire extinguishing system

NOTE

Electrically operated valves are solenoid operated, shown in the normal de-energized position. After discharging agent, open valves are held open by pressure in lines until the agent reaches the nacelle.

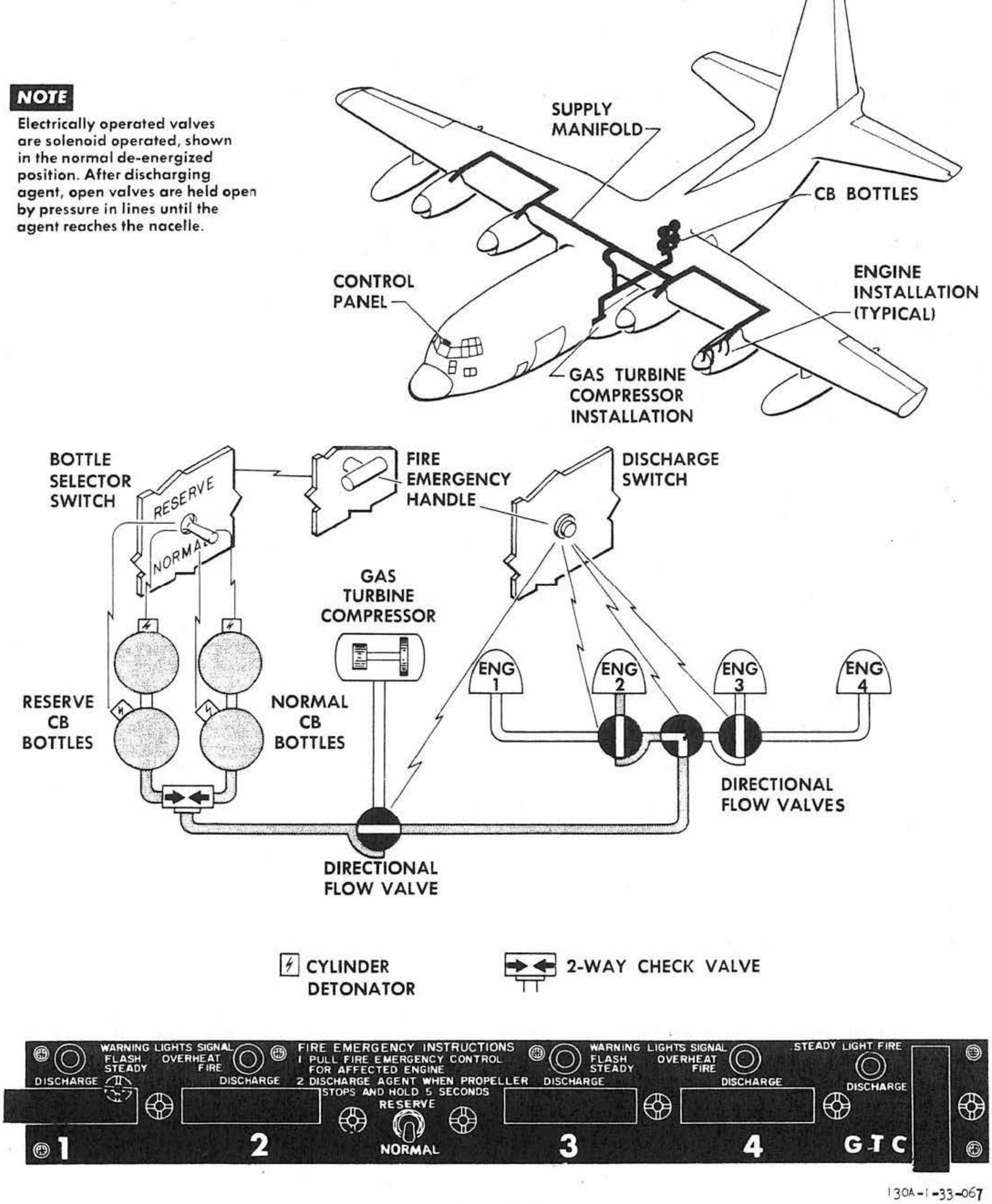
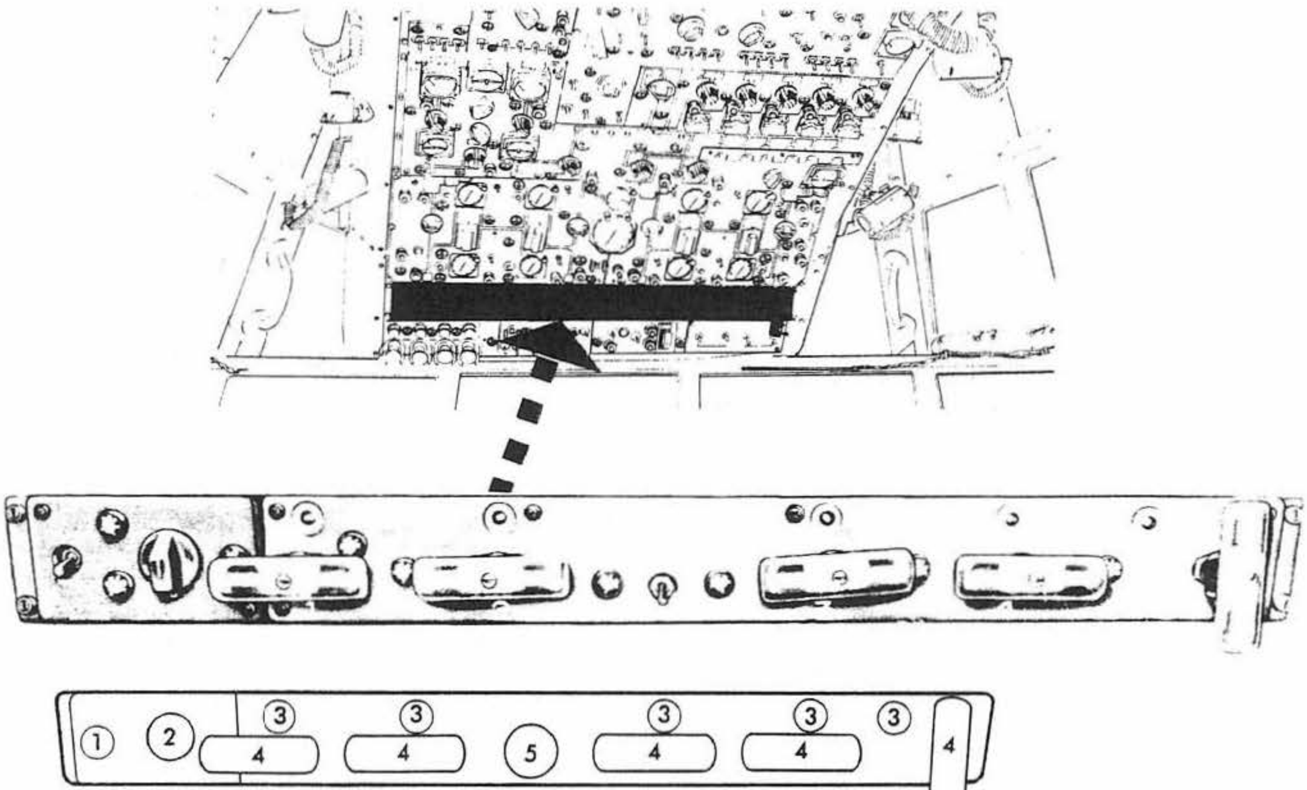


Figure 1-56.

fire emergency control panel



1. OVERHEAT DETECTOR TEST SWITCH
2. FIRE DETECTOR TEST SWITCH
3. DISCHARGE SWITCH
4. FIRE EMERGENCY CONTROL HANDLE
5. BOTTLE SELECTOR SWITCH

Figure 1-57.

ENGINE TURBINE OVERHEAT WARNING SYSTEMS.

An overheat warning system is provided for each engine. Each system consists of 4 thermal-switch detector units mounted in the "hot section" of the nacelle aft of the firewall, a flasher, and indicator lights. Components are interconnected so that an overheat condition sensed by any one of the detectors causes the lights to flash. The detectors are connected in parallel to a loop; and if part of the detectors are inoperable, the remaining detectors can still close the circuit to turn on the lights. The fenwal setting at which the detector lights will give an overheat warning is approximately 700°F. Power for energizing the systems is supplied from the dc prop and engine bus through circuit breakers labeled engine fire control handle lights, on the copilot's circuit breaker panel. A test switch permits testing all four systems at the same time.

Indicator Lights.

Two red lamps in each of the engine fire emergency handles (figure 1-57) flash to indicate an engine overheat condition.

Master Fire Warning Panel.

The master fire warning panel (figure 1-58) is located on the pilot's instrument panel. The panel lights are flashed whenever any one of the engine overheat warning systems senses an overheat condition. When the lights flash, the lights in the engine fire emergency handle flash also, and those lights indicate in which nacelle the overheat condition has been sensed. The master panel contains a master light and a panel light, both of which flash to indicate engine overheat.

NOTE

On some airplanes the MASTER FIRE WARNING light panel has been relocated from the pilot's instrument panel to the copilot's instrument panel. Operation of the system is unchanged by the relocation.

Overheat Detector Test Switch.

The overheat detector test switch (figure 1-57) is located on the warning system test panel on the overhead control panel. The switch has NORMAL and TEST positions. When positioned at TEST, it closes all four of the overheat warning system circuits in the same manner as if they were closed by detectors sensing an overheat condition. If the indicator lights all illuminate and flash when the switch is operated, circuit continuity and flasher operation are satisfactory. Operation of the detectors is not checked by the test.

FIRE DETECTION SYSTEMS.

The optical-type detector used in this system indicates the presence of fire in the engines and gas turbine compressor compartment(some airplanes)by detecting infrared radiation from a fire rather than by detecting a flickering light supplied by a fire. The optical detectors on these airplanes have ultraviolet and infrared wafer resistance elements. The wafers are placed so that radiation entering the detector must pass through the ultraviolet wafer before reaching the infrared wafer. Infrared rays from a source such as a fire will pass through the ultraviolet wafer with no electrical effect and cause a resistance drop in the infrared wafer. The resulting voltage difference between the two wafers causes a relay to close supplying power to the fire emergency control panel and indicator lights. These lights give a steady glow when activated. The test system checks, or verifies, the circuitry through the detectors, amplifiers, and fire emergency control panel. The fire detection system operates on 28-volt DC exclusively. Circuit breakers for the modified system are located on the copilot's circuit breaker panel.

Fire Detection Systems Indicator Lights.

Two lamps in each of the fire emergency handles provide fire indication. The red lamps in a handle illuminate whenever fire is detected in the corresponding nacelle. The lamps glow steadily to distinguish the indication from the flashing overheat warning indication. On some airplanes, the GTC fire warning system has been disconnected.

Master Fire Warning Panel.

The master fire warning panel (figure 1-58) is located on the pilot's instrument panel. The panel contains a warning light and a panel light. If fire is detected by any one of the detection systems, the panel and warning light are illuminated steadily. The steady light distinguishes the signal from an overheat warning indication, which is flashing of the same lights. When the master panel indicates fire, the lamps in one of the fire emergency handles will be illuminated also to indicate the location of the fire.

NOTE

On some airplanes the MASTER FIRE WARNING light panel has been relocated from the pilot's instrument panel to the copilot's instrument panel. Operation of the system is unchanged by the relocation.

Fire Detectors Test Switch.

The fire detectors test switch (figure 1-57) is located on the warning system test panel on the overhead control panel. It has a NORMAL position and A, B, C, D, E, F, and G positions. The lettered positions correspond to indicated locations of detectors in each of the detection systems. If the switch is positioned at A, for example, the A detectors of all five systems are electrically checked and verified. If the A detectors and the detection systems are functioning satisfactorily, the corresponding lights in the fire emergency handles and the light in the master fire warning panel illuminate. The other detectors are tested by turning the switch to each of the other positions. Since the gas turbine compressor uses only three detectors, they are tested on the A, B, and C positions of the switch. If the switch is at any other position, the lights in the GTC fire emergency handle do not illuminate.

HAND-OPERATED FIRE EXTINGUISHERS.

Five bromochloromethane (CB) fire extinguishers, one water-type fire extinguisher, and six fire fighter assemblies (type MB-1) are installed in the airplane to fight internal fires. For the location of the fire fighting equipment see figure 3-1.

ALARM SYSTEM.

Three combination alarm bell and bailout light assemblies are installed in the cargo compartment. One is

master fire warning light panel

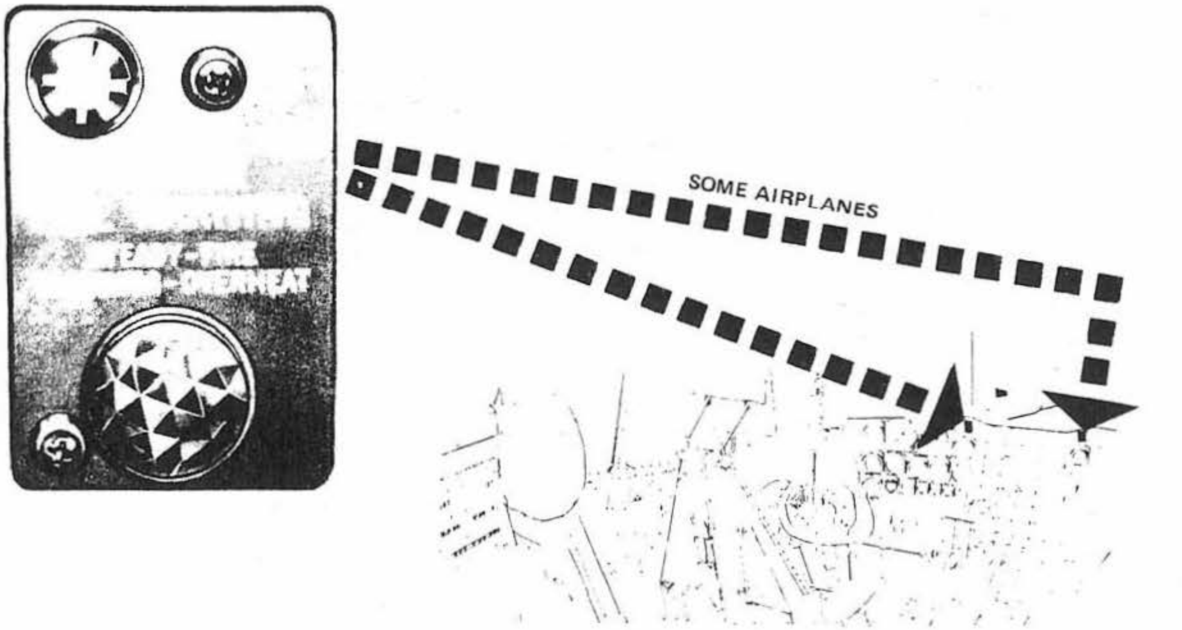


Figure 1-58.

located near the crew entrance door, one in the operators' booth, and one forward of the right paratroop door. The alarm bells and lights are controlled by the pilot's and copilot's ALARM BELL switches. When either of these switches is closed, the cargo and ramp dome lights automatically illuminate bright. To de-energize the lights, the CARGO AREA LIGHT EXTINGUISH pushbutton, located on the pilot's side panel, must be pressed. The alarm system operates on 28-volt dc power from the battery bus and overload protection is provided by circuit breakers located in the battery compartment.

DOOR WARNING SYSTEM.

The door warning system consists of a warning light on the main instrument panel and limit switches on all of the airplane doors. The light is labeled DOOR WARNING and is located on the pilot's instrument panel. If any one of the doors (crew, paratroop, aft cargo door, or the ramp) is not securely locked, one of the light switches will be closed, completing a circuit to energize the light.

NOTE

The door warning system circuit breaker will be pulled except for ferry flights.

FIRST AID KITS.

Five small first aid kits are located in the airplane and also two large combat first aid kits. For the location of these kits, see figure

HAND AXES.

Five hand axes are located throughout the airplane. See figure 3-1.

FLASHLIGHTS.

Two flashlights are added to the airplane emergency equipment for use in the event of complete electrical failure or for use after abandoning the airplane. One is located in the operators' booth and one is located on the outside of the aft wall of the operators' booth.

EMERGENCY EXIT LIGHTS. (Airplanes Modified by T.O. 1C-130-784 and T.O. 1C-130(A)A-521.)

Five portable, battery-operated emergency lights are installed on stationary terminal blocks located near each normal and emergency exit. One light is installed near the right paratroop door, one near the emergency exit on the right side of the forward fuselage, and one near each of the overhead emergency escape hatches. When installed, the lights can be either individually controlled by a three-position (ON, OFF, ARMED) switch on each light assembly or collectively extinguished by depressing an emer exit light extinguish pushbutton on a panel at the side of the overhead electrical control panel. On airplanes modified by T.O. 1C-130(A)A-521, the emergency exit light extinguish panel has been relocated from the pilot's left side panel to the paratroop jump panel. In order for the emer exit light extinguish pushbutton to be able to extinguish a light, the associated light assembly switch must be positioned to ARMED. An inertia switch in each light assembly actuates the light if the airplane is subjected to a decelerating force exceeding 2-1/2g's. The lights will also illuminate if fuselage bus power fails. An individual light assembly can be removed for emergency portable use by pulling a release handle on the light assembly. Internal batteries furnish power to the light. The control system for the installed system is supplied 28-volt DC power from the fuselage bus through the emer exit light cont circuit breaker on the main DC distribution box, and from the battery bus through the emer exit light ext circuit breaker in the battery compartment.

LIFERAFTS.

Stowage provisions exist for installation of four 20-man pneumatic liferafts (figure 3-1) in the trailing edge of the center wing section. Liferaft release handles are located as follows: two on the flight station aft bulkhead at the top of the flight deck escape ladder, two on the fuselage structure aft of the paratroop door; and two on the wing upper surface inboard of each raft storage compartment. The release handles on the wing upper surface can be reached by removing the protective canvas covering over the handle openings. The rafts are automatically inflated upon actuation of the release handles.

PARACHUTE AND SURVIVAL KIT STORAGE PROVISIONS.

There are storage provisions for chest-type parachutes and harness assemblies along the left-hand wheel well wall, aft of bulkhead 245, and on the forward outside wall of the booth.

LIFE VESTS.

There are provisions for stowing four life vests (figure 3-1) in canvas containers on the flight station aft bulkhead.

ANTI-EXPOSURE SUITS.

There are provisions for stowing four anti-exposure suits (figure 3-1) in canvas containers on the flight station aft bulkhead.

PYROTECHNIC PISTOL.

A pyrotechnic pistol (figure 3-1) is stowed in a gun mount on the forward side of the flight station bulkhead.

CAUTION

To avoid firing the pyrotechnic pistol with the pressure port closed, do not touch the trigger of the pistol until the trigger guard is in the fully extended position.

EMERGENCY ESCAPE EXITS.

Three overhead emergency escape hatches and a side emergency exit panel (figure 3-2) are provided on the airplane. The overhead emergency escape hatches are located forward of the flight station aft bulkhead, aft of the center wing section, and above the aft cargo door. The side emergency exit panel is located forward of the right wheel well. An emergency escape lever is mounted on the fuselage adjacent to each emergency escape exit. Moving this lever releases the locking latches, and allows the hatch or exit panel to be pulled into the airplane. The hatches and side exit panel may be released from outside of the airplane by means of flush-type finger handles mounted in the fuselage skin. Pulling these handles releases the hatches and side emergency exit panel in the same manner as do the emergency escape levers. Emergency chopping locations are identified by yellow markings, both inside and outside the airplane. These locations are above and forward of the paratroop door on each side of the airplane.

ALTERNATE EXITS.

Additional exits that may be used for emergency evacuation of the airplane include the ramp, right paratroop door, and the two hinged windows in the flight station. (Refer to Section III.)

EMERGENCY ESCAPE ROPES.

An emergency escape rope is installed aft of each overhead emergency escape hatch. One end of each rope is fastened to the fuselage structure. The ropes are looped in a bundle and are secured near the hatches in snap-fastened straps.

CREW ENTRANCE DOOR.

Normally the crew entrance door is removed. A modified door may be installed for ferry flights. Crew entrance will be made through the right paratroop door or ramp.

CAUTION

No attempt should be made to enter the airplane through the crew entrance door. Such action may result in damage to the TV/laser mountings.

Crew Entrance Door Jettison Handle.

The crew entrance door jettison handle (figure 1-60) is a yellow handle located on the ceiling of the flight station, three feet to the left of the centerline of the airplane and slightly aft of the pilot's seat. Pulling the handle down actuates a cable through a bell crank assembly to pull the locking pins from the top of the door at the same time that the hinge pins drop from the bottom hinge and the telescoping counterbalance is released.

SEATS.

The pilot and copilot are provided with tapered-back seats (figure 1-61) designed for use with back-style parachutes. The flight engineer and navigator have square-back seats, on swivel bases, which are adjustable both fore-and-aft and up and down. Headrests may be stowed when not in use at the rear of the pilot's or copilot's seats. Raising a vertical adjustment lever on the right side of each seat releases vertical locking pins and permits the seats to be raised by spring pressure or lowered by the weight of the occupant. A horizontal adjustment lever on the left side of each seat, when raised releases horizontal locking pins and permits the seat to be moved fore or aft. Raising swivel release levers, located forward of the vertical adjustment levers on the right side of the flight engineer's and navigator's seats, releases a locking device and permits these seats to be swiveled.

SEAT CONTROLS.

Seat controls are designed to adjust the seat position to the physical build of the individual crew member. They are easily adjusted to the comfort of the crew member and may be locked in any desired position.

emergency exit lights extinguish switch panel

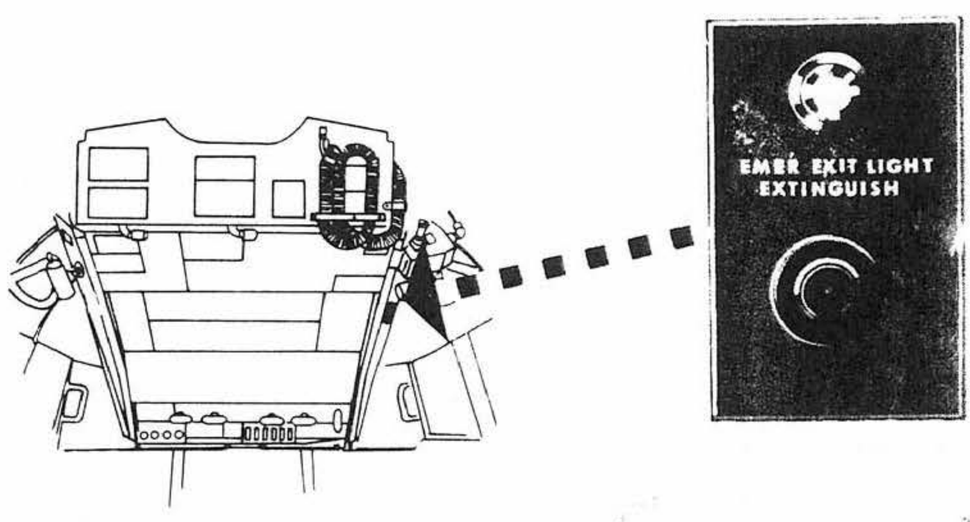


Figure 1-59.

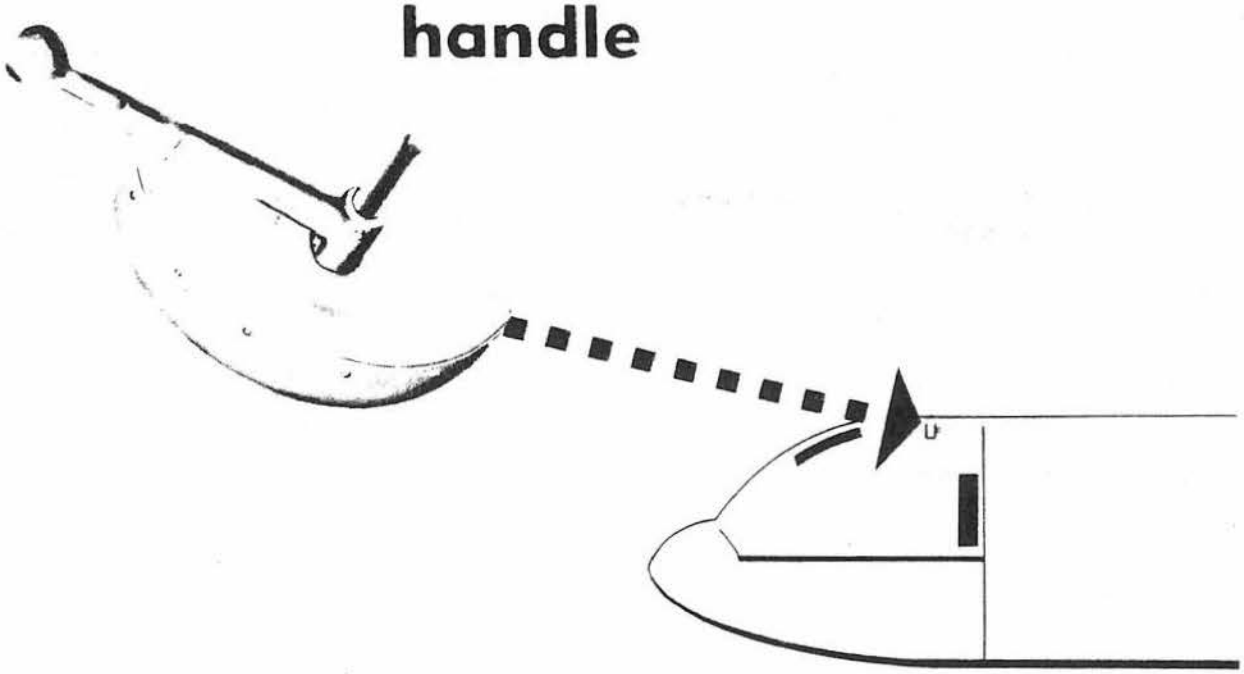


Figure 1-60.

Pilot's and Copilot's Seat Tilt Lever.

CAUTION

The pilot's and copilot's seat tilt levers should not be actuated on seats that have the armored panels installed. The armored side panel may pull loose from its attaching bracket by reclining the seat.

A seat tilt lever, located on the right side of the pilot's and copilot's seats, is a manual control which tilts the seat forward or aft.

Horizontal Adjustment Lever.

A horizontal adjustment lever, located on the left side of the seats, locks and unlocks the seat adjustment mechanism, allows the seat to be adjusted from an aft to a forward position. Placing the lever in the FORWARD detent locks the adjustment mechanism. Placing the lever in the AFT detent unlocks the adjustment mechanism.

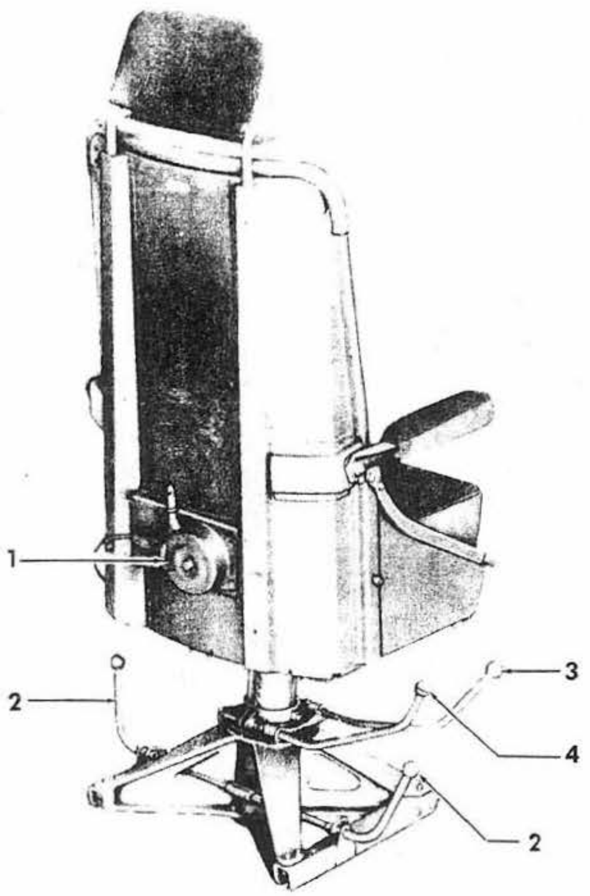
Swivel Release Lever.

A swivel release lever, located on the right side of the flight engineer's seat, controls the radial movement of this seat. When the swivel release lever is raised, the seat-locking device is released and the seat can be rotated to any desired position. When the lever is released, the locking device engages to prevent rotation of the seat.

Vertical Adjustment Lever.

A vertical adjustment lever, which is spring-loaded to the lock position, is located at the right side of each seat. The seat itself is spring-loaded to its uppermost position. To adjust the seat for height, sit down in the seat, at the same time pulling up on

crew seats



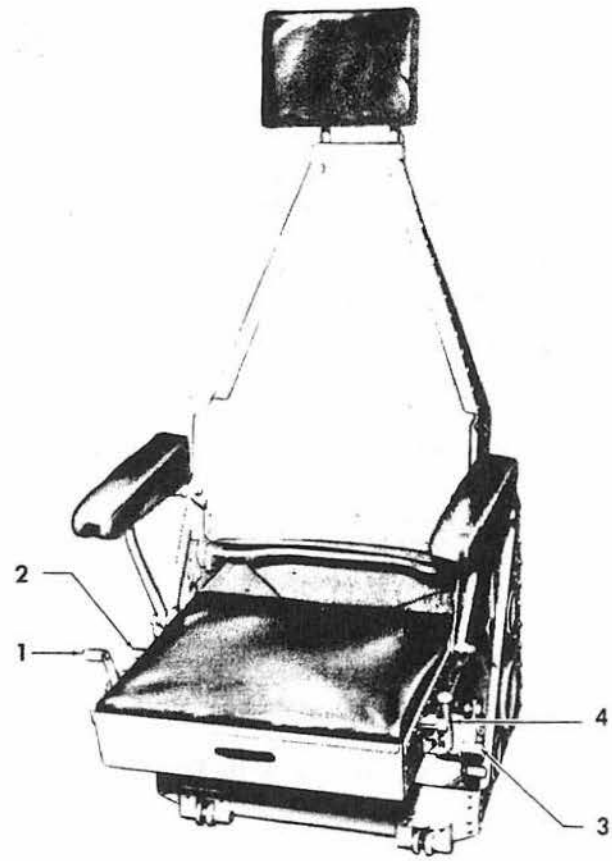
NAVIGATOR'S AND FLIGHT ENGINEER'S AND SENSOR OPERATOR'S SEATS

1 INERTIA REEL

2 HORIZONTAL ADJUSTMENT LEVER

3 SWIVEL RELEASE LEVER

4 VERTICAL ADJUSTMENT LEVER



PILOT'S AND COPILOT'S SEATS

1 SEAT TILT LEVER

2 VERTICAL ADJUSTMENT LEVER

3 HORIZONTAL ADJUSTMENT LEVER

4 INERTIA REEL LEVER

Figure 1-61.

the vertical adjustment lever. The seat will tend to move up or down, depending on the weight applied to it. When the desired height is attained, release the lever, which will lock the seat in the desired position.

SENSOR OPERATOR SEATS.

Four type E-1 seats are installed in the operator's compartment for use by the infrared (IR) operator, electronic warfare officer (EWO), FCO, and TV operator.

CRASH SEATS.

A minimum of seven crash seats are installed in the airplane. Six of these are located on the cargo ramp, and one is inboard of the electronics rank forward of the booth. These seats will be used by the weapons mechanics and illuminator operator.

SCANNER SEAT.

A scanner's seat is located aft of the electronic equipment rack adjacent to the right side emergency exit.

WARNING

The Scanner's seat is not stressed for crash landing and will not be used for takeoff and landing.

SAFETY BELTS AND SHOULDER HARNESS.

All crew seats are provided with a conventional seat safety belt and shoulder harness.

Shoulder Harness Inertia Reel Lock Control Handle.

A two-position (LOCK, UNLOCKED) shoulder harness inertia reel lock control handle (figure 1-60) is located on the left of the pilot's and copilot's seats. A latch is provided for retaining the control handle securely at either position. By pressing down on the top of the control handle, the latch is released and the handle may be moved freely from one position to another. When the control is in the UNLOCKED position, the reel harness cable will extend to allow the pilot to lean forward in his seat; however, the reel harness cable will automatically lock when an impact force of two or three g's on the airplane is encountered. When the reel is locked in this manner, it will remain locked until the control handle is moved to LOCKED andthen return to the UNLOCKED position. When the handle is in the LOCKED position, the reel harness cable is manually locked so that the pilot is prevented from bending forward. The LOCKED position is used only when a crash landing is anticipated. This position provides an added safety precaution over and above that of the automatic safety lock. The automatic feature of the inertia reel control cannot be checked by the flight crew. The navigator's and flight engineer's inertia reels will not function automatically nor will the shoulder harness provide proper restraint if the seats are facing sideways. This is due to the plane of the inertia weight and spring.

AUXILIARY EQUIPMENT.

The following equipment and its operation are described in Section IV of this manual.

Bleed Air System
Air Conditioning Systems
Cabin Pressurization System
Anti-icing and Deicing Systems
Communication and Associated Electronic Equipment
Autopilot
Navigation Equipment
Navigator Station
Booth Consoles
Lighting System
Oxygen System
Armament Equipment
Sensor Slaving System
Airborne Illumination Light Set, AN/AVQ-8
Airborne Searchlight Set, AN/AVQ-17
Flare Launcher, LAU-74/A
Flare Ejector Set, AN/ALE-20(V)
Low Light Level Television, AN/ASQ-145(V) (GLINT)
Video Recorder Set, AN/AXH-2
Solid State Laser Illuminator, AN/AAQ-7
Laser Target Designator, AN/AVQ-18
Stabilized Tracking Set, AN/AJQ-24
Infrared Detecting Set (IDS), AN/AAD-7
Black Crow ASD-5
Radar Set APQ-150
Auxiliary Power Plant
Aft Cargo Door and Ramp System
Air Deflectors
Miscellaneous Equipment

The following equipment and its operation are described in T.O. 1C-130(A)A-1-1:

AN/APR-25
AN/APR-26
ALR-46
TRIM-7A
AN/ALQ-87

SERVICING DIAGRAM

ITEM	UNIT	AGENT	SPECIFICATION	NATO SYMBOL
1	Propeller Reservoir (4 places)	Propeller Fluid	Esso Standard Oil Gov. No. 1191X, American Oil Gov. No. 6603X, FSN 9150-473-9849 Humble Oil, Gov. No. 3106X ⚠1	
2	Engine Oil and Starter Oil	Lubricating Oil	MIL-L-7808 or MIL-L-23699 ⚠2	0-148 or 0-156
3	Hydraulic Accumulators (4 places)	Dehydrated Air		
4	Fuel tanks-single Point Refueling Receptacles	Turbine Fuel	MIL-F-5624, JP-4 and JP-5 ⚠3	F-40 and F-44
5	Utility and Booster Hydraulic Reservoirs (1 place each)	Hydraulic Fluid	MIL-H-5606	H-515
6	Emergency Hydraulic Reservoir (1 place)	Hydraulic Fluid	MIL-H-5606	H-515
7	Gas Turbine Compressor	Lubricating Oil	MIL-L-7808 or MIL-L-23699 ⚠2	0-148 or 0-156
8	Air Turbine Motor	Lubricating Oil	MIL-L-7808 or MIL-L-23699 ⚠2	0-148 or 0-156
9	Fuel Tanks Wing Filler Points (4 places)	Turbine Fuel	MIL-F-5624, JP-4 and JP-5 ⚠3	F-40 and F-44
10	Fuel Tanks-Pylon (2 places)	Turbine Fuel	MIL-F-5624, JP-4 and JP-5 ⚠3	F-40 and F-44
11	Fire Extinguisher System Bottles (Engine and GTC)	Bromochloromethane	MIL-B-4394	
12	Flare Launcher LAU-74A	Dehydrated Air		
13	Liquid Oxygen Filler	Liquid Oxygen	MIL-0-27210, GRADE B Type II	
14	Aircraft Battery	Distilled Water		
15	7.62mm Gun Battery (2 places)	Distilled Water		
16	20mm Gun Battery (2 places)	Distilled Water		
17	AN/AAD-7 Detecting Set Compressor	Helium	BB-H-1168	

SERVICING DIAGRAM (CONT)

ITEM	UNIT	AGENT	SPECIFICATION	NATO SYMBOL
18	Laser Illuminator	Nitrogen	BB-N-411	
19	External Power Receptacle	De-icing and De-frosting Fluid	MIL-A-8243	S-739

1. These fluids are the only types authorized.

2. In emergencies MIL-L-7808 and MIL-L-23699 may be mixed. The amount of emergency oil added should not exceed one half tank capacity. At first opportunity, the oil will be drained and engine serviced with proper oil.

3. Refer to Section V for alternate fuels.

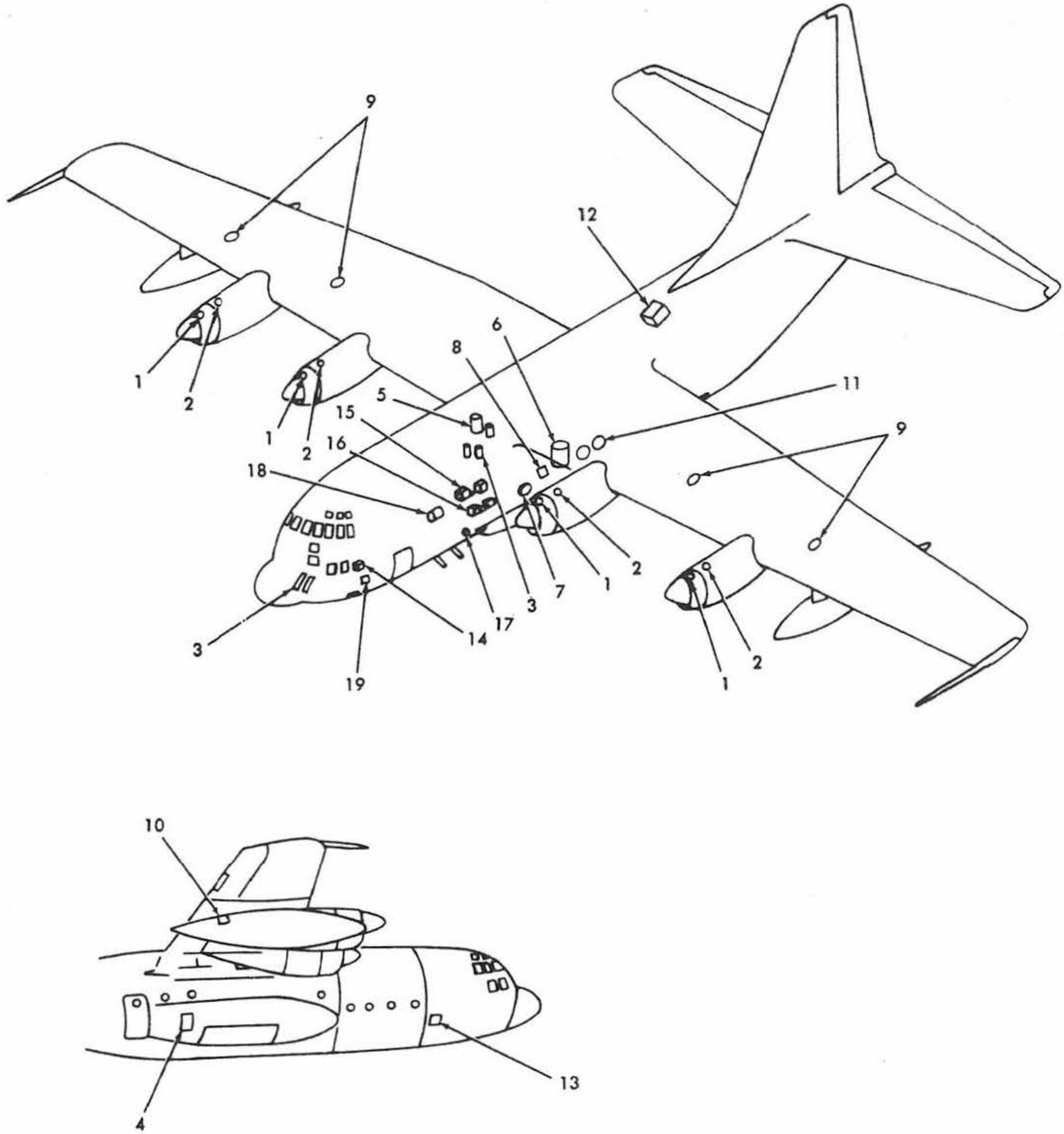


Figure 1-62.

SECTION II

normal procedures

Table of Contents

PREPARATION FOR FLIGHT.

FLIGHT RESTRICTIONS.

Refer to Section V of this handbook for information concerning the restrictions imposed on the airplane in flight.

FLIGHT PLANNING.

The wide range of speeds and altitudes possible with the airplane requires that careful attention be given to mission planning and cruise control. Remember that turboprop-powered airplanes use considerably more fuel at low altitudes than similar reciprocating engine airplanes. Use the performance charts in T.O. 1C-130(A)A-1-2 to find required fuel quantities, take-off distances, airspeeds, and power settings.

TAKE-OFF AND LANDING DATA CARD.

A take-off and landing data (TOLD) card is provided in the pilot's flight crew checklist, T.O. 1C-130(A)A-1CL-1 and flight engineer's flight crew checklist, T.O. 1C-130(A)A-1CL-10. The pilot will ensure that a TOLD card has been completed prior to take-off and landing. Take-off and landing data may be obtained from the take-off and landing data computations performance charts in T.O. 1C-130(A)A-1-2 or the take-off and landing data computer.

WEIGHT AND BALANCE.

Check the airplane weight and balance (refer to T.O. 1-1B-40, "Handbook of Weight and Balance"). Make sure that the weight and balance clearance (Form 365F) is complete and correct. Refer to Section V of this handbook for weight limitations for the airplane, and check the take-off and anticipated landing gross weights.

CHECKLISTS.

There are two categories of checklists contained in this section. They are mandatory and nonmandatory.

Nonmandatory Checklists.

These checklists cover phases of action which need not be performed with direct reference to a checklist. The flight crew is required to review these checklists before entering the indicated phase of action and to use them for cleanup after a procedure has been completed. The nonmandatory checklists are listed below:

Mandatory Checklists.

These checklists cover the phases of action that shall be performed in conjunction with direct reference to the appropriate checklist. All checklists not listed under the nonmandatory paragraph are mandatory except items 1 and 2 of the pilot's After Takeoff checklist. The Preflight and Cockpit checklists are non-challenge type checklists provided for the purpose of preparing the airplane for flight by checking systems operation and inspection of the airframe. These checklists will normally be accomplished by the individual crew member as indicated on that crew members checklist. Actual accomplishment may be delegated by the pilot as required. The flight engineer will assure that all access panels, escape hatches, and landing gear doors are closed/secure after completion of his preflight. Crew members will inform the pilot of any preflight checks that are not complete. The remainder of the checklists are performed on each flight with all necessary crew members in their respective duty positions. Each checklist for a phase of operation will be initiated by the pilot except as indicated in the narrative introduction to that checklist. The copilot will read the pilot's checklist. Only the response items need be read aloud. The copilot will accomplish all non-response items prior to proceeding to the next item. When a checklist item is followed by a crew position (i.e., (P), (CP), (E), etc.) that crew member takes the action and if the action is in quotes, responds aloud to the person reading the checklist. When more than one crew member has the same response to the same item, all subsequent to the initial crew member responding need respond only with his crew position. Sequence of response will be in the order as shown on the checklist. At the completion of each phase of operation (checklist), the response by the last crew member listed indicates that the applicable checklist is complete. Before answering a challenge that indicates a panel or system, the responsible crew member will assure that all switches/controls on that panel/system are as indicated by the subitems (letters) in the amplified checklist. When landing gear or flaps appear on a checklist, the item will be coordinated with the pilot prior to accomplishment if the aircraft is moving. Items not applicable to the airplane/mission being flown need not be challenged nor responded to. System checks or items not requiring crew coordination may be accomplished prior to the challenge when practical beginning with the Before Starting Engines checklist through the After Landing checklist. This does not preclude response to the checklist when the item is called by the copilot. The codes used in these checklists are:

P-Pilot	FCO-Fire Control Officer
CP-Copilot	EWO-Electronic Warfare Officer
E-Flight Engineer	IR-IR Operator
N-Navigator	TV-TV Operator
IO-Illuminator Operator	
WM-Weapons Mechanic	
GC-Ground Control	

The FCO will respond for all positions in the booth and the IO will respond for all crew members in the cargo compartment.

NOTE

A comma between crew positions or responses indicates that both will be applicable. A virgule (/) between positions of responses indicates that either one or the other will apply.

THRU FLIGHT OPERATION.

When the airplane is flown on the same mission and no maintenance or servicing is required, it is unnecessary for the Preflight Checks to be performed after the first flight of the day. When maintenance or servicing is required, only those items or systems affected need be checked prior to the next flight. The checklists have been designed so, for through-flight operation, the flight crew may begin with the COCKPIT checklist to assure safe operation.

ENTRANCE.

Entrance to the airplane will be through the right paratroop door or the ramp.

CAUTION

Do not enter through the crew entrance door because of possible damage to the TV/Laser equipment.

PREFLIGHT CHECK.

Enter the airplane flight station. Consult Form 781 to find the status of the airplane. Check that the airplane has been serviced with the proper amounts of fuel, oil, and oxygen. It is the responsibility of the pilot to insure that a preflight inspection has been performed as required by T.O. 1C-130A-6 and 1C-130(A)A-6, Technical Manual Inspection Requirements. Preflight checks are normally performed by the flight engineer: however, the pilot may designate other personnel to assist him.

NOTE

The aircrew inspection procedures outlined in this section are predicated on the assumption that maintenance personnel have completed all the requirements of T.O. 1C-130A-6 and T.O. 1C-130(A)A-6, Technical Manual Inspection Requirements: therefore, duplicate inspections and operational checks of systems by aircrew members have been eliminated, except for certain items required in the interest of flying safety.

BEFORE EXTERIOR INSPECTION

1. Prior to entrance — Checked
    - a. Chocks — In place
    - b. Static ground wire — Connected
    - c. External AC and DC power — In place (when available)
    - d. Nose gear lock — In place
    - e. ATM intake plug/Air conditioning duct plugs — Removed
    - f. Fire extinguisher — Serviceable/In Place
    - g. Airplane location (for emergency notification purposes) — Noted

NOTE

Items marked with an asterisk or double asterisk will normally be checked by the IO and Weapons Mechanics respectifully. If the IO and Weapons Mechanics are not on board these items will be checked by the flight engineer.

WARNING

All guns and dispensers will be electrically and mechanically safe and the loading sectors installed in the 7.62MM guns, before power is applied to the airplane.

2. Form 781	Checked
a. Status of airplane	Checked
b. Fuel, oil and oxygen service	As required
*3. Flare dispensers junction box	Checked
a. Right ALE-20 switch	Normal
b. Left ALE-20 switch	Normal
*4. Flare launcher (LAU-74/A)	SAFE
a. Power lead connector	Disconnected/Stowed
b. Shorting plug	Installed
c. Main selector valve	OFF
d. Air bottles	OFF
e. Manual jettison handle	Down/Safetied
f. Jettison safety pin	Installed

WARNING

Aft cargo door will be open anytime flares are stored in the LAU-74/A, if the pneumatic valves are open or the electrical cables connected.

*5. 40 KW illuminator power switch	Checked/OFF
*6. ALE-20 power switch	SAFE
7. Sensors position (booth panel) (if Sensors Operators not aboard)	Checked
a. Attitude reference switch	Two Axis
b. IR set control switch	OFF
c. IR gimbal control switch	OFF
d. RADAR control switch	OFF
e. ECM pod control switches	OFF
f. ASD-5 switch	OFF
g. TRIM 7 switch	OFF
h. APQ-150 switch	OFF
i. Chaff control launch switch	OFF
j. Cargo compartment temp control switches	OFF
k. Cargo compartment recirculation switch	OFF

l. TV camera power switch	OFF
m. Laser fire switch	OFF
n. Laser illuminator power switch	OFF
o. 2 KW illuminator power switch	OFF
** 8. Guns (if Weapons Mechanic not aboard)	SAFE
a. 40 MM	
(1) Arm switches	SAFE
(2) Firing selector lever	STOP FIRE
(3) Breech	Clear
**b. 7.62 MM	
(1) Arm switches	SAFE
(2) Drive motor and clearing solenoid electrical connectors	Disconnected
(3) Loading sectors and safing bars	Installed
**c. 20 MM	
(1) Arm switches	SAFE
(2) Firing electrical connectors	Disconnected
9. Cargo compartment	Checked
a. Hydraulic reservoirs	Checked
b. Spare hydraulic fluid	Checked
c. ALE-20 power switch	SAFE
d. Oxygen shutoff valve	OPEN
e. Circuit breaker panel sta. 255	Checked
f. Liquid nitrogen dewar	Checked

NOTE

Fifty per cent (50%) service minimum for one mission.

10. Flight station	Checked
a. Portable oxygen bottles pressure	Checked
b. Copilots oxygen panel	OFF/100%
c. Copilots circuit breaker panel	Checked
d. Copilots radios	OFF

11. Navigator's panel	Checked
a. Radome anti-icing	OFF
b. Radar	OFF
c. IFF (some airplanes)	OFF
12. Main power distribution panel	Checked
13. Emergency equipment	Checked
a. Escape rope	Checked
b. Emergency exit light/Flashlight	ARMED/Checked
c. First aid kit	Checked
d. Fire extinguisher	Checked
e. Hand axe (some airplanes)	Checked
f. Restraining harness	Checked/Fitted
14. Crew entrance door jettison handle	Safetied
15. Control booster shutoff switch	Safetied
16. Circuit breaker panels	Checked
a. Radio junction box	
SEE 5-19 b. Flight station distribution panel	
c. ADDED	
17. Portable oxygen bottles	Checked
18. Pylon tanks pump switches	OFF
19. Pressurization system test valves	OPEN/Safetied
20. Flare launcher jettison switch	OFF/Safetied
21. ALE-20 master arming switch	OFF
22. Weapons panels	Set
a. All gun switches	OFF/LO RATE
b. Fire mode switch	AUTO
23. Engineer's ALE-20 switch	SAFE
24. Nacelle preheat switches	OFF
25. GTC control panel	Set
a. Control switch	OFF
b. Bleed air valve switch	CLOSED
c. ATM switch	STOP
d. Fuel tank selector switch (some airplanes)	LH INT

26.	Air Conditioning panel	Set
	a. Master switch	OFF
	b. Emergency depressurization switch	NORMAL
	c. Flight deck and cargo compartment shutoff switches	NORMAL
	d. Flight deck temperature control	OFF/NORMAL
27.	Anti-icing panel	Set
	a. Wing and empennage anti-icing switch	OFF
	b. Pitot heat switch	OFF
	c. NESA windshield switches	OFF
	d. Engine inlet air duct anti-icing switches	OFF
	e. Propeller ice switches	OFF
28.	Fuel control panel	Set
	a. Tank selector switches	INT TANK TO ENG
	b. Boost pump switches	OFF
	c. No. 4 crossfeed valve switch (some airplanes)	OPEN
29.	Fire handles and test panel	Set
	a. Fire handles	IN
	b. Overheat warning, fire detector test switch	NORMAL
	c. Fire extinguisher selector switch	NORMAL
30.	Landing gear panel	Set
	a. Lever	DOWN
	b. Hi-torque switch (some airplanes)	NORMAL
31.	Hydraulic panel	Set
	a. Brake selector switch	As required
	b. Anti-skid switch	As required
	c. Engine-driven pump switches	ON
	d. Utility prime switch	OFF
32.	Landing/taxi light switches	HOLD/OFF
33.	Master arm switch	SAFE
34.	Inboard generators overload switch	ON

35. Electrical panel — Set

a. DC and AC generator switches — OFF

b. TR switches — OFF

c. Bus selector switches — ATM GEN

d. Inverter switches — OFF

e. Bus isolation switches — ON

f. Voltmeter selector switch — BATTERY/MAIN DC BUS

NOTE

Check battery voltage for a minimum of 21 volts.

WARNING

Airplane will not be flown with a defective battery.

g. Battery switch — BATTERY

(If external power available) — EXTERNAL

h. AC external power switch — EXTERNAL (if available)

CAUTION

The battery engine start button will not be used to connect AC power to the airplane.

36. Alarm system — Checked/OFF/RESET

a. Cargo compartment light reset button — Pressed

37. Radio (UHF/VHF) — ON/Checked

NOTE

If external power is available, turn radios on prior to starting GTC.

38. Fire guard — Posted

WARNING

The fire warning lights in the GTC fire emergency control handle are disconnected and will not indicate a fire in the GTC area.

39.	Start GTC	Set
	a. Control switch	START RUN
	b. Bleed valve	OPEN

CAUTION

Monitor wing and empennage anti-icing during GTC operation. An indication of a temperature rise means that an anti-icing valve is open. The GTC should be shut down as damage to leading edge surfaces or fuel tank sealant may occur.

NOTE

Do not open GTC bleed air valve until on speed light illuminates.

40.	Bleed air system	Checked

NOTE

External power must be available to perform the following check.

NOTE

Any time the bleed air system is being utilized, the overheat indicators and warning lights should be continuously monitored.

a. All propellers	Clear (with GC)
b. All systems that use bleed air	OFF
c. Engine bleed air valves	OPEN
d. System pressure	Checked

NOTE

Check system pressure for reading of 35 psi minimum. Failure to reach this pressure indicates that a valve in the system has not closed, that a duct is leaking, or that compressor output pressure is low.

e. GTC bleed air valve — CLOSED

f. System pressure leakage — Checked

NOTE

Time the drop from 30 to 15 psi. This time should not be less than 8.5 seconds.

g. Engine bleed valves — CLOSED

h. GTC bleed valve — OPEN

41. ATM switch — RUN

42. ATM generator — Checked/ON

NOTE

Place voltmeter selector switch to ATM GEN position. Check voltage. Check frequency. Turn generator on.

43. No. 1 and No. 2 TR switches — ON/Checked

NOTE

As each TR switch is turned on, check the TR unit loadmeter for a slight load increase indicating the respective TR unit has connected to the main DC bus. If no load is indicated at this time a load should be observed as the main inverter switch is placed to the inverter position.

44. Inverters — Checked

a. Place main, pilot's, and copilot's inverter switches to INV position.

b. Place phase selector switch to B.

c. Place frequency meter selector switch to each inverter position and check for normal frequency and voltage.

d. Check that all selected power out lights are extinguished.

e. Place all inverter switches to AC GEN position.

f. Check that all selected power out lights are extinguished.

45. Emergency hydraulic system pressure — Checked

46. Oxygen system — Test/Checked

NOTE

Depress quantity press-to-test until low quantity light illuminates.

47. Radio (UHF/VHF) — ON/Checked (if not previously checked)

48. Utility prime — ON/Checked

CAUTION

Assure that flap lever corresponds to the flap indicator prior to placing utility prime switch to ON.

49. Flaps — Clear/DOWN 100%

CAUTION

Do not exceed 90% when lowering the flaps with the flap control switch in EMERG DOWN.

NOTE

Movement of the flaps is essential at this time to enable detection of hydraulic leaks or malfunctions during the Walk-around Inspection.

50. Emergency exit lights (some airplanes) — Checked

NOTE

The emergency exit lights receive power from internal batteries in each light assembly. Make this check as quickly as possible to conserve the batteries. The switch on each light must be in the ARMED position for the check.

a. Fuselage bus isolation switch — OFF

b. Emergency exit lights — Checked/ON

c. Emergency exit lights extinguish switch — Depress

d. Emergency exit lights — Checked/OFF

e. Fuselage bus isolation switch — ON

f. Emergency exit lights — Checked/OFF

51. Overheat warning and fire detector systems — Checked

a. Place the engine overheat detector test switch in TEST position. Check that the warning lights in the fire emergency control handles and the master fire warning panel flash. Release the switch to NORMAL.

b. Rotate the fire detector test switch to all positions. Check that warning lights in the fire emergency control handles and the master fire warning panel glow steadily in each selected position. Return switch to NORMAL.

52. Fuel quantity and distribution — Checked

WARNING

If a fuel quantity indicator is inoperative, pull the associated fuel quantity indicator circuit breaker. The circuit breaker will not be reset until proper inspection and repairs have been made.

NOTE

Press the indicator test buttons and observe the respective fuel quantity indicators move toward zero. Check the sum of the individual gages against the totalizer indication. Compare with known fuel load. Refer to Section V for distribution. Failure of any individual tank indicator will have the following effect on the total quantity indicator: ELECTRICAL FAILURE-Amount in tank will immediately be subtracted from the total. MECHANICAL FAILURE-Amount indicated for the tank at the time of failure will continue to indicate in total quantity.

53. Fuel system (some airplanes) — Checked

NOTE

On airplanes without a crossfeed prime switch, complete this check during the taxiing checklist. However, static boost pump pressures will be checked at this time.

a. Starting with No. 4, open all crossfeed valves.

b. Turn No. 1 fuel boost pump switch ON and check for normal fuel pressure and that all low pressure warning lights are extinguished.

c. Close No. 1 crossfeed valve and depress crossfeed valve fuel primer switch until fuel pressure is depleted. Turn No. 1 boost pump switch OFF.

NOTE

The crossfeed primer button will be depressed throughout the check to facilitate fuel pressure stabilization and pressure bleedoff.

d. Repeat steps (b) and (c) for Nos. 2, 3 and 4 boost pumps.

NOTE

If the GTC is used to make this check, open No. 2 crossfeed prior to closing No. 4 crossfeed.

NOTE

When possible, the fuel system check should be completed prior to checking the dry bay areas.

54. Pylon tanks (if installed) — Checked

a. See that the pylon tank pump lights come on and stay on and that the no flow lights come on and go out immediately when the pylon tank pumps are turned ON.

b. See that the pylon tank lights remain on and the pump pressure lights and no flow lights come on and remain on when the pump operation test switch is held in the test position for 1 minute. Illumination of the pump pressure lights indicates proper pump output pressure.

NOTE

Do not perform the pylon tank check without fuel in the pylon tanks. The inboard internal tanks should not be completely full when the pylon tank pumps are turned on.

55. Tail navigation lights — Checked (with GC)

56. Flight controls and trim tabs — Checked (with GC)

a. Check for free and correct movement of all flight controls.

(1) If GTC is running and utility prime is available, flight controls will be checked.

b. Trim tab check

(1) Check all trim tab switches for trim action in both directions.

(2) Check that there is no elevator trim tab movement when the pilot's, copilot's or pedestal switches are actuated in opposite directions.

(3) Check for no movement of elevator tab with elevator tab power selector switch in OFF position.

57. Autopilot — Checked

a. Check that radio beam coupler switch is in GYRO PILOT position, the pilot control switch is in OFF position, and the gyro autopilot select switch is in K6A position.

NOTE

With the pilot control switch OFF, the servo engage switches should be in the DISENGAGED position and the altitude control switch should be in the OFF position. If they are not, a malfunction is indicated.

b. Check that the turn knob and aileron trim knob are centered and that the elevator tab power selector switch is in the NORMAL position.

NOTE

Placing the elevator tab power selector switch to NORMAL directs power to the elevator servo control. The elevator servo is rendered inoperative if the elevator tab power selector switch is positioned to OFF or EMERGENCY.

c. Place the pilot switch in the ON position.

d. Check that the trim indicator on the pedestal controller are centered.

e. Center all flight controls and place the servo engaging switches to the ENGAGE position.

f. Rotate the pitch knob forward and aft. The control columns should move forward, and aft, and a deflection should be indicated on the elevator trim indicator.

NOTE

It may be necessary to apply a small force to the control wheel in the direction of pitch knob rotation to cause control wheel to move. Considerably more force on the control wheel in the opposite direction of pitch knob rotation will be required to override the autopilot and to check that movement is correct.

g. Rotate the aileron knob to the left and right. The control wheels should turn to the left and right, and a deflection should be indicated on the aileron trim indicator located on the autopilot controller.

CAUTION

In the following checks, hold the control wheel and rudder pedals to cushion movement against limit stops. Accomplish the checks as rapidly as possible to avoid prolonged servo effort and possible overheating.

h. Rotate the turn knob to the left and right approximately 45 degrees. The control wheels should turn to the left and right, and the rudder pedals should move slowly in the direction of the turn. A deflection should be indicated on the rudder trim indicator located on the autopilot controller.

i. Place the altitude control switch to the ON position and rotate the pitch knob. The control columns should not move.

j. Push either the pilot's or copilot's release switch. The pilot switch should trip to OFF, the servo engaging switches should trip to DISENGAGE, and the AUTOPILOT OFF light should start flashing.

CAUTION

Hold the servo engaging bar close to the servo switches when the pilot's or copilot's release switch is pushed, to prevent breaking the servo switches.

k. Push the autopilot reset button to extinguish the AUTOPILOT OFF light.

58. Anti-skid test (some airplanes) — Completed

NOTE

After test switch is actuated to either forward or aft position, wait at least three seconds before selecting test switch to opposite set of wheels. This will prevent erroneous test light indications.

a. Check that all four anti-skid test lights and anti-skid inoperative light are out.

b. Place test switch in the FWD position and release. The two FWD lights should illuminate and then go out.

c. Place test switch in AFT position and release. The two AFT lights should illuminate and then go out.

d. Check to ensure that the test switch is in the OFF position.

NOTE

If external power is available, the ATM and GTC may be shut down at this time.

59. Left exterior lights — Checked (with GC)

   a. Navigation light

   b. Wing tip taxi light (some airplanes)

   c. Leading edge light

   d. Taxi light

   e. Landing light

   f. Anticollision light(s)

60. No. 1 and No. 2 propellers

CAUTION

Assure that number 3 blade is in the 9 o'clock position when viewed from front looking aft. If the propeller is not in this position, damage to the regulator seals or feather pump may occur.

CAUTION

Do not statically feather the propellers if they have been exposed to temperatures of 0°C (32° F) or below. Damage to the blade seals may occur. (See Section IX for cold weather operation.)

   a. Feather operation-place the condition levers in FEATHER. The blades should move smoothly to the feather position.

NOTE

The feather relay timer may interrupt power to the feather motor before the feather cycle is completed. If this occurs; reset by moving the condition lever to GROUND STOP, then return it to FEATHER.

   b. Unfeather operation - position the throttles to GROUND IDLE, and place the condition levers in AIR START until condition levers to GROUND STOP.

61. Pitot heat — Checked (with GC)

62. No. 3 and No. 4 propellers — Checked

NOTE

Follow procedure outlined in item 60 for feathering and unfeathering No. 3 and No. 4 propellers.

63.	Right exterior lights	Checked (with GC)
	a. Navigation light	
	b. Leading edge light	
	c. Taxi light	
	d. Landing light	
	e. Bottom navigation light	
64.	Oil cooler flaps	OPEN/FIXED

NOTE

The ground controller may be released at this time if GTC is not being used to complete Preflight check.

65.	Pilot's gun sight	Checked/OFF
	a. Altitude sight setting card	Checked
	b. Fixed and moving reticle lights both filaments	Checked/OFF
	c. Sight for security	Checked
	d. Gunsight test panel	TEST
66.	Formation lights	ON
67.	Shielded beacon light	ON
68.	Unnecessary switches	As required
	a. Utility prime	OFF
	b. Inverter selector switches	As required
	c. TR switches	OFF
	d. ATM generator switch	OFF
	e. ATM switch	STOP
	f. GTC bleed air switch	CLOSED
	g. GTC switch	OFF
	h. Radio (UHF/VHF)	OFF
	i. AC external power	As required
	j. Battery switch	As required
69.	Hydraulic pressure	Depleted
70.	Emergency exit light extinguish switch (some airplanes)	Depress

TOP OF AIRPLANE INSPECTION

WARNING

All necessary precautions should be observed. Conducting this inspection during high winds or other severe weather conditions can be dangerous. Under these circumstances, the pilot may waive this inspection.

CAUTION

Keep in mind that this is a pressurized airplane and that skin damage is dangerous. Use extreme care at all times to avoid scratching or denting the skin while walking on the fuselage.

1. Dry bay areas for fuel or hydraulic fumes and/or leaks.
2. Fuel caps and oil servicing access panels for security.
3. Emergency equipment access panels for security.
4. Wing, fuselage, empennage, control surfaces, and flaps general condition.
5. Antennas
6. Escape hatches and release handles for security.
7. Formation lights — Checked/OFF
8. Shielded beacon light — Checked/OFF

NOTE

Turn OFF shielded beacon and formation lights upon completion of inspection.

INTERIOR INSPECTION.

The duties in this checklist will normally be accomplished by the illuminator operator/scanner. During the interior inspection, ensure that all cargo and loose equipment is secured. When a weapons mechanic is included in the crew, he will perform all asterisk items on the checklist. In the event that the illuminator operator or weapons mechanic are not included in the crew, this inspection will be accomplished by the flight engineer.

1. Crew entrance area — Checked
   a. Radio and electrical equipment racks
   b. Crew door latch mechanism

c. Flashlight or emergency exit light (some airplanes) — Checked/ARMED

d. TV cameras, laser, pedestal and control boxes

e. Nose landing gear emergency extension valve or hand pump emergency valve — NORMAL

CAUTION

Maintain the nose landing gear emergency extension valve in the NORMAL position at all times except when it is being used to extend the nose gear; otherwise, the nose landing gear will not retract.

f. Forward cargo door hand pump and control valve. — NEUTRAL/Safetied

g. Interphone panel and light switches

2. Forward cargo compartment

a. Forward cargo door and locks both locking blocks installed (some airplanes)

WARNING

It is possible to lock the forward cargo door handles with the bottom hooks unlocked. Under this condition the door warning light will not illuminate. Visually check all locks and hooks for engagement.

b. Dewar flask and cryogenic lines.

* c. Guns, forward

(1) 20MM

(a) Arm switches — SAFE

(b) Drive motor and firing lead electrical connectors — Disconnected

(c) Ammo cans and service doors — Secured

(d) Batteries — Secure

(e) Dust covers — Removed

(f) Flak curtains — Condition/Security

(g) Flexible gunport shrouds — Condition/Security

(2) 7.62MM

(a) Arm switches — SAFE

(b) Drive motor and clearing solenoid	Disconnected
(c) Loading sectors and safing bars	Installed
(d) Dust covers	Removed
(e) Flak curtains	Condition/Security
(f) Flexible gunport shrouds	Condition/Security

d. IR power supply/Amplifier and control boxes

e. Left hydraulic control panel. Emergency hydraulic system reservior condition and fluid quantity. Emergency reservoir drain valve and shutoff valve.

f. Left main landing gear emergency engaging handle and handcrank

NOTE

Check the system for manual operation using the handcrank.

g. Overhead area

h. Top of booth

i. Air conditioning manual selector handle

j. Right main landing gear emergency engaging handle and handcrank.

NOTE

Check systems for manual operation using the handcrank.

k. Right hydraulic control panel, utility and booster hydraulic system reservoir condition, fluid quantity, and accumulator pressure gages.

l. Side emergency exit.

m. Flashlight/Emergency exit light (some airplanes) — Checked/ARMED

n. Overhead area.

o. First aid kits and hand axe (FWD)

p. Oxygen regulators and portable oxygen bottles (some airplanes)

q. Liquid oxygen converter (when installed)

r. Emergency equipment

s. Right side electronic rack and circuit breaker panels.

t. Galley

u. Nose wheel area including nose wheel inspection plate.

v. Electrical equipments racks (FWD)

w. Main power distribution panel.

*x. Flak curtains

3. Life history recorder (some airplanes) — Set/OFF

a. Check that tape remaining is adequate for flight, check that reserve tapes are available, dial in pertinent data and close all circuit breakers. Leave the power switch in the OFF position.

4. Aft cargo compartment area — Checked

a. Wheel well bus circuit breaker panel.

b. Left main landing gear inspection window

c. Aft wing beam, security of aileron hydraulic control and auto pilot servo, wing flap components, leaks.

*d. Guns aft.

(1) Breech — Clear

(2) Firing selector lever — STOP FIRE

(3) Dust covers — Removed

(4) Flak curtains — Condition/security

(5) Flexible gunport shrouds — Condition/security

e. Left paratroop door and uplatch mechanism and pin.

f. AN/APQ-150 radar and control box.

5. Ramp area and right side of cargo compartment. — Checked

a. Aft fuselage bus circuit breaker panel and light control switches — Checked

b. Ramp hydraulic panel and controls (pressure release valve power position).

c. Illuminator and control panel — Main power switch OFF

d. Aft cargo door uplock manual release and safety lock release handles for general condition.

e. Retaining reel

f. Left side ramp locks

g.	Aft cargo door uplock (unlocked) and safety lock.	
h.	Left side ramp telescoping arm	Connected
i.	Left side cargo door locks.	
j.	Overhead escape hatch.	
k.	Flashlight/Emergency exit lights (some airplanes)	Checked/ARMED
l.	Cabin pressure safety valve.	
m.	Rudder and elevator hydraulic control units and auto pilot servos	
n.	Bleed air ducts	
o.	Aft cargo door seals and drain seals	
p.	Right side cargo door locks	
q.	Radio equipment for security of mounting	
r.	Right side ramp telescoping arm	Connected
s.	Flare launcher and panel (when installed)	Checked/Dearmed
t.	Right side ramp locks	
u.	Life raft handle	In/Safetied
v.	Availability of tiedown equipment	

6. Cargo compartment area, aft right side — Checked

a.	Flashlight/Emergency exit light (some airplanes)	Checked/ARMED
b.	Right paratroop door, uplatch mechanism and pin.	
c.	Fire extinguishers and hand axe (aft)	
d.	Overhead escape hatch, depressurization hatch (some airplanes) and flashlight/ Emergency exit light (some airplanes)	Checked/ARMED
e.	Toilet facilities	

WALK-AROUND INSPECTION

Conduct a walk-around inspection following the route shown in figure 2-1. Work stands or a ladder will be required when checking the engine inlet air ducts and the engine exhaust area.

NOTE

Engine inlet and exhaust areas are not required to be checked at this time, if previously checked by maintenance.

exterior inspection diagram

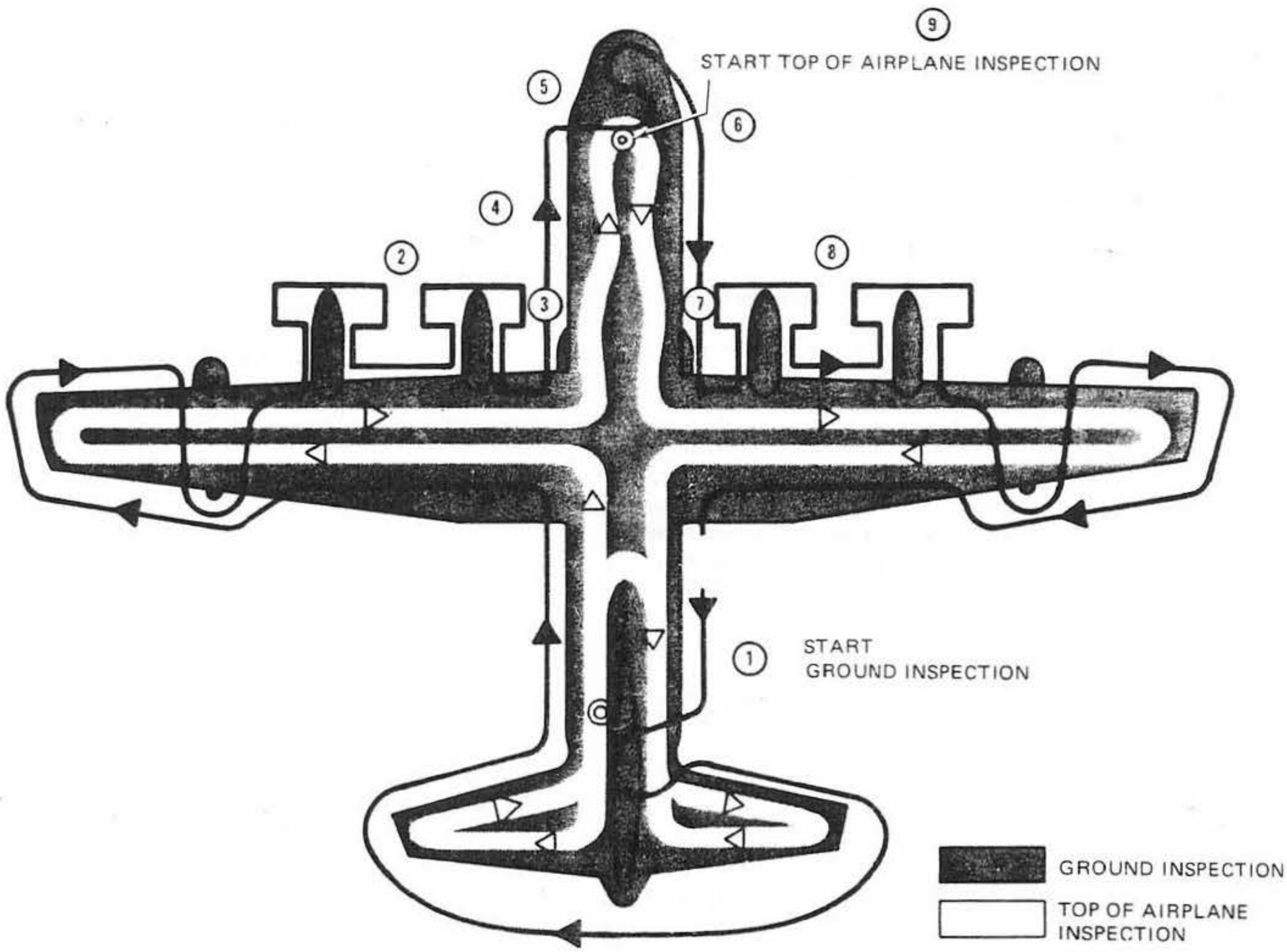


Figure 2-1

1. Aft fuselage and empennage — Checked

   a. Exterior structure general condition

   b. Cargo ramp, tail skid and aft cargo door

   c. Pressure safety valve

   d. Tail structure and control surfaces

   e. Antennas

   f. Paratroop door/AN/APQ-150 radome

   g. Left ALE-20 dispenser

2. No. 2 and No. 1 engine nacelles, propellers, left wing — Checked

   a. Life raft and emergency radio compartments exterior

   b. Flap, aileron, tab, wing skin

   c. Static boom and head

   d. Pylon tank fuel quantity (when installed)

   e. Pylon tank/ECM pod exterior structure and tank security (when installed)

   f. Engine exhaust areas

   g. Propeller spinner and blades general condition. Evidence of static oil leaks (25 drops per minute from rear of regulator maximum permissible). When static leakage exists, propeller system must be serviced just prior to every flight.

   h. Engine inlet air ducts

   i. Nacelle exterior structure general condition and fluid leaks

3. Left wheel well area and center fuselage — Checked

   a. Guns, gun ports, spoilers and battery vents

   b. Left main landing gear, wheel well area, MLG door attached (secured)

   c. GTC fuel pump

   d. Fire extinguisher bottle charge (refer to Section V for correct pressure)

   e. Exterior structure general condition

4. Forward Fuselage, left side and bottom — Checked

   a. ATM inlet and exhaust ducts

   b. No. 3 and No. 4 gunport spoilers

c. GTC area

d. IR gimbal and fairing

e. Forward cargo door (some airplanes)

f. No. 1 and No. 2 gunport spoilers

g. Antennas

h. Exterior general conditions

5. Nose section — Checked

a. Crew entrance door (Ferry Flight Only)

b. TV/Laser platform

c. Laser covers installed

d. Battery compartment

e. B C radome and deflector

f. NLG Lock and wheel well area

g. Brake accumulator pressures

h. Pitot masts and heads

i. Radome and nose exterior general condition

6. Forward fuselage, right side and bottom — Checked

a. Flight deck air conditioning intake and exhaust

b. Exterior structure general condition

c. Antennas

d. Oxygen system filler valve

7. Right wheel well area and center fuselage — Checked

a. Cargo compartment air conditioning intake and exhaust

b. Right main landing gear, wheel well area, MLG door attachment (secured)

c. Single point refueling panel (Drain valve closed)

d. Right ALE-20 dispenser

e. Antennas

f. Exterior structure general condition

8. No. 3 and No. 4 engine nacelles, propellers, right wing — Checked

a. Nacelle exterior structure general condition and fluid leaks

b. Engine inlet air ducts

c. Propeller spinners and blades general condition. Evidence of static oil leaks (25 drops per minute from rear of regulator maximum permissible). When static leakage exists, propeller system must be serviced just prior to every flight.

d. Engine exhaust areas

e. Pylon tank/ECM pod exterior structure and security (when installed)

f. Pylon tank fuel quantity (when installed)

g. Flaps, aileron, tab, wing skin

h. Static boom and head

i. Life raft compartments exterior

COCKPIT CHECKLIST

NOTE

The checklist will be completed by the flight engineer prior to the BEFORE STARTING ENGINES checklist. A crew member will remain at the airplane after completion of this checklist. If this checklist is completed and airplane does not fly, the ENGINE SHUTDOWN checklist and the BEFORE LEAVING THE AIRPLANE checklist will be completed prior to securing the airplane.

1. NLG lock, pitot,covers, dust excluders, and duct plugs. — Removed
2. ALE-20 dispenser switch (FE station) — SAFE
3. Weapon panel — Set
   a. All gun switches — SAFE/LO RATE
   b. Fire mode select switch — AUTO
4. Nacelle preheat switches — OFF
5. Engine bleed air valve switches — CLOSED
6. GTC control panel — Set
   a. Fuel tank selector (some airplanes) — LH INT.
   b. No. 4 crossfeed valve — OPEN
   c. GTC switch — OFF
   d. Bleed air switch — CLOSED

	e. ATM	STOP
7.	Air conditioning panel	Set
	a. Air conditioning master switch	OFF
	b. Emergency depressurization switch	NORMAL
	c. Flight deck emergency shutoff switch	NORMAL
	d. Cargo compartment emergency shutoff switch	NORMAL/OFF (if booth is not occupied)

CAUTION

If the booth is not occupied, position the cargo compartment emergency shutoff switch to OFF. Do not position switch to NORMAL until a crew member is in position to monitor the booth temperature.

	e. Flight deck temperature control switch	OFF/NORMAL
8.	Ice control panel	Set
	a. Wing and empennage switch	OFF
	b. Pitot heat switch	OFF
	c. NESA windshield switches	OFF
	d. Engine inlet air duct anti-icing switches	OFF
	e. Propeller ice control switches	OFF
	f. Propeller and engine anti-icing master switch	AUTO
9.	Electrical control panels	Set
	a. DC generator switches	OFF
	b. TR switches	OFF
	c. Battery switch	As required
	d. Voltmeter selector switch	MAIN DC BUS
	e. Bus isolation switches	ON
	f. Inverter switches	As required
	g. Bus selector switches	
	(1) Left and right hand switches	ATM GEN
	(2) No. 1 and No. 4 generator bus switches	No. 1 and No. 4 Bus
	h. AC generator switches	OFF
10.	Fuel control panel	Set
	a. Fuel tank selector switches	INT TANK TO ENG
	b. Fuel boost pump switches	OFF

c. INT tank purge switch	OFF
d. Crossfeed valves	CLOSED/NO. 4 OPEN
e. Pylon tanks pump switches	OFF
11. Fire panel	Set
a. Fire detector test switch	NORMAL
b. Fire handles	IN
c. Fire extinguisher bottle selector switch	NORMAL
12. Oil cooler flaps	As required

NOTE

Oil cooler flap switches should be placed in AUTO when ambient temperature is 15°C or less and OPEN/FIXED when ambient temperatures is above 15°C.

13. Remote attitude gyro switch	ON
14. Throttles/Condition levers	GROUND IDLE/GROUND STOP
15. Propeller control panel	Set
a. Synchronizer master switch	NO. 1
b. Electronic propeller governor switches	ON
c. ENTC test switch	NORMAL
16. TD valve switches	AUTO
17. Inboard generators overload switch	ON
18. MASTER ARM switch	SAFE
19. ALE-20 dispenser master arming switch	OFF
20. Alarm system	OFF
21. Air deflector door switch	OFF
22. External power DC and AC	ON

BEFORE STARTING ENGINES

Crew members should check-set their oxygen system, their individual interior lights, and clocks prior to initiating this checklist. Pilot and copilot will set Hot Mic to LISTEN ON, TALK ON. All others will set to LISTEN ON.

NOTE

Consult AFTO 781 for airplane status.

PILOTS

1. Oxygen - "Set" (CP), (P)

   a. ON/100%

2. Radio (UHF or VHF - ON/Checked (CP)

NOTE

Radios not operative at this time without external power.

3. Clear GTC - "Clear" (GC)

After flight engineer response "INVERTER", proceed with checklist.

4. Lights - Set (CP)

   a. Landing/taxi - As required

5. Fuel - "Checked" (P)

   a. Quantity and distribution

6. Flap lever - Set (CP)

NOTE

Set flap lever to correspond with flap position indicator.

7. Hydraulic panel - "Set" (CP)

   a. Brake select switch - EMER/Pressure up

   b. Anti-skid switch - As required

NOTE

On airplanes not modified by TCTO 1C-130A-743, place the switch to OFF.

   c. Engine pump switches - ON

   d. Utility prime switch - ON

   e. Hydraulic pressures - Checked

8. Parking brake - "Set, Remove chocks" (P)

CAUTION

Monitor the emergency brake pressure gauge for pressure recovery after setting the brake.

9. Chocks - "Removed" (GC)

FLIGHT ENGINEERS

1. Oxygen - Set

   a. ON/100%

2. Battery switch - BATTERY/EXTERNAL POWER (If external DC and AC power available) EXTERNAL

After GC reports "Clear":

3. Start GTC - Set

   a. GTC switch - START/RUN

   b. Bleed air valve - OPEN/Pressure up

CAUTION

Do not open the GTC bleed valve until the on speed light has illuminated. Monitor the leading edge temperature indicators. A rise in temperature indicates that an anti-icing valve is open and the GTC must be shot down to prevent damage to leading edge surfaces or fuel tank sealants.

4. ATM and generator - Set

   a. ATM switch - RUN

   b. ATM generator - As required

NOTE

Place the voltmeter and frequency meter selector switched to the representative generator positions. Check voltage and frequency of each phase of the generator before placing the generator switch to the ON position.

5. TR switches - ON

6. Main inverter switch - "INVERTER"

7. Lights - Set

   a. Interior - As required

   b. Navigation - ON/Steady

   c. Anticollision - ON

8. Fuel enrichment switches - As required

NOTE

Normal start is with enrichment OFF. If lightoff is not achieved on first attempt, record in 781A. Restart is permitted with fuel enrichment ON provided TIT is below 200°C and an overtemp was not experienced on a previous start. During extreme cold weather all starts may be accomplished with or without enrichment. Do not select enrichment after the starter has been engaged.

10. Before Starting Engines checks - "Complete" (CP), (E), (N), (FCO), (IO)

9. Before Starting Engines checks - "Complete" (CP), (E), (N), (FCO), (IO)

STARTING ENGINES.

Normal engine start sequence is 3, 4, 2, and 1. The flight engineer has the primary duty to monitor the engine start. Should any crew member note a condition which would necessitate discontinuing a start, they shall call out "Stop Start" and state the reason. The pilot will discontinue a start by placing the condition lever to GROUND STOP and pulling the starter button unless a specific emergency procedure dictates other action. During start, an engine should accelerate smoothly and continuously: TIT should increase slowly within normal limits; and the engine should stabilize on speed within one minute. For a typical engine start, the sequence of events after starter actuation and the CAUTIONS to be observed are as follows:

a. An RPM indication

b. Fuel flow/Enrichment - With fuel enrichment OFF, fuel flow will increase to approximately 300 pph. If fuel enrichment is selected, fuel flow should rapidly increase above 300 pph, then decrease to approximately 300 pph.

CAUTION

If starting with the fuel enrichment switch in the NORMAL position and enrichment is not noted but an indication of normal fuel flow or ignition is observed, position the enrichment switch to OFF and allow the start to proceed. Record in Form 781.

CAUTION

If de-enrichment does not occur and the engine lights off, excessive torching will occur. Refer to Section III for torching during starting procedure.

NOTE

The secondary pump pressure light may illuminate momentarily, then go out. It will normally illuminate again before the engine reaches 65% RPM.

c. Ignition - Should immediately follow fuel flow. Must occur by 35% RPM.

CAUTION

If an engine does not light off before 35% RPM, discontinue the start.

d. Oil pressure - Positive oil pressure (both engine and gearbox) must be indicated by 35% RPM.

CAUTION

If there is no positive indication of oil pressure on the engine and reduction gear by 35% RPM, immediately discontinue the start.

e. Hydraulic pressure - Should be observed after observation of oil pressure. Must have positive indication by time engine is on speed and normal (Static/Operating) operating pressure within 30 seconds after engine has stabilized on speed.

f. Parallel - Indicated by secondary fuel pump pressure light on (approximately 40 to 65% RPM).

g. Starter - Must pop out by 70% RPM. If not, must be pulled at 72%.

CAUTION

If the starter button does not pop out before the pull-out limit, pull the button, place the condition lever in ground stop, and close the respective engine bleed air valve. Maintenance action is required prior to operation.

h. Series - Indicated by secondary pump pressure light out at approximately 65% RPM.

CAUTION

The throttles must not be moved out of the GROUND IDLE detent during starting. The resultant increase in propeller blade angle might overload the starter and/or reduce the rate of engine acceleration.

CAUTION

If, after light off, the engine does not accelerate smoothly to ground idle RPM, and/or a rapid increase in TIT is indicated, a stalled start is occuring. Immediately discontinue the start. Before attempting another start on that engine, motor the engine to approximately 25% RPM with the condition lever in ground stop to remove gases and unburned fuel from the turbine.

i. Peak TIT - Note max TIT rise during start excluding momentary overshoot at 94% RPM. Refer to Section V for limits during start.

NOTE

The engine should accelerate to ground idle within one minute. If engine does not stabilize on speed in this time, discontinue the start. Exception: During low air density conditions (high temperature above approx 28°C/high altitude), if the engine accelerates smoothly with no indication of stall and TIT limits are not exceeded, time to stabilize on speed is 70 seconds. Do not exceed starter duty cycle limits.

CAUTION

After moving a condition lever to ground stop, do not move the lever from this position until engine rotation has stopped. Do not reengage the starter until rotation has stopped completely.

NOTE

The copilot will check each hydraulic pump after its engine is started by operating the flight controls while the respective pump is the only source of pressure for its respective system. Check operating pressure and static pressure within limits and check that the low pressure warning light illuminates for the opposite pump in the system. Failure of the light to illuminate may indicate a malfunctioning check valve in the hydraulic system.

CAUTION

If light off has not occurred and heavy fuel vapors are observed coming from the tailpipe, the ground control will call "FOGGING." Discontinue the start the placing the condition level to GROUND STOP and motor the engine with the starter to remove unburned fuel from the turbine area.

CAUTION

It is not recommended that an engine be started with the TD valve switches in the NULL position. If a start must be made with a TD valve switch in the NULL position, the TIT should be closely monitored since over-temperature protection is not provided.

PILOTS

1. Clear No. 3 - "No. 3 Clear" (GC)

   "Turning" (P)

NOTE

After engine is cleared, the pilot will place condition lever to RUN, push starter button, and state "TURNING". The light in the button will glow and an RPM indication should be noted. The starting cycle is automatic and requires no further action. Keep one hand on the condition lever and the other on the starter button of the engine being started, and be prepared to discontinue the start immediately should a malfunction occur. The ground controller will state "NEGATIVE ROTATION" if prop rotation is not observed within approximately 5 seconds after the pilot states "TURNING". Observe start sequence as outlined in this section.

After the engineer directs external equipment removal, proceed with checklist.

2. Clear No. 4 - "No. 4 Clear" (GC)

   "Turning" (P)

After the engineer responds "GENERATORS ON" proceed with checklist.

3. Utility prime - OFF (CP)

NOTE

After the utility prime is turned off, the copilot should turn off the No. 3 engine driven hydraulic pump and check for normal elevator control operation. Failure of the elevator control to operate normally may indicate that the elevator utility boost has been isolated.

4. Flaps - UP (CP)
5. External equipment/BC spoiler - "Removed/Secure" (GC)
6. Clear No. 2 - "No. 2 Clear" (GC)

   "Turning" (P)

7. Clear No. 1 - "No. 1 Clear" (GC)

   "Turning" (P)

FLIGHT ENGINEERS

1. No. 3 DC generator - RESET ON

After the engine is cleared by the GC, proceed with checklist.

2. Engine bleed air valve - OPEN

NOTE

Under low air density conditions (high temperature or high pressure altitude) GTC mass output will be reduced in comparison to that for standard day conditions, making advisable a battery engine start. Refer to Section VII for battery engine start procedures.

NOTE

Do not perform a start if TIT is above 200°C, it may be brought lower by motoring the engine with the starter while the condition lever is in GROUND STOP.

3. Observe start sequence

After engine is on speed:

4. Generators and bus selector switches - "Generators ON" (E)
   a. Generators - Checked/ON
   b. Bus selector switch - NORMAL

NOTE

Place the voltmeter(s) and frequency meter selector switch(es) to the respective generator position. With the generator switches OFF, check the voltage of the DC generator, voltage and frequency of the AC generator before positioning the generator switch(es) to the ON position.

5. Electrical control panel - Set
   a. Battery switch - BATTERY
   b. Inverters - Set
      (1) Electronic and engine inst switch - AC GEN
      (2) Pilot AC inst switch - AC GEN
      (3) Copilots AC inst switch - INV
6. Air conditioning control panel - Set
   a. Master control switch - No pressure

8. Starting Engines checks - "Complete" (CP), (E)

NOTE

After stabilization of the flight deck and cargo compartment temperatures, the temperature controls may be operated in AUTO or MANUAL.

7. GTC control panel - Set

   a. GTC bleed air valve switch - CLOSED

   b. GTC switch - OFF

"Remove external equipment and secure BC spoiler"

8. Start No. 4

Repeat steps 2 thru 4 for all engines as they are started.

9. Fuel enrichment switches - OFF

10. ATM generator - OFF

11. TR switches - OFF

12. Starting Engines checks - "Complete" (CP), (E)

BEFORE TAXI.

PILOTS

(Refer to Section V for engine limitations)

1. Compass and attitude indicators - "Checked, Set" (N/E), (P), (CP)

   a. The pilot will compare headings with the magnetic compass

   b. The copilot will set heading indicator

   c. Attitude indicators checked

2. Verticle reference system - "Checked, Set" (FCO), (P)

   a. Pilot will set and slew heading to FCO' s stated INS heading and inform FCO of heading set.

   b. Check for little or no difference in heading indication between INS and dual axis gyro.

3. Radios and Nav equipment - "Set" (CP), (P)

   a. Radios - ON (CP), (P)

   b. Radar altimeter - ON (P)

FLIGHT ENGINEERS

1. Leading edge temperature - NORMAL

2. Compass and attitude indicators (If Nav not on board) - "Checked, Set" State heading (N/E), (P) (CP)

   a. Latitude control knob - OFF

   b. Master indicator - Synchronized

   c. Vertical reference - ON

3. Radios and Nav equipment (If Nav not on board) - Set

   a. Radar - Standby

   b. IFF - Checked, Standby

4. Warning lights - Checked

c. Radar - STBY (N/E)

d. IFF - Checked, STBY (CP/N)

NOTE

See Section IV for IFF/SIF self test.

4. Hydraulic pressures - Checked (CP)

5. Altimeters - "State setting" (CP), (P), (N), (FCO)

WARNING

It is possible to set an altimeter in error by 10,000 feet. This happens if the barometric set knob is continuously rotated after the baro scale is out of view. The knob can be rotated until the numbers eventually reappear from the opposite side. If the correct altimeter setting is then established, the altimeters will read in error by approximately 10,000 feet. As a preflight check, special attention should be given to make sure that the 10,000 feet pointer is indicating correctly. Check the 10,000 foot counter indicator window for correct reading, and crosscheck counter, drum, and pointer to assure that indicated altitude agrees with field elevation.

6. Before Taxi checks - "Complete" (CP), (E), (N), (FCO), (IO)

5. Before Taxi checks - "Complete" (CP), (E), (N), (FCO), (IO)

NOTE

The flight engineer may initiate his taxi checklist without pilot direction and, as practical, after completion of Before Taxi Checklist.

TAXIING.

Skidding or skipping of the nose wheel may develop when the airplane is turning because of wet pavement or an aft center of gravity, and these conditions can be minimized by avoiding abrupt steering changes and using asymmetrical power and brake applications. See figure 2-2 for minimum turning space and clearance required.

CAUTION

Excessive or prolonged use of the brakes while taxiing will cause overheating of the brake assemblies with possible wheel failure and/or tire or brake fire resulting. Taxi speed should normally be controlled by use of minimum engine power and propeller reversing.

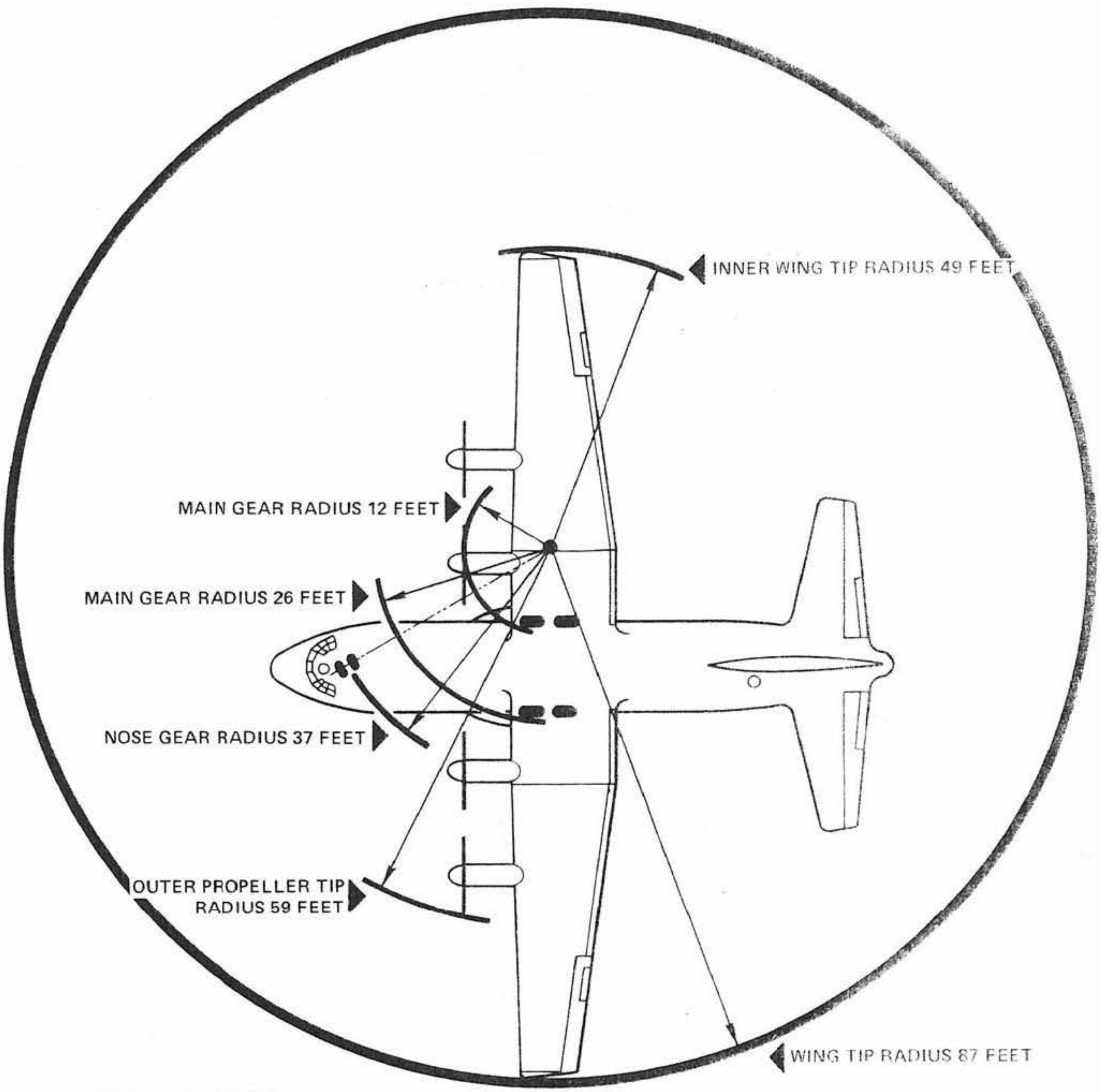
CAUTION

Use forward thrust to stop the airplane during reverse taxiing. After reverse taxiing, taxi the airplane forward approximately 5 feet to realign the main landing gear.

NOTE

If during prolonged ground operation, oil temperature approaches the maximum limit, the throttle should be advanced toward FLIGHT IDLE to increase airflow through the oil coolers.

turning radii



VERTICAL CLEARANCE

WING TIP	12 FEET
VERTICAL STABILIZER TIP	38 FEET
INBOARD PROPELLER	5 FEET
OUTBOARD PROPELLER	5 FEET 8 INCHES

CAUTION

MINIMUM SPACE REQUIRED FOR TURNING IS 174 FEET WITH THE NOSE GEAR TURNED TO THE MAXIMUM OF 60 DEGREES

Figure 2-2

CAUTION

When taxiing over rough, pitted, undulating, or washboard terrain, extreme caution must be exercised and very low taxi speeds observed.

CAUTION

Propeller reversing over unprepared surfaces may cause foreign object damage to propeller or compressor section. Every effort should be made to perform the propeller reverse check over hard surfaces.

CAUTION

Avoid turns with brakes locked on one side to prevent damage to the tires or the main landing gear tracks. When possible, avoid braking to a stop in turns, since damage to the landing gear and supporting structure may result. If such a stop is required, record it in Form 781.

PILOTS

NOTE

Item 3 will not be required on subsequent flights of the day by the same crew.

1. Brakes - "Checked" (P)

NOTE

Pilot will check emergency brakes on beginning taxi. Upon reaching an uncongested area, copilot will switch to and pilot will check normal brakes prior to responding.

2. Instruments - "Checked" (CP), (P)

NOTE

Check all heading indicators and turn and slip indicators for correct movement. Check airspeed and vertical velocity indicators for proper reading.

3. Propeller reversing - "Checked" (E)

NOTE

The pilot will place symmetrical pairs of throttles in full reverse. Flight engineer will advise pilot of any discrepancy. Pilot should note aircraft pull (if any) and compensate as necessary for any discrepancy during subsequent reverse operation.

FLIGHT ENGINEERS

NOTE

These checks will not be required on subsequent flights of the day by the same crew, except that item 3 will be required after refueling.

1. Propeller reversing - "Checked" (E)

   a. The pilot will place symmetrical throttles in full reverse. Flight engineer will observe RPM within limits and advise pilot of symmetric torque differences of 1,000 inch-pounds or more. If greater than 1,000 inch-pounds, record in Form 781.

NOTE

If minimum reverse RPM is not within limits on reverse check, closing the bleed air switches of symmetrical engines may be required to obtain reverse RPM limits.

2. Propeller and engine anti-icing - Checked

   a. Place the ice detector test switch in the No. 2 position. Note that the ice detection warning light illuminates. Place the prop and engine anti-icing master switch to the RESET position and note that the ice detection warning light is extinguished.

b. Place the ice detector test switch in the No. 3 position and note that the ice detection warning light illuminates.

c. Place each engine inlet duct anti-icing switch to the ON position (one at a time) and note a slight torque decrease and/or TIT increase. Return each switch to the OFF position and note a slight torque increase and/or TIT decrease.

d. Turn prop blade and spinner anti-icing and de-icing switches ON and then OFF (one at a time), until it is noted which propeller is in the de-icing cycle. Check the ammeter for proper amperage. When proper cycling is indicated by the proper amperage, turn the next propeller switch ON and repeat the check until all propellers have been checked.

e. Turn prop spinner anti-icing switches ON (one at a time) and note approximately 22 amp draw on each propeller. With all switches ON, check for proper amperage draw for all propellers.

f. Place the prop and engine anti-icing master switch to RESET AUTO. Note that the ice detection warning light is extinguished.

g. Place all other switches in the OFF position.

CAUTION

Never operate the propeller anti-icing and deicing for more than two cycles while the airplane is on the ground.

3. Fuel system - Checked

CAUTION

Operate all four engines with fuel supplied from the No. 4 fuel tank for at least three minutes or until trapped air indications are alleviated.

NOTE

The above step is necessary only if not accomplished during the preflight check.

NOTE

Trapped air in the fuel crossfeed manifold will be indicated by slow or sluggish operation of fuel booster pump, low pressure warning lights and fuel pressure indicator.

a. Turn No. 4 boost pump switch ON and open crossfeed valves 4, 3, 2, and 1. Operate all four engines from No. 4 tank for at least 3 minutes or until trapped air indications are alleviated. Turn No. 4 boost pump switch OFF.

b. Turn No. 1 boost pump switch ON and check for normal fuel pressure and that all low pressure warning lights are extinguished.

NOTE

With engines operating normal static pressure limitations may be exceeded.

c. Close No. 1 crossfeed valve. Observe that No. 2, No. 3, and No. 4 low pressure warning lights illuminate and that manifold pressure is depleted. Turn No. 1 boost pump switch OFF.

d. Repeat steps b and c for No. 2 and No. 3 boost pumps.

e. Turn No. 4 fuel boost pump switch ON and check for normal fuel pressure indication and No. 4 fuel boost pump low pressure warning light is extinguished. Turn No. 4 boost pump switch OFF.

f. Close No. 4 crossfeed valve.

g. Turn No. 4 boost pump ON. Note that there is no fuel pressure indicated. This indicates that No. 4 fuel crossfeed valve is operating normally.

h. Turn No. 4 boost pump switch OFF.

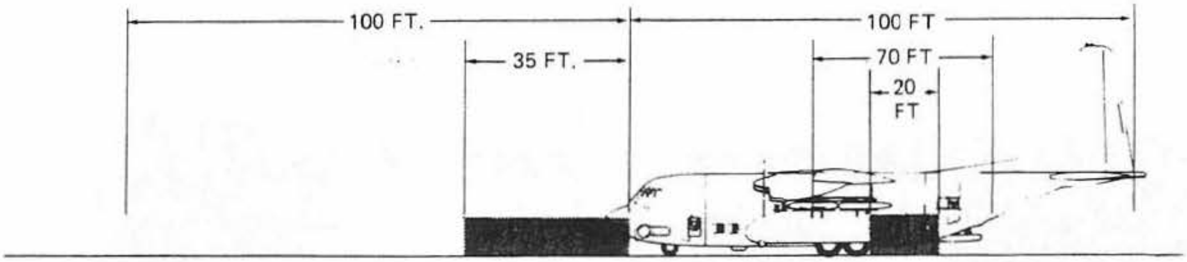
4. Taxi checks - "Complete" (CP), (E)

4. Taxi checks - "Complete" (CP), (E)

CROSSWIND TAXIING.

The airplane can be taxied in a 30-knot, 90-degree crosswind by use of nose wheel steering and rudder control only. Taxiing can be accomplished in crosswinds up to a 60-knot, 90-degree crosswind by use of nose wheel steering, rudder and aileron control, differential braking, and differential power. Turns to a crosswind heading should be performed with great caution and at slow speeds to prevent centrifugal force from aiding the wind in tipping the airplane.

radar radiation hazard area



NOTE

THE RADIATION HAZARD AREAS SHOWN ARE AROUND THE RADAR ANTENNAS. ACCIDENTAL ENTRY INTO THE HAZARD AREAS DOES NOT RESULT IN INJURY. IT IS ONLY THROUGH PROLONGED EXPOSURE THAT THE POSSIBLILITY OF DANGER EXISTS.

AREA HAZARDOUS TO PERSONNEL

POSSIBLE FUEL IGNITION AREA

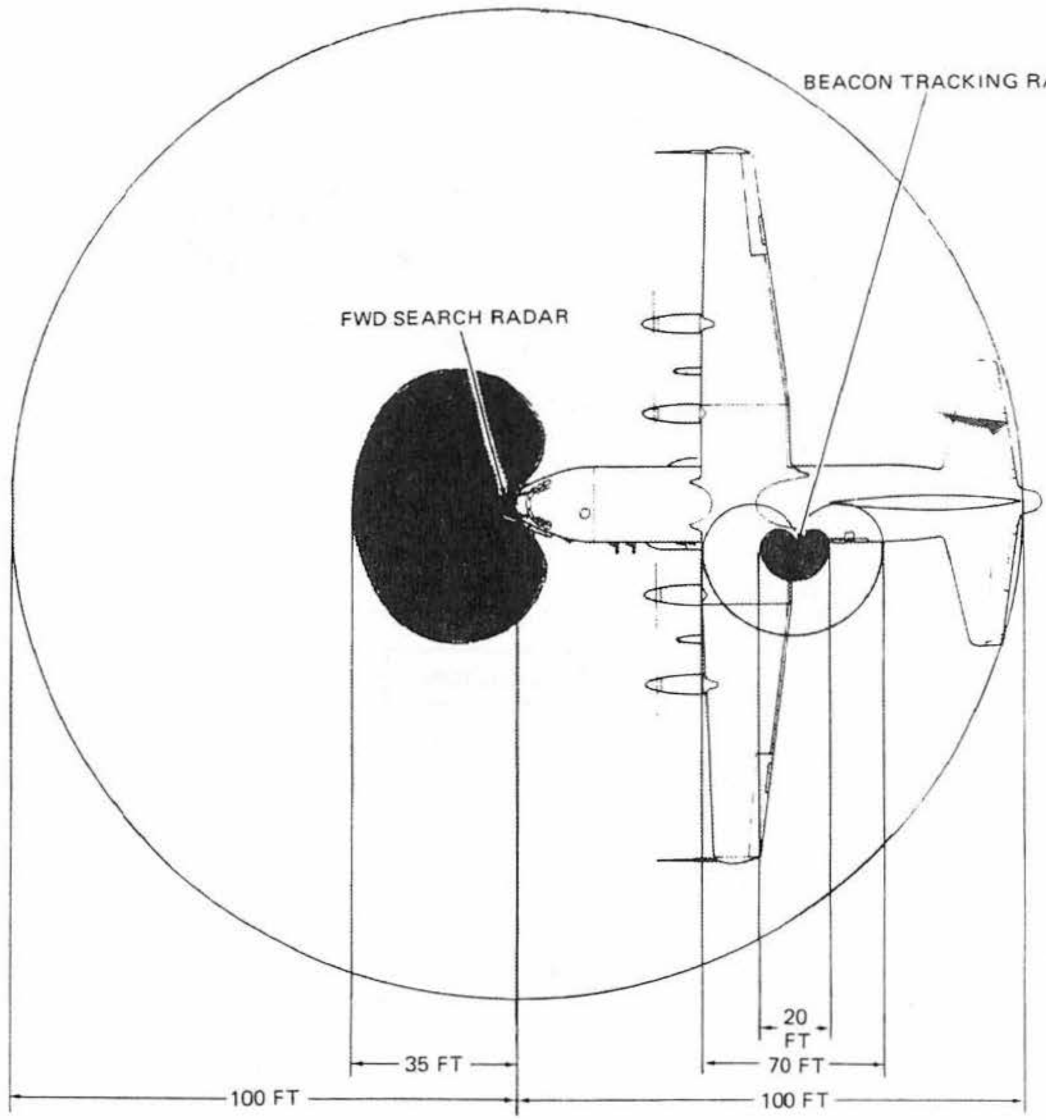
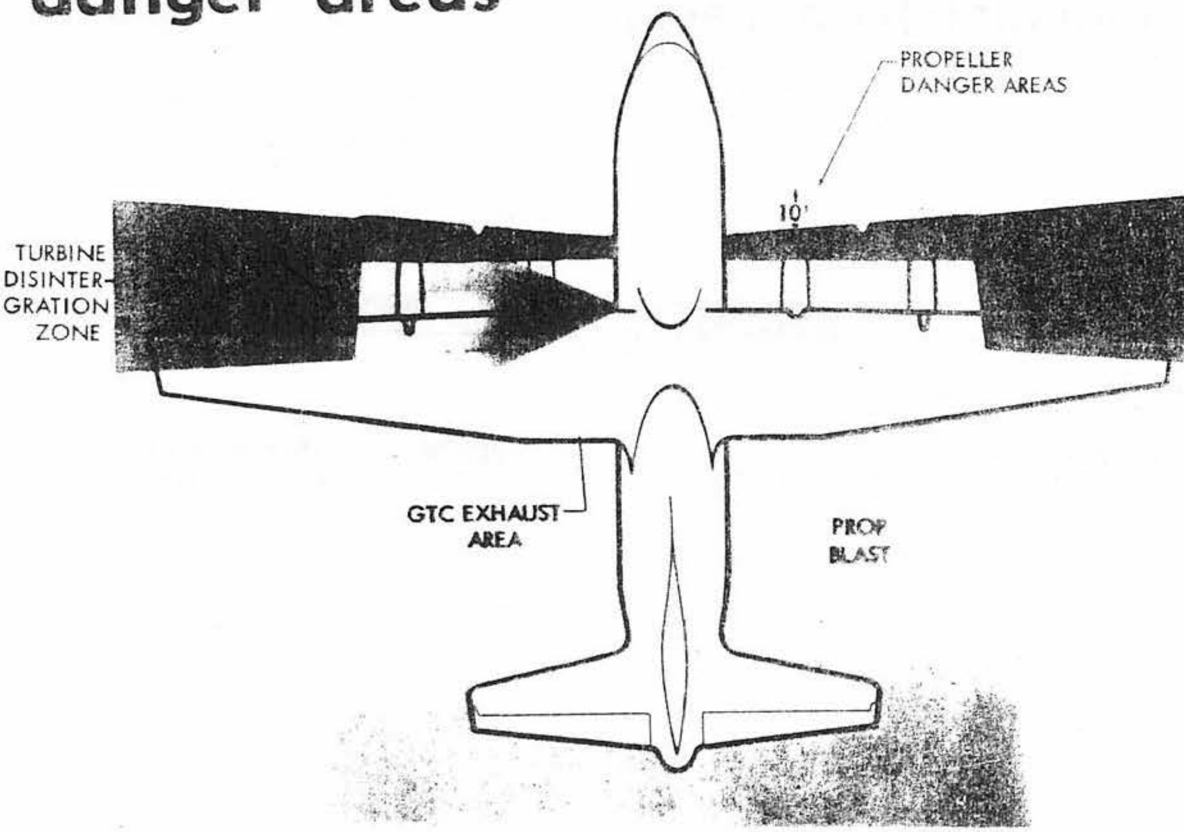


Figure 2-3

danger areas



MAXIMUM POWER, NO WIND					
DISTANCE AFT OF PROPS - FEET	100	200	300	400	500
WAKE VELOCITY - KNOTS	128	107	92	80	69

Figure 2-4

ENGINE RUNUP

Engine runup will not be required on subsequent flights of the day by the same flight crew. Select an area which is free of foreign objects. Head the airplane into the wind. (See figure 2-4 for danger areas.)

CAUTION

To prevent excessive stresses on the propeller and to prevent wing lift and resultant severe structural damage due to a propeller contacting the ground, the airplane will be headed into the wind within 30 degrees of wind direction for engine power settings in excess of 7,000 inch-pounds of torque or greater when the wind velocity is in excess of 10 knots.

CAUTION

Do not run up two engines on one side simultaneously. The thrust available is sufficient to skid the nosewheel sideways. Simultaneous full reverse power on all engines may lift the nosewheel off the ground.

NOTE

The BEFORE TAKE-OFF checklist may be performed prior to engine runup. If the BEFORE TAKE-OFF checklist is accomplished prior to engine runup, ensure all BEFORE TAKE-OFF checklist items are configured for take-off.

CAUTION

When operating the airplane on either snow surfaces at temperatures near freezing or on slippery surfaces, deviations must be made for engine and propeller check procedure. Check the engines in symmetrical pairs when necessary. Use reverse thrust on remaining pair of engines to prevent the airplane from sliding forward. Brakes alone will not prevent the airplane from moving forward if each of four engines is producing more than approximately 8,000 inch-pounds of torque. Avoid parking airplanes close together during ground tests. When runup must be conducted on slippery surfaces, do not attempt to make full power checks until the airplane is lined up on the runway ready for take-off.

PILOTS

1. Nose wheel; parking brake - "Centered, Set" (P)

2. Engine Runup - "Completed" (E)

CAUTION

Do not run up all four engines to maximum power simultaneously. The thrust available may be sufficient to skid locked wheels and chocks. Do not run up two engines on one side simultaneously. The thrust available is sufficient to skid the nose wheel sideways. Simultaneous full reverse power on all engines may lift the nose wheel off the ground.

NOTE

This check will be completed by the flight engineer. The pilot will position the throttles as requested. This checklist is considered complete upon response from the engineer.

FLIGHT ENGINEERS

1. Engine Runup - "Completed" (E)

NOTE

The engineer will request positioning of throttles switches as required. Remain silent on results of individual checks unless a discrepancy exists.

a. Ground idle RPM - Within limits

b. Flight idle RPM - Within limits

c. Propeller operation - Checked

(1) Set throttles in electronic fuel controlling and a minimum of 8,000 inch-pounds of torque.

(2) Check that RPM is within limits.

(3) Turn electronic prop governor switches OFF. Check that RPM is still within limits.

(4) Turn all four switches to SYNC. RPM of the engines should be within limits.

d. Engine instruments - Within limits

WARNING

If engine instruments are not similar in fuel flow, TIT or torque, with similar throttle position, a propulsion system malfunction may exist. Refer to Section VII for GROUND CHECKOUT OF THE TEMPERATURE DATUM CONTROL SYSTEM.

e. Throttles - GROUND IDLE

WARNING

If a positive decrease in torque is not noted as the throttles are returned to Ground Idle, a propeller malfunction exists that may prevent the propeller blade angle from decreasing to the ground idle or reverse range. Maintenance action is required prior to flight.

BEFORE TAKEOFF.

PILOTS

NOTE

Items previously briefed need not be repeated.

1. Crew briefing - "Completed" (P)
   a. Takeoff and climb data
   b. Signals for gear and flap retraction
   c. CP/E emergency actions during takeoff
      (1) Aborted takeoff
      (2) Emergency return
   d. Departure procedures
      (1) Navigation radios
      (2) Radar altimeter (set for emergency return)
      (3) Review clearance
      (4) Hazardous terrain/Obstacles
2. Trim tabs - "Set" (P)
   a. Indicators - Checked
   b. Elev tab power switch - NORMAL
3. Autopilot - "OFF" (P)
4. Flaps - "50%" (CP)
5. Flight controls - "Checked" (P)
6. Hydraulic pressures - Checked (CP)
7. Instruments - "Checked" (CP), (P)
8. Safety belt and shoulder harness - "Fastened, Unlocked" (CP), (P)

FLIGHT ENGINEERS

1. All exits - Secure
   a. Windows - Closed
   b. Hatches - Secured
2. Pressurization (ferry flight only) - Set
   a. Rate knob - MINIMUM
   b. Set controller to desired altitude, but never less than field elevation.
   c. Air condition master switch - As required
3. Propeller control switches - Set
   a. Electronic prop governor switches - SYNC
   b. Sync master switch - No. 1 or No. 2
4. Ice control panel - Set
   a. Nesa - NORMAL
   b. Pitot heat - ON
   c. Prop and engine anti-icing - ON AUTO
5. Fuel control panel - Set
   a. Crossfeed valves - CLOSED
   b. Main tank boost pumps - ON
6. Warning lights - Checked
7. Instruments - Checked
8. Lights - Set
   a. Navigation lights - As required
9. Safety belt and shoulder harness - Fastened/Unlocked

9. Before Takeoff checks - "Complete" (CP), (E), (N), (FCO), (IO)

10. Before Takeoff checks - "Complete" (CP), (E), (N), (FCO), (IO)

LINEUP.

PILOTS

This checklist will be accomplished immediately prior to or while taxiing onto the active runway.

1. Oil cooler flaps - AUTO (CP)
2. Exterior lights - As required (CP)
3. IFF/SIF - SET (CP/N)
4. Anti-skid - ON (CP)

NOTE

On aircraft not modified by TCTO 1C-130A-743, do not turn anti-skid on until start of takeoff roll.

5. Lineup checks - "Complete" (CP), (N)

TAKEOFF.

The following paragraphs discuss normal, maximum-effort, obstacle clearance, and crosswind takeoffs. Use T.O. 1C-130(A)A-1-2 as necessary to predict airplane performance for any takeoff. Refer to Section V for airplane limitations. Refer to Section III for procedures to be followed during takeoff emergencies.

NORMAL TAKEOFF.

The throttles are gradually advanced toward maximum power. The copilot will monitor the engine instruments and adjust throttles to prevent maximum allowable power from being exceeded during the takeoff. Normal takeoff is made with 50 percent flaps. Whenever charted performance is desired, maximum allowable power should be applied before the brakes are released, as all takeoff performance data are based on this type of takeoff.

CAUTION

Under low ambient temperature conditions, never place the throttles in the TAKEOFF position without monitoring the torquemeters, since it is possible to exceed the maximum allowable torque before reaching maximum turbine inlet temperature specified in Section V. In addition, increasing ram effect during takeoff will increase torque for any set turbine inlet temperature. This means that torque must either be set below maximum allowable when setting power for takeoff, or power must be reduced as airspeed builds up.

NOTE

Nose wheel steering is required in addition to aerodynamic control when takeoff is continued after engine failure and prior to reaching minimum control speed.

NOTE

During the takeoff run, the pilot maintains directional control with the nose wheel steering until the flight controls become effective. Concurrently, the copilot shall hold the control column forward and keep the wings level with the ailerons. As speed increases, the pilot discontinues nose wheel steering and maintains control of the airplane throughout the takeoff run by coordinated use of the flight controls and power, according to the circumstances of speed, crosswinds, and runway condition. The flight engineer will monitor all systems and report any malfunctions to the pilot.

For a smooth transition to takeoff attitude, rotation of the airplane should be started approximately 5 knots below the takeoff speed or at the minimum control speed, whichever is greater.

MAXIMUM EFFORT TAKEOFF AND OBSTACLE CLEARANCE.

Maximum effort takeoff should be made only when authorized or directed by the major air command concerned.

Closing engine bleed air valves will increase the total power available for takeoff.

WARNING

On an aborted takeoff with engine bleed valves closed and normal brakes fail or malfunction, emergency brake pressure will not be available unless the engine bleed valves are opened.

A maximum effort takeoff is made by holding the brakes on until engines are stabilized at maximum power. Performance data are for the 50 percent flap configuration. For a maximum effort takeoff, accelerate on the runway to takeoff speed and pull the nose up until the airplane leaves the ground. Takeoff speed may be lower than minimum control speed. Retract the landing gear and adjust the attitude of the airplane to attain obstacle clearance speed. After clearing the obstacle, slowly retract the flaps while maintaining altitude and accelerate to best climb speed.

CAUTION

Under low ambient temperature conditions, never place the throttles in the TAKEOFF position without monitoring the torquemeters, since it is possible to exceed the maximum allowable torque before reaching maximum turbine inlet temperature specified in Section V. In addition, increasing ram effect during takeoff will increase torque for any set turbine inlet temperature. This means that torque must either be set below maximum allowable when setting power for takeoff, or power must be reduced as airspeed builds up.

NOTE

On airplanes modified by T.O. 1C-130-708, the stall warning horn may be actuated during a maximum effort takeoff.

CROSSWIND TAKEOFF.

Crosswind takeoffs, with regard to directional control of the airplane, are made essentially the same as normal takeoffs. Initially, the pilot maintains directional control with nose wheel steering and rudder as it becomes effective, while the copilot maintains a wing-level attitude with the ailerons. Increase takeoff speed (see T.O. 1C-130(A)A-1-2, Takeoff Crosswind Chart) as necessary when encountering higher crosswinds. Hold the nosewheel on the runway until adjusted takeoff speed is reached and abruptly rotate the airplane to prevent skipping. After lift off, the line of flight should be aligned with the runway until crossing the airfield boundary.

AFTER TAKEOFF.

As soon as airborne (and at the command of the pilot), retract the landing gear. When a safe altitude is reached, and at no less than 20 knots above takeoff speed, retract the flaps.

NOTE

Retracting the landing gear and flaps simultaneously will result in a slower than normal operation of both.

Maintain maximum power until the airplane reaches the desired climb speed as determined from T.O. 1C-130(A)A-1-2 (Best Climb Speed) or use the table below to prevent excessive nose high attitudes.

180 KIAS to 10,000 feet

170 KIAS to 15,000 feet

160 KIAS to 25,000 feet

Performance charts above 25,000 feet.

PILOTS

1. Landing gear - "UP" (CP)

NOTE

When the last main gear contacts the up limit switch, momentary flicker of the nose gear indicator may occur. Momentary flicker is considered normal and should not cause any adverse effect.

2. Flaps - "UP" (CP)
3. Hot Mic - Talk/OFF (CP), (P)
4. Landing light panel - Set (CP)
   a. Taxi lights - OFF
   b. Landing light switches - OFF
   c. Landing light monitor switches - Retract, HOLD
5. Radar altimeter - "As required" (P)
6. After Takeoff checks - "Complete" (CP), (E)

FLIGHT ENGINEERS

1. ATM - STOP
2. Pressurization (ferry flight only) - Checked
3. Leading edge anti-icing - Checked As required

NOTE

Leading edge anti-icing will be checked on the first flight of the day. Turn the wing and empennage anti-icing on until a temperature rise is noted on the indicators. This will eliminate any moisture in the system. Turn the wing and empennage anti-icing OFF and note a decrease in temperature. The wing and empennage check will be coordinated with the pilot.

4. After Takeoff checks - "Complete" (CP), (E)

FLIGHT CHARACTERISTICS.

Refer to Section VI for detailed information on the airplane flight characteristics.

CRUISE.

Refer to Section VII, Fuel Management Procedures: refer to Appendix I, T.O. 1C-130(A)A-1-2 for cruise power settings.

CAUTION

Do not place the engine condition levers in any position other than FEATHER, RUN, or AIR START during flight.

NOTE

If offspeed or fluctuating condition occurs, refer to PROPELLER FAILURES in Section III. Turbulent flight conditions may cause excessive rpm fluctuations.

FIRE CONTROL ALIGNMENT.

PILOTS

1. Electronic fuel correction - LOCKED (CP)
2. Sight - "Set" (P)
   a. Azimuth and elevation - Set
   b. Filament switches - ON
   c. Rheostats - Set
   d. Gunsight test panel switch - TEST
3. Flaps - "Set" (CP)
4. Autopilot - "Set" (P)
5. Alignment - "Checked" (P)
   a. Ground alignment point - Identified/Confirmed
   b. Guidance - Checked

NOTE

Pilot should check for proper guidance information and make altitude or airspeed adjustments if required. When the guidance needles center transition to the sight and check the recticles aligned within command or locally established tolerances. Flap setting, computer true airspeed or indicated airspeed adjustments may be necessary to correct for differences between the guidance and gunsight presentation.

   c. Sight - Adjusted
      (1) Adjust sight so that movable recticle is superimposed on the ground alignment point.
   d. Sensors - Aligned

NOTE

Sensors should be aligned within command or locally established tolerances. Sensor alignment errors may be corrected by use of the boresight box.

   e. Wind and offset - Checked (if not ground checked)
6. Fire Control Alignment checks - "Complete" (CP), (E), (N), (FCO)

FLIGHT ENGINEERS

1. Firing mode switch - Set/AUTO
2. Master arm switch - SAFE
3. Fire Control Alignment checks - "Complete" (CP), (E), (N), (FCO)

ENROUTE

NOTE

This checklist will be coordinated between the CP and EWO and will be accomplished when CP duties permit but before entering an enemy threat area.

PILOTS

1. ALR-46 - Checked (CP)
   a. Intensity controls - Set
   b. Self test - Checked
2. Enroute checks - "Complete" (CP), (EWO)

PRE-STRIKE.

PILOTS

CAUTION

Prior to initial operation of the 40W illuminator disengage the autopilot and turn the radar to standby due to possible overload of right hand AC bus.

1. Electronic fuel correction - LOCKED (CP)
2. Sight - "Set" (P)
   a. Azimuth and elevation - Set
   b. Filament Switches - ON
   c. Rheostats - As required
   d. Gunsight test panel switch - TEST
3. Dispenser master arm switch - "As required" (P)
4. Flaps - "Set" (CP)
5. Autopilot - "Set" (P)
6. Lights - "Set" (CP), (P)

WARNING

The pilot will direct that all cockpit and cargo compartment lights be set to the minimum practical setting and that the exterior lights (except for the shielded rotating beacon) be extinguished and exterior light circuit breakers pulled before entering an enemy threat area.

FLIGHT ENGINEERS

1. Lights - Set
2. Dispensers and flare launchers - ARMED/As required
3. Master arm switch - SAFE
4. Firing mode switch - Set
5. Gun control panel - Set
   a. Gun control switches - As required
6. Guns - "ARMED"

NOTE

The flight engineer will respond only after notification from the weapons mechanic that the guns are armed.

5. Sight readings - "Complete" (N), (P)

   a. Gun selection

   b. Firing mode and rate

   c. Coincidence

6. Guns - "CLEAR TO ARM" (P)

   "ARMED" (E)

WARNING

Guns will be armed only over designated target or hostile areas.

NOTE

The flight engineer will respond only after notification from the weapons mechanics that the guns are armed.

7. Pre-Strike checks - "Complete" (CP), (E), (N), (FCO), (IO), (WM)

7. Pre-Strike checks - "Complete" (CP), (E), (N), (FCO), (IO), (WM)

POST-STRIKE.

PILOTS

WARNING

Defensive equipment will not be deactivated until clear of enemy threats.

1. Guns - "DEARMED" (E)

NOTE

The flight engineer will respond only after notification from the weapons mechanic that the guns are dearmed.

2. Dispenser master arm switch - "OFF" (P)
3. Sight - "Set" (P)

   a. Rheostats - OFF

   b. Filament switches - OFF

4. Autopilot - "As required" (P)
5. Flaps - "As required" (P)
6. Lights - "Set" (CP), (P)
7. Post-Strike checks - "Complete" (CP), (E), (N), (FCO), (IO), (WM)

FLIGHT ENGINEERS

1. Master arm switch - SAFE
2. ALE-20 dispenser switch - SAFE
3. Gun control panel - Set

   a. All gun switches - SAFE/LO RATE

   b. Firing mode switch - AUTO

4. Guns - "DEARMED"

NOTE

The flight engineer will respond only after notification from the weapons mechanic that the guns are dearmed.

5. Lights - As required
6. Post-Strike checks - "Complete" (CP), (E), (N), (FCO), (IO), (WM)

DESCENT.

PENETRATION DESCENT.

A penetration descent is made in two parts. The first part is from altitude to 20,000 feet at maximum lift over drag speeds, with throttles at FLIGHT IDLE and gear and flaps up. The second part is from 20,000 feet down at a constant 250 KIAS. Refer to the Penetration Descent chart in T.O. 1C-130(A)A-1-2.

RAPID DESCENT.

Gear and Flaps Up.

The highest rates of descent are obtained by retarding all throttles to FLIGHT IDLE with gear and flaps retracted and descending at maximum speeds, as shown in Section V and tabulated on the performance chart. The rapid descent chart with gear and flaps retracted is based on maximum speeds for 25,000 pounds of cargo or less. Refer to the Rapid Descent chart in T.O. 1C-130(A)A-1-2.

Gear and Flaps Down.

At slow airspeeds, the highest rates of descent are obtained by retarding all throttles to FLIGHT IDLE, decreasing airspeed to flap limit speed (145 knots), and extending landing gear and full flaps. Descend at 145 knots. Refer to the Rapid Descent With Full Flaps Chart, T.O. 1C-130(A)A-1-2.

NOTE

Repeated actuation of the landing gear under full cabin pressure differential conditions is not recommended.

NOTE

Flight idle engine torque during descent and approach may go negative and cause an NTS signal on one or more engines. This will cause an rpm and power fluctuation, resulting in a yawing condition on the airplane. To correct this condition, move the throttle(s) forward to bring engine torque out of the NTS range. The use of wing and empennage anti-icing will further decrease flight idle torque.

BEFORE LANDING PATTERN.

This check will be accomplished prior to traffic pattern entry and/or before commencing any type of instrument approach.

PILOTS

1. Crew briefing - "Complete" (P)
   a. Approach
   b. Minimums
   c. Missed approach intentions
   d. Radios/Nav aids
   e. Terrain/Arrival restrictions
   f. Landing data

FLIGHT ENGINEERS

1. Landing data - Computed

NOTE

A new TOLD card will be required any time gross weight changes 5,000 lbs or more or outside temperature changes 5°C or more.

2. Pressurization (ferry flight only) - Set
3. Fuel panel - Set
4. Guns - DEARMED

NOTE

Prior to landing, the pilot will advise the flight engineer of the landing field elevation and runway temperature.

2. Safety belt and shoulder harness - "Fastened, Unlocked" (CP), (P)

3. Electronic fuel correction switch - As required (CP)

NOTE

Landing is normally made with the electronic fuel correction switch, in the CONTROLLED position. When the LOCKED position is used, it is recommended that the switch be placed in LOCKED with the engines operating at stabilized TIT of 800° or above and at an airplane altitude within 5000 feet of field elevation.

4. ALR-46 Intensity - Set (CP)

5. Radar altimeter - "Set" (P)

   a. Set to 1000 ft AGL.

6. Altimeters - "State setting" (CP), (P), (N), (FCO)

WARNING

Altimeters will be set to station pressure (QNH) if available when transiting the transition level. Altimeters may be set when above, but cleared through the transition level. The altimeter's internal vibrator may become inoperative due to internal failure or dc power failure. If this should occur, the 100 foot pointer may momentarily hang up when passing through 0 (12 o'clock position). Pilots should be especially watchful for this failure when their minimum approach altitude lies within the 800 to 1,000 foot part of the scale (1,800-2,000 feet, 2,800-3,000 feet, etc) and should use any appropriate altitude backup information available. The 100 foot pointer hangup can be minimized by tapping the case of the altimeter.

7. Before Landing Pattern checks - "Complete" (CP), (E), (N), (FCO), (IO)

5. Before Landing Pattern checks - "Complete" (CP), (E), (N), (FCO), (IO)

BEFORE LANDING.

NOTE

The pilot may call for flaps and gear before calling for the BEFORE LANDING checklist.

CAUTION

Landing with ENTC test switch in the test position may result in loss of reverse thrust action on one or more engines.

PILOTS

1. Radar altimeter - "Set" (P)
   a. Appropriate HAA HAT
2. Flaps - "As required" (CP)
3. Landing gear - "DOWN, Checked" (CP), (P)

CAUTION

Just prior to landing, the nose wheel steering indicator will be checked to assure the nose wheel is not cocked.

NOTE

When climatic conditions require the use of the MLG drive switch, place the switch in HI TORQUE prior to actuating the landing gear lever. Return the switch to NORMAL after the landing gear is extended.

NOTE

The landing gear position indicators (airplanes AF53-3129 through 55-0014) or the three landing gear position lights (airplanes AF55-0029 and up) are the primary systems to indicate that the gear is down. The warning horn and light are backup systems.

4. Landing lights - As required (CP)
5. Hydraulic panel - Set (CP)
   a. Brake select switch - Checked
   b. Hydraulic pressure - Checked
6. HOT Mic - "Set" (CP), (P)

NOTE

Pilot and copilot will set control panels to LISTEN ON, TALK ON. Other crew members will set LISTEN ON.

7. Before Landing checks - "Complete" (CP), (E), (N), (IO)

FLIGHT ENGINEERS

1. Hot Mic - Listen ON
2. Landing gear indications - Checked, DOWN
3. Anti-skid test (some airplanes) - Checked
4. ATM - Set
   a. ATM switch - RUN
   b. Voltage/Frequency - Checked
5. Safety belt and shoulder harness - Fastened/Unlocked
6. Before Landing checks - "Complete" (CP), (E), (N), (IO)

LANDING.

See figure 2-5 for approach and landing pattern.

approach and landing(typical)

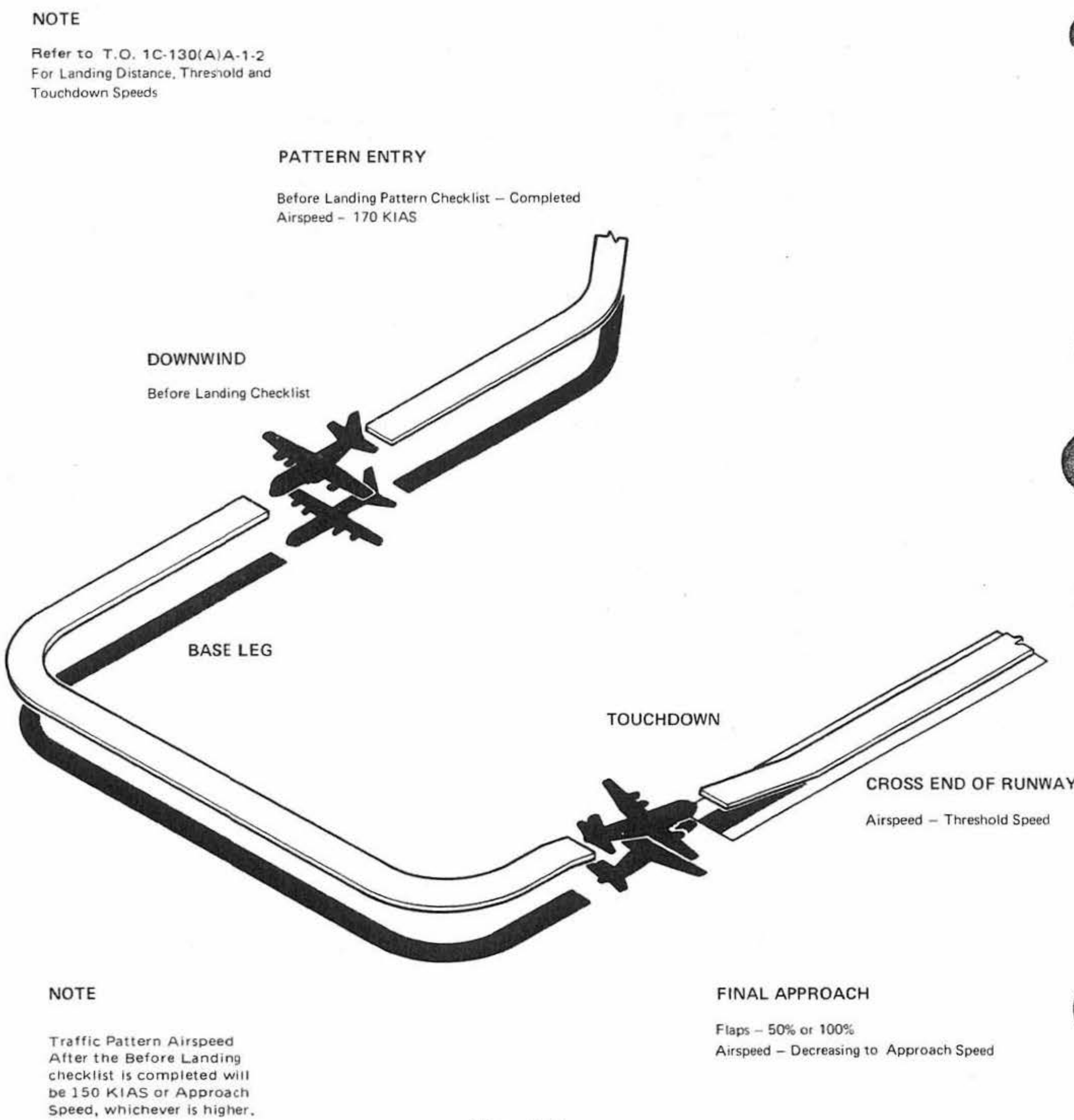


Figure 2-5

WARNING

The failure of one or more propellers to reverse may result in complete loss of directional control. After touchdown, if the throttles are moved into the ground range with a movement which is too rapid, it is possible to lose control of the airplane before a propeller malfunction can be detected. The movement from the flight range into the ground range should be made at a reasonable rate which will permit detection of a malfunction, such as failure of the low pitch stop to retract. At the first indication of directional control difficulties during reversing, immediately return all throttles to ground idle. Maintain directional control with flight controls, differential braking, and nose wheel steering as required. After identifying the affected propeller, symmetrical propellers may be reversed and the affected engine shutdown while it is in ground idle. Rudder, differential power and brakes are the primary means of directional control. During the final stages of landing roll, reduce reverse thrust if conditions permit, to prevent debris from causing restriction of visibility or engine damage.

CAUTION

It is possible to scrape the aft bottom of the airplane when landing with extreme nose high attitudes.

CAUTION

Propeller reversing with an unbalanced fuel load can cause an extreme wing-low attitude and undesirable control characteristics.

CAUTION

Do not move the throttles below the FLIGHT IDLE gate above 105 knots indicated airspeed. Even with an operable Engine Negative Torque Control disabling system, certain engine-propeller conditions may result in pitch lock of the propeller(s) in a positive thrust setting, loss of engine power, and a directional control problem.

NORMAL LANDING.

Normal landing configuration is 100 percent flaps. Refer to T.O. 1C-130(A)A-1-2 for landing speeds and distances. Every landing should be planned according to runway length available and the general prevailing operating conditions. Normal landings should also be planned so as to use all of the available runway length to promote safe, smooth, and unhurried operating practices: to preclude abrupt reverse power changes: and to save wear and tear on brakes. On final approach, begin to decrease airspeed from approach speed at a point that will allow a gradual slow-up to cross the runway threshold at threshold speed. Touchdown should be planned at the speed computed from the appropriate landing speed chart. After the main wheels touchdown, lower the nose wheel smoothly to the runway before elevator control is lost. When the main and nose landing gear are firmly on the ground, the copilot must hold forward pressure on the control column and maintain a wings-level attitude with ailerons, as needed. Concurrently, the pilot maintains directional control and decelerates the airplane through the coordinated use of the rudder, differential power, nose-wheel steering, and differential brakes according to the speed, wind, and runway conditions. Reverse thrust is applied by moving the throttles from FLIGHT IDLE to GROUND IDLE, and then into REVERSE range in coordination with nose-wheel steering. Brakes must be checked during the landing roll.

CROSSWIND LANDING.

To check the maximum allowable crosswind components for landing, refer to T.O. 1C-130(A)A-1-2. Use normal final approach speeds if the wind is steady. When winds are gusty, a slight increase in approach airspeed is recommended. (At the lighter gross weights, it is advisable to use less than 100 percent flaps in order to touchdown main gear first at these touchdown speeds which are higher than normally recommended.) Immediately after the main wheels touch down, lower the nose wheels and hold in firm contact by using the elevators. During landing roll, control the airplane directionally by using aileron and rudder control, nose-wheel steering, and differential power. The upwing wing has a tendency to rise when reverse thrust is applied. Since this tendency is especially pronounced if flaps are extended 100 percent, flaps should be raised before applying reverse power on landing in severe crosswinds.

CAUTION

An engine-out condition may add difficulty to a crosswind approach and landing by adding to the drift and weather vaning.

MAXIMUM EFFORT LANDING.

NOTE

Maximum effort landing will be made only when authorized by the major air command concerned.

Normal traffic patterns will be flown unless airfield situations or mission requirements dictate otherwise. Complete the Before Landing checklist. When established on the final approach, slow to 100% flap threshold speed. Rate of descent on the approach should be adjusted to arrive over the end of the runway at 100% flap threshold speed with approximately a 500 fpm rate of descent. The touchdown areas should normally be selected from 100 feet to 300 feet down from the approach end of the runway markers: however touchdown within 500 feet is essential. Airspeed control during the final approach is important. After crossing the end of the runway, initiate flare and retard the throttles.

During gusty wind conditions, the threshold speed will be increased by the full gust increment, not to exceed ten knots (any increase in touchdown speed will increase the minimum runway length required). Landings will be conducted only if computed touchdown speed is in the recommended area of the Landing Crosswind Chart.

Immediately upon contact and with the gear firmly on the ground, apply full reverse thrust and minimize nose gear loads by use of elevator back pressure. Apply braking action as required. Performance charts are based on full anti-skid braking which should be used when maximum performance is required.

WARNING

The nose gear must be on the ground prior to reversing.

LANDING ON WET RUNWAYS.

The anti-skid braking system, reverse thrust, and nose wheel steering capabilities minimize normal hazards associated with wet runways.

LANDING ON ICY RUNWAYS.

Operation of the airplane on ice is hazardous and should be attempted only when the mission is of the nature that such operation is necessary. Caution must be exercised when landing or taxiing on ice. Use of nose wheel steering should be minimized and used with caution. Taxi speeds must be slow and taxi turns should be planned for large radius turns. Directional control can be maintained with asymmetrical power and nose wheel steering at taxi speeds and with asymmetrical power and rudder at speeds above rudder effectiveness. Touchdown should be made from a power approach at the minimum safe speed possible. Hold the nose wheel off as long as possible to obtain maximum aerodynamic drag. Braking after lowering the nose wheel must be made with caution and use symmetrical power and reverse thrust as the primary means to obtain braking action and to prevent sudden yawing and skidding. It is also difficult for the pilot to sense that the wheels are skidding. Landing on ice covered runways should not be attempted if existing crosswinds will require large crosswind approach or taxiing correction applications.

TOUCH-AND-GO LANDING.

Touch-and-Go checklist may be used for full stop and taxi-back operations provided only flaps, trim tabs, and throttles are moved. The After Landing or Operational Stop checklist must be used when hatches/doors are opened and/or other controls not listed above are operated. Touch-and-go landings require a significant element of caution because of the many actions that must be executed while rolling on the runway at a high speed or while flying within the immediate proximity of the ground. The actions required during touch-and-go landings are divided into three categories: On the runway, after takeoff, and before landing. This procedure and checklist is designed for use when touch-and-go landings are being accomplished and the airplane remains in the traffic pattern area. Before the first touch-and-go, all normal checklists should be completed through the Before Landing checklist. After the first touch-and-go, this checklist may be used until the airplane either departs the traffic pattern area or makes a full stop landing when an immediate takeoff is not planned.

After the airplane has touched down (both main and nose gears), the pilot flying the airplane will call for flaps to be set at 50%; the copilot will set/check the flap lever to 50% and set/check the trim. When the trim is set for takeoff, he will call, "Throttle". The pilot will then advance the power and continue with a normal takeoff.

PILOTS

WARNING

When moving the flaps at low airspeeds, an asymmetrical flap may go undetected until near or above the takeoff speed.

On the runway:

1. Flaps - "50%" (CP)
2. Trim tabs - "Set" (CP)
3. Throttles - As required (P)

After takeoff:

1. Landing gear and flaps - "As required" (CP)
2. Landing lights - "As required" (CP)
3. Hot Mic - "As required" (CP), (P)
4. Touch-and-Go After Takeoff checks - "Complete" (CP), (E)

Before landing:

1. Crew briefing - "Complete" (P)
2. Flaps - "As required" (P)
3. Landing gear - "DOWN, checked" (CP), (P)
4. Landing light panel - As required (CP)
5. Hydraulic pressures - Checked (CP)
6. Hot Mic - "Set" (CP), (P)
   a. LISTEN ON
   b. TALK ON

FLIGHT ENGINEERS

After takeoff:

1. ATM - STOP

NOTE

Prior to final landing complete BEFORE LANDING checklist.

2. Touch-and-Go After Takeoff checks - "Complete" (CP), (E)

7. Touch-and-Go Before Landing checks - "Complete" (CP), (E)

NOTE

Flight engineer response is required for final landing only.

GO-AROUND.

When a go-around is being considered, the crew should be alerted as soon as possible.

When a go-around is decided upon, proceed as follows:

a. Give the command "GO-AROUND" to crew.

b. Advance the throttles as required.

c. Direct copilot to set flaps to 50 percent (when speed and altitude permit).

d. Signal the copilot to raise the landing gear when certain that the airplane will not be touched down. (As required.)

e. After the above procedures have been accomplished, proceed as though from takeoff.

AFTER LANDING (AFTER COMPLETION OF LANDING ROLL).

PILOTS

1. Flaps - UP (CP)
2. Anti-skid - As required (CP)

NOTE

On aircraft not modified by TCTO 1C-130A-743, the anti-skid should be turned off.

3. Unnecessary equipment - Set (CP)
   a. IFF - OFF
   b. Radios - As required
   c. NAV aids - OFF
4. Electronic fuel correction - CONTROLLED (CP)
5. Lights - As required (CP)
   a. Landing/taxi - As required
6. Symmetrical engines - "As required" (CP)

FLIGHT ENGINEERS

1. Air conditioning panel - Set
   a. Air condition master switch - No Pressure
   b. Temperature control switches - As required
2. Unnecessary equipment and IFF - OFF
   a. Propeller control switches - OFF
   b. IFF (If Nav not aboard) - OFF
   c. Radar (If Nav not aboard) - STANDBY

CAUTION

The radar must be in the standby mode to prevent radar damage.

3. Lights - Set
   a. Interior - As required
   b. Leading edge - As required
4. Ice control panel - Set
   a. Wing and empennage anti-icing - OFF
   b. Pitot heat - OFF

NOTE

Pilot may direct shutdown of engines 2 and 3 or engines 1 and 4. If these engines are shut down, the airplane will have the following restrictions: loss of braking and steering potential in case of malfunctioning of the remaining utility pump, loss of half of reverse thrust, reduced ability to taxi or turn in very soft fields, and reduced ability to maintain adequate control on slippery surface.

CAUTION

During engine shutdown, monitor the TIT, fuel flow, and rpm watching for relight. In case of relight indication, move condition lever to FEATHER.

CAUTION

During ground stop procedures, do not move condition lever from STOP to RUN while engine is still rotating. The engine will suffer severe overtemperature damage as a result of afterfire due to reignition.

CAUTION

Reversing with the ENTC test switch in the test position may result in loss of reverse thrust action on one or more engines.

NOTE

On engine shutdown, if the drip valves are working normally, approximately 1 to 2 pints of fuel will be seen draining from the engine drain mast. If the drip valves do not open, unburned fuel will remain in the engine and danger of an afterfire will exist.

7. After Landing checks - "Complete" (CP), (E), (N)

c. Nesa - OFF

d. Prop and engine anti-icing - OFF

e. Radome anti-icing (If Nav not aboard) - OFF

5. Symmetrical engines - ENTC shutdown

NOTE

Flight engineer should monitor engine instruments during shutdown for zero fuel flow, ENTC TEST LIGHT, and TIT and RPM decrease.

6. Fuel panel - Set

a. Boost pumps - OFF

b. No. 4 crossfeed valve - OPEN

7. After landing checks - "Complete" (CP), (E), (N)

OPERATIONAL STOP.

NOTE

During operational stop, turn Life History Recorder (some airplanes) OFF. Dial in new gross weight, fuel weight, and turn system on. BIT test is not required.

PILOTS

AFTER LANDING.

1. Flaps - As required (CP)
2. Anti-skid - As required (CP)

FLIGHT ENGINEERS

AFTER LANDING.

1. Pressurization - Set

a. Master switch - No pressure

NOTE

On aircraft not modified by TCTO 1C-130A-743, the anti-skid should be turned OFF.

3. Electronic fuel connection - CONTROLLED (CP)
4. Exterior lights - As required (CP)
5. IFF - STDBY (CP/N)
6. After Landing checks - "Complete" (CP), (E), (N)

BEFORE TAXI.

1. Crew aboard, doors closed - "Aboard, Closed, Checked" (IO)

BEFORE TAKEOFF.

1. Crew briefing - "Complete" (P)
2. Trim tabs - "Set" (P)
   a. Indicators - Checked
   b. Elevator tab pwr switch - NORMAL
3. Flaps - "50%" (CP)
4. Instruments - "Checked" (CP), (P)
5. Safety belt and shoulder harness - "Fastened, Unlocked" (CP), (P)
6. Before Takeoff checks - "Complete" (CP), (E), (N), (FCO), (IO)

LINEUP.

This checklist will be accomplished immediately prior to or while taxiing onto the active runway.

1. Exterior lights - As required (CP)
2. IFF - Set (CP), (N)
3. Anti-skid - ON (CP)

NOTE

On aircraft not modified by TCTO 1C-130A-743, do not turn anti-skid on until start of takeoff roll.

4. Lineup checks - "Complete" (CP), (N)

2. Ice control panel - Set
   a. Wing and empennage anti-icing - OFF
   b. Pitot heat - OFF
   c. Nesa heat - OFF
   d. Propeller and engine anti-icing switches - OFF
3. After Landing checks - "Complete" (CP), (E), (N)

BEFORE TAKEOFF.

1. Pressurization - Set
   a. Master switch - As required
2. Ice control panel - Set
   a. Wing and empennage anti-icing - OFF
   b. Pitot heat - ON
   c. Nesa heat - NORMAL
   d. Propeller and engine anti-icing switches - AUTO
3. Warning lights - Checked
4. Instruments - Checked
5. Safety belt and shoulder harness - Fastened/Unlocked
6. Before Takeoff checks - "Complete" (CP), (E), (N), (FCO), (IO)

ENGINE SHUTDOWN.

PILOTS

1. Nose wheel, parking brake - "Centered, Set" (P)
2. Engine Shutdown - Complete (CP)

CAUTION

Do not depress the battery engine start button during the last engine shutdown in an effort to monitor the engine instruments. To do so may cause an engine fire.

CAUTION

The proper operation of the engine negative torque control system is essential for safe flight. Inflight failure of an engine with the ENTC inoperative may cause decoupling. Failure of an outboard engine to decouple may cause a control problem, and it may cause structural damage to the empennage. Check each engine individually for proper ENTC operation as follows:

NOTE

If external power is desired before engine shutdown, the copilot will wait for the flight engineer response "EXTERNAL POWER CHECKED" before shutting down the last engine.

NOTE

If ENTC light does not illuminate when shutting down engines, a recheck of the ENTC system must be made before the next flight.

a. Place the throttle in GROUND IDLE.

b. Position the ENTC test switch to TEST: the light should illuminate. If the light does not illuminate, the throttle should be advanced until it does.

c. Slowly retard throttle to the exact point at which the light goes out: then advance the throttle approximately 1/4 inch or until just before the light illuminates again.

d. Place the condition lever in STOP: the ENTC light should illuminate. This indicates the propeller blade angle has increased in response to signal from the negative torque control when fuel was shut off.

FLIGHT ENGINEERS

1. Air conditioning control panel - Set

   a. Master switch - OFF

   b. Flight deck temperature control - OFF/NORMAL

   c. Emergency shutoff switches - OFF

2. Vertival reference system and radar (If Nav not aboard) - OFF

3. Main inverter - INV

4. Electrical control panel - Set/ "EXTERNAL POWER Checked" (if required)

   a. ATM switch - RUN

   b. ATM gen - Checked/ON

NOTE

Place voltmeter and frequency meter selector switches to the representative generator position. Check voltage and frequency of each phase of the generator before placing the generator switch to the on position.

   c. Bus selector switches - ATM GEN

   d. TR switches - ON

   e. Battery switch - EXTERNAL

   f. Engine driven generators - OFF

   g. TR switches - OFF

NOTE

If there is no power interruption when the TR switches are placed to the OFF position, this indicates that external power is powering the buses.

5. Shutdown engines - ENTC shutdown

NOTE

Engineer should monitor engine instruments during shutdown for zero fuel flow, ENTC TEST light and negative relight (TIT and RPM decrease).

6. Engine bleed air valve switches - CLOSED

CAUTION

During ground stop procedure, do not move the engine condition lever from GROUND STOP to RUN while the engine is still rotating.

3. Unnecessary equipment - "OFF" (CP), (P)
   a. Radar altimeter (P)
   b. Remote attitude gyro (P)
   c. Lights (CP), (P)
   d. Radios (CP)
4. Oxygen - "OFF" (CP), (P)
5. Exits - "Clear, Insert chocks" (P)
6. Chocks - "In place" (IO)
7. Parking Brake - "Released" (P)
8. Engine Shutdown checks - "Complete" (CP), (E), (N), (FCO)

7. Electrical control panel - Set
   a. AC and DC generator switches - OFF
   b. Inverter switches - OFF

CAUTION

Do not turn main inverter off until engine RPM is below 16%.

8. TD valves - NULL
9. All electrical switches - OFF
10 ATM switch - STOP
11. GTC control panel - Set
    a. GTC switch - OFF
    b. GTC bleed air valve switch - OFF
12. Battery switch and voltmeter selector switch - OFF/MAIN DC BUS

CAUTION

The voltmeter selector switch must be positioned to MAIN DC BUS to prevent battery discharge.

NOTE

Do not turn the battery switch OFF until pressure in the bleed air manifold is depleted. Without DC power, compressor bleed valves on the engine may close and cause stall on subsequent start.

13. Oxygen - OFF
14. Engine Shutdown checks - "Complete" (CP), (E), (N), (FCO)

BEFORE LEAVING THE AIRPLANE.

Make appropriate entries in the Form 781 covering any limits in the flight manual that have been exceeded during flight. Entries must also be made when, in the opinion of the pilot, the airplane has been exposed to unusual or excessive operations such as hard landings or excessive braking action during aborted takeoffs. The flight engineer will complete a brief general condition interior and exterior visual inspection, insuring the NLG lock and wheel chocks are in place, and the electrical ground is connected prior to leaving the airplane.

CAUTION

Never install rig pins in the control system nor secure the flight deck controls as a means of locking the surfaces against wind gust. If locked, damage to the hydraulic booster and/or cable system is likely to result.

Each crew member should turn off all lights as required both interior and exterior, which are controlled from his crew position.

FLIGHT ENGINEERS

This checklist will be performed as practical by the flight engineer.

1. Lights - Set
   a. Exterior - OFF
   b. Interior - As required
   c. Landing - RETRACT/HOLD/OFF
   d. Taxi - OFF
2. Emergency exit light extinguish switch (some airplanes) - Depressed
3. Manual diffuser handle - Pulled
4. Nose landing gear lock and ground wire - Installed

CRUISE ENGINE SHUTDOWN.

This procedure is to be used only if authorized by the major Air Command. Engine shutdown may be performed during cruise flight to achieve optimum fuel economy in order to meet mission requirements. Refer to T.O. 1C-130(A)A-1-2 for charts containing range information.

CAUTION

Operating in the freezing range with visible moisture present may cause icing that will prevent starting of shut down engines.

PILOTS

1. ENTC check - "Complete" (E)
2. Condition lever - "FEATHER" (CP)

FLIGHT ENGINEERS

1. SYNC master switch - As required
2. ENTC check - "Complete" (E)

CAUTION

The ENTC check should be performed on one engine at a time.

NOTE

It may be necessary to reduce airspeed to perform this check.

   a. Electronic propeller governor switch - OFF
   b. Torque (engine being checked for) - 4,000 inch-lbs or more
   c. Wing and empennage anti-icing - ON
   d. Bleed air switch (engine being checked) - OPEN

e. Bleed air switches (Other engines) - CLOSED

f. Slowly retard throttle, observing decrease in torque (engine being checked)

CAUTION

If ENTC action is not observed by -1,860 inch-pounds, advance the throttle to normal operation. Turn off wing anti-icing, open the other engine bleed air valves and close the valve on the one being checked.

NOTE

As torque decreases, read highest negative value. ENTC should occur at -1,260 (600) inch pounds. ENTC action is indicated by increase in torque and may fluctuate up to a positive 500 inch-pounds.

g. All affected switches - Returned to normal

After propeller rotation has stopped:

3. Cleanup - "Complete" (E)

CAUTION

After shutdown of the first engine, allow the TIT to decrease to restart TIT (200°) prior to shutdown of the second engine.

NOTE

This checklist is arranged so that, after the engineer completes his cleanup items, controls for the inoperative engine are set for an immediate airstart by moving the condition lever to AIRSTART. Refer to Section III for Airstart Procedure.

After propeller rotation has stopped:

3. Cleanup - "Complete" (E)

a. Engine bleed air valve - CLOSED

NOTE

The bleed air valve must be opened if use of the starter or engine inlet scoop anti-icing is required.

b. Engine generator switches - OFF

c. Fuel boost pump - OFF

d. Fuel enrichment switch - NORMAL

e. Throttle - 1 inch above FLIGHT IDLE

f. Oil cooler flap switch - CLOSED/FIXED

ALERT PROCEDURES.

When the airplane is placed on alert status, the following checklists will be accomplished: Preflight Checklist to include Before Exterior Inspection, Exterior Inspection, Interior and Top of Airplane Inspection. For scramble accomplish normal procedures starting with Cockpit Checklist.

SECTION III

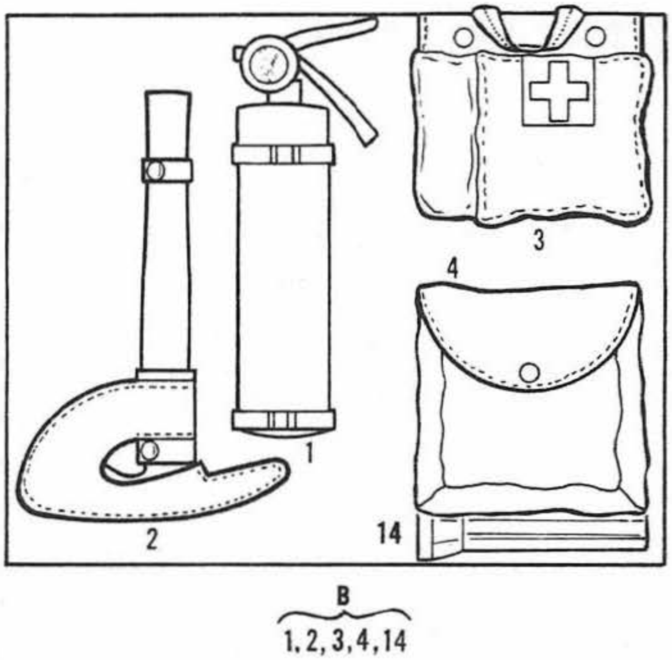
emergency procedures

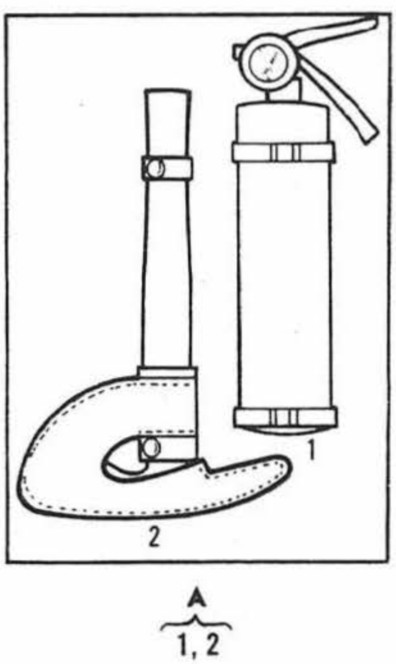
Table of Contents

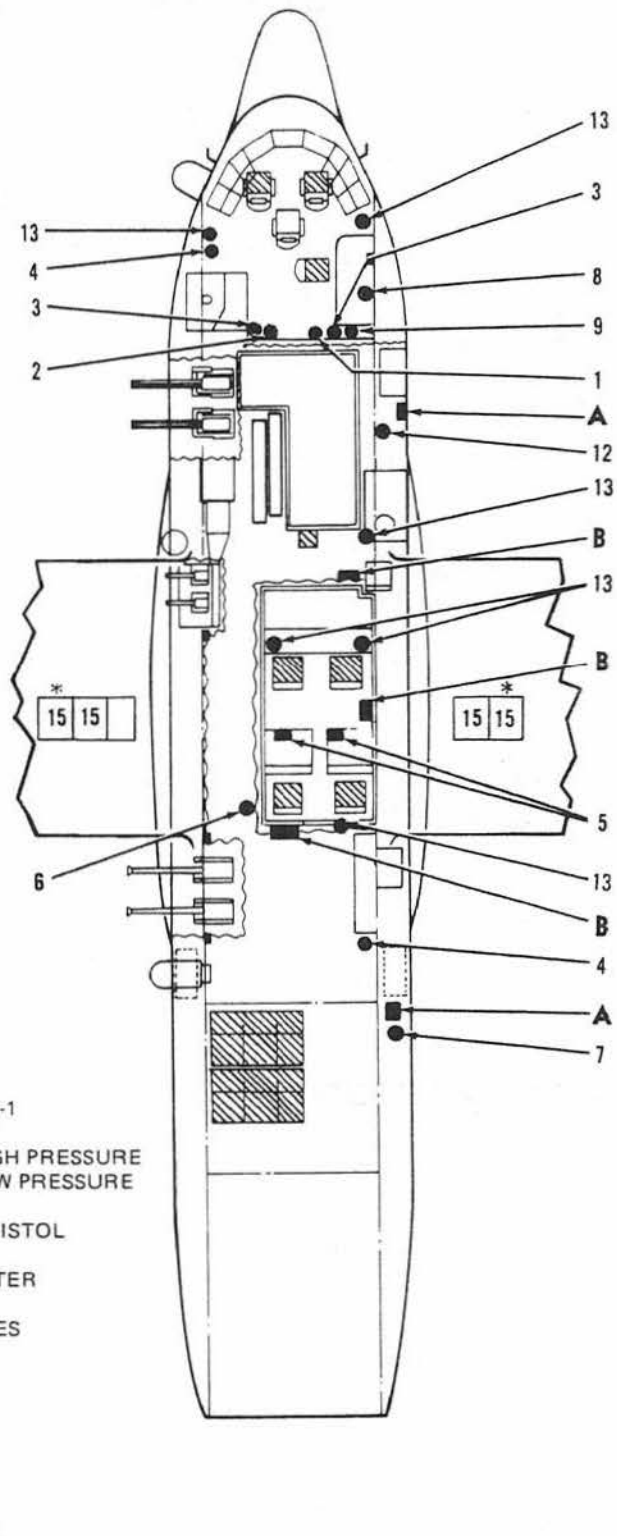
INTRODUCTION.

This section contains the procedures to be used in coping with the various emergencies that may be encouraged. A thorough knowledge of these procedures will enable crew members to perform their emergency duties in an orderly manner, and to judge more quickly the seriousness of the emergency. This will permit early planning for a bailout or forced landing and will greatly increase the crew's chances for survival. The procedures consist of items classified as critical or noncritical. The critical items are actions that must be performed immediately to avoid aggravating the emergency and causing injury or damage. Critical items are presented in boldface type and must be committed to memory. Noncritical items are actions that contribute to an orderly sequence of events. After determining that an emergency exists, the pilot should immediately establish communication with a ground station. The ground station should be given a complete description of the emergency, the action taken, and an accurate position report. The ground station should be further notified of any changes or developments in the emergency, so that the station can alert the necessary agencies. In the checklist presented, the codes P, CP, E, IO and WM stand for pilot, copilot, flight engineer, illuminator operator and weapons mechanic, respectively. This presentation does not preclude the pilot from redelegating the duties. The pilot will command initiation by calling for the procedure desired, but need not call out each step. The affected crew members will accomplish the required steps IAW the appropriate checklist. The engineer will monitor all engine shutdown steps and other coordinated emergency procedures.

emergency equipment (typical)







1. FIRE EXTINGUISHER-CB
2. HAND AXE
3. FIRST AID KITS-SMALL
4. FIRE FIGHTING ASSY-MB-1
5. FIRST AID KITS-COMBAT
6. FIRE EXTINGUISHER-HIGH PRESSURE
7. FIRE EXTINGUISHER-LOW PRESSURE
8. PYROTECHNIC PISTOL
9. FLARES-PYROTECHNIC PISTOL
10. LIFE RAFTS
11. EMERGENCY TRANSMITTER
12. LIFE VESTS
13. OXYGEN REFILLER HOSES
14. FLASHLIGHT
15. LIFE RAFTS

* NOT INSTALLED

Figure 3-1.

Never initiate an engine shutdown procedure before command of the pilot.

ENGINE SHUTDOWN CONDITIONS.

If any of the following conditions occur in flight or on the ground, shut down the affected engine when corrective action fails to remedy the adverse condition.

1. AC generator failure.
2. Engine fire.
3. Turbine overheat.
4. Visible fluid leak.
5. Uncontrollable power.
6. Certain propeller malfunctions (refer to PROPELLER FAILURE in this section).
7. Uncontrollable rise in turbine inlet temperature.
8. Uncontrollable rise in oil temperature.
9. Uncontrollable drop in oil pressure.
10. Engine-driven hydraulic pump failure.
11. Unusual vibration or roughness.

When it is necessary to continue operation of an engine with any of these conditions present, in the interest of safety of the airplane and crew, operate the engine with extreme caution, and at the minimum power required.

NOTE

Before making a precautionary engine shutdown, perform an ENTC check using the procedure in CRUISE ENGINE SHUTDOWN, Section II.

ENGINE SHUTDOWN PROCEDURE.

1. CONDITION LEVER — "FEATHER" — (CP)

2. FIRE HANDLE — "PULLED" (FOR FIRE, OR VISIBLE FLUID LEAK) — (CP)

CAUTION

When pulling a condition lever to FEATHER, pull it all the way to the detent to assure that the propeller is fully feathered when the engine fuel is shut off. If the lever is left at midposition, and the ENTC is inoperative, an engine decoupling is possible.

3. AGENT — "DISCHARGED" (FOR FIRE) — (CP)

WARNING

If condition persists, a break in the bleed air manifold may exist. Isolate the manifold by placing all bleed air valve switches to CLOSE. If personnel without supplemental oxygen are aboard, descend as required before placing the last bleed air valve switch to CLOSE. If the fire continues, discharge the remaining bottle on command of the pilot.

NOTE

The discharge switch should be actuated after the propeller stops rotating and held for 5 seconds.

4. Flap — "As required" — (CP)

5. Landing Gear — "As required" — (CP)

6. Cleanup — "Complete" (E)

a.	Fire extinguisher bottle selector switch	As required
b.	Engine bleed air valve switch	CLOSED
c.	Generator switches	Tripped/OFF
	(1) No. 1 or No. 4 GEN BUS SELECT Switch	As required
	(2) ATM/ATM generator	As required
d.	Main and pilot's inverter switches	As required
e.	Fuel panel	As required

NOTE

If on crossfeed, make sure there is a source of fuel to operate engines before shutting off fuel boost pump and crossfeed valve for the affected engine.

f.	Electronic prop governor switch	OFF
g.	Prop sync master switch	Reset as necessary
h.	TD valve	NULL
i.	Throttle	Full forward

NOTE

The throttle should be left in an advanced position so the warning horn system remains active.

j. Oil cooler flap switch — CLOSE/FIXED

NOTE

Performance data should be checked (Refer to T.O. 1C-130(A)A-1-2.)

GROUND EMERGENCIES

GAS TURBINE COMPRESSOR EMERGENCY SHUTDOWN.

NOTE

The GTC fire indicating system has been disconnected.

SEE 5-21 (E)

1. FIRE HANDLE — "PULLED"

NOTE

Pulling the GTC fire emergency control handle shuts off the flow of hydraulic fluid to emergency brake system.

2. AGENT — "DISCHARGED" (FOR FIRE) (E)

WARNING

If condition persists, discharge remaining bottle on connamd of the pilot.

CAUTION

Without external power or an engine generator on, electrical power will not be available for the fire extinguisher system unless the battery engine start switch is held in when discharging the agent.

NOTE

If taxiing, stop the airplane, set the parking brake and place the engine condition levers to ground stop.

3.	Clean up	"Complete"	(E)
	a. ATM switch	STOP	
	b. GTC control switch	OFF	
	c. Bleed valve	CLOSED	

ATM Compartment Overheat Warning Light (Ground/In-flight).

When the ATM compartment overheat warning light illuminates, immediate steps to correct the overheat must be taken by the engineer as follows:

a. ATM generator switch - OFF

b. ATM control switch - STOP

c. GTC control switch/Ext air - OFF (If required)

If the overheat light does not go out within approximately one minute.

d. No. 1, No. 2, and No. 3 engine bleed air valve switches - CLOSED.

If the overheat light does not go out.

e. All engine bleed air valve switches - CLOSED.

WARNING

Closing the engine bleed air valves will shut off the air supply to BOTH air conditioning units and will cause the airplane to depressurize. If personnel without supplemental oxygen are aboard, descend as required before placing last bleed air valve to closed position.

CAUTION

It is not recommended that the engine bleed air valve control switches be placed to the OPEN position once they have been closed for an overheat condition. Damage to the warning system may prevent detection of a subsequent overheat condition.

Cargo Compartment Refrigerator Overheat Warning Light (Ground/In-Flight)

When the cargo compartment refrigerator overheat warning light illuminates, immediate steps to correct the overheat must be taken by the engineer as follows:

a. Cargo compartment air conditioning shutoff switch - OFF

b. GTC control switch/ext air - OFF (if required)

If the overheat light does not go out within approximately one minute.

c. No. 2, No. 3, and No. 4 engine bleed air valve switches - CLOSED.

If the overheat warning light does not go out.

d. All engine bleed air valve switches - CLOSED

WARNING

Closing the engine bleed air valves will shut off the air supply to both air conditioning units and will cause the airplane to depressurize. If personnel without supplemental oxygen are aboard, descend as required before placing last bleed air valve to closed position.

CAUTION

It is not recommended that the engine bleed air valve control switches be placed to the OPEN position once they have been closed for an overheat condition. Damage to the warning system may prevent detection of a subsequent overheat condition.

DC POWER FAILURE DURING ENGINE START.

In the event of complete DC power failure during the start cycle, proceed as follows:

a. Condition lever - FEATHER (P)

b. Battery switch - BATTERY (E)

c. BATTERY ENGINE START switch - DEPRESS (P)

NOTE

The BATTERY ENGINE START switch should be depressed until engine rotation has stopped.

ENGINE AND TAILPIPE FIRES. (Ground/In flight)

Engine Fire

Engine fires are indicated by steady illumination of the light in the respective fire emergency control handle and the master fire light. If fire is indicated, follow the ENGINE SHUTDOWN PROCEDURE in this section.

CAUTION

After the last engine is shutdown, without external power or the GTC and the ATM running, the only warning of a fire will be from the ground controller. Electrical power will not be available for the fire extinguisher system unless the battery engine start switch is held in.

Tailpipe Fires or Torching during Starting.

A tailpipe fire and/or torching is defined as abnormal flame or smoke coming from the engine tailpipe.

During starting, if the condition is reported (prior to starter pop out) the condition lever should be placed in GROUND STOP and the engine motored with the starter if pneumatic starting air is available. This will normally clear the engine of oil and smoke or unburned fuel. If flames spread beyond the tailpipe, follow the ENGINE SHUTDOWN PROCEDURES.

CAUTION

After the last engine is shutdown, without external power or the GTC and the ATM running, the only warning for a fire will be from the ground controller. Electrical power will not be available for the fire extinguisher system unless the battery engine start switch is held in.

NOTE

Presence of oil and smoke in the tailpipe indicates possible leakage around the rear scavenge pumps.

NOTE

Unless taxiing, inform the ground crew of the situation so that they may use ground fire extinguishers if necessary.

Tailpipe Fires during Engine Shutdown.

If a tailpipe fire occurs during engine shutdown, continue with engine shutdown and notify the fire department.

CAUTION

Tailpipe fire during engine shutdown may be caused by an oil leak in the turbine section. Do not motor the engine when a tailpipe fire exists on engine shutdown.

ENGINE OVERHEATING (Ground/In flight).

There are three indications of overheating in the engines and nacelles: the turbine overheat warning light, high turbine inlet temperature, and high oil temperature.

Turbine Overheat Warning.

A turbine overheat is indicated by the flashing of the master fire warning light and of the light in the respective fire emergency control handle. If a turbine overheat is indicated, proceed as follows:

On the ground: move the throttle to ground idle and proceed with the engine shutdown procedure in this section.

In-Flight: Retard throttle toward flight idle. If condition persists, proceed with engine shutdown procedure in this section.

High TIT:

Should an overtemperature be indicated by a high turbine inlet temperature, proceed as follows:

On the ground: Move the throttle for the affected engine to GROUND IDLE, and place the temperature datum control switch to NULL. If this fails to eliminate the overtemperature condition, place the condition lever to GROUND STOP.

In-Flight: Retard the throttle for the affected engine toward FLIGHT IDLE and place the temperature datum control switch to NULL. If this fails to eliminate the overtemperature condition, proceed with the ENGINE SHUTDOWN PROCEDURE in this section.

High Oil Temperature.

For corrective action to be taken in case of high oil temperature, see ENGINE OIL SYSTEM FAILURE in this section.

EMERGENCY ENTRANCES.

Emergency entrances are those used by ground rescue personnel (figure 3-2).

External Releases.

The side emergency exit and the three escape hatches (figure 3-2) are equipped with external pull-type releases. The releases are flush-mounted on the fuselage surface next to the exits they release. Pulling the release permits the exit to be pushed inward, and entrance may be made.

Chopping Locations.

Chopping locations, marked in yellow (figure 3-2), are painted on each side of the fuselage above and forward of the paratroop jump doors. The locations are marked on the inside and outside of the fuselage.

GROUND EVACUATION.

If it becomes necessary to evacuate the airplane alert the crew and proceed as follows:

a. Parking Brake - SET (P)

NOTE

If fire exists in either main wheel well, set opposite brake only.

b. Tower - NOTIFIED (CP)

c. Fire handles - PULLED (CP)

d. Condition levers - FEATHER (CP)

e. Battery switch - OFF (E)

f. Alarm bell - ON (P) (CP)

g. Chocks - INSTALLED (IO)

NOTE

If main wheel well fire exists, chock nose gear only.

BRAKE SYSTEM FAILURE.

Loss of Normal Brakes.

If a malfunction occurs in the normal brake system, proceed as follows:

a. ATM switch - RUN (E)

b. Brake selector switch - EMERGENCY (CP)

CAUTION

Use brakes cautiously after landing: no anti-skid protection is available on the emergency system. Avoid taxiing into congested areas due to the possibility of emergency hydraulic pump failure.

The brake system cockpit handpump may be used for stopping the airplane in an emergency by holding the brake pedals down while the handpump is being operated. The brake selector switch must be in NORMAL and the anti-skid OFF.

CAUTION

Do not release the brakes until the airplane is stopped. Only one brake application is available when using the handpump. "Fanning" the brake pedals will bleed away pressure faster than the handpump can be operated.

Anti-Skid System Failure.

Whenever the anti-skid system is not operating as an integral part of the brake system, an anti-skid inoperative light (figure 1-43) will illuminate. Use of the anti-skid system after the light illuminates may result in uneven braking and a tendency for the airplane to swerve. The anti-skid switch should be placed in the OFF position if a malfunction is indicated. On airplanes modified by T.O. 1C-130-743, the light will also illuminate if the anti-skid switch is placed in the ON position with the parking brake set.

Anti-Skid Test Unsatisfactory (Airplanes Modified by T.O. 1C-130-743).

During test of the anti-skid system, failure of a wheel unit to test properly indicates that the wheel may have braking without anti-skid protection, or that the wheel may rotate freely without any braking capability. Use of the anti-skid system after an unsatisfactory test indication may result in uneven braking and a tendency for the airplane to swerve when brakes are applied. The anti-skid switch should be placed in the OFF position if the test indicates a system malfunction.

TAKE-OFF EMERGENCIES.

ABORT.

If it becomes necessary to abort a takeoff, proceed as follows:

a. Throttles - GROUND IDLE. (P)

b. Reverse symmetrical engines, apply brakes - As required. (P)

c. If required, initiate or continue with ENGINE SHUTDOWN PROCEDURE in this section when safe control of the airplane is assured. (P)

emergency entrances

typical

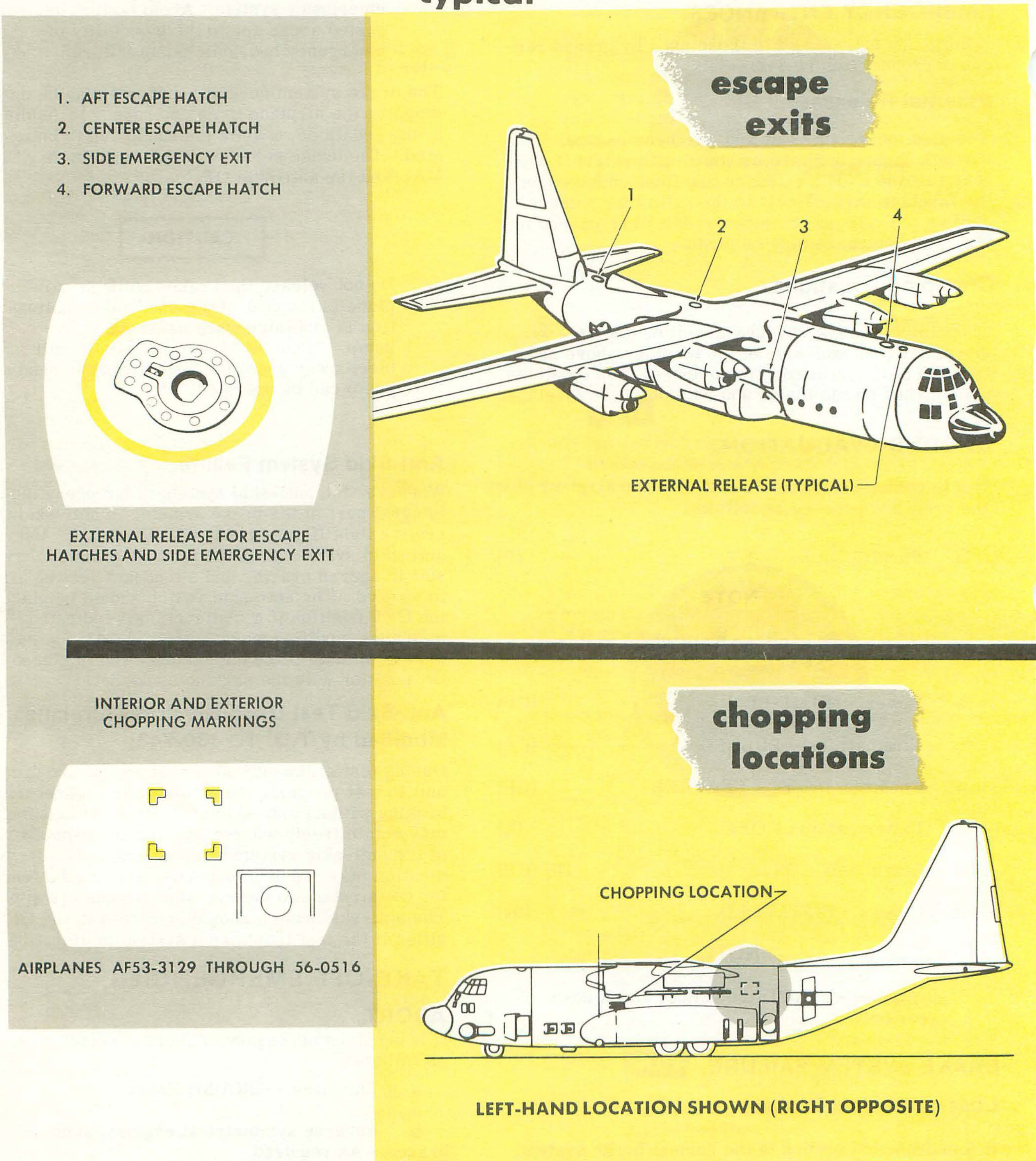


Figure 3-2.

WARNING

Directional control problems may be encountered when all throttles are placed to GROUND IDLE if a propeller malfunction prevents the affected propeller from entering the ground range. In this instance, it is recommended that the throttle of the affected engine and the other symmetrical engine be returned toward the flight idle position until the malfunctioning engine is shutdown.

TAKE-OFF CONTINUED AFTER ENGINE FAILURE.

If engine failure or fire occurs after refusal speed, the take-off should be continued.

a. Maintain directional control with flight controls and engine power as necessary.

b. When safely airborne and certain that the airplane will not touch down again, raise gear while accelerating to flap retraction speed.

c. After gear is up, and air speed permits, commence flap retraction.

NOTE

Obstacle clearance performance data are based on the assumption that gear retraction is initiated 3 seconds after take-off and propeller feathering initiated 6 seconds after take-off. Flap retraction should be accomplished in 10-percent increments with airspeed increasing approximately 5 knots between retraction increments. This procedure will prevent the airplane from settling during flap retraction at heavy gross weights.

NOTE

As soon as circumstances permit, the aft cargo door and ramp should be closed to reduce drag. This drag reduction will permit available power remaining to be used for accelerating to climb speed or improved climb performance. If a potential for on-board fire exists the flares should be jettisoned before the aft cargo door is closed. Do not jettison the flare launcher unless it is essential to aircraft recovery.

d. After gear and flaps are up, continue as a normal take-off, accelerating to three-engine climb speed.

THREE-ENGINE TAKE-OFF.

It is possible to make a three-engine take-off when required. This type of take-off requires particular caution because of the possibility of losing another engine on the same side during the take-off prior to reaching minimum control speed. A three-engine take-off should be made only when authorized by Major Air Command.

a. Before making the take-off, feather the propeller of the inoperative engine.

NOTE

If the inoperative engine could not be started because of a faulty starter, and if an air start of the inoperative engine is to be made, the starter or starter shaft should be removed prior to take-off.

WARNING

Take-off data for minimum control speed should be computed for two-engine-inoperative and three-engine climb speed.

b. Accomplish the BEFORE TAKE-OFF and LINEUP checklists to assure that all controls and switches are in proper position.

c. Hold the airplane with the brakes and advance the throttles to FLIGHT IDLE.

d. Advance the throttles for symmetrical engines to TAKE-OFF, then release the brakes and advance power for the other operating engine as directional control will permit.

e. When safely airborne and certain that the airplane will not touch down again, raise gear while accelerating to flap retraction speed.

f. After gear is up, and airspeed permits, commence flap retraction. Flap retraction should be accomplished in 10 percent increments with airspeed increasing approximately 5 knots between retraction increments.

g. After gear and flaps are up, continue as a normal take-off, accelerating to three-engine climb speed.

FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS.

The airplane has excellent flight characteristics even when an engine is inoperative. All control surfaces are booster-operated so that no great amount of pilot force is necessary to correct the turning action caused by uneven power conditions. Some trim changes will be required. More rudder deflection will be required at low speed to counteract the unbalanced thrust. With uneven power conditions, the minimum control speed will be affected by the available rudder effectiveness. Failure of an outboard engine may require the reduction of power on the opposite outboard engine. Consult T.O. 1C-130(A)A-1-2 for recommended cruise and climb procedure for two- and three-engine operation. In the event two engines fail and a safe altitude cannot be maintained, jettison equipment as necessary.

Minimum Control Speed.

Inflight minimum control speed is defined as the minimum speed for a given airplane configuration, at which directional control of the airplane may be maintained with one outboard engine inoperative and windmilling on NTS, the operating engines at maximum power, using full rudder pedal deflection and a 5-degree bank away from the failed engine. Increasing the bank away from the failed engine reduces minimum control speed because of the favorable effect of the sideslip angle which must accompany the increased bank angle. A 5-degree bank is specified in the definition of minimum control speed in order to maintain safe margins of control and operating conditions. Minimum control speeds will be higher if less than 5-degree bank angle or bank into the inoperative engine is attempted. When attempting to obtain further reductions in minimum control speed, the bank angle should never be increased beyond the point where rudder buffet is encountered (refer to T.O. 1C-130(A)A-1-2 for minimum control speeds).

WARNING

During take-off or inflight, if an outboard engine fails near air minimum control speed, it is imperative that a 5-degree bank angle away from the failed engine be established immediately. This should be done by use of ailerons before reaching full rudder input in order to maintain directional control.

Practice Maneuvers With One or More Engines Inoperative.

Engine failures may be simulated for practice, when desired. To simulate a feathered propeller, retard one or more throttles to FLIGHT IDLE position. The check list procedure for engine failure can be called out without actually performing the operations named. Practice maneuvers at a safe altitude. Select a base point and set up a simulated field elevation. Traffic patterns can be flown at the normal altitude above this base point.

WARNING

During take-off, or while airborne, do not move the throttles below the FLIGHT IDLE position. Placing any propeller in the taxi range may result in immediate loss of control of the airplane.

PRACTICE TAKE-OFF ENGINE FAILURE.

NOTE

Simulated three-engine take-offs are not recommended with the anti skid system inoperative.

a. If engine failure is simulated before refusal speed is reached, follow abort procedures outlined in this section. Simulate Engine Shutdown procedures as required.

b. If engine failure is simulated after refusal speed, follow Takeoff Continued After Engine Failure procedures in this section.

NOTE

It should be remembered that a practice engine failure does not completely simulate an engine failure. In an actual engine failure, the negative torque required to actuate the engine negative torque control system will be less than flight idle engine torque and add to the yawing tendency of the airplane until feathering is completed.

INFLIGHT EMERGENCIES.

ENGINE FAILURE.

The effect of losing various combinations of engines must be understood and anticipated, because related systems are integrated between the engines (see figure 3-3).

NOTE

In conditions of engine out operations, in order to reduce drag, consideration should be given to jettisoning all flares/markers and closing the ramp and aft cargo door.

two engines inoperative

CAUTION

In all combinations of two engine failures, monitor generator loading to keep within the range of available output.

ENGINES INOPERATIVE	SYSTEMS AFFECTED	
	HYDRAULIC	ELECTRICAL
No. 1 and No. 4	One pump each for booster and utility systems will be out. Operation of equipment will take longer.	No. 1 and No. 4 dc generators out. No 1 and No. 4 ac generators out. Turn on the transformer rectifier units for additional dc power if the remaining generators are overloaded. ECM System Pods power lost.
No. 2 and No. 3	One pump each for booster and utility systems will be out. Operation of equipment will take longer.	No. 2 and No. 3 dc generators out. No. 2 and No. 3 ac generators out. Select No. 1 ac generator to No. 2 ac bus. Select No. 4 ac generator to No. 3 ac generator bus. Turn on the transformer rectifier units for additional dc power if the remaining dc generators are overloaded. If No. 1 or No. 4 ac generators cannot be selected to No. 2 or No. 3 ac generator bus. Turn on ATM generator to supply ac power. If the ATM generator becomes overloaded, turn the transformer rectifier units off and select inverter power for all instruments. Manual operation of prop anti-icing will be necessary; closely monitor loads.
No. 1 and No. 2	One pump each booster and utility systems will be out. Operation of equipment will take longer.	No. 1 and No. 2 dc generators out. No. 1 and No. 2 ac generators out. Select No. 4 ac generator to No. 2 ac generator bus. If No. 4 ac generator cannot be selected to No. 2 ac generator bus and the remaining generators are overloaded, turn on ATM generator and the transformer rectifier as needed.
No. 1 and No. 3	Booster system pumps will be out. Flight controls boost to be supplied by the utility system at half normal force.	No. 1 and No.3 dc generator out. No. 1 and No. 3 ac generator out. Select No. 4 ac generator to No. 3 ac generator bus. If No. 4 ac generator cannot be selected to No. 3 ac generator bus and the remaining generator are overloaded, turn on ATM generator and the transformer rectifier as needed.
No. 2 and No. 4	Utility system pumps will be out. The ATM emergency system will operate flaps, landing gear and brakes. Fwd cargo door handpump available for nose gear extension. Flight controls system boost to be supplied by booster system at half normal force.	No. 2 and No. 4 dc generators out. No. 2 and No. 4 ac generators out. Select No. 1 ac generator No. 2 ac generator bus. If No. 1 ac generator cannot be selected to No. 2 ac generator bus and the remaining generators are overloaded, turn on ATM generator and the transformer rectifier as needed.

two engines inoperative (cont)

CAUTION

Nose wheel steering and anti-skid are inoperative after loss of utility system.

No. 3 and No. 4	One pump each for booster and utility systems will be out. Operation of equipment will take longer.	No. 3 and No. 4 dc generators out. No. 3 and No. 4 ac generators out. Select No. 1 ac generator to No. 3 ac generator bus. If No. 1 ac generator cannot be selected to No. 3 ac generator bus and the remaining generators are overloaded, turn on ATM generator and the transformer rectifier as needed.

During practice feathering, perform engine shutdown per the ENGINE SHUTDOWN procedure in this section. Prior to practice engine shutdown in flight, perform an ENTC check as outlined in the ENTC portion of the CRUISE ENGINE SHUTDOWN checklist in Section II.

NOTE

Normally, practice feathering should be accomplished on No. 1 or No. 4 propeller. Check the opposite AC generator before feathering if either No. 2 or No. 3 propeller is used.

Turns.

Turns can be safely made in either direction with one or more engines inoperative if airspeed is maintained sufficiently high in respect to minimum control speed and stall speed. Banking into the dead engine increases minimum control speed.

Effects of Speed on Trim.

During engine-out operation, as in all other types operation, trim is affected by speed. After trim set, any increase in airspeed increases the effect the trim tabs: conversely, any decrease in airspeed reduces the effect of trim tabs.

Landing and Go-Around.

Landings and go-arounds with feathered engines may be simulated at altitude by flying a traffic pattern over a basic altitude. Roll out most of the trim as touchdown point is reached. During a go-around practice, note the altitude lost between the go-around decision and the time the airplane is safely in a climb configuration, also note the airplane acceleration characteristics during these maneuvers.

AIR START PROCEDURE.

Unless a greater emergency exists, do not attempt to restart an engine that was shut down for a malfunction. Before restarting an engine that has been shut down in flight, be sure that the TIT for that engine has dropped below 200°C. Temperatures higher that 200°C will increase the likelihood of a hot start. NEVER move the throttle below the FLIGHT IDLE position in flight. Refer to the procedures in this section for air start after loss of AC power, or failure of a propeller feather motor or propeller feather pump.

NOTE

The best airspeed for accomplishing an air start is 150 to 180 KIAS.

1. Prepare for Air Start	"Complete"	(E)
a. Fire handle	IN	
b. Throttle	1 inch forward of FLIGHT IDLE	
c. Fuel boost pump switch	ON	
d. Fuel enrichment switch	NORMAL	
e. Oil cooler flap switch	AUTO	

f. Electronic prop governor switch — SYNC

g. TD valve — AUTO

NOTE

When possible, allow 30 seconds to warm up.

2. Condition lever — "AIR START" (On pilot's command) (CP)

NOTE

Hold condition lever in air start until light off then release to run. Monitor engine instruments as on ground start.

CAUTION

Discontinue the start by placing the condition lever to FEATHER if a lightoff does not occur by the time the engine has stabilized on ENTC (approximately 40%). Restart may be attempted.

CAUTION

If the ENTC is inoperative (as evidenced by rapid acceleration above 40%) and engine speed exceeds 60% rpm with no light off, discontinue the start by placing the condition lever to FEATHER. A restart should not be attempted.

CAUTION

If ENTC is inoperative, interruption of the start cycle after lightoff by an attempt to feather before the engine has reached a stabilized speed may result in decoupling and severe overspeed.

3. Air Start checks — "COMPLETE" (E)

a. Generator switches — RESET ON

b. Engine bleed air valve switch — OPEN

c. Fuel enrichment switch — OFF

d. Engine instruments — Within limits

NOTE

Allow the oil temperature to reach 40°C and increasing before moving the throttles above 4,500 inch-pounds torque.

PROPELLER FAILURES.

The propeller should control engine speed within the limits specified in Section V. Propeller governing malfunctions are indicated by the tachometer as underspeed, overspeed, surge, and/or fluctuation of RPM. Select the mode of governing that will give the desired RPM control. Erratic AC power may be the cause for electronic propeller governing fluctuations. To eliminate the fluctuations, change the AC power source or the mode of propeller governing to hydraulic. If the desired control cannot be obtained, refer to the appropriate propeller malfunction procedure in this Section.

Inflight Decoupling of Engine and Propeller.

The reduction gear section decouples from the power section of the engine if a propeller attempts to drive the power section, and the engine negative torque control system fails to operate. As negative torque builds up before decoupling of an engine takes place, airplane yaw may be noticed. However, there may be little or no difference in airplane feel, and the knowledge that an engine has decoupled must be gained from instrument indication.

If decoupling is caused by engine failure or flameout, the indications will be as follows:

a. Torque, TIT, fuel flow near zero.

b. Low power section oil pressure.

c. RPM may temporarily increase, then settle to normal.

d. Hydraulic pressure, generator output, and reduction gear section oil pressure normal.

If a decoupling has occurred and the engine continues to operate, the indications will be as follows:

a. Extremely low TIT and fuel flow for a given throttle setting.

b. Fluctuating and near zero torque.

When decoupling is observed, follow the ENGINE SHUTDOWN PROCEDURE in this section. Do not attempt to restart the engine.

Overspeeding, Underspeeding, or Fluctuation.

If overspeeding, underspeeding, or fluctuation of RPM is observed, proceed as follows:

a. Place the electronic prop governor switch to OFF. (E)

(1) If this action brings the RPM within limits, continue the flight with the switch in the OFF position.

NOTE

Fluctuation in RPM can also be caused by a malfunction of the engine temperature datum control system.

If RPM fluctuations are accompanied by change in torque, TIT, and fuel flow:

b. Reduce the throttle setting for the affected engine. (P)

c. Place the TD valve switch to NULL. (E)

(1) If this action brings the RPM within limits, continue the flight with the TD switch in NULL. (Refer to TD CONTROL SYSTEM MALFUNCTION in this Section.)

d. If the RPM continues to exceed limits, follow the ENGINE SHUTDOWN PROCEDURE in this section. (P)

Loss of Propeller Oil.

Loss of propeller oil usually is first indicated by a slow drop in engine RPM. If this condition is noted, place the electronic prop governor switch to OFF, monitor engine speed closely. Should RPM drop to 97%, the propeller should be feathered according to the ENGINE SHUTDOWN PROCEDURE in this section. Feathering at this point will prevent eventual loss of control of the propeller. If the propeller fails to feather, attempt to control RPM by reducing airspeed.

Propeller and Engine Control Linkage Failure.

If a failure occurs in the throttle control system, the engine power may go to either the full power or flight idle position. The flight idle stop solenoid will prevent the propeller from going into the ground range as long as the throttle is in the flight range. In the event of propeller and engine control linkage failure, refer to the ENGINE SHUTDOWN PROCEDURE in this section.

FEATHERING AFTER LOSS OF NORMAL FEATHER ACTION.

NOTE

If engine shutdown was accomplished using the condition lever only, and the prop fails to feather, attempt to feather by pulling the fire handle prior to employing this procedure.

The following procedure can be used to feather a propeller if loss of normal feather action is encountered:

NOTE

Check feather timer circuit breakers on the prop and engine circuit breaker panel, and feather pump motor circuit breakers on the main AC distribution panel.

WARNING

If the engine was shut down for fire or overheat, before resetting the emergency fire control handle, pull the firewall fire control shutoff valves fuel and hydraulic circuit breakers and the engine fire control shutoff valves air and oil and bleed circuit breakers on the copilot's circuit breaker panel.

a.	Fire handle	IN	(E)
b.	Condition lever	GROUND STOP - Return to FEATHER	(CP)

If feathering action is not complete, proceed as follows:

c.	Flaps	As required	(CP)
d.	Reduce airspeed as low as practical for gross weight and existing conditions		(P)

NOTE

If circuit breakers were pulled prior to resetting the fire emergency control handle, the engine bleed air valve circuit breaker and the air and oil firewall shutoff valve circuit breaker must be reset.

e.	Engine bleed air valve switch	OPEN	(E)
f.	Starter button	IN	(P)

CAUTION

The starter is not to be used for practice feathering and unfeathering.

NOTE

Engine RPM should increase to approximately 10 percent; this will be sufficient for the propeller regulator pump to supply pressure to increase the propeller blade angle to feather.

g.	Starter button	Pulled	(P)

CAUTION

Do not exceed the starter operating limits in Section V. Complete the ENGINE SHUTDOWN PROCEDURE in this section.

h.	Engine bleed air valve switch	CLOSE	(E)

CAUTION

If propeller rotation continues, with no indication of fire, leave the fire emergency control handle IN to supply oil to the engine, control RPM by airspeed and land as soon as practical.

Airstart After Loss of Normal Unfeather Action.

CAUTION

The starter is not to be used for practice feathering and unfeathering.

If the propeller fails to rotate or if airstart is to be attempted after loss of AC power or failure of a propeller feather motor or propeller feather pump, reduce airspeed as low as practical for gross weight and existing conditions and proceed as follows:

a. Prepare for airstart checks - "COMPLETE" (E)

b. Engine bleed air valve switch - OPEN (E)

c. Condition lever - RUN (CP)

d. Starter button - IN (P)

e. At 10% engine RPM - INCREASE AIRSPEED (P)

NOTE

The acceleration from 6 percent to 10 percent will be very slow. Airspeed should be increased immediately after 10 percent RPM is reached, because the drag at this low airspeed will cause the airplane to yaw. There will be very little aileron response until the airspeed builds up to approximately 105 KIAS. This increase in airspeed also is needed after 10 percent RPM to help accelerate the engine.

f. At 20% engine RPM - STARTER BUTTON PULLED (P)

CAUTION

Do not exceed the starter operating limits in Section V.

NOTE

Continue increasing airspeed. This will result in a normal air start from 20 percent RPM until the engine comes on speed.

g. Airstart checks - "COMPLETE" (E)

ENGINE SYSTEMS FAILURE.

Failure of 94 Percent Speed Switch (Acceleration Bleed Valves Open).

Failure of the 94 percent speed switch in the speed sensitive control during stabilized ground or flight operation will cause that engine's acceleration bleed valves to open and the TD system to limit TIT to start limiting temperature of 830°C. During ground operations, failure will be indicated by:

a. Low RPM

b. Low Torque

c. High TIT (maximum of 830°C)

d. High Fuel Flow

During flight operations, failure will be indicated by:

a. Low Torque

b. TIT will not exceed start limiting temperature of 830°C.

c. The fuel correction light will illuminate with the throttle above 65 degrees of travel.

If these indications are observed, proceed as follows:

a. Pull the ENGINE FIRE CONTROL SHUTOFF VALVE AIR & OIL circuit breaker (E)

(1) If engine operation returns to normal, leave the circuit breaker pulled and continue operation.

b. If condition persists, reset the circuit breaker and proceed with the ENGINE SHUTDOWN PROCEDURE, in this section (E) (P)

WARNING

The air and oil circuit breaker must be reset in order to close the oil tank shutoff valve in the event the ENGINE SHUTDOWN PROCEDURE is accomplished.

CAUTION

Prolonged engine operation with the acceleration bleed valves open may cause extensive damage to components in the engine nacelle.

NOTE

In either case, make a Form 781 entry for an engine inspection for possible damage prior to the next flight.

Secondary Fuel Pump Pressure Light Illumination.

Illumination of the secondary fuel pump pressure light, when engine RPM is above 65% RPM, may be caused by failure of the engine driven primary fuel pump assembly, the pressure switch for the light, paralleling valve stuck closed, or a failure of the 65 percent switch in the speed sensitive control. If the light remains illuminated above 65% RPM during engine starting, or illuminates during stabilized engine operation, proceed as follows:

a. Pull the ENG FUEL & IGN CONTROL circuit breaker (E)

(1) If the light is extinguished, leave the circuit breaker pulled and continue operation.

b. If the condition persists, leave the circuit breaker pulled and continue operation or perform a precautionary engine shutdown at pilot discretion.

NOTE

If the secondary fuel pump pressure light remains illuminated after the circuit breaker is pulled, it may indicate failure of the engine driven primary pump which could result in subsequent damage to the engine if operation is continued. If this occurs during ground operation, engine shutdown is recommended.

If the circuit breaker was pulled, proceed as follows after landing:

a. Reset the circuit breaker (E)

b. Continue with normal engine shutdown (CP)

TD Control System Malfunction.

A malfunction of the electronic fuel control system of an engine may cause a sudden increase or decrease in turbine inlet temperature, with an accompanying change in torque and fuel flow indication. If this condition occurs during stabilized operation, the engineer should proceed as follows:

a. Place TD control valve switch to NULL

(1) If TIT stabilizes and returns to near normal, continue operation in NULL

b. If malfunction persists, attempt to select an alternate AC power source.

c. If the malfunction persists, other engine systems are at fault and should be investigated.

CAUTION

Monitor turbine inlet temperature closely during NULL operation as maximum turbine inlet temperature can often be exceeded at advanced throttle settings under these conditions.

Engine Oil System Failure.

The indications of an engine oil system failure that may lead to engine failure are:

a. Loss of oil pressure.

b. Uncontrollable rise in oil temperature.

For loss of oil pressure proceed with the ENGINE SHUTDOWN PROCEDURE in this section.

CAUTION

If engine oil pressure loss was caused by a negative g condition, and gearbox and engine oil pressures do not return to normal within 10 seconds after returning to a positive g condition, perform a precautionary shutdown of the engine. After the propeller stops rotating, an air start may be attempted according to the AIR START PROCEDURE in this section.

High oil temperature may result from failure of an oil cooler flap to function in AUTOMATIC. If this occurs, proceed as follows:

a. Hold the oil cooler flap switch in OPEN position until the oil cooler flap is open.

b. Manually open or close oil cooler flaps as required to maintain normal engine oil temperature.

c. If oil temperature cannot be maintained within limits, proceed with the ENGINE SHUTDOWN PROCEDURE in this section.

If the low oil quantity light illuminates, proceed as follows:

a. Identify the engine with the low oil quantity.

b. Closely monitor the engine instruments for the engine with the low oil quantity gauge reading. No corrective action is required as long as the engine instrument readings are within limits.

NOTE

During long climbs it is possible to get a low oil quantity warning due to incomplete scavenging. Do not shut down the engine as long as oil pressure stays within limits. After leveling off, recheck oil quantity indication.

NOTE

If the rate of quantity loss is gradual and length of mission would require engine shutdown prior to termination, the pilot may elect to perform a precautionary shutdown of the affected engine and restart at a later time when conditions necessitate.

If during flight the aircrew notices a loss of engine oil quantity and/or heavy smoke coming out of the tailpipe area, the engine should be monitored during flight and shut down in accordance with the ENGINE SHUTDOWN PROCEDURE in this Section prior to landing. This should prevent oil combustion in the tailpipe after landing.

Visible Fluid Leak.

If excessive visible fuel leak is present on an engine and the leak cannot be isolated shut down the engine per engine shut down procedures.

FUEL SYSTEMS FAILURE.

Failure of a refueling valve (airplanes AF 53-3129 through AF 55-0029 may be indicated by a steady or intermittent illumination of the affected fuel boost pump low pressure light when a crossfeed valve is opened. It may be necessary to open several crossfeed valves and turn boost pumps on to extinguish the low pressure light. In a crossfeed configuration, with a refueling valve in the open position, fuel quantity in the affected tank will increase rapidly. In this situation close all crossfeed valves and fly in a tank to engine fuel feed configuration realizing that anytime a crossfeed valve is OPENED, all crossfeed fuel would be routed to the tank with the failed refuel valve.

Fuel Boost Pump Failure

In the event of a fuel low pressure warning light for a tank containing fuel, the engineer will check for failure of the fuel boost pump by use of the fuel pressure indicator. If boost pump failure is confirmed or if popout of any boost pump circuit breaker is experienced, the engineer will proceed as follows:

a. Pump switch - OFF

b. Pump circuit breakers - PULL

c. Set up another fuel supply - As required

WARNING

The fuel boost pump switch should not be turned on or the circuit breakers reset until proper inspection and repairs have been performed. Resetting of the circuit breakers and turning the switch on should be considered only to prevent fuel starvation of the engines when a landing cannot be accomplished within the range of available fuel.

If a main tank boost pump failure occurs during climb, continue as follows:

d. Crossfeed the engine from another tank and continue climb.

NOTE

Do not select crossfeed unless the crossfeed system is pressurized by operating boost pumps in other tanks.

e. After level off allow fuel to stabilize for several minutes.

f. Switch back to tank-to-engine operation and closely observe fuel flow, TIT, and torque.

(1) If engine operates satisfactorily, continue mission as planned.

NOTE

When operating in tank-to-engine position with an inoperative boost pump, avoid rapid acceleration, nose high, or nose low attitudes. Descents should be made with minimum nose down attitude. If a high rate of descent is required, it is advisable to select crossfeed operation.

NOTE

Gradual power losses will occur between twelve and twenty thousand feet during rapid climbout to an engine without boost pump pressure; this altitude will vary with the prevailing fuel temperature and type fuel in tanks (the higher the fuel temperature the lower the altitude at which the power loss will occur). This condition results from the highly aerated condition of the fuel, caused by rapidly decreasing atmospheric pressure during climb allowing entrapped air in the fuel to expand. The period of time required for the fuel to stabilize from this aerated condition will depend upon both the rate of climb and fuel temperature. Fuel stabilization should occur in a few minutes after level-off at cruise altitude once the excess air has escaped from the fuel; maximum power settings can be maintained up to altitude of 30,000 feet with a boost pump inoperative if nose-up or nose-down attitude and rapid acceleration are avoided. Fuel aeration does not occur during descent.

g. If engine will not operate satisfactorily in tank-to-engine position, switch back to crossfeed.

h. Wait several minutes and repeat step f.

i. If engine will not operate satisfactorily, re-ture to crossfeed.

j. If mission can be accomplished at a lower altitude, descend until engine will run satisfactorily on tank-to-engine flow.

NOTE

It may be necessary for the pilot to change his flight plan to avoid major fuel unbalancing and loss of range due to unavailable fuel or higher fuel consumption at lower altitudes.

If a boost pump is lost, the corresponding scavenge pump will be turned off when the boost pump switch is placed in the OFF position. This may result in fuel starvation for the affected engine in an extreme nose-down attitude unless crossfeed operation is used. If a partial tank and an empty tank are on crossfeed with the boost pump inoperative in the partial tank, the engine being fed from the empty tank will be starved by air being drawn into the fuel line. Refer to the procedure for crossfeed operation without AC power in this Section.

Fuel Quanity Indicator Failure.

A malfunction of any fuel quantity indicator may indicate a possible failure that would with the proper sequence of events allow the introduction of high voltage electrical power into the associated fuel tank. If the fuel quantity indicator goes to off scale high or off scale low, the following action must be complied with:

Pull the associated fuel quantity indicator circuit breaker.

WARNING

The indicator will not be removed or changed and the circuit breaker will not be reset until proper inspection and repairs have been made.

NOTE

The airplane may be flown on subsequent flights with a malfunctioning indicator provided the circuit breaker remains pulled.

Crossfeed Operation Without AC Power.

In the event of complete loss of AC power all fuel boost pumps will be inoperative. If crossfeed operation is necessary to maintain lateral control, the engineer will proceed as follows:

a. Turn the heavy tank crossfeed switch to OPEN.

b. Turn the receiving engine crossfeed switch to OPEN.

c. Turn the receiving engine tank selector switch to EXT. TANK TO ENG.

NOTE

This procedure should not be attempted at altitudes above 20,000 ft.

External Fuel Leaks (Drip or Running Type).

External fuel leaks encountered in flight present a fire hazard if the leak is in close proximity to an engine. The possibility of a wing fire from an external fuel leak is increased on landing if reverse thrust is applied. If an external fuel leak is encountered near an engine, shutdown of the engine should be considered. Land at the nearest airfield which has sufficient runway to complete the landing ground roll without use of reverse thrust. Because of the possibility of fire, an emergency should be declared and fire suppression equipment requested.

WARNING

Do not use reverse thrust when landing with a known or suspected fuel leak. If reverse thrust is used, a fire may develop.

ELECTRICAL SYSTEMS FAILURE.

With modern complex airplanes, it is extremely difficult to anticipate all the possible electrical failures and to plan corrective action and procedure for each failure. However, a broad analysis of the situation indicated that failures fall into three possible categories:

a. Loss of one or more of the primary power sources.

b. Faults on the main bus or distribution system.

c. Faults within equipment items.

Faults in the distribution system and load circuits should be controlled through protective devices such as circuit breakers, fuses, and current limiters. Should one of these devices fail to operate, considerable smoke can result and some emergency action on the part of the crew may be needed. Loss of the main DC bus is unlikely. Loss of one or more of the primary power sources, however, will require the crew to take prompt action by closely watching electrical loads, so that the remaining power sources will not be overloaded.

WARNING

Do not operate the airplane with a dead battery. Power will not be available to operate the fire extinguishing system alarm bells, emergency depressurization or flare launcher jettison.

NOTE

A minimum battery voltage of approximately 18 volts is required to close the battery relay (the battery relay must be closed before the generators can recharge the battery).

DC Generator Failure.

If one or more DC generators are lost, check generator loadings frequently and turn off unnecessary loads, when required, to keep within the capacity of the operating generators. Use the transformer rectifier units to supplement the operating DC generators. Occasions when all DC generator power and the main DC bus are lost will be extremely rare. Should this occur, power for the copilot's AC flight instruments will still be available from one or two sources. These instruments can be powered directly from the unregulated AC system, or the copilot's instrument inverter can receive power from the battery through the isolated bus. The battery is protected from discharging into the main DC bus by a reverse current relay. The battery, through the isolated bus, can provide power to the copilot's instrument inverter for 20 minutes. Battery life, however, can be extended considerably for other emergency needs, by using the unregulated AC power for the instruments rather than the copilot's inverter. Refer to the DC power supply schematic diagrams in Section I for equipment lost due to DC generator malfunctions.

AC Generator Failure.

In the event of failure of an engine that drives an AC generator, the air-turbine-motor-driven AC generator may be used to supply 30 kva of AC power. Although rated at 20 kva, this generator is capable of carrying a 50-percent overload in continuous operation, so long as proper cooling air is supplied for the generator. Two transformer rectifier units are provided as a supplemental source of DC power.

CAUTION

Since the ATM generator can be connected to both of the AC buses, it is necessary to monitor the ATM generator ammeter when transferring loads to avoid overloading the ATM generator.

CAUTION

In the event that the ATM generator fails, do not operate the ATM except in cases of extreme emergency, due to the possibility of fire.

Illumination of AC Generator Out Light

If an AC generator out light illuminates, the engineer will proceed as follows:

a. Check frequency, voltage and load.

b. If normal, leave generator switch ON and monitor frequency, voltage, and load.

NOTE

If the generator control switch is turned OFF, it may not be possible to utilize power from the generator because the power to energize the generator contactor relay is supplied by the transformer rectifier unit within the generator control panel.

c. If voltage and frequency are normal with no indication of load, place the generator switch to OFF and monitor the voltage and frequency.

NOTE

Under some circumstances the buses will not tie unless the generator switch is turned OFF.

d. If no voltage and frequency are indicated, place the generator switch to RESET then OFF.

e. If frequency and voltage are normal, resume normal operation.

f. If frequency and voltage are not indicated or voltage momentarily peaks above normal and returns to zero, the engine should be shutdown in accordance with the ENGINE SHUTDOWN PROCEDURE in this section.

CAUTION

Because of the possibility of fire, the engine with the failed generator should be shut down per the ENGINE SHUTDOWN PROCEDURE.

g. If use of the No. 2 or No. 3 AC generator is lost, turn the No. 1 or No. 4 GEN BUS SELECT switch to the failed generator (No. 2 or No. 3) position.

h. Reduce AC power loads and/or turn on the ATM generator if required.

NOTE

The radar should be turned to STDBY prior to selecting a different position of the main inverter switch.

NOTE

If No. 1 or No. 4 AC generator is selected to an inboard bus, the ATM generator cannot be tied to the opposite bus.

GENERATOR OVERLOAD LIGHT (No. 2 or No. 3 AC GENERATOR).

If the generator overload light should illuminate for either No. 2 or No. 3 AC generator and the overload condition is not corrected within 30 seconds, the overloaded generator will be automatically disconnected from its bus. If this occurs, the entire load of the overloaded generator will be assumed by the other generator resulting in overload of that generator and possible loss of all AC power.

If a generator overload light illuminates, the engineer will proceed as follows:

a. Turn the No. 1 or No. 4 GEN BUS SELECT switch to the overloaded bus (No. 2 or No. 3) position.

b. Turn off unnecessary AC electrical equipment to releave the overload condition.

c. Resume normal operation.

BLEED AIR SYSTEM FAILURE.

A serious bleed air system leak may cause burning of electrical wire bundles and/or overheating of aircraft equipment and may be indicated by one or more of the following conditions:

a. Illumination of the GTC fire warning lights (some airplanes).

b. Erratic operation of engine instruments.

c. Zero or fluctuating liquid oxygen quantity.

d. Inoperative or intermittent radar operation.

e. Observed smoke, flame, or overheat condition.

Two types of bleed air emergencies may occur. They are:

a. An uncontrollable loss of bleed air.

b. Failure of an engine bleed air valve.

If bleed air is being lost from the system, proceed as follows:

a. Close all engine bleed air valves one at a time (E)

WARNING

Positive closing of the engine bleed air valves must be determined by observing torque increase when closing the corresponding engine bleed air valve switch.

WARNING

Closing the engine bleed valves will shutoff the air supply to both air conditioning units and depressurize the airplane.

b. Attempt to isolate the leak (E)

c. If the bleed air leak cannot be isolated, leave all engine bleed air valves CLOSED (E)

If an engine bleed air valve cannot be closed and the bleed air system is leaking, proceed as follows:

a. Check bleed air valve circuit breakers (E)

b. If the malfunction persists, shut down the engine (conditions permitting) (P)

c. If conditions do not permit engine shutdown, turn on all pneumatic systems (E)

d. Land as soon as practical (P)

If smoke, overheat condition, or flame is observed in the GTC area from inside the cargo compartment, perform the bold face items of the GTC emergency shutdown procedure.

If smoke, overheat, or flame is not present, comply with the Emergency Operation of The Bleed Air System procedure.

For procedures concerning failures of individual pneumatic systems see Section IV.

WING FIRE.

If a fire develops in the wing proceed as follows:

a. Close all engine bleed air valves. (E)

b. Sideslip the airplane to keep the fire away from the fuselage. (P)

c. Land the airplane as soon as possible. (P)

d. If unable to land and the fire cannot be blown out or controlled, abandon the airplane immediately.

ELECTRICAL FIRE.

WARNING

Because of the important part electrical controls play in the operation of this airplane, it is recommended that electrical power not be shut off until the pilot is reasonably certain that it is, or will be, a contributing factor to smoke or fire, and that the loss of electrical controls will not be a greater hazard than the smoke or fire.

In case the fire originates in a nacelle, refer to procedures given under ENGINE FIRES for extinguishing the flame. Trip the generator control switch for the generator in that nacelle, then turn the switch to the OFF position. If fire occurs in other areas, and electrical wiring or equipment is suspected as being the cause of a potential hazard, open all circuit breakers to equipment in the area containing the fire, other than that equipment which is absolutely essential for flight. It should be noted that any short circuit will propably open the appropriate protective device, reducing the possibility of fires. If the source of fire can be determined, the nonaffected circuit breakers should be pushed in.

NOTE

If electrical power to the IFF is lost, Mode 4 codes will be zeroized unless the hold function has been activated.

FUSELAGE FIRE/SMOKE AND FUME ELIMINATION.

WARNING

If flammable fumes are present, electrical equipment not required to complete this procedure should not be turned on or off until fumes are eliminated.

If a fire, smoke, or fumes develop in the fuselage, notify the crew and passengers and proceed as follows:

1. OXYGEN - "ON/100 PERCENT" (P)

a. The pilot will direct all crew members to don oxygen smoke masks (as appropriate) and to select 100 percent on their oxygen regulators.

WARNING

Prolonged exposure (5 minutes or more) to high concentrations (pronounced irritation of eye and nose) of Bromochloromethane (CB) or its decomposition products should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

NOTE

Three types of regulators, types A-21, A-15, and A-13 are provided with portable oxygen bottles. For 100 percent oxygen with the A-15 regulator, place hand over the diluter valve opening. With the A-21 regulator place the control knob at NORMAL. The A-13 regulator will provide 100 percent oxygen at all times.

NOTE

The pilot will direct crew members to fight the fire as required.

2. Pressurization — "EMERGENCY DEPRESSURIZATION" (On Command of the Pilot) — (E)

WARNING

If passengers are aboard and oxygen equipment is not available for them, descend to a lower altitude before actuating the emergency depressurization switch.

3. Descent — As required — (P)

4. Engine bleed air switches (If source of smoke or fumes has not been isolated) — "CLOSED" — (E)

CAUTION

Closing all bleed air switches will eliminate the pneumatic air source for the ATM.

If depressurization was necessary, proceed as follows:

5. Air conditioning master switch — "AUX VENT" — (E)

6. Flight station emergency escape hatch — "OPEN" — (E)

WARNING

If a flare ignites in the cargo compartment during flare launch operations, the density of smoke will be severe. This smoke will be drawn into the crew compartment if the overhead escape hatch is open. Under these circumstances, do not remove the overhead escape hatch.

7. Right paratroop door — "OPEN" (On Pilot's command) — (IO)

WARNING

The IO will open the door only when wearing a parachute or restraining harness.

INFLIGHT DOOR WARNING.

When the door warning light illuminates, notify crew and passengers, check the ramp and door control switch OFF and proceed as follows:

1. Oxygen "As required" (P)

   a. The pilot will direct all crew members to don oxygen masks (if required).

   b. The IO will notify all crew members/passengers that are not on interphone.

WARNING

All personnel will immediately fasten their safety belts upon notification of a door warning light.

2. Pressurization "BEGIN DEPRESSURIZATION" (E)

3. Descent "As required" (P)

NOTE

If range is an important consideration, and passengers without supplemented oxygen are not being carried, the pilot may elect to have the flight crew go on oxygen, the airplane depressurized, and the door inspection made at altitude.

4. Air conditioning master switch "AUX VENT" (E)

5. Doors "CHECKED" (IO/E)

WARNING

The airplane shall be completely depressurized before making a door check. Do not unlock any door with the airplane pressurized. The IO/FE will check the door wearing a restraining harness. If it cannot be determined what caused the door light to illuminate, the flight may be continued with partial pressurization at the discretion of the pilot (below the point where the light illuminates and with all personnel secured with safety belts). If the doors are secure and the trouble is determined to be a door warning switch, the airplane may be fully pressurized. Do not pressurize with the door warning light on.

INFLIGHT RELEASE OF LIFERAFT.

If severe vibration occurs in flight, cause unknown, immediately retard power and decrease airspeed. Lower the flaps and have an aircrew member make a visual inspection of the liferaft compartments through a rear cargo compartment window. (The absence of a liferaft should be noticeable through one of the inspection windows provided on the lower sides of the liferaft compartments.) If a raft has released and lodged on the tail, "fish-tail" the airplane slightly, or execute a shallow banking maneuver right or left. Make an emergency landing at the nearest suitable base, and conduct a thorough inspection.

WINDSHIELD AND WINDOW FAILURE.

If the inner or outer pane of a windshield or cargo compartment window cracks during flight reduce the cabin differential pressure to 10 inches of mercury or less. If both panes of a windshield crack, flight may be continued at 10 inches of mercury or less. If both panes of a cargo compartment window crack, reduce cabin differential pressure to zero.

RAPID DECOMPRESSION.

Sudden and uncontrollable loss of cabin pressure is known as rapid decompression. This may result from losing a nonstructural member, such as a door or window, or from a rupture in the fuselage. If a rapid decompression occurs, proceed as follows:

a. Oxygen - As required. Pilot will direct crew to go on oxygen as required. (P)

If descent is required, continue as follows:

b. Throttles - FLIGHT IDLE (P)

c. Descent - As required (P)

The flight engineer should make an inspection of the fuselage during descent (using a walk-around oxygen bottle, if required, and wearing a restraint harness or parachute to determine what caused the decompression and the extent of any damage. With no structural damage, descent airspeed may be increased not to exceed maximum speeds, as shown in section V.

With structural damage, the flight will be completed at a safe speed as determined by the pilot, the flap configuration for landing will depend on type of structural damage.

CAUTION

With certain types of structural damage, changing the center of lift with the flaps may induce further damage. Careful consideration should be given to type of damage prior to changing airplane configuration.

FLARE LAUNCHER/DISPENSER EMERGENCIES.

WARNING

If a flare ignites in the cargo compartment, density of the smoke will be severe. This smoke will be drawn into flight deck if the overhead escape hatch is opened. Under these conditions, do not remove the overhead escape hatch. The side emergency exit should be removed for flare smoke elimination.

NOTE

The following emergency equipment is required and will be readily available for all flare operations:

a. Asbestos gloves.

b. Welder's goggles, FMU-2.9P.

c. Smoke mask

d. Oxygen walk-around bottles.

e. Dowel rod 1-1/2 inches diameter by 6 feet long.

f. High pressure water extinguisher.

HUNG FLARE PROCEDURE (LAU-74/A)

1. Pilot	Advised	(IO)
2. Selector valve	OFF	(IO)
3. Ejector shutoff valve of malfunctioning chute	OFF	(IO)
4. Selector valve	ON	(IO)
5. Resume normal operation for remaining chutes		

WARNING

Do not attempt to down load flares during flight. To do so could result in the cap coming loose from the flare and pulling the lanyard, resulting in a flare fire.

WARNING

Chaff canisters will not normally be down loaded during flight. However, if mission requirements necessitate down loading, extreme care must be taken to insure canister end-caps are not pulled loose during download. Lanyard activation could result in explosive canister activation.

NOTE

If protruding canister cannot be cleared from LAU-74/A chute, the canister must be secured to the LAU-74. This will insure canister security during landing.

DISPENSER FIRE (ALE-20)

NOTE

The ALE-20 cannot be jettisoned. The three controlling crewmembers will attempt to launch all remaining flares.

FLARE FIRE (LAU-74/A).

In the event of a fire in the flare launcher, the following procedures will be accomplished:

The pilot will be advised and all crewmembers not required to control the airplane will immediately go on 100% oxygen. The pilot will direct crewmembers to fight the fire as required.

WARNING

Due to the intensity of a flare fire, an extremely short period of time is available to jettison the flare launcher and/or to evacuate the airplane.

NOTE

The oxygen bottles in the aircraft may be equipped with one of three types of regulators: The A-13, the A-15, or A-21. For 100% oxygen on the A-15, the crewmember must cover the diluter opening with his hand.

1. Flare launcher	Jettison	(P/IO)

2. Eliminate smoke and fumes (refer to FUSELAGE SMOKE AND FUMES ELIMINATION)

MANUAL FLARE EJECTION (LAU-74/A).

In the event of an electrical failure, and launcher air pressure is above 750 psi, flares can be manually launched by the following steps:

WARNING

Visually verify correct placement of the flare in the launcher tube breech before pressing the manual ejection level for which no ready light indication is present.

1. Pilot	Advised	(IO)
2. Manual ejection lever lock pin	Unlocked	(IO)
3. Manual ejector lever	Pressed	(IO)

ILLUMINATOR EMERGENCIES.

Should any malfunction of the illuminator be indicated by illumination of the interlock lights or apparent smoke or fire, and the unit not shut down automatically, employ the following procedure:

1. Main power switch	OFF	(IO)

WARNING

Do not use high pressure water extinguisher on electrical fires.

2. Store illuminator by manual operation		(IO)

GUN EMERGENCY AND MALFUNCTION PROCEDURES.

NOTE

After completing emergency and malfunction procedures, refer to Gun Arming or Gun Safing checklists as required.

M61 20 MM Gun.

WARNING

Serious personal injury can result when attempting to clear or repair a malfunctioning gun before allowing adequate cooling time to preclude the possibility of a cook off.

1. ARM/SAFE switches (both malfunctioning and adjacent gun)	SAFE	(WM)
2. FE/Pilot	Advised	(WM)
3. Firing lead	Disconnected	(WM)
4. Gun	Malfunction cleared if possible	(WM)

MXU-470/A Module and GAU-2B/A Gun.

WARNING

Serious personal injury can result when attempting to clear or repair a malfunctioning gun before allowing adequate cooling time to preclude the possibility of a cook off.

1. ARM/SAFE switches (both malfunctioning and adjacent gun)	SAFE	(WM)
2. FE/Pilot	Advised	(WM)
3. Gun switch	SAFE/LOAD	(WM)
4. Drive motor lead	Disconnected	(WM)
5. Safing sector	Removed	(WM)

WARNING

Any time ammunition is present in the gun, no attempt will be made to remove the gun from the module.

6. Gun	Malfunction cleared if possible	(WM)

40 MM LOADER JAM.

WARNING

These procedures will be used whenever gun stoppage occurs with the loader tray and breech clear.

1. ARM/SAFE switch	SAFE	(WM)
2. FE/Pilot	Advised	(WM)
3. Breechblock locking bolt	Installed	(WM)
4. Firing selector lever	STOP FIRE	(WM)
5. Hand operating lever	COCKED, SAFE	(WM)
6. Loader	Cleared if possible	(WM)

40 MM FAILURE TO FIRE.

WARNING

These procedures will be used whenever gun stoppage occurs with the breech closed or whenever a round is either fully or partially chambered.

1. Permission to manually fire round	Obtained from Pilot	(WM)

2. Attempt to fire round manually

a. Bring hand operating lever back to the re-cock position then forward.

NOTE

If round does not fire proceed with the following.

3. ARM/SAFE switch	SAFE	(WM)
4. Fire select lever	STOP FIRE	(WM)
5. Ammunition from loader	Removed	(WM)

WARNING

If round cannot be removed and discarded overboard within 5 minutes after first attempt to fire, there will be a 30 minute cooling period before any further attempt is made to remove the round.

WARNING

No attempt will be made to remove a round from the chamber until the hand operating lever is moved to the cocked or safe position.

6. Round — Removed and discarded (On pilot's command) (WM)

HYDRAULIC SYSTEMS FAILURE.

CAUTION

In the event that either the utility or the booster hydraulic supply system is lost, do not position the utility prime switch ON.

Loss of System Pressure.

If a pressure loss is indicated, proceed as follows:

a. Hydraulic pump switches (affected systems only) - OFF (CP)
(If emergency system pressure is lost, stop the ATM.) (E)

b. Controllable check valve for return suction boost system (affected system only) - CLOSE (Located below Booster and Utility System Reservoirs.) (E)

c. Hydraulic reservoir level - CHECKED (E)

If reservoir is low:

d. Check for fluid loss at units supplied by malfunctioning system. (E)

e. Isolate units causing trouble, if possible. If not possible, leave pump switches off.

Engine-Driven Pump Failure.

When an engine pump low pressure warning light illuminates (pressure normal) proceed as follows:

a. Other hydraulic pump switch for affected system - OFF (CP)

b. Hydraulic pressure for affected system - CHECK (CP)

(1) If pressure is normal, return to normal operation.

(2) If pressure drops, it may be assumed the engine driven hydraulic pump has failed. Follow ENGINE SHUTDOWN PROCEDURE in this section.

NOTE

After the affected engine is shutdown, and a loss of hydraulic fluid is not noticed in the hydraulic system, the pilot may direct the other system pump to be turned on.

c. At the first indication of fluid loss, follow Loss of System Pressure procedures.

Hydraulic Suction Boost Pump Failure.

Controllable check valves in the return lines of the suction boost hydraulically driven motors that are located in the reservoir drip pan will permit stopping of the hydraulically driven suction boost pump, should this action be warranted. The valves are safety wired open. When the valves are closed, a liquid lock in the line return will prevent motor rotation. Should a pump or motor fail or begin to fail, contamination of the supply lines and engine pumps may be prevented by stopping the hydraulic motor.

Utility System Failure.

Failure of the utility hydraulic system will result in loss of:

a. Normal landing gear extension and retraction.

b. Flap retraction and normal extension.

c. Normal brake supply.

d. Nose wheel steering.

e. Half the power supplied to the flight controls.

In each case, alternate provisions are made for essential operations. For emergency operation of the particular systems, refer to LANDING GEAR SYSTEM FAILURE, FLAP SYSTEM FAILURE, FLIGHT CONTROLS SYSTEMS FAILURE, and BRAKE SYSTEM FAILURE in this Section.

Booster System Failure.

Failure of the booster hydraulic system affects only the flight controls systems. See FLIGHT CONTROLS SYSTEMS FAILURE in this Section for information on emergency management.

Emergency System Failure.

WARNING

Do not operate the ATM with a failed hydraulic pump, because of the possibility of fire or contamination of the remaining hydraulic systems, except in the case of a greater emergency.

Failure of the emergency hydraulic system results in the loss of hydraulic power for:

a. Normal operation of the ramp and aft cargo door.

b. Emergency extension of the landing gear.

c. Emergency extension of flaps.

d. Emergency brakes.

If circumstances require opening the ramp and aft cargo door without emergency hydraulic system pressure, the handpump may be used. (Handpump emergency supply is separate from the emergency system normal supply, so that loss of fluid from the pressure system does not prevent use of the handpump.)

If there is no emergency hydraulic pressure, and normal extension of the landing gear fails, the handcranks for the main gears and gear emergency release and the handpump for the nose gear may be used. Refer to LANDING GEAR and BRAKE SYSTEMS FAILURE in this section. If utility or emergency hydraulic pressure is not available for flap extension, there is no other provision for flap extension. If both utility and emergency pressure are lacking for brakes, stopping and taxiing control must be accomplished with reverse thrust and differential power application. Stop the airplane as soon as possible: taxiing the airplane under its own power without brakes is not recommended.

CARGO JETTISON.

Jettisoning of cargo can be dangerous, due to possible loss of airplane control or structural damage: therefore, the aircraft commander must consider carefully the emergency situation, operational considerations, availability of suitable drop area, and whether jettisoning is necessary.

Parachutes, or restraining harness, will be worn by personnel jettisoning cargo. Depressurization will be required prior to jettison operations, and the crew members must use oxygen or the airplane must descend to an altitude below 10,000 feet. Cargo should be jettisoned out the ramp and aft cargo door opening. The ramp and aft cargo door should be in the airdrop position.

Jettison by Hand.

Relatively light cargo should be jettisoned by hand. The aft ramp and cargo door will be used for cargo jettisoning. Use the paratroop doors if ramp and cargo doors cannot be opened.

BAILOUT PROCEDURE.

Inflight evacuation exits are shown in figure 3-4.

Reference to pressurization are not applicable unless the airplane is in a ferry flight configuration.

Order of preference for bailout exits is as follows:

1. Aft cargo ramp.
2. Right paratroop door.
3. Side emergency exit.

WARNING

Bailout from crew entrance door is not recommended.

If bailout is required:

a. Bailout warning will be given over the interphone and by three short rings on the alarm bell.

b. Reduce airspeed if possible.

c. Place the air conditioning master switch in the AUX VENT position.

d. Depressurize airplane.

e. If possible, head the airplane toward an isolated area and engage the autopilot.

f. Turn on the air turbine motor.

g. Open the cargo door and ramp.

h. If unable to open cargo door and ramp, open the right air deflector and right paratroop door.

i. Give abandon-airplane signal over the interphone, and by one long ring on the alarm system.

j. Evacuate the airplane.

crash stations (typical)

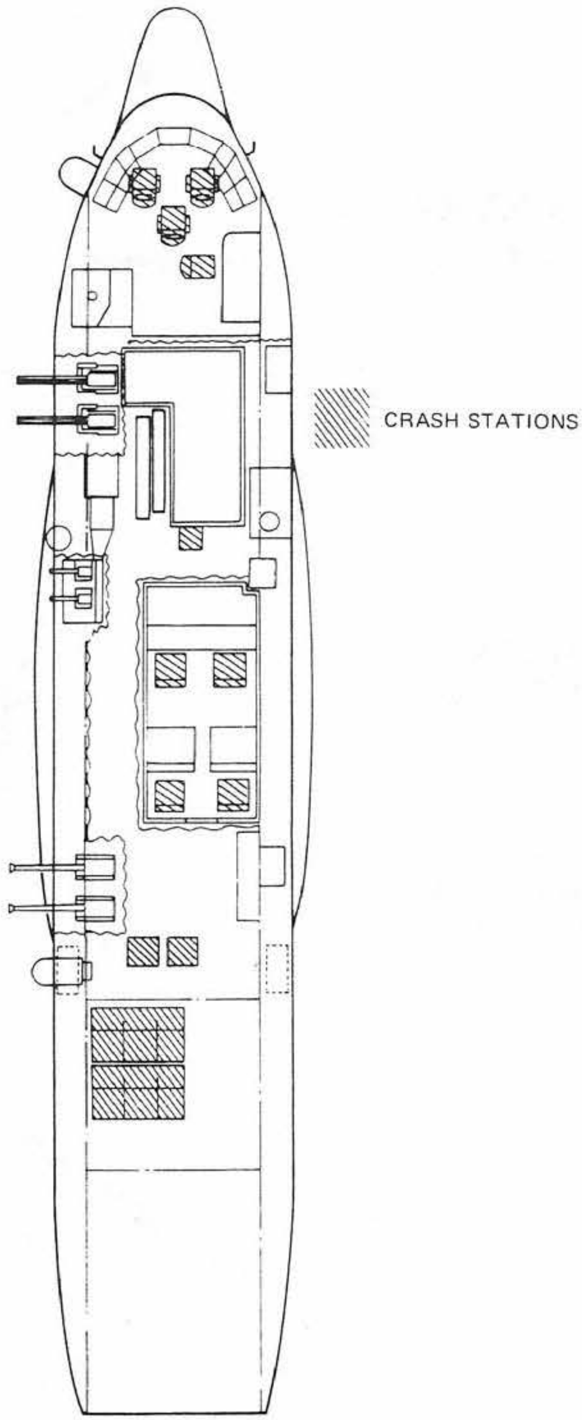


Figure 3-3.

emergency exits

GROUND

AIR

WATER

* SECONDARY EXITS

△1 BOOTH HAS KICK-OUT EMERGENCY PANEL FOR EXIT TO CARGO COMPARTMENT.

WARNING

SIDE EMERGENCY EXIT AND FLIGHT STATION HINGED WINDOWS ARE SECONDARY EXITS AND ARE EXPECTED TO BE BELOW WATER LEVEL, AND UNUSABLE.

WARNING

DO NOT LOCK FLIGHT ENGINEER'S AND NAVIGATOR'S SEATS IN A POSITION THAT WILL BLOCK THE PILOT'S AND COPILOT'S EVACUATION ROUTE.

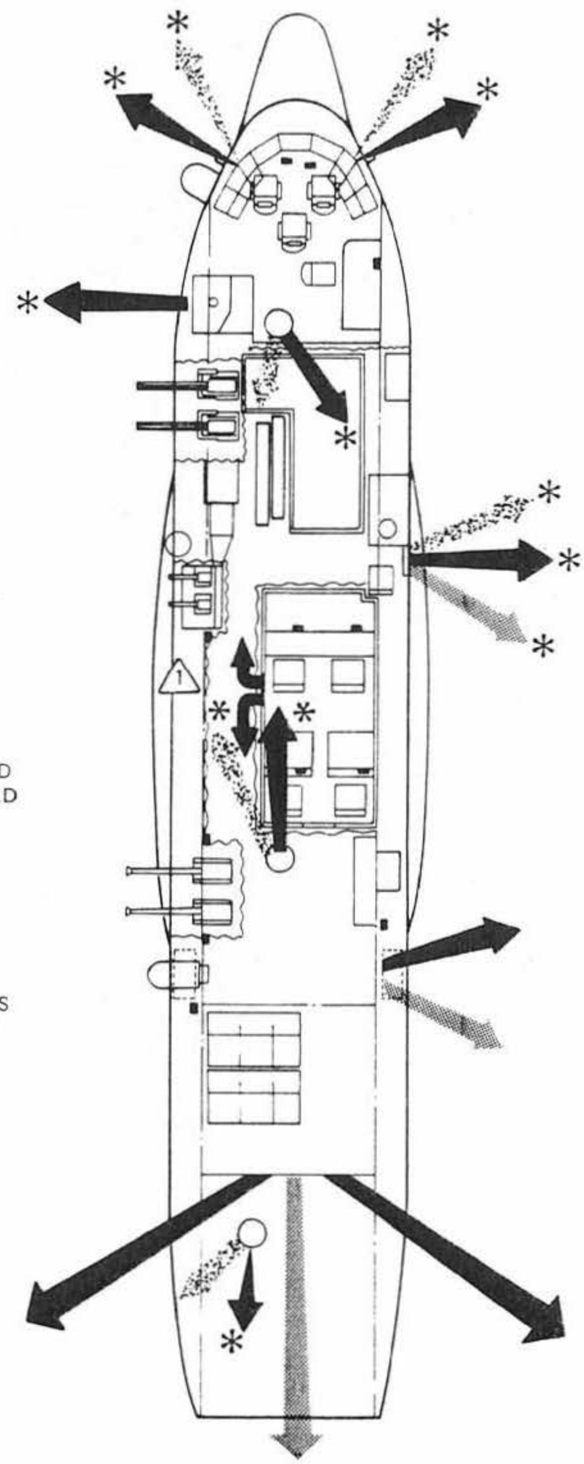


Figure 3-4.

Bailout Over Water.

The following procedures in addition to normal BAIL-OUT PROCEDURES will be employed:

a. Give spoken warning over interphone and three short rings of the alarm bell.

b. Turn IFF to EMERGENCY. The copilot should send distress signals and position reports as directed by the pilot.

c. If time permits (approximately one extra minute is required) put on exposure suits over flying clothing. (Exposure suits are carried on special missions.)

d. Don life jackets and parachutes making certain the individual life-raft pack is secured to the parachute harness. Personnel should check the equipment of each other for completeness and proper adjustment.

WARNING

Do not attempt to inflate the life jacket prior to bailing out as it may be damaged in egress from the airplane as well as hinder the wearer in his exit.

e. Reduce airspeed as much as possible without losing control.

f. Trim airplane to approximately level flight.

g. Open cargo door and ramp.

h. If a ship is in the vicinity, make a run so that personnel, on bailing out, will drift onto the course and just ahead of the ship.

i. Give bailout order over the interphone and one long ring of the alarm bell.

FLIGHT CONTROLS SYSTEM FAILURE.

WARNING

Never purposely remove hydraulic assistance from the flight control boosters to simulate loss of boost assistance. An immediate and unpredictable control response may occur upon either removal or restoration of boost assistance.

Flight Control Hydraulic Booster Unit Failure.

If a serious leak develops in a booster unit, proceed as follows:

a. Determine leaking hydraulic system (booster or utility) (E)

(1) If unable to confirm visually which system is leaking, turn both engine driven hydraulic pumps for one system at a time OFF, and check for leak stoppage.

b. Follow LOSS OF SYSTEM PRESSURE procedure in this section for malfunctioning system.

NOTE

If leak was determined to be in the elevator utility boost unit, the leak may be isolated by turning the Elevator Utility Control Booster Emergency Shutoff switch (Figure 3-5) to OFF. The utility hydraulic system may then be restored to normal operation.

Failure of either one of the hydraulic systems will reduce boost unit forces to the flight controls to approximately one-half normal.

Complete loss of hydraulic assistance for ailerons, elevators or rudder will result in a loss of ability to move these controls except at low airspeeds. Maneuvering the airplane under these conditions must be accomplished with trim tabs and high manual force.

Landing the airplane without hydraulic assistance is a marginal operation and requires skillful handling of trim tabs and engine power, plus coordinated efforts of both pilots on the flight controls. When possible, avoid crosswinds, short fields, or narrow runways.

When landing without hydraulic assistance for the flight control(s) proceed as follows:

a. Reduce weight of airplane.

b. Reduce airspeed to approximately 160 knots and maintain until landing is assured.

c. With elevator hydraulic assistance failure, land with minimum flaps.

d. Make a long flat approach to minimize attitude change at touchdown and fly the airplane onto the ground.

The trim tabs may be used to control the airplane. The EMERGENCY position of the elev tab switch will give slow trim tab actuation: it should be used at cruising speeds or higher because it will give better control of the airplane with less pilot reaction effort. The NORMAL position will give fast tab action: it should be used on the final approach to correct for power adjustments and to compensate for trim changes when the flaps are lowered.

CAUTION

The trim tab actuating motors are not the continuous duty type and caution should be exercised in using them.

control booster emergency shutoff panel

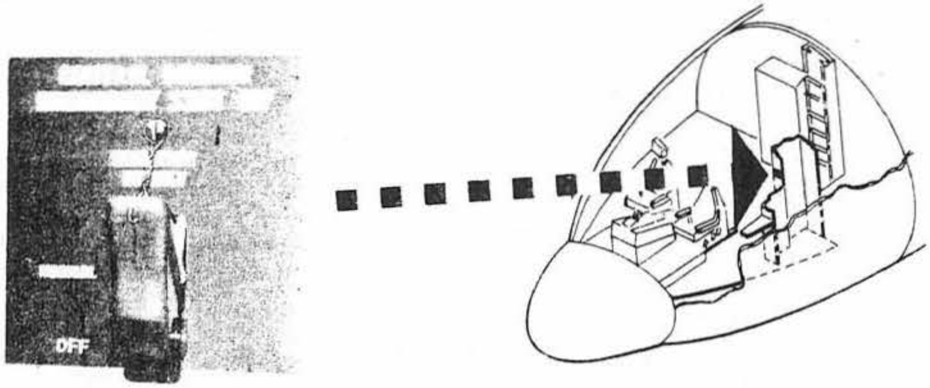


Figure 3-5.

Tab System Failure.

AILERON AND RUDDER TRIM TAB SYSTEM FAILURE.

Failure or runaway of the aileron trim tab will not cause a serious control problem.

WARNING

Directional control cannot be maintained at high airspeeds if the rudder trim tab runs away to an extreme position. If rudder trim tab runaway occurs, hold the rudder tab switch in the opposite direction to tab movement and proceed as follows:

a. Pull the rudder trim tab circuit-breaker.

b. If required, reduce airspeed until directional control is regained.

ELEVATOR TRIM TAB SYSTEM FAILURE.

In the event of runaway elevator trim tab hold the elevator tab switch on the control wheel in the opposite direction of tab movement and proceed as follows:

NOTE

If the tab runs away to nose-up position, placing the airplane in a bank may assist in maintaining control.

a. Elevator tab power switch - OFF

b. Elevator tab power switch - EMERGENCY

c. Operate elevator trim tab switch on the control pedestal to retrim the airplane.

NOTE

The elevator tab switches on the control wheels will not operate the emergency system. Emergency operation is controlled only by the pedestal-mounted switch.

When on autopilot operation and elevator tab power switch is in the EMERGENCY or OFF position, the elevator servo is disconnected from the autopilot and the elevator must be controlled manually.

FLAP SYSTEM FAILURE.

WARNING

If an outboard flap fails, it is possible that contact between the flap and aileron will result in binding, and restriction of movement of the aileron. Under these conditions, if it is possible to control the airplane, no attempt should be made to move the flaps. If movement of the flaps must be attempted, return them in increments of 10 percent toward the position last selected before failure. During flap movement, check aileron control constantly. If aileron control is freed, or if it is noted that binding increases, stop flap movement immediately.

Failure of the wing flaps to operate normally may be caused by failure of the flap electrical control system or by failure of the utility hydraulic system. Protection against asymmetrical extension or retraction of the flaps is provided only when DC power and utility hydraulic pressure are simultaneously available for the flap system. If the flaps fail to operate normally, alternate methods of operation listed in order of preference are:

a. Override of the normal flap selector valve.

b. Extension using the emergency hydraulic system.

c. Extension by override of the emergency flap selector valve.

CAUTION

If the utility system quantity has been depleted and the emergency system is used for flap extension, the return emergency fluid will be retained in the utility reservoir. This may result in the emergency hydraulic quantity being insufficient for emergency landing gear extension and emergency brakes. Under these circumstances and if conditions permit, consideration should be given to landing without flaps or to reservicing the emergency reservoir.

Override of Normal Flap Selector.

If the wing flap selector valve normal circuit breaker is in, or if resetting the circuit breaker does not clear the trouble:

a. Place flap lever in the desired position (CP)

b. Remove utility panel cover (E)

NOTE

Crew member accomplishing this operation will remain in communication with the flight station.

c. Lower or raise flaps to desired position using the wing flap selector valve. Depress LOWER or RAISE button intermittently on the flap selector valve (figure 3-6) moving the flaps in approximately 10-degree increments until flaps are in desired position, or until directed by the pilot to stop. (E)

WARNING

Protection against asymmetrical operation is provided only during normal hydraulic flap operation. Should a failure of flap drive torque tubes occur during override operation, resulting in a change in trim about the roll axis, stop flap movement immediately. Return the controllable flaps to the position assumed by the uncontrollable flaps. During flap movement, check aileron control. If it is noted that the ailerons are binding, stop flap movement.

Extension Using the Emergency Hydraulic System

If flaps fail to operate due to loss of utility hydraulic pressure, investigate the cause of the pressure loss. Do not use emergency system unless reason for pressure loss can be determined. If it can be determined that the cause of the pressure loss is not in the flap system, and if the pilot chooses to extend the flaps by use of emergency hydraulic pressure, proceed as follows:

a. ATM - RUN (E)

b. Emergency Flap Control Switch - EMERG DOWN (P)

If trouble is encountered using emergency power.

c. Return the EMERGENCY FLAP CONTROL Switch - OFF

Override of Emergency Flap Selector Valve.

If flap extension cannot be completed by use of the Emergency Flap Control Switch and the wing flap selector emergency circuit breaker is in, or if resetting the circuit breaker does not clear the trouble: proceed as follows:

a. ATM - ON (E)

b. Lower flaps to desired position using emergency flap selector valve (E)

wing flap selector valve

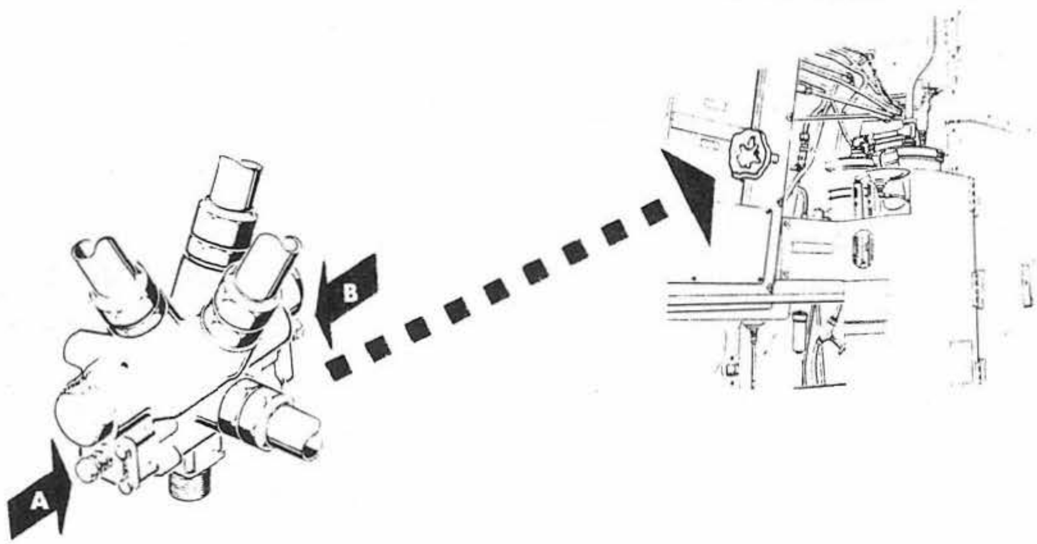


Figure 3-6.

WARNING

Pull the lever on the emergency flap selector valve intermittently moving flaps in approximately 10-degree increments until flaps are in desired position or until directed by the pilot to stop.

WARNING

Exercise caution while operating the manual override on the emergency flap control valve, since no asymmetrical flap protection is provided.

NOTE

Crew member accomplishing this operation will remain in communication with the flight station.

NOTE

The emergency flap selector valve is located on the right hand side of the center wing rear beam below the flap gear box and may be reached from the top of the booth.

Asymmetrical Flap Positioning.

Should flap movement stop before the flaps have reached the position desired, failure of the flaps to move in either direction may be due to engagement of the emergency flap brake. The flap handle should be positioned to correspond to the position of the flaps, and no further inflight movement of the flaps should be attempted.

WARNING

Do not release the manual override on the emergency flap brake valve while the airplane is in flight, as an asymmetrical condition of the flaps may result. This manual override is for ground use only.

WARNING

Asymmetrical protection is not provided when the emergency system is used during flap extension. Should any change in trim about the roll axis occur during flap extension, stop extension immediately.

If emergency hydraulic pressure was being used when flap movement stopped, check the wing flap sel emer circuit breaker on the main power distribution box. If flap extension cannot be completed by use of the flap control switch, proceed to lower them by manual operation of the emergency flap selector valve.

Wing Flap Position Indicator Failure.

If no change in flap position is shown on the wing flap position indicator after movement of the flap lever, the trouble may be in the indicator rather than in the flap system. This trouble may be identified by observing hydraulic pressure and by observing the pitch attitude of the airplane. Immediately after selecting a change in flap position, a pressure drop in the hydraulic system being used indicates either that the flaps are moving or that there is a hydraulic leak. If the flaps are moving, this will be indicated by a change in the pitch attitude of the airplane. During flap extension, the pilot may direct the flight engineer or the IO to make a visual inspection of the flap position. Also, while in the cargo compartment, the flight engineer or IO may check the tabs and flaps position indicators circuit breaker on the aft fuselage junction box.

LANDING GEAR SYSTEM FAILURE.

CAUTION

> If a malfunction is encountered in lowering the landing gear, once the landing gear is down and locked it will not be moved from this position. If one or more landing gear will not retract, do not attempt to obtain an up and locked condition by recycling the gear. Extend the gear and attempt to obtain a down and locked condition. Visually confirm all the gear is down and locked and land as soon as practicable.

> If the main and nose landing gears fail to extend after normal operation of the landing gear control lever, attempt to identify the malfunction before making further attempts to lower the gear. Check circuit breakers, utility hydraulic pressure, and hydraulic fluid quantity. Check for evidence of hydraulic leaks.

> If a hydraulic leak is the cause of the malfunction, or hydraulic pressure was lost after the landing gear handle was placed in the down position, return the gear handle to the up position and proceed with the manual gear extension procedure. In all other cases, if the gear fails to extend normally, continue with alternate extension methods.

The following alternate methods of gear operation are listed in order of preference:

a. Use of Main Landing Gear Drive Switch (Airplanes 55-0029 and up).

b. Overriding the Utility Landing Gear Selector Valve.

c. Emergency Hydraulic Extension.

d. Overriding the Emergency Landing Gear Selector Valve.

e. Manual Extension of Nose Landing Gear (Emergency Hydraulic Fluid Available).

f. Manual Extension of Nose Landing Gear (Emergency Hydraulic Fluid Depleted).

g. Manual Extension Retraction of Main Landing Gear.

h. Main Landing Gear Extension After Manual Gearbox Failure.

NOTE

> The landing gear position indicators should continue to operate regardless of landing gear malfunction. The pilot should inform the flight engineer when a down and locked position is indicated so that the flight engineer will know when to release the manual override buttons. If a malfunction of the landing gear position indicator is suspected, observe the main landing gear position through the glass panels on the wheel wells and the nose gear position through the nose wheel well inspection window.

Emergency Retraction

If the landing gear lever will not move to the UP position due to malfunction of the touchdown switch or lock solenoid, manually release the lock solenoid by pushing the lock release button on the landing gear lever panel. If either or both of the main gears fail to retract, an emergency retraction may be attempted at the discretion of the pilot. Investigation of the system should be made prior to manual retraction.

NOTE

> No provisions exist for manual retraction of the nose landing gear. The main landing gear cannot be retracted by the emergency hydraulic system. If the nose landing gear fails to retract, check to assure that the nose landing gear emergency extension valve is in the normal position.

Use of Main Landing Gear Drive Switch (Airplanes AF 55-0029 and Up).

If one or both of the main landing gear fails to extend.

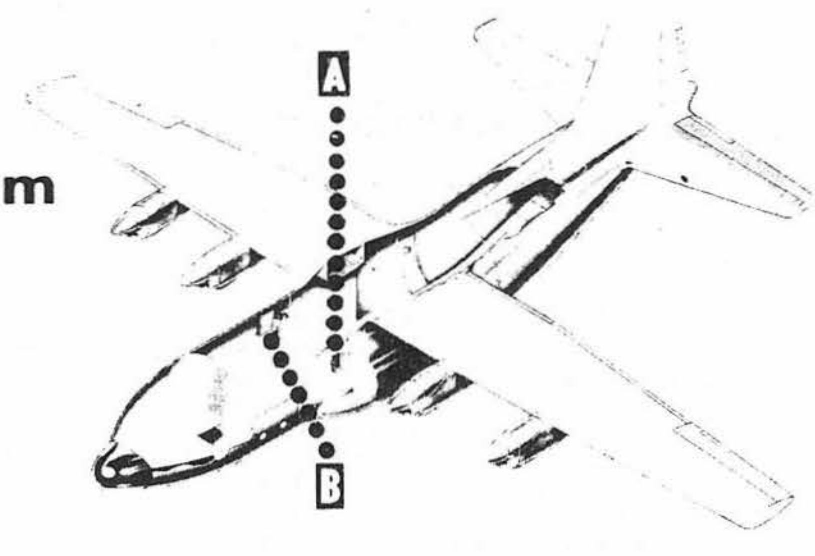
a. Place the MLG drive switch to HI-TORQUE position. (CP)

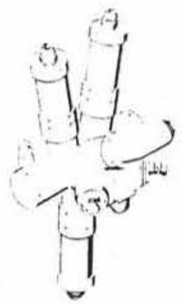
b. Place landing gear lever to DOWN. (CP)

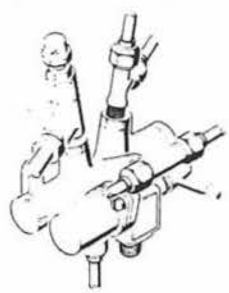
CAUTION

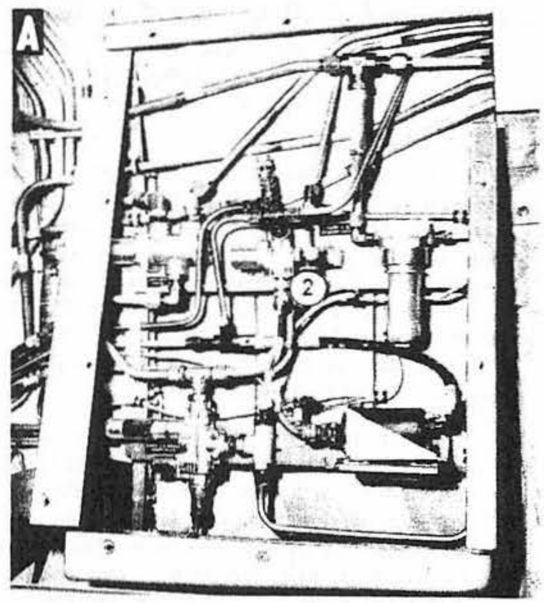
> Do not operate the MLG drive switch while the landing gear is being extended.

landing gear system control valves









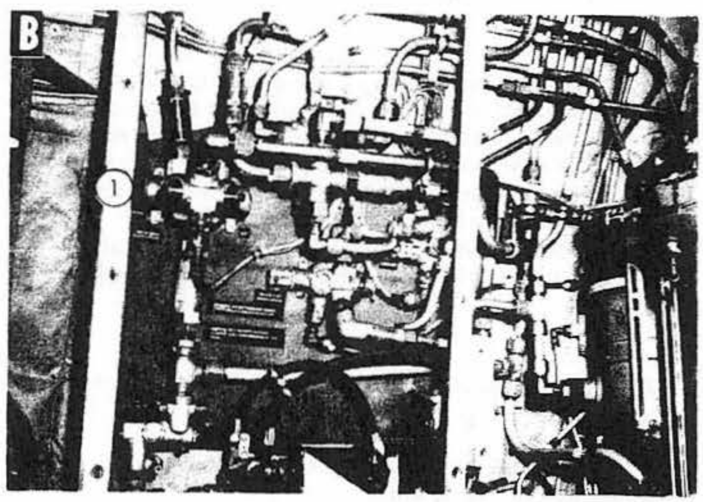


Figure 3-7.

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landing gear emergency extension controls

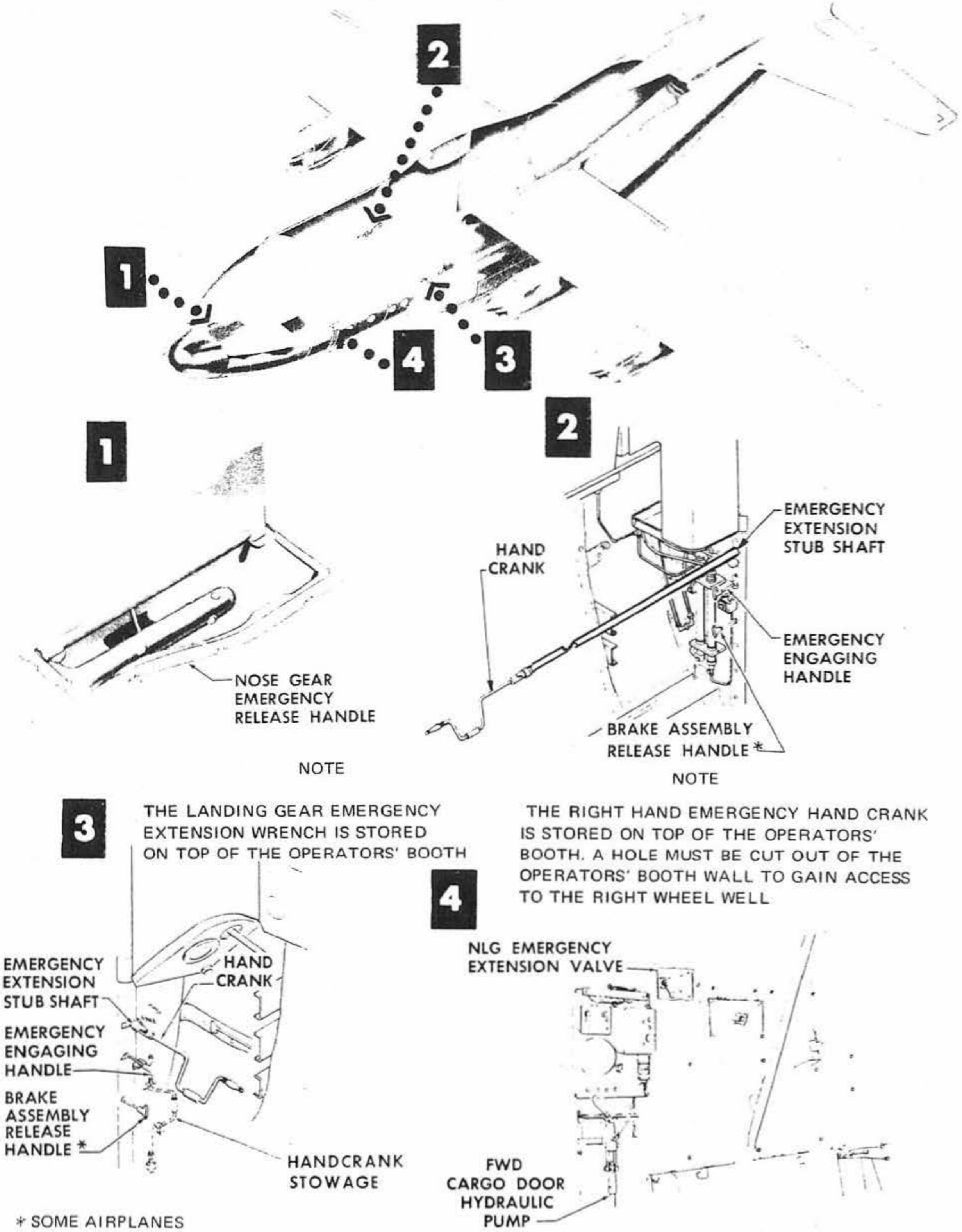


Figure 3-8.

Overriding the Utility Hydraulic Control Valves.

If the landing gears fail to extend or retract while using utility hydraulic system pressure because of failure of the control valves to operate (no evidence of hydraulic pressure loss), proceed as follows:

a. Pull the lg sel and dn press dump valve normal circuit breaker (E)

b. Pull the lg sel and dn press dump valve emergency circuit breaker (E)

c. Place landing gear lever in the desired position (CP)

d. Remove right wheel well hydraulic panel cover. (E/IO)

NOTE

Crew member accomplishing this operation will remain in communication with the flight station.

e. To extend the landing gear, depress landing gear selector valve DOWN button and hold, if required. (E/IO)

f. To retract the landing gear, depress landing gear selector valve UP button and hold, if required. (E/IO)

CAUTION

If the button requires holding to lower the gear, the mechanical detent in the landing gear selector valve has failed. If nose wheel steering and normal brakes are required, the button must be held in.

Emergency Hydraulic Extension.

If utility hydraulic pressure is not available for gear extension, proceed as follows:

a. ATM - RUN (E)

b. LG SEL DN pressure dump valve emergency circuit breaker - IN (E)

c. Landing gear lever - EMERG DOWN (CP)

CAUTION

If the utility system quantity has been depleted and the emergency system is used for landing gear extension, the return emergency fluid will be retained in the utility reservoir. This may leave little or no emergency fluid in the emergency reservoir for emergency brake use. Under these circumstances consideration should be given to manually extending the landing gear, or reservice the emergency reservoir.

CAUTION

Deplete the utility hydraulic system pressure prior to engine shutdown to avoid inadvertent retraction of the nose landing gear. (This caution takes into consideration the possibility of the landing gear control valve sticking in the UP position.)

NOTE

Nose wheel steering and normal brakes will not be available when the emergency system is used to lower the landing gear. During practice emergency extension pull the lg sel and dn press dump valve normal circuit breaker. This will simulate the failed condition.

NOTE

Watch the emergency hydraulic system pressure gage while the landing gear lever is in the EMER DOWN position. A drop in pressure without movement of the landing gear indicates a leak in the emergency hydraulic system.

Overriding the Emergency Landing Gear Selector Valves.

If the landing gears failed to extend while using emergency hydraulic system pressure because the emergency landing gear selector valve failed to operate (no evidence of loss of hydraulic pressure), proceed as follows:

a. Pull the lg sel and dn press dump valve normal circuit breaker (E)

b. Pull the lg sel and dn press dump valve emergency circuit breaker (E)

c. Place the landing gear lever in the EMERG DOWN position. (CP)

d. Remove left wheel well hydraulic panel cover (E/IO)

NOTE

Crew member accomplishing this operation will remain in communication with the flight station.

e. Pull knob on emergency selector valve and hold until all landing gear are fully extended. (E/IO)

Manual Extension of Nose Landing Gear (With Emergency Hydraulic Fluid Available).

If the landing gears fail to extend and lock after the manual override control valves are used, extend the nose landing gears as follows:

a. Pull the LG SEL and DN PRESS dump valve normal circuit breaker (E)

b. Pull the LG SEL and DN PRESS dump valve emergency circuit breaker. (E)

c. Place the landing gear lever in the DOWN position. (CP)

d. Pull the nose landing gear emergency release handle. (CP)

NOTE

With emergency hydraulic fluid available the forward cargo door hand pump will release the nose gear uplock if the manual release is inoperative.

e. Move the nose landing gear emergency extension valve (located above the crew entrance door) to NLG EMER EXT. (E/IO)

f. Operate the forward cargo door handpump until the nose landing gear is extended and locked. (E/IO)

Manual Extension of Nose Landing Gear (Emergency Hydraulic Fluid Depleted).

If loss of utility and emergency hydraulic pressure is experienced, extend the nose landing gear as follows:

a. Place the landing gear lever in the DOWN position. (CP)

b. Decrease airspeed to or below 120 KIAS. (P)

c. Pull the nose gear emergency release handle. (CP)

NOTE

The nose gear should extend into the airstream. Allow the nose gear to extend until the forward gear door starts to close at reduced speed: this may require 30 to 45 seconds.

d. Increase airspeed as possible to the gear speed limit. (P)

NOTE

The nose gear should extend to the down-and-locked position.

Manual Extension Retraction of the Main Landing Gear.

If the main landing gear fails to extend/retract after normal override procedures was attempted, extend/retract the main landing gear as follows:

NOTE

Complete depressurization of the airplane before manual operation of the main landing gear may assist in the operation of the gear.

a. Pull the LG SEL and DN PRESS dump valve normal circuit breaker. (E)

b. Pull the LG SEL and DN PRESS dump valve emergency circuit breaker. (E)

c. Place the landing gear lever in the desired position. (CP)

d. Turn off No. 2 and No. 4 engine driven hydraulic pumps and deplete utility pressure (CP)

CAUTION

Do not force the emergency engaging handle out. To do so may result in a bent manual drive shift lever, making it difficult or impossible to engage the manual drive. It may be necessary to place the extension handcrank on the emergency extension stub shaft and rotate slightly until the manual drive gear teeth align.

e. Engage manual extension system. (E/IO)

(1) Airplanes with one emergency engaging handle: Pull the emergency engaging handle (figure 3-4) to its stop and lock it out by turning it one-quarter turn counter clockwise.

(2) Airplanes with two emergency engaging handle: Follow step (1) for upper emergency engaging handle (figure 3-4) then for lower emergency engaging handle.

WARNING

Make sure the ratchet on the handcrank is set for down rotation before placing it on the emergency extension stub shaft. If the main landing gear starts to free fall after the handcrank is placed on the emergency extension stub shaft. Immediately remove the handcrank. The extension handle ratchet may change direction due to the rotation speed of the emergency extension stub shaft.

f. Extend or retract using the extension handcrank. Place the extension handcrank on the emergency extension stub shaft and rotate in appropriate direction until the landing gear is in the desired position. (E/IO)

NOTE

If the manual drive fails to engage, or the spring-loaded brake fails to release, it may be an indication of the emergency engaging handle cable being broken or disconnected. This may be indicated by the emergency engaging handle being extremely easy to pull to the extended position. Should this occur, remove the access panel on the forward upper wheel well area (see figure 3-8) for main landing gear brake and gear box assembly. Pull down and hold (secure) the manual shift lever at the bottom of the gear box to disengage the brake and shift gear box to manual drive. Continue with manual extension of gear.

NOTE

If manual extension mechanism does not disengage, pull the emergency engaging handles again, and rotate the handcranks in each direction and release the handles again.

g. After gear is in desired position, return the emergency engaging handle(s) to the disengaged position by rotating clockwire to its stop and pushing in. Verify proper disengagement by rotating the handcrank one turn in each direction. If the manual shift lever was manually pulled and secured, ensure its return to the up position. (E/IO)

h. Remove the extension handcrank. (E/IO)

i. Return No. 2 and No. 4 hydraulic pumps to ON (if utility hydraulic system is available). (CP)

j. Check that the landing gear stays in the selected position. If the landing gear moves from the selected position, place the utility hydraulic switches in the OFF position and repeat the manual extension/retraction procedure leaving the pump switches OFF.

Main Landing Gear Extension After Normal, Emergency and Manual System Failure.

A malfunction that locks any component of the main landing gear extension system may also lock the remainder of the system. In such a case, if the universal joints on the vertical torque shaft are disconnected, the landing gear may free-fall to the down position. If the landing gear does not free-fall each landing gear strut can be extended by rotating the jackscrews, using the vertical torque shaft as an improvised wrench, or with the emergency extension wrench. Use this procedure to lower the main landing gear only after all other normal and emergency procedures have failed. Refer to figure 3-8 for access doors.

CAUTION

Extend the aft strut first. The main landing gear doors are opened by a mechanical connection to the aft strut, and damage to the doors could result if the forward strut is extended first.

a. Leave the main landing gear manual extension system engaged, the utility hydraulic system depleted, and the landing gear control circuit breaker pulled. Depressurize the airplane. Place the air conditioning master switch to AUX VENT (E)

b. Remove the upper access doors with the emergency extension handcrank.

NOTE

Access to the right hand access doors may be gained from inside the booth.

c. At the aft strut, remove the two outboard bolts and nuts connecting the companion flanges at the lower end of the vertical torque shaft. (E/IO)

d. Remove the nuts from the two inboard bolts, and remove the bolts without extending the hands through the access hole. (E/IO)

WARNING

The weight of the landing gear may cause the gear to extend rapidly when released. If the above steps are not followed in proper sequence, serious injury to the hands may result when the gear free falls.

NOTE

If the strut does not free-fall, application of g forces may aid in extending the strut.

e. If the aft strut free-falls approximately halfway down, attempt to extend the forward strut using the manual extension system. The horizontal torque strut will prevent the landing gear strut from fully extending.

f. If the landing gear does not extend using the above procedure, extend the struts using the emergency extension wrench or the vertical torque shaft.

NOTE

The emergency extension wrench is stowed on the top right front corner of the booth.

g. To remove the vertical torque shaft on airplanes without the emergency extension wrench, cut a hole above the upper access door (see figure 3-8). Secure the top of the vertical torque shaft to some point inside the cargo compartment with wire to prevent loss of the shaft. Remove the bolt and nut that retains the upper end of the shaft spline to the gearbox. Pull the vertical torque shaft into the cargo compartment through the upper access hole.

h. At the aft strut, slip the companion flange off the splines on the upper end of the jackscrew.

i. Using the vertical torque shaft or the emergency extension wrench, engage the splines on the upper end of the jackscrew. Rotate the jackscrew counterclockwise approximately one-half revolution. Application of g forces may aid in extending the strut.

NOTE

Use the fixed end of the wrench to start the jackscrew.

j. If the strut has not extended, rotate the jackscrew counterclockwise to extend the strut halfway down.

NOTE

Use the ratchet end of the emergency extension wrench to rotate the jackscrew. The handcrank may be installed in the square drive of the wrench to extend the strut more rapidly.

k. Extend the forward strut using the above procedure. Check that the aft strut is fully extended.

Main Landing Gear Tie-Down

Before landing with a broken shelf bracket, or drag pins not engaged in the shelf bracket, the following procedure will be used to tie down the landing gear. If 25,000-pound tiedown chains are not available, two tiedown devices and six 10,000-pound chain segments, forming three chain loops, are required to tie down each pair of opposite struts. If 25,000-pound chains are available, two devices, and three 25,000-pound chain segments are required. See figure 3-10 for the arrangement of the chains.

If main landing gear tiedown is required, proceed as follows:

a. Depressurize the airplane and place the air conditioning master switch to AUX VENT AND GROUND CART.

b. Remove the wheel well inspection windows at the struts to be tied down.

c. Cut hole in booth wall as shown in figure 3-9.

d. Pass the ends of two 10,000-pound chain segments (or the end of a single 25,000-pound chain segment, if available) around the applicable strut and back through the inspection opening. Repeat this for the opposite strut. Securing a piece of safety wire to the end of the chain may assist in guiding the end of the chain around the strut.

e. Fasten two other 10,000-pound chain segments (or a single 25,000-pound chain segment, if available) between the ends of the chains placed around the struts.

f. Install connectors between the remaining loose ends of the chains around the struts, and tighten the connectors.

WARNING

Move all personnel away from the wheel well area to avoid injury if a chain should break.

g. Repeat the process for the other pair of opposite struts, if necessary.

h. Notify the control tower of the difficulty and request that the crash equipment be alerted.

i. During landing, hold the nose wheels off the ground as long as possible, but touch down while elevator effectiveness allows gentle lowering of the nose. Do not attempt to taxi the airplane after landing.

CAUTION

Do not attempt a takeoff with a known or suspected main landing gear malfunction.

Unsafe Nose Gear Indication.

Prior to landing the airplane with a nose gear that does not indicate down and locked by the indicator or visual inspection, use the following procedure:

NOTE

Due to the configuration of the nose landing gear on these airplanes, tie-down is not necessary, nor is it practicable.

a. Visually check the pin which protrudes from the aft end of the actuator and operates the down-and-locked indicator switch.

(1) If a band of fluorescent paint is visible on the pin, the downlock is engaged. If this band is not visible, the downlock is not engaged.

b. Maintain pressure on the down side of the nose landing gear hydraulic system.

c. During landing, hold the nose wheels off the ground as long as possible, but touch down while elevator effectiveness allows gently lowering of the nose. Do not attempt to taxi the airplane.

d. Set the parking brake.

e. Place chocks in front of the nose wheels, or jack the nose of the airplane and then install the ground lock pin.

LANDING EMERGENCIES.

WARNING

Under certain conditions it may be impossible to obtain or maintain safe flight. When ground contact is unavoidable, maintain directional control and touchdown wings level and at minimum power setting.

LANDING WITH NO FLAPS.

The approach for landing with "flaps up" may be necessitated by the need to keep drag to an absolute minimum under partial power operation, or by a complete failure of the flap system. Minimum airspeed on downwind leg, base leg and turn to final will be 150 KIAS, or approach speed whichever is higher. The no flap approach speed is ten knots above the computed no flap threshold speed T.O. 1C-130(A)A-1-2. If possible extend the downwind slightly in order to have more time on final to properly set up a no flap approach. Complete the turn to final and slow to no flap approach speed. Monitor airspeed closely. The airplane pitch (angle of attack) on final will approximate a landing attitude and the rate of descent should be controlled with the throttles. Do not attempt to round out or flare the airplane, but allow it to touchdown by maintaining the landing attitude and using power, as necessary, to control the descent rate.

CAUTION

If a normal landing round out or flare is used at touchdown with no flaps, the tail skid may contact the runway.

CAUTION

Do not move throttles below flight idle until the airspeed is 105 KIAS or below.

LANDING WITH ENGINES INOPERATIVE.

Landing With One Engine Operative.

The approach for landing with one engine inoperative is made in the same manner as for a normal landing. Below 110 knots airspeed during flareout the combined flight idle thrust on the side with two operating engines will tend to turn the airplane into the side with only one operating engine. This is particularly noticeable when a landing is made with an outboard engine shut down. This effect may best be counteracted by treating it as a crosswind and using crosswind techniques.

NOTE

At light gross weights, counteracting the crosswind effect by adding power to the side with the dead engine will contribute to floating and consequent overshooting.

After nose wheel touchdown, retard throttles to GROUND IDLE, and use reverse thrust from symmetrical engines.

CAUTION

Reverse thrust on unsymmetrical engines may cause the airplane to veer to one side.

Landing With Two Engines Inoperative.

WARNING

With two engines inoperative on one side, airspeed should be maintained above 150 KIAS for all flight conditions requiring high power settings on the operative engines. Directional control may be impossible if maximum power is used at speeds less than 150 KIAS. Flaps should not be extended more than 50% until the landing is assured. After the landing is assured, normal approach and touchdown speeds may be used.

After loss of two engines, attempt to decrease aircraft weight, if necessary, by jettisoning cargo. Use the following procedures:

a. Downwind Leg

150 KIAS or approach speed whichever is higher.

Gear and Flaps - UP

b. Base Leg

150 KIAS or approach speed whichever is higher.

Gear and Flaps - As Required

c. Turn to Final

150 KIAS or approach speed whichever is higher.

Gear and Flaps - As Required

d. Final Approach

Maintain 150 KIAS, or approach speed, whichever is higher, until landing is assured.

Landing gear - Extended

Flaps - As Required

Slow to approach speed

CAUTION

For landing with two engines inoperative on one side, do not use reverse thrust. Ground idle power alone can cause the aircraft to veer unless used cautiously and with firm nosewheel contact.

Go-Around Procedure With One or Two Engines Inoperative.

WARNING

If a go-around is attempted after landing, and if the touchdown speed is less than minimum control speed; directional control must be maintained by use of nose wheel steering and coordinated use of flight controls. It may be necessary to reduce power on the opposite engine to help maintain directional control until minimum control speed is obtained.

a. Alert crew by giving command "go-around".

b. Begin the go-around at or above minimum control airspeed.

c. Advance throttles for all operating engines to maximum power as directional control will permit. Power applied to the asymmetrical engines will depend on the airspeed on the airplane at initiation of go-around.

d. Give command to copilot to raise flaps to 50 percent.

e. Raise gear when certain that airplane will not touch down.

f. Continue to raise flaps as airspeed and altitude permit.

NOTE

At low airspeeds, raise flaps in 10 percent increments with airspeed increasing approximately 5 knots between retraction increments.

NOTE

Two-engine minimum control speed must be obtained as soon as possible after initiation of go-around.

g. After gear and flaps are up, continue as a normal take-off.

(1) If on three engines use three engine climb speed.

(2) If on two engines use a minimum of Vmca (two engines out) or 150 knots if gross weight and altitude permit.

WARNING

The use of 5 degrees of bank away from the inoperative engine will aid in directional control when power is applied during go-around. Go-around with two engines inoperative on the same side, should be avoided unless absolutely necessary. Every precaution should be taken so as not to let a situation develop that necessitates a go-around under these conditions. Descents below safe, comfortable altitudes and airspeeds should not be made until absolutely assured of landing.

LANDING WITH TIRE FAILURES.

Nose Landing Gear Tire Failure.

If one nose wheel tire is flat at time of landing, a normal landing may be made. If both wheel tires are flat at the time of landing, keep the nose wheels off the ground as long as possible. After nose gear contact use maximum reverse thrust and minimum braking. This procedure gives minimum nose wheel loading. Taxiing is not recommended.

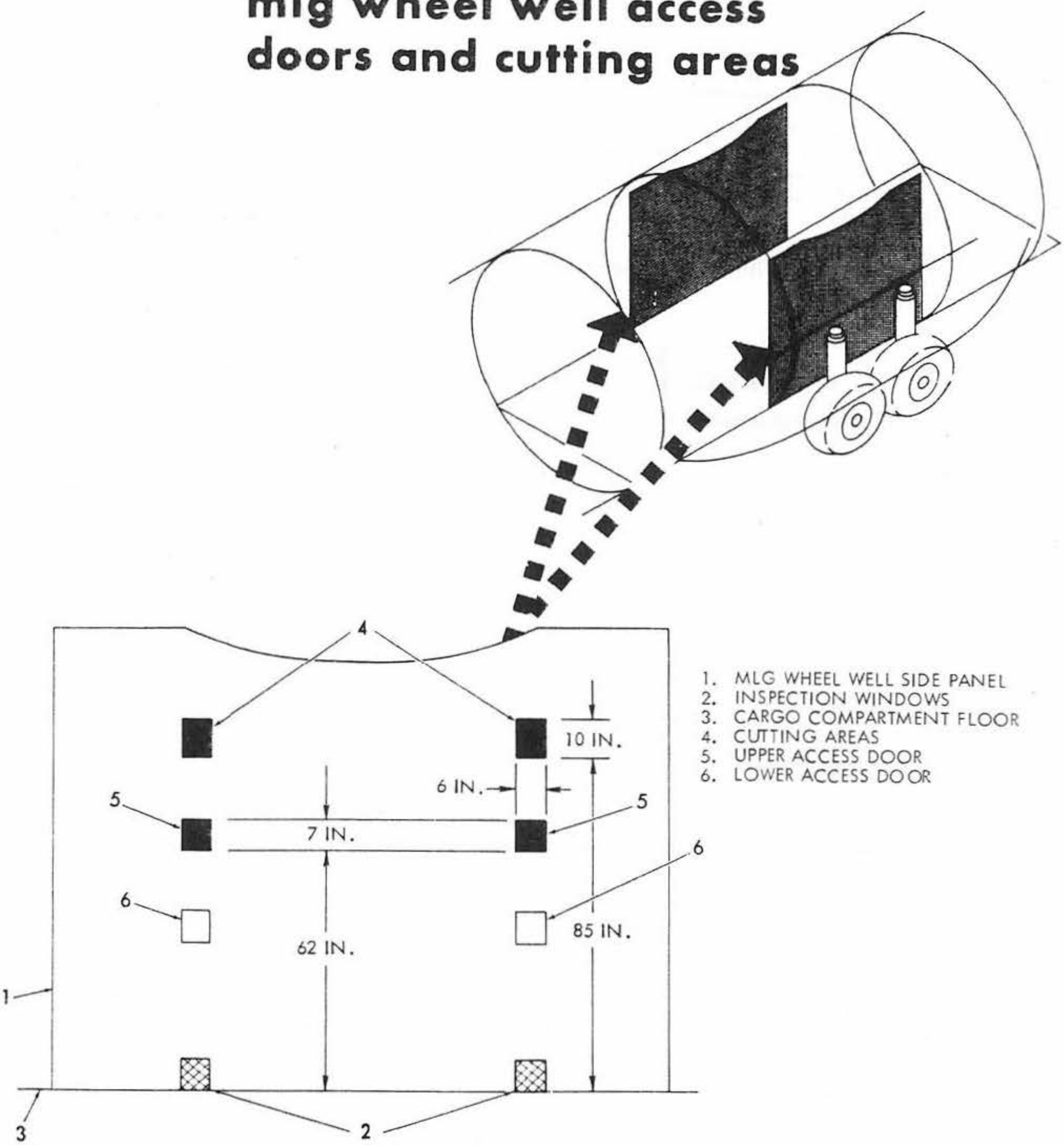
Main Landing Gear Tire Failure.

NOTE

If time and conditions permit, it is recommended the main landing gear be tied down for the affected tire to reduce vibration and possible damage.

If a main landing gear tire is flat at the time of landing, touch down the nose gear as soon as possible and use maximum reverse thrust. Taxiing is not recommended. If both tires of the main landing gear are flat, there will probably be a tendency to swerve toward that side. Line up and land on the side of runway with the good tires. Touch down the nose gear as soon as possible, hold forward pressure on the control column, and assume directional control with the nose wheel steering system. Use wheel brakes (on the side opposite the flat tires only) to assist the nose gear in maintaining directional control. Use reverse thrust cautiously, but to the fullest extent possible to reduce landing roll to a minimum. Do not attempt to taxi.

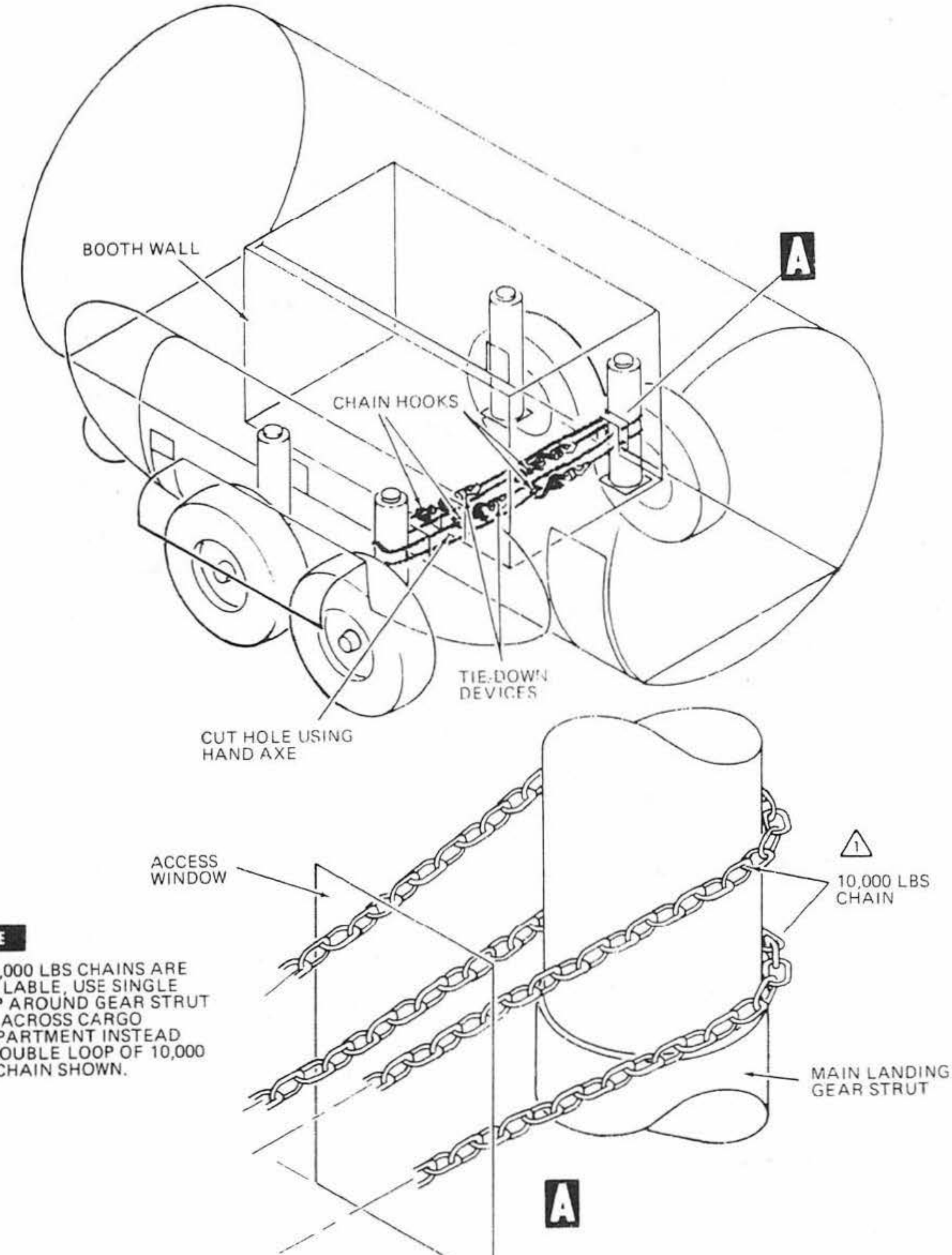
mlg wheel well access doors and cutting areas



1. MLG WHEEL WELL SIDE PANEL
2. INSPECTION WINDOWS
3. CARGO COMPARTMENT FLOOR
4. CUTTING AREAS
5. UPPER ACCESS DOOR
6. LOWER ACCESS DOOR

Figure 3-9.

landing gear tie-down



NOTE

⚠1 IF 25,000 LBS CHAINS ARE AVAILABLE, USE SINGLE LOOP AROUND GEAR STRUT AND ACROSS CARGO COMPARTMENT INSTEAD OF DOUBLE LOOP OF 10,000 LBS CHAIN SHOWN.

Figure 3-10.

LANDING WITH GEAR RETRACTED.

Landing With One or Both Main Gears Retracted.

If one main landing gear cannot be extended, the recommended procedure is to retract the other main gear and land with only the nose landing gear down, or to belly-land with all landing gears retracted. Refer to GEAR UP LANDING in this section. This will prevent the propeller on the gear-up side of the airplane from contacting the ground.

Landing With Nose Gear Retracted and Main Gears Down.

If the nose gear cannot be extended, an emergency landing may be accomplished, holding the nose of the airplane up as long as possible. Use the following procedure to make a nose-gear-up landing:

a. Give warning over the interphone and give six short rings on the alarm bell.

b. If cargo can be safely moved, shift it to an aft center of gravity location not to exceed limits in Section V.

c. Stow or secure all loose equipment.

d. Depressurize the airplane and close all engine bleed air valves.

e. Open the emergency escape hatches, the paratroop door and the aft cargo door.

f. Turn off all unnecessary electrical equipment.

g. Don helmet and take crash position.

h. Lock shoulder harness inertial reel.

WARNING

Ensure that all controls which cannot be easily reached are properly positioned before locking the harnesses.

i. Request foam on runway.

j. Assume a normal landing attitude.

k. Give warning over the interphone and give one long ring on the alarm bell to brace for impact.

l. Immediately upon ground contact, apply sufficient up-elevator to keep the airplane in a level attitude as long as possible. DO NOT use brakes.

m. After nose contact, use reverse thrust, but do not allow the nose to rise off the ground.

n. When the airplane comes to a complete stop, follow the GROUND EVACUATION procedures in this section.

Gear-Up Landing.

Before making a gear-up landing, perform the following operations:

a. Give warning over the interphone and give six short rings on the alarm bell.

b. Stow or secure all loose equipment.

c. Depressurize the airplane and close all engine bleed valves.

d. Jettisoning of cargo should be considered.

e. Consume all unnecessary fuel.

f. Open the emergency escape hatches, the paratroop door and the aft cargo door.

g. Turn off all unnecessary electrical equipment.

h. Don helmet and take crash position.

i. Fasten shoulder harness and inertia reel lock.

WARNING

Ensure that all controls which cannot be easily reached are properly positioned before locking the harnesses.

j. Request foam on the runway. (An area 3,000 feet long by 30 feet wide should be requested, if available.)

k. Assume a normal landing attitude.

l. Give warning over the interphone and give one long ring on the alarm bell to brace for impact.

m. When the airplane comes to a complete stop, follow GROUND EVACUATION PROCEDURES in this section.

EMERGENCY LANDING ON SOFT GROUND.

If it should become necessary to land on soft ground, the decision to land with gears extended or retracted must be made by the pilot. However, if the decision is to land with the landing gear retracted, the recommended procedure is to land with the nose gear extended and the main gear retracted.

LOSS OF NOSE WHEEL STEERING DURING LANDING.

Whenever a loss of nose wheel steering is indicated by an immovable pilot's steering wheel, no further attempt will be made to "force" the wheel to turn, as this might prevent the nose wheel from castering.

Under this condition, the pilot will pull back on the control column to relieve pressure on the nose wheel and maintain directional control of the airplane through the coordinated use of flight controls, differential power and differential brakes according to the prevailing circumstances of speed, crosswinds, engine out, and runway conditions.

LANDING WITH A COCKED NOSE WHEEL.

The procedure for landing with a cocked nose wheel is the same as that for landing with loss of nose wheel steering, with the following addition. Request foam on the runway.

NOSE WHEEL SHIMMY.

Nose wheel shimmy is an indication of an unbalanced condition of one or both of the nose wheel tires or failure of the steering system. If this occurs during takeoff, the decision regarding whether to abort or to continue will depend on the severity of the shimmy and whether the refusal point has been passed. If shimmy occurs during the landing roll, decelerate gradually and apply up-elevator to keep as little load on the nose wheels as possible. When landing with a known shimmy condition, keep the nose wheels off the ground as long as possible, but touch down while elevator effectiveness allows gentle lowering of the nose.

BATTLE DAMAGE.

If suspected or actual inflight damage occurs to the airplane, immediate steps must be taken to determine the extent of damage and the controllability of the airplane for landing. If at anytime it becomes apparent that a safe landing cannot be made, consideration should be given to bailing out the engine crew while controlled flight is still possible. If inflight damage occurs, attempt to maintain positive control of the airplane at all times and proceed as follows:

a.	Guns	SAFE	(E) (WM)
b.	Engine Bleed Air Valves	Closed	(E)
c.	Air Conditioning Master Switch	AUX VENT	(E)
d.	Crew Check-in	Crew Position	(ALL)
e.	Unnecessary Electrical Equipment	Off	(ALL)
f.	Electrical Buses	Isolate (as required)	(E)
g.	ECM Pods	Isolate (if required)	(E)

CAUTION

In the event damage has been received to ECM equipment, it will be necessary to field trip both No. 1 and No. 4 AC generators to remove power to the ECM equipment.

h.	Fuel Boost Pumps	As Required	(E)
i.	Airplane Controllability	Checked	(P)

(1) Attempt climb to or above 10,000 feet

(2) Jettison cargo if required

(3) Configure for landing

WARNING

With structural damage, there is a possibility of a split flap condition when flaps are lowered.

(4) Slow to landing speed in 5 knot increments and execute turns as required to determine controllability of the airplane.

(5) If at any point a stall buffet occurs or the airplane becomes uncontrollable, immediately accelerate to a safe flying speed. Plan landing at a speed where safe control of the airplane can be maintained.

DITCHING.

WARNING

Ditching of the airplane should be attempted only as a last resort. If conditions permit, all personnel not required for the final ditching operation should bail out of the airplane

Under ideal conditions of wind and sea, and by skillful execution of the recommended techniques, the ditching of transport-type airplanes can usually be accomplished with a high degree of success. However, due to the high-wing configuration of this airplane, the fuselage may be expected to settle after touchdown with consequent flooding of the cargo compartment. The decision to ditch or bailout must be made by the pilot in view of the existing circumstances. This decision should never be delayed until the fuel supply is exhausted since the most effective ditching approach is made with power on at a speed slightly above the stall speed.

Preparation for Ditching.

Plans for ditching cannot be made without taking the wind direction into consideration. Waves move downwind, and the spray from wave crest is also blown downwind, swells, however, do not always indicate wind direction and can be very large even when the wind is calm. Swells are the result of underwater disturbances. Over a sea, a pilot must be more exacting and alert when judging height. The ditching chart (figure 3-12) give duties of personnel prior to and during ditching. Figure 3-4 illustrates the emergency exists and evacuation routes used during ditching. Figure 3-11 shows the liferaft releases.

Ditching Characteristics.

Ditching characteristics of the C-130 airplane are not known; however, NACA controlled ditching tests of models similar to the C-130 in configuration indicate that there is a reasonably high probability that the airplane can be landed on water without major collapse of structure or a sudden rush of water into occupied compartments. On the basis of these tests, it is concluded that the following results can be expected upon ditching.

NOTE

These characteristics assume the airplane is ditched at a nose high attitude with 50% flaps, gear up, and at an airspeed of 10 knots above stalline speed. (On airplanes modified by T.O. 1C-130-708 speed would be reflected in a reading of approximately 1.15Vs on the angle of attack indicator.)

Upon contact with the water, moderate bottom damage may occur in the area immediately forward of the cargo loading ramp hinge. The bottom damage will tend to stabilize the airplane laterally during the ditching run, maintaining the wings in an essentially level attitude. Wing dipping or water looping are not expected.

During the initial portion of the ditching run (the tail-down portion) the aft cargo door may be damaged. But the damage probably will not affect either the ditching run or the sinking rate since the location of the door is such that it will be above the water line when the nose settles during the latter part of the run. It is very unlikely that the ramp will open. The crew door, the side emergency exit, and the paratroop doors, which will be out of the water during the tail-down portion of the ditching run, probably will not experience damage at any time during the ditching run.

As the nose settles during the final part of the ditching run, the fuselage should fill with water fairly fast, sink to the wings, then float.

Ditching Alarm Signals.

The following are the standard alarm signals for ditching:

SIX SHORT RINGS . . PREPARE FOR DITCHING
ONE LONG RING . . BRACE FOR IMPACT

Instructions will be given by pilot to Don Helmets, gloves and remain seated with safety belts fastened until the airplane has stopped forward movement. On water landings, there are normally two or more water impacts. The initial impact is (normally) lighter than the second water impact and the subsequent impacts (if any) will diminish in force.

Ditching Equipment.

Ditching equipment should be in readiness at all times when flying over water. Prior to each over-water flight, the pilot will ensure that the necessary equipment is aboard, in serviceable condition, and stowed in the proper places.

Ditching Exits.

Refer to figure 3-4 for emergency exits. Normally, crew members on the flight deck will use the forward escape hatch for each after ditching. Crew members in the cargo compartment will use the center and aft escape hatches for exit.

WARNING

The flight station hinged windows may be used as a last resort emergency exit for the pilot and copilot but not in heavy seas or nosedown condition.

Ditching Technique.

WARNING

Maintain deck angle of at least seven degrees, optimum nine degrees. Do not exceed recommended airspeed. Rate of descent not to exceed 200 feet per minute. (Recommend 100 feet per minute.) Maintain constant back pressure on control column. Under no circumstances should the airplane be stalled in, since this will result in severe impact and cause the airplane to nose into the water.

If possible, use most of the fuel supply to lighten the airplane and reduce stalling speed. Empty tanks also help keep the airplane afloat. Jettison cargo, if possible, to lighten the airplane.

NORMAL POWER-ON DITCHING. Best results will be obtained by following the procedures outlined below:

a. Ditch while power is available. Power will allow the pilot to choose the spot for ditching, and the most favorable landing position and attitude.

b. Use 50% flaps with gear up.

c. Ditch at 10 knots above stalling speed.

In daylight it is recommended that the airplane be ditched along the top of the swell, parallel to the rows of swells, if the wind does not exceed 30 knots. In high winds, it is recommended that ditching be conducted upwind to take advantage of lowered forward speed. However, it must be remembered that the possibility of ramming nose-on into a wave is increased, as is the possibility of striking the tail on a wave crest and nosing in.

PARTIAL-POWER DITCHING. When ditching with one or more engines inoperative, the following technique is recommended:

a. With two engines inoperative on the same side of the airplane, use power on the operative inboard engine only.

b. If power is available from the No. 2 and 4 engines or the No. 1 and 3 engines, considerable power may be required to control the airplane. With symmetrical power conditions, use power as required using 50% flaps and gear up.

c. On final approach, it is advisable to hold speed 20 knots above stall speed until flareout, at which time speed will be reduced to 10 knots above stall speed.

CROSSWIND DITCHING. The basic rules for ditching listed in Normal Power-On Ditching will still apply, in addition to the following:

a. Crab the airplane to kill drift.

b. Land on the downward side of the swell or wave.

UPWIND DITCHING. The basic rules for ditching listed in Normal Power-On Ditching will still apply, in addition to the following:

a. Maintain a nose-up attitude to prevent the nose striking the wave face.

b. Touchdown immediately behind the crest of a rising wave and avoid the face of the wave.

c. Hold the nose up after the first impact.

NIGHT DITCHING. Night ditching will be conducted with the aid of instruments to establish the proper airplane attitude.

a. Make an instrument approach, holding airspeed 20 knots above stall speed.

b. At 500 to 700 feet above the water (use radar altimeter if available) set up approximately 200 feet per minute rate of descent and establish an airspeed 10 knots above stall speed with 50% flaps and gear up.

c. Use landing lights as necessary.

d. Hold the wings level to avoid digging a wing into the water and cartwheeling the airplane.

e. Land at 10 knots above stall speed using 50% flaps and gear up.

Abandoning The Airplane.

Evacuation of the airplane should be accomplished in an orderly manner in the shortest time possible. Practice abandonment will aid in evacuating the airplane during an actual ditching.

WARNING

Personnel must not leave their ditching positions until it is ascertained that the airplane has stopped forward movement. When it is certain that the airplane has come to a complete stop, each crew member will proceed with the duties shown in the ditching charts (figure 3-14 and 3-15). Additional emergency equipment may be collected and distributed to crew members. Each crew member will evacuate the airplane through the assigned exit and board a liferaft.

liferaft releases

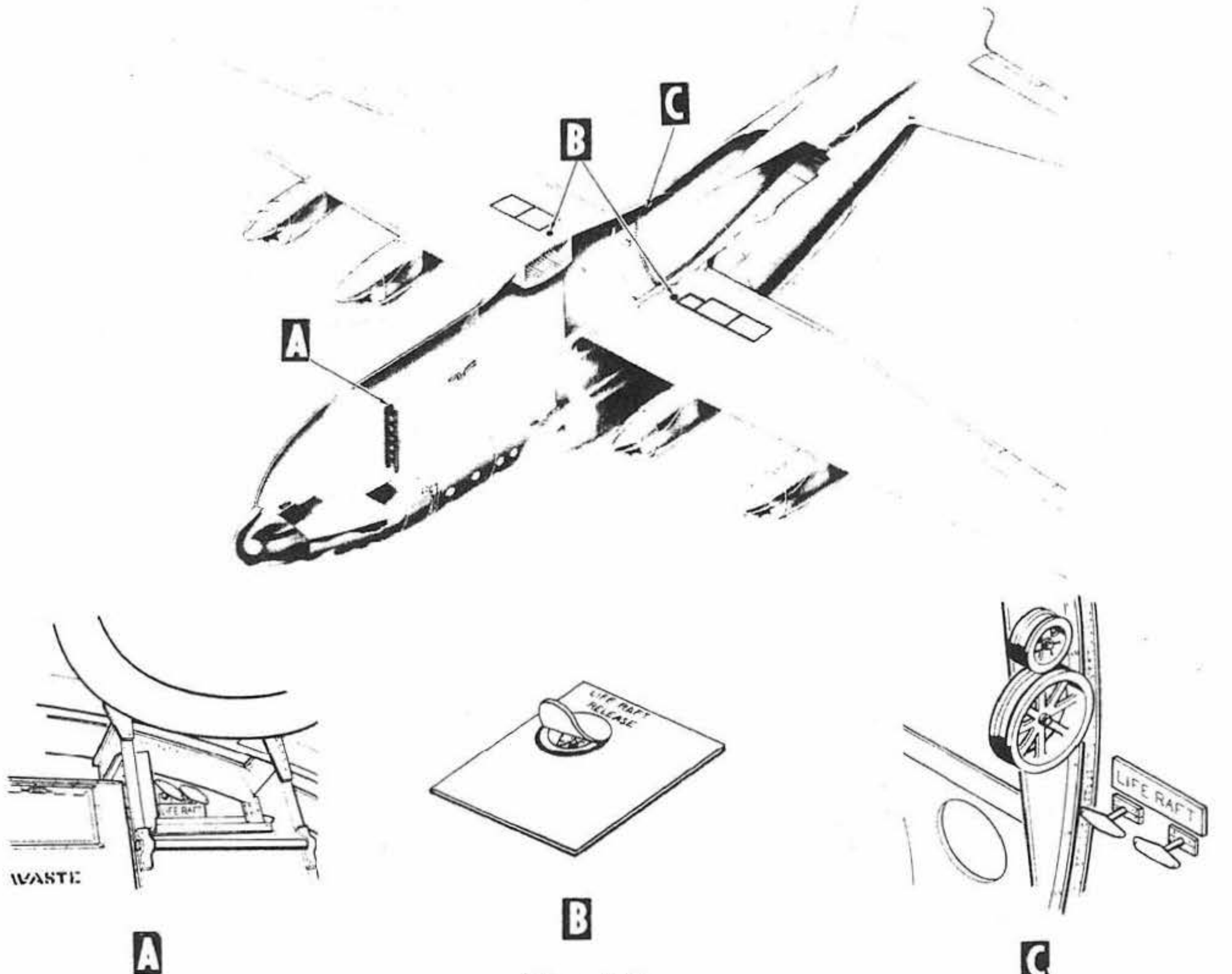


Figure 3-11.

130A-1-33-093

WARNING

Assure that personnel are out of the airplane and clear of the escape hatches prior to inflating their life vests.

Crew Duties After Ditching.

When it is certain that the airplane has come to a complete stop, each crew member will proceed with the following duties:

All - Check persons nearest you for injury.

E/N/IO - Pull liferaft release handles.

WARNING

Life raft release handles must be pulled through their full travel, for complete ejection and inflation of the liferaft.

E - Exit through forward emergency escape hatch and assist with unloading emergency supplies from a position outside the hatch.

N, CP - Pass emergency supplies and equipment to E, exit through forward emergency escape hatch, board assigned liferaft, and assist with loading emergency supplies and equipment into liferafts.

NOTE

Make sure that all emergency supplies and equipment are secured in the liferafts to prevent them from being lost overboard.

NOTE

Ascertain that liferafts have ejected properly, pull release handles on top of wing if they did not eject.

IO - Pass emergency supplies to personnel outside center and aft emergency escape hatches, exit through aft or center emergency escape hatches, board assigned liferaft, and assist with loading emergency supplies into liferafts.

P - Ensure that all necessary emergency supplies and equipment have been removed, check that crew members have been safely evacuated, exit through forward emergency escape hatch, and board assigned liferaft.

E - Board assigned liferaft.

All - Cast off liferafts and rally with other liferafts.

ditching chart

CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 MINUTES LEFT)	AFTER DITCHING
PILOT'S DUTIES	1. Order crew to prepare for ditching, giving approximate time remaining, order crew to start emergency procedures. Each crewmember will acknowledge.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar.	1. Check flight station and cargo compartment to insure that all personnel and emergency equipment have been evacuated.
	2. Transmit on UHF/VHF emergency frequency "Mayday" 3 times, identification 3 times, transmit tone for 20 seconds, and request fix or bearing.	2. Alert cargo compartment personnel with interphone and six short rings on the alarm system.	2. Exit through flight station emergency escape hatch and inflate life vest.
	3. Obtain flashlight and first aid kit.	3. Order copilot to send final distress signal.	3. Board left life raft and receive emergency equipment.
	4. Don antiexposure suit and life vest. Fasten shoulder harness and safety belt.	4. Order all crewmembers and other personnel to turn on emergency flashlights connected to life vests, if at night.	4. Destroy classified documents and equipment.
		5. Order all crewmembers and other personnel to secure themselves in ditching position.	
		6. Lock shoulder harness.	
		7. Immediately before ditching, warn personnel over interphone to brace for impact, and order copilot to give one long ring on alarm system.	
COPILOT'S DUTIES	1. Acknowledge pilot's order to prepare for ditching.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar.	1. Exit through flight station emergency escape hatch.
	2. Send emergency signal on HF radio followed as soon as possible by emergency message, as provided by navigator.	2. Send final distress signal and intentions of pilot as to ditching.	2. Inflate life vest.
	3. Obtain DF service, bearing, fixes, etc.	3. Lock shoulder harness.	3. Board right life raft.

Figure 3-12. (Sheet 1 of 4)

CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 MINUTES LEFT)	AFTER DITCHING
COPILOT'S DUTIES (Cont)	4. Obtain flashlight, first aid kit, and confidential folder.	4. On orders from pilot, give one long ring on alarm system.	
	5. Destroy classified documents and equipment.		
	6. Don antiexposure suit and life vest. Fasten shoulder harness and safety belt.		
	7. Continue transmitting outlined emergency message as required.		
NAVIGATOR'S DUTIES	1. Acknowledge pilot's order to prepare for ditching.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar.	1. Acutate life raft release handles.
	2. IFF/SIF-Emergency	2. Turn seat to face forward and lower seat to full down position. Fasten safety belt and lock shoulder harness.	2. Exit through flight station emergency escape hatch, inflate life vest, and check life raft for proper ejection.
	3. Provide position, time, true heading, TAS, altitude, estimated ditching position, and relay fix or bearing to copilot for inclusion in the distress signal.		3. Board left life raft.
	4. Transmit "Mayday" and airplane position coordinates on UHF/VHF.		
	5. Collect essential navigation equipment.		
	6. Destroy classified documents and equipment.		
	7. Don antiexposure suit and life vest.		
	8. Inform crew and other personnel of distance and direction of nearest land or rescue vessel.		
FLIGHT ENGINEER'S DUTIES	1. Acknowledge pilot's order to prepare for ditching.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar.	1. Actuate life raft release handles.
	2. Depressurize airplane (ferry flight only), engine bleed air valve switches off, emergency depressurization	2. Remove and stow flight station emergency escape hatch.	2. Exit through flight station emergency escape hatch.

Figure 3-12. (Sheet 2 of 4)

CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 MINUTES LEFT)	AFTER DITCHING
FLIGHT ENGINEER'S DUTIES (Cont)	switch normal (ferry flight only), air conditioning master switch-manual press, hold manual press, control switch to increase for 90 seconds.		
	3. Obtain flashlight, hand axe, and first aid kit.	3. Secure loose articles.	3. Inflate life vest.
	4. Don antiexposure suit and life vest.	4. Turn seat to face forward and lower seat to full down position. Fasten safety belt and lock shoulder harness.	4. Discard hand axe.
	5. Destroy classified documents and equipment.		5. Board right life raft.
ILLUMINATOR OPERATOR'S DUTIES	1. Acknowledge pilot's order to prepare for ditching.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar.	1. Actuate aft life raft release handles.
	2. Instruct noncrew-members to prepare for ditching.	2. Jettison flare launcher, stow 40KVA and close cargo door. Remove aft emergency escape hatch and secure.	2. Exit through aft emergency escape hatch.
	3. Don anti-exposure suit and life vest.	3. Occupy crash seat.	3. Inflate life vest.
	4. Secure loose articles.	4. Fasten seat belt.	4. Assist in loading raft.
	5. Destroy all classified documents and equipment.		5. Board left life raft.
WEAPONS MECHANIC'S DUTIES	1. Acknowledge pilot's order for ditching.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar.	1. Exit through aft emergency escape hatch.
	2. Obtain flashlight and first aid kit.	2. Assist flight engineer and illuminator operator as required.	2. Inflate life vest.
	3. Don antiexposure suit and life vest.	3. Occupy crash seat.	3. Assist in loading raft.
	4. Secure loose articles.	4. Fasten safety belt.	4. Board right life raft.
	5. Destroy all classified documents and equipment.		

Figure 3-12. (Sheet 3 of 4)

CREW MEMBER	FIRST ACTION	DITCHING IMMINENT (10 MINUTES LEFT)	AFTER DITCHING
TV OPERATOR'S DUTIES	1. Acknowledge pilot's order to prepare for ditching. 2. Obtain flashlight and large first aid kit. 3. Don antiexposure suit and life vest. 4. Destroy all classified documents and equipment.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar. 2. Secure loose articles. 3. Face forward, lock seat, fasten seat belt and lock shoulder harness.	1. Exit through aft emergency escape hatch. 2. Inflate life vest. 3. Board left life raft.
EWO OPERATOR'S DUTIES	1. Acknowledge pilot's order to prepare for ditching. 2. Obtain flashlight. 3. Don antiexposure suit and life vest. 4. Destroy all classified documents and equipment.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar. 2. Secure loose articles. 3. Face forward, lock seat fasten seat belt and lock shoulder harness.	1. Exit through aft emergency escape hatch. 2. Inflate life vest. 3. Board left life raft.
FCO DUTIES	1. Acknowledge pilot's order to prepare for ditching. 2. Obtain flashlight, large first aid kit and survival supplies. 3. Don antiexposure suit and life vest. 4. Destroy all classified documents and equipment	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar. 2. Secure loose articles. 3. Face forward, lock seat, fasten seat belt and lock shoulder harness.	1. Exit through aft emergency escape hatch. 2. Inflate life vest. 3. Board right life raft.
IR OPERATOR'S DUTIES	1. Acknowledge pilot's order to prepare for ditching 2. Obtain flashlight and large first aid kit. 3. Don antiexposure suit and life vest. 4. Destroy all classified documents and equipment.	1. Remove parachute or any other bulky items which may hinder movement, and loosen collar. 2. Secure loose articles. 3. Face forward, lock seat, fasten seat belt and lock shoulder harness.	1. Exit through aft emergency escape hatch. 2. Inflate life vest. 3. Board left life raft.

Figure 3-12. (Sheet 4 of 4)

SECTION IV

auxiliary equipment

Table of Contents:

BLEED AIR SYSTEM.

The bleed air system (figure 4-1) consists of high-pressure, stainless steel ducts and air shutoff valves which direct compressed air to pneumatically operated systems of the airplane. The entire system of ducts serves as a plenum from which air is distributed to other systems. The pneumatic systems served by the bleed air system are the following:

Engine starting systems
Engine compressor unloading systems
Nacelle preheat systems
Air conditioning systems
Cabin pressurization system
Windshield defogging system
Engine air inlet scoop anti-icing systems
Leading edge anti-icing system
Radome anti-icing system
Air turbine motor

Compressed air is supplied to the bleed air system from the engines when they are running or from either the gas turbine compressor or an external pressure source when the airplane is on the ground and the engines are not running. Normal procedure is to supply air from the gas turbine compressor or an external source until the first engine is started; then, engine bleed air is used. The main bleed air manifold extends across the leading edge of the wing. Air enters the main manifold through five ports, four from the engines and the fifth from the GTC or external pressure source. Branch ducts connected to the main manifold distribute air for operation of the following:

Air conditioning systems
Radome anti-icing system
Leading edge anti-icing system
Compressor unloading systems
Air turbine motor

Each engine bleed air manifold is connected to the main manifold just aft of the fire wall by an engine bleed air shutoff valve. Branch ducts connected to the engine manifold forward of the firewall distribute air for operation of the following:

Engine starting system
Nacelle preheat system
Engine air inlet scoop anti-icing

Check valves installed in each engine bleed air manifold, the GTC supply duct, and the external pressure supply duct prevent reverse flow when any of these sources of supply are inoperative.

Air is supplied from the bleed air system to the pneumatic isolators that support the AN/AAD-7 Infrared Detecting Set (IDS) receiver group (Fig 4-1). This air is routed through a check valve and pressure regulator and then through a water separator to the receiver group located forward of the left main gear well. A filler valve upstream of the pressure regulator is provided for external pressurization.

ENGINE BLEED AIR VALVE CONTROLS.

Four engine bleed air valve control switches on the gas turbine compressor control panel (figure 4-1) provide control for opening and closing the engine bleed air valves. The control circuit for each valve is connected through a switch actuated by the fire emergency control handle. When the fire emergency control handle is pulled, the engine bleed air valve is driven closed; and the normal switch control is rendered inoperative. Power for operation of each of the motor-driven valves is supplied through an engine bleed air circuit breaker panel.

BLEED AIR PRESSURE GAGE

A direct reading pressure gage is located on the bulkhead aft of the navigator's station. It indicates bleed air pressure in pounds per square inch. The gage is used to check the pressure of the bleed air supply and operation of the pneumatic systems.

GROUND CHECKOUT OF BLEED AIR SYSTEM.

The bleed air pressure gage can be used to check the bleed air system. Use the following steps to check out the bleed air system with air supplied by an engine.

a. Close the engine bleed air valves, and turn off all systems which use bleed air.

b. Open the bleed air valve for one operating engine and all engines not operating.

c. When the system pressure reaches 70 PSI or higher, close the bleed air valve of the operating engine. Pressure should begin to drop almost immediately. If pressure does not drop, the engine bleed air valve has failed to close.

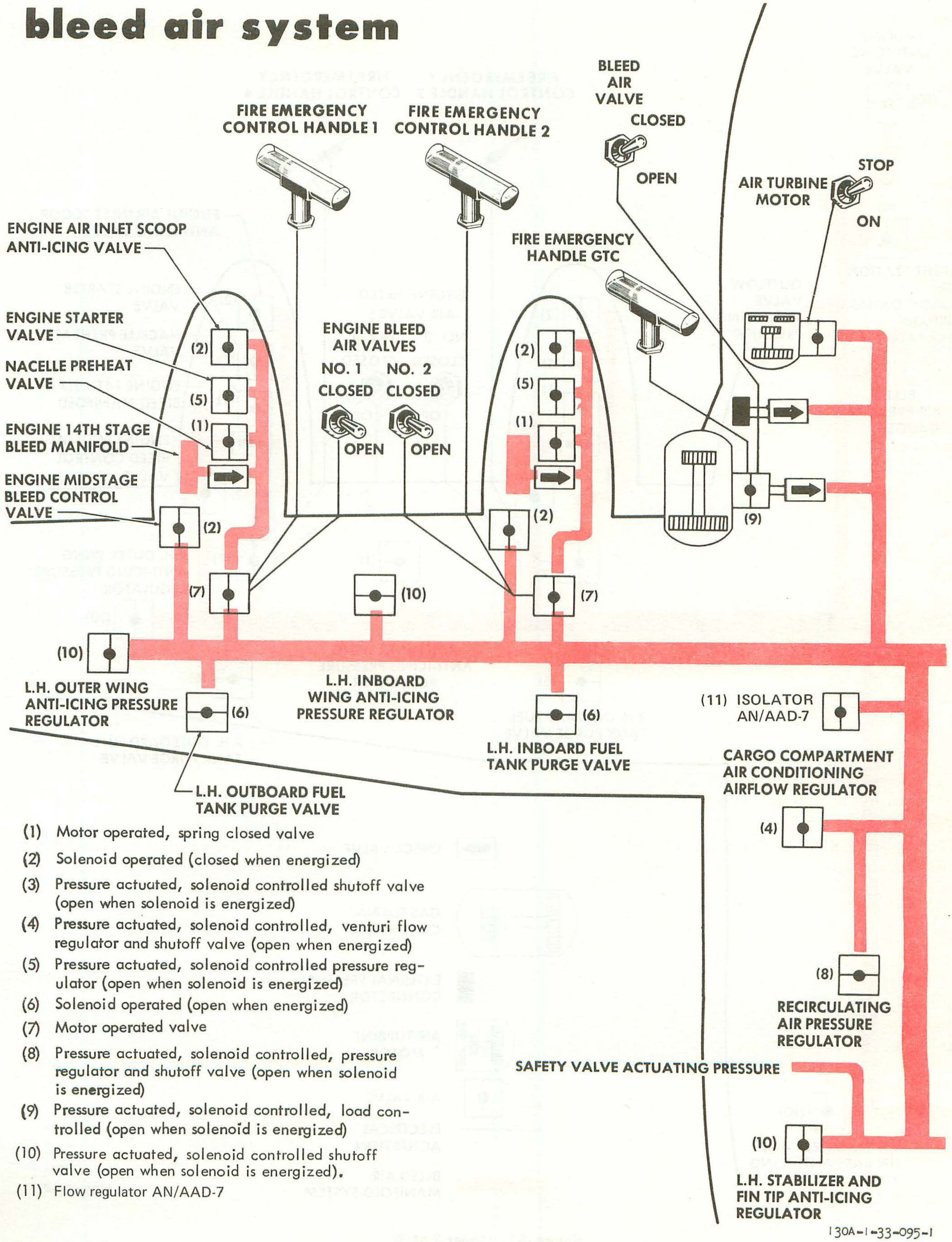
d. Time the pressure drop from 65 to 35 PSI. This time should not be less than 10 seconds.

AIR CONDITIONING SYSTEMS.

The airplane is equipped with two air conditioning systems - one for the flight station and one for the cargo compartment. Each receives high-temperature, high-pressure air from the bleed air system, conditions the air in accordance with the temperature control system setting, removes moisture, and distributes the air to the compartment. The following components are included in each system:

An airflow regulator to maintain a constant-weight flow of air when engines are supplying the bleed air system and to reduce the weight flow of air when the gas turbine compressor is supplying the bleed air system.

bleed air system



(1) Motor operated, spring closed valve
(2) Solenoid operated (closed when energized)
(3) Pressure actuated, solenoid controlled shutoff valve (open when solenoid is energized)
(4) Pressure actuated, solenoid controlled, venturi flow regulator and shutoff valve (open when energized)
(5) Pressure actuated, solenoid controlled pressure regulator (open when solenoid is energized)
(6) Solenoid operated (open when energized)
(7) Motor operated valve
(8) Pressure actuated, solenoid controlled, pressure regulator and shutoff valve (open when solenoid is energized)
(9) Pressure actuated, solenoid controlled, load controlled (open when solenoid is energized)
(10) Pressure actuated, solenoid controlled shutoff valve (open when solenoid is energized).
(11) Flow regulator AN/AAD-7

Figure 4-1. (Sheet 1 of 3)

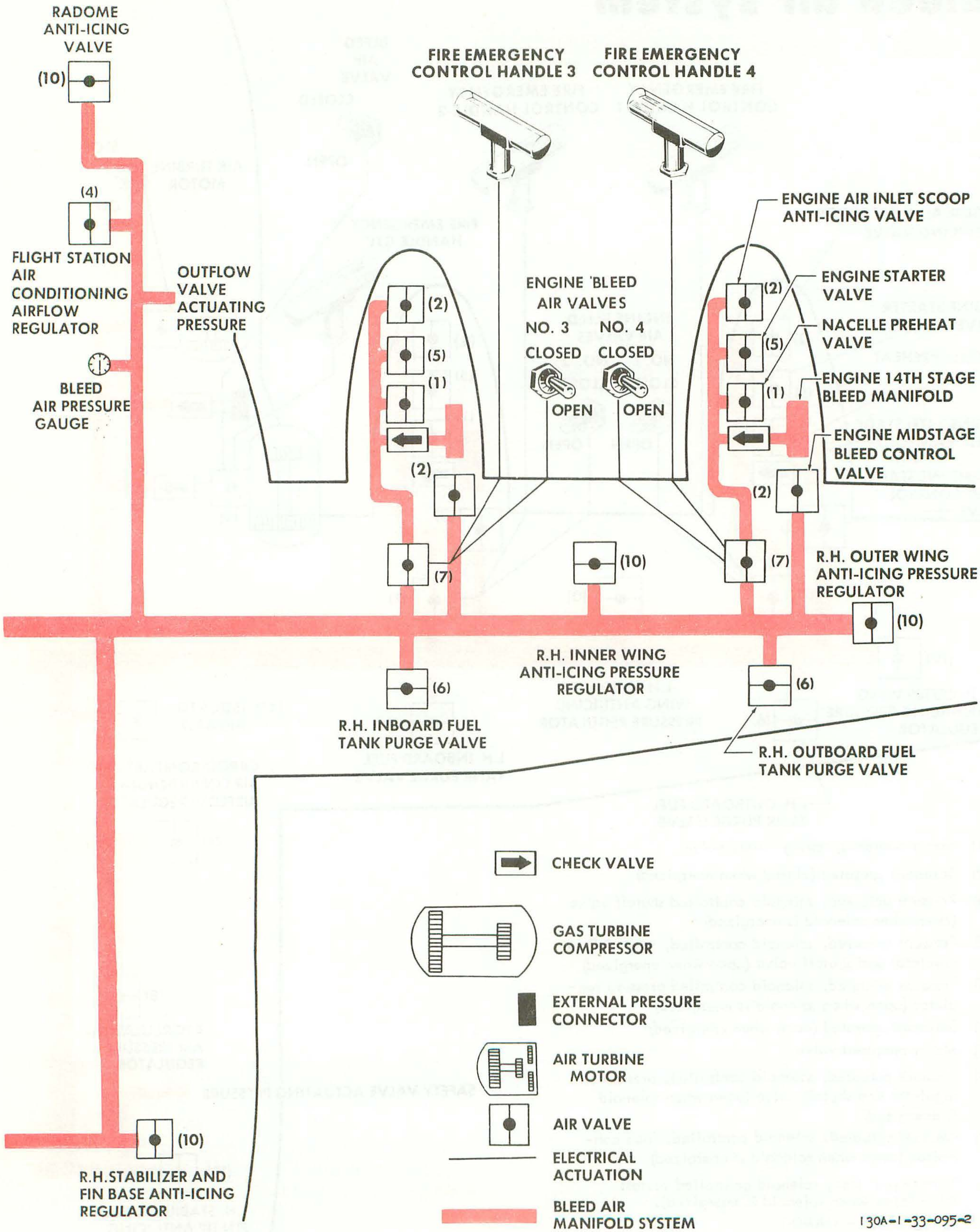


Figure 4-1. (Sheet 2 of 3)

isolator pressure diagram

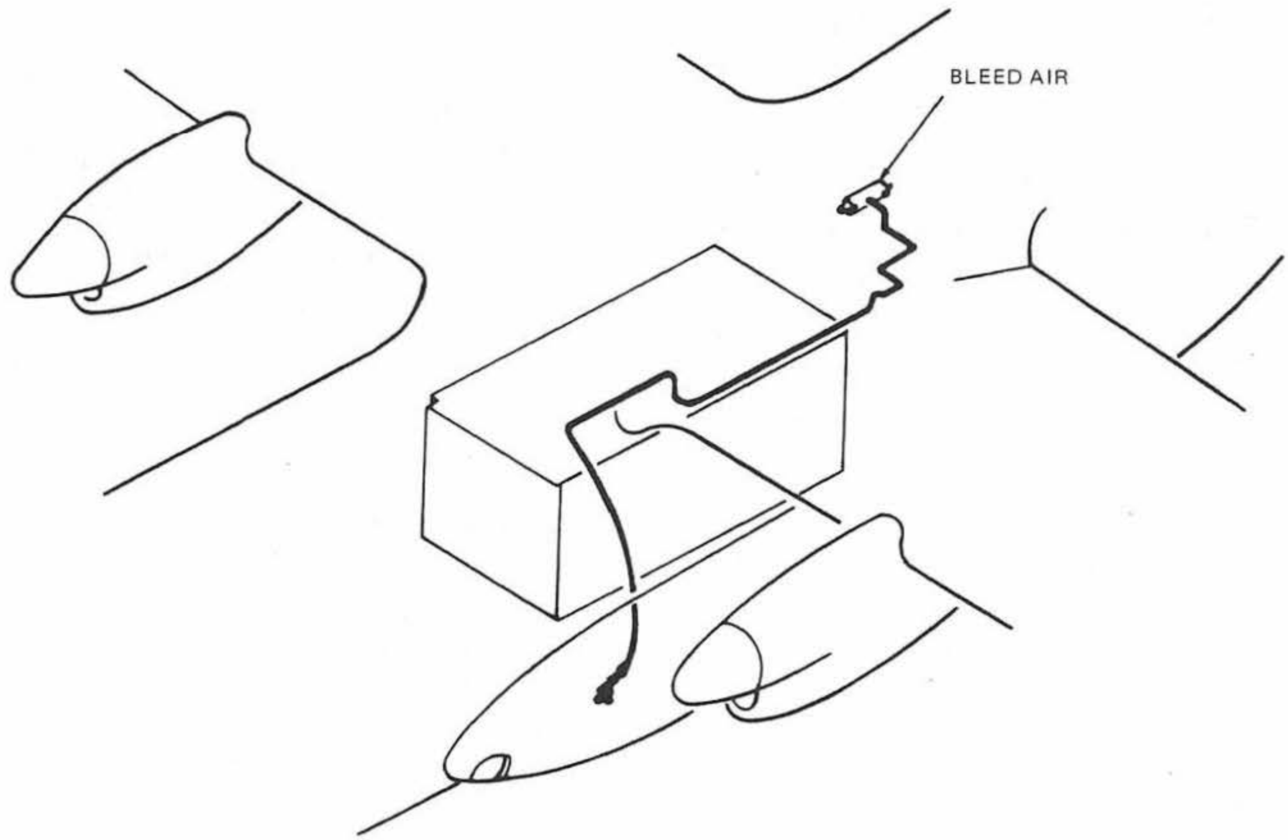


Figure 4-1. (Sheet 3 of 3)

An electrical temperature control system for positioning the temperature control valve to maintain the desired air temperature.

A temperature control valve for controlling the proportions of total airflow which pass through the heat exchanger and turbine.

An air-to-air heat exchanger for cooling all or part of the bleed air.

A turbine unit for further cooling all or part of the air cooled by the heat exchanger.

A water separator to remove part of the moisture from the cooled air.

Distribution duct systems to carry air into the compartments.

An auxiliary ventilation valve with controls to open the valve to direct ram air, or air from an external conditioner, into the distribution ducts in lieu of air conditioned by the airplane systems.

A duct provides air flow to the booth. A manually operated diffuser controls the amount of air flow to the cargo compartment or booth. The manual diffuser control handle is located on the right side of the cargo compartment above the right scanner's seat. Air flow to the cargo compartment and booth can be adjusted by turning the control handle CCW and moving it FWD or AFT. Positioning the handle full AFT (IN) directs air flow to the booth; full FWD (OUT) directs air flow to the cargo compartment. To distribute air to both cargo compartment and the booth, the manual diffuser handle must be positioned between the maximum limits. Turning the handle CW locks it into position.

Note

On some airplanes, the handle is mounted vertically. Positioning the handle up (IN) directs airflow to booth, down (OUT) directs airflow to the cargo compartment.

The flight station distribution ducts include the windshield defogging system. The cargo compartment distribution ducts include provisions for recirculating air to warm the cargo compartment floor. Electrical power for control of the air conditioning systems is supplied from the flight station DC bus through five circuit breakers labeled air conditioning control on the flight station distribution panel.

AIRFLOW REGULATION.

The flight deck airflow regulator maintains a constant airflow of 30 pounds per minute when the air conditioning master switch is in the AIR COND AUTO PRESS, AIR COND MAN PRESS, or AIR COND NO PRESS position, and 15 pounds per minute when in the AIR COND GTC position. The cargo compartment airflow regulator maintains a constant airflow of 70 pounds per minute when the air conditioning master switch is in the AIR COND AUTO PRESS, AIR COND MAN PRESS, or AIR COND NO PRESS position. When the switch is in the AIR COND GTC position, the airflow regulator maintains a minimum pressure upstream of the valve at 22 PSI, regardless of flow through the cargo compartment air conditioning system, to insure air turbine motor operation and to allow airflow through the flight deck air conditioning system. These airflow regulators also act as shutoff valves to stop the bleed airflow through the air conditioning systems. They are pneumatically actuated and electrically controlled through solenoid valves to select the normal airflow, reduced airflow, or shutoff condition.

AIR TEMPERATURE CONTROL.

The dual temperature control valve in each air conditioning system opens or closes two bypass ports to establish flow routes for bleed air entering the system. For different temperature selections, the valve is set as follows:

	HOT	WARM	COOL	COLD
Turbine bypass	closed	open	open	closed
Heat exchanger bypass	open	open	closed	closed

Conditioned air is the combined flow of bypassed bleed air, heat exchanger cooled air, and air cooled by the turbine unit. The dual temperature control valve is electrically operated by either automatic or manual control. During automatic operation, a desired temperature is selected; and the system positions the valve intermittently until the selected temperature is sensed by a cabin thermostat. Approximately 5 minutes is required for the valve to travel from one extreme position to the other during automatic operation. A high-limit thermostat prevents excessive air output temperature during automatic operation of the temperature control valve. When the valve is controlled manually, it will travel from full cold to full hot in 3-1/2 to 5 minutes and from full hot to full cold in only 35 seconds.

REFRIGERATION.

Part or all of the bleed air flowing to each air conditioning system flows through the heat exchanger and turbine. The first stage of cooling is provided by heat transfer in the air-to-air heat exchanger. During flight, ambient air under ram pressure passes through the heat exchanger and provides the cooling medium to initially reduce the bleed air temperature. Air which enters the turbine after being partly cooled in the heat exchanger is cooled further by expending its energy to drive the turbine, which is loaded by the cooling air fan. In loading the turbine, the fan also augments the cooling airflow through the heat exchanger. During ground operation, with no ram air being provided, the fan will draw air through the heat exchanger whenever the turbine is rotating to assure first-stage cooling of the bleed air. The cargo compartment air conditioning system incorporates a jet pump in series with the cooling fan to assure augmented cooling airflow over the entire area of the heat exchanger. The temperature of the output air depends on what portion of the total airflow is routed through the heat exchanger and turbine.

WATER SEPARATION.

Each water separator will remove approximately 80 percent of the moisture which condenses when air is refrigerated. Moisture remaining in the air maintains a comfortable humidity level in the compartments. The water separator contains a cone-shaped bag, eliminator tubes, and a drain. The bag causes fog in the air to form into water droplets which are blown

FLIGHT STATION air conditioning

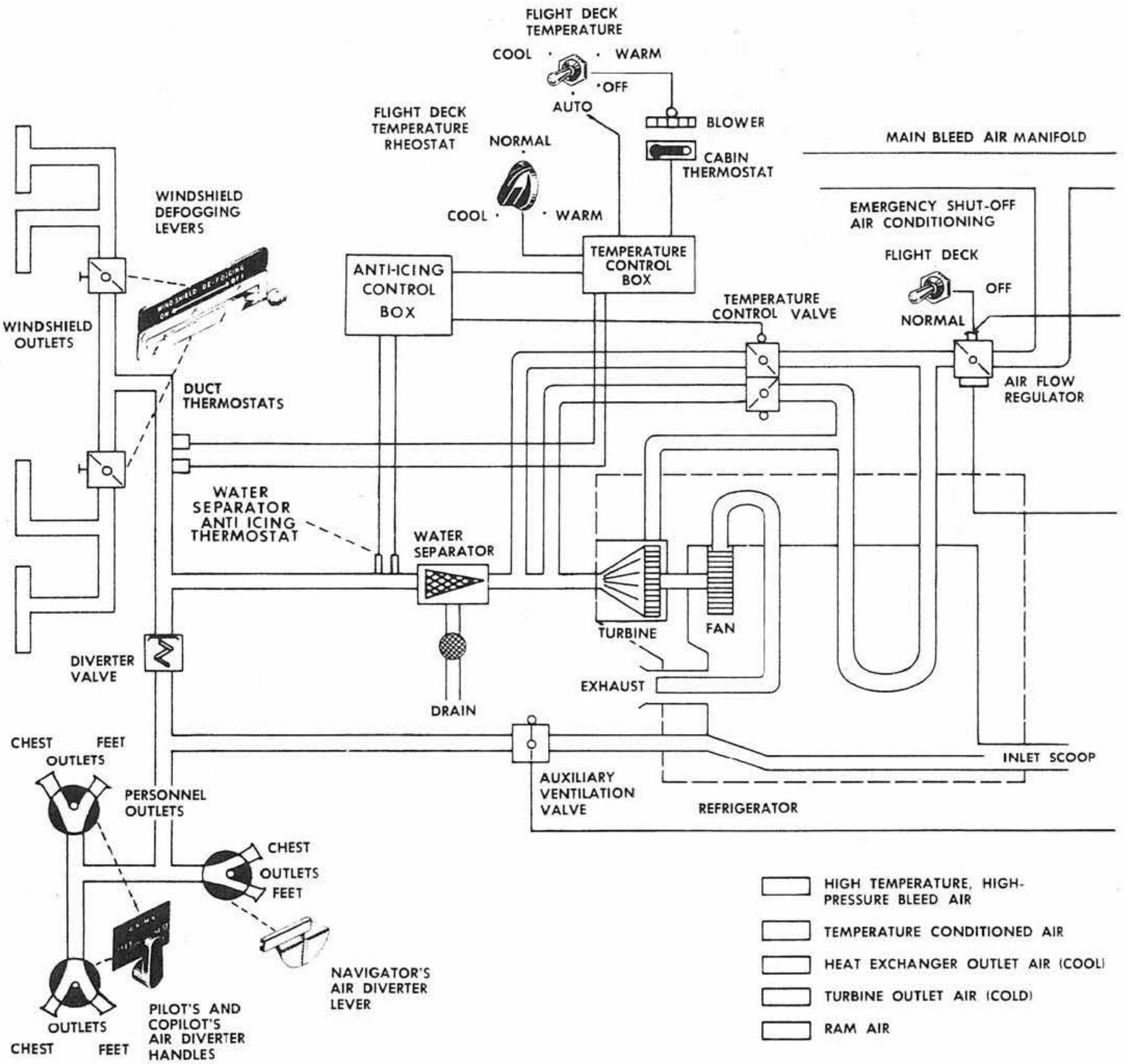


Figure 4-2 (Sheet 1 of 2)

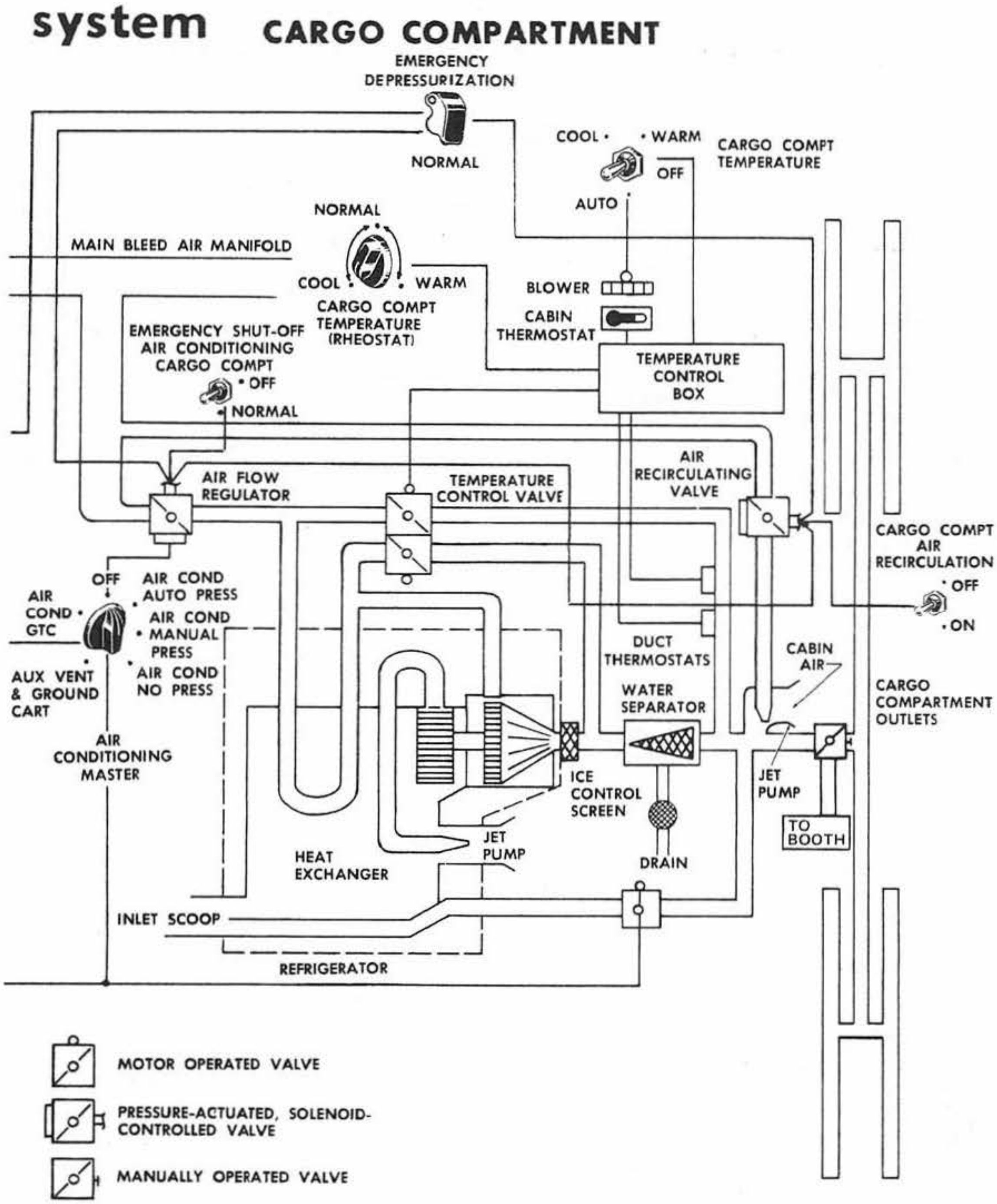


Figure 4-2 (Sheet 2 of 2)

against the eliminator tubes and out through a filter and drain line. If the bag in the separator becomes clogged, a pressure-sensitive relief valve at the tip of the bag opens to bypass the airflow. Icing of the cargo compartment separator is prevented by an ice control screen at the turbine outlet, which keeps the turbine outlet air temperature above freezing. The ice control screen is removed from the flight deck system; thus, icing of the flight deck separator is prevented by addition of an anti-icing control box and two thermostats that eliminate temperatures below 35°F in the water separator.

Note

Under atmospheric conditions of high humidity, fog may be discharged from the air conditioning outlet ducts into the compartments. The fog can be removed by increasing the air temperature.

CARGO COMPARTMENT AIR RECIRCULATION.

The air recirculation unit pulls air through a system of baffles under the cargo compartment floor, mixes this air with hot bleed air, and forces the mixture through the overhead distribution ducts. This has the effect of increasing airflow in the cargo compartment and raising the temperature at the floor level. A pressure regulator is operated to allow a flow of bleed air through a jet pump to control the recirculating airflow. The regulator is electrically controlled and pneumatically actuated to keep the pressure of the recirculating air above cabin pressure so that the recirculating air will flow.

AUXILIARY VENTILATION.

The auxiliary ventilation provisions in each system consist of a valve connecting the heat exchanger cooling air inlet duct to the conditioned air distribution ducts. When the valve is opened, most of the air entering the cooling air scoop flows directly into the distribution ducts. In flight, the air thus admitted to the airplane is ambient air under ram pressure. On the ground, adapters can be attached to the cooling air scoops so that air from an external air conditioner can be supplied for ventilation. Ventilating air does not enter the defogging ducts in the flight station. If the cabin is pressurized, a differential pressure switch prevents the auxiliary vent valves from opening until the differential pressure is reduced to approximately 0.6 inch of mercury. The purpose of the switch is to prevent differential pressure from collapsing the air conditioning low-pressure ducts.

AIR CONDITIONING SYSTEMS CONTROLS.

The main controls for the two air conditioning systems consist of a six-position rotary master switch, temperature control switches and rheostats, a cargo compartment air recirculation switch, shutoff switches, and a guarded two-position emergency depressurization switch. They are all located on the air conditioning control panel. The cargo compartment temperature control switches on the air conditioning panel are inoperative. A temperature control panel, located in the upper right section of the electronic warfare officer's panel, regulates the temperature in the booth or cargo compartment. A cargo compartment refrigerator overheat warning light is located near the pressurization controller. Manual controls are also provided to direct flight station airflow to individual air outlets for the pilot, copilot and navigator, and to the windshield defogging outlets. A manual diffuser is installed in the air conditioning duct to allow the air to be distributed as desired to the booth and the cargo compartment.

Air Conditioning Master Switch.

The air conditioning master switch, located on the air conditioning and pressurization control panel (figure 4-3) is a six-position rotary switch which selects the type of air conditioning and pressurization desired. The six positions and control functions of the master switch are as follows:

AUX VENT AND GROUND CART.
Air flow regulators shutoff bleed air flow.
Auxiliary ventilation valves open.
Outflow valve opens.
Safety valve opens.

AIR COND GTC.
Flow regulators open and provide reduced airflow.
Auxiliary ventilation valves close.
Outflow valve opens.
Safety valve opens.
Thermostat blowers turned on.

CAUTION

Do not turn the master switch to AIR COND GTC while engines are running because bleed air pressure can damage the airflow regulators.

OFF.
Airflow regulators shutoff flow of bleed air.

Outflow valve opens.
Safety valve closes.
Auxiliary ventilation valves open (some airplanes).

AIR COND AUTO PRESS.
Airflow regulators provide normal airflow.

Auxiliary ventilation valves close.
Thermostat blowers turned on.
Outflow valve actuated pneumatically in response to pressure controller.
Safety valve closed.

AIR COND MANUAL PRESS.
Airflow regulators provide normal airflow.
Auxiliary ventilation valves close.
Thermostat blowers turned on.
Outflow valve positioned by electric actuator, which is controlled by manual pressure switch.
Safety valve closed.

AIR COND NO PRESS.
Airflow regulators provide normal airflow.
Auxiliary ventilation valves close.
Thermostat blowers turned on.
Outflow valve opens.
Safety valve opens.

Note

> On airplanes AF53-3129 through 55-0046 the outflow valve is opened electrically when the master switch is turned OFF. On airplanes AF56-0469 and up, the outflow valve is opened electrically when the master switch is turned to any no-pressure position. As long as 40 seconds may be required for the valve to be opened fully by electric actuator under these conditions.

Electrical power for the auxiliary ventilation valves and power for control circuits to the outflow and safety valves is supplied through the CABIN PRESS AND AUX VENT circuit breakers on the flight station distribution panel. Electrical power for the flight deck and cargo compartment airflow regulators is supplied through the FLIGHT DECK AND CARGO COMPT SHUTOFF VALVES circuit breakers on the flight station distribution panel.

Flight Deck and Cargo Compartment/Booth Temperature Controls.

The flight deck and cargo compartment booth temperature controls consist of two toggle switches and two rheostats on the air conditioning and pressurization and EWO control panels (figure 4-3). One switch and one rheostat are used to control temperature con ditions within the flight deck. The EWO's switch and rheostat, control temperature within the cargo compartment and booth.

The toggle-type temperature control switches are used to select warm, cool, or automatically controlled temperature conditions, but they function only when the air conditioning master switch is set to one of the four AIR COND positions. Each switch may be moved from the center (off) position upward to COOL or WARM or downward to AUTO. With the temperature control switch set to AUTO, the temperature control valve is controlled automatically to maintain the compartment booth temperature selected on the temperature rheostats. When the switch is moved to the COOL position, the temperature control valve moves toward the extreme cold setting; the switch must be held for approximately 35 seconds for the valve to move from the extreme hot position to the extreme cold setting. With the switch at WARM, the valve turns to the extreme hot setting, complete movement of the valve from the extreme hot position taking approximately 4 minutes. The switch may be released at any time from either the WARM or COOL positions and is spring-loaded to return to the center (off) position; the temperature control valve will remain at the setting achieved when the switch is released. On airplanes AF53-3129 through 54-1630, the blower for the cabin thermostat is also controlled by the temperature switch. It is turned on when the switch is in the AUTO position, and may be cycled on and off when the switch is held at WARM. On airplanes AF55-0011 and up, the cabin thermostat blower is turned on whenever the air conditioning master switch is moved to one of the AIR COND positions. Power for the temperature control system is supplied through temp control circuit breakers on the flight station bus.

The two temperature rheostats, located below their respective temperature control switches, are used to select the temperature conditions desired within the flight deck and cargo compartment booth during automatic temperature control. The settings of each rheostat cover a temperature range from COOL through NORMAL to WARM.

Flight Deck and Cargo Compartment/Booth, Temperature Rheostats.

The temperature rheostats (figure 4-4) are used to select the desired cabin temperature when the temperature control systems are in automatic operation.

Cargo Compartment Booth Air Recirculation Switch.

The air recirculation switch (figure 4-3) is an on-off control for the cargo compartment booth air recirculation pressure regulator. When the switch is ON, a solenoid on the regulator is actuated. The regulator is then operated by pneumatic pressures to maintain the flow of recirculating air. Airflow can be started at any time, regardless of the position of the air conditioning master switch. Power to control the regulator is supplied through the cabin press and aux vent circuit breaker on the flight station bus. Actuation of the emergency depressurization switch or positioning of the cargo compartment emergency shutoff switch of OFF deactivates the air recirculation valve, regardless of the position of the air recirculation switch.

Note

The desired operation of cargo compartment/booth air recirculation is to turn it on with OAT below 10°C and off with temperature higher than 10°C.

Electronic Equipment Rack Blower.

A blower is installed to provide cooling air to the electronic equipment rack. Power for operation of the blower is 115 volts ac through the radio rack blower circuit breaker on the cargo compartment ac circuit breaker panel.

Air Diverter Levers.

The pilot's and copilot's air diverter levers are on the main instrument panel. The navigator's lever is at his feet. These levers mechanically control butterfly valves in the foot outlet ducts at each station, which direct the flow of conditioned air toward either the person's feet or chest, or divide the airflow.

Windshield Defogging Levers.

Windshield defogging levers are located on the pilot's and copilot's auxiliary control panels. Each lever is linked mechanically to a valve which is opened to admit conditioned air to defogging outlets on one side of the compartment. If the valves are opened, the defogging airflow is given priority over the airflow through the personnel outlets.

Flight Deck and Cargo Compartment Emergency Shut-off Air Conditioning Switches.

Two emergency shutoff switches (figure 4-3) are provided so that either air conditioning system can be shut down individually. When either switch is positioned to NORMAL, operation of that system is controlled by the air conditioning master switch. When either switch is positioned to OFF, the airflow regulator for that system is de-energized to stop the flow of bleed air, regardless of the position of the air conditioning master switch. If the cargo compartment switch is positioned to OFF, the air recirculation valve is also closed to stop the flow of bleed air. The system is powered by 28-volt DC from the flight station bus through the flight deck and cargo compartment shutoff valves circuit breakers located on the flight station distribution panel.

Cargo Compartment Refrigerator Overheat Warning Light.

A red press-to-test light (figure 4-3) located on the air conditioning control panel is provided to warn the crew of an overheat condition in the cargo compartment refrigerator area. When an overheat condition of 200°F exists, the warning light will illuminate and the overheat condition must be corrected to extinguish the light.

Emergency Depressurization Switch.

The emergency depressurization switch (figure 4-3) is a guarded toggle switch with NORMAL and EMERGENCY DEPRESSURIZATION positions. When the switch is positioned to EMERGENCY DEPRESSURIZATION, battery power is utilized to override the normal control circuits to open the outflow and safety valves and close both air conditioning shutoff valves and air recirculating air regulator. Power is supplied to the switch from the battery bus through the emergency depressurization circuit breaker located in the battery compartment. When the switch is positioned to NORMAL, battery power is disconnected, and the normal control circuits position the valves to the position selected by the air conditioning master switch.

NORMAL OPERATION OF AIR CONDITIONING SYSTEMS.

The air conditioning systems can be operated on the ground, from bleed air supplied by the gas turbine compressor or by the engines, or an external ground air conditioning unit which may be attached to the systems. The engines supply bleed air for operating the air conditioning systems in flight.

Air Conditioning With External Unit.

1. Place a ground air conditioning adapter in the air scoop of the system to be operated.

Note

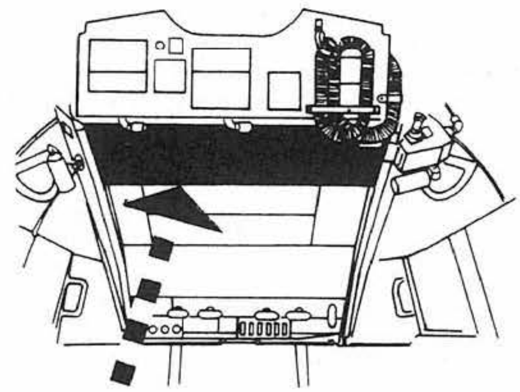
Ground air conditioning adapters are stored on the right side of the aft cargo compartment.

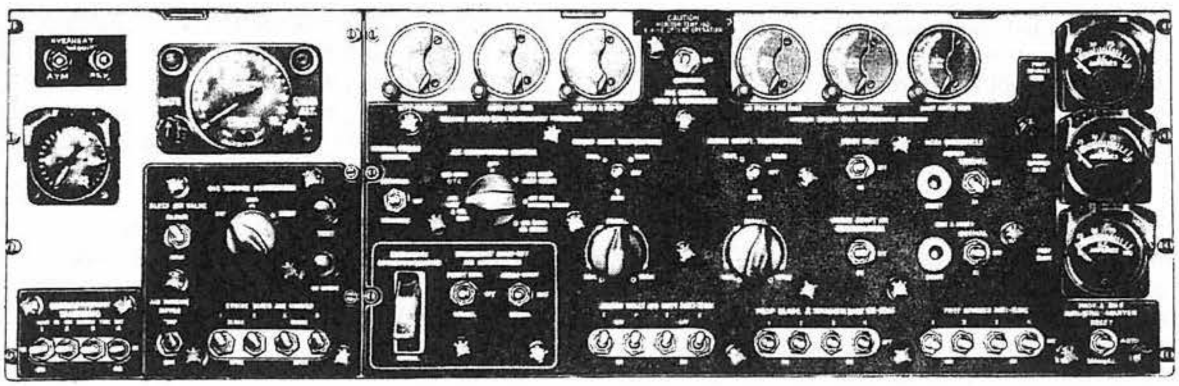
2. Attach the hose of the external unit to the adapter.

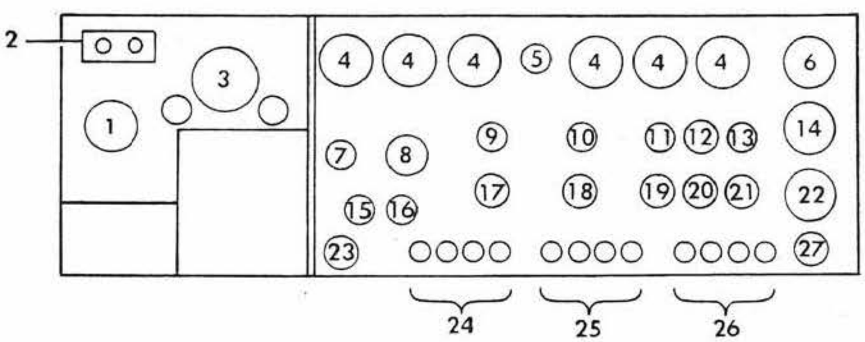
3. Ensure that DC power is available to the flight station bus.

4. Position the air conditioning master switch to AUX VENT and GRD CART.

air conditioning control panel
typical







1. CABIN DIFFERENTIAL PRESSURE INDICATOR
2. ATM AND REFRIGERATOR COMPARTMENT OVERHEAT WARNING LIGHTS
3. CABIN PRESSURE CONTROLLER
4. SURFACE LEADING EDGE TEMPERATURE INDICATORS
5. WING AND EMPENNAGE ICE CONTROL SWITCH
6. PROPELLER SPINNER NOSE ANTI-ICING AMMETER
7. MANUAL PRESSURE CONTROL SWITCH
8. AIR CONDITIONING MASTER SWITCH
9. FLIGHT DECK TEMPERATURE SWITCH
*10. CARGO COMPARTMENT TEMPERATURE SWITCH
11. PITOT HEAT SWITCH
12. CENTER NESA WINDSHIELD RESET SWITCH
13. CENTER NESA WINDSHIELD SWITCH
14. PROPELLER SPINNER BASE DE-ICING AMMETER
15. FLIGHT DECK EMERGENCY SHUT-OFF AIR CONDITIONING SWITCH
16. CARGO COMPARTMENT EMERGENCY SHUT-OFF AIR CONDITIONING SWITCH
17. FLIGHT DECK TEMPERATURE RHEOSTAT
*18. CARGO COMPARTMENT TEMPERATURE RHEOSTAT
*19. CARGO COMPARTMENT AIR RECIRCULATION SWITCH
20. SIDE AND LOWER NESA WINDSHIELD RESET SWITCH
21. SIDE AND LOWER NESA WINDSHIELD SWITCH
22. PROPELLER BLADE DE-ICING AMMETER
23. EMERGENCY DEPRESSURIZATION SWITCH
24. ENGINE INLET AIR DUCT ANTI-ICING SWITCHES
25. PROPELLER BLADE AND SPINNER BASE DE-ICING SWITCHES
26. PROPELLER SPINNER ANTI-ICING SWITCHES
27. PROPELLER (DE-ICING) AND ENGINE ANTI-ICING MASTER SWITCH

*INOPERATIVE

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Figure 4-3. (Sheet 1 of 2)

air conditioning system controls

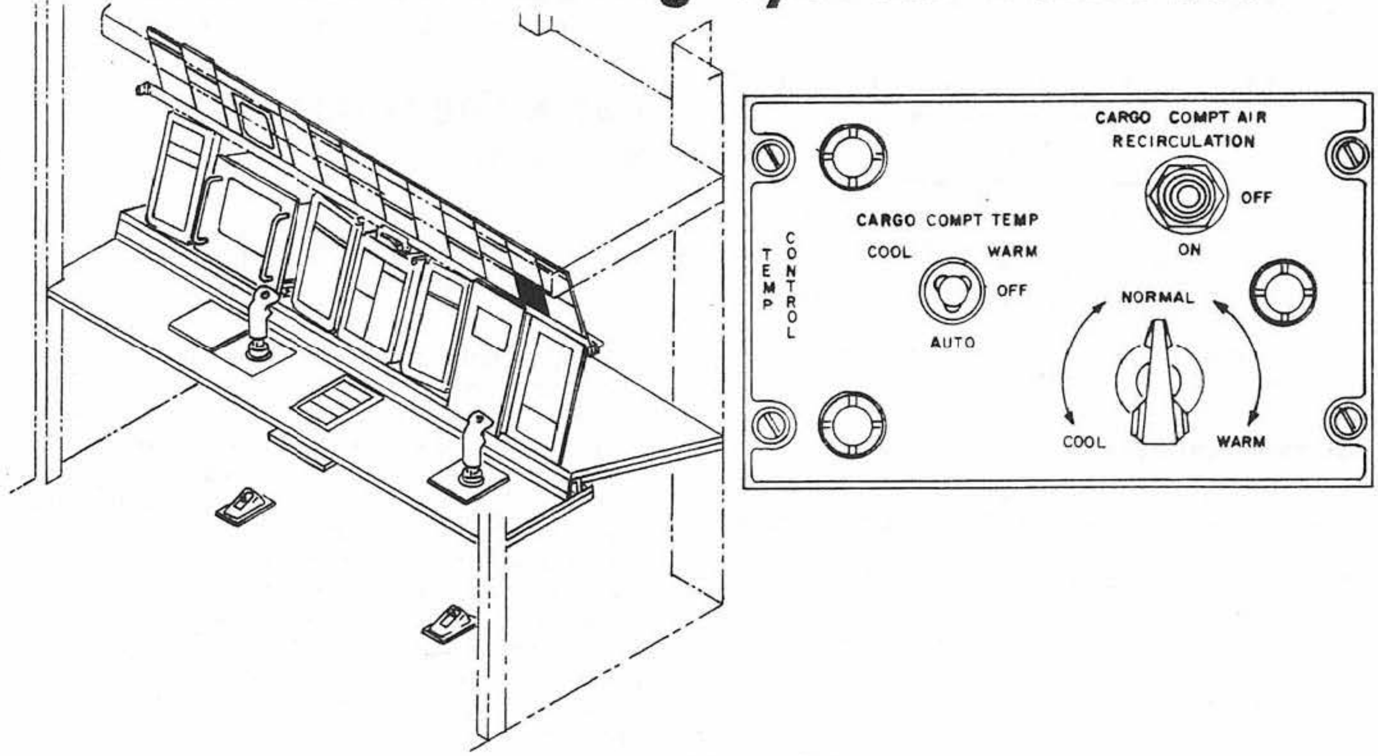


Figure 4-3. (Sheet 2 of 2)

Note

Excessive loss of conditioned air from the external unit will be prevented if duct plugs are installed in the heat exchanger outlets.

Air Conditioning With Bleed Air From Gas Turbine Compressor.

1. Start GTC and pressurize the bleed air manifold.

2. Insure that DC power is available to the flight station bus.

3. Position both air conditioning shutoff switches and the emergency depressurization switch to NORMAL.

4. Turn the air conditioning master switch to AIR COND GTC.

5. Hold the temperature switches to COOL or WARM, as desired, for 30 seconds then position to AUTO.

Note

Hot air may be supplied initially. Manual operation will position the temperature control valve more rapidly to the approximate position to provide the desired temperature.

6. Position the temperature rheostats as desired.

7. Position the air conditioning master switch to OFF prior to engine start.

CAUTION

A possibility of fire and/or equipment damage exists when the manual diffuser handle is left in the "mid" or "full in" position and the booth temperature control switches are not monitored. When the booth is not manned, the handle will be pulled out and locked.

Air Conditioning With Bleed Air From An Engine(s).

CAUTION

The air condition master switch should be in the OFF position for engine start, and should never be positioned to AIR COND GTC while an engine is supplying bleed air pressure. The airflow regulators may be damaged by the increased pressure from the engine.

1. After one or more engines are operating, position the air conditioning master switch to AIR COND NO PRESS.

2. Hold the temperature switches to COOL or WARM, as desired for 30 seconds, then position to AUTO.

3. Position the temperature rheostats as desired.

CAUTION

A possibility of fire and/or equipment damage exists when the manual diffuser handle is left in the "mid" or "full in" position and the booth temperature control switches are not monitored. When the booth is not manned, the handle will be pulled out and locked.

Normal Flight Operation.

1. Position the air condition master switch to the selected method of air conditioning-pressurization.

2. Position temperature switches to AUTO.

3. Position temperature rheostats as desired.

Before Landing.

1. Position air conditioning master switch as desired.

2. Position temperature switches as desired.

Emergency Operation of Air Conditioning Systems.

An air conditioning system failure can result in an emergency condition when, as a result of the failure, cabin pressurization cannot be maintained, or when the system is malfunctioning and cannot be shut down. As long as operation of the cargo compartment air conditioning system (70 pounds per minute) can be maintained, sufficient air output is available to keep the airplane pressurized. With cargo compartment air conditioning units inoperative, the flight station unit may or may not be able to maintain selected cabin pressure, depending on cabin leakage rate and airplane altitude. Consult the paragraph in this section on pressurization system failure for procedure to follow when pressurization cannot be maintained. When temperature of the air output of an air conditioning system cannot be controlled either automatically or manually, the crew has the option of shutting down the system or suffering the discomfort in order to maintain pressurization if at altitude.

CAUTION

If a system is leaking hot bleed air into the airplane, it should be shut down immediately. If the system cannot be shut off because of regulator malfunctioning and it is leaking bleed air, the engine bleed air valves must be closed to depressurize the bleed air system.

CABIN PRESSURIZATION SYSTEM.

Note

The cabin pressurization system may be used for ferry flights when close out panels are installed.

The flight station and cargo compartments of the airplane are pressurized for high-altitude flight. The air for pressurization is supplied by the bleed system and is ducted to the air conditioning system, after which it is distributed through the flight station and cargo compartments. The compartments are pressurized when enough of the conditioned air is retained within the fuselage to raise cabin pressure above the surrounding atmospheric pressure. Cabin pressurization is maintained by controlling the amount of air allowed to flow from inside the airplane to atmosphere through the outflow valve. During automatic operation the outflow valve is operated and controlled pneumatically by a cabin pressure controller. During manual operation the valve is operated and controlled electrically. An automatic safety valve is provided to relieve cabin pressure when excessive differential pressures are applied to the fuselage structure. The valve is operated pneumatically to relieve positive differential pressure (cabin pressure higher than ambient pressure) and negative differential pressure (cabin pressure lower than ambient pressure). The outflow valve and the safety valve are opened to depressurize the airplane. On later airplanes, a manually actuated door in the center escape hatch is provided to relieve pressure more rapidly for emergency depressurization. The door in the center escape hatch is attached to the airplane by bungee cord and can be reset in flight.

OUTFLOW VALVE.

The outflow valve is located on the right side of the airplane at the aft end of the flight station. It exhausts cabin air to atmosphere through a louver in the skin. The valve consists of a butterfly valve, a main actuating diaphragm, a relay valve, an air jet pump, a solenoid dump valve, and an electric actuator. During automatic pressurization, the butterfly valve is pneumatically positioned by differential pressure across the main actuating diaphragm. The relay valve and air jet pump control the differential pressure in accordance with the cabin altitude selected on the pressure controller. The solenoid dump valve opens the butterfly valve for depressurization and for any nonpressure operation. The electric actuator is controlled by a switch to position the butterfly valve during manual operation of the system. Electrical power for manual operation of the out flow valve is supplied from the flight station distribution panel.

CAUTION

Do not operate the cabin pressurization system in such a manner as to drive the outflow valve to the closed position with the opening of the safety valve as a result.

CABIN PRESSURE CONTROLLER.

The cabin pressure controller (figure 4-3) is located on the left side of the air conditioning control panel. It pneumatically regulates the outflow valve during automatic operation of the cabin pressurization system. Three control systems are incorporated into the pressure controller, as follows:

Isobaric control - constant cabin pressure altitude.
Differential control-varying cabin pressure altitude.
Rate control - cabin pressure altitude rate of change.

The isobaric control system positions the outflow valve to maintain a constant cabin pressure. Any desired cabin cabin altitude from - 1,000 feet to 10,000 feet can be selected on the controller, and during automatic pressurization the cabin pressure will be held constant upon reaching the selected cabin altitude. The differential control system positions the outflow valve to vary the cabin pressure altitude. The cabin altitude will change in order to maintain a constant differential pressure. This system protects the airplane structure from excessive pressures by overriding the isobaric control system when cabin differential pressure reaches 15.16 inches of mercury. The rate control system positions the outflow valve to maintain a constant rate of cabin pressure change up to the isobaric altitude selected. Any desired rate of cabin pressure change from MIN (30 to 200 feet per minute) to MAX (1,600 to 2,900 feet per minute) can be selected on the controller; and during automatic pressurization, the cabin pressure will change at the rate selected until the cabin pressure altitude reaches the isobaric altitude selected on the controller.

SAFETY VALVE.

The safety valve is located on the aft cargo door. It is electrically controlled in any non-pressure condition and pneumatically operated to provide pressure and vacuum relief when cabin differential pressures become excessive. The valve is normally closed during any pressurized operation and will open to relieve cabin pressure if the positive differential pressure reaches 15.9 inches of mercury or if the negative differential pressure reaches 0.76 inch of mercury. When either depressurization or non pressure operation is selected, the valve is opened to assure increased airflow through the airplane and more rapid depressurization.

CABIN PRESSURIZATION CONTROLS.

Controls for the cabin pressurization system consist of the air conditioning master switch, a pressure controller, a manual pressure control switch, and an emergency depressurization switch. All controls are located on the air conditioning control panel. A manually operated emergency depressurization system is provided on later airplanes.

Air Conditioning Master Switch.

The air conditioning master switch, located on the air conditioning and pressurization control panel (figure 4-3) is a six-position rotary switch which selects the type of air conditioning and pressurization desired. It directly controls pressurized and nonpressurized operations. For functions of the switch positions refer to Air Conditioning Master Switch under AIR CONDITIONING SYSTEM CONTROLS in this section.

Note

On airplanes AF53-3129 through 55-0046, the outflow valve is opened electrically when the master switch is turned to OFF. On airplanes AF56-0469 and up, the outflow valve is opened electrically when the master switch is turned to any no-pressure position. As long as 40 seconds may be required for the valve to be opened fully by electric actuator under these conditions.

Electrical power for control circuits to the outflow and safety valves is supplied through a cabin press and aux vent circuit breaker on the flight station bus.

Cabin Altitude Selector.

The cabin altitude selector on the pressure controller (figure 4-3) consists of a cabin altitude knob and an indicator. When the knob is turned, it turns the large pointer and small rotating dial of the indicator and also mechanically opens or closes the metering valve, which sets into the isobaric system of the controller a selected cabin altitude. When the knob is set as required, the large pointer indicates the cabin altitude selected, and the small rotating dial indicates the maximum airplane altitude at which the isobaric control system can maintain control of the outflow valve.

pressurization system

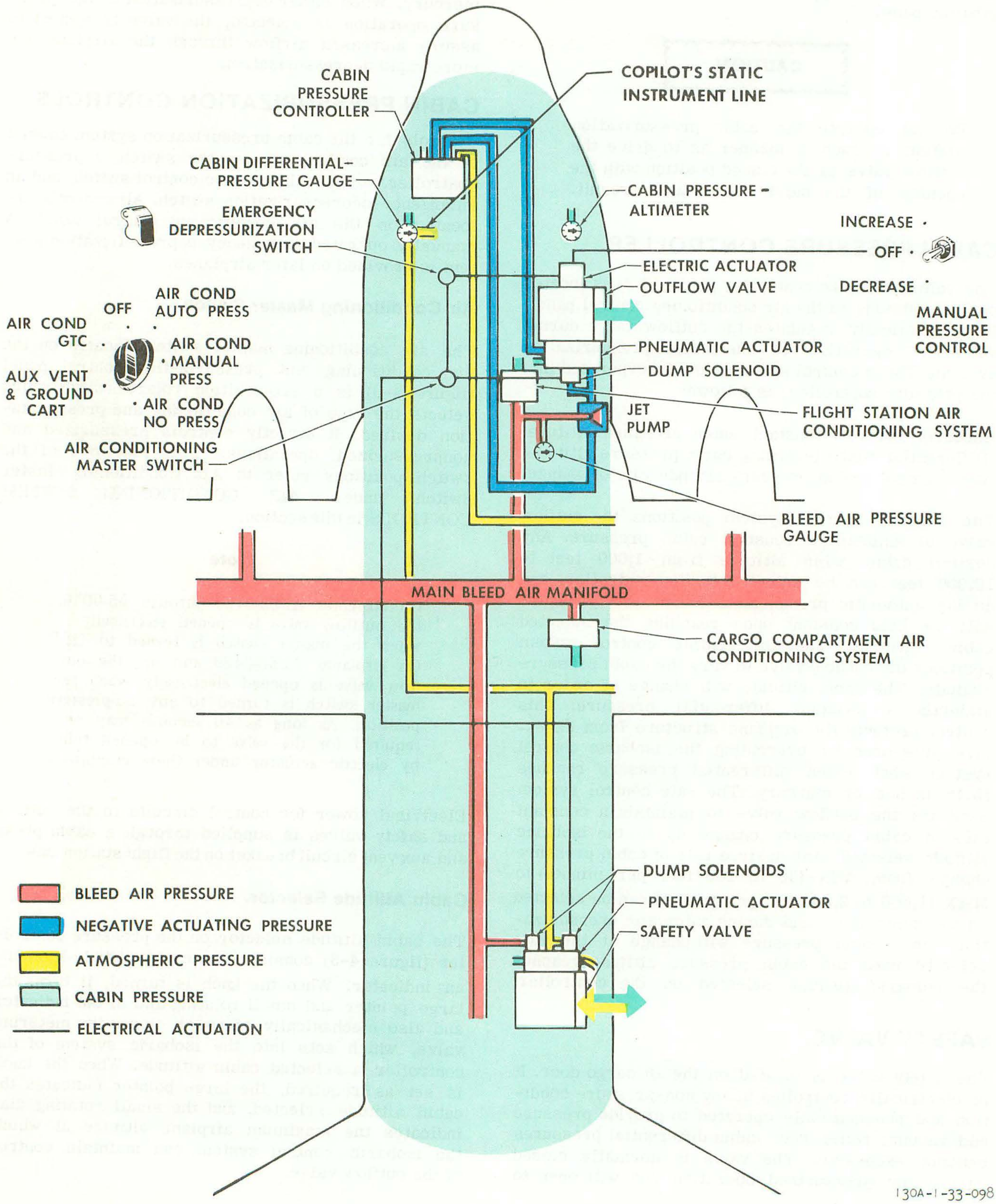


Figure 4-4.

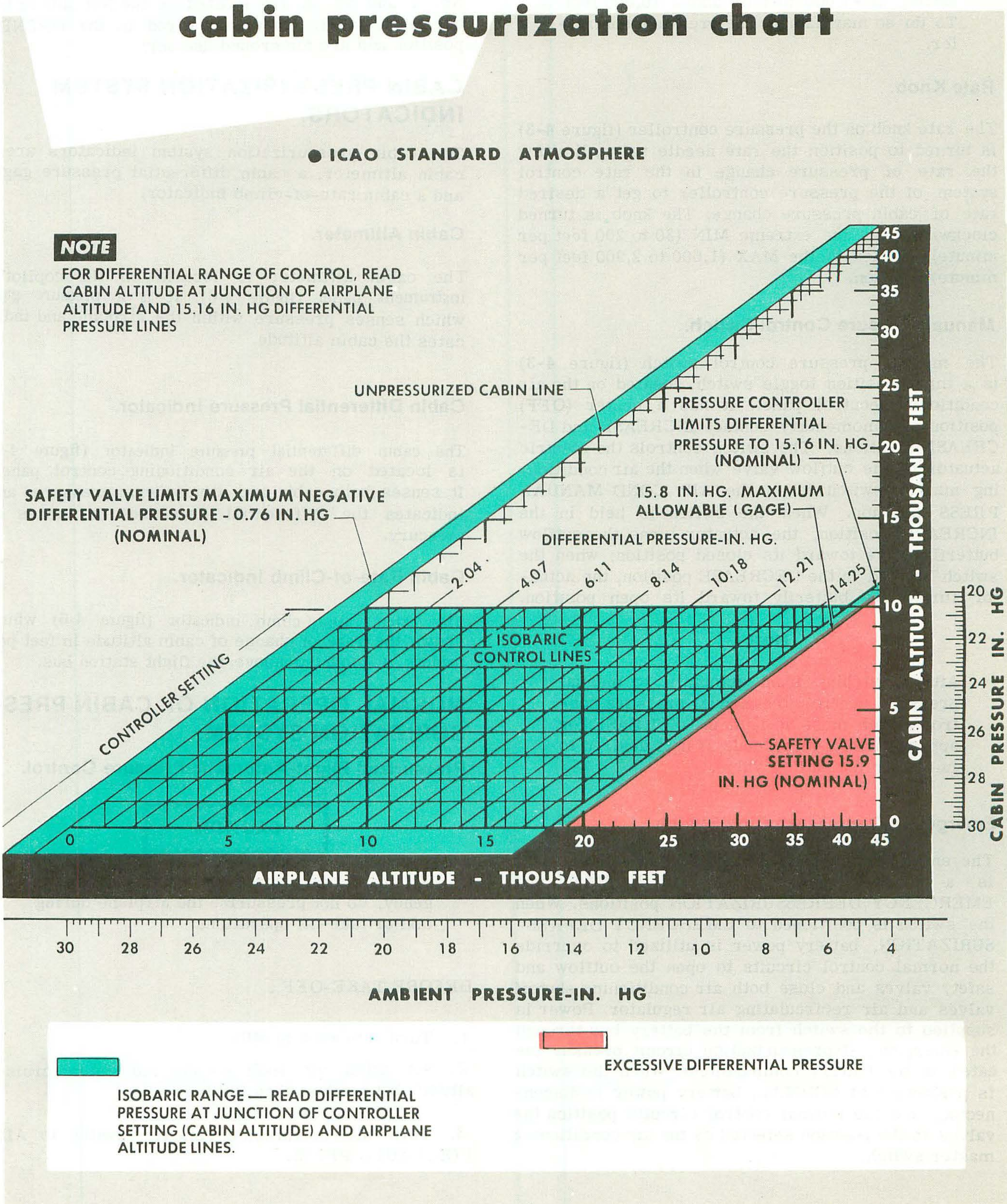

cabin pressurization chart
● ICAO STANDARD ATMOSPHERE
NOTE
FOR DIFFERENTIAL RANGE OF CONTROL, READ CABIN ALTITUDE AT JUNCTION OF AIRPLANE ALTITUDE AND 15.16 IN. HG DIFFERENTIAL PRESSURE LINES
UNPRESSURIZED CABIN LINE
PRESSURE CONTROLLER LIMITS DIFFERENTIAL PRESSURE TO 15.16 IN. HG (NOMINAL)
SAFETY VALVE LIMITS MAXIMUM NEGATIVE DIFFERENTIAL PRESSURE - 0.76 IN. HG (NOMINAL)
15.8 IN. HG. MAXIMUM ALLOWABLE (GAGE)
DIFFERENTIAL PRESSURE-IN. HG.
2.04
4.07
6.11
8.14
10.18
12.21
14.25
ISOBARIC CONTROL LINES
CONTROLLER SETTING
SAFETY VALVE SETTING 15.9 IN. HG (NOMINAL)
CABIN ALTITUDE - THOUSAND FEET
0
5
10
15
20
25
30
35
40
45
CABIN PRESSURE IN. HG
20
22
24
26
28
30
AIRPLANE ALTITUDE - THOUSAND FEET
0
5
10
15
20
25
30
35
40
45
30
28
26
24
22
20
18
16
14
12
10
8
6
4
AMBIENT PRESSURE-IN. HG
ISOBARIC RANGE — READ DIFFERENTIAL PRESSURE AT JUNCTION OF CONTROLLER SETTING (CABIN ALTITUDE) AND AIRPLANE ALTITUDE LINES.
EXCESSIVE DIFFERENTIAL PRESSURE

Figure 4-5.

Note

Do not force the cabin altitude knob below a setting of -1,000 feet or above 10,000 feet. To do so may damage the pressure controller.

Rate Knob.

The rate knob on the pressure controller (figure 4-3) is turned to position the rate needle valve, limiting the rate of pressure change in the rate control system of the pressure controller to get a desired rate of cabin pressure change. The knob is turned clockwise from the extreme MIN (30 to 200 feet per minute) position to the MAX (1,600 to 2,900 feet per minute) position.

Manual Pressure Control Switch.

The manual pressure control switch (figure 4-3) is a three-position toggle switch, located on the air conditioning control panel. It has a center (OFF) position and momentary contact INCREASE and DECREASE positions. The switch controls the electric actuator of the outflow valve when the air conditioning master switch is in the AIR COND MANUAL PRESS position. When the switch is held in the INCREASE position, the actuator turns the outflow butterfly valve toward its closed position; when the switch is held in the DECREASE position, the actuator turns the butterfly toward its open position.

Note

After switching from automatic to manual pressure control, the manual pressure control switch must be held in DECREASE for approximately 40 seconds if it is desired to fully open the outflow valve.

Emergency Depressurization Switch.

The emergency depressurization switch (figure 4-3) is a guarded toggle switch with NORMAL and EMERGENCY DEPRESSURIZATION positions. When the switch is positioned to EMERGENCY DEPRESSURIZATION, battery power is utilized to override the normal control circuits to open the outflow and safety valves and close both air conditioning shutoff valves and air recirculating air regulator. Power is supplied to the switch from the battery bus through the emergency depressurization circuit breaker located in the battery compartment. When the switch is positioned to NORMAL, battery power is disconnected, and the normal control circuits position the valves to the position selected by the air conditioning master switch.

Pressure Shut-off Valves.

An isobaric and an atmospheric shutoff valve, labeled No. 1 and No. 2, are located on the left side of the overhead panel. They are wired in the OPENED position and are for ground use only.

CABIN PRESSURIZATION SYSTEM INDICATORS.

The cabin pressurization system indicators are a cabin altimeter, a cabin differential pressure gage, and a cabin rate-of-climb indicator.

Cabin Altimeter.

The cabin altimeter is located on the copilot's instrument panel (figure 4-6). It is a pressure gage which senses pressure within the airplane and indicates the cabin altitude.

Cabin Differential Pressure Indicator.

The cabin differential pressure indicator (figure 4-6) is located on the air conditioning control panel. It senses both cabin and atmospheric pressures and indicates the differential pressures in inches of mercury.

Cabin Rate-of-Climb Indicator.

The cabin rate-of-climb indicator (figure 4-6) which shows the rate of change of cabin altitude in feet per minute is mounted above the flight station bus.

NORMAL OPERATION OF CABIN PRESSURIZATION SYSTEM.

Pressurized Flight-Automatic Pressure Control.

CAUTION

To allow rapid egress in event of an emergency, do not pressurize the airplane during taxi or take-off operations.

BEFORE TAKE-OFF.

1. Turn rate knob to MIN.

2. Set cabin alt knob to desired cabin cruise altitude but not less than field elevation.

3. Turn air conditioning master switch to AIR COND AUTO PRESS.

AFTER TAKE-OFF.

Note

Monitor cabin altitude against airplane altitude to make sure that cabin altitude stays within isobaric range depicted in figure 4-5.

1. Set rate knob to desired rate.

Adjust the rate setting as required during climb so that the cabin reaches the selected altitude at the same time the airplane reaches cruise altitude. Thus, the rate of cabin pressure change is held to a minimum. The rate of cabin pressure change is held constant only up to pressure controlled differential limit. At this differential pressure, the cabin pressure altitude and airplane pressure altitude change at constant rate.

CRUISE. During pressurized flight, monitor cabin differential pressure and cabin altitude. Cabin altitude must not exceed 10,000 feet when the airplane is carrying passengers or troops. The crew will don oxygen masks when the cabin altitude exceeds 10,000 feet. Do not allow cabin differential pressure to exceed the maximum allowable for the airplane.

DESCENT.

1. Set cabin alt knob for the cabin altitude equal to the airplane altitude to which depressurization is desired.

2. Set rate knob to desired rate.

Note

Adjust the rate setting as required during the descent so that the cabin reaches the selected altitude at the same time the airplane reaches the selected altitude. Thus, the rate of cabin pressure change is held to a minimum.

BEFORE LANDING. Check the cabin differential pressure before landing. If more than 0.5 inch of mercury is indicated, the cabin altitude selector and the rate knob should be adjusted to higher settings to increase the rate of depressurization. If the differential pressure is less than 0.5 inch of mercury, no discomfort will be experienced when the air conditioning master switch is turned to a non-pressure position. Cabin differential pressure should be zero for landing.

AFTER LANDING. Turn air conditioning master switch to AIR COND NO PRESS.

Pressurized Flight-Manual Control.

BEFORE TAKE-OFF.

1. Turn air conditioning master switch to AIR COND MANUAL PRESS.

   a. Turn cabin altitude selector to 10,000 feet.

   b. Position rate control to maximum.

2. Hold the manual pressure control switch to the INCREASE position for approximately 30 seconds or until a pressure indication is noted on the cabin rate-of-climb indicator (some airplanes).

AFTER TAKE-OFF.

1. Hold manual pressure control switch in INCREASE.

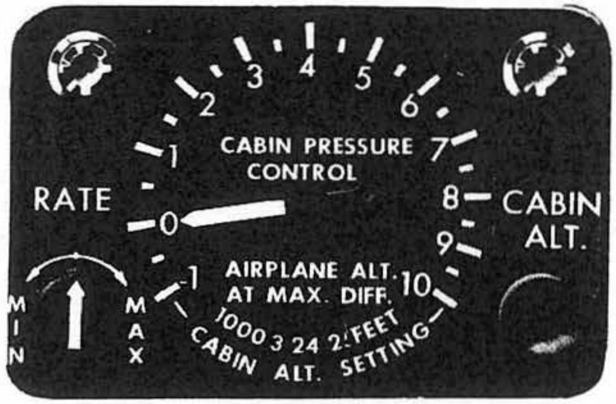
Hold the manual pressure control switch momentarily to the INCREASE position until an indication of cabin pressure is observed on the cabin differential pressure gage and the cabin altimeter. Exercise caution during manual pressure control in order to prevent excessive rates of cabin pressure change which can cause extreme discomfort to passengers and crew. Operation of the manual pressure control switch by momentarily holding it in the desired position and then releasing it to the OFF position will provide satisfactory control. Monitor the airplane rate of climb, the cabin differential pressure gage, and the cabin altimeter. Establish as closely as possible a constant cabin rate of climb by intermittently positioning the manual pressure control switch momentarily to the INCREASE position. By reaching the maximum differential pressure at the desired cabin altitude when the airplane reaches cruise altitude, the minimum rate of cabin pressure change will be attained.

CRUISE. When the airplane has reached stabilized cruise conditions, adjust the outflow valve with the manual control switch to maintain a constant differential pressure and constant cabin pressure altitude.

Monitor the cabin differential pressure gage and the cabin altimeter so as not to exceed the allowable limits.

DESCENT. As soon as the airplane starts to descend, position the manual pressure control switch momentarily to the INCREASE position, in order to establish a decrease of cabin pressure altitude. Maintain a comfortable rate of cabin pressure change

cabin controller, cabin rate of climb indicator, and cabin pressure altitude indicator



CABIN CONTROLLER

CABIN RATE OF CLIMB INDICATOR

CABIN PRESSURE ALTITUDE INDICATOR

130A-1-33-101

Figure 4-6.

by intermittently positioning the outflow valve until obtaining a cabin altitude equal to airplane altitude at which depressurization is desired. Maintain this cabin altitude as the airplane descends. Allow cabin differential pressure to decrease by positioning the manual pressure control switch to open the outflow valve.

BEFORE LANDING. Check the cabin differential pressure prior to landing. If more than 0.5 inch of mercury differential pressure exists, momentarily position the manual pressure control switch to the DECREASE position, to control the rate of cabin depressurization. If cabin differential pressure does not exceed 0.5 inch of mercury, no discomfort will be experienced when the airplane is depressurized by turning the air conditioning master switch to a non-pressure position. Cabin differential pressure should be zero for landing.

AFTER LANDING. Turn air conditioning master switch to AIR COND NO PRESS.

Transition From Manual to Auto Pressurization.

Note

For medical evacuation it may be desired to takeoff in manual pressure to insure a more stable rate of cabin change during takeoff and initial climb and then transition to auto pressure.

1. Set pressure controller slightly above cabin altitude.

2. Set temperature control to manual. A temperature change can cause a cabin change due to change in air input.

3. Set rate knob to maximum and allow 1 to 3 minutes for the controller to stabilize.

4. Toggle manual pressurization switch to decrease and allow cabin to climb at 100 FPM and zero itself out. Repeat this procedure until the manual pressurization switch can be held to decrease for 10 seconds with the cabin vertical velocity indicator showing zero change in cabin altitude.

5. Select auto pressure and select desired rate of cabin altitude.

Alternate Method.

1. Set rate knob to minimum.

2. Set cabin controller to 500 feet below cabin altitude.

CAUTION

Do not set cabin altitude knob below a setting of -1000 feet. To do so may damage the pressure controller.

3. When cabin altitude begins to come down, as indicated on the cabin vertical velocity indicator, select auto pressure.

Non-pressurized Flight

BEFORE TAKE-OFF.

1. Turn air conditioning master switch to AIR COND NO PRESS or AUX VENT.

Transistion from Non-pressurization to Pressurization During Flight.

1. Turn rate knob to MIN.

2. Set cabin alt knob to desired cabin altitude.

3. Turn air conditioning master switch to AIR COND AUTO PRESS.

4. Turn rate knob to desired rate.

Adjust the rate setting so that the cabin reaches the selected altitude at the same time the airplane reaches cruise altitude. The rate of cabin pressure change is thus held to a minimum.

Transistion from Pressurization to Non-pressurization During Flight.

1. Set rate knob to desired rate.

2. Set cabin alt knob to airplane altitude at altitudes below 10,000 feet. Cabin altitude will increase at the rate selected until cabin pressure equals atmospheric pressure. The differential pressure is thus reduced at a controlled rate.

3. When above 10,000 feet, turn the air conditioning master switch to AIR COND MANUAL PRESS and hold the manual pressure control switch in the DECREASE position.

4. Turn air conditioning master switch to AIR COND NO PRESS (as soon as differential pressure reaches zero).

EMERGENCY OPERATION OF CABIN PRESSURIZATION SYSTEM.

Two types of pressurization system failures may occur. One type can result only from failure of the outflow valve in a closed or nearly closed position when it cannot be opened either by automatic or manual control methods. In this case cabin pressure might increase at an excessive rate and could not be reduced by normal means. If this condition is encountered, proceed as follows:

1. Immediately close engine bleed air valves, one at a time, until the rate of pressure increase is at a safe value.

2. Control pressure by opening and closing engine bleed air valves as necessary to vary the amount of conditioned air supplied for pressurization.

3. If necessary for further control when descending, one of the air conditioning systems can be shut down to expedite depressurization of the airplane.

The other type of pressurization system failure is loss of ability to pressurize or maintain pressurization on either automatic or manual control and may result from any of several causes. If this situation is encountered, proceed as follows:

1. Descend to or maintain an airplane altitude at which cabin altitude can be maintained at 10,000 feet or below.

2. If cabin altitude is above 10,000 feet, the crew should don oxygen masks immediately while instituting a descent.

3. Check for excessive cabin leakage by checking warning light, windows, doors, hatches, and the safety valve.

WARNING

Do not attempt to lock or unlock any door or hatch while the airplane is pressurized. First, depressurize the airplane; then turn the air conditioning master switch to AUX VENT.

4. Check the bleed air system for excessive external leakage. Turn off all pneumatic systems, and observe the bleed air pressure gage. Close all engine bleed air valves, and time the bleed air system pressure drop from 65 to 35 PSI. The time required for the pressure to drop from 65 to 35 PSI should not be less than 10 seconds.

ANTI-ICING AND DE-ICING SYSTEMS.

Anti-icing systems, which can be used to prevent the formation of ice on critical areas of the airplane, and deicing systems, which will remove ice after it is formed, are installed on the airplane. Heat for the systems is obtained either by the use of electrical heating elements or by heated air drawn from the engines.

Anti-icing systems using heated air from the bleed air system serve the wing and empennage leading edges, fuel tank vent masts, radome, and the engine inlet air scoops. Anti-icing of the engine compressor inlet vanes and the housing over the extension shaft is accomplished by heated air supplied directly from the 14th stage of each individual engine, not through the bleed air system.

Anti-icing systems using electrical heating are installed for the propeller spinner nose, pitot tubes, static booms and windshields. Deicing systems using electrical heating are installed for the propeller blades and propeller spinner bases.

Anti-ice detection system may be used to provide automatic operation of the following systems:

Radome anti-icing.
Engine inlet scoop anti-icing.
Compressor inlet vane anti-icing.
Extension shaft housing anti-icing.
Propeller spinner nose anti-icing.
Propeller blade deicing.
Propeller spinner base deicing.

Note

If engine was shut down using fire emergency control handle, inlet scoop anti-icing for that engine will not be possible. Units requiring 14th stage bleed air for anti-icing cannot be anti-iced under any engine shutdown condition.

WING AND EMPENNAGE LEADING EDGE ANTI-ICING SYSTEM.

The leading edge anti-icing system is divided into six sections, each consisting of a shutoff valve, ejectors, and control components. The shutoff valve controls the flow of air from the bleed air system to the ejectors, where it is ejected through small nozzles into mixing chambers. The resultant mixed air at approximately 177°C (350°F) flows through passages, is drawn back for recirculation, and a lower percentage of bleed air is required for continuous anti-icing. Each of the six shutoff valves is a solenoid controlled, pneumatically operated, deenergized closed, hot air shutoff valve.

leading edge anti-icing system

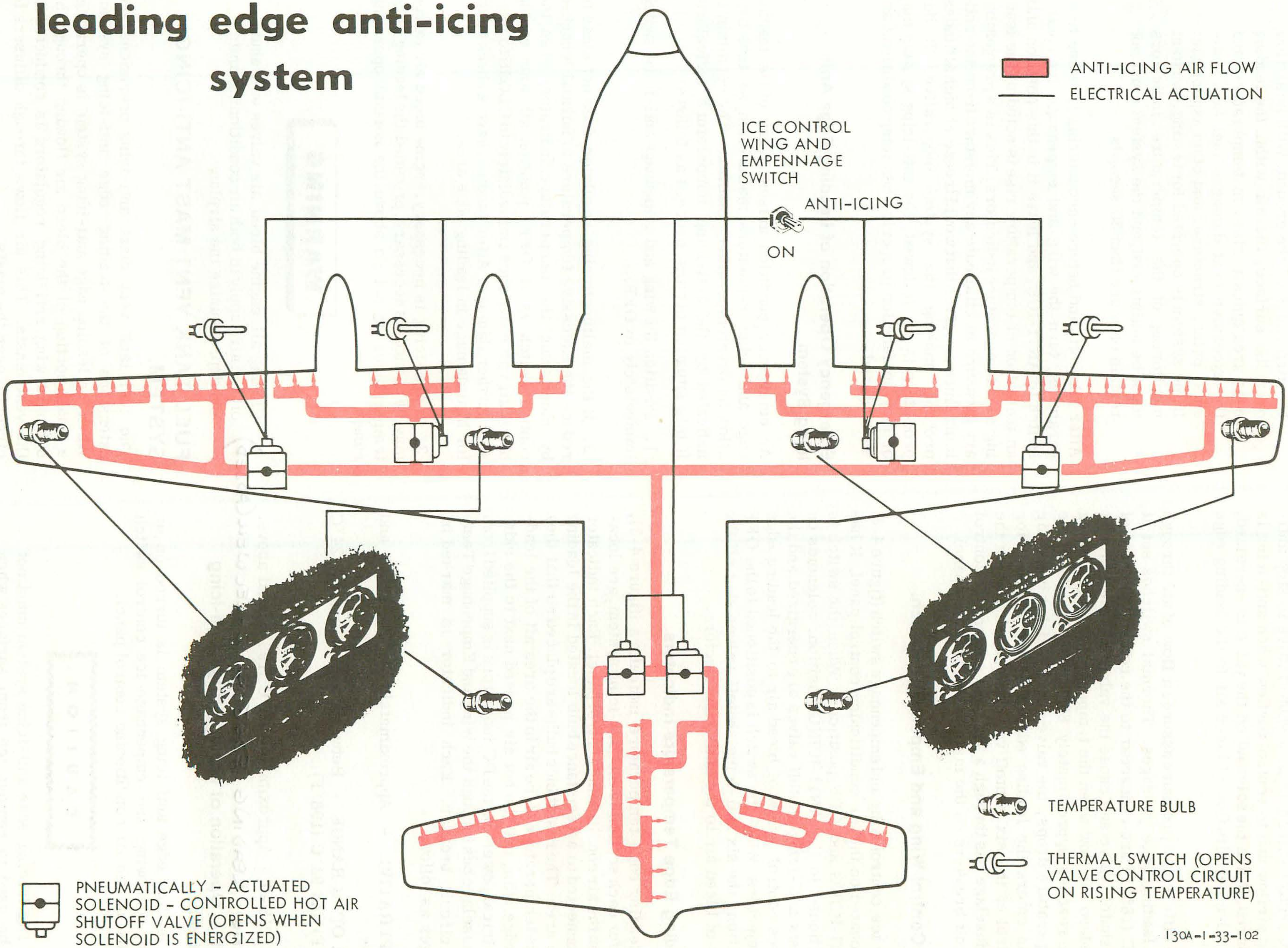


Figure 4-7

Each shutoff valve acts as a shutoff valve to stop anti-icing airflow and to control airflow when anti-icing is required. When the solenoid on the valve is energized, the valve permits flow of bleed air to the leading edge area.

The differential pressure assures a flow of air through the leading edge passages. Thermal switches set at 85°C (185°F) are connected to the control solenoid of the shutoff valve and cause the valve to close and shut off bleed air flow when the temperature in the leading edge reaches approximately 85°C (185°F). When the temperature drops, the valve opens and hot bleed air again enters the leading edge. Electrical power for control of the six shutoff valves is supplied from the DC fuselage bus through a wing and empennage control circuit breakers on the main DC distribution panel.

Ice Control Wing and Empennage Switch.

The ice control wing and empennage switch (figure 4-3) is located on the air conditioning control panel. It has ANTI-ICING and OFF positions. When the switch is positioned to the ANTI-ICING position, solenoids on the six anti-icing shutoff valves are energized and the valves control a flow of bleed air to the leading edge air ejectors. When the switch is positioned to the OFF position, the six anti-icing shutoff valves shut off the flow of bleed air to the anti-icing ejectors.

Leading Edge Temperature Indicators.

Six leading edge temperature indicators (figure 4-3), one for each section of the anti-icing system, are located on the air conditioning control panel. Each indicator is connected to a resistance bulb located in the leading edge area. The resistance bulbs are placed so that they sense temperature of the air in the area aft of the leading edge skin, not the hot air passed next to the skin. Electrical power for the DC indicators is supplied from the fuselage bus through the Wing and Empennage Temp Ind circuit breaker. Each indicator is marked in ranges as follows:

INOPERATIVE - Approximately 24°C (75°F) and below.

NOR OPER RANGE - Between approximately 24°C (75°F) and 93°C (198°F).

SEE 5-20 OVERHEAT - Approximately 93°C (198°F) and above.
WING LEADING EDGE & WHEELWELL (ADDED)

Normal Operation of Leading Edge Anti-icing System.

The leading edge anti-icing system is turned on or off by the wing and empennage ice control switch located on the air conditioning control panel.

CAUTION

The leading edge anti-icing system must not be used to remove ice from surfaces when the airplane is on the ground. With no airflow over the surface, the air within the leading edge area quickly rises in temperature, and the excessive heat damages fuel tank sealants, paint, structure, and other equipment. If the system is operated for testing, constant monitoring of the temperature indicators must be maintained, and the system must not remain on more than 30 seconds.

After take-off, and before encountering freezing temperatures, turn the wing and empennage ice control switch to ANTI-ICE, and leave it in this position until an indication of temperature rise is noted on the leading edge temperature indicators. This is a precautionary measure to eliminate any moisture from the anti-icing lines or valves that would freeze at high altitudes, probably making the system inoperative. If this procedure is not followed, the anti-icing system may or may not function properly when icing conditions are encountered.

Emergency Operation of Leading Edge Anti-icing System.

An emergency condition arises if any of the leading edge anti-icing regulators malfunction so that they allow an overtemperature condition. The condition is indicated by the anti-icing temperature indicators. If this situation occurs, proceed as follows:

1. Position the wing and empennage anti-icing switch immediately to OFF.

2. If the malfunctioning regulator does not close to reduce the excessive temperature to normal (checked by monitoring the temperature indicator) when the control switch is at OFF, position all four engine bleed air valve switches immediately to CLOSE to prevent further damage. After landing, have a check made for heat damage in leading edge area.

3. If anti-icing is necessary, engine bleed air valves may be opened as necessary, provided the leading edge temperatures do not go above the normal operating range.

WARNING

Closing all engine bleed air valves will shut off the air supply to both air conditioning units and depressurize the airplane.

FUEL TANK VENT MAST ANTI-ICING SYSTEM.

The fuel tank vent mast anti-icing provisions are extensions of the leading edge anti-icing system. When the leading edge anti-icing system is operating, a small portion of the bleed air flowing through the outboard wing anti-icing regulators is conducted to the vent masts. This air flows through diffusers to circulate over the masts.

RADOME ANTI-ICING SYSTEM.

The radome anti-icing system conducts a mixture of hot bleed air and recirculated return air through passages in the radome structure to heat the radome surface. The flow of bleed air is controlled by a throttling and shutoff valve, which is pneumatically actuated and electrically controlled. When the system is operating, the valve opens to allow hot bleed air at a temperature of approximately 316°C (600°F) to flow through a nozzle in an ejector. Return air from the radome passages is mixed with the bleed air in the ejector to provide a mixture at approximately 125°C (257°F), which is ejected into the radome passages. A pneumatic thermostat controls the valve so as to regulate anti-icing air temperature and another thermostat prevents air at a temperature higher than 135°C (275°F) from entering the radome passages. Pressure of air in the radome passages is held constant by a relief valve on the ejector. A solenoid on the throttling and shut-off valve is energized to permit the valve to open and is deenergized to cause the valve to close to shut off the airflow. Power for valve control is supplied from the DC fuselage bus. The valve control circuit is interconnected with the ice detection system so that the radome anti-icing can be turned on automatically when the detection system senses icing.

Nose Radome Anti-Icing Switch.

The nose radome anti-icing switch (figure 4-8) is located on the navigator's instrument panel. It has three positions - AUTO, OFF, and MANUAL. When at AUTO, it permits control of the radome anti-icing valve by the ice detection system. If the prop and engine anti-icing master switch is then also at AUTO, the radome system is turned on automatically when ice is detected by the ice detection system. When the radome anti-icing switch is at OFF, the anti-icing valve is closed to shut off all air flow through the radome passages. When the switch is at MANUAL, the anti-icing system is on. If the nose radome anti-icing switch is in the AUTO position and the prop and engine anti-icing master switch is set to MANUAL, radome anti-icing will be on.

Normal Operation of Radome Anti-icing System.

1. Position the nose radome anti-icing switch at MANUAL to turn the system on immediately.

2. Position the nose radome anti-icing switch and the prop and engine anti-icing switch at AUTO to allow the radome anti-icing to be turned on automatically when the ice detection system detects ice.

3. If the radome anti-icing switch is at AUTO position, radome anti-icing can be turned off by positioning the prop and engine anti-icing master switch at RESET if icing conditions no longer exist.

4. To turn off the radome anti-icing immediately, position the nose radome anti-icing switch at OFF.

CAUTION

The radome anti-icing system must not be operated when the airplane is on the ground. With no airflow over the outer surface of the radome, it may be overheated because the heat of the anti-icing air is not dissipated rapidly enough. Overheating damages the radome.

CAUTION

If the noise associated with the radome anti-icing persists after the system is turned off, a suspected malfunction of the anti-icing valve is evident. To preclude damage to the radome, the bleed air system should be isolated.

5. Normally, radome anti-icing should not be used except when ice accumulation interferes with the scope presentation or when climbing through the freezing level to remove possible moisture from the radome or from the anti-icing system valves.

ENGINE INLET AIR DUCT ANTI-ICING SYSTEMS.

Two systems are provided for engine inlet air duct anti-icing. One conducts bleed air from the bleed air system to passages in the inlet scoop to heat the scoop. The other conducts air from the compressor diffuser section of the engine to passages in the compressor inlet vanes and into a housing over the extension shaft. The scoop anti-icing airflow is shut off by a solenoid valve which is energized closed. The air flows when the valve is deenergized and open. The vane anti-icing airflow is controlled by two pressure-actuated valves, which are controlled by a single solenoid valve. When the solenoid valve is energized, the pressure-actuated valves shut off the airflow, and when the solenoid valve is deenergized, the pressure-actuated valves open. Both the scoop and vane anti-icing systems are termed fail-safe, meaning that anti-icing is provided when all DC power supply is lost. Power for operation of the solenoid valves of both systems is supplied from the DC wing buses. The electrical control circuits are interconnected with the ice detection system so that the duct anti-icing can be turned on automatically when the detection system senses icing.

Engine Inlet Air Duct Anti-icing Switches.

Four engine inlet air duct anti-icing switches (figure 4-3) are located on the air conditioning control panel. Each switch has ON and OFF positions. If a switch is at ON, the scoop and vane anti-icing systems for the engine are turned on if the propeller and engine anti-icing master switch is at MANUAL. If the master switch is at AUTO, anti-icing is turned on

radome anti-icing system

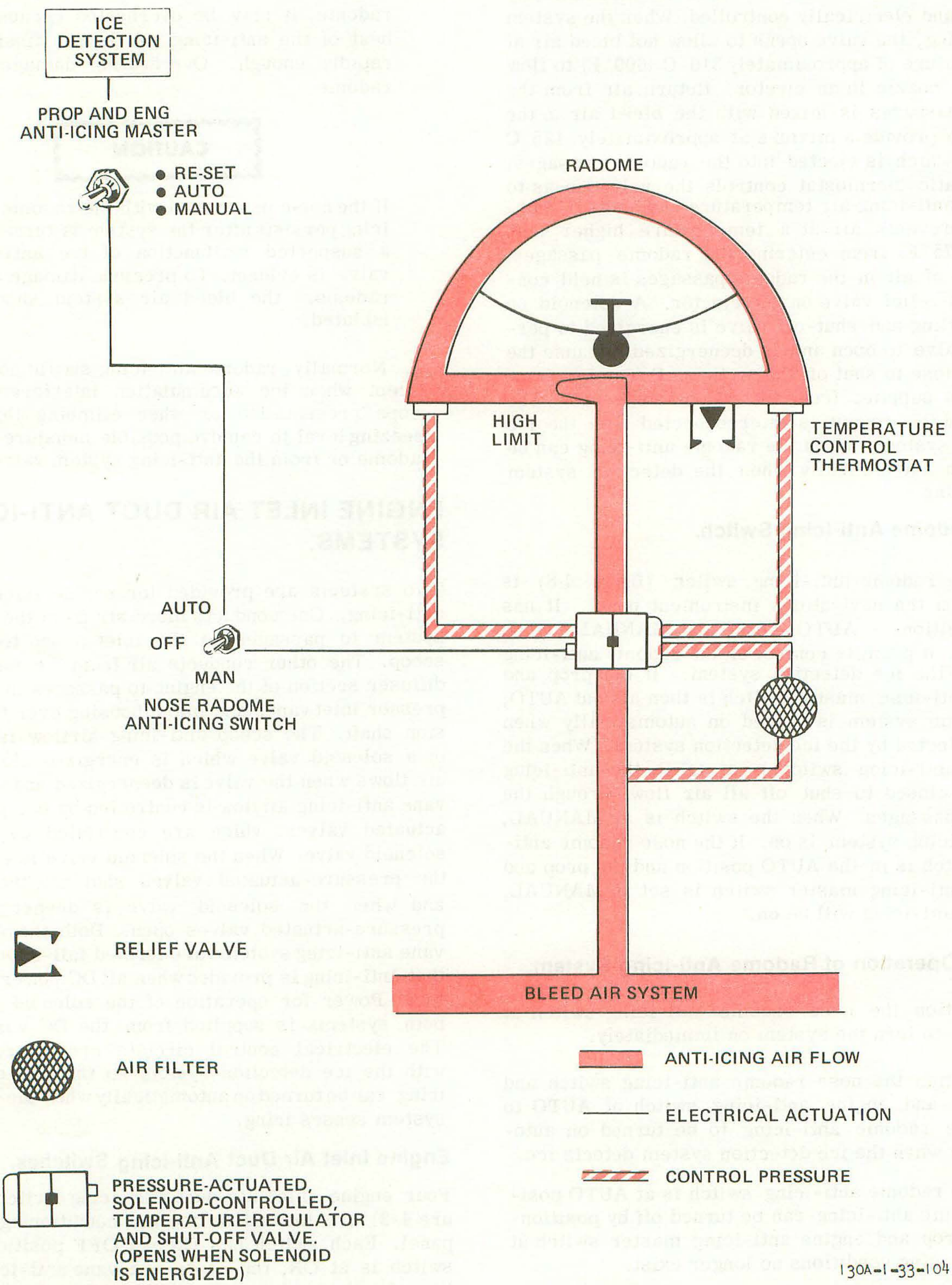


Figure 4-8.

engine anti-icing system

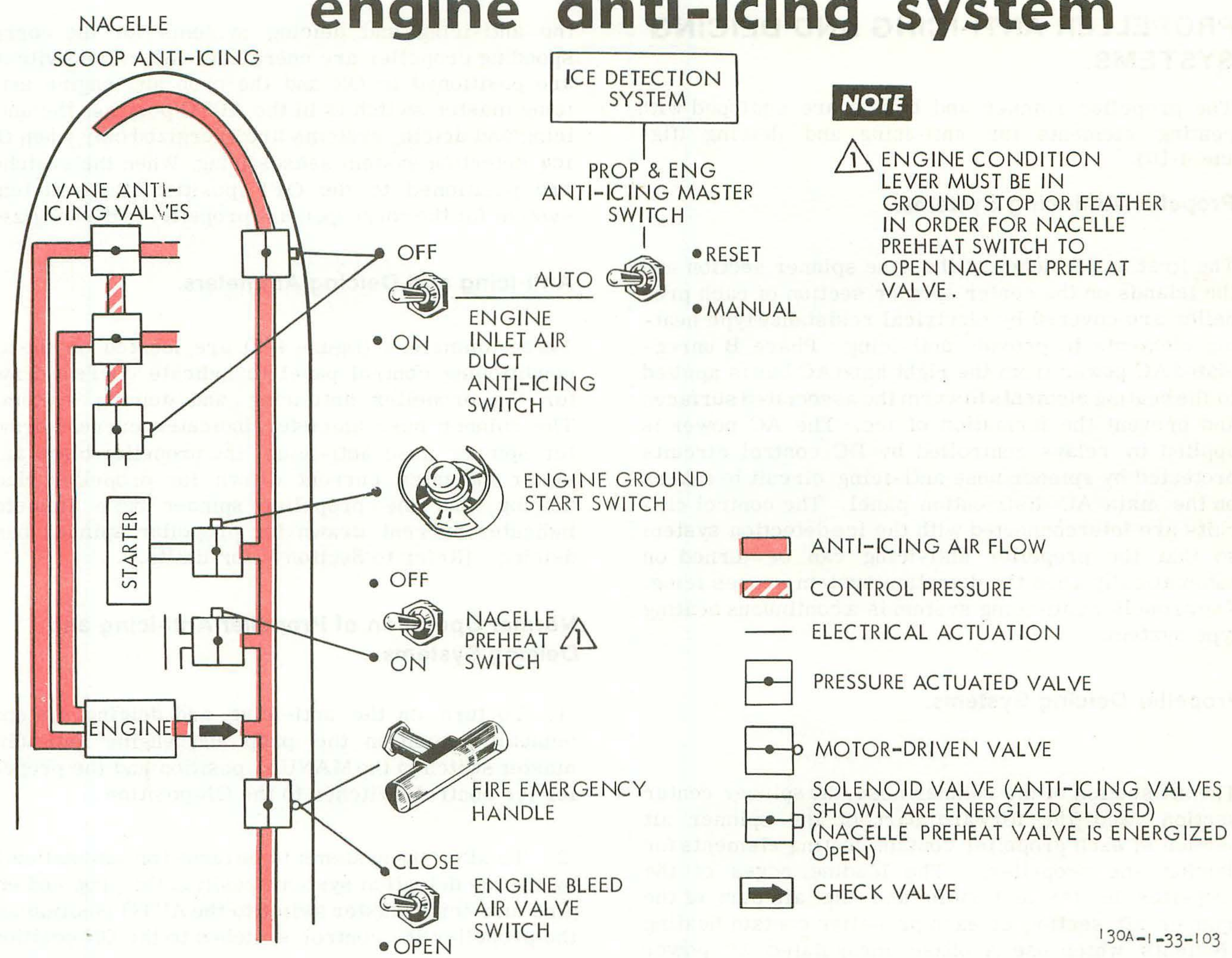


Figure 4-9.

when the ice detection system detects ice. When an engine inlet air duct anti-icing switch is at OFF, both scoop and vane anti-icing valves for the corresponding engine close to shut off the anti-icing airflow.

Normal Operation of Engine Inlet Air Duct Anti-icing Systems.

1. To turn the systems on manually, position the propeller and engine anti-icing master switch at MANUAL and the engine inlet air duct anti-icing switches at ON.

2. To allow the systems to be turned on automatically by the ice detection system, position the propeller and engine anti-icing master switch at AUTO and the engine inlet air duct anti-icing switches at ON.

3. To shut the systems off while leaving them subject to automatic control, place the propeller and engine anti-icing master switch to RESET then to AUTO and let the system switches remain at ON.

4. To shut the systems off, position the engine inlet air duct anti-icing switches at OFF.

Note

If an engine is shut down during flight, the inlet duct anti-icing should be left on if icing conditions exist. This will not be possible if the engine is shut down using the fire emergency control handle.

Note

A preflight check of the inlet duct anti-icing can be made on airplanes with a bleed air pressure gage by noting a bleed air pressure drop as the switch for each engine is turned on.

PROPELLER ANTI-ICING AND DEICING SYSTEMS.

The propeller spinner and blades are equipped with heating elements for anti-icing and deicing (figure 4-10).

Propeller Anti-icing Systems.

The first 8-1/2 inches of the nose spinner section and the islands on the center spinner section of each propeller are covered by electrical resistance type heating elements to provide anti-icing. Phase B unregulated AC power from the right hand AC bus is applied to the heating elements to warm the associated surfaces and prevent the formation of ice. The AC power is applied by relays controlled by DC control circuits protected by spinner nose anti-icing circuit breakers on the main AC distribution panel. The control circuits are interconnected with the ice detection system so that the propeller anti-icing can be turned on automatically when the detection system senses icing. The propeller anti-icing system is a continuous heating type system.

Propeller Deicing Systems.

The aft section of the spinner nose, the spinner center section, and the forward part of the spinner aft section of each propeller contain heating elements for deicing the propeller. The leading edges of the propeller blades and cuffs and the aft part of the spinner aft section of each propeller contain heating elements which use A phase unregulated AC power from the right hand AC bus. The center section of the spinner contains heating elements which use C phase unregulated AC power from the right hand AC bus. Power is applied to the elements through relays and automatic thermal circuit breakers. The relays are controlled by a DC control circuit which includes a timer. The timer controls the relays so as to apply power to elements of only one propeller at a time; the elements of each propeller are energized 15 seconds and deenergized 45 seconds during each 1-minute cycle. The control circuit is interconnected with the ice detection system so that they may be turned on automatically when the detection system senses icing. The DC control circuit for deicing relays is protected by propeller deicing control circuit breakers on the main AC distribution panel.

Propeller Ice Control Switches.

The eight propeller anti-icing and deicing switches are located on the air conditioning control panel. These 2-position (ON, OFF) toggle switches control the propeller anti-icing and deicing systems. When any switch is positioned to the ON position and the prop and engine anti-icing master switch is in the MANUAL position, the anti-icing and deicing systems for the corresponding propeller are energized. When the switches are positioned to ON and the prop and engine anti-icing master switch is in the AUTO position, the anti-icing and deicing systems are energized only when the ice detection system senses icing. When the switches are positioned to the OFF position, the anti-icing system for the corresponding propeller is deenergized.

Anti-icing and Deicing Ammeters.

Three ammeters (figure 4-3) are located on the air conditioning control panel to indicate current drawn for the propeller anti-icing and deicing systems. The spinner nose ammeter indicates current drawn for spinner nose anti-icing, the propeller blade ammeter indicates current drawn for propeller blade deicing, and the propeller spinner base ammeter indicates current drawn for propeller spinner base deicing. (Refer to Section V for limits.)

Normal Operation of Propeller Anti-icing and Deicing Systems.

1. To turn on the anti-icing and deicing systems manually, position the prop and engine anti-icing master switch to the MANUAL position and the propeller ice control switches to the ON position.

2. To allow the systems to be turned on automatically by the ice detection system, position the prop and engine anti-icing master switch to the AUTO position and the propeller ice control switches to the ON position.

3. To turn the systems off and leave them subject to automatic control by the ice detection system, move the prop and engine anti-icing master switch momentarily to the RESET position and release it to the AUTO position.

4. To turn off the propeller anti-icing systems, position the propeller ice control switches to the OFF position.

CAUTION

Do not operate the propeller anti-icing or deicing for an engine that is not running, when the airplane is on the ground. The engine must be running in order to dissipate the heat generated by the heating elements to prevent damage to the elements. Never operate the system for more than two cycles while the airplane is on the ground. Anti-icing and deicing may be used for a propeller feathered in flight.

propeller anti-icing and de-icing system

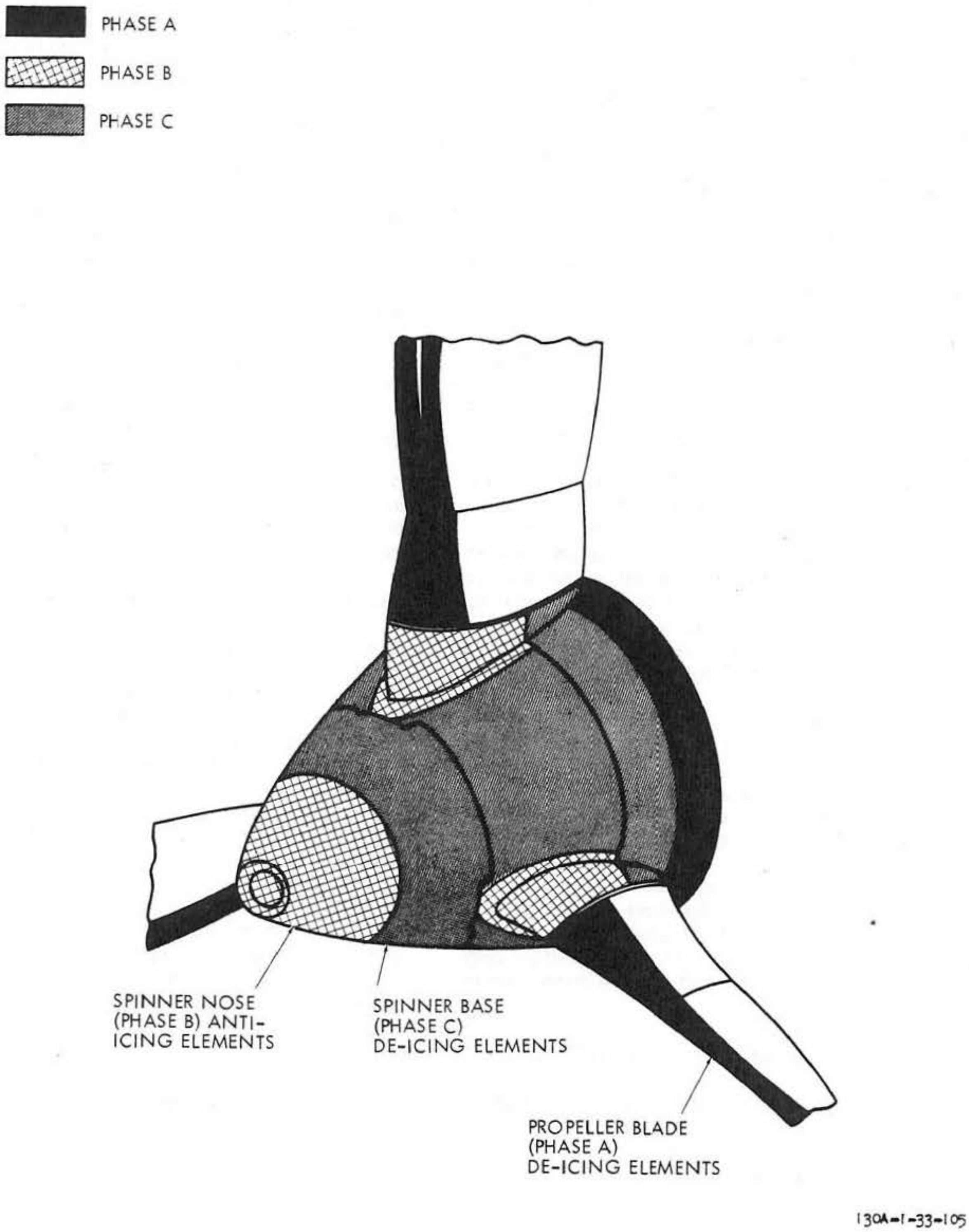


Figure 4-10.

Note

During propeller deicing operation on airplanes not modified by T.O. 1C-130A-666, extreme pointer oscillations may be apparent in the turbine inlet temperature, fuel flow and fuel flow totalizer indicators. If flight conditions require the use of propeller deicing, turn the propeller blade and spinner base deicing switches to OFF periodically to determine that the affected instruments are within the desired range.

ICE DETECTION SYSTEM.

The ice detection system is used as an automatic control for turning on the radome anti-icing, engine inlet air duct anti-icing, and propeller anti-icing and deicing systems. The detection system consists of a prop and engine anti-icing master switch, two sets of detector units connected in parallel, indicator lights, a test switch, and control relays. Each set of detection units includes a probe; one is mounted in the No. 2 engine inlet air duct, and the other is in the No. 3 engine duct. The detection units are armed by DC power applied through the engine starting circuits, and they are operative when the No. 2 or No. 3 engine is running with the condition lever in the RUN position with approximately 40 knots of airflow across the probe and the prop and engine anti-icing master switch is at AUTO. If either probe becomes iced over while the engine in which it is installed is running, and if the prop and engine anti-icing master switch is at AUTO position at that time, the detection units trigger a control relay. This relay turns on the anti-icing and deicing systems if the switches for those systems are at ON or AUTO positions. The relay also turns on an indicator light. The ice detection system does not turn off the anti-icing and deicing systems automatically when icing conditions no longer exist, but the master switch can be held at RESET position momentarily to turn them all off simultaneously. Timers in the ice detection system operate after the No. 2 and No. 3 engines are shut down and disarm the detection system. If any of the anti-icing or deicing systems have been left in automatic operation, they are turned off upon disarming of the detection system at engine shutdown.

Propeller and Engine Anti-Icing Master Switch.

The prop and engine anti-icing master switch (figure 4-3) is located on the air conditioning control panel. It has three positions - AUTO, MANUAL, and RESET. When at AUTO position, it permits control of the radome anti-icing, engine inlet air duct anti-icing, and propeller anti-icing and deicing systems by the ice detection system. The AUTO position is also used to permit testing of the ice detection system. When at MANUAL position, the switch permits control of the anti-icing and deicing systems by the individual control switches for the systems. The RESET position is a momentary position used to turn off the anti-icing and deicing systems when icing conditions no longer exist. When the switch is positioned at RESET and allowed to return to AUTO, the ice detection system remains armed; therefore, it will automatically turn on the anti-icing and deicing systems again if it senses icing.

Test Switch.

The test switch (figure 4-11) is located on the ice detection panel on the engine control panel. It has No. 2 and No. 3 momentary positions and a center off position. It is used to test operation of the two sets of ice detector units by simulating detection of icing. If it is held at No. 2 position while the No. 2 engine is running and the prop and engine anti-icing master switch is at AUTO, the ON indicator light on the ice detection panel comes on to indicate that the ice detection system has triggered the control relay which turns on the anti-icing and deicing systems. The No. 3 position of the switch is used in the same manner to test operation of the other set of detector units. After the test switch is operated to either position, the prop and engine anti-icing master switch must be held at RESET momentarily to unlock the control relay and re-arm the detection system.

On Light and Extinguish Light Switch.

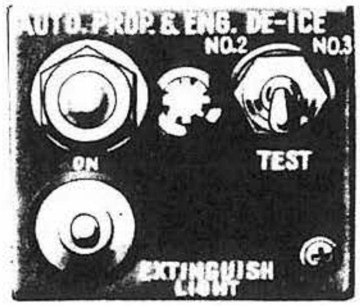
The on light and the extinguish light switch are located on the ice detection panel (figure 4-11). The indicator light is turned on by the ice detection system whenever it detects ice while the prop and engine anti-icing master switch is at AUTO. When lighted, it indicates that icing has been detected by probes in the engine inlet air scoops and that anti-icing and deicing systems have been turned on automatically if the individual system switches are at ON or AUTO. It also lights when the test switch is operated and then indicates that the detection units are functioning. The extinguish light switch can be operated to turn the light out. It is a momentary switch. Anti- and deicing systems will remain in operation when the switch is pressed to extinguish the light. If the prop and engine anti-icing master switch is held at RESET to turn off the anti-icing and deicing systems, the light remains off if icing no longer exists.

CAUTION

If the extinguish button is used, the reset switch must be used to turn off the prop and engine anti-icing and deicing before engine shutdown.

ice detection panel

AIRPLANES AF53-3129
THROUGH 55-0046



AIRPLANES AF56-0469
AND 56-0509

Figure 4-11.

PITOT TUBE AND STATIC BOOM ANTI-ICING SYSTEM.

Pitot tube and static boom anti-icing is provided by electrical heating elements in the tubes and booms. Power to the pitot tube heaters is controlled by the PITOT HEAT switch on the air conditioning panel. Pitot tube anti-icing is provided by DC electrical heating elements in the two tubes. The left pitot tube heater uses power from the flight station bus; the right pitot tube heater uses power from the isolated bus. This arrangement permits power to be drawn from the battery to heat the pitot tube serving the copilot's instruments when normal DC power sources have failed. Circuit protection for the right pitot tube is provided by the COPILOTS AND NAV PITOT HEAT circuit breaker on the main power distribution panel. Circuit protection for the left pitot tube is provided by the PILOTS PITOT HEAT circuit breaker on the flight station distribution panel. This circuitry also provides circuit protection and control of the static boom heater power. When the PITOT HEAT switch is ON, power from the isolated and flight station buses energizes two relays in the cargo compartment, allowing power from the 115-volt, 400-Hz, phase A and 115-volt, 400-Hz, phase B LK bus to flow through contacts of these relays to the static boom heaters. The two relays are located just aft of the ac generator No. 1 and No. 4 control wiring junction box. Circuit protection for the left static boom is provided by the PILOTS PITOT HEAT PWR circuit breaker, and circuit protection for the right static boom is provided by the NAV PITOT HEAT PWR circuit breaker. These circuit breakers are located on the main power distribution box.

ANGLE OF ATTACK/STALL WARNING SYSTEM WING TRANSMITTER DE-ICING SYSTEM (AIRPLANES MODIFIED BY T.O. 1C-130-708).

The wing transmitter deicing system is activated when the pitot heat switch is placed in the ON position. With the switch in the ON position, a small amount of power, isolated by a one amp fuse, is used to activate a relay which in turn connects the wing transmitter heat circuit breaker (located on the RH wing bus of the main power distribution box) to the wing transmitter deicing system.

Note

The angle of attack/stall warning system wing transmitter deicing system will not operate when the airplane's electrical circuits are operated on the isolated DC bus only.

WINDSHIELD ANTI-ICING SYSTEM.

The three windshields and two windows on each side of the windshields are NESA-type. On airplanes AF54-1623 and up, the two lower windows in front of the pilot are also NESA-type. These panels are heated by applying unregulated AC power from the left AC bus through transformers to elements between the layers of glass. The AC power is applied by automatic DC control systems which cycle so as to maintain window temperature within specific limits. A center windshield system controls heating of the three center windshields, and a side and lower system controls heating of the side and lower windows. The two systems are identical except for the amount of total AC power provided. Provisions are made for selecting either normal or high rate for the windshields. When high rate is selected, higher voltage is applied for shorter periods of time to the heater elements in the windows so that they heat more rapidly, but not to a higher temperature. Provisions are also made for controlling the temperature increase manually when the window panels are extremely cold. The control systems do not function automatically when window temperature is below approximately -45°F.

Nesa Windshield Switches.

The NESA windshield switches (figure 4-3) are on the air conditioning control panel. Each switch has NORMAL, OFF, and HI positions. When the center windshield switch is at NORMAL, the three center windshields are heated at normal rate. If the switch is positioned at HI, the three center windshields have high voltage supplied to the heater elements causing the temperature to rise more rapidly; and the heat is applied for a shorter period of time in each cycle. Heating of the side and lower windows is controlled in the same manner by the side and lower windshield switch.

Nesa Windshield Reset Switches.

The reset switches (figure 4-3) are located next to NESA windshield control switches on the air conditioning control panel. The purpose of the switches is to provide for manual control of windshield heating to raise the windshield temperature gradually from extremely cold temperature so as to prevent damaging the glass panels. If temperature of the windshield panels is below approximately -45°F the control systems do not function automatically. Pressing the reset switches causes the control systems to apply AC power to the windshield panels while the switches are held.

Normal Operation of Windshield Anti-icing System.

a. Always turn the NESA anti-icing switches to NORMAL before take-off. This will reduce thermal shock and the possibility of cracking the windshield.

Note

Use of normal anti-icing at altitudes below 12,000 feet improves the resistance of the windshields to damage from bird strikes.

CAUTION

Monitor operation of the anti-icing system by feeling the glass and observing whether ice is accumulating on any panels. Turn off the switch for either of the two systems if any of the following conditions is noticed:

Panels feel excessively hot.

Electrical arcing is observed in one of the panels.

One of the panels containing thermisters is not heating. This might cause overheating of other panels in the same system.

b. If ice is forming on the windshields at a rate higher than it can be removed by operating the anti-icing system with switches in NORMAL, set the switches to HI until out of the extreme icing conditions. Do not use the HI position of a switch when turning on a system initially.

c. When ambient temperature is below -43°C (-45°F), use the reset switch by operating it 5 seconds on, 10 seconds off with the NESA anti-icing switch in normal to raise the temperature of the windshield gradually until it is above approximately -45°F. The system will then function to control windshield temperature automatically.

CAUTION

Do not exceed the operating limits of 5 seconds on, 10 seconds off, when operating the reset switch with the switches in NORMAL. To do so might cause the windshield panels to be damaged.

NACELLE PREHEAT SYSTEM (Some Airplanes).

The nacelle preheat system allows hot air from the bleed air system to flow into any nacelle to heat the engine and nacelle equipment before starting the engine. A motor-operated valve and a diffuser in each nacelle control the airflow. The engine bleed air valve in a nacelle must be open before bleed air can flow to the preheat valve. The preheat valves are controlled by switches, one for each valve, at the flight station, and the valves are normally closed, energized open. The control circuits for the valves are energized by DC power supplied from the fuselage bus only while corresponding engine condition levers are at GROUND STOP or FEATHER position.

nacelle preheat control panel

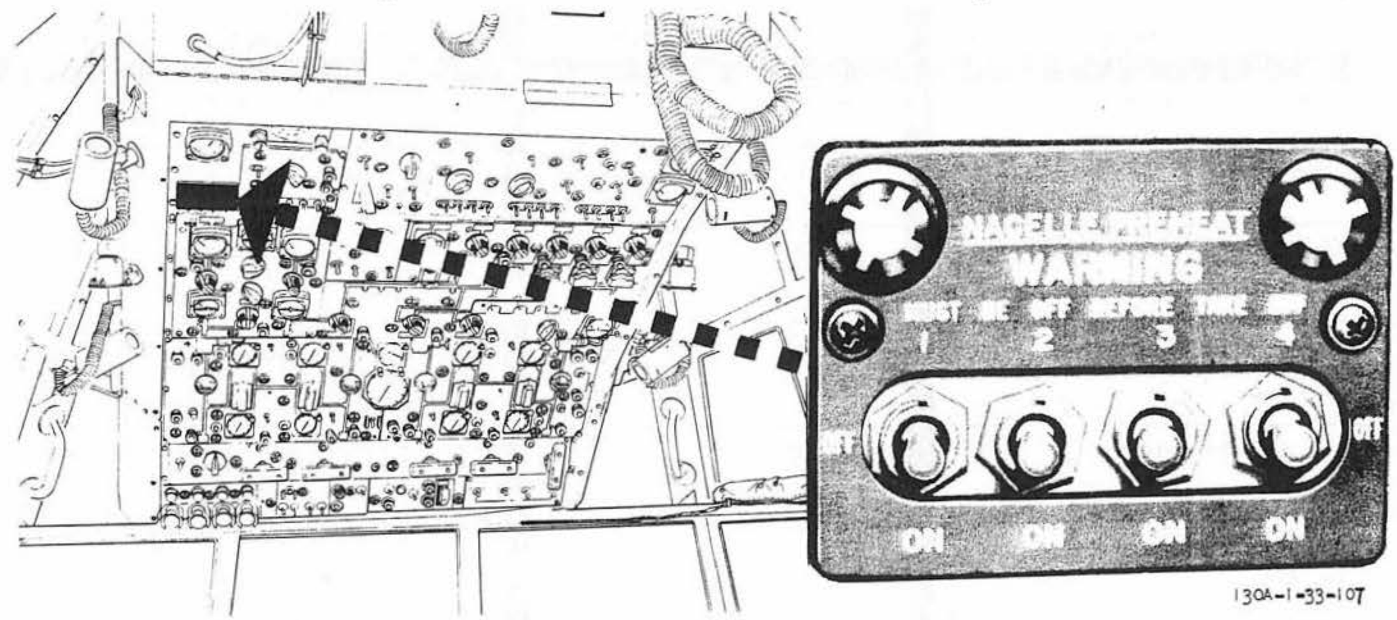


Figure 4-12.

NACELLE PREHEAT SWITCHES.

The four nacelle preheat switches are on a panel (figure 4-12) at the left end of the air conditioning control panel. Each switch has ON and OFF positions. When a switch is at ON and the corresponding engine condition lever is at GROUND STOP or FEATHER, the corresponding preheat valve is opened and remains open as long as the switch remains at ON.

NORMAL OPERATION OF NACELLE PREHEAT SYSTEM.

To prevent high engine turbine inlet temperature during engine starting at low ambient temperatures, the use of nacelle preheat is recommended when OAT is below -18° C (0° F). When preheating the nacelles, use air from the GTC and preheat all engines at one time to allow maximum dissipation of the air. This will allow air at moderate temperature to be applied to the engines and provide a gradual warming of the engine starting components. Apply preheat to the engines for 15 to 30 minutes before engine starting, depending upon ambient temperature. Do not use engine bleed air for nacelle preheat if bleed air from the GTC is available. Be especially careful when using engine bleed air for preheat, as the high temperature of the engine bleed air (approximately 600°F) can cause damage to the electrical cables and electronic components if applied for more than a very short period of time.

1. Start GTC, pressurize bleed air manifold, and position the condition lever for the engine to be preheated to GROUND STOP.

2. Position the engine bleed air valve switch for that engine to OPEN and the corresponding nacelle preheat switch to ON.

3. To stop preheat, position the nacelle preheat switch to OFF.

WARNING

Never position a nacelle preheat switch to ON in flight. Because of the interconnection of nacelle preheat control circuits, operation of a nacelle preheat switch can cause one or more engines to be shut down if any engine condition lever is at GROUND STOP or FEATHER. Nacelle preheat is not required for any in flight operation.

COMMUNICATION AND ELECTRONIC EQUIPMENT.

See figure 4-13 for the table of communication and associated electronic equipment and figure 4-27 for antenna locations.

table of communications and

TYPE	DESIGNATION	FUNCTION
Intercommunication Equipment	AN/AIC-18/AIC-25	Crew Intercommunication
VHF Command Radio	Collins VHF-101	Two-Way Voice Communication In the Range of 116.00 to 149.95 mc
UHF Communication System	AN/ARC-34C AN/ARC-164V	Voice Transmission and reception in the range of 225 to 399.95 MHz
UHF Communication System	AN/ARC-133(V)	Plain and secure voice communication in the range of 225 to 399.9 MHz
HF Communication System	HF-103	Two-way voice communication in the range of 2 to 30 MHz
VHF/FM Transceiver System	FM-622	Two-way voice communication in the range of 30.00 to 75.95 MHz (FM1 also has homing provisions; FM2 has secure voice capability)
Radio Compass	AR/ARN-6	For Homing and Bearing; also Receives Voice and Code Signals
Marker Beacon Receiver	AN/ARN-12	Receives Location Marker Signals
VOR Receiver	AN/ARN-14	Reception of All VHF VOR, Tone Localizer and Voice Facilities in the 108 to 135.9 Megacycle Range
Tacan	AN/ARN-21	Receives Bearing and Distance Information
Glideslope Receiver	AN/ARN-18	Receives glideslope Information for Vertical Guidance In I.L.S. Operation
Direction Finder	AN/ARA-25	Homing on UHF Transmitter
Radio Altimeter	SCR-718	To Determine Absolute Altitude of Airplane Above the Terrain
Radar Altimeter	AN/APN-22	Indicates Absolute Altitudes of Airplane Above the Terrain
Search Radar	AN/APN-59	Navigation and Search Radar
Doppler Radar	AN/APN-147	Provides Continuous Ground Speed and Drift Angle Information While Airplane is in Flight

Figure 4-13. (Sheet 1 of 6)

associated electronic equipment

POWER SOURCE (BUS ONLY)	RANGE	LOCATION OF CONTROLS
Isolated Bus	Crew Stations Within the Airplane	Crew Stations
DC Radio Bus and Left-Hand AC Bus	Line of Sight	Flight Control Pedestal
DC Radio Bus	Line of Sight	Control pedestal
DC Radio Bus	Line of Sight	Right copilot's panel
Main DC Bus, Left-Hand AC Bus, and Regulated 115-volt, 1 ϕ AC Bus	100-2500 miles	Navigator's control panel - HF-1, control Pedestal-HF-2
DC Radio Bus	Line of Sight	Right copilot's control panel - FM-2, Navigator's control panel - FM-1
DC Radio Bus	200 Miles, Depending on Frequency and Time of Day	Flight Control Pedestal, Navigator's Control Panel
DC Radio	Any Altitude	Hi-Lo Switch on Pilot's Instrument Panel
DC Radio Bus	Localizer-45 Miles, Omni-100 Miles Depending on Altitude	Flight Control Pedestal
DC Radio Bus and Regulated 115-Volt, 1 ϕ AC Bus	199 Miles Line of Sight, Depending on Altitude	Flight Control Pedestal
DC Radio Bus and Left-Hand AC Bus	15 Miles	Automatically Controlled from VHF Nav Panel
DC Radio Bus	Line of Sight	Flight Control Pedestal
Left-Hand AC Bus	40,000 Feet Altitude	Navigator's Station
DC Radio Bus and Left-Hand AC Bus	10,000 Feet Altitude	Pilot's Instrument Panel
DC Radio Bus, Left-Hand AC Bus, and Regulated 115-volt 1 ϕ AC Bus	240 Miles	Navigator's Control Panel
Left-Hand AC Bus and Flight Station DC Bus	Ground Speed 0 to 999 Knots; Drift Angles to 40 Degrees Either Side (Limited by Airplane Structure)	Navigator's Station

Figure 4-13. (Sheet 2 of 6)

table of communications and

TYPE	DESIGNATION	FUNCTION
Doppler Computer	AN/ASN-35	Displays Distance in Nautical Miles on Distance to Destination and Cross-Track Deviation
Loran	AN/APN-70 B	Navigation
IFF	AN/APX-72 AIMS	Provides Automatic Radar Identification, Position, and Altitude Information to Interrogating Ground Stations
Inertial Navigation System	LTN-51	Inertial Targeting and Navigation
Radar Set	AN/APQ-150	Search for, acquire and track I-band radar beacons
X-Band Radar Transponder	SST-181XE	Provides air to-ground identification beacon in the frequency range of 9310 to 9415
LORAN-C/D	AN/ARN-92	Long range navigation
Speech Security System	KY-28	Provide secure voice communication
Radar Warning Receiver (RWR)	AN/ALR-46(V)	Radar Warning Indication
Jammer	Trim-7	ECM
ECM POD	AN/ALQ-87	ECM
Flare Ejector System	AN/ALE-20	Flare Ejector
Moving Target Indicator	- - -	Target Acquisition
40 KVA Light Set	AN/AVQ-8	Visible and IR Illumination
Flare Launcher	LAU-74/A	Provides Target Illumination and Self Protection
FCS Inverter		Primary Power for the FCS
Attitude Indicating System (2 Axis Gyro)	A24G	Backup Heading and Attitude Reference to the FCS
Fire Control Computer	AYK-9	Navigation/Fire Control
Fire Control Display		Fire Control Data Presentation
Sensor Angle Display		Sensor Look Angles

Figure 4-13. (Sheet 3 of 6)

associated electronic equipment

POWER SOURCE (BUS ONLY)	RANGE	LOCATION OF CONTROLS
Received Through the Doppler Radar System	999 Nautical Miles; Cross-Track to 99.9 Nautical Miles	Navigator's Station
DC Radio Bus and Left-Hand AC Bus	700 to 900 Miles During Day; Up to 1,400 Miles at Night	Navigator's Station
DC Radio Bus and Left-Hand AC Bus		Flight Control Pedestal or Navigator's Station
Left-Hand AC Bus	- - -	FCO Console
Main DC Bus and Left-Hand AC Bus	2000 ft to 10 miles	EWO Console
DC Radio Bus	Minimum 100 miles	Navigator's control panel
Main DC Bus, Right-Hand AC Bus, Left-Hand AC Bus		Navigator's control panel
DC Radio Bus	- - -	Right copilot's control panel
LH AC, Main DC	- - -	EWO Console, Copilot Panel
LH AC, Main DC	- - -	EWO Console
No. 1 AC Generator; No. 4 AC Generator	- - -	EWO Console
Main DC	- - -	Co-Pilot Station, FE Station, Right Scanner, I.O. Station
LH AC, Main DC	- - -	Navigator Console
No. 1 AC Generator; No. 4 AC Generator	- - -	Flight Deck and Ramp
DC Battery Bus, Main DC	- - -	Ramp
Main DC	- - -	Navigator Console
RH AC or FCS Inverter	- - -	Navigator Console
RH or FCS Inverter Main DC	- - -	Navigator Console
Main DC, Right-Hand AC or FCS Inverter	- - -	Navigator Console
Main DC	- - -	Left Side of Pilot, FCO Console, IR/BC Console and TV Console

Figure 4-13. (Sheet 4 of 6)

table of communications and

TYPE	DESIGNATION	FUNCTION
Slave Switching Unit		Provides Sensor Automatic Slaving
Video Tape Recorder	AN/AXH-2	Record LLLTV and IR Imagery and FCO Interphone Audio
LLLTV	AN/AXQ-10	Target Acquisition
Laser Illuminator	AN/AAQ-7	Laser Illumination and Ranging
LTD	AN/AVQ-18	Laser Target Designator
2 KW Light	AN/AVQ-17	Provides Target Illumination
IR	AN/AAD-7	Target Acquisition
Black Crow	AN/ASD-5	Target Acquisition
Pilot's Gunsight		Target Sighting System

Figure 4-13. (Sheet 5 of 6)

INTERCOMMUNICATION SYSTEM, AN/AIC-18/AIC-25.

The AN/AIC-18/AIC-25 intercommunication system provides intercommunication between the crewmembers. Control panels are located at the following positions pilot, copilot, flight engineer, navigator, scanner, fire control officer, TV operator, IR operator, electronic warfare officer (EWO), illuminator operator, and gunners. Interphone monitor panels are located at the pilot's, copilot's and navigator's positions. Two MIC TRANSFER panels are located on the control pedestal and one is located at the navigator's station. Operating power is 28-volt dc and overload protection is supplied by circuit breakers on the radio junction box. Interphone communication is available with loss of dc power through the isolated bus as long as the battery switch is ON and battery is charged.

Intercommunication Set Control.

The intercommunication set control (figure 4-14) contains a seven-position rotary transmission selector switch, eight combination monitor switch-volume control, a VOL control, a CALL button, and a "HOT" microphone switch. The transmission selector switch provides transmission with side tone of the selected transmitter. The monitor switch-volume controls are push-pull-on-off switches that rotate to regulate the volume of the individual signal. The VOL control adjusts the level of all audio circuits incoming to the particular control panel. The CALL button enables emergency communication to all crew stations regardless of interphone position selected. When call button is pressed, all radio receivers are disconnected from the main intercommunication panels and all intercommunication stations are connected to the calling station with a 6db louder signal. The "HOT" microphone switch permits intercommunication between the crew stations without use of the microphone button. The control panel is illuminated by two panel lights with the intensity of illumination controlled by a panel light rheostat.

Monitor Panel.

The monitor panel (figure 4-14) contains eight combination monitor switch-volume controls mounted on the front panel. The monitor switch-volume controls are push-pull switches which rotate to provide individual volume control of the signal being received. The monitor panel contains no amplifiers and cannot be used individually. PVT 1 on the EWO's panel is audio for the EWO on some aircraft.

MIC TRANSFER PANELS.

Three MIC TRANSFER panels (figure 4-14) are installed in the airplane. The panels in the control pedestal contain HF1/HF2 and UHF1/FM1 toggle switches which connect the respective communication system to the pilot's and copilot's intercommunication set controls. The panel at the navigator's station contains UHF1/FM1, HF1/HF2, and PVT1/PVT2 toggle switches which connect the respective communication function to the navigators's illuminated by panel lights with the intensity of illumination controlled by a panel light rheostat.

associated electronic equipment

POWER SOURCE (BUS ONLY)	RANGE	LOCATION OF CONTROLS
LH AC, Main DC	- - -	Navigator Console
LH AC, Main DC	- - -	FCO Console
Main DC, LH AC	- - -	TV Operator Console
Main DC	- - -	TV Operator Console
Main DC, RH AC	- - -	TV Operator Console
Main DC, RH AC	- - -	TV Console
LH AC, Main DC	- - -	IR Operator Console
RH AC, Main DC	- - -	EWO Console
RH AC or FCS Inverter	- - -	Left Side of Pilot

Figure 4-13. (Sheet 6 of 6)

Microphone Switches.

A foot-operated microphone switch is located at the following positions - flight engineer, navigator, TV operator, IR operator, EWO, and FCO. Pressing the switch energizes the respective microphone for transmission on the facility selected on the wafer switch of the crewmember's intercommunication set control. A pushbutton microphone switch is installed on the pilot's and copilot's control wheels, and on the IR operator's gimbal position control (slew stick). The microphone switch on the slew stick is for main interphone system only. At other positions the microphone switches are located on the plug connector on the microphone cord. The IO and forward scanner microphone cords have a call button as well as a microphone switch.

VHF COMMAND RADIO (COLLINS VHF 101)

The VHF communication system consists of a VHF transmitter, a VHF receiver and a control unit. The VHF system provides communication facilities in the frequency range of 116.00 to 149.95 megacycles with reception possible up to 151.95 megacycles. There are 680 crystal-controlled channels available for transmission and 720 channels available for reception; all channels may be selected at intervals of 50 kilocycles from the control panel (figure 4-15) located on the pedestal. The VHF command radio receives 28-volt DC power from the radio bus through the vhf xmtr and rcvr circuit breakers located on the radio junction box. The VHF system also receives 115-volt, 400 cycles. A-phase, AC power from an AC bus through the vhf xmtr and rcvr fuses located on the radio junction box.

VHF Command Radio Controls

A panel (figure 4-15) on the flight control pedestal provides operating control for the VHF command radio. The controls consist of a frequency indicator, a power on-off switch, an scs-dcs/dcd switch, two frequency selector knobs, and a dual control for squelch and volume control. The two frequency selector knobs are used to select an operating channel. The selected frequency appears as a direct reading number (in megacycles) in the frequency indicator window. The power on-off switch controls the power application to the system. The vol control is provided to adjust the receiver volume level in the interphone system. The sq control is provided to adjust the squelch threshold on the receiver output. The scs-dcs/dcd switch is provided to select the mode of operation. When SCS (single-channel-simplex) is selected, the receiver and transmitter are tuned to the same frequency and the receiver is disabled during operation of the transmitter, thereby restricting operation to either transmission or reception on the assigned channel. When DCS/DCD (double-channel-simplex/double-channel-duplex) is selected, the operation is the same as scs, except that the transmitter is automatically tuned to a frequency that is six megacycles above the receiver frequency indicated on the control panel.

The VHF command radio system has been modified by the addition of a top antenna and a VHF ANTENNA SELECT panel to enable normal use of the VHF101 and AN/AAD-7 systems simultaneously without interference to the AN/AAD-7 display.

Note

> Use of the lower antenna when transmitting in certain frequencies causes severe interference to the AN/AAD-7 display presentation.

On those missions where the optimum AN/AAD-7 is desired, the top VHF antenna selection should be made by the navigator. Should the AN/AAD-7 operation not be required, or when the line of slight condition requires the use of the bottom VHF antenna, it should be selected and the subsequent potential degradation of the AN/AAD-7 display accepted. Selection of the antennas is made available by the TOP-BOTTOM switch on the VHF ANTENNA SELECT panel which is located at the navigator's console (figure 4-29). Power of 28-volt dc is supplied to the ANTENNA SELECT panel through the VHF RCVR circuit breaker located on the radio junction box.

Normal Operation of the UHF Command Radio

To put the UHF command radio into operation:

1. Place the power switch in the ON position.
2. Allow one minute for warmup.
3. Select the mode of operation desired (SCS or DCS).

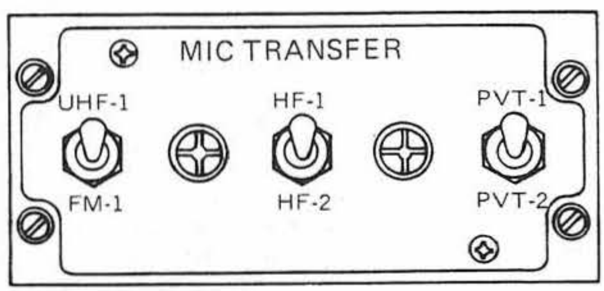
Note

> When operating in SCS, all transmissions and voice communications will be on the frequency indicated on the control panel. When operating in DCS, the receiver frequency is indicated on the control panel and the transmitting frequency will be automatically tuned 6 megacycles higher than the receiving frequency.

4. Select the desired operating frequency.
5. Adjust the SQ and VOL control as necessary to obtain a comfortable reception level.
6. To receive, place the vhf comm mixer switch on the intercommunications control panel in the ON (up) position.

intercommunication controls

PILOT, COPILOT

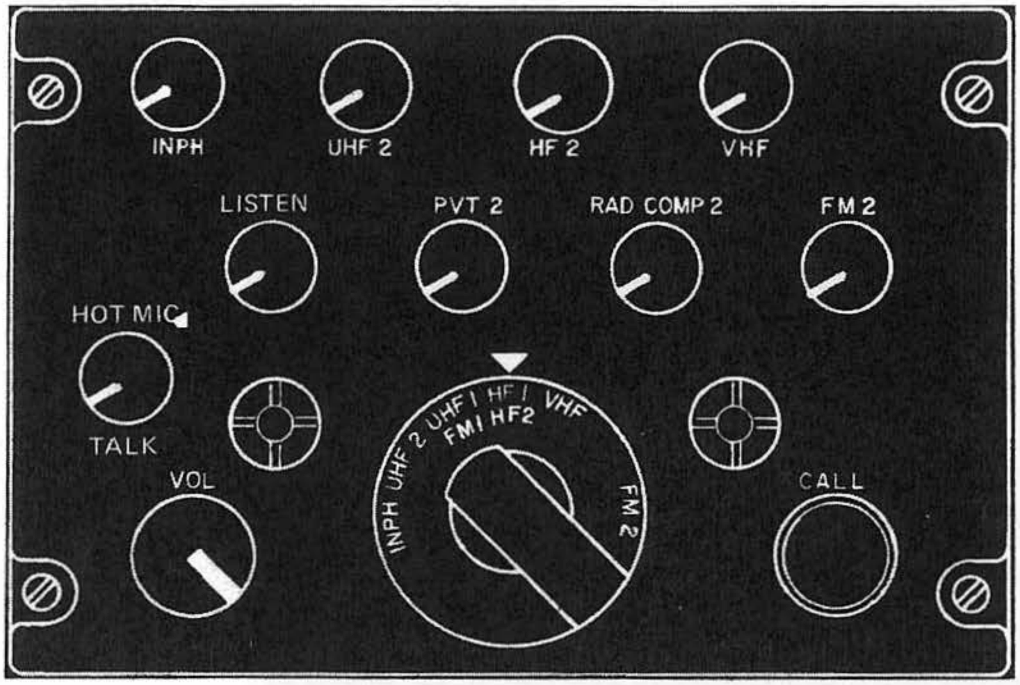


NAVIGATOR

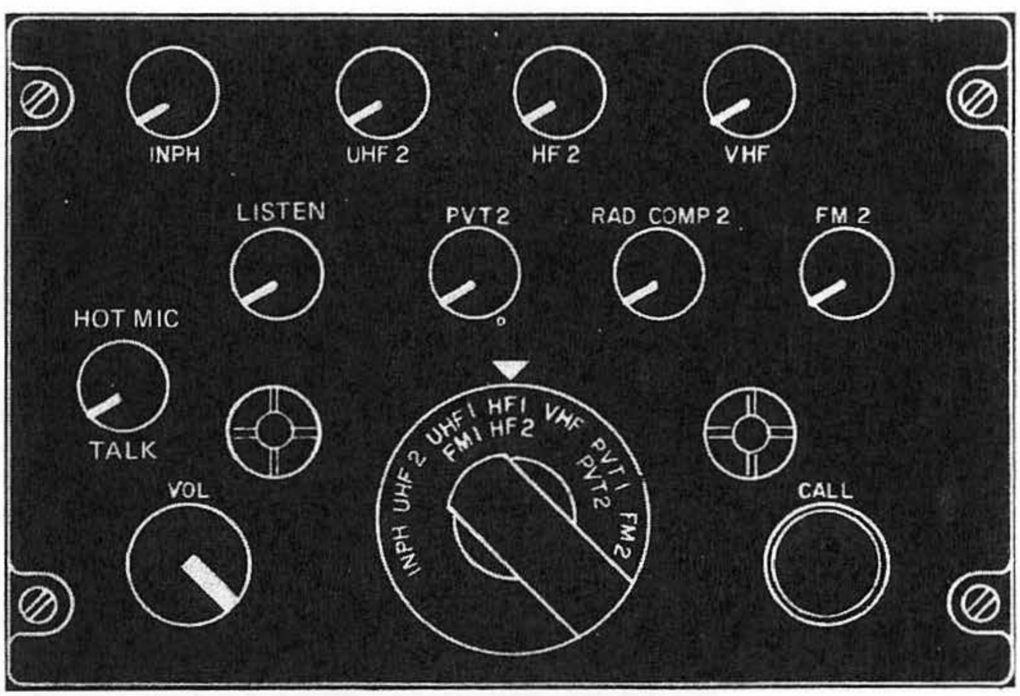
PILOT, COPILOT AND NAVIGATOR

Figure 4-14 (Sheet 1 of 3).

intercommunication controls (cont)



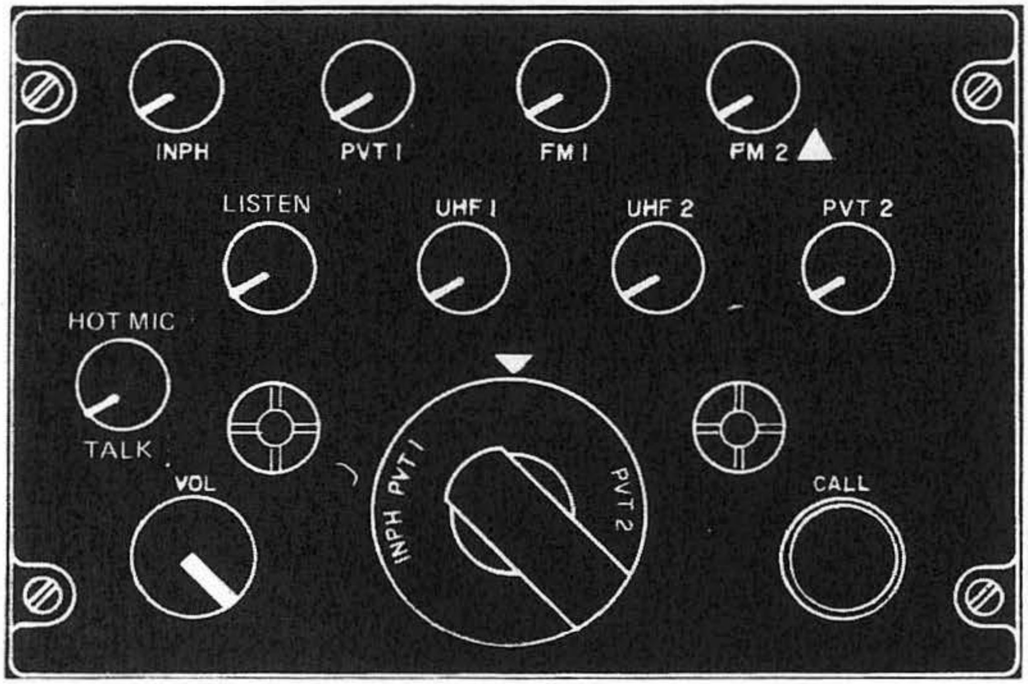
NAVIGATOR



PILOT AND COPILOT

Figure 4-14 (Sheet 2 of 3).

intercommunication controls (cont)



⚠1 ON ALL BUT FLIGHT ENGINEER'S, THIS SWITCH PLACARDED VHF

FLIGHT ENGINEER
FIVE WEAPON MECHANICS' POSITIONS ILLUMINATOR OPERATOR IR OPERATOR AND EWO OPERATOR
TV OPERATOR

FIRE CONTROL OFFICER

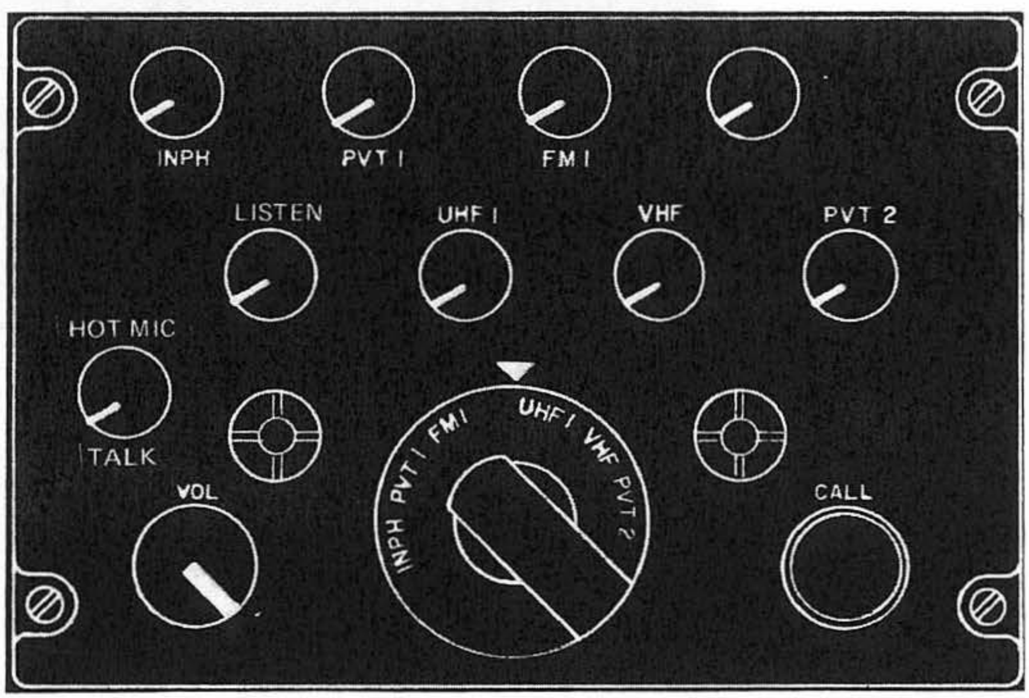


Figure 4-14. (Sheet 3 of 3)

7. To transmit, place the transmission selector switch on the intercom panel in the VHF COMM position.

To turn the VHF command radio off:

8. Place the power switch in the OFF position.

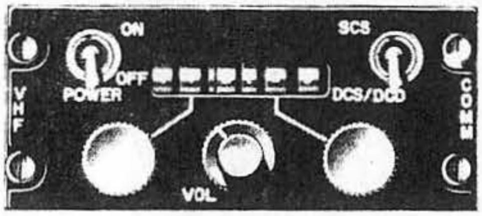


Figure 4-15.

UHF 1 COMMUNICATION SYSTEM, AN/ARC-34C

The AN/ARC-34C UHF communication system is designated UHF 1 and is used to transmit and receive amplitude modulated signals in the frequency range of 225.00 to 399.95 MHz on any one of 3500 selectable frequencies in steps of 1/100 of a megacycle. Receiver and transmitter tuning is automatically completed after a frequency change. Two receivers, a main receiver and a guard receiver, are used. The main receiver tunes to any selected frequency; the guard receiver remains on the guard frequency. The UHF command radio operates from 28-volt DC power through a circuit breaker located on the radio junction box.

UHF Command Radio Controls

The UHF command panel (figure 4-16) located on the flight control pedestal provides operating control of the UHF command radio. Any one of 20 preset, crystal-controlled channels may be selected by the large, centrally located selector knob. Any frequency in the operating range may be manually selected by the four knobs located across the top of the set. The setting of the three-position (MANUAL, PRESET, GUARD) rotary selector switch determines whether a manual or a preset channel is being used. In GUARD position, the transmitter and the main receiver, as well as the guard receiver, are tuned to the guard frequency. A four-position (OFF, MAIN, BOTH, ADF) function switch on the right side of the panel is used to turn the set on and to control receiver operation. (ADF position is used to supply signals to the AN/ARA-25 UHF direction finder.) A tone button and a volume control are also provided.

Normal Operation of the UHF Command Radio

To put the UHF command radio into operation:

1. Place the function switch in any position except OFF.

2. Allow one minute for warmup.

3. Select a channel, using preset knob or manual set knobs.

Note

It is possible to set the preset knob or the manual frequency-selector knobs for frequencies below 225.0 megacycles. Since this is below the operating frequency range of the set, the automatic-tuning mechanism cannot tune. The mechanism will remain on for approximately two minutes, then will be turned off by a protective relay.

4. To receive, place the UHF comm mixer switch in the ON (up) position.

5. To transmit, place the transmission selector switch to the COMM UHF position.

To turn the UHF command radio off:

6. Place the function switch in the OFF position.

Emergency Operation of UHF Command Radio

When the equipment fails in some function, the remaining workable functions may satisfy minimum requirements for operation. If transmission on a preset channel is not possible, attempt to use a manually selected channel or guard frequency. If reception fails on a selected channel, attempt to receive on guard frequency.

Note

When operating UHF command radio under emergency conditions, set the manual preset switch to GUARD and the function switch to MAIN. Do not use the BOTH position since the noise from the two receivers may make the incoming signal unintelligible.

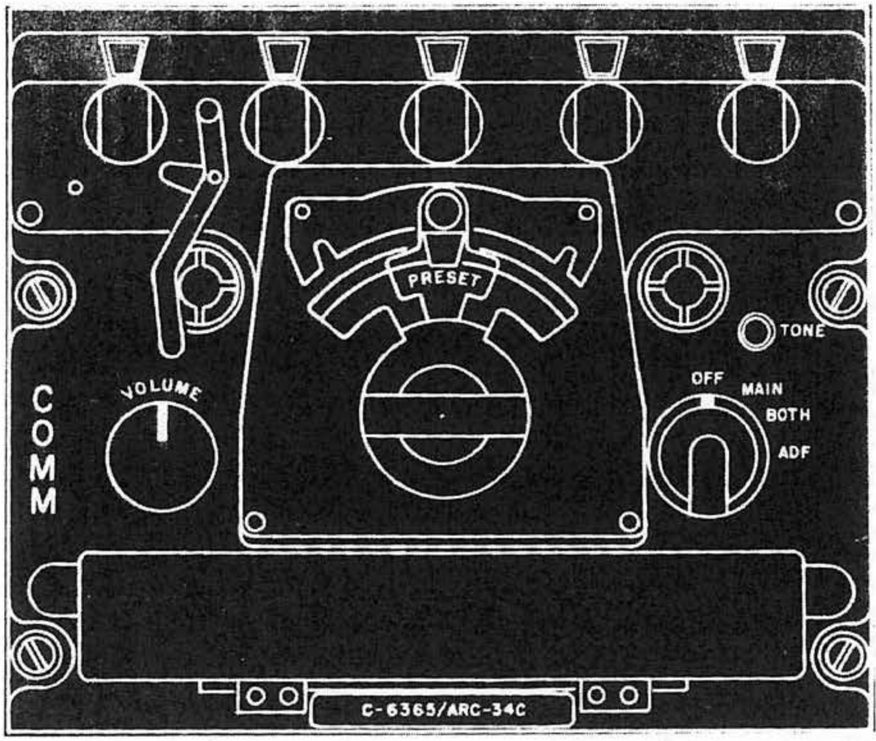
Note

If continuous recycling of the receiver-transmitter occurs, turn the set off, and check the preset or manually set frequency being used. It is possible to set the preset buttons or the manual frequency selector knobs for frequencies below 225.0 megacycles. Since this is below the operating frequency range of the set, the automatic-tuning mechanism cannot tune. Set the channel to the proper frequency, and set the function switch to the position for the type of operation desired.

UHF COMMAND RADIO (AN/ARC-164(V))

The UHF command radio provides voice transmission and reception in the frequency range of 225.000 to 399.975 megahertz, with 7000 frequencies available in steps of .025 megahertz. Receiver and transmitter tuning is accomplished automatically after a frequency change. A main receiver and a guard receiver are used in each system. The main receiver tunes to any selected frequency; the guard receiver remains tuned

uhf-1 communication system controls



UHF 1 CONTROL UNIT

UHF 1 ANTENNA SELECT PANEL

Figure 4-16.

to a guard frequency. In addition, the UHF radio set is capable of automatic direction finder (ADF) reception. The UHF command radio system is supplied with 28-volt dc power from circuit breaker on the radio junction box. Electrical power is supplied through the main DC bus from the radio bus.

UHF Command Radio Controls

COMMAND CONTROL PANEL. (See figure 4-17.) The three-position (MANUAL, PRESET, GUARD) frequency mode selector switch, located on the right side of the control panel, is used to select the type of frequency control desired. With the switch positioned to PRESET, the preset channel selector knob, located at the top right of the control panel, can be used to select any one of 20 preset frequencies. The preset channel selected is displayed on the CHAN readlout indicator to the left of the preset channel selector knob. When the frequency mode selector switch is positioned to MANUAL, the five manual selector knobs, located across the top of the control panel, can be used to select any one of 7,000 frequencies in the operating range. The manual selector knobs (the 0.025 megahertz knob is inoperative) control the digits making up the desired frequency. Each of the digits appears in a window above the associated knob. When the selector switch is positioned to GUARD, reception and transmission are on the guard frequency.

NOTE

The GUARD position of the frequency mode selector switch should not be used except in actual emergencies.

The four-position (OFF, MAIN, BOTH, ADF) function selector switch on the left side of the control panel turns the radio set on and determines whether the main or the guard receiver is being used in conjunction with the transmitter. When the switch is positioned to MAIN, the main receiver and the transmitter are ready for use, and the guard receiver is inoperative. If the function selector switch is at MAIN and the frequency mode selector switch is at GUARD, the main receiver and the transmitter will be ready for use on the guard frequency. With the function selector switch positioned to BOTH, the main receiver, guard receiver, and the transmitter are all ready for use; the main receiver and transmitter are ready for use on the selected frequency and the guard receiver monitors the guard frequency. When the function selector switch is positioned to ADF, the guard receiver is disabled and the main receiver is switched to the UHF direction finder antenna. When the switch is in this position, the transmitter will tune to the manual, preset, or guard frequency, depending on the position of the frequency mode selector switch, but the switching arrangement within the command control panel is such that no transmissions can be made. When the function selector switch is in any position other than ADF or OFF, the tone button at the bottom of the control panel can be used to transmit a continuous wave tone modulated at 1,020 Hz. Pressing the tone button energizes the transmitter and an audio oscillator.

A volume control knob, located at the bottom center of the control panel, is used to adjust the level of the audio signal. The two-position (ON, OFF) squelch switch enables (ON position) or disables (OFF position) the main and the guard receiver squelch.

ANTENNA SELECTOR PANEL. (See figure 4-16.) The antenna selector panel for each UHF command radio is equipped with a single toggle-type switch which can be set to one of three positions: TOP, AUTO, or BOTTOM. The switch permits manual selection of operation through the top-mounted antenna; automatic selection of the antennas is achieved by placing the switch at the center (AUTO) position.

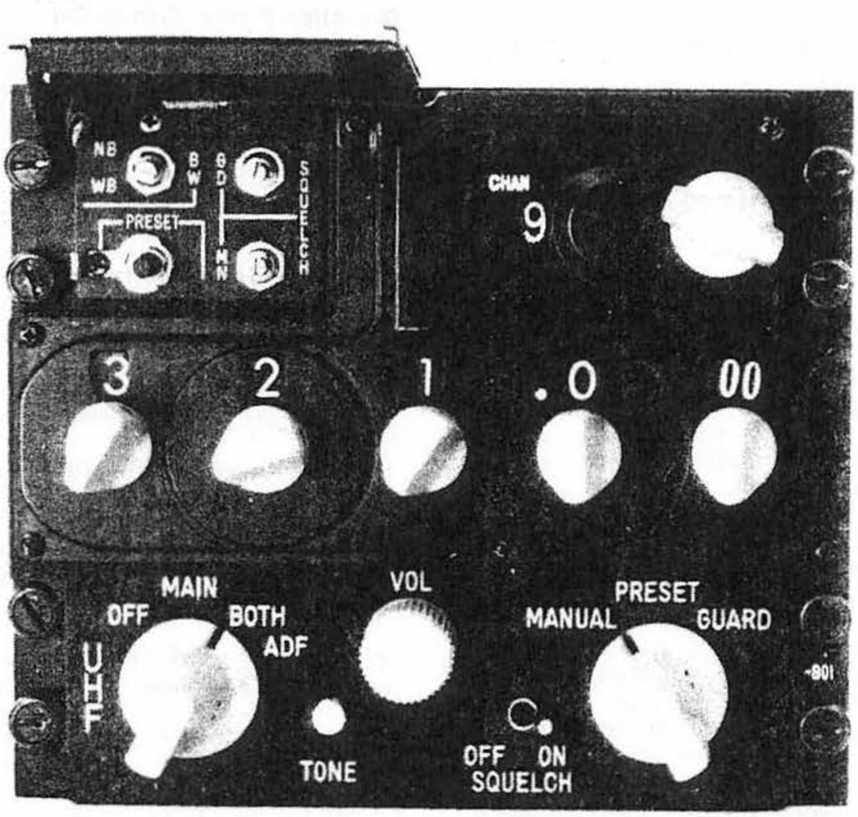


Figure 4-17.

Note

Due to unreliable operation of the automatic antenna selector, it is recommended that the antenna selector switch not be placed in AUTO.

Normal Operation of the UHF Command Radio

To put the radio into operation, proceed as follows:

1. Place the function selector switch for the selected radio to any position except ADF or OFF allow 1 minute for warmup.

2. Select a channel, using the preset channel selector knob or the manual selector knobs.

3. To receive, actuate the respective UHF monitor switch on the intercommunication system control panel.

4. To transmit, place the rotary transmission selector on the intercommunication system control panel to UHF.

5. Select the desired antenna for the radio being operated by placing the antenna selector switch to TOP or BOTTOM.

To turn the UHF command radio system off, place the function selector switch to OFF.

Emergency Operation of UHF Command Radio

Note

When operating a UHF command radio under emergency conditions, set the frequency mode selector switch to GUARD and the function selector switch switch to MAIN. Do not use the BOTH position, since the noise from the two receivers may make the incoming signal unintelligible.

The dual installation of the UHF command radio systems should make emergency operation of the radio unnecessary, since a malfunctioning radio could be switched off and the remaining radio operated in its place. If the equipment fails in some particular function, the remaining workable functions may satisfy minimum requirements for operation. If transmission on a preset channel is not possible, an attempt may be made to use a manually selected channel or the guard frequency. If reception fails on a selected channel reception on the guard frequency may be tried.

UHF 1 Antenna Selector

The antenna selector, located in the lower outboard radio rack, provides automatic selection of the top or bottom antenna for the UHF 1 communication system. The selector is operational when the UHF 1 ANTENNA SELECT panel switch is set to AUTO.

UHF 1 Antenna Selector Panel

The antenna select panel (figure 4-16), located on the pilot's pedestal, provides manual top, bottom, or automatic antenna selection for the UHF 1 system.

Circuit protection is provided by the UHF 1 ANT SEL circuit breaker on the radio junction box.

UHF DIRECTION FINDER GROUP (AN/ARA-25).

A direction finder group is used to indicate the relative bearing of, and to home on, radio signals being received by the UHF AN/ARC-34 or AN/ARC-164V command radio. Continuous indication of relative bearing is provided by the No. 1 pointer of the ID-1103/ARN Bearing Distance Heading Indicator (BDHI) located on the pilot's instrument panels, and by the No. 1 pointer of the ID-250/ARN radio magnetic indicatior (RMI) located on the copilot's instrument panel (figure 4-23). The UHF direction finder operates from 28-volt DC power through a circuit breaker in the radio junction box.

Direction Finder Group Controls

The direction finder group is controlled from the UHF command panel (figure 4-16 through 4-18) on the flight control pedestal. The direction finder is turned on by placing the function switch of the UHF command set in the ADF position. The operating frequency of the direction finder is selected on the UHF command panel.

Normal Operation of the Direction Finder Group

HOMING. Home on UHF radio stations as follows:

1. Rotate the function switch on the UHF command panel to the ADF position.

2. Select operating frequency on UHF command panel.

3. Turn the airplane until the arrow of the No. 1 pointer of the radio magnetic indicator points to the fixed index mark at the top of the instrument.

4. Turn off, move the function switch on the UHF command panel from the ADF position.

DIRECTION FINDING. Perform direction finding as follows:

1. Rotate the function switch on the UHF command panel to the ADF position.

2. Select the operating frequency on the UHF command panel.

3. Observe the direction of the received signal, as indicated on the azimuth scale of the radio magnetic indicator by the No. 1 pointer.

4. To turn off, move the function switch on the UHF command panel from the ADF position.

Emergency Operation of the Direction Finder Group

The direction finder group has no provision for emergency operation. If a fault in the direction finder interferes with operation of the UHF command radio, remove the P-101 power plug from J-101 on the front panel of the AM-608/ARA-25 electronic control amplifier. This amplifier is located on the lower inboard radio rack (figure 4-28), and is easily reached.

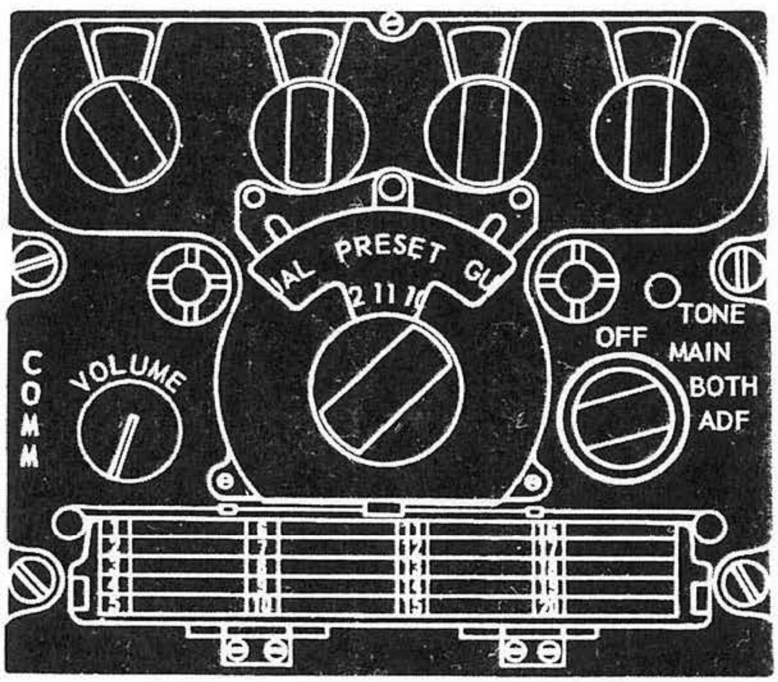
COMMUNICATION SYSTEM, (AN/ARC-133(V)

The AN/ARC-133(V) UHF communication system is designated as UHF 2. (Figure 4-18). This system provides secure or plain voice communications in the frequency range of 225.0 to 399.9 MHz on any of 1750 selectable frequencies. Frequency selection knobs are provided to set an operating frequency manually without disturbing any of the preset frequencies. The system consists of a receiver-transmitter, control unit, antenna select panel, and two antennas. This communications system functions and operates the same as the AN/ARC-34. Power of 28-volt dc for system operation is provided from buses in the radio junction box. Circuit protection is provided by the UHF NO. 2/ARC-133 circuit breaker on the radio junction box.

UHF 2 Antenna Select Panel

The antenna select panel (figure 4-18), located on the copilot's side panel, provides top or bottom antenna selection for the UHF 2 system. This panel is located directly above the UHF 2 (AN/ARC-133(V)) radio control unit (figure 4-18). Circuit protection (28-volt dc) is provided by the UHF 2 ANT SEL circuit breaker on the radio junction box.

uhf-2 communication system controls



UHF 2 CONTROL UNIT

UHF 2 ANTENNA SELECT PANEL

Figure 4-18.

VHF/FM TRANSCEIVER SET, FN-622A

There are two VHF/FM communications systems installed on the airplane, FM 1 and FM 2. The VHF/FM transceiver is used to transmit and receive frequency modulated (FM) signals between the airplane and ground stations or other airplanes. FM transmission and reception is possible on any one of 920 crystal-controlled channels in the band from 30.00 to 75.95 MHz. In addition, the FM 1 system homes on any radio signal in the tuning range and sensitivity of the system. The instrument approach indicator presents homing information to the pilot. Homing is automatically interrupted for voice communication from the aircraft and is resumed when transmission is complete. The FM 2 system consists of a transceiver, a control panel, and an antenna. The FM 1 system has a transceiver, instrument approach indicator, control panel and two antennas. FM 2 system has secure voice capability. The No. 1 FM set control is located at the navigator's position and the No. 2 FM control is at the copilot's position. Remote control of the transceiver is accomplished by the knobs on the control panel. Both transmission and reception are on the same frequency using the same antenna. Power for operation of the set is 28-volt dc through the FM NO. 1/622 and FM NO. 2/622 circuit breakers on the radio junction box.

VHF/FM Controls and Indicators

CONTROL PANEL. There are two control panels installed in the airplane. The control panel (figure 4-19) contains all controls necessary for complete remote control operation of the transceiver. Four rotary selector knobs are used for frequency selection. Two of the knobs are used to adjust the frequency in 10 MHz and 1 MHz steps. The other two knobs adjust the frequency in 100 kHz and 10 kHz steps. A SQUELCH selector switch and VOL control are provided to control the audio. The SQUELCH selector switch has three positions: DIS (disabled, squelch not operating), CARR (operated by carrier signal), and TONE (operated off a signal containing a 150 Hz tone modulation). During normal FM operation the CARR position is selected. If, by prior arrangement, both the transmitting and receiving FM operators have agreed to use the TONE position, then TONE must be selected. The 150 Hz tone signal is then used to unsquelch the receiving radio set. The mode selector switch is used to energize the transceiver. The T/R position is connected to control the reception and transceiver mode of operation on both systems. The RETRAN position is not operative on either set. The HOME position is operative only on FM No. 1.

INSTRUMENT APPROACH INDICATOR, ID-48. This instrument (figure 4-19) is installed on the pilot's flight panel. The vertical needle of the indicator indicates left, right, or on-course position. The horizontal needle indicates relative signal strength of the transmitter. The flags indicate the sufficiency of the homing signal.

VHF/FM Transceiver Operation

All controls necessary to operate the set are located on the control panel. To operate the set, rotate the mode selector switch to T/R. To operate the FM 1 system in the homing mode, rotate the mode selector switch to HOME and observe indication on the ID-48 indicator. Rotate the frequency selectors to set the desired frequency. Adjust the VOL control to set the audio level.

SPEECH SECURITY SYSTEM, KY-28

Provisions are included for the installation of the KY-28 speech security system. The C7213 control panel (figure 4-20) is located outboard of the copilot's seat, and the RE-978 relay in the cargo electronic rack. When installed, the TSEC/KY-28 secure speech unit will also be located in the same rack. The control panel provides a means of remotely controlling the operation of secure speech equipment used in conjunction with the FM2 and UHF2 communications systems. Circuit protection is provided by the SECURE SPEECH circuit breaker on the radio junction box.

Speech Security Controls

WARNING

Simultaneous keying of an unsecure HF or UHF transmitter is prohibited when FM2 or UHF2 is being used for classified conversation in the same airplane compartment or area.

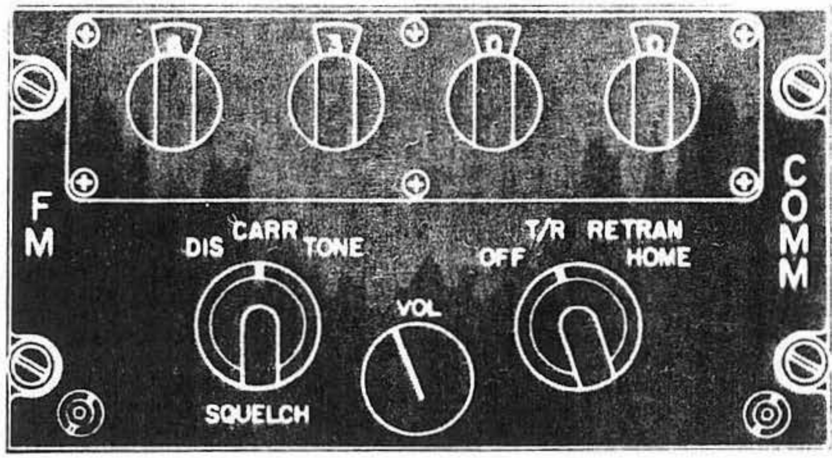
Controls for the speech security system are located on the speech security control panel. A POWER switch applies power to the secure speech equipment. A function switch connects the UHF2 (C RAD 2 position) of VHF FM2 (C/RAD 1 position) to the secure speech equipment. In the PLAIN position neither communication set is connected to the secure speech equipment and both communication sets operate in the normal mode.

Note

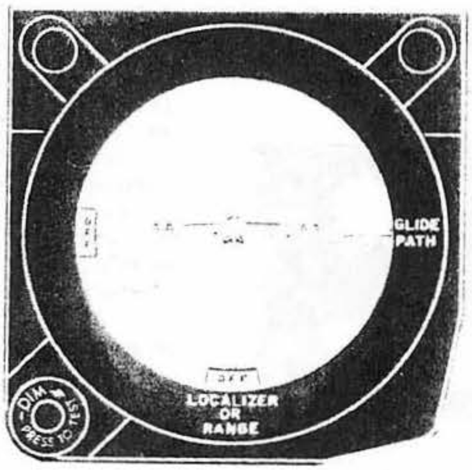
When operating UHF2 in SECURE SPEECH mode, the UHF2 antenna selector control should not be changed during transmission.

A DELAY switch connects the retransmit delay line to system ground. A ZEROIZE switch connects zeroize control line to the +28-volt dc input. Function switch position is visually indicated by three indicators. Panel illumination is provided by two lamps.

vhf/fm controls and indicators



VHF/FM CONTROL PANEL



INSTRUMENT APPROACH INDICATOR, ID-48

Figure 4-19.

speech security control panel

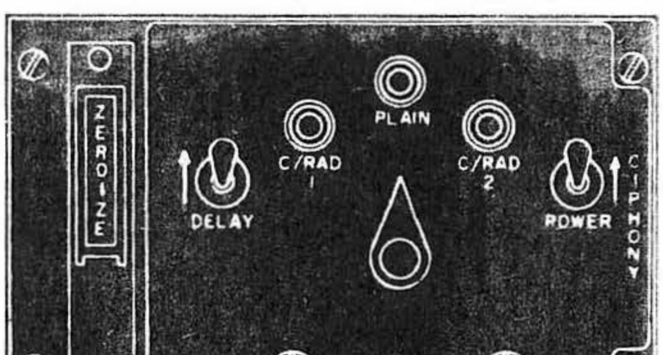


Figure 4-20.

HF COMMUNICATION SYSTEM, HF-103

The HF communication systems (HF 1 & 2 liaison) provide voice communication in the frequency range of 2.00 to 30.0 MHz on any one of 28,000 directly selectable frequencies. Each system contains a transceiver, a control unit, antenna coupler, and antenna. HF 1 system provides a control unit at the navigator station, while the HF 2 system has an identical control located on the control pedestal. The left-hand long wire antenna is utilized for HF 1, and the right-hand long wire for HF 2 for transmission and reception. The systems provide communication capabilities in the single sideband (SSB) or amplitude modulation (AM) mode. The mode of system operation is controlled by switches on the respective control unit. An interlock feature in the systems protects the loran receiver circuits during transmitting periods of the HF transceivers. Power for operation of the systems is 28-volt dc and 115-volt ac, supplied through circuit breakers on the radio junction box.

hf control panel

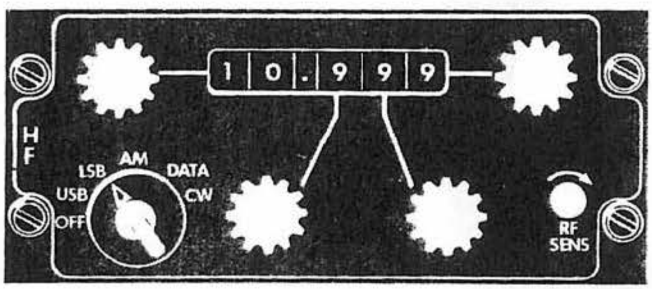


Figure 4-21.

Control Panel

The HF control panel (figure 4-21) provides remote selection of the 28,000 frequencies available in the transceiver. A control panel is located on the control pedestal and one is located at the navigator station. The frequency indicators display the frequency selected by the frequency selection knobs. The function selector switch is used to turn the system on and select SSB (upper or lower) or AM operation. The RF SENS control adjusts the RF gain of the transceiver.

HF Communications System Operation

All controls necessary to operate the HF communications system are located on the control panel. To operate the system, rotate function selector switch to either USB, LS, CW, or AM position. The DATA position is not used. Rotate frequency selectors to set the desired frequency. Adjust the RF SENS control to increase the gain of the system until the desired signal strength is obtained.

LOCALIZER AND VOR RECEIVER (AN/ARN-14).

A localizer and VOR receiver is installed to receive signals from VHF VOR stations and signals from instrument landing system (ILS) localizers. Course indication from the receiver is fed to the No. 2 pointer of the ID-250/ARN radio magnetic indicator on the Co-pilot's instrument panel to the No. 2 pointer of the ID-1103/ARN on the pilot's and navigator's instrument panel; to the course deviation indicator of the ID-249/ARN course indicator on the pilot's insturment panel to the course deviation indicator of the ID-48/ARN course indicator on the Co-pilot's instrument panel. A VOR select switch located below the navigator's ID-1103 indicator is utilized to switch the information provided by the No. 2 needle of the navigator's ID-1103 from radio compass No. 2 to VOR bearing. Audio signals from VOR stations may be selected by the VHF nav mixer switch. The localizer and VOR receiver operates from 28-volt DC power through a circuit breaker on the radio junction box.

Localizer and VOR Receiver Controls

Controls for the localizer and VOR receiver are located on the VHF navigation panel (figure 4-22) on the flight control pedestal. On this panel are the two-position (ON, OFF) power switch, a frequency selector control, and a volume control. Any frequency in the range of 108.0 through 135.9 megacycles is tuned by the frequency selector and displayed in a vertical window. Reading downward, the numbers represent hundreds, tens, units, and tenths of megacycles.

Normal Operation of the Localizer and VOR Receiver

Operate the equipment by the following procedure:

1. Place the power switch on the VHF nav panel (figure 4-22) in the ON position.

2. Select the desired operating frequency with the frequency selector.

3. Set the course to be flown with the course set knob on the ID-249/ARN indicator. (Figure 4-23).

4. Position the instrument select switch to VOR-ILS.

5. If audio monitoring is desired, place the VHF nav receiver switch (figure 4-22) in the ON (up) position.

6. To turn the receiver off place the power switch in the OFF position.

Emergency Operation of the Localizer and VOR Receiver

The localizer and VOR receiver is a critically adjusted instrument. Any attempt at repairs in flight may temporarily destroy all usefulness of the equipment. In case of failure, check all cables for security. If spare tubes are carried, check for tubes with burned-out filaments.

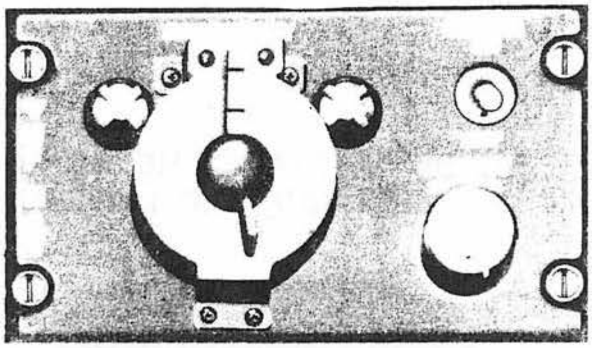


Figure 4-22.

MARKER BEACON RECEIVER

A marker beacon receiver gives visible and audible coded signals whenever the airplane passes over a marker beacon transmitter. The visible signal is given by an amber light on the copilot's course indicator (ID-48) and by an amber light on the pilot's course indicator (ID-249) or by a marker beacon light on the pilot's instrument panel. The audible signal may be received at the pilot's, copilot's and the navigator's intercommunication stations through the marker mixer switch. A two-position (HI, LO) marker beacon switch on the pilot's instrument panel is used to select the sensitivity of the marker beacon receiver and the level of audio output to the intercommunication system. The marker beacon receiver operates from 28-volt DC power through a circuit breaker on the radio junction box.

Note

To narrow the apparent width of marker beacon transmissions, it is necessary to select the LO position of the marker beacon switch when flying at high altitude.

INSTRUMENT SELECT SWITCH

A two-position (VOR-ILS, TACAN) instrument select switch (figure 4-24) is installed on the flight control pedestal of TACAN equipped airplanes. It is used to select either the localizer/VOR or TACAN receiver signals for presentation of: course information on the pilot's and copilot's course indicators bearing information on the pilot's, copilot's or navigator's radio magnetic indicators (RMI's); and, at the same time, connect the selected receiver to the VHF NAV mixer switch on the pilot's, copilot's and navigator's intercommunication control panels.

GLIDESLOPE RECEIVER (AN/ARN-18)

CAUTION

A glideslope warning flag failure indication will appear in the event of an unreliable or complete loss of signal. However, certain mechanical failures/malfunctions in the glide slope receiver will give an erroneous "on glide slope" indication without a failure flag indication, when in actuality a partial failure has occured in the ILS glide slope receiver. A cross check of all other available approach aids, i.e., radar monitor, etc., should be utilized to insure safe airplane operations.

A glideslope receiver is installed to provide ILS glideslope information to the course indicators. The glideslope receiver is automatically placed on the proper frequency by selection of an ILS localizer frequency on the VHF/Nav control panel (figure 4-22). The glideslope receiver operates from 28-volt DC power and 115-volt unregulated AC power through circuit breakers on the radio junction box. Power is supplied through the TACAN/ILS instrument selector switch.

TACAN (AN/ARN-21)

The tacan set is a tactical air navigation system which provides cockpit displays of range and bearing to a tacan station. Slant range of the set is line-of-sight up to approximately 195 nautical miles. The tacan system is supplied 28 VDC and 115 VAC power through circuit breakers on the radio junction box.

WARNING

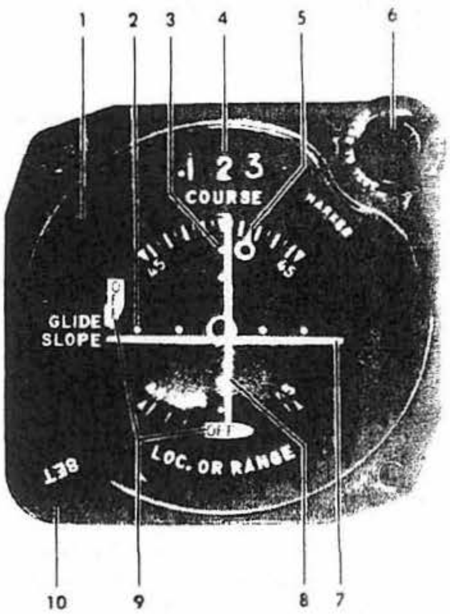
On airplanes not modified by TCTO 1C-130-668, when both AN/ARN-14 and AN/ARN-21 are turned on with the selector switch positioned to VOR/ILS and there is an ARN-14 power failure, tacan will be selected automatically on course deviation and RMI instruments even though the selector switch is still positioned to VOR/ILS. There will be no warning flag indicating ARN-14 failure. Until a fix is accomplished, make sure that the tacan set is turned off when using VOR or ILS.

On airplanes modified by TCTO 1C-130-668, regardless of the position of the instrument select switch, (figure 4-24) VHF VOR bearing is continuously displayed on the No. 2 pointer of the pilot's and copilot's ID-250 indicators. Tacan information is presented on the No. 1 pointers unless UHF/DF is selected, and eliminates the automatic selection of tacan if power to the VOR or ILS power circuits fails.

On airplanes modified by TCTO 1C-130-668, it will not be necessary to turn tacan OFF when using VOR/ILS.

The TACAN select switch located below the navigator's ID1103 indicator is utilized to switch the information provided by the No. 1 needle of the navigator's ID1103 from radio compass No. 1 to TACAN

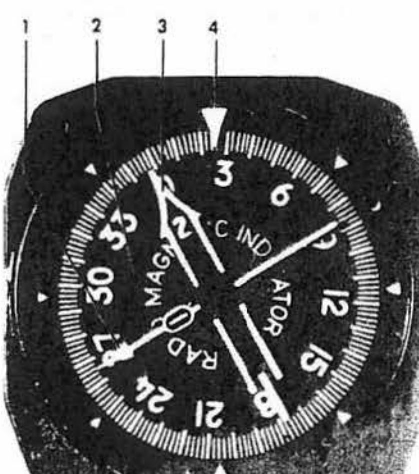
COURSE INDICATOR ID-249/ARN



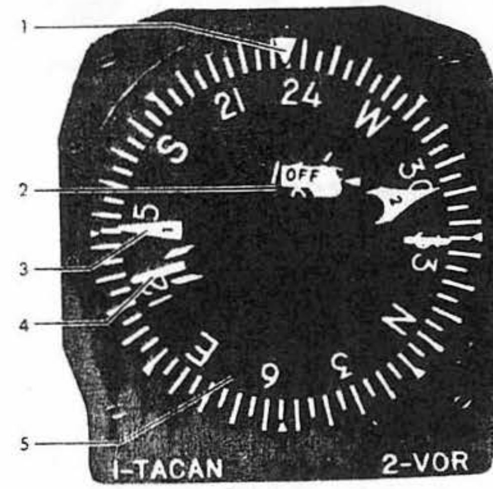
1. To-From Indicator
2. Course Deviation Scale
3. Glide Slope Deviation Scale
4. Course Selector Window
5. Heading Pointer
6. Marker Beacon Light
7. Glide Scope Indicator (GSI)
8. Course Deviation Indicator (CDI)
9. Course and Glide Slope Warning Flags
10. Course Set Knob

RADIO MAGNETIC (RMI) ID 250/ARN

1. Bearing Pointer
2. Rotating Compass Card
3. Bearing Pointer
4. Top Index



BEARING-DISTANCE-HEADING INDICATOR (BDHI) ID-1103/ARN



1. Top Index
2. Range Indicator and Warning Flag
3. Bearing Pointer
4. Bearing Pointer
5. Rotating Compass Card

INSTRUMENT APPROACH INDICATOR, ID-48

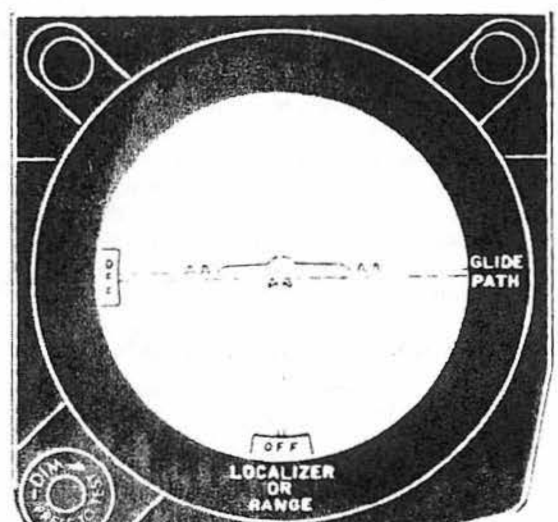
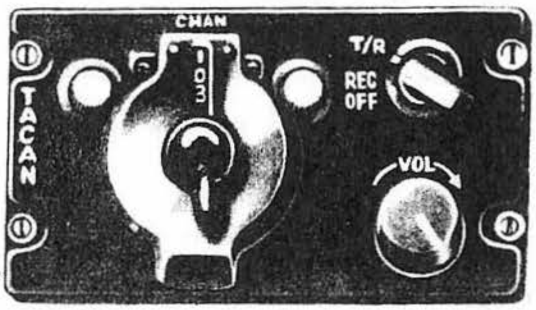


Figure 4-23.

bearing. When the switch is in the up position, radio compasss No. 1 bearing is provided by the needle, and when in the down position, TACAN bearing is provided by the needle. DME readout will be valid whenever the AN/ARN-21 is locked on to a TACAN station regardless of the position of the navigator's TACAN select switch. A TACAN antenna select panel (figure 4-24) is provided at the navigator station. The toggle switch on the panel allows a selection between the top or bottom TACAN antennas for reception.

A low pass filter, located on the upper equipment rack, is connected in the transmission line between the receiver-transmitter and coax switch to alleviate EMI problems.

tacan control indicator



instrument select switch

tacan antenna select panel

Figure 4-24.

Tacan Controls

Controls for the tacan system are located on the tacan control panel (figure 4-24) on the flight control pedestal. A three-position (OFF, REC, T/R) function switch selects the mode of operation. With the switch in REC position, only bearing information is received; with the switch in T/R position, both bearing and range data are received. The channel selector tunes the equipment to any of 126 frequency channels. The volume control knob varies the volume of audio signals received from the surface beacon and heard through the intercom system when the instrument select switch is in TACAN position.

Normal Operation of the Tacan System

1. Place the instrument select switch in TACAN.

2. Move the function switch to the desired position (REC or T/R).

3. Position the channel selector to the desired TACAN channel.

Note

Normal warmup time is 90 seconds. There is no delay when switching from receive to transmit-receive.

Note

In flight, cross-check the tacan bearing information periodically against other navigation equipment. This is necessary because improperly adjusted or malfunctioning tacan equipment may result in lockon to a false bearing. The error will probably be plus or minus 40 degrees, but may be any value which is a multiple of 40 degrees, and can be to eigher side of the correct bearing. When the tacan locks on a false bearing, switching to another channel and then back to the desired channel, or turning the set off and then back on, will recycle the search mode. This will most probably result in a correct lockon. This deficiency does not affect the range indication.

4. Identify the tacan station and monitor.

5. Place proper settings in the course indicator.

SEE 5-21 TACAN AN/ARN-118(V) (ADDED)

RADIO COMPASS (AN/ARN-6)

Two radio compasses are installed to perform direction finding and homing in the 100- to 1750-kilocycle range. The radio compasses may also be used as communication and range receivers in the 100- to 1750-kilocycle range. Control panels (figure 4-25) for the No. 1 radio compass are located on the flight control pedestal or under the copilot's side window on airplanes modified by T.O. 1C-130-838) and on navigator's panel. A control panel (figure 4-25) for the No. 2 radio compass is located on the flight control pedestal. Visual bearing indication is provided by the lo freq indicators on the pilot's, copilot's and navigator's instrument panels. The No. 1

pointer of these indicators operates from the No. 1 radio compass, and the No. 2 pointer operates from the No. 2 radio compass. The navigator has no control of the No. 2 radio compass, but may receive the station selected from the flight control pedestal by placing his lo freq indicator switch in the No. 2 RADIO COMP position. The radio compasses operate from 28-volt DC power through circuit breakers located on the radio junction box.

Radio Compass Controls

A function switch with OFF, COMP, ANT, LOOP, and CONT positions selects the type of operation of the radio compass and, if necessary, takes control of the set from the alternate control panel. A loop control knob provides for rotation of the loop antenna. The volume knob controls the audio output to the intercommunication system. The band switch and tuning crank provide for frequency tuning. A CW-voice switch controls the beat frequency oscillator.

radio compass control panel

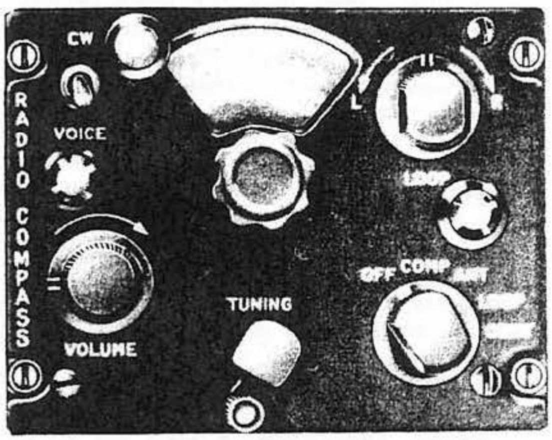


Figure 4-25.

Normal Operation of the Radio Compass

To put the radio compass into operation:

1. Place the function switch in the ANT. position.

Note

> If the No. 1 radio compass is being used, place the function switch in the LOOP position, and rotate the loop l-r control. If the ID-250/ARN pointer does not rotate, momentarily move the function switch to the CONT position to gain control of the set.

2. Allow a five-minute warmup period.
3. Place the CW-voice switch in the desired position.
4. Place the mixer switch for the set being used in the ON position.
5. Select the operating frequency with the band switch and tuning crank.

To use the radio compass for automatic position finding:

6. Move the function switch to ADF position.

Note

> Do not use a station unless it can be identified by aural or CW signals as appropriate.

To use the radio compass for aural-null position finding:

7. Move the function switch to the LOOP position.
8. Rotate the loop with the loop l-r control knob.

To turn the radio compass off:

9. Place the function switch in the OFF position.

Emergency Operation of the Radio Compass

The No. 1 radio compass has two control panels. If one control panel is inoperative, the No. 1 radio compass may still be operated from the other control panel.

RADAR ALTIMETER (AN/APN-22)

A radar altimeter is provided to indicate the terrain clearance of the airplane. Altitude above the terrain is indicated, in feet, on a calibrated indicator located on the pilot's instrument panel. The radar altimeter operates from 28-volt DC power and 115-volt unregulated AC power through circuit breakers in the radio junction box.

WARNING

> The terrain clearance indications received from the AN/APN-22 are unreliable when operating over large depths of snow and ice, since the radar waves will actually penetrate the surface and indicate greater terrain clearances than actually exist.

Radar Altimeter Controls

The only control for the radar altimeter is the on-limit knob. Rotating the on-limit knob to move the preset altitude indicator pointer above zero turns the radar altimeter on and sets the clearance altitude below which warning will be given. A red light on the indicator glows whenever the airplane is below the preset altitude.

Normal Operation of the Radar Altimeter

To put the radar altimeter into operation:

1. Rotate the on-limit knob clockwise.

2. Set the desired altitude reference with the on-limit knob.

To turn the radar altimeter off:

3. Rotate the on-limit switch to the extreme counter-clockwise position.

AIMS RADAR IDENTIFICATION SYSTEM (IFF) (AN/APX-72)

Note

The term AIMS as applied to the radar identification system installed in C-130 airplanes modified by T.O. 1C-130-838 is defined as follows:

A - Air traffic control radar beacon

I - Identification—friend or foe

M - Military equipment

S - Special systems

The AIMS radar identification system provides automatic radar identification of the airplane when interrogated by the surface or airborne radar sets using correctly coded pulse transmissions. Five modes of interrogation are used in the AIMS (IFF) system, and the set will reply to any or all of these depending on how the master selector and mode switches are set. Airplane identification, location, and pressure altitude are transmitted to interrogating radar sets utilizing Modes 1, 2, 3 and C. A special altimeter-encoder (figure 1-53) is used to produce a digital output of altitude which is transmitted when interrogated on Mode C. Mode 4 provides a secure (encrypted) IFF capability. The special Mode 4 computer processes Mode 4 interrogations and causes the transponder to generate appropriately coded reply signals.

When the IFF transceiver replies to an interrogation, a blinking pulse is routed to the SAD-5 system.

The system also enables friendly airplanes to identify themselves apart from other friendly airplanes and provides a means of transmitting a special coded signal known as an emergency reply.

The system is powered by 28 volt DC, and regulated 115 volt AC through circuit breakers on the radio junction box circuit breaker panel.

Transponder Control Panel

Operation and control of the system is accomplished with the transponder control panel (figure 4-26) which contains the following controls and indicators:

MASTER SWITCH. A rotary-type, five-position MASTER switch allows the operator to select the following operating conditions: OFF, STBY (standby), LOW (low sensitivity), NORM (normal sensitivity), and EMER (emergency). When the switch is set to OFF, all power is removed from the system. In STBY, operating power is applied and the system is ready for immediate operation when the MASTER switch is set to LOW or NORM. However, when in STBY, the absence of replies when interrogated in Mode 4 causes the IFF CAUTION light to illuminate. When the MASTER switch is set to EMER, the system transmits an emergency reply when interrogated. To prevent accidentally switching to either EMER or OFF, the switch knob must be pulled out before the switch can be turned to either of these positions.

IDENT-OUT-MIC SWITCH. A three-position IDENT, OUT, MIC toggle switch controls the IDENT function. When the switch is set to IDENT, and the MODE 1 or MODE 3 coder group selector control has a code set in, the system generates coded replies for MODES 1 through 3. MODE C and 4 are not affected. The IDENT pulse trains are transmitted from 15 to 30 seconds, plus the time the switch is held to IDENT. The switch is spring-returned to the OUT position from the IDENT position. The OUT position disables the IDENT function. When the MIC position is selected, control of the IDENT function is transferred to the pilot's microphone switch when the UHF command radio is operating.

MODE 1 ENABLE AND TEST SWITCH. A three position toggle-type switch allows the operator to enable, test, and disable Mode 1. When held in the test position, the transponder test set is energized and generates a Mode 1 interrogation. If a correct reply is made by the transponder the TEST indicator light illuminates. ON position enables the Mode 1 function and the OUT position disables the Mode 1 function. The switch is spring returned from the TEST position to the ON position.

MODE 2 ENABLE AND TEST SWITCH. This switch is the same as the MODE 1 switch and performs functionally for MODE 2 in the same manner as MODE 1.

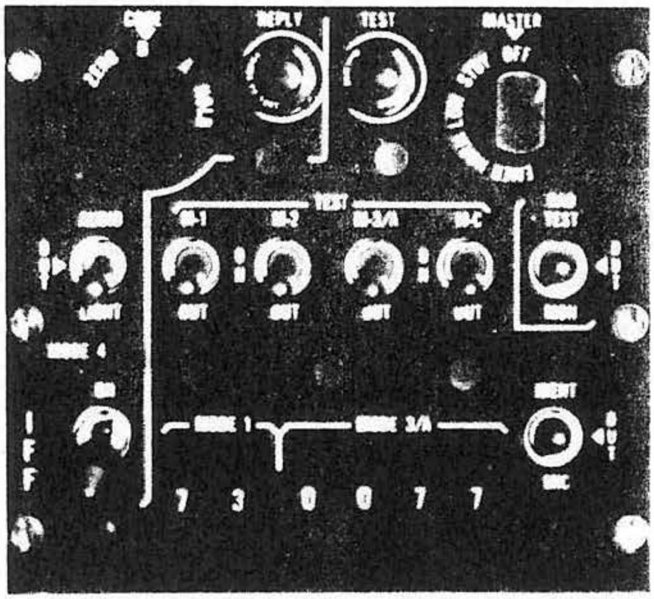
MODE 3/A ENABLE AND TEST SWITCH. This switch is the same as the MODE 1 switch and performs functionally for MODE 3/A in the same manner as MODE 1.

MODE C ALTITUDE REPORTING ENABLE AND TEST SWITCH. This switch is the same as the MODE 1 switch and performs functionally for MODE C in the same manner as MODE 1.

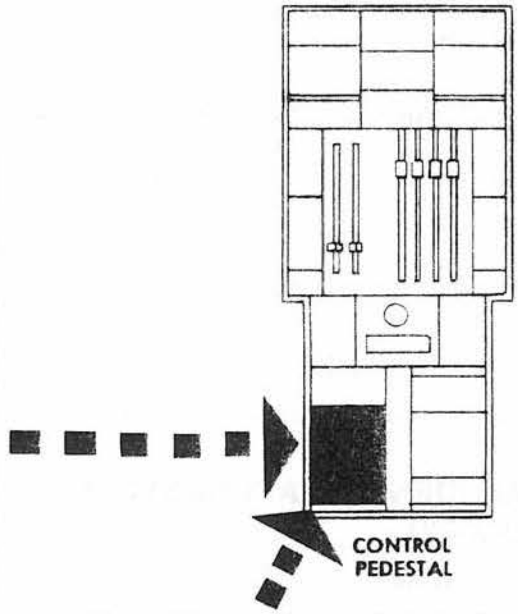
RADIATION-TEST-MONITOR ENABLE SWITCH. A three-position (RAD TEST, OUT, MON) toggle-type

iff control panel

AIRPLANES MODIFIED BY T.O. 1C-130-838



TRANSPONDER CONTROL PANEL



IFF ANTENNA SWITCH AND CAUTION LIGHT PANEL

Figure 4-26.

switch is provided for control of the monitor and radiation-test functions of the system. When placed to the MON position, the monitor circuits of the transponder test set are enabled for inflight monitoring of the transponder's replies to interrogations on any mode other than Mode 4. Correct replies are indicated by illumination of the TEST indicator light. The RAD TEST position is used by maintenance personnel when performing checkout of the system utilizing an IFF test set. The switch is spring-returned from the RAD TEST position to the OUT position.

Note

A bypass cable is installed adjacent to the transponder test set mount, and may be used in lieu of the test set or to bypass a malfunctioning test set. Operation of the AIMS (IFF) system, with the bypass cable installed, is normal except for the self test and monitoring functions.

MODE 1 CODE SELECTORS. These selectors consist of two in-line edgewise-mounted thumb wheels which select the MODE 1 codes, and are continuously rotatable with no stops. The left wheel has eight positions, numbered 0 through 7 consecutively. The right wheel is similar to the left except that the numbering is 0 through 3, appearing twice (once on each half of the drum).

MODE 3/A CODE SELECTORS. These selectors consist of four in-line edgewise-mounted thumb wheels which select the MODE 3 codes, and are continuously rotatable with no stops. Each wheel has eight positions, numbered 0 through 7 consecutively.

MODE REPLY SELF-TEST INDICATOR LIGHT. A green TEST indicator light is provided to indicate satisfactory operation of the transponder for self tests of Modes 1, 2, 3, and C and for monitoring proper response to any interrogation other than Mode 4.

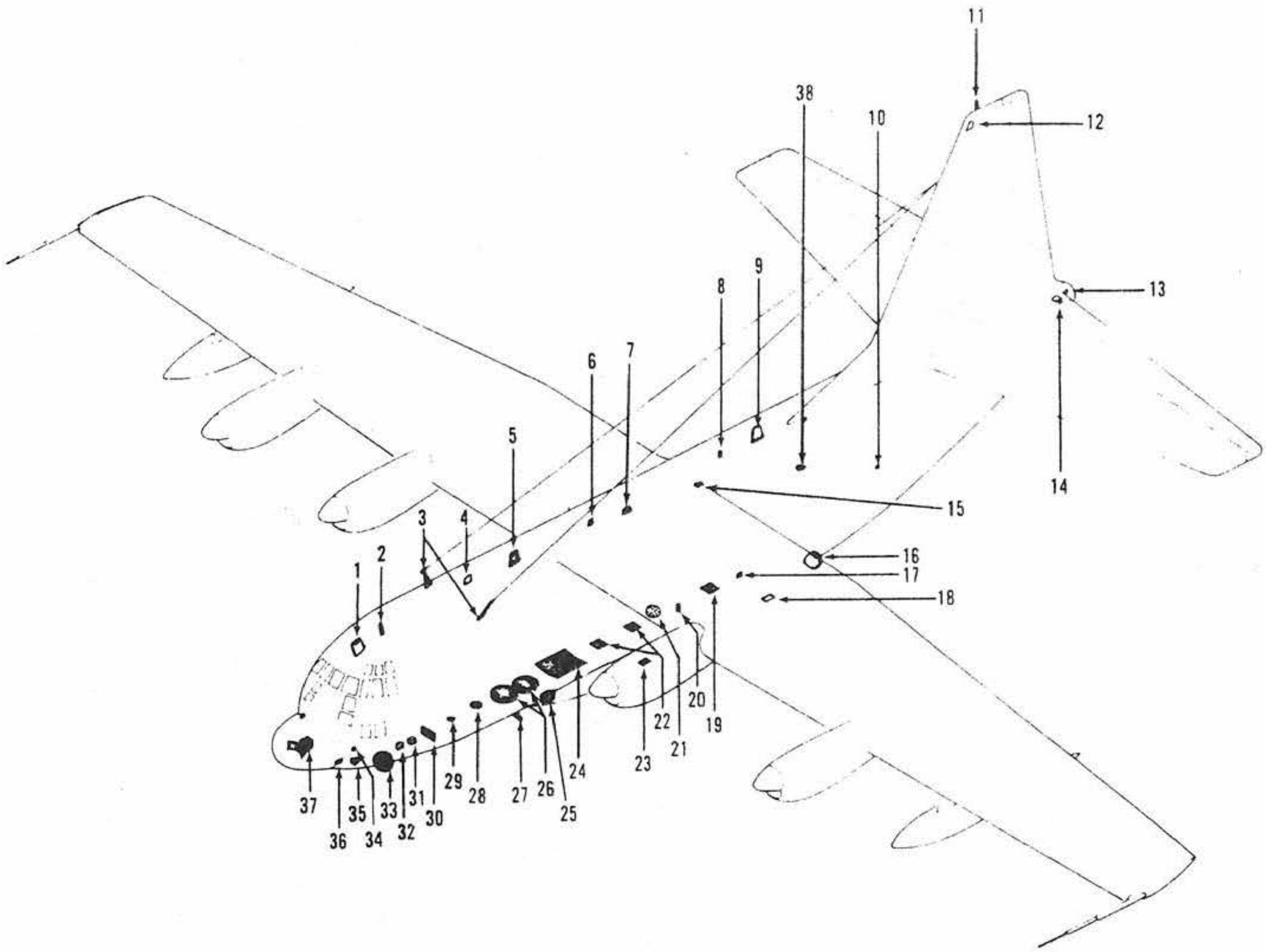
MODE 4 ENABLE SWITCH. A two-position, lever-lock type switch is provided for control of the MODE 4 operation. When placed to ON, the switch is in the up and locked position and MODE 4 is enabled. When the switch is unlocked and moved down, it is in the OUT position.

MODE 4 INDICATION SWITCH. A three-position, (AUDIO, OUT, LIGHT) toggle-type switch is provided for control of the MODE 4 indication. The AUDIO position enables both the visual and audio reply indication. The OUT position disables the MODE 4 indication function of the system. When the switch is placed to LIGHT, only the visual indication is enabled.

Note

No provision is made for audio indications, therefore, only the visual indication can be received whether in AUDIO or LIGHT position.

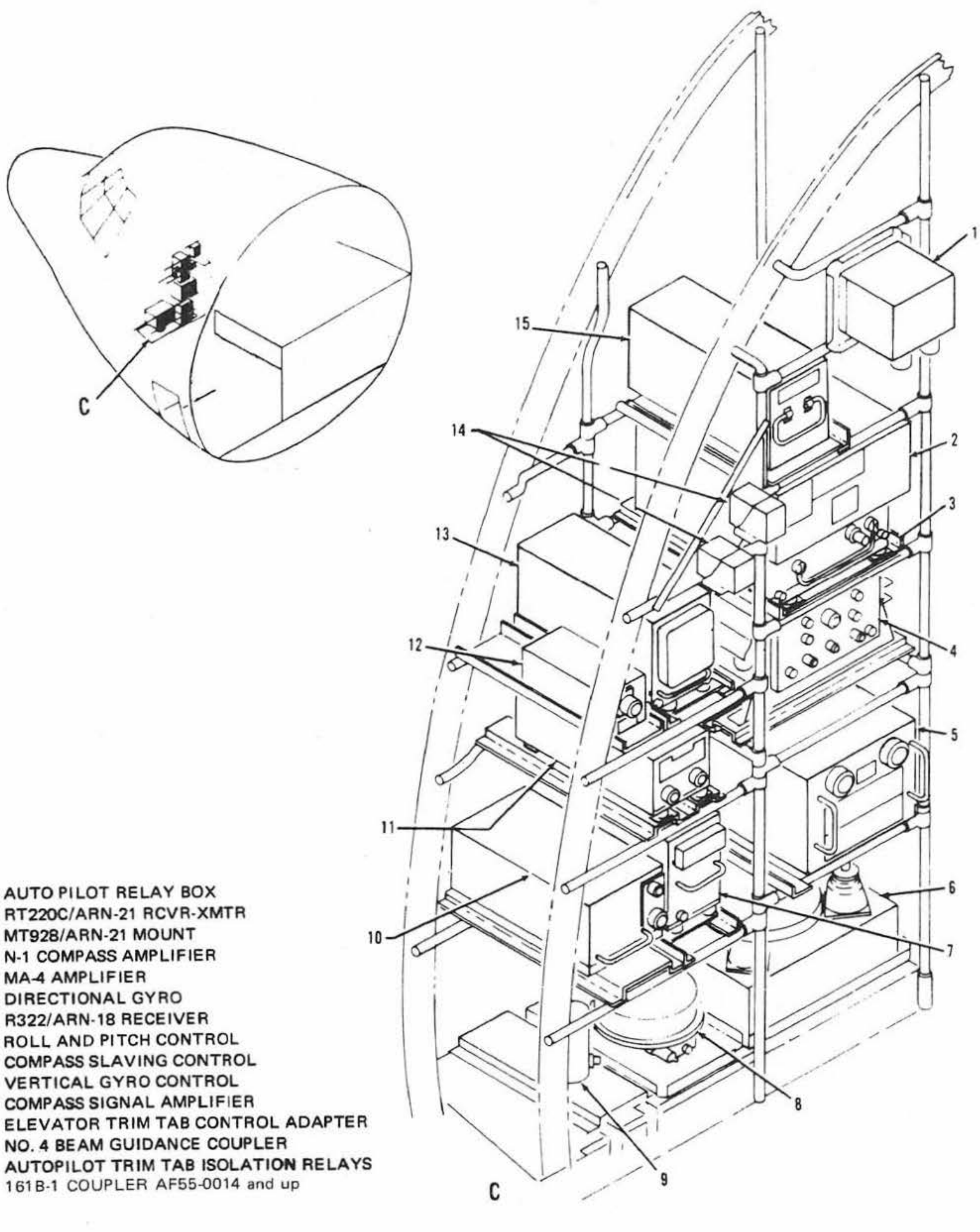
antenna locations



1. VHF 101 ANTENNA
2. ARC-34 ANTENNA (LEFT R1: RIGHT R2)
3. LONG WIRE ANTENNA
4. AT74/U APX-72 ANTENNA
5. 437S-1 VHF/FM ANTENNA
6. VHF 101 ANTENNA
7. AT741/U TACAN ANTENNA
8. ARC-133 ANTENNA
9. 437S-1 VHF/FM ANTENNA
10. TRIM 7 RECEIVER ANTENNA (1 EACH SIDE)
11. SST-181X TRANSPONDER ANTENNA
12. ARN-14 VHF ANTENNA
13. ALR-46 ANTENNA (1 EACH SIDE)
14. TRIM 7 RECEIVER ANTENNA
15. ALR-46 ANTENNA
16. APQ-150 ANTENNA
17. ALR-46 ANTENNA
18. APN-22 ANTENNA
19. ARN-5 ANTENNA
20. ARC-133 ANTENNA
21. UHF-DF ANTENNA
22. SCR-718 HIGH ALTITUDE ALTIMETER
23. ARN-12 ANTENNA
24. ARC-34 UHF ANTENNA
25. AAD-7 ANTENNA
26. TRIM 7 TRANSMITTER ANTENNAS
27. AT-741 TACAN ANTENNA (LEFT SIDE ONLY)
28. APN-147 ANTENNA
29. APX-72 ANTENNA
30. 637A-3 FM HOMING ANTENNA
31. SCR-718 HIGH ALTITUDE ALTIMETER ANTENNA
32. AT234 ANTENNA (NOT USED)
33. AN/ASD-5 ANTENNA
34. ALR-46 ANTENNA (EACH SIDE)
35. TRIM 7 RECEIVER ANTENNA
36. ARN-18 ANTENNA GLIDE SLOPE
37. APN-59 ANTENNA
38. ALR-46 ANTENNA

Figure 4-27.

UPPER RADIO RACK

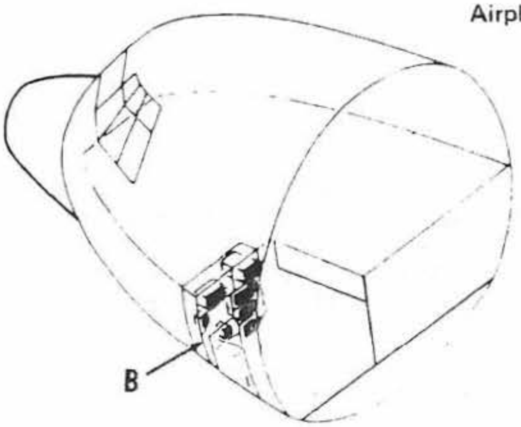


1. AUTO PILOT RELAY BOX
2. RT220C/ARN-21 RCVR-XMTR
3. MT928/ARN-21 MOUNT
4. N-1 COMPASS AMPLIFIER
5. MA-4 AMPLIFIER
6. DIRECTIONAL GYRO
7. R322/ARN-18 RECEIVER
8. ROLL AND PITCH CONTROL
9. COMPASS SLAVING CONTROL
10. VERTICAL GYRO CONTROL
11. COMPASS SIGNAL AMPLIFIER
12. ELEVATOR TRIM TAB CONTROL ADAPTER
13. NO. 4 BEAM GUIDANCE COUPLER
14. AUTOPILOT TRIM TAB ISOLATION RELAYS
15. 161B-1 COUPLER AF55-0014 and up

Figure 4-28. (Sheet 1 of 6)

LOWER RADIO RACK

Airplanes AF53-3129 through AF55-0011



1. HIGH RANGE ALTIMETER RCVR-XMTR
2. AIMS ANTENNA SWITCHING UNIT
3. 161B-1 COUPLER
4. 618T-3 TRANSCEIVER
5. 618T-3 TRANSCEIVER
6. R122A/ARN-12 RECEIVER
7. AIMS (IFF) RECEIVER-TRANSMITTER
8. TEST SET BYPASS ASSEMBLY
9. AIMS (IFF) TEST SET

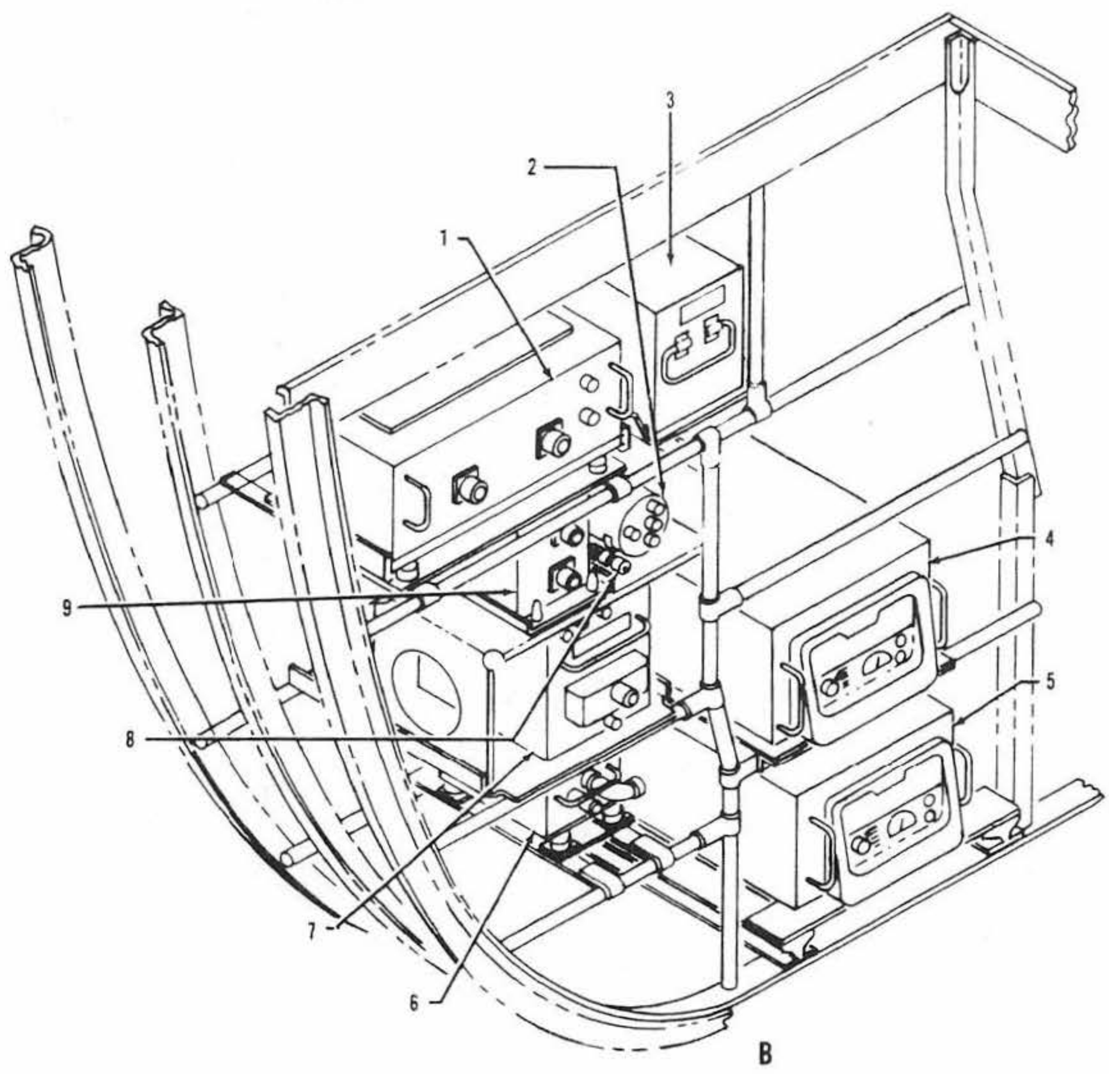
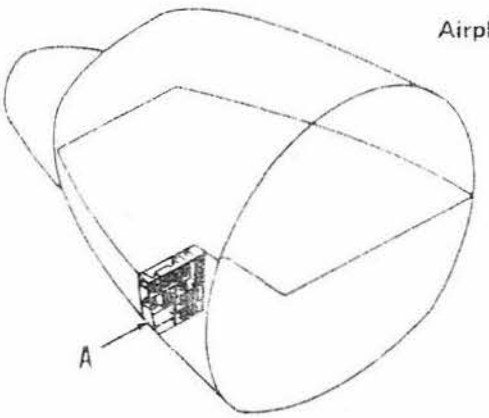


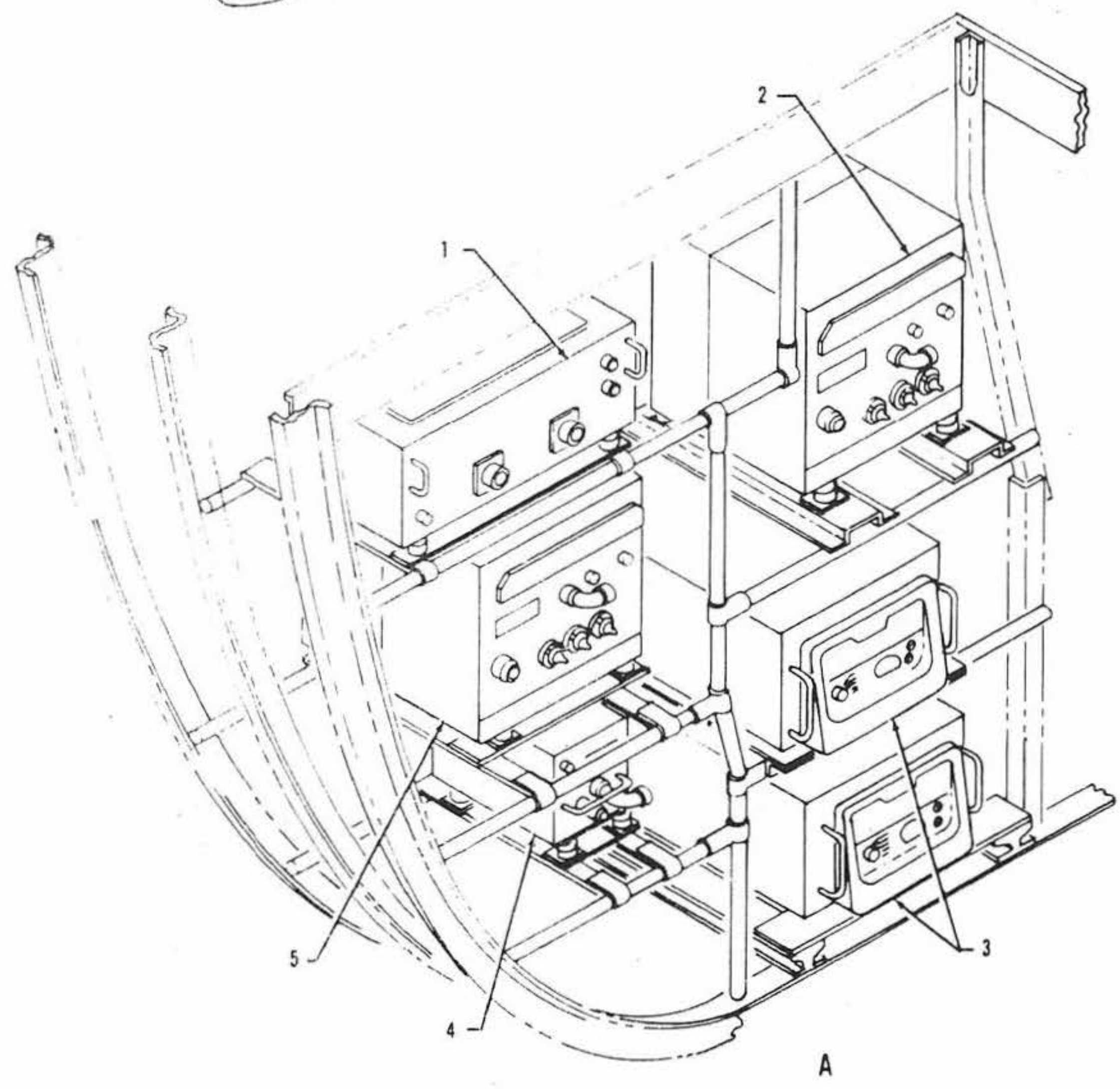
Figure 4-28. (Sheet 2 of 6)

LOWER RADIO RACK

Airplanes AF55-0014 and up



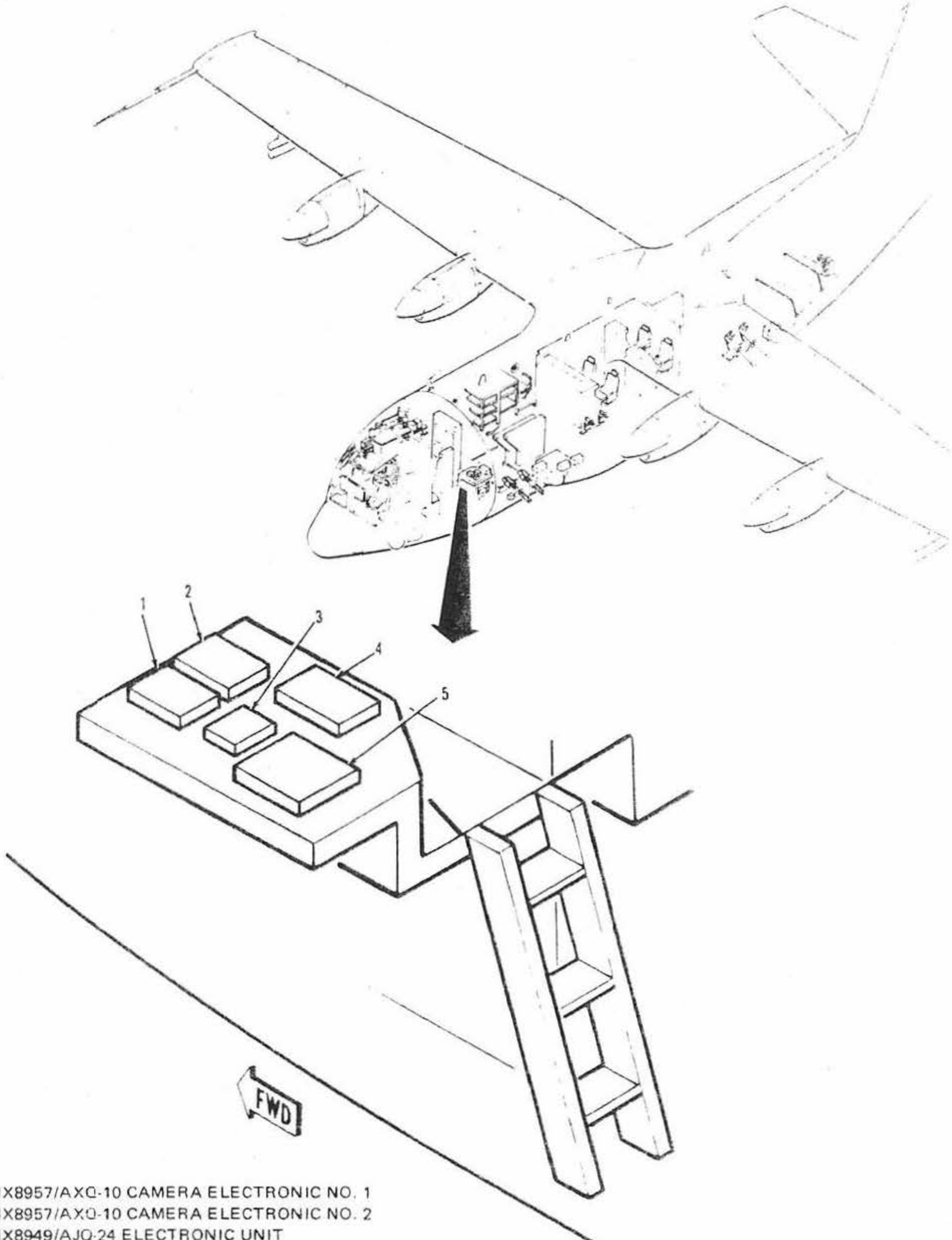
1. HIGH RANGE ALTIMETER RCVR-XMTR
2. RT279/APX RECEIVER-TRANSMITTER
3. 618T-3 TRANSCEIVER
4. R122A/ARN-12 RECEIVER
5. RT279/APX RECEIVER-TRANSMITTER



A

Figure 4-28. (Sheet 3 of 6)

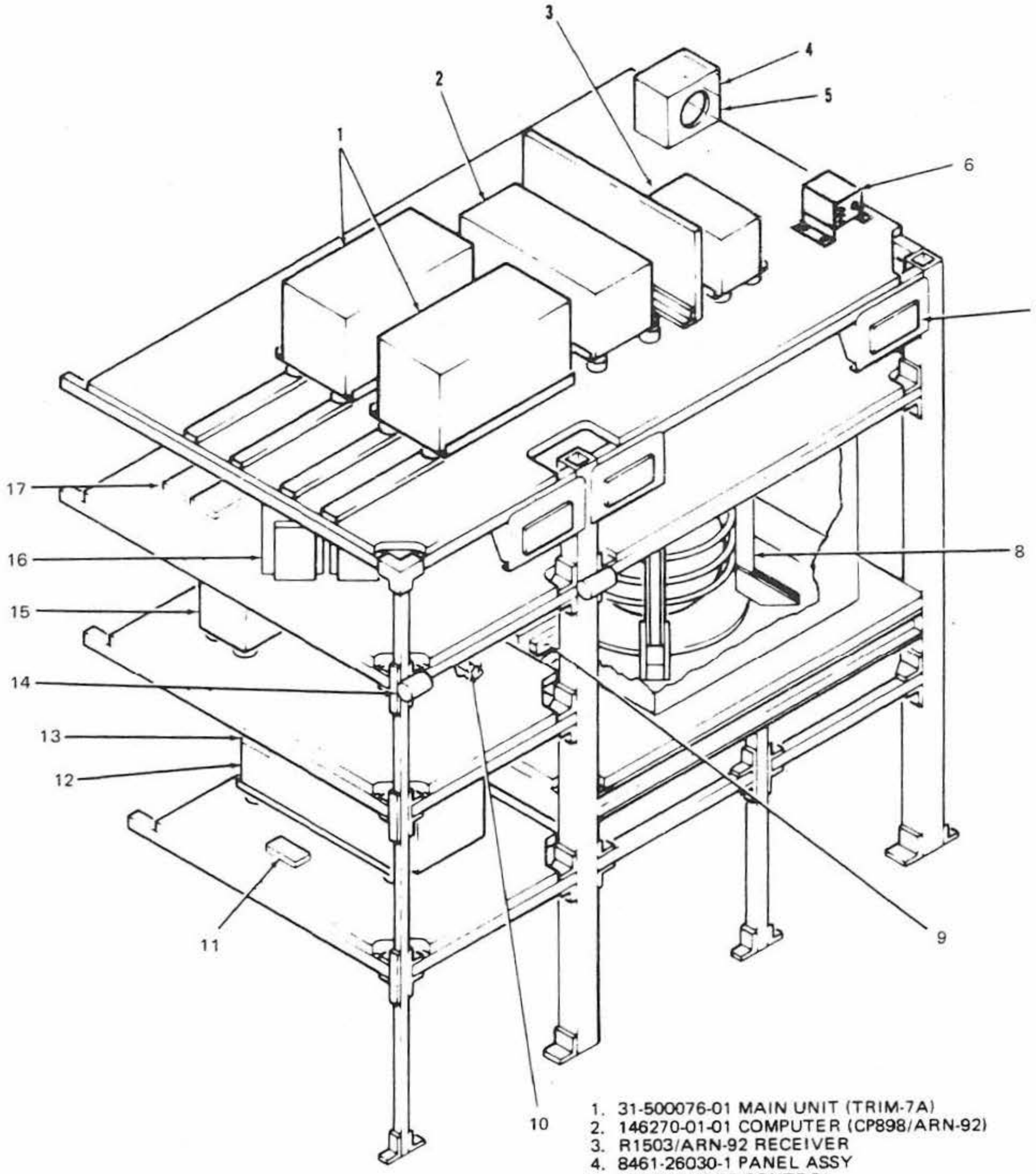
TV/LASER EQUIPMENT RACK



1. MX8957/AXQ-10 CAMERA ELECTRONIC NO. 1
2. MX8957/AXQ-10 CAMERA ELECTRONIC NO. 2
3. MX8949/AJQ-24 ELECTRONIC UNIT
4. AM6596/AAQ-7 ELECTRONIC CONTROL AMPLIFIER
5. 910178-901 LASER POWER SUPPLY

Figure 4-28. (Sheet 4 of 6)

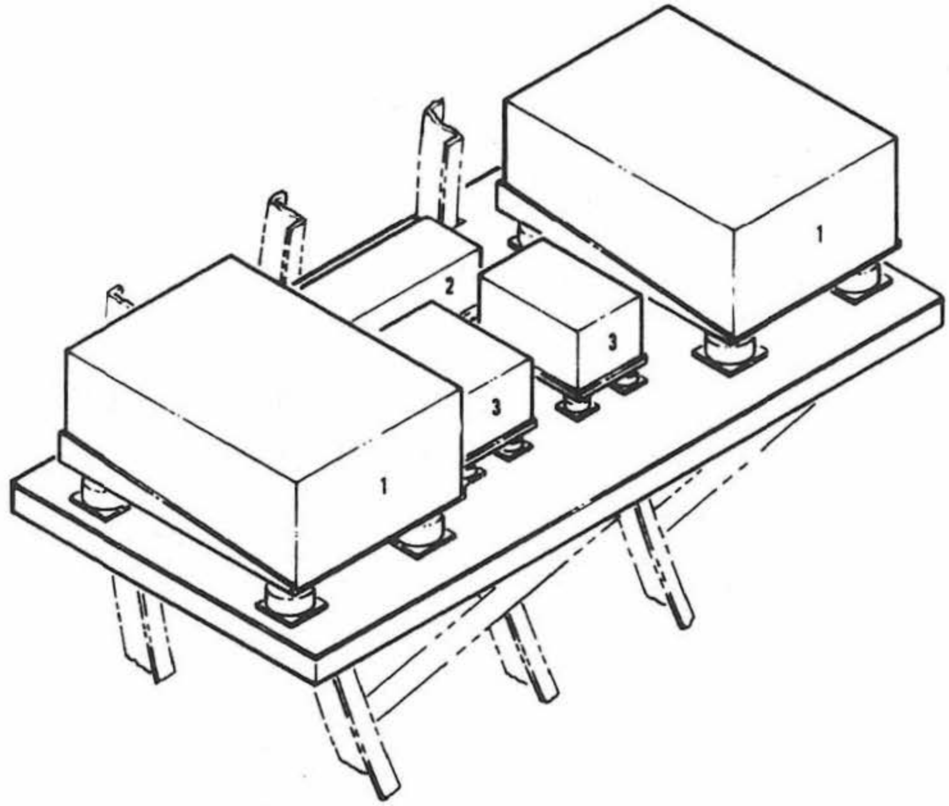
REMOTE EQUIPMENT RACK



1. 31-500076-01 MAIN UNIT (TRIM-7A)
2. 146270-01-01 COMPUTER (CP898/ARN-92)
3. R1503/ARN-92 RECEIVER
4. 8461-26030-1 PANEL ASSY
5. C6567/AIC-25 CONTROL
6. 117-00515-9 LORAN COMPUTER POWER PROTECTOR
7. OXYGEN REGULATOR
8. 8477M11100-1 CONVERTER (TYPE ME 3)
9. INVERTER, 32E03-3C (TYPE MB2)
10. SA521A RF SWITCH
11. RE978/ARC RELAY
12. RT847/ARC-133 RCVR-XMTR
13. PP1990/ARC-34A POWER SUPPLY
14. SIGNAL PROCESSOR CM442/ALR-46
15. 31-011201-03 ANALYZER AN/APR-25
16. 709299-801 CONNECTOR KIT (FM 622A)
17. 5463B FILTER

Figure 4-28. (Sheet 5 of 6)

ELECTRONIC SHELF (BEHIND AMMO RACK)



1. R-101A/ARN-6 RECEIVER
2. COUNTERMEASURES R-1854/ALR-46
3. AM203C/ARA-19 AMPLIFIER

Figure 4-28. (Sheet 6 of 6)

MODE 4 CODE SWITCH. A four-position, (HOLD, A, B, ZERO) rotary-type switch is provided for control of Mode 4 operation. HOLD position provides for retaining Mode 4 codes during a refueling stop. When placed to the HOLD position momentarily and 15 seconds is allowed before turning power off, the codes are mechanically latched and will be retained when power is removed from the set provided the airplane's landing gear is down and locked. The switch is spring loaded to return to A from the HOLD position. The A position selects A codes. The B position selects B codes. The ZERO position zeroizes the code settings. The switch is designed so that it must be pulled out before it can be turned to ZERO or OFF thereby preventing inadvertent selection of these positions.

MODE 4 REPLY INDICATOR LIGHT. A green indicator light is provided for indication of MODE 4 replies that occur when the MODE 4 indication switch is either in the AUDIO or LIGHT position.

IFF CAUTION LIGHT. An IFF CAUTION light on the IFF antenna switch and caution light panel (figure 4-26) is provided to warn the pilots that the transponder has not replied to a Mode 4 interrogation.

IFF ANTENNA SWITCH. A three-position toggle-type switch on the IFF antenna switch and caution light panel (figure 4-26) is provided for selection of IFF antennas. TOP position selects the top IFF antenna only, BOT position selects the bottom IFF antenna only, and BOTH position selects both top and bottom IFF antennas.

IFF SELF TEST.

1. Master switch	Stby
2. M-1/M-2/M-3A/M-C	Out
3. Master switch	Norm
4. M-1 Hold M-1 in test. The green test light indicates a good check. Return M-1 to out. Repeat with M-2, M-3, and M-C	Test illuminated
. Master switch	Stby
Mode switches	As Required

Normal Operation of IFF

To place the IFF in operation, proceed as follows:

Set the MASTER switch on the transponder control panel to NORM before take-off and during flight, and to LOW during descent.

Select the desired mode of operation (1, 2, or 3A).

Set in the desired code with the code selectors or mode enable switches.

4. Set MODE C to ON.

5. Set MODE 4 to ON.

6. Set Mode 4 CODE switch to appropriate code (A or B).

7. Set IFF ANT switch to TOP, BOT, or BOTH as desired.

Emergency Operation of IFF

To place the IFF in emergency operation, pull up on the MASTER switch and rotate to the EMER position.

To turn the IFF system off:

1. Pull up on the MASTER switch and rotate to the OFF position.

NAVIGATION EQUIPMENT

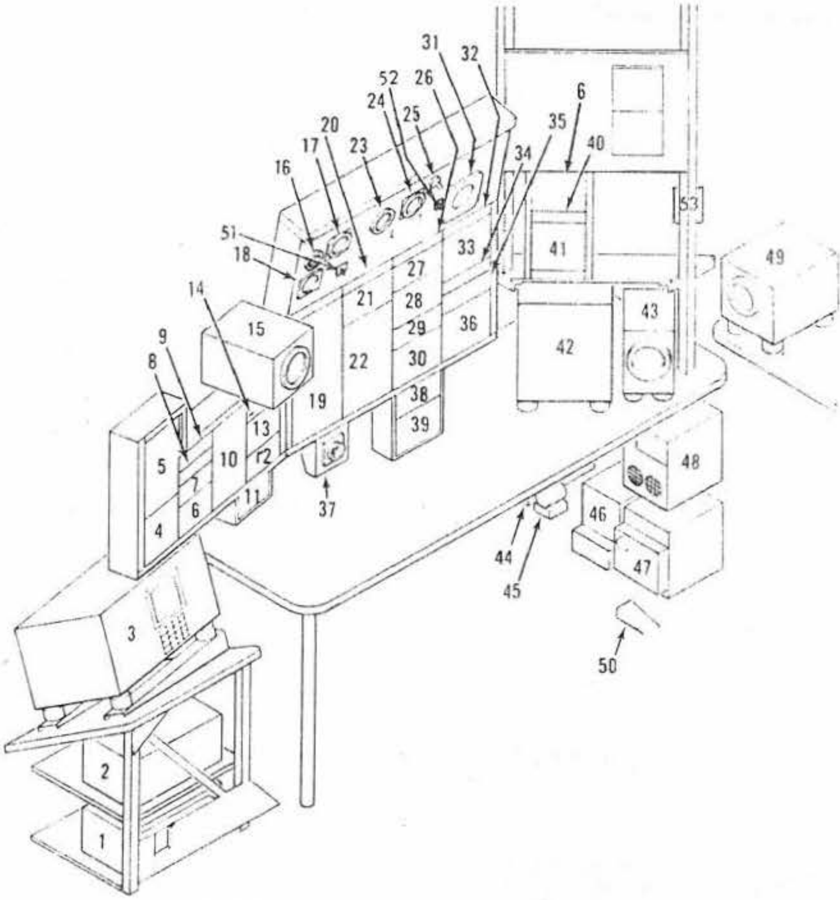
NAVIGATOR STATION

The navigator station (figure 4-29) provides the necessary controls and indicators for performing enroute navigation, airplane positioning in the target area, and triffic separation. Some controls and equipment at the station such as the AYK-9 Fire Control Computer and fire control display unit are used with the fire control system.

N-1 COMPASS SYSTEMS.

The system is a remote indicating, gyro-stabilized compass system designed for use in all latitudes. The compass system has two modes of operation: magnetic slaved and directional gyro. In the magnetic slaved mode, the directional gyro is fed signals from the remotely located magnetic compass and thus is slaved to it, and this stabilized magnetic indication is presented on the indicator. Magnetic slaved operation may be used in any locality except where severe magnetic distortion occurs. In directional gyro operation, the system operates free of magnetic influence as a directional gyro, using an arbitrary gyro heading reference selected by the navigator. The directional gyro mode, which may be used in any latitude, is especially useful where the magnetic field is weak or distorted, or when used for grid navigation in the polar regions. Directional reference information is supplied to the RMI and BDHI compass cards, the heading pointers of the course indicators, the autopilot, the AN/APN-59 radar, and the Doppler. A master indicator, which incorporates the system controls, is mounted at the navigator's station. (See figure 4-31 for N-1 compass system tie-in.) The N-1 compass system uses 28-volt, DC power from the flight station bus, 115-volt, single-phase power, 115-volt, three-phase power, and 26-volt AC single-phase power. The system operates anytime power is on the buses. Equipment is protected by circuit breakers in the main power distribution box and the flight station distribution panel.

navigator's station



1. CP-1034/AYK-9 FIRE CONTROL COMPUTER (SOME AIRCRAFT)
2. SA-1786A MASTER SWITCH UNIT
3. FIRE CONTROL DISPLAY UNIT
4. FLOOD LIGHT CONTROL
5. WORK & PANEL LIGHT CONTROL
6. OXYGEN REGULATOR
7. VERTICAL REFERENCE CONTROL PANEL
8. SENSOR ANGLE CONTROL PANEL
9. MASTER SWITCH UNIT
10. C1242/APN59 RADAR SET CONTROL
11. VHF/FM COMMUNICATIONS CONTROL
12. C8475/APQ-136(V)MTI CONTROL
13. C1173/ASQ RADAR PRESSURE UNIT
14. ISO-ECHO SWITCH
15. IP239/APN59 INDICATOR
16. OUTSIDE AIR TEMP INDICATOR
17. ALTIMETER
18. CLOCK
19. FIRE CONTROL PANEL
20. TACAN ANTENNA SELECT PANEL
21. ARN-92 TAS CONTROL
22. C-7417/ARN 92 CONTROL INDICATOR
23. TRUE AIRSPEED INDICATOR
24. ID-1103/ARN INDICATOR
25. ADF/TACAN SELECTOR SWITCH, # 2 RC/VOR
26. VHF ANTENNA SELECT PANEL
27. 714E3 CONTROL
28. C1513A/ARN6 CONTROL
29. ARN-92 LIGHT CONTROL
30. MIC TRANSFER PANEL
31. N-1 COMPASS INDICATOR
32. TRANSPONDER SELECT PANEL (X-BAND)
33. ID938/APN-147 INDICATOR
34. C3747/APN-147 PANEL
35. C3749/ASN-35 CONTROL INDICATOR
36. C3748/ASN-35 CONTROL INDICATOR
37. 4012F ATTITUDE INDICATOR
38. INTERPHONE MONITOR PANEL
39. INTERCOMMUNICATIONS SET CONTROL
40. AIMS ANTENNA SELECTOR
41. APX-72 IFF CONTROL
42. AN/APN-70 LORAN RECEIVER OR AYK-9 FIRE CONTROL COMPUTER
43. AN/APN-70 LORAN INDICATOR
44. WAVE FORM CONVERTER
45. SA521A RF SWITCH
46. VHF-101 RECEIVER
47. VHF-101 TRANSMITTER
48. CV2833/APQ CONVERTER
49. SCR-718 RADIO ALTIMETER
50. MICROPHONE FOOT SWITCH
51. RADOME ANTI-ICING SWITCH
52. RADIO COMPASS POINTER SELECT SWITCH, # 1 RC/TAC
53. ARN-92 SYNCHRO EXCITATION

Figure 4-29.

WARNING

During prolonged orbits the N-1 Compass system may become erratic and unreliable. If this occurs, pull the N-1 Compass circuit breaker located on the flight station distribution panel. Once straight and level flight has been acheived, re-set the N-1 Compass circuit breaker and synchronize the system. A 10-minute warm up period may be required. In the absence of the N-1 Compass 2-axis or INS heading may be used.

N-1 Compass System Controls

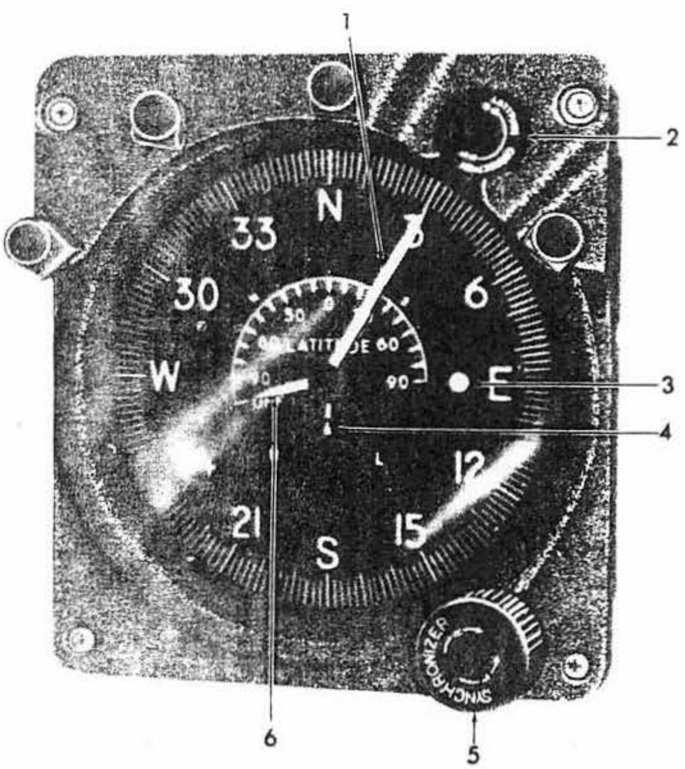
The controls for the N-1 compass system are located on the master indicator (figure 4-30) at the navigator's position.

LATITUDE-CORRECTION KNOB. A latitude-correction knob is located on the upper right side of the master indicator. Turning this knob positions the latitude-correction pointer and latitude-correction mechanism. Latitude correction compensates for the apparent drift of the gyro, due to rotation of the earth, while the system is in the directional gyro mode. In addition, the correction knob is the control switch which selects the mode of operation. When turned so that the latitude-correction pointer is in the OFF position, the system is in the magnetic slaved mode of operation. When turned so that the latitude-correction pointer is anywhere on the latitude scale, the system is in the directional gyro mode.

SYNCHRONIZER KNOB. A synchronizer knob is located on the lower right side of the master indicator. Turning this knob synchronizes the master indicator heading pointer with the correct magnetic heading when the system is in magnetic slaved operation. In addition, the knob provides a means of setting the master indicator heading pointer on the desired gyro heading reference when the system is in directional gyro operation. An annunciator pointer, located below the heading pointer on the master indicator, indicates the direction in which to rotate the master indicator heading pointer to accomplish synchronization.

CORRECTION SERVO INDICATOR. The servo indicator (figure 4-30) intermittently displays a white dot to indicate a correction is being supplied to the system. During magnetic slaved operation, the system receives corrections because of apparent changes in the earth's magnetic field; and, during directional gyro operation, corrections are for apparent gyroscopic precession.

N-1 compass



1. HEADING POINTER
2. LATITUDE CORRECTION KNOB
3. CORRECTION SERVO INDICATOR
4. ANNUNCIATOR POINTER
5. SYNCHRONIZER KNOB
6. LATITUDE CORRECTION POINTER

Figure 4-30.

N-1 Compass System Indicators.

Compass system indicators present the directional information provided by the N-1 compass to the pilot and the navigator.

MASTER INDICATOR. The master indicator (figure 4-30) located on the navigator's instrument panel provides control of the N-1 system, airplane heading information, and indication of system operational modes. The heading pointer and scale indicate the airplane's magnetic heading when the system is in magnetic slaved operation, and give the airplane heading reference to the preselected gyro heading datum when the system is in directional gyro operation.

Note

Erratic movement or oscillation of the heading pointer indicates a malfunction in the N-1 compass system, and that the master and repeater indicators cannot be relied upon. Disengage autopilot rudder axis if the autopilot is to be used.

N-1 compass system tie in

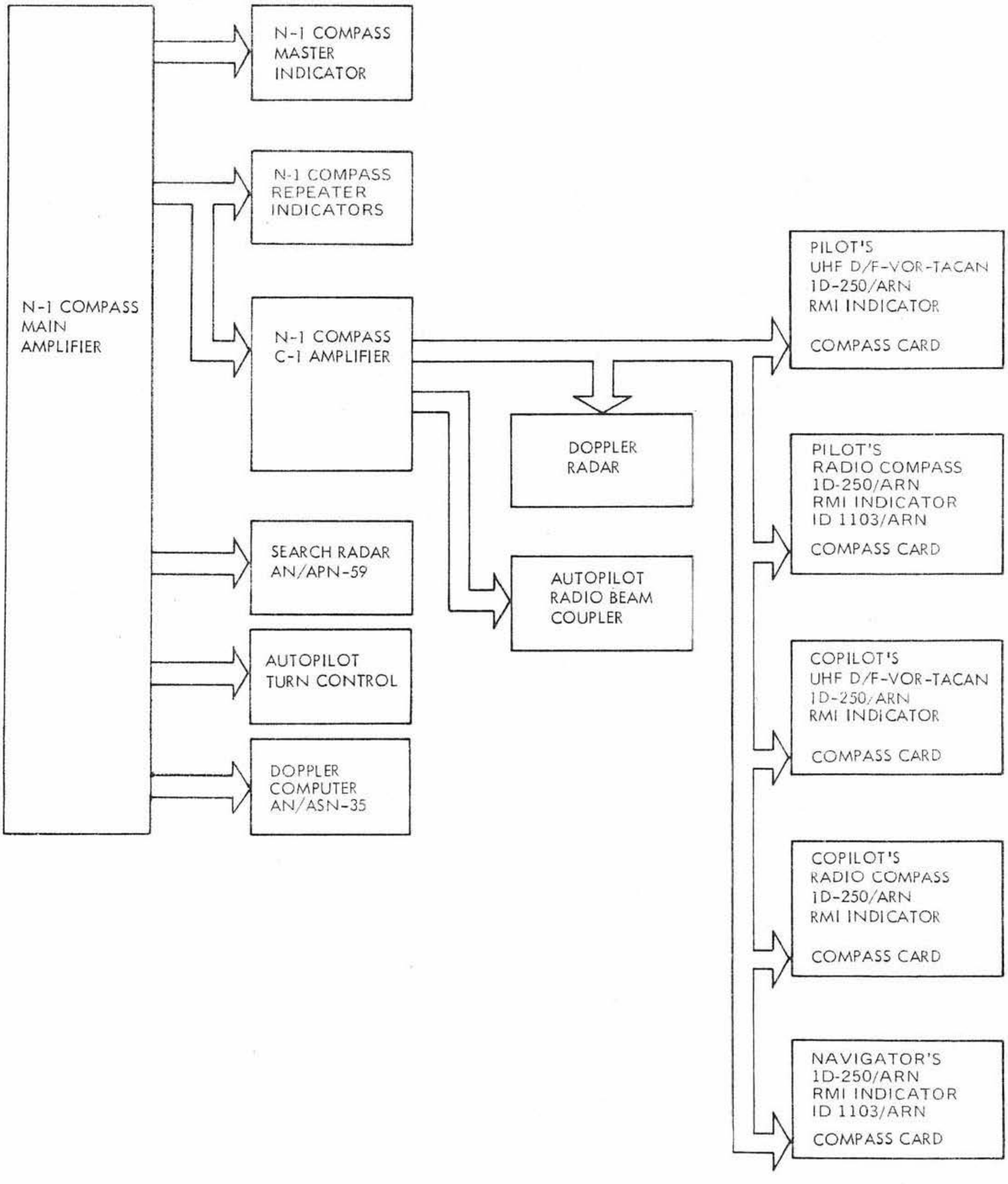


Figure 4-31.

A latitude-correction scale has OFF and 90°N through 0 to 90° S markings, graduated in two-degree increments. When the latitude-correction pointer indicates OFF, the system is operating as a magnetic slaved compass system. When the pointer is anywhere on the latitude scale, the system is operating in the directional gyro mode. The latitude indicated is the latitude for which correction is applied to the heading pointer due to apparent drift of the gyro. An annunciator scale and pointer indicate the direction in which to rotate the heading pointer to synchronize it while in magnetic slaved operation. The heading is synchronized when the annunciator is on the center index mark.

REPEATER INDICATOR. A repeater indicator is installed on the pilot's instrument panel and on the TV and IR OPERATORS' consoles (figure 1-53) and contains a scale and heading pointer which gives the same reading as given by the master indicator.

DIAL KNOB. A dial knob on the repeater indicators provides a means of manually rotating the dial through 360 degrees without changing the pointer indication. This allows the crew member to place the needle in a vertical position while following any course which makes off-course indications easier to detect.

Normal Operation of N-1 Compass System. ı.

The N-1 compass system operates whenever AC and DC power are available, but should be allowed about 10 minutes warmup before use. Operation of the N-1 compass system is controlled by the navigator, using the procedures which follow.

MAGNETIC SLAVED OPERATION. For magnetic slaved operation, proceed as follows:

1. Rotate the latitude-correction knob until the latitude-correction pointer reads OFF.

Note

The system should be synchronized before use as a magnetic slaved compass, since airplane movement on the ground without power may cause the system to be out of synchronization. The system will automatically synchronize itself, but only at a slow rate which may consume a large amount of time if far out of synchronization. Manual synchronization greatly lessens the amount of time required.

2. Synchronize the master indicator by engaging and rotating the synchronizer knob until the annunciator pointer is on the center index. The synchronizer knob must be rotated counterclockwise when the annunciator pointer is in the L area of the scale, and clockwise when the annunciator pointer is in the R area of the scale.

3. Check the heading pointer reading with the pilot's standby compass to assure that the system synchronization was not attempted on the heading which is 180 degrees from the correct heading. Once the system is correctly synchronized, the heading pointer will continuously indicate the magnetic heading of the airplane. During autopilot operation, the system will hold the airplane on a constant magnetic heading.

Note

During turns, the annunciator pointer may swing to the L or R area of its scale. This is a normal condition, requiring no correction. Do not attempt to reposition the master indicator heading pointer during or immediately after turns, since the system will remain in synchronization during and after the turn. When on autopilot, during magnetic slaved operation, rotation of the synchronizer knob from the synchronized position will cause the airplane to alter course at approximately three degrees per minute, and assume the new heading set on the master indicator heading pointer.

DIRECTIONAL GYRO OPERATION. For directional gyro operation, proceed as follows:

1. Rotate the latitude-correction knob clockwise until the latitude-correction pointer indicates the latitude of airplane position. The system is then independent of the magnetic compass equipment, and latitude correction for apparent gyro drift is given to the heading pointer.

Note

As the airplane changes latitude in flight, the latitude-correction pointer should be reset (at approximately two-degree intervals) to the new latitude.

2. Set the master indicator heading pointer to the desired gyro heading datum with the synchronizer knob. The gyro reference datum is not referenced to a geographical coordinate system; and, if a constant heading is flown, the path of the airplane will be a great circle course under a no-wind condition.

Note

During directional gyro operation, repositioning the heading pointer with the synchronizer knob will cause a change only in the heading datum, and will not cause the airplane to change heading, whether on or not on autopilot. Do not rotate the synchronizer knob without checking or recording the old and new headings on the master indicator; otherwise the basic heading datum may be lost.

LORAN C/D SYSTEM, AN/ARN-92

The ARN-92 navigation system (figure 4-32) is a computerized system that has the capability of handling airplane navigation problems with information derived from loran C or D, and A24G gyro or INS. The AN/ARN-92 has three modes of operation. They are loran (LRN), doppler/inertial (DOP/INS) and dead reckoning (DR). LRN is the primary mode while DOP/INS and DR are backup modes. The DOP/INS mode is not available in the AC-130A because the AN/ARN-92 is not provided the necessary input signals. The system consists of a receiver, antenna coupler unit, computer, control indicator, ARN-92 true airspeed control, and ARN-92 light control. The system functions in conjunction with two or more pairs of loran C or loran D ground stations. The ground stations are geographically situated from each other to form a triad (master and two slave stations) configuration. These stations transmit a series of 100 kHz pulses at designated time intervals and at specific pulse repetition rates to provide fixes for airplanes within a designated area. Transmitted loran signals from the ground stations are received by the airplane's antenna and applied to the loran receiver via the antenna coupler. The coupler resonates the connected antenna at 100 kHz and amplifies the received signals to levels which enable low noise transmission to the receiver. The receiver accepts the loran signals and automatically synchronizes gain control and time difference measuring programs to these signals. The navigational computer receives data from both the receiver and control indicator and in turn supplies both input components with further data. The control indicator unit energizes the system and supplies the computer with basic and specific rates and latitude and longitude data. Further, true airspeed (TAS) is supplied by the manual ARN-92 TAS control and heading is provided by the A24G two-axis gyro or INS. Primary power from the airplane of 115-volt, 400-Hz, three-phase ac is applied to both the receiver and the computer from the No. 2 (left-hand) ac bus and 28-volt dc is supplied from the dc bus. Overload protection is provided by the AN/ARN-92 circuit breakers located on the cargo compartment ac and dc circuit breaker panel, and by the loran computer power protector installed on the electronic rack. ARN-92 synchro excitation voltage is supplied from the ARN-92 synchro excitation box at the navigator station, and protected by the ARN 92 EXCITATION circuit breaker located on the main power distribution box.

Loran System (AN/ARN-92) Controls and Indicators

The loran system controls and indicators consist of the control indicator (C-7417/ARN-92), the ARN-92 TAS (true air speed) control, and the ARN-92 light control.

CONTROL INDICATOR, C-7417/ARN-92

The control indicator (figure 4-33), located at the navigator's station, provides the controls for operating the loran navigational system and includes illuminated indicators that display latitude and longitude data and indicate the operating status of the loran system. The control indicator energizes the loran system and supplies the computer with basic and specific rates. Controls and indicators consist of control switches, the input-output keyboard switches, dimmer controls, warning lights, and the alphanumeric gas tube display (display readout assembly).

MODE SWITCH. The MODE switch turns the system on and selects the mode for the computer to use. Switch positions and description are:

OFF - System power off.

STBY - Standby position. Clock oven power on in receiver and computer.

LRN - Loran position. System power on. Computer using loran for navigation.

DOP/INS - Doppler/inertial position. System power on. Computer using doppler (and magnetic heading) or inertial inputs for navigation depending upon which system is available. Inputs for this mode are not provided in this airplane.

DR - Dead reckoning position. System power on. Computer using true airspeed, inserted winds and heading inputs for navigation.

I/D SWITCH. The I/D (insert/display) switch is a 12-position rotary switch. The parameters display or inserted are relative to the position of the I/D switch. Switch positions and description are:

PP - Present Position

PF - Position Fix

1 - Destination 1

2 - Destination 2

3 - Destination 3

4 - Destination 4

M - Loran master station

W - Loran slave W station

X - Loran slave X station

loran system block diagram

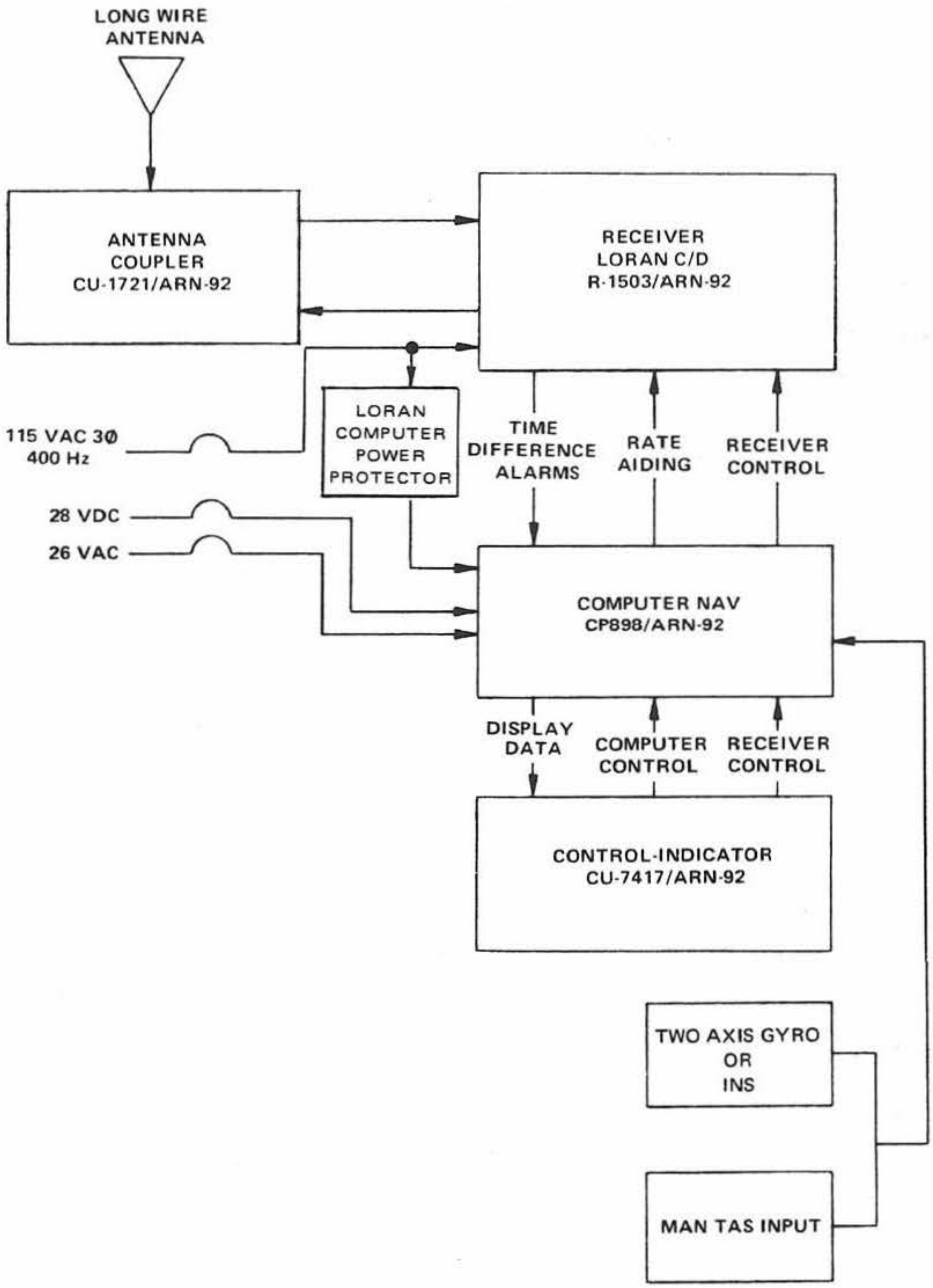


Figure 4-32.

loran control indicator (ARN-92)

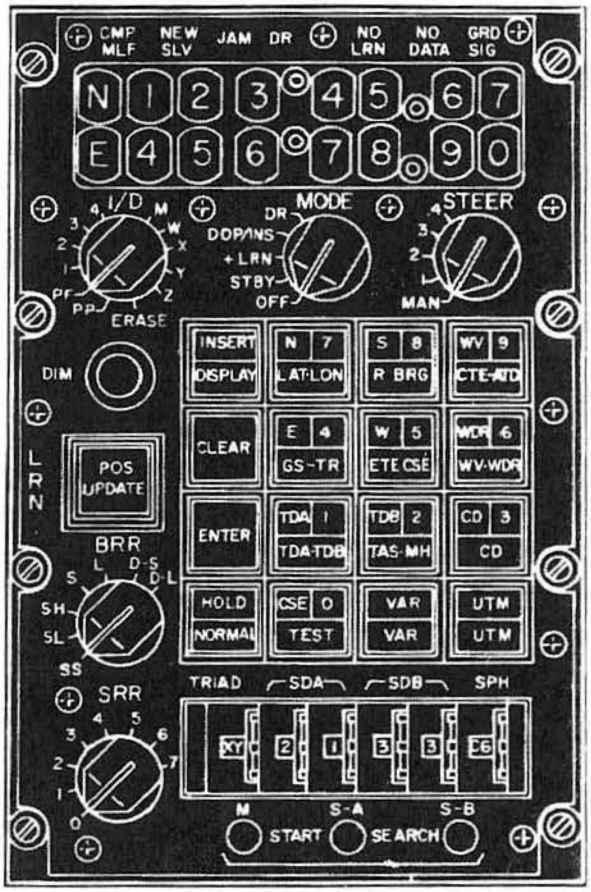


Figure 4-33.

Y - Loran slave Y station

Z - Loran slave Z station

ERASE - Erases all station parameters

STEER SWITCH. The STEER switch selects one of four destinations inserted in positions 1, 2, 3, or 4 on the I/D switch.

REPETITION RATE AND SEARCH DELAY SWITCHES. The basic repetition rate (BRR), specific repetition rate (SRR), search delay A (SDA), and search delay B (SDB) switches select the loran stations to be received. The SDA and SDB switches also provide for decreasing search time for the desired stations.

SPHEROID SWITCH. The spheroid (SPH) switch allows the selection of sheroid base for universal transverse mercator (UTM) computations. The switch positions are as follows:

SWITCH POSITION	SPHEROID
AN	Australian National
EV	Everest
BD	Bessel
IN	International
C8	Clarke 1880
C6	Clarke 1866

TRIAD SWITCH. The TRIAD switch informs the computer which two slave stations should be utilized. That is, it selects the slave station constants programmed on the I/D switch.

START SEARCH SWITCHES. The three START SEARCH switches provide for starting the receiver searching for master (M), slave A (S-A), and slave B (S-B) loran stations. The slave stations searched for depend upon the setting of the SDA and SDB switches. The search routine is started from the SDA and SDB switch settings.

DIM CONTROLS. The dim controls are concentric knobs, the large knob controlling the keyboard group intensity and the small knob controlling the gas tube display brightness. The control indicator panel lighting is controlled by the ARN-92 light control located at the navigator station.

WARNING LIGHTS. The warning lights are groups of incandescent lamps. Each light has an associated color relative to the degree of warning. The dead reckoning (DR) light is amber. The computer malfunction (CMP MFL) and no data (NO DATA) lights are red. The new slave (NEW SLV), jammed (JAM), no loran (NO LRN), and ground signal (GRD SIG) lights are green.

POSITION UPDATE SWITCH. The POS UPDATE switch allows updating of the computer's Dead Reckoning (DR) program. It updates the DR program to the position inserted in PF on the I/D switch.

KEYBOARD. The input-output keyboard group consists of an array of momentary pushbutton switches, used to insert or display information from the computer. If it is an insert command, the data is displayed as inserted from least significant decade and shifted to the more significant decades each time a button is pushed. This means that each number inserted moves across the display from right to left. The display is checked for correctness, then the ENTER key is depressed. This enters the inserted data into memory. If it is a display command, the parameters for the key depressed will be displayed. These keys and their functions are:

INSERT/DISPLAY key - The INSERT/DISPLAY key is alternate action switch used to select either INSERT or DISPLAY mode of operation. Insert mode illuminates the top half and display mode illuminates the bottom half of the split keys on the keyboard.

CLEAR key - The CLEAR key removes incorrectly inserted parameters before the ENTER key is depressed. Blinks to indicate that computer will not accept data. Not used in display mode of operation.

ENTER key - The ENTER key is used to enter information into temporary memory.

HOLD/NORMAL key - The HOLD/NORMAL key is an alternate action switch. HOLD will freeze displayed present position parameters selected on keyboard except ETE. NORMAL allows insertion of data into the computer.

N-7/LAT-LON key - Allows the insertion of a 7 or N (north) and the display of LAT (latitude) and LON (longitude).

E-4 GS-TR key - Allows the insertion of a 4 or E (east) and display of GS (ground speed) and TR (track).

TDA-1/TDA-TDB key - Allows the insertion of a 1 or TDA (time difference A) and the display of TDA (time difference A) and TDB (time difference B).

CSE-0/TEST key - Allows the insertion of a zero (0) or CSE (course) and the results of the TEST (built-in test).

S-8/R-BRG key - Allows the insertion of an 8 or S (south) and the display of R (range) and BRG (bearing).

W-5/ETE-CSE key - Allows the insertion of a 5 or W (west) and display of the ETE (estimated time enroute) and the CSE (course) parameters.

TDB-2/TAS-MH key - Allows the insertion of a 2 or TDB (time difference B) and the display of TAS (true airspeed) and A24G gyro heading/INS.

VAR/VAR key - Allows the insertion and display of VAR (magnetic variation).

WV-9/CTE-ATD key - Allows the insertion of a 9 or WV (wind velocity) and the display of CTE (cross track error) and ATD (along track distance).

WDR-6/WV-WDR key - Allows the insertion of a 6 or WDR (wind direction) and the display of WV (wind velocity) and WDR (wind direction).

CD-3/CD key - Allows the insertion of a 3 or CD (coding delay) and the display of CD (coding delay.)

UTM/UTM key - Allows the insertion and display of UTM (universal transverse mercator) coordinates.

DISPLAY READOUT ASSEMBLY. The display readout assembly (gas tube display) consists of two alpha display tubes and fourteen numeric display tubes. There are also two degree and two decimal tubes. From this unit data is displayed in terms of two simultaneous seven decimal digits. The type of information being displayed is designated by an alphabetical character preceding the decimal number. Punctuation in terms of decimal points and angular degrees are provided according to the type of information being displayed. Figure 4-35 shows the display mode of operation. The keyboard has been blacked out to show only the display mode of operation. The symbols displayed on the parameter display tubes are the result of the computer self-test.

ARN-92 TAS CONTROL

The manual TAS input control (figure 4-34) contains a knob dial setting which is used to dial the aircraft's true airspeed. The dial has a calibrated linear range from 60 to 310 knots. The calibration limit is ±10 knots. Lighting is provided and controlled by the ARN-92 lighting control. TAS being supplied to the ARN-92 computer may be read on the control indicator by depressing the TAS-MH key. To accurately set the ARN-92 TAS, select the TAS-MH on display and rotate TAS control until the desired TAS is displayed.

Normal Operation of the Loran C/D Systems

The loran system has three modes of operation, loran (LRN), doppler/inertial (DOP/INS) (DOP/INS mode not available in this airplane) and dead reckoning (DR). LRN is the primary mode and DR is the backup mode. A rate aid signal generated from information provided by the TAS input control and the A24G gyro or INS is supplied to the receiver to aid in track. The DR mode utilizes the TAS input and A24G gyro or INS input to provide DR information.

If, while operating in the LRN mode, the loran signals are lost or the receiver malfunctions, the NO LRN warning light on the control indicator illuminates. When the DR warning light illuminates the computer has changed to the dead reckoning mode and the system automatically starts operating in the DR mode.

The DR warning light actually tells the operator he has the LRN mode selected, but the system is operating in the DR mode. The DR warning light does not illuminate when either the DOP/INS or DR mode is selected unless the system is in automatic DR.

The control indicator has three basic operating modes; display, insert, and erase. Figures 4-35 and 4-36 show the display and insert modes respectively. Each figure has the keyboard blacked out to show only its respective operating mode. The display mode (figure 4-35) is shown with the display readout assembly indicating the result of the computer self-test. The erase mode is used to remove from computer memory all station parameters (latitude, longitude, coding delay, and secondary phase correction) previously entered. Therefore, if any of the parameters of any complex is to be retained, this data must be reinserted into the control indicator after the erase procedure. Operating procedures for the system consist of the following:

Note

Although all station parameters have been erased, the nixie lights will still display the last inserted coordinates. An indication of this condition will be a blinking NO DATA light.

CONTROL INDICATOR OPERATION.

To operate the control indicator proceed as follows:

NAVIGATION COMPUTER SYSTEM TURN ON. Turn on navigation computer system as follows:

CAUTION

If a power loss or fluctuation is anticipated, turn the ARN-92 off.

Note

The control indicator MODE switch may initially be placed in the on (LRN) position, if necessary, to insert information before elapsed warmup period.

ARN-92 tas control

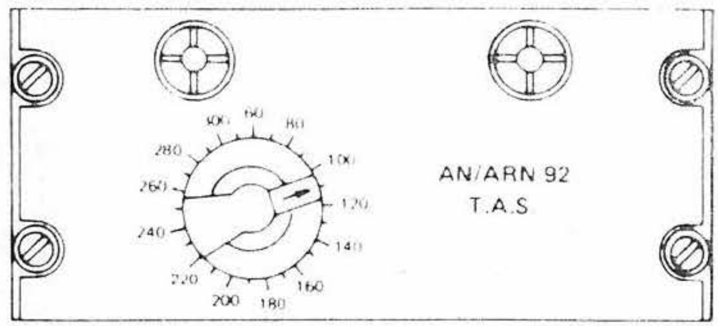


Figure 4-34.

1. Place control indicator MODE switch to STBY position. In this position computer power is off, but the clock oven power is applied. Allow approximately 15 minutes for the clock to stabilize.

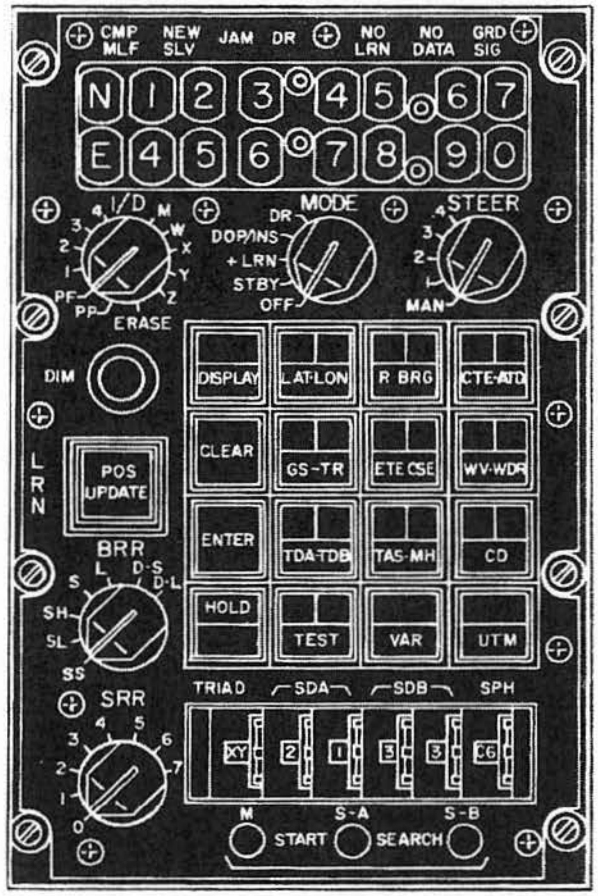
2. Place control indicator MODE switch to LRN position. This applies power to the system. If the computer is located in an accessible position, the elapsed time indicator may be observed. The indicator shall be running.

3. Set the INSERT/DISPLAY key to DISPLAY mode. The bottom half of the split keys will light up. Depress TEST key. The display shall show the configuration shown in figure 4-35 and all warning lights will be illuminated.

OPERATION OF THE HOLD/NORMAL KEY. When the HOLD/NORMAL key is depressed to light the bottom (NORMAL) portion, the display will continually update the changing paramenters requested to be displayed. When HOLD/NORMAL key is depressed to light its top (HOLD) portion the display of LAT-LON, UTM, TDA-TDB, CTE-ATD, R-BRG, TAS-MH, WV-WDR and GS-TR will be frozen when requested to be displayed. This does not stop, however, the updating of the parameters in the computer, but merely holds the display of the parameters at the value they had when HOLD/NORMAL key was depressed to HOLD condition. Those parameters not held are ETE-CSE. The HOLD/NORMAL key does not affect the insertion of data; ie. data may be inserted with the HOLD/NORMAL key in HOLD position.

PROCEDURE FOR OPERATING THE CLEAR KEY. If the operator wishes to change parameters while he is in the process of insertion, he should depress the CLEAR key. This will wipe out all data inserted back to the last time the ENTER key was depressed. The display will also revert back to show all zeros. If the operator inserts VAR or UTM data and is not following the correct sequence, the CLEAR key will start blinking. This indicates that data will not be

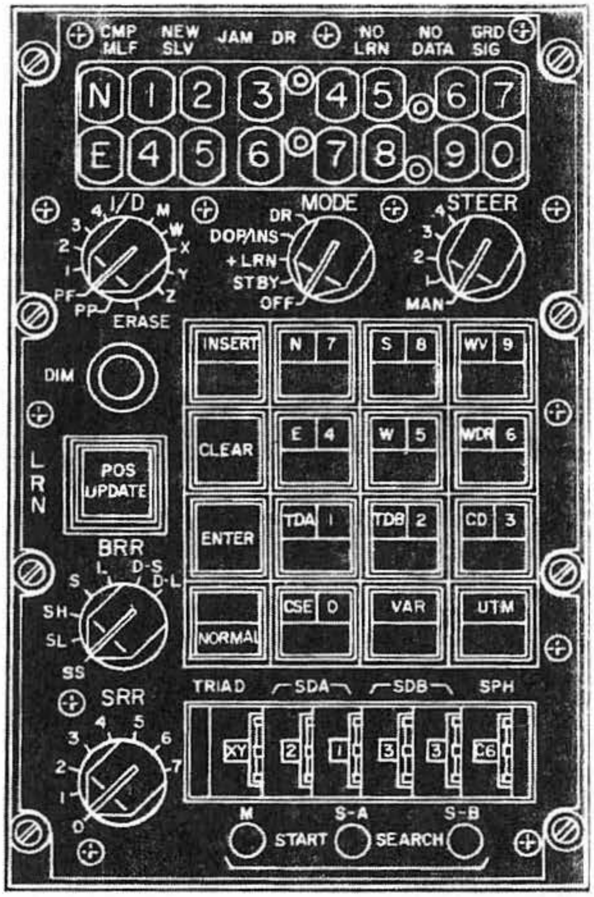
loran control indicator display operation



Control	Symbols Displayed on Parameter Tubes: Top Row	Symbols Displayed on Parameter Tubes: Bottom Row	Description	Function
Disp			Disp	Selects display mode of operation. Illuminates bottom half of split switches.
Clear			Clear	Not used in display mode.
Enter			Enter	Not used in display mode.
Hold			Hold	Will freeze displayed present position parameters selected on keyboard, except ETE-CSE.
Lat-Lon	N or S	E or W	Latitude Longitude	Displays the latitude and longitude of selected position of I/D switch.
GS TR	G	T	Ground Speed, Track Angle	Displays ground speed and track angle parameters of present position.
TDA-TDB	Δ	Δ	Time Difference A and B	Displays time difference of present position and selected destinations.
Test			Test	Displays the results of the computer self-test. Also, the seven warning lights will be illuminated while the test switch is depressed.
R-BRG	R	B	Range, Bearing	Displays range and bearing parameters of selected destinations.
ETE-CSE	T	C	Estimated Time Enroute, Course	Displays estimated time enroute to selected destinations, and course inserted via keyboard.
TAS-MH	A	H	True Air Speed, Magnetic Heading	Displays true air speed and magnetic heading parameters of present position.
Var	V	E or W	Magnetic Variation	Displays inserted parameter
CTE-ATD	R or L	D	Cross Track Error, Along Track Distance	Displays cross track error and along track distance parameters of selected destinations relative to inserted course.
WV-WDR	V	D	Wind Velocity, Wind Direction	Displays wind velocity and wind direction parameters of present position.
CD		C	Coding Delays	Displays coding delays relative to the programmed loran complex selected. Secondary phase correction for the master station cannot be displayed.
UTM	N or S	U	Universal Transverse Mercator	Displays universal transverse mercator coordinates of present position, and selected destinations.

Figure 4-35.

loran control indicator insert operation



CONTROL	DESCRIPTION	FUNCTION
Insert	Insert	Selects insert mode of operation. Illuminates top half of split keys.
Clear	Clear	Removes incorrectly inserted parameters before enter sw is depressed.
Enter	Enter	Enters word displayed into memory. The display will return to all zeros.
Normal	Normal	Allows the insertion of data into computer. This sw should always be in this position, except to "freeze" displayed parameters.
N - 7	North - Seven	The first time this sw is pressed, north will be entered: after the first time, a seven will be entered.
E - 4	East - Four	This sw is handled the same as N - 7, above.
TDA - 1	Time Difference A - One	This sw is handled the same as N - 7, above.
CSE - 0	Course - Zero	This sw is handled the same as N - 7, above.
S - 8	South - Eight	This sw is handled the same as N - 7, above.
W - 5	West - Five	This sw is handled the same as N - 7, above.
TDB - 2	Time Difference B - Two	This sw is handled the same as N - 7, above.
Var	Magnetic Variation	This sw informs computer that the next sw pressed (E or W) will be direction of magnetic variation.
WV - 9	Wind Velocity - Nine	This sw is handled the same as N - 7, above.
WDR - 6	Wind Direction - Six	This sw is handled the same as N - 7, above.
CD - 3	Coding Delay - Three	This sw is handled the same as N - 7, above.
UTM	Universal Transverse Mercator	This sw informs computer that next sw pressed (N or S, before northing; E before easting) will be parameter for the UTM. If an E is pressed, for easting, it will be displayed as a U; indicating UTM.

Figure 4-36.

accepted by the computer. The CLEAR key should now be depressed which will stop the blinking and the control indicator is ready to accept correctly inserted data again.

PROCEDURE FOR DISPLAYING PARAMETERS. Display parameters as follows:

1. Set INSERT/DISPLAY key to DISPLAY.

2. Depress key showing the parameters requested to be displayed. The upper portion of the display will show the first parameter shown on the key. The bottom portion of the display will show the second parameter shown on the key. The parameter displayed is relevant to the I/D switch setting, except that inserted wind velocity, wind direction, and secondary phase correction cannot be displayed.

INSERTION OF STATION PARAMETERS. Insert station parameters as follows:

1. Insert master station parameters as follows:

Note

The memory capacity of the computer is for three station complexes, with one master and four slave stations each. In order to insert a new station complex when the maximum capacity is stored, a stored station complex needs to be ERASED prior to entering the new station complex. Refer to ERASE PROCEDURE.

a. Set I/D switch to M position.

b. Set BRR and SRR (repetition rate) switches to select desired station.

c. Set INSERT/DISPLAY key to INSERT position.

d. Insert latitude by first depressing the N (north) or S (south) key, followed by numbers in left to right sequence.

e. Verify that the top row of the display contains correct data, then depress ENTER key. If data in the top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

f. Insert longitude by first depressing E (east) or W (west) key, followed by numbers in left to right sequence.

g. Verify that the bottom row of the display contains correct data, then depress ENTER key. If data in the bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

Note

If the master station secondary phase correction is not known, insert a 1.00.

h. Insert the master station secondary phase correction by first depressing CD (coding delay key, followed by numbers in left to right sequence.

i. Verify that the top row of the display contains correct data, then depress ENTER key. If data in the top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

2. To insert parameters for the slave stations (W, X, Y, Z) repeat steps (c) through (g) of paragraph 1 of INSERTION OF STATION PARAMETERS, after setting the I/D switch to applicable slave (W, X, Y, Z). Insert coding delay by first depressing coding delay (CD) key, followed by numbers in left to right sequence.

Note

The ERASE procedure removes from computer memory all station parameters (LAT, LON, coding delay, and secondary phase correction) previously entered for all three complexes of five transmitters each. Therefore, if any on the parameters of any complex is to be retained, this data must be reinserted into the control indicator, after the ERASE procedure. However, to correct erroneously inserted individual stations or complexes, parameters may be reinserted without using the ERASE procedure.

Note

The NO DATA light will be on before erasing if the TRIAD switch is selecting slaves not programmed into the computer for the selected complex (BRR, SRR).

ERASE PROCEDURE. Perform erase procedure as follows:

1. Set I/D switch to ERASE position.

2. Set INSERT/DISPLAY key to INSERT position.

3. Depress N key.

4. Depress ENTER key. The NO DATA light will go on after depressing the ENTER key.

POSITION FIXING. Position fixing is used to initially insert present position to aid LORAN lock-on as well as to give a starting point and to update the DR position of the computer. The DR position will be continually updated from the PF position based on true airspeed and heading inputs. Perform position fixing as follows:

1. Insert position fixing, with latitude and longitude coordinates, as follows:

    a. Set I/D switch to PF position.

    b. Set MODE switch to DR position.

    c. Set INSERT/DISPLAY key to INSERT position.

    d. Insert the position fix latitude by first depressing N (north) or S (south) key, followed by numbers in left to right sequence.

    e. Verify that top row of display contains correct data, then depress ENTER key. If data in the top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

    f. Insert the position fix longitude by first depressing E (east) or W (west) key, followed by numbers in left to right sequence.

    g. Verify that bottom row of display contains correct data, then depress ENTER key. If data in bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

    h. Depress POS UPDATE key when location of the aircraft coincides as closely as possible with inserted latitude and longitude coordinates.

    i. Set I/D switch to PP position. The computer will compute present position based on TAS and heading inputs.

2. Insert position fixing, with time difference coordinates, as follows:

    a. Set I/D switch to PF position.

    b. Set MODE switch to DR position.

    c. Set BRR and SRR (repetition rate) switches to select desired station.

    d. Set TRIAD switch to select desired triad.

    e. Set INSERT/DISPLAY key to INSERT position.

Note

To resolve ambiguity, the approximate latitude and longitude inserted must be closer to the actual position than to the alternate time difference intersection point.

    f. Insert the approximate latitude by first depressing N (north) or S (south) key, followed by numbers in left to right sequence.

    g. Verify that top row of the display contains correct data, then depress ENTER key. If data in the top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

    h. Insert the approximate longitude by first depressing E (east) or W (west) key, followed by numbers in left to right sequence.

    i. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in the bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

    j. Insert position fix time difference A parameter by first depressing TDA key, followed by the numbers in left to right sequence.

    k. Verify that top row of the display contains correct data, then depress ENTER key. If data in the top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

    l. Insert position fix time difference B parameter by first depressing TDB key, followed by the numbers in left to right sequence.

    m. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in the bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

    n. Depress the POS UPDATE key when location of the aircraft coincides as closely as possible with inserted time difference coordinates.

    o. Set I/D switch to PP position. The computer will compute present position based on TAS and heading inputs.

3. Insert position fixing, with universal transverse mercator coordinates, as follows:

   a. Set I/D switch to PF position.

   b. Set MODE switch to DR position.

   c. Set SPH (spheroid) switch to select the desired spheroid.

   d. Set INSERT/DISPLAY key to INSERT position.

   e. Insert the position fix parameter for northing by first depressing UTM (universal transverse mercator) key, then N (north) or S (south) key, followed by numbers in left to right sequence.

   f. Verify that top row of the display contains correct data, then depress ENTER key. If data in top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

   g. Insert the position fix parameter for easting by first depressing UTM key, then E (east) key, followed by numbers in left to right sequence. W (west) key is not used in conjunction with UTM. When E key is depressed it will be displayed as a U. This indicates UTM.

   h. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in the bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

   i. Depress the POS UPDATE key when location of the airplane coincides as closely as possible with inserted UTM coordinates.

   j. Set I/D switch to PP position. The computer will compute present position based on TAS and heading inputs.

INSERTION OF DESTINATION DATA. Insert destination data into the loran system computer as follows:

1. Insert destination in latitude and longitude coordinates as follows:

   a. Set I/D switch to destination desired (1, 2, 3, or 4)

   b. Set MODE switch to LRN position.

   c. Set BRR and SRR (repetition rate) switches to select desired station.

   d. Set TRIAD switch to select desired triad.

   e. Set INSERT/DISPLAY key to INSERT position.

   f. Insert latitude of the destination selected by first depressing N (north) or S (south) key, followed by numbers in left to right sequence.

   g. Verfiy that top row of the display contains correct data, then depress ENTER key. If data in the top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

   h. Insert longitude of the destination selected by first depressing E (east) or W (west) key, followed by numbers in left to right sequence.

   i. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in the bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

   j. Insert magnetic variation of destination selected by first depressing VAR key, then E (east) or W (west) key, followed by the numbers in left to right sequence. When E or W key is depressed, a V will appear on the upper display parameter tube and an E or W on the lower display parameter tube.

   k. Verify that the display contains correct data, then depress ENTER key. If data is incorrect, depress CLEAR key, then reinsert correct data.

2. Insert destination in time difference coordinates as follows:

   a. Set I/D switch to destination desired (1, 2, 3, or 4).

   b. Set MODE switch to LRN position.

   c. Set BRR and SRR (repetition rate) switches to select desired station.

   d. Set TRIAD switch to select desired triad.

   e. Set INSERT/DISPLAY key to INSERT position.

Note

To resolve ambiguity, the approximate latitude and longitude inserted must be closer to the actual position than to the alternate time difference intersection point.

   f. Insert the approximate latitude of destination selected by first depressing N (north) or S (south) key, followed by numbers in left to right sequence.

g. Verify that top row of the display contains correct data, then depress ENTER key. If data in the top row is incorrect, depress CLEAR key, then reinsert correct data, and depress ENTER key.

h. Insert approximate longitude of the destination selected by first depressing E (east or W (west) key, followed by numbers in left to right sequence.

i. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in the bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

j. Insert time difference A parameter of the selected destination by first depressing TDA key, followed by numbers in left to right sequence.

k. Verify that top row of the display contains correct data, then depress ENTER key. If data in top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

l. Insert time difference B parameter of selected destination by first depressing TDB key followed by numbers in left to right sequence.

m. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in the bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

n. Insert the magnetic variation of selected destination by first depressing VAR key then E (east) or W (west) key, followed by numbers in left to right sequence. When the E or W key is depressed, a V will appear on the upper display parameter tube and an E or W in the lower display parameter tube.

o. Verify that the display contains correct data, then depress ENTER key. If data is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

3. Insert destination in universal transverse mercator coordinates as follows:

a. Set I/D switch to destination desired (1, 2, 3, or 4).

b. Set MODE switch to LRN position.

c. Set SPH (spheroid) switch to select desired spheroid.

d. Set TRIAD switch to select desired triad.

e. Set BRR and SRR (repetition rate) switches to select desired station complex.

f. Set INSERT/DISPLAY key to INSERT position.

g. Insert universal transverse mercator coordinates of desired destination by first depressing UTM key, then N (north) or S (south) key, followed by numbers in left to right sequence.

h. Verify that top row of the display contains correct data, then depress ENTER key. If data in top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

i. Insert easting coordinates by first depressing UTM key, then E (east) key, followed by numbers in left to right sequence. W (west) key is not used in conjunction with UTM. When E key is depressed, it will be displayed as a U. This indicates UTM.

j. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

k. Insert the magnetic variation of selected destination by first depressing VAR key, then E (east) or W (west) key, followed by numbers in left to right sequence. When the E or W key is depressed, a V will appear on the upper display parameter tube and an E or W on the lower display parameter tube.

l. Verify that the display contains correct data, then depress ENTER key. If data is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

INSERTION OF WIND DIRECTION AND WIND VELOCITY.

1. Insert wind velocity parameters by first depressing INSERT and then WV key, followed by numbers in left to right sequence.
2. Verify that top row of the display contains correct data, then depress ENTER key. If data in top row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.
3. Insert wind direction parameters by first depressing WDR key, followed by numbers in left to right sequence.
4. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

PROCEDURE FOR INITIATION OF RECEIVER SEARCH FOR REQUIRED STATION COMPLEX AND TRIAD. Initiate receiver search for required station complex and triad as follows:

1. Set BRR and SRR (repetition rate) switches to select desired station.

2. Set TRIAD switch to select desired triad.

Note

It is assumed that desired station parameters have been inserted.

3. Set MODE switch to LRN position.

4. The setting of I/D switch and STEER switch are inconsequential.

Note

The expected time differences are determined from the airplane's assumed present position. If the position of the airplane is somewhat vague, the slave delays should be set to the coding delays of the respective slaves.

5. Set SDA (slave delay A) switch approximately 1000 microseconds below the expected time difference for slave A. The first listed slave station of a triad is always A.

6. Set SDB (slave delay B) switch approximately 1000 microseconds below the expected time difference for slave B. The first listed slave station of a triad is always A.

7. Depress the start button for M (master station). When lock-on has been achieved by the receiver, the NO LRN (no loran) and DR (dead reckoning) lights will go out.

8. When the receiver has settled, the GRD SIG light will extinguish, and the time differences and positioning from the receiver will be accurate.

NAVIGATION PARAMETER COMPUTATIONS. Compute navigation parameters as follows:

1. Compute range and bearing to selected destination from present position as follows:

   a. Set I/D switch to PP position.

   b. Set STEER switch to MAN position.

   c. Set INSERT/DISPLAY key to INSERT position.

   d. Insert magnetic variation of present position by first depressing VAR key, then E (east) or W (west) key, followed by numbers in left to right sequence. When the E or W key is depressed, a V will appear on the upper display parameter tube and an E or W on the lower display parameter tube.

   e. Verify that the display contains correct data, then depress ENTER key. If data is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

   f. Set I/D switch to desired destination position (1, 2, 3, or 4).

   g. Set INSERT/DISPLAY key to DISPLAY position.

   h. Depress R-BRG key. The top row of the display will now display range, and bottom row will display bearing to destination selected on I/D switch.

2. Use alternate method to compute range and bearing to selected destination from present position as follows:

   a. Set I/D switch to PP position.

   b. Set STEER switch to select desired destination.

   c. Depress R-BRG key. The top row of the display will now display range, and bottom row will display bearing to destination selected on STEER switch.

3. Compute along track distances and cross track error for a selected destination, using the computer inserted course, as follows:

   a. Set I/D switch to PP position.

Note

The DR mode may be selected for computing navigation parameters providing that the applicable paragraph under POSITION FIXING has been completed.

   b. Set MODE switch to LRN.

   c. Set INSERT/DISPLAY key to INSERT position.

   d. Insert magnetic variation parameters for the present position by first depressing VAR key, then E (east) or W (west) key, followed by numbers in left to right sequence. When the E or W key is depressed, a V will appear on the upper display parameter tube and an E or W on the lower display parameter tube.

e. Verify that the display contains correct data, then depress ENTER key. If data is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

f. Insert course parameters by first depressing CSE (course) key, followed by numbers in left to right sequence.

g. Verify that bottom row of the display contains correct data, then depress ENTER key. If data in bottom row is incorrect, depress CLEAR key, then reinsert correct data and depress ENTER key.

h. Set STEER switch to desired destination.

i. Set INSERT/DISPLAY key to DISPLAY position.

j. Depress CTE-ATD key. The display now shows cross track error in top row and along track distance in bottom row relative to the steer switch position and selected course.

Control Indicator Warning Lights

The indicator warning lights located at the top of the control indicator front panel inform the operator when manual intervention is necessary or a malfunction exists. These lights function as follows:

When illuminated, these lights indicate any single or combination of conditions noted in the following procedures, which provide instructions as to the actions required to correct the condition(s) that caused the indicator to illuminate.

CMP MLF (COMPUTER MALFUNCTION) LIGHT. The CMP MLF light will illuminate as follows:

1. When the internal computer-generated self-test cycle detects a malfunction in computer operation. The computer should not be trusted for correctness of any computer function.

2. The CMP MLF light will blink continuously if synchro excitation voltage is not being provided.

Note

If the CMP MLF light comes on, even momentarily, the station parameters should be checked for correctness. If any parameters are found to be incorrect, perform ERASE procedure, then reinsert station parameters.

NEW SLV (NEW SLAVE) LIGHT. The NEW SLV light will illuminate as follows:

Note

The appropriate SDA and SDB switch positions are 1000 microseconds less than the expected time differences

LIGHT	COLOR	INDICATION
CMP MLF	Red	Computer malfunction - Computer selftest failure or loss of 26 VAC excitation voltage of the servo.
NEW SLV	Green	New slave - Loran triad in use out of accuracy region, or will blink if TRIAD switch calls for a slave not programmed on the I/D switch.
JAM	Green	Receiver is being jammed.
DR	Amber	Dead Reckoning - Computer in automatic dead reckoning mode.
NO LRN	Green	No loran - Loran signals not being received or receiver malfunction.
NO DATA	Red	Loran station constants not inserted or heading and TAS inputs not connected.
GRD SIG	Green	Ground signal available - Receiver sky wave lock-on, but senses ground wave and is attempting to lock on to the ground wave.

1. When NEW SLV light illuminates set the TRIAD switch to a position causing the light to go out. Reset search delay switches (SDA and SDB) to appropriate positions, if required, and depress the START SEARCH buttons S-A and S-B.

2. The NO LRN (no loran) light will illuminate because lock-on has been lost.

3. The DR (dead reckoning) light then will illuminate indicating that the computer has automatically gone over to dead reckoning mode of navigation.

4. When the loran receiver has again locked on to a new triad, the NO LRN light will go out. The DR light will then go out, indicating that the computer has automatically gone back to loran mode.

JAM (JAMMING) LIGHT. The JAM light will illuminate as follows:

1. When JAM light illuminates, it indicates that the receiver is receiving very high noise loran signals and, therefore, the computer should not be trusted for accuracies in the loran mode of navigation.

2. The NO LRN (no loran) light may illuminate, if the receiver has lost lock-on.

3. The DR (dead reckoning) light will illuminate, indicating that the computer has automatically gone over to dead reckoning mode.

4. If the NO LRN light does not go out within 2 minutes after JAM light goes out, reset SDA and SDB switches to 1000 microseconds less than the expected time differences and depress the START SEARCH buttons. The NO LRN light will go out when the receiver locks on again.

DR (DEAD RECKONING) LIGHT. The DR light will illuminate as follows:

1. When the computer has automatically gone over to dead reckoning mode when the jamming signal comes into the receiver while operating in the loran mode.

2. When the computer has automatically gone over to the dead reckoning mode if a loran transmitter malfunction has occurred, or if receiver power fails. (The NO LRN light will illuminate also.)

3. When the computer has automatically gone over to dead reckoning mode if the loran receiver has lost lock-on.

NO LRN (NO LORAN) LIGHT. The NO LRN light will illuminate as follows:

1. The NO LRN light illuminates if the receiver is not locked-on to the complete triad set into the controller, if the loran transmitter malfunctions or if receiver power fails.

Note

The loss of loran lock on may be caused by transmission exceeding 24 seconds on either HF radio.

2. The JAM light may illuminate if above condition is caused by signal jamming.

NO DATA LIGHT. The NO DATA light will illuminate as follows:

1. The NO DATA light illuminates if selected loran station complex and triad requested are either not entered in the computer or incompletely entered

2. The NO DATA light will illuminate any time the DOP/INS mode is selected because of no input.

3. The NO DATA light will illuminate if either the TAS or heading input is disconnected.

GRD SIG (GROUND SIGNAL) LIGHT. The GRD SIG light illuminates when the ground wave signal becomes available while the receiver is locked on the sky wave signal. It remains on until the receiver transfers lock-on to the ground wave.

Loran Computer Power Protector

The loran computer power protector (figure 4-37) consists of a lever-type trip-free circuit breaker and three power indicator lights located in the 115-volt, 400-Hz, three-phase circuit to the loran computer. This circuit breaker and the power indicator lights are contained in a panel installed on the electronic rack. The circuit breaker has positions ON and OFF, and the lights are identified as ØA, ØB, and ØC. The lights illuminate as long as voltage and frequency supplied the computer are correct, and extinguish upon failure of a given phase or phases. If overvoltage occurs, the circuit breaker will trip to the OFF position.

RADAR SET (AN/APN-59)

Note

When the AN/APN-59 is in operation, do not switch, apply, or remove power to the electronics and engine instrument bus without notifying the navigator (or the electronics maintenance man) to turn off the radar set, using normal turn-off procedures. The AN/APN-59 radar will not be turned back on until stable power is being provided to the electronic and engine instrument bus.

loran computer power protector

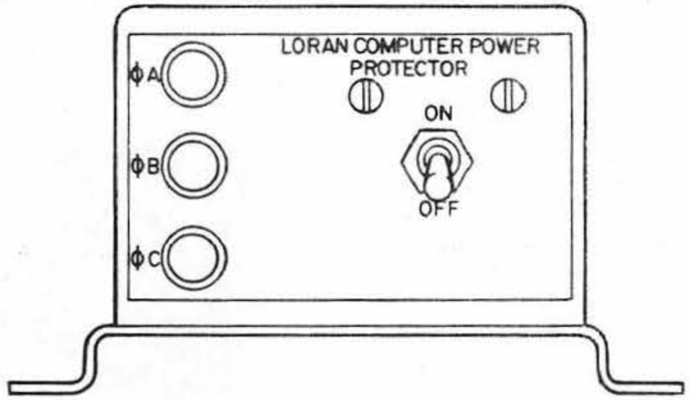


Figure 4-37.

pilot's and navigator's search radar (AN/APN-59)

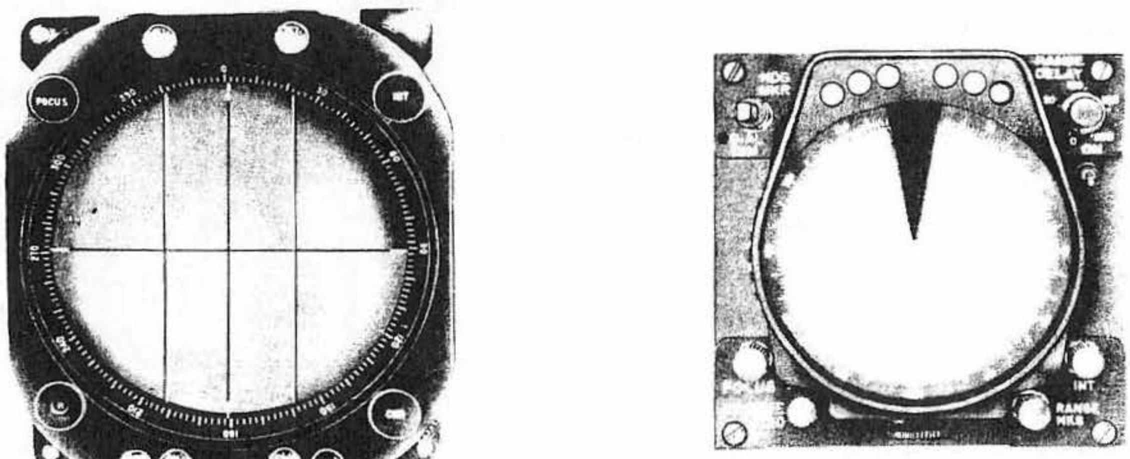


Figure 4-38.

Radar set AN/APN-59 is designed to operate as a navigational and search radar, a weather radar, or a racon (beacon) interrogator-receiver. When used as a search radar, it displays a map-like scope picture showing cities and smaller terrain features, rivers, islands, shorelines, mountains, and ships at sea, up to a distance of 240 nautical miles. When used as a weather radar, it displays storm fronts, heavy rainfall, or other turbulent weather features with precipitation. When used for racon navigation, it transmits an interrogating signal and then displays, in plan position, the space-coded identification of the automatic racon reply or replies. The radar set enables the navigator to see targets or check points on the ground through clouds, fog, overcast, or darkness. It enables him to determine accurate ground speeds and ground tracks. It is not, however, a means of navigation by itself, but is a means of establishing an accurate position so that conventional methods of dead reckoning can be supplemented. The radar set operates from 28-volt DC power; 115-volt unregulated AC power; and 115-volt 400-cycle regulated AC power through the AN/APN-59 radar AC and DC circuit breakers on the radio junction box.

WARNING

Dangerous voltages (at times as high as 15,000 volts) are present in radar set AN/APN-59. Do not attempt to make any internal repairs or adjustments. If such repairs or adjustments are necessary, notify authorized service personnel.

Radar Set Controls.

Functional control of the set is accomplished from a radar control panel (figure 4-39) on the navigator's control panel. Selection of the radar function, range, type of scanning, and antenna tilt is done on this control set. By selecting the proper combination of these switches, the desired function and indicator presentation can be obtained. The following controls are used for operating the radar set.

RANGE SELECTOR - Selects desired range.

FUNCTION SWITCH -

OFF position - No power to set.

STANDBY position - Used for 3-minute warmup. In this function the magnetron is not operating.

SEARCH position - Presents a visual map-like scope picture.

BEACON position - Presents a space-coded identification of radar beacons.

WARNING position - Used to detect weather buildups.

search radar (AN/APN-59) control panel

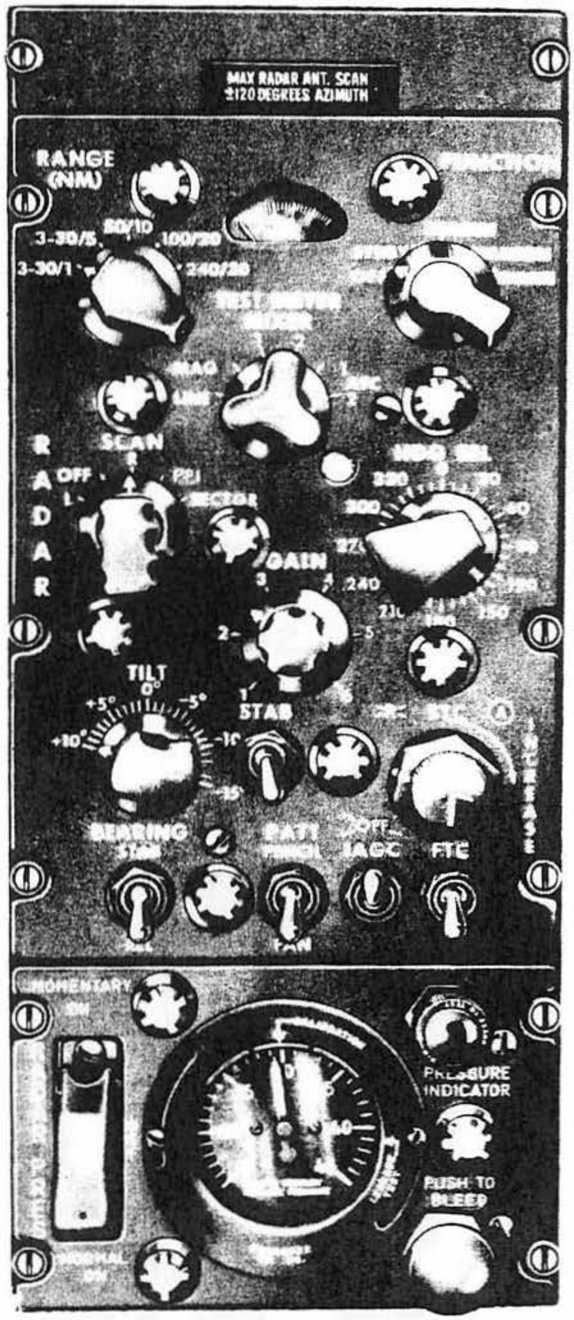


Figure 4-39.

Note

Avoid flying through fuzzy returns.

TEST METER - MIXER CONTROL - Used to monitor line, magnetron, mixer and AFC systems voltages.

Note

Line milliampers should read 0.6 (+0.08) and steady. Magnetron milliamperes should read 0.65 (+0.35) and steady. Mixer No. 1 and No. 2 and AFC No. 1 and No. 2 milliamperes should read 0.60 (+.30) and steady. If line voltage fluctuates, have the flight engineer check the airplane power supply for fluctuations.

SCAN SELECTOR - Used to select the type of antenna scan. The following selections may be made with the SCAN SELECTOR.

L - Rotates counterclockwise (12 RPM).

OFF - Antenna is stationary.

R - Rotates clockwise (12 RPM).

PPI - Rotates clockwise (12 RPM).

SECT - Antenna scans back and forth across lubber line of the airplane.

HDG SEL CONTROL - Numeral in window at left of control shows knob setting. Used in conjunction with the bearing switch.

GAIN CONTROL - Used to adjust receiver gain. OFF is fully counterclockwise.

TILT CONTROL - Used to control tilt of radar antenna beam.

STAB SWITCH - Used to select stabilization of antenna.

UP - The antenna is stabilized perpendicular to the earth through rotation.

DOWN - The antenna is locked to the plane of the airplane.

STC CONTROL - Reduces gain on short range returns. Inner knob controls the amount of reduction. Outer knob controls the range (maximum of approximately 40 miles).

OFF - Turn inner knob fully counterclockwise.

BEARING SWITCH - Used to select PPI reference azimuth.

STAB - PPI top center is true north plus HDG SEL setting.

REL - PPI top center is airplane heading.

PATT SWITCH - Used to select type of radar beam.

IAGC SWITCH - Used to reduce gain of strong returns. System is operating when switch is in the UP position.

FTC SWITCH - Used to break up large target area returns. In the down position system is inoperative.

The following controls are located on the IP-239/APN-59 indicator (figure 4-38) at the navigator's station:

RANGE DELAY CONTROL - Used to set in the amount of desired range delay.

RANGE DELAY SWITCH - Used to set in the desired range delay.

INT. CONTROL - Used to adjust intensity of PPI trace for best visibility and contrast. Optimum setting is just visible with receiver gain at minimum.

RANGE MKS - Used to adjust intensity of range marks.

RETICLE GEAR - Used to move reticle.

RANGE 3-30 CONTROL - Will vary range on scope from 3 to 30 miles. Fully counterclockwise represents 3 miles on scope.

FOCUS CONTROL - Used to adjust focus of sweep spot.

DIAL DIM SWITCH - Used to adjust azimuth ring illumination.

RANGE-INDICATOR LAMPS - Used to indicate range selected by range selector switch.

AZIMUTH RING - Used to read azimuth of targets.

CURSOR - Used to indicate azimuth of targets.

RETICLE - Used to facilitate offset-track flying.

The following controls are located on the IP-268 APN-59 indicator (figure 4-38) that is located above the main instrument panel.

INT. CONTROL - Used to adjust intensity of PPI trace for best signal visibility.

FOCUS CONTROL - Used to adjust focus of sweep spot.

VIDEO GAIN ADJUSTMENT - Used to adjust intensity of PPI picture for best contrast.

S-R SWITCH - To select slaved ("S") or relative ("R") PPI orientation for pilot's indicator.

Use of Iso-Echo Unit (Some Airplanes).

The iso-echo unit (Waveform Converter CV402A AP) is fastened underneath and on the right side of the navigator's desk. It is protected by one fuse located on the front of the converter unit. An IN-OUT switch is located on the navigator's control panel (figure 4-29. Is is used to switch the converter in or out of the search radar as desired. When the converter is used, a distinction is made between strengths of echo returns from masses of moisture in the air, such as clouds or rain, and more detailed information is displayed on the PPI presentation than is obtained normally without the converter. High rain gradient areas appear as narrow rings of light with darkeded center areas, denoting areas of extreme turbulence. When the converter is not used, rain areas appear as large blotches of light without definition of turbulence. The converter is powered by a self-contained, regulated 115-volt, 400-cycle power supply. The power supply is energized whenever the radar set is on, either in standby or operating condition.

Normal Operation of the AN/APN-59 Radar Set.

WARNING

Before placing the function switch in SEARCH, BEACON or WARNING make sure that all personnel are clear of the antenna radiation pattern. Avoid directing the energy beam toward inhabited structures, personnel groupings, or areas where airplanes are being refueled/defueled (see figure 2-3).

To put the AN/APN-59 Radar Set into operation:

a. Turn all controls on control panel fully counterclockwise, down, or OFF. Turn the intensity and range marks fully counterclockwise.

b. Turn function switch to STANDBY and allow a 3-minute warmup.

Note

For best results, avoid using the WARNING function, the 100/20, or the 240/30 ranges for the first 10 minutes of operation.

c. Turn range control to 50/10.

d. Turn function switch to SEARCH.

e. Check with the test meter for proper voltages in all systems.

f. Select type of scan desired.

g. Turn the intensity control (on indicator) until a faint sweep appears on the face of the scope.

h. Adjust the range markers.

i. Adjust the gain control for the best scope presentation; use the tilt control in conjunction with the gain control.

To turn the Radar Set off:

j. Turn all controls on the control panel fully counterclockwise, down, or OFF. Turn the intensity and range marks on the indicator fully counterclockwise.

CAUTION

Stab switch must be OFF (down) prior to touchdown and during all ground operations. This will insure engagement of antenna locking pins and prevent damage to the antenna during ground operations.

k. Turn function switch to STANDBY.

l. Turn the function switch to OFF after engine shutdown.

RADAR PRESSURIZATION.

Pressurized air for operation of an AN/APS-42 or an AN/APN-59 receiver-transmitter and a radio frequency wave guide is supplied by a pressure pump which is mounted on the lower inboard radio rack and is driven by a DC motor. The pressure pump draws from the cabin through a dehydrator, and then pressurizes the air before it is routed to the units.

Radar Pressurization Controls and Operation.

CAUTION

During the leakage test, hold the radar press control switch in the MOMENTARY ON position until the pressure gage indicates approximately 40 inches of mercury. Note the air leakage in the system does not exceed 2 inches of mercury in 10 minutes with antenna stationary. Do not allow pressure to exceed 41 inches.

The radar pressurization system control panel at the navigator's station has a radar press switch, a pressure gage, an indicator light, and a push to bleed valve (figure 4-39). The radar press switch is a 3-position (NORMAL ON, OFF, MOMENTARY ON), guarded toggle switch that selects the desired type of system operation. When the switch is in NORMAL ON position, operation of the pressure pump is controlled automatically by the action of a pressure switch in the system. When the switch is in the springloaded MOMENTARY ON position, the pressure pump is manually actuated, and continues to operate until the switch is released. The indicator light glows when the pump is in operation. If the pressure exceeds its specified limits, as indicated on the pressure gage, stop the pump by placing the radar press switch in OFF position. Excessive pressure may be bled from the system by depressing the push to bleed valve.

CAUTION

Do not operate the radar set until the radar transmitter-receiver pressure gage reads between 27 and 32 inches of mercury. By maintaining the pressure, arc-over is prevented within the receiver-transmitter and the waveguide pattern is held normal regardless of airplane altitude.

MOVING TARGET INDICATOR (MTI) (AN/APN-59)

The moving target indicator system is a feature added to the AN/APN-59 Radar Navigation Set. It consists principally of the CV-2833 Air to Ground Moving Target Indication Processor (AGMTIP) and associated C-8475 MTI set control. The AGMTIP cancels non-moving targets and displays only moving targets on the pilot's IP-268 indicator and on the navigator's IP-239 indicator. The moving targets appear on the indicators as a bright solid dot. In open terrain, the dot repeats progressively down or across the indicator. In dense terrain the target may appear intermittently due to being hidden from the radar by hills, trees, and obstacles. Moving targets may be displayed with or without the ground fixed targets in the background. The system also includes an MTI data converter. Power of 28-volt dc and 115-volt, 400-Hz three-phase ac is furnished the system through the APN-59 MTI circuit breakers located on the radio junction box.

MTI Set Control, C-8475

The MTI control (figure 4-40) is located at the navigator station and provides the main controls and indicators for the system. A circuit breaker on the face of the control provides overload protection for internal circuits of the AGMTIP processor. The controls and indicators are described as follows:

MODE Control: The OFF position turns the AGMTIP operation off. In the STBY/ALERT position, the AGMTIP processes video from moving targets or stationary targets. When a target appears within a range of 0 to 10 miles, the ALERT indicator illuminates. OPR position is selected when a moving target within a range of 0 to 10 miles is indicated by the ALERT light. The target is displayed on the IP-239 indicator.

THRESHOLD Control: This control is used to eliminate noise feedback. Full cw position displays MTI video and eliminates noise feedback. For maximum operating efficiency the control should be adjusted cw as far as possible.

Note

Setting the GAIN control on the APN-59 radar control panel will cause excessive noise feedback.

BACKGROUND Control: This control is used to blend APN-59 video with MTI video so that the target's relationship to surrounding terrain is displayed.

Note

The BACKGROUND control should be turned to full ccw when searching for target.

BIT Control: This pushbutton performs an end-to-end check of the AGMTIP. When BIT button is pressed and MODE control is in OPR, 12 bright evenly spaced video bands are displayed for approximately 12 miles on the IP-239 indicator. Minimum video or noise feedback should be present between these bands. The FAIL indicator should not light during a BIT check.

Note

When performing a BIT check, the BACKGROUND control must be at full ccw and the THRESHOLD control to full cw.

FAIL-ALERT Indicator: The ALERT indicator illuminates when a moving target appears on the video display. The FAIL indicator illuminates when the supply monitor detects an incorrect voltage, video bands not present, or video not present between the bands.

SCAN Switch: This toggle switch selects the basic scan speed of the radar and should always be in the SLOW position.

AGMTIP Processor, CV-2833

The AGMTIP processor is located below the table at the navigator station and is a general purpose, dual line canceller. It is used with the APN-59 radar to distinguish between ground based stationary targets and moving targets. The input to the processor is the normal video of the APN-59. This video input is processed and the resultant output, video containing only moving targets, is applied to the navigator's IP-239 azimuth and range indicator. On the front of the processor are three circuit breakers which provide overload protection for the 115-volt, 400-Hz, three-phase ac circuits. An elapsed time meter indicates total operating time of the processor.

MTI Data Converter

The MTI Data Converter is located in an equipment rack just forward of the navigator station, and adapts the input signals from the APN-59 radar for application to the CV-2833 AGMTIP Processor.

Normal Operation of MTI System

Note

To obtain maximum performance of the AGMTIP, the APN-59 radar must be in good operating condition. The radar controls must be set properly and the antenna scan control set so that antenna is directed at the target.

1. Set controls on AN/APN-59 radar control panel as follows:

   a. FUNCTION control - STDBY

   b. RANGE (NM) control - 3-30/1 or 3-30/5

   c. FUNCTION control - SEARCH

   d. SCAN control - L or R as required

   e. HDG SEL control - As required

   f. GAIN control - As required for normal map

   g. TILT control - Set to illuminate target area

   h. STAB switch - ON

   i. STC control - As required

   j. FTC switch - OFF

   k. BEARING switch - REL

   l. PATT switch - PENCIL or FAN

   m. IAGC switch - OFF

   n. STC control - CCW (OFF)

2. Set controls on IP-239 Indicator as follows:

   a. RANGE DELAY switch - OFF

   b. RANGE MKS control - OFF

3. Set controls on AGMTIP control panel as follows:

   a. Set MODE control as follows:

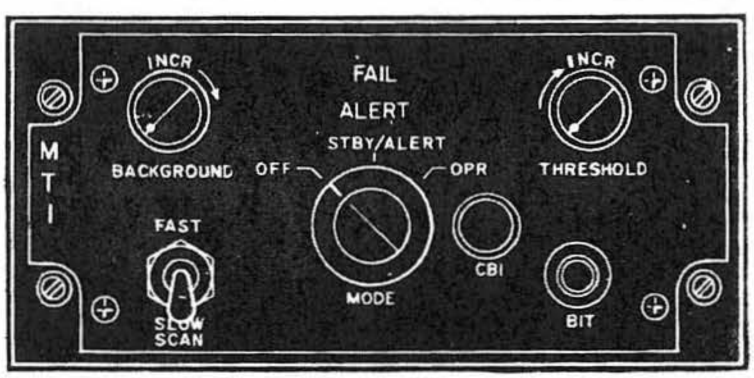
      (1) Taxi and takeoff - STBY/ALERT

      (2) During mission - STBY/ALERT. When ALERT indicator illuminates (MTI targets are displayed), turn to OPR mode.

      (3) Completion of Mission - OFF

   b. BACKGROUND control - As required when MODE control is in OPR.

MTI (APN-59) controls



C-8475 MTI CONTROL

Figure 4-40.

c. THRESHOLD control - Turn to full cw position. Adjust ccw until optimum video is displayed.

d. FAST/SLOW scan switch - SLOW

e. BIT control - Depress BIT pushbutton when AGMTIP check is desired.

Emergency Shutdown Procedure

Emergency shutdown procedure for the AGMTI processor depends on the location of the operator at the time of the emergency. If the operator is located next to the set control, perform the following step:

1. Place MODE switch to OFF.

If operator is located next to the AGMTI processor, perform the following step:

1. Disengage circuit breakers CB1, CB2, and CB3 on the AGMTI processor.

DOPPLER RADAR (AN/APN-147)

The doppler radar provides continuous indications of drift angle and ground speed. This system consists of an antenna, receiver/transmitter, frequency track unit, control unit, and a drift angle-ground speed indicator. The system is self-contained and functions independently of any ground installation. Ground speed and drift information is obtained by radiating beams of energy toward the ground, forward and aft of the airplane, and measuring the Doppler effect which is observed on the signals reflected from the ground. Figure 4-42 illustrates this principal.

The Doppler radar navigation system receives 28-volt DC and 115-volt AC from the flight station bus and left-hand AC bus, respectively, through the Doppler circuit breaker on the flight station distribution panel The power from these circuit breakers is routed through the AN/APN-147 junction box to the frequency tracker where it is further distributed to other components in the system. The design performance limits are as follows:

Altitude - Approximately 40 to 50,000 feet.

Drift Angle - 30 degrees left or right, within 0.25 degree.

Ground Speed - 90 to 999 knots within 0.5 percent.

Antenna Attitude:

Pitch - Plus or minus 20 degrees, stabilized to plus or minus 1 degree, up to a 12-degree climb or 8-degree dive.

Bank - 30 degrees right or left.

Doppler Radar Navigation Systems Controls.

The control unit (figure 4-41) on the navigator's control panel contains all switches necessary for inflight operation of the Doppler radar. This unit is comprised of four toggle switches and a warning light.

POWER SWITCH. The power switch has three positions (OFF, SLEW, ON). The SLEW position is used for warmup and taxiing and it activates the G/S and DR slew switches. With the power switch in the ON position, the system is fully active.

G/S SWITCH. The two-position (INCR, DECR) groundspeed switch is spring-loaded to the unlabeled center position. This switch becomes active when the power switch is in SLEW position and is used in conjunction with the drift angle-groundspeed indicator to set up the system to approximate groundspeed values prior to operation.

DR SWITCH. The two-position (LEFT, RIGHT) drift switch is spring-loaded to the unlabeled center position. This switch is activated when the power switch is in SLEW position and is used in conjunction with the drift angle-groundspeed indicator to set up the system to approximate drift angle values prior to operation.

LAND-SEA SWITCH. The land-sea switch, or terrain selector, has three positions (LAND, SEA HI, SEA LO). The LAND position is used for flights over land. In SEA HI position, the system is calibrated for the reflective properties of water and may operate in either Janus or smooth sea mode, depending on reflected signal strength. The SEA LO position is used for flights over water which involve frequent turns and bank angles in excess of 20° such as in low level search missions.

In this position the system is calibrated for the reflective properties of water and is maintained in the Janus mode.

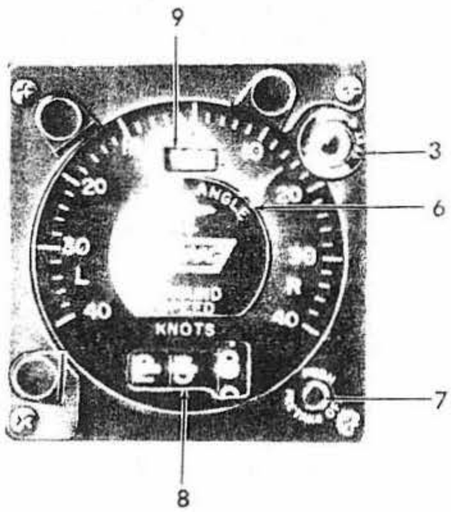
MEMORY WARNING LIGHT. The press-to-test warning light in the center of the radar control is illuminated when the power switch is in SLEW position or when the unit is in memory mode and serves to warn the operator of deteriorated system performance.

Drift Angle-Ground Speed Indicator (1D938).

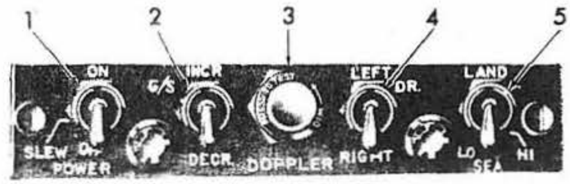
This indicator (figure 4-41) gives visual indications of prevailing drift angle and groundspeed. The drift angle scale is marked from zero to 40 degrees left or right, but the antenna stops are set at 30 degrees left or right. The groundspeed counter reads from zero to 999 knots.

MEMORY WARNING LIGHT. This light operates in the same manner as the memory warning light on the control panel.

doppler radar controls and indicators



DRIFT ANGLE - GROUND SPEED INDICATOR (ID-938)



DOPPLER RADAR CONTROL PANEL

1. POWER SWITCH
2. GROUND SPEED SWITCH
3. MEMORY WARNING LIGHT (2 PLACES)
4. DRIFT SWITCH
5. TERRAIN SELECTOR SWITCH
6. DRIFT ANGLE POINTER
7. PUSH PRE-TAKEOFF BUTTON
8. GROUND SPEED COUNTER
9. INDICATOR WARNING FLAG

Figure 4-41.

INDICATOR WARNING FLAG. This flag indicates OFF in the event of 28-volt DC power loss, or when the system is operating in the memory mode.

PUSH PRE-TAKEOFF BUTTON. When depressed, this button automatically slews the groundspeed indicator to a take-off value (165 ± 10 knots) and the drift angle pointer to zero. Use of this button is not recommended unless there is insufficient time to slew the indicator manually with the G/S and DR switches.

Modes of Operation.

Three modes of operation are possible; they occur automatically as determined by the position of the land-sea switch, the available signal strength, and system performance.

JANUS MODE. The Janus mode is the normal mode of operation over land and water, if there is sufficient reflected signal. The highest accuracy is realized when in this mode.

SMOOTH SEA MODE. This mode occurs automatically when the land-sea switch is in SEA HI position only, and if there is insufficient reflected signal to maintain proper operation. The forward end of the antenna is tilted down 7 degrees to improve signal strength from the forward area. The rear beams are blocked resulting in some loss of accuracy. During a prolonged flight over smooth sea surfaces the system will cycle in and out of this mode, returning to Janus mode every 2 minutes for a period of 1 minute. If sufficient signal is obtained while in Janus mode, the system will remain in this mode. This process is indicated by a cyclic operation of the memory warning lights and flag.

Note

> At times, during smooth sea mode when the memory warning lights are out, the pointers are at prevailing values of groundspeed and drift with some loss of accuracy in the groundspeed indication only. Drift angle accuracy is unaltered.

MEMORY MODE. This mode is indicated by the operation of the memory warning lights and flag, and occurs automatically if the reflected signal is too weak or if the system performance is deteriorated. In this mode, the groundspeed and drift angle indications are locked at the last readings prior to memory operation.

Normal Operation.

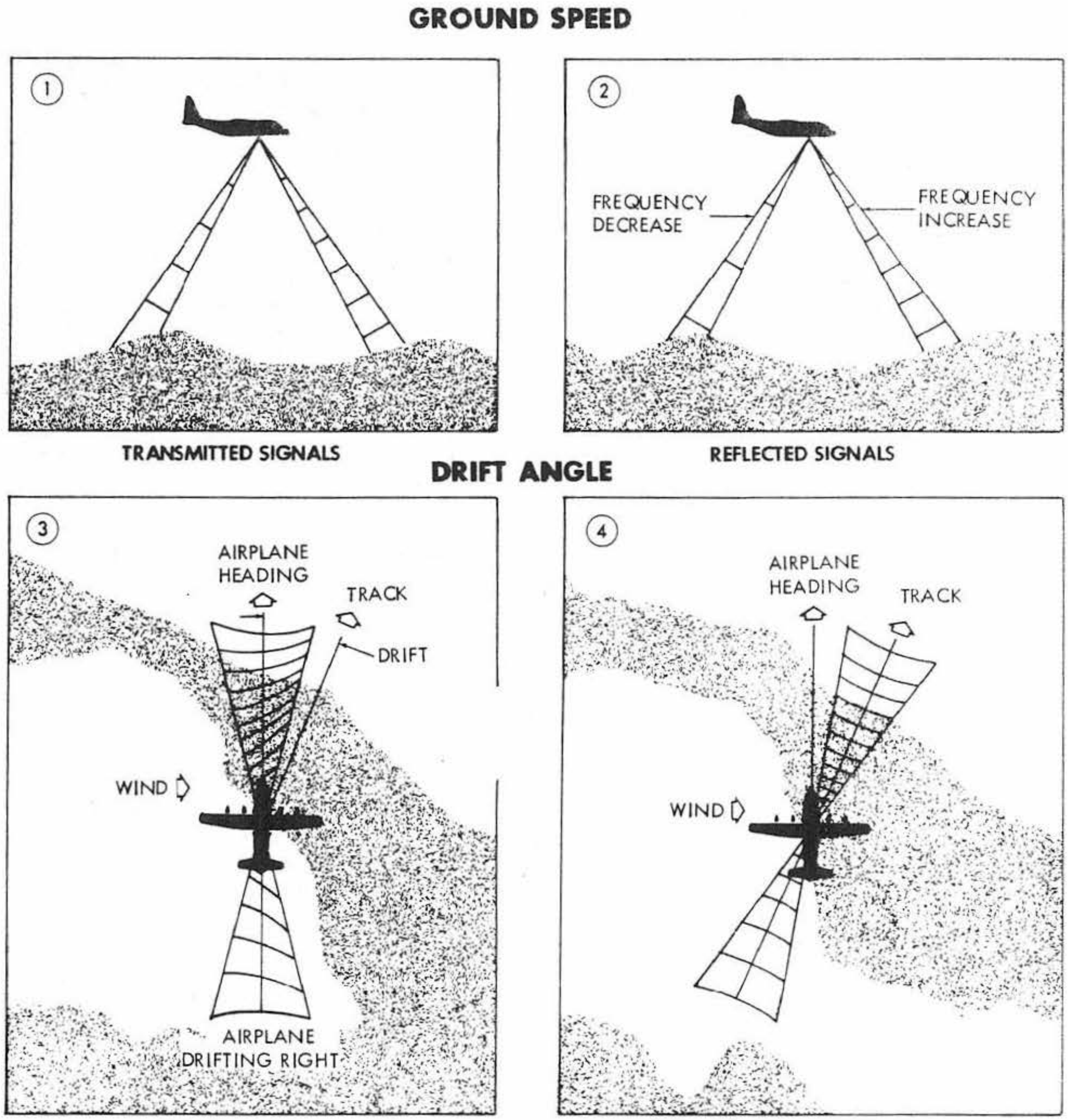
STARTING PROCEDURES BEFORE TAKEOFF.

1. Set the power switch on the Doppler radar control unit to SLEW, and allow one minute for warmup.

2. Slew the groundspeed to approximately 165 knots using the G/S switch.

3. Slew the drift to zero, using the DR switch.

doppler radar principles of operation



1. ANTENNA RADIATES TWO FAN SHAPED SIGNALS IN JANUS MODE.
2. FREQUENCY CHANGES CAUSED BY DOPPLER SHIFT. GROUND SPEED PROPORTIONAL TO DOPPLER SHIFT.
3. UNEQUAL FREQUENCY OF REFLECTED SIGNALS BETWEEN LEFT AND RIGHT LOBES OF ANTENNA.
4. ANTENNA ROTATES UNTIL REFLECTED SIGNAL OF LEFT AND RIGHT LOBES OF ANTENNA ARE AT SAME FREQUENCY. ANTENNA POSITION GIVES DRIFT ANGLE RELATIVE TO AIRPLANE HEADING.

30A- -33-129

Figure 4-42.

4. Set the land-sea switch as required.

5. Turn the power switch ON at the time of liftoff.

STARTING PROCEDURE - INFLIGHT. The starting procedure inflight is similar to that for a ground start, except that the groundspeed and drift angle must be slewed to the estimated or flight plan values. Groundspeed must be slewed within 20 percent of actual value and drift angle within 15 degrees of prevailing value.

OPERATING INDICATIONS.

Refer to figure 4-43 for the various Doppler radar navigation system indications available during operation of the system.

Suspected Malfunction in Flight.

In the event of a suspected malfunction inflight as indicated by illumination of the memory warning lights for more than 3 minutes, proceed as follows.

1. Set the power switch to SLEW.

2. Slew the groundspeed and drift indications to the prevailing value.

3. Set the power switch to ON.

4. If the memory warning lights remain illuminated, slew the groundspeed about 20 percent higher and/or lower than the estimated value, and try for a lock-on.

5. If the memory warning light still remains illuminated, slew the groundspeed and drift to the prevailing values, and leave the set in operation as a DR computer.

Note

Excessive memory periods should not be encountered over land at any altitude. Should this occur it is an indication of deteriorated performance and should be recorded in maintenance forms.

WARNING

When airplanes are flying in close proximity, the signals radiated from one Doppler radar can cause interference with the set operating in the other airplane. This interference can produce unreliable system indications in both.

DOPPLER SYSTEM ERRORS. There are two main categories of system errors: design limitations and external sources of error. If errors are additive, they can amount to 2 to 3 percent of distance flown and can vary with type of sea surface, tidal currents, wave motion, and several other factors. Some of these errors can be avoided by adequate preflight planning and calibration.

DOPPLER COMPUTER SYSTEM (AN/ASN-35)

The Doppler navigation computer derives groundspeed and drift angle information from the Doppler navigation system and displays continuous and direct-reading data, in nautical miles, on mission distance and deviation from planned track. The major components of the computer system (see figure 4-44) are the control indicator, the auxiliary cross-track control panel, pilot's multiple indicator, and the computer unit. The last operates in two independent stages to permit programming of a subsequent intended track or second leg of a planned course while operating on the first leg. Thus, when the first stage or leg of a planned course is completed and the unit is switched over to the next leg, the first stage becomes available to program a further stage of the flight plan. The power sources for the Doppler computer system are received through the Doppler radar circuit breakers on the flight station distribution panel.

Computer Main Control Indicator.

The computer main control indicator is divided into two separate stages comprising two desired track angle controls and two "distance to go" counters, with a stage selector control to transfer from one stage to the second. This allows the operator to program the inactive stage for the second leg of the intended flight while using the active stage for the first leg. This computer main control indicator also contains a function selector, a warning light and a "distance cross-track" counter.

DESIRED TRACK ANGLE CONTROLS. The desired track angle controls are located at the top of the computer main control indicator and are used by the operator to program the computer with the intended or desired course which can be set in degrees and tenths of a degree by a reset knob. If a magnetic heading reference is used, the desired track angle is equal to the true course plus or minus the average variation. If a gyro heading reference is used, the desired track angle is equal to the grid course plus or minus the gyro precession.

DISTANCE TO GO COUNTERS. The "distance to go" counters are located at the bottom of the computer main control indicator and are used by the operator to program the computer with the intended distance to go along the desired course. In flight, the computer operates to reduce this distance as the airplane progresses towards the intended destination. If a magnetic heading reference is used, the distance to go is

doppler radar system indications

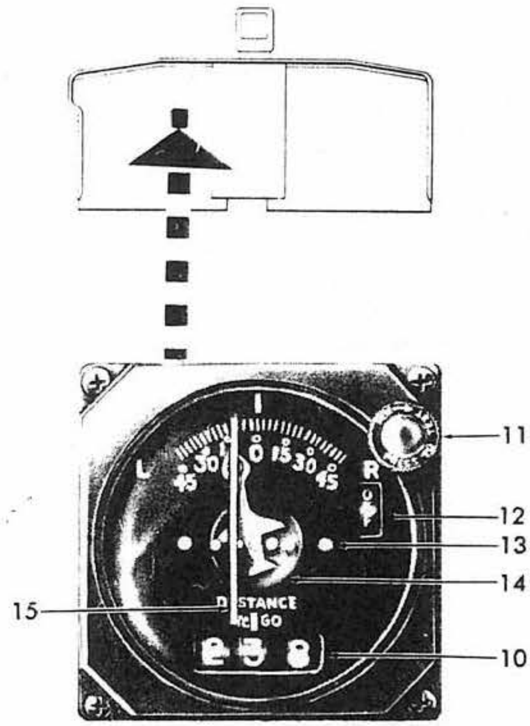
	TERRAIN SELECTOR SWITCH POSITION	LAND		SEA-HI ② AND SMOOTH SEA			SEA-LO	
	Modes	Janus	Memory	Janus	Non-Janus	Memory	Janus	Memory
INDICATORS	Memory Warning Lights	Off	On	Off	Off 120 seconds, on 50 seconds, alternately	On	Off	On
	Drift Angle - Ground Speed Warning Flag	No Indication	Off	No Indication	No indication 120 seconds, off 50 seconds alternately.	Off	No indication	Off
	Ground Speed Counter ①	Prevailing Value	Last Indication or as set	Prevailing Value	Prevailing Value or last indication	Last indication or as set	Prevailing value	Last indication or as set
	Drift Angle Pointer	Prevailing Value	Last Indication or as set	Prevailing Value	Prevailing value or last indication	Last indication or as set	Prevailing value	Last indication or as set

① When radar is tracking, and oscillation occurs about the mean value of the ground speed. This is a normal indication and is caused by the lock-check circuit. If the oscillation becomes irregular or ceases altogether, the system reverts to the memory mode after a 5 second delay period.

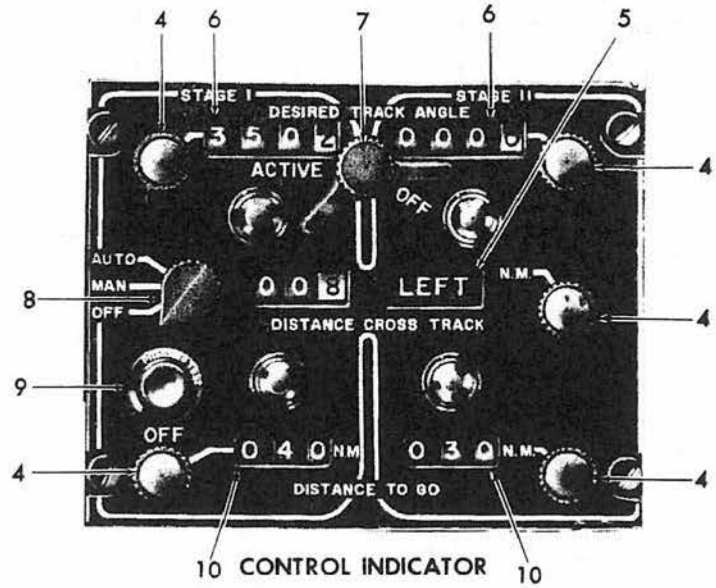
② The system automatically cycles between the smooth sea and memory modes when the signals are too weak to maintain the janus mode. This cycle continues until a change in signal level causes the system to return to the janus mode or remain in the memory mode. This signal condition is most likely to occur at high altitudes over smooth seas.

Figure 4-43.

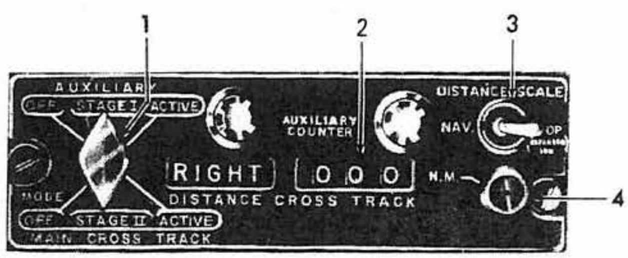
course computer controls and indicators



PILOT'S MULTIPLE INDICATOR (ID-939)



CONTROL INDICATOR



AUXILIARY DISTANCE CROSS TRACK CONTROL PANEL

1. AUXILIARY CROSS TRACK MODE SELECTOR SWITCH
2. AUXILIARY DISTANCE CROSS TRACK COUNTERS
3. DISTANCE SCALE SWITCH
4. COUNTER SET KNOB (6 PLACES)
5. MAIN DISTANCE CROSS TRACK COUNTER
6. DESIRED TRACK ANGLE COUNTERS (2 PLACES)
7. STAGE SELECTOR SWITCH
8. FUNCTION SWITCH
9. EQUIPMENT FAILURE WARNING LIGHT
10. DISTANCE TO GO COUNTERS (3 PLACES)
11. ALERT LIGHT
12. POWER OFF INDICATOR FLAG
13. DISTANCE CROSS TRACK DOTS
14. HEADING POINTER
15. TRACK DEVIATION INDICATOR (TDI)

Figure 4-44.

the magnetic rhumb line distance. If a gyro heading reference is used, the distance to go is the average great circle distance. The counters are calibrated to read from 000 to 999 nautical miles (or 99.9 nm, see DISTANCE SCALE SWITCH), but are free to move through zero if required. For example, if the distance to go is overflown by 9 miles, the counter will read 991 miles.

STAGE SELECTOR. This stage selector is a two-position rotary switch located below the desired track angle display. Its positions are marked ACTIVE and OFF for each stage. When Stage I is active, Stage II is off, and vice versa. The active stage can be selected manually by setting the function selector to MAN position and turning the stage selector to the desired position. Automatic stage-transfer can be achieved when the active distance to go reaches 1,000 miles if the function selector is in AUTO position. However, automatic transfer will occur only if the inactive stage is programmed with some distance to go.

CAUTION

The function selector switch should be in the manual position if manual change of stage is to be accomplished.

FUNCTION SELECTOR. The function selector switch is located on the left of the computer main control indicator and is a three-position switch marked OFF-MAN-AUTO. The computer becomes active immediately when the function selector is placed in the MAN or AUTO position. In the MAN position, power is applied to the computer, and stage selection is achieved manually. In the AUTO position, power is applied to the computer, and stage selection can be achieved automatically.

OFF WARNING LIGHT. The warning light below the function selector is not fully operational as an equipment failure indicator; it is illuminated only in the event of a 115-volt AC failure (such as a disengaged circuit breaker).

DISTANCE CROSS TRACK COUNTER. The distance cross track counter is located in the center of the computer main control indicator and functions to display cross-track distance left or right of track up to 99.9 nautical miles (or 9.99 nm, see DISTANCE SCALE SWITCH). This counter may be reset or offset, as required, by a reset knob.

Auxiliary Cross-Track Control Indicator.

The auxiliary cross-track control indicator, used in conjunction with the computer main control indicator, consists of a distance cross track counter identical to that used in the computer main control indicator, an auxiliary-main cross track selector, and a distance scale switch.

Auxiliary-Main Cross Track Selector Switch.

This switch, located on the left side of the auxiliary cross-track control indicator, is used to permit selection of cross-track counters. It is a three-position switch providing the following three separate modes:

Fully counterclockwise - main cross-track counter active on both stages.

Fully clockwise - auxiliary cross-track counter active on both stages.

Center-vertical - auxiliary counter active on Stage I. Main counter active on Stage II.

This selector switch will normally be used in the center-vertical position but provides the means of changing to an updated counter, part way along a programmed leg. It is particularly desirable to have a record of the cross-track reading at the time of stage transfer when a change in course in planned. By operating with the selector in the vertical position, the cross-track counters are changed at the time of stage transfer, and the formerly active stage is left with a reading of cross-track distance. This distance can then be resolved using an MB-4 computer with respect to the new course, and the inactive counter set up to the corrected cross-track distance and selected as active.

DISTANCE SCALE SWITCH. The distance scale switch is located on the right side of the auxiliary cross-track control indicator, and is a two-position switch marked NAV and DROP (EXPANDED x 10). This switch is used to change the scale of the computer readout on both "distance to go" and "distance cross-track." In NAV position, the "distance to go" readings are in increments of one nautical mile, and "distance cross-track" is in increments of one-tenth of a mile. In DROP position the "distance to go" readings are in increments of one-tenth of a mile and "distance cross-track" is in increments of one-hundredth of a mile.

Note

The distance scale switch must be used on a stage which has been programmed with distance consistent with the scale selected, and it must not be changed part way along a leg.

Pilot's Multiple Indicator.

The multiple indicator (figure 4-44) presents a pictorial display of the airplane's horizontal position with respect to a desired track. This is a repeater type instrument which displays data developed and processed within the computer. The "distance to go" is shown on a three-drum digital counter The track deviation indicator vertical bar represents the desired track. The first two small dots represent "distance-cross-track" in approximately 2-nautical-mile increments. (When the computer is in the DROP function, the first dot is approximately .06 nautical mile or 121 yards and the second dot is .12 nautical mile or 242 yards.) The track heading pointer with aircraft symbol shows the airplane position with respect to desired track. If the airplane is flown so that the head of the heading pointer is centered under the track deviation indicator, smooth track interceptions with no overhsoot may be accomplished. The power-off flag indicates OFF when the function switch is OFF or in the event of 28-volt DC power loss. The alert light comes on when the distance to go counter in use reads 10 and remains on until stage switchover, or 10 after zero if no stage transfer occurs.

Doppler Autopilot Selector Switch.

The autopilot sel switch, located on the flight control pedestal (aft, below the electronic prop governor and ENTC test panel), enables the pilot to select either radio (AN/ARN-14 or AN ARN-21) or the Doppler system for autopilot radio beam coupler operation.

Operation of the Doppler Computer.

Operation of the Doppler computer is contingent upon concurrent operation of the Doppler navigation system and the N-1 compass since these provide the sources of navigational information fed to the computer unit. The computer unit is directly controlled at the navigator's control panel by means of the computer controller and the auxiliary cross-track control indicator. To place the computer in operation:

a. Set the desired track angle for Stage I on the computer controller.

b. Set the "distance to go" for Stage I. ("Distance to go" for Stage II may be set at this time if known and required.)

c. Set the counters on the main and auxiliary cross-track indicators to RIGHT-OOO.

d. If NAV operation is desired then:

(1) Position the distance scale switch to NAV.

(2) Position the mode selector switch to AUXILIARY OFF-MAIN CROSS TRACK ACTIVE.

(3) Select AUTO or MAN on the operation selector switch.

(4) The computer controller will now monitor the actual versus the desired (programmed) flight path for Stage I. The accuracy of the main cross-track indicator can be subjected to a cross-reference check at any time during the flight prior to reaching the drop point of a currently active stage. To accomplish this, position the mode selector switch to AUXILIARY ACTIVE-MAIN CROSS TRACK OFF; this engages the counters of the auxiliary cross-track indicator and disengages (deactivates) the counters of the main cross-track indicator. A system malfunction can be detected by warning lights on both the computer controller and the APN-147 control panel and by the appearance of the word "OFF" in the window of the pilot's air navigation multiple indicator and the navigator's Drift Angle/Groundspeed Indicator ID 938.

e. If drop operation is desired then:

(1) Position the distance scale switch to DROP for closer approximations of the cross-track deviation and the distance to go along track, if desired.

(2) Position the mode selector switch to AUXILIARY OFF-MAIN CROSS TRACK ACTIVE.

(3) Select AUTO or MAN on the operation selector switch.

f. If the drop or NAV point of Stage I defines a final destination, no further steps are required, If, however the drop or NAV point of Stage I is to serve as the point of intersection with the next leg of a planned flight path, then prior to reaching the drop or NAV point of the currently active stage:

(1) Determine the track angle that will be required for Stage II, and set this up on Stage II of the computer controller.

(2) Set the distance to go for Stage II, if it has not already been set.

g. If the aircraft is on the desired track with the track angle steady and the cross-track deviation zero then:

(1) Position the operation selector switch to AUTO, if it has not already been so positioned.

(2) Turn the mode selector switch to AUXILIARY STAGE I-MAIN CROSS TRACK STAGE II.

(3) Position the distance scale switch to NAV or DROP, as desired.

(4) Reset the counters of the main cross-track indicator to RIGHT-OOO; then uninterrupted monitoring of the transition from Stage I to Stage II should now be available.

Note

The AN/ASN-35 is a completely transistorized unit and requires no warmup period.

In the event of a failure of the N-1 compass system or the Doppler radar, the computer performance will be seriously affected. However, the Doppler computer system can often be used as a simple D/R computer even if the Doppler radar is not fully operational. This is achieved by slewing the Doppler radar to estimated or flight plan values of groundspeed and drift angle and frequently updating these as conditions change. The computer will function on the information shown on the Doppler drift angle and groundspeed indicator and the compass heading.

RADIO ALTIMETER (SCR 718).

A radio altimeter (Fig 4-45) is provided at the navigator's station to indicate the altitude of the airplane above the terrain. The radio altimeter operates from 115-volt unregulated AC through a circuit breaker in the radio junction box.

WARNING

The terrain clearance indications received from the SCR718 are unreliable when operating over large depths of snow and ice, since the radar waves will actually penetrate the surface and indicate greater clearances than actually exist.

Radio Altimeter Controls.

All operating controls of the radio altimeter are located on the front panel of the indicator. Controls are provided for adjusting circle size, range, receiver gain, and the reference lobe position.

Normal Operation of the Radio Altimeter.

CAUTION

Except in emergency, the SCR-718 radio altimeter equipment will be used only over broad ocean areas, starting not less than 50 miles off shore unless restriction is specifically waived by Headquarters USAF.

WARNING

When operating the SCR-718 Radio Altimeter in the Zone of Interior, interference may be encountered which could cause unreliable indications to be presented.

To put the radio altimeter into operation:

1. Rotate the rec gain knob clockwise to turn power on.
2. Position the scale switch to the desired range.
3. Allow a 3-minute warmup period.
4. Adjust rec gain and circle size as required.

To turn the radio altimeter off:

5. Rotate the rec gain knob to the extreme counterclockwise position.

radio altimeter

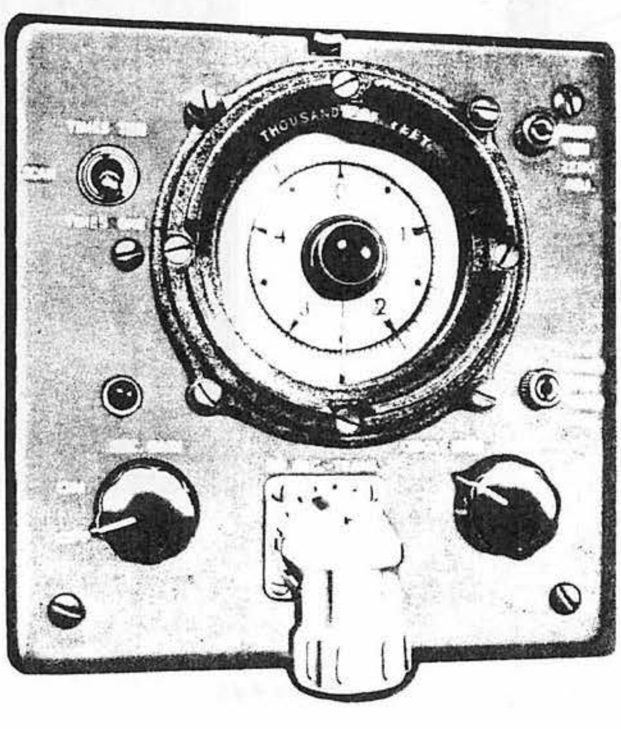


Figure 4-45

Note

Set zero adjustments on the times 1 and times 10 scale before each use, to position the counterclockwise edge of altitude pulse on zero. Adjust circle size as required.

LONG RANGE NAVIGATION (LORAN) EQUIPMENT.

The loran equipment provides reception of loran signals on both the high-frequency and low-frequency bands. The receiver is the direct-reading type, where the "indicated time difference" is shown in microseconds on revolution counters. Charts and tables are used for interpreting the loran readings to determine the geographical location of the airplane. The equipment is powered by 28-volt DC power and 115-volt unregulated AC power through circuit breakers located on the radio junction box. The loran indicator and receiver are located on the navigator's station.

Loran Controls.

All operating controls of the loran equipment are located on a control panel (figure 4-46) on the loran receiver. Adjustment controls for focus and intensity of the signals shown on the indicator screen are located on the loran indicator. The purpose of each control is as follows:

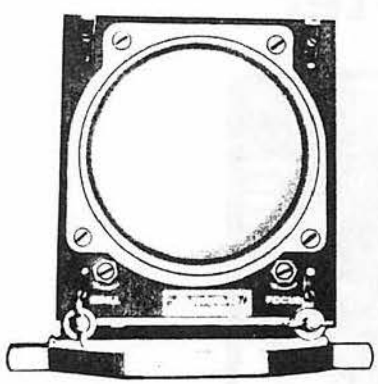
W-DELAY AND Y-DELAY COUNTERS. - These two cranks are revolution counters which give a direct reading of delay time in microseconds.

R-RATE CONTROL - Used in conjunction with channel selector to obtain desired loran station.

L-R SWITCH - Used to move the pulses to position the master (leading pulse) pulse on the master pedestal.

ADC (Automatic Drift Control) - Locks master pulse in position.

loran control panel



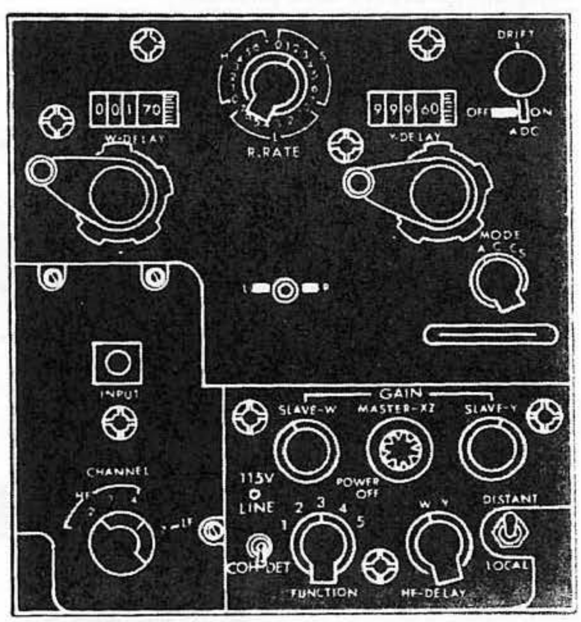


Figure 4-46.

CHANNEL SELECTOR - Used in conjunction with r-rate selector to obtain the desired loran station.

GAIN CONTROLS - The three knobs are used to vary the corresponding pulse amplitudes. The master-xz gain control the power to the set; the full counterclockwise position turns the set OFF.

FUNCTION SWITCH - The first three functions are used in taking fixes and in primary calibration of the set. Function four is used for homing. Function five is used for set calibration.

HF-DELAY - This control is used to divide the set to permit taking time difference readings from two stations almost simultaneously.

LOCAL-DISTANT SWITCH - This switch on the receiver changes signal amplification in the antenna coupler.

Normal Operation of Loran.

1. Rotate master-xz knob clockwise to turn the set ON. Allow 1 minute for warmup.

2. Select and set in the desired loran station with the channel and r-rate selector switches.

3. Turn the function switch to 1.

4. Use the X controls to obtain two pulses.

5. Position the leading pulse on the top pedestal by using the X delay knob and L-R switch.

6. Obtain LOP using function 2 and 3.

7. Put hf-delay switch to Y.

8. Obtain a second LOP according to the instructions in steps 1 through 6.

9. To turn the set off, turn the master-xz switch fully counterclockwise.

The AN/APN-70B has been modified to provide LORAN C capability.

LORAN C CONTROLS

MODE selector - Allows selection of A, C, Cs (C Special) modes of operation.

COH-DET switch - Reduces noise in the down position.

loran control panel

1. Rotate MASTER-XZ knob clockwise to turn the set on. Allow 5 minutes for warmup.
2. Set CHANNEL selector to 7 and R-RATE control to desired loran station.
3. Turn the MODE selector to desired position.
4. Set COH-DET switch down to reduce noise.
5. Turn the FUNCTION switch to 1.
6. Use the gain controls to obtain two pulse trains.
7. Position the leading pulse of the master train on the left pedestal by using the L-R switch.
8. Obtain LOP using functions 2 and 3.
9. Set HF-DELAY switch to Y.
10. Obtain a second LOP by repeating steps 6 and 7 using a third train.
11. To turn the set off, turn the MASTER-XZ switch fully counterclockwise.

PERISCOPIC SEXTANT MOUNT AND ASTROWINDOW.

A periscopic sextant mount and an astrowindow are located in the center of the flight station overhead fuselage, above the navigator's seat. This installation permits the use of a periscopic sextant to determine the relative or true bearing and the altitude of a celestial body. The D-1 periscopic sextant is a precise and delicate navigation instrument; it should be handled with care. The sextant may be rotated in azimuth through 360 degrees, and minus 10 degrees to plus 92 degrees in elevation, with a true field of 15 degrees. An averaging device on the sextant gives a continuous moving average; after 30 seconds use it can be terminated. The light for the sextant mount is powered by 28-volt DC from the flight station bus through the interior utility lights circuit breaker on the flight station distribution panel.

Normal Operation of the Periscopic Sextant.

1. Insert the sextant in the mount.

a. Align the arrow on the tube of the sextant with the arrow on the mount.

b. Insert the sextant as far as possible, and turn it clockwise.

c. Open the mount shutter with the lever.

d. Pull out the knob marked "TO INSERT, REMOVE-PULL," and insert the sextant until the knob snaps into place.

e. Make the cable connection between the mount and the sextant.

f. Turn the light switch ON.

2. Adjust the size of the bubble as desired.

3. Check the alignment of the sextant mount.

a. Set 180.4 degrees in the azimuth counter.

b. Sight on the liaison tie-in bracket mounted on the vertical stabilizer. The heading in field of vision should be 0

4. Remove the sextant from the mount.

a. Turn the light switch OFF, and disconnect the electrical cable.

b. Pull out the knob marked "TO RETRACT SEXTANT-PULL," and lower the sextant.

c. Close the mount shutter.

d. Pull out the knob marked "TO INSERT, REMOVE-PULL," and rotate the sextant until the arrows are aligned.

e. Lower the sextant.

f. Return the sextant to the carrying case and stow.

CAUTION

Before replacing the sextant in the case, always press the actuating lever or button. Always rotate the bubble knob to the maximum increase position.

Emergency Operation of the Periscopic Sextant.

Do not loosen, tamper with, or remove any screws on the sextant shaft. The sextant mount may be loosened and aligned if necessary. Do not leave the sextant in the mount during rough weather: it should be removed and stowed. If the averager is inoperative, the sextant can be used to take instantaneous shots.

I-BAND RADAR TRANSPONDER, SST-181XE

The I-band radar transponder is a receiver-transmitter operating in a frequency range of 9310 to 9415 MHz. This transponder provides an air-to-air/air-to-ground identification beacon with a minimum range

i-band beacon transponder control

figure 4-47.

of 100 nautical miles at all azimuth angles at radar line of sight altitudes. The major components are a receiver-transmitter and an antenna. Manual control of the transponder is provided by a switch on the transponder control (figure 4-47) at the navigator's station. Power for operation of this unit is supplied by the airplane's 28-volt dc system and circuit protection is provided by the X BAND BEACON SST-181XE circuit breaker on the radio junction box. The I-band radar transponder will operate when the X-BAND BEACON switch is in the ON position and is on one of nine codes preset by maintenance personnel. For an explanation of the codes see the radar set, AN/APQ-150.

AUTOPILOT.

CAUTION

Do not overpower the autopilot unnecessarily.

The E-4 autopilot operates the flight control system of the airplane to maintain normal stabilized attitudes automatically. The autopilot also maintains any desired heading by using N-1 compass information. The system provides coordinated turn control, automatic elevator trim, constant-pressure altitude control, automatic VOR, Doppler radar, and TACAN tracking. and automatic ILS approach control for instrument landings. The autopilot is powered by 28-volt DC power through circuit breakers on the flight station distribution panel, and 115-volt 400-cycle AC power from the single-phase bus through a circuit breaker on the main power distribution box. When changing AC power supply the autopilot will be disengaged. On some airplanes the autopilot cannot be re-engaged for approximately three minutes.

Note

Pitch reference for the autopilot may be obtained from either the K6A gyro or the LTN-51 Inertial Navigation System.

CAUTION

Pitch oscillations up to ±1 degree may occur above 20,000 feet while using the altitude hold function of the autopilot. Oscillations normally occur with center of gravity loadings aft of 27 degrees MAC and at airspeeds below 135 knots indicated airspeed.

Note

The control wheel may jitter, especially in a bank, when the autopilot is operated with normal AC generator power supply. This is caused by modulation of the AC generator power supply, and it can be eliminated by turning the electronic and engine inverter switch to the INV position. Inverter power should be used only as long as necessary to eliminate the jitter.

AUTOPILOT CONTROLS.

The autopilot controls are located on the autopilot controller and the autopilot control panel on the flight control pedestal.

Pilot Switch.

A pilot switch (figure 4-48) on the autopilot controller controls the power to the electronic circuit of the autopilot. The pilot switch can be placed in the ON position only if the following conditions are met:

a. All autopilot circuit breakers are IN.

b. Servo engaging switches are in the DISENGAGE position.

c. Turn knob is centered (in indent).

d. Airplane AC and DC power buses have been energized to supply power to the autopilot for approximately three minutes.

Servo Engaging Switches.

There are three servo engaging switches for the autopilot (figure 4-48). These two-position (ENGAGE, DISENGAGE) switches are located on the autopilot control panel and are labeled rudder, aileron and elevator. The ENGAGE position of the switches provides individual engaging of the rudder, aileron, elevator, and elevator trim tab controls.

Gyro Select Switches.

Selection between the K6A or LTN-51 is provided by switches on the autopilot gyro select panel. This panel is located at the pilot's station below the oxygen regulator (figure 4-49).

Pitch Control Knob.

Two pitch knobs (figure 4-48), one on each side of the autopilot controller, are mounted on a common shaft and control climb and glide. Forward rotation of the knobs gives nose down; aft rotation gives nose up. The climb or glide angle is proportional to the amount of rotation of the pitch knobs.

Turn Control Knob.

A turn control knob (figure 4-48), located on top of the autopilot controller, provides for coordinated turns at all airspeeds. A climbing or descending turn can be made by using the pitch and turn knobs simultaneously. The turn control knob is left in the centered (detent) position at all times except when being used to maneuver the airplane.

Aileron Trim Knob.

An aileron trim knob (figure 4-48), located on the autopilot controller, is used to make minor corrections should a wing-low attitude occur when the aileron servo is engaged.

Altitude Control Switch.

A two-position (OFF, ON) altitude control switch is located on the autopilot controller (figure 4-48). Placing the switch in the ON position disengages the pitch knobs and engages a barometric pressure control unit, which then controls the elevator servomotor and the elevator trim tab control to provide a constant-pressure altitude flight.

CAUTION

Do not engage the altitude control if the vertical velocity indicator gives an indication of ascent or descent greater than 300 feet per minute.

Autopilot Release Buttons.

Release buttons are provided on both the pilot's and the copilot's control wheels. Pressing either of these pushbutton switches releases the pilot switch and the altitude control switch, allowing them to return to the OFF position, and releases the engaging switches, allowing them to return to the DISENGAGE position.

Radio Beam Coupler Switch.

A four-position radio beam coupler switch (figure 4-48), located on the autopilot control panel, provides coordination of the autopilot with the localizer and omnirange receiver and the glideslope receiver for instrument landing approach. It also provides co-ordination with the localizer and omnirange receiver for flying range signals. The first switch position, BLUE LEFT-LOC, connects the localizer and omni-range receiver to the autopilot for flying outbound on the localizer beam or inbound on the back course of the localizer. The switch knob must be depressed before it can be turned left to this position. The second position, GYRO PILOT, is used during all operations not involving the use of radio signals. With the switch in this position, the airplane is kept straight and level by the gyros, unless maneuvered by means of the autopilot controller. The third switch position, RANGE-LOC, connects the localizer and VOR receiver, or TACAN receiver to the autopilot for flying the localizer beam, VOR courses or TACAN courses. It is also used to connect the Doppler system to the autopilot for flying Doppler courses. The fourth switch position, APPROACH, connects the localizer and omnirange receiver and the glideslope receiver to the auto-pilot to control both the azimuth direction of the airplane and the descent angle on final approach.

Autopilot Selector Switch (Airplanes Modified by T.O. 1C-130A-793).

A two-position (VOR, DOPPLER) autopilot selector switch mounted on the aft side of the condition lever quadrant has been added to the autopilot circuit. This switch operates with the RANGE-LOC position of the radio beam coupler switch on the autopilot control panel. When the switch is in the VOR position, the autopilot receives input data from the localizer and omnirange receiver as previously. When the switch is in the DOPPLER position, the autopilot receives input data from the Doppler radar instead of the omnirange receiver.

AUTOPILOT INDICATORS.

Autopilot indicators are provided so that operation of the autopilot may be monitored and to warn of malfunction.

Trim Indicators..

The autopilot system includes three trim indicators (figure 4-48). These trim indicators are located on the autopilot controller and labeled RUD, AIL, and EL. Average meter deflection away from zero, on the RUD and AIL indicators, is evidence that the airplane is improperly trimmed and that an unnecessary load is being imposed on the servo system.

Note

Rudder trim is coupled to the roll attitude. The rudder should be used to correct trim only if the pilot is satisfied that the airplane is in level flight.

The EL indicator should show an average signal of zero at all times as the elevator trim tab is controlled by the autopilot in this installation.

Autopilot Off Light.

The autopilot off light (figure 4-48) has one function. The airplane is protected against possible malfunctions of the autopilot by a system of circuit breakers and interlocking relays. Circuit overloads which could affect the operation will immediately cause the pilot switch to return to and lock in the OFF position. At the same time the autopilot off light will flash on and off to warn the pilot that the autopilot is no longer functioning. This light will also flash on and off when the pilot switch has been in the ON position and, either intentionally or unintentionally, is placed in the OFF position. The light is extinguished by depressing the reset button (figure 4-48).

Beam Coupler Off Light.

The beam coupler off light (figure 4-48) on the autopilot control panel, lights whenever the beam guidance coupler unit is inoperative and the radio beam coupler switch is in a position other than GYRO PILOT. The light does not indicate receiver or transmitter malfunctioning.

NORMAL OPERATION OF THE AUTOPILOT.

WARNING

Do not have the autopilot engaged below 1,000 feet above the terrain. The only exception allowed is for automatic ILS approach control, during which time (operational mode) the controls must be continuously monitored.

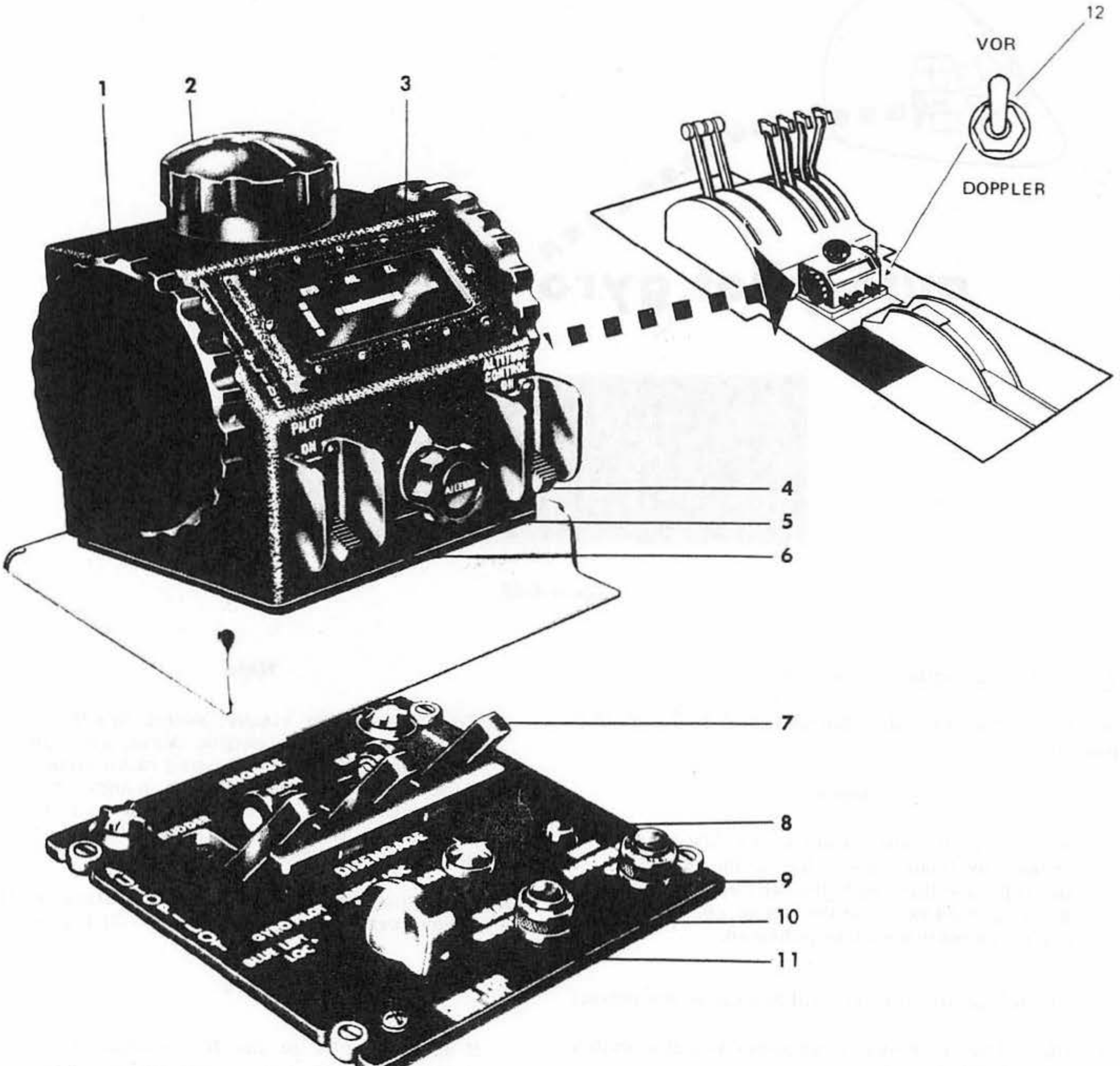
WARNING

Do not operate the autopilot system at speeds in excess of the recommended speed limit or 250 KIAS whichever is lower.

WARNING

Do not operate with the autopilot engaged at gross weights above the maximum normal takeoff weight.

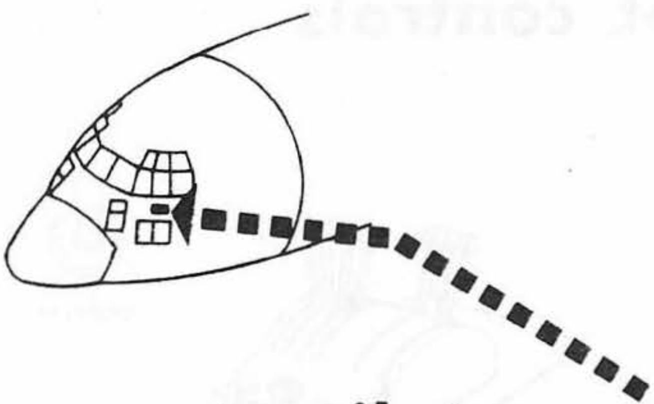
autopilot controls



1. PITCH KNOB
2. TURN KNOB
3. TRIM INDICATORS
4. ALTITUDE CONTROL SWITCH
5. AILERON TRIM KNOB
6. PILOT SWITCH
7. SERVO ENGAGING SWITCHES
8. RESET BUTTON
9. AUTO-PILOT OFF LIGHT
10. BEAM COUPLER OFF LIGHT
11. RADIO BEAM COUPLER SWITCH
12. AUTO-PILOT SELECT SWITCH (AIRPLANES MODIFIED BY T.O. 1C-130A-793)

130A-1-33-138

Figure 4-48.



auto-pilot gyro select panel

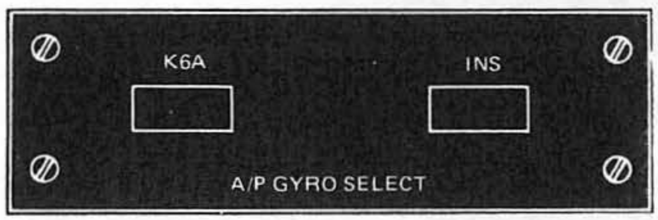


Figure 4-49.

To place the autopilot in operation:

1. Check that the pilot control switch is in the OFF position.

Note

> With the pilot control switch OFF, the servo engage switches should be in the DISENGAGED position and the altitude control switch should be in the OFF position. If they are not, a malfunction is indicated.

2. Check that the turn control knob is in the detent.

3. Check that the elevator tab power selector switch is in the NORMAL position.

Note

> Moving the elevator tab power selector switch from the NORMAL position renders the autopilot pitch control inoperative.

4. Place the radio beam coupler switch in the GYRO PILOT position.

Note

> The radio beam coupler switch should be in the GYRO PILOT position during all flights when the autopilot is not using radio signals. If the switch is accidentally left in another position and a VOR, TACAN, localizer or Doppler signal is intercepted, an undersirable maneuver may result.

5. Check that the N-1 compass is operating and that the latitude correction pointer is in the OFF position.

Note

> If power is lost to the N-1 compass, the rudder servo engaging switch will be locked in the DISENGAGED position by the autopilot interlock circuit. With this axis disengaged, the autopilot will not maintain a heading.

WARNING

> Trim the airplane for hands-off flight. An improperly trimmed airplane imposes an unnecessary load on the autopilot servomotors.

6. Place the pilot switch in the ON position.

WARNING

Check that the trim indicators on the autopilot controller indicate an average signal of zero before placing the engaging switches in the ENGAGE position. A permanent deflection of any of the meters indicates that the automatic synchronization is not functioning and that the servo for that axis should not be engaged. Engaging a servomotor for an axis with an out-of-trim condition may result in a violent maneuver.

7. Select mode of operation (K6A or INS)

8. Move the engaging switches to the ENGAGED position.

Note

The autopilot may be used to provide a stable, weapons delivery platform when the airplane is in the attack posture. By engaging only the elevator servo and altitude hold, the pilot can coordinate aileron and rudder control pressures manually while the autopilot maintains a stable altitude.

WARNING

During normal operation, do not attempt to overpower or assist autopilot pitch control through use of the control column. To do so will cause the autopilot to oppose pilot input with elevator trim causing an adverse out-of-trim condition. If the autopilot is disconnected while in this condition, a violent pitch maneuver may result with possible structural damage.

Note

Do not engage the autopilot when in a turn or just after a prolonged turn.

WARNING

Continually monitor the autopilot trim indicators during normal autopilot operation to ensure that the aircraft is properly trimmed. If a sustained out-of-trim condition is observed, disengage the appropriate autopilot axis, retrim the airplane, re-engage the autopilot axis.

WARNING

Prior to disengaging any autopilot axis, maintain firm control of the rudder pedals and control wheel. Failure to do so may result in a violent maneuver if an out-of-trim condition exists during disengagement.

The airplane is now under automatic control about all three axes. Any axis may be controlled manually by placing the engaging switch for that axis in the DISENGAGED position. Standard maneuvers may be executed with the pitch and turn knobs.

WARNING

To prevent possible structural damage to the vertical stabilizer in the event of a rudder malfunction, perform the following while accelerating or decelerating through 200 KIAS, disengage the autopilot rudder axis, retrim the airplane, re-engage the rudder axis.

Note

In recovering from a turn, return the turn knob to the detent slowly. Returning the turn knob to the detent too quickly will result in a control overshoot and then stabilizing in a wing-low attitude.

Note

Substantial changes in airspeed (20 to 30 knots) with the autopilot engaged and with the altitude control on, may result in altitude gain or loss. The recommended procedures to follow under the above conditions is to disengage the autopilot, retrim the airplane at the desired airspeed, and then re-engage the autopilot and turn the altitude control on.

Automatic flight may be discontinued at any time by pressing the pilot's or copilot's autopilot release button, by placing the servo engaging switches in the DISENGAGED position, or by placing the pilot switch in the OFF position.

RADIO BEAM COUPLER EQUIPMENT.

The radio beam coupler equipment operates with the autopilot to provide automatic flight on VOR, TACAN and Doppler courses or guide the airplane on localizer and glidepath beams. The radio beam coupler amplifies and modifies signals received by the ILS, VOR, or tacan receivers, and supplies the modified signals to the autopilot to guide the airplane on the selected course. The various functions of the radio beam coupler are connected to the autopilot by the radio beam coupler switch. The autopilot must be in operation for the radio beam coupler to function. The radio beam coupler is powered through the autopilot circuit breakers.

OPERATION OF RADIO BEAM COUPLER EQUIPMENT.

By radio signals received from the localizer and VOR, TACAN, and glide slope receivers, signals from the Doppler system and heading information from the No. 1 N-1 compass, the radio beam coupler controls the autopilot to accomplish automatic range flight or automatic approaches.

VOR and Tacan Operation..

To accomplish automatic flight on a VOR or TACAN course:

a. Place the autopilot in operation.

b. Tune the TACAN or VOR receiver to the desired frequency.

c. Turn pilot's instrument selector switch to desired system.

d. Set the desired course on the pilot's horizontal situation indicator, or ID-249.

Note

On Doppler equipped airplanes, the autopilot selector switch should be positioned to VOR prior to turning the radio beam coupler switch to the RANGE-LOC position.

e. Turn the radio beam coupler switch to the RANGE-LOC position.

If the airplane is not on the selected course, the autopilot will turn the airplane to a 60-degree intercept heading. When the selected course is reached, the autopilot will turn the airplane to bracket the course. After course interception and bracketing, the autopilot, through the beam coupler, will fly the airplane along the selected course. When the "zone of confusion" over the station is reached, a sensor circuit cuts out coupler response to the erratic beam signal and provides smooth straight flight on a course that is indicated by gyro reference and corrected heading information. Upon reaching the far side of the "zone of confusion", the radio beam coupler smoothly re-establishes beam signal control. Within the "zone of confusion", course changes up to 30 degrees may be accomplished by selecting a new course on the HSI, or ID-249. Between stations, course changes up to 5 degrees may be accomplished in the same manner. If larger course changes are required, it is necessary to recycle the radio beam coupler switch to the GYRO PILOT position after selecting the new course to re-establish the initial bracket coupler configuration; then the radio beam coupler switch should be returned to the RANGE-LOC position.

Automatic Approach (ILS).

To accomplish an automatic approach to an instrument landing facility:

a. Place the autopilot in operation.

b. Tune the localizer and VOR receiver to the desired frequency.

c. Position the instrument select switch to VOR ILS.

d. Establish an intercept course, up to 60 degrees, to the localizer beam.

Note

Interception must take place beyond the outer marker and below the glide path.

Note

On Doppler equipped airplanes, the autopilot selector switch should be positioned to VOR prior to turning the radio beam coupler switch to the RANGE-LOC position.

e. Turn the radio beam coupler switch to the RANGE-LOC position. The autopilot will fly the airplane on the intercept heading and turn onto the localizer beam upon interception. When the localizer heading is established turn the radio beam coupler switch to the APPROACH position. When the glide slope is intercepted, the altitude control switch will go to the OFF position, and the airplane will begin a descent down the glidepath.

Note

The radio beam coupler system is not an automatic landing system. Under all conditions, automatic control should be discontinued at a safe altitude and the landing completed manually. All operations of the radio beam coupling equipment can and should be monitored on the attitude-director indicators.

Localizer Operation.

WARNING

The radio beam coupler guidance is not cut out automatically in the zone of confusion over the localizer transmitter when the airplane is flown over the transmitter.

To accomplish automatic flight inbound on the front beam or outbound on the back beam of a localizer course:

a. Place the autopilot in operation.

b. Tune the localizer and VOR receiver to the desired frequency.

c. Position the instrument select switch to VOR ILS.

d. Establish an intercept course, up to 60 degrees, to the localizer beam.

Note

On Doppler-equipped airplanes, the autopilot selector switch should be positioned to VOR prior to turning the radio beam coupler switch to RANGE-LOC.

e. Turn the radio beam coupler switch to RANGE-LOC. The autopilot will fly the airplane on the intercept heading and turn onto the localizer beam upon interception. After interception, the autopilot will fly the airplane along the localizer beam course.

f. If accomplishing a front beam localizer approach, position the altitude control switch to OFF and control airplane descent with the pitch control knob(s).

To accomplish automatic flight inbound on the back beam or outbound on the front beam of a localizer course:

a. Accomplish above steps a through d.

b. Turn the radio beam coupler switch to BLUE LEFT-LOC. The autopilot will fly the airplane on the intercept heading and turn onto the localizer beam upon interception. After interception, the autopilot will fly the airplane along the localizer beam course.

c. If accomplishing a back beam localizer approach, position the altitude control switch to OFF and control airplane descent with pitch control knob(s).

OPERATION OF THE AUTOPILOT IN CONJUNCTION WITH THE DOPPLER COMPUTER.

Once the Doppler computer system has been placed in operation at the navigator's station, according to the instructions in the paragraph OPERATIONS OF THE DOPPLER COMPUTER, the autopilot can be used to navigate the airplane to the desired destination.

To accomplish automatic flight using the Doppler computer:

a. Place the Doppler computer system in operation at the navigator's station.

b. Position the distance scale switch on the auxilary cross-track panel to NAV.

c. Place the autopilot in operation.

d. Position the autopilot selector switch to DOPPLER.

e. Turn the radio beam coupler switch to the RANGE-LOC position. The autopilot will now fly the airplane to the desired destination.

Note

If the airplane is being flown on a course which has several "destinations" in the form of end points of the various legs of a planned flight, the autopilot should be turned to the GYRO PILOT position prior to reaching these destinations, and the airplane turned to the new heading. The 5-degree bank-angle turn characteristics of the autopilot would otherwise introduce an unnecessary, long-way-around, deviation from the planned flight plan.

FIRE CONTROL SYSTEM.

The fire control system performs analog computations to provide attack guidance steering information, optical gunsight aiming information, attack situational display data, and weapons fire-enable signals for employing the gunship firepower against selected ground targets. The system operates on azimuth and elevation resolver signals from one of four selectable sensors or from synthetic signals developed by the inertial targeting system (INS); pitch, roll, and heading signals from the gunship attitude reference system; and manually selected inputs. The fire control system assumes that the guns are pointed at a predetermined point, and when a target is sighted by one of the sensors, the azimuth and elevation angles received from the sensor can be correlated with the gun angles to calculate the firing orbit of the aircraft. Information from the fire control computer is displayed on the attitude directional indicator for guidance to the attack circle and in the optical gunsight to maneuver the aircraft into proper firing position. The system consists of a fire control computer (FCC), fire control panel (FCP), optical gunsight, fire control display unit (FCD), boresight box, attitude directional systems, inertial targeting system (INS), and the sensor systems (Figures 4-50 and 4-51).

fire control system diagram

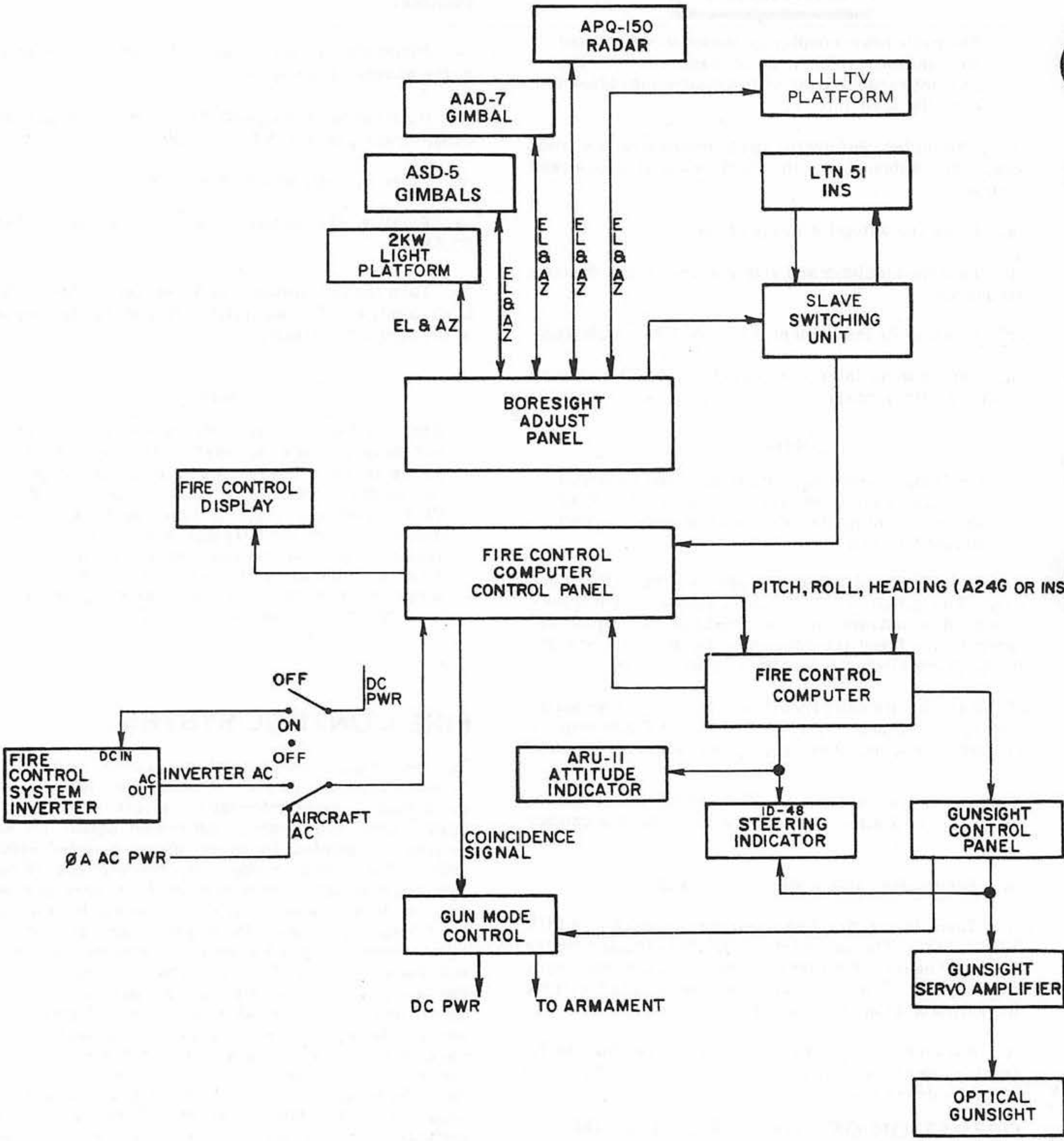


Figure 4-50.

major fire control system components

EQUIPMENT	LOCATION	OPERATOR	FUNCTION	ELEC SYS	PROTECTION AMP	TYPE	LOCATION
AIRBORNE ILLUMINATION LIGHT SET AN/AVQ-8 (40 KW)	AFT CARGO RAMP	IO	AIRBORNE ILLUMINATION	AC	50	CB (3 EA)	AUX. AC POWER BOX
				DC	5	CB	CARGO COMPT. DC CB PANEL
				DC	50	CB	CARGO COMPT. DC CB PANEL
AIRBORNE SEARCHLIGHT SET AN/AVQ-17 (2 KW)	AFT OF LEFT PARA-TROOP DOOR	TV OPERATOR	AIRBORNE ILLUMINATION (VISUAL & IN-FRARED)	AC	5	CB	CARGO COMPT. AC CB PANEL
				AC	7.5	CB	CARGO COMPT. AC CB PANEL
				DC	100	FUSE	MAIN POWER DIST. BOX
ATTITUDE INDICATING SYSTEM, A24G	UNDER IR OPERATOR CONSOLE (PALLET)	PILOT & NAV	PITCH, ROLL, & HEADING IN-FORMATION	AC	2	CB	MAIN POWER DIST. BOX
				AC	5	CB (3 EA)	MAIN POWER DIST. BOX
ATTITUDE INDICATOR, ARU-11/A	PILOT INST. PANEL AND FCO CONSOLE	RECEIVES SIG-NALS FROM FIRE CONTROL COMPUTER, AND A24G OR LTN-51 SYS.	DISPLAYS PITCH, ROLL, HEADING, & FIRE CONTROL INFORMATION.	AC	2	CB	MAIN POWER DIST. BOX
				AC	5	CB (3 EA)	MAIN POWER DIST. BOX
BORESIGHT ADJUST PANEL	BELOW AND AFT OF OPTICAL GUNSIGHT		SENSOR BORE-SIGHT		–	–	–
FIRE CONTROL COMPUTER	NAVIGATOR STATION	NAVIGATOR	SOLVES THE FIRE CONTROL PROBLEM	AC	5	CB	MAIN POWER DIST. BOX
				DC	2	CB	CARGO COMPT. DC CB PANEL
				DC	5	CB	MAIN POWER DIST. BOX
FIRE CONTROL DISPLAY	NAVIGATOR STATION	NAVIGATOR	DISPLAYS FIRE CONTROL IN-FORMATION	AC	5	CB	MAIN POWER DIST. BOX
				DC	5	CB	MAIN POWER DIST. BOX
FLARE EJECTOR SET, AN/ALE-20(V)	CONTROL PEDESTAL, FLIGHT ENGINEER STATION, FWD AND AFT SCANNER STATIONS, FWD OF RIGHT PARATROOP DOOR, LEFT AND RIGHT WHEEL WELL	COPILOT, ENGINEER, FWD SCANNER, AFT SCANNER	AIRBORNE COUNTER-MEASURES	DC	5	CB (2 EA)	CARGO COMPT DC CB PANEL
				DC	25	CB	CARGO COMPT DC CB PANEL
GUNSIGHT SERVO AMPLIFIER	PILOT'S SIDE SHELF		AMPLIFIES SIG-NALS TO THE OPTICAL GUN-SIGHT	AC	.5	FUSE	PILOT'S SIDE SHELF
INERTIAL NAVIGATION SYSTEM, LTN-51	FCO STATION	FCO	PROVIDES AIR-PLANE ATTI-TUDE AND TAR-GET POSITION DATA	AC	10	CB (3 EA)	FCO CB PANEL
				DC		CB	FCO CONSOLE
INFRARED DETECTING SET, AN/AAD-7	FORWARD OF LEFT MAIN GEAR WELL	IR OPERATOR	TARGET SEARCH	AC	10	CB (2 EA)	CARGO COMPT AC CB PANEL
				DC	7.5	CB	CARGO COMPT. DC CB PANEL
				DC	15	CB	CARGO COMPT. DC CB PANEL
				DC	20	CB	CARGO COMPT. DC CB PANEL

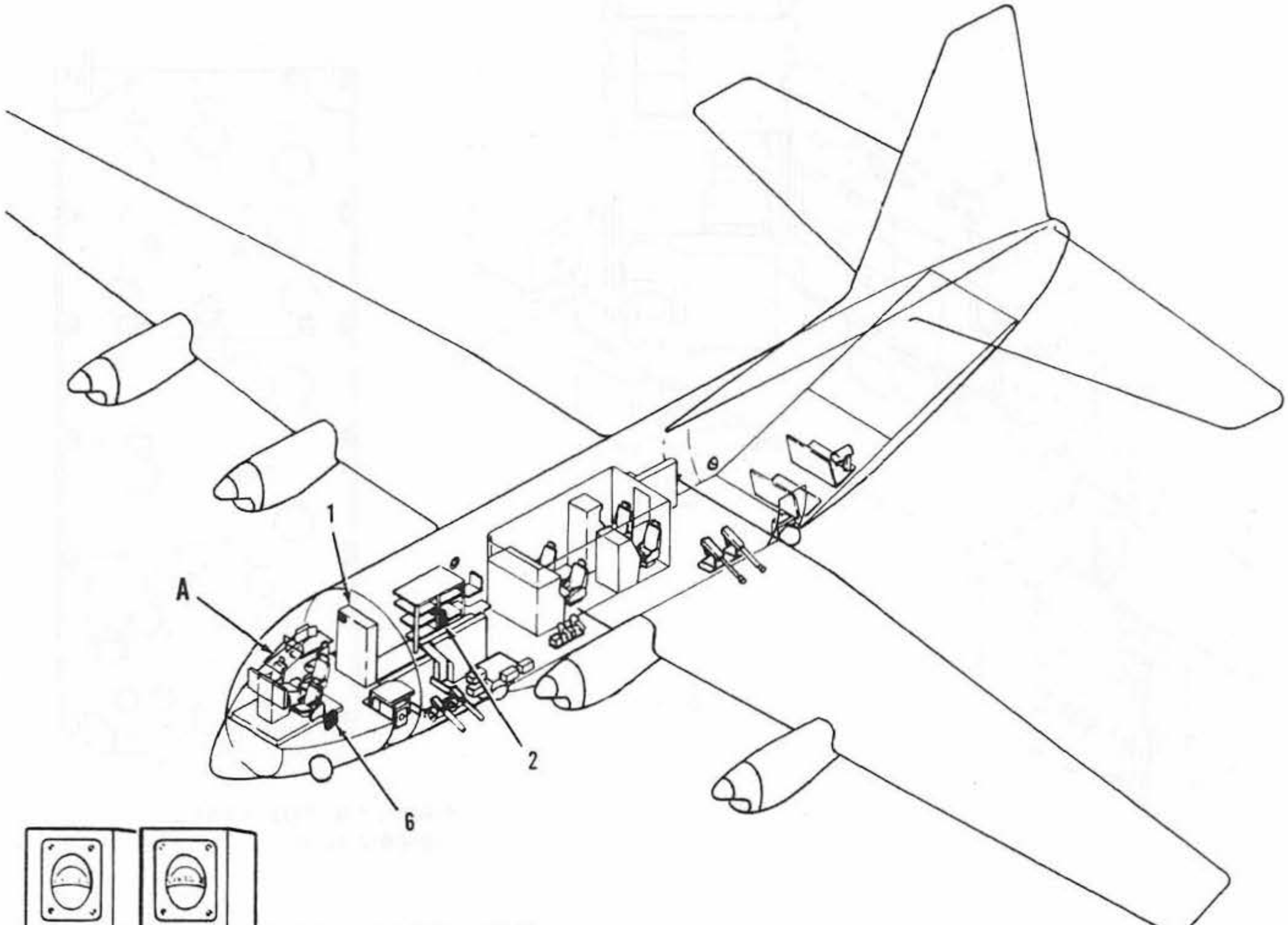
Figure 4-51. (Sheet 1 of 2)

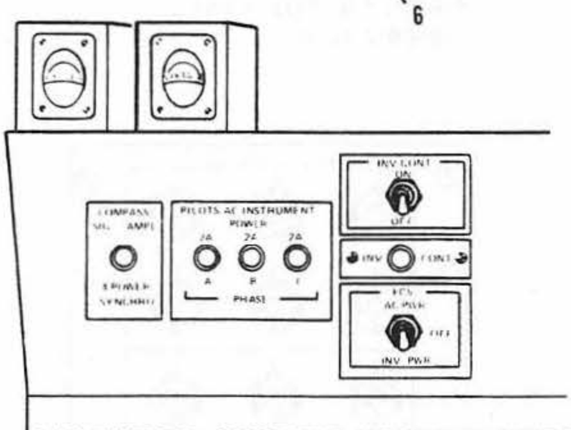
major fire control system components (cont)

EQUIPMENT	LOCATION	OPERATOR	FUNCTION	ELEC SYS	PROTECTION AMP	TYPE	LOCATION
LASER ILLUMINATOR, AN/AAQ-7	TV/LASER PLATFORM	TV OPERATOR	NIGHT TARGET SEARCH AND RANGING	DC DC	5 20	CB (2 EA) CB	TV CONSOLE CARGO COMPT DC CB PANEL
LASER TARGET DESIGNATOR, AN/AVQ-18	TV/LASER PLATFORM	TV OPERATOR	LASER TARGET DESIGNATION	AC DC	5 50	CB CB	MAIN POWER DIST. BOX MAIN POWER DIST. BOX
LLLTV, AN/ASQ-145 (V) (GLINT)	TV/LASER PLATFORM	TV OPERATOR	NIGHT TARGET SEARCH	AC DC DC AC DC AC DC	5 5 7 5 5 5 5	CB (2 EA) CB (5 EA) CB (2 EA) CB CB (2 EA) CB CB (2 EA)	TV CONSOLE TV CONSOLE TV CONSOLE FCO CONSOLE FCO CONSOLE IR OP. STATION IR OP. STATION
MOVING TARGET INDICATOR (AN/APN-59)	NAVIGATOR STATION	NAVIGATOR	DISPLAY OF MOVING RADAR TARGETS	AC DC	5 5	CB (3 EA) CB	RADIO JUNCTION BOX RADIO JUNCTION BOX
OPTICAL GUNSIGHT	PILOT STATION	PILOT	DISPLAYS TARGET INFORMATION	AC DC	5 5	CB CB	MAIN POWER DIST. BOX MAIN POWER DIST. BOX
RADAR SET, AN/APQ-150	LEFT PARATROOP DOOR	EWO	SEARCH FOR, ACQUIRE AND TRACK I-BAND RADAR BEACONS	AC DC	10 5	CB CB	CARGO COMPT. AC CB PANEL CARGO COMPT. DC CB PANEL
SENSOR ANGLE DISPLAY (SAD)	PILOT, FCO, EWO, IR, TV STATIONS	NAVIGATOR, PILOT, FCO, EWO, IR OPERATOR, TV OPERATOR	DISPLAY OF SENSOR ANGLE INFORMATION	DC	5	CB	MAIN POWER DIST. BOX
SLAVE SWITCHING UNIT, SA-1786/A (SSU)	NAVIGATOR STATION	OPERATED BY CONTROL SWITCHING UNITS AT IR, EWO, FCO, & TV STATIONS.	RELAY SWITCHING & POWER AMPLIFICATION FOR SENSOR PLATFORM SLAVING. ALSO JUNCTION BOX FOR SENSOR SIGNAL AND POWER LINES.	AC DC AC AC DC	2 7.5 2 2 7.5	CB CB CB CB CB	SSU SSU RADIO BUS RADIO BUS RADIO BUS
STEERING INDICATOR, ID-48	PILOT'S INSTRUMENT PANEL	RECEIVES SIGNALS FROM FIRE CONTROL COMPUTER	DISPLAYS STEERING INFORMATION TO ATTACK CIRCLE				
VIDEO TAPE RECORDER, RO-404/AXH-2	FCO STATION	FCO	RECORDS VIDEO AND AUDIO SIGNALS	AC DC	5 5	CB (3 EA) CB	FCO CONSOLE FCO CONSOLE

Figure 4-51. (Sheet 2 of 2)

fire control computer, display, boresight panel, and FCS inverter component locations





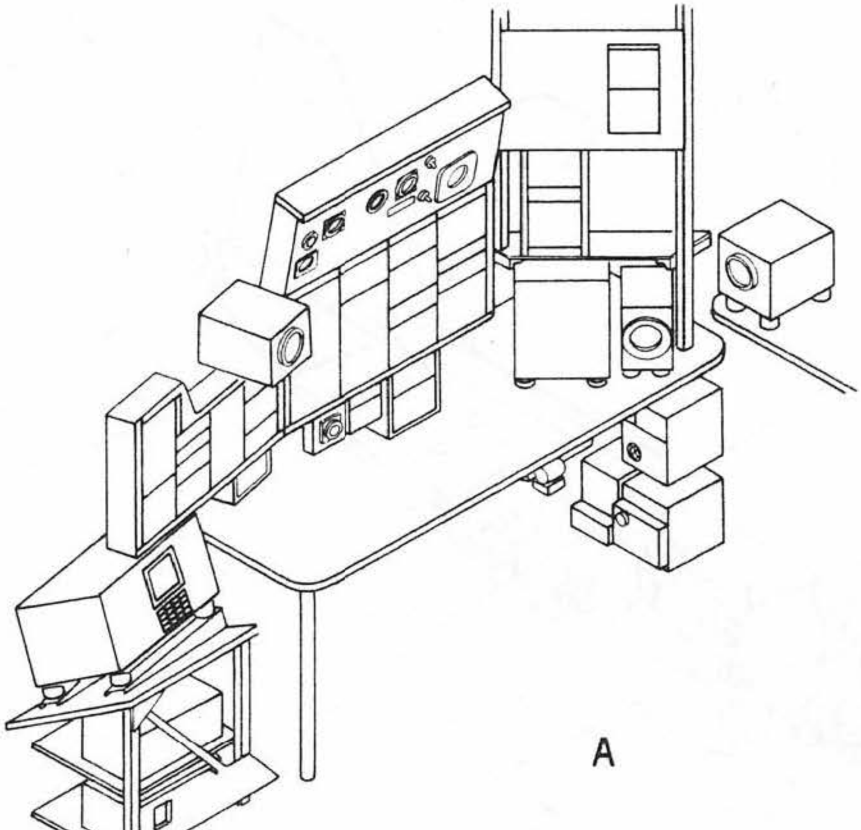
VOLTMETER, AMMETER, INV CONT, SWITCH AND F.C.S. SWITCH

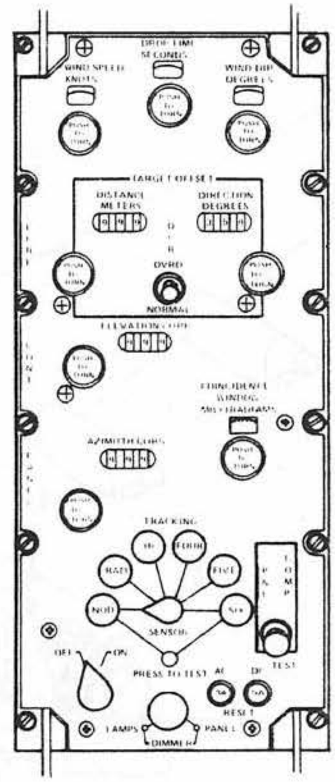
FCS INVERTER

1. VOLTMETER, AMMETER, INV CONT SWITCH, AND F.C.S SWITCH
2. FCS INVERTER
3. FIRE CONTROL COMPUTER CP-1034/AYK-9 (A)
4. FIRE CONTROL DISPLAY E247900-4 (A)
5. FIRE CONTROL PANEL C-8569/AYK-9 (A)
6. BORESIGHT ADJUST PANEL C70905010

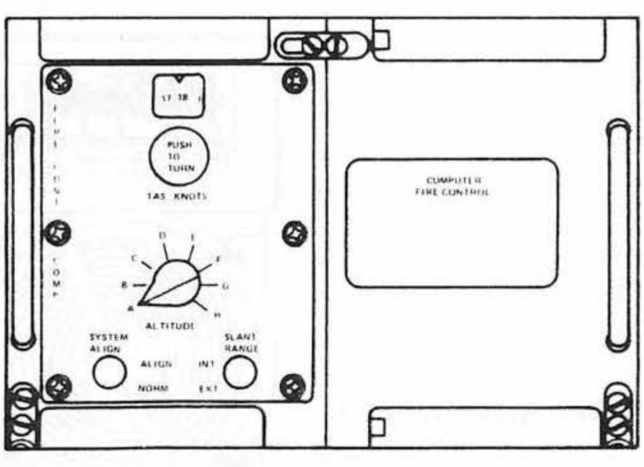
Figure 4-52.

fire control computer, display, boresight panel, and FCS inverter component locations

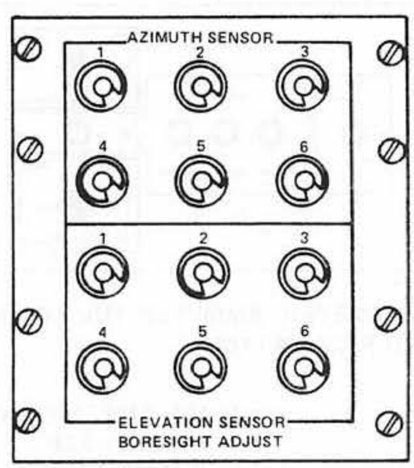




FIRE CONTROL PANEL
C-8569/AYK-9



FIRE CONTROL COMPUTER CP-1034/AYK-9



BORESIGHT ADJUST PANEL C709095910

Figure 4-53.

BORESIGHT CONTROL PANEL. The boresight control panel, located on the pilots side panel as shown in figure 4-54 consists of a panel and housing which contains 12 four-wire resolvers. The resolvers are geared to shafts that extend through the panel for Allen wrench adjustment. Each adjustment is locked with knurled thumbnuts. The adjustments AZIMUTH SENSOR and ELEVATION SENSOR 1, 2, 3, 4, 5, and 6, correspond to TV, RAD, IR, BC, spare, and 2KW ILLUM, respectively. Adjustments are made to correct for associated system installation errors.

Note

The TV platform can be most accurately aligned to the gunship hard-point alignment reference and should be used as the reference platform for inflight alignment adjustments. Inflight alignment adjustments to the TV platform should only be made in cases of serious geometry problems after thorough analysis of other geometry factors.

ALIGNMENT HARD-POINT

Sensor boresight/alignment procedures are performed to insure harmonization of the guns, the gunsight, and the sensors. All are aligned to a common reference called the hard-point. The hard-point is a block of machined metal that is bolted to the cargo floor at station 255 just aft of the TV/ Laser Platform. It is precisely aligned parallel to the wing axis and perpendicular to the longitudinal axis of the aircraft to provide a zero azimuth and zero

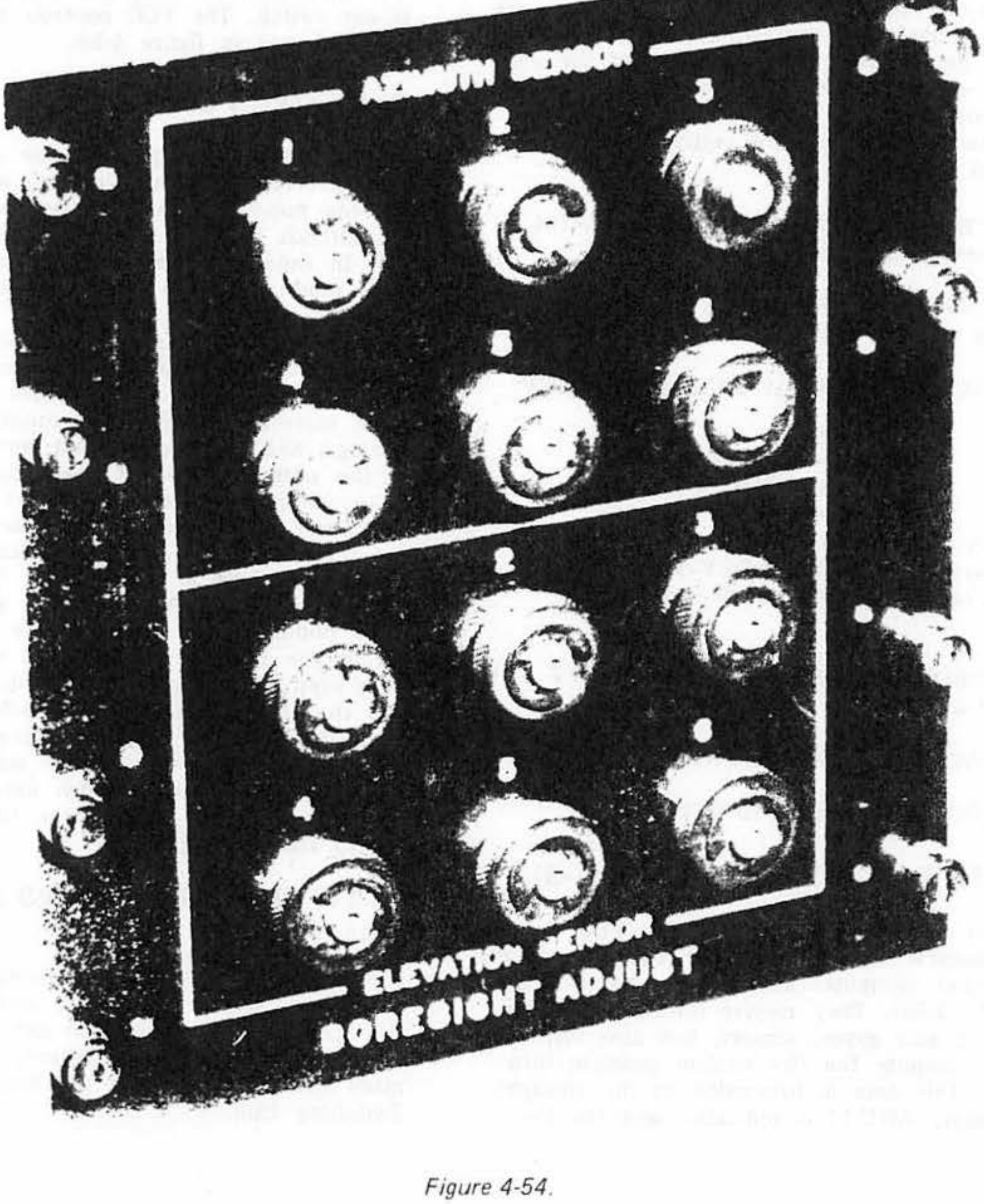


Figure 4-54.

elevation reference on the left side of the aircraft. A 20mm hole is bored into the end of the block for insertion of a specially adapted D-1 sextant which is used for alignment sighting.

FIRE CONTROL SYSTEM INVERTER

The fire control system inverter is the primary source of power for the fire control system, while the airplane system is a backup source of power. The inverter is controlled by the two-position (ON-OFF) INV CONT toggle switch located on the main power distribution box (figure 4-52). When use of the inverter is not required the switch should be turned OFF. Power is supplied from the main dc bus. Two meters are installed on top of the main power distribution box; one indicates inverter (115 ± 3 volts ac) and the other inverter frequency (380-420 Hz). A three-position (AC PWR-OFF-INV PWR) FCS toggle switch, below the INV CONT switch, enables the navigator to select either the airplane power supply or the fire control inverter. There are two circuit breakers for protection. One is mounted in front of the inverter on the outside of the electronics rack on the forward right-hand side of the cargo compartment. The other one is located between the two inverter control switches on the main dc bus.

FIRE CONTROL SYSTEM INVERTER TURN-ON. Turn on inverter as follows:

1. Place INV CONT switch to ON position. Allow 2 minutes warmup time.
2. Place AC PWR-OFF-INV PWR switch to INV PWR.

CAUTION

The INV CONT switch must always be in ON position before AC PWR-OFF-INV PWR switch is placed in INV PWR position.

FIRE CONTROL SYSTEM INVERT TURN-OFF. Turn off inverter as follows:

1. Place AC PWR-OFF-INV PWR switch to OFF.
2. Place INV CONT switch to OFF.

FIRE CONTROL COMPUTER (AYK-9)

The fire control computer (figure 4-52, 4-53) located at the navigator's station consists of two subsystems, the fire control computer and the fire control panel. (Figure 4-55, 4-56). They receive information from the INS or 2 axis gyros, sensors, and also manual inputs, and compute the fire control problem into usable data. This data is forwarded to the gunsight, ID-48 indicator, ARU-11/A indicator, and the fire control display to accurately control weapons fire on the designated target. Controls on the computer and panel provide manual inputs for the wind speed and direction, target offset distance and direction, elevation and azimuth corrections, projectile drop time, coincidence window, and true airspeed and altitude. Power for operation of the computer is 28-volt dc and 115-volt ac through circuit breakers located on the main power distribution box, cargo compartment dc circuit breaker panel, and fire control panel.

FIRE CONTROL PANEL CONTROLS AND FUNCTIONS

The controls and functions are shown in figure 4-57.

Fire Control Computer (FCC) Controls and Functions

The Fire Control Computer is activated by the FCP power switch. The FCC controls and their functions are explained in figure 4-58.

SYSTEM OPERATION

For proper system operation the correct azimuth and elevation counts, computer TAS, and computer true altitude must be input by the operator to enable the aircraft to fly a coordinated turn about the target. In order to place ordnance on the target the guns must be set to values corresponding to the computer settings. If fixed reticle operation is anticipated then the gunsight must be properly set. These values may be obtained from T.O. 1C-130(A)A-34-1-1. In addition to the above nominals (computer TAS, azimuth and elevation counts, and altitude; gun settings; and sight setting) the aircraft must be flown at the nominal, 30° left bank angle. This bank angle is computer hard wired and must not vary. Assuming the above mentioned nominals are properly set then the pilot must maneuver the aircraft to place it on the attack circle at the nominal TAS, bank angle, and altitude. If, at gunfire time, the aircraft varies from these nominals then the projectile cannot be expected to hit the target. In most cases there will be a ballistic wind acting on the projectile between the gun and the target. The computer will compensate for wind if the proper drop time and wind velocity/direction are inserted. In close support situations, an offset may be inserted which moves the computed aiming point from the position the sensor is tracking to the offset point.

ATTITUDE INDICATORS (ARU-11A) (4012F)

Five instruments are located throughout the airplane to display aircraft pitch, roll, and in the case of the ARU-11/A heading from either the INS (primary) or the 2 axis (secondary). The selection is made by the FCO using the Attitude Reference Switching Unit.

fire control panel (fcp)

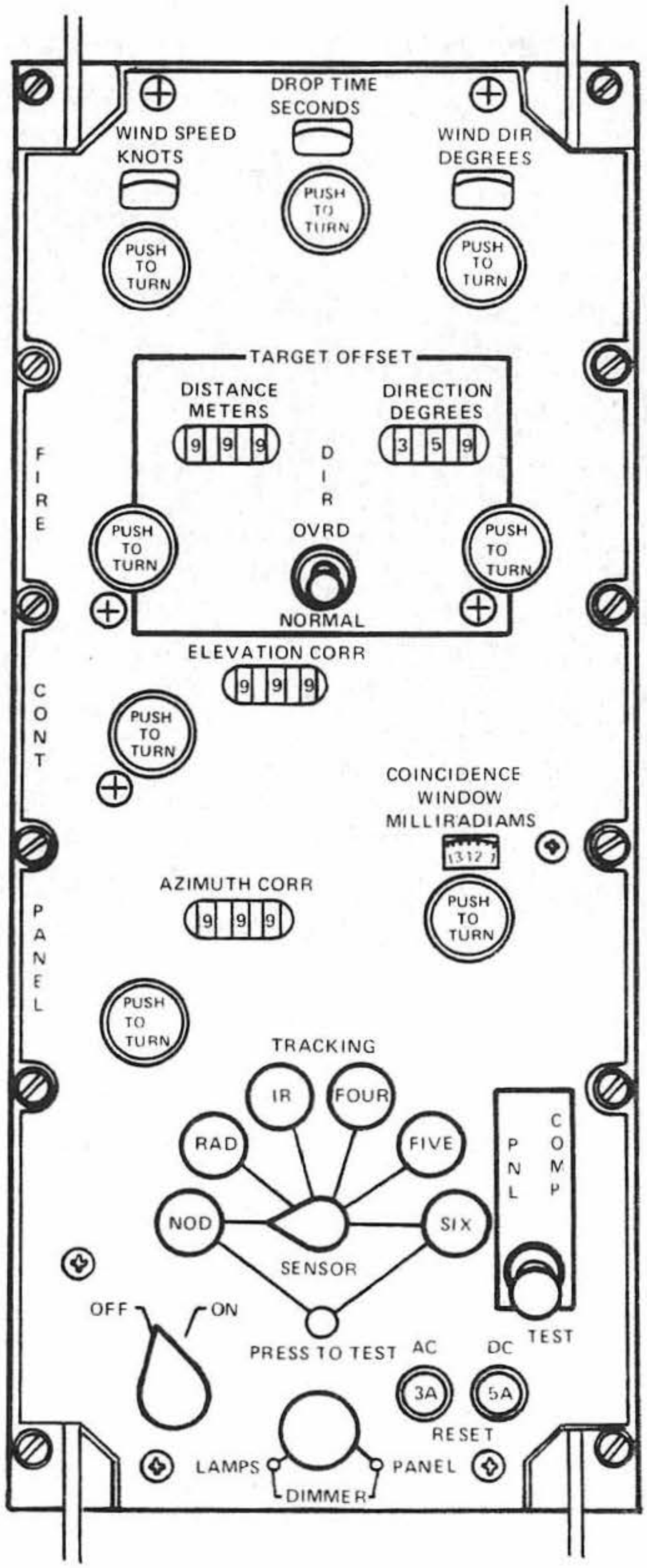


Figure 4-55.

fire control computer (FCC)

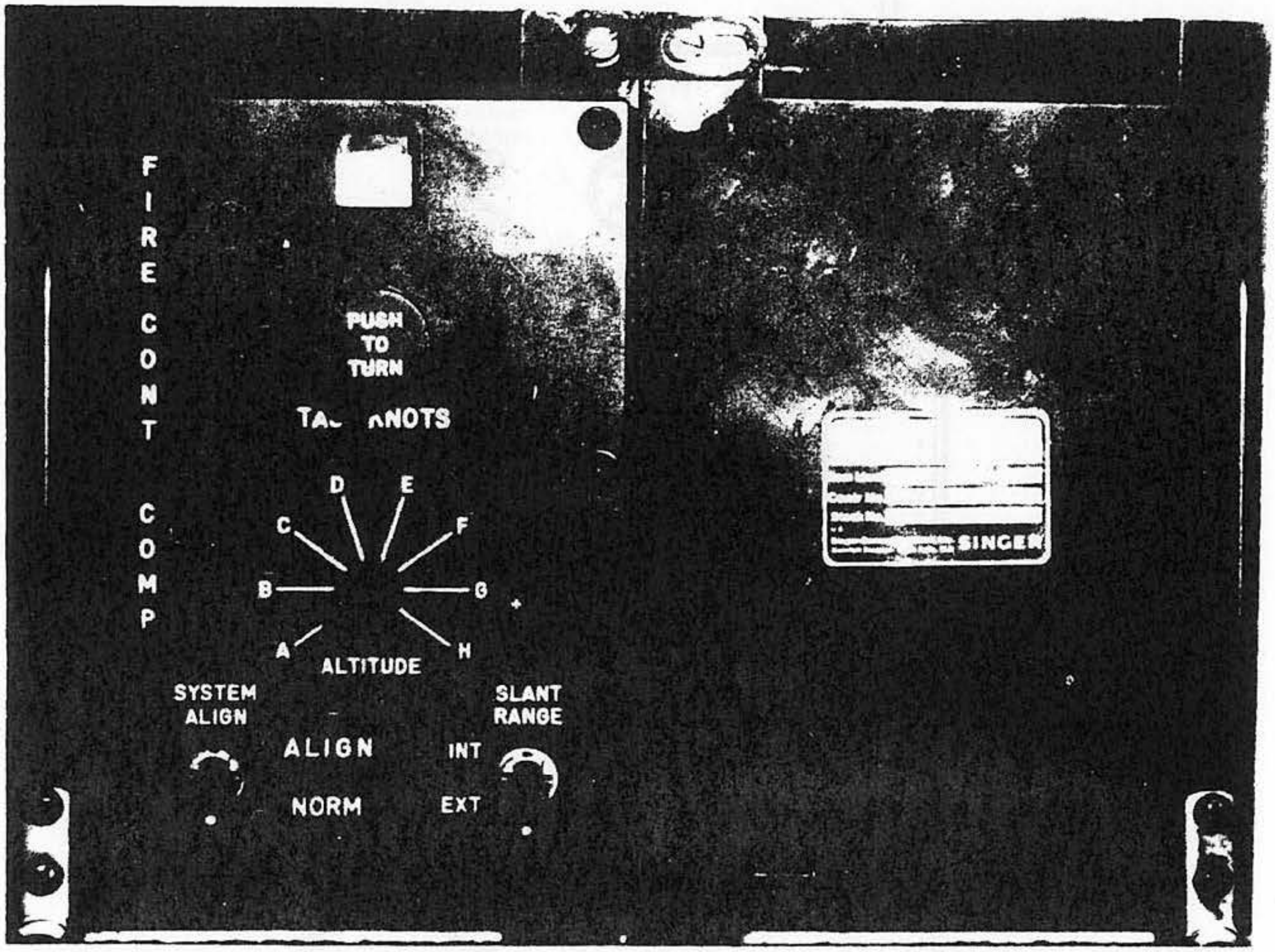


Figure 4-56.

4012F Indicators: (Figure 4-59). One indicator is located at each of the following stations; Nav station, IR/EWO station, and the TV station.

ARU-11/A Indicators: (Figure 4-59). One indicator is located at the Pilots station and one at the FCO station. The Target Bar and the Bank Steering Bar on the pilot's indicator are used for approach guidance to place the aircraft in the firing orbit (figure 4-60). The pilot should be able to center the needles at 30° of bank, transition to the gunsight and find the fixed reticle, within 8.5 mils of the target reticle. The target bar and bank steering bar are inoperative on the instrument located at the FCO station.

OPTICAL GUNSIGHT

The optical gunsight (figure 4-61) provides a fixed reticle and a computer-controlled movable reticle display to the pilot suitable for steering the airplane on a course that maintains the target within the field of fire of the airplane guns. The sight reflects five optical displays from the sight reflector on to a combining glass in the field of view of the pilot. These displays are a fixed reticle, a movable reticle, four sets of two reticle limit indicators, eight sensor not tracking indicators, and eight coincidence window indicators. Gunsight components are located on and above the pilot side panel. Guidance information is received from the fire control computer through

fire control panel (FCP) controls and functions

CONTROL	FUNCTION
Power Switch	OFF/ON rotary switch that controls power supplied to the computer.
AC and DC Reset Circuit breakers	Provide 3 Amp AC and 5 Amp DC protection for the FCC.
SENSOR SELECTOR Switch	Six-position rotary switch that selects the primary sensor input to be processed by the FCC for attack guidance.
1. NOD	Selects the AN/ASQ-145(V) LLLTV.
2. RAD	Selects the APQ-150 Beacon Tracking Radar.
3. IR	Selects the AN/AAD-7 Infrared Detecting Set.
4. FOUR	Selects the ASD-5 Black Crow (BC) Sensor.
5. FIVE	Selects the LTN-51 INS.
6. SIX	SPARE
CONSENT indicators and PRESS-TEST switch	6 Green consent lights will illuminate when the PRESS-TEST switch is depressed provided the lamps dimmer control is properly adjusted. The consent lights will illuminate for each sensor when the respective sensor consent switch or circuit is activated, without regard to whether or not that sensor is the primary sensor. The computer consent circuit will permit the guns to fire only when the primary sensor's consent circuit is activated (AUTOMATIC MODE ONLY). The RADAR automatically provides a consent signal as long as lock-on is maintained. The INS provides a continuous consent signal.
Dimmer Control Knobs	Tandem rotary knobs: Inner knob controls the intensity of the consent indicators and outer knob controls the intensity of the panel illumination lights.
PNL/COMP TEST Switch	Down position for normal operation. Placing switch in the UP position initiates test function. PNL indicator illuminates when test problem is correctly set into system to indicate sensed panel voltages are present. COMP indicator illuminates when computer solution is within 30 min. of arc.
AZIMUTH CORR	Indicates azimuth correction (0 to 500 to 999 counts) representing a correction of –10 to 0 to +10 degrees at 50 counts per degree. Nominal setting is 500 counts or 0 degrees for all altitudes. Corrections are set into the counter with the adjacent PUSH TO TURN control knob.
ELEVATION CORR counter and control knob	Indicates elevation correction (0 to 100 to 999 counts) representing +5 to 0 to –45 degrees sight line depression angle. There are 20 counts per degree with a setting of 100 counts representing 0 degrees sight line. A new nominal value must be set for each altitude and airspeed. Corrections are set into the counter with the adjacent PUSH TO SET control knob.
COINCIDENCE WINDOW	Used to set diameter of coincidence angle circuit. The coincidence circuit indicates allowable firing angle error and inhibits gun firing when the fixed and movable gunsight reticles become separated by a distance equal to one-half the setting (AUTOMATIC mode only). The dial is manually set by the adjuacent PUSH TO TURN knob. Range 0-30 milliradians.
TARGET OFFSET Controls	Provide offset attack guidance to a target up to 999 meters in any selected direction from the primary sensor aim point.
DISTANCE METERS counter and control knob.	PUSH TO TURN knob manually sets offset distance in meters (0 to 999) in the counter window.

Figure 4-57 (Sheet 1 of 2).

fire control panel (FCP) controls and functions (cont.)

CONTROL	FUNCTION
DIRECTION DEGREES Counter and Control	PUSH TO TURN knob manually sets offset direction (0 to 360 degrees) in the counter window. **NOTE** If the FCC is receiving true heading reference, set true offset direction. If the FCC is receiving magnetic heading reference, set magnetic offset direction.
Target Offset Override (OVRD/NORMAL) Switch	NORMAL position provides offset attack guidance. Direct fire at the primary sensor aim point is maintained whenever DISTANCE METERS setting is ZERO. OVRD position overrides target offset distance which is set into computer providing direct fire at the primary sensor aim point. RED DIR (direct) light will blink when OVRD is selected.
Wind Circuit	Wind information set into the computer provides an offset aim point upwind from the target which the gunship orbits and allows the wind to blow the projectiles to the target. The wind set into the computer is a ballistic wind - the average wind affecting the projectile from the muzzle to impact.
WINDSPEED KNOTS counter and control knob	PUSH TO TURN control knob sets in a ballistic wind speed from 0 to 50 knots.
WIND DIR DEGREES and control knob	PUSH TO TURN control knob sets in the ballistic wind direction from 0 to 360 degrees. **NOTE** If the FCC is receiving true heading reference, set true wind direction. If the FCC is receiving magnetic heading reference, set magnetic wind direction.
DROP TIME SECONDS counter and control knob	PUSH TO TURN control knob sets in the time of fall (0 to 10 seconds) of the projectile being fired. The time of fall setting determines the amount of ballistic wind effect which the computer uses in its computations. It is a wind scaling factor. Time of fall must be set greater than zero in order to apply wind to the fire control computation problem.

Figure 4-57 (Sheet 2 of 2).

the gunsight control panel and the gunsight servo amplifier. Power for operation of the gunsight is 28 volt dc and 115 volt ac through circuit breakers located on the main power distribution box.

GUNSIGHT COMPONENTS

Gunsight Head Assembly

The gunsight head assembly (figure 4-61) is mounted above the pilot side panel just aft of the pilot swing window and contains a lense that projects the images on to the combining glass. The head assembly has provisions for elevation and azimuth adjustments and access for light bulb replacement.

Combining Glass

The combining glass (figure 4-61) is a transparent window mounted on the upper right hand side of the gunsight head. The optical displays are reflected on the glass for pilot view.

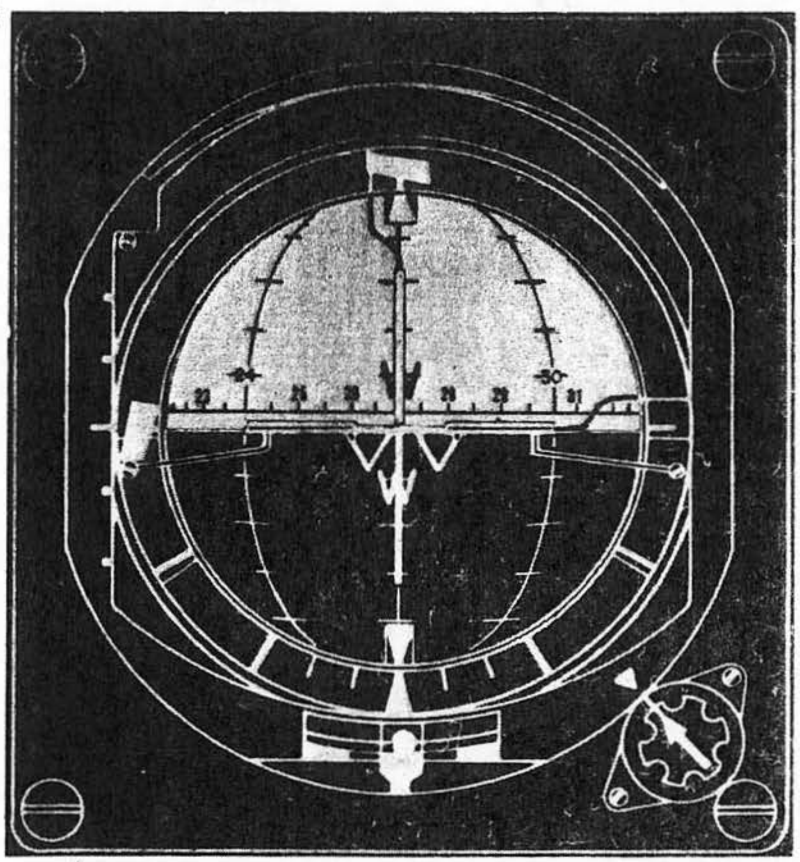
Azimuth Adjust

The azimuth adjust knob (figure 4-61) is used to adjust the azimuth of the gunsight head. A lock nut behind the adjust knob may be used to lock the knob in the desired position.

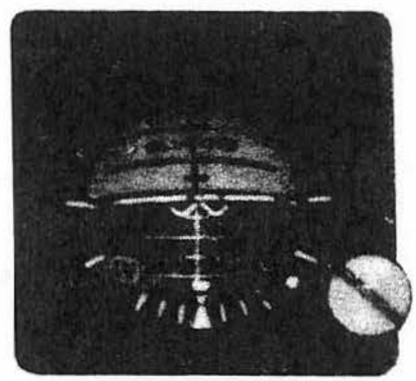
fire control computer (FCC) controls and functions

CONTROL	FUNCTION
TAS KNOTS indicator and control knob	PUSH TO TURN control knob sets the firing orbit nominal computer true airspeeds from 150 to 220 knots.
ALTITUDE Switch	Selects the nominal firing altitude from A through H.
SYSTEM ALIGN Switch	Two-position NORM/ALIGN Spring - guarded toggle switch.
NORM	The normal inflight position
ALIGN	Used for system ground alignment, the ALIGN position selects a preset simulated left 30 degree bank angle.
SLANT RANGE Switch	Not functional in present installation. The switch position is immaterial.
ALIGN indicator	Indicates system is in align mode.

Figure 4-58.

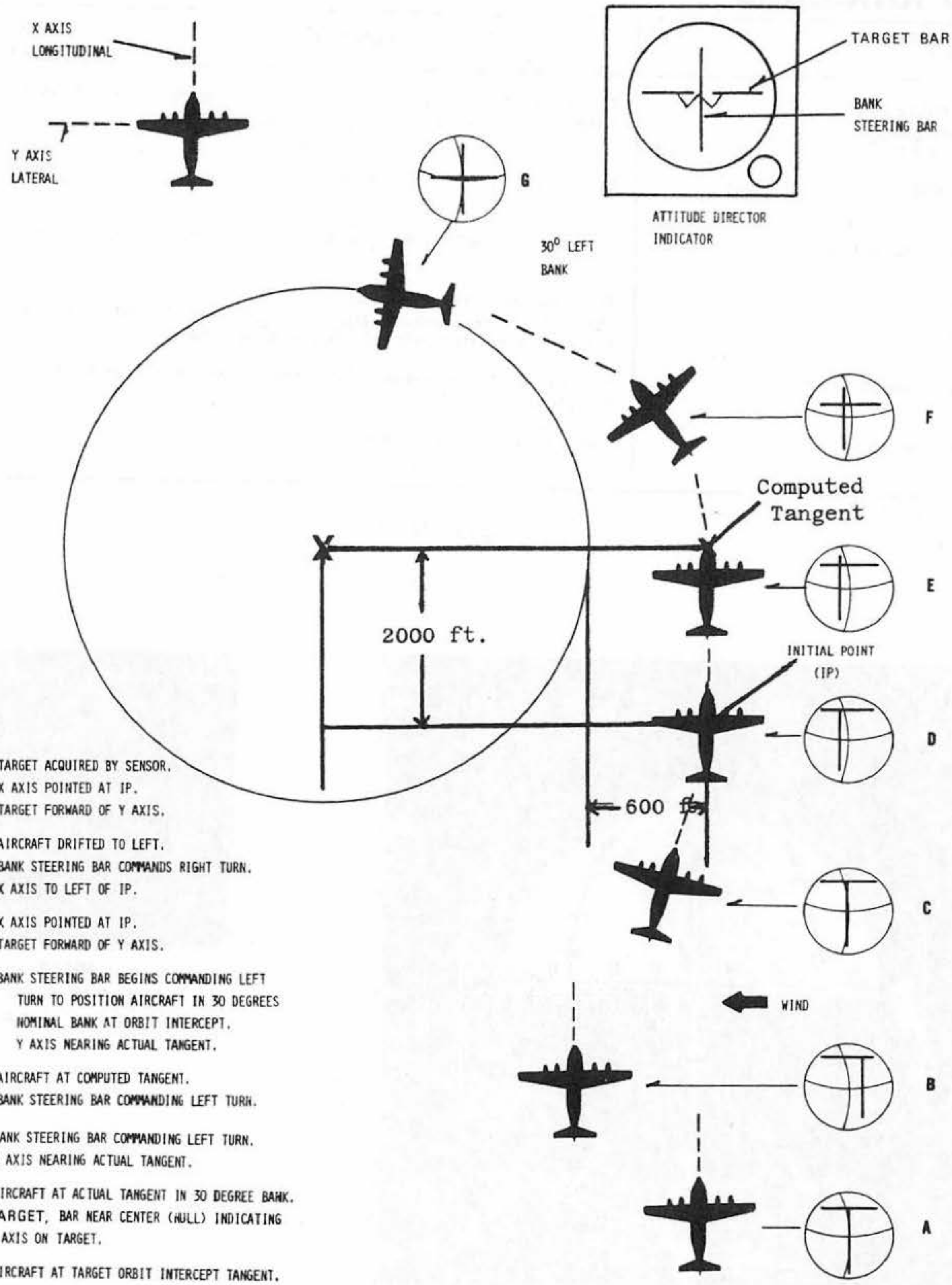


ARU-11/A ATTITUDE INDICATOR



4012F AUXILIARY ATTITUDE INDICATOR

Figure 4-59.



A TARGET ACQUIRED BY SENSOR.
X AXIS POINTED AT IP.
TARGET FORWARD OF Y AXIS.

B AIRCRAFT DRIFTED TO LEFT.
BANK STEERING BAR COMMANDS RIGHT TURN.
X AXIS TO LEFT OF IP.

C X AXIS POINTED AT IP.
TARGET FORWARD OF Y AXIS.

D BANK STEERING BAR BEGINS COMMANDING LEFT TURN TO POSITION AIRCRAFT IN 30 DEGREES NOMINAL BANK AT ORBIT INTERCEPT.
Y AXIS NEARING ACTUAL TANGENT.

E AIRCRAFT AT COMPUTED TANGENT.
BANK STEERING BAR COMMANDING LEFT TURN.

F BANK STEERING BAR COMMANDING LEFT TURN.
Y AXIS NEARING ACTUAL TANGENT.

G AIRCRAFT AT ACTUAL TANGENT IN 30 DEGREE BANK.
TARGET, BAR NEAR CENTER (NULL) INDICATING Y AXIS ON TARGET.

AIRCRAFT AT TARGET ORBIT INTERCEPT TANGENT.
TRANSITION POINT TO GUNSIGHT.

Figure 4-60.

Azimuth Protractor

The azimuth protractor (figure 4-63) indicates the gunsight head azimuth setting in degrees and minutes.

Elevation Adjust

The elevation adjust knob (figure 4-61) is used to adjust the elevation of the gunsight head. A lock nut behind the adjust knob may be used to lock the knob in the desired position.

Elevation Protractor

The elevation protractor (figure 4-63) indicates the gunsight head setting in degrees and minutes.

Gunsight Amplifier

The gunsight amplifier is located just aft of the gunsight head and consists of an azimuth amplifier, an elevation amplifier, and a power supply. The amplifiers provide amplification of the azimuth and elevation input signals. These amplified signals are supplied to the servo network which furnishes a control circuit to the gunsight to drive the movable reticle. The power supply provides the necessary power required for the amplifier circuitry. The amplifier is protected by a 1/2 amp fuse which screws into the base of the amplifier housing.

Gunsight Control Panel

The gunsight control panel (figure 4-61) located outboard of the pilot provides intensity control of the illuminated reticles and indicator lamp displays of the gunsight. The panel contains five rheostat controls and two filament selector switches. The FIXED RETICLE and MOVING RETICLE controls are used to control intensity of the fixed and movable reticle displays. The OUTSIDE WINDOW (coincidence), SENSOR NOT TRACK (consent), and RETICLE LIMIT controls are used to control respective indicator lamp displays. Lowering the intensity of the moving reticle display below the intensity settings of the indicator lamps will cause the intensity of the indicator lamps to lower correspondingly. The filament switches allow selection of filament 1 or filament 2 of the gunsights reticle double-filament lamps. An OFF position is also provided for each filament switch which deenergizes the reticle illumination circuit.

Gunsight Test Panel

The gunsight test panel (figure 4-61) provides the capabilities to energize the moving reticle of the sighthead without requiring the master arm switch to be set in ARM as long as the gun mode control panel is set in SEMI-AUTO or AUTO. The panel contains a GUNSIGHT NORMAL-TEST toggle switch which is used to provide the necessary ground to the gunsight control panel bypassing the master arm switch when the toggle switch is set to the TEST position. In the NORMAL position, the moving reticle will only be energized when the master arm switch is placed in ARMED and the gun mode control panel is set to SEMI-AUTO or AUTO. The panel is located on the pilot side panel.

GUNSIGHT INDICATORS

Fixed Reticle

The fixed reticle (figure 4-61 through 4-62) is present on the combining glass whenever power is applied to the gunsight and the fixed reticle light filament switch and light rheostat are turned on. It is stationary and is projected in the center of the combining glass. The fixed reticle represents the aiming point of the guns.

Movable Reticle

The movable reticle (figure 4-61 through 4-62) is differentiated from the fixed reticle by its broken lines and cursors. It will appear on the combining glass whenever the gunsight is powered, the moving reticle light filament switch and rheostat are turned on, the fire control computer is powered, a sensor is selected at the fire control panel, and that sensor's look angle is within the limits of the gunsight. Additionally, the firing mode selector switch must be positioned to either the SEMI-AUTO or AUTO position. The movable reticle is servo-driven by computed azimuth and elevation signals corresponding to the sensor that is selected on the fire control panel. The movable reticle represents the target and is often referred to as the target reticle.

Outside Window (coincidence) Lights

Four sets of two amber lights (figure 4-61) are spaced around the periphery of the gunsight display at 90 degrees apart and illuminate when the movable and fixed reticle are separated by more than half the amount that is set in the fire control computer coincidence window.

Sensor Not Track (consent) Lights

A set of eight red lights (figure 4-61) are equally spaced around the periphery and illuminate to indicate when sensor consent is not provided to the computer.

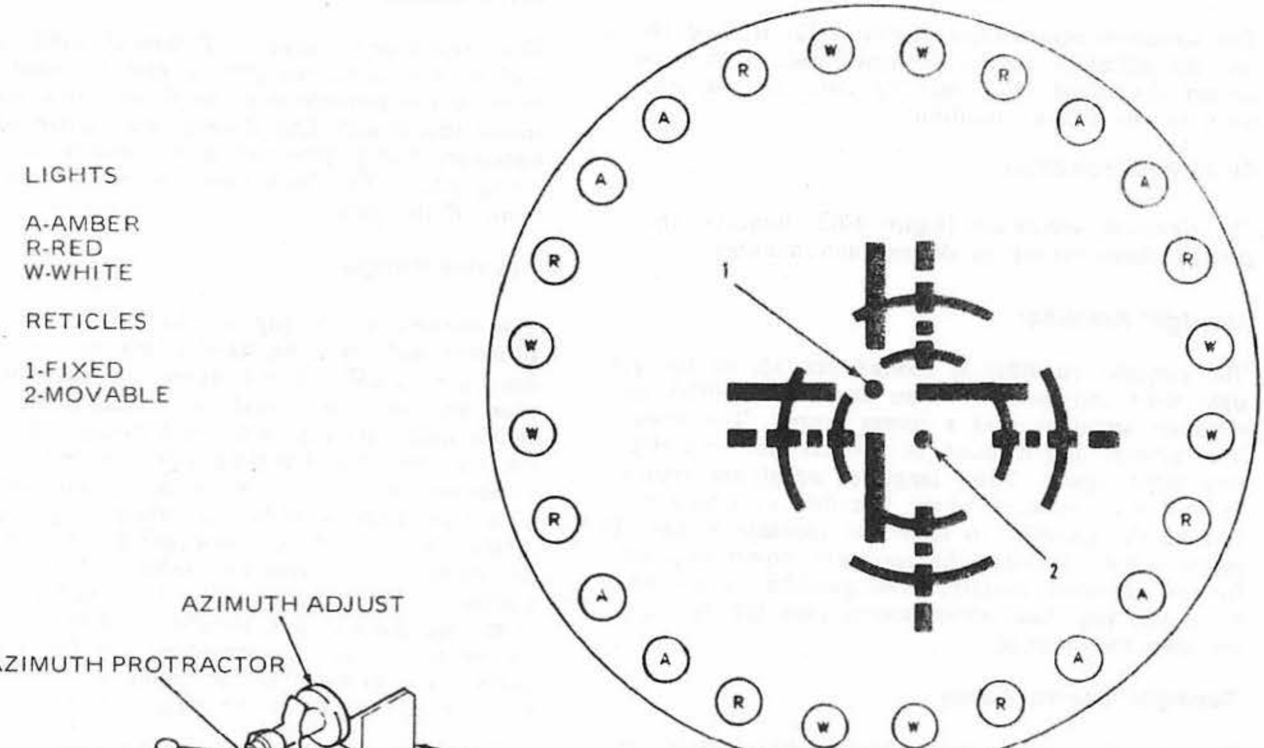
Reticle Limit Lights

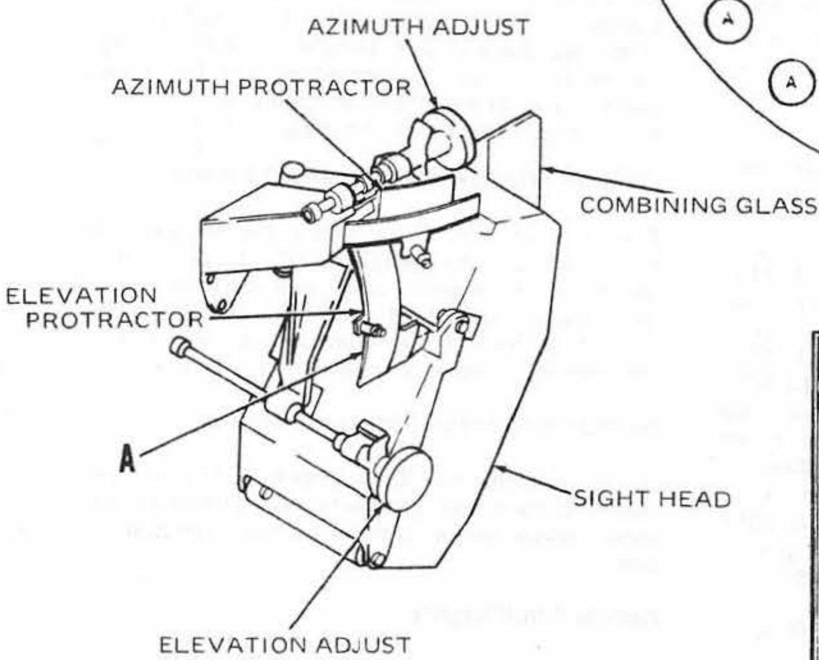
Four sets of two white lights (figure 4-61) are spaced around the periphery of the gunsight display at 90 degrees apart. A set will illuminate in one quadrant to indicate that the movable reticle has reached the limit of its travel and in which direction the reticle has moved off the display.

NORMAL OPERATION OF THE OPTICAL GUNSIGHT

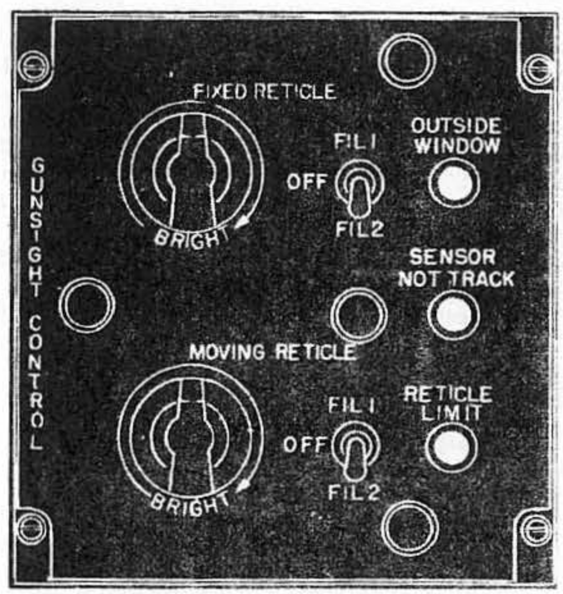
1. Set computer ON/OFF power switch to ON.
2. Set fixed reticle and moving reticle switches to FIL 1. If either reticle fails to illuminate, set associated switches to its FIL 2 position.

optical gunsight components and indicators





SIGHTHEAD INSTALLATION



PILOTS GUNSIGHT CONTROL PANEL

PILOT GUNSIGHT TEST PANEL

Figure 4-61.

gunsight reticle display

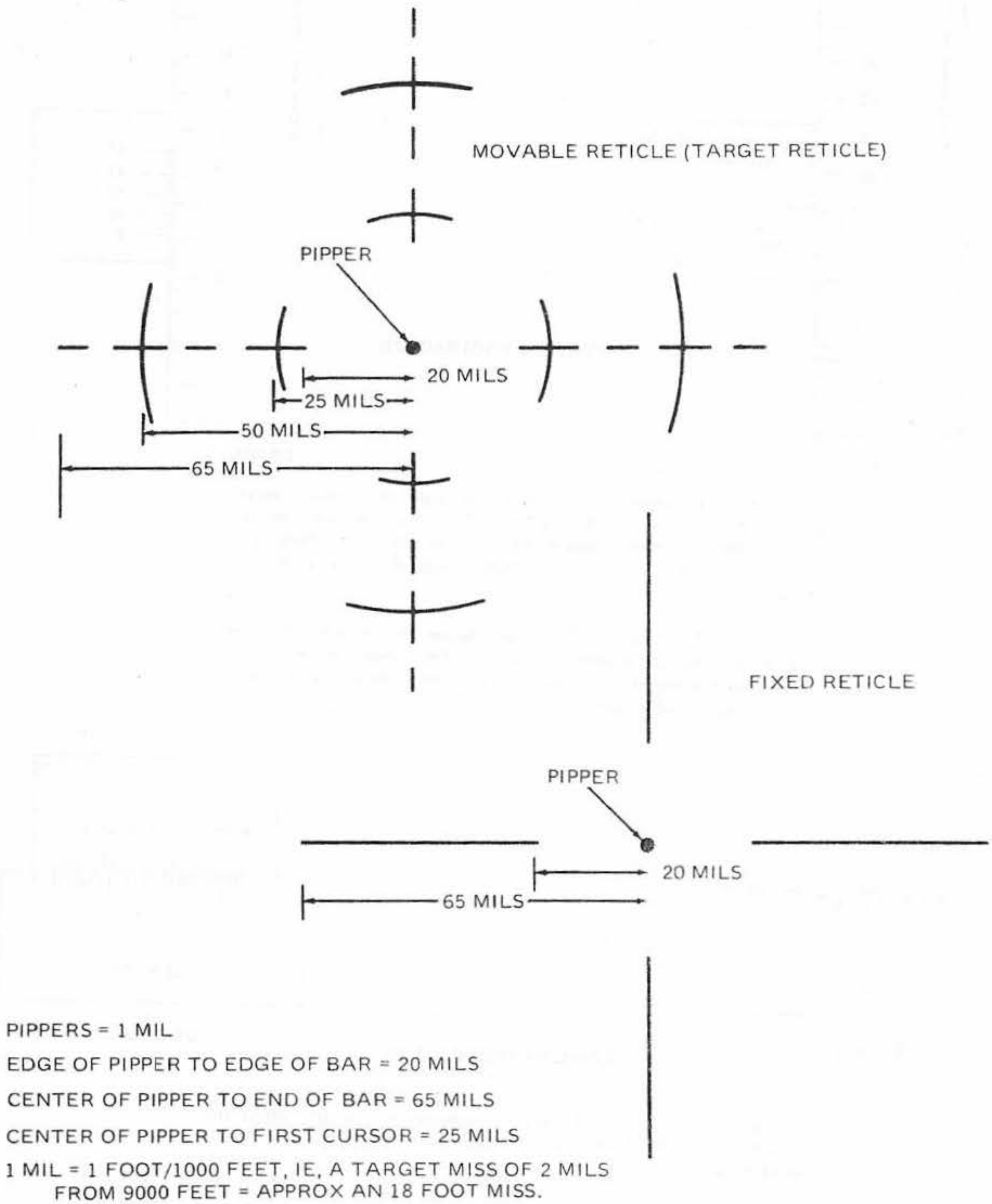
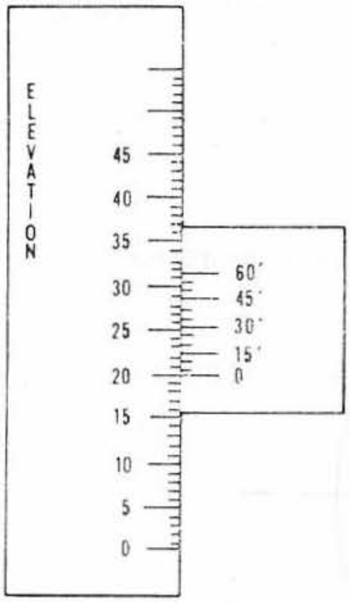


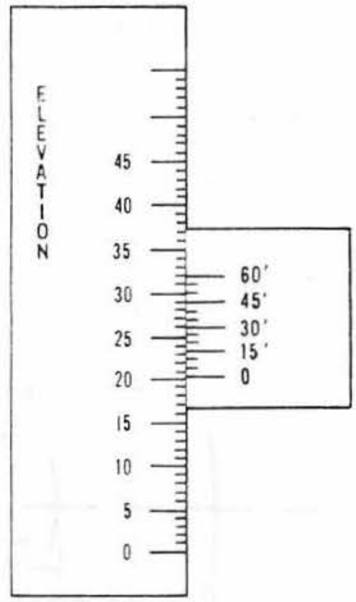
Figure 4-62.

gunsight adjustment



DETAIL 1

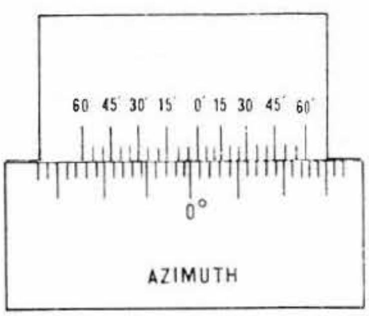
ELEVATION PROTRACTOR



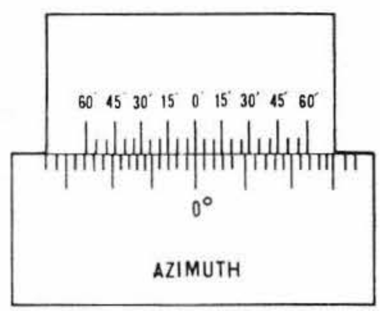
DETAIL 2

a. Elevation: To set the gunsight in elevation, adjust the elevation control knob until the "O" on the minute scale is aligned with the desired degree mark. Then move the elevation control knob until the desired minute is aligned to the closest degree mark.

b. Example: To set 20 degrees 45 minutes. First set the gunsight for 20 degrees (Detail 1). Then move the elevation control knob until the 45 minute mark is aligned with the closest degree mark (Detail 2)



DETAIL 1



DETAIL 2

AZIMUTH PROTRACTOR

c. Azimuth: To set the gunsight in azimuth, adjust the azimuth control knob until it is zeroed out. Then set the required minutes.

d. Example: To set 60 minutes, first zero out the scales. (Detail 1). Then adjust the sight to the desired minutes. (Detail 2).

NOTE: The gunsight is always set for zero or aft azimuth due to the gunsight mounting.

Figure 4-63.

3. Adjust reticle rheostats as desired.
4. Adjust cue light rheostats as desired.
5. Allow 5 minutes for warmup.

Note

Target acquisition may be accomplished by any sensor that provides the necessary input to the fire control computer.

6. Adjust elevation and azimuth scales to settings corresponding to the firing altitude.
7. Fly the aircraft into the attack orbit by approach guidance on the pilot ARU-11A attitude indicator.
8. Transition to the gunsight and maneuver the aircraft so as to super-impose the fixed reticle on top of the target reticle.
9. Maintain the reticles super-imposed so that they have little or no rate of movement and the outside window lights remain extinguished. Fire until the objective has been accomplished.
10. Turn all rheostats and switches off prior to landing.

GUNSIGHT ADJUSTMENT

For information on adjusting the gunsight see figure 4-63.

Fire Control Display

The fire control display (figure 4-65) displays various sensor inputs, firing zone, safety zone, and a target symbol to control weapons fire on a designated target. These displays are presented on a crt and give the relationship of the pointing angles of any three of the five sensors, direction to the gunfire impact pattern on the ground, and location of the target. The displays are identified by different symbols. A safety zone circle may be centered around the symbol of the sensor trained on a friendly force and used to determine when firing approaches too close to the friendly force. The display may be used as a guide to direct an individual sensor to look in a specified direction. Primary controls and indicators (figure 4-64) of this unit are located on the front panel. Power for operation of the display is through two circuit breakers on the main power distribution box dc. One dc fuse and one ac fuse, as well as a spare fuse for each, are located on the lower left side of the unit.

fire control display controls and indicators

CONTROL/INDICATOR	FUNCTION
NOTE The SENSOR SYMBOL ASSIGNMENT section switches CHANNEL A, CHANNEL B positions, and the SAFETY ZONE and CHANNEL STATUS indicators provide coverage for six sensors, but only three of the six are decaled. However, five platform pointing angle signals are now being supplied to the fire control display. These are signals from the TV, RAD, IR, BC and INS. Starting with the switches in the fully counterclockwise position, (TV selected OD indicated) when moving the switch clockwise the positions will correspond to TV, RAD, IR, BC and INS respectively. The corresponding six STATUS SYMBOL indicators should illuminate in turn from left to right. **NOTE** For proper referenced fire control display symbols refer to the front panel of the fire control display shown in figure 4-65.	
SENSOR SYMBOL ASSIGNMENT CHANNEL STATUS Indicators	Consists of four groups of indicators: PRIMARY, A, B, and SAFETY ZONE. Each group contains an indicator for each of the sensors. Illumination of an indicator in each of the A, B, and SAFETY ZONE groups indicates position of associated CHANNEL A, CHANNEL B, and SAFETY ZONE select switches.
ETI HOURS	Indicates total elapsed time of unit operation.
DIMMER STATUS Control	Controls degree of illumination of A, B, and SAFETY ZONE indicators of SENSOR SYMBOL ASSIGNMENT section and the display graticule.

Figure 4-64 (Sheet 1 of 3).

fire control display controls and indicators (cont.)

DIMMER PANEL Control	Controls degree of illumination of PRIMARY portion CHANNEL STATUS indicators and panel edge-lighting.
SYMBOL SIZE SAFETY ZONE Control	Adjusts diameter of safety zone symbol. (There is a linear relationship between circle diameter and calibrations on SAFETY ZONE control.)
SYMBOL SIZE FIRING ZÓNE AZ Control	Adjusts azimuth dimension of firing zone symbol. (There is a linear relationship between azimuth dimension or ellipse and calibrations on FIRING ZONE AZ control.)
SYMBOL SIZE FIRING ZONE EL Control	Adjusts elevation dimension of firing zone symbol. (There is a linear relationship between elevation dimension of ellipse and calibrations on FIRING ZONE EL control.)
ALIGNMENT CENTER EL Control	Aligns elevation position of dot (located on display when GAIN/OPR/CENTER switch is in CENTER position) to center of display.
ALIGNMENT CENTER AZ Control	Aligns azimuth position of dot (located on display when GAIN/OPR/CENTER switch is in CENTER position) to center of display.
ALIGNMENT GAIN EL Control	Aligns elevation position of dot (located on display when GAIN/OPR/CENTER switch is in GAIN position) to a position 3 cm above center of display.
ALIGNMENT GAIN AZ Control	Aligns azimuth position of dot (located on display when GAIN/OPR/CENTER switch is in GAIN position) to a position 3 cm to right ot center of display.
FOCUS Control	Standard CRT focus control.
INTENSITY Control	Standard CRT intensity control.
CENTER Pushbutton Switch	When pressed, channel symbols or dots (depending on position of SYMBOL CONDITION switches) are displayed at center of display.
SCALE FACTOR SELECT COARSE/ FINE Alternate-Action Switch/Indicator	Selects scale factor of display. In COARSE position, display scale factor is 9 degrees per cm. Upper half of switch lights COARSE to indicate selection of coarse scale factor. In FINE position, display scale factor is 3 degrees per cm. Lower half of switchlight lights FINE to indicate selection of fine scale factor.
SAFETY ZONE Switch	Selected sensor symbol on display is encircled with safety zone symbol when SYMBOL CONDITION SAFETY ZONE switch is in symbol position. Safety zone dot is positioned at origin of selected sensor symbol when SYMBOL CONDITION SAFETY ZONE switch is in DOT position, or displays safety zone circle or dot at center of display when corresponding sensor is not selected. Associated CHANNEL STATUS SAFETY ZONE indicator lights.
CHANNEL B Switch	Selects sensor to be assigned to channel B. Lights associated CHANNEL STATUS B indicator. (Channel B selection of sensor designated as primary sensor results in removal of channel B symbol from display).

Figure 4-64 (Sheet 2 of 3).

fire control display controls and indicators (cont.)

CHANNEL A Switch	Selects sensor to be assigned to channel A. Lights associated CHANNEL STATUS A indicator. (Channel A selection of sensor designated as primary sensor, or sensor selected by CHANNEL B results in removal of channel A symbol from display).
SYMBOL CONDITION CHANNEL B DOT/symbol/OFF Switch	In DOT position, replaces channel B symbol on display with a dot. In symbol position, displays channel B symbol on display. In OFF position, removes channel B symbol from display.
SYMBOL CONDITION CHANNEL A DOT/symbol/OFF Switch	In DOT position, replaces channel A symbol on display with a dot. In symbol position, displays channel A symbol on display. In OFF position, removes channel A symbol from display.
SYMBOL CONDITION SAFETY ZONE DOT/symbol/OFF Switch	In DOT position, replaces safety zone symbol on display with a dot. In symbol position, displays safety zone symbol from display. In OFF position, removes safety zone symbol from display.
SYMBOL CONDITION FIRING ZONE DOT/symbol/OFF Switch	In DOT position, replaces firing zone symbol display with a dot. In symbol position, displays firing zone symbol on display. In OFF position, removes firing zone symbol from display.
SYMBOL CONDITION TARGET DOT/symbol/OFF Switch	In DOT position, replaces target symbol on display with a dot. In symbol position, displays target symbol on display. In OFF position, removes target symbol from display.
ALIGNMENT GAIN/OPR/CENTER Switch	In GAIN position, permits alignment (via GAIN-EL and GAIN-AZ potentiometers) of elevation and azimuth positions of dot on display to a position 3 cm above and to the right of display center. In OPR position, permits unit to function in normal operating mode. In CENTER position, permits alignment (via CENTER-AZ and CENTER-EL potentiometers) of elevation and azimuth positions of dot to center of display.
PRIMARY POWER ON/OFF Switch	In ON position, applies +28 Vdc and 115 Vac to circuits. In OFF position, removes input power.
CRT	Displays symbols representing the angular location of three sensors, location of the target, location of the firing zone, and location of the safety zone surrounding friendly forces.

Figure 4-64 (Sheet 3 of 3).

The following symbols are used:

Symbol representing position of the primary sensor as selected on the FCC.

Symbol representing position of selected sensor (channel A).

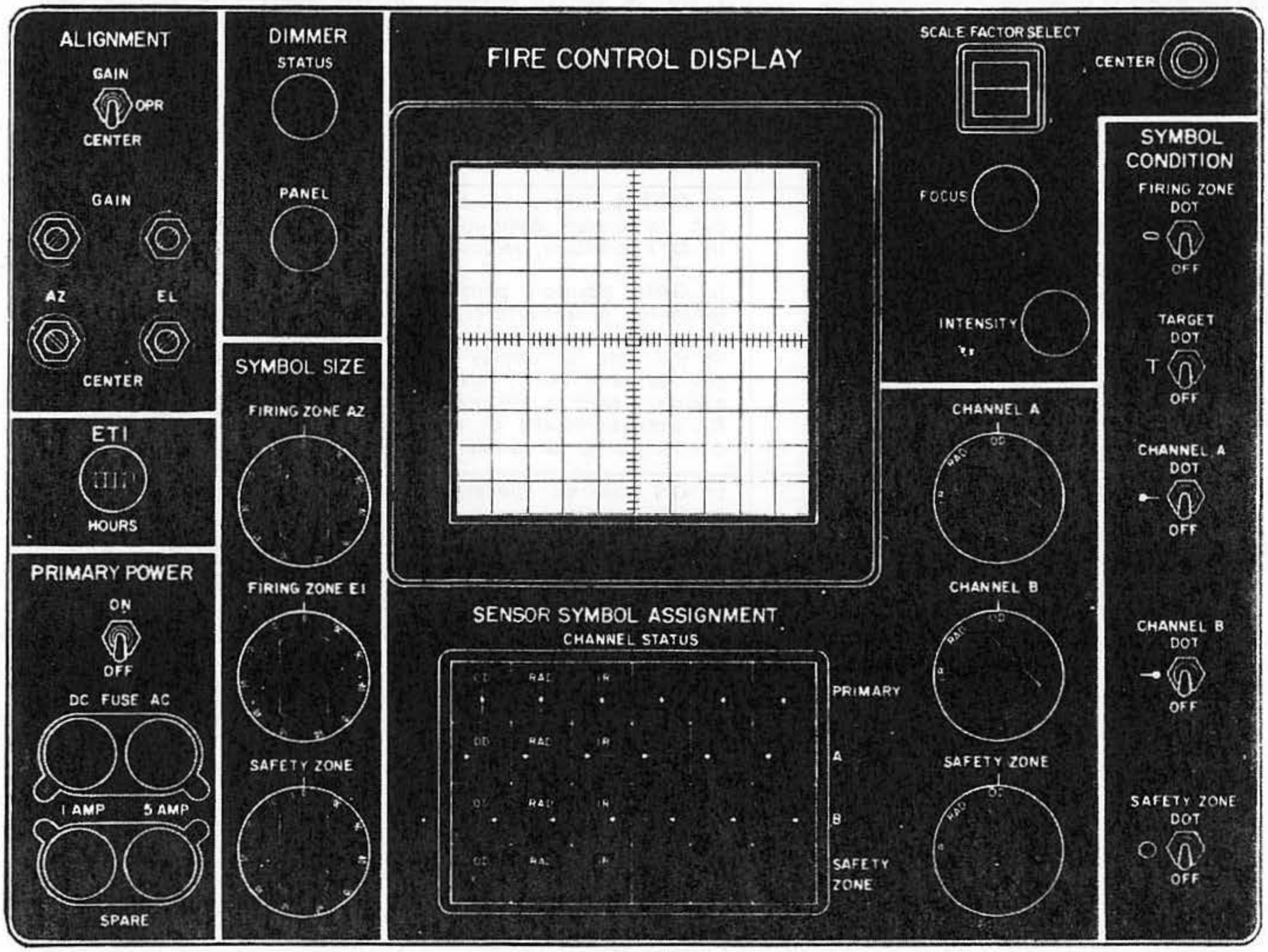
Symbol representing position of selected sensor (channel B).

Indicates target. The target is at the intersection of the horizontal and vertical segments of the symbol. The symbol is displayed at the primary sensor or, with offset, at offset distance and direction from the primary sensor.

Firing Zone - represents bullet impact area as set by operation.

Safety Zone - set by operator to represent arbitrary no-fire area around friendly position.

fire control display

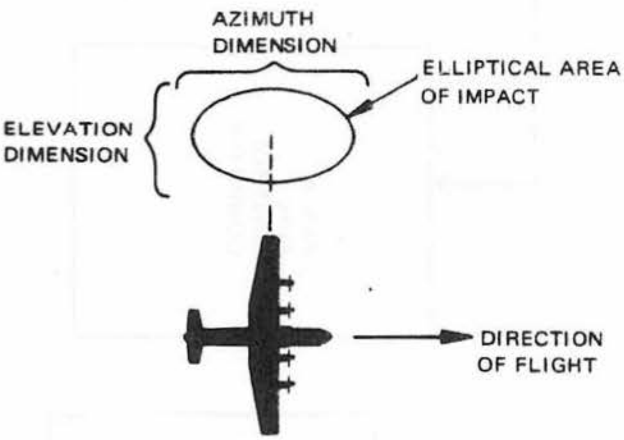


NAVIGATOR

Figure 4-65.

Firing Zone and Safety Zone Symbol Control Settings

The fire control display provides the means of establishing the size of an elliptical firing zone symbol to represent the area of munition impact on the ground. The FCD also enables the operator to set the safety zone to a desired radius. The method of adjustment is to set the FIRING ZONE EL, FIRING ZONE AZ, and SAFETY ZONE SYMBOL SIZE controls.



ATTITUDE REFERENCE SWITCHING UNIT (Figure 4-66)

This unit is located at the FCO station and permits the selection of either the INS (primary) or the 2 axis (secondary) to supply inputs to three Attitude Indicators, 2 Attitude directional Indicators, the Fire Control System, and the ARN-92 LORAN. (Figure 4-67).

INS Heading Corr. Control: Used to correct the INS gyro heading to either true Heading or Magnetic Heading. (The Heading could be set to any heading reference desired; i.e., true, magnetic, grid, and etc.) The Attitude Ref. switch must be set to the INS position in order to set the INS heading.

Attitude Ref. Switch: Used to select the INS or the 2 axis as the reference source for pitch, roll, and heading.

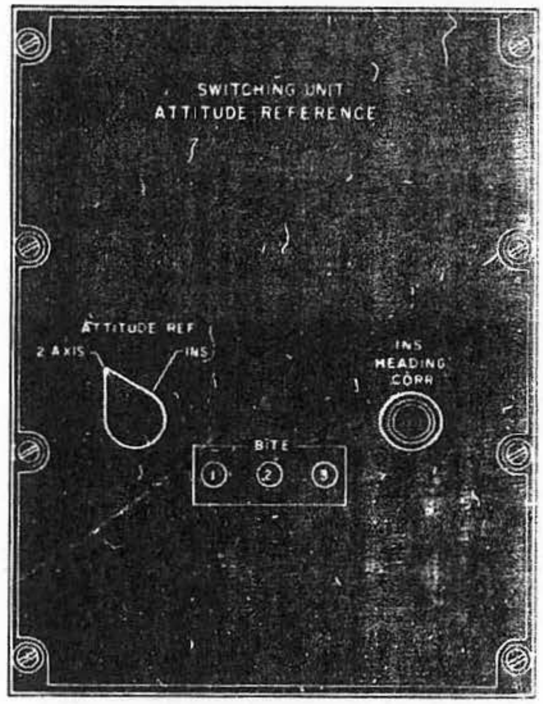
NOTE

> The Attitude Reference Switching unit must be set to the 2 axis position in order to set the heading of the 2 axis gyro on the pilots ARU-11/A indicator.

Bite Indicators: Illuminates when a fault is present in the INS signals to this unit. No. 1 indicator - heading, No. 2 indicator - roll, and No. 3 indicator - pitch.

ATTITUDE INDICATING SYSTEM, A-24G (2 Axis)

The attitude indicating system provides backup pitch, roll, and heading information to the Fire Control System, and two ARU-11/A attitude direction indicators, backup heading to the ARN-92 LORAN, and backup pitch and roll to 3 (4012F) Attitude indicators (figure 4-67). The system is made up of a pallet containing the gyro and amplifiers located under the IR operator's console; the vertical reference system panel located at the Nav panel; and the compass controller located on the pilot's pedestal (figure 4-69). The system operates from 115-volts, 400-HZ, 3-phase AC power with overload protection provided by four circuit breakers, three (ϕA, ϕB, ϕC) are labeled Vertical Ref. Sys. and one is labeled 2-axis gyro. The circuit breakers are located on the main power distribution box. System controls and functions are shown in figure 4-68.



ATTITUDE REFERENCE SWITCHING UNIT

Figure 4-66.

Normal Operation of the A-24G Attitude Reference System:

1. Vertical Ref. Sys. Power Switch	ON
2. Compass Controller Mode Switch	DG
3. Attitude Reference Switching Unit	2 Axes
4. Heading Control	Set desired heading
5. Latitude Control	Set, Reset every 2 degrees

CAUTION

> Do not turn vertical reference gyro off until the airplane is parked.

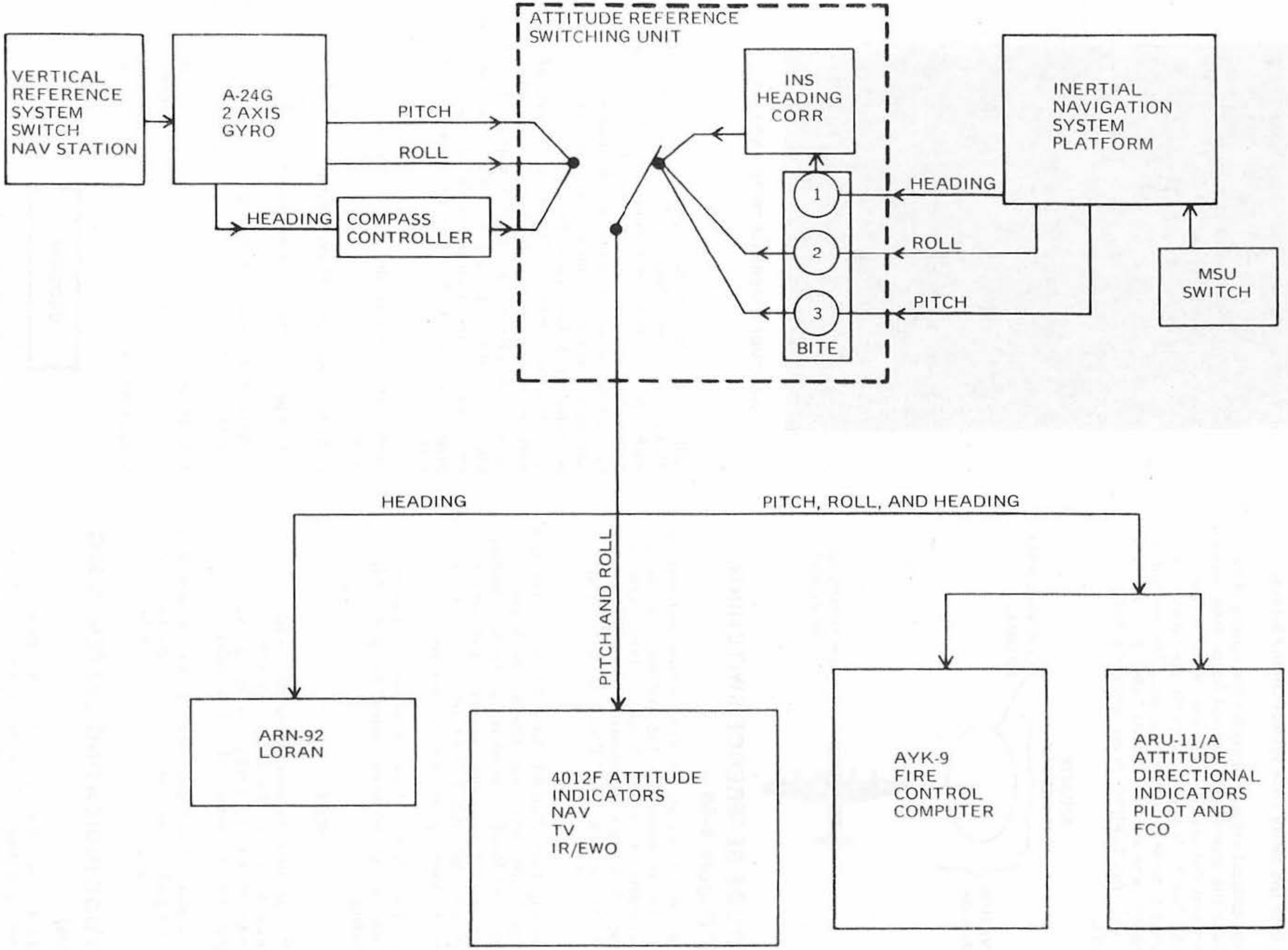

VERTICAL REFERENCE SYSTEM SWITCH NAV STATION
A-24G 2 AXIS GYRO
PITCH
ROLL
HEADING
COMPASS CONTROLLER
ATTITUDE REFERENCE SWITCHING UNIT
INS HEADING CORR
1
2
3
BITE
HEADING
ROLL
PITCH
INERTIAL NAVIGATION SYSTEM PLATFORM
MSU SWITCH
HEADING
PITCH AND ROLL
PITCH, ROLL, AND HEADING
ARN-92 LORAN
4012F ATTITUDE INDICATORS NAV TV IR/EWO
AYK-9 FIRE CONTROL COMPUTER
ARU-11/A ATTITUDE DIRECTIONAL INDICATORS PILOT AND FCO

Figure 4-67.

VERTICAL REFERENCE SYSTEM PANEL CONTROLS AND FUNCTIONS

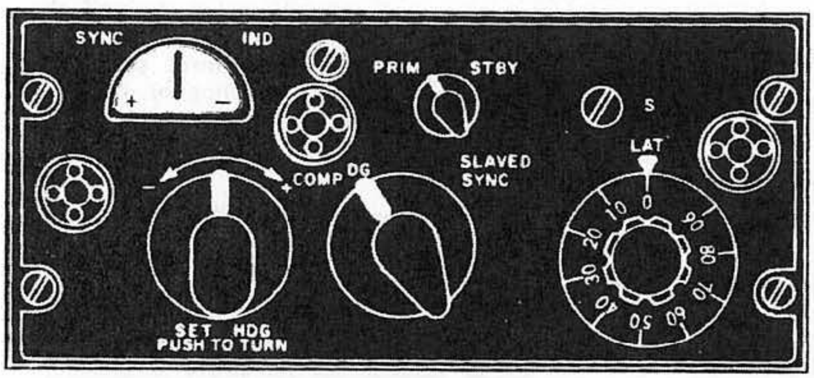
Power Switch	Applies power to the system
Fast Erect Pushbutton	Not used in this configuration
Compass Controller Controls and Functions	
Prim-Stby Switch	Not used in this installation
Set Hdg Control	Used to set heading
Mode Switch	DG mode is the only operational mode

NOTE

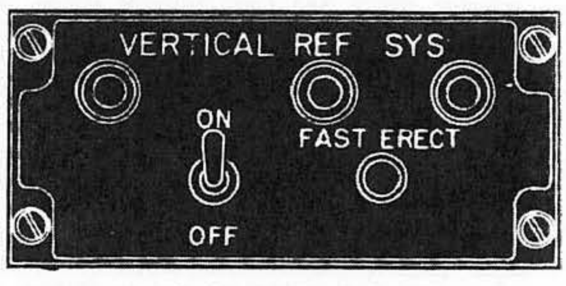
DG mode must be selected for the system to provide correct signals to the Fire Control System.

Lat Control	Used to provide latitude compensation to reduce apparent drift due to earth rate precession.
N-S Switch	Used to select direction of latitude compensation. N position is used in the northern hemisphere and S position in the southern hemisphere.
Sync Ind Meter	Not used in this configuration.

Figure 4-68.



COMPASS CONTROLLER



CONTROL PANEL

Figure 4-69.

INERTIAL NAVIGATION SYSTEM, LTN-51

The inertial navigation system (INS) (also called the inertial targeting system) is used to provide airplane attitudes and navigational data, target position data, storage with recall capability, and sensor pointing angles for target acquisition to support short range targeting runs of ± 5 degrees of latitude and ± 8 degrees of longitude or 430 nautical miles whichever is less in longitude. These data are provided visually to the targeting system operator, and electronically to the fire control computer. Also, when selected, airplane pitch attitudes are supplied by the INS to the autopilot. Refer to AUTOPILOT in this section. The system incorporates a precision gyro-stabilized gimbal assembly for attitude and heading reference and a digital computer for data computation and event programming.

The system is made up of a mode selector unit (MSU), control display unit (CDU), inertial navigation unit (INU), and a battery. A control switching unit (CSU) is also used with the INS system. The CSU is part of the Sensor Slaving System. The INU and battery are located on a pallet on the underside of the FCO console and the MSU, CDU, and CSU are located on the FCO console (figure 4-70).

The INS operates from 115-volt, 400-Hz 3 phase ac power with overload protection provided by three circuit breakers labeled INS ϕA, INS ϕB, and INS ϕC on the FCO circuit breaker panel. Power is converted to 28-volt dc for INS operation.

The system also uses 26 VAC synchro excitation voltage from the ARN-92 LORAN Synchro excitation box.

The LTN-51 system has been modified to include a converter, changeover relay, and autopilot gyro select panel. The autopilot gyro select panel, located at the pilot's side panel, allows pitch reference from the LTN-51 gyro to be selected as a backup to the K6A gyro when needed.

INERTIAL NAVIGATION UNIT (INU)

The inertial navigation unit has a front and rear section. The front section is temperature controlled independently from the rest of the unit and contains the gimbal assembly and associated electronics. The rear section contains the power supply, computer, and data converters.

MODE SELECTOR UNIT (MSU)

The mode selector unit (figure 4-73) contains a rotary selector switch and two indicator lamps. The unit is used to select the modes of operation for the inertial navigation system. The MSU is heavily detented in the NAV position to prevent inadvertent switching in flight.

CONTROL DISPLAY UNIT (CDU)

The control display unit (figure 4-73) is used to enter present position and waypoint coordinates, to control track selection, and to display navigational data generated by the systems. The CDU contains its own stepdown 5-volt power supply which operates from the 28-volt power supply in the INU. The 5-volt supply serves the electronics and the numerical display lamps of the unit.

BATTERY UNIT

The battery unit is a 6.5 ampere-hour battery which acts as backup power source for the inertial navigation system and will operate the system for 15 minutes, minimum, when fully charged.

INTERNAL NAVIGATION SYSTEM CONTROLS AND INDICATORS

Controls and indicators for the inertial navigation system are contained on the mode selector unit and the control display unit. The INU contains a fault indicator and an elapsed time indicator.

MODE SELECTOR UNIT (MSU)

The mode selector unit (figure 4-73) is used to select the operating modes of the inertial targeting system. Control and annunciator functions are listed in figure 4-71.

CONTROL DISPLAY UNIT (CDU)

The control display unit (figure 4-73) is used to insert and display targeting and navigational data. Control, display, and annunciator functions are listed figure 4-72.

NORMAL OPERATION OF INS

Preflight Procedures

The INU automatically initiates a self-alignment sequence when the mode selector switch is set to STBY during start up. After placing the mode selector switch to STBY the operator performs a display test to verify that the controls and indicators are operating correctly. The airplane's present position must be entered while the mode selector switch is in STBY, after which the switch is set to ALIGN.

In ALIGN, after present position is entered, the airplane must not be taxied or towed until the alignment is completed and the mode selector switch is set to NAV. The alignment procedure is not significantly affected by fueling or cargo and crew loading. The destination waypoint coordinates are entered after the mode selector switch is set to NAV.

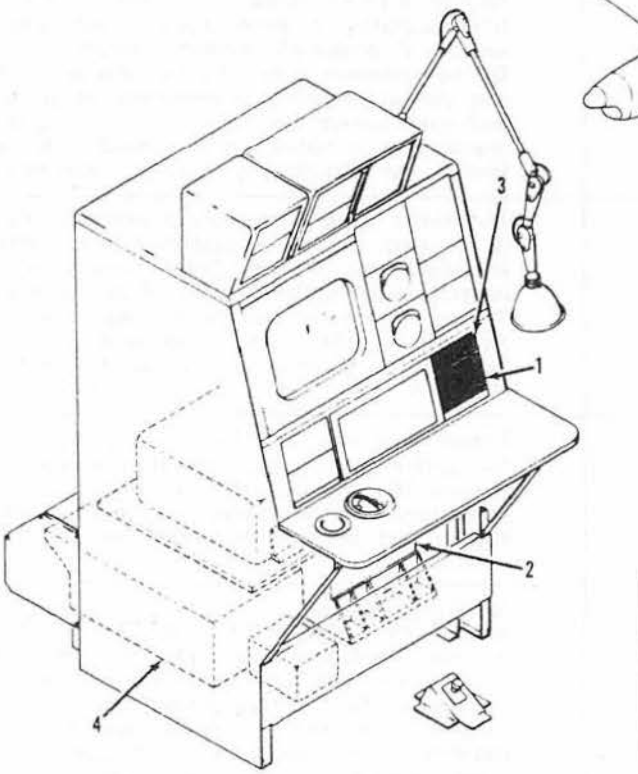
CAUTION

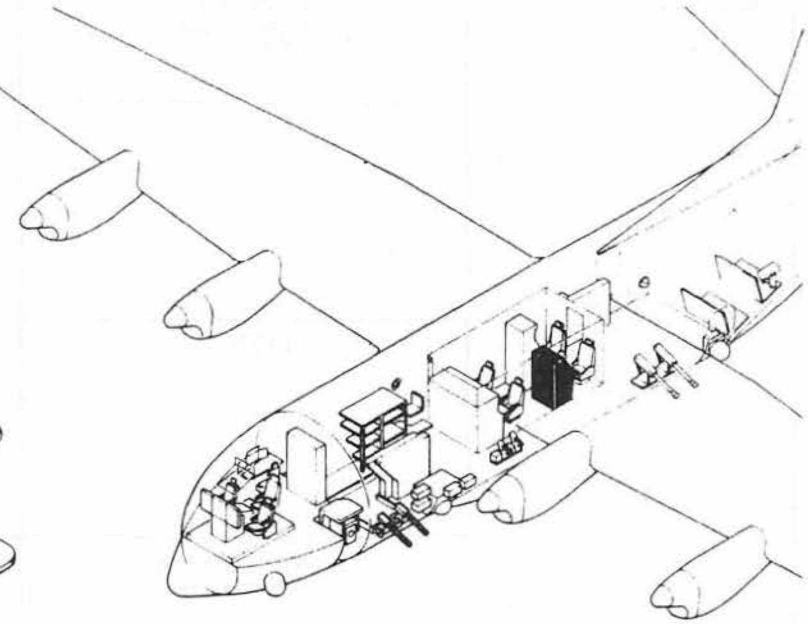
If present position latitude is inserted incorrectly, the INU will determine during calculations performed later in the alignment sequence that an error exists, flash the warn annunciator, and stop the self-alignment sequence. The preflight procedures must then be repeated, resulting in a time loss of ten to fifteen minutes.

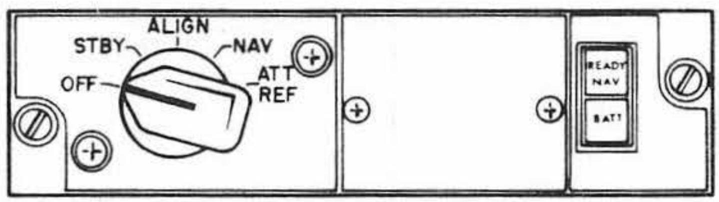
During the self-alignment sequence, the operator performs the alignment status check. If the CDU WARN annunicator flashes during preflight procedures, alignment failure has occurred.

The coordinates of up to eight pre-determined targets can be entered in locations 01 through 08 of waypoint 8 with waypoint selector set to 8 and when in the NAV mode. Entered targets will

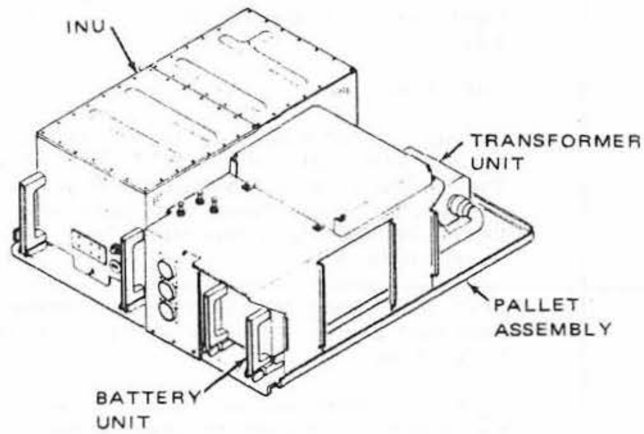
LTIV-51 inertial navigation system component locations

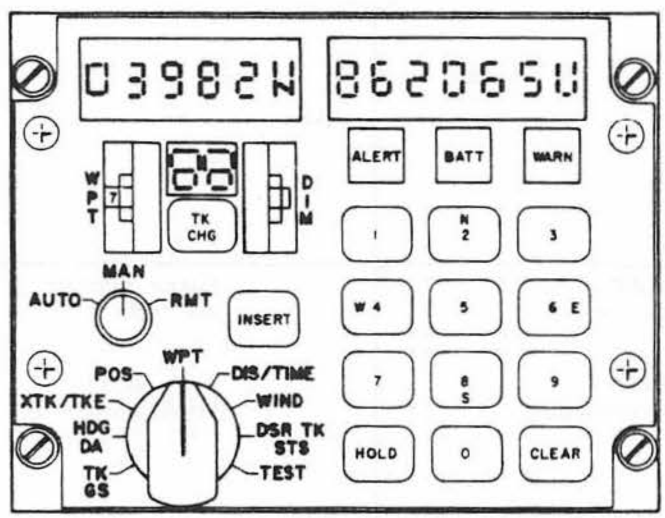






MODE SELECTOR UNIT





1. CONTROL DISPLAY UNIT
2. INERTIAL NAVIGATION UNIT
3. MODE SELECTOR UNIT
4. BATTERY UNIT

CONTROL DISPLAY UNIT

Figure 4-70.

LTN-51 INS mode selector unit controls and functions

Control	Description	Functions
Mode Selector Switch	5-position Rotary Switch OFF	Removes primary power from system. Panel edge lighting is available to MSU and CDU.
	STBY	Applies primary power to system. CDU is fully operable to allow display, test, and insertion of airplane's present position. Gimbal assembly cages to the airplane axes and gimbal assembly temperature stabilization and gyro run-up are initiated. The alignment sequence is initiated. In this mode, the system is not affected by aircraft movement.
	ALIGN	Automatic gimbal assembly alignment sequence is initiated. When the system has completed alignment, the READY NAV annunciator lights, indicating NAV mode may be entered. The airplane must not be moved while in ALIGN; however, fuel, cargo, and crew loading may be accomplished without affecting alignment.
	NAV (heavily detented position)	Enables the normal inflight operating mode of the system which must be entered before moving the airplane. Removing the switch from this position causes shutdown of the system and the system cannot be re-activated in flight.
	ATT REF	Normally selected only in the event of the loss of navigational capability. There are no navigational outputs and the numerical displays on the CDU are blank. Power is maintained to the INS gimbal section to provide pitch, roll and directional gyro heading information to the Attitude Reference Switching Unit. The mode selector switch may be turned directly from OFF to ATT REF to utilize the INS gyro on flights when navigational data is not required. CAUTION: Do not use attitude outputs for three minutes after selection of ATT REF mode. The system is in a high-gain leveling mode and aircraft accelerations and maneuvers should be kept to a minimum for the three-minute period.
READY NAV Annunciator	Green press-to-test light	Illuminates when the system has completed alignment and is ready for entry into the NAV mode.
BATT Annunciator	Red press-to-test/press-to-reset light.	Illuminates when backup power is less than the minimum required to operate the system. System will shutdown and mode selector switch should be turned OFF before normal power is restored. Annunciator must be pressed to reset to OFF when power is restored. The annunciator will remain on as long as sufficient lighting power is available.

Figure 4-71.

LTN-51 control display unit controls, displays and functions

Control/Display	Description	Functions
Display Selector Switch	9-Position Rotary Switch	Selects data for presentation on left and right numerical displays. An explanation of CDU displays for the various Display Selector Switch and WPT selector switch settings is depicted in figure 4-79.
WPT Selector Switch	10-position thumbwheel dial	Enabled when the display selector switch is set to WPT. Position 9 permits insertion or display of latitude and longitude of the destination waypoint. Position 8 permits insertion or display of latitude and longitude of 8 targets. Position 1 permits insertion of airplane altitude. Position 0 enables display of laser-derived altitude (not available on current gunship configuration). Positions 2 through 7 are not used.
Display dimmer control	Thumbwheel dial	Controls intensity of left and right numerical and from/to displays.
TK CHG pushbutton	Green push-to-activate switch	When pressed, allows manual track changes to be made with the data keyboard to select a new destination or target on the from/ to display.
FROM/TO Waypoint Display	Digital Display Lamps	Inserting 09 into display selects track to destination Waypoint 9 and enables navigational data to be displayed in numerical displays. Inseting 01 through 08 enables targeting data insertion when WPT 8 is selected. Navigational data to 01 through 08 targets can be displayed accurately in numerical displays when within 16 nautical miles of selected target.
AUTO/MAN/RMT Switch	3-position switch	Always set to MAN (Manual) with the inertial targeting program. The automatic and remote functions are disabled in this system.
Numerical Displays	Digital Display Lamps	Display coordinates and navigational data selected on the display selector switch. Latitude and longitude values are to the hundredths of an arc-minute. The tens of degrees of latitude and the hundreds of degrees of longitude are not displayed. Also, for latitude and longitude displays, the degree, arc-minute, and decimal marks are blanked.
HOLD Push-Button	Green Press-to-Actuate/Automatic or Press-to-Release Switch	Freezes the present position latitude and longitude displays when pressed, but does not stop position computations within the system. Provides for convenient position reporting/recording and manual position update.
DATA Keyboard	White DATA Pushbuttons	Used to enter data into the computer when the display selector is positioned to POS or WPT.

Figure 4-72 (Sheet 1 of 2).

LTN-51 control display unit controls, displays and functions

Control/Display	Description	Functions
CLEAR Key	White Pushbutton	Use after a data insertion error has been made and prior to pressing the Insert Key.
INSERT Key	White Pushbutton	Transfers data displayed on the numerical displays into the INU computer. Enters track changes into the FROM/TO display.
Alert Annunciator	Amber Light	Disabled in this system.
BATT Annunciator	Amber Light	Indicates that the primary AC power has failed and the system is operating on the back-up DC power source.
WARN Annunciator	Red Light	A steady red WARN light indicates that the system self-test and monitoring circuits have detected a malfunction and that the navigational data is no longer reliable. A flashing WARN light indicates system degradation and will only occur during system alignment.

Figure 4-72 (Sheet 2 of 2).

override any target data previously stored in these locations. Target data can be changed as often as desired, each new set of co-ordinates destroys the previously entered data. This is true whether the target data are entered manually from the keyboard or automatically from the sensors. Targeting data are not destroyed when power is removed from the system.

OPERATING PROCEDURES

Warn Indications

If the WARN annunciator flashes during the self-alignment sequence, proceed as follows:

1. Set display selector switch to POS and determine if present position latitude and longitude on left and right numerical displays are correct.

2. If present position latitude and longitude are correct and WARN annunciator continues flashing, set display selector switch to DSR TK/STS and note status number on right numerical display.

3. Set mode selector switch to OFF.

4. Set mode selector switch to STBY and enter correct present position latitude and longitude as described in PRESENT POSITION ENTRY paragraph.

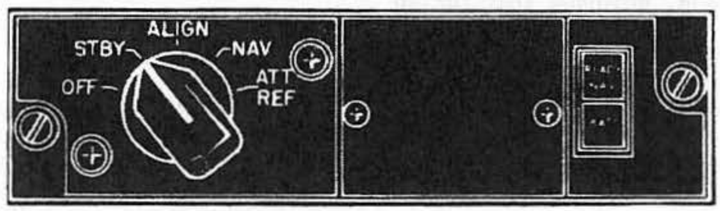
5. If a flashing WARN light occurs again; note the latitude, longitude, and alignment status number; turn the system OFF; and notify maintenance.

If the WARN annunciator flashes after 17 minutes have elapsed since turnon, and the READY NAV annunciator has not come on, the INU has not aligned. Notify maintenance.

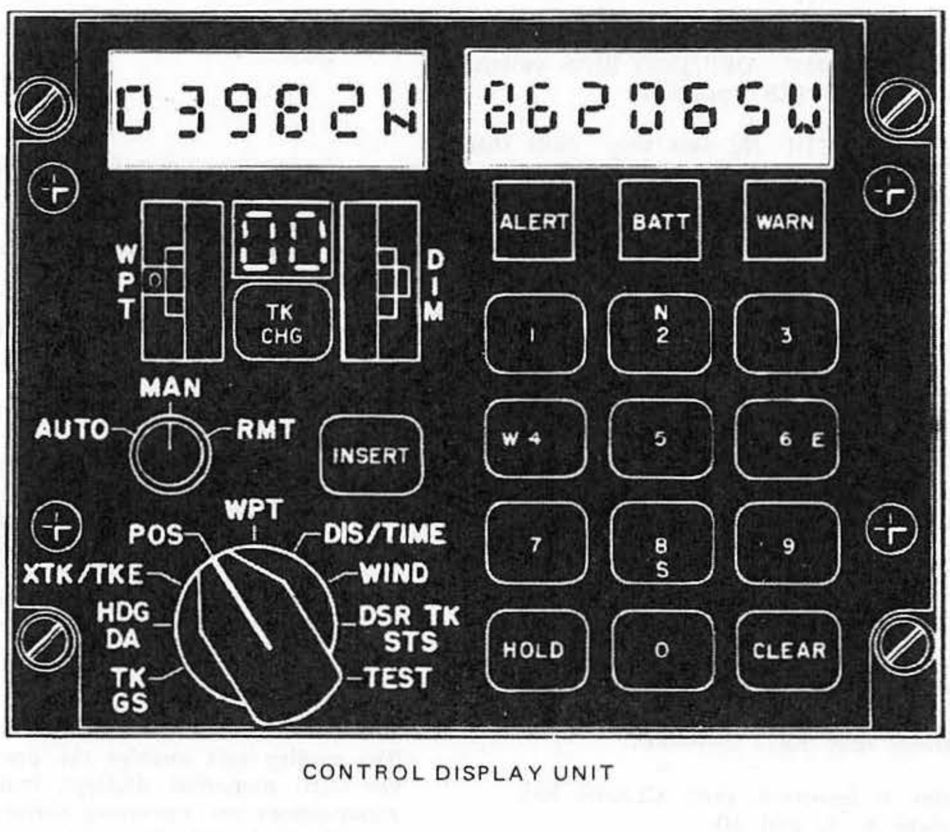
INERTIAL TARGETING SYSTEM OPERATIONAL AREAS

The inertial targeting system program is modified to give greater position accuracy than the worldwide inertial program. To accomplish this the operating envelope around the alignment position is limited to ± 5 degrees latitude and ± 8 degrees longitude or 430 nm whichever is less in longitude (Figure 4-74). Within this operating envelope the system has a position accuracy of 0.01 arc-minute in latitude and longitude. Since the basic system is designed for accuracy to 0.1 arc-minute, the left and right numerical displays do not have counter space to display tens of degrees latitude and hundreds of degrees longitude with the targeting program. To prevent computer position ambiguity during INS alignment, the targeting system program contains memory locations for

present position display



MODE SELECTOR UNIT



CONTROL DISPLAY UNIT

Figure 4-73.

17 initial position latitude operating areas and 3 initial position longitude operating areas (figure 4-74). As depicted in figure 4-74, an aircraft can align at location A and have an operating envelope extending beyond the 30 to 40 degree north initial position operational area. Should the aircraft land at a base located in the 20 degree to 30 degree initial position latitude operational area, the INS could not be aligned and would display a flashing WARN light at status 60 unless a latitude memory location change is made.

CHANGE OF INS OPERATIONAL AREA

The Gunship Inertial targeting system program can be used anywhere in the world, providing that the appropriate initial position operational area memory location is called up in the computer. In the example (figure 4-75), the airplane is at 28 degrees north latitude and 84 degrees west longitude and the system is set up to operate in the 30N to 40N operational area. In order to ALIGN the INS, the operational area must be changed as follows:

1. Complete the Interior (Power OFF) checklist.
2. Complete the Interior (Power ON) checklist through item number 6.
3. Using a number 1 Phillips screwdriver remove the cover plate from the MSU OFF/TEST/BIAS switch. Set the switch to the TEST position.
4. Press and release the CDU N2 data key. Note that the N illuminates on the left numerical display otherwise display is blank.
5. Press and release data keys 7-5-7-6 to allow access to computer memory location 7576.
6. If left numerical display is incorrect, push CLEAR key and repeat steps 4 and 5.
7. If left display is correct press INSERT key. Check that INSERT light goes out and left display reads 07576.
8. Press and release the CDU W4 data key. Note the W illuminates on the right numerical display, otherwise display is blank.
9. Enter Octal Value Table I (figure 4-76) to find the Octal Value for the alignment latitude location. For 20°N to 30°N latitude, the OCTAL VALUE is 024000.
10. Press and release data Keys 2-4-0-0-0.
11. If right display is incorrect, press CLEAR Key and repeat steps 8, 9, and 10.
12. If right display is correct, press INSERT key. Check that INSERT light goes out and right display reads 024000.
13. If initial position longitude operating area were also incorrect, OCTAL VALUE for correct longitude area would be obtained from OCTAL TABLE II (figure 4-76). The OCTAL VALUE from TABLE II would then be entered using steps 4 thru 12 with computer memory location 7577 entered in steps 4 thru 7.
14. Turn MSU OFF/TEST/BIAS switch OFF and replace cover plate.
15. Turn OFF the MSU Mode Selector switch.
16. The system can now be aligned at the new operating location.

Start Up Procedure

The primary power source is the airplane's 115-volt ac bus. Synchro excitation is 26 volts ac. If the primary power is interrupted, the system automatically switches to the battery unit which provides a dc backup power. When airplane power is restored, the system will automatically switch back to the airplane primary power sources. Perform startup as follows:

1. Verify that mode selector switch is set to OFF.

Note

Ensure ac power is available.

2. Verify that all applicable circuit breakers are pushed in (on).
3. Verify that AUTO/MAN RMT switch is set to MAN.
4. Set display selector switch to POS.
5. Set mode selector switch to STBY.
6. Verify that left numerical display and from/to display are all zeros, and that right numerical display is a six-digit number. The six-digit number is the tape identification for Inertial Targeting System: 2770XX.

Display Test

The display test enables the operator to verify that the CDU numerical displays, from/to displays, and annunciators are operating correctly. The display test is performed with the mode selector switch set to STBY. Perform the display test as follows:

1. Set display selector switch to TEST.

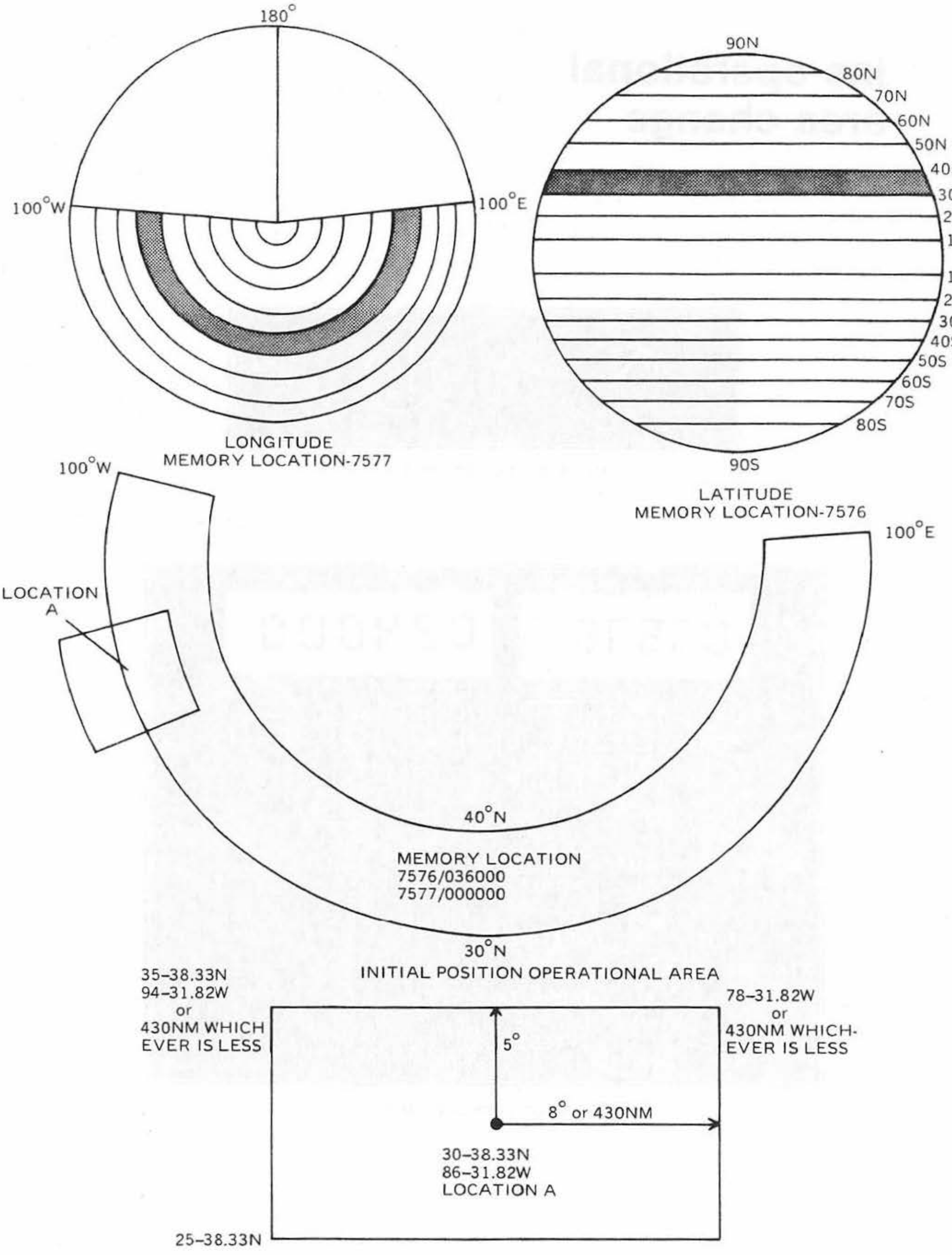
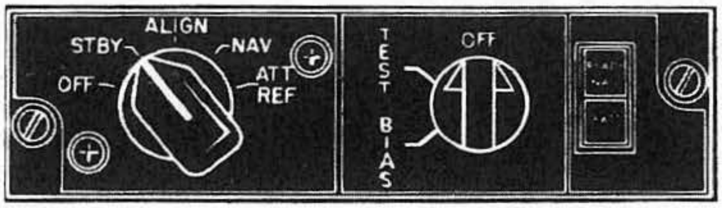
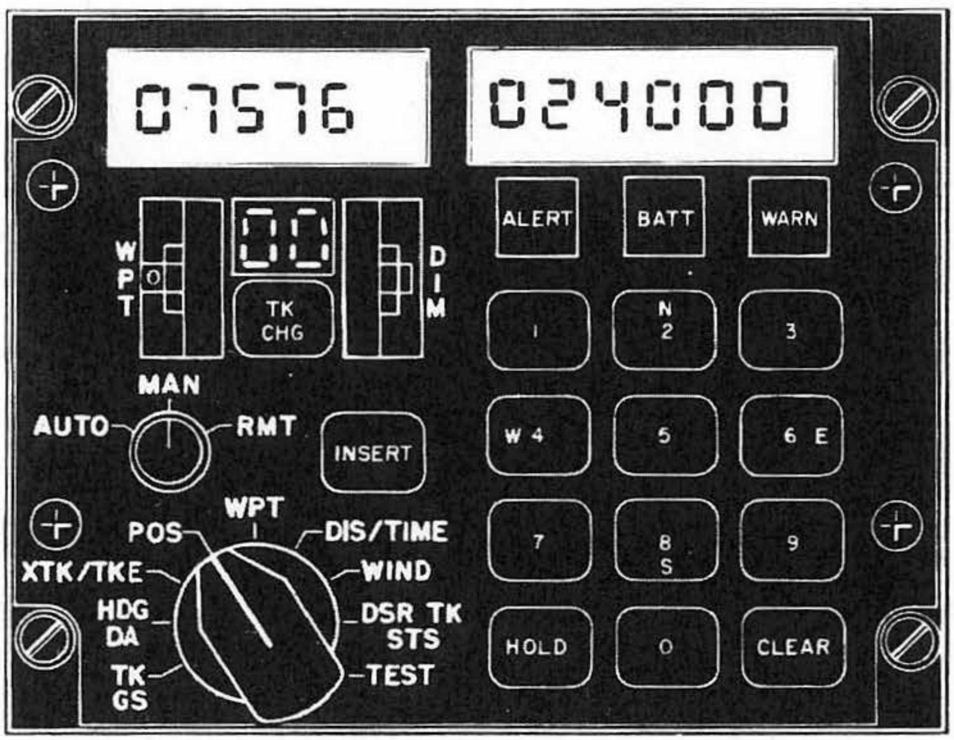

180°
100°W
100°E
LONGITUDE
MEMORY LOCATION-7577
90N
80N
70N
60N
50N
40N
30N
20N
10N
10S
20S
30S
40S
50S
60S
70S
80S
90S
LATITUDE
MEMORY LOCATION-7576
100°W
100°E
LOCATION A
40°N
MEMORY LOCATION
7576/036000
7577/000000
30°N
INITIAL POSITION OPERATIONAL AREA
35-38.33N
94-31.82W
or
430NM WHICH EVER IS LESS
78-31.82W
or
430NM WHICH-EVER IS LESS
5°
8° or 430NM
30-38.33N
86-31.82W
LOCATION A
25-38.33N

Figure 4-74.

ins operational area change



MODE SELECTOR UNIT



CONTROL DISPLAY UNIT

Figure 4-75.

CHANGE OF INS OPERATIONAL AREA

TABLE I

MEMORY LOCATION	OCTAL VALUE	INITIAL POSITION LATITUDE
7576	120000	N90 to N80
	106000	N80 to N70
	074000	N70 to N60
	062000	N60 to N50
	050000	N50 to N40
	036000	N40 to N30
	024000	N30 to N20
	012000	N20 to N10
	000000	N10 to S10
	766000	S10 to S20
	754000	S20 to S30
	742000	S30 to S40
	730000	S40 to S50
	716000	S50 to S60
	704000	S60 to S70
	672000	S70 to S80
	660000	S80 to S90

TABLE II

MEMORY LOCATION	OCTAL VALUE	INITIAL POSITION LONGITUDE
7577	144000	E180 to E100
	000000	E100 to W100
	634000	W100 to W180

Figure 4-76.

2. Verify that displays and annunciators come on as follows:
   a. Left numerical display all eights and NS superimposed.
   b. Right numerical display all eights and EW superimposed.
   c. From/to display all eights.
   d. Batt (amber) and WARN (red) annunciators are on. ALERT annunciator (not used).

Present Position Entry

If an error is made during the keying procedures, press the CLEAR pushbutton and repeat procedures. In the example, the airplane is at latitude 30 degrees, 39.82 minutes North, longitude 86 degrees, 20.65 minutes West. Enter present position (figure 4-77) as follows:

1. Verify that MSU mode selector switch is set to STBY.
2. Set CDU display selector switch to POS. Setting of WPT selector switch is not critical.
3. Verify that AUTO/MAN/RMT switch is set to MAN.
4. To start latitude entry procedures, press N or S pushbutton (in this case, N) on data keyboard.
5. Verify that left and right numerical displays blank, N on left numerical display illuminates and INSERT pushbutton illuminates.
6. Starting with left to right sequence, enter latitude to nearest hundredth of a minute (03982) by pressing corresponding pushbuttons on data keyboard. As each pushbutton is pressed, verify that corresponding digit is displayed on left numerical display as least significant digit. All preceding digits move one place to the left.

7. Verify that latitude display is correct; then press INSERT pushbutton. Verify that INSERT pushbutton goes out, signifying that latitude data are inserted into digital computer.

8. Verify that latitude on left numerical display, which at this point represents data in digital computer, is within 0.01 arc-minutes of inserted value, and that right numerical display is all zeros.

9. If left numerical display is incorrect, repeat steps 4 through 8. If left numerical display is correct, proceed with step 10.

10. To start longitude entry procedures, press W or E pushbutton (in this case, W) on data keyboard.

11. Verify that left and right numerical displays blank, W on right numerical display comes on, and INSERT pushbutton comes on.

12. Enter longitude (862065) in same manner as latitude.

13. Verify that longitude display is correct; then press INSERT pushbutton. Verify that INSERT pushbutton goes out, signifying that longitude data are inserted into the digital computer.

14. Verify that latitude on left numerical display and longitude on right numerical display, which at this point represents data in the digital computer, are within 0.01 arc-minutes of inserted value.

15. If right numerical display is incorrect, repeat steps 10 through 14.

16. Verify that left and right numerical displays are correct.

17. Set mode selector switch to ALIGN and display selector switch to DSR TK/STS.

Alignment Status Check

NOTE

Airplane must be within program envelope in order to accomplish alignment.

With the mode selector switch set to STBY or ALIGN, and the display selector switch set to DSR TK/STS, the right numerical display indicates the status of the self-alignment sequence. When the mode selector switch is set to STBY, the status number will start at 90 and step to 80 after one minute. System alignment and temperature stabilization will continue automatically. Status does not change until the present position coordinates are entered and the mode selector switch is set to ALIGN, at which time the INU will automatically initiate a fine alignment sequence. Status number will automatically step to 70 (provided duration of status 80 was 2 minutes or more) and remain at 70 until system has reached correct operating temperature. At status 60, an automatic system alignment test is made. If test is satisfactory, coarse heading is computed and alignment continues through status 50 and 40. After status 40 is completed, the status number changes to a low value, generally less than 10, and then decreases toward 00 as the alignment sequence progresses toward completion.

Perform the alignment status check as follows:

CAUTION

A flashing WARN annunciator indicates performance degradation.

1. Set display selector switch to DSR TK/STS.

2. Verify that mode selector switch is set to ALIGN and AUTO/MAN/RMT switch is set to MAN.

3. Observe status number on right numerical display and the WARN annunciator. If status number is 60 and WARN annunciator is flashing, proceed to step 4. If WARN annunciator is not flashing, verify that after the status number decreases to 02 or less and 8 minutes have elapsed since the start of status 40, the READY NAV annunciator comes on. If the status number increases to 03 or more for a two-minute period, verify that the READY NAV annunciator goes off and stays off until the status number decreases to 02 or less. Proceed to step 5.

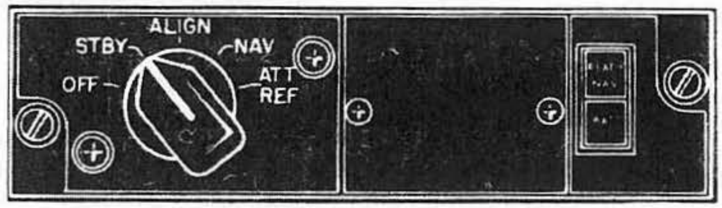
4. If test is not satisfactory, set display selector switch to POS and verify that present position latitude display is correct. If correct, set mode selector switch OFF/STBY and enter correct present position. Set mode selector switch to ALIGN and repeat this procedure.

5. When the READY NAV annunciator comes on, set mode selector switch to NAV and verify that READY NAV annunciator goes off. Airplane may now be moved.

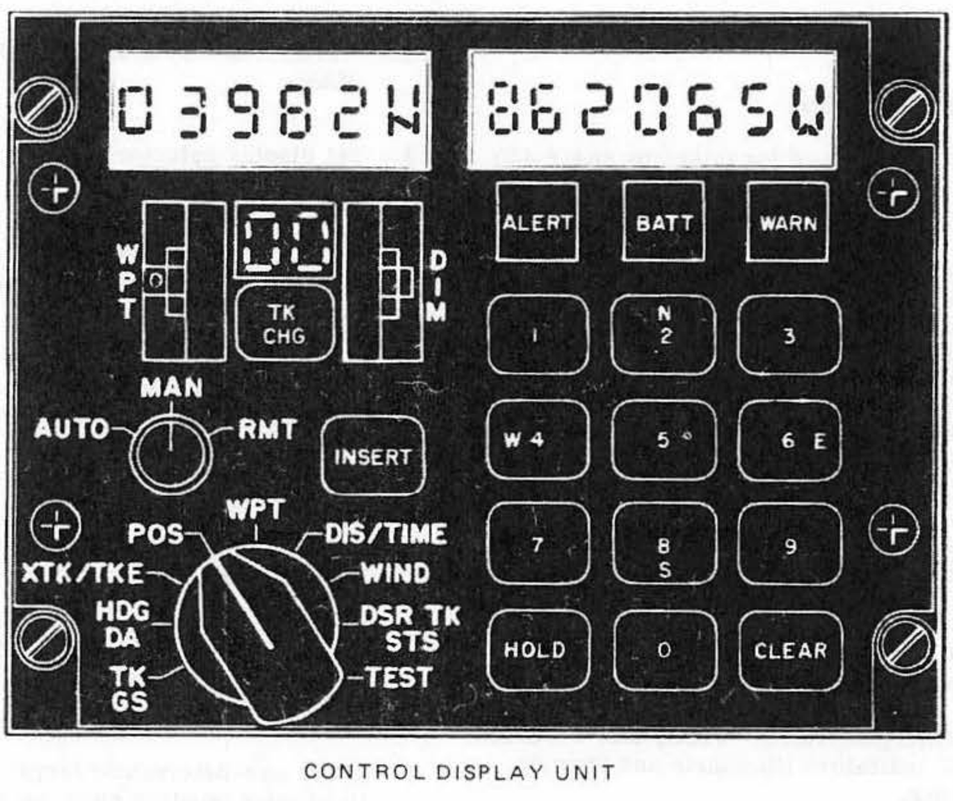
CAUTION

Do not set the mode selector switch out of NAV except when an INU malfunction occurs, otherwise the alignment must be repeated on the ground by setting the mode selector switch to OFF and then to STBY, and repeating present position entry procedures.

present position display



MODE SELECTOR UNIT



CONTROL DISPLAY UNIT

Figure 4-77.

6. Proceed to destination waypoint entry.

Destination Waypoint Entry

Waypoint 9 is used for storage of destination coordinates and track 09 is used to provide complete navigational data. Distance to waypoint 9 is limited to 430 nautical miles. Waypoint 9 can be entered only when system is in the NAV mode. In the example, the destination is at latitude 31 degrees, 06.22 minutes North, longitude 88 degrees, 13.47 minutes West. Enter destination waypoint (figure 4-78) as follows:

1. Verify that mode selector switch is set to NAV.
2. Set display selector switch to WPT.
3. Set WPT selector switch to 9.
4. Verify that AUTO/MAN/RMT switch is set to MAN.
5. Enter destination waypoint coordinates as per present position entry procedures steps 3 through 16, except use destination waypoint coordinates.
6. Proceed to destination track selection.

Destination Track Selection

Since the system is designed for missions under 430 nautical miles, navigational computations are based on a flat-earth approximation. The destination track is the shortest route between the airplane's present position and the destination waypoint, waypoint 9. The operator must initiate the destination track. A track initiated on the ground represents the route from the airplane's present position at the airport to WPT 9. A track initiated in flight represents the route from the airplane's position at the time of initiation to WPT 9. Refer to inflight procedures for inflight track initiation. Select destination track as follows:

1. Verify that destination waypoint 9 coordinates have been entered.
2. Verify that AUTO/MAN/RMT switch is set to MAN. Settings of display selector and WPT selector switches are not critical.
3. Press TK CHG pushbutton. Verify that TK CHG and INSERT indicators illuminate and from/to display blanks.
4. Press 9 pushbutton on data keyboard. Verify that from/to display is displaying blank, 9.
5. Press INSERT pushbutton. Verify that INSERT and TK CHG indicators go out and that 09 is in from/to display.

Taxi Speed/Track Angle Monitoring

The CDU displays taxi speed when taxi speed exceeds 2 knots, and displays meaningful track angle indications at taxi speeds in excess of 10 knots. Monitor taxi speed and track angle as follows:

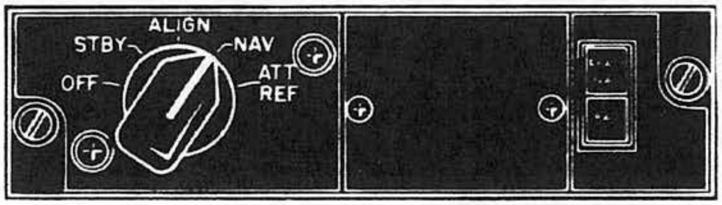
1. Verify that AUTO/MAN/RMT switch is set to MAN and that from/to display is 09.
2. Set display selector switch to TK/GS.
3. Read track angle to nearest tenth degree from left numerical display.
4. Read ground speed to nearest knot from right numerical display.

Pre-determined Targets Entry

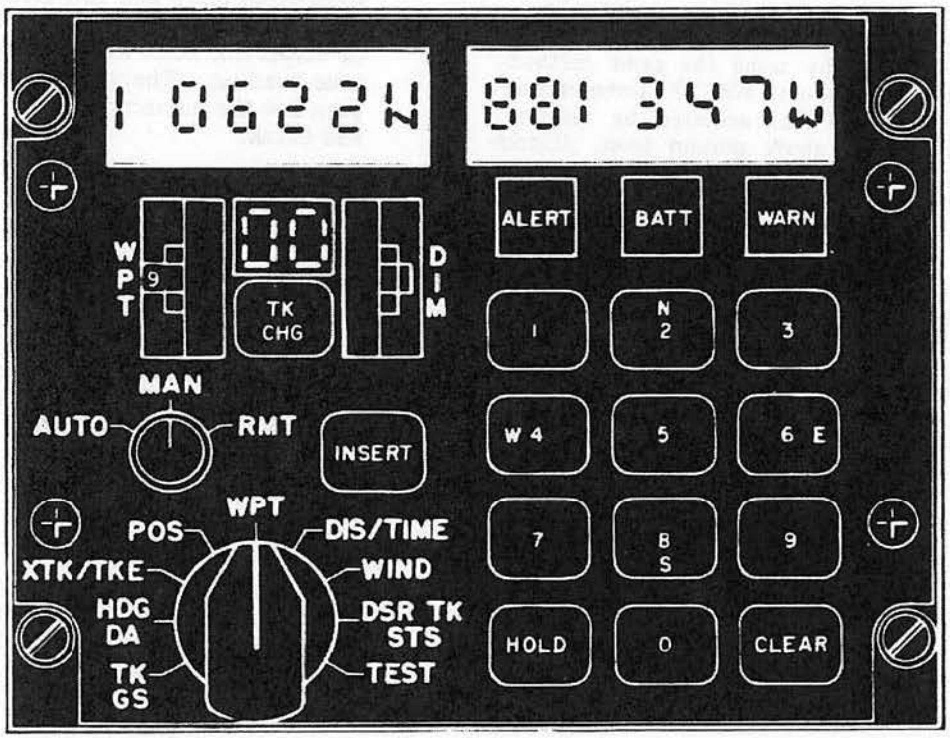
In the following procedures, if an error is made during the keying procedures, press the CLEAR pushbutton and repeat the procedure. One to eight targets can be entered. Sequence of loading locations is not critical. Ensure that CSU is set to LOC and enter target coordinates as follows:

1. Verify that mode selector switch is set to NAV.
2. Verify that AUTO/MAN/RMT switch is set to MAN.
3. Set display selector switch to WPT and set WPT selector switch to 8.
4. Press TK CHG pushbutton. Verify that TK CHG and INSERT indicators illuminate and from/to display blanks.
5. Press X (when X is any number 1 through 8) pushbutton on data keyboard. Verify that from/to display is displaying blank, X.
6. Press INSERT pushbutton. Verify that INSERT and TK CHG indicators go out and that 0 X is in from/to display.
7. If it is desired to retain present targeting data, document values displayed in left and right numerical displays.
8. Enter pre-determined target coordinates (refer to present position entry procedures, steps 3 through 16, except use target coordinates). The new latitude coordinates will not be displayed until the nav longitude coordinates have also been entered and inserted into the digital computer.
9. Repeat steps 4 through 8 for other targets.

destination waypoint display



MODE SELECTOR UNIT



CONTROL DISPLAY UNIT

Figure 4-78.

In-Flight Procedures

In-flight procedures consist of navigational procedures and targeting procedures. CDU displays pertinent to navigation and targeting are also part of the in-flight procedures.

Navigational procedures are used to traverse from a present position to a selected destination designated as WPT 9. WPT 9 coordinates can be changed as required or desired. If target coordinates have been entered, the target location can be used as a waypoint. The navigational data for tracks 01 through 08 are in different units from those for track 09. The system provides the desired track but not the airplane heading to achieve the desired track. The desired track can be maintained by steering a course that results in zero cross-track error. Wind direction and force are neither computed nor displayed.

The targeting procedures are used to define the geographical coordinates of eight targets. Elevation and azimuth angles are computed to the target coordinates and provided to the fire control system for acquisition guidance and target tracking. These coordinates can be displayed on the CDU. Targets can be acquired by the sensors, and can also be entered manually via the CDU. Navigation to a target can be accomplished by using the same methods as for the selected destination, WPT 9. Computation of target coordinates from data acquired by sensors requires entry of altitude above ground level. Altitude above ground level is entered manually. Target data are retained in the system until overriden by new data.

Navigational Procedures

The following cautions must be observed during operation:

CAUTION

Do not set the mode selector switch out of NAV unless a system malfunction occurs. If the system is switched out of NAV, NAV cannot be reset in flight as the INU must be aligned on the ground.

CAUTION

If the CDU BATT annunciator comes on, the system is operating on dc back-up power. If dc back-up power is supplied by a battery unit, the dc voltage will drop within 15 to 30 minutes to a level that is less than the minimum required to operate the system, which will automatically shut down. If primary operating power cannot be restored within 15 to 30 minutes, take appropriate action to substitute for the affected system.

CAUTION

If the MSU BATT annunciator comes on, the dc back-up power is less than the minimum required to operate the system. Automatic system shutdown will occur and the WARN annunciator will come on. Set the mode selector switch to OFF.

CAUTION

If the WARN annunciator comes on, the system is malfunctioning and may not be providing accurate data. Set the mode selector switch to ATT REF. The system continues to provide pitch and roll attitudes. The heading output reverts to a directional gyro type of output and does not represent airplane true heading. There are no navigational outputs and the numerical displays on the CDU are blank.

Note

When targeting data are not being acquired, the operator may insert TK CHG 00 to prevent the possibility of recording target locations during other action. Each new target entered destroys the old target in that target memory location.

Note

When target locations are used as waypoints, navigational data will change when new targets are acquired. Be sure to make proper allowances for course changes and other data when targets are redefined.

Destination Track Selection.

If track selection is made in flight, the track is the route from the airplane's present position at time of initiation to WPT 9. Select destination track as follows:

1. Set display selector switch to WPT, and the WPT selector switch to 9. Verify that left and right

CDU displays

DISPLAY SELECTOR SWITCH SETTING	WPT SELECTOR SWITCH SETTING	FROM/TO DISPLAY	LEFT NUMERICAL DISPLAY (All latitude displays drop tens of degrees)	RIGHT NUMERICAL DISPLAY (All longitude displays drop hundreds of degrees)
TK/GS	Not critical	Not critical	Track angle in tenths of degree ±0.1 degree	Ground speed in knots ±1 knot
HDG/DA	Not critical	Not critical	True heading in tenths of degree ±0.1 degree	Blank
XTK/TKE	Not critical	01 thru 08	Cross-track distance when aircraft is abeam target if present track is maintained in tens of feet ±10 feet (Multiply displayed value by 10)	Angle between airplane heading and bearing to target in tenths of a degree. (±0.1 degree)
		09	Cross-track distance when aircraft is abeam destination WPT if present track is maintained in tenths of nautical mile (±0.1 nm)	Angle between present track and bearing to destination in tenths of degrees (±0.1 degree)
POS	Not critical	Not critical	Present latitude in hundredths of arc-minute (±0.01 arc-minute)	Present longitude in hundredths of arc minute ±0.01 arc-minute
WPT	0	01 thru 09	Blank	Laser-derived altitude above ground in feet when available
	1	01 thru 09	Blank	Manually-inserted altitude above ground in feet (±1 foot)
WPT	2 thru 7	01 thru 09	Blank	Unused
	8	01 thru 08 NOTE tk chg 08 cannot be sensor acquired	Latitude of manually inserted or sensor-acquired target in hundredths of arc-minute (±0.01 arc-minute)	Longitude of manually inserted or sensor-acquired target in hundredths of arc-minute (±0.01 arc-minute)

Figure 4-79. (Sheet 1 of 2)

CDU displays (cont)

DISPLAY SELECTOR SWITCH SETTING	WPT SELECTOR SWITCH SETTING	FROM/TO DISPLAY	LEFT NUMERICAL DISPLAY (All latitude displays drop tens of degrees)	RIGHT NUMERICAL DISPLAY (All longitude displays drop hundreds of degrees)
WPT	8	09	Blank	Blank
	9	01 thru 09	Latitude of destination in hundredths of arc-minute (±0.01 arc-minute)	Longitude of destination in hundredths of arc-minute (±0.01 arc-minute)
DIS/TIME	Not critical	01 thru 08	Distance to target in tens of feet (±10 feet). Multiply displayed value by 10	Time until airplane is abeam target, if present ground speed is maintained, in seconds (± 1 second)
		09	Distance to destination WPT in nautical miles (±1 nm)	Time until airplane is abeam destination WPT, if present ground speed is maintained, in tenths of minutes (± 0.1 minute)
WIND	Not critical	01 thru 09	Blank	Blank
DSR TK/STS	Not critical	01 thru 08	Bearing to target in tenths of degree (±0.1 degree)	Blank
		09	Bearing to destination WPT in tenths of degree (±0.1 degree)	Blank

Figure 4-79 (Sheet 2 of 2).

numerical displays are displaying the correct WPT 9 coordinates. If coordinates are incorrect or absent, enter correct coordinates. Refer to destination waypoint entry in preflight procedures.

2. Verify that AUTO/MAN/RMT switch is set to MAN.

3. Press TK CHG pushbutton. Verify that TK CHG and INSERT indicators come on and from/to display blanks.

4. Press 9 pushbutton on data keyboard. Verify that from/to display is displaying 09.

5. Press INSERT pushbutton. Verify that INSERT and TK CHG indicators go out and that 09 is in from/to display.

Heading and Cross-track Distance Selection.

With the display selector switch set to DSR TK/STS and the from/to display on 09, desired track to destination waypoint 9 will be displayed in the left numerical display. In order to make this track good, however, the pilot must adjust the airplane's true heading to compensate for wind and drift. This is accomplished by altering airplane's heading until cross-track error is reduced to zero or as close to zero as possible. Heading to intercept a target is determined in the same manner except that the from/to display designates the target. If it is desired to pass waypoint 9 or a target at a given distance abeam, the airplane's heading must be adjusted until the cross-track distance displayed in the left numerical display equals the desired abeam distance. Determine airplane true heading as follows:

1. Verify that from/to display is 09 (for WPT 9) or 01 through 08 for a specific target.

2. Verify that AUTO/MAN/RMT switch is set to MAN.

3. Set display selector switch to DSR TK/STS and observe left numerical display. Change airplane's true heading to that of DSR TK.

4. Set display selector switch to XTK/TKE and observe left numerical display. Change airplane's course until cross-track value in left display is zero or as close to zero as possible. If it is desired to pass WPT 9 or target at a given distance abeam, change airplane's course until cross-track value in left display is equal to desired abeam distance.

5. Set display selector switch to HDG/DA and observe left numerical display. This is airplane's true heading - note for future reference.

6. Perform step 4 at frequent intervals and whenever wind changes are noted.

Present Position Update.

At any time during flight, the present position display can be compared with an accurate position fix obtained by other means and if desired, present position can be updated.

Pressing the HOLD pushbutton freezes the present position display, allowing comparison of system and fix coordinates. Updating the system position is accomplished by entering new latitude and/or longitude on the data keyboard. Check/update the inertial targeting system as follows:

1. Verify that AUTO/MAN/RMT switch is set to MAN.

2. Set display selector switch to POS.

3. When fix position is noted, press HOLD pushbutton. Verify that present position display freezes and that HOLD pushbutton illuminates.

4. Compare system position coordinates frozen on left and right numerical displays with fix coordinates. If comparison is acceptable, restart display by pressing HOLD pushbutton. Verify that HOLD pushbutton goes off. Position changes during display freeze period are automatically compensated for and position display reflects airplane's new present position.

5. If necessary, enter new latitude and/or longitude, noting that original (not updated) coordinates will appear on numerical display when INSERT pushbutton is pressed and will not be updated until second coordinate is inserted or HOLD pushbutton is pressed.

If both latitude and longitude have been updated, numerical displays will restart when the INSERT pushbutton is pressed the second time. If only latitude or longitude is updated, press HOLD pushbutton to restart the display. Updating procedures are automatically compensated for and position display reflects new present position referenced from updated coordinates.

Destination Changes.

The coordinates of the destination waypoint 9 can be changed as required or desired whether enroute to WPT 9 or to a target. After arrival at destination WPT 9, a new set of coordinates of waypoint 9 must be entered in order to utilize the navigational data for track 09. Enter new destination waypoint as follows:

1. Set display selector switch to WPT.

2. Set WPT selector switch to 9.

3. Verify that AUTO/MAN/RMT switch is set to MAN.

4. Enter destination waypoint coordinates (reference PRESENT POSITION UPDATE paragraphs, steps 3 through 16, except use destination waypoint coordinates).

5. Perform destination track selection procedures.

Targeting Procedures

NOTE

To prevent inadvertently recording unwanted target locations, insert TK CHG 00 when not actively acquiring targets.

NOTE

Document targeting data for any target that it is desired to preserve. Targeting data entered overrides and destroys old targeting data.

Pre-determined Targets Entry.

Pre-determined targets can be entered on the ground or while in flight. New coordinates can be entered at any time. The new coordinates override the old coordinates. Refer to pre-determined targets entry under preflight procedures.

Altitude Entry.

Airplane's altitude above ground must be entered before the coordinates of sensor-acquired targets can be computed by the system. The airplane's altitude must be maintained at this altitude when acquiring targets. Altitude entry can be changed as desired. If an error is made during the keying procedures, press the CLEAR pushbutton and repeat procedures. An altitude of 4550 feet is entered in the example that follows:

1. Verify that AUTO/MAN/RMT switch is set to MAN.

2. Set display selector switch to WPT and WPT selector switch to 1.

3. Press E pushbutton on data keyboard. Verify that left and right numerical displays blank, E on right numerical display illuminates, and INSERT pushbutton illuminates.

4. In a left to right sequence, enter altitude to the nearest foot (4550) by pressing corresponding pushbuttons on data keyboard.

5. Verify that altitude on right numerical display is correct, then press INSERT pushbutton. Verify that INSERT pushbutton goes out, signifying that altitude is inserted into digital computer.

6. Verify that altitude on right numerical display is within one foot of inserted value.

Sensor Targets Entry.

Up to seven targets can be entered into the system. Entered targets will override and destroy any targeting data that was in the memory location. Airplane must be flying at inserted altitude for target accuracy. Enter sensor targets as follows:

1. Verify that altitude has been entered and that airplane is flying at that altitude.

2. Verify that AUTO/MAN/RMT switch is set to MAN.

3. Set display selector switch to WPT and WPT selector switch to 8.

4. Select one of the seven target data memory locations 01 through 07.

5. Press TK CHG pushbutton. Verify that TK CHG and INSERT pushbuttons illuminate.

6. Press pushbuttons on data keyboard corresponding to numbers selected in step 4. Verify that numbers display in from/to display.

7. Press INSERT pushbutton. Verify that TK CHG and INSERT pushbuttons go out. If there are targeting data in memory location, coordinates will appear in left and right numerical displays. Document these data if required for future reference.

8. When sensor operator is tracking the target, with consent on, the INS operator selects the desired sensor on the CSU. The target then can be stored in two ways:

   a. Sensor operator releases consent.

   b. INS operator selects a new TK CHG on CDU, and target coordinates are then stored in the previous TK CHG location.

NOTE

The sensor operator must release consent or the INS operator must select LOC on CSU prior to calling up a stored target.

9. Repeat steps 4 through 8 for other targets. Step 8 may be repeated for a recheck or for greater accuracy.

10. When targeting procedures are temporarily suspended, press TK CHG, 00, and INSERT pushbuttons. Verify that from/to display displays 00 and left and right numerical displays blank.

Target Coordinates Display.

Target coordinates entered into the system can be displayed into the left and right numerical displays. Predetermined targets entered by the keyboard are accurate to ± 0.01 arc-minutes of the entered values. Display target coordinates as follows:

1. Verify that AUTO/MAN RMT switch is set to MAN.
2. Set display selector switch to WPT and WPT selector switch to 8.
3. Select one of the seven target data memory locations.
4. Press TK CHG pushbutton. Verify that TK CHG and INSERT pushbuttons illuminate.
5. Press pushbuttons on data keyboard corresponding to numbers selected in step 3. Verify that numbers display in from/to display.
6. Press INSERT pushbutton. Verify that target coordinates are displayed in left and right numerical displays. Verify that TK CHG and INSERT pushbuttons go out.
7. Repeat steps 3 through 6 for other targets.
8. When display procedures are completed, press TK CHG, 00, and INSERT pushbuttons. Verify that from/to display displays 00.

Displays

The latitude and longitude of targets, present position, and destination waypoint can be displayed on the CDU displays (figure 4-79). The navigational data pertaining to these locations are always available for display. Data for targets and waypoints are often in different units. Wind data is not displayed.

Post-flight Procedures.

After a flight is completed, the inertial targeting system may be left in the navigate mode if the landing is temporary and another flight is to be made. If flight operations are completed, the INS must be shut down.

CAUTION

After completing a flight, always set the mode selector switch to OFF if primary operating power (airplane or ground) is shut down or is undependable. If primary operating power goes off, the INS automatically switches to dc backup from the battery until the primary operating power is restored. The battery will be depleted in 15 to 30 minutes of operation.

SHUTDOWN

Shutdown consists of removing power from the inertial targeting system and from the system pallet assembly. The mode selector switch is heavily detented in the NAV position. The knob must be pulled away from the panel before the switch can be set out or moved through the NAV position. Perform shutdown as follows:

1. Set mode selector switch to OFF. Verify that READY NAV annuciator goes out and that all CDU displays blank.
2. Set all applicable circuit breakers to OFF (pulled out). Verify that all edgelights go out.

WORLDWIDE PROGRAM OPERATION OF INS

The LTN-51 INS has a worldwide program available. A maintenance avionics section with the programming equipment can reprogram the INS and check the new program in approximately two hours. The INS can then be aligned anywhere in the world. The computer steering commands are referenced to great-circle routes between the desired waypoint coordinates. Unrestricted worldwide navigation is provided by a wander-azimuth technique, which eliminates the problems normally associated with navigation in the polar regions. Equipment operation with the worldwide program is explained in the following section.

MODE SELECTOR UNIT

The mode selector unit controls and indicators operate the same as described in figure 4-71.

CONTROL DISPLAY UNIT

Controls and indications on the CDU with the worldwide program are described in figure 4-80.

BOOTH CONSOLES

Two Man Console (IR, EWO)

The two-man console (figure 4-82) is located at the forward bulkhead of the booth. Equipment, controls and indicators for the IR operator and electronic warfare officer (EWO) are provided on this console.

LTN-51 CDU controls, displays, and functions with worldwide program

CONTROL/DISPLAY	DESCRIPTION	FUNCTIONS
Display Selector Switch	9-Position Rotary Switch	Same functions as figure 4-72. CDU displays are depicted in figure 4-81.
WPT Selector Switch	10-Position Thumbwheel	Enabled when display selector switch is set to WPT. Coordinates of 9 waypoint positions can be inserted in WPT positions 1 thru 9.
Display Dimmer Control	Same as figure 4-72.	
TK CHG Push-button	Green Push-To-activate switch	When pressed, allows manual track changes with the data keyboard. This data is displayed on the FROM/TO display and represents the active track leg.
FROM/TO Waypoint Display	Digital Display lamps.	Visual indication of the FROM and TO waypoint numbers representing the active track leg.
AUTO/MAN/ REMOTE switch	3-Position switch	Controls the method of waypoint sequencing and data entry. In AUTO, track leg changes are automatically sequenced in order, as 1-2, 2-3, etc. by the system at the appropriate time. In MAN the operator manually initiates track changes. REMOTE position enables a TAS Keyboard insert into DSRTK/STS position by addressing Key 5. REMOTE is also used for the REMOTE RANGING feature to call up Distance between waypoints other than the active track leg.
Numerical Displays	Digital display lamps	Same as figure 4-72, except: Latitude and longitude values are to the tenth of an arc-minute. Tens of degrees of latitude and hundreds of degrees of longitude are displayed. Degree, arc-minute and decimal lamps are displayed.
HOLD push-button	Same as figure 4-72.	
Data Keyboard	Same as figure 4-72.	
CLEAR Key	Same as figure 4-72.	
INSERT Key	Same as figure 4-72.	

Figure 4-80 (Sheet 1 of 2).

LTN-51 CDU controls, displays, and functions with worldwide program (cont.)

CONTROL/DISPLAY	DESCRIPTION	FUNCTIONS
ALERT Annunciation	Amber light	With AUTO/MAN/REMOTE switch in AUTO, ALERT illuminates when the aircraft is within 2 minutes of the selected destination waypoint and extinguishes 30 seconds prior to the destination waypoint when an automatic sequential track change is made. In MAN the ALERT illuminates 2 minutes prior to the selected destination waypoint and starts flashing 30 seconds before the selected waypoint. The ALERT will continue flashing until a new track leg is inserted. The system is modified to illuminate at ground speeds greater than one knot.
BATT Annunciator	Same as figure 4-72.	
WARN Annunciator	Same as figure 4-72.	

Figure 4-80. (Sheet 2 of 2)

Equipment for the IR operator occupies the left portion of the two-man console. The IR operator controls and monitors the AN/AAD-7 Infrared Detecting Set and assists the navigator, FCO, and other sensor operators. IR monitoring is provided by an infrared viewer, and positioning of the IR receiver is adjusted by a gimbal control. Sensor azimuth and elevation angles are displayed selectively on a sensor angle display (SAD) panel. The IR operator can also monitor the LLLTV system. For additional information on the IR operator's equipment, refer to T. O. 1C-130(A)A-1-1. Equipment for the EWO occupies the right portion of the two-man console. The EWO operates the AN/APQ-150 radar set which searches for, acquires, and tracks I-band radar beacons. Additionally, the EWO employs the AN/ASD-5 (Black Crow) to acquire, identify, and track targets/beacons. Sensor azimuth and elevation angles are displayed selectively on a sensor angle display (SAD) panel. The EWO also can make intervalometer settings for the LAU-74/A flare launcher, and operate the LAU-74/A remotely through switching on the chaff control panel. For additional on the EWO's equipment, refer to T.O. 1C-130(A)A-1-1.

FCO Console

The FCO (fire control officer) console (figure 4-82) occupies the left, rear portion of the booth. The FCO is the flight crew gunnery officer. He is primarily involved with the delivery of ordnance and assessing of inflicted battle damage. Also he coordinates the sensors in flight. Sensor azimuth and elevation angles may be selected for display on a sensor angle display (SAD) panel. He is provided equipment for operation of the inertial navigation system (INS) and the AN/AXH-2 Video Recorder. A TV monitor at the console allows observation of the LLTV or infrared systems.

TV Console

The TV console (figure 4-82) is located at the aft, right side of the booth and contains controls for the wide and narrow angle cameras for the Low Light Level Television (LLLTV) (AN/AXQ-10(V), Laser Illuminator (AN/AAQ-7), TV/Laser platform (AN-AJQ-24A), 2KW Searchlight (AN/AVQ-17), and the Laser Target Designator (AN/AVQ-18). The 8- and 14-inch monitors display the information from either TV camera and/or IR set. The type of imagery displayed is selected on a remote control unit of the video distribution system. The LLLTV cameras, laser illuminator and LTD heads are mounted on the TV/Laser platform and controlled by a TV/Laser platform hand control (joystick). The laser illuminator provides supplemental illumination to the LLLTV. Azimuth and elevation angles of the

worldwide program CDU displays

DISPLAY SELECTOR SWITCH SETTING	WPT SELECTOR SWITCH SETTING	FROM/TO DISPLAY	LEFT NUMERICAL DISPLAY	RIGHT NUMERICAL DISPLAY
TK/GS	Not Critical	Not Critical	True track angle in tenths of degree ± 0.1 degree	Ground speed in knots ± 1 knot
HDG/DA	Not Critical	Not Critical	True heading in tenths of degree ± 0.1 degree	Angle in tenths of degree (± 0.1 degree) that aircraft track angle is to the right (R) or left (L) of aircraft heading.
XTK/TKE	Not Critical	Active Track Displayed	Cross track distance is distance left (L) or Right (R) from the desired track to the present position. Measured perpendicular to desired track 0 to 399.9nm ± 0.1nm.	Track angle error is the angle in tenths of degree that aircraft track angle is to the Left (L) or right (R) of the desired track angle.
POS	Not Critical	Not Critical	Present latitude in tenths of an Arc-minute ± 0.1 arc-minute	Present longitude in tenths of an arc-minute ± 0.1 arc-minute.
WPT	1 thru 9	Not Critical	Latitude of manually inserted destination waypoint to tenths of an arc-minute ± 0.1 arc-minute	Longitude of manually inserted destination waypoint to tenths of an arc-minute ± 0.1 arc-minute.
	0	01 thru 09	Latitude of present position when a OX track change was inserted.	Longitude of present position when a OX track change was inserted.
DIS/Time	Not Critical	Active Track Displayed	Great circle distance from the aircraft present position to the next selected waypoint 0 to 9999nm ± 1.0 nm	Time-to-go is based on present ground speed along the desired track. 0 to 480.0 minutes ± 0.1 min. Reads zero at ground speeds below 10 knots.
		00	Distance–to–go and Time–to–go read zero until a track leg is inserted in the FROM/TO waypoint display.	

Figure 4-81. (Sheet 1 of 2)

worldwide program CDU displays (cont.)

DISPLAY SELECTOR SWITCH SETTING	WPT SELECTOR SWITCH SETTING	FROM/TO DISPLAY	LEFT NUMERICAL DISPLAY	RIGHT NUMERICAL DISPLAY
WIND	Not Critical	Not Critical	TRUE WIND direction from zero to 359 degrees ± 1.0 degree NOTE: Wind direction and speed are available if a TAS is manually inserted into the computer.	Wind speed from zero to 399 knots ± 1.0 knots.
DSRTK/ STS	Not Critical	Active Track Displayed	Great circle flight path connecting the departure and destination positions or any two waypoints. In tenths of a degree ± 0.1 degree. Reads zero until a track leg is inserted in the FROM/TO waypoint display. Track hold mode is operational.	TAS in knots ± 1.0 knot. TAS is manually inserted into the DSR TK/STS position by selecting REMOTE on the AUTO/MAN/REMOTE switch and addressing key 5 on the data keyboard.

Figure 4-81. (Sheet 2 of 2)

LLLTV and other sensors are displayed on the sensor angle display panel (SAD). The control switching unit allows the TV operator to slave (azimuth and elevation) the TV platform to any of the other sensors or the inertial navigation system (INS). The 2 KW searchlight is used for target illumination in either a visual or covert mode. Circuit breaker protection for the console is provided by circuit breakers located on the cargo compartment AC and DC circuit breaker panels.

SENSOR AND ASSOCIATED ELECTRONIC EQUIPMENT

The sensor angle display system is independent of the fire control system and is a backup for the (automatic) sensor slaving system.

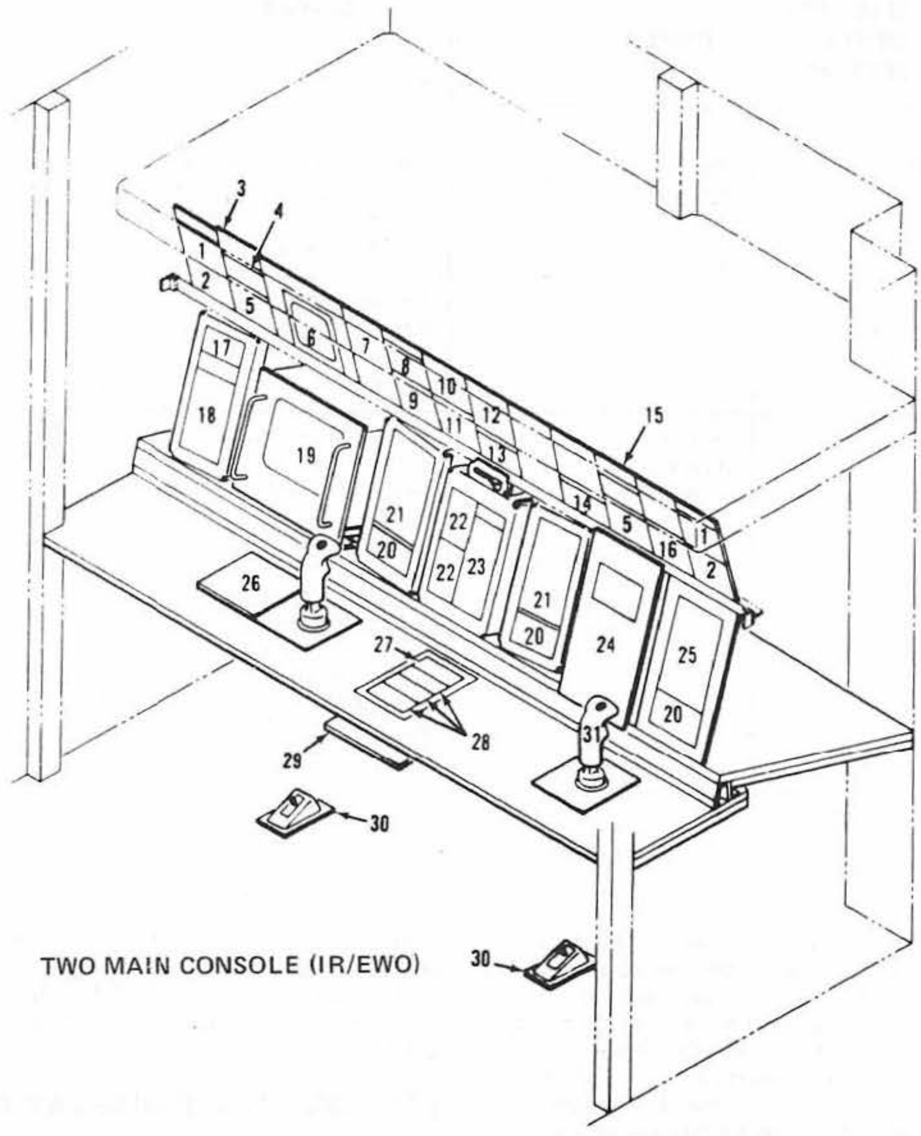
SENSOR ANGLE DISPLAY (PILOT AND FCO)

A sensor angle display panel (see figure 4-83) is located on the pilot and FCO consoles. The panel consists of an azimuth meter, elevation meter and a rotary switch. The meters display selected sensor angle information in elevation and azimuth. The rotary switch allows selection of desired sensor. Power is provided through the SAD power switch on the navigator's console. The SAD panel light control is located outboard of the pilot's station and contains a dimmer control.

SENSOR ANGLE DISPLAY (EWO, IR, TV).

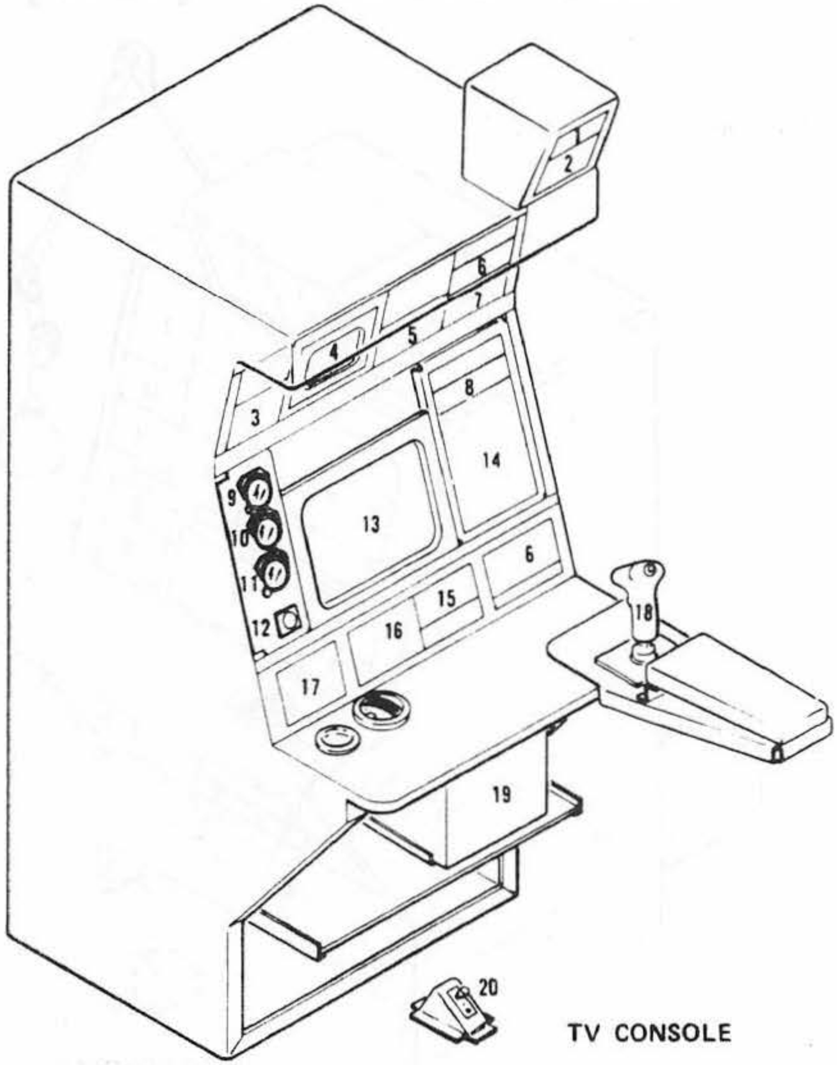
Three sensor angle display panels (see figure 4-84) are located in the airplane: one at the EWO, IR and TV stations. The panel contains azimuth and elevation meters which display absolute azimuth and elevation angles of the sensor near the panel; REL azimuth and REL elevation meters display relative angles from that sensor to the selected sensor; and REL sensor select switch allows selection of the desired sensor. A sensor operator may approximately align his sensor with another by selecting the other sensor on his REL sensor select switch and moving his sensor in the indicated direction until the REL azimuth and REL elevation meters are zeroed. Power is provided through the SAD switch on the electrical equipment switch panel located on the navigator's station (see figure 4-29).

booth console



1. LIGHTING CONTROL
2. OXYGEN REGULATOR
3. IR OPERATIONS PANEL
4. CLOCK
5. INTERPHONE CONTROL
6. TV MONITOR (8 INCH)
7. CIRCUIT BREAKER PANEL
8. 4012F ATTITUDE INDICATOR
9. V8 HEADING INDICATOR
10. AIRSPEED INDICATOR
11. ALTIMETER
12. CIRCUIT BREAKER PANEL
13. CEILING LIGHT CONTROL
14. CLOCK
15. ELECTRIC TEST PANEL
16. COMPARTMENT TEMPERATURE CONTROL
17. C-8767/ASQ-145(V) REMOTE CONTROL UNIT (8" MONITOR)
18. INFRARED SET CONTROL
19. IP-1902/AAD-7 VIEWER (IR)
20. C-8777/A CONTROL SWITCHING UNIT
21. SENSOR ANGLE DISPLAY PANEL
22. TRIM -7A CONTROL UNIT
23. ALR-46/TRIM-7A SWITCHING UNIT
24. CONTROL AND DISPLAY UNIT, ASD-5
25. C-8802/APQ-150 CONTROL-INDICATOR
26. GIMBAL POSITION CONTROL (AAD-7)
27. CONTROL SYNC (ECM)
28. C-6175 CONTROL (ECM)
29. PALLET (A24G)
30. FOOT SWITCH
31. MANUAL CONTROLLER (ASD-5)

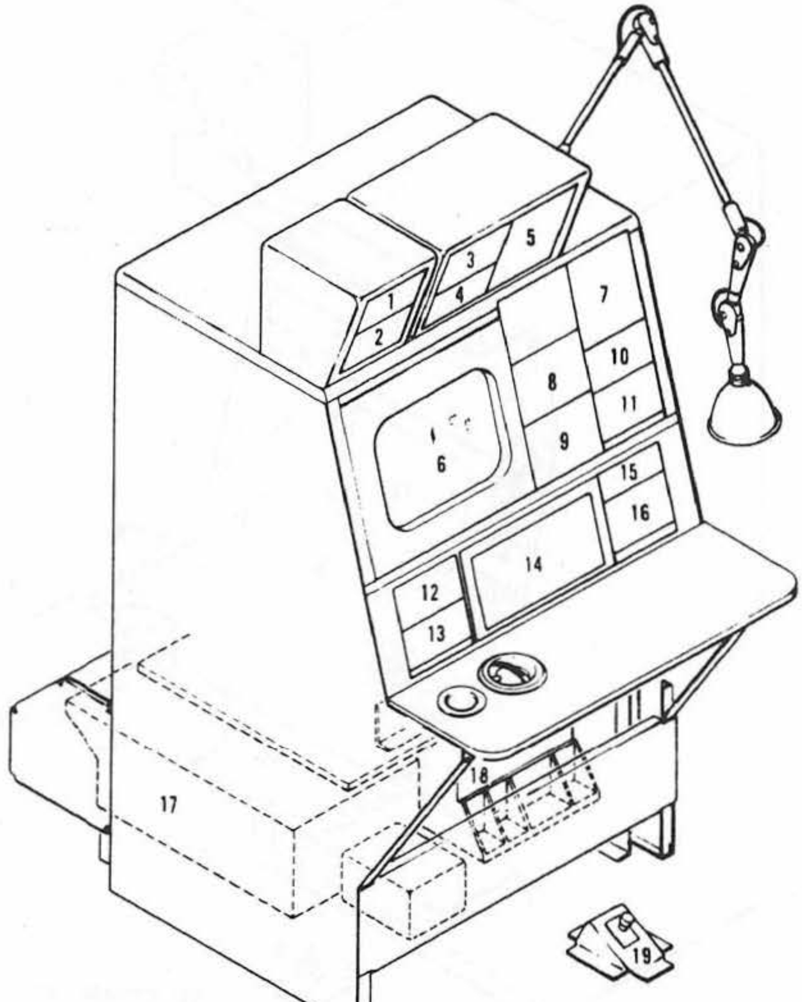
Figure 4-82. (Sheet 1 of 3)



1. OXYGEN REGULATOR
2. CIRCUIT BREAKER PANEL
3. LIGHTING CONTROL
4. TV MONITOR (8 INCH)
5. INTERPHONE CONTROL
6. C-8777/A CONTROL SWITCHING UNIT
7. 2KW SEARCHLIGHT CONTROL
8. C-8767/ASQ-145(V) REMOTE CONTROL UNIT (14 " MONITOR)
9. ALTIMETER
10. AIRSPEED INDICATOR
11. V8 HEADING INDICATOR
12. 4012F ATTITUDE INDICATOR
13. TV MONITOR (14 INCH)
14. SENSOR ANGLE DISPLAY PANEL
15. C-8767/ASQ-145(V) REMOTE CONTROL UNIT (8" MONITOR)
16. C-9330/AAQ-7 LASER ILLUMINATOR CONTROL
17. C-9329/AXQ-10(V) TV/LASER CONTROL
18. C-8765/AJQ-24 PEDESTAL CONTROL
19. SA-178/ASQ-145 (V) VIDEO SWITCHING UNIT
20. INTERPHONE FOOTSWITCH

Figure 4-82. (Sheet 2 of 3)

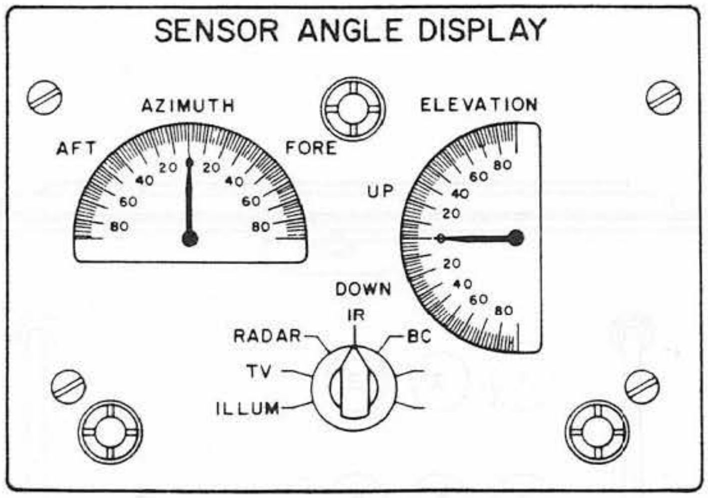
booth consoles (cont)



FCO CONSOLE (TYPICAL)

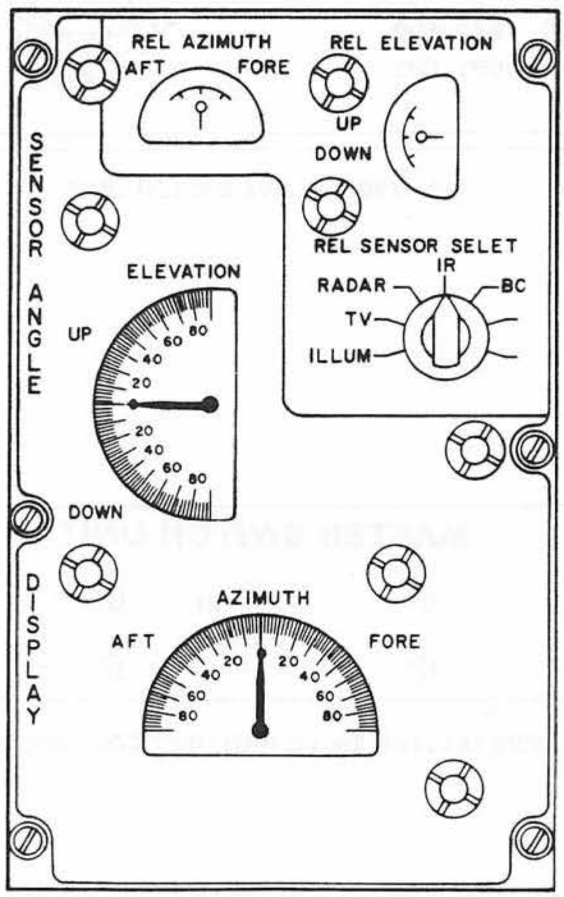
1. OXYGEN REGULATOR
2. CIRCUIT BREAKER PANEL
3. 5 VOLT LIGHT CONTROL
4. LIGHTING CONTROL
5. ATTITUDE REFERENCE SWITCHING UNIT
6. TV MONITOR (14 INCH)
7. ALTIMETER
8. AIRSPEED INDICATOR
9. ARU-11 ATTITUDE INDICATOR
10. C-8768/AXQ10 RECORDER CONTROL
11. C-8777/A CONTROL SWITCHING UNIT
12. INTERPHONE CONTROL
13. C-8767/ASQ-145(V) REMOTE CONTROL UNIT
14. SENSOR ANGLE DISPLAY PANEL
15. MODE SELECTOR UNIT
16. CONTROL DISPLAY UNIT
17. BATTERY UNIT
18. INERTIAL NAVIGATION UNIT
19. INTERPHONE FOOT SWITCH

Figure 4-82. (Sheet 3 of 3)



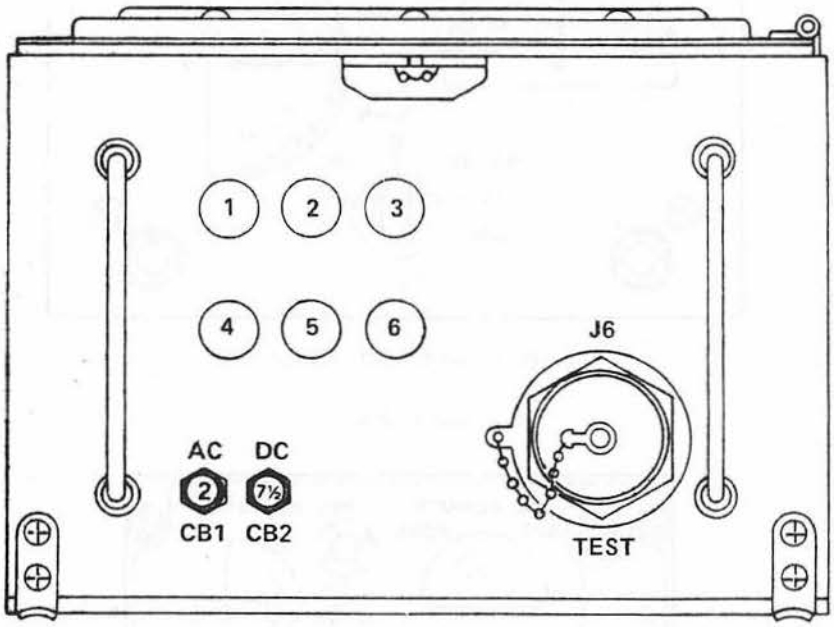
PILOT'S/FCO SAD INDICATOR

Figure 4-83.

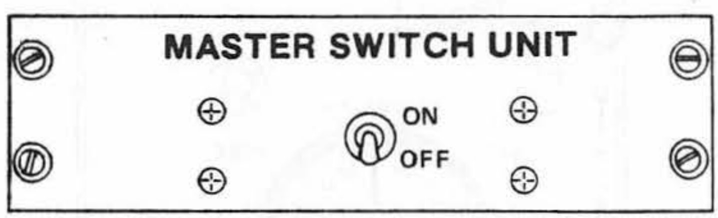


EWO/IR AND TV SAD INDICATOR

Figure 4-84.

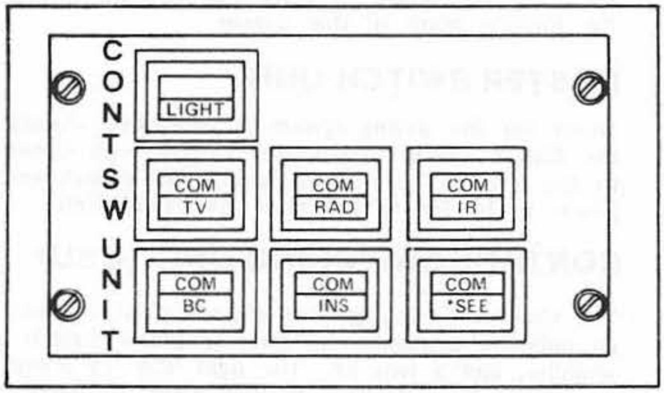


SA-1786/A SLAVE SWITCH UNIT

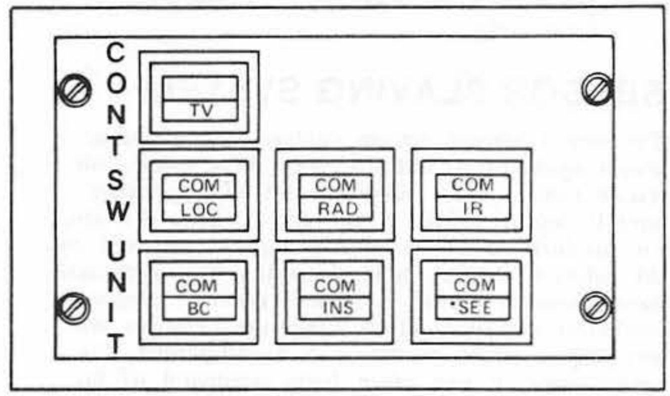


8477-94050 MASTER SWITCHING UNIT CONTROL PANEL

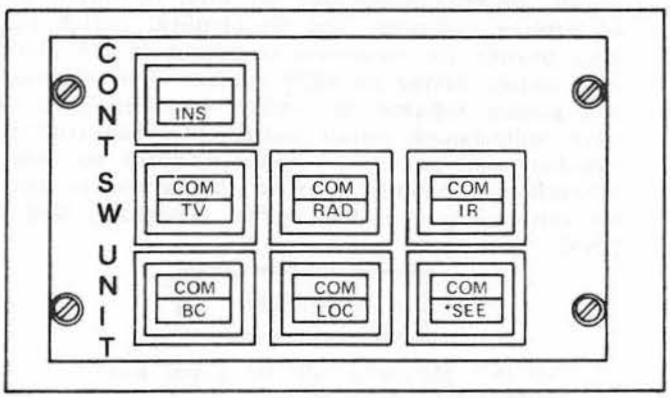
Figure 4-85.



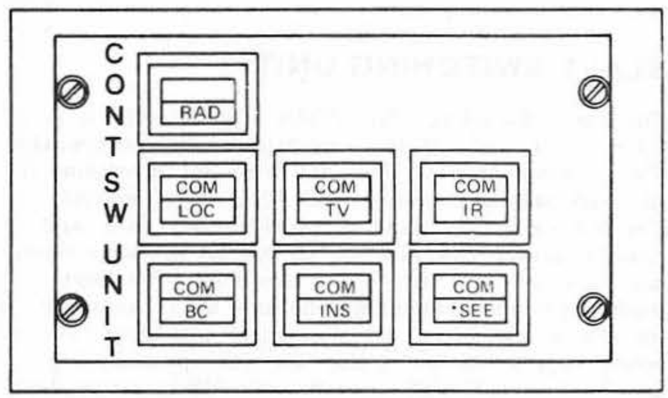
CONTROL SWITCHING UNIT (2KW ILLUM)



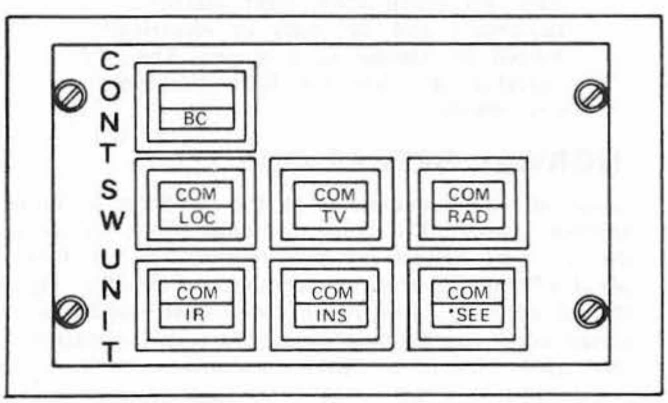
CONTROL SWITCHING UNIT (TV)



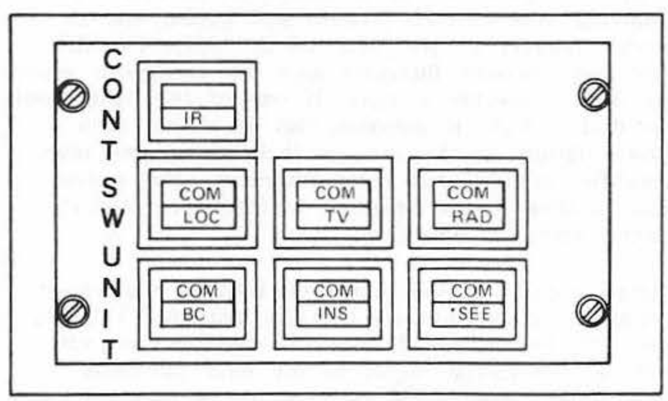
CONTROL SWITCHING UNIT (INS)



CONTROL SWITCHING UNIT (RAD)



CONTROL SWITCHING UNIT (BC)
PROVISIONS ONLY



CONTROL SWITCHING UNIT(IR)

Figure 4-86.

Note

The system has a tolerance of ± 6° and should be used for reference purposes only.

SENSOR SLAVING SYSTEM

The sensor slaving system enables the individual sensor operator to automatically drive (slave) his sensor head to the looking point of any other aircraft sensor. While in the slave mode, the sensor platform is driven by the signals produced by the selected sensor tracking handle. This automatic slaving feature allows rapid and accurate target validation and/or hand-off operation between sensors. When target validation is accomplished, the sensor operator can select local command of his platform and target hand-off operation can be made. Power for the slave switching unit is provided by the LH AC Bus (115 VAC 1 ϕ 400 Hz and the Main DC Bus 28 VDC). The circuit breakers (2 amp AC and 7-1/2 amp DC) are on the front of the slave switching unit.

SLAVE SWITCHING UNIT

The Slave Switching Unit (SSU) (figure 4-85) is located to the left of the navigators station below the Fire Control Display. This unit contains provisions for six relay/amplifier modules and two relay modules. The relay/amplifier modules provide relay logic and synchro power amplification to enable slaved positioning of sensor and non-sensor platforms. The relay module provides switching functions used exclusively for slaved control of the non-sensor platforms. The power supply module within the SSU provides regulated 28 + 0-8 VDC (nominal 28 VDC) power for operation of the relay/amplifier modules.

The Built-In-Test-Equipment (BITE) indicator lights are located on the front of the Slave Switching Unit. The BITE indicators should be checked by applying power to the system and pulling the AC circuit breaker on the front of the SSU. The first five lights should illuminate and will extinguish when the circuit breaker is reset. If one of the lights come on during flight it indicates that there has been a power failure to the SSU or that one of the relay/amplifier modules has failed internally. The system can continue to be operated in flight provided the circuit breakers remain set.

Slaved control of the sensor platform is enabled by actuation of switches on controls units for TV, IR, and BC. Switch actuation at the control unit outputs as control-line signal to the slave switching unit which initiates the relay switching functions required for platform-to-platform slaving. On control units for TV, IR, and BC control switch actuation of the slave control mode also outputs a slaving-command signal to the platform electronics, causing the platform to operate in a receiver capacity. One or several platforms may be slaved to another platform even if the platform slaved to is not in a local-control mode. For example the 2 KW light can be slaved to the TV, the TV slaved to the IR and the IR slaved to the BC. The BC tracking handle will be driving all of the platforms. When one of the three platforms is in the local-control mode, any or all of the remaining platforms may be slaved to the looking point of that sensor.

MASTER SWITCH UNIT

Power for the slaving system is controlled through the Master Switch Unit switch (figure 4-85) located to the left of the ANP-59 radar. This switch enables power to be fed to the Slave Switching Unit.

CONTROL SWITCHING UNIT (CSU)

The Control Switching Unit (figure 4-86) consists of an indicator assembly, six interchangeable switch assemblies, and a lens kit. The light and TV controls are at the TV operators position and the radar (APQ-150) and BC controls are at the EWO position. The IR control is at the IR position. The indicator assembly illuminates to identify an individual control unit with its assigned platform. The switch assembly accepts operator commands for local or slaved control of airplane platforms. The six identical switch assemblies provide for local/slave command of six platforms, each switch having an engraved lens. The engraved lens placard indicates the switch function (local or slave control-mode sensor assignment). The control switching unit allows the sensor operator to slave (azimuth and elevation motion) his sensor to any of the other sensors or the Inertial Navigation System (INS).

CAUTION

No two platforms will be slaved simultaneously to each other.

Note

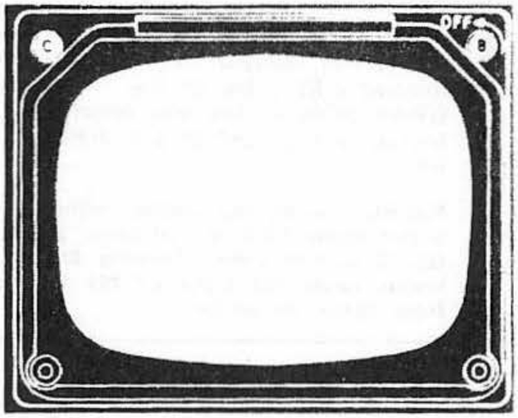
The 2 KW light platform has no control stick for independent light platform movement and can only be electrically moved by slaving to a sensor. The TV operator can slave the light platform to any sensor.

NORMAL OPERATION

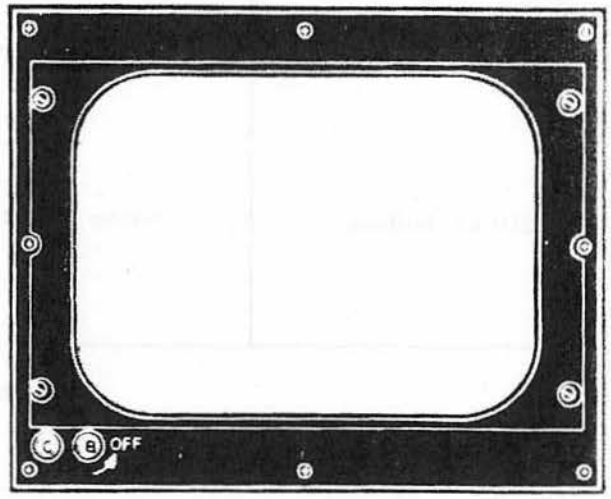
Local or slaved operation of the platform is implemented through the Slave Switching Unit by actuation of push-button switches located on the front panel of each control switching unit control. Operational control status (local mode/slave mode) is annunciated on illuminated split screen indicators associated with each switch. Operation of the system is basically the same from any sensor operator position.

Local control of three (TV, IR, BC) sensor platforms is performed by operator manipulation of the sensor platform joystick. Any of these three sensor platforms may be placed in the local command mode on an individual basis at the discretion of each sensor station operator. Actuation of the COM/LOC (Command/Local) switch (SI) on switching control units

television monitors and remote control unit

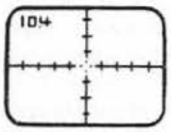


8 INCH TV MONITOR

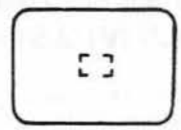


14 INCH TV MONITOR

A DOTQUAD AND/OR CROSSHAIR RETICLE CAN BE GENERATED WHEN WIDE ANGLE OR NARROW ANGLE TV VIDEO IS SELECTED. RANGE RETICLE CAN BE GENERATED WHEN ACTIVE NARROW ANGLE TV VIDEO IS SELECTED/AND TV OPERATOR HAS THE CROSSHAIRS PULLED ON THE 14 INCH MONITOR



A RETICLE WITH 4 X 3 ASPECT RATIO APPEARS AT CENTER OF MONITOR TO MARK 3.5 DEGREE FIELD-OF-VIEW WHEN WIDE ANGLE TV VIDEO IS SELECTED



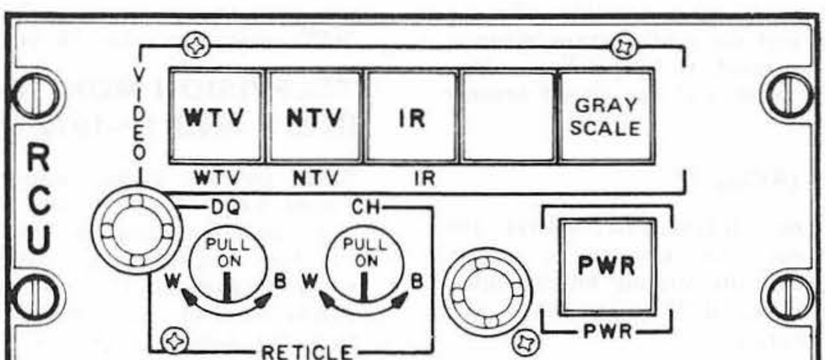


Figure 4-87

RCU controls and functions

Control	Description	Function
1. PWR Switch	Pushbutton switch	Applies power to the RCU and the VSU.
2. VIDEO Switches	Pushbutton switches	Permits the selection of wide TV (WTV), narrow TV (NTV), infrared (IR) video or the GRAY SCALE. The one remaining button is not used at the present time.
3. RETICLE buttons	Pull-on potentiometers	Pulling a knob out applies either a dot quad (DQ) or crosshair (CH) reticle to the video. Turning the knobs varies the color of the reticles from black to white.

Figure 4-88.

No. 1, 2 and 3 will illuminate the command switch to indicate the transmitting mode of the sensor platform. The COM/LOC switch is not available at the light control unit.

VIDEO SWITCHING GROUP (QA-8627(V)/ASQ-145(V)).

The Video Switching Group is made up of the Video Switching Unit (SA-1784/ASQ-145(V)) and the Remote Control Unit (C-8707/ASQ-145(V)).

Video Switching Unit (VSU).

The Video Switching Unit, located under the TV console (figure 4-82) provides for video distribution to all monitors and the video recorder. In addition the VSU generates the TV gray scale presentation, TV video electronic reticles and the AAQ-7 range readout. Overload protection is provided by (2 Vid Proc) circuit breakers on the TV panel and one circuit breaker on the video switching unit.

Remote Control Unit (RCU).

The Remote Control Units, (figure 4-87) activate the video switching unit, select the video to be supplied each monitor, and control the various reticles presented on the monitors. An RCU is associated with each monitor in the aircraft.

The GRAY SCALE button allows the presentation of a ten (10) shade black-to-white (presented left to right) gray scale on a monitor. This is used to adjust the contrast and brightness on the monitors. It also acts as a check to determine if the monitor and/or the video switching unit are functioning properly. Either the NTV or the WTV must be operating for the gray scale generator to function. The units receive 28-volt dc power with overload protection provided by circuit breakers located on circuit breaker panels at the TV, IR, and FCO consoles.

A list of controls and functions associated with the RCU is provided in figure 4-88. When the AN/AAQ-7 Laser Illuminator is operating, a range readout is displayed in the upper left corner of each monitor on which NTV video is being viewed. This range readout is the slant range from the aircraft to the center of the range gate in kilofeet (Example 12.1 is twelve thousand one hundred feet) and is accurate to plus/minus 100 feet (in "C" camera gate width only). The TV operator's 14 inch RCU crosshair control must be out (the crosshair being displayed) for the range indication to appear on any monitor. The range indication is updated once every second and will appear on video tape if the FCO has NTV selected on his 14 inch RCU.

TELEVISION MONITORS (1P-1071/U(8 INCH) AND 1P-1072/U(14 INCH))

There are two 14-inch and two 8-inch TV monitors (figure 4-87) located in the airplane. The TV Operator console contains a 14-inch and 8-inch monitor, the Fire Control Officer console contains a 14-inch monitor, and the IR Operator console contains an 8-inch monitor. Each monitor has front panel controls for power, brightness, and contrast.

Recessed controls are located on the bottom of each unit (hand-adjustable) for horizontal hold, vertical hold, and height. The monitor has provisions for a filter and contains an implosion panel to protect the operator from flying glass should picture tube implosion occur. The monitors operate from 115-volt, 400-Hz ac and 28-volt dc with overload protection provided by circuit breakers on circuit breaker panels at the TV, IR, and FCO consoles. Each monitor has a single circuit breaker and a 75 ohm-high toggle switch on the rear. The switch should be in the 75 ohm position.

VIDEO RECORDER SET, AN/AXH-2

The video recorder set is provided at the FCO console for recording of both video and audio signals. The system consists of the RO-404/AXH-2 Video Tape Recorder and C-8768A/AXQ-10 Recorder Control. Video signals recorded include data from the wide or narrow TV cameras or the IR set and are selected by the FCO at his RCU. Audio signals recorded can be FCO interphone activity, selected by the FCO at the recorder control, or signals from the gun firing circuitry or fire control computer. The signals from the gun firing circuitry of fire control computer are recorded automatically. Power of 115-volt, 400-Hz, three-phase ac is supplied to the video recorder and 28-volt dc to the recorder control. Circuit protection is provided by circuit breakers located on the FCO circuit breaker panel.

RECORDER CONTROL, C8768A

The recorder control (figure 4-89) is located in the FCO console and provides the controls and indicators for operation of the video recorder. A circuit breaker located on the back of the control limits the 28-volt dc supplied the control to 3/4 ampere. A list of controls, indicators and functions associated with the recorder control is provided in figure 4-91.

VIDEO TAPE RECORDER, RO-404

The video tape recorder (figures 4-89, 4-90), installed on the left booth wall by the FCO console, is a self-contained dual-head helical scan recorder which is controlled by the C-8768A Recorder Control. Audio and video channels are provided. Two 8-inch diameter reels are included for 1800 feet of tape which move at a speed of 15 in/s. This speed provides a recording time of 24 minutes. A rotary mode selector switch on the recorder has positions FAST FORWARD, NEUTRAL, and RECORD. In NEUTRAL position, the drum head and servo operate, but the capstan and reels do not. The FAST FORWARD position winds

video tape recorder (AN/AXH-2)

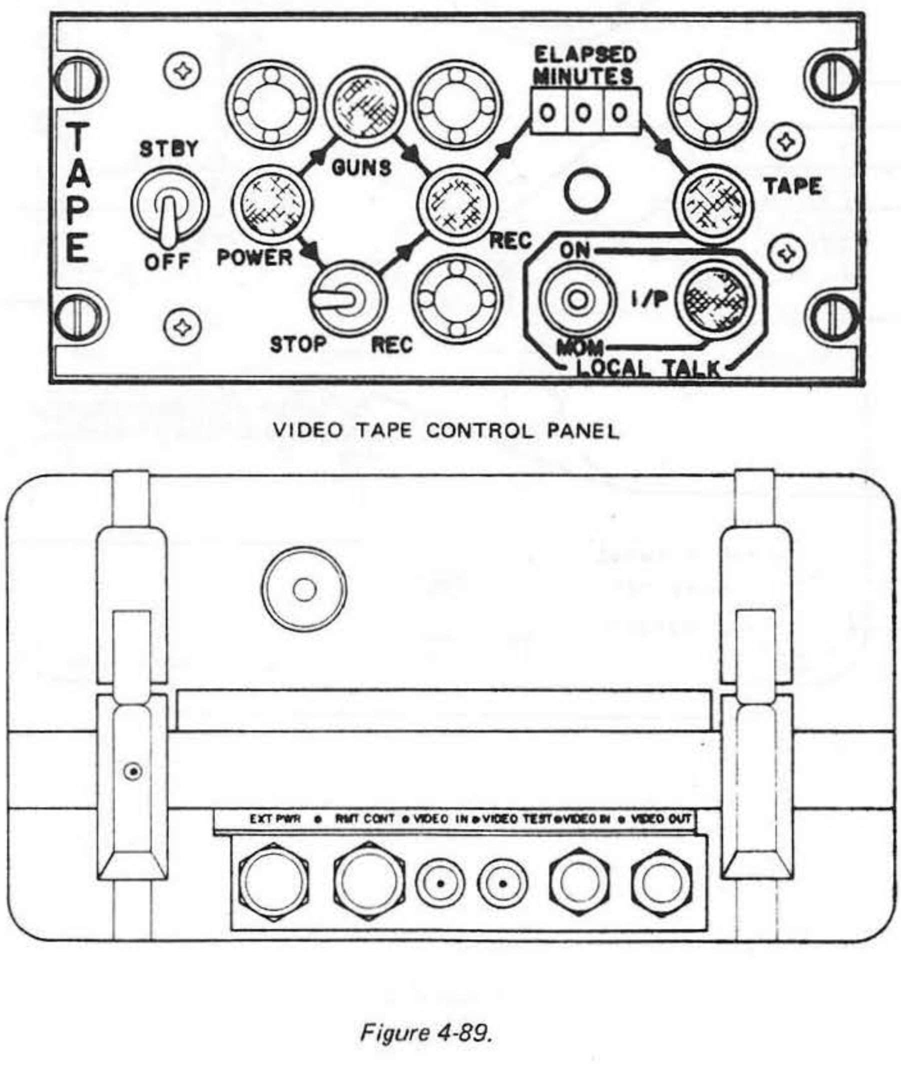


Figure 4-89.

RO-404 video tape recorder (AN/AXH-27)

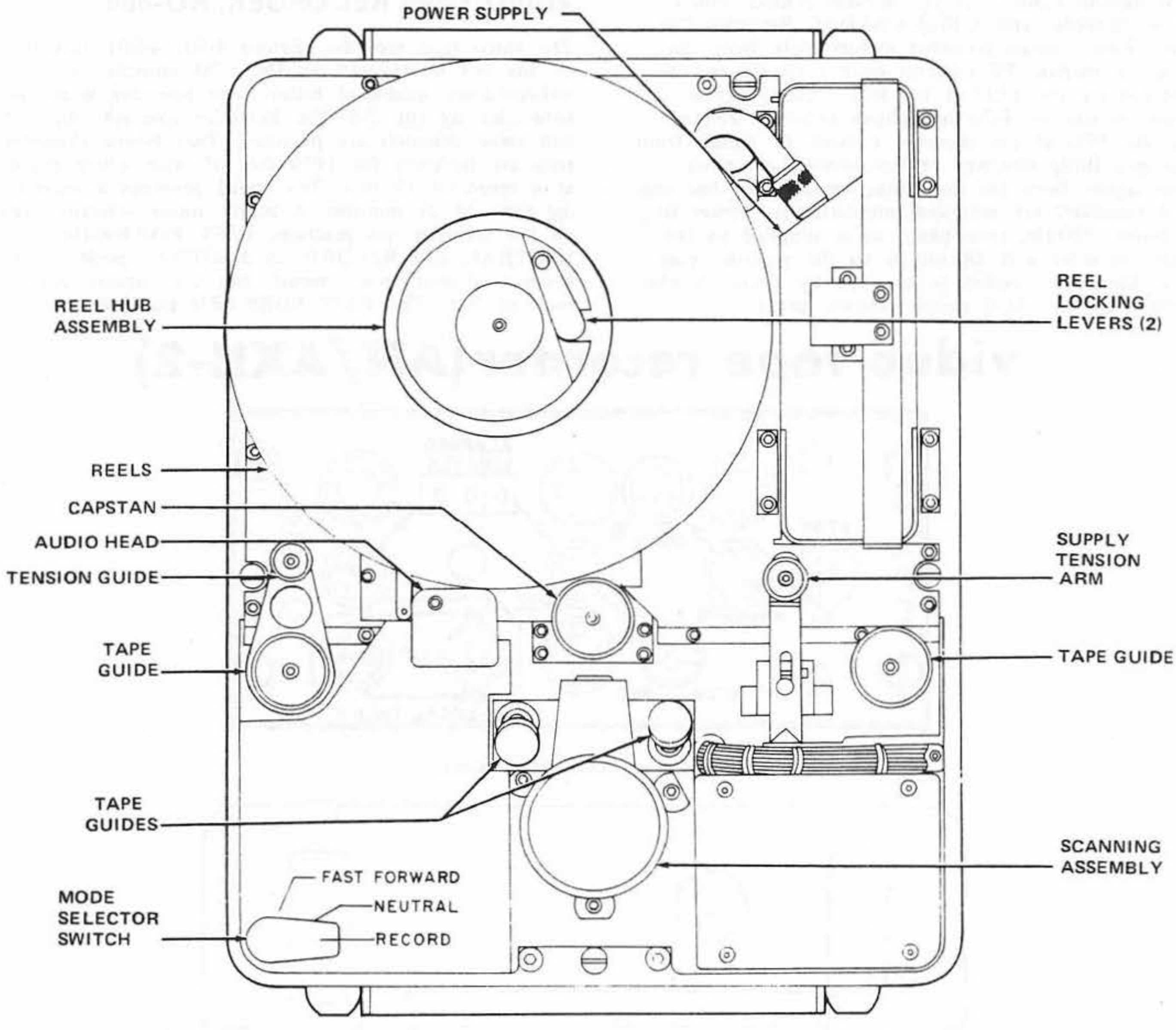


Figure 4-90.

recorder control controls and functions

CONTROL	DESCRIPTION	FUNCTION
OFF-STBY SWITCH	Toggle Switch	In STBY position applies power to recorder electronics, but does not start recorder. In OFF position, removes power.
POWER Indicator	Light	Illuminates green to indicate that standby power is being applied to recorder.
STOP-REC switch	Toggle Switch	In REC position causes recorder to begin recording. In STOP position causes recorder to stop recording.
GUNS Indicator	Light	Illuminates red to indicate that a command is being received from the airplane gun firing circuitry (pilot depresses trigger or coincidence lights out). This causes recorder to begin recording in STBY, regardless of STOP-REC switch position. Recorder continues for 30 seconds after light goes out.
REC Indicator	Light	Illuminates amber to indicate that recorder is in record mode and is recording properly.
ELAPSED MINUTES Counter	A three-digit resettable counter	Indicates in minutes and tenths of a minute the amount of time the recorder has been operating in the record mode.
COUNTER RESET BUTTON	Knurled rotary button	Push and turn to reset ELAPSED MINUTES counter to 00.0 for new video tape.
TAPE OUT indicator	Light	Illuminates amber to indicate that recorder tape supply is exhausted or that tape transport has stopped due to broken tape or loss of tape tension.
LOCAL TALK Switch	Three-position toggle switch	In I/P position whatever the FCO hears in his headset will be recorded when the recorder is running. In ON or MOM (momentary spring loaded back to the I/P position) only the FCO's microphone signal is recorded.
LOCAL TALK indicator	Light	Illuminates green to indicate that the LOCAL TALK switch is in the ON or MOM position.

Figure 4-91.

video recorder tape threading diagram

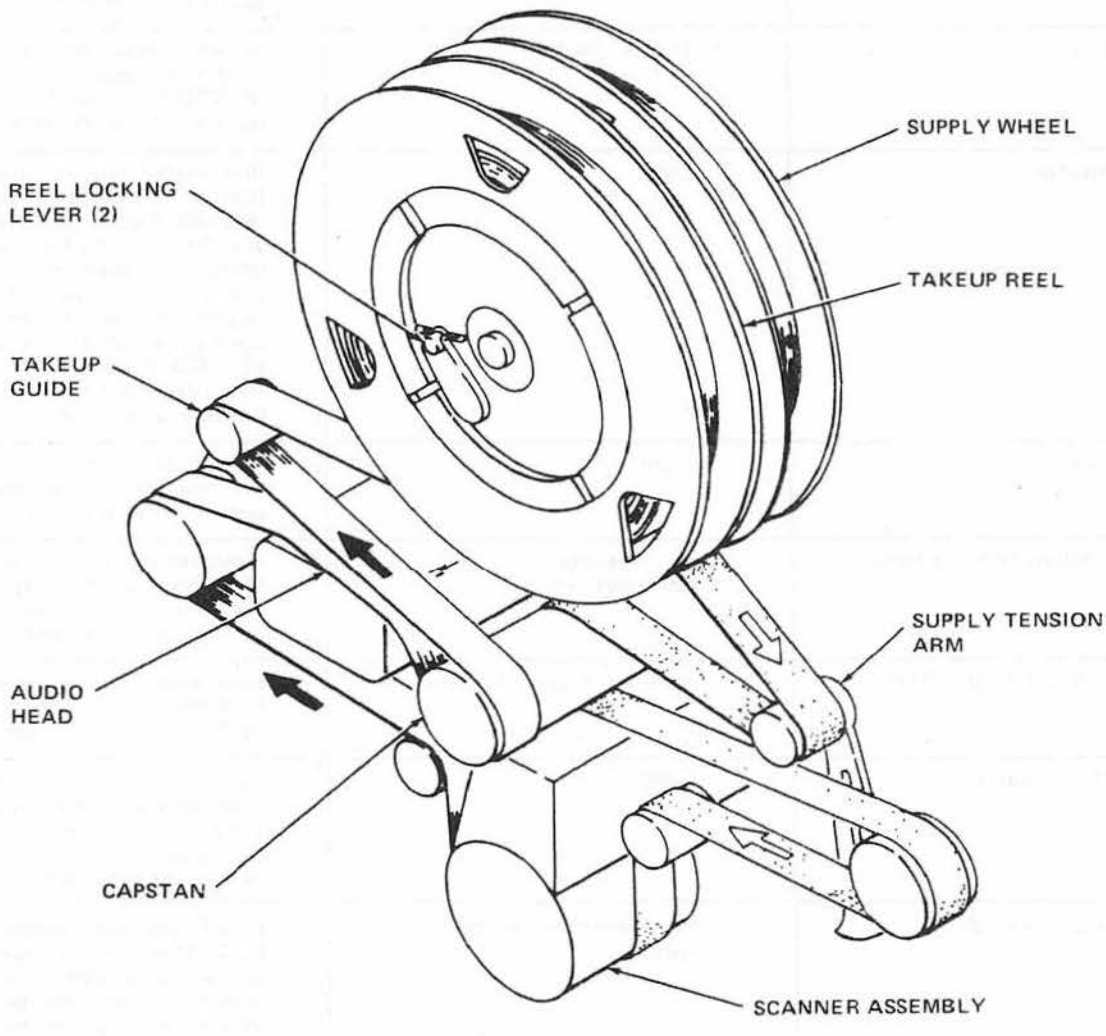


Figure 4-92.

tape from the supply reel to the takeup reel at approximately 60 in/s when the recorder control panel STOP-REC switch is placed in REC. The RECORD position allows normal operation of the recorder with the recorder control STOP-REC switch.

A list of controls and functions associated with the video tape recorder is provided in figure 4-93.

NORMAL OPERATION OF VIDEO TAPE RECORDER

1. Remove recorder cover and set recorder mode selector switch to the neutral position.
2. As shown in figure 4-93, move both reel locking levers to their full counterclockwise positions.

CAUTION

Do not attempt to rotate the takeup reel hub clockwise. A one-way clutch is used to prevent tape slackening when the recorder is under vibration and prevents rotation in a clockwise direction.

3. Turn takeup reel hub counterwise until the two hubs lock together.
4. Unwind approximately five feet of tape from the supply reel, place the supply reel on the inner reel hub and lock the reel in place with the supply reel locking lever.
5. Thread tape on the video recorder to the take-up reel as shown in figure 4-92. Threading instructions are inside the video tape recorder top cover.

Note

The supply reel hub brake is activated by the supply tape tension arm. If necessary, move the arm to the left to release brake.

6. Place the takeup reel on the outer reel hub and lock in place with reel locking lever. Thread tape onto takeup reel.
7. Turn capstan counterclockwise to takeup tape and move supply tension arm to the left.
8. Place the Video Tape recorder mode selector switch to RECORD.

CAUTION

If the recorder mode selector switch is left in the NEUTRAL position and the recorder control is set to STBY and REC, damage to the tape will occur.

9. Press the counter reset button and rotate button for 00.0 setting on the recorder control ELAPSED Minutes Counter.
10. Insure VID RCDR circuit breakers on the FCO panel are set IN.
11. On recorder control, position OFF/STBY switch to STBY.
12. To cause tape movement, position STOP/REC switch to REC. Tape also moves upon command from gun firing circuitry or whenever gunsight reticles are within coincidence.

RO-404 video tape recorder controls and functions

CONTROL	DESCRIPTION	FUNCTION
MODE SELECTOR	Detented rotary three-position switch, FAST FORWARD, NEUTRAL, and RECORD.	In NEUTRAL position, the drum head and SERVO operate, but the capstan and reels do not. In FAST FORWARD position tape is transported from the supply reel to the take up reel at 60 in/sec when the recorder control panel is in STBY and REC. The RECORD position allows normal operation of the recorder when the recorder control panel is in STBY and REC or STOP with a gun/computer signal.

Figure 4-93.

13. To record airplane interphone signal, position LOCAL TALK switch to I/P. To record FCO's microphone signal, position LOCAL TALK switch to ON or MOM (Momentary).

14. Check recorder tape transport operation and return recorder control switches to OFF and STOP.

15. Replace Video Tape Recorder cover.

STABILIZED TRACKING SET (AN/AJQ-24A).

The stabilized tracking set (see figure 4-94) consists of a gyro stabilized platform, a servo electronic unit and a platform control unit. The gyro stabilized TV/Laser Platform is located under the flight deck extension and houses two low light level television cameras, a laser target designator head, and a laser illuminator head. (The TV/Laser Platform is also referred to as the Multisensor Platform and the Mount.) It is stabilized in elevation and azimuth movement under all aircraft flight conditions within range of the platform's freedom of movement. The elevation gimbal can be moved from +5 degrees to -70 degrees about the horizontal. The azimuth gimbal can be moved ± 65 degrees in azimuth about the platform's nominal zero reference. The platform can be operated in the manual and slave modes. In manual mode, it follows rate signals produced by the platform hand control.

The TV Laser Platform Hand Control is a stationary grip handle with a movable thumb switch. The thumb switch is pressure sensitive and will cause the TV Laser platform to move at a rate proportional to the pressure. The relationship between the platform movement rate and the thumb pressure is controlled by the sensitivity control.

During preflight the operator should check for proper balance of the platform by manually releasing the elevation dog (elevation locking mechanism). If the platform is properly balanced with all lens covers off and the WTV filter on, it should hold near the mid position of the elevation travel. If it does not hold notify maintenance to adjust the balance weights.

Power supplied to the system is 28-volt dc and 115-volt, 400-Hz ac. The circuits are protected by circuit breakers on the cargo compartment dc circuit breaker panel, cargo compartment ac circuit breaker panel, and on the servo electronic unit. A list of the controls and functions of the TV/Laser platform control unit is provided in figure 4-96.

OPERATION.

1. Ensure all circuit breakers are depressed.

2. Check platform for proper balance.

Note

The balance of the multi-sensor platform is critical to the proper operation of the equipment. The balance weights of the platform should be adjusted so that the platform will hold near the mid position in its elevation travel.

3. Ensure the area around platform is clear of personnel and obstructions.

4. Select local command (LOC) on the TV control switching unit.

5. MOUNT POWER switch ON.

Note

Allow approximately 30 seconds for gyros to reach operational speed and uncage.

6. Wait for MOUNT OPERATE light on TV/LTD CONT panel to illuminate.

7. Set the SENSITIVITY controls (AZ and EL) to desired position.

8. Set DRIFT controls (AZ and EL) to the desired position.

Note

There should be no interaction between the DRIFT and SENSITIVITY controls.

9. Use platform hand control.

SHUTDOWN PROCEDURES.

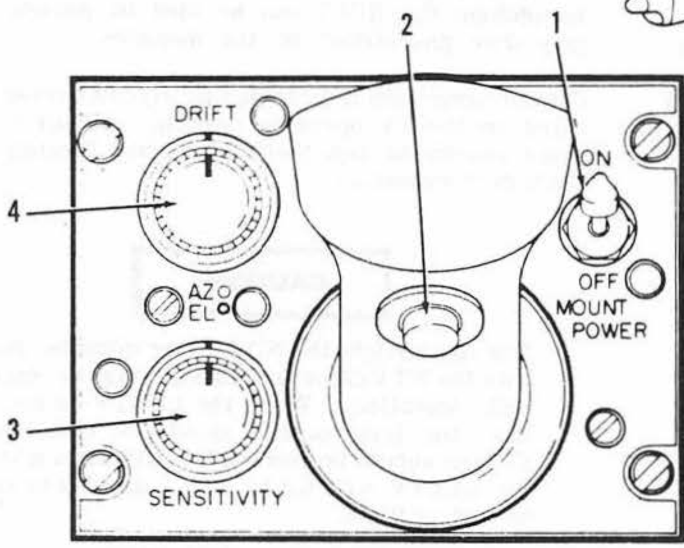
1. MOUNT POWER switch OFF.

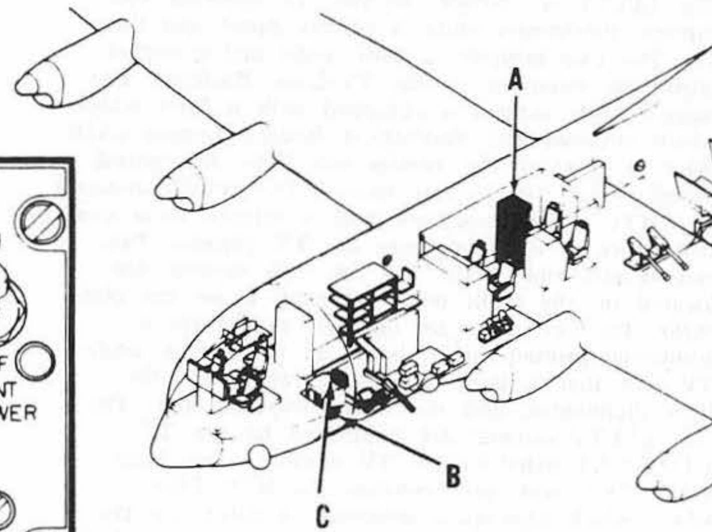
Note

To prevent disabling the automatic caging operation, do not pull any circuit breakers on the servo electronics unit.

2. When the system completes its automatic caging operation, the MOUNT OPERATE light will extinguish.

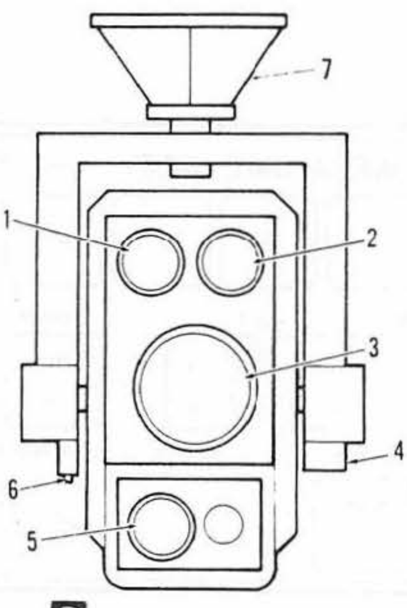
stabilized tracking set





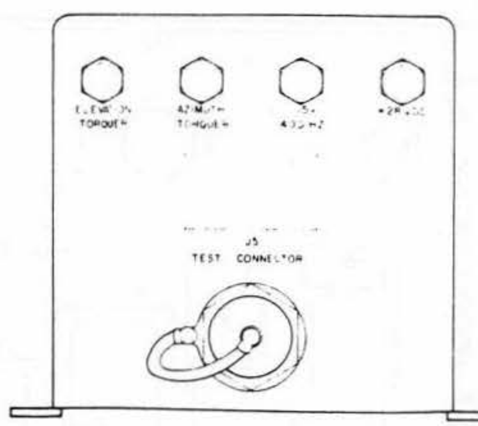
A TV/LASER PLATFORM CONTROL UNIT

1. MOUNT POWER SWITCH
2. PLATFORM HAND CONTROL
3. AZ AND EL SENSITIVITY CONTROLS
4. AZ AND EL DRIFT CONTROLS



1. WIDE ANGLE TV LENS
2. LASER ILLUMINATOR
3. NARROW ANGLE TV LENS
4. ELEVATION DOG RELEASE
5. LTD
6. LN_2 VENT PORT
7. AZIMUTH DOG RELEASE

B TV/LASER PLATFORM



C SERVO ELECTRONIC UNIT

Figure 4-94.

LOW LIGHT LEVEL TELEVISION SET (LLLTV) (AN/AXQ-10(V)).

The low light level television set (figures 4-94, 4-95), provides the operators with a real-time visual data. The LLLTV set consists of two TV cameras, two camera electronics units, a control panel and filter set. The two cameras (a wide angle and a narrow angle) are mounted on the TV/Laser Platform. The narrow angle camera is equipped with a filter wheel which automatically positions a Neutral Density (ND) filter in front of the camera any time the control switch is set for daylight narrow TV (NTV) operation. The NTV is also equipped with a remote focus control which is operated from the TV console. Two camera electronic units, one for each camera, are located on the flight deck extension above the platform. The two units are identical except for an additional printed circuit board in the narrow angle TV unit that is used to interface the NTV, the laser illuminator, and the video switching unit. The two LLLTV cameras are controlled by the TV LTD CONT panel in the TV console. (See figure 4-95.) This panel also controls the NTV filter wheel which provides a selection of filters for the NTV camera. The filter set contains a ND5 daylight filter for the WTV, a Gauss filter for the WTV when using laser illumination, a WTV lens and the various lens caps.

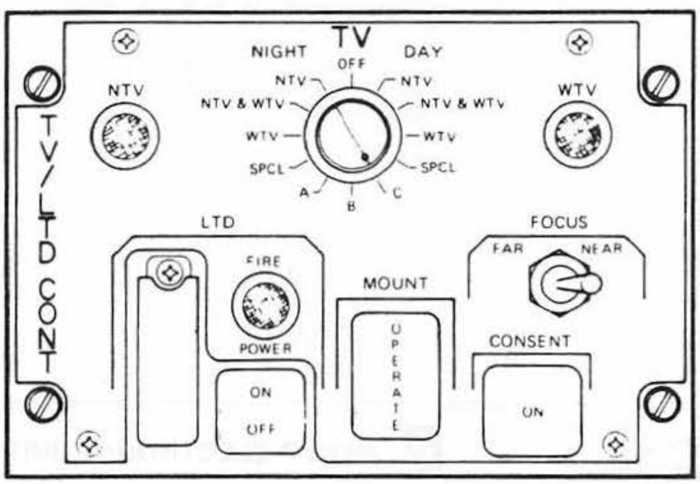
Video signals from the TV cameras, the infrared set (AN/AAD-7) and the laser illuminator range signal from the NTV are applied to the video switching unit located under the TV operators console. Remote control units (RCU) on the FCO, IR and TV operator consoles allow the operator to select either TV or IR imagery for display on the appropriate TV monitors. Vidoe selected for the FCO's 14-inch monitor can be recorded on the video tape recorder. In addition the RCU's can be used to provide a gray scale presentation on the monitors.

Circuit protection is provided by circuit breakers located on the TV operator console circuit breaker panel and on the two electronic boxes located on the flight deck extension.

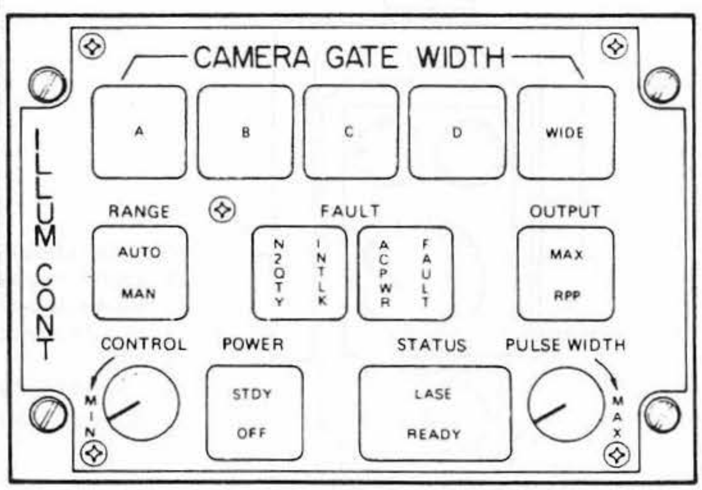
CAUTION

During daylight the ND 5 filter must be used with the WTV camera lens and must be manually installed. When the LLLTV is not in use, the lens covers should be installed. Covers should be removed for flight on which the LLLTV will not be used, as covers can be lost in flight.

LLLTV equipment



A TV/LTD CONTROL PANEL



B LASER ILLUMINATOR CONTROL PANEL

Figure 4-95.

WARNING

Due to moderate turbulence around the TV/Laser platform, extreme care must be exercised when the TV lens covers/filters and laser covers are installed or removed during flight. When filters are to be changed during flight a safety observer will be present. When there is a need to go behind the flight deck ladder during flight, a restraining harness will be worn.

Note

At the higher light levels, a honeycomb pattern may appear on the monitors (caused by light saturation of the intensifier). This pattern does not indicate damage or abnormal operation of the equipment.

When viewing a large amount of light at night, the camera intensifier may be over-driven. Rapid blanking recovery can be obtained by directing camera away from the light. Figure 4-98 gives a list of LLLTV controls and functions. Figure 4-97 shows the TV control knob positions.

SYSTEM PARAMETERS.

Wide Angle Camera (WA)

The wide angle camera contains a 70 millimeter focal length lens to provide a 20 degree field of view, and is mounted on the TV/laser platform with its optic axis parallel to the optic axis of the laser illuminator. This camera consists of a lens, focus mount, image intensifier, and camera head. The camera is focused before takeoff and is generally not refocused during flight.

Parameters for the wide angle camera are as follows:

a. Diagonal field of view (FOV)	$20^\circ \simeq 350$ mils 15°(260 mils)
b. Horizontal FOV	$16^\circ \simeq 280$ mils 12°(210 mils)
c. Vertical FOV	$12^\circ \simeq 210$ mils 9° (160 mils)

Narrow Angle Camera (NA)

The narrow angle camera contains a 410 millimeter focal length lens to provide a 3.5 degree field of view and is mounted on the TV/laser platform. The optic axis of the camera is parallel to the optic axis of the laser illuminator. Components of the camera consist of a lens, filter wheel, remote focus assembly, image intensifier, and camera head. The filter wheel and remote focus assembly are controlled during flight by signals from the TV/LTD control. Power is supplied to the camera from the related camera electronics unit. The parameters for the NA camera are:

a. Diagonal FOV	$3.5^\circ \simeq 61.0$ mils
b. Horizontal FOV	$2.8^\circ \simeq 49.0$ mils
c. Vertical FOV	$2.1^\circ \simeq 36.6$ mils

Parameters for the reticles are as follows:

a. Narrow FOV	Two crosshairs, crosshatched at 5 mil intervals. Dot quad, 2.5 mils across (4 centered dots, each dot 1/4 mil diameter)
b. Wide FOV	Two crosshairs, crosshatched 30 (20) mil intervals. Magnification is approximately 6 (4) to 1 from wide FOV to narrow FOV. Four small corners near center of picture mark the area that will appear on the narrow angle presentation. Dot quad, 15 (10) mils across, 4 centered dots each 1.5(1.0)mils diameter. (Numbers in parentheses are for 15° FOV lens.)

OPERATION.

WARNING

Do not remove unit covers on camera, camera electronics or monitors. High voltages are present in these units.

CAUTION

Never point a TV camera at the sun even if camera is turned OFF. During daylight do not turn cameras on unless a neutral density filter is used. At night do not aim cameras at any bright light source. Serious damage to the intensifier and/or the vidicon tube may result from too much light.

Note

Operators should remember that even though the narrow TV is pointed away from a bright light, the light may still be in the wide TV field of view.

When the LLLTV sensor system is not in use, set controls to the following positions:

1. TV LTD CONT panel

   a. TV power - OFF

   b. LTD power - OFF

   c. Fire switch - OFF

   d. CONSENT - OFF

2. TV/Laser platform:

   a. MOUNT POWER switch - OFF

3. Remote Control Units (RCU) (5)

   a. PWR switch - OFF

   b. VIDEO pushbuttons - As required/GRAY SCALE

TV/laser platform control unit controls and functions

CONTROL	DESCRIPTION	FUNCTION
1. MOUNT POWER SWITCH	SPRING LOADED TOGGLE SWITCH	ON position energizes the power relay to power the mount and start gyro spin-up to operational speed. OFF position cages the elevation and azimuth gimbals, drives the mount to the stow position and removes power from the mount.
2. PLATFORM HAND CONTROL	HAND GRIP WITH PRESSURE SENSITIVE BUTTON	Provides a force control button which initiates rate commands for the TV/Laser platform in azimuth and elevation. It is used only in the manual mode.
3. AZ and EL SENSITIVITY CONTROLS	DUAL POTENTIOMETER CONTROL	Dual separate controls which make the command rate of the TV/Laser platform azimuth and elevation gimbals more or less sensitive to operator pressure on the joystick hand control. The lower black knob is for azimuth and the upper red knob is for elevation.
4. AZ and EL DRIFT CONTROLS	DUAL POTENTIOMETER CONTROL	Dual separate controls that adjust the azimuth and elevation drift rates. The range of adjustment compensates for such external effects as aircraft rate, and run-to-run azimuth and elevation gyro drifts. (Drift control can vary the rate from 0 degrees/second to ±4 degrees/second.) The lower black knob is for azimuth and the upper red knob is for elevation.

Figure 4-96.

TV control knob positions

POSITION OF OUTSIDE KNOB	POSITION OF INSIDE KNOB	CAMERA IN USE	NARROW FILTER
OFF	ANY (A, B, or C)	NONE	SHUTTER
DAY – NTV	ANY (A, B, or C)	NTV	ND5
DAY – WTV	ANY (A, B, or C)	WTV	SHUTTER
DAY–WTV + NTV	ANY (A, B, or C)	NTV and WTV	ND5
DAY–SPEC	A	NTV and WTV	SHUTTER
DAY–SPEC	B	NTV and WTV	ND3*
DAY–SPEC	C	NTV and WTV	ND4*
NIGHT–NTV	ANY (A, B, or C)	NTV	CLEAR
NIGHT–WTV	ANY (A, B, or C)	WTV	SHUTTER
NIGHT–NTV + WTV	ANY (A, B, or C)	NTV and WTV	CLEAR
NIGHT–SPEC	A	NTV and WTV	SHUTTER
NIGHT–SPEC	B	NTV and WTV	SHUTTER
NIGHT–SPEC	C	NTV and WTV	SHUTTER

** The ND-4 filter allows ten times more light to enter the intensifier than the ND-5. The ND-3 filter allows ten times more light to enter the intensifier than the ND-4.*

Figure 4-97.

c. DQ and CH controls - Pushed in

4. Monitors (4)

a. Brightness control - OFF (CCW) (Use caution, knob shaft is brittle.)

5. TV Laser platform

a. Lens covers (4). Installed

For normal operation, perform the following steps:

1. Ensure all circuit breakers are depressed

2. Remove camera lens covers.(Install filter as required.)

CAUTION

Never remove a TV camera lens cover or a daylight filter from a camera lens when the camera is turned "ON". The sudden change in light level can seriously damage intensifier and/or vidicon tube.

WARNING

Due to turbulence around the multi-sensor platform, extreme care must be exercised when TV lens covers/filters and laser covers are installed or removed in flight. When filters are to be changed during flight, a safety observer will be present. When there is a need to go behind the flight deck ladder during flight, a restraining harness will be worn.

LLLTV controls and functions

Control	Description	Function
1. NTV light	Green push to test light	Indicates NTV camera is selected.
2. WTV light	Green push to test light	Indicates WTV camera is selected.
3. TV control knob	Rotary switch	Controls power to both TV cameras and selects filter positions for NTV. (See figure 4-97).
4. FOCUS Switch	Center off momentary switch	Controls focus adjustment for the NTV.
5. CONSENT button	Internally illuminated (yellow) buttontype switch	Provides operator interface with the aircraft fire control system and indicates that "consent" has been given.
6. MOUNT OPERATE light	Green Light	When illuminated indicates that TV/Laser platform can be operated; when extinguished indicates that platform has completed automatic caging sequence and is stowed in -65 degree azimuth and 0 degree elevation position.

Figure 4-98.

3. MOUNT POWER switch - ON
4. RCU's - ON/Set

CAUTION

Operator will insure that LLLTV cameras are pointed away from any light source including those inside the aircraft before turning the LLLTV on.

5. Monitors - ON
6. TV Control Knob - Reference figure 4-97 - ON
7. RCU's - GRAY SCALE/As required
8. Monitors - Adjust as required

Note

The VERT HOLD, HORIZ HOLD and HEIGHT CONTROLS are located on the recessed panel at bottom of the monitor chassis.

a. If picture is horizontally unstable, adjust HORIZ HOLD control

b. If picture height is abnormal, adjust HEIGHT control.

c. If picture is rolling vertically, adjust VERT HOLD control.

9. When MOUNT OPERATE light illuminates, use platform hand control to slew TV/Laser platform.

10. On the remote control unit, select desired video by pressing WTV, NTV or IR pushbutton.

11. Adjust focus on NTV as required.

12. To produce a dot-quad or crosshair reticle during WTV or NTV operation, pull out DQ or CH control. Rotate control to vary reticle shade from black to white.

13. After sighting a possible target, slew field of view until the target is centered in the reticle dot quad. If reticle is not centered on the monitor, the dot quad must still be superimposed on the target.The reticle center represents the boresight point of the TV. (If not centered, it can be moved by maintenance personnel.)

14. Press the CONSENT switch on the TV/LTD control panel when tracking a target. Consent must be ON before the pilot can fire in the Auto mode or before target storing can be accomplished with the inertial targeting system.

15. Adjust SENSITIVITY and DRIFT controls on the platform hand control unit as necessary to facilitate ease of tracking.

16. Before landing, return switches and controls to OFF.

17. After landing, install TV and Laser lens covers.

SOLID STATE LASER ILLUMINATOR, AN/AAQ-7

The solid state laser is a device which provides pulsed beam illumination and range of an object during operation of the narrow angle TV camera. The narrow angle camera detects the laser reflection which is selected for viewing on a TV monitor. This camera turns on only after the laser beam has returned to the airplane. Range is presented as a reticle on the TV monitor. The laser is aimed by the TV Operator who controls movement of the TV/laser platform with a joystick. Since the optic axes of the laser head and narrow angle TV camera are parallel, the laser aims at what is centered in the narrow angle field of view. Included in the laser system is the laser illuminator control, laser head, and electronic control amplifier (ECA), and dewar flask (figure 4-99). The laser illuminator control is located at the TV Operator console, the laser head on the TV/laser platform, and the electronic control amplifier on the flight deck extension above the TV/laser platform. The dewar flask, containing coolant for the laser head, is on a shelf in the left side of the cargo compartment, just aft of the TV/laser platform. Power for the system is 28-volt dc protected by circuit breakers on the cargo compartment dc circuit breaker panel and TV console circuit breaker panel.

NOTE

Because the laser illuminator operates at a wavelength of 0.86 microns and the LTD operates at a wavelength of 1.06 microns, both lasers may be operated simultaneously without interfering with each other. Laser guided bombs will guide only on the LTD.

LASER ILLUMINATOR CONTROL, C-9330

The illuminator control (figure 4-95) is provided for control of the solid state laser, and is located at the TV Operator console. Included on the control are nine pushbutton switches, two variable controls, and a four-section indicator light. Functions of the controls and indicators are depicted in figure 4-101.

The auto range gate function will keep the range gate centered automatically under all but the most rapid platform motions. Also, the auto range may break lock due to a sudden bright explosion or an imbalance return situation such as a land/water contrast, i.e., land on top half of scope and water on bottom half. If the range gate breaks lock it will automatically initiate a search around the slant range selected on the manual range control. The search will start 3000 feet more than the selected slant range and continue until 3000 feet less than the selected slant range. The search function will then reverse itself and search outward until it is 3000 feet beyond the selected slant range. Each 6000 foot scan will take one second. When system is in auto search, picture will blink twice each second until system reacquires range gate.

For most operating conditions the B, C, and D positions of the CAMERA GATE WIDTH should be used. The position selected will depend on atmospheric conditions, slant range, and the depression angle of the sensor. The intensifier pulse widths for the respective laser control camera gate widths are (A) 0.5 microseconds; (B) 1.0 microseconds; (C) 2.0 microseconds; (D) 3.0 microseconds, and WIDE which is 38.1 microseconds.

The mount power must be on and platform positioned within operating limits to get laser to illuminate. Under most conditions the WIDE position of the CAMERA GATE WIDTH should not be used. This position operates the camera gate at a 50% duty cycle and allows much of the backscattered energy to enter the camera reducing the scene contrast. Wide position will work very well on clear night. The camera is gating in this position and the range reticle will appear, but will not be accurate (9000 feet in error). In addition, unless it is very hazy and/or it is raining, the A position of the CAMERA GATE CONTROL should be avoided. This position employs a very narrow gate pulse that causes the image intensifier to defocus slightly causing a small loss of resolution.

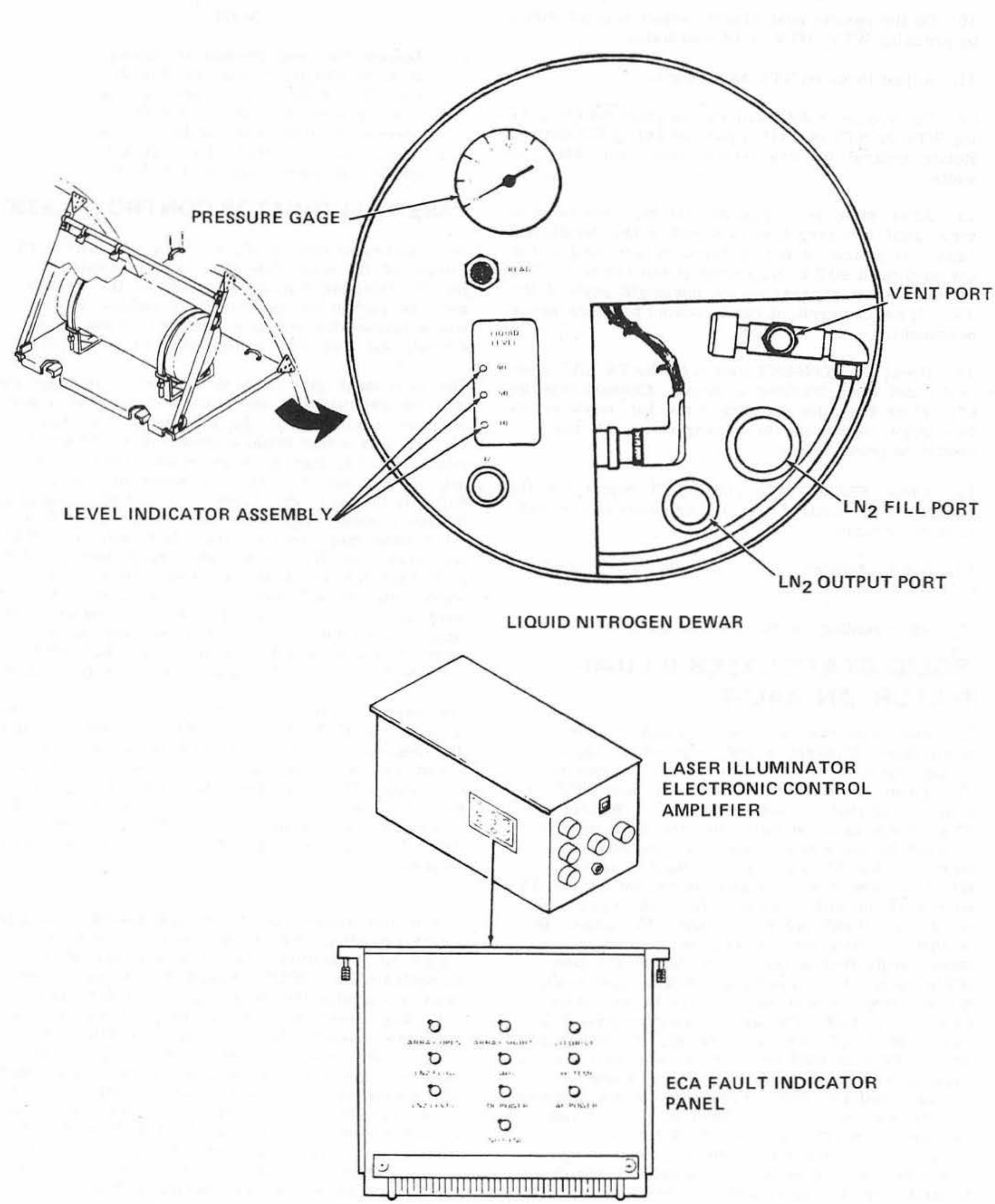

PRESSURE GAGE
VENT PORT
LEVEL INDICATOR ASSEMBLY
LN_2 FILL PORT
LN_2 OUTPUT PORT
LIQUID NITROGEN DEWAR
LASER ILLUMINATOR ELECTRONIC CONTROL AMPLIFIER
ECA FAULT INDICATOR PANEL

Figure 4-99.

Laser Head, MX-9411

WARNING

Personnel shall avoid nitrogen vent ports of the laser head, to preclude injury if liquid nitrogen is forced overboard.

The laser head, which is located on the TV/laser platform, generates a pulsed laser beam on command. This beam is directed at an object of interest and its reflection detected by the narrow-angle TV camera. The reflected image can then be selected for viewing on a TV monitor. Triggering of the laser is accomplished by a pulse from the ECA. When this occurs, laser light is produced at the lens. The laser head mainly consists of an illuminator and trigger pulse amplifier. Laser power is generated by 72 gallium arsenide diodes connected in series in the illuminator. The laser head is cooled by liquid nitrogen, which is stored in the dewar flask and routed to the laser head through transfer lines. In the laser head the nitrogen circulates through a heat exchanger where it is converted to a gas by heat from the diode array. This gas then exits through a vent pipe. The laser head receives dc voltages from, and sends fault indications to the ECA.

ELECTRONIC CONTROL AMPLIFER, AM-6956

The electronic control amplifier (ECA) provides power and trigger pulses for the laser head, and monitors various parameters for possible faults. Power generated by the ECA power supply is +5, +12, -12, and +150 volt dc. The ECA is located on the flight deck extension above the TV/laser platform. Controls and indicators include a circuit breaker, elapsed time indicator, and fault indicator panel (figure 4-99). A description of indications on the fault indicator panel is contained in figure 4-102.

DEWAR FLASK, MX-9413

The dewar flask (figure 4-99) is a storage reservoir for liquid nitrogen which is used for laser head cooling. The flask is located on a shelf in the left side of the cargo compartment just aft of the TV/laser platform. Usable capacity of the dewar is 26 liters. During system operation nitrogen is consumed at rates from 3.0 liters per hour during maximum laser output, to 0.5 liter per hour in the standby mode. When nitrogen drops below the 10 percent level, the N2 QTY fault indicator on the laser illuminator control illuminates. A pressure gage, READ switch, and LIQUID LEVEL indicator are provided on the dewar. The level indicator is read by pressing the READ switch. When the READ switch is pressed, indicator lights will illuminate to show either 10%, 50%, or 90% level. Level-sensing circuitry is powered by +12-volt dc from the ECA, or from a 9-volt battery when the +12-volt dc is absent. The battery is part of the dewar.

If none of the level sense indicators illuminate and the dewar is known to have liquid nitrogen in it, the indicators can be checked by disconnecting the plug on the right side of the level sense assembly and pushing the READ button. This should illuminate all the indicators.

Note

Dewar should be 90% full to fly two missions and at least 50% full to fly one mission.

Nitrogen pressure within the dewar is normally 8 to 10 psi. If pressure drops below 3 psi, a pressure switch activates a heater which accelerates pressure buildup. If pressure exceeds approximately 8 psi, a relief valve in the top of the dewar will open.

dewar controls and indicators

Control	Description	Function
1. Dewar pressure	Pressure gauge	Indicates pressure inside dewar.
2. READ button	Spring loaded pushbutton switch	Depressing READ button applies internal dewar battery power to level sense circuit in dewar.
3. LIQUID LEVEL indicators	Light emitting diodes (LED)	When READ button is depressed indicators show quantity of liquid nitrogen in dewar. Accuracy of indicators is 90%, 24 (+2, -1) liters; 50%, 15 (+4, -3) liters, 10%, 4 (+2, -1) liters.

Figure 4-100.

The system requires a minimum pressure of 6 psi for normal operation. During preflight, if nitrogen pressure is below 6 psi, it is often possible to raise pressure by turning the system to STBY. This turns on an internal heater in the dewar which increases the liquid nitrogen evaporation rate, increasing the gas pressure in the dewar. If nitrogen pressure will not reach 6 psi after about 15 minutes of STBY operation, the system has a malfunction. If the system pressure reads less than 6 psi during inflight operation, it has a malfunction. There is also a problem in the system if it indicates more than 11 psi on the ground or more than 14 psi in flight.

WARNING

Personnel should avoid vent port of dewar to preclude injury if liquid nitrogen is forced overboard. Normal operation of the system requires bleed off of nitrogen gas, from a valve located at the base of the TV mount. The indication of bleed off will be a noise similar to a small fog horn and a vapor may appear.

SYSTEM PARAMETERS

Maximum Output Power (Nominal)	28 Watts
Operating Wavelength	0.86 microns
Pulse Repetition Rate	13.12 KHz ± 1.313 KHz
Pulse Width	1.00 to 0.25 microseconds
Field of Illumination	2.8° (49.0 mils) horizontal 2.1° (36.6 mils) vertical
System Operating Temperature	100 to 135° Kelvin
Liquid Nitrogen Supply	26 liters
Liquid Nitrogen Usage Rate	3 liters of liquid nitrogen per hour at maximum power
Liquid Nitrogen Evaporation	2 1/2 liters of liquid nitrogen per day

NORMAL OPERATION OF LASER ILLUMINATOR

WARNING

Permanent eye damage can occur from viewing laser at distances of less than 80 feet or reflected laser beam at a total distance of less than 80 feet. Area in front of crew entrance door should be cleared and guard posted before operation of laser is attempted without lens cap in place.

When the laser illuminator is not in use, set illuminator controls to the following positions:

1. POWER - OFF
2. RANGE - MNL
3. OUTPUT - RPP
4. PULSE WIDTH - MIN (full CCW)
5. CAMERA GATE WIDTH - C
6. Lens cap - Installed

For normal operation, perform the following steps:

1. Remove lens cap and place in lens filter case.
2. Ensure liquid nitrogen dewar is pressurized to at least 6 psi and that it is 50% full if one mission is to be flown and 90% full if two missions are to be flow. If dewar contains liquid nitrogen but pressure is less than 6 psi, it is often possible to raise pressure by turning the system on. This turns on an internal heater in the dewar which increases the liquid nitrogen evaporation rate, increasing the gas pressure in the dewar.
3. Circuit breakers checked -
   a. Laser illuminator electronic control amplifier.
   b. Cargo compartment dc circuit breaker panel
   c. TV console circuit breaker panel
4. TV/LTD control panel - NTV on

   (DAY NTV/NIGHT NTV as required)
5. Illuminator control panel -
   a. PWR - STBY (READY light should illuminate in 10 to 15 minutes). If no cooldown within 30 minutes system will not operate.
   b. STATUS - LASE (as required). Lasing will be interrupted when multisensor platform engages a limit switch and will automatically resume firing when limit switch is disengaged.
   c. OUTPUT - RPP (MAX if required).

AN/AAQ-7 controls and functions

<table>
<tr><th>Control</th><th>Description</th><th>Function</th></tr>
<tr><td>1. POWER switch</td><td>Internally illuminated (White/ green) pushbutton switch</td><td>In OFF position all power removed from laser. In STBY position laser starts cool down.</td></tr>
<tr><td>2. STATUS Switch</td><td>Internally illuminated (Green/ red) pushbutton switch</td><td>READY light illuminates when laser is cooled down. Depressing switch initiates lasing, LASE portion of switch illuminates. Depressing switch during lasing returns it to the READY state.</td></tr>
<tr><td colspan="3">Note
Lasing cannot be initiated until the STATUS switch is depressed after the READY light has illuminated.</td></tr>
<tr><td>3. OUTPUT Switch</td><td>Internally illuminated (Green) pushbutton switch</td><td>In MAX position laser emits maximum power. In RPP (Range Proportional Power) laser output varies according to slant range and the setting of the PULSE WIDTH control. Min pulse time is .25 microseconds (2.25 watts)/MAX pulse time is 1.00 microseconds (28 watts).</td></tr>
<tr><td>4. PULSE WIDTH knob</td><td>Rotary potentiometer</td><td>Varies laser pulse width and power when OUTPUT control is in the RPP position.</td></tr>
<tr><td>5. FAULT indicators</td><td>Lights</td><td></td></tr>
<tr><td colspan="3">a. N2 QTY – Indicates dewar is less than 10% full. Approximately one hour of operating time remaining.
b. INTLK – Indicates lasing has ceased due to TV/Laser platform engaging limit switches. Limits are minus 14 degrees to plus 44 degrees azimuth, plus 3.5 minus 64 degrees elevation.
c. AC PWR – Indicates aircraft DC power has exceeded 30 volts or fallen below 22volts. Laser may shut down; however the Laser and TV equipment need not be turned off and may continue to operate normally.
d. FAULT – Indicates self-monitoring circuits have detected an undesirable condition(s). Lasing will not start or will stop if condition(s) is damaging to the unit. Type of fault is displayed behind the window on the electronic control amplifier on the flight deck extension. (See figure 4-99.) The FAULT light illuminatess when the system is turned on and may remain on for up to five minutes after the READY light illuminates. If the FAULT light is still illuminated after this time a legitimate fault exists and the diagnostic panel on the laser electronic unit should be checked.</td></tr>
<tr><td>6. RANGE Switch</td><td>Internally illuminated (Green) pushbutton switch</td><td>In MNL the CONTROL knob is used to adjust the range gate. In AUTO the range gate is controlled automatically and will re-acquire if the gate breaks lock.</td></tr>
<tr><td>7. RANGE CONTROL Knob</td><td>Rotary potentiometer</td><td>Varies range gate when RANGE switch is in the MNL position from approximately 1000 to 36,000 feet.</td></tr>
<tr><td>8. CAMERA GATE WIDTH selectors switches</td><td>Internally illuminated (Green) pushbutton switches</td><td>Allows operator to select A, B, C, D or WIDE gate widths.</td></tr>
</table>

Figure 4-101.

ECA fault indicator panel indication and description of fault

Indicator	Fault Description
ARRAY OPEN	Break in diode array circuitry.
ARRAY SHORT	SHORT in diode array. It is possible to get indication at turn on due to high ramp temperature causing low impedance across array.
LO DRIVE	Diodes not pulsing at proper voltage (below 1/2 power).
LN2 FLOW	Stays on for approximately 10 minutes during initial cooldown. After cooldown N2 level in head is maintained by 90% and 70% level sensors. At 70% full a flow signal is generated. If a 90% full condition is not achieved within 2 minutes, an LN2 FLOW indication will come on.
SRO (Sensing Resistor Open)	A level or temperature resistor in the laser head is open.
HI TEMP	Will be on during initial cooldown and anytime diode array warms above a normal operating temperature. (If there is an actual LN2 FLOW blockage associated with a HI TEMP signal, the set will eventually shut itself off.)
LN2 LEVEL	Less than 10% LN2 in DEWAR. N2 QTY fault indicator on laser illuminator control also illuminates.
DC POWER	Illuminates if any of the DC voltages (+150, +5, +12, or −12VDC) are abnormal in the ECA. May not turn system off - could lose a sensing circuit, for example.
AC POWER	Aircraft power is below 22VDC or above 30VDC. Laser may shut off; however, the laser and TV equipment need not be turned OFF and may continue to operate normally.
NO SYNCH	No RPP pulse from camera electronic unit (can get laser indication but will not lase.)

Figure 4-102.

d. CAMERA GATE WIDTH - A, B, C, D or WIDE (as required)

e. RANGE - MNL (adjust RANGE control for proper setting)

f. RANGE - AUTO

g. TV Operator 14 inch RCU - CH RETICLE on

6. Before landing - POWER to OFF

7. After landing - Install lens cover.

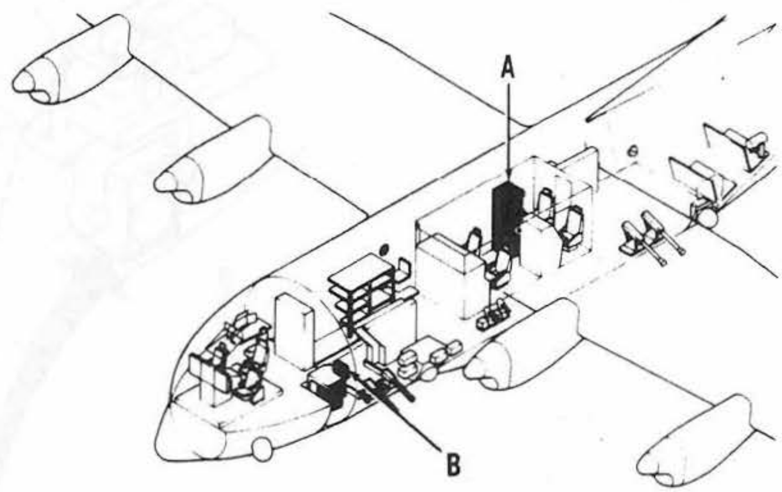
LASER TARGET DESIGNATOR, AN/AVQ-18

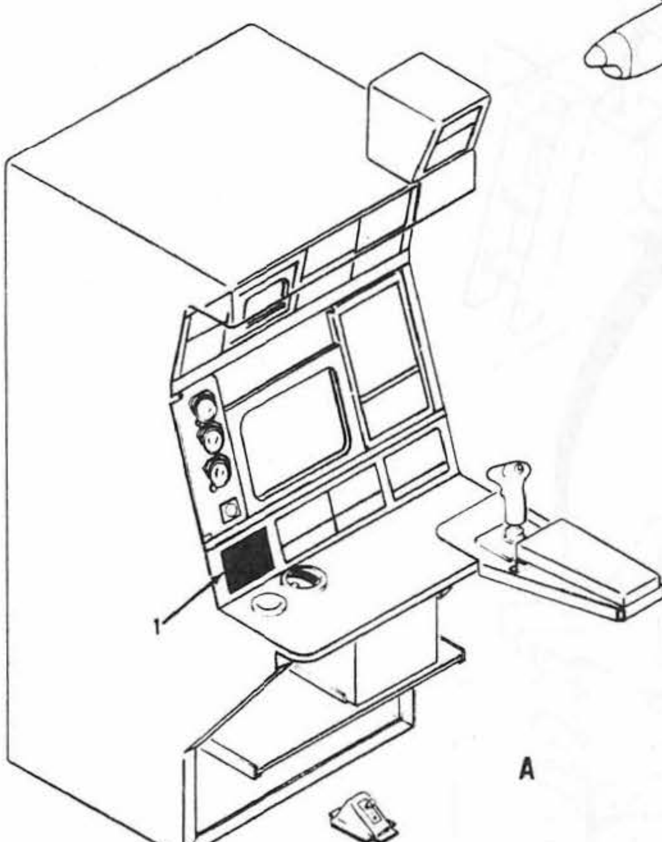
The laser target designator (LTD) (figure 4-103), is an electro-optical device that provides laser target designation for cooperating strike aircraft. The LLLTV points the laser at the target. Included in the LTD is a power supply, transmitter, and a TV/LTD control. Location of the power supply is above the TV/laser platform on the flight deck extension. The transmitter is on the TV/laser platform, is boresighted to the narrow angle TV camera, and the control is located at the TV operator console. Power supplied to the system is 28-volt dc, and 115-volt, 400-Hz ac protected by two circuit breakers on the main power distribution box.

WARNING

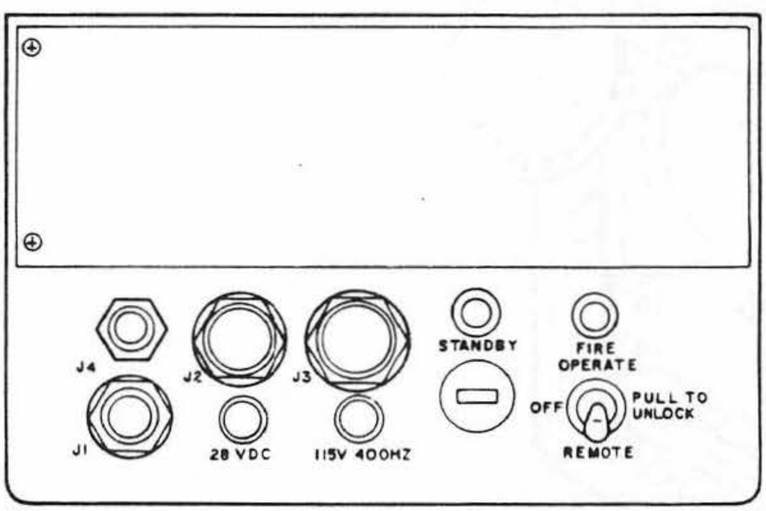
Exercise extreme caution when operating the LTD. The laser beam can cause serious eye damage, or blindness, if it enters directly, or is reflected into the eyes. Do not direct the beam at personnel or at objects with a reflective surface during checkout.

AN/AVQ-18 laser target designator (LTD) component locations

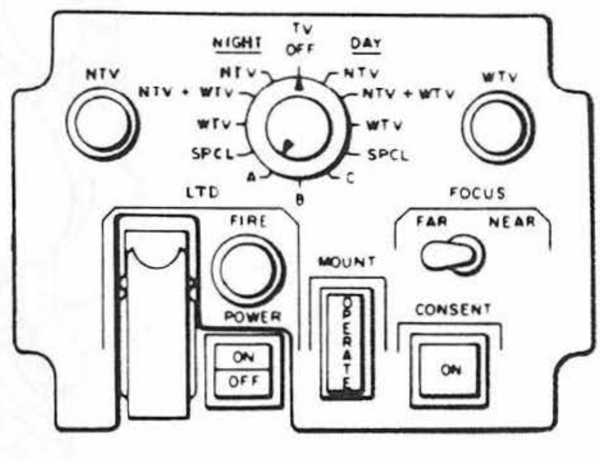




1. C-9329/AXQ-10(V) TV/LTD CONTROL PANEL
2. 910175 901 TRANSMITTER
3. 910178 901 POWER SUPPLY



910178-901 POWER SUPPLY



C-9329/AXQ-10(V) TV/LTD CONTROL PANEL

Figure 4-103 (Sheet 1 of 2).

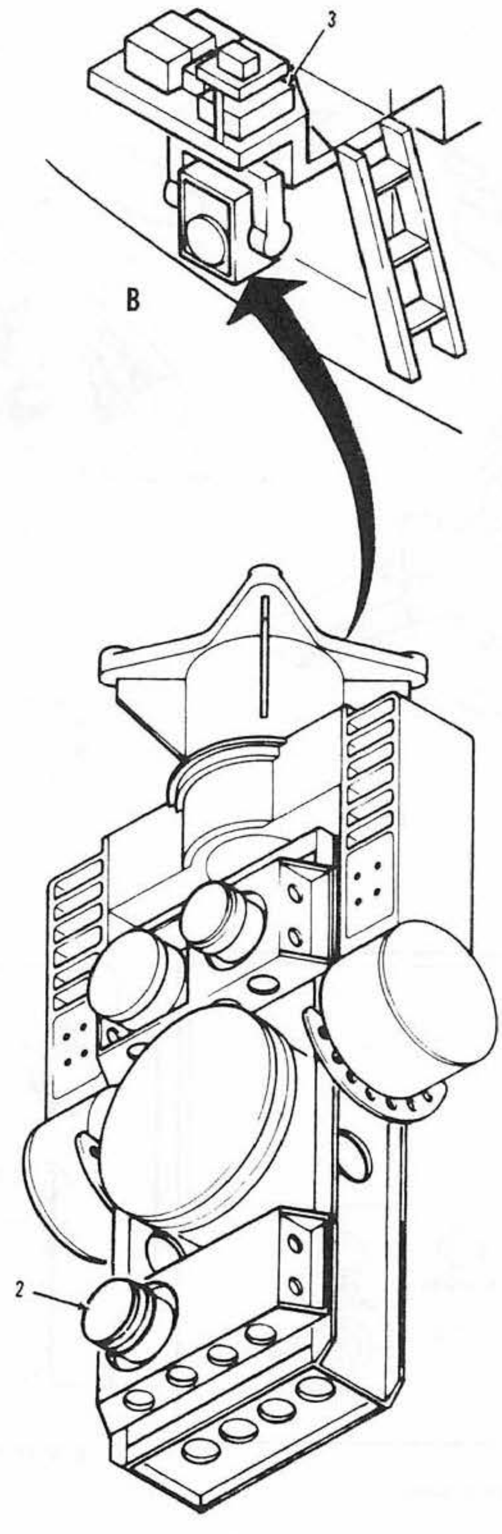


Figure 4-103 (Sheet 2 of 2).

TV/LTD CONTROL

On this panel (figure 4-104), controls and indicators which pertain to operation of the LTD are the LTD POWER pushbutton, guarded LTD FIRE toggle switch, and the LTD FIRE indicator. Indications and functions of the TV/LTD control LTD switches and indicators are listed in figure 4-105.

TV/LTD control

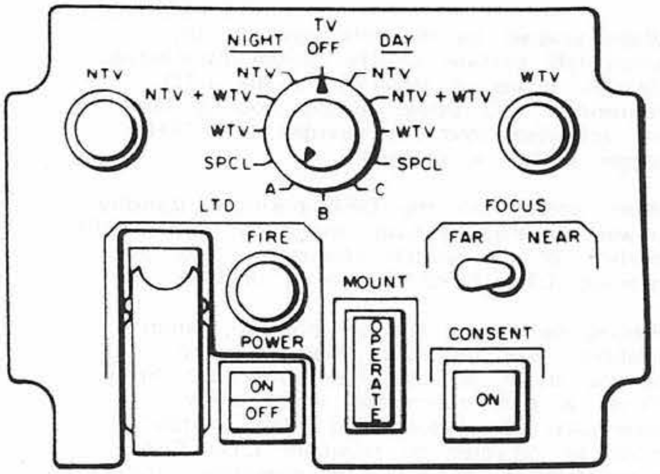


Figure 4-104.

LASER SAFETY INTERLOCKS

Interlocks are provided for the TV/laser platform that prevent firing inside the airplane or reflection off various airplane surfaces. When laser firing is discontinued because of defeat by the platform interlock, recycle the laser fire switch when laser is within operating limits. Laser interlock limits are 3.5 degrees up, 64 degrees down, 14 degrees aft, and 44 degrees forward.

LASER TARGET DESIGNATOR POWER SUPPLY

The LTD power supply provides the control and operating voltages for the LTD system, and is located above the TV/laser platform. Also the laser standby and fire commands are processed through the power supply. Provided on the front panel are circuit breakers for ac and dc overload protection, STANDBY and FIRE lamps, OPERATE-OFF-REMOTE toggle switch, and a total time meter which indicates elapsed time in hours. The STANDBY lamp illuminates when the system is in the standby mode, and the FIRE lamp flashes bright and dim when the system is lasing. System power is activated by the OPERATE-OFF-REMOTE switch. For remote system operation from the TV console, this switch is maintained in REMOTE position.

CAUTION

To prevent overheating, do not cover cooling fan on back of power supply.

LASER TARGET DESIGNATOR TRANSMITTER

The LTD transmitter, which is mounted in a gimbal on the TV/laser platform, consists primarily of optical components and high voltage circuits. Upon command, the transmitter will emit a collimated, pulsed laser beam in the near infrared spectrum. The external optical components include a telescope and beam steering prism attached to the telescope mount at the front of the transmitter. Integral with the transmitter is a liquid cooling system and liquid-to-air heat exchanger. Heat from the laser rod and flashlamp is transferred to the coolant which is then pumped through the heat exchanger. A fan circulates ambient air through the heat exchanger to provide hea dissipation up to 250 watts.

NORMAL OPERATION OF LTD

1. Position LTD POWER switch at TV/LTD control to ON. Verify that LTD POWER ON lamp illuminates.
2. To fire laser, position LTD FIRE switch at TV/LTD control to ON. Verify that FIRE lamp illuminates.

WARNING

Serious eye damage or blindness may result if the energy of the LTD is beamed either directly or indirectly into the eyes from a distance of less than 4000 feet. If the laser does not stop lasing when the laser safety limits are reached, turn laser OFF.

3. To stop firing, position LTD FIRE switch to OFF Verify that FIRE lamp extinguishes.
4. Position LTD POWER switch to OFF. Verify that LTD POWER ON lamp extinguishes.

AIRBORNE SEARCHLIGHT SET, AN/AVQ-17 (2KW LIGHT)

An AN/AVQ-17 airborne searchlight set (figure 4-106) is installed on the left side of the aircraft aft of the left paratroop door. The searchlight set provides a visual and infrared (IR) light source to illuminate and track fixed targets on the ground. The system

TU/LTD Laser target (designator controls and functions

Control	Description	Function
	NOTE The LTD power supply power switch must be set to REMOTE for the TV/LTD power and fire switches to be enabled.	
Power Switch	Pushbutton POWER ON/OFF indicator switch	When pressed to the ON position, the green ON portion of the switch illuminates, standby power is supplied to the LTD, transmitter and power supply cooling fans are activated, and the guarded LTD FIRE toggle switch is enabled. When pressed to the OFF position, standby power is removed from the LTD, white OFF portion of the switch illuminates, and the guarded LTD FIRE Switch is disabled.
LTD FIRE Switch	Guarded toggle Switch	Placing switch to the up position, when enabled, fires the LTD. Placing switch to the down position interrupts LTD firing Firing is also interrupted when safety interlocks are engaged and FIRE switch must be recycled to reinitiate LTD Fire when laser is again within operating limits.
Fire Indicator	Red Light	Illuminates while the laser is firing.

Figure 4-105.

provides 40,000 lumens output in the spectrum from 0.25 to 2 microns with a nominal lamp power of 2.2 KW. A 2KW xenon arc lamp is used as the light source. A collector mirror, mounted behind the lamp, collects and directs lamp energy in a uniform 6 degree beam and provides a reflectivity of at least 85% throughout the visible spectrum. Searchlight cooling is provided by a vane blower. Either an IR filter assembly or visual cover assembly can be mounted on the front of the searchlight. Operating controls (figure 4-106) are located on the searchlight control panel at the TV operator station.

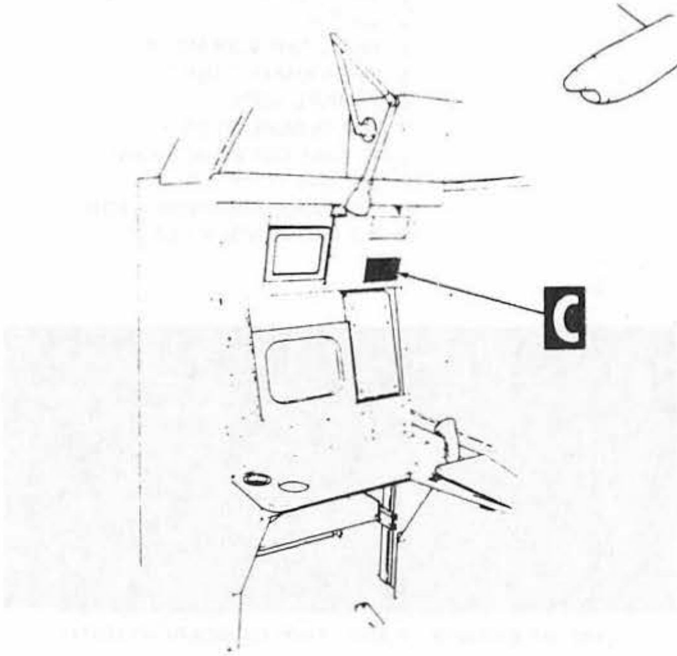
The searchlight is mounted on a servo driven gimballed platform capable of being slaved to align itself to the angular position in elevation and azimuth of the sensors. The platform provides the elevation and azimuth gimballing to the attached searchlight. Gimbal may be inclined at any position through ±50 degrees in elevation (about the horizontal) and ±91 degrees in azimuth (about the platform's nominal zero reference). Installation limitations for this airplane are ±15° of azimuth and +5° to -40° in elevation. The platform operates in the slave mode only. Cushioned mechanical stops are provided in each axis. The stops are adjustable so that gimbal travel may be limited to suit the installation. Each gimbal has provisions for manual caging and uncaging by means of stop pins. The platform can be caged at -90 degrees, 0 degrees and +90 degrees in azimuth; and 0 degrees in elevation.

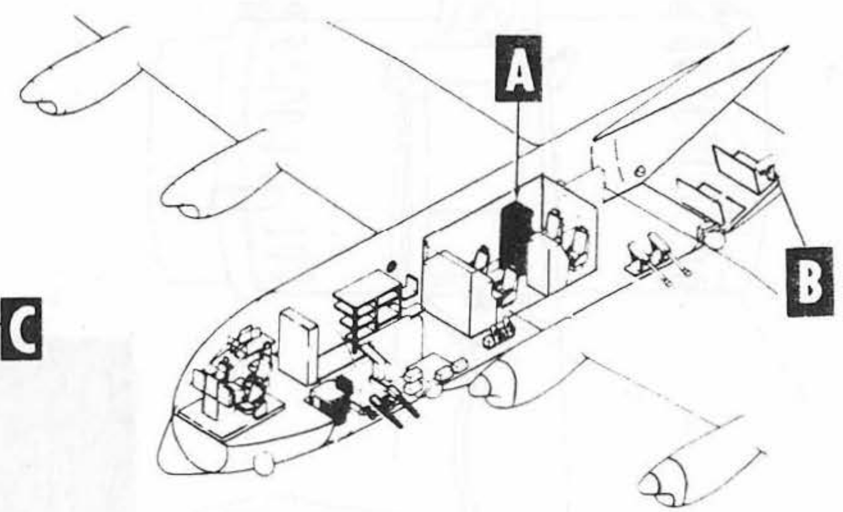
Operating power of 115-volt, 400-Hz is supplied to the searchlight set through circuit breakers located on the cargo compartment ac circuit breaker panel, and 28-volt dc is supplied from the main dc bus. Circuit breakers are provided on top of the searchlight for electrical protection.

Mounted at the rear of the searchlight is an elapsed time indicator which continuously runs whenever the SEARCHLIGHT POWER ON switch (located on the searchlight control) is energized. The elapsed time indicator indicates the total hours the lamp has been operated.

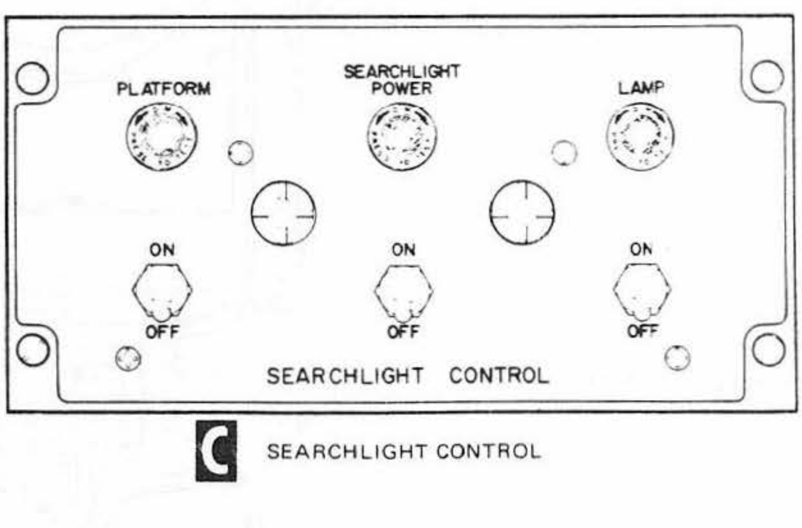
A list of the 2KW searchlignt controls and functions is depicted in figure 4-107.

2kw searchlight system (AN/AVQ-17)





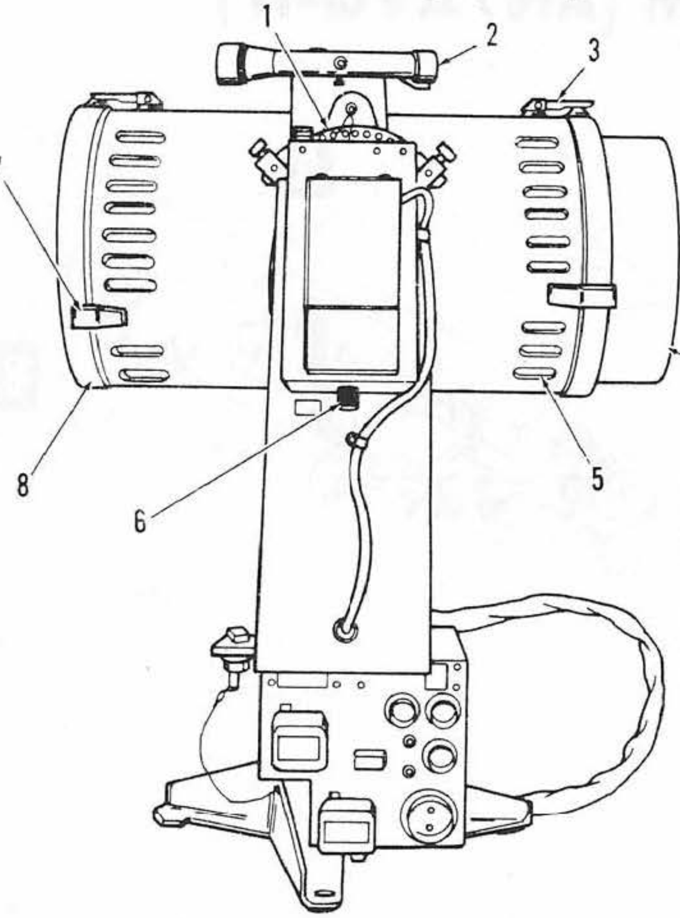
A TV CONSOLE



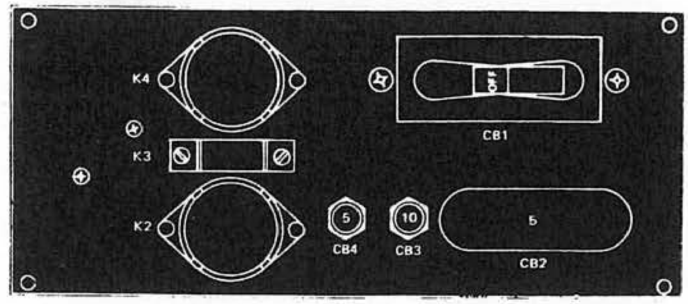
C SEARCHLIGHT CONTROL

Figure 4-106. (Sheet 1 of 2)

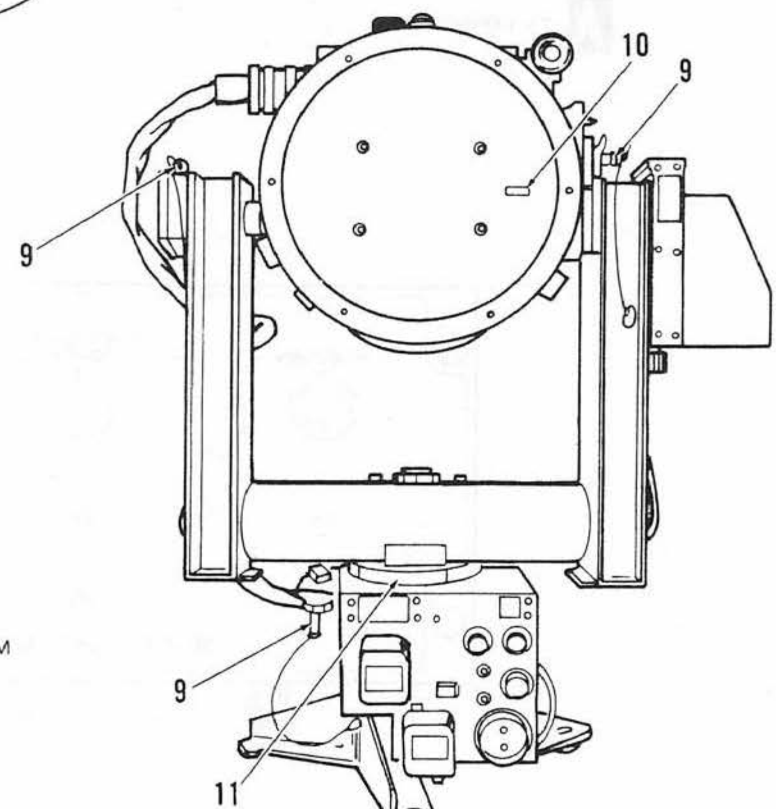
2kw searchlight system (AN/AVQ-17)



1. ELEVATION INDEX PLATE
2. TELESCOPE
3. LATCH
4. IR FILTER ASSEMBLY
5. AIR EXHAUST DUCT
6. GIMBAL LOCK
7. AIR INTAKE DUCT
8. VISUAL COVER ASSEMBLY
9. CAGING LOCK PIN
10. ELAPSED TIME INDICATOR
11. AZIMUTH INDEX PLATE



CIRCUIT BREAKER PANEL (TOP OF SEARCHLIGHT)



B SEARCHLIGHT AND PLATFORM

Figure 4-106. (Sheet 2 of 2)

TURN-ON PROCEDURE

1. Remove caging pins from platform.

NOTE

On some airplanes friction locks are installed. They must be loosened before utilization of the platform.

CAUTION

Do not operate the platform while caging pins are installed.

2. Place platform ON-OFF switch to the ON position. Green PLATFORM ON indicator should illuminate.

3. Place SEARCHLIGHT POWER ON-OFF switch to the ON position. Green SEARCHLIGHT POWER indicator should illuminate.

CAUTION

Allow 15 seconds for capacitor to charge before turning lamp on.

CAUTION

Check at searchlight to assure blower is operating, and air is flowing in the rear slots. If reversed, or very small amount of air flow is noted the SEARCHLIGHT POWER ON switch must be turned OFF and the illuminator should not be used.

2KW searchlight controls and functions

Control	Description	Function
Platform Switch	ON/OFF toggle switch	Energizes or de-energizes the platform power circuits.
Platform Indicator	Green Press-to-Test Light	Illuminates when platform power circuits are energized.
Searchlight Power Switch	ON/OFF toggle switch	Applies power to lamp starting capacitor, blower motor and elapsed time indicator.
Searchlight Power Indicator	Green Press-to-Test Light	Illuminates when power is applied to blower motor and elapsed time indicator.
LAMP Switch	ON/OFF toggle switch	Energizes or de-energizes the remainder of searchlight electrical circuits and xenon lamp. The lamp cannot be energized until searchlight power switch has been turned on for approximately 15 seconds.
Lamp indicator	Amber Press-to-Test Light.	Illuminates when the xenon lamp is energized. LAMP indicator should come on approximately 1 to 2 seconds after LAMP switch is turned on.

Figure 4-107.

4. Place LAMP ON-OFF switch to the ON position. Amber LAMP indicator will illuminate when xenon lamp is on.

WARNING

The xenon lamp used in the searchlight is of extreme high intensity. Serious eye damage may result if eyes are unprotected while looking into the lamp. Always wear protective welders goggles.

WARNING

20,000 volts are present when the lamp is started.

WARNING

The IR filter should be positioned in front prior to takeoff if it will be used during the mission. Slipstream wind blast in flight makes changing of this filter very hazardous.

WARNING

The xenon lamp located inside the searchlight has a potential for explosion. It is mandatory that personnel working around the lamp house assembly (when filter or visual housing is removed) wear protective face shields, gloves, and outer clothing.

CAUTION

The ballast assembly will not be properly cooled if the light is operated without either the visual housing or IR filter installed.

CAUTION

Ensure that the locking pins are fully installed. Failure to accomplish this will leave the light loose in the mount.

CAUTION

If amber LAMP indicator or xenon lamp does not come on at least 5 seconds after LAMP ON-OFF switch has been turned ON, immediately turn switch OFF and determine trouble.

CAUTION

Do not turn xenon lamp on and off unnecessarily. Each ignition of the xenon lamp is equal to 30 minutes of operation.

NOTE

The circuitry is constructed so that the lamp will not operate until the SEARCHLIGHT POWER ON-OFF switch has been turned ON. If light will not ignite recycle at least 15 to 20 times allowing 15 seconds between attempts.

TURN-OFF PROCEDURE

1. Place the LAMP ON-OFF switch to the OFF position. Xenon lamp and amber LAMP indicator should extinguish.
2. Wait approximately 30 seconds, then place the SEARCHLIGHT POWER ON-OFF switch to the OFF position. The SEARCHLIGHT POWER indicator should extinguish.

NOTE

The 30 second time delay is to allow adequate cooling of the searchlight before disabling the system.

3. Place the PLATFORM ON-OFF switch to the OFF position. The green PLATFORM indicator should extinguish.
4. Engage caging pins in the platform.

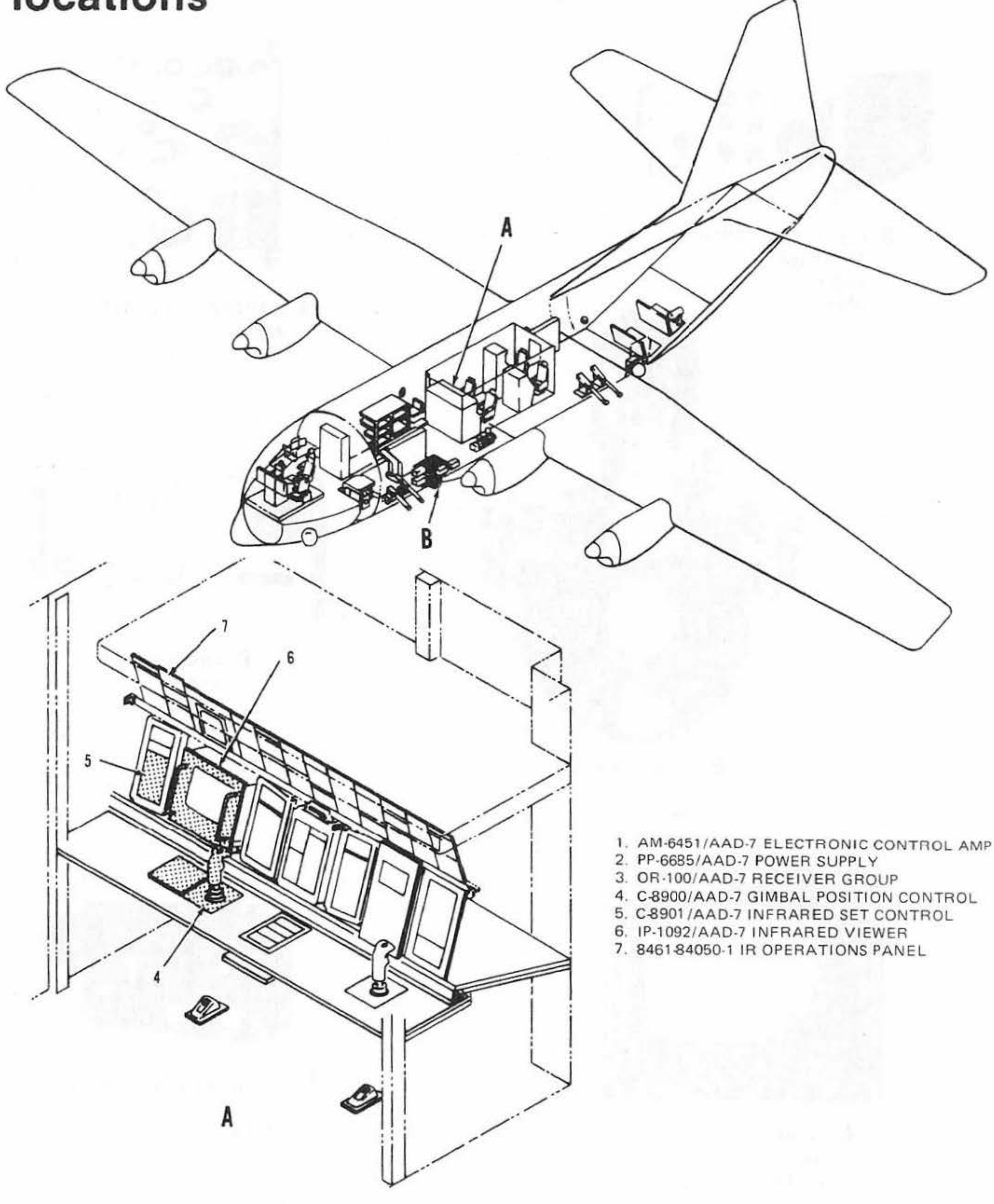
NOTE

If it is inconvenient to immediately engage the caging pins, after shutting down the searchlight, leave platform power on, allowing the searchlight set to track within its limits.

INFRARED DETECTING SET (IDS), AN/AAD-7

The Infrared Detecting Set (AN/AAD-7), (see figure 4-108), is an airborne infrared surveillance system which provides visual presentations of terrestrial

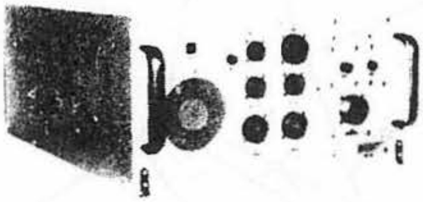
AN/AAD-7 infrared detecting set component locations



1. AM-6451/AAD-7 ELECTRONIC CONTROL AMP
2. PP-6685/AAD-7 POWER SUPPLY
3. OR-100/AAD-7 RECEIVER GROUP
4. C-8900/AAD-7 GIMBAL POSITION CONTROL
5. C-8901/AAD-7 INFRARED SET CONTROL
6. IP-1092/AAD-7 INFRARED VIEWER
7. 8461-84050-1 IR OPERATIONS PANEL

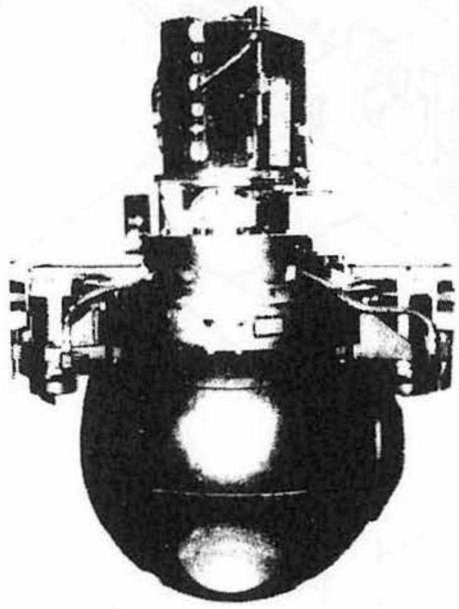
Figure 4-108. (Sheet 1 of 2)

infrared detecting set AN/AAD-7

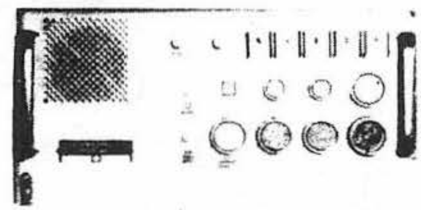


B ELECTRONIC CONTROL AMPLIFIER
AAD-7
UNIT 1

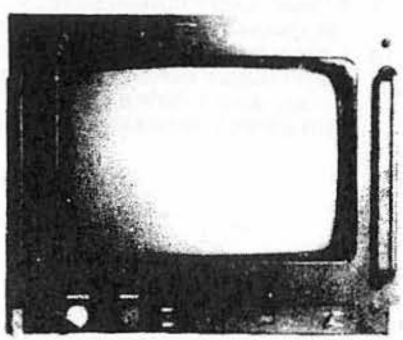
A INFRARED SET CONTROL
AAD-7
UNIT 5



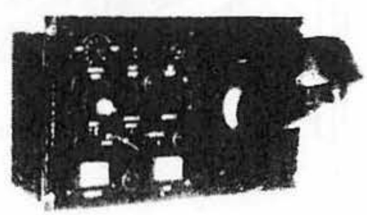
B RECEIVER GROUP
AAD-7
UNIT 3



B POWER SUPPLY
AAD-7
UNIT 2



A INFRARED VIEWER
AAD-7
UNIT 6



A GIMBAL POSITION CONTROL
AAD-7
UNIT 4

Figure 4-108. (Sheet 2 of 2)

objects over which the viewer is flying. The AN/AAD-7 is a passive system in that it senses an object by detecting the infrared energy radiated by that object. Wavelengths of infrared radiation are longer than visible light and shorter than microwaves, ranging from 0.7 to several hundred microns. All objects radiate infrared energy; the amount of energy radiated depends on the temperature of the object and its emissivity. Infrared radiation travels at the speed of light. As infrared energy passes through the atmosphere, some energy is lost through atmospheric scattering or absorption. The amount lost depends on the radiation wavelength and particles in the atmosphere (smoke, haze, fog or moisture). Infrared radiation is detected by detectors which change their resistance according to the number of photons absorbed. The detectors are transducers that convert infrared energy to an electrical signal which is amplified and processed to produce a representation of the detected radiation (figure 4-109). For controls and functions see figure 4-110 thru 4-116.

The Infrared Detecting Set (IDS) utilizes optical means to focus the infrared energy onto the detectors. The electronic signal received from the transducers is amplified and processed by electronic circuitry within the infrared receiver for viewing on a cathode ray tube (CRT) in the infrared viewer. Major components of the system are an electronic control amplifier, power supply, gimbal position control, (IDS) control, IR viewer, and receiver group. Power of 28 VDC and 115 V, 400 Hz, 3 Ø AC is supplied to the set through two circuit breakers on the cargo compartment AC circuit breaker panel and two circuit breakers on the cargo compartment DC circuit breaker panel.

The gimbal hand control is a stationary grip handle with a movable thumb switch. The thumb switch is pressure sensitivity and will cause the IR platform to move at a rate proportioned to the pressure. The relationship between the platform movement rate and the thumb pressure is controlled by the sensitivity control.

SYSTEM PARAMETERS

1. Parameters for SEARCH field of view (FOV) are as follows:

   a. Diagonal FOV $15^\circ \simeq 260$ mils

   b. Horizontal FOV $12^\circ \simeq 210$ mils

   c. Vertical FOV $9^\circ \simeq 160$ mils

2. Parameters for the TRACK field of view are as follows:

   a. Diagonal FOV $3.75^\circ \neq 65.6$ mils

   b. Horizontal FOV $3.00^\circ \simeq 52.5$ mils

   c. Vertical FOV $2.25^\circ \simeq 39.4$ mils

3. Parameters for the reticles are as follows:

   a. TRACK FOV — Two crosshairs, cross hatched at 5 mil intervals.

      Dot quad, 2.5 mils across.

   b. SEARCH FOV — Two crosshairs, crosshatched at 20 mil intervals. Magnification is approximately 4 to 1 from the SEARCH FOV to the TRACK FOV.

      Dot quad, 10 mils across.

OPERATING PROCEDURES

Ground Operation

1. Before turning set on, place controls on IDS control panel as follows:

   a. Mode select switch OFF.

   b. Built-in-test equipment (BITE) switch to SYS.

   c. Set polarity switch to WHT HOT.

   d. Set field of view select switch to REMOTE.

2. Check system circuit breakers for on/in condition (Power Supply, Electronic Control Amplifier and Cargo Compartment AC & DC CB Panels) and that connecting cables are secure.

3. Set gimbal mode select switch to BRAKE position. If amber STBY lamp on hand control illuminates, wait until it extinguishes and green OPERATE lamp illuminates before proceeding to step 4 (usually within 7 minutes). If amber STBY lamp does not illuminate and green OPERATE lamp is illuminated, wait 30 seconds before proceeding to step 4. Azimuth and Elevation limit lamps may illuminate when BRAKE position is selected.

SCHEMATIC OF AN/AAD-7 IR CONCEPT

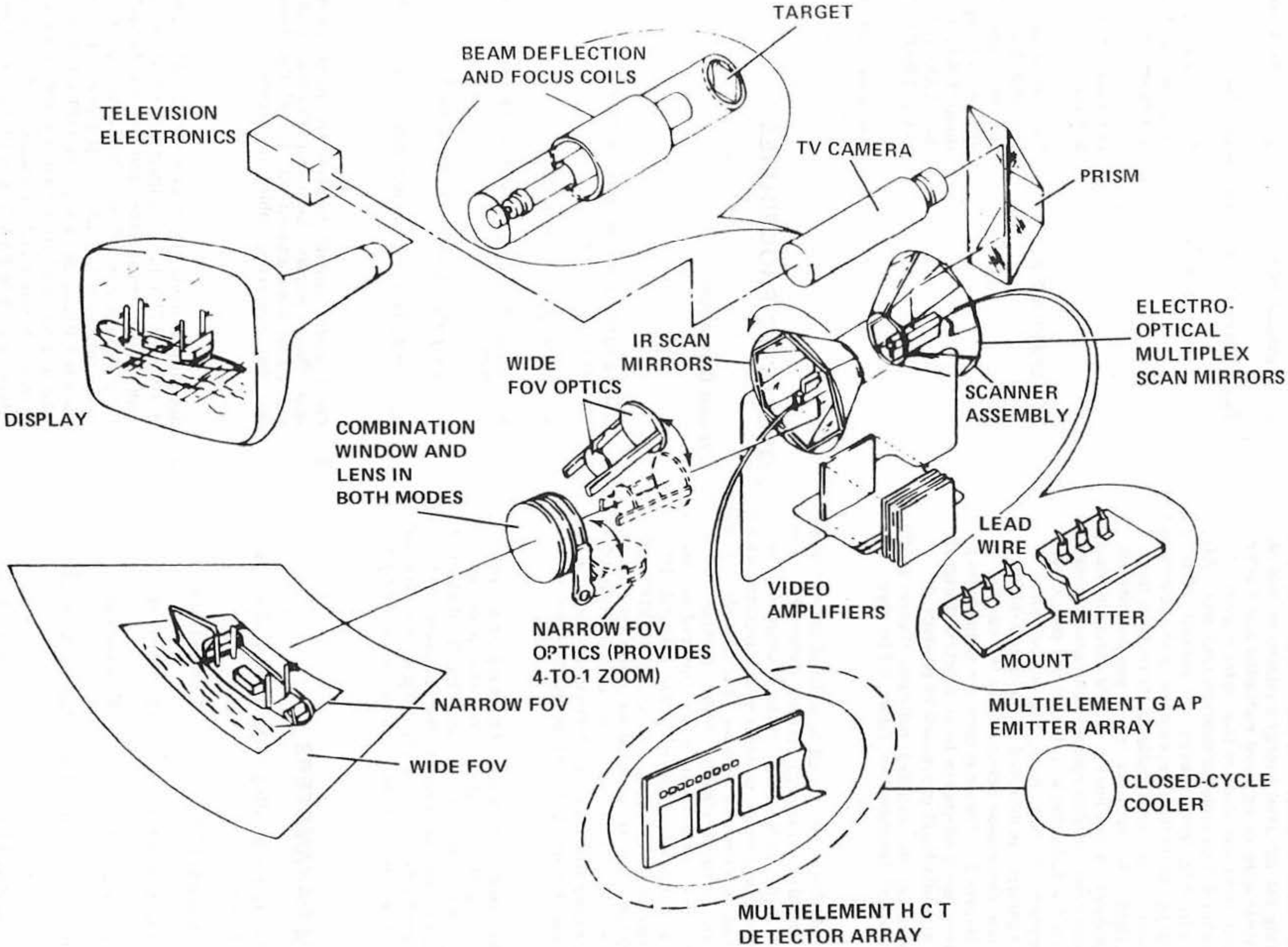
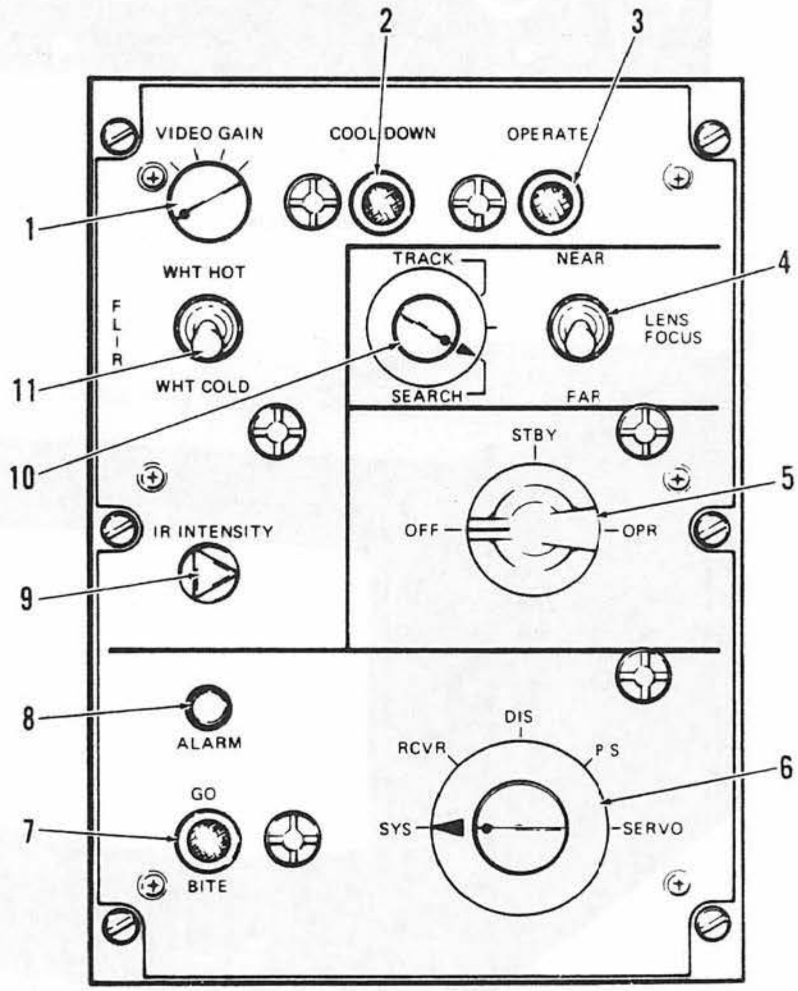


Figure 4-109.

infrared detecting set (AN/AAD-7)

1. VIDEO GAIN
2. COOLDOWN LAMP
3. OPERATE LAMP
4. FOCUS SWITCH
5. IDS MODE SELECT SWITCH
6. BITE SWITCH
7. GO LAMP
8. ALARM BUTTON
9. IR INTENSITY
10. FOV SELECT SWITCH
11. POLARITY SWITCH



INFRARED DETECTING SET CONTROL

Figure 4-110.

infrared detecting set (AN/AAD-7)

1. VIDEO DISPLAY CATHODE RAY TUBE
2. 0.8/FULL SWITCH
3. METER (HOURS)
4. HORIZONTAL HOLD CONTROL
5. CONTRAST CONTROL
6. BRIGHTNESS CONTROL
7. CIRCUIT BREAKER

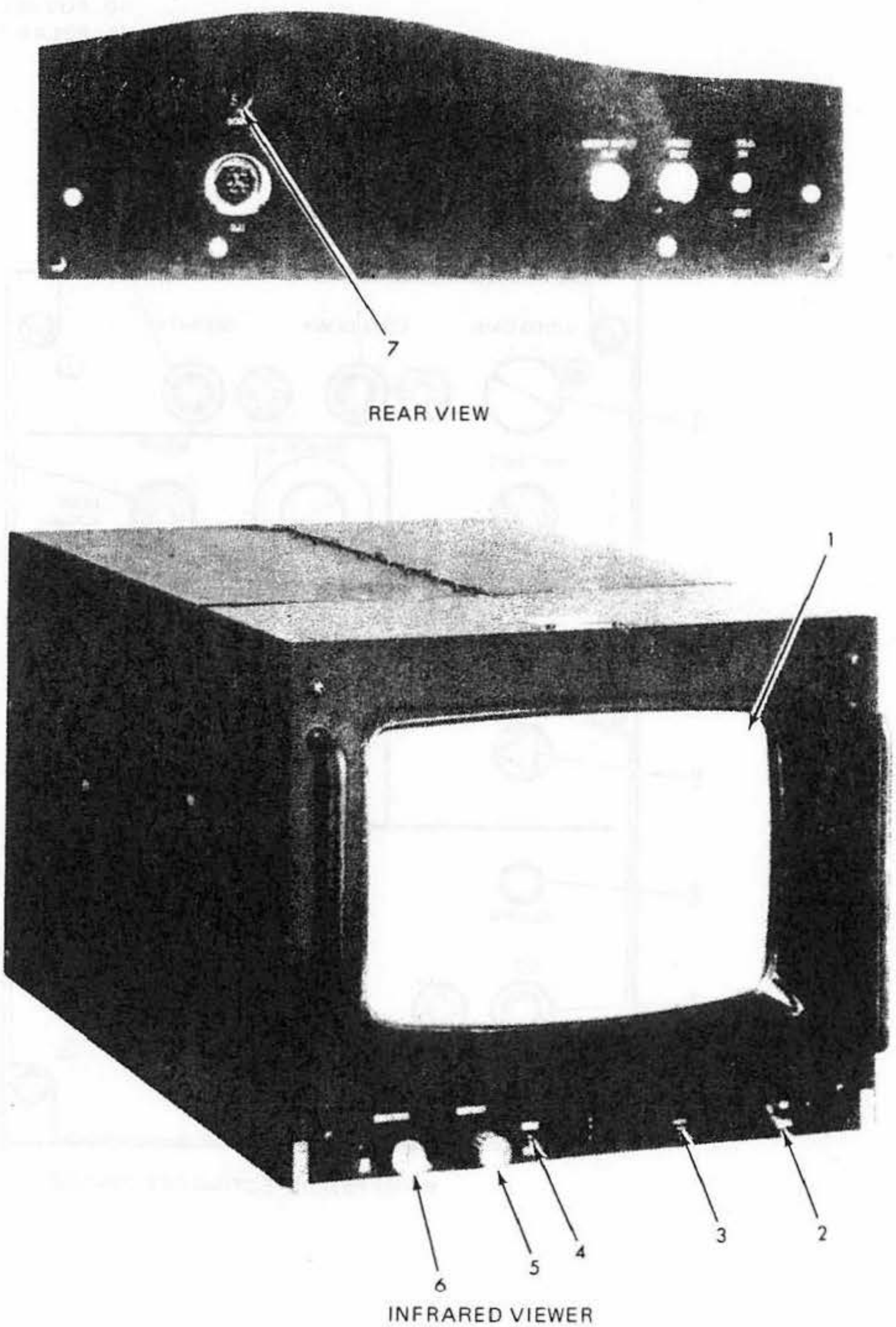
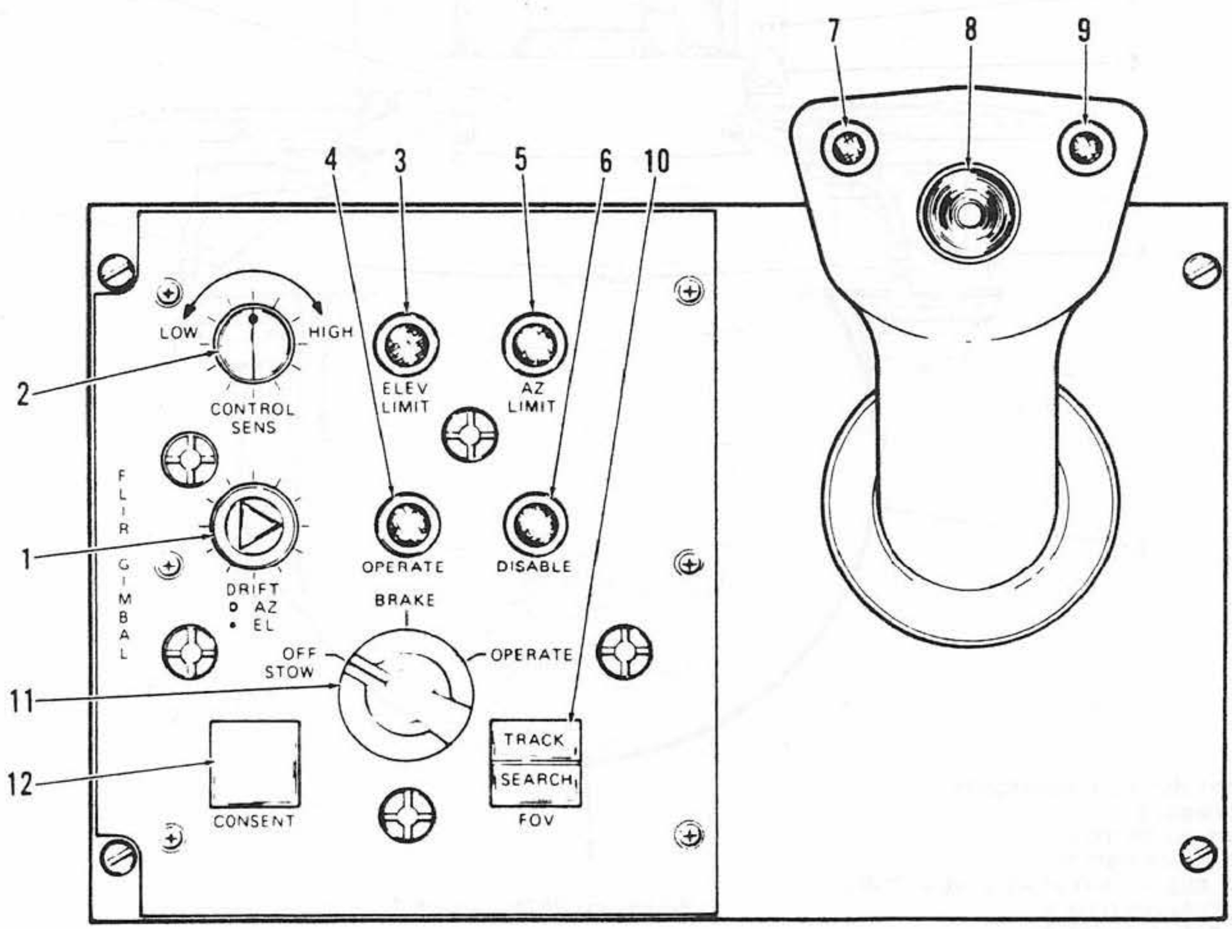


Figure 4-111.

infrared detecting set (AN/AAD-7)

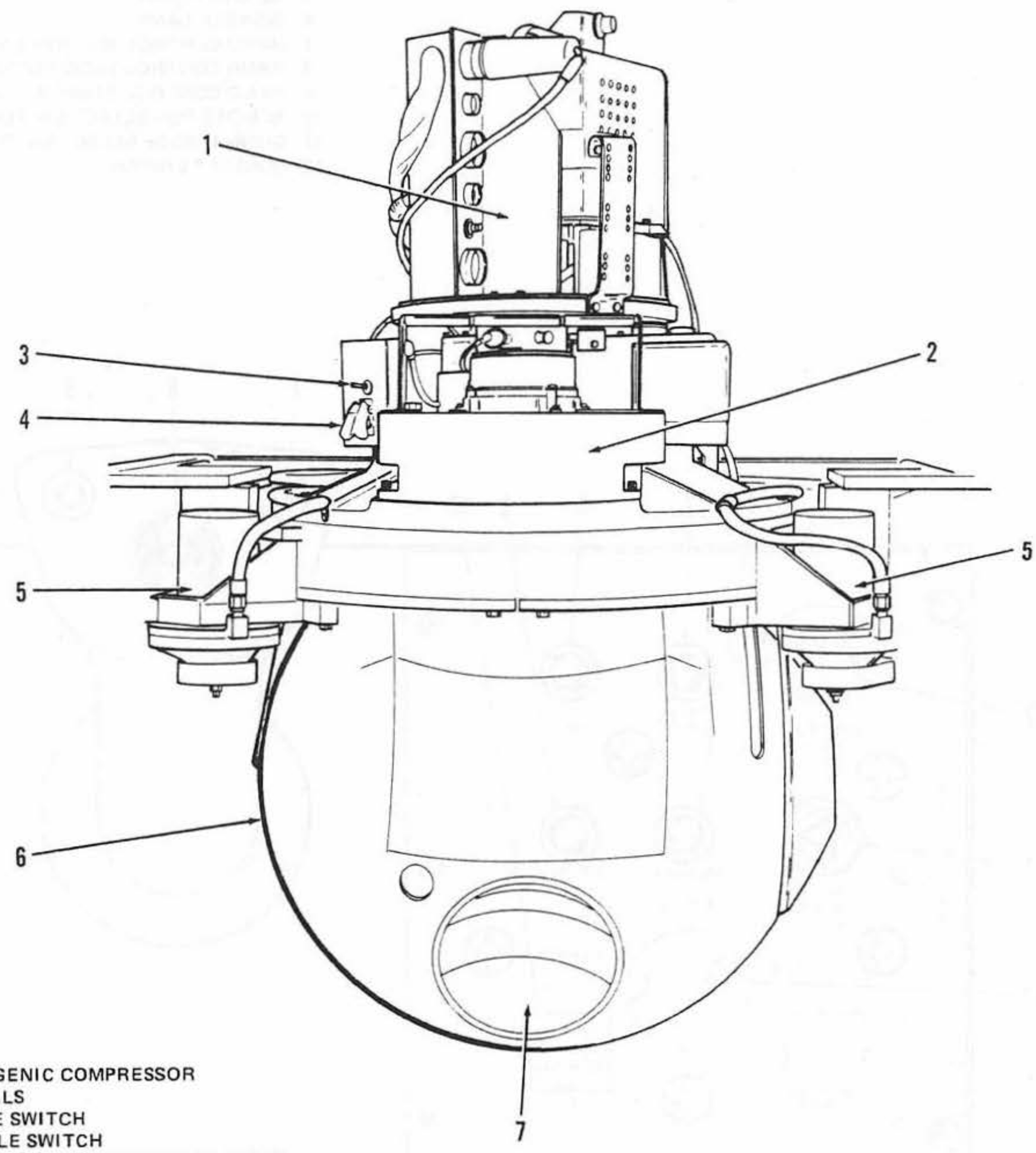
1. DRIFT CONTROL
2. CONTROL SENS CONTROL
3. ELEVATION LIMIT LAMP
4. OPERATE LAMP
5. AZ LIMIT LAMP
6. DISABLE LAMP
7. HAND CONTROL BUTTON SWITCH
8. HAND CONTROL SLEW BUTTON
9. HAND CONTROL STANDBY LAMP
10. REMOTE FOV SELECT SWITCH
11. GIMBAL MODE SELECT SWITCH
12. CONSENT SWITCH



GIMBAL POSITION CONTROL

Figure 4-112.

infrared detecting set (AN/AAD-7)



1. CRYOGENIC COMPRESSOR
2. GIMBALS
3. BRAKE SWITCH
4. DISABLE SWITCH
5. BLEED AIR PNEUMATIC ISOLATORS
6. RECEIVER GROUP
7. RECEIVER WINDOW

INFRARED DETECTOR UNIT

Figure 4-113.

infrared detecting set controls and functions (see figure 4-110)

Control	Description	Function
1. VIDEO GAIN	Rotary Switch 4 position	Used to provide four different video gain settings. Gain controls gain of all video amplifiers simultaneously
2. COOL DOWN LAMP	Push to test lamp	Used to provide cool down indication when detectors have reached operating temperature
3. OPERATE LAMP	Push to test lamp	Used to indicate when MODE SELECT switch is set to OPR position
4. FIELD OF VIEW SELECT SWITCH	Rotary Switch Positions:	
	TRACK	Used to select narrow field of view (FOV)
	RMT	Used to allow remote FOV selection at the Gimbal position control
	SEARCH	Used to select wide field of view (FOV)
5. MODE SELECT SWITCH	Rotary Switch Positions:	
	OFF	Used to remove power from Infrared Set (except gimbals)
	STBY	Applies power to begin cool down cycle
	OPR	Applies power to all circuits (except gimbals)
6. BITE SWITCH	Rotary Switch Positions:	
	SYS (SYSTEM)	Used to monitor test voltage or BITE circuitry for all units simultaneously for go conditions
	RCVR (RECEIVER), DIS (DISPLAY), P/S (POWER SUPPLY), SERVO (ELECTRONIC CONTROL AMPLIFIER)	Used to monitor BITE test voltage on an individual basis to isolate defective LRU's
7. GO LAMP	Push to test lamp	Indicates go condition when lighted
8. IR INTENSITY	Potentiometer control	Adjusts video amplifier gating voltage (video background level)
9. ALARM SWITCH	Pushbutton switch, spring loaded	Used to ring warning bell on airplane to warn gimbal is going to be slewed.
10. FOCUS SWITCH	Toggle switch, spring loaded, center-off	Used to adjust optical focus in track or search mode
11. POLARITY SWITCH	Toggle switch	Used to switch video polarity so that hot targets appear white or black on viewer depending on switch position

Figure 4-114.

gimbal position controls and functions

(see figure 4-112)

Control	Description	Function
1. DRIFT Control	Dual potentiometer controls	Controls azimuth and elevation drift
2. CONTROL SENS Control	Potentiometer control	Adjusts the sensitivity of the azimuth and elevation slew button on hand control
3. ELEV LIMIT	Push to test lamp	Indicates when receiver reaches elevation limit
4. OPERATE	Push to test lamp	Indicates when the system is on and gyros are warmed up
5. AZ LIMIT	Push to test lamp	Indicates when receiver reaches azimuth limit
6. DISABLE	Push to test lamp	Indicates that disable switch located on gimbal is set to up position (ON)
7. HAND CONTROL BUTTON SWITCH	Push to close switch	Enables operator to talk on interphone regardless of intercom switch position
8. HAND CONTROL SLEW BUTTON	Dual axis potentiometer control	Provides operator control for elevation and azimuth gimbal movements
9. HAND CONTROL STANDBY LAMP	Indicator lamp	Indicates that system is on and gyros are in warm-up phase. When lamp goes off, hand control slew button is operable and gimbal position green, operate light illuminates
10. REMOTE FOV SELECT SWITCH	Lighted switch	Used by operator to select TRACK or SEARCH MODES when Set Control is set for remote (RMT) operation. (From gimbal control)
11. GIMBAL MODE SELECT SWITCH	Rotary Switch Positions:	
	OFF/STOW	Used to place gimbals in stow position followed by automatic removal of gimbal power
	BRAKE	Used to lock gimbals in fixed position
	OPERATE	Used to allow normal operator control with hand control
12. CONSENT SWITCH	Lighted switch	Used to provide operator interface with airplane fire control system.

Figure 4-115.

4. Sound scanner alarm and wait 5 seconds.

CAUTION

If the hand control standby lamp illuminates momentarily or not at all when the gimbal mode select switch is set to BRAKE, wait 30 seconds before switching to OPERATE.

WARNING

During ground operation, press ALARM button switch on IDS control panel momentarily before operating gimbal control.

CAUTION

Gimbal should remain in the stowed position during engine start, taxi, takeoff, and landing to protect the receiver window against flying objects.

5. Set gimbal mode select switch to OPERATE.
6. Check gimbal movement and limits (Elevation +20°, -75°, Azimuth -58°, +90°
7. Check limit lights.
8. Set gimbal mode select switch to BRAKE.

CAUTION

The IDS Mode select switch should not remain in STBY or OPR position during ground operations for over 45 minutes with the wheel well fairing door installed or overheating of the cooling compressor could result.

9. Set IDS mode select switch to STBY.
10. Check all indicator lamps using press-to-test method. All lamps should illuminate.
11. Set IR viewer controls as follows:
    a. CONTRAST control to mid-range.
    b. BRIGHTNESS control to mid-range.
    c. 0.8-FULL switch to FULL.
12. Perform bite test as follows:
    a. IDS mode select switch to operate (it is not necessary to have cool down to run the bite test).
    b. Check SYS position of bite switch for GO lamp illumination. (There is a built-in time delay of 30 to 60 seconds for the display when the IDS mode select switch is set to operate. If no illumination of the GO lamp, isolate defective unit, then continue with normal turn-on procedure. The system may still be usable.)
    c. IDS mode select switch OFF.
    d. Gimbal mode select switch OFF.

Normal Operation

1. IDS mode select switch to STBY.
2. Gimbal mode select switch to BRAKE.
3. When cool down light illuminates, place IDS mode select switch to OPR.

CAUTION

Gimbal should be placed in the stow position during rain showers. Water is detimental to the IR lens coating.

NOTE

Cool down normally occurs within 20 minutes. If cool down lamp does not illuminate within 45 minutes, continue with normal turn-on procedure after noting discrepancy. The system may still be usable depending on quality of displayed image.

CAUTION

Gimbal should remain in the stowed position during engine start, taxi, take-off and landing to protect the receiver window against flying objects (The gimbal mode select switch may be set to OPERATE just after lift-off when there is little danger of flying objects).

4. Set gimbal mode select switch to OPERATE.
5. Slew gimbals until field of view is centered on a distant object and adjust sensitivity and drift controls as desired.
6. Adjust contrast, brightness, IR intensity and video gain controls to obtain optimum display.

infrared viewer controls and functions

(see figure 4-111)

	Control	Description	Function
1.	VIDEO DISPLAY	Cathode ray tube	Provides a visual display for the operator.
2.	0.8/FULL SWITCH	Switch Toggle	Used to shrink CRT raster so that edges may be seen during TV camera alignment.
3.	METER (Hours)	Meter	Used to indicate total elapsed running time of the set in hours
4.	VERT HOLD	Potentiometer	Used to adjust vertical syne of viewer unit.
5.	HORIZ HOLD	Potentiometer	Used to adjust horizontal sync of viewer unit.
6.	BRIGHTNESS CONTROL	Potentiometer	Used to control brightness of viewer CRT.
7.	CONTRAST CONTROL	Potentiometer	Used to control contrast control of viewer unit.
8.	POWER CIRCUIT BREAKER	CB on rear of viewer	Power protection.

Figure 4-116.

NOTE

VHF, UHF, and TACAN radio transmissions from the aircraft may cause interference on the AN AAD-7 video display in the form of shaded spokes.

7. Set polarity switch from WHT HOT to WHT COLD to verify that polarity reversal of image is achieved on the display.

8. Depress the remote field of view select switch on the gimbal control panel to ensure lens are switching.

9. Operate video gain adjustment to verify that display imagery of objects with small temperature differentials can be improved or degraded with this adjustment.

10. Set look angle at desired position. For checkpoint navigation enroute to mission search area, a fixed look angle can be selected by placing the gimbal control in the BRAKE position and releasing the slew button.

11. Select SEARCH on the remote FOV select switch to locate large targets/area navigating.

12. After sighting possible target, slew field of view until the reticle on viewer exactly intersects the selected target or target area. Then, set remote FOV select switch to TRACK. Even if the reticle is not centered on the viewer it must still be superimposed on the target because it represents the boresight point of the IDS. (If not centered, it can be moved to the center of the viewer by maintenance personnel.)

13. Press CONSENT switch on gimbal control panel when exactly tracking the target within the reticle. Consent must be ON before the pilot can fire in the auto mode or before target storing can be accomplished with the Inertial Targeting system.

14. Adjust the azimuth and elevation DRIFT controls on the gimbal control panel as necessary to keep the target within the reticle or facilitate ease of tracking.

15. If go indicator should extinguish and the system appears to be malfunctioning, recheck the bite system to isolate the defective unit.

16. If all or a few of the detector banks disappear from the viewer recheck the toggle switch circuit breakers on power supply unit, one or more of them may have been inadvertently switched Off (down).

17. If the field of view should stick in either search or track, switch field of view, utilizing the FOV select switch on IDS control panel. If it remains stuck, only maintenance personnel can correct the malfunction.

NOTE

When flying, if the image on the viewer cannot be brought into sharp focus with the focus switch, the problem may be due to excessive atmospheric attenuation. To determine, slew the gimbals to the up and forward position (near stow) to view the fields by focusing for sharpest image of the infrared detector array. If, after focusing, the ground targets still cannot be viewed properly, the problem is atmospheric attenuation.

SYSTEM SHUTDOWN

1. Set gimbal mode select switch to OFF/STOW. Crosscheck AZ/ELEV limit lights and sensor angle display panel to ensure stow position is attained. Power will be automatically removed from the gimbal control once the stow position is attained.

2. Set IDS mode select switch to OFF.

DIRECTION FINDER SET, AN/ASD-5 (BLACKCROW)

The Black Crow (DF Set) is an electronic sensor which searches for and tracks targets appearing to the left of the airplane. It is comprised of:

1. Antenna Pedestal Group
2. Power Supply
3. Data Processor
4. Control and Display Unit
5. Calibrate Generator
6. Servo Electronics Unit

DESCRIPTION OF COMPONENTS

Antenna Pedestal Group

The Antenna Pedestal Group is comprised of three units: The Antenna Pedestal Assembly is located on the left side of the nose wheel well. It consists of an antenna array, an antenna mount, and a pedestal interconnected to form a gimballed motor-driven antenna steering platform. The platform can be controlled remotely in both azimuth and elevation to provide target direction information. The entire assembly is enclosed by a radome. The antenna is horizontally and vertically polarized.

The Servo Electronic Unit in the nose wheel well receives DC position control signals and amplifies them to the power level required to drive the azimuth and elevation gimbal torque motors.

The Manual Controller, located at the EWO position provides the means of manually directing the antenna in azimuth and elevation. It contains a two-axis, four-directional button mounted on a hand grip controller.

Power Supply

The Power Supply is located below the flight deck in the electronic equipment section. The power inputs from the airplane power source are single phase 115V AC, 400 Hz, and +28V DC unregulated. Regulated DC voltages are obtained from four power supply modules located inside the power supply.

Data Processor.

The data processor, located on the antenna pedestal mount, generates video azimuth and elevation signals for the control and display indicator.

Control and Display Unit.

The Control and Display Unit, located at the EWO console, provides the EWO with a visual display of target location and an audio signal thru the interphone syste. It receives the signals from the data processor and conditions them to produce a CRT dot cluster target display, automatic antenna tracking drive signals, an audio tone, and timing signal for target gating. The display shows antenna azimuth and elevation with respect to airplane fire control boresight; and target position with respect to antenna electrical boresight.

Calibrate Generator.

The Calibrate Generator is located in the nose wheel well on the antenna pedestal mount assembly. It develops a test signal that appears as a target dot cluster on the CRT screen to check for proper system alignment (boresight) or as a DF Set gain check.

MODES OF OPERATION

The DF Set has three modes of operation:

1. Search
2. Manual Track
3. Auto Track

In Search mode, the antenna sweeps back and forth automatically between programmable azimuth limits. Changes in elevation of this sweep have to be made manually, using the Manual Controller. Targets will appear as small dot clusters within or slightly outside the antenna position reference frame.

Manual Track is the mode usually used in initial target acquisition. In this mode, changes in both azimuth and elevation have to be made manually using the Manual Controller. Once a target has been acquired, it may be tracked either manually or automatically depending upon various conditions and the operators desires.

Auto Track mode can be used to track the target if the target is located within the Angle Gate and strong enough to exceed the Threshold. Manual tracking may be accomplished in the AUTO TRACK mode by manually overriding the AUTO TRACK function. Depending upon the settings of the ANGLE GATE and THRESHOLD ADJUST controls, the authority of the auto track control loop may be too great to override. The EWO then has the option of switching to Manual Track or readjusting the ANGLE GATE and THRESHOLD ADJUST controls to permit manual override in the AUTO TRACK mode. When the DF Set is tracking a target, target bearing information is fed to the airplane's Fire Control System.

CONTROL AND INDICATOR UNIT CONTROLS AND INDICATORS (FIGURE 4-117)

DF Set controls and indicators are located on the Control and Indicator Unit and on the Manual Controller. Circuit breakers protecting BC power circuits are located on the main DC circuit breaker panel, the Power Supply Unit, and the Servo Electronics Unit. Five CBs are accessible in flight. During normal operation, the BC operator's right hand remains on the Manual Controller; his left hand remains free to operate the other controls.

SYSTEM POWER - In the ON position, the SYSTEM POWER switch applies single-phase 400Hz airplane power to the Control and Display Unit and to the four DC Power Supplies in the Power Supply package. Regulated DC voltage from the Power Supply is applied to all DF Set components with the exception of the Antenna Pedestal, Servo Electronics Unit and Manual Controller. The SYSTEM POWER lamp, located above the SYSTEM POWER switch, lights green and the power lamp on the oscilloscope lights green.

PEDESTAL POWER Lamp - The PEDESTAL POWER Lamp lights green a maximum of one minute after the MOUNT POWER switch on the Manual Controller is placed to ON. The delay allows sufficient time for the antenna pedestal to uncage and the rate gyros to come up to speed. The PEDESTAL POWER lamp remains lighted for 15 seconds after the MOUNT POWER switch is set to OFF, while a related time delay holds power on the pedestal until the antenna drives to the cage position.

Cathode Ray Tube - The CRT provides the EWO with two visible displays simultaneously.

1. Antenna position - The whole CRT screen represents the movement envelope of the antenna. The antenna reference square shows where in the envelope the antenna is positioned.

2. Target position - The central portion of the CRT screen represents the antenna field of view, 18° x 18°. The dot cluster shows where on the antenna the signal is being received.

BITE - The BITE (Built In Test Equipment) switch is a three-position, center-off, toggle switch used to operate the Calibrate Generator for checkout and trouble shooting. In the BORESIGHT position, the Calibrate Generator produces a signal on the CRT screen at the boresight position (screen center). In the GAIN CHECK position, the Calibrate Generator produces a signal dot cluster on the CRT screen one cm to the right and one cm below the antenna boresight. With the BITE switch in either BORESIGHT or GAIN CHECK, the BITE lamp lights amber. Use of BORESIGHT OR GAIN CHECK does not prevent external signals from being displayed as dot clusters on the CRT screen in the normal manner.

TRACK MODE DISPLAY SCALE - The TRACK MODE DISPLAY SCALE switch is a two-position toggle switch used to select a normal or expanded scale on the CRT display. In NORMAL, the CRT scale is 3°/cm; is EXPAND, 1°/cm. The expanded scale reduces the antenna field of view displayed, but gives optimum target resolution and discrimination when targets are close together. In EXPAND, only the video of the target display is effected. The target audio presentation is not changed; therefore, a target can be heard while the dots may be off the scope. The display of the Antenna Reference Square is not effected. With the BITE switch in GAIN CHECK and TMD SCALE in NORMAL, the dot cluster will appear one cm to the right and one cm below boresight. With the BITE switch in GAIN CHECK and TMD SCALE in EXPAND, the dot cluster will be 3 cm right and 3 cm below boresight.

MODE SELECT - The MODE SELECT switch is a three-position toggle switch used to select the BC operating mode of AUTO TRACK, MNL TRACK or SEARCH.

BLANKING DISABLE - This switch should be in the OFF position for all operations except troubleshooting and system check.

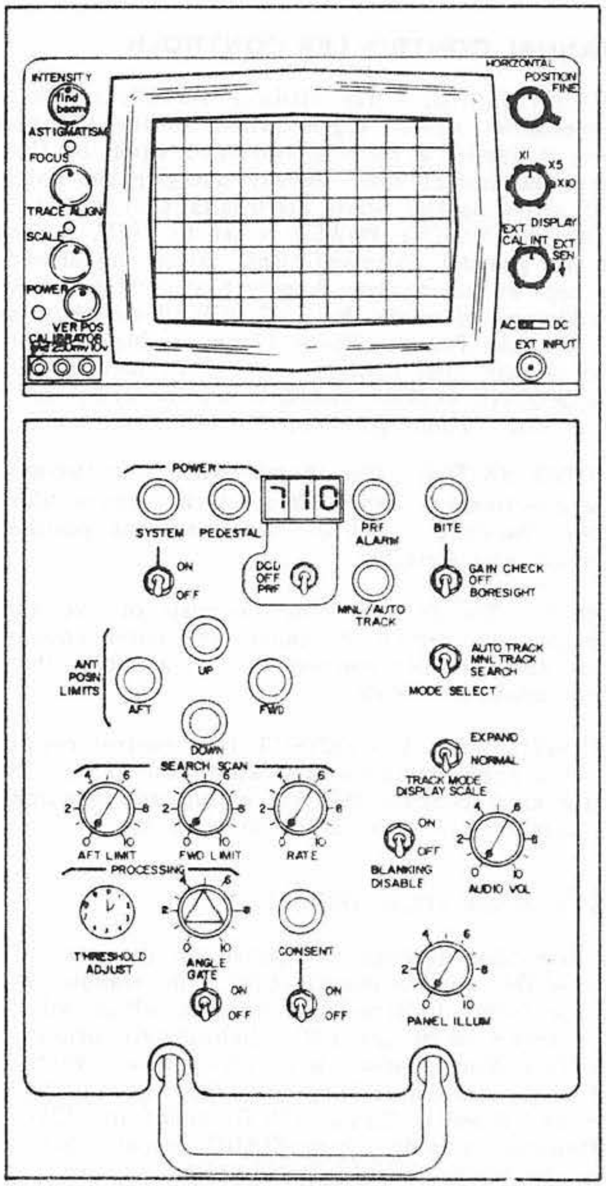
CONSENT - The CONSENT switch is a two-position, on-off, toggle switch used to indicate to the Navigator that a target is being tracked by the DF Set. With the CONSENT switch ON, the CONSENT Lamp lights green. (With BC selected in FCO's Control Switching Unit (CSU) turning the CONSENT switch off will store the target coordinates in the INS.) Consent ON also enables the FCS to provide an automatic mode control signal.

ANGLE GATE switch - The ANGLE GATE switch is a two-position, on-off, toggle switch used to display an angle gate reference square on the CRT screen, instead of the antenna position reference square. Target dot clusters falling within the angle gate reference square can be auto tracked if they meet signal strength requirements. Target dot clusters falling outside the angle gate reference square can not be auto tracked.

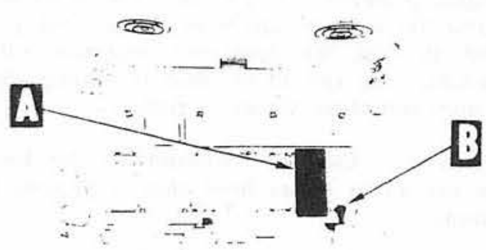
ANGLE GATE potentiometer - The ANGLE GATE pot controls the electrical size of the angle gate. The size of the angle gate reference square represents the electrical angle gate limits and can be adjusted from 0° to 18° in diameter.

SEARCH SCAN AFT LIMIT AND FWD LIMIT - The aft limit and forward limit knobs control the size of the azimuth angle thru which the antenna sweeps in SEARCH mode of operation.

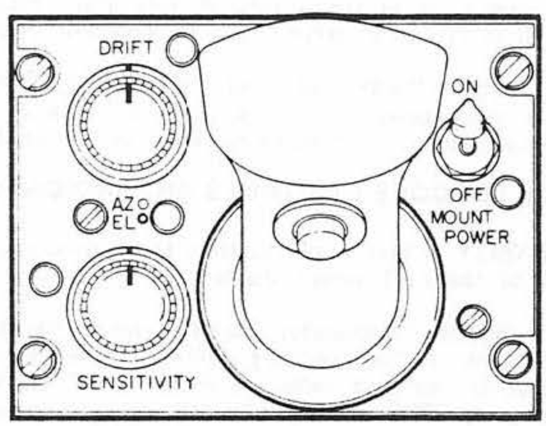
direction finder set (AN/ASD-5)



A CONTROL AND DISPLAY UNIT



IR/EWO CONSOLE



B MANUAL CONTROLLER

Figure 4-117.

SEARCH SCAN RATE - The SEARCH SCAN RATE potentiometer controls the antenna sweep rate in SEARCH mode. Sweep rate is variable from zero to 30° per second, increasing with clockwise rotation of the knob.

THRESHOLD ADJUST - The THRESHOLD ADJUST potentiometer controls the processing threshold level of the Data Processor by establishing the signal strength a received signal must exceed in order to be processed by the DF Set. In so doing, this control establishes sensitivity of the BC. The threshold is adjustable from noise saturation to a level greater that 50 db. The threshold level decreases with clockwise rotation of the knob, thus increasing the sensitivity and admitting weaker signals.

AUDIO VOL - Clockwise rotation of the knob increases the audio signal level that is applied to the interphone.

PANEL ILLUM - The PANEL ILLUM potentiometer varies the brightness of the control panel illuminating lamps.

PRF ALARM - The PRF ALARM Lamp lights red when a signal having a specific pulse repetition rate is received by the set. The specific rate is set by Maintenance.

MNL/AUTO TRACK- When the MNL/AUTO TRACK lamp is lighted steady amber, the received signal is capable of providing usable auto track data. When the lamp flickers or remains out, the target signal is not capable of providing suitable auto track data. In the latter case, the target must be manually tracked.

ANT POSN LIMITS (AFT, FORWARD, UP, DOWN) The antenna position limit lamps light whenever the antenna reaches the mechanical limit switch positions.

OSCILLOSCOPE CONTROLS AND INDICATORS

INTENSITY - This knob controls the intensity (brightness) of the CRT screen display.

FIND BEAM - Pushbutton mounted inside the INTENSITY knob. If the centering controls are so maladjusted that the antenna reference frame is off the CRT, pressing the FIND BEAM will bring the frame onto the scope. This will indicate to the EWO which direc- the frame is displaced so he will know where to initiate corrections.

FOCUS - This knob controls the sharpness of the CRT display.

SCALE - This potentiometer controls the illumination of the oscilloscope reticle.

VERT POS - The vertical position knob adjusts the vertical position of the CRT display.

HORIZONTAL POSITION - This knob is the coarse adjustment of the horizontal position.

FINE - This ring knob (with "ears") is used to fine adjust the horizontal position of the CRT trace.

MAGNIFIER CONTROL - This control has no function for the DF Set and must be left in the X10 position.

DISPLAY - This control has no function for the DF Set and must be left in the EXT CAL position.

EXT INPUT - The External Input switch is not used in DF Set operation and must be left in the AC position.

MANUAL CONTROLLER CONTROLS

MOUNT POWER - The MOUNT POWER switch is a two-position, on-off, toggle switch. In the ON position, it applies a pedestal command signal to the Servo Electronics Unit, thereby uncaging the antenna and activating the Servo Electronics Unit power. When the MOUNT POWER is set to OFF, removal of the pedestal command signal causes the antenna to cage at the airplane boresight axis. Sixty seconds (maximum) after the MOUNT POWER switch is set to ON, the Pedestal Power Lamp on the Control and Display Unit lights green. Fifteen seconds after the MOUNT POWER switch is set to OFF, the Pedestal Power Lamp goes out.

THUMB SWITCH - The thumb switch is a two-axis, four-directional switch located on the Manual Controller handgrip, used to control antenna position in azimuth and elevation.

DRIFT - The DRIFT control consists of two knobs mounted one within the other. The outer knob provides antenna drift compensation in azimuth; the inner knob, in elevation.

SENSITIVITY - The SENSITIVITY control consists of two knobs mounted one within the other. The outer knob controls the rate of antenna movement in azimuth; the inner knob, in elevation.

PAVE MACE (DCD/OFF/PRF)

A Pave Mace readout is supplied on the front of the ASD-5, just below the CRT. The readout is in the form of illuminated numerals which will be interpreted by the EWO. Immediately below the Pave Mace readout is a three-position, center-off, toggle switch. Setting the toggle switch to Decoder Readout Display (DCD) yields the EWO information decoded from TEMIG beacons. Setting the toggle switch to the "PRF" position yields the EWO the last three digits of the PRF of any signal being tracked.

TACTICAL OPERATIONS AND PROCEDURES - Black Crow tactics and employment procedures are discussed in the appropriate 55-series manuals and T.O. 1C-130(A)A-1-1, some aspects of which are classified.

RADAR SET, AN/APQ-150

AN/APQ-150 radar set is a beacon tracking set which searches for, acquires, and tracks I band radar beacons appearing on the left side of the airplane. The set is designed for field applications such as target location for close support. A total coverage is provided by the antenna in azimuth of 70° either side of bore-sight, and in elevation of +20° to -70°. The set has The set has two beacon acquisition modes; manual and automatic. In the automatic mode the antenna has a linear scan of 50° in the elevation plane and is positioned manually in azimuth. It is also possible to have a spiral scan in this mode.

In the search mode, a spiral scan is used to cover a 20° by 20° sector which the operator can position anywhere in the total coverage pattern. The radar set has an acquisition range of 2000 feet to 10 nautical miles with an angular tracking error of 2 mils at 5 nautical miles. The system consists of an RT-1031 Receiver-Transmitter and antenna mounted on the gimbal support which is fastened to the antenna support housing in the left paratroop door, and C-8802 Control-Indicator at the Electronic Warfare Officer's station. Power of 115-volt, 400-Hz, three-phase ac, and 28-volt dc is supplied to the receiver-transmitter through two TRACK RADAR circuit breakers (one ac and one dc) on the cargo compartment ac and dc circuit breaker panels.

SYSTEM PARAMETERS

Transmitter	Magnetron
Frequency	9375 ± 5 MHz
Power output	5KW (min)
Pulse width	0.5μs
PRF	800 pps
Receiver	
Frequency	9310 MHz (center)
IF center frequency	60 MHz
IF band width (3db)	16 MHz (min)
Antenna	
Beam width	4.5 degrees
Gain	28db (min)

The control-indicator (figure 4-118) is located at the Electronic Warfare Officer (EWO) station and contains the radar control panel and display indicator. The controls allow the operator to acquire and track a transponder. With the indicator, which consists of a crt B-scope display, the operator can monitor both transponder range, and antenna azimuth and elevation angles. The system range gate is also displayed to allow identification of the transponder being tracked.

Function and description of the controls and indicators is as follows:

RSLVR EXC CONTROL. When set to ON, and MODE control is set to STBY, connects azimuth and elevation resolvers to external system.

28V CKT BRKR CONTROL. When set to ON, applies external source of 28-volt dc to radar set.

ASTIG control. Adjusted to reduce astigmatism on the crt trace.

RANGE ZERO CONTROL. Aligns start of range sweep with zero RANGE graticule.

EL ZERO CONTROL. Adjusted in boresight mode, only. Aligns elevation angle mark with ELEVATION 0 DEG graticule.

FOCUS CONTROL. Provides means to focus crt display.

AZ ZERO CONTROL. Adjusted in boresight mode, only. Aligns azimuth angle mark with AZIMUTH 0 DEG graticule.

PANEL ILLUM CONTROL. Used to adjust the brightness of the backlighted control-indicator panel.

SCALE ILLUM CONTROL. Used to adjust the brightness of the display graticule.

IF GAIN CONTROL. Provides manual gain of the receiver except when tracking.

DISPLAY INTEN CONTROL. Used to adjust the desired crt display intensity.

MODE CONTROL. Used to apply radar set operating power and select modes of operation. The control positions are: (1) STBY; (2) MNL (manual tracking); (3) AUTO (automatic tracking); (4) MTD (microwave target designator) which is not used; (5) SLAVE (slaved to external system); and (6) BRSIT (boresight).

CODE SELECT CONTROL. The code select control is used to select one of ten codes for acquisition and tracking. Setting of code must correspond to desired transponder code setting. In position 1, the radar set will acquire a responding transponder independent of the transponder code. When the radar set interrogates a transponder, the transponder replies with a preset coded transmission. The first reply pulse is the transponder position. The second reply pulse will be separated from the first by the distance shown as follows:

AN/APQ-150 radar controls and indicators

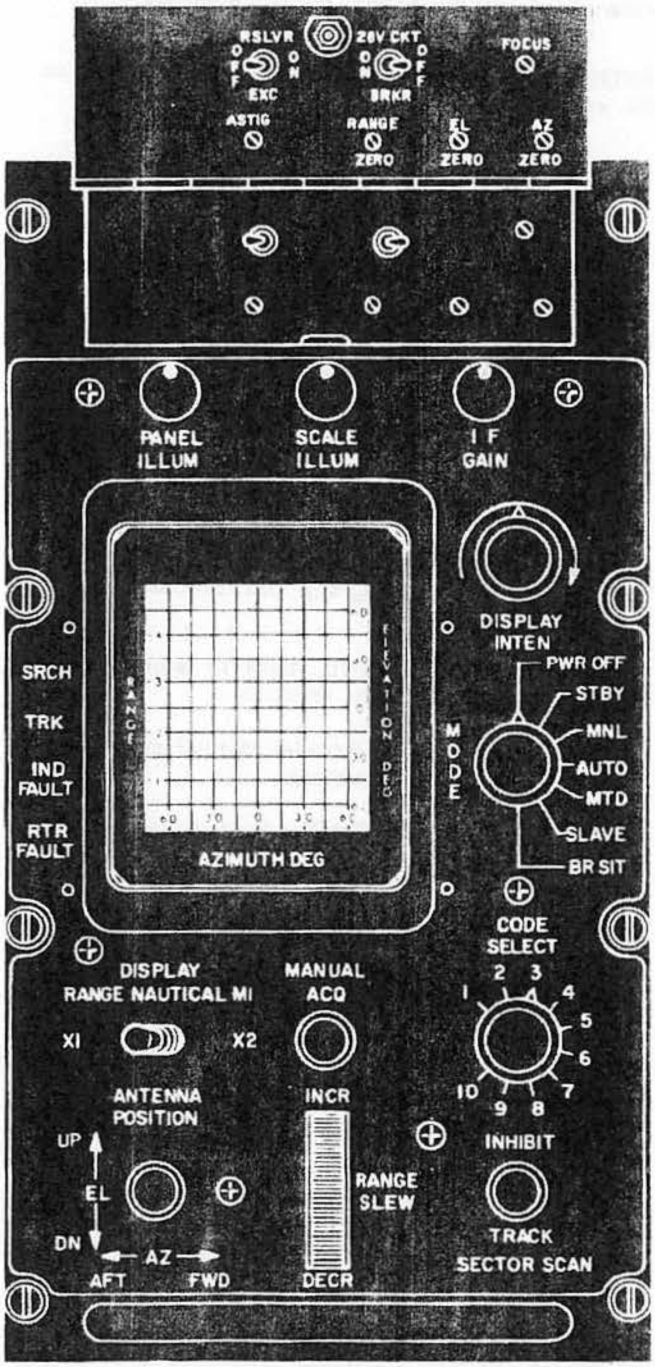


Figure 4-118.

CODES	FIRST PULSE TO SECOND PULSE SEPARATION (NM)
1	One Pulse Only
2	4
3	5
4	6
5	7
6	8
7	9
8	10
9	11
10	12

INHIBIT CONTROL. When pressed, inhibits function as indicated by illuminated TRACK or SECTOR SCAN indicators.

TRACK INDICATOR LAMP (Amber). When illuminated, indicates function of radar set to be inhibited if INHIBIT switch is pressed.

SECTOR SCAN INDICATOR LAMP (Amber). When illuminated, indicates function of radar set to be inhibited if INHIBIT switch is pressed.

RANGE SLEW CONTROL. Used to position (increase or decrease range of) the range gate. Used in conjunction with MANUAL ACQ control to acquire target lock-on conditions.

ANTENNA POSITION CONTROL. Used to position antenna UP (+20 degrees maximum), DWN (-70 degrees maximum), FWD (+70 degrees maximum), and AFT (-70 degrees maximum).

MANUAL ACQ CONTROL. Used in the manual mode. With the range gate centered about the target, target acquisition is achieved by pressing the MANUAL ACQ switch.

DISPLAY RANGE NAUT MI CONTROL. Selects either 5-mile (X1) or 10-mile (X2) display range.

CONTROL-INDICATOR DISPLAY CATHODE RAY TUBE (crt). Displays target range and angular position of antenna (azimuth and elevation) with respect to airplane fire control boresight.

RTR FAULT INDICATOR (amber). When illuminated, indicates malfunction in the RT-1031 receiver-transmitter.

NOTE

If the amber RTR FAULT indicator light illuminates after initial turn on, recycle the mode switch to OFF and back to STBY to clear the fault. If the fault cannot be cleared, turn the set OFF.

IND FAULT INDICATOR (amber). When illuminated, indicates malfunction in C-8802 control-indicator.

CAUTION

If the amber IND FAULT indicator light illuminates and remains lit after turn on, turn the mode switch to OFF and do not turn the set back on. Damage to the set may occur.

TRK INDICATOR (Green). When illuminated, indicates radar set has achieved target acquisition.

SRCH INDICATOR (Green). When illuminated, indicates radar set is searching in either the sector scan (spiral) or the linear scan modes.

NORMAL OPERATION OF AN/APQ-150

The normal operation of the set consists of the starting procedure, preliminary control settings, manual target acquisition, automatic target acquisition, slave mode operation, boresight mode operation, and the shutdown procedure.

Starting Procedure

WARNING

The microwave power level radiated from the antenna is a hazard and can cause damage to the eyes. Do not look directly at, or stand closer than 10 feet from the antenna when the transmitter is on.

1. Position 28V CKT BRKR switch to ON.
2. Rotate MODE control to STBY.
3. After 60 seconds, radar set is ready for operation in any mode. Perform the following preliminary control settings.

CAUTION

If radar set is to remain in standby or boresight modes for an indefinite time, reduce intensity of crt display.

Preliminary Control Settings

1. Position RSLVR EXC switch to OFF.
2. Adjust PANEL ILLUM control for brightness of panel markings.
3. Adjust SCALE ILLUM control for graticule illumination.
4. Rotate IF Gain control fully clockwise.
5. Increase RANGE SLEW control until range gate (two spots) is centered on crt.
6. Adjust DISPLAY INTEN, FOCUS, and ASTIG controls for sharp, clear range gate on crt.
7. Adjust RANGE ZERO control, if necessary, until start of range sweep coincides with zero RANGE graticule.
8. Rotate MODE switch to BRSIT. Adjust AZ ZERO control until azimuth angle mark coincides with 0 AZIMUTH DEG graticule. Rotate MODE switch to STBY.
9. Rotate MODE switch to BRSIT. Adjust EL ZERO control until elevation angle mark coincides with 0 ELEVATION DEG graticule. Rotate MODE switch to STBY.

Manual Target Acquisition

These procedures cover acquisition of both single and double-pulse transponders.
ponders.

TARGET ACQUISITION USING SINGLE PULSE CODE (Code 1):

1. Rotate MODE control to MNL position. Note range and angular position of target transponder operating in code 1.
2. Rotate CODE SELECT switch to code 1.

3. Operate ANTENNA POSITION control until target is centered within 20-degree azimuth scan area.

4. Operate ANTENNA POSITION control at EL UP until target just disappears. Note position (in degrees) of elevation angle mark at center of scan. Operate ANTENNA POSITION control at EL DN until target just disappears. Note position (in degrees) of elevation angle mark at center of scan. Set antenna position at halfway point between the noted positions.

5. Reposition range gate, using RANGE SLEW control, until target is centered within range gate.

6. Press MANUAL ACQ pushbutton to acquire target. Confirm target acquisition by the following indications: (1) antenna sector scanning stops, (2) SRCH indicator extinguishes, (3) TRK indicator illuminates, and (4) TRACK indicator illuminates. The antenna position cannot be controlled by ANTENNA POSITION control. If target acquisition is obtained and rejected, repetitiously, trouble may be due to a short range target having a relatively high power transmitter. The sidelobe rejection circuits may be activated. When this happens, reduce receiver gain using IF GAIN control (fully ccw, if necessary).

NOTE

The elevation position of antenna may be assumed correct if target is displayed on crt. If radar set does not hold acquisition when MANUAL ACQ pushbutton is pressed, request navigator to set APN-59 radar to STBY or OFF and repeat step 4.

7. Confirm that the target transponder is operating in code 1 by slowly rotating CODE SELECT switch sequentially through code positions 2 through 10, and pressing MANUAL ACQ pushbutton for each code. If radar set loses acquisition and returns to sector scanning, and does not regain acquisition at any code except code 1, transponder is operating in code 1.

8. If it is desired to lose acquisition, select a code other than code 1, or if TRACK indicator is illuminated, press INHIBIT pushbutton.

TARGET ACQUISITION USING DOUBLE PULSE CODE:

1. If desired code is known, operate CODE SELECT switch to desired code. The example used in this procedure is for code 2.

2. Note range and angular position of target transponder first pulse.

3. Rotate CODE SELECT switch to code 2.

4. Operate ANTENNA POSITION control until target is centered within the 20 degree antenna scan area.

5. Position range gate, using RANGE SLEW control, until target transponder first pulse is bracketed within range gate. Target should be centered within range gate.

6. Press MANUAL ACQ pushbutton to acquire target. Confirm acquisition by the following indications: (1) antenna sector scanning stops, (2) SRCH indicator extinguishes, (3) TRK indicator illuminates, and (4) TRACK indicator illuminates.

7. If it is desired to lose acquisition, select a code other than code 2, or if TRACK indicator is lit, press INHIBIT pushbutton.

Automatic Target Acquisition

Because acquisition control circuits examine all targets when using AUTO MODE, use of code 1 (single pulse) is not desirable. In code 1, radar set can acquire any target and any target pulse.

1. Rotate MODE control to AUTO. Observe that search mode is linear scan, SRCH indicator is lit, TRK indicator is extinguished, and that TRACK and SECTOR SCAN indicators are extinguished.

2. Operate CODE SELECT switch to desired code.

3. Operate ANTENNA POSITION control at AZ FWD and AFT to locate target transponder. If the target transponder is within look-angle of antenna, automatic acquisition will occur. Operator no longer has control of antenna position, SRCH indicator is extinguished, TRK and TRACK indicators illuminate, and antenna scanning stops. If target acquisition is obtained and rejected, repetitiously, trouble may be due to IF GAIN control set too high. Near targets which have relatively high output power may activate the sidelobe rejection circuits. In this case reduce receiver gain by turning IF GAIN control counterclockwise (maximum ccw, if necessary).

4. If target transponder is in look-angle of antenna and acquisition does not occur, check that correct code is selected. If correct, radar set is malfunctioning. If not, select correct code and repeat step 3.

5. If target transponder is not within look-angle of antenna, set antenna position at approximately +40 degrees as indicated by azimuth angle mark. Acquisition of target transponder will occur when interrogated by radar set.

6. If it is desired to release radar set from an acquired target transponder, one of three methods may be used as follows:

   a. Press INHIBIT pushbutton and hold until transmitted beam moves away from, and no longer interrogates transponder. When released, operation resumes as in step 1.

   b. Rotate CODE SELECT switch to any position except code 1. Antenna begins sector scan, SRCH and SECTOR SCAN indicators illuminate, and TRK and TRACK indicators extinguish. If linear scanning is desired, press INHIBIT pushbutton. SECTOR SCAN indicator extinguishes and linear scan begins.

   c. Rotate MODE switch to MNL and press INHIBIT switch.

Slave Mode

1. Rotate MODE switch to SLAVE. Observe that azimuth and elevation angle marks are present on control-indicator crt. Their presence indicates that radar transmitter is operating, producing the system trigger.

2. Observe that azimuth and elevation angle marks track with remote equipment, in degrees, as remote equipment operator changes antenna position.

Boresight Mode

1. Rotate MODE switch to BRSIT.

2. Observe that azimuth and elevation angle marks are present on control-indicator crt.

3. Observe that azimuth angle mark coincides with 0 AZIMUTH DEG graticule. If not, adjust AZ ZERO control for coincidence.

4. Observe that elevation angle mark coincides with 0 ELEVATION DEG graticule. If not, adjust EL ZERO control for coincidence.

CONSENT. The Radar automatically provides a consent signal as long as lock-on is maintained. Automatic consent (to the Fire Control Panel -- NAV position) and azimuth/elevation slaving outputs (slave-to signals) are not generated unless the system is tracking (locked-on to) a radar beacon/transponder. Therefore, the Radar should not be selected Primary in the FCC and other sources should not slave to the Radar, unless the system is tracking a transponder target.

Shutdown

1. Rotate MODE switch to STBY.

NOTE

STBY position prevents radar set transmissions without deenergizing the system and maintains radar set in ready state.

2. To completely deenergize radar set, rotate MODE switch to PWR OFF.

NOTE

In PWR OFF position, antenna moves to 0 AZIMUTH DEG and -65 ELEVATION DEG where it is mechanically locked.

3. Position 28V CKT BRKR switch to OFF.

GUNNERY EQUIPMENT

The gunnery equipment consists of a pilot's trigger button, pilots's gun control panel, pilot's gun mode and lighting control panel, pilot's gun status indicator panel, the arm/safe panels, individual gun control panels, two 20 mm cannons, two 7.62 mm miniguns, two 40 mm cannons, two ammunition dispensers for 20 mm ammunition, two feeder modules for 7.62 mm ammunition, and one storage rack for 40 mm ammunition. Flexible shrouds inside the airplane exclose each gun barrel and gunport. A master arm switch, located on the flight deck, provides power for the gun arming circuits. Control voltage for the gunnery equipment is provided by the 28-volt dc airplane electrical system. DC electrical power for operation of the 20 mm and 7.62 mm gunnery equipment is provided by individual storage batteries for each gun. The batteries are located near the guns and are recharged by use of the 28-volt dc airplane electrical system. DC electrical power for operation of each 40 mm gun is provided by utilizing the existing 20 mm recharging circuits. The 20 mm systems also use 115-volt ac as a source for firing voltage. System operation and controls and indicators pertaining to the gunnery equipment are described in the following paragraphs.

Note

The 40 mm cannons may be removed to facilitate the installation of two additional 20 mm cannons, ammunition cans, and batteries. The same electrical controls, arm/safe switches, and circuit breakers are used.

PILOT'S TRIGGER BUTTON

The pilots trigger button is located on the left hand control assembly. The button is used to supply the trigger bus power to fire the gun(s) that is/are selected and armed at the gun control panel, the arming and safing control(s), and the master arm switch. With the gun(s) selected and armed, actuation of the trigger button closes the trigger relay which completes the trigger bus circuit from the power source to the selected gun(s).

MASTER ARM SWITCH

The master arm switch is located at the center pedestal. This switch deactivates the master arm power, trigger relay, pilot's trigger button and gunsight power circuits when the switch is in the SAFE position. In the ARM position these circuits are activated.

WEAPON FIRING MODE

The weapons can be fired in any one of three firing modes, manual, semi-automatic, or automatic. Upon direction of the pilot, the weapons are armed by the flight engineer using switches on the gun control panel and the master arm switch and the airborne weapons mechanic at each gun station by ARM/SAFE switches. The flight engineer will also position the gun mode selector switch on the gun mode panel.

To fire the weapons selected in the mode selected, the pilot must depress the trigger button located on his control wheel.

AUTOMATIC MODE: With the gun mode selector in automatic mode, the fire control computer coincidence circuit and the primary sensor consent circuit are placed in series with the weapon firing circuitry. The pilot must achieve or surpass the parameters of coincidence, and the primary sensor consent switch and appropriate gun arming switches must be activated before power is applied to the pilot's trigger button.

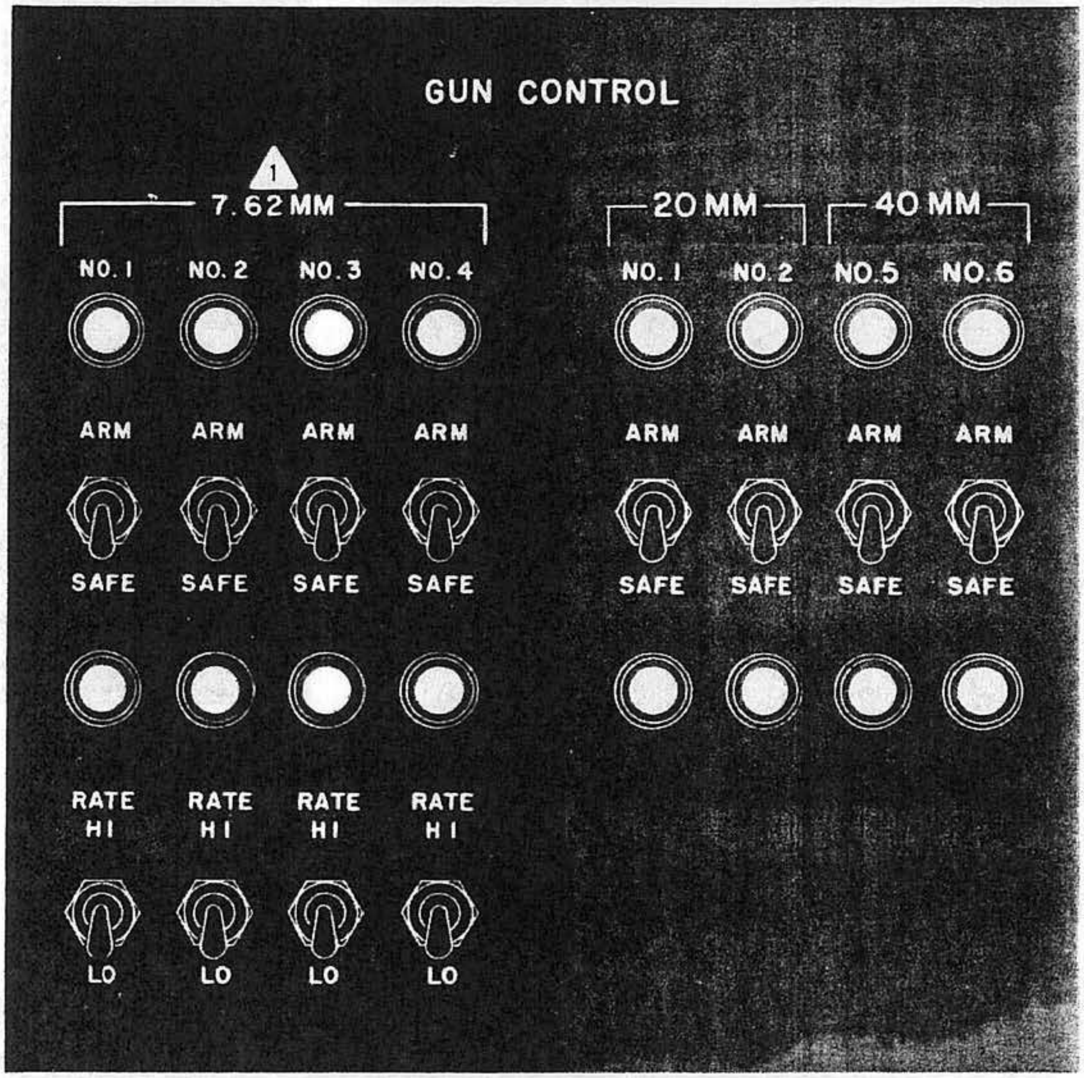
SEMI-AUTOMATIC: With the gun mode selector in semi-automatic mode, the pilot receives the same visual indication in the gunsight, but coincidence and sensor consent circuits are removed from the trigger arming circuitry, therefore the guns will fire when the appropriate gun arming switches are activated and the trigger button depressed.

MANUAL MODE: With the gun mode selector in the manual mode, the pilot will observe only the fixed reticle. The coincidence and sensor consent circuits are removed from the trigger arming circuitry, therefore the guns will fire when the appropriate gun arming switches are activated and the trigger button depressed. The manual mode is normally used only when the pilot can acquire the target visually.

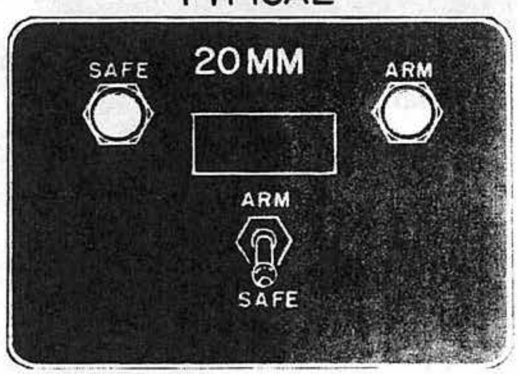
GUN CONTROL PANEL

The gun control panel (figure 4-119) permits selection of any or all weapons. The unit contains a bank of SAFE/ARM switches for safing and arming of each firing station. Individual colored indicator lights show the status of all weapons when the aircraft MASTER ARM circuit is energized. When a firing station safing and arming control switch is set to ARM position, the red (ARM) light will come on when the gun control switch for that station is set to ARM. This enables the flight engineer to determine which guns will be firing when the trigger button is energized. If the firing station SAFE/ARM switch is placed to SAFE position, the gun control panel will simultaneously show the change of status by extinguishing the red indicator and lighting the green (SAFE) indicator for the affected station. All indicator lights have press-to-test circuits for lamp testing. In addition, HI/LO RATE switches are provided for controlling the rate of fire for the 7.62mm guns at 3000 or 6000 rounds per minute.

gunnery equipment panels



TYPICAL



1. ON AIRPLANES INCORPORATING T. O. 1C-130(A)A-506 THE NO. 3 AND NO. 4 7.62 MM LIGHTS ARE INOPERATIVE.
2. PROVISIONS ARE PROVIDED FOR REINSTALLATION OF THE 7.62MM AND 20 MM GUNS.

Figure 4-119. (Sheet 1 of 2)

gunnery equipment panels (cont)

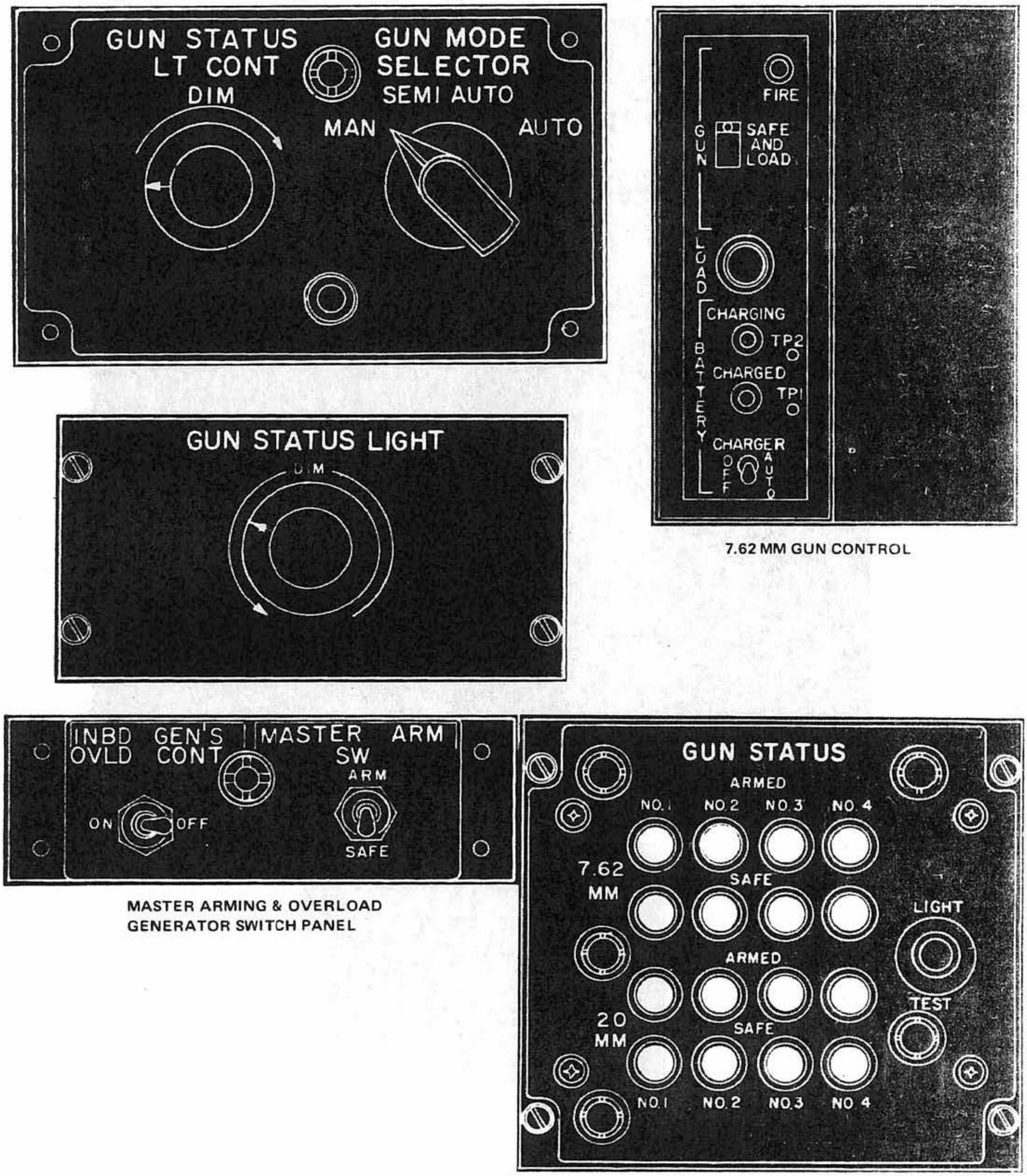


Figure 4-119. (Sheet 2 of 2)

Gun Mode and Lighting Control Panel

This panel (figure 4-119) is located on the flight station overhead panel. The lighting control dimmer switch regulates the light intensity of the ARM/SAFE indicators on the gun control panel and safing and arming assemblies at each gun station. The GUN MODE SELECTOR switch controls the weapon firing modes described in the section under Weapon Firing Mode.

GUN STATUS Indicator Panel

The GUN STATUS indicator panel (figure 4-119) is located outboard of the pilot. This panel contains lights that indicate SAFE or ARMED status of each cannon and minigun. The panel also contains a LT TEST pushbutton switch for checking the condition of the indicator lights.

GUN STATUS LIGHT Control Panel

The GUN STATUS LIGHT control panel (figure 4-119) is located outboard of the pilot. The panel contains a dimmer switch to regulate the intensity of the gun status panel indicators.

SAFING AND ARMING PANELS

Safing and arming panels are located near each weapon. The panel provides local control status of each weapon by a SAFE/ARM toggle switch. Status of each weapon can be determined by indicator lights (SAFE - Green; ARM - Red) provided on each panel. The ARM (red) light is on whenever the master arm, appropriate gun control panel switch, and individual safing and arming panel toggle switch are in the ARM position. The SAFE (Green) light should illuminate anytime the arming circuit is not complete. Each light contains a press-to-test circuit.

7.62MM GUNS (MXU-470/A GUN MODULE)

Two machine gun modules, 7.62MM, Air Force Model MXU-470/A are installed in the No. 3 and 4 gun positions. Each module consists of a GAU-2B/A, 7.62mm aircraft machine gun, linkless ammunition storage and feed system, battery power supply, electrical control package and stand. The battery power supply provides operating voltage for the electric drive assembly to drive the gun and feed system which supplies ammunition to the gun. Each gun module is operated from a remote location and is capable of firing 3000 or 6000 rounds of 7.62mm ammunition per minute.

GUN MODULE MAJOR COMPONENTS

The MXU-470A machine gun module is composed of seven major assemblies. The GAU-2B/A 7.62mm machine gun is mounted to the ammunition drum by two recoil adapters and a rear mounting ball. Ammunition is transfered to the GAU-2B/A gun by a feeder assembly attached to the bottom of the gun housing. Gun rotation is achieved using an electric drive motor bolted to the forward portion of the gun housing. Ammunition is stripped from links and fed into the storage drum using a delinker loader attached to the upper drum cover. The storage drum accepts ammunition during loading and stores it for firing. When firing commences, ammunition is transfered from the storage drum to the feeder assembly. Power routing and timing sequences of the MXU-470A are administered by the control assembly mounted on the outer drum. Electrical power to energize the drive motor is received from a battery assembly attached to the outer drum.

GAU-2B/A Gun

The GAU-2B/A gun is composed of 10 major components. These include the rotor assembly, six tracks, six bolt assemblies, gun housing assembly, aft gun support, the guide bar, six barrels, the barrel clamp assembly, safing sector and housing cover.

ROTOR ASSEMBLY: The rotor assembly is the main structural component of the gun and is supported in the gun housing assembly by annular ball bearings. The front part of the rotor assembly supports the barrel cluster. Six S-shaped triggering cams are machined into the rotor, providing a path for each firing pin tang to follow until it reaches the cocking shoulder where it is held until the bolt head completes its rotating action and releases the firing pin tang from the cocking shoulder. This is accomplished by the locking pins until the bolt reaches the forward portion of the elliptical cam path. At this point, the firing pin is released and the cartridge fired.

BOLT TRACKS: Six tracks are spaced equally around the rotor assembly surface. Each track is composed of a front and center portion, with grooves cut into the rotor assembly, and a removable track. The removable tracks are attached to ribs along the rotor assembly and are removed for installation or removal of bolt assemblies.

BOLT ASSEMBLY: The bolt assembly is of a rotary-head and fixed extractor design, with side slots which engage the bolt tracks in the rotor assembly. The angular position of the firing pin relative to the bolt head is controlled by action between the firing pin tang and the triggering cam in the rotor assembly. The firing pin extends through the bolt body into the bolt head and connects the two parts during ramming and extraction. Extractor lips machined in the bolt head extract spent cartridge cases. The firing pin is held in position by two bolt locking pins in the bolt head until firing is completed and extraction begins.

GUN HOUSING ASSEMBLY: The gun housing assembly is a one-piece casting which covers the rotor assembly and provides a mount for the safing sector, housing cover, and guide bar. The inner surface of the gun housing assembly contains the elliptical cam path which controls the bolt assembly motion. When the rotor assembly turns, bolt assembly rollers follow the elliptical cam path and move the bolt assemblies in the rotor assembly bolt tracks.

AFT GUN SUPPORT: The aft gun support is secured to the rear of the rotor assembly, retaining the rotor assembly in the gun housing assembly and serving as the rear support point for the gun.

GUIDE BAR: The guide bar is held to the gun housing assembly by a permanently installed pin at the front and a screw at the rear. The guide bar fingers direct cartridges from the feeder assembly into the extractors and cam the spent cartridge cases out of the extractors into the ejection chute.

BARRELS AND BARREL CLAMP ASSEMBLY: Six barrels are designed for the 7.62mm NATO cartridge. A barrel lock flange, located near the breech end of the barrel, locks in a rotor groove when the barrel is inserted in the rotor assembly and given a half turn. Steps along the barrel and at the muzzle provide mounting for the barrel clamp assembly, which is locked in place on the barrel cluster by a bolt and self locking nut.

SAFING SECTOR: The safing sector is attached to the gun housing assembly by two quick release pins and acts as a safing device for the gun when removed. The inner surface of the safing sector contains the dwell segment of the cam path which brings bolt assemblies into battery by manual or mechanical rotation of the barrels.

HOUSING COVER: The housing cover is secured to the gun housing assembly and safing sector by two quick release pins. The cover provides an inspection and service access to the bolt assemblies:

Feeder Assembly

The feeder assembly is attached to the gun by a quick release pin and feeder pin. The feeder consists of a housing, feeder gear and shaft, sprocket, inner guide, solenoid and clearing mechanism. The feeder gear and sprocket are pinned to the shaft; and the clearing guides are pinned on the clearing shaft. The solenoid is connected to the clearing mechanism by a link. When the trigger signal is applied, the solenoid is energized and moves the clearing guides into the firing position, thus permitting rounds to be transfered into the gun. When firing is terminated, the solenoid is deenergized, and the clearing guides return to the clearing position, interrupting the flow of ammunition to assure the gun is clear of rounds when it stops.

Electric Drive Assembly

The electric drive assembly is secured to the gun with three bolts and consists of an electric motor, a drive housing and gear assembly. The gun drive assembly meshes with the forward gear on the gun rotor and drives the gun when the trigger signal is applied or during power loading.

Delinker Loader Assembly

The delinker loader is mounted to the upper cover and secured in position by a quick release pin and a pivoting link. A spring loaded detent pin, located at the rear of the housing, engages one of two holes in the pivoting link to secure the loader in the fire or load position. The loader must be secured in the fire position to fire the gun. When in the load position, self-timing gears on the exit shaft are engaged by the self-timing gear on the loader and power the delinker loader. The loader removes the rounds from the links, transfers them to the exit sprocket and ejects the links into the link ejection chute.

Storage Drum

The upper cover provides mounting for the gun, delinking loader, rounds counter assembly and exit shaft. The exit sprocket transfers ammunition from the drum to the feeder during firing and the delinker loader to the drum during loading. The end of the exit shaft has an elongated pin through it to mate with the handcrank for manual loading. A flexible chute assembly is attached to the upper cover to convey spent brass and cleared rounds to a storage container. The rounds counter assembly and bracket are mounted at the rear of the drum cover. The assembly is driven by a counter gear on the exit shaft. The counter records the cumulative total of rounds cycled through the gun module (TOTAL ROUNDS ON MODULE) and a total of rounds remaining in the module (ROUNDS IN MODULE). The number of rounds in the drum is automatically set into the counter when the drum is being loaded. A switch in the counter (full drum switch) will automatically stop power when the drum is full of ammunition. Another switch in the counter (last round switch) will terminate firing when the drum is empty. The storage drum will hold a total of 2,000 rounds.

Control Assembly

The control assembly contains the circuitry necessary for operating gun module (firing, gun clearing, battery charging and power loading). A panel on the front contains the power loading control, power indicator lamp, safing switch, the battery charging control indicators and test points.

Battery Assembly

The battery assembly is mounted to the bracket below the control assembly. The battery is recharged by power supplied from the aircraft.

MXU-470/A Special Equipment

Handcrank. The handcrank is stowed on clips riveted to the control assembly cover and is used to rotate the module components for loading in the event power loading cannot be accomplished. The handcrank is inserted over the exit shaft and engages a pin on the shaft. The handcrank is designed to rotate components in the load direction only.

Loading sector. The loading sector is stowed on clips riveted to the control assembly cover and is used in place of the safing sector on the gun during loading operation. The loading sector is secured to the gun by the same quick release pins that secure the safing sector. The loading sector prevents damage to the bolt assemblies when the gun is rotated in the load direction.

Safing bar. The safing bar is stowed on clips riveted to the control assembly and is used to prevent mechanical rotation of the gun. The long arm of the bar is inserted between the gun barrels and into the center hole of the module.

7.62MM Gun Firing Cycle

The firing cycle begins when mechanical power is applied to the forward gear of the rotor assembly. The rotor and barrels rotate ccw (viewed from the rear). As the rotor turns, the roller on the outer surface of each bolt follows the elliptical cam path formed in the inner surface of the gun housing. Each bolt, in turn, picks up a cartridge from the guide bar fingers.

The continuing camming action on the bolt roller moves the bolt and cartridge forward to chamber the cartridge in the barrel. As the cartridge is chambered, the bolt roller reaches the forward dwell portion of the elliptical cam. The cartridge is chambered by the bolt traveling forward along the elliptical cam path. The bolt head is allowed to rotate by the bolt head helix camming into the cam path on the bolt subassembly. The firing pin tang travels along the S-shaped groove in the rotor until it strikes the cocking shoulder. As the rotation of the bolt head continues, the firing pin is held in position by the two locking pins in the bolt head. Once the bolt head is in the proper position for firing, the locking pins force the firing pin tang off the cocking shoulder allowing the firing pin to travel forward and strike the cartridge.

After the cartridge has fired, the bolt assembly remains locked until the projectile has traveled through the barrel and gas pressure in the barrel is reduced. At the end of the forward dwell of the elliptical cam path, the bolt roller enters the reverse segment of the path. The bolt head unlocks. Further travel of the bolt roller along the reverse segment moves the bolt assembly to the rear and extracts the spent cartridge case from the barrel. A lip on the face of the bolt head holds the spent case until it is cammed out by the guide bar and ejected. The bolt assembly continues to follow the elliptical cam path into position to receive another cartridge. At this point the bolt assembly has completely cycled through the elliptical cam path. All six bolts repeat this cycle while power is applied to the front gear of the rotor.

20MM AUTOMATIC GUN

The two 20MM automatic guns are mounted in gun stands at No. 1 and 2 gun positions. The stands are bolted directly to the aircraft floor at each gun position. Each 20MM gun has its own power supply, firing control unit and safing and arming unit. The 20MM automatic guns each fire at a rate of 2500 rounds per minute from a fixed position. Each gun stand boresight may be adjusted aft in azimuth and depressed in elevation. Each gun is powered by an electric drive assembly mounted on the housing. A declutching feeder is driven by the gun rotor gear and it in turn drives the ammunition booster through a flexible shaft.

The M61 Automatic Gun has six rotating barrels that fire electrically primed 20mm ammunition. During each 1/6th revolution, a round is fed, chambered, fired, extracted and ejected. Firing voltage (320 VDC) is applied to the round when the respective barrel is rotated to the firing position.

M61 20MM GUN

The M61 gun is secured within the gun stand by two quick release pins at the front and a rear mounting pin. The gun stand allows a maximum of 15 degrees azimuth adjustment and 30 degrees of gun depression. The M61 gun is composed of seven major components which are the rotor assembly, tracks, bolt assemblies, housing assembly, the firing contact, barrels and barrel clamps.

Rotor assembly. The rotor assembly is the major unit of the gun. It is driven by an electric motor meshing with the drive gear. Front support for the rotor is a double row of ball bearings and the rear support is needle bearings located inside the rotor. The end plate provides the needle bearings with a stationary inner race for rear support of the rotor. These units are attached to the rear of the housing by a coupling clamp.

Tracks. Six sets of rotor tracks are attached to the ribs along the rotor body. Each set is composed of a front, center, and removable track. The removable track can be easily removed to permit removal of the bolt assemblies for servicing.

Bolt Assemblies. The function of the bolt assemblies are: to transport the round from the guide bar to the firing chamber; lock the round in the firing position; transmit firing voltage to the primer; and transport the empty case to the guide bar and ejection chute. An extractor lip on the front of the bolt engages the rim of the round. The rim of the round remains in the bolt extractor lip until cammed out by the guide bar fingers and ejected. Ways on the side of the bolt allow the bolt to slide fore and aft on the tracks. The position of the bolt on the rotor is determined by the bolt roller engaging the cam path in the housing. The firing circuit components of the bolt assemblies are the firing pin and firing pin spring, firing pin cam, and contact stop. Molded insulation in the bolt body insulates these components.

Housing Assembly. The housing assembly consists of an upper and lower section assembled as a unit and bolted at the front to the bearing retainer. The bearing retainer maintains the rotor assembly in the housing. Recoil adapters are secured to the bearing retainer and provide the forward mounting point for the gun. The housing assemblies function is to provide a cam path for the bolt rollers to follow and a means of support for the rotor. The main cam path is elliptical in shape and determines the position of the bolt in relation to the chamber. The indexing pin is used when timing the feeder assembly to the rotor assembly. When the indexing pin is inserted into any of the three indexing holes in the body of the rotor, the rotor is positioned to properly mesh the feeder gear with the rotor gear.

Firing Contact. The firing contact is attached to the top of the housing. Its function is to supply current from the connector to each bolt assembly in turn.

Barrels. The barrels are supported by the stub rotor which is attached to the forward end of the rotor. Three rows of interrupted locking lugs on the barrels mate with similar interrupted locking lugs in the rotor body to secure the barrels.

Barrel Clamps. The center barrel clamp positions the barrels for positive locking in the breech locking lugs and consists of a clamp body and guide, three inner clamp and nut assemblies which secure the clamp. The muzzle clamp consists of the clamp, muzzle clamp lock, spring pin and self-locking nut. The muzzle clamp lock is secured on the bevelled shoulder of three of the barrels.

Gun Drive Motor

The gun drive motor receives power from the gun battery. The drive motor is bolted to the left hand side of the gun housing and the drive gear meshes with the rotor drive gear to rotate the gun rotor CCW. Drive brakes are released electrically when trigger power is received and applied at trigger cessation. The drive brakes can be released by positioning both szuba brake release levers perpendicular to the motor axis to facilitate manual rotation.

Feeder Assembly

The feeder is mounted to the lower right side of the gun housing and secured by two feeder pins. It is timed to the gun using the indexing pins on the gun and feeder. As linked rounds are pulled into the feeder by the sprockets, each link is engaged and guided by the "T" rail until the round is removed from the link by the stripper.

Ammunition Feed Can

At each firing station ammunition cans are connected to the respective gun's declutching feeder by a flexible shaft and ammunition chute. A 1500 round belt of linked ammunition is stored in each can in suspended loops. The upper two rounds of the loop slide freely on horizontal rails until they reach the front of the top cover. There torsion springs retard the loops and prevent their dropping off the end of the rails and causing gun stoppage. The ammunition booster assembly mounted at the forward end of the can pulls looped ammuntion forward and delivers it to the ammunition chute. The ammunition belt flows down the ammunition chute into the declutching feeder.

Gun Control Units

The gun control unit regulates and times the various gun sequential operations. The clearing time delay and fire-volts time delay signals are originated in this unit.

20MM Special Equipment

Special equipment required to operate the 20MM system includes a pan to deflect brass and links into the ammunition box, a hand crank for manual rotation of the system, a shovel for removal of brass and links, and an azimuth/elevation adjustment handle.

20MM Gun Firing Cycle

The firing cycle begins when power is applied simultaneously to the firing contact and the drive motor. The main cam path guides the bolt assembly forward on the rotor and upward in the housing which chambers the round. After the round is chambered, the locking cam forces the bolt shaft roller down into the front well of the rotor insuring the round is fully chambered. As the bolt passes the insulated portion of the contact cam, it depresses the firing pin cam and moves the firing pin into the firing position. The insert (electrical contact) comes in contact with the firing pin cam and fires the round at the 1 o'clock position.

After the round is fired, the bolt remains locked until the projectile leaves the barrel and barrel pressure is reduced. The projectile may leave the barrel at any point in the 50° arc (dwell) depending upon the rate of fire and ammunition characteristics. The unlocking cam in the housing lifts the bolt shaft, thus retracting the bolt locking block and unlocking the bolt. As the cam path brings the bolt rearward, the empty case is extracted from the chamber by the extractor lips located on the face of the bolt. The bolt and spent case travel down to the seven o'clock position where the guide bar guides the case out of the housing through the spent case ejection chute. The bolt continues its travel along the rear cam path and into position to receive the next round. At this point, the bolt assembly has completely cycled through the elliptically shaped main cam path. All six bolts repeat this cycle until power is cut off to the weapon and the drive motor brakes stop the rotor.

Built into the firing circuit is a combination mechanical and electrical interlock. Its function is to provide a means of preventing the round from firing, if the locking block is not depressed into the locking well when the bolt is in the firing position. If the bolt shaft is in the unlocked position, the small tip on the back of the contact stop assembly rides against the side of the bolt shaft. The contact stop prevents the firing cam pin from being depressed far enough to cam the firing pin into contact with the round. The current is conducted through the rear tip of the contact stop to the bolt shaft and is shorted out to the weapon. When the shaft is in locked position, the small tip can enter a vertical slot in the bolt shaft. The firing cam pin can then be depressed far enough to cam the firing pin into contact with the round. The contact stop assembly is cammed backward so that only the insulated portion is in contact with the bolt shaft. The current passes through the firing pin cam and firing pin to fire the round. Recoil forces are transmitted from the bolt and locking block through the rotor to the housing ball bearing on the front of the rotor and to the bearing retainer and the recoil adapters.

Description of Clearing Cycle

During the clearing cycle a 28-volt dc signal is fed from the 20 mm control box to the feeder solenoid mounted on the feeder. This signal actuates the solenoid which stops the feeder rotation for a period of 0.6 of a second.

This allows the rounds to stop in the feeder and the rounds that have passed through the feeder to be fired. Firing voltage is held for approximately 0.4 second to fire those rounds which have been fed into the gun rotation stops. This action completely clears the gun of all rounds and eliminates the possibility of a cook-off (firing of the round by the heat of high gun temperature).

40MM AUTOMATIC GUN M2A1 (MODIFIED)

Two modified M2A1, 40mm automatic guns are installed in the No. 5 and 6 gun positions. Storage is provided for 480 rounds of ammunition by a rack, located on the right side of the airplane between the main landing gear and paratroop door. Ammunition is manually fed to the guns and the expended cases are stored for post mission disposal. The gun firing and status circuits allow monitoring of individual weapons during loading, arming operations, and firing. The control panels contain necessary circuitry for firing the guns.

The M2A1 gun is recoil operated and has a vertical sliding breechblock. The gun is supported in the top carriage of the gun mount by a gun box assembly and trunnions on the side of the breech casing. The gun depression adjustment. The gun employs a percussion firing mechanism and is limited to firing 100 rounds per minute of fixed type ammunition. The 40MM gun is composed of five major assemblies. These are the breech casing, recoil cylinder, barrel assembly, breechring assembly, and the automatic loader.

40MM Breech Casing. The breech casing is the housing or support unit for the various subassemblies of the gun. The recoiling parts of the gun slide in recoil and counterrecoil in the breech casing. The recuperator spring on the breech end of the barrel assembly is compressed in the tubular front portion of the casing. The breechring is guided in its forward and backward movement in the casing by channels on the inner sides of the casing.

Four hinged or detachable covers provide access to the interior of the casing. The top cover, which is hinged to the upper surface of the casing near the front, provides a means of visually inspecting the breech area. The side cover has a cam surface on the inside which operates the breechring outer crank assembly to lower the breechblock during recoil of the gun. The bottom cover is not hinged but is retained by a flange at its rear end. This cover permits removal of the breechring inner componets without further disassembly of the gun. The rear cover acts as an abutment for the automatic loader. This cover carries the cartridge case deflector and bracket. The recoil indicator is mounted to this bracket. The rear cover is hinged at the bottom and permits removal of the units within the casing. This cover has an opening through which the rear end of the loader tray moves in recoil and counterrecoil and through which the empty cartridge cases are ejected against the cartridge case deflector and down into the spent case storage barrel.

HAND OPERATING LEVER: The hand operating lever on the side of the breech casing opens the breech and prepares the gun to receive the first round. The lever also provides a means of mechanically safing the weapon.

FIRING SELECTOR LEVER: The three position firing selector lever is located on the side of the breech casing. In the SINGLE FIRE position, a single round will be fired each time a firing signal is received. In the RAPID FIRE position, the gun will fire at its adjusted rate as long as a firing signal is received. In the STOP FIRE position, the gun cannot be fired. The firing plunger, which protrudes through the trunion, is the means of contact between the firing solenoid and the parts of the firing mechanism housed within the breech casing.

RECOIL CYLINDER: The recoil cylinder is bolted under the tubular front end of the breech casing and the piston rod of the recoil cylinder is connected to the breech ring. By regulating the fluid flow within the cylinder, the recoil cylinder provides the necessary retarding force during recoil and counterrecoil to control the velocity of counterrecoil. Adjustment of the recoil cylinder control rod inward (SLOWER) or out (FASTER) meters weapon rate of fire.

BARREL ASSEMBLY: The gun barrel contains and controls the explosion of the propelling charge and provides interior guiding surfaces to direct the discharged projectile. The barrel assembly consists principally of the tube, recuperator spring, flash suppressor, and the necessary mounting devices.

The flash suppressor, which is fastened to the muzzle end of the tube minimizes the hazard of being accurately observed by enemy forces during night operations.

The recuperator spring is installed near the breech end of the tube and in conjunction with the recoil cylinder, absorb a portion of the rearward thrust caused by firing the gun. The spring is compressed during recoil and energy stored in the spring is extended during counterrecoil to force the gun back into the battery position.

BREECH RING ASSEMBLY: The breech ring assembly consists of a breech ring, breech ring barrel catch, extractors, breechblock assembly, inner and outer cranks, and a closing spring.

The breech ring is threaded internally at the front to receive the barrel assembly. It has a recess area from top to bottom in which the breechblock slides. Stops mounted at the top surface of the breech ring limit the upward travel of the breechblock when closing.

The breech ring barrel catch locks the barrel assembly to the breech ring by engaging a slot in the breech end of the barrel. The breech ring barrel catch, when locked, prevents the barrel assembly from rotating to a position where it could be removed from the breech ring. It is installed in the upper part of the breech ring and the pointed rear end of the catch guides the cartridges into the chamber.

The cartridge case extractor group consists of two extractors with bushings, extractor spindle, and extractor arm. An extractor release lever is provided to manually release the extractors. The extractors serve two purposes. They hold the breechblock in the open position until released by the extractor release lever (manual operation) or by the ramming of a round into the breech (automatic operation). They also extract and eject empty cartridge cases from the firing chamber of the gun.

The breechblock assembly is composed of a breechblock and percussion mechanism. The percussion mechanism is made up of breech block inner and outer cocking levers, inner cocking lever plunger and spring, and the firing pin, spring, and cover.

The breech ring inner crands raise and lower the breechblock assembly, operate the outer cocking lever, and actuate the inner cocking lever plunger. The breech ring inner crands are splined to the breech ring crank shaft and are rotated by the breech ring outer crank or the breech closing spring.

AUTOMATIC LOADER ASSEMBLY: The automatic loader is both a cartridge magazine and a loading device. Cartridges, in clips of four, are inserted in the top of the loader. They are fed onto the loader tray, the clips are removed automatically during the process. For rapid firing, the loader feeds the loader tray with a continuous supply of cartridges, ensuring that only one cartridge is fed onto the loader tray at a time. There are also provisions to ensure that automatic firing can be stopped when only one cartridge remains on the feed rollers and a cartridge is on the loader tray. This eliminates the necessity of manual cocking and placing a round on the loader tray. All parts of the loader except the loader tray remain in a fixed position in the breech casing. The loader tray is bolted to the breech ring and is a source of energy for operation of the feed mechanism.

40MM Special Equipment

A cartridge remover tool is required to depress the feed and stop pawls to remove cartridges from the loader assembly. A shell pusher tool is provided to be used in positioning the last round for firing and to aid in clearing gun system malfunctions. Two spent brass barrels are provided for storage of spent brass for post mission disposal. An azimuth/elevation adjustment handle and a 1 1/4" open-end wrench are provided for boresight adjustment.

40MM Gun Firing Cycle

The stages of the 40 mm automatic firing cycle are described in the following paragraphs. Each firing cycle is shown in figure 4-120.

FIRST STAGE - DURING RECOIL. Detail 1 of figure 4-120 shows the position of the parts just after the primer of the cartridge case has been struck by the firing pin. Immediately after firing; the barrel, breech ring, and loader tray begin to recoil. The projection on the bottom of the loader tray relieves its pressure from the rammer releasing level permitting the tray rammer catch lever to rise. During the first few inches of the recoil, the breech ring outer crank rotates enough to cause the firing pin to be withdrawn into the breechblock. As recoil continues, the breech ring outer crank continues to be rotated by the cam surfaces of the side cover. The breech ring inner cranks begin to lower the breechblock. In doing so, they actuate the breechblock outer cocking lever which cocks the firing pin for the next cycle. The breechblock inner cocking lever plunger engages the breechblock inner cocking lever.

As the loader tray moves to the rear, the cam grooves move past the feed rod rollers on the ends of the feed rods. The rollers enter the inclined portion of the grooves, raising the feed rods. The feed rods carry the feed pawls upward and over the next cartridge in the loader. The cartridges are prevented from being raised by the stop pawls. The loader tray pawls on the front of the loader tray are depressed by and pass under the lugs which extend sidewise from the feed roller catch heads.

SECOND STAGE - DURING RECOIL. Detail 2 of figure 4-120 shows the position of the parts when the breechblock has been lowered part of the way in its slides in the breech ring. The feed rods, holders, and pawls are nearing their extreme upward position. The rammer shoe is over the tray rammer catch lever. The loader tray is free of obstructions which permits the ejection of the empty case. The rammer levers were forced to the sides of the tray by their cam slots at the same time they released the cartridge in ramming it.

As the breechblock decends, the projections at the sides of the front face of the breechblock strike the toes of the extractors. The extractors are rotated toward the rear and their lips catch the rim of the cartridge case and eject it. The empty case is thrown with considerable force out of the chamber, along the loader tray, through the rear cover opening, against the cartridge case deflector.

THIRD STAGE - DURING RECOIL. Detail 3 of figure 4-120 shows the position of the parts at the end of recoil. The empty cartridge case has been extracted. The breechblock is in its lowered position. The feed rod rollers are in the upper horizontal portion of the loader tray cam grooves and the feed rods are fully raised. Recoil has been stopped by the action of the recuperator spring and the recoil cylinder. The hook-shaped heads of the extractors are over the notched tops of the projections on the front face of the breechblock. The rammer shoe is to the rear of the tray rammer catch lever, and the loader tray pawls are to the rear of the feed roller catch heads.

FOURTH STAGE - DURING COUNTER-RECOIL. Detail 4 of figure 4-120 shows the position of the parts as the cartridge drops onto the loader tray and is engaged by the rammer levers. The tube, breech ring, and loader tray start to move toward battery position. The breechblock moves slightly upward under the action of the closing spring until it is brought to a stop and held by the extractor heads engaging the notches in the tops of the breechblock projections. The rammer shoe is engaged by the tray rammer catch lever, holding the shoe and compressing the rammer spring as the tube, breech ring, and loader tray move toward battery position. The feed control rammer catch lever is held out of engagement because there are sufficient cartridges in the loader to hold the feed control lever in its rearward position. The trigger rammer catch lever is held out of engagement because the firing plunger is depressed and the firing selector lever is set for automatic fire. As the loader tray moves forward, the loader tray pawls on the front end of the tray engage the lugs on the feed roller catch heads, rotating the catch heads and releasing the feed rollers on one-quarter turn. At the same time the feed rollers enter the declined portion of the loader tray cam grooves, forcing the feed rods and feed pawls downward. The feed pawls engage the cartridges, forcing them downward.

The lowest cartridge rotates the feed rollers, passes through them and drops on the loader tray into the rammer levers. The pawls on the feed roller catch heads engage the feed rollers; preventing them from revolving more than one-quarter turn, thus preventing more than one cartridge from passing through. The cam slots in the top of the loader tray force the heads of the rammer levers inward to grip the rim of the cartridge.

FIFTH STAGE - DURING COUNTER-RECOIL. Detail 5 of figure 4-120 shows the position of the parts as the cartridge enters the chamber. When the feed rollers have completed a quarter turn, they are re-locked by the catch heads which are returned to their normal positions by their torsion springs. As the gun nears the end of counter-recoil; the beveled projection on the bottom of the loader tray trips the rammer releasing lever, freeing the rammer shoe from the restraint of the tray rammer catch lever.

The rammer shoe is pulled forward by the rammer spring, and the rammer levers carry the cartridge forward with the shoe. As the rammer shoe nears the end of its travel; the cam slots in the top of the loader tray force the rammer levers outward, releasing the cartridge. The cartridge is thrown forward through the u-shaped channel in the top of the breechblock and into the chamber of the gun.

SIXTH STAGE - DURING COUNTER-RECOIL. Detail 6 of figure 4-120 shows the position of the parts the instant before the cartridge is fired. After the rim of the cartridge passes through the u-shaped channel at the top of the breechblock, it engages the extractors; pulling them forward, releasing the breechblock. The closing spring forces the breechblock upward. The beveled front surface of the breechblock engages the rear of the cartridge, forcing it completely into the chamber. As the breechblock reaches its uppermost position, the projection on the breech ring inner crank contacts the beveled end of the inner cocking lever plunger; moving the plunger to the left, releasing the inner cocking lever, and permitting the firing pin to be thrust forward by the firing pin spring. The cartridge is fired and the cycle starts again.

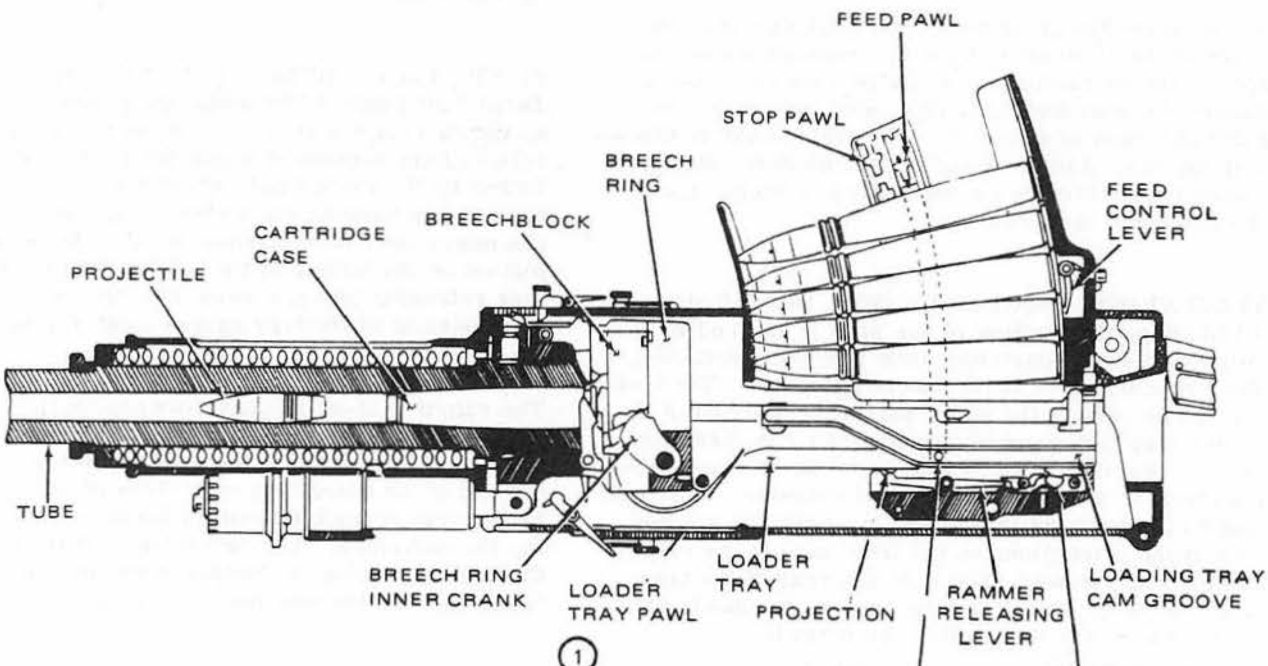
GUNFIRE SIMULATOR LIGHT (T.O. 1C-130-871)

On training airplanes incorporating T.O. 1C-130-871 a light is installed in lieu of the aft 20 mm (No. 2) gun. This light is used during training missions to simulate live fire from the airplane. Power of 28-volt dc and 115-volt, 400-cycle, three-phase ac is supplied to the light through circuit breakers located on the main power distribution box.

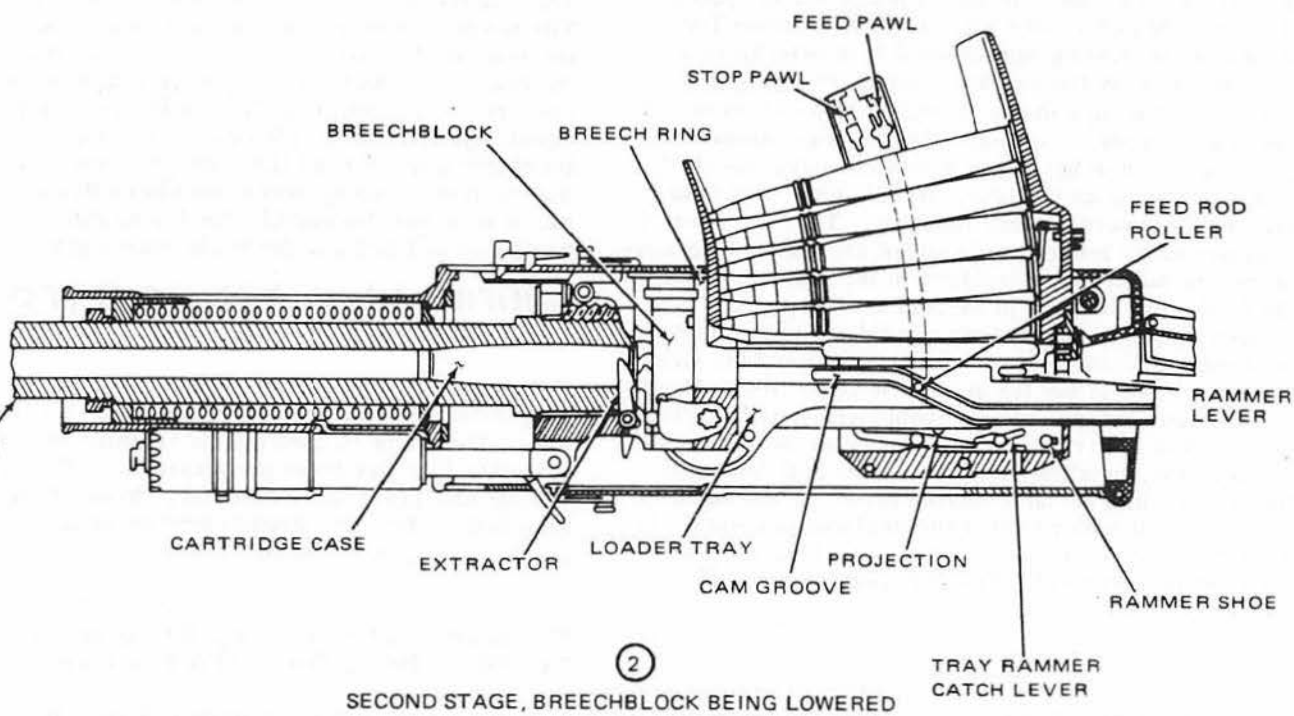
The following procedures are for operation of the GUNFIRE SIMULATOR light during flight:

1. Reset both gunfire simulator light CB's on main power distribution box.

40 mm gun automatic firing cycle



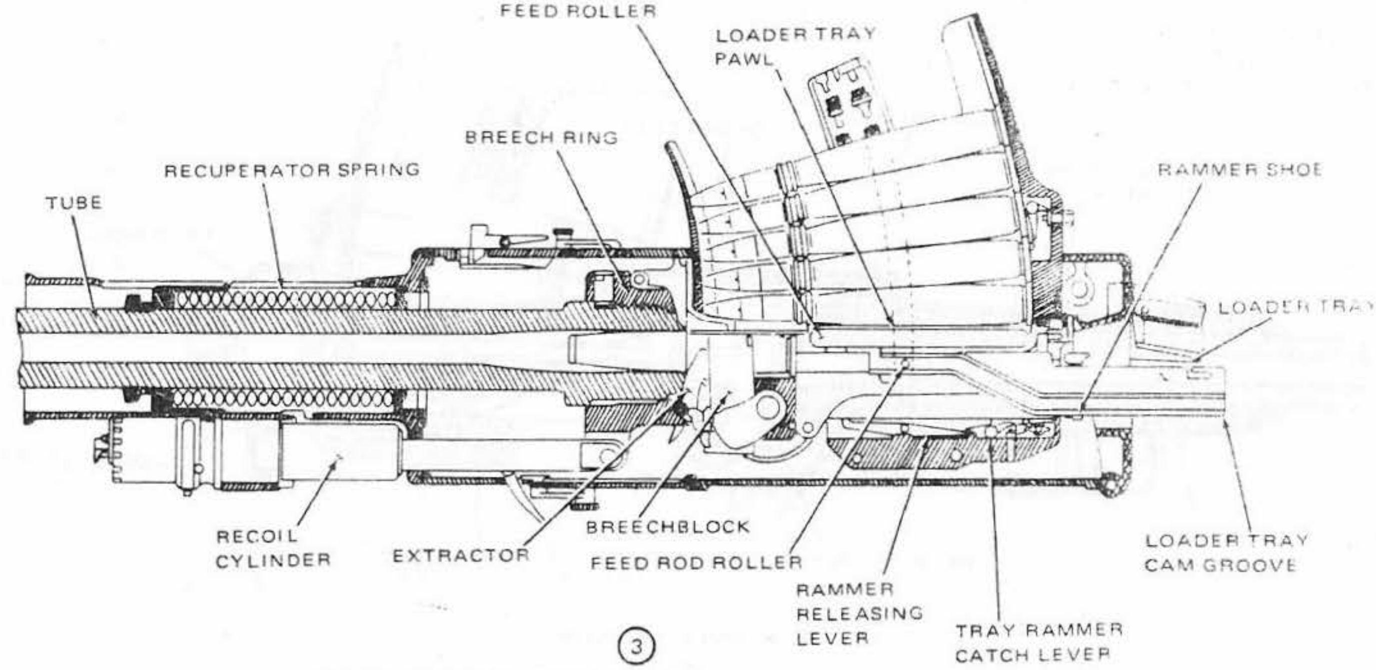
① FIRST STAGE, GUN FIRING



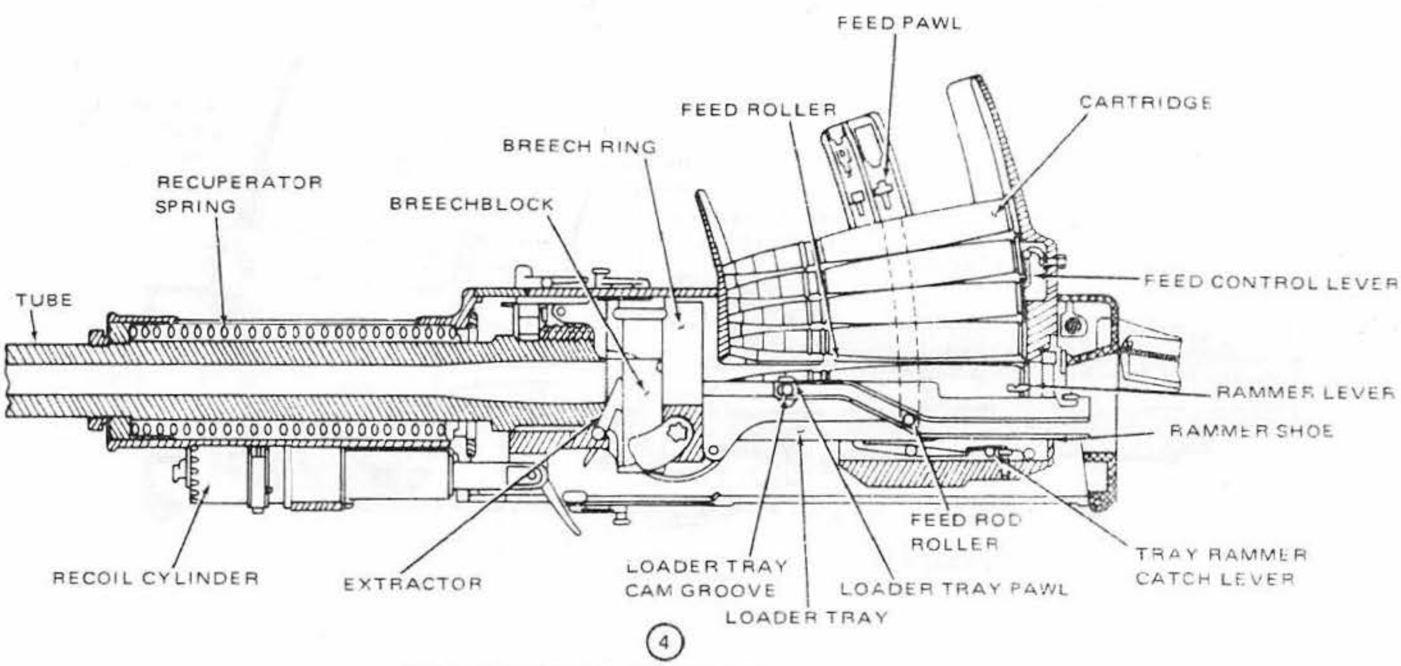
② SECOND STAGE, BREECHBLOCK BEING LOWERED

Figure 4-120. (Sheet 1 of 3)

40 mm gun automatic firing cycle (cont)



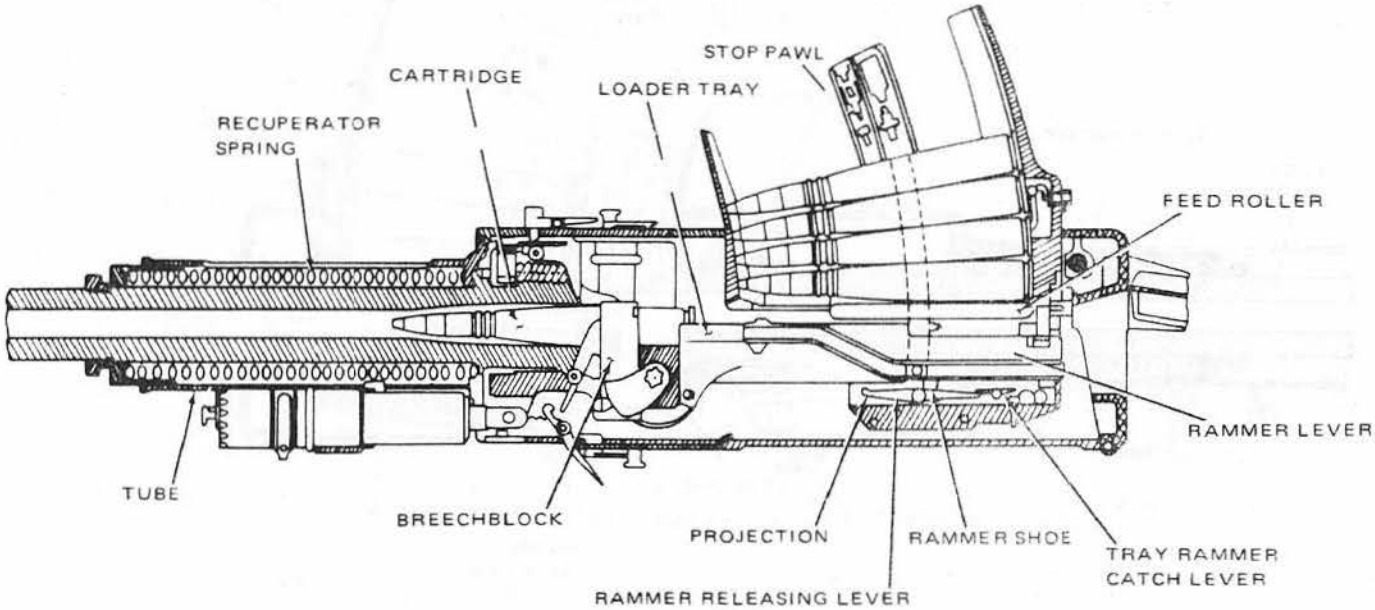
(3)
THIRD STAGE, BREECHBLOCK LOWERED AND CARTRIDGE CASE EXTRACTED



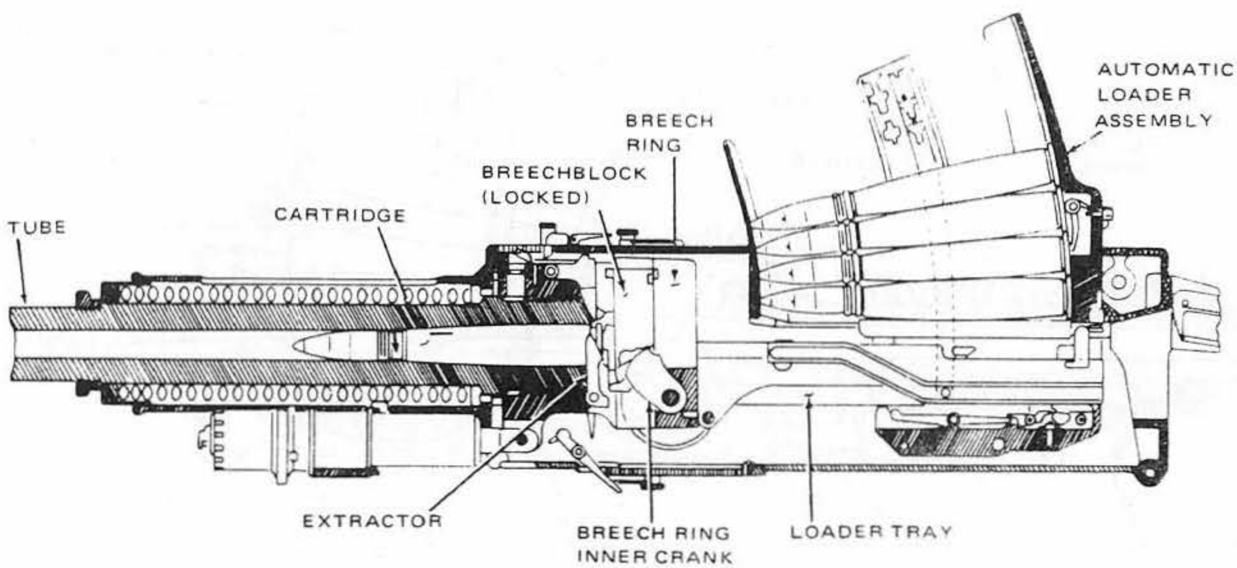
(4)
FOURTH STAGE, CARTRIDGE ON LOADER TRAY

Figure 4-120. (Sheet 2 of 3)

40 mm gun automatic firing cycle (cont)



(5)
FIFTH STAGE, CARTRIDGE BEING RAMMED



(6)
SIXTH STAGE, CYCLE COMPLETED AND GUN IN ACT OF FIRING

Figure 4-120. (Sheet 3 of 3)

2. Reset the CB's on top of the light.

3. Coordinate with flight engineer and place No. 2 20MM gun arm switch to ARM position (gun control panel).

4. Place #2 20MM gun arm switch (at the #2 20MM gun) to ARM.

5. Place master arm switch to ARM position, gun mode selector switch to SEMI AUTO position.

6. At gun fire simulator light place light selector switch to STANDBY.

7. Place mode selector switch to STEADY.

8. Coordinate with pilot for light boresight, and lock elevation and azimuth when light is on target.

9. Place mode selector switch to REMOTE.

Note

The gunfire simulator light must be boresighted for 30° bank angle with the pilot flying good geometry.

NORMAL OPERATION OF THE ARMAMENT SYSTEM

Note

It is assumed that proper preflight by ground crew and aircrew has been accomplished.

1. Enroute to the target, navigator will update fire control computer data as required.

2. Navigator will energize sensor angle display system and each SAD observer will select desired sensor on his panel.

3. Navigator will energize fire control display unit and select desired sensors for display.

   a. Adjust FOCUS, INTENSITY, and SYMBOL SIZE controls as desired.

   b. Set SCALE FACTOR SELECT switch to COARSE.

Note

As target is approached, this switch may be set to the FINE position for display expansion.

4. Ensure the gunnery panels are set to meet mission requirements as follows:

   a. On selected 7.62 mm minigun control panel, set SAFE/LOAD-FIRE switch to FIRE.

   b. On selected 7.62 mm and/or 20 mm safing and arming panel set SAFE/ARM switch to ARM.

   c. On the GUN CONTROL panel set the selected 7.62 mm RATE HI/LO switch to desired rate and set selected 7.62 mm switch to ARM. Set selected 20 mm switch to ARM.

   d. Set pilot's MASTER ARM SW to ARM.

   e. Observe that selected 7.62 mm and/or 20 mm ARM indicator on the GUN CONTROL panel is illuminated and that selected ARMED indicator on the GUN STATUS panel is illuminated.

   f. Set GUN MODE SELECTOR to MAN, SEMI AUTO, or AUTO as desired.

Note

Refer to GUN MODE AND LIGHTING CONTROL PANEL paragraph in this section for proper positioning of the associated gunnery switches when in the AUTO, SEMI AUTO, and MAN modes of operation.

5. Pilot will monitor gunsight and fire when required conditions are met.

Note

The navigator acts as safety officer and if friendly forces are endangered, he shall notify the pilot who will ensure that the firing circuits are disabled by placing MASTER ARM SW to SAFE.

6. To deenergize the armament system proceed as follows:

   a. Set MASTER ARM SW to SAFE.

   b. Set applicable switch on GUN CONTROL panel to SAFE.

   c. Set applicable ARM/SAFE switches on the safing and the arming panels to SAFE.

   d. When using the miniguns, set SAFE/LOAD-FIRE switch to SAFE/LOAD.

e. If use of the FIRE CONTROL DISPLAY unit or fire control computer is no longer contemplated, set PRIMARY POWER switch on the unit to OFF or set the computer power ON/OFF switch to OFF.

f. If use of the sensor angle display system is no longer contemplated, set SENSOR ANGLE DISPLAY switch to OFF.

AIRBORNE ILLUMINATION LIGHT SET, (when installed)

The airplane contains provisions for the airborne illumination light set (illuminator), which is a self-contained xenon arc lamp system that bolts to the aft cargo ramp. Crash seats and the illuminator cannot be installed on the cargo ramp simultaneously. Two 20 kw xenon lamps are used and are capable of visible and infrared modes of operation. Beam spread resulting from the collected radiation from each lamp is continuously variable between 20 and 40 degrees. Transformer-rectifier (TR) and heat exchanger units are permanently mounted on the frame, and the lamp house and gimbaling support assemblies are installed on shock-mounted tubes to allow the illuminator to be extended and aimed in flight. These motions are remotely controlled and permit the beam to be rotated +15 degrees about the pitch axis, and from +10 to -90 degrees about the toll axis. Operational controls and position and status indicators are located on the aft control panel on the transformer-rectifier unit and on a remote control console. The remote control console is located on the flight deck. Power required for system operation is 115-volt, 400-Hz, three-phase ac and 28-volt dc supplied through circuit breakers on the aux ac power box and cargo compartment dc circuit breaker panel. Power for the fixed lamp is No. 1 ac generator and for the variable lamp is No. 4 ac generator (figure 4-121).

CAUTION

Prior to initial operation of the illuminator, disengage autopilot and turn radar and IR to standby due to possible overload of right hand ac bus.

REMOTE CONTROL CONSOLE CONTROLS AND INDICATORS

The remote control panel (figure 4-122) is located on the aft bulkhead of the flight deck. Descriptions and functions of the indicators and controls are described in the following paragraphs.

FWD CONTROL Indicator - Indicates forward control panel has control of illuminator.

LAMP F ON Indicator - Indicates that LAMP F is illuminated.

FWD/NOD Control - In FWD, transfers control of illuminator to remote control panel. With NOD equipment removed, NOD position of control is disabled.

INTERLOCK OPEN Indicator - Illuminates when any interlock circuit is open.

LAMP V ON Indicator - Indicates LAMP V is illuminated.

KILL SWITCH Control - Kills LAMP F and LAMP V.

ZOOM Position Indicator - Indicates zoom position.

PITCH & ROLL Indicator - Indicates position of illuminator.

MODE SELECT Control - Selects infrared or visual illumination mode of operation.

PITCH ROLL & ZOOM CONTROL Switch - This four-position (FWD/AFT/UP/DOWN) switch controls positioning of illuminator.

IR Mode Indicator - Indicates IR (infrared) mode of operation.

VISUAL Mode Indicator - Indicates visual illumination mode of operation.

Darklight Dimmer - Controls intensity of panel edge-lights.

AFT CONTROL PANEL CONTROLS AND INDICATORS

The aft control panel (figure 4-123) is located on the stationary portion of the illuminator assembly. Descriptions and functions of the indicators and controls are described in the following paragraphs.

CURRENT Indicator - Indicates dc amperage of either the F or V lamps.

VOLTAGE Indicator - Indicates voltage of either the F or V lamps.

SYSTEM STATUS/RUNNING TIME Meter - Starts when power is applied to the illuminator by the MAIN POWER ON switch.

generator load switching combinations

GENERATOR COMBINATION	FUNCTIONAL OPERATION
NOTE Boxed areas indicate functions that are lost with a specific switching combination.	
GENERATOR 1 ON GENERATOR 4 ON GENERATOR 3 ON	TR-F carriage motor TR-V 20 kw Main pump, roll motor, mode motors, and heater
GENERATOR 1 OFF GENERATOR 4 ON GENERATOR 3 ON	TR-F OFF, carriage motor OFF TR-V 20 kw Main pump, roll motor, mode motors, and heater
GENERATOR 1 OFF GENERATOR 4 OFF GENERATOR 3 ON	Carriage motor, TR-V 20 kw, TR-F OFF (Load transferred to GENERATOR 1) Main pump, roll motor, mode motors, and heater
GENERATOR 1 OFF GENERATOR 4 OFF GENERATOR 3 ON	TR-F OFF, carriage motor OFF TR-V OFF Main pump, roll motor, mode motors, and heater
GENERATOR 1 ON GENERATOR 4 ON	TR-F, carriage motor TR-V 16 kw maximum limit, main pump, roll motor, mode motors, and heater
GENERATOR 3 OFF GENERATOR 1 OFF GENERATOR 4 ON	(Load transferred to GENERATOR 4) TR-F OFF, carriage motor OFF TR-V 16 kw maximum limit, main pump, roll motor, mode motors, and heater
GENERATOR 3 OFF GENERATOR 1 ON	(Load transferred to GENERATOR 4) Carriage motor, TR-V 16 kw maximum limit, main pump, roll motor, mode motors, and heater. TR-F OFF
GENERATOR 4 OFF GENERATOR 3 OFF	(Load transferred to GENERATOR 1) (Load transferred to GENERATOR 1)

Figure 4-121.

airborne illumination light set remote control panel

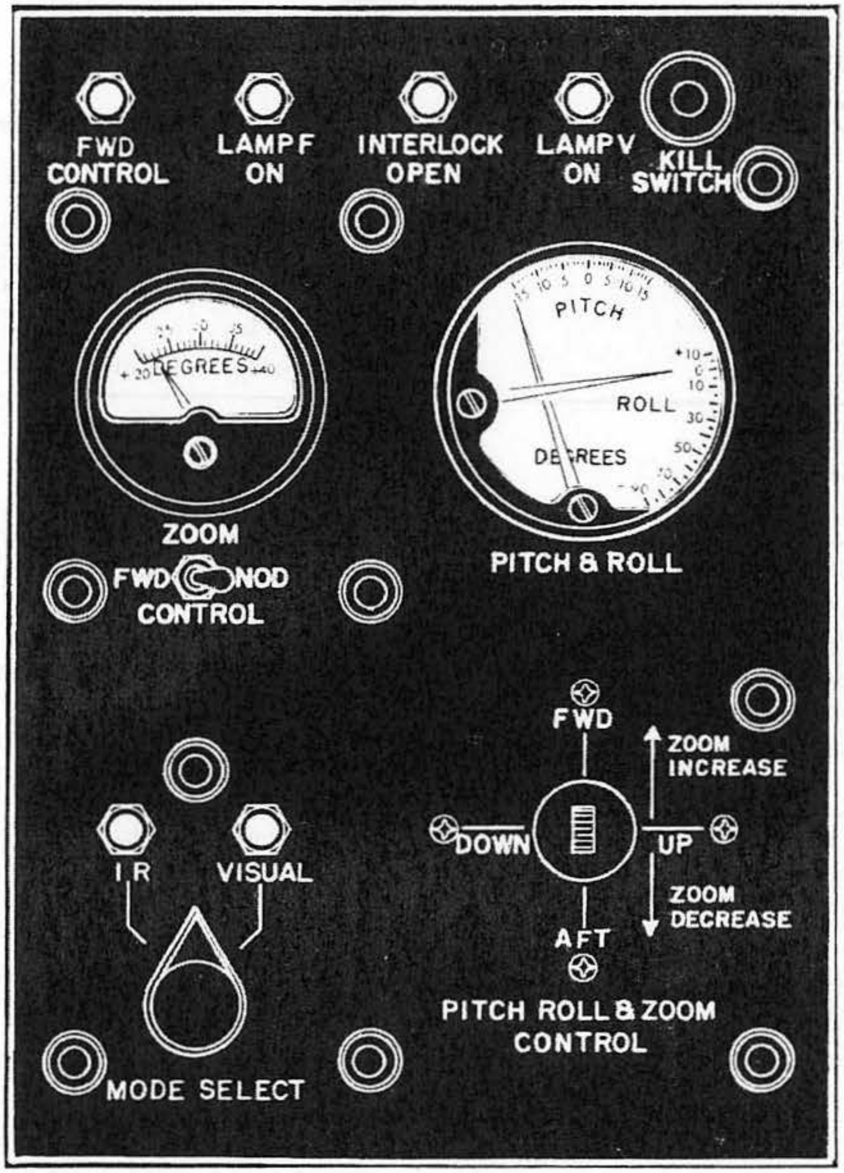


Figure 4-122.

airborne illumination light set aft control panel

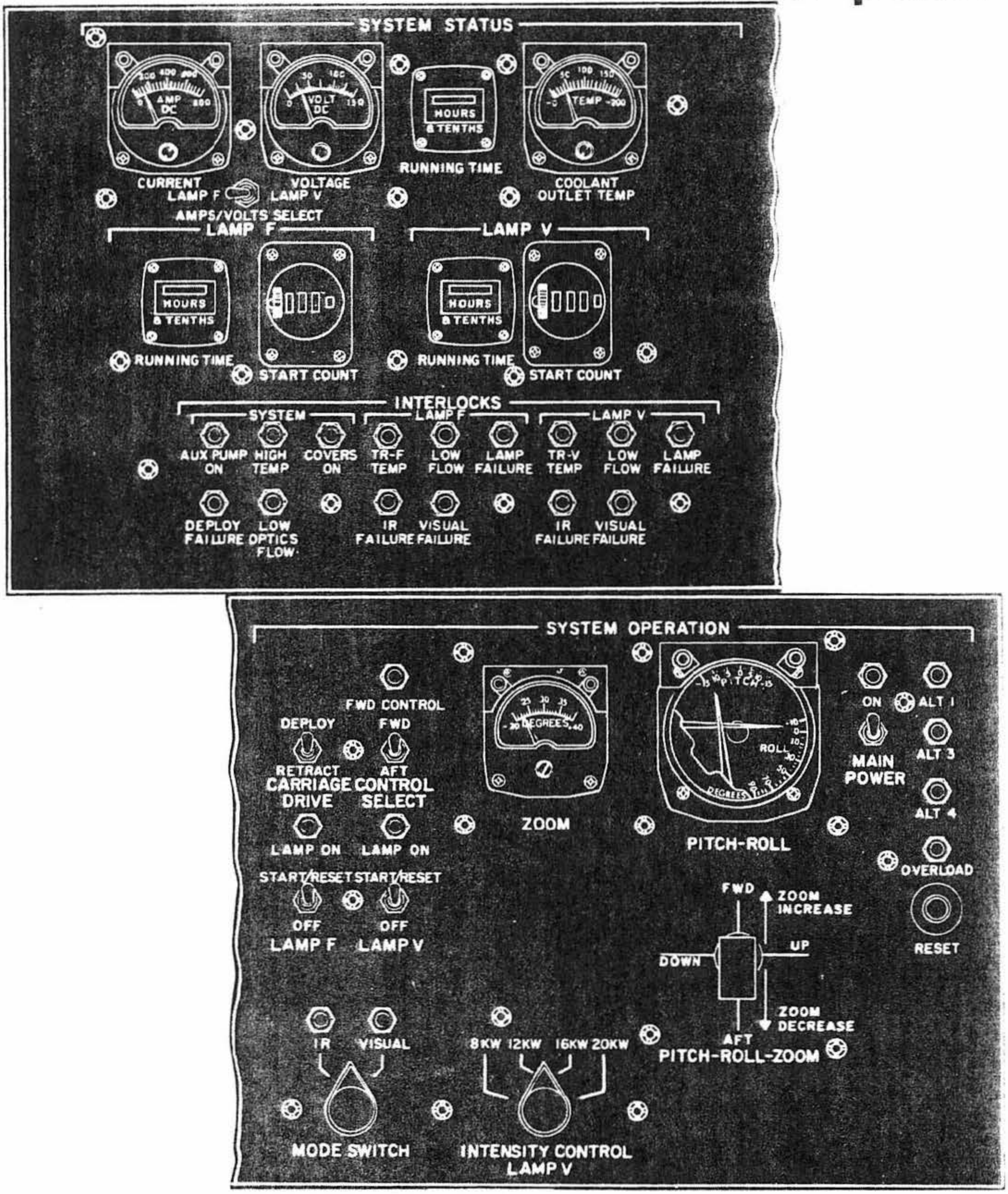


Figure 4-123.

COOLANT OUTPUT TEMP Indicator - Indicates coolant outlet temperature.

AMPS VOLTS SELECT Switch - This two-position toggle switch is used to select either LAMP F or LAMP V for indications on the CURRENT and VOLTAGE indicators.

LAMP F RUNNING TIME Meter - Indicates LAMP F operating time.

LAMP F START COUNT Indicator - When a pulse is sent to LAMP F, this indicator will record the event.

LAMP V/RUNNING Time Meter - Indicates LAMP V operating time.

LAMP V/START COUNT Indicator - When a pulse is sent to LAMP V, this indicator will record the event.

AUX PUMP ON Indicator - Indicates the system coolant is below 45°F and the auxiliary pump and heater are in operation.

HIGH TEMP Indicator - Indicates the system coolant exiting from the heat exchanger is above 150°F. When illuminated, both TR packages are turned off, both running time meters are stopped, and all LAMP ON Indicators are extinguished.

COVERS ON Indicator - Indicates lamp covers are installed.

DEPLOY FAILURE Indicator - Indicates the illuminator is not extended. When this indicator is illuminated, the lamps cannot be started and the pitch and roll mechanism is inoperative.

LOW OPTICS FLOW Indicator - Indicates the total coolant flow is below safe level of operation. When illuminated, both TR packages are turned off, both running time meters are stopped, and all LAMP ON indicators are extinguished.

LAMP F/TR-F TEMP Indicator - Indicates the temperature of the fixed TR package is over the safe limit of operation. When illuminated, the fixed TR package and fixed LAMP ON indicator are turned off and the fixed lamp running time meter is stopped.

LAMP F/LOW FLOW Indicator - Indicates the water flow through the fixed TR package is below the safe level of operation. When illuminated, the fixed TR package is turned off, the fixed LAMP ON indicator extinguishes, and the fixed running time meter is stopped.

LAMP F/LAMP FAILURE Indicator - Indicates LAMP F did not start and the operator must actuate the START/RESET switch again.

LAMP F/IR FAILURE Indicator - Indicates the mode change of the fixed lamp from visual to IR has not been completed. The interlock switch has not been tripped. When illuminated, the fixed lamp cannot be illuminated.

LAMP F/VISUAL FAILURE Indicator - Indicates the mode change of the fixed lamp has not been completed. The interlock switch has not been tripped. When illuminated, the fixed lamp cannot be started.

LAMP V/TR-V TEMP Indicator - Indicates the temperature of the variable TR package is over the safe limit of operation. When illuminated, the TR package is turned off, the variable LAMP ON indicator extinguishes, and the variable lamp running time meter is stopped.

LAMP V/LOW FLOW Indicator - Indicates the water flow through the variable TR package is below the safe level of operation. When illuminated, the variable TR package is turned off, the variable LAMP ON indicator is extinguished, and the variable lamp running time meter is stopped.

LAMP V/LAMP FAILURE Indicator - Indicates the variable lamp did not illuminate and the START RESET switch must be actuated again.

LAMP V/IR FAILURE Indicator - Indicates the mode change of the variable lamp from visual to IR has not been completed. The interlock switch has not been tripped. When illuminated, the TR unit is turned off.

LAMP V/VISUAL FAILURE Indicator - Indicates the mode change of the variable lamp from IR to visual has not been completed. The interlock switch has not been tripped. When illuminated, the variable lamp cannot be illuminated and the TR package is turned off.

CARRIAGE DRIVE Switch - Controls extension and retraction of the illuminator.

CONTROL SELECT Switch - This two-position (FWD/AFT) toggle switch allows transfer of control of the illuminator to either the remote or aft control panels.

FWD CONTROL Indicator - Indicates that command of the system is from the remote control panel.

ZOOM Position Indicator - Indicates zoom position.

PITCH-ROLL Indicator - Indicates pitch and roll angles, in degrees, of the illuminator.

MAIN POWER Switch - This two-position toggle switch energizes and deenergizes the system.

ON Indicator - Indicates system is in operation.

ALT 1 Indicator - Indicates No. 1 alternator power is available to the system.

ALT 3 Indicator - Indicates No. 3 alternator power is available to the system.

ALT 4 Indicator - Indicates No. 4 alternator power is available to the system.

OVERLOAD Indicator - Indicates the airplane deice system is being used, which diables one alternator for use by the illuminator.

RESET Switch - This switch is used to reset the system to receive alternator power after an alternator overload condition has occurred.

LAMP F Switch - This switch is used to start LAMP F by momentarily placing switch in the START/RESET position. If the lamp does not start, momentarily place switch in START/RESET position again. A maximum of three pulses in 3 seconds is provided to start the lamp.

LAMP F/LAMP ON Indicator - Indicates LAMP F illumination.

LAMP V Switch - This switch is used to start LAMP V by momentarily placing switch in the START/RESET position. If the lamp does not start, momentarily place switch in START/RESET position again. A maximum of three pulses in 3 seconds is provided to start the lamp.

LAMP V/LAMP ON Indicator - Indicates LAMP V illumination.

MODE SWITCH Control - Selects either infrared (IR) or visual illumination (VISUAL) mode of operation.

IR Mode Indicator - Indicates infrared mode of operation is selected.

VISUAL Mode Indicator - Indicates visual illumination mode of operation is selected.

LAMP V INTENSITY CONTROL Switch - Selects either 8KW, 12KW, 16KW, or 20KW light intensity of the LAMP V.

PITCH-ROLL-ZOOM Control - Controls positioning of illuminator.

Darklight Dimmer - Controls intensity of panel edge-lights.

Pressure Gages

There are five pressure gages in front and above the aft panel. P1 gage indicates accumulator preload air pressure. P2 gage indicates coolant head pressure. P3 and P4 gages indicate coolant pressure to LAMP V and LAMP F respectively. P5 gage indicates coolant pressure to the optics.

NORMAL OPERATION OF THE AIRBORNE ILLUMINATION LIGHT SET

WARNING

Intense visible light, ultraviolet, and infrared radiations are emitted from the lamps. Use eye protection during operation. Do not look into the beam.

1. Prior to operation:

   a. Remove zoom dust covers.

   b. Disengage turnbuckle from yoke clevis.

   c. Engage all system circuit breakers.

   d. Set CONTROL SELECT switch on aft control panel to AFT.

   e. Open airplane door and ramp.

2. Set CARRIAGE DRIVE, ROLL DRIVE, and PITCH DRIVE brakes to POWER positions.

3. Set MAIN POWER switch to ON.

4. Hold CARRIAGE DRIVE switch in DEPLOY position.

chaff control panel

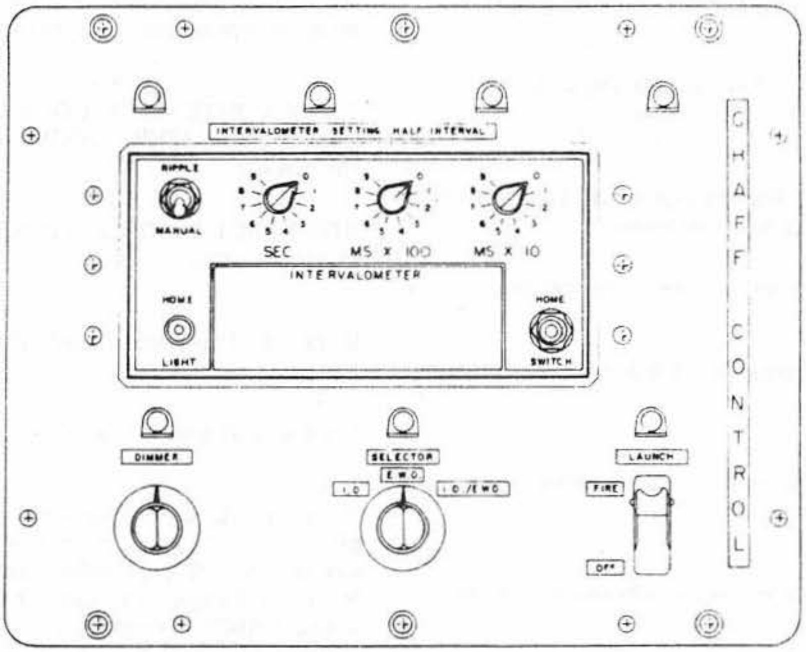


Figure 4-124.

5. Check that no INTERLOCKS indicators are illuminated.

6. Start lamps by switching LAMP F and/or LAMP V switches to START/RESET.

7. Set CONTROL SELECT switch to FWD to operate remote control only.

8. To retract the illuminator, hold CARRIAGE DRIVE switch in RETRACT position.

9. Set MAIN POWER switch to off.

10. Disengage all system circuit breakers.

11. Replace dust covers.

EMERGENCY OPERATION OF THE AIRBORNE ILLUMINATION LIGHT SET (ALTERNATOR POWER FAILURE)

1. Set MAIN POWER switch on aft control panel off.

2. Set ROLL DRIVE BRAKE in MANUAL.

3. Attach wrench to manual roll drive. Turn counterclockwise until lamphouse yoke is rolled to +10-degree position and meets roll stop.

4. Set ROLL DRIVE BRAKE in POWER.

5. Remove pitch brake cover. Disengage brake by turning knurled knob clockwise with fingers until seated.

6. Attach pitch wrench to MANUAL PITCH DRIVE. Turn clockwise until lamphouse is pitched -15 degrees aft and meets end stop. Replace pitch wrench.

7. Engage brake by turning knurled knob one and one-half turns counterclockwise from seated position. Replace pitch brake cover.

8. Set CARRIAGE DRIVE BRAKE in MANUAL.

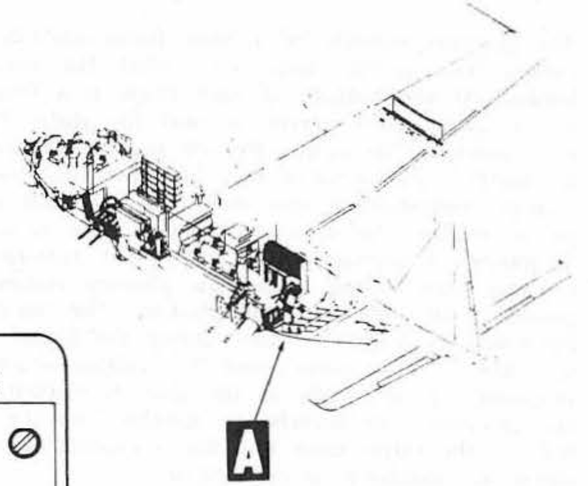
9. Attach wrench to MANUAL CARRIAGE DRIVE. Turn clockwise until carriage is fully retracted and meets end stop. Replace wrench.

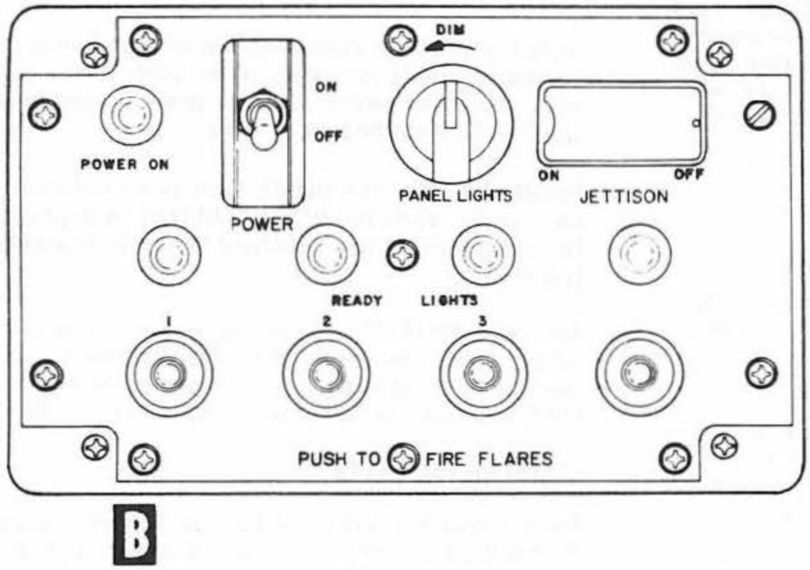
10. Place CARRIAGE DRIVE BRAKE in POWER.

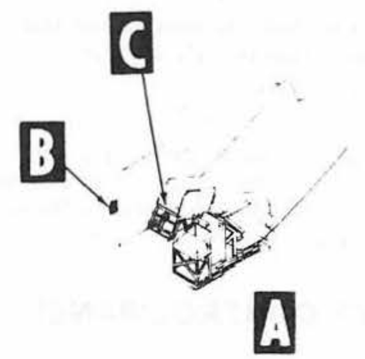
FLARE LAUNCHER, LAU-74/A

The flare launcher system (figure 4-125) is an airborne self-contained mechanical electro-pneumatic launching device. The system consists of a four tube semi-automatic store launcher, a control panel and a pneumatic subsystem. Operating power (28 VDC) is supplied to the system through a circuit breaker on the cargo compartment DC circuit breaker panel and the battery bus circuit breaker panel.

flare launcher (LAU-74/A)







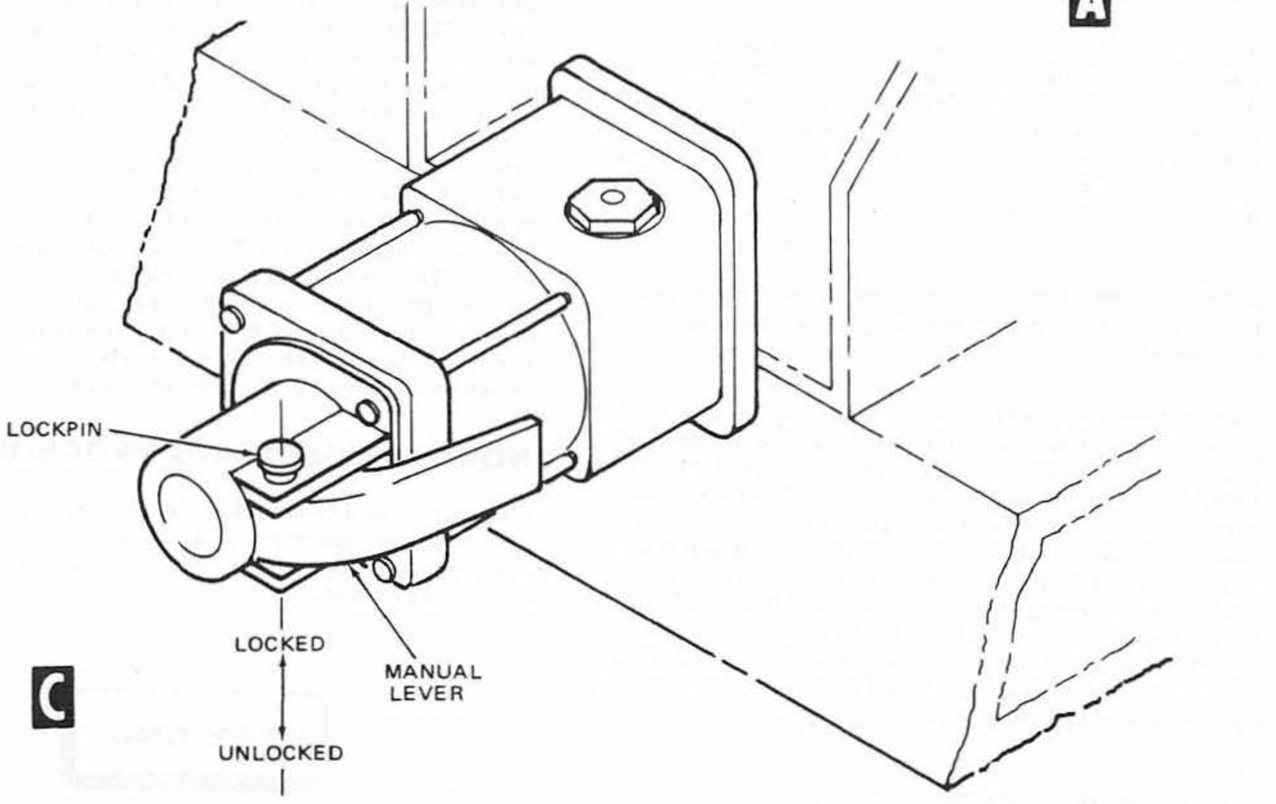


Figure 4-125.

The launcher consists of a basic frame assembly enclosing four storage chutes into which the stores are loaded. At the bottom of each chute is a free piston actuator which serves to eject the stores from the launcher. The stores are fed to the actuator by gravity. The actuator is a longitudinally-slotted cylinder containing a free piston. An arm on the piston engages the store, and launching is accomplished as pneumatic pressure forces the piston through the cylinder. After firing, pneumatic pressure returns the piston to the original firing position. The launcher automatically arms the store during the launch cycle; the safety pin is pulled, and the ignition sequence is triggered simultaneously as the store is ejected from the launcher. The launcher is mounted on the right side of the cargo ramp and has a capacity of 24 stores, six cannisters in each chute.

CAUTION

To preclude damage to the flare launcher, the ramp must be full up prior to closing the ramp cargo door.

Operators of the launcher are the EWO and IO. The launcher is controlled electrically by switches on a chaff control panel located on the wall by the EWO station and by switches on the launcher control box.

CHAFF CONTROL PANEL

The chaff control panel (figure 4-124) provides intervalometer controls which allow the EWO to select the cannister release interval desired. This panel is located on the right wall of the booth adjacent to the EWO station and also contains switches for remote operation of the flare launcher. Controls and indicators are described as follows:

DIMMER CONTROL. This rotary switch controls brightness of the seven panel lights on the chaff control panel.

SELECTOR CONTROL. This is a rotary switch with positions IO, EWO, and IO/EWO. In the IO switch position the IO has complete control of the LAU-74/A. EWO switch position provides the EWO with complete control of the LAU-74/A and allows launch of eight stores in sequence 1, 2, 3, 4, 1, 2, 3, 4, using intervalometer settings. The IO/EWO switch position allows the IO control over tubes 3 and 4 and the EWO control over tubes 1 and 2. With the switch in this position the EWO can launch eight stores in sequence 1, 2, 1, 2, etc., and the IO can launch stores in any sequence desired from tubes 3 and 4.

RIPPLE-MANUAL SWITCH. This is a two-position toggle switch which in the RIPPLE position permits up to eight cannisters to be released in continuous succession. In the manual position a single cannister is released each time the launch switch is placed to the FIRE position.

INTERVALOMETER SETTING SWITCHES These rotary switches select the cannister release interval and provide intervalometer settings from 0.00 to 9.99 seconds. Each of the three switches has ten positions numbered 0 through 9. To select an interval of 2.5 seconds, for example rotate SEC knob to 1, MS X 100 knob to 2, and MS X 10 knob to 5. The intervalometer setting is half the firing cycle.

HOME SWITCH - This momentary pushbutton switch is used to reset the relay to the first firing pulse position. The switch must be pressed and held until the HOME light begins to blink.

HOME LIGHT The HOME light is an indicator that blinks when the HOME SWITCH is depressed and the rotary relay has returned to the first firing pulse position.

LAUNCH SWITCH This two-position guarded toggle switch has positions FIRE and OFF. In FIRE position, the cannister firing circuit is enabled. In OFF position, the cannister firing circuit is disabled.

CONTROL BOX

The control box (figure 4-125) is located forward of the right paratroop door. The control provides remote operation of the launcher system. Controls and indicators are on the front panel of the unit. The power ON indicator lamp illuminates when power is applied to the control. The power ON/OFF switch controls electrical power to the control and launcher, except jettison circuit power. The jettison circuit power is controlled by the flare emergency power circuit breaker on the battery bus circuit breaker panel and flare launcher circuit breaker on the cargo compartment DC circuit breaker panel. The panel lights controlled is used to adjust the panel lighting level. The jettison ON/OFF switch (a covered toggle switch) allows the operator to activate jettison sequence. The four ready lights illuminate when flares are in the launch position. The flares pushbutton switches are used to fire the free piston.

NORMAL OPERATING PROCEDURES

This paragraph contains those instructions necessary to operate the launcher in all possible modes. Additionally, the theory of launcher operation is described in this paragraph.

WARNING

Except when isolating a malfunctioning ejector, the four ejector shutoff valves must remain open at all times.

WARNING

The aft cargo door will be open whenever flares are stored in the launcher, if the pneumatic valve is open or the electrical cables connected.

Note

The door may be closed during aircraft preflight and during take-off.

NORMAL OPERATION

Note

Unless stated otherwise, all controls and indicators mentioned in the following steps are on the launcher control box.

Preparation:

1. JETTISON switch OFF and safetied.
2. Check ejector manual lever lockpins (four places) are in locked positions so that levers cannot be operated. (figure 4-125).
3. Check launcher assembly ejector shutoff valves OPEN (four places).
4. Remove shorting plug and install power cable.
5. Remove launcher jettison safety pin.
6. Open the reservoir shutoff valves by turning the knobs fully counterclockwise.
7. Place selector valve on.
8. Verify that pressure gage indicates 3075 psi ±75 for each bottle.
9. Set POWER switch at ON.
10. Verify that POWER ON indicator light is illuminated.
11. Verify that launch and jettison SYSTEM PRESSURE ON LIGHTS are illuminated.
12. Verify that READY LIGHTS 1, 2, 3, and 4 are illuminated.
13. On chaff control panel set RIPPLE MANUAL switch to RIPPLE.
14. Select desired flare release interval with intervalometer setting switches.

IO Mode:

15. Rotate chaff control panel IO-EWO-IO/EWO switch to IO position.

WARNING

To avoid possible personal injury and damage to launcher that can arise from the existance of a partially ejected store, do not perform steps 16 or 17 if launcher assembly pressure gage indicates less than 750 (+50) PSI.

16. To launch a single store, press any PUSH TO FIRE FLARES pushbutton for which the corresponding READY LIGHT is illuminated.
17. To launch a series of stores, press ready-indicated PUSH TO FIRE FLARES pushbutton sequentially so that chutes are emptied as evenly as practicable. To permit pneumatic system recovery, allow a minimum of 5 seconds to elapse before repushing the same PUSH TO FIRE FLARES pushbutton.

WARNING

To avoid possible personal injury and damage to launcher that can arise from the existence of a partially ejected store, do not perform step 18 if the launcher assembly pressure gage indicates less than 1000 PSI.

18. To salvo-launch two, three, or four stores, simultaneously press ready-indicated PUSH TO FIRE FLARES pushbuttons. To permit pneumatic system recovery allow a minimum of 5 seconds to elapse before repushing the same PUSH TO FIRE FLARES pushbutton.

EWO Mode:

19. Rotate chaff control panel IO-EWO-IO/EWO switch to EWO position.
20. Check that all READY LIGHTS illuminate on launcher control panel.
21. Press the HOME switch on the CHAFF CONTROL PANEL until the HOME light begins to blink (indicating that the intervalometer is ready for operation).

WARNING

To avoid possible injury to personnel and damage to launcher that can arise from the existence of a partially ejected store, do not perform step 22 if the launcher assembly pressure gage indicates less that 750 (+50).

22. Position LAUNCH switch on the chaff control panel to FIRE. Launcher tubes will fire in a sequence of 1, 2, 3, 4, at intervals selected, until a total of eight stores have been dispensed. To launch additional stores the HOME SWITCH on the chaff control panel must be depressed until the HOME LIGHT blinks.
23. Position LAUNCH switch on chaff control panel to OFF.

IO/EWO Mode:

24. Rotate chaff control panel IO-EWO-IO/EWO switch to IO/EWO position.

NOTE

In the IO/EWO position, EWO controls tubes 1 and 2, and IO control tubes 3 and 4.

25. Check that all READY LIGHTS illuminate on launcher control panel.

WARNING

To avoid possible injury to personnel and damage to launcher that can arise from the existence of a partially ejected store, do not perform step 26 if the launcher assembly pressure gage indicates less than 750(+50).

26. Fire tubes 1 and 2 as follows:
    a. Position LAUNCH switch on chaff control panel to FIRE. Tubes 1 and 2 will fire at intervals selected.
    b. Position LAUNCH switch on chaff control panel to OFF.

WARNING

To avoid possible personal injury and damage to launcher that can arise from the existence of a partially ejected store, do not perform step 27 if the launcher assembly pressure gage indicates less than 750(+50).

27. Fire tubes 3 and 4 by pressing No. 3 and 4 PUSH TO FIRE FLARES pushbuttons.

JETTISONING

The launcher can be jettisoned by any one of three jettison modes: automatic, operator or pilot initiated, and manual. Automatic jettison will occur as a result of an extreme temperature rise within or immediately adjacent to the launcher. Both electrical and pneumatic pressure are required to complete the sequence. The jettisoning sequence is initiated by the activation of one or more heat detectors which are located on the front and rear faces of the launcher. When a detector is activated it energizes a jettison delay relay and a warning horn installed on the launcher.

Although the horn sounds immediately, the relay has a built-in two-second delay. At the end of two seconds, the relay energizes a second circuit and this results in the detonation of an explosive bolt located in the jettison actuator. As the explosive bolt shears, pneumatic pressure within the launcher actuator forces the launcher along the rails and out of the airplane. A lanyard is provided for automatic separation of the power cable from the launcher upon jettisoning.

The illuminator operator or pilot can initiate jettison of the system by actuating the jettison switch on the control box or the jettison switch located on the pilot's side panel. The sequence of jettisoning is identical to that of automatic jettisoning.

Manual jettisoning is accomplished by upward movement of the manual jettison handle located on the launcher. As the handle is moved, a locking pin is withdrawn releasing the launcher from the arm guide. The launcher is then pushed from the airplane.

Automatic Jettison

If any of the fire detector switches close, the horn will sound immediately. Two seconds later, the launcher will be driven aft on the mounting rails by the pneumatic jettison actuator.

Semi-automatic Jettison

To voluntarily jettison the launcher assembly by use of the pneumatic system, place the jettison switch on the control box panel or pilot's jettison switch to On. The horn will sound immediately. Two seconds later, the launcher assembly will be driven aft on the mounting rails by the pneumatic jettison actuator.

Pneumatic Jettison

Pneumatic jettison of the launcher assembly is accomplished either automatically or by voluntary action. In either case, jettisoning is electrically initiated and pneumatically actuated.

Pneumatic jettisoning requires that the following conditions prevail:

1. Flare launcher jettison, flare and illuminator door interlock and flare emergency power circuit breakers IN.
2. Aft cargo door open.
3. Power cables connected.
4. Jettison reservoir shut-off valve open.
5. Jettison system pressure ON indicator illuminated.
6. Safety pin removed.

Manual Jettison

Manual jettisoning of the launcher assembly is a last-resort procedure and is employed only if jettisoning cannot be accomplished as stated in the paragraph pneumatic jettison. Manual jettisoning requires that the launcher assembly be hand-pushed aft and overboard. To release the launcher assembly so it can be pushed, lift upwards on the manual jettison lever located on the forward end of the launcher assembly.

MANUAL OPERATION

For so long as adequate pneumatic pressure exists (refer to warnings stated in the paragraph normal operation), stores may be launched by manually operating the ejectors in the event of total electrical power loss, or of total or partial failure of the launcher electrical system.

WARNING

To avoid possible personal injury and damage to the launcher, do not manually operate an ejector unless visual inspection confirms that the store to be launched is properly emplaced.

An ejector is manually actuated by pressing the ejector manual lever lockpin down to the unlocked position and by then pressing the ejector manual lever: and, in the event of partial launcher electrical system failure wherein the applicable control box panel ready light is operating, stores may be launched in accordance with the paragraph normal operation with the exception that ejector manual levers are substituted for control box panel push to fire flares pushbuttons.

Electrical power loss or launcher electrical system failure that results in the loss of one or more control box panel ready light indications requires that the operator shall visually verify correct placement of the store in the breech before pressing the ejector manual lever of any ejector for which no READY LIGHT indication is present. He shall verify that the store to be launched is aligned with the launch tube and that the store is positioned so as to be properly engaged by the ejector piston arm.

SHUTDOWN

At the conclusion of a flight or mission, shut down the launcher as follows:

1. Set control box panel power switch and launch switch on chaff control panel to OFF.
2. Close both reservoir shutoff valves by turning the knobs fully clockwise.
3. Set launcher assembly selector valve to Off. (Bleed air pressure to zero.)
4. Disconnect power cable connector and install shorting plug.
5. Install jettison safety pin.

EMERGENCY OPERATION

1. Close the selector valve.
2. Close all four ejector shutoff valves.

   Observe pressure gage. If a continuing pressure loss is no longer indicated, open the selector valve. Close the open shutoff valve on the launch reservoir by turning the knob fully CW.

4. Set the ejector shutoff valves at open, one at a time, observing the pressure gage each time a shutoff valve is opened. A decrease in pressure will be indicated on the pressure gage when the shutoff valve for the leaking ejector is set at open.
5. Set the shutoff valve for the leaking ejector at closed, and set the shutoff valves for the other three ejectors at open and open reservoir shutoff valve.

6. If pressure depletion is corrected, resume normal operation in accordance with the paragraph normal operation, but avoid push to fire flares pushbutton controlling the disabled ejector.

7. If the cause of pressure depletion is not isolated or corrected, launch operations must be terminated when the launch system supply system pressure gage indicates less than 750 PSI.

8. Closely monitor pressure depletion for jettison of the flare launcher. A minimum of 1000 psi is required to jettison the launcher.

FLARE EJECTOR SET, AN/ALE-20(V)

The AN/ALE-20(V) Flare Ejector Set is an airborne countermeasure system which fires high infrared energy flares. The flares are fired manually with pistol grip controls and provide a false target for infrared guidance controls of missiles. Components of the ejector set include the flare dispenser master arming control located on the control pedestal, one ALE-20 dispenser arming panel and pistol grip flare launcher control each at the flight engineer and forward and aft scanner stations, the flare system junction box, and one flare ejector case (dispenser) and associated stepping switch located in each main wheel well. Landing gear touchdown switches, on the main landing gear, deactivate the flare ejector set when the weight of the airplane is on the landing gear. The landing gear touchdown switches may be bypassed on the ground, however, by opening the ALE-20 touchdown disconnect override toggle switches located on the cargo compartment flare system junction box. Refer to FLARE SYSTEM JUNCTION BOX, this section. The flare ejector set is powered by 28-volt dc furnished through three circuit breakers located on the cargo compartment dc circuit breaker panel.

CONTROLS AND INDICATORS, AN/ALE-20(V)

Master Arming Control - The flare dispenser master arming control (figure 4-126) is located on the control pedestal and consists of a guarded toggle switch. This switch is identified as DISPENSERS, and has positions OFF and ARMED. With the airplane airborne and the switch in the ARMED position, flares may be fired. With the switch in the OFF position, the ejector set is disabled and flares cannot be fired. Power of 28-volt dc is supplied to the switch through the FLARE ARM PWR circuit breaker located on the cargo compartment dc circuit breaker panel.

ALE-20 Dispenser Arming Panel - Three of these panels (figure 4-126) are provided in the airplane, one each at the flight engineer station, forward scanner station, and aft scanner station. Each panel contains a guarded arming toggle switch identified as ALE-20 DISPENSER with positions SAFE and ARM. With this switch in ARM at any station (and the master arming control switch in ARMED), flares may be launched utilizing the associated pistol grip flare launcher control. With the switch in SAFE, the pistol grip flare launcher control is disabled. A hook is provided near each ALE-20 dispenser arming panel for stowing the pistol grip control. Power supplied to each ALE-20 dispenser arming switch is 28-volt dc protected by the ALE-20 FLARE DISP circuit breaker located on the cargo compartment dc circuit breaker panel.

Pistol Grip Flare Launcher Control - One pistol grip flare launcher control (figure 4-126) each is provided at the flight engineer, forward scanner, and aft scanner station and is used for firing flares. The controls are wired in parallel and each incorporates two momentary switches. One is a thumb switch, and the other a trigger, both of which must be closed simultaneously to fire flares. The thumb switch, on the upper part of the grip, may be either a pushbutton or a slide type. When the two switches are closed, one flare is fired from the right ejector case, and one from the left ejector case. The three pistol grip flare launcher controls are powered by 28-volt dc protected by the ALE-20 FLARE DISP circuit breaker on the cargo compartment dc circuit breaker panel.

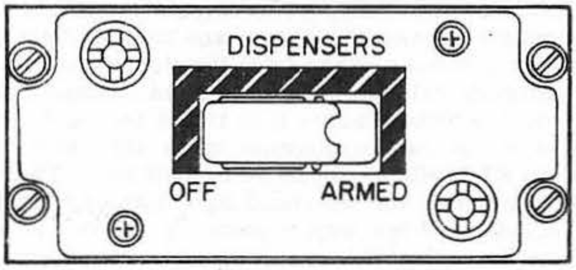
FLARE SYSTEM JUNCTION BOX

The junction box (figure 4-126) primarily contains the control relays and touchdown disconnect relay for the flare ejector set, and is located on the right wall forward of the paratroop door. On the side of the box are located the guarded left and right ALE-20 and SUU-42/A touchdown disconnect override toggle switches, left and right ALE-20 reset indicators, a momentary ALE-20 reset toggle switch, and a rotary ALE-20 reset pulse switch. The two SUU-42/A switches are not part of this system and are not functional. The left and right ALE-20 touchdown disconnect override toggle switches are provided for ground test and allow the touchdown disconnect relay in the junction box to be bypassed. The momentary RESET toggle and rotary RESET PULSE switch and the two press-to-test RESET indicators are utilized for resetting the flare stepping switches to the number one position. When the stepping switches reset, the RESET indicators illuminate green.

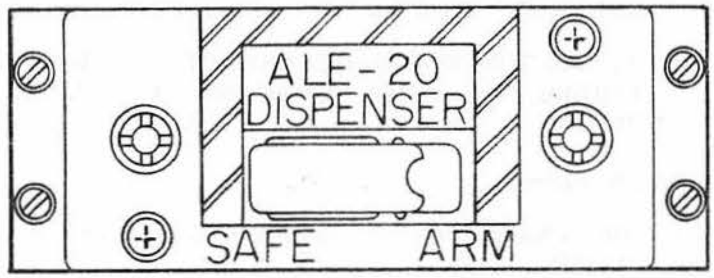
FLARE EJECTOR CASE

One flare ejector case is located in the left and one in the right wheel well. Each case contains a flare set which comprises eight flare tubes. Two flares can be loaded in each tube. A stepping switch on each ejector case provides the contacts which complete 26-volt dc ignition circuits to the flare squibs. As each squib is ignited a flare is fired.

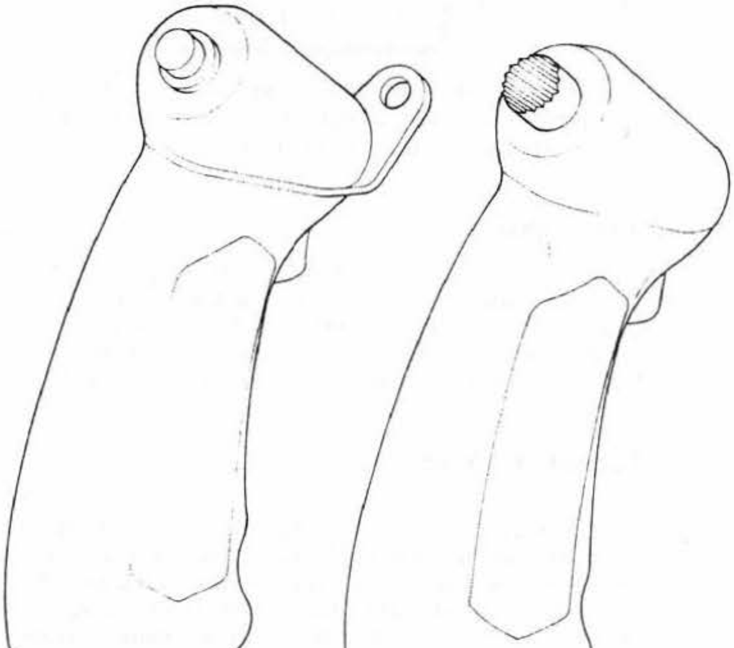
flare ejector set controls and indicators



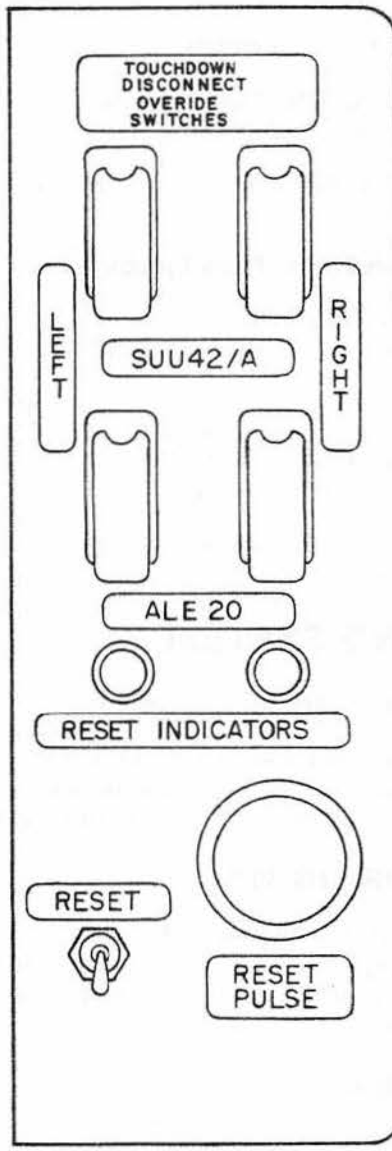
FLARE DISPENSER MASTER ARMING CONTROL
(CONTROL PEDESTAL)



ALE-20 DISPENSER ARMING PANEL
(FLIGHT ENGINEER STATION)
(FORWARD SCANNER STATION)
(AFT SCANNER STATION)



GRIP ASSEMBLY
(FLIGHT ENGINEER STATION)
(FORWARD SCANNER STATION)
(AFT SCANNER STATION)



FLARE SYSTEM JUNCTION BOX
(AFT RIGHT SIDE FUSELAGE)

Figure 4-126.

Normal Operation of Flare Ejector Set

1. Circuit breakers on cargo compartment dc circuit breaker panel - Set

2. ALE-20 TOUCHDOWN DISCONNECT OVERRIDE switches (flare system junction box) - Closed (down)

To fire flares:

3. DISPENSERS switch (master arming control) - ARMED

4. Applicable ALE-20 DISPENSER switch (ALE-20 dispenser arming panel) - ARM

5. Applicable flare launcher control switches - Close

When operation is complete:

6. ALE-20 DISPENSER switches (ALE-20 dispenser arming panel) - SAFE

7. DISPENSERS switch (master arming control) - OFF

Reset Operation of Flare Ejector Set

1. ALE-20 DISP PWR circuit breaker (cargo compartment dc circuit breaker panel) - Closed

2. At flare system junction box, hold RESET toggle switch up and rotate RESET PULSE knob until rotation blinks both RESET indicators (six or more full turns).

3. Flare selectors are now reset to the number one position.

LIGHTING SYSTEM.

The lighting system is composed of exterior and interior groups of lights and their controls. Receptacles are also provided on the sides of the pilot's and copilot's auxiliary control panels for connecting a signal light. All of the lights operate on DC power.

EXTERIOR LIGHTS.

Exterior lights are provided to insure safe inflight and landing operations of the airplane. Power for all the lights except the landing light lamps is supplied from the flight station bus.

Landing Lights.

A retractable landing light is mounted in the underside of each wing approximately midway between the inboard and outboard engine nacelles. Switches for extension and retraction and for illumination control are located on the landing lights control panel (figure 4-128). The two extension and retraction switches, labeled right motor and left motor, are three-position (EXTEND, HOLD, RETRACT) toggle switches. The right switch energizes the right-hand landing light actuator, by directing power from the flight station bus to a reversible drive motor on the right landing light. Power on this motor causes it to rotate the light to an extended or retracted position when the switch is moved to EXTEND or RETRACT position. The left switch energizes the left-hand light actuator in the same manner. When either switch is moved to the HOLD position, the landing light mechanism is de-en-energized and will lock in position. Two two-position (OFF, ON) toggle switches labeled right light and left light, control the illumination of the landing lights. When either switch is moved to the ON position, the corresponding light illuminates. When either switch is moved to OFF, the corresponding light is de-energized. Power for the lamps is supplied from the left-hand and right-hand wing buses through the landing lights circuit breakers.

CAUTION

Do not operate the landing lights for prolonged periods while the airplane is on the ground, neither light has any cooling facilities.

Taxi Lights

Illumination of the taxi lights, which are mounted on the under side of the main landing gear door, is controlled by a two-position (OFF, ON) toggle switch located on the landing light control panel (figure 4-128). Moving the switch to ON turns on the lights and to OFF turns off the lights.

Formation Lights.

Nine formation lights are installed on the airplane. Three are located on the outer panel of each wing, and three are located on top of the fuselage, aft of the wing. A single, rheostat switch (OFF, BRIGHT) located on the external lights control panel (figure 4-129) controls the brilliance of all nine formation lights simultaneously. When the switch is in OFF, the lights are de-energized. Turning the switch clockwise increases the brilliance of the lights and counterclockwise decreases the brilliance of the lights.

Shielded Beacon Light

A shielded beacon light is installed on the last formation light on the top aft fuselage. It has two bulbs and a rotating, motor-operated reflector. The beacon switch is a two-position (ON-OFF) toggle switch, located on the overhead external lights control panel. Power for the light is 28-volt dc from the formation light circuit breaker on the flight station bus.

exterior lights location

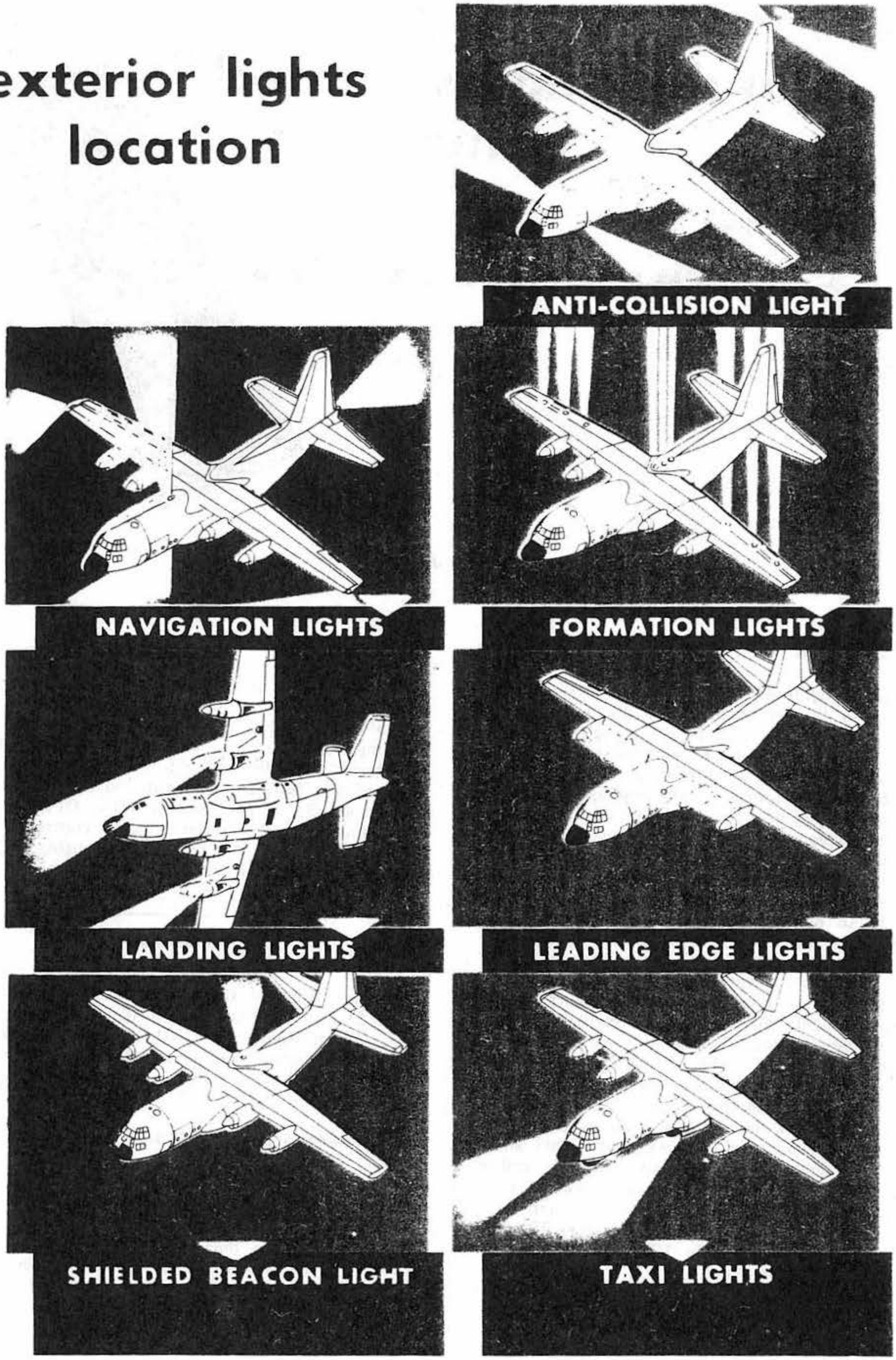


Figure 4-127.

landing lights control panel

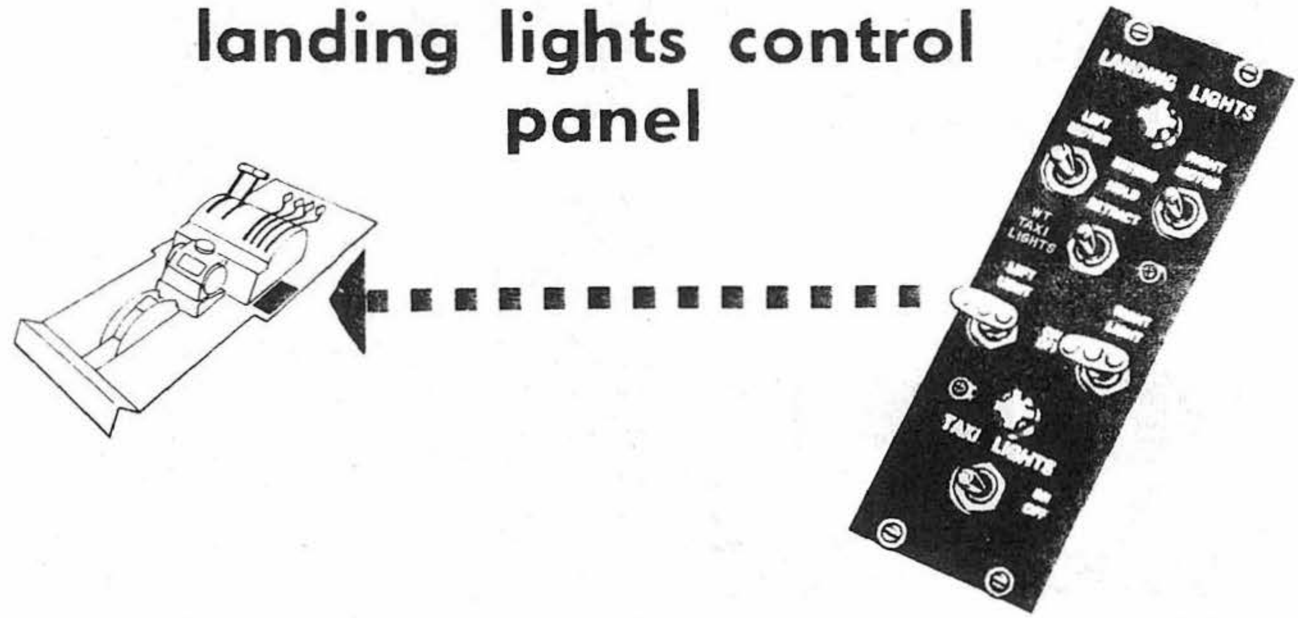


Figure 4-128.

Navigation Lights.

The navigation lighting system consists of six lights: a red light on the left wing tip, a green light on the right wing tip, a white and a yellow light on the trailing edge of the tail cone, a white light on top of the fuselage forward of the wing, and a white light on the lower surface of the fuselage. The navigation lighting system shows the position and direction of the airplane. The wing tip lights and the white and yellow tail lights will glow continuously or can be made to flash intermittently. While either glowing continuously or flashing, these lights can be changed from bright to dim and from dim to bright. The white lights on the top and bottom of the fuselage can be changed from bright to dim, but cannot be made to flash. The navigation lights selector switch controls the flashing mechanism of the lights, and the navigation lights dimming switch controls the intensity of illumination. The selector switch is a three-position (STEADY, OFF, FLASH) toggle switch, located on the external lights control panel (figure 4-128). When the switch is in the STEADY position, navigation lights glow continuously. When the switch is in the FLASH position, the wing tip lights and the white tail light flash alternately with the yellow tail light. The navigation lights dimming switch is a two-position (BRIGHT, DIM) toggle switch and is located on the external lights control panel (figure 4-128). When the switch is in DIM, lights glow dimly. When the switch is in BRIGHT, the lights glow much more brightly. Plastic reflectors on the wing tips furnish visual assurance that the wing tip lights are functioning.

Anti-Collision Light(s).

An anti-collision light is mounted at the top of the vertical stabilizer, in conjunction with a revolving motor-driven reflector, inside a red transparent glass housing. On airplanes modified by T.O. 1C-130-824, a second anti-collision light is installed on the underside of the fuselage. The anti-collision light(s) switch (figure 4-129), a two-position (ON, OFF) toggle switch, is mounted on the external lights control panel. When the switch is ON the anti-collision lights will illuminate and the motor revolves the reflector.

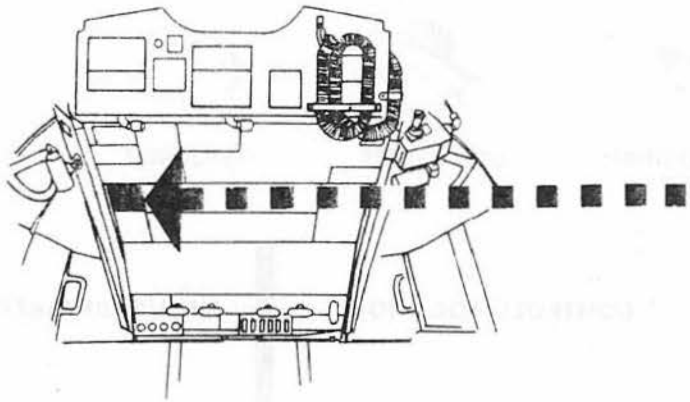
WARNING

Operation of the anti-collision light(s) when flying in actual instrument conditions is not recommended. The light(s) reflecting from surrounding clouds may cause spatial disorientation.

Wing Leading Edge Lights.

Two white leading edge lights are located on the sides of the fuselage in such a position as to illuminate the engine nacelle and wing leading edge areas. The lights are energized by a leading edge lights switch (figure 4-129) on the external lights control panel. The switch is a two-position (OFF, ON) toggle switch.

external lights control panel



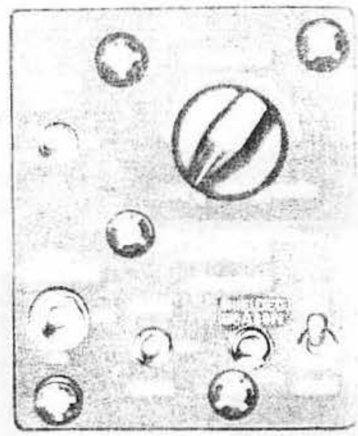


Figure 4-129.

Note

To preclude inadvertently turning lights on over target area, it may be necessary to pull the following circuit breakers: on flight station distribution panel-taxi, leading edge, and LH and RH landing light motor and navigation light: on the main dc bus-nose wheel well light, and left hand and right hand landing light.

SIGNAL LAMP.

A portable, sealed-beam signal lamp is mounted on the forward wall of the flight station distribution box, to the left of the pilot's seat, Below the pilot's auxiliary control panel is mounted a box containing red, amber, blue, and green lenses which may be snapped on the signal lamp. A trigger-type switch illuminates the lamp when the switch is depressed. An extension cord permits the signal lamp to be plugged into receptacles on either the pilot's or copilot's auxiliary control panel assembly. Power for operation of the light is supplied from the flight station bus through pilot and copilot signal outlet circuit breaker on the flight station distribution panel.

INTERIOR LIGHTING.

The interior lighting of the airplane has been modified to meet mission requirements. The various types of lighting, locations of light controls, and locations of circuit breakers for the light circuits are listed in figure 4-130. Lighting control panels are shown in figure 4-131. Power for the various interior lights is supplied from the 28-volt dc bus.

OXGEN SYSTEM

Note

There are 18 portable units on airplanes modified by T.O. 1C-130(A)A-532 (figure 4-132). Four portable units are located on the flight deck, one just aft of the crew entrance door, nine on top of the booth and four inside the booth.

The oxygen system (figure 4-132) includes 18 oxygen regulators, 8 portable units, 6 recharger outlets, and a 25-liter liquid oxygen converter. The portable units, each containing a regulator and cylinder and chargeable through the main system, are provided for crewmembers moving within the airplane or for emergency use. Location of the converter is in the right-hand side of the airplane in the electronic rack, forward of the operators' booth. The converter is filled through an externally accessible valve. Oxygen is fed from the converter through a warming coil (where it is converted to a gas) and through a manual emergency shutoff valve to regulators in the flight deck, cargo compartment, and operators' booth. The system also supplies the recharger outlets - one located beside the pilot, one at the navigator's station, one aft of the electronic rack, two in the operators' booth, and one aft of the

interior lighting

THUNDERSTORM LIGHT — UTILITY LIGHT — DOME LIGHT — FLOODLIGHT

flight station

LIGHTS	CONTROLS LOCATION	CIRCUIT BREAKER LOCATION
pilot		
Instrument Red Lighting	Pilot's Instrument Panel or Auxiliary Panel	Copilot's Panel
Engine Instrument Red Lighting	Pilot's Instrument Panel or Auxiliary Panel	Copilot's Panel
Pedestal and Auxiliary Panel Red Lighting	Pilot's Auxiliary Panel	Flight Station Panel
Flight Station White or Red Dome Lights	Pilot's Auxiliary Panel	Flight Station Panel
Pilots ARU-11A INDICATOR	PILOTS INSTRUMENT PANEL (ON ARU-11A)	COPILOTS PANEL
Angle of Attack Indicator Lighting Control (Airplanes Modified by T.O.1C-130-708)	Left Side of Pilot's Main Instrument Panel	Main D-C Panel
(Thunderstorm Lights Switch also Turns on Flight Station White Dome Lights.)		
Two White Thunderstorm Lights on Sides of Overhead Panel	Pilot's Instrument Panel or Auxiliary Panel	Flight Station Panel
(Dome Lights Switch turns on these lights when white light is selected.)		
Pilot's and Engine Instrument Panel White Floodlighting	Pilot's Auxiliary Panel	Flight Station Panel
(Thunderstorm Lights Switch also turns on these lights.)		
Pilot's and Engine Instrument Panel Red Floodlighting	Pilot's Auxiliary Panel	Flight Station Panel
Two Pilot's Utility Lights on side of overhead panel	On lights	Copilot's Panel

Figure 4-130. (Sheet 1 of 4)

LIGHTS	CONTROLS LOCATION	CIRCUIT BREAKER LOCATION
copilot		
Instrument Red Lighting	Copilot's Instrument Panel or Auxiliary Panel	Copilot's Panel
Instrument Panel Red Floodlighting	Copilot's Auxiliary Panel	Main D-C Panel
Overhead Panel Edge Lighting	Copilot's Auxiliary Panel	Flight Station Panel
Overhead Panel Red Floodlighting	Copilot's Auxiliary Panel	Flight Station Panel
Copilot's Auxiliary Panel and Circuit Breaker Panel Red Lighting	Copilot's Auxiliary Panel	Flight Station Panel
Two Copilot's Utility Lights on side of overhead panel	On lights	Copilot's Panel
navigator		
Navigator's Instrument and Control Panels Red Lighting	Navigator's Control Panel	Flight Station Panel
Navigator's Panels White Floodlighting	Navigator's Control Panel	Flight Station Panel
Navigator's Work Table Light	Navigator's Control Panel	Flight Station Panel
Navigator's Utility Light	On light	Flight Station Panel
Sextant Utility Light	On light	Flight Station Panel
Sextant Lights	On Sextant	Flight Station Panel
flight engineer		
Flight Engineer's Utility Light	On light	Flight Station Panel
miscellaneous		
Main Power Distribution Panel Edge Lighting	On panel	Main D-C Panel
Main Power Distribution Box Lights	Main Power Panel	Main D-C Panel
Flight Station and Radio Circuit Breaker Panel Red Lighting	Flight Station Distribution Panel	Flight Station Panel
Nose Wheel Well Inspection Light	Left Side of Nose Wheel Well and Below Flight Deck Near Nose Gear Access Panel and Window.	Main D-C Panel

TABLE LIGHT

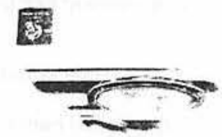
130A-1-33-145-2

Figure 4-130. (Sheet 2 of 4)

cargo compartment

DOME LIGHT

RAMP LOADING LIGHT



UTILITY LIGHT UNDER FLIGHT STATION FLOOR

FORWARD CARGO DOOR LOADING LIGHT

JUMP PLATFORM LIGHT AND RAMP DOOR UPLOCK INSPECTION LIGHT

LIGHTS	CONTROLS LOCATION	CIRCUIT BREAKER LOCATION
Forward Dome Lights (White or Red)	Cargo Area Lights Panel	Main D-C Panel
Center Dome Lights (White or Red)	Cargo Area Lights Panel	Main D-C Panel
Aft Dome Lights (White or Red)	Aft Fuselage Junction Box	Aft Fuselage Junction Box
Ramp Dome Lights (White or Red)	Aft Fuselage Junction Box	Aft Fuselage Junction Box
Ramp Loading Lights	Aft Fuselage Junction Box	Aft Fuselage Junction Box
Ramp Door Uplock Inspection Light	Aft Fuselage Junction Box	Aft Fuselage Junction Box
Utility Light under flight station floor	Switch adjacent to light	Flight Station Panel
One at each 20 mm and 40 mm cannon area	On light	Cargo compartment dc circuit breaker panel
Two on the electronic equipment rack	On light	

Figure 4-130. (Sheet 3 of 4)

LIGHT	NUMBER AND LOCATION	SWITCH LOCATION	CIRCUIT BREAKER LOCATION
BOOTH	CEILING-Three red and three white in operators booth	Two-man console	Two-man console
	One red and one white in operators booth	On wall near door	Two-man console
	WORK - Four above two-man console	G-247 Lighting Controls	Operators' console
	Two below table at two-man console	On light	Operators' console
	One at FCO console	G-247 Lighting Control	Operator's console
	One at TVO console	G-247 Lighting Control	Operator's console
CARGO COMPARTMENT	Two on the cargo compartment	On panel	Cargo compartment
CIRCUIT BREAKER PANEL	CB panel		DC circuit breaker panel
EDGE LIGHTING			
GALLEY	Two on galley and one in ceiling	Right of galley	Cargo compartment dc circuit breaker panel

Figure 4-130. (Sheet 4 of 4)

operators' booth by the right wheel well. The availability of oxygen, based on the 25-liter converter furnishing 670 cubic feet of oxygen for use and calculated for the crew, is shown in tabular form in figure 4-133.

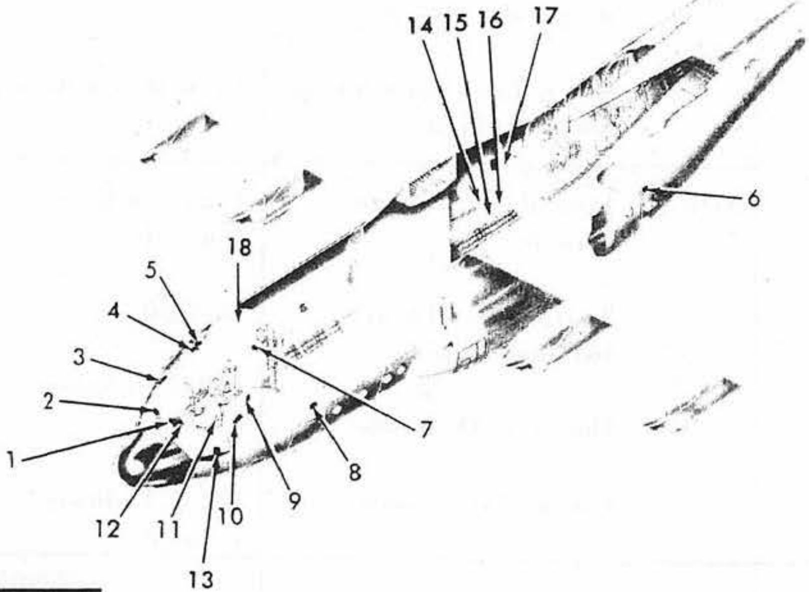
OXYGEN REGULATORS

Eighteen type CRU-52/A or CRU-68/A oxygen regulators (figure 4-134) are installed in the airplane. Six of these regulators are installed in the flight deck, one on the inboard side of the electronic rack, four in the operators' consoles, five on top of the operators' booth (two forward and three aft) and one by each paratroop door. Oxygen hoses to the regulators on top of the booth are of considerable length to allow free movement of crewmembers within the fore and aft cargo areas. These hoses are suspended by hooks from overhead cables. Each regulator contains a visual flow indicator, pressure gage, switches to control regulator operation, and an inlet filter to prevent entry of foreign matter into the system. The following controls and indicators are provided:

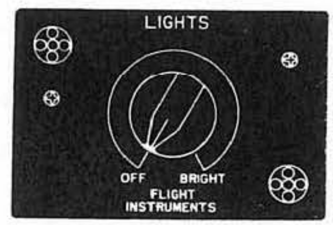
Oxygen Supply Lever

A guarded, two-position OXYGEN SUPPLY lever is located at the lower right-hand corner of each regulator. When the lever is set to ON, oxygen is

interior lighting controls

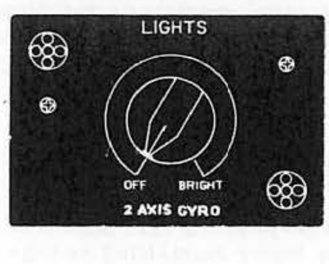


1 PILOT'S INSTRUMENT LIGHTS CONTROL PANEL

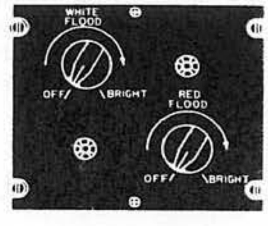


2 COPILOT'S INSTRUMENT LIGHTS RHEOSTAT

3 COPILOT'S AUXILIARY CONTROL PANEL

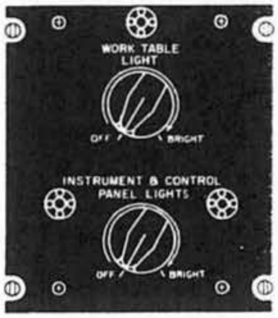


13 PILOT'S ARU-11A INDICATOR RHEOSTAT



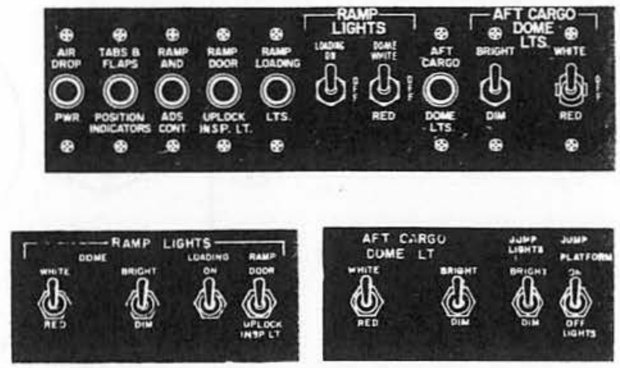
4 NAVIGATOR'S FLOOD LIGHTS CONTROL PANEL

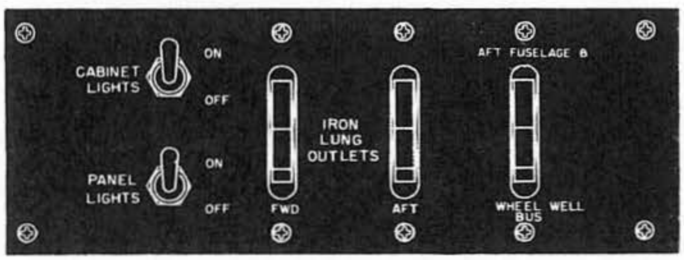
Figure 4-131. (Sheet 1 of 4)



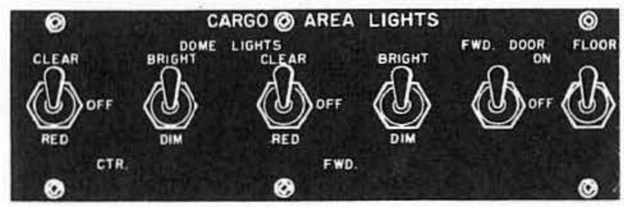
5 NAVIGATOR'S INSTRUMENT LIGHTS CONTROL PANEL

6 AFT FUSELAGE JUNCTION BOX PANEL



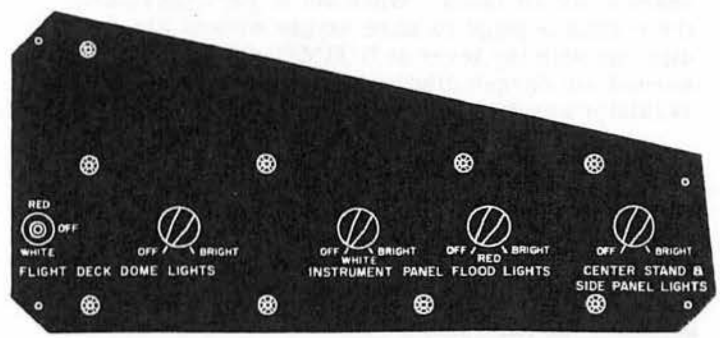


7 MAIN DISTRIBUTION BOX LIGHTS SWITCH PANEL



8 CARGO AREA LIGHTS CONTROL PANEL

9 FLIGHT STATION DISTRIBUTION PANEL LIGHTS RHEOSTAT



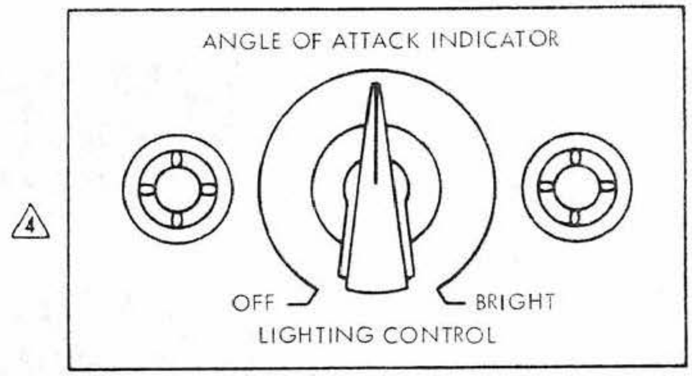
10 PILOT'S AUXILIARY CONTROL PANEL

11 NOSE WHEEL WELL LIGHT SWITCH

NOTE

THE NOSE WHEEL WELL LIGHT IS CONTROLLED BY EITHER OF TWO SWITCHES, ONE LOCATED ON THE LEFT SIDE OF THE NOSE WHEEL WELL AND THE OTHER BELOW THE FLIGHT DECK NEAR THE NOSE GEAR INSPECTION WINDOW.

Figure 4-131. (Sheet 2 of 4)



12 ANGLE OF ATTACK INDICATOR LIGHTING CONTROL (AIRPLANES MODIFIED BY T.O. 1C-130-708)

Figure 4-131. (Sheet 3 of 4)

supplied to the regulator unit; when the lever is at OFF, the oxygen supply to the regulator is shut off to prevent any waste of oxygen from the regulator unit when not in use.

Diluter Lever

The guarded, two-position diluter lever on each regulator unit may be used to shut off the air port and allow the regulator to deliver pure oxygen at all altitudes or to provide automatic mixing of air and oxygen as required to maintain normal body oxygen needs at all altitudes. When set to 100% OXYGEN, the regulator supplies pure oxygen without air dilution; with the lever at NORMAL OXYGEN, the normal air/oxygen dilution characteristics of the regulator are maintained.

Emergency Lever

The emergency lever on each regulator may be set to one of three positions: EMERGENCY, NORMAL, and TEST MASK. With the lever at EMERGENCY, oxygen is supplied to the mask at continuous positive pressure for emergency use. With the lever at NORMAL, oxygen flow is controlled automatically by the regulator. The TEST MASK setting is used when a positive pressure is required at any altitude to test the fit of the mask around the face.

CAUTION

When positive pressure is required, it is mandatory that the oxygen mask be well fitted to the face. Unless special precautions are taken to ensure no leakage, the continued use of positive pressure under these conditions will result in rapid depletion of the oxygen supply. Except when unscheduled pressure increase is required, the emergency lever should remain in the NORMAL position.

Visual Flow Indicator

The visual FLOW indicator on each regulator is a slide-and-window device in which, during normal use of the oxygen mask, the indicator shows oxygen flow by blinking with the breathing cycle of the user. The blinker is masked when the oxygen flow ceases.

Pressure Gage

The pressure gage on the regulator is a dial-type instrument indicating system pressure in pounds per square inch.

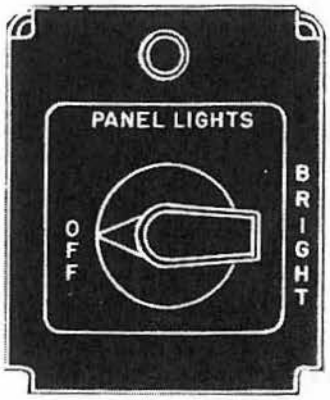
LIQUID OXYGEN CONVERTER

The 25-liter liquid oxygen converter is mounted in the right side of the airplane in the electronic rack, forward of the operators' booth. It is filled through a combination filler-buildup-vent valve contained in a filler box adjacent to the converter, but accessible through a door in the lower right side of the fuselage. The converter is also connected to a drain valve in the same area. The function of the combination filler-buildup-vent valve is automatic, and charging of the oxygen system is accomplished automatically on completion of the filling operation. The converter may be isolated from the rest of the oxygen system by closing the manual emergency oxygen shutoff valve, located on the electronic rack immediately forward of the converter.

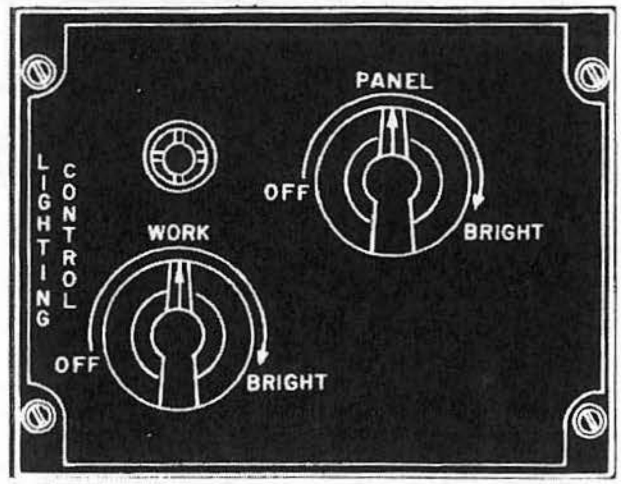
LIQUID OXYGEN QUANTITY INDICATOR

A capacitance-type quantity indicator (figure 4-134), which permits monitoring of the total airplane supply of liquid oxygen available in the converter, is installed at the copilot's station. A PRESS TO TEST switch adjacent to the quantity indicator allows functional checking of the indicator. Operating power for the indicator is 115-volt, 400-Hz LH ac bus and

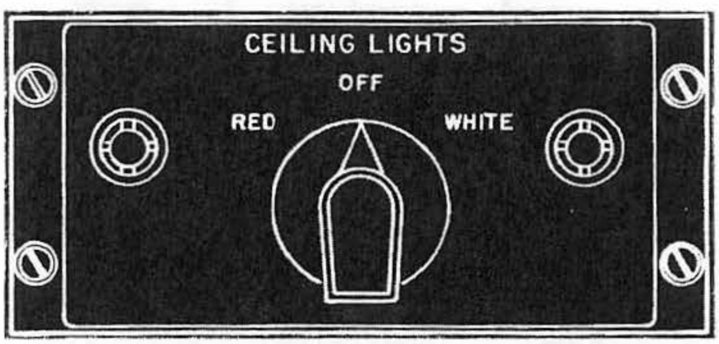
interior lighting controls



14 PANEL LIGHTS CONTROL

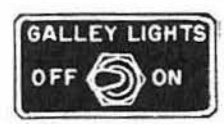


15 OPERATOR LIGHTS CONTROL



16 CEILING LIGHTS CONTROL

17 CEILING LIGHTS CONTROL



18 GALLEY LIGHTS CONTROL

Figure 4-131. (Sheet 4 of 4)

oxygen system schematic

(TYPICAL)

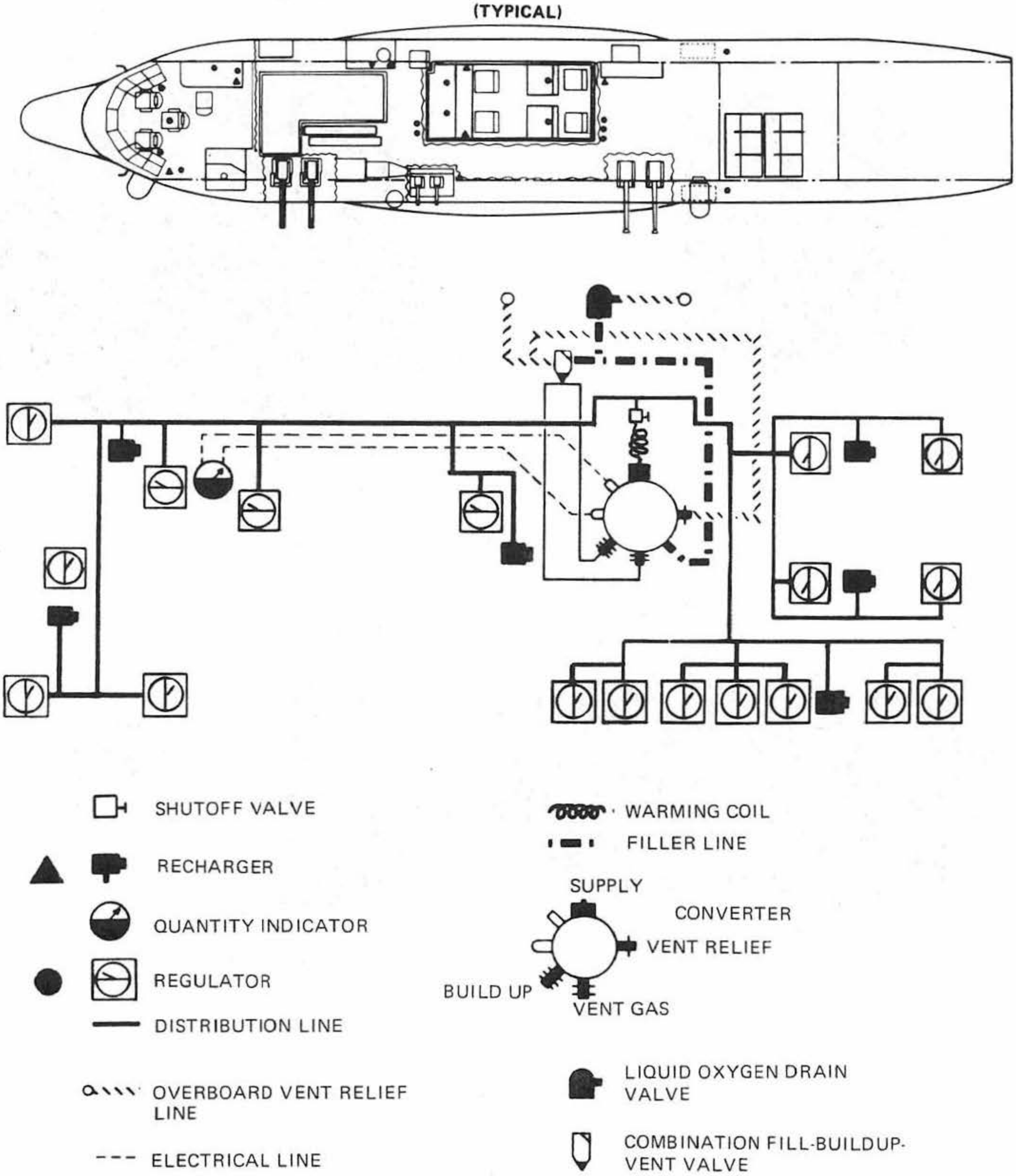


Figure 4-132.

oxygen duration chart

OXYGEN DURATION CHART (HOURS)			
CABIN ALTITUDE IN FEET	DILUTER	LEVER	BASED ON ONE 25 LITER CONVERTER
35,000	NORMAL		12.44
	100%		12.44
30,000	NORMAL		9.22
	100%		9.10
25,000	NORMAL		8.70
	100%		7.00
20,000	NORMAL		9.83
	100%		5.30
15,000	NORMAL		11.96
	100%		4.25
10,000	NORMAL		11.96
	100%		3.42
5,000	NORMAL		11.96
	100%		2.70
SEA LEVEL	NORMAL		11.94
	100%		2.19

BASED ON 11 USERS

Figure 4-133.

oxygen system controls and indicators

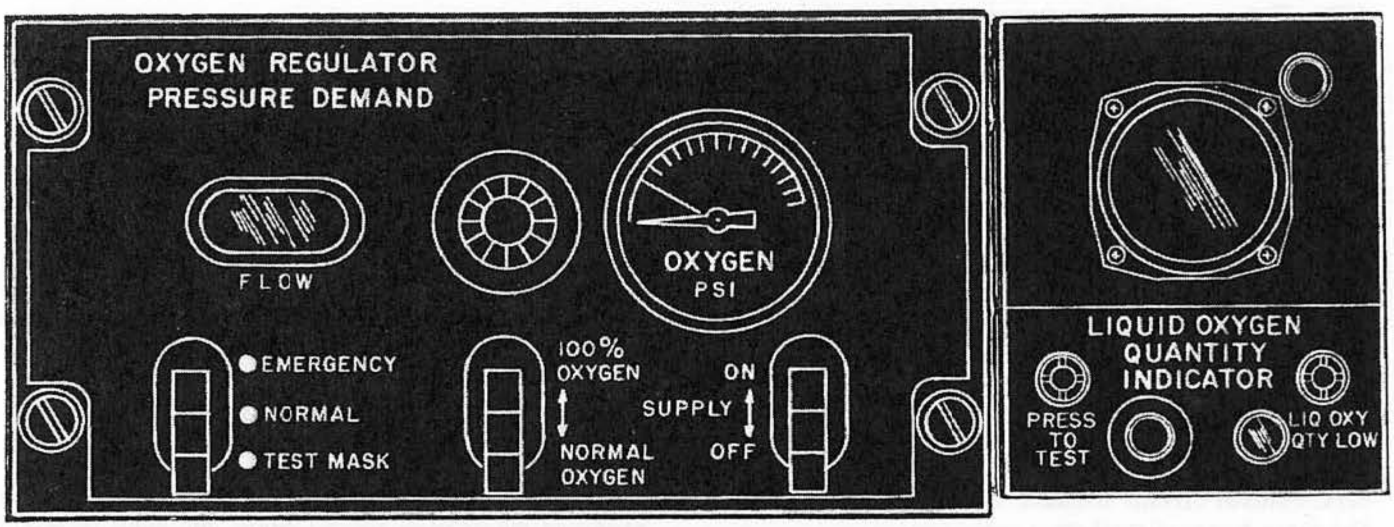


Figure 4-134.

overload protection is provided by a circuit breaker on the copilot's circuit breaker panel.

LOW LEVEL WARNING LIGHT

A warning light (figure 4-134), which illuminates to indicate that the supply of liquid oxygen remaining within the converter has reached a low level of approximately 2.5 liters, is mounted at the copilot's station, adjacent to the oxygen system quantity indicator. The indicator operates on 28-volt dc power and overload protection is provided by a circuit breaker on the copilot's circuit breaker panel.

EMERGENCY OXYGEN SHUTOFF VALVE

A rotary emergency oxygen shutoff valve (figure 4-132) is installed in the oxygen distribution line downstream of the oxygen converter, and when closed isolates the converter from the rest of the oxygen system. The valve is located on the inboard side of the electronic rack, immediately forward of the converter, and is closed or opened manually. The valve is closed by clockwise rotation of the control knob and opened by counterclockwise rotation.

EMERGENCY OPERATION OF OXYGEN SYSTEM

If the regulator fails to supply positive pressure to the mask at cabin altitude of 30,000 feet or more, the emergency toggle must be actuated. It may be placed to either side and will remain in this position without being held. This manually opens the valve and increases the oxygen pressure by two inches of water.

AUXILIARY POWER PLANT.

The auxiliary power plant consists of the GTC and the ATM. The gas turbine compressor (GTC) supplies the compressed air and an air turbine motor (ATM), driven by some of the compressed air, turns an AC generator and a hydraulic pump.

GAS TURBINE COMPRESSOR.

The gas turbine compressor (figure 4-135) located forward in the left wheel well, supplies compressed air for ground operation of the air turbine motor, engine starting, nacelle preheat, and the air conditioning system. The unit is composed of a compressor assembly, power turbine assembly, and an accessory assembly. Twenty-eight volt DC power energizes the gas turbine compressor starter, ignition, and electrical controls. Circuit protection is provided by the GTC control circuit breaker from the isolated bus in the main power distribution box.

Note

The gas turbine compressor (GTC) has been modified for inflight operation. This modification consists of removal of the forward GTC air intake panel, installation of a screen in the GTC exhaust panel, disabling of the GTC start interlock circuit, and installation of an air deflector forward of the GTC inlet.

Compressor Assembly.

The two-stage centrifugal compressor uses impellers with backward-curved blades. The centrifugal compressor takes air in toward the center of the first rotating impeller, and the backward-curved blades sling the air away from the center, compressing the air between the curved blade and the chamber wall. This compressed air from the first stage is then discharged into a second stage, where the process is repeated, and the air further compressed. Following the second stage compression the air is discharged into the power turbine. When the compressor is operating at full speed, part of the compressed air discharged into the power turbine is used to support combustion and the remainder is available for pneumatic power.

Power Turbine Assembly.

The power turbine assembly drives the compressor and the gas turbine compressor accessories. The assembly consists of a turbine section and a combustor. Fuel is injected into the combustion chamber, mixed with air, and burned. The combustion gases are directed against the turbine wheel, which supplies rotary power to drive the compressor and accessory assemblies. After being used to turn the turbine wheel, the combustion gases pass out the exhaust.

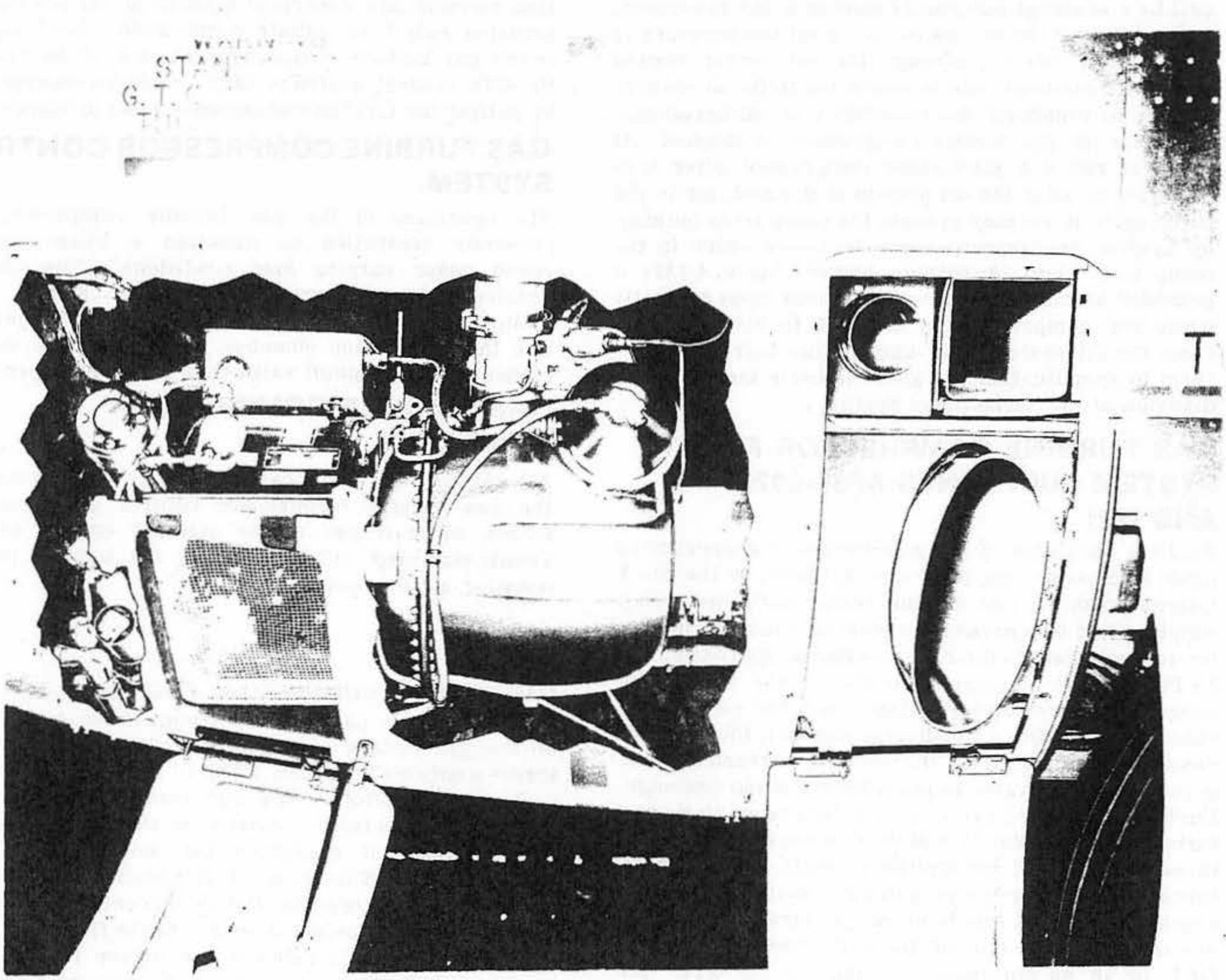
Accessory Assembly.

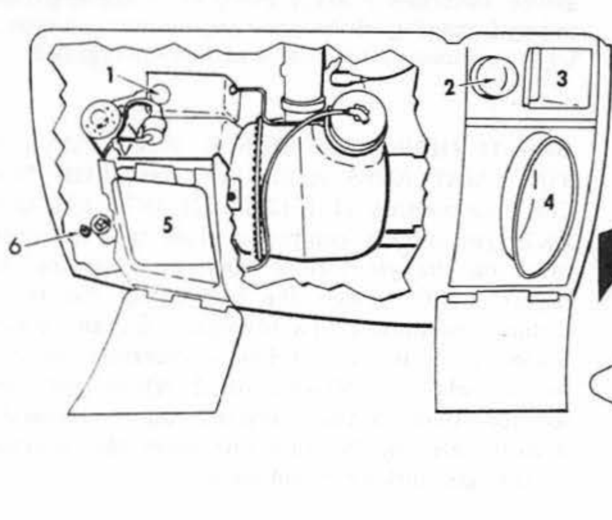
The accessory assembly of the gas turbine compressor consists of a starter motor, oil and fuel pumps, oil cooler fan, and a governor. The accessory group, with the exception of the starter motor, is powered through a reduction gear train directly coupled to the compressor drive shaft. The starter motor is coupled to the reduction gear train by a spring-loaded clutch and furnishes initial rotation of the gas turbine compressor during the starting period, but is disengaged by centrifugal force when the unit reaches approximately 35 percent of its nominal governed speed.

GAS TURBINE COMPRESSOR OIL SYSTEM.

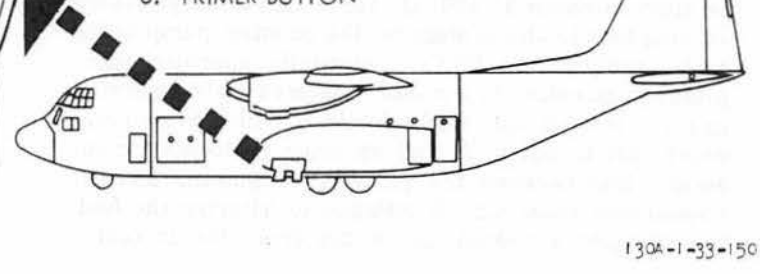
The gas turbine compressor oil circulation system provides lubrication for all gears and shaft bearings.

gas turbine compressor





1. HOURMETER
2. EXTERNAL PRESSURE CONNECTION
3. GTC COOLING FAN EXHAUST
4. EXHAUST
5. INLET
6. PRIMER BUTTON



130A-1-33-150

Figure 4-135

Oil from an externally mounted reservoir is delivered by a gear-type pump through an oil filter to the various lubrication points. A relief valve in the system maintains the desired pressure. Oil is removed from the unit by a scavenge pump and returned to the reservoir, either through the oil cooler or, if oil temperature is below 27°C (80°F), through the oil cooler bypass valve. An oil drain line is connected to the accessory section to eliminate the possibility of oil accumulation after the gas turbine compressor is stopped. At the first run of a gas turbine compressor after it is installed or after the oil system is drained, air in the pump inlet lines may prevent the pump from building up system pressure to open the check valve in the pump inlet line. A primer button (figure 4-135) is provided so that the valve can be held open manually while the compressor is motored to bleed the air from the oil system. Oil used in this unit must conform to specification and grade listed in the servicing diagram at the beginning of Section I.

GAS TURBINE COMPRESSOR FUEL SYSTEM (AIRPLANES AF55-0029 AND UP)

Fuel for operation of the gas turbine compressor is taken from either the No. 2 internal tank, or the No. 3 internal tank. A gas turbine compressor fuel pump supplies fuel to a pressure regulator which maintains the fuel pressure to the fuel governor at approximately 15 PSI. A fuel strainer is located in the supply line between the pressure regulator and the combustion chamber. In addition to filtering the fuel, the strainer removes any water from the incoming fuel and collects it in a sump. A valve is provided for sump drainage. During the starting cycle, when oil pressure in the gas turbine compressor oil system reaches approximately three PSI, the fuel and ignition circuits are energized through an oil-pressure-actuated switch to initiate combustion. Fuel supply to the gas turbine compressor is shut off by moving the GTC control switch to OFF or in an emergency by pulling the GTC fire emergency control handle.

GAS TURBINE COMPRESSOR FUEL SYSTEM (AIRPLANES AF53-2129 THROUGH 55-0014)

Fuel for operation of the gas turbine compressor may be supplied from any fuel tank through the crossfeed manifold. A gas turbine compressor fuel booster pump (some airplanes) supplies fuel to a pressure regulator which maintains the fuel pressure to the fuel governor at approximately 15 PSI. On some airplanes, pressure is supplied to the system by the booster pump of the tank supplying the GTC; a manually operated valve plumbed parallel to a motor-operated valve permits gravity feed of the GTC should the motor-operated valve fail to open. A fuel strainer is located in the supply line between the pressure regulator and the combustion chamber. In addition to filtering the fuel, the strainer removes any water from the incoming fuel and collects it in a sump. A valve is provided for sump drainage. During the starting cycle, when oil pressure in the gas turbine compressor oil system reaches approximately three PSI, the fuel and ignition circuits are energized through an oil-pressure-actuated switch to initiate combustion. Fuel supply to the gas turbine compressor is shut off by moving the GTC control switch to OFF or, in an emergency, by pulling the GTC fire emergency control handle.

GAS TURBINE COMPRESSOR CONTROL SYSTEM.

The operation of the gas turbine compressor is governor controlled to maintain a near-constant speed under varying load conditions. The speed-sensing governor, powered by the accessory gear train, controls the unit by regulating fuel injection into the combustion chamber. An overspeed switch closes the fuel shutoff valve to prevent overspeeding.

GAS TURBINE COMPRESSOR CONTROLS.

All gas turbine compressor controls are located on the gas turbine compressor control panel (figure 4-136), which is part of the overhead control panel. Twenty-eight volt DC power from the isolated bus energizes all the controls.

GAS TURBINE COMPRESSOR SWITCH. A selector switch for the gas turbine compressor is located on the gas turbine compressor control panel. This three-position (OFF, RUN, START) rotary switch controls the operation of the gas turbine compressor. Holding the selector switch in the spring-loaded START position energizes the self-holding GTC starter relay. This relay will remain closed until the circuit is broken by the 35 percent speed switch or by moving the selector switch to the OFF position. When the switch is released, it moves to the RUN position. In RUN position, all GTC automatic control circuits are energized. Oil-pressure and speed-sensitive switches control circuits to accomplish starting and running of the gas turbine compressor. In the OFF position, all circuits are de-energized.

GAS TURBINE COMPRESSOR FUEL TANK SELECTOR (AIRPLANES AF53-3129 THROUGH 55-0014). The four-position (LH EXT, LH INT, RH INT, RH EXT) gas turbine compressor fuel tank selector, located on the gas turbine compressor control panel (figure 4-136), selects the fuel source for the gas turbine compressor. Twenty-eight volt DC power is routed from the gas turbine compressor selector switch (when on START or RUN) to the fuel tank selector, then to the energize-to-open, solenoid-operated shutoff valve in the fuel line from the selected tank to the gas turbine compressor.

BLEED AIR VALVE SWITCH. A bleed air valve switch is located on the gas turbine compressor control panel. After the compressor reaches operating speed, this two-position (OPEN, CLOSED) toggle switch controls the normally closed, solenoid-operated bleed air valve. With the valve closed, air is supplied to the power turbine combustion chamber only. With the valve open, air is supplied to both the combustion chamber and the bleed air duct of the airplane. Too-early application of bleed air load to the compressor is prevented by the 95 percent speed switch, which completes the circuit from the isolated bus to the bleed air valve switch only after that speed is reached.

FIRE EMERGENCY CONTROL HANDLE. The GTC fire emergency control handle, located on the overhead control panel, provides for emergency shutdown of the gas turbine compressor. This handle, when pulled, breaks the circuit from the isolated bus to the gas turbine compressor switch and actuates the motor-operated emergency hydraulic fluid shutoff valve to the closed position, thus closing the emergency hydraulic suction line from the emergency hydraulic reservoir to the emergency hydraulic pump. Breaking the circuit to the selector switch allows the deenergized-closed, solenoid-operated fuel valve and the deenergized-closed, solenoid-operated bleed air valve to close. Thus, all fuel and oil into, and all bleed air from, the gas turbine compressor are shut off.

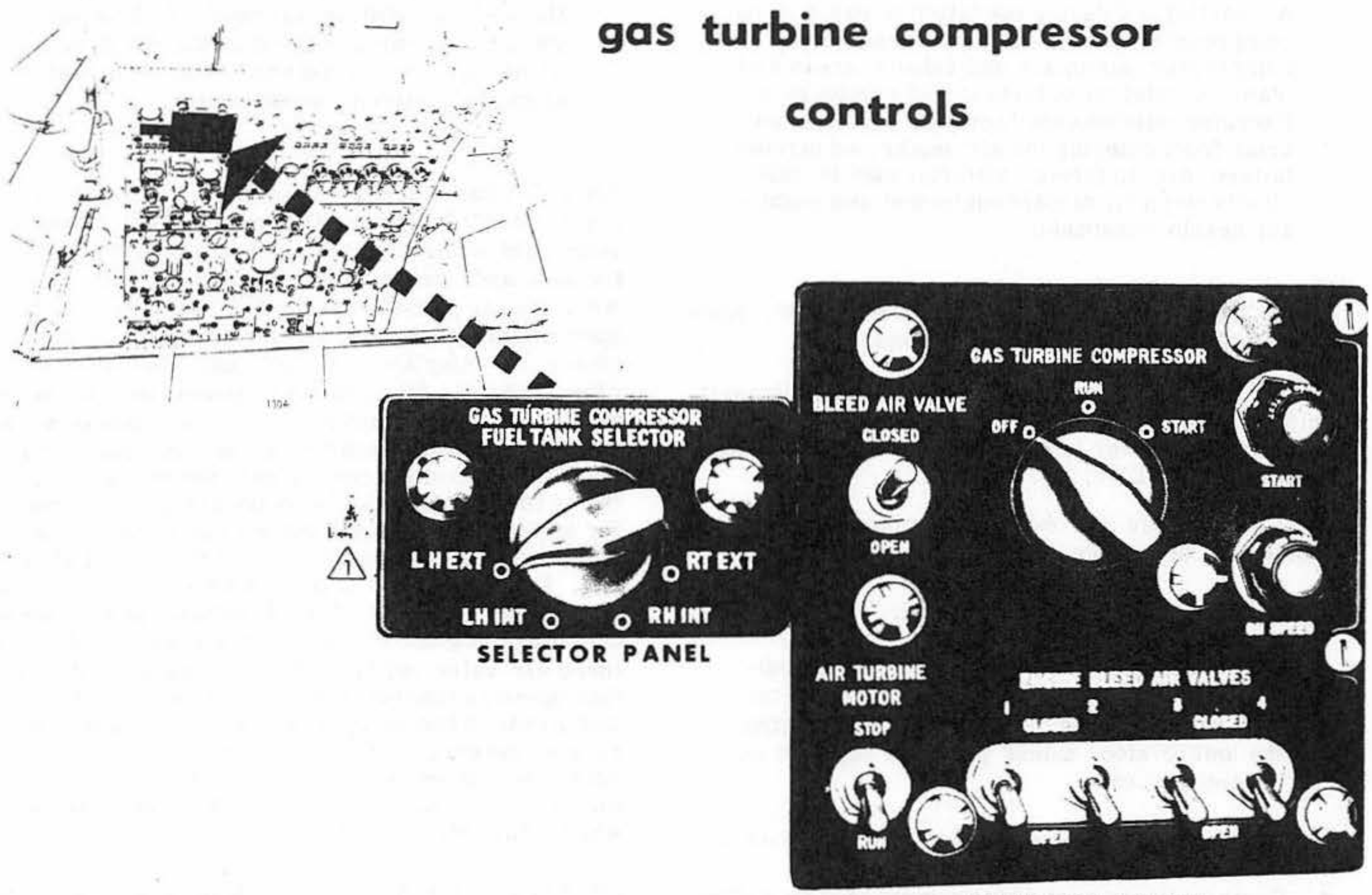
GAS TURBINE COMPRESSOR INDICATORS.

The indicators for the gas turbine compressor are located on the gas turbine compressor control panel (figure 4-136), which is part of the overhead control panel.

START LIGHT. A start light is located on the gas turbine compressor control panel (figure 4-58). This press-to-test light glows to indicate that the starter motor is energized. The light stays on until the compressor reaches approximately 35 percent RPM, at which time a centrifugal switch de-energizes the starter and the start light.

ON SPEED LIGHT. An on speed light is located on the gas turbine compressor control panel (figure 4-136). This press-to-test light is energized through

gas turbine compressor controls



⚠1 AIRPLANES AF53-3129 THROUGH AF55-0014

Figure 4-136.

the 95 percent speed switch and indicates that the compressor has reached or is maintaining operating speed.

GAS TURBINE COMPRESSOR OPERATING INSTRUCTIONS.

WARNING

The fire warning lights in the GTC fire emergency control handle are disconnected and will not indicate a fire in the GTC area.

The gas turbine compressor (GTC) has been modified for inflight operation. This modification consists of removal of the forward GTC air intake panel, installation of a screen in the GTC exhause panel, disabling of the GTC start interlock circuit, and installation of an air deflector forward of the GTC inlet.

The compressor is operated from the gas turbine compressor control panel on the overhead control panel.

WARNING

At starting and during operation of gas turbine compressor, personnel must stand clear of compressor air intake and exhaust areas and plane of rotation of turbine and compressor. Exercise extreme care to prevent foreign material from entering the air intake, as turbine failure due to foreign material may be sufficiently violent to damage equipment and endanger nearby personnel.

STARTING THE GAS TURBINE COMPRESSOR. Start the gas turbine compressor as follows:

1. Turn on DC power. (If external DC power is available, turn the battery switch to EXTERNAL POWER. If external DC power is not available, turn the battery switch to BATTERY.)

2. Check intake and exhaust openings for possible obstruction or foreign material.

Note

If the battery switch is turned from one position to another while the GTC is running, the GTC control circuit will be opened, causing the unit to stop, unless power is supplied to the isolated bus.

3. Check that the fuselage bus isolation switch is ON.

4. Route fuel to the gas turbine compressor by setting the fuel tank selector (airplanes AF53-3129 through 55-0014 modified by T.O. 1C-130A-521) or by opening a crossfeed valve (airplanes AF55-0029 and up).

5. Place the bleed air valve switch in the CLOSED position.

6. Turn the gas turbine compressor control switch to the spring-loaded START position. The start light should illuminate immediately.

7. Release the control switch. The spring will move the switch to the RUN position.

CAUTION

Watch the start light. As soon as the starter disengages, the light will go out. If the light does not go out within 1 minute, move the control switch to OFF and wait 4 minutes before making another start attempt. The starter duty cycle is 1 minute on, 4 minutes off.

Note

If the GTC does not light off, the cause could be a lack of oil pressure in the line to actuate the fuel and ignition circuits. In this case, the primer button located on the check valve in the GTC sump assembly can be actuated manually. Attempt another start.

After the gas turbine compressor control switch is placed in START, power is supplied to the starter, the start light, and to the fuel and ignition circuits, though the fuel and ignition circuits are not yet complete. When the oil pressure in the GTC oil system reaches approximately 3 PSI, an oil-pressure-operated switch closes to complete the fuel and ignition circuits. After lightoff, the combined power of the starter and the combustion taking place in the power turbine continues the acceleration of the assembly. The 35 percent switch of the centrifugal switch assembly then opens to break the starting relay circuit when the relay is deactivated, the starter is disengaged, the ignition system is deenergized, and the start light goes out. The gas turbine is now under its own power and acceleration continues. At 95 percent speed, another centrifugal switch closes and connects power to the bleed air valve switch and the on speed light. When full speed is reached the governor assumes control and limits RPM to approximately 100 percent. In case of governor failure, the overspeed switch prevents the turbine from "running away" by breaking the circuit to the fuel shutoff valve holding relay, which shuts off the fuel.

LOADING OPERATION. Apply load to the gas turbine compressor as follows:

1. Insure that the unit is on speed.

2. Place the bleed air valve switch in the OPEN position.

3. Check bleed air pressure.

STOPPING THE GAS TURBINE COMPRESSOR. Stop the gas turbine compressor as follows:

1. Place the bleed air valve switch in CLOSED position.

2. Turn the gas turbine compressor control switch to OFF position.

Note

If the GTC control switch is in RUN, the timer on the unit runs whether the GTC is running or not.

AIR TURBINE MOTOR.

The air turbine motor, located in the left wheel well above the gas turbine compressor, is a single-stage, axial-flow turbine used to drive an AC generator and the emergency hydraulic system pump. Compressed air for ground operation of the air turbine motor is furnished either by the gas turbine compressor or by an external source. Compressed air for operation while in flight is supplied by bleed from the engines. The speed of the unit is controlled by a speed-sensing butterfly valve in the turbine inlet, which meters the amount of air supplied the turbine. A cooling fan for the AC generator is energized from the isolated bus through the ATM control switch. Circuit protection for the cooling fan is provided by the ATM fan circuit breaker on the isolated bus in the main power distribution box.

Note

The ATM hydraulic shutoff valve can be manually actuated. To manually open the valve, remove the cable plug from the bottom of the shutoff valve, and manually position the mechanical lever to open. The ATM may then be safely operated.

Air Turbine Motor Control Switch.

The air turbine motor control switch is located on the gas turbine compressor control panel (figure 4-136). This 2-position (RUN, STOP) toggle switch controls a shutoff valve in the air turbine motor inlet line. When the switch is moved to the RUN position, the shutoff valve is opened and compressed air is admitted to drive the air turbine motor. Twenty-eight volt DC power for the valve control circuit is taken from the isolated bus. Circuit protection is provided by the ATM valve circuit breaker in the main power distribution box.

ATM Compartment Overheat Warning Light.

A red press-to-test light (figure 4-3) located on the air conditioning control panel is provided to warn the pilot of an overheat condition in the ATM compartment. When an overheat condition of 200°F exists, the warning light will illuminate and the overheat condition must be corrected to extinguish the light.

Air Turbine Motor Operation.

Operation of the air turbine motor is possible only when the bleed air manifold is pressurized, either from an outside pressure source or from bleed air from the gas turbine compressor or the engines. The unit is started by placing the air turbine motor control switch in RUN position, and stopped by placing the switch in STOP.

CARGO LOADING EQUIPMENT.

The cargo loading equipment has been removed from all airplanes covered by this manual.

TIE-DOWN FITTINGS.

Tie-down fittings are installed on the cargo floor, ramp, and side walls for securing cargo. The floor fittings are flush-mounted and consist of tie-down rings and attachment studs. The floor rings are rated at 10,000 pounds strength. The ramp and side wall fittings are tie-down rings rated at 5,000 pounds strength. Threaded sockets are distributed along the edges of the fuselage floor for the attachment of 25,000-pound-strength fittings (eight on earlier airplanes and 12 on later airplanes). The 25,000-pound-strength fittings are stowed in boxes beneath the flight station and on the right side wall above the ramp when not installed.

LOAD ADJUSTER.

A load adjuster, computer identification card, and an instruction book are stowed in a case attached to the side of the navigator's cabinet beneath the navigator's table. This equipment is used for computing the correct center of gravity under varying load conditions.

FORWARD CARGO DOOR SYSTEM.

The forward cargo door system has been rendered inoperative on the airplanes covered by this manual.

AFT CARGO DOOR AND RAMP SYSTEM.

A rear aft cargo door and ramp provide an entrance and exit during ground operations, and an emergency exit both inflight and on the ground. Both ramp and

forward cargo door hydraulic system

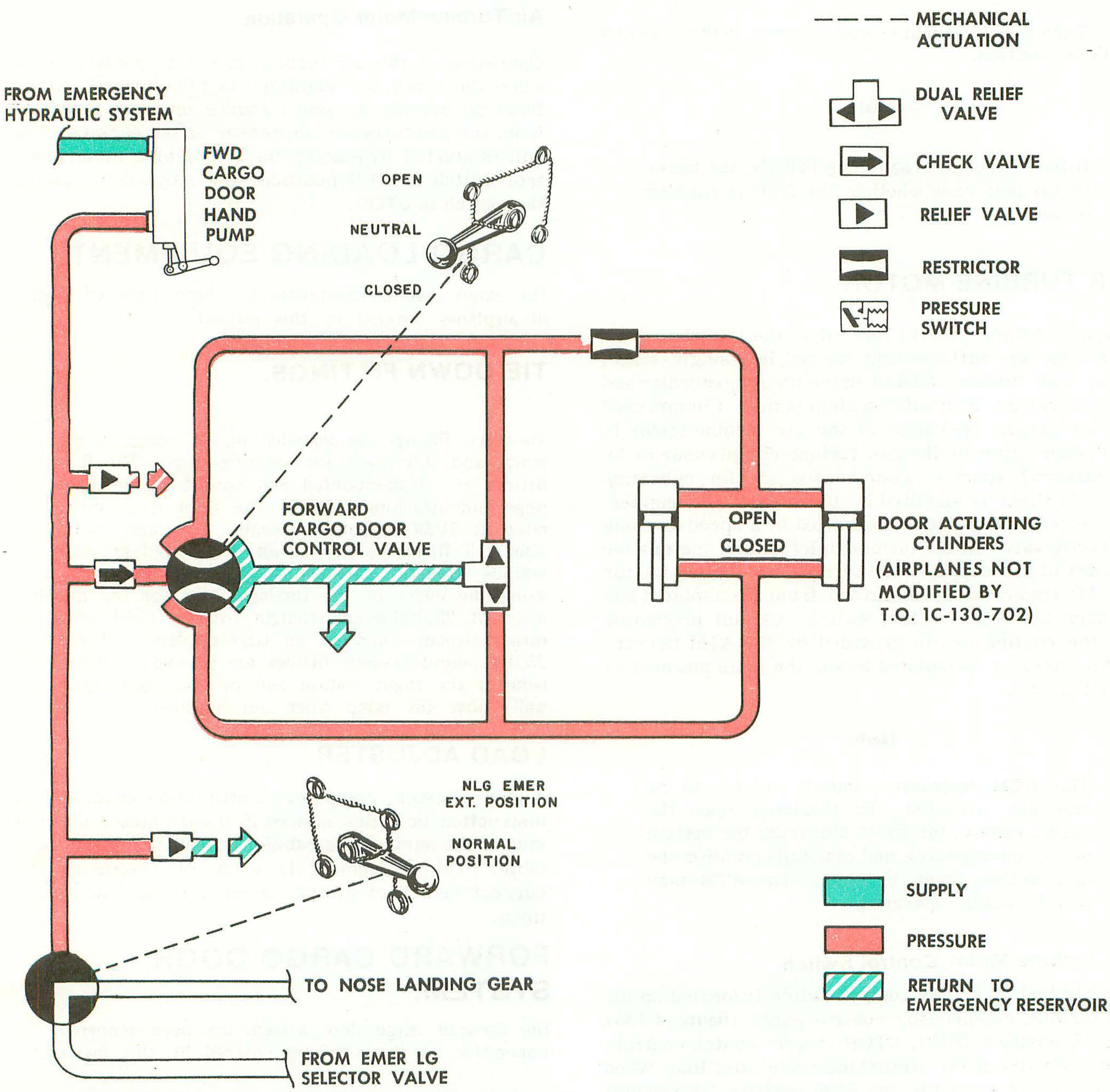


Figure 4-137.

forward cargo door controls

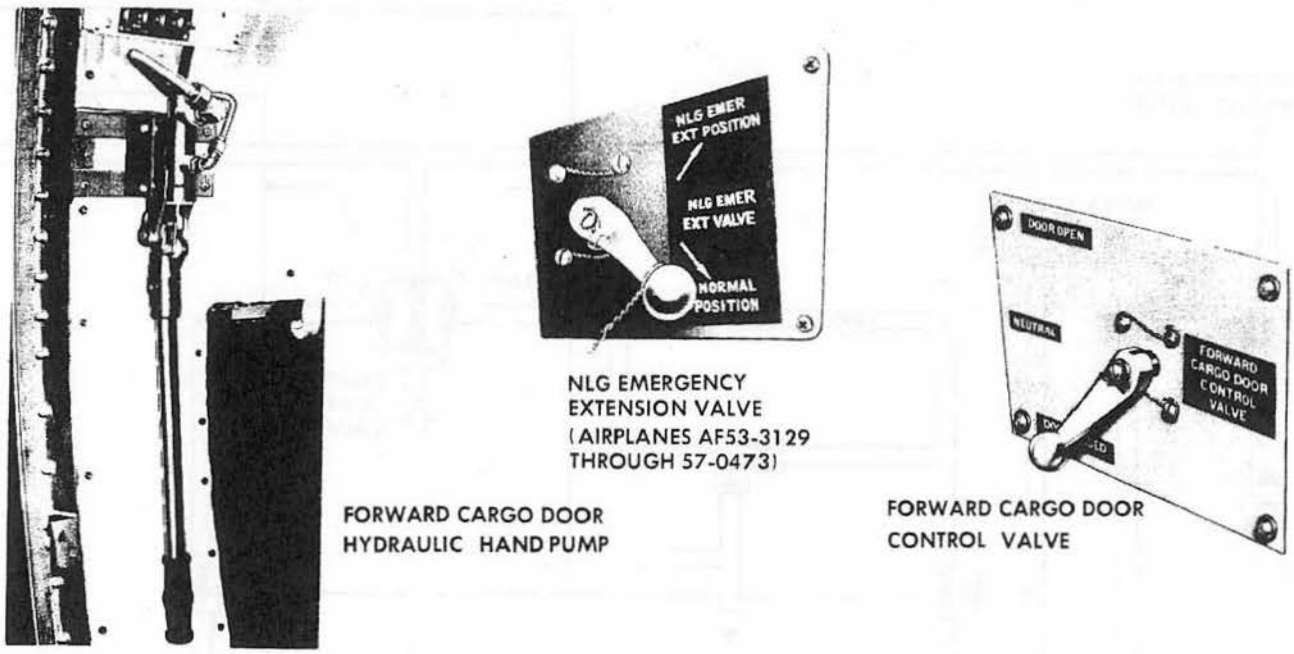


Figure 4-138.

door are normally operated with hydraulic pressure supplied by the emergency hydraulic system (figure 4-139), or can be pressurized with a handpump connected to a reserve compartment of the emergency hydraulic system reservoir. Control of the system is from a ramp control panel located aft of the left paratroop door.

AFT CARGO DOOR AND RAMP SYSTEM CONTROLS.

Aft cargo door and ramp system controls consist of electrically and manually operated hydraulic valves.

Aft Cargo Door Control Switch.

An aft cargo door control switch is located on the ramp control panel aft of the left paratroop door (figure 4-140). It is a 3-position (CLOSE, NEUTRAL, OPEN) toggle switch, spring-loaded to the neutral position, that controls the normal ground operation of the aft cargo door. When the switch is held in the OPEN position, the aft cargo door control valve is energized by 28-volt DC power through the ramp and ADS circuit breaker in the aft fuselage junction box. The control valve directs hydraulic pressure to the open side of the aft cargo door actuating cylinder to open the aft cargo door. As the door reaches the open position it engages the aft cargo door uplock assembly, which latches mechanically. Hydraulic pressure is directed to the aft cargo door up lock cylinder, which unlatches the uplock. Then the control valve directs pressure to the close side of the door actuating cylinder, and the door swings downward to the closed position and locks in place. When the switch is released, the aft cargo door circuit is de-energized. In the NEUTRAL (center) position the valves return to a neutral position, permitting any entrapped fluid to flow to return.

Ramp Control Switch.

A ramp control switch is located on the ramp control panel immediately forward of the ramp door control switch (figure 4-140). It is a 3-position (RAISE, NEUTRAL, LOWER) toggle switch, spring-loaded to the NEUTRAL position, that controls the normal ground operation of the ramp. When the switch is held in the LOWER position, the ramp control valve is energized by 28-volt DC power through the ramp and ADS circuit breaker in the aft fuselage junction box. The control valve directs hydraulic pressure to the up side of the ramp actuating cylinders and to the unlock side of the ramp uplock control valve, until the uplock is unlatched. Then the hydraulic pressure is directed to the down side of the ramp actuating cylinders to lower the ramp and lock it in position during ground loading. When the switch is held in the RAISE position, the ramp control valve directs hydraulic pressure to the up side of the ramp actuating cylinders to raise the ramp. At the same time, pressure is directed into the uplock side of the ramp uplock control valve to unlock the ramp uplock until the ramp is raised into the normal raised position. Then the pressure is directed to the lock side of the ramp uplock control valve to lock the ramp in place. When the switch is released and is in the NEUTRAL

ramp hydraulic system

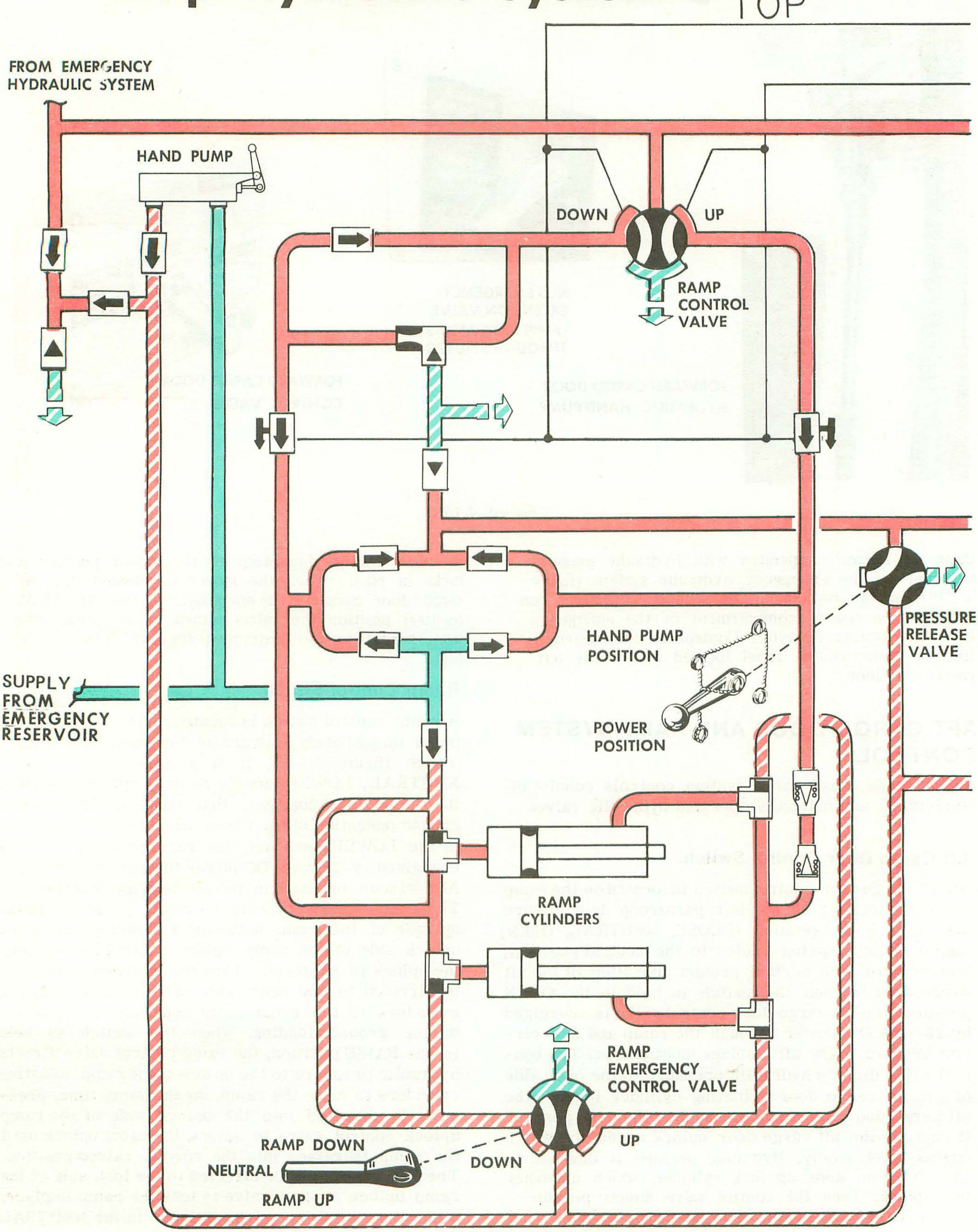


Figure 4-139 (Sheet 1 of 3)

130A-1-33-154-1

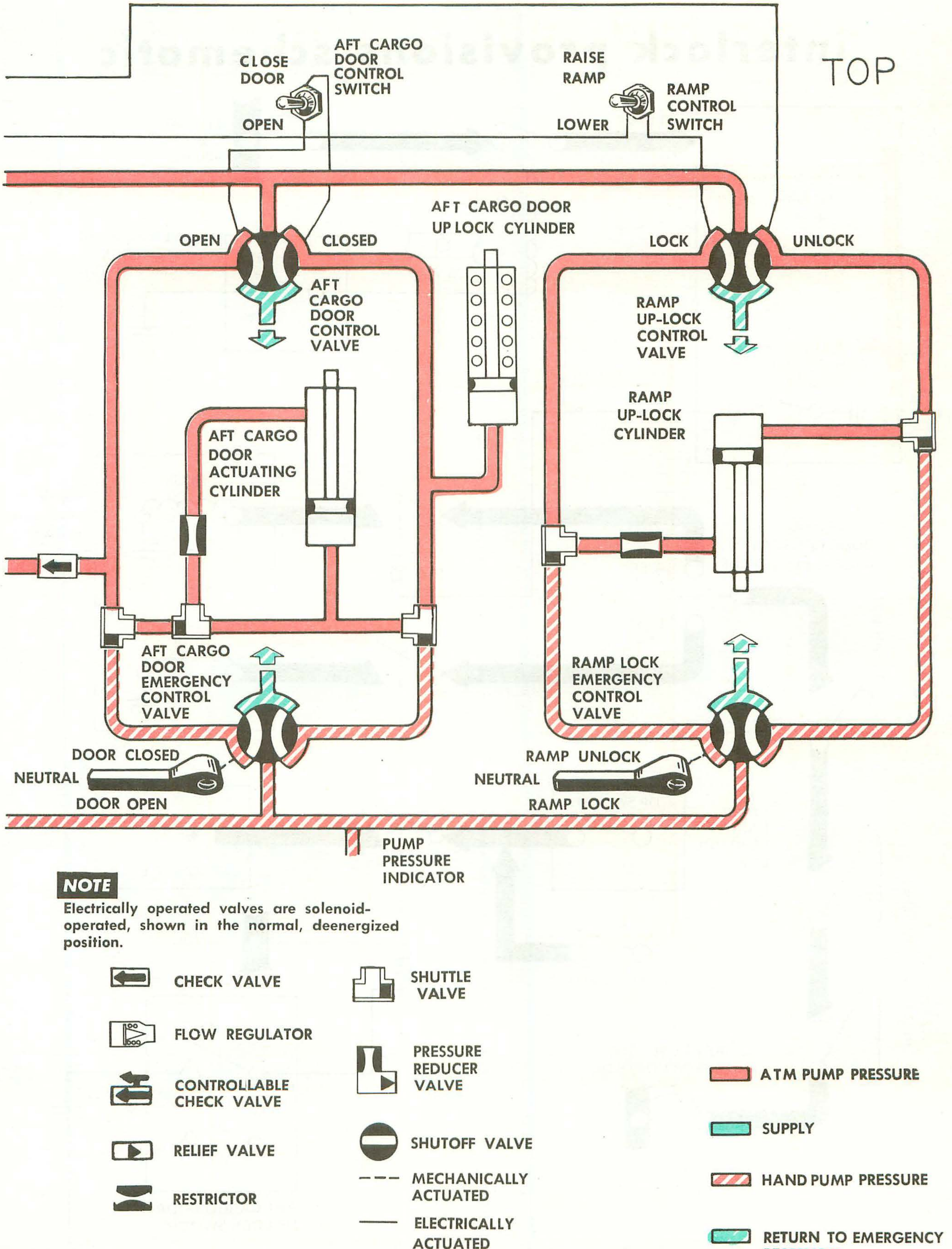


Figure 4-139 (Sheet 2 of 3)

130A-1-33-154-2

interlock provisions schematic

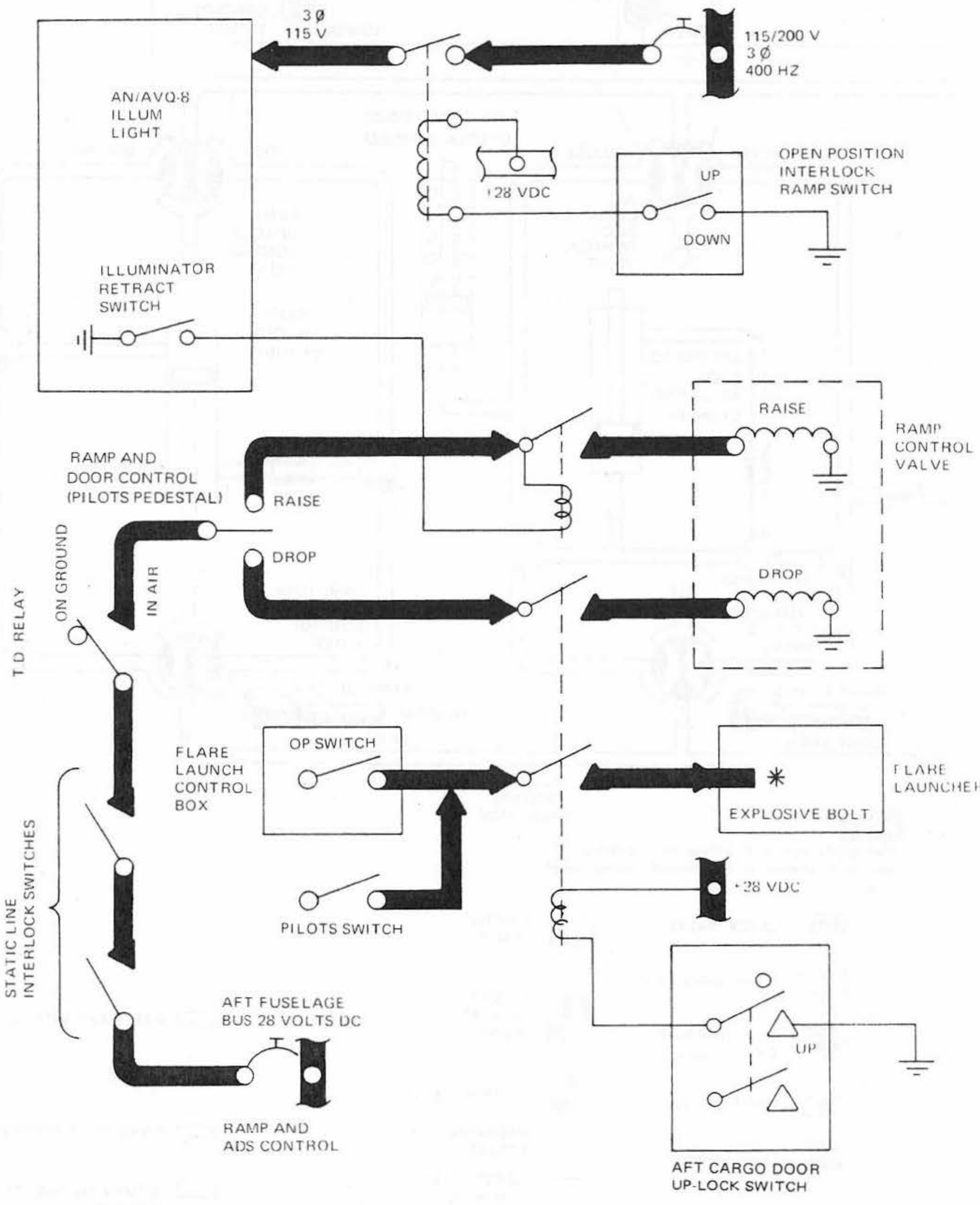
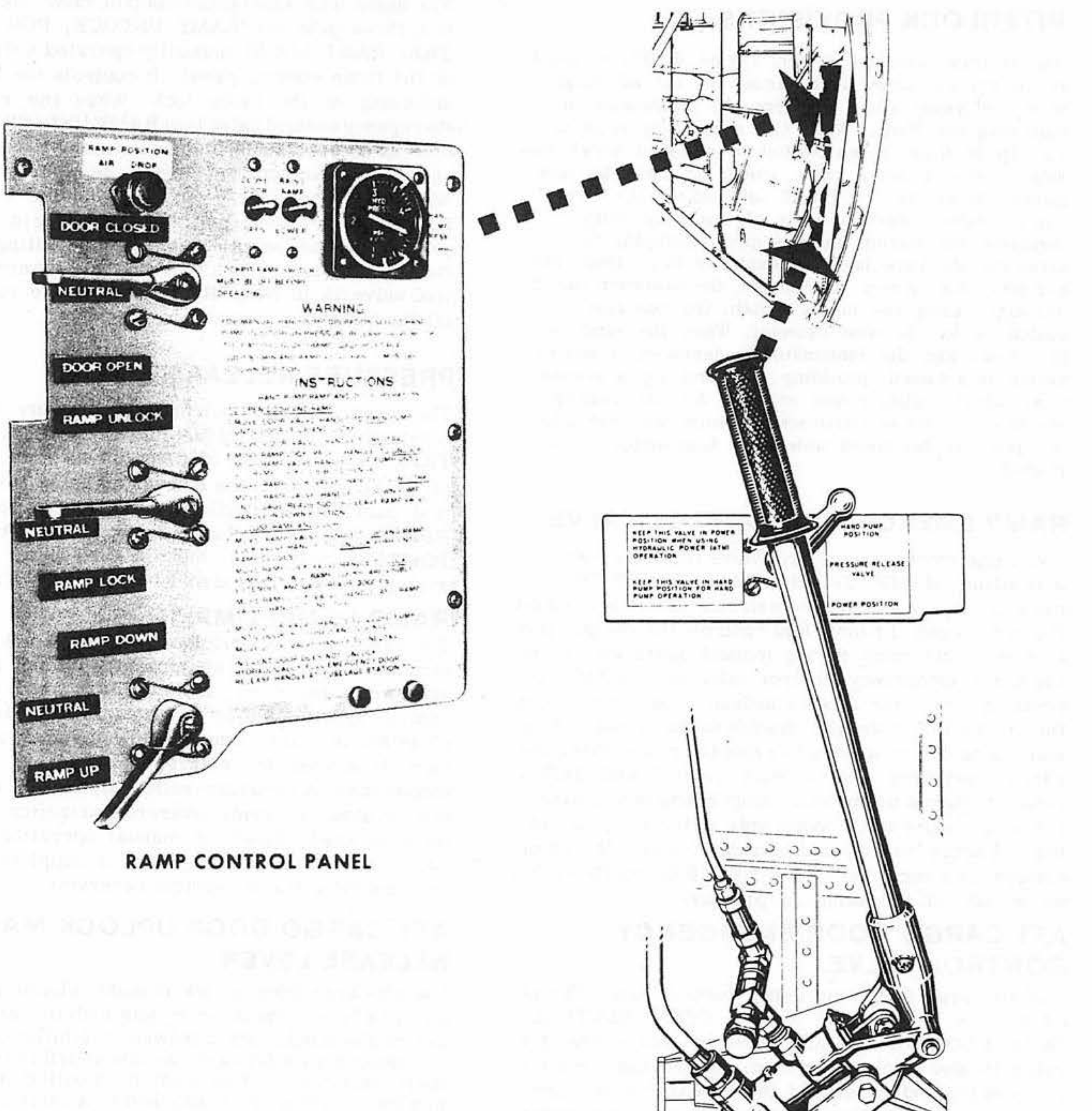


Figure 4-139 (Sheet 3 of 3)

ramp controls



RAMP CONTROL PANEL

RAMP AND AFT CARGO DOOR HAND PUMP AND VALVE

130A-1-33-155

Figure 4-140.

or CENTER position, the valves return to a neutral position.

INTERLOCK PROVISIONS.

An electrical interlock system (figure 4-139) is installed to prevent inadvertent damage to the aft cargo door and ramp while operating the illuminator or launching the flares. When the ramp door is in the full up position, a microswitch is actuated which provides a ground for a relay, energizing the relay and routing power to the DROP solenoid of the ramp control valve. Other contacts of this same relay complete one circuit, making power available for actuating the flare launcher explosive bolt. Once the explosive bolt power is available, the launcher can be jettisoned using the pilot's switch, the operator's switch or by the heat detector. When the ramp is full down and the illuminator is deployed, a microswitch is actuated, providing a ground for a second relay which makes power available for illuminating the lamps. Another interlock provision will not allow the ramp to be raised unless the illuminator is retracted.

RAMP EMERGENCY CONTROL VALVE.

The ramp emergency control valve (figure 4-140), is a 3-position (RAMP UP, NEUTRAL, RAMP DOWN), manually operated, rotary selector valve, located on the ramp control panel, that controls the opening and closing of the ramp during manual operation. When the ramp emergency control valve is in RAMP UP position, the valve directs hydraulic pressure from the emergency hydraulic system to the up side of the ramp actuating cylinders to raise the ramp. When the ramp emergency control valve is in RAMP DOWN position, hydraulic pressure from handpump is directed by the valve to the down side of the ramp actuating cylinders to lower the ramp. When the ramp emergency control valve is in NEUTRAL position, the valve shuts off the handpump pressure.

AFT CARGO DOOR EMERGENCY CONTROL VALVE.

The aft cargo door emergency control valve (figure 4-140) is a three-position (DOOR, OPEN, NEUTRAL, DOOR CLOSED), manually operated rotary selector valve, located on the ramp control panel, that controls the opening and closing of the aft cargo door during manual operation. When the aft cargo door emergency control valve is in the DOOR OPEN position, the valve directs handpump pressure to the up side of the aft cargo door actuating cylinder to raise the aft cargo door. When the aft cargo door emergency control valve is in the DOOR CLOSED position, the valve directs handpump pressure to the down side of the aft cargo door actuating cylinder to lower the door. When the aft cargo door emergency control valve is in the NEUTRAL position, the valve shuts off the handpump pressure.

RAMP LOCK EMERGENCY CONTROL VALVE.

The ramp lock emergency control valve (figure 4-140) is a three-position (RAMP UNLOCK, POWER POSITION, RAMP LOCK), manually operated valve located on the ramp control panel. It controls the locking or unlocking of the ramp lock. When the ramp lock emergency control valve is in RAMP UNLOCK position, the valve directs handpump pressure to the unlock side of the lock actuating cylinder, unlocking the ramp. When the ramp lock emergency control valve is in RAMP LOCK position, the valve directs handpump pressure to the lock side of the lock actuating cylinder, locking the ramp. When the ramp lock emergency control valve is in NEUTRAL position, the valve shuts off the handpump pressure.

PRESSURE RELEASE VALVE.

The ramp pressure release valve (figure 4-140) is a two-position (HAND PUMP POSITION, POWER POSITION) valve, mounted on the left side of the fuselage, aft of the left paratroop door and below the ramp control panel. The handle is normally placed in the POWER POSITION, and is moved to the HAND PUMP POSITION only when the aft cargo door and ramp system is being operated by means of the handpump.

RAMP HANDPUMP.

The ramp system handpump mounted on the fuselage structure aft of the left paratroop door, is used to pressurize the ramp, aft cargo door, and ramp lock control systems. This handpump is used to open and close the aft cargo door and ramp and to actuate the ramp lock when the emergency hydraulic system is inoperative. A pressure-relief valve in the ramp control system prevents overpressurization when the pump is used. Fluid for manual operation of the aft cargo door and ramp system is supplied from the emergency hydraulic system reservoir.

AFT CARGO DOOR UPLOCK MANUAL RELEASE LEVER

The aft cargo door uplock manual release lever (figure 4-141) is a metal lever attached to the outboard side of the tubular strut between the toilet and urinal. The lever pivots forward and downward from the normally vertical position when it is pulled down to the unlocked position. It is attached to a cable and pulleys in such a way that when it is pulled down to the unlocked position, the uplock mechanism unlatches the aft cargo door. When the lever is released it returns upward into its normal (locked) position and resets itself.

AFT CARGO DOOR AND RAMP SYSTEM INDICATORS.

Aft cargo door and ramp system indicators are provided to show hydraulic pressure of the system and to verify that the ramp and door are closed and locked.

Handpump Pressure Gage.

A handpump pressure gage (figure 4-140) is located on the ramp control panel. It is a direct-indicating gage which registers the pressure available in the ramp emergency system.

Door Warning System.

See EMERGENCY EQUIPMENT in Section I.

Aft Cargo Door Uplock Indicator

The aft cargo door uplock indicator is a black metal flag with a yellow circle. It is attached to the uplock mechanism in such a way that when the aft cargo door is fully open and locked the flag will swing outward and downward as a visual indication that the door is locked in the up position. As the indicator swings downward it turns on a RAMP & DOOR OPEN LIGHT. It is spring-loaded to return to a hidden position whenever the aft cargo door is not locked in the up position. The visibility of the indicator is increased by means of a red inspection light which can be turned on by a switch on the aft fuselage junction box.

AFT CARGO DOOR AND RAMP OPERATION.

WARNING

During ground operation, clear the area of personnel and equipment prior to operation of the cargo ramp and door to prevent damage to the aircraft and injury to personnel.

aft cargo door uplock manual release

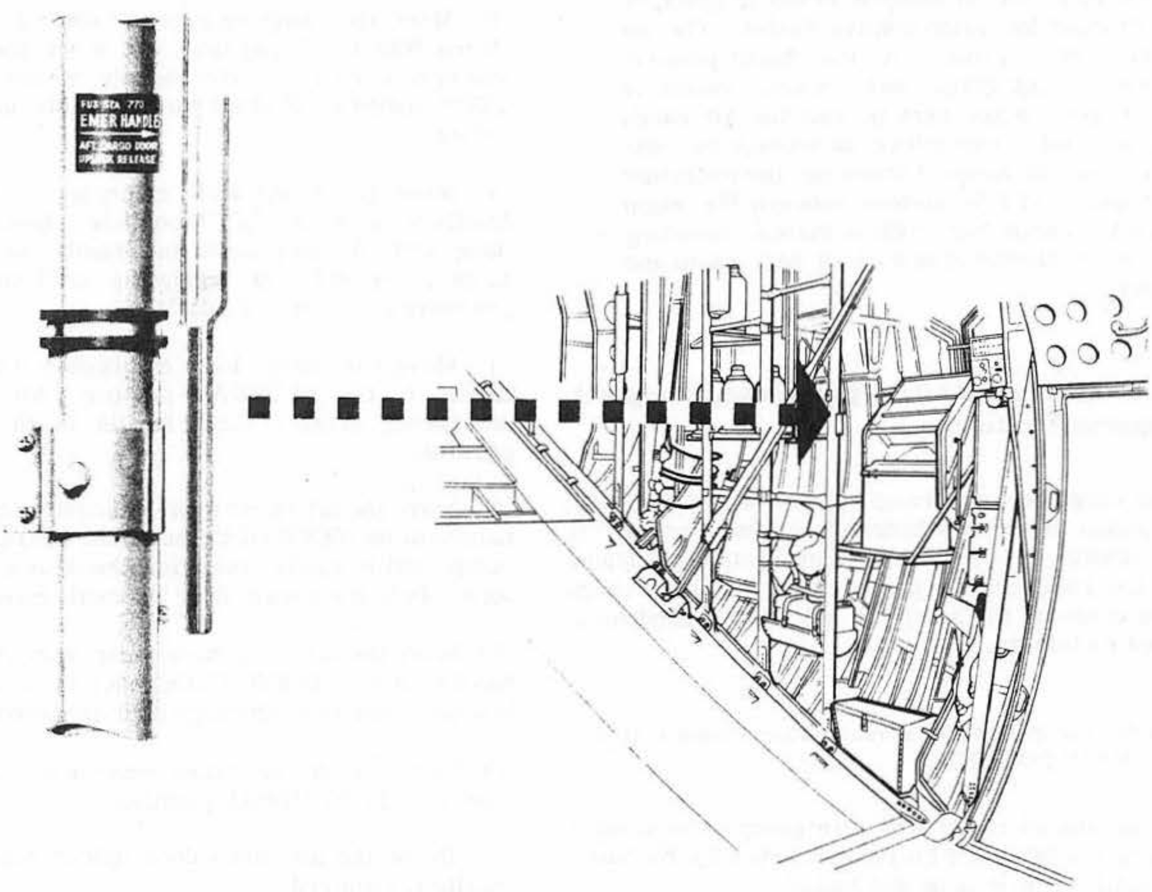


Figure 4-141.

130A-1-33-157

The aft cargo door and ramp can be operated to open and to close either by emergency system hydraulic power for normal operation or by use of the handpump for emergency operation.

Operation of Aft Cargo Door and Ramp with Air Turbine Motor Pump Pressure.

During operation with ATM pump pressure, the aft cargo door and ramp are opened by holding the aft cargo door control switch in the OPEN position until the door is open and locked; then by holding the ramp control switch in the LOWER position until the desired position of the ramp is reached. The ramp and door are closed by holding the ramp control switch in the RAISE position until the ramp is up and locked. The door is closed by holding the cargo door switch to the OPEN position and pulling the aft cargo door manual release until the uplock is released. After the uplock is released, hold the cargo door switch to the CLOSE position until the door is closed and locked.

Note

> The ramp can be stopped in any position by releasing the ramp control switch. The aft cargo door returns to the closed position when the aft cargo door control switch is released. Make certain that the aft cargo door is fully open before an attempt is made to lower the ramp. Otherwise, the hydraulic pressure will be divided between the ramp and aft cargo door control valves, resulting in much slower operation of both ramp and door.

Manual Operation of Aft Cargo Door and Ramp with Handpump Pressure.

The aft cargo door and ramp system can be operated, even though emergency hydraulic system pressure is not available, by use of the ramp system handpump below the ramp control panel. To open the aft cargo door and lower the ramp by use of the handpump, proceed as follows:

1. Move the pressure release valve handle to the HAND PUMP POSITION.

2. Move the aft cargo door emergency control valve handle to the DOOR OPEN position. Operate the handpump until the door is up and locked.

3. Move the aft cargo door emergency control valve handle to the NEUTRAL position.

4. Move the ramp lock emergency control valve handle to the RAMP UNLOCK position, and move the ramp emergency control valve handle to the RAMP UP position. Operate the handpump until all ramp locks visibly disengage.

5. Move the ramp emergency control valve handle to the RAMP DOWN position. Operate the handpump until the pressure gage reads 500 PSI. Leave the ramp emergency control valve handle in the RAMP DOWN position.

CAUTION

> Do not use the ramp for loading and unloading when the handpump pressure gage reads less than 500 PSI. Serious damage may result if the locking action of the ramp cylinders is lost because of reduced hydraulic pressure in the cylinders.

To close the aft cargo door and raise the ramp by use of the handpump, proceed as follows:

6. Move the ramp emergency control valve handle to the RAMP UP position, and move the ramp lock emergency control valve handle to the RAMP UNLOCK position. Operate the handpump until the ramp closes.

7. Move the ramp lock emergency control valve handle to the RAMP LOCK position. Operate the handpump until all ramp locks are visibly extended. Continue to operate the handpump until the handpump pressure gage reads 3,000 PSI.

8. Move the ramp lock emergency control valve handle to the NEUTRAL position. Move the ramp emergency control valve handle to the NEUTRAL position.

9. Move the aft cargo door emergency control valve handle to the DOOR OPEN position. Operate the handpump until it can be seen that the door is off the uplock. Pull the cargo door manual release handle.

10. Move the aft cargo door emergency control valve handle to the DOOR CLOSE position. Operate the handpump until the aft cargo door is closed and locked.

11. Move the aft cargo door emergency control valve handle to the NEUTRAL position.

12. Reset the aft cargo door uplock manual release handle if required.

13. Move the pressure release valve handle to the POWER position.

Emergency Operation of Aft Cargo Door and Ramp.

The aft cargo door and ramp can be operated manually, in the event of a valve malfunction or an electrical failure, without having to use the handpump. The doors are opened by using manual overrides on the valves as follows:

1. Go to the aft fuselage junction box and pull the ramp and ADS cont. circuit breaker.

2. Press and hold the RAMP UNLOCK button on the ramp uplock control valve (located above and to the left of the aft fuselage junction box) until the ramp is unlocked.

3. Press and hold the DOOR OPEN button on the ramp door control valve until the aft cargo door is up and locked.

4. Press and hold the RAMP DOWN button on the ramp control valve and the override button on the right ramp position valve until the ramp is in the desired position.

To close the aft cargo door and raise the ramp by using the override buttons, proceed as follows:

5. Press and hold the RAMP UP button on the ramp control valve and the override button on the left ramp position valve until the ramp closes.

6. Press and hold the RAMP LOCK button on the ramp uplock control valve until the locks are extended visibly.

7. Pull the aft cargo door uplock manual release handle to unlock the aft cargo door.

8. Press and hold the DOOR CLOSED button on the ramp door control valve until the aft cargo door is closed and locked.

AIR DROP SYSTEM.

The air drop system equipment has been removed from airplanes covered by this manual.

TROOP CARRYING EQUIPMENT.

The troop carrying equipment has been removed from airplanes covered by this manual.

CASUALTY CARRYING EQUIPMENT.

The casualty carrying equipment has been removed from airplanes covered by this manual.

PARATROOP EQUIPMENT.

The paratroop equipment has been removed from airplanes covered by this manual.

PARATROOP JUMP DOORS.

A paratroop jump door is installed on the right side fuselage, just forward of the ramp. The door is maintained in the locked position by four latch pins which are actuated by a handle located in the center of the door. After the latch pins are released, the door is raised manually with an inward vertical movement.

The door is held in the open position by a spring-loaded latch, which must be manually released before the door can be closed.

WARNING

Do not open the paratroop door at airspeeds above 150 KIAS.

JUMP SIGNALS (Some Airplanes)

Jump signals consist of green and red lights. A green and a red light are located on the forward frame of the right paratroop door, on the forward lighting control panel, and on the paratroop panel (figure 4-142). The lights are controlled by a three-position (CAUTION, OFF, JUMP) toggle switch located on the paratroop panel. The lights are operated by DC power through the troop jump signal circuit breaker on the battery compartment distribution panel. When the jump signal switch is in the CAUTION position, the red lights illuminate, and when the switch is in the JUMP position, the green lights illuminate.

AIR DEFLECTORS

The left air deflector has been disabled on airplanes covered by this manual; however, a fixed air deflector is located at each of the following positions: the 20MM and 40MM gun positions, GTC intake, 2 KW illuminator, and right scanners window. An air deflector is located on the right side of the fuselage, forward of the right paratroop door, forming the rear section of the main landing gear wheel well faring. The air deflector is opened electrically to approximately 30 degrees (15.5±0.5 inches) by actuation of a three-position (OPEN, OFF, CLOSE) air deflector switch on the paratroop panel (figure 4-142). A warning light below the switch glows when the door is not completely closed. The switch and the warning light are energized by 28-volt DC power through the paratroop air deflector circuit breaker in the main power distribution box.

paratroop panels

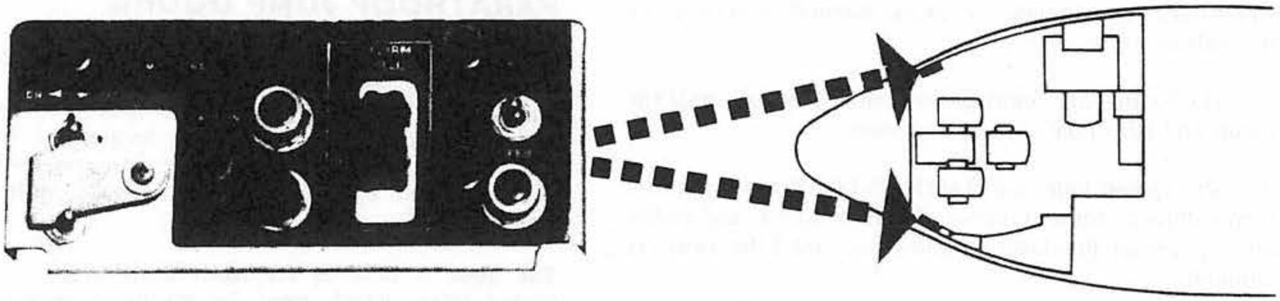


Figure 4-142.

Note

Placing either air deflector door control switch to the CLOSE position will cause the air deflector door to close regardless of the position of the other control switch. The door cannot be opened by either switch if the other switch is in the CLOSE position.

SINGLE POINT REFUELING.

A single point refueling and defueling system is built into the airplane. By using this system, all normal refueling and defueling can be done without climbing on the wings or moving the fuel truck. The hose from the fuel truck is attached to the fueling receptacle, located in the right wheel fairing, and any or all tanks may be serviced from that point. Controls and indicators for the single point system are located on the single point fuel panel, which is located immediately above the fueling receptacle. If tanks are to be filled to their single point capacity, a dual float valve in each tank shuts off flow when the upper limit of that tank is reached.

Note

All external tank provisions on the single point refueling panel were provided for a type of combat pylon tank that was not installed in production; and are inoperative for the pylon tanks installed on the airplanes. All fueling of the pylon tanks must be accomplished at the individual filler ports of the pylon tanks.

Note

For maximum range missions, tanks may be topped off through the individual tank filler ports after single point servicing.

Defueling and tank-to-tank transfer operations are accomplished by use of the tank boost pumps.

SINGLE POINT REFUELING SYSTEM (AIRPLANES AF53-3129 THROUGH 55-0014)

On these airplanes refueling and defueling is accomplished through the crossfeed manifold (figure 1-18). On refueling, fuel flow is through the fueling receptacle, through the crossfeed manifold, and into the tanks. On defueling, fuel flow is reversed.

SINGLE POINT REFUELING SYSTEM (AIRPLANES AF55-0029 AND UP)

On these airplanes refueling is accomplished through the refueling manifold (figure 1-19). On refueling, fuel flow is through the fueling receptacle, through the refueling manifold, and into the tanks. On defueling, fuel flow is from the tanks, into the crossfeed manifold, through the ground transfer valve to the refueling manifold, then through the fueling receptacle.

SINGLE POINT REFUELING SYSTEM CONTROLS.

Controls for the single point refueling system are located on the fuel panel in the right wheel fairing.

Master Switch (Airplanes AF53-3129 through 55-0014).

A master switch for the single point refueling system is located on the single point refueling control panel (figure 4-143). The switch is a five-position (REFUEL, DE-FUEL, PRE-CHK PRI, PRE-CHK SEC, DRAIN & OFF) rotary switch by which the system function is selected. In the REFUEL position, the system is set up to supply fuel as far as the individual tank inlet valves, and the fuel quantity gages are energized. In DE-FUEL, the valves controlled in REFUEL are moved to the same positions. In addition, the individual tank inlet valves are closed (overriding the tank-selector switches if necessary) to prevent accidental fuel transfer or recirculation, and the quantity gages are deenergized. In PRE-CHK PRI, the system is energized as in REFUEL and, in addition, power is supplied to one set of checkout solenoids in the tank dual float valves. Operation of the checkout solenoids closes the dual float valves. If placing the switch in the PRE-CHK PRI position stops fuel flow to the tanks, it is an indication that the dual float valves are functioning normally and automatically shut off flow when single point capacity is reached. PRE-CHK SEC performs the same test on the second set of checkout solenoids in the dual float valves. In the DRAIN & OFF position the refueling system is isolated from the crossfeed manifold. All circuits of the master switch are energized by 28-volt DC, through the refuel valves circuit breakers from the wheel well bus.

Master Switch (Airplanes AF55-0029 and Up).

A master switch for the single point refueling system is located on the single point refueling control panel (figure 4-143). The switch is a six-position (REFUEL, DE-FUEL, PRE-CHK PRI, PRE-CHK SEC, DRAIN, OFF) rotary switch by which the system function is selected. In the REFUEL position the system is set up to supply fuel as far as the individual tank inlet valves, and the fuel quantity gages are energized. In DE-FUEL, the valves controlled in REFUEL are moved to the same positions as during refueling. In addition, the individual tank inlet valves are closed (overriding the tank-selector switches if necessary) to prevent accidental fuel transfer or recirculation. The quantity gages are deenergized. In PRE-CHK PRI the system is energized as in REFUEL and, in addition, power is supplied to one set of checkout solenoids in the tank dual float valves. Operation of the checkout solenoids closes the dual float valves. If placing the switch on the PRE-CHK PRI position stops fuel flow to the tanks, it is an indication that the dual-float valves are functioning normally and will automatically shut off flow when single point capacity is reached. PRE-CHK SEC performs the same test on the second set of checkout solenoids in the dual float valves. In the DRAIN position the drain pump is turned on and the drain valve, which allows the transfer of trapped fuel in the refueling manifold to the No. 3 internal tank, is opened. In OFF, the single point refueling system is isolated from the remainder of the fuel system. All circuits of the master switch are energized by 28-volt DC, through the refuel valves circuit breakers from the wheel well bus.

Tank-Selector Switches.

Eight tank-selector switches are located on the single point refueling control panel (figure 4-143). The switches are two-position (REFUEL, OFF) rotary switches that route 28-volt DC to the motor-driven refueling shutoff valves located in the supply lines to the fuel tanks. The external tank switches are not used.

Note

The master switch must be placed in REFUEL, PRE-CHK PRI, or PRE-CHK SEC position to energize the refueling relays before the tank-selector switches will function.

Ground Transfer Switch (Airplanes AF55-0029 and Up).

A ground transfer switch is located on the single point refueling control panel (figure 4-143). This two-position (GROUND TRANSFER, OFF) rotary switch controls the ground transfer valve. Twenty-eight volt DC is routed from the wheel well bus to the REFUEL and DE-FUEL positions on the master switch, to the ground transfer switch, then to the valve. Thus, the ground transfer valve may be opened only when the master switch is in either the REFUEL or the DE-FUEL position. In any other positions of the master switch, the ground transfer switch is bypassed, and the transfer valve is energized to the closed position.

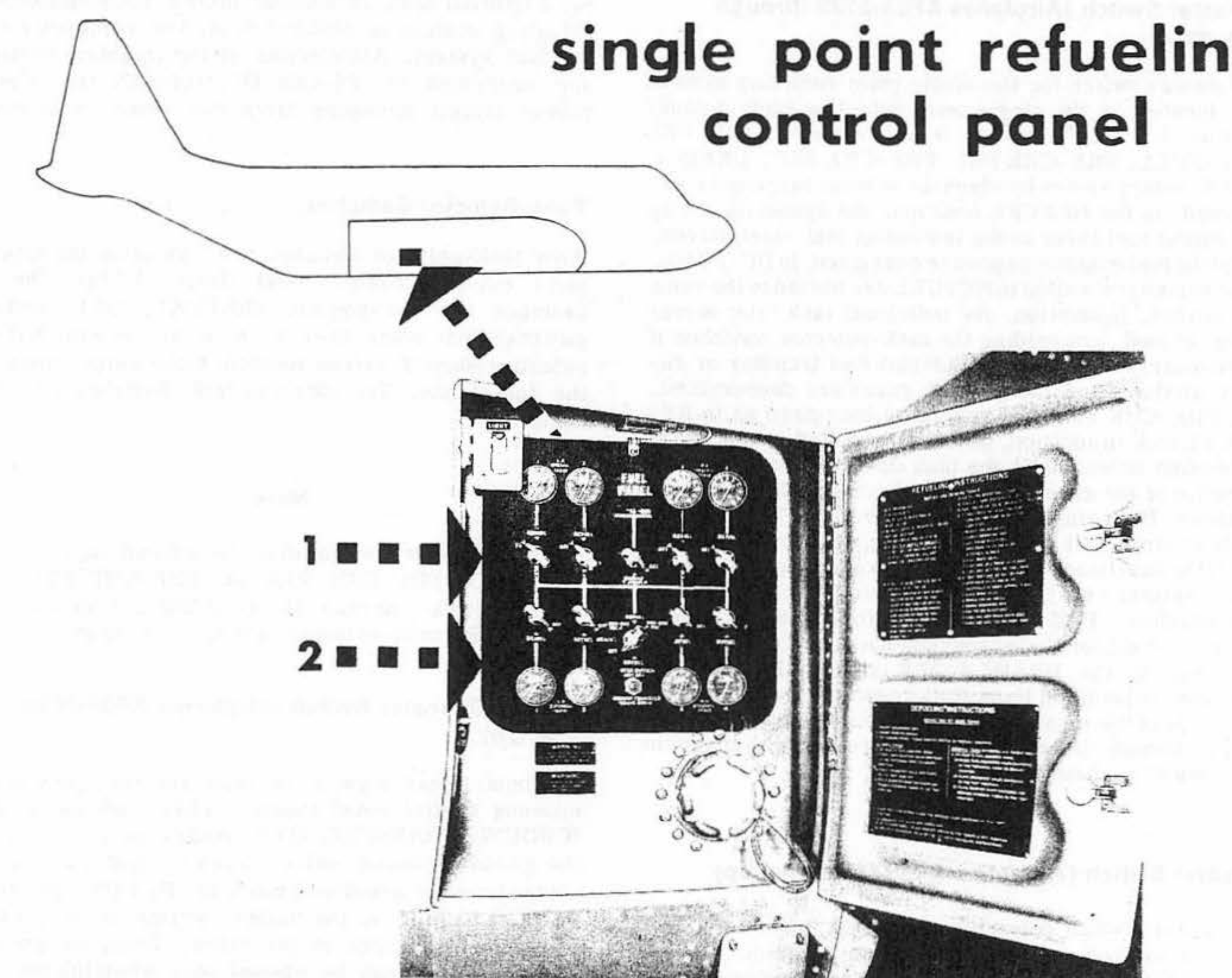
SINGLE POINT REFUELING SYSTEM INDICATORS.

Indicators for the single point refueling system are located on the fuel panel in the right wheel fairing.

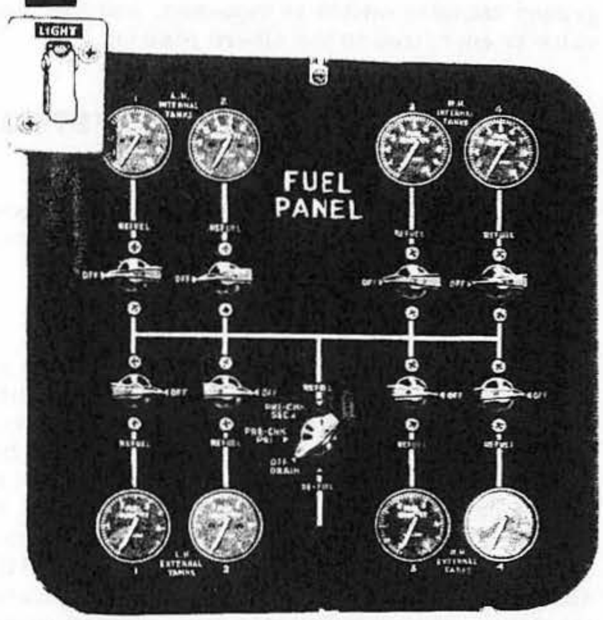
Fuel Quantity Indicators.

Eight fuel quantity indicators are located on the single point refueling control panel (figure 4-143). Each of the four internal tank indicators is electrically connected to a capacitance gage in a fuel tank and gives a visual indication, in pounds, of the fuel in that tank. The indicators are energized through the master switch when the switch is in the REFUEL, PRE-CHK PRI, or PRE-CHK SEC POSITION. Single-phase 115-volt 400-cycle AC to operate the quantity indicators is taken from the main inverter bus. Circuit protection

single point refueling control panel



1 AIRPLANES AF53-3129 THROUGH 55-0014



2 AIRPLANES AF55-0029 AND UP

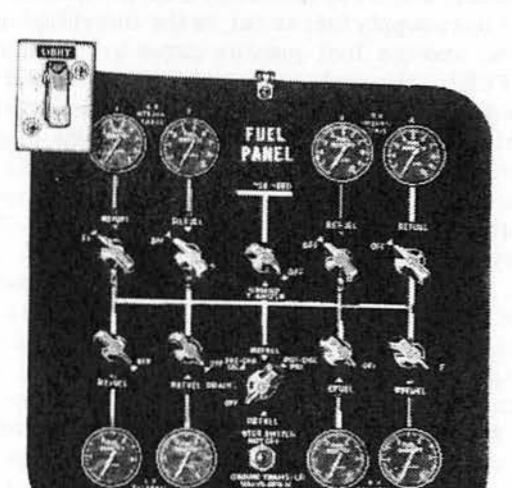


Figure 4-143.

is provided by the fuel quantity power units circuit breakers on the main power distribution panel.

Fuel Pump Warning Light (Airplanes AF55-0029 and Up)

A master switch not off ground transfer valve open warning light is located on the single point refueling control panel (figure 4-143). This warning light is illuminated when the master switch is in any position other than OFF. Also, in case of failure of the ground transfer valve in the open position (normally, turning the master switch to OFF closes the ground transfer valve) the light remains illuminated. The purpose of this light is to warn anyone closing the single point refueling door that the system is not in flight condition.

REFUELING, DEFUELING, AND FUEL TRANSFER OPERATIONS.

Note

Refer to the C-130A Maintenance Instruction handbook for refueling, defueling, and fuel transfer operations.

ANGLE OF ATTACK/STALL WARNING SYSTEM. (AIRPLANES MODIFIED BY T.O. 1C-130-708)

The angle of attack/stall warning system provides the pilot and copilot with a positive visual indication of the airplane's stall margin (V/Vs), and an audible warning of impending stall. The visual reference is provided by two indicator assemblies (pilot's and copilot's) mounted on the main instrument panel (figures 1-53 and 1-54). The color coded bands and reference points on the indicator scale represent specific angle of attack ranges and specific maximum performance indexes for controlling the airplane, especially during assault operations. These indicator calibrations are based on the known aerodynamic characteristics of the airplane as derived from flight tests. The audible warning of impending stall is accomplished by actuating a stall warning horn mounted at the bottom left of the main instrument panel. The angle of attack/stall warning system is intended to provide the pilot with a supplement to the presently available instruments for obtaining maximum airplane performance during assault operations. During maximum performance missions, use of the angle of attack/stall warning system as the flight reference in close-up stall maneuvers usually eliminates the need for constant checking of the airspeed indicator and performance data curves. It should be noted, however, that the basic aerodynamic characteristics and data, provided in T.O. 1C-130A-1-1, are valid and applicable with or without the operation of the angle of attack/stall warning system. Knowledge of the airplane's characteristics and limitations is essential to correct interpretation of system outputs and to enable corrective maneuvering of the airplane. The angle of attack/stall warning system consists of a wing transmitter assembly, a flap position transmitter assembly, a computer unit assembly, two indicator assemblies, an angle of attack and stall warning test switch function, a press-to-test continuity fault light, and a stall warning horn assembly.

WING TRANSMITTER ASSEMBLY.

The wing transmitter assembly (mounted on the leading edge of the right wing) is the sensing element of the angle of attack/stall warning system. It contains a movable vane mechanically coupled to the shaft of two tandem-mounted potentiometers. The vane senses and moves with the airflow pattern which varies with changes in wing angle of attack. The potentiometers translate the movement of the vane to corresponding electrical signals. The output signal of one potentiometer is applied to the angle of attack circuitry; the other potentiometer signal is applied to the stall warning circuitry.

FLAP POSITION TRANSMITTER ASSEMBLY.

The flap position transmitter assembly consists of two tandem-mounted rheostats. The rheostats are mechanically coupled to the wing flaps (Position Drive Coupling) so that the position of the rheostat wipers is determined by the position of the flaps. The rheostats provide the required electrical compensation into the system circuits to offset the aerodynamic influence of the flap position. The output of one rheostat is applied to the angle of attack circuitry, the output of the other rheostat is applied to the stall warning circuitry.

COMPUTER UNIT ASSEMBLY.

The computer unit assembly consists of four plug-in modules which contain the principle electric and electronic circuitry of the angle of attack/stall warning system.

Angle of Attack Circuit Module Assembly.

This module contains a bridge circuit which translates the electrical inputs received from the wing transmitter assembly and the flap position transmitter into an electrical signal. The signal output of the angle of attack circuit module assembly is applied to the indicator assemblies.

Stall Warning Circuit Module Assembly.

The stall warning circuit module assembly contains an electronic switch which activates the stall warning horn assembly. Whenever the level of the electrical signals applied to the module exceeds a threshold or predetermined level, the switch closes and 28 volts DC activates the stall warning horn. The signals applied to the stall warning circuit module assembly are received from the wing transmitter assembly and the flap position transmitter assembly.

Angle of Attack and Stall Warning Test Circuit Module Assemblies.

These two modules contain the necessary switching and circuitry to self-test the angle of attack/stall warning system. The modules, together with the angle of attack and stall warning test switch and the press-to-test continuity fault light, provide the system with a pre-flight or in-flight checkout capability.

INDICATOR ASSEMBLIES.

The pilot and copilot indicator assemblies are mounted above the main instrument panel glare shield. Each of the indicator assemblies is a damped DC-milliammeter with an illuminated scale. The scale is calibrated and color-coded to designated specific performance ranges of the C-130A airplane. With the system inoperative, the indicator pointer is positioned at 1.01 V_S on the scale. With power applied (airplane on the ground), the pointer rests at a point corresponding to the quiescent position of the wing transmitter assembly vane. During flight the pointer registers the airplane's angle of attack relationship to V/V_S sensed by the wing transmitter assembly.

Note

The 1.4 V/V_S reading is not to be used as an airspeed-V/V_S comparison point during the flaps-up condition.

ANGLE OF ATTACK AND STALL WARNING TEST PANEL.

The angle of attack and stall warning test panel mounted on the pilot's main instrument panel, consists of a spring-loaded, three-position switch with center off. When the switch is placed in the ANGLE OF ATTACK position (LEFT), the angle of attack circuitry is tested for function and calibration. If the system is operative, the pointers of both indicator assemblies should deflect to the center of the indicator scale (1.4 V_S ±1 pointer width) and the A/A TEST S/W fault indicator light should not light. Placing the switch in STALL WARNING position (RIGHT), enables the testing of the stall warning circuitry and stall warning horn assembly. If the stall warning system is operative the stall warning horn will be actuated and the A/A TEST S/W fault indicator light should not light. Failure to obtain a functional reaction or lighting of the A/A TEST S/W fault indicator light during a test indicates a malfunction in the circuitry being tested.

POWER DISTRIBUTION.

The angle of attack/stall warning system is supplied 28-volts DC from the airplane's RH wing bus. Power is applied to the system through four circuit breakers. Two of the circuit breakers supply the angle of attack and stall warning sections separately. The third circuit breaker supplies the deicing heater elements located in the wing transmitter assembly. The fourth circuit breaker supplies the angle of attack indicator lighting control. Power is applied to the system whenever the airplane's 28-volt RH wing bus is energized.

NORMAL FLIGHT OPERATION.

With the exception of manual operation of the wing transmitter assembly deicing circuit, the angle of attack/stall warning system is fully automatic. Precise information based on the airplane's angle of attack is continuously displayed on the pilot and copilot indicator assemblies and audible warning of impending stall is provided at a point predetermined to enable recovery maneuvers. During impending stall conditions, the pointer of the indicator moves towards the red stall warning bar on the scale. When the pointer reaches 1.1 V/V_S the stall warning horn is actuated. The actual stall point will occur when the indicator pointer reaches 1.0 V/V_S.

MISCELLANEOUS EQUIPMENT.

Miscellaneous equipment consists of windshield wipers, toilet and galley facilities, ladders, protective covers and alarm bells.

WINDSHIELD WIPERS.

Two electrically actuated windshield wipers are installed, one on the pilot's windshield panel and one on the copilot's windshield panel. The speed of the windshield wipers is controlled by a six-position (PARK, OFF, FAST, 2, 3, SLOW) rheostat-type windshield wiper control switch on the copilot's auxiliary control panel (figure 1-4). The windshield wipers are powered by 28-volt DC power through the windshield wiper circuit breaker on the flight station distribution panel.

Note

Windshield wipers are ineffective at airspeeds greater than 180 knots.

TOILET FACILITIES.

Toilet facilities consist of an urinal located to the rear of the right paratroop door.

GALLEY EQUIPMENT.

A galley (figure 1-1) is installed at the forward right-hand end of the cargo area and is equipped with two B-1 hot cups, two CNU-2/C insulated thermos jugs, and a cup dispenser containing 100 cups. A waste storage container is provided on the cargo floor in this area. Power to each thermos jug is controlled by a toggle switch located on the front of the galley. Each switch has ON and OFF positions. An indicator light, adjacent to each switch, illuminates when power is applied. Hot cup temperature is selected by individual rotary switches. Power supplied to the thermos jugs and hot cups is 115-volt, 400-Hz, singlephase ac supplied through the GALLEY POWER circuit breaker on the cargo compartment ac circuit breaker panel.

LADDERS.

An escape ladder is installed on the flight station aft bulkhead and a permanently installed ladder and hand rail are provided for access to the flight deck. One maintenance ladder, and one paratroop door ladder is provided. The maintenance ladder has no specific area in which to be stowed.

WARNING

With the escape ladders installed, it is impossible to exit the airplane from the center overhead cargo compartment escape hatch using the left side of the ladder.

RAMP SAFETY LANYARD

A safety lanyard, consisting of a reel-mounted cable with a loop in the end is installed at the aft left-hand side of the cargo compartment. This lanyard is provided for personnel safety, by securing lanyard to a belt or harness worn by personnel, when working in this area during flight.

PROTECTIVE COVERS.

Protective covers for the engine tailpipes are stowed in a container attached to the left side of the cargo compartment fuselage, next to the aft cargo door (figure 1-1). Protective covers for the engine inlet air ducts are stowed (figure 1-1) on the left and right sides of the cargo compartment. Protective covers for the pitot tubes are stowed in the miscellaneous stowage container on the floor aft of the flight station ladder.

CREW ENTRANCE DOOR

The aircraft is normally operated with the crew entrance door removed. A modified door (figure 4-144) may be installed for ferry flights.

WARNING

When operating the handle, stand clear of the door. This will prevent injury to personnel should the door fall free.

CAUTION

Do not enter the aircraft through the crew entrance door because of possible damage to TV/Laser equipment.

CAUTION

When opening the door from the inside, use the hand lanyard to restrain the door if it should fall free.

ALARM BELLS.

See EMERGENCY EQUIPMENT in Section I.

AIRPLANE/ARMOR/BALLISTIC CURTAINS

Armor plating and ballistic felt is installed in the aircraft for personnel security and protection of some vital aircraft components.

LIFE HISTORY RECORDER SYSTEM (MXU-553/A) (LHR), AIRPLANES

A life history recorder system (LHR) is installed which will obtain structural stress and airplane usage data for the purpose of more accurately predicting life expectancy of the airframe in support of the Aircraft Structural Integrity Program (ASIP). The recorder is located on the right side of the fuselage just aft of FS274.

The system consists of airborne elements: A recorder, converter-multiplier and various airplane sensors. Parameters monitored by these sensors are airspeed, altitude, normal acceleration, control surface positions, cabin pressurization, pitch and yaw rates, strain at various locations and certain taxi related parameters. 115-volt AC power is supplied to the recorder from the RH AC BUS and 28-volt DC power is supplied to the recorder from the MAIN DC BUS through the ASIP/LHR circuit breakers located on the main power distribution box.

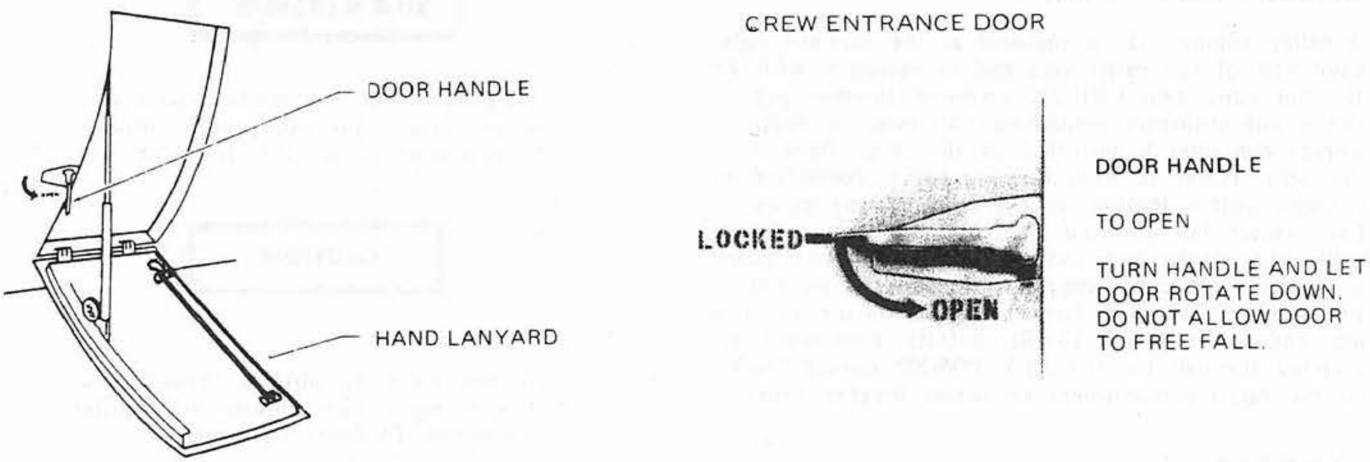


Figure 4-144.

DOCUMENTARY DATA SWITCHES

Twenty-four documentary data thumb wheel type switches, accessible through the lower hinged door, are provided to manually dial in pertinent documentary data (figure 4-145). Data is manually dialed in by the flight crew prior to taxiing for take-off and again after all taxiing has been completed. These switches are grouped in sets to record data as follows:

1. AIRCRAFT SERIAL NUMBER. - Dial in the last four digits of the airplane serial number.

2. Airplane GROSS WEIGHT. When gross weight is 1000,000 pounds or greater, dial in the first four digits of gross weight. When gross weight is less than 1000,000 pounds, the first digit dialed in will be zero, then dial in first three digits of gross weight. (Before and after flight.)

Note

First digit will always be zero if gross weight does not exceed 99,999 pounds.

3. FUEL WEIGHT. Enter fuel weight in hundreds of pounds, excluding fuselage benson tank fuel. When fuel weight is 10,000 pounds or greater, the first digit dialed in will be zero; then dial in first three digits of fuel weight. When fuel weight is less than 10,000 pounds, the first two digits dialed in will be zero; then dial in first two digits of fuel weight. (Before and after flight.)

4. BASE of ASSIGNMENT. Dial in zero zero (00).

5. MISSION. Dial in zero zero (00) since the mission will be automatically obtained from recorded data.

6. CONFIGURATION. Dial in 010 for C-130A airplanes or 020 for C-130D-6 airplanes.

7. Date, YR - MONTH - DAY. Dial in the zulu date on which the flight takes place. For single digits on month and day, precede the number with a zero.

RECORDER TAPE CARTRIDGE

A removable recorder tape cartridge, with a capacity to record 15 hours of data, is contained within the recorder. The tape cartridge is removed when full and shipped to the data processing facility. Installation/removal of the tape cartridge is accomplished by opening the upper hinge door of the recorder and depressing the center spring lock. If it is determined that inadequate tape remains for the flight, remove the existing cartridge and replace with a fresh one. Tape remaining may be read directly from the cartridge, in percent of usable hours, through a window (figure 4-145) located on the front of the recorder unit.

POWER SWITCH AND MOMENTARY ON SWITCH

A two-position (ON-OFF) switch is installed on the circuit breaker panel below the recorder. A spring loaded momentary ON switch is installed next to the power switch.

BUILT-IN-TEST BUTTON

A pres-to-test button, located on lower front of the recorder, is used to allow the system to perform a self test (figure 4-145). When the button is pressed, the recorder will self-test.

INDICATOR LIGHTS

There are four indicator lights on the lower front of the recorder (figure 4-145). These lights are decaled TEST, MUX, SUP DATA and REC. The function of

life history recorder system

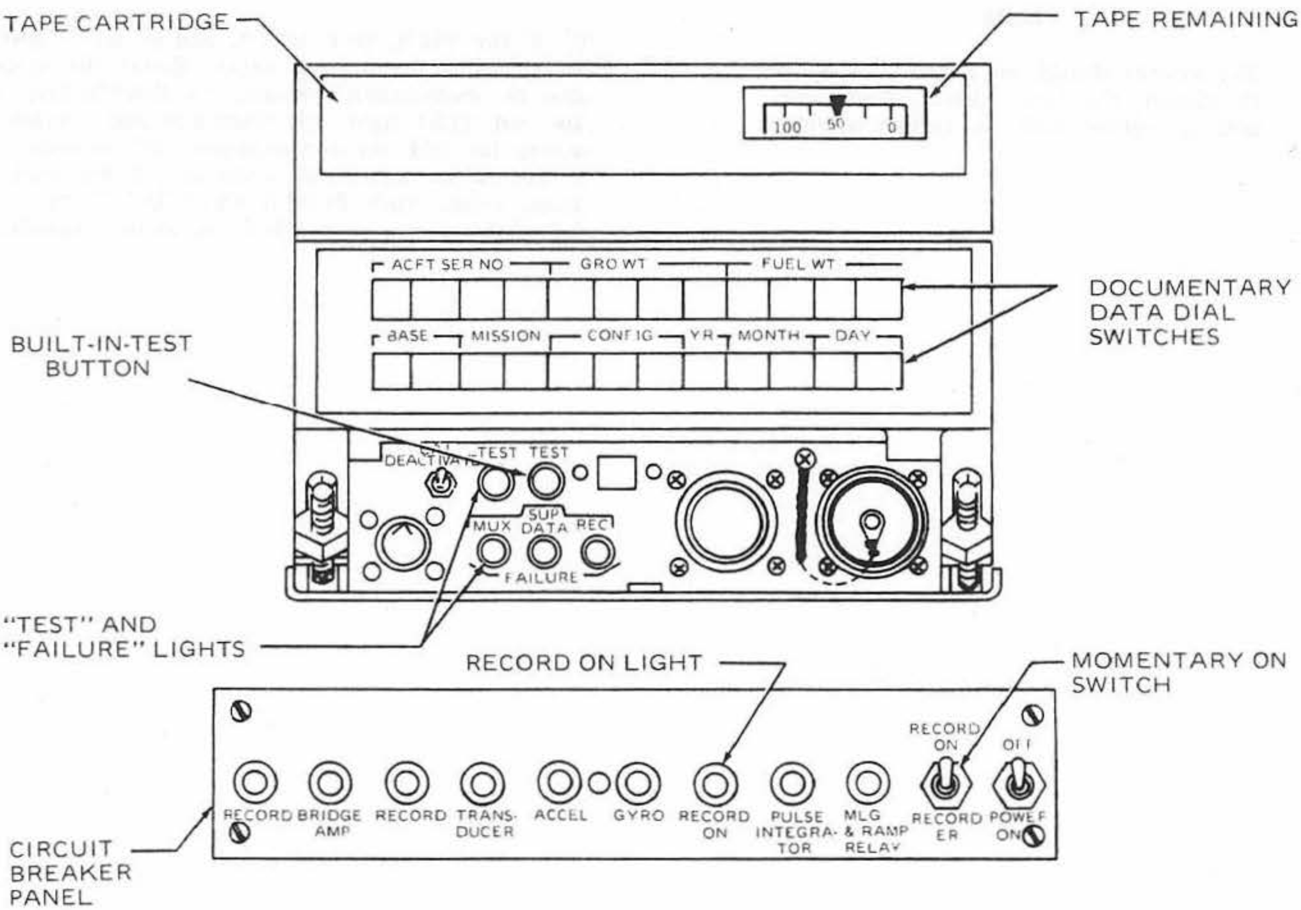


Figure 4-145.

the TEST light while illuminated is to indicate the recorder is performing a self-test. The function of the MUX, SUP DATA and REC lights if illuminated is to indicate that the system has a malfunction and to isolate the malfunction. A power on indicator light labeled RECORD ON is located on the recorder circuit breaker panel and remains illuminated during recorder operation.

OPERATIONAL CHECKOUT OF THE RECORDER SYSTEM

The operational checkout of the recorder will be accomplished by the flight crew after dialing in the pertinent data. Accomplish system check as follows:

1. Ensure tape cartridge is installed properly by firmly pressing the left and right hand corners of cartridge. Ensure remaining tape is adequate for flight.

2. Ensure all pertinent data has been dialed into the recorder.

3. Close both doors on the recorder and latch sec securely. The tape cartridge door must be closed as recorder will not operate because a built-in switch is closed by the upper door.

Note

CAL/DEACTIVATE switch on the recorder should remain in DEACTIVATE (UP) posi-ition at all times.

4. Ensure all circuit breakers are closed. Press to test RECORD ON light. Position the ON/OFF power switch to ON. Position the momentary ON switch to the UP position until the RECORD ON light remains illuminated.

5. Press TEST, MUX, SUP DATA, and REC lights for light bulb check. Approximately 30 seconds after Power Switch has been turned on, the red TEST light will illuminate. This light indicates that an automatic built-in-test (BIT) is being accomplished. This TEST light will last for approximately 20 seconds and will go out. If MUX, SUP DATA and REC lights do not illuminate, recorder system is now in a "GO" condition.

Note

The system should be allowed to operate throughout the taxi, takeoff, flight and landing regimes with no further attention.

6. If the MUX, SUP DATA, and/or REC light should illuminate, a malfunction exists. Retest the system again by momentarily pressing the Built-In-Test button. The red TEST light will illuminate and remain on during the BIT for approximately 20 seconds. If any of the failure lights still illuminate, a malfunction condition exists. Turn POWER SWITCH off. Maintenance will perform system checkout at earliest possible time.

SECTION V

operating limitations

PROP RESTRICTIONS ↔ SEE 5S-16

Table of Contents

INTRODUCTION.

This airplane has certain well-defined operational limitations. To obtain maximum performance requires careful consideration of these limitations. This section contains limitations which are not repeated elsewhere in the handbook, although specific references to this section will be found. Some limitations are shown as instrument markings (figure 5-1). Power plant limits, other than those included as instrument markings, are shown in figure 5-2. A summary of limitations is shown in figure 5-8.

MINIMUM CREW REQUIREMENTS.

The minimum crew required to operate this airplane is a pilot, copilot, and flight engineer. Additional crew members may be added, as required, at the discretion of the commander.

INSTRUMENT MARKINGS.

Flight and engine instrument markings are shown in figure 5-1 and are not repeated in text.

Note

The markings shown in this section are for flight station indications and are not to be confused with limits shown in the Handbook of Maintenance Instructions.

POWER PLANT LIMITS.

Operating time limits, allowable observed turbine inlet temperature ranges, engine speed limits, and oil pressure and temperature limits are tabulated in figure 5-2 and are not repeated in text.

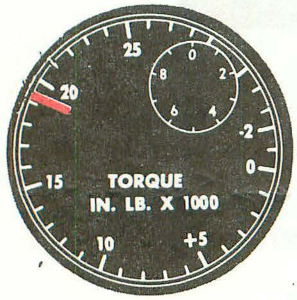
FUEL.

The fuels recommended for the T56-A-9 engine are Specification MIL-T-5624, JP4 and JP5. Mixing of these fuels with each other and with JP-3, or with NATO equivalents of these fuels is permissible. In this case, the mixture will be considered as the grade which predominates in the mixture, and all operations will be in accordance with the operating instructions for that grade. If fueling at a field where JP-4 and JP-5 are not available, certain other fuels may be used as alternate or emergency fuels (see figure 5-3).

TOP

instrument markings

NOTE Instrument markings should reflect the corresponding numerical values. Actual numerical values govern limitations.

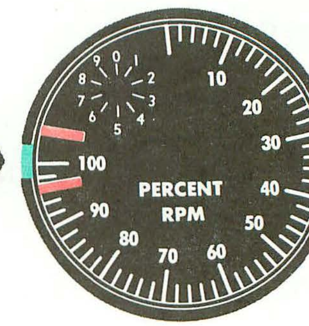


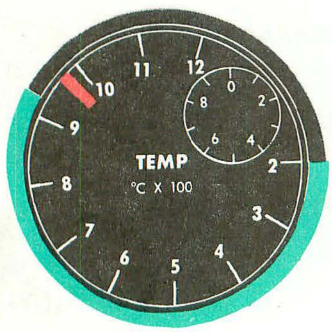
TORQUEMETER

- (red) 19,400 In. Lb. Maximum Allowable

TACHOMETER

- (red) 103 Pct Maximum Allowable.
- (green) 98 Pct To 102 Pct Normal
- (red) 97 Pct Minimum Allowable





TURBINE INLET TEMPERATURE

- (red) 977°C Maximum Allowable.
- (green) 200°C To 927°C Normal (Continuous).

OIL PRESSURE

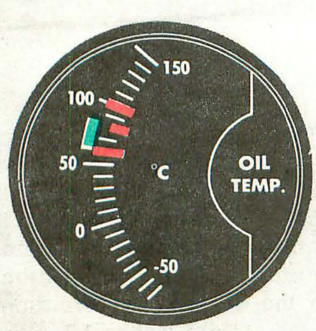
Both Power Section And Gear Section Oil Pressure Are Indicated On This Instrument: Power Section Pressure By The Front Pointer; Gear Section Pressure By The Rear Pointer.

POWER SECTION

- (red) 205 PSI - Maximum Allowable After Start and Warmup
- (red) 250 PSI - Maximum Allowable During Warmup
- (green) 185 To 205 PSI - Normal
- (red) 185 PSI - Minimum Allowable (100% RPM, Oil Temperature Normal)

GEAR SECTION

- (red) 250 PSI - Maximum Allowable Except During Start and Warmup at Temperatures Below 15°C
- (green) 120 To 250 PSI - Normal (Flt operation)
- (green) 130 - 250 PSI Normal (Ground operation) 100% Rpm, Temp. Normal
- (red) 130 PSI - Minimum Allowable (Ground Operation at 100% RPM, Temp. Normal)
- (red) 120 PSI - Minimum Allowable (Flight Operation)



OIL TEMPERATURE

- (green) 60°C To 85°C Normal.
- (red) 60°C Minimum
- (red) 85°C Maximum Continuous.
- (red) 85°C To 100°C Taxi Maximum. (30 Min.) And Inflight 5-Minute Maximum

FUEL GRADE
JP-4

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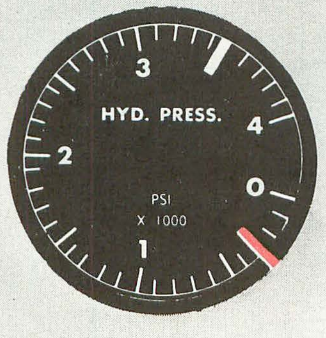
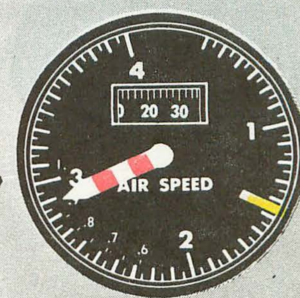
Figure 5-1. (Sheet 1 of 5)

TOP



BRAKE MODULATOR PRESSURE GAGE

[red] 300 PSI Minimum (Preload Air Charge)



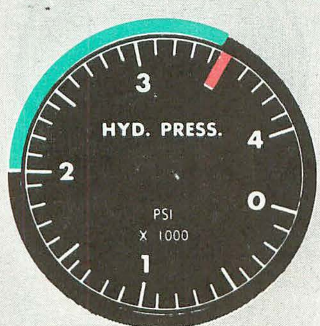
AIR SPEED

[yellow] Radial; 145 Knots Maximum Allowable With Full Flaps.

[red banded] The Red Banded Pointer Constantly Indicates The Structural Speed Limit At Sea Level.

NOTE: Disregard The Red Banded Pointer (Yellow Banded On Some Airplanes). Fly The White Pointer Using The Limits In This Section.

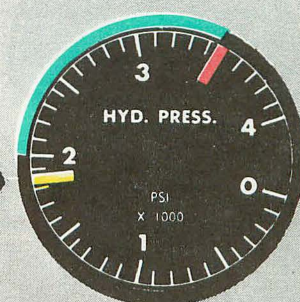
[white] The White Pointer (Not Shown) Shows Indicated Air Speed.



HYDRAULIC PRESSURE (Utility, Booster, and Emergency)

[red] 3,500 PSI Maximum Allowable.

[green] 2,000 PSI To 3,500 PSI Normal Operation. (2,900 PSI To 3,200 PSI Static Pressure)

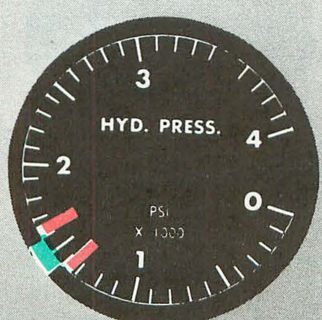


BRAKE PRESSURE (Normal and Emergency)

[red] 3,500 PSI Maximum Allowable.

[green] 2,000 PSI To 3,500 PSI Normal Operation. (2,900 PSI To 3,200 PSI Static Pressure)

[yellow] 1,850 PSI One Brake Application Remaining.



ACCUMULATORS

[red] 1,600 PSI - Maximum

[green] 1,400 To 1,600 - Normal

[red] 1,400 PSI - Minimum

FREQUENCY METER

[red] 380 Cycles Minimum Allowable.

[green] 380 Cycles To 420 Cycles Normal.

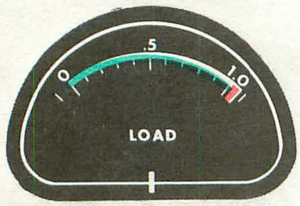
[white] 420 Cycles Maximum Allowable.

Figure 5-1. (Sheet 2 of 5)

TOP

AMMETERS (D-C GENERATORS)

- Red: 400 Amps Maximum Allowable.
- Green: 0 To 400 Amps Normal.



LOADMETERS (TRANSFORMER RECTIFIERS)

- Red: 1.03 Maximum Load.
- Green: 0-1.03 Normal Load.

VOLTMETERS (A-C GENERATORS)

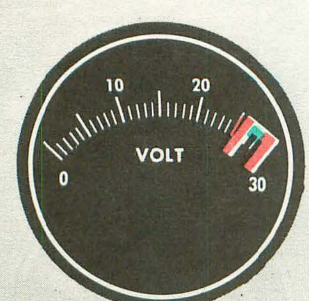
- Red: 110 Volts Minimum Allowable.
- Green: 110 Volts To 125 Volts Normal.
- Red: 125 Volts Maximum Allowable.

AMMETERS(ENG DRIVEN A-C GENERATORS)

- Red: 115 Amps Maximum Allowable.
- Green: 0 - 115 Amps Normal.

AMMETER (ATM A-C GENERATORS)

- Red: 83 Amps Maximum Allowable.
- Green: 0-83 Amps Normal



VOLTMETER (D-C GENERATORS)

- Red: 27 Volts Minimum Allowable.
- Green: 27 To 29 Volts Normal.
- Red: 30 Volts Maximum Allowable.

NOTE

DC Generators are Limited To 175 Amps For 45 Minutes, During Ground Operations, For Cooling Purposes.

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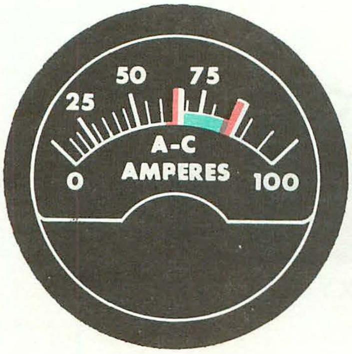
Figure 5-1. (Sheet 3 of 5)

TOP



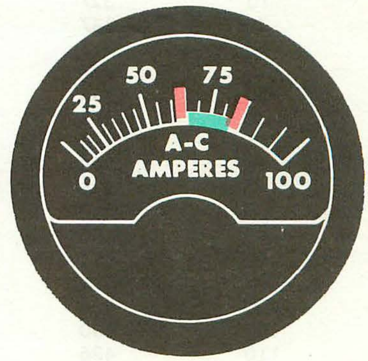
AMMETERS (PROPELLER SYSTEM DE-ICE A-C)

PROPELLER SPINNER BASE

- 65 Amps Minimum Sufficient.
- 65 Amps To 85 Amps Normal.
- 85 Amps Maximum Allowable.

PROPELLER BLADE

- 65 Amps Minimum Sufficient.
- 65 Amps to 85 Amps Normal.
- 85 Amps Maximum Allowable.

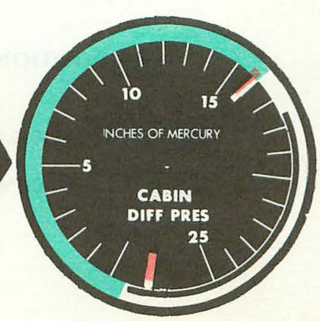


PROPELLER SPINNER NOSE

- 75 Amps Minimum Sufficient.
- 75 Amps To 100 Amps Normal.
- 100 Amps Maximum Allowable.

CABIN DIFFERENTIAL PRESSURE GAGE

- -1.2 In. HG Minimum Allowable.
- -1.2 In. HG To 15.8 In. HG Normal.
- 15.8 In. HG Maximum Allowable.

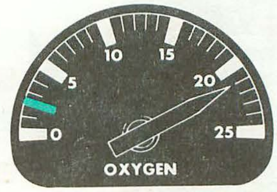


130A-1-33-167-4

Figure 5-1. (Sheet 4 of 5)

FIRE EXTINGUISHER SYSTEM

Temperature (°F)	GAGE READING MINIMUM	GAGE READING MAXIMUM
-30	288	348
-20	297	359
-10	307	369
0	317	379
10	327	389
20	337	399
30	347	410
40	357	420
50	368	432
60	378	443
65	384	449
70	390	455
75	395	460
80	400	467
85	406	473
90	412	479
95	418	486
100	424	492
105	430	498
110	436	505
115	442	511



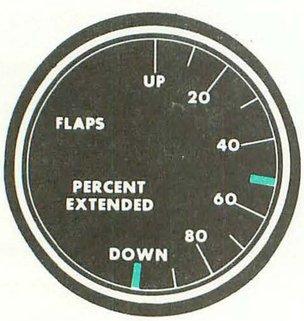
LIQUID OXYGEN QUANTITY

25 Liters (Full)

2.5 Liters (Minimum For Normal Use).

NOTE

IN CASE OF EMERGENCY, OXYGEN USAGE MAY BE CONTINUED UNTIL SYSTEM IS EMPTY.



FLAP POSITION

Flaps 50% Down

Flaps 100% Down

FUEL PRESSURE TEST INDICATOR

30 PSI Maximum Allowable Pressure.

20 To 30 PSI Normal

20 PSI Minimum Allowable Pressure.

NOTE

Markings Are For Ground Check Of The Fuel Boost Pump.

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Figure 5-1. (Sheet 5 of 5)

power plant limits

ENGINE CONDITION	TIT °C	RPM %	OIL PRESS (PSIG) R/G △1	OIL PRESS (PSIG) P/S △1	OIL TEMP °C	MAX INDICATED TORQUE - IN. LB
GROUND OPERATION						
START LIMITS	See sheet 2		Positive Oil Pr. Indication by 35% RPM		100 / -54 △	
GROUND IDLE	SEE 5-21	100.5 ~~102~~ / 93.5 ~~94~~	250 △4	250 Start And Warm Up Only / 205	85-100 For 30 Mins. Flight Idle and Below	Minimum until oil Temp Above 0°C
MAX. REVERSE		105.0 / 96.5			60 - 85	4,500 With Oil Temp Between 0° to 40°
FLIGHT IDLE	SEE 5-21	99.0 ~~100.5~~ / 92.5 △2	130	185 △3	-54 △6	
STABILIZED		100	130 △5		60° to 85°	
TAKE-OFF						
TAKE-OFF POWER 5 MINUTES	977 / 957	102 Except Momentary Surge / 98	250 / 130	205 / 185	85-100 For 5 Minutes / 40 and increasing	19,400 5 Minutes
FLIGHT OPERATION						
MILITARY (30 Mins.)	977 / 957	102	250	205	85-100 For 5 Mins. Then 85	19,400 30 Minutes
CLIMB	927				60 - 85	16,100
MAXIMUM CONTINUOUS	927	98	120	185	40 and Increasing	CONTINUOUS OPERATION

△1 UNDER STABILIZED CONDITIONS ALLOWABLE FLUCTUATION IS ± 20 PSI.

△2 INDICATED LIMITS FOR GROUND OPERATION ONLY. AT THE LOWER LIMIT FOR FLIGHT IDLE, ENGINE DRIVEN GENERATOR SHOULD STAY ON THE LINE AND BLEED VALVES MUST REMAIN CLOSED.

△3 160 PSI IS THE MINIMUM POWER SECTION OIL PRESSURE AT LESS THAN 100% RPM DURING GROUND OPERATION.

△4 250 PSI MAY BE EXCEEDED DURING START AND WARMUP WITH AMBIENT TEMPERATURES BELOW 15°C.

△5 OPERATION BELOW 130 PSI WHEN RPM IS BELOW 100% IS PERMITTED IF 130 PSI CAN BE MAINTAINED AT 100% RPM WITH OIL TEMPERATURE 60° TO 85°C.

△6 −54°C WITH MIL-L-7808 OIL
−40°C WITH MIL-L-23619

Figure 5-2. (Sheet 1 of 2)

START LIMITS - TIT

OVERTEMPERATURE DURING START

CONDITION	ACTION
TIT exceeds 830°C excluding: 1. Initial momentary overshoot 2. Momentary peak at 94 percent rpm.	Record in Form 781.
TIT exceeds 850°C (excluding momentary peak at 94 percent rpm).	Discontinue the start and record in Form 781. One restart is permitted after cooling to below 200°C TIT. If TIT exceeds 850°C on second start, discontinue start and record. Restart is not recommended.
CAUTION TIT exceeds 965°C.	Discontinue the start and record in Form 781. (An overtemperature inspection is required.

A torch other than normal enrichment burst requires an overtemperature inspection.

POWER ACCELERATION PEAK

TIT exceeds 977°C for more than 5 seconds or exceeds 1070°C momentarily.	Reduce power to hold temperature within limits. Record in Form 781. (Overtemperature inspection required before next flight).

PROPELLER GOVERNING LIMITS

NORMAL 98.0 - 102.0 percent. If a stable RPM cannot be maintained, excluding allowable cyclic variations of plus (+) and minus (-) 0.5% within normal operating limits (total of 1%), refer to Propeller Failures in Section III. (Cyclic variation of plus (+) and minus ( ) 0.5% is actually ½% on either side of a stable RPM for a total of 1%)
97% Minimum - Shut down engine.
103% Maximum - (Does not apply to momentary surges)

STARTER OPERATING LIMITS

1 minute ON, 1 minute OFF, 1 minute ON, 1 minute OFF, 1 minute ON, 30 minutes OFF.

POPOUT: BY 70% RPM.

PULLOUT: AT 72% RPM MAX.

NOTE
Underscored values on sheet 1 denote limits; values not underscored on sheet denote normal operating values. All limits on this figure are flight station limits and are not to be confused with maintenance manual limits

Power applications above 927°C (except for take-off) will be used only as an emergency requirement. A form entry, transcribing the amount of temperature and its duration, is required for each application above 927°C (other than take-off).

Figure 5-2. (Sheet 2 of 2)

The following defines fuel categorizations:

(1) Recommended Fuel: A fuel which has been determined through engine qualification testing to satisfactorily perform in affected engines under all conditions.

(2) Alternate Fuel: A fuel which can be used with a possible loss of efficiency. The use of this fuel might result in increased maintenance or overhaul cost. Limitation of significant nature such as reduced rate of climb, altitude, range, etc, properly places a fuel in the alternate category rather than recommended.

(3) Emergency Fuel: A fuel which will cause significant damage to the engine or other systems; and therefore, its use is limited to a one-time flight.

The fuels are listed below in order of preference:

(1) Recommended Fuels:
MIL-T-5624, JP-4 and JP-5.

(2) Alternate Fuels:

(a) Jet B (wide cut gasoline).

(b) Aviation gasoline (non-leaded grades 73 and 80 not containing TCP).

(c) JP-3.

(d) High flash point kerosene (JP-5 type).

(e) Kerosene fuels Jet A and Jet A-1.

(3) Emergency Fuels:

Aviation gasoline (leaded grades) 80/87, 100/130, and 115/145 not containing TCP.

See figure 5-3 for applicable specifications and NATO symbols for fuels that may be used in the T56-A-9 engine.

CAUTION

NATO fuels F-30 and F-42 should not be used if mission requirements necessitate operation in temperatures below -30° F. NATO fuels F-34 and F-44 should not be used if operating temperatures below -40° F are anticipated.

CAUTION

The presence of even relatively small quantities of TCP results in severe erosion, scaling, and pitting of the first stage turbine nozzle vanes and the turbine inlet thermocouples. Automotive gasoline is not acceptable due to the common use of TCP and a variety of other undesirable additives. The use of aviation gasoline containing tetraethyl lead (grades 80/87, 100/130, and 115/145) must be held to a minimum due to the heat absorbing quality of the lead coating which is deposited in the turbine section. If engines have operated an accumulated total of 50 hours on emergency fuels, the hot section of the engine must be inspected. Damage derived from use of alternate fuels will be determined during the next scheduled phase inspection. When aviation gasoline is used, decreased lubricity to all fuel components can be expected. Further, continued use of aviation gasoline will result in engine power loss and decreased engine operating efficiency.

The engine power available when using alternate or emergency fuels is not affected in electronic fuel scheduling since a specific turbine inlet temperature is scheduled for each throttle position. However, external temperature datum valve adjustment may be necessary for consistent engine starts when using alternate or emergency fuels.

CAUTION

When attempting a start with JP-5 and kerosene type fuels at ambient temperatures below -37°C (-35°F), the TIT and RPM should be closely monitored since stall and overtemperature may be experienced during the start.

HIGH RATES OF CLIMB.

High rates of climb may create a fuel boiling venting problem. The rate of climb should be restricted to the values shown in the following table, depending on the fuel used and the fuel temperature (all figures estimated).

Type of Fuel	Fuel Temperature, Start of Mission	Rate of Climb
Aviation gasoline and JP-3	80° to 90°F	Max. rate of climb to 30,000 ft. Above 30,000 ft, 300 ft/min.
Aviation gasoline and JP-3	90° to 100°F	Max. rate of climb to 24,000 ft. Above 24,000 ft, 300 ft/min.
Aviation gasoline and JP-3	100° to 110°F	Max. rate of climb to 18,000 ft. Above 18,000 ft, 300 ft/min.
Aviation gasoline and JP-3	110° to 120°F	Max. rate of climb to 14,000 ft. Above 14,000 ft, 200 ft/min.

fuel availability chart

NOTE

FUELS LISTED FROM TOP TO BOTTOM IN ORDER OF PREFERENCE

	MILITARY SPECIFICATION	FUEL GRADE	NATO SYMBOL	FREEZE POINT °F	COMMERCIAL DESIGNATION	BELGIUM	CANADA	DENMARK	FRANCE	GERMAN FEDERAL REPUBLIC	GREECE	ITALY	NETHER-LANDS	NORWAY	PORTUGAL	TURKEY	UNITED KINGDOM	UNITED STATES
RECOMMENDED FUELS																		
	MIL T 5624	JP-4	F-40	-76		*	*	*	*	*	*	*	*	*	*	*	*	*
	MIL-J-5624	JP-5	F-44	-55														*
ALTERNATE FUELS																		
HIGH FLASH POINT KEROSENE		JP-5B	F-42	-40			*		*	*			*				*	
KEROSENE			F-34	-40	JET A	*		*	*			*					*	*
			F-34 F-35 WITH FS II	-55	JET A-1				*						*		*	*
EMERGENCY FUELS																		
LEADED AVIATION GASOLINE	MIL-G-5572	80/87	F-12	-76	AvGas 80/87	*	*	*	*		*	*	*	*	*	*		*
	MIL-G-5572	100/130	F-18	-76	AvGas 100/130		*		*		*	*	*	*	*		*	*
	MIL-G-5572	115/145	F-22	-76	AvGas 115/145	*	*	*	*	*	*	*	*	*	*	*	*	*

130B-1-40-225

Figure 5-3

AVERAGE FUEL DENSITY VARIATIONS

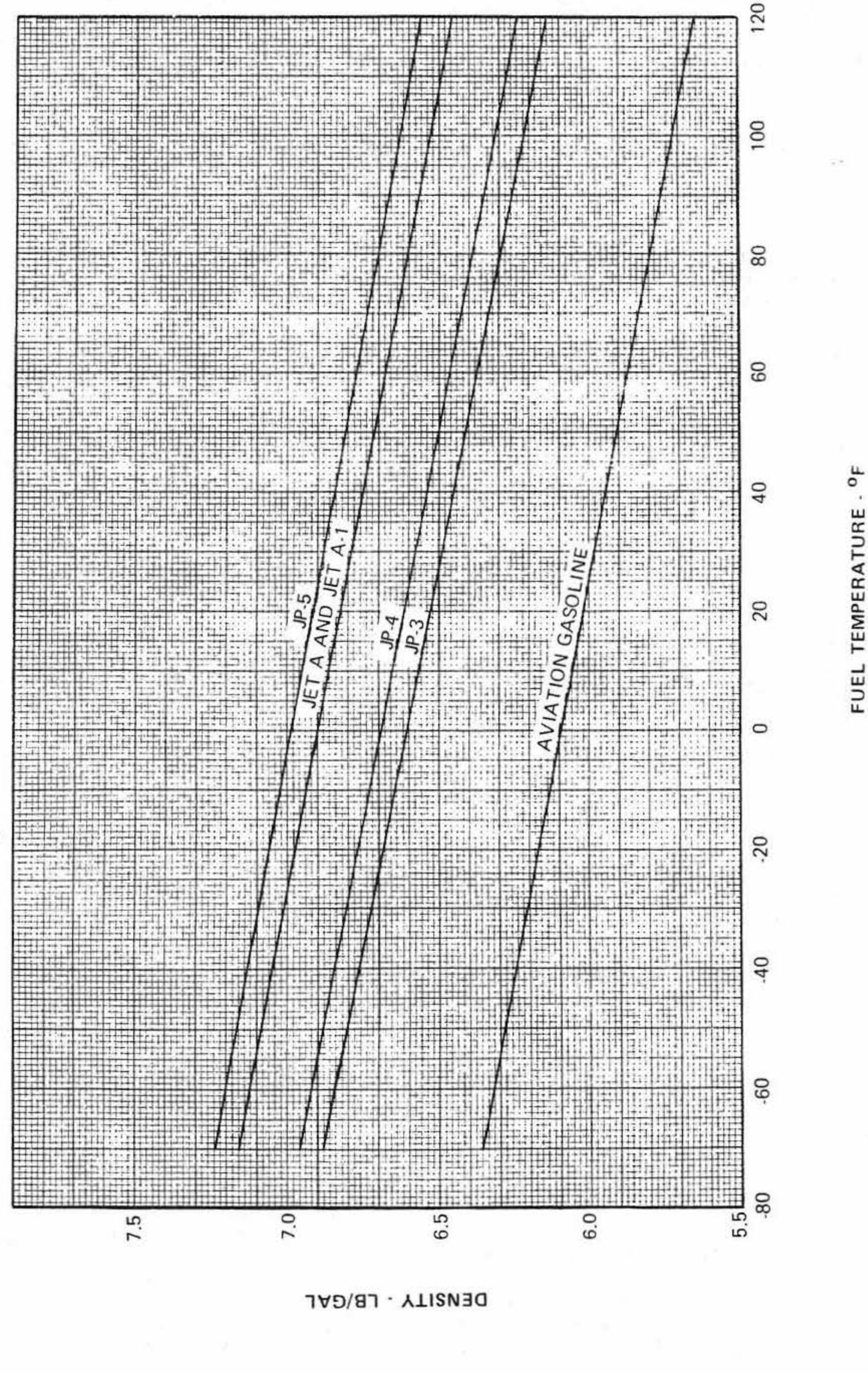


Figure 5-4.

Type of Fuel	Fuel Temperature, Start of Mission	Rate of Climb
JP-4	Up to 125°F	Not restricted.
JP-4	125°F to 135°F	Max. rate of climb to 29,000 ft. Above 29,000 ft. 300 ft/min.
JP-5	Up to 135°F	Not restricted.

When using high vapor pressure fuels, JP-3, and aviation gasoline, loss of fuel in climb can be incurred by boil-off, due to volatility, and by slugging.

Slugging occurs as a result of the fuel frothing, and departing vapors entrain large quantities of froth while spewing from the vents. Foaming tendencies are aggravated by high vapor pressures, low ambient pressures, high initial fuel temperatures, and high rate of climb.

Note

The presence of small quantities of aviation gasoline in turbine fuel can trigger foaming.

Loss of fuel due to boil-off and slugging should occur in a relatively short period following arrival at boiling altitude. All such losses should be assumed to occur during climb. As with JP-4, commercial jet fuels, and JP-5 turbine fuels are characterized by low volatility, therefore boil-off and slugging are considered unlikely. However, JP-3 and aviation gasoline have relatively high volatility, and boil-off and slugging are likely to occur under normal operating conditions.

The following table demonstrates the estimated loss of range due to boil-off when using JP-3 or aviation gasoline:

Fuel Temperature	Approximate loss of range when climbing to these cruise altitudes 25,000 Ft.	35,000 Ft.
125°F	12 percent	20 percent
110°F	8 percent	15 percent
90°F	3 percent	10 percent
70°F	0 percent	5 percent

EFFECT OF ALTERNATE FUEL ON RANGE.

The BTU content per pound of all fuels does not vary significantly, therefore, the range will depend primarily on the pounds of fuel aboard.

For a given volume of fuel, the approximate variation of range, using JP-4 as the basis for comparison, is: JP-5, 6 percent greater range; aviation gasoline, 8 percent less range; high flash point (NATO standardized F34-type), 4 percent greater range.

CAUTION

When using high density fuels do not exceed a maximum of 36,224 pounds wing tank fuel only or 42,364 pounds wing tank and pylon tank fuel. (see FUEL DISTRIBUTION EFFECTS in this section).

AIRSPEED LIMITATIONS.

The limiting airspeed for a mission is interrelated with the cargo weight and maneuver load factors required for the mission and the gust load that may be encountered in turbulence. Recommended and maximum airspeeds are shown on the Limit Flight Speed vs Altitude Chart of figure 5-5, sheet 1 or 2. These speeds are referenced to specific fuel-cargo combinations on the Weight Limitations Chart, figure 5-5, sheets 3 and 4, and to the allowable maneuver load factors. Any cruise speed up to the recommended speed may be utilized up to and including moderate turbulence.

Note

Operation in the areas between recommended speed limits and maximum speed limits is permissible for initiating penetrations from 20,000 feet at 250 knots provided the corresponding maneuver load factors are not exceeded.

CAUTION

Maximum speed limits should never be exceeded. Maneuver load factors and weight limitations (figure 5-5) should be carefully observed.

The airplane should not be operated in conditions of severe turbulence because gusts can be encountered that may impose excessive loads. However, if flight in severe turbulence cannot be avoided, flight should be in the range of 65 knots above power-off stalling speed for the operating gross weight. (See figure 6-1).

Never exceed the following indicated airspeeds for the condition noted:

1. MORE THAN 2,000 POUNDS OF PYLON TANK FUEL:

To prevent excessive loads in rough air when operating at gross weights of less than 115,000 pounds with more than 2,000 pounds of pylon tank fuel, the following airspeeds should not be exceeded:

Gross Weight	Airspeed (knots)
73,000 pounds	185
96,000 pounds	212
115,000 pounds	250

2. FLAPS EXTENDED:

Percentage	Airspeed (knots)
10	220
20	210
30	200
40	190
50	180
60	165
70	155
80	150
90	145
100	145

3. LANDING GEAR OPERATION:

Do not exceed 170 knots while the landing gear is being extended or retracted.

4. LANDING GEAR EXTENDED:

Do not exceed 170 knots with the landing gear extended

5. AFT CARGO DOOR AND/OR RAMP OPEN:

Do not exceed 150 knots with the ramp open. Do not exceed 185 knots with the aft cargo door open and the ramp closed.

6. PARATROOP AIR DEFLECTOR:

Do not exceed 150 knots when operating the paratroop air deflector or with the air deflector extended regardless of whether the paratroop door is open or closed.

7. PARATROOP DOOR:

Do not open paratroop door at speeds above 150 knots.

8. LANDING LIGHTS EXTENDED:

Do not exceed 170 knots during extension or retraction of landing lights or with landing lights extended.

9. PAINTED FLIGHT CONTROL SURFACES:

Do not exceed 250 knots when any flight control surface is painted, unless the following has been accomplished:

a. The underside of the ailerons and elevators and either side of the rudder have been stenciled as follows:

CAUTION

Subsequent repainting restricted to minor touch-ups unless performed at depot level.

OR

Only minor touch-up is authorized. Repaint in accordance with T.O. 1C-130A-2.

b. An entry has been made in the aircraft Form 781 that painting and rebalance have been accomplished in accordance with Work Specification 66-14, dated 16 Aug 65, or in accordance with T.O. 1C-130A-2 and T.O. 1C-130A-3.

ACCELERATION LIMITATIONS.

Never exceed the structurally safe maneuver load factor for the applicable flight conditions and for the airplane load distribution. The limit load factor for fuel load and cargo load combinations is given in the Weight Limitations Charts (figure 5-5 sheet 2). Since feel is often misleading, particularly when the pilot's attention is diverted or distracted, abrupt and unnecessary maneuvering must always be avoided.

LOAD FACTORS.

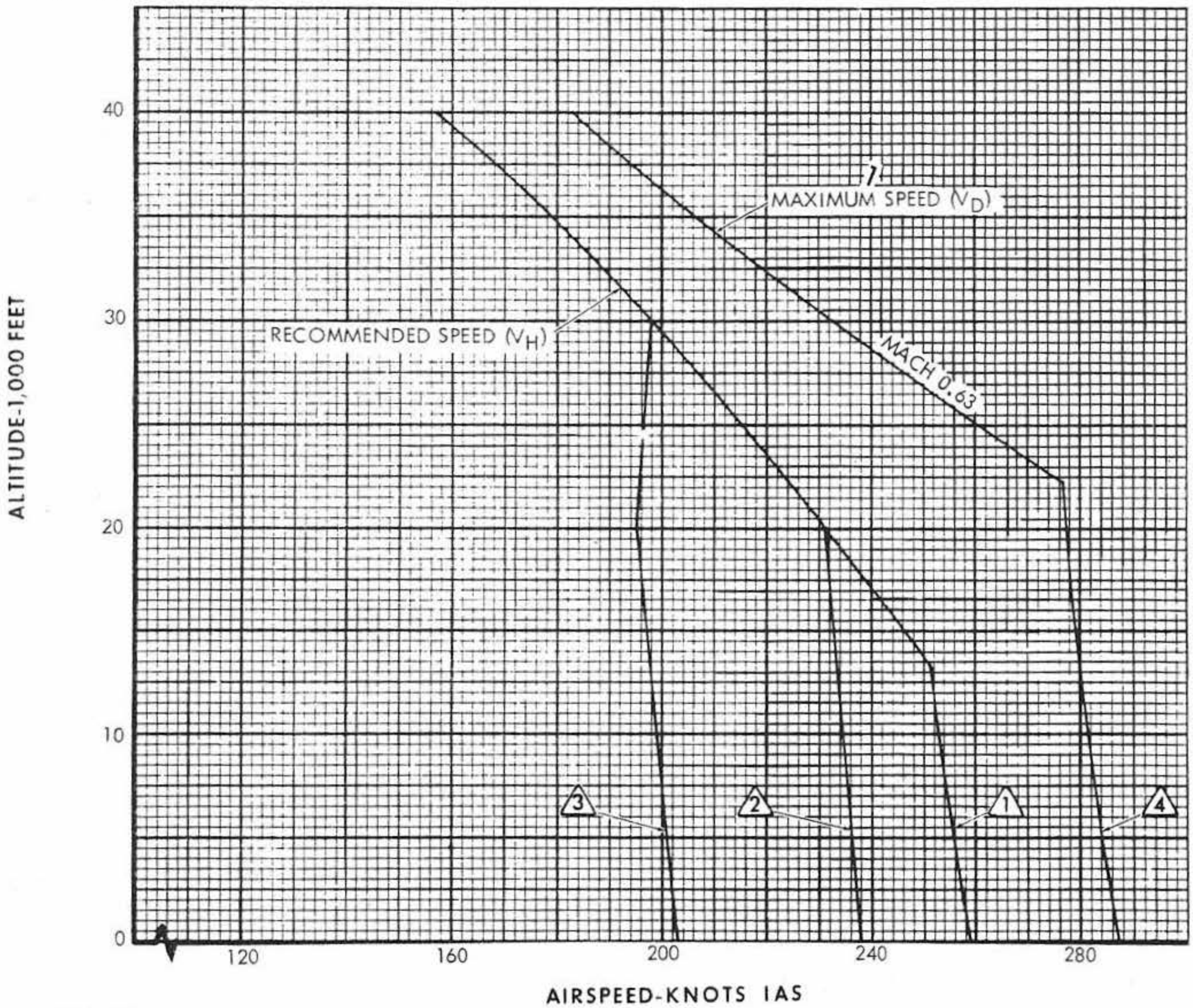
A load factor is the ratio of the load imposed on an object to the weight of the object. It is expressed in terms of g's, 1.0g being 1 times the weight of the object. The letter "g" stands for gravity, the accelerating pull the earth exerts on all objects. Since gravity is an acceleration, it is easy to understand that other types of acceleration also can produce load factors. The accelerations in which the pilot is most interested occur as a result of changes in his flight path, such as turns, pull-ups, and touchdowns on landings.

Because the airplane structure (particularly the wings) can only withstand certain maximum forces acting on it, it is necessary to limit the number of g's (the load

LIMIT FLIGHT SPEED vs ALTITUDE CHART

MODELS: AC-130A
ENGINES: T56-A-9

DATA BASIS: FLIGHT TEST



NOTE

RECOMMENDED SPEED

1. V_H. MANEUVER LOAD FACTOR LIMITS ARE -1.0G TO 3.0G. USE WITH AREA A OF SHEET 2 of 2.
2. V_H. MANEUVER LOAD FACTOR LIMITS ARE 1.0G TO 2.5G. USE WITH AREA B OF SHEET 2 of 2.
3. V_H. MANEUVER LOAD FACTOR LIMITS ARE 0.0G TO 2.0G. USE WITH AREA C OF SHEET 2 of 2.

MAXIMUM SPEED

4. V_D. MANEUVER LOAD FACTOR LIMITS ARE 0.0G TO 2.5G FOR AREAS A AND B OF SHEET 2 of 2 AND 0.0G TO 2.0G FOR AREA C OF SHEET 2 of 2.
5. FOR THUNDERSTORM OPERATION, REDUCE AIRSPEED TO 65 KNOTS ABOVE POWER-OFF STALL SPEED.
6. NORMAL PENETRATIONS UP TO 250 KNOTS IAS ARE PERMISSIBLE IN SMOOTH TO MODERATELY TURBULENT AIR BELOW 20,000 FEET.

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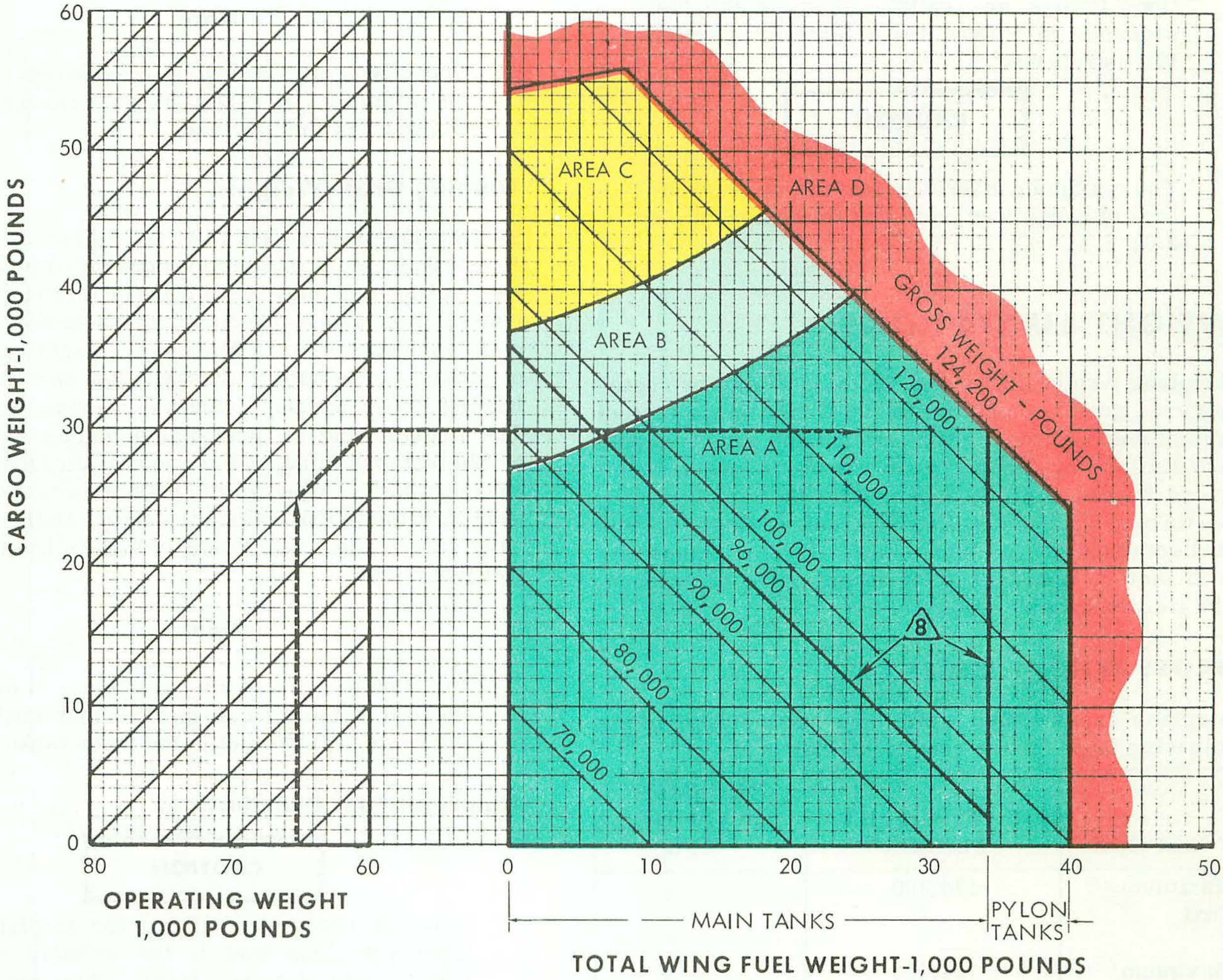
Figure 5-5 (Sheet 1 of 2)

WEIGHT LIMITATIONS CHART



AREA A - RECOMMENDED - CARGO-FUEL COMBINATIONS FOR 3.0G MANEUVER LOAD FACTOR WITH V_H ⚠1 OF SHEET 1.

AREA B - RECOMMENDED - CARGO-FUEL COMBINATIONS FOR 2.5G MANEUVER LOAD FACTOR WITH V_H ⚠2 OF SHEET 1.

AREA C - CAUTIONARY - PERMISSIBLE AT LOAD FACTORS UP TO 2.0G WITH V_H ⚠3 OF SHEET 1. EXCEEDING THE LIMIT LOAD FACTOR OR PERMISSIBLE AIRSPEED CAN RESULT IN STRUCTURAL DAMAGE TO THE AIRPLANE.

AREA D - NOT RECOMMENDED

NOTE CONTINUED:

7. THIS FIGURE IS BASED ON THE FUEL MANAGEMENT PROCEDURES IN SECTION VII AND ON THE STANDARD DAY DENSITY OF JP-4 (6.5 POUNDS/GAL.). IT IS PERMISSIBLE TO REFUEL THE AIRPLANE TO ITS VOLUME CAPACITY WITH JP-5 (STANDARD DAY DENSITY OF 6.9 POUNDS/GAL.).

⚠8 LANDING RATE OF SINK LIMIT IS 540 FPM UP TO 96,000 POUNDS GROSS WEIGHT, 420 FPM FROM 96,000 POUNDS TO 124,200 POUNDS GROSS WEIGHT, OR 300 FPM WITH EXTERNAL FUEL AT ANY GROSS WEIGHT.

130A-1-33-171-3.

Figure 5-5 (Sheet 2 of 2)

factor) which may be safely applied. A load factor in excess of these safety limits may result in structural damage to the airplane.

Note

The wing load factors on the Weight Limitations Charts are valid only when the fuel sequence in FUEL MANAGEMENT, Section VII, is followed.

CAUTION

The maximum maneuver load factor, regardless of cargo load, with any flap extension is 2.0g

WEIGHT LIMITATIONS.

Airplane weight limits may be divided into two categories - gross weight limits and limits on cargo-fuel weight combinations. Taxi and landing gross weights are limited by landing gear strength, and take-off gross weight is limited primarily by wing strength, performance, and handling characteristics. Cargo-fuel combinations, as functions of airspeed, maneuver load factor, and degree of atmospheric turbulence, are limited by wing strength.

GROSS WEIGHT LIMITS.

Airplane gross weight limits are summarized in the following table for the conditions indicated:

CONDITION	GROSS WEIGHT POUNDS	MAXIMUM RATE OF SINK
Maximum Taxi	124,200	
Maximum Take-off	124,200	
Maximum Landing	124,200	420 fpm without external fuel or 300 fpm with external fuel
Normal Landing	96,000	540 fpm without external fuel or 300 fpm with external fuel

Maximum Taxi Gross Weight.

Observe the limitations given in TAXI AND GROUND LIMITATIONS of this Section.

Maximum Take-Off Gross Weight.

Take-off gross weights must take into account the available runways, surrounding terrain, airfield elevation, atmospheric conditions, mission requirements, and the urgency of the mission.

Note

Gross weights exceeding those required for the mission will result in unnecessary risk and wear of the airplane.

Landing Gross Weights.

The airplane is designed to be able to land at any gross weight up to the maximum for take-off provided limiting relationships between landing gross weight, contact rate of sink, and fuel weight are observed. The airplane is designed for a maximum contact rate of sink of 540 feet per minute at gross weights up to the normal landing gross weight if the pylon tanks are empty. The airplane may be landed at a contact rate of sink of 420 feet per minute at the maximum landing gross weight, which is equal to the maximum take-off gross weight, if the pylon tanks are empty. With fuel in the pylon tanks, the contact rate of sink is limited to 300 feet per minute.

Note

The service life of the airplane will be increased if fuel is managed so that landings are made with no fuel in the pylon tanks.

Abnormal Fuel Distribution.

CAUTION

It is not recommended that the airplane be flown with less fuel in the outboard tanks than in the inboard tanks. The airplane should be flown with the outboard tanks empty only as an emergency measure.

If it becomes necessary to fly with the outboard tanks empty, the following load factors and speed limits apply unless they are further limited by maximum level flight speeds at high altitude, in this section:

GROSS WEIGHT (LB)	AIRSPEED	LOAD FACTOR
up to 83,000	Normal Operation	
83,000 to 90,000	230 KIAS	3g
90,000 to 100,000	210 KIAS	2.5g
100,000 to 107,000	200 KIAS	2.2g

If it is desired to fly with all or most of the fuel in the outboard tanks, the maneuver limitations of the Weight Limitations Chart apply.

FUEL UNBALANCE.

Because fuel tanks are located in the wings, it is important to maintain a balanced weight, within 1,500 pounds, between wings, However, the distribution should never vary more than 1,000 pounds between tanks 1 and 4. If fuel weight becomes unbalanced through varied rates of consumption or from having one engine shut down, periodic trimming is required. Also, 617 pounds more fuel should be maintained in each outboard tank than in each inboard tank. Fuel gages should be read while the airplane attitude is within ±3 degrees roll and 0 degrees nose-up pitch to obtain the most reliable readings.

WEIGHT LIMITATIONS CHART.

The Weight Limitations Chart, sheet 2 of figure 5-5, presents graphically the cargo carrying capability of the airplane as a function of wing fuel weight, maneuver load factor, airspeed, and operating weight.

The Weight Limitations Chart is divided into several areas which represent varying cargo capabilities with varying airspeeds and varying maneuver load factors. The chart shows, for a given cargo weight, the minimum fuel weight at which a selected maneuver load factor and airspeed may be utilized, with a further reduction in fuel weight requiring a reduction in maneuver load factor and airspeed.

Operating Weight Effects.

The cargo carrying capability of the airplane is determined for a specific operating weight which includes crew, oil, unusable fuel, and standard equipment, but does not include cargo and usable fuel. Since the operating weight of the individual airplanes will vary because of special equipment, variations in standard equipment, modifications, and other factors, the cargo weight must be adjusted accordingly by a pound-for-pound trade-off; that is, if 2,000 pounds of special equipment are added to an airplane, the cargo capability is reduced by 2,000 pounds. To facilitate accounting for a range of operating weights, an operating weight scale is shown on the left side of the Weight Limitations Chart.

NOTE

Gunship equipment can be considered as cargo weight to determine fuel load and maneuver load factor limitations. For example, an operating weight of 83,000 lbs could be composed of a combination of theoretical operating weight of 68,000 lbs with fixed cargo weight of 15,000 lbs.

Any other combinations that represent the actual operating weight of the aircraft are acceptable for chart use within the limitations of the chart scales.

Fuel Distribution Effects.

The Weight Limitations Charts and the Limit Flight Speed Chart are based on JP-4 fuel at the standard day density of 6.5 pounds per gallon. Starting with fully serviced main tanks and assuming equal flow rates from each tank, a difference of 617 pounds more fuel in each outboard tank than in each inboard tank will be maintained. The lines separating area A, B and C on the Weight Limitations Charts are based on this difference being maintained. By using the fuel sequence given under FUEL MANAGEMENT in Section VII, this difference of 617 pounds will be maintained or exceeded.

For flight , this distribution helps reduce wing upbending by maintaining a spanwise center of gravity of the fuel that is outboard of the center of lift on the wing. Increasing or decreasing the differential fuel weight between the outboard and inboard tanks increases or decreases the cargo capability shown on the Weight Limitations Chart.

Although the Weight Limitations Charts are based on JP-4 fuel at the standard day density of 6.5 pounds per gallon, it is permissible to refuel the airplane to its volume capacity with JP-5 fuel having a standard day density of 6.9 pounds per gallon. Fuel volume capacities are shown in the Fuel Quantity Data Table, Section I. Do not exceed the following fuel weights per tank:

Tank 1 or 4	9,384 pounds
Tank 2 or 3	8,728 pounds
Pylon or Wing Auxiliary Tank	3,070 pounds

Recommended Loading Areas.

The Weight Limitations Chart, figure 5-5, has two areas of recommended cargo-fuel combinations, provided the associated limits on maneuver load factor and airspeed are observed. These recommended areas are shown in green. Area A represents those cargo-fuel combinations for which the maximum maneuver load factor is 3.0g at speeds up to the highest recommended speed, V_H △1 on sheet 1 of figure 5-5. Area B represents those cargo-fuel combinations for which the maximum maneuver load factor is 2.5g and, to preclude excessive forces due to turbulence, the recommended speed is V_H △2

Cautionary Loading Area.

A cautionary area, area C, is shown in yellow on the Weight Limitations Chart. This area includes those cargo-fuel combinations which are permissible, but which require extra caution to avoid damaging the airplane during flight. Cargo-fuel combinations in area

C require that the maximum maneuver load factor be limited to 2.0g and the recommended speed be reduced to V_H △3 .

Loading Area Not Recommended.

The red area, area D, of the Weight Limitations Chart is composed of cargo-fuel combinations which present a high degree of risk of structural damage. Under conditions of extreme emergency when the risk of damage to the airplane is secondary, the Commander will determine if the degree of risk warrants operation of the airplane at loadings appearing in the red zone. Cargo weights in the red area at the top of the chart represent a high risk of damage during flight; if used, the maximum maneuver load factor is 2.0g and flight through severe turbulence is prohibited. Exceeding the maximum gross weight shown on the chart imposes a high risk of damage to the landing gear and supporting structure during taxi.

Note

> Whenever flights are conducted at weights shown in the red area of the chart, entry in Form 781 is required.

Using the Charts.

The following examples illustrate the use of the Weight Limitations Chart. Example 1 illustrates the method of determining recommended airspeed and maneuver load factor when cargo and fuel weights are established by mission requirements. Example 2 illustrates the use of the charts to determine recommended cargo weight when gross weight is limited by field length and fuel weight is established by mission requirements. Example 3 shows the determination of minimum fuel at flight termination to attain a required airspeed and maneuver load factor.

Example 1:

PROBLEM: Determine the maneuver load factors and airspeeds recomended for an AC-130A mission transporting 25,000 pounds of cargo with a required fuel load of 25,000 pounds. The operating weight is 65,000 pounds.

SOLUTION: Enter sheet 2 of figure 5-5 at 65,000 pounds operating weight and move vertically up to 25,000-pound cargo weight line. From this point, move parallel to the diagonal operating weight guide lines until intersecting the minimum operating weight. From this point, move horizontally to the right until intersecting the 25,000-pound fuel line. Note that this point is in area A. The airplane can be operated in area A at a 3.0g maneuver load factor and V_H △1 speeds of sheet 1. Fuel burn-off causes the fuel weight to move to the left. To operate with a 3.0g maneuver load factor, 7,700 pounds of ballast fuel must be maintained; however, if maneuver load factor can be reduced to 2.5g the operation then can be continued into area B with V_H △2 speed of sheet 1.

Example 2:

PROBLEM: Determine the amount of cargo which can be carried in an AC-130A airplane when field length restricts gross weight to 117,000 pounds and the mission requires 30,000 pounds of fuel. The operating weight is 68,000 pounds.

SOLUTION: Enter sheet 2 of figure 5-5 on the fuel weight scale at 30,000 pounds, and move vertically until the gross weight line of 117,000 pounds is reached. Then move horizontally to the left until the minimum operating weight line is reached. From this point, move parallel to the diagonal lines (that run from the minimum operating weight to the maximum operating weight) until the operating weight of 68,000 pounds is reached. Then, move horizontally to the left, and read the cargo weight of 19,000 pounds permissible for the mission. Note that for this mission, the airplane may be operated at V_H △1 and at a maneuver load factor of 3.0g.

Example 3:

PROBLEM: Determine the minimum amount of fuel required for an AC-130A airplane at flight termination for a 2.5g maneuver load factor when transporting 28,000 pounds of cargo. Also, determine the maximum fuel for take-off that allows operation in the green area. The operating weight is 72,000 pounds.

SOLUTION: Enter sheet 2 of figure 5-5 on the operating weight scale at 72,000 pounds, and move vertically until the 28,000-pound cargo weight line is reached. From this point move parallel to the diagonal operating weight guidelines until the minimum operating weight line is intersected. Then move horizontally to the right to the intersection of the recommended 2.5g area (area B). From this point, first move vertically down, and read the required minimum fuel of 8,300 pounds. Then, move horizontally to the edge of the green area (at the gross weight of 124,200 pounds) and then move vertically down to read the maximum fuel for take-off of 24,200 pounds.

CENTER OF GRAVITY LIMITATIONS.

The location of the center of gravity for any gross weight configuration, determined from T.O. 1-1B-40, Handbook of Weight and Balance Data, must fall within the percent of the mean aerodynamic chord (MAC) shown on the Center of Gravity Limitations Chart (figure 5-6). These limitations represent the combined structural, aerodynamic, and control limitations that must be observed to obtain safe and effective airplane performance. For information and method of calculating the airplane center of gravity, refer to T.O. 1C-130A-9, Cargo Loading Handbook, and T.O. 1-1B-40, Handbook of Weight and Balance Data.

If a landing must be made with the center of gravity forward of the normal limit, use 50 percent flaps, airspeed for a normal 50 percent flap landing, maximum reverse thrust, and minimum wheel brakes.

PROHIBITED MANEUVERS.

Aerobatics of any kind, including intentional spins, power-on stalls, and any other maneuvers which result in abrupt or excessive acceleration, are strictly prohibited. Do not exceed a 60-degree angle of bank with flaps retracted or a 45-degree angle of bank with flaps extended. Do not make hard rudder kicks that result in large angles of yaw.

RAMP LOADING LIMITATIONS.

High positive-maneuvering load factors require a download on the empennage which becomes greater as the center of gravity moves forward. These loads, along with the downloads of cargo on the ramp, develop critical stresses in the fuselage around the area of the paratroop doors. These stresses may be limited to safe levels by limiting the maneuver load factor to 2.5g, by restricting the forward center of gravity, or by limiting the cargo on the ramp. For missions requiring maneuver load factor capability between 2.5g and 3.0g, the most forward center of gravity must be restricted as a function of ramp cargo as shown by the Center of Gravity Limitations chart, figure 5-6, or, alternately, the cargo on the ramp must be limited as a function of airplane gross weight and center of gravity.

Note

Because of fuselage structural limitations, 5,000 lbs is the maximum ramp cargo load.

TAXI AND GROUND LIMITATIONS.

CAUTION

When operating at forward areas and substandard airfields and mission completion is not jeopardized, outboard engines may be shutdown during taxi to curtail FOD.

Taxiing over rough terrain should be avoided. If this is unavoidable, extreme caution must be exercised and very low taxi speeds observed. Do not exceed the following taxi speeds, regardless of runway conditions:

5 knots with nose gear deflected 60 degrees.

20 knots with nose gear deflected 20 degrees.

With fuel in the pylon tanks, the taxi speed should not exceed 20 knots.

Note

For taxi limitations on substandard airfields, see SUBSTANDARD AIRFIELD OPERATIONS.

BRAKING LIMITATIONS.

CAUTION

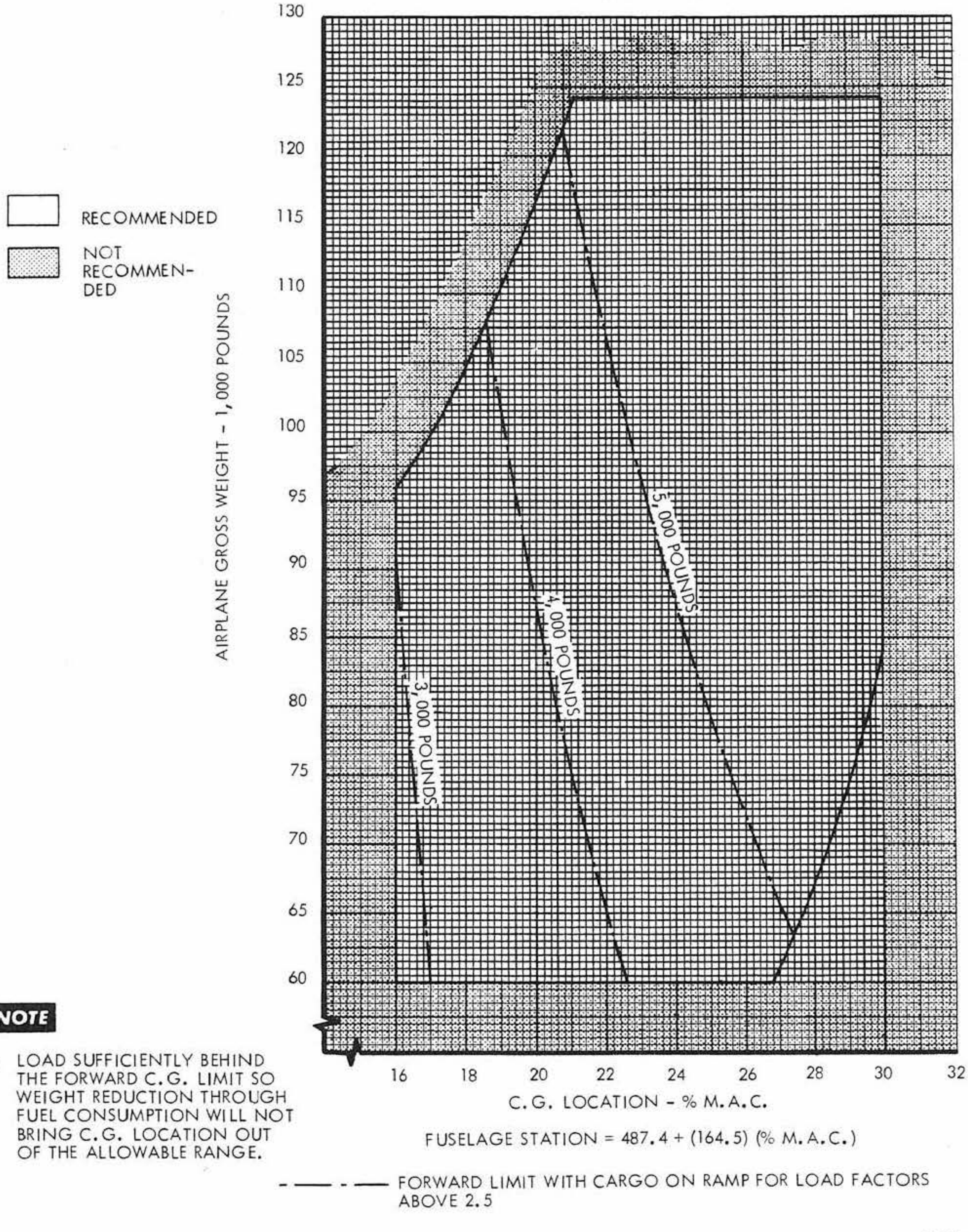
Avoid turns with brakes locked on one side to prevent damage to the tires or the main landing gear and supporting structure. Avoid braking in turns at any taxi speed, since damage to the nose landing gear and supporting structure may result. If hard braking is required during a turn, record it in Form 781.

If maximum braking has been used in landing, it is recommended that the gear be left extended after subsequent take-off for a minimum of 15 minutes before retraction or before another braked landing is attempted. The parking brakes should not be set if the airplane is parked subsequent to such a landing, and the airplane should be taxied using the minimum amount of brakes necessary for safety.

CAUTION

After the brakes have been heated by excessive use, the airplane should not be taxied into a crowded parking area, nor should the parking brakes be set. Peak temperatures occur in the brake assembly (trimetalic or single disc) from approximately 1 to 5 minutes and in the wheel and tire assembly (magnesium or aluminum) from approximately 20 to 30 minutes after a maximum braking action. To prevent brake fire and possible wheel assembly explosion, follow the procedure for cooling brakes.

center of gravity limitations



NOTE

1. LOAD SUFFICIENTLY BEHIND THE FORWARD C.G. LIMIT SO WEIGHT REDUCTION THROUGH FUEL CONSUMPTION WILL NOT BRING C.G. LOCATION OUT OF THE ALLOWABLE RANGE.

Figure 5-6.

GROUND FLOTATION CHARACTERISTICS CHART.

The ground flotation characteristics chart (figure 5-7) is provided for generalized operational planning. This chart permits matching the load that the airplane imposes on an airfield to the strength capability of the airfield. Ground flotation characteristics are correlated for the following five methods of evaluating airfield/runway strength:

FOOTPRINT LOADING (PRESSURE).

For operational planning purposes footprint loading is the same as tire inflation pressure. Figure 5-7 shows tire pressure values versus gross weights for normal operation from either high strength airfields or marginal strength airfields.

UNIT CONSTRUCTION INDEX (UCI).

UCI values are used to determine relative flotation characteristics of comparative aircraft and are seldom used in operational planning.

EQUIVALENT SINGLE WHEEL LOAD (ESWL).

Values of ESWL are determined from the geometry of the multiple wheeled landing gears, the number and size of the tires, and the airplane gross weight. Where airfield strength data are given in terms of ESWL, values of UCI and LCN can be calculated from these values of ESWL when required.

LOAD CLASSIFICATION NUMBER (LCN).

When LCN airfield strength data are used (primarily outside the United States) the data shown on the ground flotation chart can be used to estimate the capability of the airplane to operate from a given airfield.

CALIFORNIA BEARING RATIO (CBR).

Values of CBR shown in figure 5-7 represent the required airfield surface hardness for operation of the airplane in terms of gross weight and number of passes. Only unpaved surfaces (dirt, grass, gravel, coral, etc.) can be evaluated in terms of CBR.

AIRFIELD CONDITIONS.

High Strength Airfields.

Where airfield/runway strength data are available in terms of any of the methods shown in figure 5-7, the chart should be used as a guide to airfield-airplane compatibility. Where airfield/runway data are not available, the airplane can operate satisfactorily from most smooth, relatively-hard surface airfields. Permanent type (paved) airfields listed in the USAF/USN Flight Information Publications are adequate for most operations. For normal operation, tire pressure for high strength airfields from figure 5-7 should be used.

Marginal Strength Airfields.

This category includes marginal strength airfields, temporary airfields such as airfields with minimum surfacing, or unsurfaced airfields such as would be encountered as forward area airfields used in airhead operations or airfields in remote areas of the world. The minimum soil strength required for operation of C-130 type airplanes is within the CBR values of 3 to 5. Operational feasibility on unsurfaced airfields depends upon the type soil, soil moisture content, and operational frequency. For marginal strength airfields, use tire pressure as shown in figure 5-7.

CAUTION

Do not use tire pressures less than those for marginal strength airfields.

EXAMPLES OF USE OF CHARTS.

Example 1:

GIVEN: A C-130 type airplane is required to operate into a thinly surfaced, marginal strength runway where C-130 type airplanes have never been operated. C-119 airplanes have operated into this runway.

FIND: The allowable gross weight which will impose the same load on the runway as the C-119 airplane.

SOLUTION: Read a UCI of 26 for the C-119 airplane. Enter the left side of the chart at a UCI of 26 and proceed horizontally to the UCI line. Then proceed vertically downwards to read 120,000 pounds gross weight for the C-130 airplane. From the chart, also read a tire pressure of 66 PSI for operation on a marginal strength runway.

Example 2:

GIVEN: A C-130 type airplane is required to operate into an unsurfaced airfield with a gross weight of 110,000 pounds.

FIND: Footprint loading and ESWL for soft field operation.

GROUND FLOTATION CHARACTERISTICS

COMPARATIVE AIRPLANE DATA		
AIRPLANE	WEIGHT (LB)	UCI
C-47	33,000	18
C-119	74,000	26
C-54	82,000	27.2
C-124	170,000	30.2
P-2	64,900	33.2

NOTE:

1. FOR SOFT FIELD OPERATION, REDUCE THE VALUES OF ESWL AND UCI BY 10 PERCENT.
2. LCN ARE BASED ON LOWER TIRE PRESSURE WITH TIRE DEFLECTION APPROXIMATELY 39 PERCENT ASSUMING RIGID PAVEMENT STIFFNESS OF φ =30 AND FLEXIBLE PAVEMENT THICKNESS OF 20 INCHES OVER CBR 6.
3. SOIL STRENGTH IS BASED ON LOWER INFLATION PRESSURE.

AC-130A MAIN TIRES 20.00 - 20/22 PR

Aircraft Gross Weight (Pounds)	High Strength Airfields Pressure (PSI)	Marginal Strength Airfields PRESSURE (PSI)
Up to 90,000	55 ± 5	47 ± 5
90,000 - 100,000	64 ± 5	53 ± 5
100,001 - 110,000	73 ± 5	59 ± 5
110,001 - 120,000	82 ± 5	65 ± 5
120,001 - 130,000	91 ± 5	72 ± 5

AC-130A Main Tires 20.00 - 20/26 PR

Aircraft Gross Weight (Pounds)	High Strength Airfields Pressure (PSI)	Marginal Strength Airfields Pressure (PSI)
Up to 90,000	63 ± 5	57 ± 5
90,000 - 100,000	69 ± 5	60 ± 5
100,001 - 110,000	75 ± 5	63 ± 5
110,001 - 120,000	81 ± 5	66 ± 5
120,001 - 130,000	87 ± 5	69 ± 5
130,001 - 140,000	93 ± 5	73 ± 5

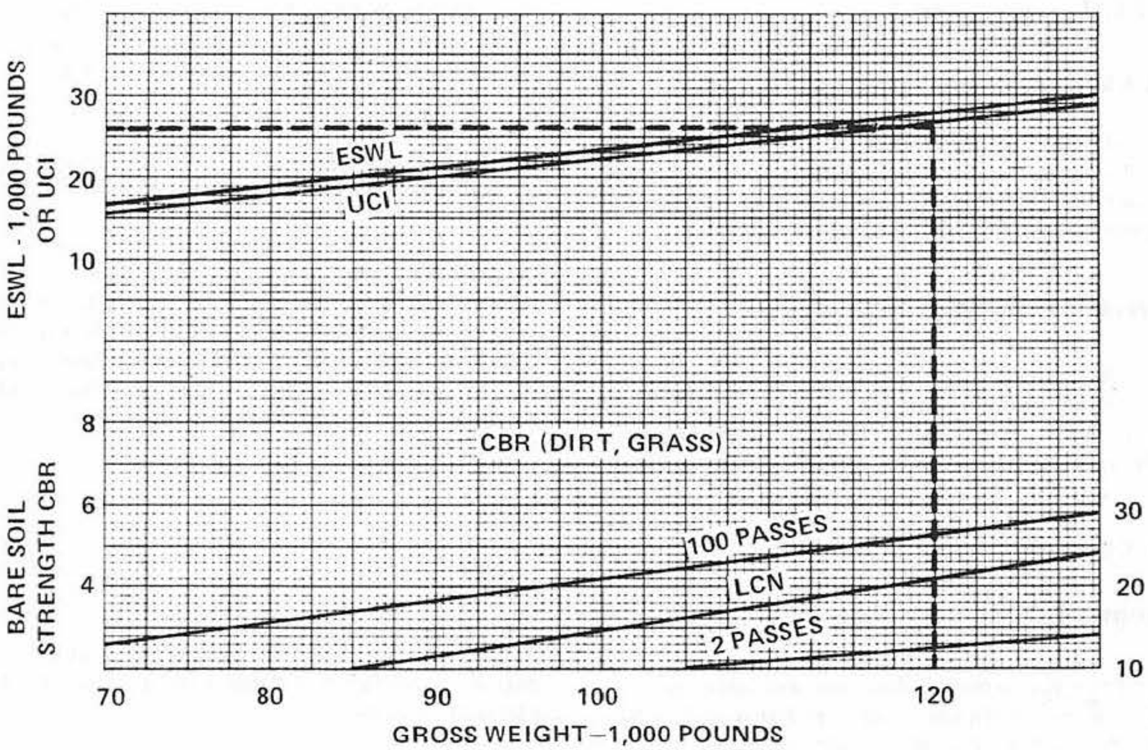


Figure 5-7.

SOLUTION: Enter figure 5-7, at the bottom of the chart on the vertical line which represents 110,000 pounds gross weight. Where the vertical line representing 110,000 pounds gross weight crosses the ESWL line, read 26,000 pounds; then reduce this value by 10 percent for soft field operation to obtain a final ESWL value of 23,400 pounds. From the table for marginal strength runways, read 63 PSI for the tire pressure.

Example 3:

GIVEN: A C-130 type airplane is required to operate into an airfield with an LCN of 20.

FIND: Footprint loading and maximum gross weight for unpaved runway operation.

SOLUTION: Enter figure 5-7 on the horizontal line representing an LCN value of 20; where this line crosses the LCN line, proceed vertically down from this point to read a maximum gross weight of 117,000 pounds. Obtain a minimum main landing gear tire inflation pressure of 66 PSI from the table for marginal strength airfields.

SUBSTANDARD AIRFIELD OPERATIONS.

Substandard airfield operations generally imply operating on other than paved airfields. In general, the loading on the airplane is more severe while operating on these fields. Operation from substandard airfields may be critical, and the following instructions are to minimize the chance of damaging the airplane.

a. The pylon tanks must be empty.

b. Taxi at minimum speed (approximately 10 knots or less).

c. Minimize braking if porpoising results.

d. Service main landing gear tires as shown on Ground Flotation Characteristics Chart.

e. Minimize nose gear loads by use of elevator during take-off and landing rollout.

LANDING GEAR LIMITATIONS.

The landing gear can withstand the loads imposed by a contact sink rate of 540 feet per minute at a landing weight of 96,000 pounds. As the landing weight is increased above 96,000 pounds, the allowable rate of sink decreases to 420 feet per minute at a weight of 124,200 pounds. When operating at weights up to 124,200 pounds, no operating restrictions are required on prepared fields. Sharp turns should be avoided at all times to prevent excessive loads on the gear. See Section II for minimum space and clearance required for turning. The maximum gross weight of 124,200 pounds is a landing gear limitation for all ground operations.

GUN AND STORES LIMITATIONS.

CAUTION

Do not fire 40mm guns at depression angles less than 18 degrees to prevent muzzle blast damage to the left wing trailing edge structure and flaps.

CAUTION

Do not fire 40mm guns simultaneously or at an individual gun firing rate in excess of 100 rounds per minute to prevent exciting dynamic structural response modes of the fuselage structure.

CAUTION

Do not fire 40mm guns when recoil exceeds 8.3 inches to prevent excessive pressures in the recoil cylinder and excessive stresses elsewhere in the mechanism.

CAUTION

When two ALQ-87 stores are carried on each side, they shall be located on the fore and aft centerline store stations on the MER.

CAUTION

When three ALQ-87 stores are carried on each side, the third store shall be located on one of the remaining available forward store locations.

CAUTION

Do not fire any of the guns when the pylon tanks are installed.

summary table of limitations

NOTE

REFERENCE SHOULD BE MADE TO APPLICABLE DISCUSSIONS WITHIN THIS SECTION FOR THE VALUES SHOWN BELOW.

WEIGHT-POUNDS

CONDITION		
MAXIMUM TAXI	124,200	
MAXIMUM TAKE-OFF	124,200	
MAXIMUM LANDING	124,200	420 FPM RATE OF SINK WITHOUT EXTERNAL FUEL 300 FPM RATE OF SINK WITH EXTERNAL FUEL
NORMAL LANDING	96,000	540 FPM RATE OF SINK WITHOUT EXTERNAL FUEL 300 FPM RATE OF SINK WITH EXTERNAL FUEL

SPEEDS-KNOTS INDICATED AIRSPEED

FLAPS EXTENDED:	
10%	220
20%	210
30%	200
40%	190
50%	180
60%	165
70%	155
80%	150
90%	145
100%	145
LANDING LIGHTS OPERATION/EXTENDED	170
AFT CARGO DOOR AND RAMP OPEN	150
PAINTED CONTROL SURFACES (REFER TO TEXT FOR EXCEPTIONS)	250
LANDING GEAR EXTENDED/ IN TRANSIT	170
PARATROOP AIR DEFLECTORS OPEN	150
PARATROOP DOORS (OPENING OR CLOSING)	150
THUNDERSTORM OPERATION	65 KNOTS ABOVE POWER-OFF STALL SPEED

SYSTEM LIMITS

FUEL

FUEL BOOST PUMP PRESSURE	MIN 20 PSI - MAX 30 PSI

HYDRAULIC

UTILITY SYSTEM	NORMAL 2900 TO 3200 PSI - MAX 3500 PSI
BOOSTER SYSTEM	NORMAL 2900 TO 3200 PSI - MAX 3500 PSI
EMERGENCY SYSTEM	NORMAL 2900 TO 3200 PSI - MAX 3500 PSI

ACCUMULATOR PRELOAD

NORMAL 1400 TO 1600 PSI - MIN 1400 PSI - MAX 1600 PSI

PRESSURIZATION

CABIN DIFFERENTIAL PRESSURE MIN - 1.2 IN. HG - MAX 15.8 IN. HG

Figure 5-8. (Sheet 1 of 2)

STARTER

1 MINUTE ON, 1 MINUTE OFF, 1 MINUTE ON, 1 MINUTE OFF, 1 MINUTE ON, 30 MINUTES OFF.

POPOUT: BY 70% RPM.

PULLOUT: AT 72% RPM MAX.

ELECTRICAL

FREQUENCY	MIN 380 CPS - MAX 420 CPS
VOLTAGES	
AC (GENERATORS AND INVERTERS)	MIN 110 VOLTS – MAX 125 VOLTS
DC GENERATORS	MIN 27 VOLTS – MAX 30 VOLTS
LOADS	
ATM AC GENERATOR	MAX 83 AMPERES
ENGINE AC GENERATORS	MAX 115 AMPERES
TR	MAX 1.03%
PROP SPINNER BASE DE-ICE	MIN SUFFICIENT 65 AMPERES MAX 85 AMPERES
PROP BLADE DE-ICE	MIN SUFFICIENT 65 AMPERES MAX 85 AMPERES
PROP SPINNER NOSE ANTI-ICE	MIN SUFFICIENT 75 AMPERES MAX 100 AMPERES

Figure 5-8. (Sheet 2 of 2)

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SECTION VI

flight characteristics

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INTRODUCTION.

The airplane was designed for support and utility operations from small fields and emergency airstrips. In this, and in all other areas of flight operations including formation and instrument flying, the airplane has satisfactory flight characteristics. The outstanding and most useful characteristics in all ground and flight operating conditions is the capability of the airplane for rapid acceleration and its immediate and precise response to power and control applications.

STALLS.

Note

During turns, different indicated airspeeds will be presented by the pilot's and copilot's airspeed indicators. The difference increases with bank angle and can be as much as 10 KIAS at 45 degrees bank angle. This is because the static sources located in the wing tip probes are not manifolded and provide independent static sources for the pilot's and copilot's airspeed indicators. The indicator to the inside of the turn always reads lowest; i.e., the pilot's airspeed indicator reads lower during a left turn and the copilot's indicator reads lower during a right turn. When the aircraft approaches stall speed in a turn, the airspeed indicator to the inside of the turn will read lower and should be used as the primary airspeed indicator.

The unaccelerated stalling characteristics of the airplane in the FLIGHT IDLE power setting are satisfactory with all flap settings. (See figure 6-1 for power-off stalling speeds.) A very weak stall warning is received close to the stalling speed, but the heavy buffeting encountered in the stall and the slow rate of pitch out of the nose will give ample warning of a stalled condition. Depending on center of gravity location and residual flight idle power, the nose may or may not pitch below the horizon. During the stall a rolling-off tendency may be encountered when uneven flight idle power is prevalent. The aileron control is effective in bringing up a wing, and no difficulty should be expected even in a prolonged full stalled condition. However, if the airplane is held in a prolonged stall, buffeting will be heavy. The airplane will recover from a stall automatically, with no tendency to spin, as long as the back pressure on the control column is released. Power-on stalls with low power settings are similar to power-off stall conditions except for the nose-high attitudes. Accelerated stalls, while in a power approach turn, may result in a sharp tuck-under condition if the stall is prolonged. However, in this configuration there is a very adequate stall warning buffet preceding the stall.

WARNING

Clean configuration stalls should be discontinued at onset of buffet. Power-on stalls are prohibited because of the excessively nose-high attitude required.

POWER OFF STALLING SPEEDS (KIAS)
LANDING GEAR UP OR DOWN
OUT OF GROUND EFFECT

MODEL: AC-130A
T56-A-9 ENGINES
DATE: APRIL, 1971

DATA BASIS: CATEGORY II FLIGHT TEST

GROSS WT 1000 #	FLAPS UP SPEED			50% FLAP SPEED			100% FLAP SPEED		
	LEVEL	15° BANK	30° BANK	LEVEL	15° BANK	30° BANK	LEVEL	15° BANK	30° BANK
70	88	90	94	83	85	89	72	73	77
80	94	96	101	87	89	93	76	78	81
90	99	101	106	92	94	98	81	83	87
100	106	108	113	97	99	104	84	86	90
110	111	113	115	100	102	107	89	91	95
120	115	117	123	103	105	110	92	94	98
130	119	121	127	107	109	114	96	98	103

Figure 6-1

Use care to avoid accidental stalls. Should a stall be entered, it is recommended that recovery be made as follows:

1. If in level or approximately level flight, immediately and simultaneously apply power and drop the nose. Use ailerons and rudder to counteract any wing-dropping tendency. Move controls smoothly, avoiding abrupt actions. Avoid diving the airplane and avoid abrupt or accelerated pull-up after recovery.

2. If in climbing or banked attitude, immediately and simultaneously apply power, drop the nose. and level the wings with the ailerons and rudder. Move controls smoothly, and avoid abrupt actions. Avoid diving the airplane, and avoid abrupt or accelerated pull-up after recovery.

Note

The rudder is less effective than the ailerons for leveling the wings in stalled or near-stalled flight.

PRACTICE STALLS.

Any practice in stall entry and recovery should be made at light weights and at a minimum altitude of 10,000 feet above the ground. Avoid abrupt control movements, and avoid any control action that may result in sudden attitude change or in excessive acceleration or buffeting.

SPINS.

Spins are a prohibited maneuver, and should never be intentionally entered. Accidental spins can be prevented by immediate recovery from any stall condition. If a spin is accidentally entered, it is anticipated that a normal recovery for multi-engine airplane will be effective. Reduce power to flight idle, apply full rudder opposite the direction of the spin and ailerons against the spin and hold until rotation stops, hold elevator control forward of the neutral position. When rotation stops, immediately return rudder and aileron to neutral. Perform dive recovery. As in any maneuvering flight, proper care should be taken to avoid exceeding the structural limits of the airplane by a sudden pull-up.

FLIGHT CONTROLS.

The flight controls are designed to be operated with hydraulic boost on at all times. With boost on, the airplane can be controlled without undue effort by the pilot under any reasonable load, flap, and power combinations. In case of complete failure of the hydraulic-powered control systems, the airplane can be controlled by careful manipulation of the trim tabs.

WARNING

Maneuvering the airplane at cruising speeds under these conditions must be accomplished with the trim tabs. Landing the airplane without hydraulic assistance is a marginal operation and requires skillful handling of the trim tabs and engine power, plus coordinated efforts of the pilot and copilot on the flight controls. When possible, avoid cross-winds, short fields, or narrow runways since the chances of making a successful landing will be decreased.

LEVEL-FLIGHT CHARACTERISTICS.

The range between slow and high-speed flight is unusually large, but control and stability are normal for any trimmed condition. During landing at light gross weights the airplane has a tendency to float due to the large wing area, the propeller blade angle, and the flight idle horsepower.

MANEUVERING FLIGHT.

Maneuvering flight within the category of acrobatics is prohibited. Do not make hard rudder kicks that result in large angles of yaw. Normal maneuvers may be accomplished with moderate pilot effort since control movement is assisted by the boost system. There are no conditions of normal maneuvering flight which will produce a reversal of control pressures. and maneuvers can be accomplished with ease. In executing turns under combat conditions remember that 60 degrees is the maximum bank angle. The recommended speed for minimum-radius turns is the best climb speed at that altitude.

CAUTION

Abrupt push-over to a negative g condition with flaps either up or down should be avoided. This type of maneuver will result in a reduction in maneuvering longitudinal stability, in that the angle of pitch-down and the negative g condition continue to increase even after the stick direction has been reversed. After movement of the stick toward the former position is begun, there is a time lag before the airplane starts to reverse its pitching motion. Final recovery from the maneuver requires considerable pull force. This is due to the large pitching inertia of the airplane and the longitudinal rotational effect on the hinge moments of the elevator. These characteristics could result in an excessive negative load factor, an uncomfortable nose-down attitude, and an excessive positive load factor due to an abrupt recovery.

FIN STALL.

WARNING

Fin stall maneuvers are prohibited.

If the airplane is maneuvered to abnormally high sideslip angles (15-20 degrees), a fin stall resulting in large yawing transients and a loss of directional stability can be encountered. This is an unusual flight maneuver and will not result from power transients, gusts, wake turbulence or execution of normal flight maneuvers. The fin stall condition is more likely to occur during abnormally high left rudder input maneuvers if held until fin buffet occurs. Fin stall can be achieved at all speeds between stall speed and approximately 170 knots in all flap configurations with power on. The susceptibility of encountering the fin stall condition is greatest at low speed with high power. Consequently, under these conditions rapid yawing maneuvers can be produced with (1) relatively low abrupt rudder inputs or (2) abnormally high rudder deflections. As the airplane attitude approaches the critical sideslip angle, heavy vertical fin buffet will develop. Recovery can be initiated at this point by simply returning the rudder to neutral or by rolling to a wings level attitude. However, if the sideslip is allowed to increase past the fin buffet condition, the rudder pedal force will decrease to zero or reverse along with a nose up pitching tendency; recovery at this point can be affected by returning the rudder to neutral which will require from approximately 50 to 100 pounds rudder pedal force, and by rolling to a wings level attitude. (If flight conditions permit, pushing the nose down and reducing power will assist in recovery). To avoid large yawing and rolling transients on recovery do not overcontrol the rudder and ailerons. Sideslip maneuvers increase drag and reduce lift; therefore, degradation in climb performance will be experienced and loss of airspeed may be experienced. Insure that adequate flying speed is maintained immediately after recovery.

DIVING.

Conduct dives or descents within the airspeed limitations given in Section V. Avoid abrupt pull-ups at any time.

SECTION VII

systems operation

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INTRODUCTION.

The descriptions and operating instructions contained in this section are for systems which are peculiar to this airplane or systems that require emphasis. In some cases the information given overlaps with that given in the general description of the system concerned. In some cases, instructions are given which do not appear elsewhere in the handbook.

PROPULSION SYSTEM CHECKS.

ELECTRONIC FUEL CORRECTION.

The electronic fuel correction is operated by a switch on the copilot's instrument panel. With the switch in the CONTROLLED position, the brakes are unlocked on the TD control valves and the valves are controlled by the electronic control systems to provide temperature limiting or controlling, depending on throttle position. The electronic fuel correction lights are on while the throttles are in temperature-limiting range (below 65 degrees) and go out when the throttles are advanced to the temperature-controlling range (above 65 degrees) if the control systems are functioning normally. The LOCKED position locks the correct fuel setting of the TD control valves only when the throttles are in the temperature-controlling range, the TD control valve switch is in the AUTO position, and the electronic fuel correction lights are out. Locking the valves permits all the engine fuel controls to maintain more equal power distribution during landing. If a valve is locked by the electronic fuel correction switch and an overtemperature condition occurs, the valve's control system will unlock the valve to correct the condition; the electronic fuel correction light for that engine will illuminate to indicate that the valve is unlocked.

Locking the TD valve provides these advantages:

a. During the landing approach. locking the TD valve will give more equal power distribution on all engines.

b. In the event of a TD control malfunction causing RPM and temperature fluctuations, locking the TD valve may stop the fluctuation.

c. During tactical operations, locking the TD valve will prevent a crossover bump which will aid in more precise airspeed control.

Note

Do not lock the TD valve during power transients; wait for the engine to stabilize at new power setting. The TD valve setting locked in at the higher altitude may result in a lean fuel mixture at lower altitude.

Temperature Controlling Check.

Advance the throttles and observe the turbine inlet temperature change as electronic fuel controlling is reached (as indicated by the electronic fuel correction lights going out). The turbine inlet temperature at this point, when normal, will be 740 to 780°C. If the TIT does not change when electronic fuel controlling is reached, proceed as follows:

a. Symmetrical throttles - Approximately 850°C TIT

b. Engine bleed valve switch - Closed (Engine to be checked)

c. All anti-icing and de-icing switches - Off

d. Anti-icing master switch - Manual

e. Inlet duct anti-icing switch - On (Engine to be checked)

Note

The TIT should rise slightly and then return to the previous setting. If the TIT does not return to the previous setting, the electronic temperature controlling system has malfunctioned.

f. Inlet duct anti-icing and deicing and anti-icing master switch - Off/Auto

g. Engine bleeds - Open

h. Throttles - As required

ENGINE STARTING.

USE OF FUEL ENRICHMENT.

The fuel enrichment system furnishes unmetered fuel to the temperature datum valve to supplement normal flow through the fuel control. This enriching starts at 16 percent RPM and lasts only until fuel manifold pressure reaches approximately 110 PSI.

BATTERY ENGINE START.

During a normal engine start for the first engine, the GTC powers both the ATM and engine starter. Since low air density conditions (high temperature of high field altitude) lower the GTC mass output, at certain times the capacity of the GTC will not be great enough to perform a normal start on the first engine. Indication of this condition is slow acceleration while attempting a normal start in low density air. The battery engine start system is provided to enable all of the GTC output to be used by the engine starter. It shuts off the ATM and supplies necessary DC power during starting from the battery. At 65 percent RPM the ATM is again supplied compressed air and the ATM generator is driven. All engine and GTC functioning is normal from this point on. A normal start without external power may be switched to a battery engine start, if acceleration lags, by depressing the battery engine start button and holding it in until RPM exceeds 16 percent. Above 16 percent RPM a relay holds the circuit closed until a generator comes on the line. If low air density conditions require a battery engine start, proceed as follows:

Note

If the battery engine start button is used when external DC power is available, it will have to be held until 65 percent RPM as the holding relay will be inoperative with external DC power.

a. Depress and hold the battery engine start button until RPM exceeds 16 percent. When engine RPM reaches 65 percent, bleed air is again supplied to the air turbine motor.

Note

If the holding relay fails, place the condition lever to feather and allow the engine to come to a complete stop prior to attempting another start. If the holding relay fails, record in Form 781. On the second attempted start, depress and hold the battery engine start button until 65 percent engine RPM is reached.

b. Start the remaining engines by normal method, using engine bleed air.

NORMAL ENGINE STARTING SEQUENCE.

During a normal start the following actions take place automatically (provided Section II checklist procedures have been followed) as listed. An examination of the sequence will be helpful in understanding the overall operation of any start.

% ENGINE RPM (approximate)	ACTION	CONTROLLED BY
0 - 94%	TIT Limited to 830°C by Temperature Datum Control	Speed-Sensitive Control
0 - 94%	5th and 10th Stage Compressor Bleeds Open	Speed-Sensitive Control

Note

Valves are opened as engine decelerates on normal shutdown. If engine is shut down by using the fire emergency control handle, the valves remain closed until the bleed air manifold is depressurized.

% ENGINE RPM (approximate)	ACTION	CONTROLLED BY
0%	Diffuser Bleed Valve Open	Normally Open
16%	Fuel Shutoff Opened	Speed-Sensitive Control
16%	Fuel Enrichment Valve Open (if selected)	Speed-Sensitive Control and Fuel Enrichment Switch
16%	Fuel Pumps in Parallel Operation	Speed-Sensitive Control
16%	Drip Valve Closed	Speed-Sensitive Control
16%	Ignition On	Speed-Sensitive Control
110 PSI Fuel Manifold Pressure	Fuel Enrichment Valve Closed (if selected)	Manifold Pressure Switch
33%	Diffuser Bleed Valve Closed	Compressor Discharge Air Pressure
62%	Starter Disengaged	Starter Cutout Switch
65%	Fuel Pumps in Series Operation	Speed-Sensitive Control
65%	Fuel Enrichment Circuit De-energized	Speed-Sensitive Control
65%	Ignition Off	Speed-Sensitive Control
65%	Drip Valve De-energized (held closed by fuel manifold pressure)	Speed-Sensitive Control
94%	5th and 10th Stage Compressor Bleeds Closed	Speed-Sensitive Control
94%	Start Control Circuit De-energized	Speed-Sensitive Control
94%	TIT Limited to 977°C by Temperature Datum Control	Speed-Sensitive Control

BUDDY/WINDMILL TAXI START.

Note

> Buddy starts should have priority over a windmill taxi start and may be used to start an engine if it cannot be started by normal procedures. Buddy or windmill taxi starts should be used only when authorized or directed by the major command concerned.

BUDDY START.

Buddy starts are defined as an engine start utilizing the propeller airblast of another airplane to effect engine starting.

Note

> Position the airplanes as nearly as possible into the wind and observe cautions in ENGINE RUNUP in Section II.

a. Assure the ramp area is free of any objects that might cause FOD.

b. Inspect engine to be started as necessary to assure maximum safety.

CAUTION

> Prior to attempting a buddy start because of a defective starter, assure that the starter or starter shaft is removed, as it may remain engaged with resultant damage to the starter, engine or airplane.

c. Place condition lever to FEATHER until the blade cuff is in line with the island on the spinner base.

d. Establish and maintain radio contact with the other airplane.

e. Position airplane with the engine to be started approximately 10 feet behind the starter airplane.

f. Set parking brakes.

g. Place chocks fore and aft of each forward MLG wheel.

h. Brief crews of special signals that will be used during starting and position ground observers for visual sighting from each cockpit and each other.

i. Perform Normal Procedures Checklists through Before Starting Engines checklist with the following exceptions:

(1) Propeller cuff lined up with island on spinner base.

(2) Place throttle in FLIGHT IDLE.

(3) Leave chocks in place.

(4) Flaps - UP (when possible).

j. Close all doors, windows and hatches.

k. Condition lever run, leave bleed air valve closed until engine is on speed.

l. Front airplane, upon signal from rear airplane, increase power to 900 TIT on all engines.

m. If propeller rotation does not begin, request maximum power on front airplane.

n. After propeller rotation starts, observe normal start sequence and at 60 percent RPM place throttle to GROUND IDLE.

o. Signal front airplane to reduce power.

Note

> If constant acceleration fails to occur prior to 16 percent RPM, move condition lever to feather position momentarily and return to run. Increased RPM and acceleration should occur. Do not move condition lever toward feather after 16 percent RPM unless a stop start situation exists.

Note

> In the event above procedures are ineffective, starting may be attempted by pre-setting propeller blade angles at an intermediate position between alignment with spinner base island and the full feather position and/or changing airplane position to offset propeller alignment by approximately six feet.

WINDMILL TAXI START.

The following procedure can be used to start an engine if it cannot be started by normal procedures. IT SHOULD BE USED ONLY IF MISSION REQUIREMENTS DICTATE. A minimum runway length of 5,000 feet is recommended to assure safety in accomplishing a windmill taxi start.

Note

> Practice windmill taxi starts are not recommended with the anti-skid system inoperative.

CAUTION

Prior to attempting a windmill taxi start because of a defective starter, make sure that the starter or starter shaft is removed as it may remain engaged with resultant damage to the starter, the engine, or the airplane.

a. Inspect the engine to be started as necessary to assure maximum safety.

b. Place the condition lever to FEATHER until the blade cuff is in line with the island on the spinner base.

c. Perform the Before Take-Off and Line Up checklist to assure that all controls and switches are in the proper position.

Note

Flaps will be set at 0 percent. This will prevent creating lift and extra drag at low speeds.

(1). Fuel enrichment - NORMAL

d. Place the throttle in the FLIGHT IDLE position.

e. Place the condition lever in the RUN position.

f. Align the airplane on the runway with the parking brakes set. Advance the throttles to FLIGHT IDLE for the operating engines, then advance the throttles on the symmetrical engines to take-off power. Release the brakes, and increase power on the other operating engine as directional control becomes available through coordinated use of nose wheel steering and the rudder. The copilot should monitor the control column, maintaining positive pressure on the nose wheel. The pilot should maintain control of nose wheel steering, throttles, and rudder.

g. The propeller should start to rotate as the airspeed increases, and a normal light-off should occur. As the RPM increases to about 40 percent, retard all throttles to GROUND IDLE, reverse symmetrical on-speed engines, and apply brakes as required to stop the airplane. The engine should accelerate and come on speed as the airplane is brought to a stop. Oil pressure and engine instruments should be monitored the same as for a normal start.

WARNING

When throttles are moved into the ground range with a movement which is too rapid, it is possible to lose control of the airplane before a propeller malfunction can be detected. The movement from the flight range into the ground range should be made at a reasonable rate which will permit detection of a malfunction such as failure of the low-pitch stop to retract. At the first indication of directional control difficulties during reversing, immediately return all throttles to ground idle. Maintain directional control with flight controls, differential braking, and nose wheel steering as required. After identifying the affected propeller, symmetrical propellers of on-speed engines may be reversed and the affected engine shutdown.

CAUTION

Regardless of the progress of the windmill taxi start, when the airplane reaches a speed of 100 KIAS or a point where 3,500 feet of the runway remains, whichever occurs first, retard all throttles to GROUND IDLE and stop the airplane.

h. Resume normal operation beginning with the STARTING ENGINES Checklist.

(1) Fuel enrichment - OFF

i. Return to the active runway and complete the ENGINE RUNUP and BEFORE TAKEOFF checklists.

FUEL MANAGEMENT.

Internal wing tank fuel management is accomplished at the fuel control panel, which is located overhead within reach of both the pilot and the flight engineer. Fuel routing is governed by fuel tank selection and crossfeed valve positioning. Fuel gages on the panel indicate quantities in each tank, and a totalizer indicates total fuel remaining. An additional check of fuel quantity may be made by keeping a log based on engine fuel flow and time. Pylon tank fuel is controlled at the fuel control panel and at the pylon tanks fuel control panel. A booster pump for each pylon tank pumps the fuel to the internal inboard tanks when enough fuel has been used.

FUEL FLOW.

Design of the airplane allows internal wing tank-to-engine or crossfeed fuel flow. Tank-to-engine routing is normally used at all times. Crossfeed flow is used when transferring pylon tank fuel to the internal wing tanks, when trimming the internal wing tanks, or in other special uses. Boost pump operation is recommended at all times to ensure adequate supply pressure to the engines, although static pressure is usually sufficient under most conditions. All fuel is fed to the engines from the four internal wing tanks. Refer to figures 1-21, 1-22, 1-23 and 1-25 for the fuel system schematic diagrams.

FUEL MANAGEMENT FOR INTERNAL WING TANKS.

CAUTION

When the airplane is parked with the fuel tanks more than three-quarters full, all crossfeed valves should be closed, otherwise low tanks may be overfilled by slow transfer of fuel through the boost pump check valve bleed orifice from the crossfeed manifold.

Take-off.

To obtain the correct fuel flow for take-off:

a. All crossfeed valves - CLOSED.

b. All main tank boost pumps - ON.

Climb and Cruise.

As the pylon fuel tanks have only one boost pump, it is recommended that this fuel be transferred to the internal wing tanks as soon as possible. In the event of a pylon or auxiliary wing tank pump failure, this procedure would assure sufficient fuel to return to the point of departure. On short-range missions, it is recommended that fuel be used from the pylon tanks first, to preclude landing with fuel in the pylon tanks.

CAUTION

The pylon tanks should be used prior to the main wing tanks in order to maintain the airspeed and weight limitations shown in Section V.

When opening main wing tank crossfeed valves, observe a fluctuation of fuel pressure for an indication that the valve has opened. When changing fuel routing, monitor TIT, torque, and fuel flow indications for approximately one minute to assure proper flow.

CAUTION

When fuel quantity of any main tank is less than 1000 pounds, the engine being fed by that tank will be placed in crossfeed operation.

When operating with less than 6000 pounds of total fuel in the main fuel tanks, place the crossfeed valve switch to OPEN and the boost pump switch to ON for ALL tanks containing fuel.

Note

To obtain the most reliable readings, fuel tank gages should be read while airplane attitude is within $\pm 3^{\circ}$ roll and 0° pitch.

Main Fuel Tank Trimming.

Fuel in the main wing tanks may become unbalanced because of different power settings or because of engine shutdown. If an unbalanced condition exists, the fuel tanks may be trimmed by the following procedures.

To take fuel from a heavy tank:

a. Crossfeed valve for heavy tank - OPEN.

b. Crossfeed valve for light tank or tanks - OPEN.

c. Boost pump for light tank or tanks - OFF.

WARNING

Normally, one boost pump is capable of supplying fuel through the crossfeed manifold to all engines. However, it is mandatory that at least one engine is left on tank-to-engine fuel flow so that all power is not dependent on one tank system.

When trimming is complete:

d. All boost pumps - As required (normally ON).

e. All crossfeed valves - As required (normally CLOSED).

FUEL MANAGEMENT WITH PYLON TANKS (SOME AIRPLANES).

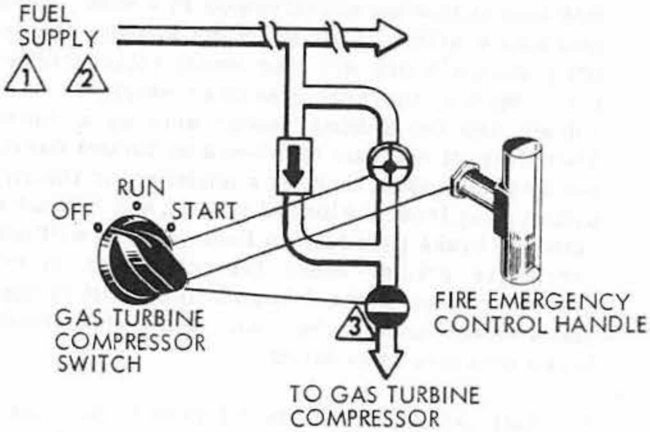
Fuel management is accomplished as described under FUEL MANAGEMENT FOR INTERNAL WING TANKS. When pylon tank fuel is carried, proceed as follows to transfer pylon tank fuel:

a. After take-off, open all four crossfeed valves.

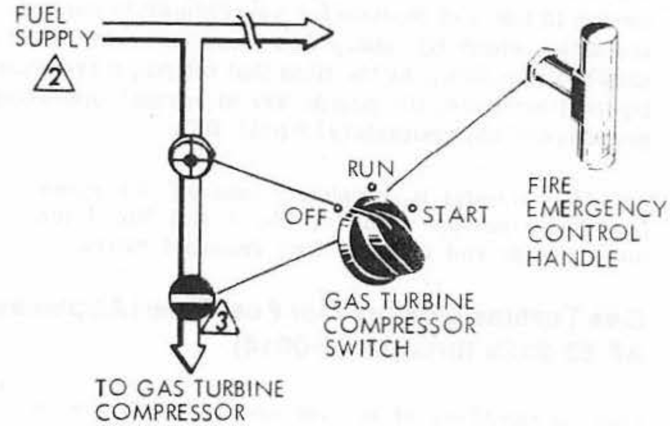
b. Turn off No. 1 and No. 4 fuel tank boost pumps to decrease the No. 2 and No. 3 tank fuel quantities.

fuel management

(GAS TURBINE COMPRESSOR)



AIRPLANES AF55-0029
THROUGH AF55-0046.



AIRPLANE AF56-0469.

NOTE

(1) FUEL SUPPLIED FROM EITHER NO. 2 OR NO. 3 INTERNAL TANK. AIRPLANES AF53-3129 THROUGH 55-0014.

(2) FUEL SUPPLIED FROM ANY TANK THROUGH CROSSFEED MANIFOLD. AIRPLANES AF55-0029 AND UP.

(3) VALVES ARE OPERATED BY ENERGIZE-TO-OPEN SOLENOIDS.

(4) MOTOR-OPERATED VALVE.

FUEL PUMP

MANUALLY OPERATED VALVE

—— ELECTRICAL ACTUATION

Figure 7-1.

c. When the No. 2 and No. 3 fuel quantity indicators show approximately 7,000 pounds of fuel each, turn on the pylon tank fuel boost pumps.

Note

During turns, when the internal fuel tanks are nearly full, the no flow lights for the pylon tanks may blink on and off.

Note

The exact time that the pumps are turned on is recorded for use in computing the remaining fuel at any time until the tanks are empty.

Note

If icing of pylon fuel feed lines is suspected, operate the wing and empennage anti-icing for approximately 3 minutes to eliminate possible ice congestion.

The airplane fuel system should remain on manifold feed, using fuel from the inboard tanks until the pylon tank fuel transfer has been completed. As long as the pylon tank pumps are on, the pylon tank pump indicator lights will be illuminated. When the fuel in each pylon tank has been pumped into the inboard tanks, or when the flow has been reduced to approximately 2-1/2 gallons per minute, a pylon tank no flow light for that pylon tank will illuminate. The fuel should be pumped from each pylon tank in approximately 90 minutes. To find the amount of fuel remaining in the pylon tanks, multiply the pumping rate of each pylon fuel pump (approximately 5.0 gallons per minute) by the number of minutes the pumps have been on, and subtract this amount from the total usable fuel that was in the tanks.

Pump pressure is checked with the pump switches in the ON position by holding the pump operation test switch in the test position for approximately one minute after which the pump pressure indicator lights should illuminate. At the time that the pump pressure lights illuminate, the pumps are at normal operating pressure of approximately 13 to 15 PSI.

d. After transfer is completed, turn off the pylon tank boost pumps. Turn on No. 1 and No. 4 fuel boost pumps and close all four crossfeed valves.

Gas Turbine Compressor Fuel Flow (Airplanes AF 53-3129 through 55-0014).

Fuel for operation of the gas turbine compressor is taken from the No. 2 internal or the No. 3 internal tanks. Selection of the fuel source is made by positioning the gas turbine compressor fuel tank selector switch on the gas turbine compressor control panel.

Gas Turbine Compressor Fuel Flow (Airplanes AF 55-0029 and Up).

Fuel for operation of the gas turbine compressor is taken from any tank through the crossfeed manifold. Selection of the fuel source is made at the fuel control panel. To obtain fuel flow for the operation of the gas turbine compressor from any tank, proceed as follows:

a. Select any tank or tanks with the tank-selector switches.

b. Turn the crossfeed valve switches for the tanks selected to the OPEN (vertical) position.

USE OF WHEEL BRAKES.

It is absolutely necessary that airplane brakes be treated with respect. Although the anti-skid system will give consistently shorter landing rolls on dry runways, it should not be used to its maximum potential to make all landings as short as possible. To minimize brake wear, the following precautions should be observed insofar as practicable:

a. Use extreme care when applying brakes immediately after touchdown or any time there is considerable lift on the wings. A heavy brake pressure can result in locking the wheels more easily if brakes are applied immediately after touchdown than if the same pressure is applied after the full weight of the airplane is on the wheels. A wheel once locked in this manner will not unlock when the load is increased, as long as brake pressure is maintained. Brakes, by themselves, can merely stop the wheel from turning. Stopping the airplane is dependent on the friction of the tires on the runway. There are two reasons for this loss in braking effectiveness in a skid. First, the immediate action is to scuff the rubber, tearing off little pieces which act like small rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant. Therefore, if one pair of wheels is locked during application of brakes, there is a tendency for the airplane to turn away from the locked wheels, and further application of brake pressure to those wheels will offer no corrective action. Since the coefficient of friction goes down when a wheel begins to skid, it is apparent that a wheel, once locked, will never free itself until brake pressure is reduced.

b. Anti-skid systems are intended to prevent skids at high speeds under light wheel loads. Therefore, brakes may be applied immediately after touchdown, with anti-skid, but this should be done only when definitely necessary. The anti-skid system will function to prevent tire skidding if it is operating properly; however, it is not designed to perform as a completely automatic braking system. Continuous braking from the point of touchdown will result in considerable overworking of the anti-skid system in addition to causing excessive wear and extreme heating of the brakes.

c. If maximum braking is required after touchdown, lower the nose as soon as possible, apply the brakes, and raise the flaps. Reverse thrust should be used, whenever possible.

d. For short field landings, a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable.

e. If maximum braking has been used in landing, it is recommended that the gear be left extended after subsequent takeoff for a minimum of 15 minutes before retraction or before another braked landing is attempted. The parking brakes should not be set if the airplane is parked subsequent to such a landing, and the airplane should be taxied using the minimum amount of brakes necessary for safety.

WARNING

Failure to cool the brakes could result in a tire explosion and damage to the airplane.

f. The full landing roll and propeller reversing should be used at all times to minimize the use of brakes.

g. Do not drag the brakes while taxiing. If taxiing downhill or downwind and the use of reverse thrust results in excessive oil temperature, stop the airplane to accellerate until brakes must be reapplied to avoid high taxi speeds. Continue this cycle as required. This will result in less heat build up than dragging the brakes. Use the brakes as little as possible for turning the airplane on the ground.

h. At the first indication of brake failure or after the brakes have been used excessively or hot brakes are suspected, have the fire department crash crew make an inspection of the brakes and tires as brake fires are possible.

WARNING

Do not taxi into crowded parking areas or set the parking brake when the brakes are overheated. Peak temperatures occur in the brake assembly (tri-metallic or single disc) from approximately 1 to 5 minutes and in the wheel and tire assembly (magnesium or aluminim) from approximately 20 to 30 minutes after a maximum braking operation. If maximum brakes are used, record in Form 781. Do not taxi or tow the airplane for at least 15 minutes after overheated brakes have been cooled. All personnel other than those in the fire department should evacuate the immediate area. The area on both sides of the wheel will be cleared of personnel and equipment for at least 300 feet. Do not approach the main wheel area when extreme temperatures due to excessive braking are suspected. If conditions require personnel to be close to an overheated wheel or tire, the approach should be from the fore or aft only.

i. Release the parking brakes as soon as possible after the wheel chocks are in place.

NESA WINDSHIELD SWITCHES.

Checked/OFF

WARNING

Do not check the temperatures of a crazed outer glass with the bare hand.

a. Place the NESA windshield switches in the normal position and allow glass to warm. Place the switches in the off position and check for heating by feeling the outside glass panels.

Note

If the ambient temperature is higher than 27°C (81°F) do not operate NESA on the ground. If the ambient temperature is below this figure, turn NESA to NORMAL. If the temperature of the glass is below approximately -45°F, the NESA control system will not function automatically, and the coldstart switch must be used to raise the temperature of the glass into the normal operating range.

CAUTION

Do not exceed the operating limits of 5 seconds on, 10 seconds off when operating the coldstart switch.

SECTION VIII

crew duties

Table of Contents.

CREW DUTIES

Each flight crewmember has duties other than the main duties covered in NORMAL PROCEDURES, Section II. These additional duties are prescribed in this section. Items in quotes indicate that response is required.

PILOT

The checklist for the Pilot is covered in detail in Section II and III.

a. Ensures that a thorough inspection of the airplane and all equipment is properly conducted.

b. Plans the mission by analyzing information concerning its nature, the expected weather, intelligence information, and special instructions.

c. Prepares or supervises the preparation of the flight plan and clearance.

d. Supervises and coordinates the activities of the crew members during flight planning and mission preparation.

e. Determines that weight and center of gravity are within prescribed limits.

f. Ensures that passengers are briefed on the location and operational use of emergency equipment and are familiar with emergency signals and exits.

g. Operates controls to start and check engines, and to taxi, takeoff, land, and maintain airplane in flight under varying conditions of weather, daylight and darkness, and combat conditions.

h. Monitors operation of pressurization system to ensure safety of airplane and personnel.

i. Directs the employment of navigational and communications equipment by the navigator and copilot.

j Coordinates the air-to-ground gunnery mission.

k. Monitors the fire control guidance and the gunsight and flies the aircraft in the firing pattern.

l. Fires the guns.

m. Assesses target damage during or after the strike when practical.

n. Ensures that required flight logs, records and maintenance forms are prepared.

COPILOT

The checklist for the copilot is covered in detail in Sections II and III.

a. Assists the pilot in planning mission by obtaining pertinent weather forecast, intelligence reports, maps, and other documents.

b. Assists navigator in plotting the mission route and calculating the route information and fuel requirements. Performs these duties in the absence of a navigator.

c. Performs inspections upon instructions of the pilot.

d. Assists the pilot in operating controls and equipment on the ground and in flight.

e. Operates the airplane upon instructions from the pilot.

f. Operates the communication equipment and assists the pilot in navigating the airplane in the absence of a navigator.

g. During airstrikes, monitors all flight instruments, follows through on the flight controls and controls throttles to maintain desired airspeed.

h. Maintains a watch for enemy aircraft and gun fire.

i. Takes emergency procedure actions as required by the flight manual and/or the pilot.

j. Prepares the flight log, required records, and maintenance forms.

k. Attends post mission debriefing as required.

FLIGHT ENGINEER

Operates system controls and regulates electrical system. Operates fuel system and regulates fuel management. Operates bleed air system, controls cabin air to provide proper ventilation, pressurization and temperature. Operates anti-icing and de-icing systems. Starts gas turbine compressor and air turbine motor to provide auxiliary power as required. Operates external light panel. May operate aft cargo door and ramp in flight. Observes engine instruments, system indicators, and control devices. Continuously monitors turbine inlet temperature, tachometer, and torquemeter indicators and reports unusual conditions to the pilot. Monitors fuel flow, temperature, pressure and quantity indicators, electrical voltage and loads, circuit breaker panels and cabin pressure control and altitude indicators. Observe fire, overheat and warning light indicators. Reports abnormal conditions to pilot and recommends or completes corrective action as briefed. Maintains power plant cruise control and performance log plan. Computes airplane weight and balance when required. Performs the aircrew visual inspections. Inspects the airplane for flight preparedness and continuation, turbo-prop engines for general condition of compressor inlet/turbine exhaust blades and systems for absence of fuel and oil leaks. Ascertains that the airplane and engines have not exceeded limits. Records limitations exceeded. Troubleshoots malfunctioning of the airplane systems in flight. May supervise airplane servicing and the removal and replacement of such components as starters, generators, flight control surfaces, propellers, pressure-transmitters and oil filters. May assign repair work to ground crew members; reviews work for completion and accuracy. Instructs and may evaluate subordinates in flight engineer duties and procedures.

In addition to his normal duties, the flight engineer is required to understand the function and performance of the subsystems and their interface with the airplane. He monitors and controls the gun control panel as directed by the pilot.

NAVIGATOR

The navigator has the responsibility for enroute and target navigation, target area clearance to fire, traffic separation with other combat aircraft, the successful operation of his assigned avionic subsystems, and functions as safety officer during combat missions. He attends pre-mission briefings, assimilates mission data and is instrumental in evolving a coordinated mission plan of attack. He must be thoroughly familiar with the functions and performance of the navigation, sensor, and fire control subsystems. He operates the fire control subsystem, and he assists in inflight ballistic wind and gun alignment error calculations (tweeking). The navigator attends maintenance, operations and intelligence debriefing and is responsible for completion of the mission report log. The navigator must be thoroughly familiar with the navigator's challenge items in Section II and the emergency procedures as they pertain to his duties.

NAVIGATOR'S CHECKLIST

This checklist covers the duties of the navigator on the AC-130A. Items in quotes indicate that response is required.

PREPARATION FOR FLIGHT

1. Flight plan	Completed
2. Range control chart	Completed (as applicable)
3. Maps and charts	Required information plotted and checked

4. Professional, personal, and survival equipment	Checked
5. Time hack	Obtained
6. Weather/Mission briefing	Attended

INTERIOR (POWER OFF)

NOTE

Upon arrival at the aircraft, and prior to entrance, DC and AC power should be available from an operational connected power cart to provide internal lights and system preflight power.

1. Form 781	Checked
2. Attitude ref switch	2 Axis
3. Circuit breakers/Loran power protector	Checked/Set
a. Loran power protector	ON
b. Cargo compartment panels	IN
c. Main power distribution box	IN
d. Radio junction box	IN
4. Parachute	Checked (as required)
5. In flight publications	Checked
6. Fire control display	OFF
7. SSU	OFF
8. SAD	OFF
9. 2 Axes gyro	Set/OFF
a. Power switch	OFF
b. Latitude	Set local lat.
c. Hemisphere	Set
d. Mode switch	D. G.
10. Radar	Checked
a. Range switch	50/10 or Less
b. Function switch	OFF
c. Gain control	CCW
d. Intensity	CCW
e. ISO - Echo	OUT
11. MTI	OFF
12. Radios	OFF
a. FM-1	OFF

b. HF-1	OFF
c. ADF-1	OFF
13. Clock	Set
14. Fire control panel	OFF
15. Radome anti-ice	OFF
16. Arn 92 TAS	CCW
17. ARN-92 loran	OFF
18. X band beacon	OFF
19. Doppler radar	OFF
20. Doppler computer	OFF
21. IFF (some airplanes)	OFF
22. APN-70 loran	OFF
23. Radio altimeter	OFF
24. Fire control system power switch	A/C power

Items preceded by an asterisk will be performed on all tactical missions, but need not be performed on non-tactical missions.

INTERIOR (POWER ON)

*1. FCS inverter control switch — ON/Checked

NOTE

Check 115 ± 3 volts, Hz 380-420. Allow two min warmup before use.

2. Interior lights	SET
3. Interphone	SET (as required)
a. Wafer switch	Interphone
b. Hot mike listen	ON
*4. SSU	ON
*5. SADS	ON
6. 2 Axes gyro	ON
7. ARN-92 loran	SET

CAUTION

Turn Mode Switch OFF if computer malfunction light is on steady.

a. Mode switch	LRN
b. Test	Depressed

Check all warning lights illuminated. Display reads N1234567 E4567890

c. Brr SRR	SET
d. Triad/SDA/SDB/SPH	SET
e. Master search	Depressed
8. Search radar	Standby
*9. FCS power control switch	Inv. Pow
*10. FCP power switch	ON
*11. FCC	SET
a. TAS	155

NOTE

TAS will not affect the BIT green lights, but will be required to obtain a correct guidance display.

b. Altitude switch	B
c. Sys align switch	Down
*12. FCD	SET
a. Power switch	ON
b. Alignment switch	OPR
c. Safety zone scale setting	5
d. Dimmers	CW
e. CH A	OD
f. CH B	IR
g. Safety zone scale setting	Rad
h. Symbol condition switches	SET
(1) Safety zone	0
(2) CH B	DOT
(3) CH A	DOT
(4) TGT T	T
(5) Firing zone	DOT
i. Scale factor select	Fine
j. Intensity/Focus	SET
k. Scale factor select	COARSE
l. Alignment	Checked
(1) Alignment switch	CENTER

Adjust dot to center of display with center EL and AZ controls.		
(2) Alignment switch	GAIN	
Adjust dot to position 3 CMS up 3 CMS Right of center with gain EL and AZ controls.		
(3) Alignment switch	OPR	
(normal operating position)		
*13. Attitude reference switch	2 AXIS/SET	(FCO)
*14. 2 Axes gyro	SET 360°	(P)
*15. FC panel	SET	
a. Pwr switch	ON	
b. Light controls	CW	
c. Windspeed	40	
d. TOF	6.0	
e. Wind direction	075°	
f. Offset distance	844 meters	
g. Offset direction	050.8°	
h. Override switch	NRML	
i. Coincidence window	14.7 mils	
j. EL Correction	494 mils	
k. AZ Correction	894 mils	
l. Sensor select switch	RAD	
m. Test switch	UP	
*16. BIT	Checked	
a. PNL/Comp	Green	
One or both lights not illuminating indicates a malfunctioning unit(s), and/or burned out lamps. The lamps are not in the press-to-test circuitry.		
b. FCD firing zone and TGT T	Both within 1 CM square aft and low of center	
c. FCD primary sensor symbol	In the lower left corner of FCD	
d. FCD safety circle symbol	High and forward of primary sensor symbol	
e. Reticles (pilot's gunsight)	SUPERIMPOSED (± 8.5 mils)	(P)
f. Guidance Needles	CENTERFD (± 1/8 inch)	(P)

*17. FCC	Reset	
a. TAS	198 Knots	
b. Altitude switch	B	
c. Sys align switch	ALIGN	
*18. FCD	Reset	
a. Safety zone select switch	BC	
b. Scale factor select	FINE	
*19. FC panel	Reset	
a. Test switch	Down	
b. Wind speed	CCW	
c. TOF	4.2	
d. Wind direction	000°	
e. Offset distance	105 Meters	
f. Offset direction	000°	
g. Override switch	OVRD (red light flashing)	
h. Coincidence window	6.0 mils	
i. Sensor select switch	BC	

NOTE

Verify that the BC is pinned before using for the following test problem.

j. EL/AZ corr controls	FCD/RETICLES superimposed	(P)

Reduce the EL/AZ corr settings toward nominal values of 100 (EL) and 500 (AZ). As the superimposed FCD symbols appear on the FCD FINE scale display, use the FCD to bring the symbols into the display center with the EL/AZ corr controls. Approaching FCD center have the pilot direct over interphone the final EL/AZ corr settings to superimpose the gunsight reticles.

NOTE

If BC is more than 20 computer counts off nominal in EL and/or 50 computer counts off in AZ, manually lock TV pedestal to 0-0 position and select TV as primary for this test.

*20. Coincidence Window	Centering Checked	(P)

Using the coincidence window knob, reduce the size of the window toward 0 until the gunsight coincidence limit lights illuminate. The

Lights should illuminate at 2 mils or less; if [illegible], [illegible] with the following check. Return the [illegible] window to 6 mils.

Using the [illegible] corr controls, one at a time, move the pilot's pipper up, down, forward and aft. Note the counts required to illuminate the pilot's sight coincidence limit lights in each direction. If window is not centered, the window should be recentered by Maint. prior to flight if time permits.

*21. Consent lights	Checked	(N, P)
Check for consent lights for all applicable sensors, on the FC panel and in the pilot's sight.		
*22. Wind circuits	Checked	
a. Windspeed	Set 50 knots	
(1) FCD - Firing zone	Moves to 1 CM aft	
(2) FCD - TGT T	Centered	
(3) Moving reticle	50 ± 3 MILS fwd	(P)
(4) Guidance needles	Checked	(P)
(a) Pitch steering bar	Slightly up	
(b) Bank steering bar	Slightly right	
(5) FCP wind direction	090°	
(a) Pitch steering bar	Null	(P)
(b) Bank steering bar	Slightly right	(P)
(c) Movable reticle	25 ± 3 MILS down	(P)
(d) FCD firing zone	1/2 CM high	
(6) 2 Axes gyro	Rotated through to 360 degrees	(P)
The firing zone symbol TGT T on the FCD, and the moving reticle in the pilot's sight, will all describe a 2:1 (length to height) ellipse as they react to the changing heading. The visual direction however, is not the same. If the heading is rotated from N-E-S-W-N, the FCD display symbols will rotate clockwise; the pilot's sight movable reticle counterclockwise. During the heading rotation, the safety circle and primary sensor symbol should not move.		
(7) Windspeed	CCW	

Recheck that the FCD display is centered and that the pilot's reticle is superimposed.

*23.	Offset circuits	Checked	
	a. Attitude reference switch	INS/SET	(FCO)
	b. FC panel override switch	NRML (red light out)	
	(1) FCD TGT T	1 CM fwd	
	(2) Movable reticle	50 ± 3 MILS fwd	(P)
	(3) Guidance needles	Checked	(P)
	(a) Pitch steering bar	Slightly up	
	(b) Bank steering bar	Slightly right	
	(4) FCP offset direction	090°	
	(a) Pitch steering bar	NULL	(P)
	(b) Bank steering bar	Slightly right	(P)
	(c) Movable reticle	25 ± 3 MILS down	(P)
	(d) FCD TGT T	1/2 CM low	
	(5) Offset direction	Rotated through to 360 degrees	

The FCD safety circle, primary sensor and firing zone symbols should not move. The FCD TGT T and the pilot's movable reticle, however, should now describe a 2:1 (length to height) ellipse as they react to the changing offset direction. If the offset direction is changed from N-E-S-W-N, both the TGT T and the movable reticle will now move clockwise.

	(6) FCP offset distance	0 Meters	

Remove offset with control knob, FCD symbols should be recentered and pilot's reticles superimposed (± 2 mils)

24.	Vertical reference system	SET Hdg.	(P)
*25.	FCC	SET for flight	
	a. Alignment switch	Down	
	b. TAS	SET	
	c. Altitude	SET	
*26.	FCD	OFF	

*27. FC Panel	Set for flight
a. Wind	SET
b. Time of fall	SET
c. Offset range & bearing	SET
d. Azimuth & Elevation counts	SET
e. Power switch	OFF
28. Radar pressurization system	Checked/Normal

NOTE

Set at 40 inch Hg, should hold a minimum of 38 inch Hg for 10 minutes.

CAUTION

Do not exceed 41 Hg.

29. Search Radar — Checked

WARNING

Before placing the function switch to SEARCH, BEACON, or WARNING, make sure that all personnel are clear of the antenna radiation pattern. Avoid directing the energy beam toward inhabited structures, personnel groupings, or areas where airplanes are being refueled/defueled.

CAUTION

If refueling or defueling operation is taking place in the vicinity of the aircraft, this check will be completed during runup.

a. Function switch	SEARCH
b. Antenna selector	R
c. Test meter (line .5 to .7 mag .3 to 1.0 mixer 1, 2 and AFC 1, 2 - .3 to .9)	Checked/Mag
d. Intensity control	Adjusted
e. Range marks	Adjusted
f. Gain and tilt	Adjusted (for pictures)
g. Stab switch	OFF

CAUTION

The stab switch will be off at any time the aircraft is taxiing or moving on the ground. If thunderstorms or heavy buildups are in the area, then pencil beam, iso-echo and tilt will be positively checked prior to takeoff.

*30. MTI	Checked (as required)
a. Mode switch	STANDBY/ALERT
b. Scan switch	SLOW
c. Mode switch	OPERATE
d. BIT switch	Depressed/Checked
e. Mode switch	OFF
31. Search radar	OFF
32. ARN-92 loran	
a. Position fix	Inserted
b. Variation	Checked
c. Position update	Depressed
d. Station parameters	Checked/Inserted
e. Destinations	Inserted (As required)
f. Mode Control	OFF
33. N-1 compass operational check	Checked/Set
a. Latitude correction pointer	OFF
b. Master indicator	SYNCHRONIZED AND HEADING CROSS-CHECKED

(1) Synchronize the master indicator to the C-2 transmitter by engaging synchronizer knob and rotating azimuth pointer of the master indicator until the annunciator is zeroed. Check N-1 repeaters. Check against magnetic compass for proper orientation.

c. Master indicator	Checked in D. G. MODE

(1) Set latitude pointer alternately to 60 degrees North, 60 degrees South, then zero. The annunciator dot should rotate clockwise in northern latitudes, and counterclockwise in southern latitudes.

At zero degrees, there should be no movement of the dot. If the dot moves, the latitude dial should be adjusted to stop the movement. The latitude reading at the point of no dot rotation must now be applied as a correction factor when flying in D.G. Mode.

NOTE

If the dot movement is stopped with pointer indicating a northern latitude reading; e.g., 1 degree N, the latitued set into the dial must be increased by 1 degree for northern latitude flights.

d. Latitude correction pointer	OFF
(1) Cross-check N-1 compass with magnetic compass to assure that 180 degrees ambiguity is not present.	
34. Doppler	Checked/OFF
a. Power switch After warmup of one minute	Slew
b. G/S switch	SET/165K
c. DR switch	SET/0
d. Land-sea switch	As required
35. Computer-main control/indicator	SET Mag. track and distance (as applicable)
a. Nav/Drop Switch	As required
36. Radios, Electrical Switches and Antennas	Checked/Set
a. FM #1	Checked (as required)
b. HF #1	Checked (as required)
c. ADF #1	Checked (as required)
d. VHF and TACAN antenna select	As required

NOTE

VHF and TACAN may cause IR Interference. Selection of top antenna may reduce the interference.

e. Radio compass select switches (2)	As required
37. APN-70 loran	Checked/Off

38. Radio Altimeter	Checked (As required) OFF	
39. IFF (some airplanes)	Checked	
a. Master switch	Stby	
b. M-1/M-2/M-3A/M-C	OUT	
c. Master switch	Normal	
d. M-1	Test	
Hold M-1 in test. The green test light illuminated indicates a good check. Return M-1 to out. Repeat with M-2, M-3A, and M-C.		
e. Master switch	OFF	
f. Mode switches	As required	

BEFORE STARTING ENGINES

1. Oxygen equipment	Checked, SET	

NOTE

Each crew member should check the oxygen regulator with mask on and connected to oxygen supply hose as follows:

a. Supply lever	ON	
b. Diluter lever	100%	
c. Emergency toggle lever	EMERGENCY	
d. Breathe normally for a minimum of three cycles. The blinker should show alternately black and white.		
e. Hold breath momentarily (blinker should remain black). Return emergency toggle lever to NORMAL (blinker should remain black).		
f. Breathe normally for a minimum of three cycles as in step d above. Leave the regulator in the following positions:		
(1) Emergency toggle lever	NORMAL	
(2) Diluter lever	100%	
(3) Supply lever	ON	
(4) Oxygen Mask	Connected	
2. Before starting engines check	"Complete"	(CP), (E), (N), (FCO), (IO)

BEFORE TAXI

1. Compass & attitude indicators	"Checked, Set (state hdg)"	(N), (P), (CP)
2. INS/2 axes gyro check	Monitored	
Monitor heading on ARN-92 loran		
3. ARN-92 loran	SET	
a. MODE Cont	LRN	
b. Master search button	Depressed (after MAL light flashes out)	

The loran receiver automatically goes into the fast search mode after the master search button is depressed. This takes about two minutes. If no signals are detected satisfactorily, the receiver then switches to the slow search mode, which is 16 times slower (32 minutes for a full cycle). If no signals are locked on in the first 2 minutes due to the receiver oscillator not being properly warmed up, there is a chance that an excessive lockon time will occur due to the set having switched to the slow search mode. If no lockon has occurred after the 5 minute warm-up period, redepress the master search button.

4. Radios, radar & IFF	On/Standby (as required)	
a. Radios	As required	
b. Search radar	Standby	
c. MTI	As required	
d. IFF (some airplanes)	Standby	
5. Doppler radar	Slew	
6. Radio Altimeter	Adjusted	
7. Altimeters	"State Setting"	(CP), (P), (N), (FCO)
8. Before taxi checks	"Complete"	(CP), (E), (N), (FCO), (IO)

BEFORE TAKEOFF

1. Safety belt & shoulder harness	Fastened, Unlocked	
2. Departure procedures coordinated with pilots & copy clearance	As required	
3. Before takeoff checks	"Complete"	(CP), (E), (N), (FCO), (IO)

LINEUP

1. IFF/SIF (some airplanes)	SET
2. Seat facing forward	

NOTE

Items 3 thru 6 completed after start of takeoff roll.

3. Loran TAS	SET
4. Loran update	Depressed
5. Doppler radar	ON
6. Doppler computer	As Required
7. Lineup check	"Complete" (CP), (N)

AFTER TAKEOFF

1. Takeoff time	Recorded
2. Search radar	SET
3. X-band beacon	As required
4. Radar pressurization	Monitored
5. Hot mike listen	As required

ENROUTE

1. Instrument Checks	Completed
a. TAS	Checked (as required)
b. Deviation	Checked (as required)

FIRE CONTROL ALIGNMENT CHECK

1. Interphone	SET
a. P2 monitor	UP
2. Alignment altitude and indicated air speed	Computed, Announced
a. TAS	Computed
b. Indicated altitude	Computed
3. Fire control display	SET
a. Power switch	ON
b. Symbol condition switches	SET
c. Firing zone	SET
d. Safety zone	SET
4. Fire control panel	SET

a. Power switch	ON	
b. Primary sensor	Selected	
c. Gun AZ/EL correction	SET	
d. Coincidence	SET	
5. Computer	SET	
a. TAS	SET	
b. Altitude	SET	

The following items will be completed after alignment orbit is established:

6. Altimeters and airspeed meters	Checked, Compared	
a. Compare altitude to SCR 718 and adjust as necessary		
b. Compare the TAS meter to computed values after copilot announces IAS meter reading.		
7. Relative sensor alignment	Monitored/Assisted	
Select primary sensor as required by the pilot. Sensors will usually be checked and aligned to the TV.		
8. Wind/Offset circuits	Checked if not performed on the ground check	
a. Wind values inserted, bearing and distance displacement checked.		
b. Offset values inserted, bearing and distance displacement checked.		
9. Fire control alignment check	"Complete"	(CP), (E), (N), (FCO)

PRE-STRIKE

1. Fire control display	SET
a. Power switch	ON
b. Symbol condition switches	SET
c. Firing zone	SET
d. Safety zone	SET
2. Fire control panel	SET
a. Power switch	ON
b. Primary sensor	Selected

c. AZ/EL correction	SET	
d. Coincidence	SET	
3. Computer	SET	
a. TAS	SET	
b. Altitude	SET	
4. Lights	As required	
5. Strike briefing	"Complete"	(N), (P)
a. Indicated altitude		
b. IAS		
c. Target elevation		
d. High terrain within 5nm		
e. Other misc information		
Complete the strike briefing as required during the strike portion of the mission.		
6. Inertial position update	Completed as required by FCO	
Completed as required by the FCO during the strike portion of the mission.		
7. Prestrike check	"Complete"	(CP), (E), (N), (FCO), (IO), (WM)

POST-STRIKE

1. Fire control display	OFF	
a. Intensity control	CCW	
b. Power switch	OFF	
2. Fire control panel	OFF	
3. FCS power control switch	A/C PWR	
4. FCS inv control switch	OFF	
5. N-1 Compass	Checked/Set	
Reslave and resynchronize compass after airplane is straight and level. Compare to INS or 2 axes gyro.		
6. Post-Strike Check	"Complete"	(CP), (E), (N), (FCO), (IO), (WM)

BEFORE LANDING PATTERN

1. IFF/SIF (some airplanes)	Checked	

2. Altimeter	"State setting"	(CP), (P), (N), (FCO)
3. Safety belt and shoulder harness	Fastened/Unlocked	
4. Before Landing Pattern Check	"Complete"	(CP), (E), (N), (FCO), (IO)

BEFORE LANDING

1. Hot mike listen	ON	
2. Radar	Set	
a. Stab	OFF	
b. Radome anti-ice	OFF	
3. Approach	Monitored	
4. NAV seat	Facing forward (just before touchdown)	
5. Before Landing Checks	"Complete"	(CP), (E), (N), (IO)

AFTER LANDING

1. Radar/IFF and unnecessary equipment	STANDBY/OFF	
a. Vertical reference system	ON	
b. Search radar	Standby	
c. Radios being used	ON	
d. All other equipment	OFF	
2. Ice control panel	SET	
a. Radome anti-icing switch	OFF	
3. Landing time	Recorded	
4. After Landing Checks	"Complete"	(CP), (E), (N)

OPERATIONAL STOP

After Landing.

1. Radar/IFF	STDBY	
2. Ice control panel	Set	
a. Radome anti-icing	OFF	
3. Ops stop after landing	"Complete"	(CP), (E), (N)

BEFORE TAKE-OFF

1. Safety belt and shoulder harness	Fastened, Unlocked	
2. Ops stop before takeoff	"Complete"	(CP), (E), (N), (FCO), (IO)

LINEUP

1. IFF (some airplanes) — SET
2. Ops stop lineup check — "Complete" (CP), (N)

ENGINE SHUTDOWN

1. Oxygen regulator — Set
   a. Diluter lever — 100%
   b. Supply lever — OFF
2. Vertical reference system, and radar — OFF
3. FCS power control switch — A/C power
4. FCS inverter control switch — OFF
5. Engine shutdown checks — "Complete" (CP), (E), (N), (FCO)

IR OPERATOR

The IR operator has the responsibility of preflighting, operating, and monitoring the forward looking infrared system. He must understand the function of the IR in relation to other sensors, navigation equipment, and the fire control system. He assists, as required, in mission planning. During flight, he activates the IR system, searches for targets, and provides firing guidance to destroy targets. In addition, the IR operator assists the navigator, the fire control officer, and the other sensor operators as required. The IR operator must be familiar with the emergency procedures as they pertain to his duties.

IR OPERATOR'S PROCEDURES

These procedures cover the duties of the IR operator using the AN/AAD-7 forward looking infrared system in the AC-130A aircraft.

PREPARATION FOR FLIGHT

1. Mission planning — Completed

   NOTE

   IR Operator will assist the navigator and fire control officer in preparation and assimilation of target data, maps and charts. He will also study the target area for the mission.

2. Professional, personal and survival equipment. — Checked
3. Mission weather briefing — Attended

EXTERIOR (POWER OFF)

1. Form 781 (A and K sections) — Checked
2. Helium pressure gages — Checked

NOTE

If helium pressure is below 100 PSI it should be serviced to 125 PSI. If pressure is below 60 PSI system should be purged.

3. Receiver Group (shroud/sphere) — Checked

NOTE

Check the entire assembly for security and general condition. Ensure that the unit is intact and there is nothing visibly wrong with the assembly which will prevent it from functioning properly (i. e. missing screws, rivets or damaged metal).

INTERIOR (POWER OFF)

1. Lights — Set
2. 8 inch monitor — OFF
3. IR console circuit breakers — Checked
4. IDS control panel — Set
   a. Field of view select switch - RMT
   b. Mode select switch - OFF
   c. BITE switch - SYS
5. Gimbal mode select switch — OFF/STOW
6. Clock — Set
7. Oxygen system — Checked

NOTE

Each crew member should check the oxygen regulator with mask on and connected to oxygen supply hose as follows:

a. Supply lever - ON
b. Diluter lever - 100%
c. Emergency toggle switch - EMERGENCY
d. Breathe normally for a minimum of three cycles. The blinker should show black and white alternately.
e. Hold breath momentarily (blinker should remain black). Return emergency toggle lever to NORMAL (blinker should remain black).
f. Breathe normally for a minimum of three cycles as in step d above. Leave regulator in following positions:

(1) Emergency toggle lever - NORMAL

(2) Diluter lever - 100%

(3) Supply lever - ON

(4) Oxygen mask - Connected

(5) Walk around bottle - Checked

8. Cargo compartment circuit breakers — Set

   a. Cargo compartment circuit breaker panel - Set

   b. Electronic control amplifier circuit breakers - Set

   c. Power supply circuit breakers - Set

NOTE

Electronic control amplifier and power supply are located outboard of the 20MM ammunition holders.

9. Parachute — Checked

10. Life preserver — Checked/As required

INTERIOR (POWER ON)

1. Work and panel lights — Set

2. Interphone panel — Checked/Set

3. IDS mode select switch — Operate

CAUTION

The IDS mode select switch should not remain in the STBY or OPR position during ground operation for over 45 minutes.

4. Gimbal mode select switch — BRAKE

5. BITE system — Checked

   a. BITE switch - SYS

   b. GO lamp - Illuminated

NOTE

There is a built-in time delay of 30 to 60 seconds for the display circuitry when the IDS mode select switch is set to OPERATE.

6. IR Reticle and scan lines	Checked
7. IDS mode select switch	OFF
8. Remote Control Unit	ON Set

a. PWR switch - ON

b. Video select switches - GRAY SCALE

c. Dot quad Crosshair controls - ON

9. Control switching unit	LOC
10. Scanner alarm (hold for 5 seconds)	Depressed

WARNING

Serious personal injury can result if personnel are in contact with gimbal at time of gimbal movement.

CAUTION

After setting the gimbal select switch from OFF STOW to BRAKE, wait a minimum of 30 seconds before switching to OPERATE.

11. Gimbal mode select switch (after gimbal STBY lamp goes out)	OPERATE
12. Gimbal position control	Checked Set

a. AZ and ELEV movement - Checked

b. Drift and sensitivity - Checked/Set

13. Gimbal AZ Limit/ELEV limit lights	Checked	
14. Fire control interface Sensor movement (SLADS)	Checked Checked	(FCO)
15. Gimbal position control (observe SAD to ensure gimbal stows sphere full forward and up, AZ limit/ELEV limit lights illuminate).	OFF STOW	
16. 8 inch Monitor	ON/Adjusted (TV)	

NOTE

A TV camera must be on before this check can be completed.

a. Brightness control - ON/Adjusted

b. Contrast (10 shades of Gray) - Adjusted

17. 8 inch Monitor	OFF
18. Remote control unit	OFF

BEFORE STARTING ENGINES

1. Lights	Set
2. Hot mike listen	ON
3. Oxygen	Set

BEFORE TAXI

1. IDS mode select switch (note time for cool down) — STBY
2. Compass and attitude indicators — Checked, Set
   a. Compass heading - Checked
   b. Vertical reference pitch bar - Checked/Set
3. Altimeters — Set
4. Overhead bookcase — Secured

TAXIING

1. Gimbal mode select switch — BRAKE

BEFORE TAKEOFF.

1. Booth door	Secured open
2. Safety belt and shoulder harness	Fastened, locked
3. Hot mike listen	ON

FIRE CONTROL ALIGNMENT (PRE-STRIKE)

CAUTION

After approximately 15-20 minutes of cooling time, the cool-down light on the IDS control panel will illuminate, indicating cool-down. This checklist may then be completed. If cool-down lamp does not illuminate within 45 minutes, complete steps 2, 3, and 5 of this checklist. If video on the viewer cannot be achieved, turn IDS mode select switch to OFF and enter the discrepancy in the Form 781.

1. Lights	Set
2. IDS control panel	Set
a. IDS mode select switch - OPR	
b. FOV - Set/as required (TRACK/RMT/SEARCH)	
3. Gimbal mode select switch	OPERATE
4. Control Switching Unit	LOC
5. IR Viewer	Adjusted
a. BRIGHTNESS control - Adjusted	
b. CONTRAST control - Adjusted	
c. IDS video gain - Adjusted	
d. IDS IR intensity - Adjusted	
e. IDS focus switch - Adjusted	
f. 0.8/FULL switch - As required	

CAUTION

Gimbal should be placed in the stow position during rain showers. Water is detrimental to the IR lens coating.

6. Gimbal control panel	
a. AZ/ELEV sensitivity - Set	
b. AZ/ELEV drift - Set	
7. Remote Control Unit	ON/set
a. Power switch - ON	
b. Video select switches - As required	
c. Dot quad/Crosshair controls - Set	
8. 8 inch Monitor	ON/adjusted
a. Brightness - On/Adjusted	
b. Contrast (10 shades of gray) - Adjusted	
9. Sensor alignment point/target	Identified, Tracked

NOTE

Compare boresight of SEARCH and TRACK FOV of IDS.

10. Consent switch	ON (as required)
11. SAD and Slaving	Checked (FCO)

POST-STRIKE

1. 8 inch Monitor	OFF
2. Remote control unit	OFF
a. Dot quad Crosshair controls - OFF	
b. Power switch - OFF	
3. IDS mode select switch	OFF
4. Gimbal mode select switch (check SAD to ensure sphere stows full up and full forward)	OFF STOW
5. Lights	

BEFORE LANDING PATTERN

1. Hot mike listen	ON
2. Altimeters	Set
3. Safety belt and shoulder harness	Fastened/locked

ENGINE SHUTDOWN

1. Oxygen	OFF/100%
a. Supply lever - OFF	
b. Diluter lever - 100%	
c. Emergency toggle lever - NORMAL	
2. Interphone cords	Stowed
3. Lights	OFF
a. Panel lights - OFF	
b. Work lights - OFF	
c. Forward overhead lights - OFF	
4. Form 781	Completed

ELECTRONIC WARFARE OFFICER

Duties:

a. Attend pre-mission briefings.

b. Assimilate required data and intelligence for the mission.

c. Responsible for being thoroughly familiar with the performance and operation of:

1. AN/ASD-5 Black Crow (Direction Finder Set)

2. AN/APQ-150 Beacon Tracking Radar Set

3. All installed ECM equipment

d. Search for, acquire and track both friendly forces and enemy targets.

e. Coordinate with the Pilot, other Sensor Operators, Navigator, and Fire Control Officer in acquiring and attacking targets.

f. Advises crew of threats to the aircraft.

g. Directs appropriate countermeasures.

h. Assists the Navigator and FCO in preparation of the mission report.

i. Generates appropriate logs, RWR reports as required.

j. Attends post-mission debriefings as required.

ELECTRONIC WARFARE OFFICER'S CHECKLIST

Items in quotations indicate that a response is required.

PREPARATION FOR FLIGHT

1. Mission planning — Accomplished

NOTE

The EWO will study the target area, and gather all available intelligence data needed for the mission. He will assist the Navigator in making charts and planning the mission.

2. Mission briefings — Attended

NOTE

The EWO will attend all required mission briefings and will conduct appropriate portions of those briefings.

3. Professional, personal and survival equipment — Checked

EXTERIOR INSPECTION

1. Form 781 — Checked

NOTE

Check for equipment status, expendable loading and pod settings.

2. Antennas, radomes, and dispensers — Checked

a. ECM pods (Right) - Checked. (Check overall general condition.)

b. TRIM-7A center radome - Checked (Visually check right side of radome for obvious damage.)

c. ALR-46 antenna (right forward) - Checked (Verify cleanliness, condition and security.)

d. TRIM-7A antenna (nose) - Checked (Verify cleanliness, condition and security. Cabling in nose wheelwell should be checked.)

e. ALR-46 antenna (left forward) - Checked (Verify cleanliness, condition and security.)

f. ASD-5 radome and deflector - Checked (Check radome for security and damage or deterioration; the deflector should be secured open until after external power has been removed from airplane; check deflector and hinge for security and damage.)

NOTE

The Servo Electronics Unit and Trim 7A antenna cabling in the nose wheelwell should be checked at this time to verify four CB's are IN. This may be coordinated with, and performed by the Flight Engineer.

g. ASD-5 power supply - Checked (Verify CBs are in and cables connected.)

h. TRIM-7A center radome - Checked (Visually check left side of radome for obvious damage.)

i. ECM (left) - Checked (Verify cleanliness, condition and security.)

j. ALR-46 antenna (upper) - Checked (Verify cleanliness, condition and security.)

k. ALR-46 antenna (lower) - Checked (Verify cleanliness, condition and security.)

l. APQ-150 radome - Checked (Check radome for security of mounting, damage or deterioration, and condition of firing. Check that the radome locking screw is safety wired if a wing nut is used.)

m. TRIM-7A antenna (left) - Checked (Verify cleanliness, condition and security.)

n. AFT ALR-46 antennas (Verify cleanliness, condition and security.)

o. AFT TRIM-7A antenna - Checked (Verify cleanliness, condition and security.)

p. TRIM-7A antenna (right) - Checked (Verify cleanliness, condition and security.)

q. LAU-74 (Flare Launcher) - Checked (Verify chaff canister configuration, if applicable)

INTERIOR INSPECTION

1. TRIM-7A cabling (right) — Checked

2. TRIM-7A cabling (left) — Checked

3. APQ-150 receiver-transmitter — Checked

    a. Door (Check the left paratroop door is secured in the Up position (down position for ferry configuration with the locking lever and safety pin in place.)

    b. Locking pins — Checked

    (Two locking pins secure the antenna assembly in either the retracted or extended position; check the pins for secure installation.)

    c. Cables and wires — Checked

4. ALR-46 receiver counter measure/R1854 — Checked

NOTE

Check receiver for security of mounting and proper cable attachment.

5. Manual diffuser handle — Set

NOTE

Setting the manual diffuser handle FULL IN is recommended to establish adequate air flow necessary to ensure normal equipment operation/cooling.

6. TRIM-7A main units (2) — Checked

    a. Cables and mounting - Checked

    b. Test switch - OFF

    c. 115-volt switch - As required (Checked in the ON position unless a particular TRIM-7A is not to be used during the mission in which case it would be checked OFF.)

NOTE

The power supply on the left powers the left-right unit, and the power supply on the right, powers the nose tail unit.

7. TRIM-7A switching units (2) — Checked

NOTE

Checked for security of mounting and proper cable attachment.

8. ALR-46 Signal Processor/CM 442 — Checked

NOTE

Checked for security of cables and mounting.

9. Cargo compartment circuit breaker panels — Checked

10. ECM wing pod circuit breaker panel	Set
11. EWO flight deck circuit breakers	Checked

NOTE

The flight deck circuit breakers may be checked by the flight engineer.

12. Lights	Set as desired
13. Emergency equipment	Checked secure

a. Fire extinguisher (Verify pressure in green)

b. Crash axe (Securely anchored)

c. First aid kit (Check security and inspection due dates)

d. Portable oxygen bottle (Full charged and set on NORMAL)

14. LPU	Inspected adjusted (as required)

a. Check inspection record card for due date of next inspection.

b. Check general condition of LPU i.e.; check security of retaining pins. Ensure no port of preserver is exposed. Ensure container is free from oil, dirt, holes and tears.

15. Parachute	Inspected adjusted (as required)

a. Check inspection record book for currency; i.e; 30-day inspection and 120-day repack.

b. Check general condition of parachute, i.e.; check security of T-Handle, check proper positioning of quick release rings, and check parachute is free from oil, dirt and tears.

c. Adjust parachute for proper fit.

16. Oxygen equipment	Checked, Set

NOTE

See Section IV for Oxygen Procedures

17. Two-man console circuit breaker panel	Checked
18. ECM pod controls	OFF
19. TRIM-7A	OFF, Set

a. Power - OFF

b. Mode - CW

c. Frequency selector switch (1, 2, 3, VAR) - 1

NOTE

The FREQ VAR and SWEEP controls consist of two knobs, coaxially mounted. The smaller knobs are fine adjustments and should be set at mid-travel.

d. FREQ. VAR - CCW, centered

e. Sweep - CCW, centered

f. INT - CCW

20. Antenna switching unit — OFF

21. ALR-46 intensity and audio — CCW

22. ALR-46 display unit — OFF

NOTE

Turn up ALR-46 DIM control to confirm billboard lights are out, indicating the unit is off.

23. ASD-5 — Set

a. System power - OFF

b. Decoder (PAVE MACE) - OFF

c. Manual control - Set

(1) Mount power - OFF

(2) Sensitivity - CW, CW

d. Indicator - Set

(1) Intensity - CCW

(2) Magnifier - X10

(3) Display - Ext Cal

(4) Ext input - AC

e. Control unit - Set

(1) BITE - OFF

(2) Mode select - MNL Track

(3) Track mode display scale - Normal

(4) Audio volume - CCW

(5) Blanking disable - OFF

(6) Consent - OFF

(7) Angle gate - OFF

(8) Angle gate pot - Appr. setting 5

(9) Threshold - Set

CAUTION

Threshold knob should be set to a minimum of 100 to avoid damage to the knob detent.

(10) Search scan (AFT limit) - CCW

(11) Search scan (FWD limit) - CW

(12) Search scan rate - CW

CAUTION

If the ASD-5 is operated in search mode and the forward and aft pots are reversed, the system will drive against itself causing a current overload in the power supply and servo amplifier.

NOTE

The ASD-5 may be checked prior to engine start by utilizing applicable parts of the AFTER TAKEOFF checklist steps 1 and 2, and shutting the system down using the POST-STRIKE checklist step 2.

24. APQ-150 — Set
    a. Mode select - OFF
    b. RSLVR EXC - OFF
    c. 28V CKT BRKR - ON
    d. IF GAIN - CCW
    e. Display intensity - CCW
25. Chaff control panel — OFF (safety cover down)
26. Interphone and radios — Set, monitored
    a. Select the pull out buttons that are to be monitored.
    b. Adjust the master volume control for optimum audio.
    c. Adjust the individual button volumes as required.
    d. Check CALL position with other crew members.
    e. Monitor at least normal interphone and hot mike listen at this time.
27. Clock — Set

BEFORE STARTING ENGINES

CAUTION

Transient voltages may damage the ASD-5 system if both the mount power and the system power are not removed prior to starting engines.

1. Hot mike listen	ON
2. Oxygen system	Set

a. Emergency toggle lever - Normal

b. Regulator diluter lever - 100%

c. Oxygen supply lever - ON

d. Oxygen mask - Connected

BEFORE TAXI

1. Compass and heading indicators	Checked
2. Alarm system	Checked
3. Altimeter	Set
4. Air conditioning panel	Set

a. Cargo compartment temperature control - Set as desired

b. Cargo compartment air recirculation - OFF

TAXIING/BEFORE TAKE-OFF

1. Flight instruments	Checked

NOTE

Check magnetic heading indicator for correct indications on turns. Check attitude indicator adjusted to indicate straight and level flight with no "OFF" flag showing.

2. Safety belt and shoulder harness (Seat facing forward and locked into position).	Fastened locked

AFTER TAKE-OFF

1. Power switches (except possibly ALR-46)	ON, standby

CAUTION

The ALR-46 should not be turned on in close proximity to high power radars or damage to the detectors may result.

a. ECM pods - STBY

b. TRIM-7A - STBY

c. Antenna switching unit - ON

d. ASD-5 system power - ON

e. Decoder (PAVE MACE) - ON

f. ASD-5 mount power - ON

g. APQ-150 - STBY

2. Interphone — Set (As required)

3. ASD-5 — Set

a. Scale - Adjusted (so grid is easily visible)

b. Intensity - Adjusted (increase until antenna reference square becomes visible).

NOTE

The vertical and horizontal centering controls may be so maladjusted as to place the antenna reference square off the scope. In order to locate it, press the BEAM FIND control located on the intensity control.

c. Focus - Adjusted

d. BITE - Boresight

e. DCD/PRF switch - Checked

f. Threshold - Adjusted

NOTE

Adjust threshold sensitivity until a steady dot cluster appears near the antenna square. This threshold setting represents only a test and calibration setting and not the optimum operating setting.

NOTE

The PRF ALARM light (red) and the AUTO TRACK light (amber) should illuminate.

g. Audio - Adjusted

h. Vertical and horizontal position - Centered

i. BITE - Gain check

j. Track mode display scale switch - Checked

(1) NORMAL - the dot cluster should deflect down 1 cm and to the right 1 cm

(2) EXPANDED - the dot cluster should deflect down 3 cm and to the right 3 cm.

(3) Return to NORMAL.

k. Angle Gate - ON/Checked/OFF

NOTE

Turn the angle gate display on. Then, vary the size of the angle gate, noting that while the dot cluster is within the limits of the angle gate, the MANUAL/AUTO TRACK light is on and steady. Decreasing the size of the angle gate until the dot cluster is no longer within it, should cause the light to go out.

NOTE

Difficulty in obtaining auto track may result if the angle gate pot is left positioned at or near minimum setting. Therefore, the angle pot should be set on an approximate setting of 5 or larger to ensure a rapid transition from manual track to auto track.

l. BITE - OFF

m. Pedestal Power Lamp - ON

NOTE

Pedestal power lamp will illuminate following a 60-second delay after the mount power switch is turned ON.

n. Mode select - SEARCH

o. Antenna position limits - Checked (Drive the antenna to each limit and check to see that AFT, UP, FWD and DOWN indicators light amber).

p. Search scan limits - Checked/Set

(1) AFT LIMIT pot - Rotate CW and note that the sweeping antenna stops short of its original stop. Set pot to desired setting.

(2) FWD LIMIT pot - Rotate CCW and note the sweeping antenna stops short of its original stop. Set pot to desired setting.

CAUTION

If the AFT limit and FWD limit pots are reversed, the system will drive against itself causing a current overload in the power supply and servo amplifier.

q. Scan rate - Checked Set (Vary the rate pot while the antenna is sweeping and watch for a corresponding change in antenna speed)

r. Mode select - Manual Track

s. Threshold - Set Increase the threshold setting to achieve optimum sensitivity.

t. Blanking disable switch - ON Checked OFF

4. APQ-150 — Checked

CAUTION

If the amber IND FAULT indicator light illuminates and remains lit after turn-on, turn the mode switch to OFF and do not turn the set back on. Damage to the set may occur.

NOTE

If the amber RTR FAULT light illuminates after initial turn-on, recycle the mode switch to OFF and back to STBY to clear the fault. If the fault cannot be cleared, turn the set OFF.

NOTE

After the set is initially placed in standby a 60 second time delay is required before the set can be placed in full operational use.

a. Indicator - Tuned

   (1) PANEL ILLUM - Set (to desired brightness of panel markings).

   (2) SCALE ILLUM - Set (to desired graticle illumination).

   (3) IF GAIN - Fully CW

   (4) DISPLAY INTEN - Adjusted (to obtain a sharp well defined scope display)

b. Antenna drive - Checked (for aft, forward, up, and down drive)

NOTE

The antenna can be electrically driven past its physical limits, and may require up to 15 seconds of depression on the control stick in the opposite direction before the antenna will move off the limit.

c. Range slew - Checked (using the range slew switch, check to see that the range gate will drive correctly)

d. Display range - Checked (using the DISPLAY RANGE NAUTICAL MI switch, go from the X1 position to the X2 position and check, using an actual signal or the range gate, that the range is actually changing)

e. Mode selector - MNL

f. Antenna scan - Checked (Spiral) (that antenna spiral scans from the reference angle a maximum of ± 10 degrees in azimuth and elevation and returns to the reference angle. The green SRCH indicators should be lit.)

g. Mode selector - AUTO

h. Antenna scan - Checked (Linear) (that the antenna scan is linear ± 25 degrees either side of the reference angle.) The amber TRACK light and the green SRCH indicator should be lit.

NOTE

When in Auto mode and acquisition is lost, the antenna will go into a spiral scan. At times an outside signal may cause the antenna to go into the Spiral mode. If this happens, the operator may go to STBY and then return to AUTO or push the INHIBIT if the Sector Scan operation is not desired.

i. Mode Selector - BRST

j. Antenna Alignment - Checked (Check that antenna reference angle mark is at zero in both azimuth and elevation.)

k. Mode selector - STBY/AUTO

NOTE

Selector may be left in AUTO to facilitate acquisition and tracking for sensor alignment.

FIRE CONTROL ALIGNMENT CHECK

1. Electronic interference — Reduced (as required)

NOTE

Reduce electronic interference to the ASD-5 and to the APQ-150 as required to complete the sensor alignment. This may include but is not necessarily limited to: propeller governing, TD valves, APN-59, TACAN and IFF. Coordination with other crew members will be required in the elimination of most forms of interference.

2. ASD-5 Checked

   a. Mode selector - MNL TRACK

   b. Drift Controls - Adjusted for geometry

NOTE

When the aircraft is at alignment altitude, and is in proper geometry, adjust the drift controls to stop movement of the antenna. This must be accomplished in Manual Mode.

   c. Beacon - Acquired

   d. Mode selector - AUTO TRACK

   e. Threshold - Adjusted(to eliminate as much of the background noise and other signals as possible.)

   f. Angle Gate - Adjusted (to eliminate other signals as necessary.)

   g. Centering - Adjusted (Adjust vertical and horizontal centering controls to place the beacon return under the crosshairs.)

   h. Decoder (Pave Mace) - Checked (that correct coding is being received in DCD position, and that PRF position is operating correctly.)

   i. Consent - ON

3. APQ-150 Checked

NOTE

When trying to acquire a radar transponder, the APN-59 should be placed to STANDBY or OFF.

   a. Code select switch - As required (set code of beacon if known)

   b. Mode control - Slave

NOTE

Checking of the Slave Mode of operation, steps b and c. can be accomplished after the system has been checked in the HUD if "lockon" has already occurred.

   c. Slaving - Checked (that the APQ-150 will slave to within two degrees of each of the other sensors that are tracking the alignment point.)

   d. Mode control - AUTO, MNL (Acquire and track the beacon.)

CAUTION

If the radar set is to remain in the STBY mode for an indefinite period of time, reduce the CRT DISPLAY INTEN or damage to the CRT may result.

e. Mode control - STBY/OFF (as required after sensor alignment is complete.)

4. ASD-5 SAD and Slaving — Checked

a. SAD - Checked (that the relative needles are nulled when each of the sensors that are tracking are selected.)

b. SLAVING - Checked (that the ASD-5 will slave to within 10 mils of each of the other tracking sensors.)

c. INS Storage - Checked (that targets can be stored in the INS from the ASD-5.)

ENROUTE

NOTE

The enroute checks should be accomplished as soon as possible after takeoff because of the impact that equipment malfunctions could have on continuing the mission.

1. Antenna switching unit — Set

a. Dimmer - Set

b. Attended - Selected

c. Normal - Selected

2. ALR-46 — Checked

a. Power switch - On

b. Dim control - Set

c. Intensity - Set (coordinated with CP)

d. Audio - Set (coordinated with CP)

e. Self test - Checked (coordinated with CP)

f. Enroute ALR-46 check - Complete

3. TRIM-7A — Checked

a. Intensity - Set (to a level high enough to display on the CRT.)

b. Self-test - Performed

(1) Test button - Depressed

(2) Control switch - READY

(3) Intensity - Set (Optimum)

(4) Sweep - Adjusted

(5) Focus - Adjusted

(6) Mode select switch - Checked

NOTE

As each mode is selected, check the CRT for the correct display pattern. Lights will also be checked for correct indications.

(7) Frequency switch - Checked

NOTE

During the mode select switch check, the frequency switch will be checked for proper operation.

(8) Frequency VAR - Checked (The frequency knob will be checked for proper operation through its entire range.)

(9) Antennas - Checked (for proper operation. Note any interference on other systems at this time.)

(10) Control switch - STBY

c. Control unit — Set (as required)

4. ECM pods — Checked

a. Selector - Transmit 1 (Check that white lamp number 1 goes out and green lamp number 1 blinks.)

b. Selector - Transmit 2 (Check that white lamp number 2 goes out and green lamp number 2 blinks.)

c. Selector - Both (Check that both white lamps 1 and 2 go out and green lamps 1 and 2 blink.)

d. Interference - Checked

e. Selector - STBY

5. Enroute Checks — "Complete" — (CP) (EWO)

PRE-STRIKE

NOTE

The EWO's pre-strike checklist will be accomplished prior to entering any threat area.

1. Electronic interference (reduce as necessary to perform the strike portion of the mission.) — Reduced (as required)

2. ASD-5 — Set

   a. Threshold - Adjusted (optimum setting)

   b. Audio - Set

   c. Angle gate - Set

   d. VERT POS and HORIZONTAL POS - Centered

3. APQ-150 — Set

NOTE

When trying to acquire a radar transponder, the APN-59 must be placed to STANDBY or OFF. Leaving the search radar in a transmitting mode, will cause over interrogation of the transponder and could make acquisition impossible.

   a. Transponder code - Set

   b. Indicator - Tuned

   c. Mode selector - As required

4. Dispensers and flare launchers (chaff control panel) — ARMED (As required)

CAUTION

Do not release cannisters at 2 1/2 second intervals or faster, when in the IO/EWO position.

   a. MANUAL/RIPPLE switch - Set as required

   b. Intervalometer - Set/as required

   c. HOME switch - Depress

   d. Launch safety cover - Up

   e. Selector - As required

5. ECM equipment — Checked, Set

   a. ALR-46 - Set, Monitored

      Set the controls as required for the mission. Monitor the equipment as long as the aircraft remains in a possible threat area.

   b. TRIM-7A - Set (as required for the mission)

   c. ECM Pods - Set (as required for the mission).

POST-STRIKE

1. AN APQ-150 — OFF

   a. Display inten - CCW

   b. Mode switch - OFF

2. ASD-5 — OFF

   a. Mode selector - MNL TRACK

   b. Threshold - CCW (100) (stop CCW rotation at 100 to prevent damage to control)

   c. Mount power - OFF

   d. Decoder (Pave Mace) - OFF

   e. Antenna - Pinned

NOTE

The antenna should move to the aircraft boresight position and remain there after the pedestal power light goes out. The pedestal power light extinguishes even if the antenna is not properly caged.

   f. Intensity - CCW

   g. Scale - CCW

CAUTION

Damage to the system can occur if system power is turned off before mount power light goes out.

   h. System power - OFF

BEFORE LANDING PATTERN

1. TRIM-7A's — OFF
    a. Intensity - CCW
    b. Control switch - OFF
2. Antenna switching unit — OFF
3. ALR-46 — Set
    a. INTEN controls - CCW (CP, EWO)
    b. Audio - CCW
    c. Power switch - OFF
4. ECM pods — OFF
5. Chaff control panel — OFF (Red guard down)
    a. Launch switch - OFF (Guard down)
    b. Intervalometer 9-9-9 - Set
6. Altimeter — Set
7. Safety belt and shoulder harness — Fastened, locked
8. Hot mike listen — ON
9. Main interphone — Set (As required)

AFTER LANDING

1. Unnecessary equipment and switches — OFF

ENGINE SHUTDOWN

1. Oxygen regulator — OFF, 100%
    a. Diluter lever - 100%
    b. Supply lever - OFF
2. Air conditioning control panel — Set
    a. Cargo compartment air recirculation control — OFF
3. Panel and work lights — OFF
4. Forms — Completed (as required)
    a. 781 Forms

b. RWR Reports

c. Logs

5. Debriefings attended — As required

TV OPERATOR

The TV operator attends premission briefing, assimilates mission data and is thoroughly familiar with the functions of the TV sensor system and its subsystems. He coordinates with the other sensor operators, navigator and fire control officer in the target area, acquiring and tracking targets, and maintaining proper target orientation. He assists in the assessment of target damage and destruction. He attends maintenance, operations and intelligence debriefings as required.

TV OPERATOR'S PROCEDURES

These procedures cover the TV Operator's duties on all missions of the airplane.

PREPARATION FOR FLIGHT

1. Maps and charts — Checked
2. Professional, personal and survival equipment — Checked
3. Mission/Weather briefing — Attended

EXTERIOR (POWER OFF)

1. Form 781 (A and K sections) — Checked

INTERIOR (POWER OFF)

NOTE

The purpose of the power off inspection is to insure that power to the individual items of equipment is off. Since many of the power switches are pushbutton type, lights must be on to determine whether a pushbutton is OFF or ON.

1. Lights — Set
2. TV monitors — Set
   a. Circuit breakers — Set
   b. Cables — Connected
   c. 75 OHM/High switches — 75 OHM
3. Filter box — Checked

NOTE

Insure box contains proper WTV filters.

4. TV console circuit breakers	Set
5. Video switching unit	Checked
a. Circuit breakers	Checked
b. Cables	Checked
6. 8 inch and 14 inch monitors	OFF/Secure
7. 2KW search light control panel	OFF
a. Platform power switch	OFF
b. Searchlight power switch	OFF
c. Lamp power switch	OFF
d. Press-To-Test lights	Checked
8. Remote control units	OFF
9. Mount power switch	OFF/STOW
10. TV/LTD control panel	Set/OFF
a. Laser power switch	OFF
b. Laser fire switch	OFF (safety cover down)
c. TV control knob	OFF
d. Filter control knob	C position
e. Press-To-Test lights	Checked
11. Laser illuminator control panel	Set/OFF
a. Power switch	OFF
b. Range switch	Man
c. Output switch	RPP
d. Pulse width knob	Max
12. Oxygen equipment	Checked/Set

NOTE

Each crewmember should check the oxygen regulator with mask on and connected to oxygen supply hose as follows:

a. Supply lever	ON
b. Diluter lever	100%

c. Emergency toggle lever	EMERGENCY
d. Breathe normally for a minimum of three cycles. The blinker should show alternately black and white.	
e. Hold breathe momentarily (blinker should remain black). Return emergency toggle lever to NORMAL (blinker should remain black).	
f. Breathe normally for a minimum of three cycles as in step d above. Leave the regulator in the following positions:	
(1) Emergency toggle lever	NORMAL
(2) Diluter lever	100%
(3) Supply lever	ON
(4) Oxygen mask	Connected
(5) Walk around bottle	Checked
13. 2KW searchlight	Checked
a. Filter	IR or Clear (as required)
b. Filter clamps	Checked
c. Circuit breakers	Set
d. Illuminator switch	ON (AFT)
e. Pedestal lock pins	Removed
f. Friction locks (if installed)	Lowered
g. Rain cover	Removed
14. Circuit breaker panel (cargo compt)	Checked
a. 4 AC circuit breakers	Checked
b. 3 DC circuit breakers	Checked
15. TV/laser platform	Checked
a. TV cameras	Secured
b. TV lens cover	Removed
c. WTV filter	As required
d. Laser illuminator lens cover	Removed
e. LTD lens cover	Removed
f. Platform balance	Checked
g. Cables and cryogenics lines	Connected
16. IFF	Set MODE II code

17. Laser illuminator Dewar	Checked

NOTE

Dewar should be 90% full to fly two missions and at least 50% full to fly one mission.

a. Pressure gage (6 psi minimum)	Checked
b. Nitrogen quantity	Checked
c. Filler caps	Replaced
18. Camera electronics boxes	Checked
a. Circuit breakers	Checked
b. Cables	Connected
19. TV laser platform electronics box	Checked
a. Circuit breakers	Checked
b. Cables	Connected
20. Laser electronics box	Set/As required
a. Operate/Off/Remote switch	Remote
b. Circuit breakers	Set
21. Laser illuminator electronic control amplifier	Checked
22. LTD power circuit breakers (on main DC and AC panels)	Pulled
23. Parachute	Checked
24. Life preserver	Checked/As required

INTERIOR (POWER ON)

1. Panel lights	ON
2. Interphone	Checked/Set
3. TV control switching unit	LOC
4. Mount power switch	ON

NOTE

Observe mount operate light comes on within 30 seconds.

5. Remote control units	ON Set
a. Power switches	ON
b. 8 inch RCU	ON
c. 14 inch RCU	ON
d. Crosshair and dot quad switches	ON
6. Monitors	ON
7. TV/laser platform	Checked, Positioned

NOTE

Using SAD, check for freedom of movement within field of view outside of aircraft.

8. TV control knob	ON/(as required)

CAUTION

When checking gray scale retain a picture on the opposite monitor at all times to prevent cameras from pointing at any bright light source.

NOTE

Set filter select knob if TV control knob is set to SPCL position.

9. Remote control units	Gray scale/Alternately Set
10. Monitors	Checked, Alternately
a. Brightness	Adjusted
b. Contrast (10 shades of gray)	Checked
11. TV imagery	Checked (FCO, IR)
a. WTV Video	Checked
b. NTV Video	Checked
c. Dot Quad	Checked
d. Drift and sensitivity	Checked/Set

12. TV Control/Filter select knobs	OFF/C
13. Fire control interface	Checked/(FCO)
a. Sensor movement (SLADS)	Checked
14. Monitors	OFF
15. Remote control units	OFF
16. 2 KW searchlight platform	Checked
a. Searchlight CSU	TV
b. Platform power	ON
c. Platform movement	Checked
d. Platform power	OFF
17. Mount power switch	OFF/Stow
18. 2KW searchlight pins	Installed

CAUTION

Avoid looking outside aircraft with TV/laser platform during engine start to prevent damage to TV/laser lens.

19. WTV filter	As required

BEFORE STARTING ENGINES

1. Lights	Set
2. Hot mike listen	ON
3. Oxygen	Set, ON, 100%
a. Emergency toggle lever	Normal
b. Regulator diluter lever	100%
c. Oxygen supply lever	ON
d. Oxygen mask	Connected

BEFORE TAXI

1. Compass and attitude indicators	Checked, Set
a. Compass heading	Checked

b. Attitude indicator pitch bar - Checked

2. Altimeter	Set
3. Laser illuminator power switch (Note time for cool down)	STANDBY

BEFORE TAKEOFF

1. Booth door	Secured/Open
2. Safety belt and shoulder harness	Fastened/Locked

AFTER TAKEOFF

1. Booth door	Closed
2. Lights	Set
3. 2KW searchlight pins	As required
4. TV control switching unit	LOC
5. Mount power switch	ON
6. TV laser platform	Positioned
7. Remote control units	Set
a. Power switches	ON
b. WTV, NTV, IR, gray scale	As required
c. Dot quad and crosshairs	ON
8. Monitors	ON
9. TV Control/Filter select knobs	ON (as required)

CAUTION

During daylight do not turn cameras on unless a neutral density filter is used; do not aim cameras at any bright light source at anytime.

10. Monitors	Adjusted
a. Brightness	Adjusted
b. Contrast (10 shades of gray)	Adjusted
11. 2KW searchlight	Set (as required)
a. Platform power switch	ON
b. Searchlight power	ON
c. Lamp power	ON

d. Searchlight CSU	TV
12. Laser illuminator control panel	Set

WARNING

Permanent eye damage can occur from viewing laser at distances of less than 80 feet or reflected laser beam at a total distance of less than 80 feet. If lasing does not stop when the lasing limits are exceeded with the TV/laser platform, turn the laser off and do not use.

a. Lase switch (after ready light illuminates)	LASE (as required)
b. Range switch	MAN
c. Range control knob	Adjusted
d. Range switch	Auto
e. Camera gate width	As required
f. Output	RPP (MAX if required)
g. Pulse width	Adjusted (as required)

NOTE

The GAAS filter should be installed on WTV camera when laser illuminator is being used.

FIRE CONTROL ALIGNMENT

1. LTD power circuit breakers (on main DC and AC panels)	Set/As required
2. Alignment point/target	Tracked

Coordinate with other sensors and pilot

3. Drift and sensitivity	Adjusted
4. Auto slaving (control switching unit)	Checked
5. Sensor angle display	Checked

WARNING

Serious eye damage or blindness may result if the energy of the LTD is beamed directly or indirectly into the eyes from a distance of less than 4000 feet. If lasing does not stop when the lasing limits are exceeded with the TV/laser platform, turn the laser off.

6. LTD boresight	Completed/As required

PRE-STRIKE

1. LTD power circuit breakers (on main DC and AC panels)	Set/As required
2. Consent switch	ON/As required
3. TV/LTD control panel Power/Fire switches	As required
4. 2KW searchlight	As required

POST-STRIKE

1. 2KW searchlight control switches	OFF/As required
a. Lamp power	OFF

CAUTION

After turning lamp switch off wait at least 30 seconds before turning searchlight power switch off.

b. Searchlight power	OFF
c. Platform power	OFF
2. TV/LTD control panel Power/Fire switches	OFF
3. Laser illuminator control panel	OFF
a. Power switch	OFF
b. Range switch	OFF
c. Output	RPP
d. Pulse width knob	CCW
4. TV/LTD control panel	OFF/C
a. TV control knob	OFF
b. FILTER select knob	C position
5. Consent switch	OFF
6. Monitors	OFF

7. Remote control units	OFF
a. Dot quad and crosshair switches	OFF
b. Power switches	OFF
8. Mount power switch	OFF Stow
a. Check SAD for movement to stowed position.	
b. Observe that mount operate light extinguishes.	
9. 2KW searchlight lock pins	Installed

BEFORE LANDING PATTERN

1. Booth door	Open/Secured
2. Hot mike listen	ON
3. Safety belt and shoulder harness	Fastened Locked

ENGINE SHUTDOWN

1. Oxygen regulator	OFF/100%
2. LTD power circuit breakers	Pulled
3. Laser electronics box switch	OFF
4. TV cameras and laser lens covers	Replaced
5. IFF	Remove MODE II setting
6. Form 781	Completed/As required
7. Lights	OFF
8. Personal equipment	Removed from aircraft
9. Debriefing	As required

FIRE CONTROL OFFICER

The Fire Control Officer performs duties as the coordinator between the booth and flight deck. His duties are focused on solving the ballistic wind problem and fire control errors (tweeking) for deliverance of accurate ordinance on the target. He asseses the inflicted battle damage. He must fully understand the fire control problem. the fire control system. the sensor system. the inertial navigation (targeting) system. and the gun system. Premission activities include determining and briefing the assigned aircraft's status as a weapons system and INS alignment. In flight. he coordinates the sensors in detecting. validating and destroying targets. After flight. he attends the mission debriefing. The FCO must be thoroughly familiar with the FCO's challange items in Section II and the emergency procedures as they pertain to his duties.

FCO CHECKLIST

Items in quotes indicate that response is required.

PREPARATION FOR FLIGHT

1. Professional and personal equipment — Checked
2. Mission planning — Completed
   a. Sensor status

      Determine present maintenance status.

   b. Fire control system status

      Determine present maintenance status.

   c. Guns status

      Determine present maintenance status.
3. Mission briefing — Attended
   a. Mission profile coordination with aircraft commander. and navigator during flight planning phase: to include a discussion of sensor alignment. wet boresight and target recce sequencing.

   b. Brief pilots. navigator and sensor operators on status of sensors. fire control system and guns.

   c. Obtain time hack.

   d. Receive mission intelligence. weather and aircraft commander's briefing.

INTERIOR (POWER OFF)

1. Form 781 — Checked
   a. Check gun settings and scale corrections and determine proper settings for briefed altitudes.

   b. Check equipment status in form 781, parts A and K.
2. Gun settings — Submitted to lead gunner
3. Lights — Set

4. Attitude reference switching unit	2 Axis
5. Monitor	OFF
6. Remote control unit (RCU)	OFF
7. BDA recorder control	OFF/STOP
8. MSU mode selector switch	OFF
9. FCO console circuit breakers	Checked
a. FCO panel circuit breakers	Set/as required
(1) INS Ø A, B, and C	Out (OFF)
(2) BDA recorder circuit breakers	Set/as required

NOTE

If BDA recorder is not installed, pull BDA circuit breakers.

b. INS pallet circuit breakers	Set
(1) 115 VAC sys	Set
(2) 115 VAC HTR	Set
(3) 26 VAC EXC	Set
(4) Battery circuit breaker	Set
c. Monitor circuit breaker	Set
d. Monitor impedance switch	Set to 75 Ohms
e. BDA recorder control circuit breaker	Set
10. BDA recorder and spare tapes	Installed/On board

INTERIOR (POWER ON)

1. Lights	Set
a. Panel lights	
b. Worklight	
c. 5 volt lighting	
2. Aircraft power AC/DC	Checked
3. FCO panel INS circuit breakers (Ø A, B, and C)	IN (ON)
4. Auto/MAN/Remote switch	MAN
5. MSU Mode selector switch	STBY
6. CDU Display selector switch	POS

7. MSU BATT annunciator	Out
8. Left numerical display	OOOOON
9. Right numerical display	277OXX
10. FROM/TO display	OO
11. CDU Display selector switch	Test
a. Left numerical display	88°88. 8° N/S (N/S Superimposed)
b. Right numerical display	888°88. 8° E/W (E/W Superimposed)
c. From/To display	88
d. ALERT annunciator	ON (amber)
e. BATT annunciator	ON (amber)
f. WARN annunciator	ON (red)
12. CDU Display selector switch	POS
13. Alignment position coordinates	ENTERED
a. WPT selector switch	Not critical
b. Latitude designator pushbutton (N2 or 8S)	Press
c. INSERT pushbutton (indicator)	Illuminated
d. Latitude degrees, minutes, and hundredths of minutes (tens of degrees inhibited) pushbuttons.	Press Consecutively
e. Left numerical display	Desired latitude (no degree, minute, or decimal marks)

NOTE

In this and subsequent data keyboard entry procedures, if a keying error is made, press the CLEAR pushbutton and repeat the data entry procedures.

f. INSERT pushbutton	Press (Indicator goes out)
g. Left numerical display	Entered latitude ±0. 01 arc-minute
h. Longitude designator pushbutton (W4 or 6E)	Press
i. INSERT pushbutton (indicator)	Illuminated
j. Longitude degrees, minutes, and hundredths of minutes (hundreds of degrees inhibited) pushbuttons.	Press consecutively

k. Right numerical display	Desired longitude (No degree, minute, or decimal marks)
l. INSERT pushbutton	Press (indicator goes out)
m. Right numerical display	Entered longitude ±0.01 arc-minute

CAUTION

DO NOT allow the aircraft to be moved during ALIGNMENT.

14. MSU mode selector switch	ALIGN
15. CDU Display selector switch	DSR TK/STS
16. Right numerical display	Monitored

a. 90 (at STBY)

b. 80 (one minute after STBY)

c. 70 (at ALIGN or 2 min after STS 80)

d. 60 (System has reached operating temperature and an automatic system alignment test is made).

17. Annunciator Lights	Out

NOTE

If WARN annunciator flashes during alignment, set display selector switch to POS and verify that correct present position coordinates were initially inserted. Turn MSU mode selector switch OFF and reinitiate alignment procedures. If WARN annunciator flashes again, note present position coordinates and status, turn MSU mode selector switch OFF, and notify maintenance.

18. Personal and professional equipment	Checked and Stowed
19. Parachute	Inspected and adjusted
20. Oxygen equipment	Checked/Set

NOTE

Each crewmember should check the oxygen regulator with mask on and connected to oxygen supply hose as follows:

a. Supply lever	ON
b. Diluter lever	100%
c. Emergency toggle lever	EMERGENCY

d. Breathe normally for a minimum of three cycles. The blinker should show alternately black and white.

e. Hold breath momentarily (blinker should remain black). Return emergency toggle lever to NORMAL (blinker should remain black).	
f. Breathe normally for a minimum of three cycles as in step d above. Leave the regulator in the following positions:	
(1) Emergency toggle lever	NORMAL
(2) Diluter lever	100%
(3) Supply lever	ON
(4) Oxygen mask	Connected
21. BDA Recorder	Threaded/Checked
a. Cover removed from recorder	
b. Recorder mode switch in neutral position and in Detent	
c. Tape properly threaded	
d. Recorder mode switch in RECORD position and in DETENT	
e. Circuit breakers	IN (press to test)
f. Control panel	Lights checked (press to test)
g. Tape counter set to zero position	
h. Control panel power switch	STBY
i. STOP/REC switch	REC
j. Check: Record light Tape transport operation Tape counter operation	ON
k. STOP/REC switch	STOP
l. Control panel power switch	OFF
m. Recorder cover installed	
n. Spare reels stowed and reel numbers recorded	
22. Remote control unit (RCU)	ON/Set
a. RCU power switch	ON
b. WTV, NTV, or gray scale	Selected as required
c. Reticle buttons	Set as required
23. Monitor	Checked
a. Brightness knob	ON/Adjusted

b. Contrast (10 shades of gray)	adjusted
c. Brightness knob	OFF
24. Remote control unit (RCU)	OFF
25. Interphone	Checked/Set
a. Headset	Connected
b. Monitor switches	Pulled/Adjusted
(1) Hot mike listen	Pulled
(2) Interphone	Pulled
(3) Private 2	Pulled
(4) UHF-1, VHF, and FM-1	As required
c. Wafer switch	Set as required
26. FCO/Sensor SAD interface (Coordinate with IR/TV by comparing readings on SAD panel.)	Checked
27. CDU-Right numerical displays	Monitored
a. 50 (alignment continues satisfactorily)	
b. 40 (alignment continues satisfactorily)	
c. 02 (Mini-bias corrections being made, keep movement on aircraft to a minimum)	
28. Ready NAV annunciator (eight minutes after status 40 disappears)	On (02 or less in right numerical display)
29. MSU mode selector switch Ready NAV annunciator goes out	NAV

CAUTION

Do not set MSU mode selector switch out of NAV except when an INU malfunction occurs.

30. Preplanned destination coordinates	Enter (WPT 9)
a. CDU Display selector switch	WPT
b. WPT selector switch	9
c. Latitude designator pushbutton (N2 or 8S)	Press
d. INSERT pushbutton (indicator)	Illuminated
e. Latitude degrees, minutes, and hundredths of minutes (tens of degrees inhibited) pushbuttons.	Press Consecutively

f.	Left numerical display	Desired latitude (no degree, minute, or decimal marks)
g.	INSERT pushbutton	Press (Indicator goes out)
h.	Left numerical display	Entered latitude ±0.01 arc-minute
i.	Longitude designator pushbutton (W4 or 6E)	Press
j.	INSERT pushbutton (indicator)	Illuminated
k.	Longitude degrees, minutes, and hundredths of minutes (hundreds of degrees inhibited) pushbuttons.	Press consecutively
l.	Right numerical display	Desired longitude (no degree, minute, or decimal marks).
m.	Insert pushbutton	Press (indicator goes out)
n.	Right numerical display	Entered longitude ±0.01 arc-minute

31. Preplanned target coordinates — Enter (WPT8, TK CHG 01 thru 08)

a.	CDU Display selector switch	WPT
b.	WPT selector switch	8
c.	TK CHG pushbutton	Press (indicator comes on)
d.	INSERT pushbutton (indicator)	Illuminated
e.	FROM/TO display	Blanks
f.	Any target number pushbutton (1 thru 8)	Press
g.	FROM/TO display	Blank X (x is any target number 1 thru 8)
h.	INSERT pushbutton	Press (indicator goes out)
i.	FROM/TO display	OX
j.	TK CHG pushbutton (indicator)	Out
k.	Left numerical display	Previously entered latitude ±0.01 arc-minute (no degree, minute, or decimal marks)
l.	Perform steps "c" through "n" in preplanned destination coordinates entry procedure (Item 30).	

m. Target storage number	Log (as required)
32. Preplanned alignment altitude	Set (WPT 1)
a. CDU Display selector switch	WPT
b. WPT selector switch	1
c. Left numerical display	Blanks
d. 6E pushbutton	Press
e. Right numerical display	E
f. INSERT pushbutton (indicator)	Illuminated
g. Feet of altitude-above-ground pushbuttons	Press consecutively
h. Right numerical display	Desired altitude-above-ground in feet
i. INSERT pushbutton	Press (indicator goes out)
j. Right numerical display	Entered altitude above ground
33. Inertial Fire Control heading interface. (Coordinate INS heading inputs to FCS with NAV during FCS BIT check.)	Checked
34. Vertical reference system headings	Set
a. 2 Axis gyro heading (Have NAV set 2 Axis gyro to INS heading after FCS BIT check).	Set
b. INS heading (Set INS heading on the ARU-11/A indicator using the altitude reference heading correction knob)	Set
35. Gun Settings	Checked
a. Confirm proper gun settings with Lead gunner.	
b. Visually check:	
(1) Exterior gun alignment	
(2) Gun scale settings	

BEFORE STARTING ENGINES

1. Lights	Set	
2. Oxygen	Checked/Set	
3. Before starting engines checks (through out remainder of checklist FCO responds for entire booth)	"Complete"	(CP), (E), (N), (FCO), (IO)

BEFORE TAXI

1. Compass and attitude indicators	Checked/Set	
a. N-1 compass repeaters	Checked	
b. Altitude indicators	Checked/Set	
2. Vertical reference system	Checked/Set	(FCO, P)
a. "INS heading ____°, 2 axis gyro selected, checked FCO"		
b. P verify/set 2 axis gyro heading		
c. "INS gyro selected, checked FCO"		
d. P verify INS gyro readout		
3. Altimeter	"State Setting"	(CP), (P) (N), (FCO)
4. Forms	Started (As required)	
5. Before taxi checks	"Complete"	(CP), (E), (N), (FCO), (IO)

BEFORE TAKEOFF

1. Booth Door	Secured open	
2. Safety belt and shoulder harness	Fastened/Locked	
3. Hot mike listen	ON	
4. Before takeoff checks	"Complete"	(CP), (E), (N), (FCO), (IO)

AFTER TAKEOFF

1. RCU	ON/Set	
a. Power switch	ON	
b. WTV, NTV, IR, gray scale	Selected as required	
c. Reticle buttons	Set as required	
2. Monitor	ON/adjusted	
a. Brightness knob	ON/adjusted	
b. Contrast (10 shades of gray)	Adjusted	
3. Sensor alignment altitude	Obtained	
a. Navigator will announce initial altitude for sensor alignment.		
4. INS Altitude - above - ground entry	Checked/Set	
a. CDU Display selector switch	WPT	

b. WPT selector switch	1	
c. Verify correct alignment altitude in right numerical display or reset following procedures listed in Item 32 of Power ON preflight.	Set	

FIRE CONTROL ALIGNMENT CHECK

1. Inertial and 2 axis gyro	Checked/Set	
a. CDU display selector switch	HDG/DA	
b. ARU-11/A indicator INS heading	Checked	
c. 2 Axis/INS switch positions	Selected alternately and compared	

NOTE

If 2 Axis gyro and INS headings differ by more than 5 degrees, reset the 2 Axis gyro heading as follows:

d. 2 Axis/INS switch	2 Axis	
e. Aircraft attitude	Wings level	
f. Have pilot reset 2 Axis gyro to INS TRUE heading	Checked/Set	(P), (FCO)
2. INS altitude-above-ground entry	Checked/Set	
a. CDU display selector switch	WPT	
b. WPT selector switch	1	
c. ... umerical display	Checked/Set as required	
3. Sensor-acquired targets entry	Completed	
a. CDU display selector switch	WPT	
b. WPT selector switch	8	
c. TK CHG push-button	Press (Indicator Comes ON)	
d. INSERT push-button (indicator)	Illuminated	
e. FROM/TO display	Blanks	
f. Any target number push-button (1 thru 7)	Press	
g. FROM/TO display	Blank, X	
h. INSERT push-button	Press (Indicator goes out)	
i. FROM/TO display	O, X	
j. TK/CHG push-button (indicator)	Out	

k. Left/Right numerical displays	Previously entered latitude/longitude ±0.01 arc-minute (no degree, minute, or decimal marks).
l. Aircraft	At entered altitude-above-ground
m. Sensor	Tracking Target
n. FCO CSU	Select desired sensor
o. Ready to accept sensor target	Ready to accept (sensor) target X
p. Sensor consent switch Sensor call "pickle" when consent turn off.	ON-OFF
q. Left/Right numerical displays	Target X Latitude/Longitude ±0.01 arc-minute (no degree, minute, or decimal marks).
r. FCO CSU	LOG/Sensor as required
s. Left/Right numerical displays	LOG (as required)
4. INS inflight wind and TAS check	Obtained (as required)
a. CDU display selector switch	TK/GS
b. IAS, TK, and maximum/minimum GS	Recorded
c. W/V and TAS	Computed
5. Sensor slaving and SAD checks	Monitored/Completed
a. FCO CSU	Select each sensor in turn to check target storing/slaving to INS.
b. Call slaving checks complete.	
6. INS update	Complete (as required)
a. CDU display selector switch	POS
b. Loran/INS (coordinate countdown with navigator).	HOLD
c. Position coordinates of INS and loran/ geographic fix	Record/Compare/update (as required)
d. Position update procedure	
(1) Latitude designator push-button (N2 or 8S)	Press
(2) INSERT pushbutton (Indicator)	Illuminated
(3) Latitude degrees, minutes, and hundredths of minutes (tens of degrees inhibited) push-buttons.	Press consecutively

(4) Left numerical display	Desired latitude (no degree, minutes, or decimal marks)	
(5) INSERT push-button	Press (indicator goes out)	
(6) Left numerical display	Latitude at time HOLD button was depressed.	
(7) Longitude designator push-button (W4 or 6E)	Press	
(8) INSERT push-button (indicator)	Illuminated	
(9) Longitude degrees, minutes, and hundredths of minutes (hundreds of degrees inhibited) push-buttons.	Press consecutively	
(10) Right numerical display	Desired longitude (no degree, minutes, or decimal marks)	
(11) INSERT push-button	Press (indicator goes out)	
(12) HOLD push-button (indicator)	Out	
(13) Left and Right numerical displays	Entered latitude and longitude corrected to new present position.	
7. Forms	Data Logged (as required)	
8. Fire control alignment checks	"Completed"	(CP), (E), (N), (FCO)

PRE-STRIKE

1. Inertial and dual axis gyro (Refer to Item 1, Fire Control Alignment Check)	Checked/Set	
2. Lights	As Required	
3. INS altitude-above-ground entry	Checked/Set	
4. Fire control data Coordinate fire control computer settings with Navigator	Checked/Set	
a. Firing altitude	Set	
b. Computer TAS	Set	
c. Ballistic Wind	Set	
d. Time of Fall	Set	
e. Offset	As Required	
f. Azimuth and Elevation Counts	Set	
5. INS update (Refer to Item 6, Fire Control Alignment Check)	Complete/as required	(FCO), (N)

6. BDA recorder	ON: STANDBY/STOP (as required)	
7. Predetermined targets	Checked/Inserted (as required)	
8. Target information	Provided as required	
a. Escort information		
(1) Run-in directions and distances		
(2) Total and type targets in the area		
b. Target information to the navigator		
(1) Total targets		
(2) BDA		
(3) Direction of travel		
(4) Other information		
9. Pre-Strike Checklist	"Completed"	(CP), (F), (N), (FCO), (IO), (WM)

POST-STRIKE

1. BDA Recorder	OFF	
2. BDA	Coordinated with Navigator	
3. Forms	Completed (as required)	
4. Lights	As required	
5. Inertial and dual axis gyro (Refer to Item 1, Fire Control Alignment Check)	Checked/Set	
6. INS Update (Refer to Item 6, Fire Control Alignment Check)	Complete/As Required	(N, FCO)
7. Post-Strike Checklist	"Completed"	(CP), (F), (N), (FCO), (IO), (WM)

BEFORE LANDING PATTERN

1. Crew briefing	Monitored
2. Booth door	Secure open
3. Unnecessary lights and equipment	OFF
a. Monitor	OFF
b. RCU	OFF
c. BDA recorder	OFF

4. Altimeter	"State setting"	(CP), (E), (N), (FCO)
5. Safety belts and shoulder harness	Fastened/Locked	
6. Before Landing Pattern Checks	"Complete"	(CP), (E), (N), (FCO), (IO)

BEFORE LANDING

1. Hot mike listen	ON

OPERATIONAL STOP

After Landing

1. MSU mode selector switch	ON

Before Takeoff

1. Safety belt and shoulder harness	Fasten/Locked	
2. Before take off checks	"Complete"	(CP), (E), (N), (FCO), (IO)

ENGINE SHUTDOWN

1. MSU mode selector switch	OFF	
a. All displays	Blank	
b. All annunciators and indicators	Out	
2. FCO panel INS circuit breakers (Ø, A, B, and C)	Out (OFF)	
3. Oxygen regulator	OFF/100%	
4. All electrical switches	OFF	
5. Attitude Reference Switching Unit	2 Axis	
6. Engine Shutdown Checks	"Complete"	(CP), (E), (N), (FCO)

AFTER ENGINE SHUTDOWN

1. Form 781	Complete
2. Lights	OFF
3. Personal equipment and BDA tape	Removed from aircraft
4. Debriefing	Attended
5. Fire control data form and BDA tape	Filed/Secured

WEAPONS MECHANIC

The weapon mechanics are required to have a thorough knowledge of the aircraft gunnery systems and interphone procedures. Using the checklist as a guide, they must be capable of performing all tasks outlined in this section without supervision. In addition to their normal crew duties, the weapons mechanics will be required to make all adjustments on weapons as directed by the fire control officer. Explosive safety, crew coordination and emergency procedures will be adhered to at all times. Weapons mechanics will continuously monitor the gun/ammunition status and report this to the pilot as requested. Familiarization knowledge of general aircraft systems is required. These personnel will engage in scanner/observer duties when mission requirements dictate. The weapons mechanic must be thoroughly familiar with the emergency procedures as they pertain to his duties.

WEAPONS MECHANIC'S CHECKLIST

MISSION PREPARATION

1. Professional equipment — Checked
   a. Flight crew checklist
   b. Weapons mechanic tool kit
   c. Flashlight
2. Mission briefing — Completed

   The lead WM will brief other WMs on firing altitudes, duties, safety and interphone procedures.
3. Personal emergency and survival equipment — Checked
   a. Helmet with clear visor
   b. Headset (optional)
   c. Oxygen mask (if required)
   d. Gloves

PREFLIGHT

1. Form 781 — Checked

   Check the Form 781A for any open discrepancies pertaining to the weapon systems. Check the Form 781K for any delayed discrepancies or incomplete equipment inspections.

   WARNING

   If ammunition is present in any gun, discontinue operation until the gun has been cleared.
2. 40MM guns — Safe/Clear
   a. ARM/SAFE switch — SAFE

b. Firing selector lever	STOP FIRF
c. Breech area	Checked/Clear
d. Loader	Checked/Clear
e. Repeat steps 2a thru 2d for each 40MM gun installed.	
3. 7.62MM guns	Safe/Clear
a. ARM/SAFE switch	SAFF
b. Gun switch	SAFF/LOAD
c. Drive motor lead	Disconnected
d. Safing bar	Removed
e. Loading sector	Removed
f. Gun	Checked/Clear

Rotate the gun counterclockwise. Slide each bolt to the rear and visually inspect each chamber to insure that the gun is clear.

g. Loading sector	Installed
h. Safing bar	Installed
i. Repeat steps 3a thru 3h for each 7.62MM gun installed.	
4. Right scanner's ALE-20 dispenser switch	SAFF
5. 20MM guns	Safe/Clear

NOTE

If ammunition is present in the 20MM feed chute or feeder, the feeder must be declutched prior to rotating the gun.

CAUTION

Rotate the 20MM gun counterclockwise only.

a. ARM/SAFE switch - SAFF

b. Firing lead - Disconnected

c. Drive motor lead - Connected

d. Gun - Checked

(1) Disengage the drive motor brakes.

(2) Rotate the gun and visually check each chamber to insure that the gun is clear.

(3) Engage the drive motor brakes.

e. Repeat steps 5a thru 5d for each 20MM gun installed.

6. MASTFR ARM switch — SAFE

7. Armament circuit breakers — In

a. A.C. circuit breakers

(1) No. 1 and 2 20MM gun

b. D.C. circuit breakers

(1) No. 1 and 2 7.62MM gun

(2) Gun control manual mode

(3) Gun control auto mode

(4) No. 1 and 2 20MM gun

(5) No. 1 and 2 40MM gun

(6) Gun trigger relay manual mode

(7) Gun trigger relay auto mode.

8. (20MM) Drive motor brakes — Disengaged

9. (20MM) Gun — Checked

Rotate gun and insure gun rotates freely.

10. (20MM) Firing Contact Assembly — Checked

Check that the firing contact assembly is secure, mounting screws are safety wired and that the connector is not damaged.

11. (20MM) Feeder — Checked

a. Check feeder lock pins for serviceability.

b. Check that the ammunition feed can booster sprockets and feeder sprockets rotate.

c. Declutching mechanism checked

d. Feeder solenoid lead connected.

12. (20MM) Feeder timing — Checked

13. (20MM) Feed chute and flex drive — Checked

14. (20MM) Elevation and azimuth scales — Checked

Check scale legible and secure.

15. (20MM) Elevation and azimuth locks — Checked

Insure elevation lock plate and azimuth lock arm are tight.

16. (20MM) Drive motor brakes — Checked/Engaged

Check that drive motor is secure and lead connected.

17. (20MM) Firing and drive motor leads — Checked

Check connectors and leads are not broken or frayed.

18. (20MM) Repeat steps 8 thru 17 for each 20MM installed.

19. (20MM) Ballistic curtains — Checked

Check that the ballistic curtains and chute sleeves are serviceable and can be secured.

20. (20MM) ARM/SAFE lights — Checked

21. (20MM) Ammunition feed cans — Checked

a. Check that the feed chute and flex drive are secured.

b. Check that the rounds counter is serviceable.

c. Check that the feed can cover and cover springs are serviceable.

d. Check that the rear doors are secured.

22. (20MM) Gun control units — Checked

Check control units are secure and all leads connected.

23. (20MM) Batteries — Checked

Check batteries are secured and vent hose connected.

24. (20MM) Special equipment — Checked

a. Shovel

b. Hand crank

c. Azimuth and elevation adjustment handle

d. Brass chute

e. Brass bags (if applicable)

25. (MXU-470A) Gun — Checked

Insure gun and inner drum rotates freely.

26. (MXU-470A) Gun and feeder timing — Checked

27. (MXU-470A) Safing bar — Installed

28. (MXU-470A) Delinker loader	Checked
a. Check loader rotates freely	
b. Insure loader can be positioned to the load and fire positions.	
29. (MXU-470A) Drive motor cables	Checked
a. Check drive motor secure and receptacle serviceable.	
b. Insure rounds counter, feeder solenoid and loader link switch cables are connected.	
30. (MXU-470A) Control packages	Checked
a. Check package secure	
b. Indicator lights - checked	
31. (MXU-470A) Elevation and azimuth scales	Checked
a. Check adjustment screw locknuts tight and base support fittings secure.	
b. Check scale legible and secure.	
32. (MXU-470A) Brass chute and can	Installed
33. (MXU-470A) Safing sector and housing cover	Checked
34. (MXU-470A) Repeat steps 25 thru 33 for each MXU-470A installed.	
35. (MXU-470A) Hand crank	Checked
36. (MXU-470A) Ballistic curtains	Checked
Check that the ballistic curtains are serviceable and can be secured.	
37. (MXU-470A) ARM/SAFE lights	Checked
38. (40MM) Breechblock	Checked
a. Barrel catch secure	
b. Check firing pin for proper operation	
c. Cock gun and insure extractors operate properly	
39. (40MM) Automatic loader	Checked
a. Stop pawls and feed pawls - checked	
b. Recoil indicator - legible	
c. Rammer shoe - released and checked	
d. Trigger rammer catch lever - operated	
e. Feed control system - operated	

f. Gun cocked - rammer levers checked

40. (40MM) Firing Selector Lever — STOP FIRE

41. (40MM) Feed roller catch mechanism — Checked

Operate the catch heads and check that they engage and disengage the feed rollers.

42. (40MM) Hand operating lever — SAFE

43. (40MM) Breechblock locking bolt — Installed

44. (40MM) Side door — Checked

Check that the side door hinge pin is secure and that the door is latched.

45. (40MM) Elevation and azimuth scales — Checked

a. Check that the elevation and azimuth scales are legible and secured.

b. Check that the elevation and azimuth locks are tight.

46. (40MM) ARM/SAFE lights — Checked

47. (40MM) Repeat steps 38 thru 46 for each 40MM installed.

48. (40MM) Special equipment — Checked

a. Cartridge remover

b. Shell pusher

c. Spent brass barrels

d. Tie down straps

e. Adjustment wrench

49. (40MM) Ammunition rack — Checked

50. (40MM) Barrels — Checked

Check locking collar and flash hider are secure.

51. (MXU-470A) Flash suppressors — Checked

Insure flash suppressor is installed and the fingers are not broken.

52. (20MM) Barrels and flash suppressors — Checked

a. Check that the center barrel and muzzle clamps are properly installed.

b. Check that the flash suppressors do not have any cracked or broken ribs and that the bushings are not missing. (If installed)

53. Gun settings	Checked/Set
a. Verify guns set at planned firing altitude.	
b. (40MM) Firing rod connected.	

BEFORE STARTING ENGINES

1. Oxygen	Checked/Set
2. Hot mike listen	ON

BEFORE TAKEOFF

1. Seat Belts	Fastened

INFLIGHT 20 MM LOADING

1. ARM/SAFE switch	SAFE
2. FE/Pilot	Advised

NOTE

Omit steps 3 and 4 for loading a partially loaded can.

3. Firing lead	Disconnected
4. Ammunition can service door and cover	Open (as required)
5. Ammunition	Loaded
6. Ammunition can service door and cover.	Closed
7. Ammunition	Advanced
8. Rounds counter	"Set as required"
9. Repeat steps 3 thru 8 for each 20MM to be loaded.	

INFLIGHT 7.62 MM LOADING

1. ARM/SAFE switch	SAFE
2. FE/Pilot	Advised
3. Gun Switch	SAFE/LOAD
4. Safing bar	Removed
5. Link container	Positioned
6. Rounds counter	Set (as required)

7. Loader	Load Position
8. Ammunition	Loaded

a. Load first 20 rounds manually.

b. Connect drive motor lead and load remaining ammunition electrically.

c. Disconnect drive motor lead.

9. Loader	Fire Position
10. Link container	Removed (as required)

Prior to removing container, insure loader and surrounding areas are clear of all links.

11. Ammunition	Advanced
12. Safing bar	Installed

13. Repeat steps 1 thru 12 for each module to be loaded.

GUN ARMING

WARNING

Gun arming will not be accomplished until directed by the Pilot.

GUN ARMING 20MM

1. Drive motor lead connected	Check
2. Firing lead	Connected
3. Brass pan	Positioned
4. ARM/SAFE switch	ARMED
5. FE/Pilot	Advised

GUN ARMING MXU-470A

1. Safing bar	Removed
2. Loading sector	Removed
3. Safing sector/housing cover	Installed
4. Solenoid lead	Connected
5. Drive motor lead	Connected
6. Gun switch	FIRE Position

7. ARM/SAFE switch	ARMED
8. FE/Pilot	Advised

GUN ARMING 40MM

1. Case deflection chute	Down/Secured
2. Spent case barrel	Positioned
3. Breechblock locking bolt	Installed
4. Firing selector lever	STOP FIRE
5. Hand operating lever	COCKED/SAFE
6. Firing rod	Connected
7. Ammunition in loader	Loaded
8. Thumb lever	Toward arrow
9. Hand operating lever	Forward
10. Firing selector lever	As required
11. Breechblock locking bolt	Removed
12. ARM/SAFE switch	ARM
13. FE/Pilot	Advised

PRE-STRIKE

1. Dispensers	ARMED as required	
2. Pre-strike Check	"Complete"	(CP), (E), (N), (FCO), (IO), (WM)

GUN SAFING

GUN SAFING 20MM

1. ARM/SAFE switches	SAFE (both guns)
2. Firing lead	Disconnected
3. Gun	Cleared

GUN SAFING MXU-470/A

1. ARM/SAFE switch	SAFE (both guns)
2. Gun switch	SAFE/LOAD
3. Drive motor lead	Disconnected
4. Safing sector and housing cover	Removed
5. Gun	Cleared

GUN SAFING 40MM

1. ARM/SAFE switch	SAFE
2. Breechblock locking bolt	Installed
3. Firing selector lever	STOP FIRF
4. Hand operating lever	Safe
5. Thumb lever	Away from arrow
6. Gun/Loader	CLEARED

POST-STRIKE

1. FE/Pilot	Advised (all guns safe and clear)	
2. Dispensers	SAFE	
3. Post-strike	"Complete"	(CP), (E), (N), (FCO), (IO), (WM)

BEFORE LANDING

1. Hot mike listen	ON
2. Safety belts	Fastened

BEFORE LEAVING AIRCRAFT

1. All guns and subassemblies	Checked
2. Oxygen	OFF/100%
3. Interphone cords	Stowed
4. Form 781	Completed as required

ILLUMINATOR OPERATOR

The Illuminator Operator is required to have a thorough knowledge of the performance and operating procedures of the illuminator and flare launcher. He must also possess a thorough knowledge of the aircraft systems to provide required assistance to the flight engineer. He performs the duties of loadmaster as required on the aircraft and must be familiar with aircraft loading procedures. In flight he operates the battle field illuminator, the flare launcher, and defensive flare and chaff dispensers, and performs inflight maintenance on this equipment as required. He also coordinates closely with the electronic warfare officer on aircraft defenses and advises the crew of all visually observed threats to the aircraft, and directs appropriate counter measures. He launches ground marks and flares as directed. He performs inflight loading of various pyrotechnic stores and keeps the pilot and crew informed as to their status. The Illuminator Operator will also perform the duties of crew jump master as directed by the pilot.

ILLUMINATOR OPERATOR'S CHECKLIST

This checklist covers the illuminator operator's duties on the missions of the airplane. Items in quotes indicate that response is required. All items proceeded by an asterisk (*) will normally be accomplished by a weapons mechanic. In the absence of the weapons mechanic the Illuminator Operator will accomplish the item.

PRIOR TO ENTERING

1. ALE-20 Dispensers
   - a. Check for security
   - b. Flares
2. Flare launcher jettison safety pin — Installed

INITIAL PREFLIGHT

1. Form 781 — Check for status of airplane discrepancies and life support equipment inventory.
2. Life support equipment — Checked
3. Flare launcher — Checked
   - a. Power cable - disconnected
   - b. Shorting plug - Installed
   - c. Jettison cannon plug - Connected
   - d. Manual jettison handle - Down/Safetied
   - e. Manual jettison handle locking pin and cable - Engaged/Safetied/Secure
   - f. Manual ejector lever lockpin - Locked
   - g. Selector valve - Off
   - h. Ejector shutoff valve - Open (four places)
   - i. Reservoir bottle pressures - Checked (2000 PSI Minimum)
   - j. Flares/Markers - Loaded and Properly Set
4. 40KW illuminator power switch (if installed — Checked/OFF
5. ALE-20 power switch — SAFE

*6. Guns — SAFE
   - *a. 40MM guns (aft)
     - (1) Arm switches — SAFE
     - (2) Firing selector lever — STOP FIRE
     - (3) BREECH — CLEAR
   - *b. 7.62MM guns (fwd)
     - (1) Arm switches — SAFE
     - (2) Drive motor and clearing solenoid electrical connectors — Disconnected
     - (3) Loading sectors and safing bars — Installed

*c. 20MM guns (fwd)	
(1) Arm switches	SAFE
(2) Firing electrical connectors	Disconnected
7. Cargo compartment	Checked
a. Hydraulic reservoirs fluid level	Checked
b. Spare hydraulic fluid	Checked (as required)
c. Loran computer power protector switch	Checked/OFF
d. Liquid nitrogen dewar	Checked

NOTE

Fifty percent (50%) service minimum for one mission.

POWER ON

CARGO COMPARTMENT (RIGHT SIDE)

1. Right paratroop door	Checked
2. Interphone panel (Forward of right paratroop door)	Checked/Set
3. Emergency exit light (Forward of right paratroop door)	Checked/Armed
4. Flare launcher control box	Checked
a. Jettison switch - Off/Safetied	
b. Main power switch - On	
c. Press-to-test light - Checked	
d. Panel light dim control - Checked/Off	
e. Main power switch - Off	
f. Cable assemble - Checked/Condition	
5. Dispenser junction box	Checked
a. Right SUU-42/A-Normal	
b. Left SUU-42/A-Normal	
c. Right ALE-20-Normal	
d. Left ALE-20-Normal	
e. Two green light - Checked	
6. Emergency Equipment	Checked
a. Fire flighting assy. (MB-1) (AFT 40MM Ammunition Rack) - Checked	

7. Center escape hatch and escape rope	Checked
8. Emergency exit light (Right of center escape)	Checked/Armed
9. Booth	Checked

a. Door condition - Checked

b. Ceiling light control - Checked/Off (AFT & foward of booth)

(1) Red - Checked

(2) White - Checked

c. Emergency equipment - Checked

(1) Two large combat first aid kits - Checked

(2) Hand axe - Checked

(3) First aid kit (Small) - Checked

(4) Fire fighting assy. (MB-1) - Checked

(5) Fire extinguisher (CB) - Checked

(6) Flashlight - Checked/Off

d. Chaff control panel - Set

(1) Selector (IO-EWO-IO/EWO) - SET

e. Right main landing gear inspection windows	Checked
10. Aileron and flap control (AFT wing beam)	Checked

a. Security of aileron hydraulic control and auto pilot servo, wing flap components, leaks.

11. Emergency equipment (AFT top of booth)	Checked

a. Oxygen regulators and hoses - OFF/Checked

b. Walk around oxygen bottle - Checked

12. Recharge hose (AFT side, right of booth)	Checked
13. Emergency Equipment (AFT left of booth)	Checked

a. Fire fighting assy. (MB-1) - Checked

b. Fire extinguisher (CB) - Checked

c. Flashlight - Checked/OFF

d. Hand axe - Checked

e. First aid kit - Checked

14. Walk around oxygen bottle (Left side top of booth)	Checked
15. Fire extinguisher (water) (Left side of booth)	Checked

16. Wheel well bus circuit breaker panel (Station 477)	Checked
17. Oxygen regulators and hoses (Forward left top of booth)	Checked/OFF
18. Emergency equipment (Forward right of booth)	Checked

a. Fire fighting assy. (MB-1) - Checked

b. Fire extinguisher (CB) - Checked

c. Hand axe - Checked

d. First aid kit - Checked

19. Walk around oxygen bottle (Forward right of booth)	Checked
20. Emergency extension handcrank (Top right forward of booth)	Checked
21. Right hydraulic control panel	Checked

a. Utility and booster hydraulic system reservoir condition, fluid quantity, and accumulator pressure gauges.

22. Right main landing gear emergency engaging handle	Checked

NOTE

Check the system for manual operation using the handcrank.

23. Air conditioning manual diffuser handle	Checked/Out
24. Top of booth	Checked
25. Emergency exit light (Top of emergency exit)	Checked/Armed
26. Side emergency exit (Ferry flight only)	Checked
27. Interphone panel	Checked/OFF
28. ALE-20 ARM/SAFE switch	Safe
29. ALE-20 pistol grip assemble (Condition of cord)	Checked
30. Scanner seat	Checked

a. Safety belt - Checked

b. Seat for security - Checked

31. Recharge hose	Checked
32. Oxygen regulator and hoses	OFF/Checked
33. Overhead area	Checked
34. Oxygen shutoff valve	Checked/On

35. Liquid oxygen converter — Checked

36. Life history recorder (some airplanes) — Set/OFF

   a. Check that tape remaining is adequate for flight, check that reserve tapes are available, dial in pertinent data and close all circuit breakers. Leave the power switch in the OFF position.

37. Emergency equipment (Forward of electronics rack) — Checked

   a. Fire extinguisher (CB) - Checked

   b. Hand Axe - Checked

   c. First Aid Kit - Checked

38. Galley — Checked/Serviceable

39. Galley light — Checked/On

40. Circuit breakers — Checked/Set

   a. Rheostat switch - Checked

41. Circuit breakers (AFT Station 245) — Checked/Set

42. Nose wheel area including nose wheel inspection plate — Checked

43. Electrical equipment racks (FWD) — Checked

44. Main power distribution panel — Checked

45. Flak curtains — Checked

CARGO COMPARTMENT (LEFT SIDE)

1. Forward cargo compartment light panel — Checked/Set

   a. Red checked

   b. White (Dim/Bright) - Checked

2. Nose landing gear emergency extension valve — Checked

   a. Safetied to normal position - Checked

   b. Hand pump - Checked

CAUTION

Maintain the nose landing gear emergency extension valve in the NORMAL position at all times except when it is being used to extend the nose gear; otherwise, the nose landing gear will not retract.

3. Interphone panel — Checked/Set
4. IR power supply/amplifier and control boxes — Check/Secure
5. Interphone panel (Forward of mini gun emplacement) — Checked/OFF
6. Overhead area — Checked
7. Left hydraulic control panel
   a. Emergency hydraulic system reservoir condition and fluid quantity. Emergency reservoir drain valve and shutoff valve. — Checked
8. Emergency extension wrench and handcrank (Below emergency reservoir) — Checked
9. Left main landing gear emergency engaging handle — Checked

NOTE

Check the system for manual operation using handcrank.

10. Left main landing gear inspection windows — Checked
11. Interphone panel (Forward and AFT of 40MM guns) — Checked
12. Paratroop door — Checked/SECURE

RAMP AREA

1. Retainer reel assembly — Checked/Set
2. AFT Fuselage Bus Circuit Breaker Panel — Checked
3. Aft cargo compartment light panel — Checked/Set
   a. Red - Checked
   b. White (Dim/Bright) - Checked
4. Oxygen regulator and hoses — Checked/OFF
5. Interphone panel — Checked/OFF
6. Hydraulic lines (Aft left of paratroop door) — Checked for leaks
7. Ramp and door control for operation — Checked

CAUTION

Do not lower ramp unless cargo door is up and locked. Also do not close cargo door unless ramp is up and locked.

CAUTION

Visually observe lamp as ramp is lowered to insure it clears the airplane.

a. Door (Electrical)	Open
b. ADS arms	Installed
c. Ramp (Electrical)	Down
d. Ramp actuators	Checked
e. Ramp locks	Disengaged
f. Ramp (Electrical)	Up
(1). Ramp locks - Checked	
g. Door (Electrical)	Closed
(1). Cargo door locks - Checked	
8. AFT cargo door uplock manual release and safety lock release handles	Checked for general condition
9. Walk around oxygen bottle	Checked
10. ALE-20 ARM/SAFE switch	SAFE
11. ALE-20 pistol grip assembly (condition of cord - check)	Checked
12. Crash seats	Checked
a. Safety Belts - Check	
b. Cables - Check	
13. Illuminator (40KW)	Checked/Set

a. Main power switch - OFF

b. Start reset switch - OFF

c. Illuminator - Stowed (visually check for + 10 degrees roll and -15 degrees pitch).

d. Power cables - Connected and general condition

e. Chain drive and rail - Condition

f. Carriage drive brake - POWER position

g. Pitch drive brake - POWER position

h. Roll drive brake - POWER position

i. Turnbuckle - Stowed

j. Lens cover - Removed and stowed

k. Lens - Cleanliness and security

l. Plumbing - Check for leaks and condition

m. Circuit breakers - In

n. Main pump circuit breakers - Off

o. Generator power switch - OFF

p. Visual mode lock out switch - OFF

q. Accumulator precharge - Checked 30 ± 5 PSI

r. General condition of illuminator assembly - Check for security and cleanliness

s. Carriage retraction wrench - On hand/serviceable

14. AFT cargo door uplock and safety lock	Checked
15. AFT cargo door seals (left side)	Checked
16. AFT overhead escape hatch and rope	Checked
17. Emergency exit light	Checked/Armed
18. Bleed air ducts (left side)	Checked
19. Elevator hydraulic control unit and autopilot servo	Checked
20. Cargo door actuator	Checked
21. Cabin pressure safety valve (ferry flight only)	Checked
22. Bleed air ducts (right side)	Checked
23. Rudder hydraulic control unit and autopilot servo	Checked
24. Radio equipment for security and mounting	Checked
25. AFT cargo door seals and drain seals (right side)	Checked
26. Fire extinguisher (water)	Checked
27. Life raft handles	In/safetied
28. Oxygen regulator and hose	Checked/Off
29. Emergency equipment	Checked

a. Crash axe - Checked

b. Fire extinguisher (CB) - Checked

30. Urinal	Checked
31. Cargo Door	As required
32. Ramp	As Required

33. Availability of tiedown equipment	Checked
34. Loose equipment	Secured

BEFORE STARTING ENGINES

1. Oxygen	Checked/Set	
2. Lights	Set	
3. Fire extinguishers	On hand and serviceable	
4. External air conditioner	Removed	
5. TV Lens covers	Removed (if TV operator is not on board)	
6. Headset and extension cord	Ready	
7. Clear GTC	"Clear"	
8. Chocks	"Removed"	
9. Before starting engine checks	"Completed"	(CP), (E), (N), (FCO), (IO)

STARTING ENGINES

1. Clear No. 3 engine — "No. 3 clear"
2. Remove external equipment, and Secure BC spoiler

NOTE

When additional ground crew personnel are available, the IO will signal them to remove external equipment and secure BC spoiler. He will then proceed with checklist. If additional ground crew personnel are not available, the IO will accomplish these items before proceeding.

3. Clear No. 4 engine	"No. 4 clear"
4. External equipment/BC spoiler	"Removed/secure"
5. Clear No. 2 engine	"No. 2 clear"
6. Clear No. 1 engine	"No. 1 clear"

BEFORE TAXI

1. Crew aboard, doors closed.

WARNING

Visually check the locks on the forward crew entrance door to see that they contact the eyebolts any time airplane will be pressurized.

2. Hydraulic pressure and quantities — Checked

3. Air conditioning, manual diffuser handle — As Required

CAUTION

If booth is not to be occupied during flight, leave handle locked out.

4. Foward interphone cord — Secure

5. Life history recorder (some airplanes) — ON/checked

6. Before taxi checks — "Complete" — (CP), (F), (N), (FCO), (IO)

TAXI AND ENGINE RUNUP

1. Monitor cargo compartment hydraulic panels for leaks and quantities

2. Observe lower side of wings and engine nacelles for leaks, etc.

3. Inform EWO of cargo compartment temperature changes when necessary.

BEFORE TAKEOFF

1. All exits — Secured

2. Flaps — Checked

3. Hydraulic pressure and quantities — Quantities checked

4. Safety belts and shoulder harness — Fastened cabin secure

5. Hot mike listen — ON

6. Before takeoff checks — "Complete" — (CP), (E), (N), (FCO), (IO)

AFTER TAKEOFF

1. Wings and Nacelles — Scanned

2. Hydraulic systems — Checked for leaks

3. Wheel Well — Monitor temperature

4. Gear and flaps — Check that the MLG is up and doors closed after retraction. Check that the flaps have retracted to the full up position.

CRUISE

1. Scan wings and nacelles and report any abnormal indication to cockpit.

2. Check complete cargo compartment for leaks, hydraulic quantities, etc. periodically.

PRE-STRIKE

1. Chute harness — On/properly fitted
2. Retainer reel — Connected
3. Cargo door — (As required)
4. Ramp — (As required)

CAUTION

Visually observe lamp as ramp is lowered to insure it clears the airplane. Do not lower ramp if airplane is not in straight and level flight.

5. Dispensers and flare launcher — (As required)
   a. A20 ARM/SAFE switch - ARMED (if required)
   b. Flare launcher - ARMED (if required)
      (1) Power cable - Connected
      (2) Reservoir bottles - Open
      (3) Selector valve - ON
      (4) Ejector shutoff valve - Open (four places)
      (5) Manual ejector lever lockpin - Unlocked
      (6) Main power switch - ON
      (7) Red lights - Checked
      (8) Safety pin - Removed
6. Illuminator/Searchlight — (As required)
   a. Main pump circuit breakers - On
   b. Generator switch - ON
   c. Voltage alternators - Checked (with FE)
   d. Main power switch - ON

CAUTION

Prior to initial operation of the illuminator, disengage autopilot and turn radar and IR to standby due to possible overload of right hand AC bus.

e. Pump pressure - Checked

f. Accumulator pressure - Checked

g. Lamp house - Deployed

CAUTION

Visually observe lamp house as it deploys to insure it clears the airplane. Do not extend lamp house if airplane is not in straight and level flight.

h. Interlock lights - Checked (out)

i. Mode selector switch - As required

j. Amps/Volts selector switch - As required

k. Lamp start switch - Momentary start

l. Current and voltage - Monitored

m. Pitch, roll, and zoom - As required

n. Control selector switch - As required

7. Lights (As required)

8. Prestrike checks "Complete" (CP), (F), (N), (FCO), (IO), (WM)

POST-STRIKE

1. ALE-20 dispenser switch SAFE

2. Illuminator/Searchlight As required

a. Lamp start switch - OFF

CAUTION

Visually observe lamp house as it retracts to insure it clears the airplane. Do not retract lamp house if airplane is not in straight and level flight.

b. Lamp house - Retracted

c. Generator switch - OFF

d. System circuit breakers - Pulled

3. Flare launcher
   a. Power switch - OFF
   b. Reservoir-Jettison bottles - OFF
   c. Selector valve - OFF (pressure depleted)
   d. Power cable - Disconnected
   e. Shorting plug - Connected
   f. Manual ejector lever lock pin - Locked
   g. Jettison safety pin - Installed

4. Lights	As required	
5. Post strike checks	"Completed"	(CP), (E), (N), (FCO), (IO), (WM)

BEFORE LANDING PATTERN

1. Equipment	Secured	
2. Before landing pattern check	"Complete"	(CP), (E), (N), (FCO), (IO)

BEFORE LANDING

1. Main landing gear	Checked/Down	
2. Hydraulic pressure and quantities	Checked	
3. Hot mike listen	ON	
4. Safety belt, shoulder harness	Fastened/Cabin secure	
5. Before landing checks	"Complete"	(CP), (E), (N), (IO)

AFTER LANDING

1. Observe drip valve operation as engines are shut down.
2. Unnecessary equipment and switches — OFF

OPERATIONAL STOP

NOTE

During operational stop; turn life history recorder OFF. Dial in new gross weight, fuel weight, and turn system ON. BIT test is not required.

BEFORE TAXI

1. Crew aboard, door closed — "Aboard/closed/checked"

BEFORE TAKEOFF

1. Safety belt and shoulder harness	"Fastened/cabin secure"	
2. Before takeoff checks	"Complete"	(CP), (E), (N), (FCO), (IO)

ENGINE SHUTDOWN

1. Life history recorder (some airplanes)	OFF
a. Set the recorder by dialing in final landing gross weight and fuel weight. Allow system to remain on for a minimum of 30 seconds after dialing in data, then turn OFF. (Refer to Section IV).	
2. Oxygen regulators	OFF/100%
3. Observe drip valve operation as engines are shutdown.	
4. Exit clearance	Clear/insert chocks
5. Chocks	"In place"

BEFORE LEAVING AIRPLANE

1. Unnecessary equipment	OFF
2. Airplane	Cleaned
3. Galley power	OFF
4. Air conditioning manual diffuser handle	OUT
5. Illuminator lens covers	Installed
6. TV lens covers	Installed (if TV operator not on board)
7. Equipment	Checked/secured
8. Form 781	Discrepancies entered

SECTION IX

all-weather operations

Table of Contents

This section contains only those procedures that differ from or are in addition to the normal operating instructions covered in Section II, except for some repetition necessary for emphasis, clarity, or continuity of thought. References in this section to operation of the airplane component systems or auxiliary equipment mean the operation described in Sections VII and IV, respectively.

instrument flight procedures

The airplane is completely equipped for the use of all standard radio navigational and flight aids; however, safe instrument flight requires instrument proficiency and exacting preflight planning on the part of the pilot, and thorough coordination on the part of all members of the crew. It is the responsibility of the pilot to ensure that each crew member is thoroughly briefed on the exact procedures he is expected to follow during all phases of airplane operation. Fuel requirements at low altitudes are considerably greater than the fuel requirements of like aircraft with reciprocating engines. Therefore, if required to land under IFR conditions, additional allowance must be made for letdown and holding procedures, and the maximum range and endurance is reduced accordingly.

PREFLIGHT AND GROUND CHECKS.

Perform the normal preflight inspections, as outlined in the normal operating instructions in Section II.

INSTRUMENT TAKE-OFF.

1. Tune, identify, and monitor navigational aids to be used during departure. Select desired departure course.

2. Align the horizon bar of the pilot's attitude indicator with the wings of the miniature aircraft. Align the wings of the miniature aircraft of the copilot's attitude indicator with the horizon bar.

3. Place TACAN, VOR/ILS selector switch to the primary navigational radio aid to be used for departure.

4. Align the airplane on the take-off runway and recheck the heading indication of the N-1 compass repeater indicator and the ID-250 indicators on the pilot's panels.

Note

Any erratic movement or oscillation of the heading pointer on the N-1 indicator indicates a malfunction, and the system should not be relied upon.

5. Use nose wheel steering (until rudder control becomes effective) as the primary directional control during take-off roll.

6. At take-off speed or minimum control speed, whichever is higher, raise the nose wheel off the ground, establish a nose up attitude of approximately seven degrees (a 3-1/2 bar width on the B-1A and J-8 indicators) and allow the airplane to fly off the ground.

WARNING

A slight amount of pitch error in the indication of the attitude indicators will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the take-off run and will vary from 1/2 to two degrees. The exact amount of error will depend upon the acceleration and elapsed time of each individual take-off. The erection system will automatically remove the error after the acceleration ceases.

7. When the airplane is in a definite climb, as indicated by the altimeter and vertical velocity indicator, retract the gear.

8. Make the initial climb at 500 feet per minute and retract the flaps when the airplane accelerates to a minimum of 20 knots above take-off speed. Allow the airplane to accelerate to desired climb speed.

9. Minor trim changes may be required at flap retraction.

10. Establish climb power and turn on anti-icing as required. Be alert for the loss of engine power that occurs when wing and empennage anti-icing is used.

INSTRUMENT CLIMB.

1. After flap retraction, maintain a 500 FPM rate of climb until intercepting the desired climb schedule.

Note

Insure that the established rate of climb is equal to or greater than the applicable standard instrument departure.

2. Limit the angle of bank to that required for standard rate (three degrees per second) turns or 30 degrees, whichever is less.

CRUISE.

Conduct instrument cruise flight according to the normal operating procedures outlined in Section II; however, existing published instructions for utilization of radio aids and instructions from airway traffic control must be followed.

HOLDING.

Conduct holding operations at 170 KIAS. If maximum endurance is required, conduct holding operations at maximum endurance airspeed plus 20 KIAS. This airspeed permits holding to be accomplished at a constant power setting and allows turns to be executed with little, if any, loss of airspeed. Any loss of airspeed may be regained when level flight attitude is resumed.

PENETRATIONS.

Penetrations may be accomplished in this airplane, making certain that the current airspeed limitations in Section V are adhered to. Handling characteristics are very good and pitch attitude is not extreme. A typical penetration is shown in figure 9-1.

Note

Penetrations may be initiated from 20,000 feet, accelerating to 250 KIAS, provided the maneuver load factors given in Section V are not exceeded.

The recommended procedure is as follows:

1. Before reaching the initial approach fix, begin Before Landing Pattern checklist.

2. Begin the penetration at or below penetration airspeed from initial approach fix, in the clean configuration, by retarding throttles to FLIGHT IDLE and smoothly establishing a descent of at least 4,000 fpm until reaching the penetration airspeed.

Note

During penetration, turbulence may be encountered without warning.

3. Follow the published penetration procedure.

4. Start level-off 1,000 feet above the published minimum inbound altitude. Establish an airspeed of 170 KIAS at the published minimum inbound altitude.

5. Complete the Before Landing Checklist prior to reaching the final approach fix. Allow the airspeed to decrease to approach speed and execute an approach as depicted in figures 9-2 through 9-10.

INSTRUMENT APPROACHES.

All conventional systems of instrument approach may be used. Flight characteristics during instrument approaches do not differ from those encountered during normal visual flight. Normally 170 KIAS is used for entry. Airspeed after the Before Landing checklist is initiated will be 150 KIAS (or approach speed, whichever is higher).

Establish approach speed prior to the final approach fix or glide slope intercept point. The Before Landing checklist may be initiated at any point in the approach pattern, but will be completed prior to the final approach fix or glide slope intercept point.

Automatic ILS Approach.

Note

> The beam guidance coupler is not cut out automatically when making an ILS approach and the airplane is flown over the ILS transmitter.

In automatic approach the ILS receiving equipment is coupled to the auto-pilot to provide automatic response of the airplane to ILS signals. With the automatic approach controller in the GYRO PILOT position, the airplane may be flown to intercept the localizer course, from either side of the runway, on a suitable intercept heading. Altitude and distance from the runway should be such that the airplane is beneath the glide slope beam when the localizer course is intercepted. The Before Landing pattern and Before Landing checklists should be completed prior to the glide slope intercept point. Refer to figure 9-5 for airplane configuration and airspeeds. When the edge of the localizer course is reached, the controller may be switched to APPROACH. The airplane will establish a heading such that its ground track is coincident with the center of the localizer course. The airplane will remain at a constant altitude until the glide slope is intercepted if altitude control is engaged.

Note

> The airplane will normally overshoot the glide slope center less than one-half scale deflection, and then automatically return to and bracket the glide slope center in approximately 30 seconds. The reason for this is that before the autopilot receives a signal to return to glide slope center it is necessary to develop an initial glide slope error of sufficent amplitude to produce the nose down attitude required to fly the glide path.

The airplane is brought down the intersection of the glideslope and localizer course on a correct path for a normal landing. The pilot must monitor the flight instruments, including the crosspointer indicators and maintain the desired airspeed with power applications. The landing is executed in the normal manner after visual contact has been established and the autopilot disengaged. See AUTO-PILOT and RADIO BEAM COUPLER EQUIPMENT in Section IV for descriptive information on the radio beam coupler switch, the radio beam coupler, and RANGE-LOC position of the automatic approach controller. For missed approach, disconnect the auto-pilot and execute as outlined in this section.

Radar Approach Procedure.

(See figure 9-7.)

Airborne Radar Approach Procedure.

A typical airborne radar approach is shown in figure 9-4.

INITIAL APPROACH.

The pilot will perform the following:

1. Begin the BEFORE LANDING PATTERN checklist before enroute descent or penetration.

2. Begin the descent from the navigator's radar fix.

3. Reduce airspeed to 170 KIAS.

4. Maintain normal pattern airspeeds on downwind and base leg, and accomplish the BEFORE LANDING checklist as required.

Note

> If a straight-in approach is to be made after descent, establish the landing configuration not less than 10 miles out on final approach heading.

The navigator will perform the following:

5. The instrument approach used will be the letdown approved for the applicable airport.

Note

> The recommended procedure, when traffic permits, is to make an enroute descent or penetration from a radar fix. This procedure allows the navigator to keep the target on his scope from the beginning of the descent until final touchdown.

6. Before low fix, adjust the radar to the optimum setting.

7. At low fix, check the pressure altimeter with the absolute altimeter.

8. The crosswind leg should be at least 5 miles long and the downwind should be 10 miles.

9. While on base leg, set the cursor to a heading sufficient to lead turn to final. As the runway intercepts the cursor, direct the airplane to the final heading. This should be accomplished 8 miles from the runway.

FINAL APPROACH.

The pilot will perform the following:

1. After turning final, establish approach speed.

2. At the final approach fix, establish approximately 300 feet per minute descent.

Note

The wind component may require varying the rate of descent to remain on the glideslope. The normal rate of descent should not be more than 300 feet per minute.

3. Heading changes should be made with the minimum possible bank.

4. Advise the navigator when visual alignment is possible. The navigator may continue to give range and altitude information.

5. Execute a missed approach by climbing on the runway heading to a safe altitude. If another approach is desired, re-enter the pattern on the downwind leg.

The navigator will perform the following on final approach:

6. Set the cursor to the runway heading and adjust the heading for expected drift.

7. If the airplane is not on track, overcorrect by three times the apparent error to align the airplane with the runway.

8. Notify the pilot as the airplane approaches the glideslope (6.5 miles out).

9. When the airplane is on the glideslope, indicate the correct heading and give the pressure altitudes for the corresponding ranges.

10. Correct the airplane back to the runway heading before reaching a point 1 mile out.

11. Notify the pilot when reaching weather minimums so he may execute the missed approach, if necessary.

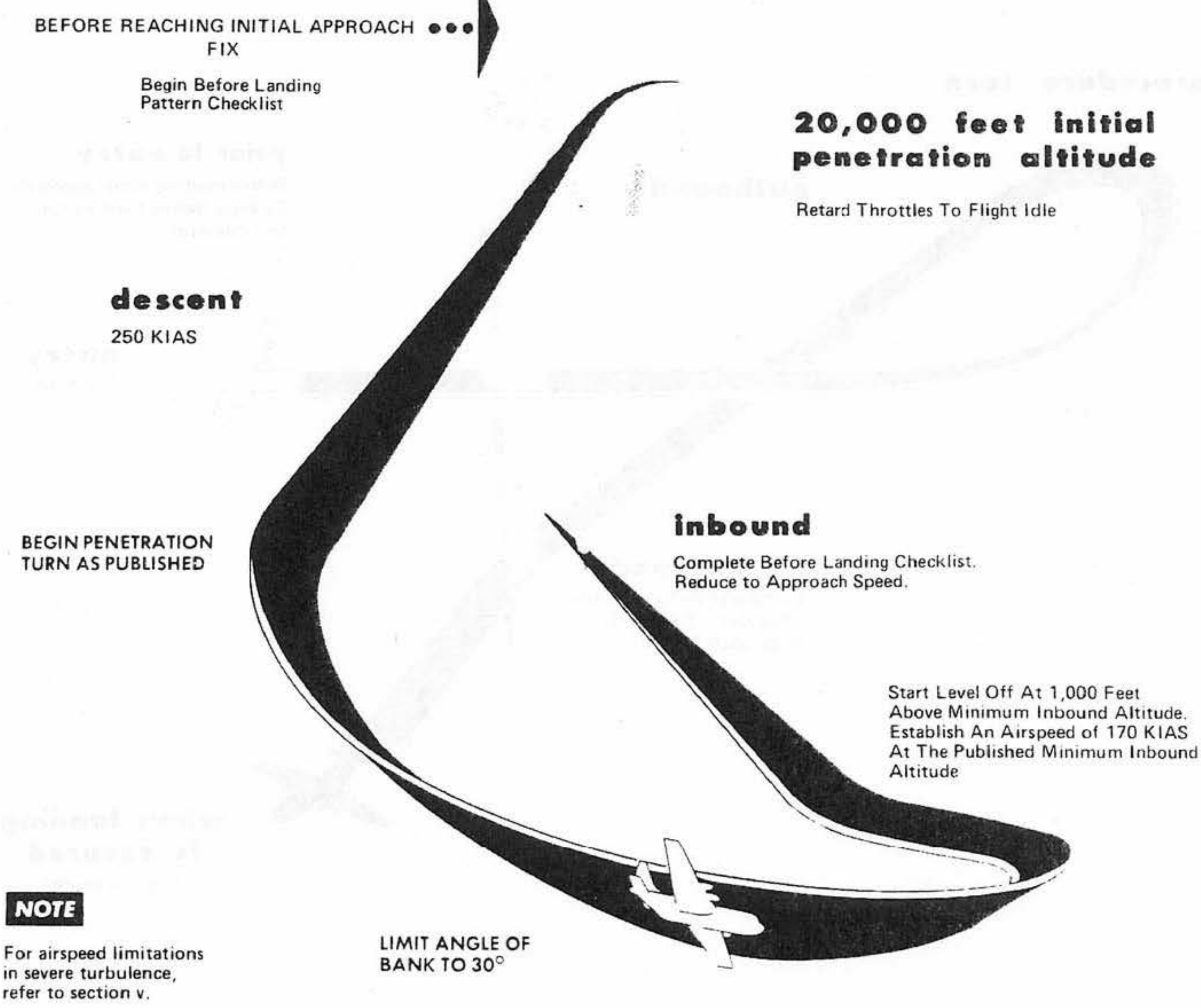
Circling Approach.

The penetration and approach procedures are based on straight-in approach speeds. If a circling approach is required, follow normal approach procedures except delay final flap setting until on final approach and maintain 140 KIAS or computed approach speed, whichever is higher, until on the final approach, then proceed with a normal landing.

Missed Approaches.

In the event of a missed approach, immediately apply required power and establish a climb. When a definite climb is shown on the vertical velocity indicator and altimeter, complete the normal go-around procedure, as appropriate, described in Section II. For engine(s) out operation, complete the go-around procedure described in Section III. Accelerate to climb speed and maintain until reaching desired missed-approach altitude. Execute the appropriate missed-approach procedure.

typical penetration



NOTE

For airspeed limitations in severe turbulence, refer to section v.

Figure 9-1.

typical instrument approach - four or three engines - adf, vor, tacan, or range procedures

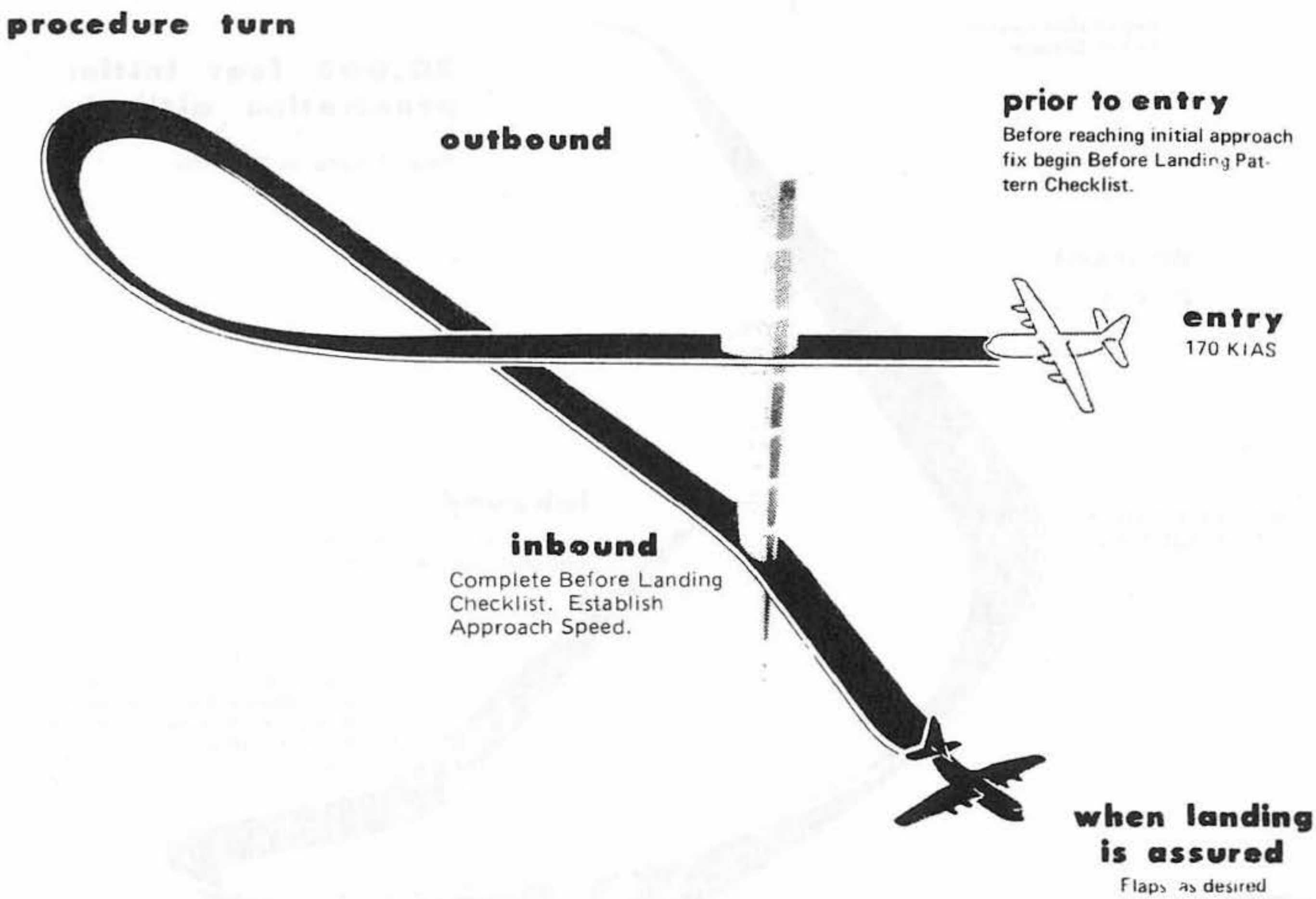


Figure 9-2.

typical instrument approach two engines-adf, vor, tacan, or range

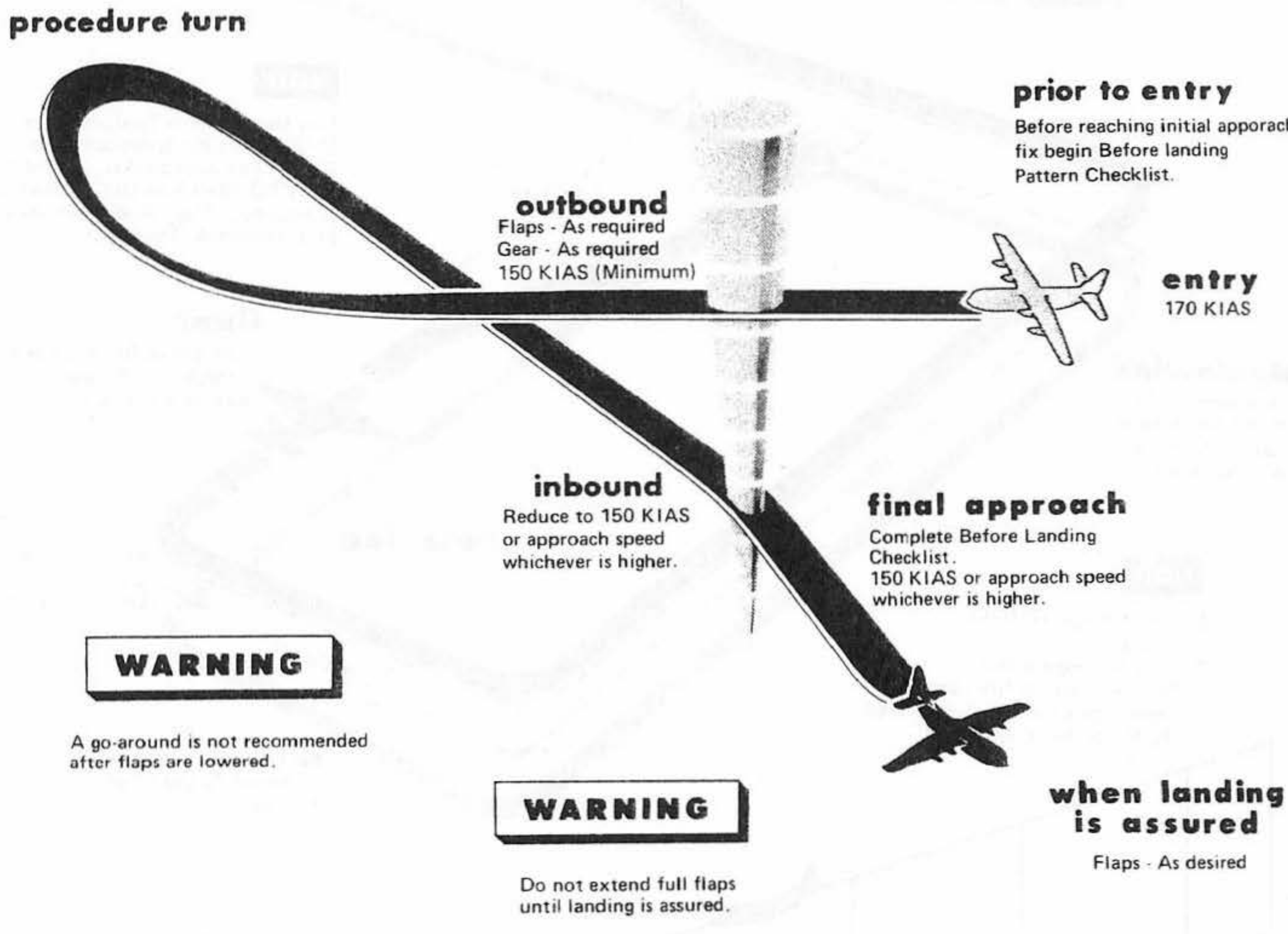


Figure 9-3.

typical airborne radar descent and approach

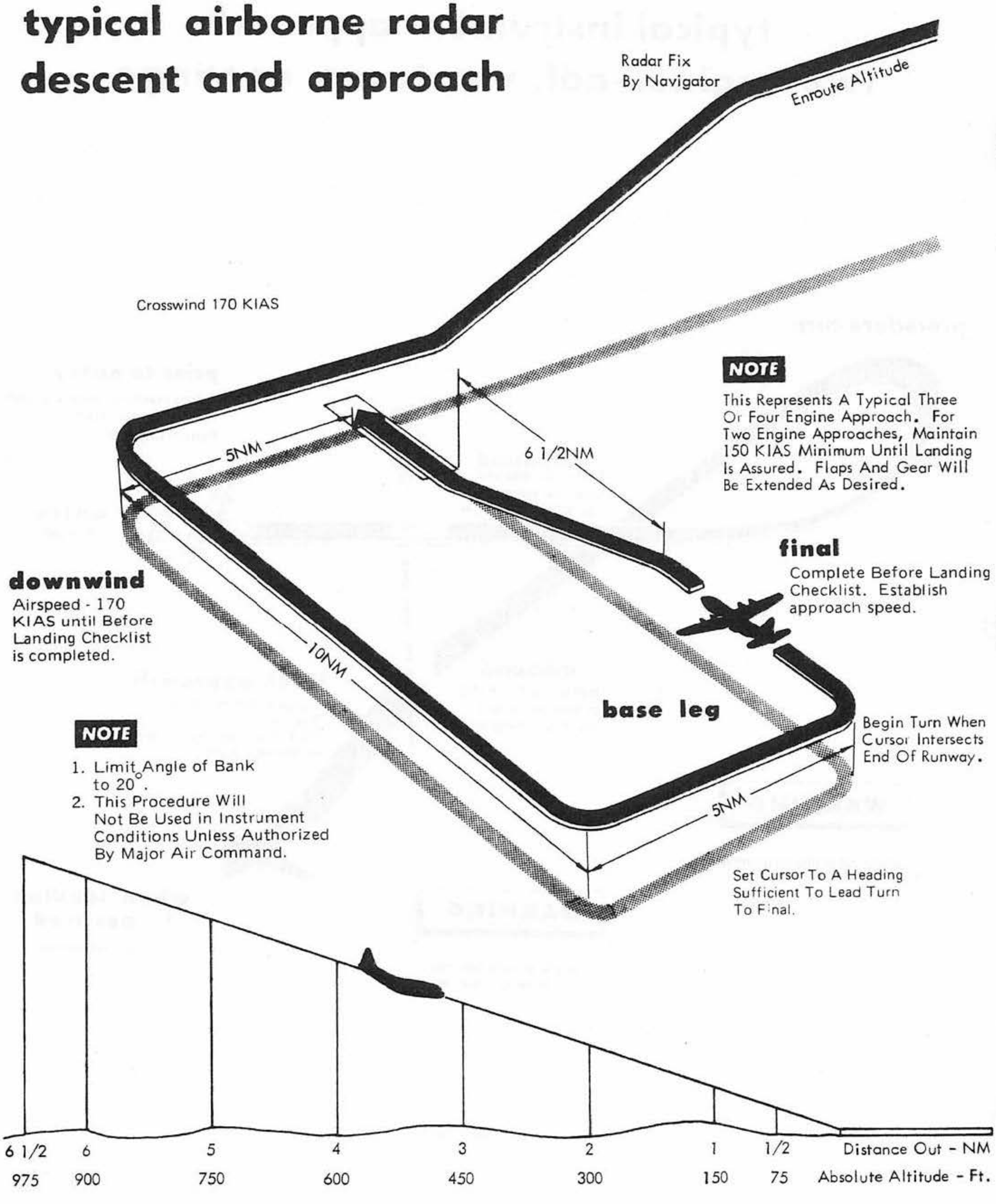


Figure 9-4.

typical ils four or three engines

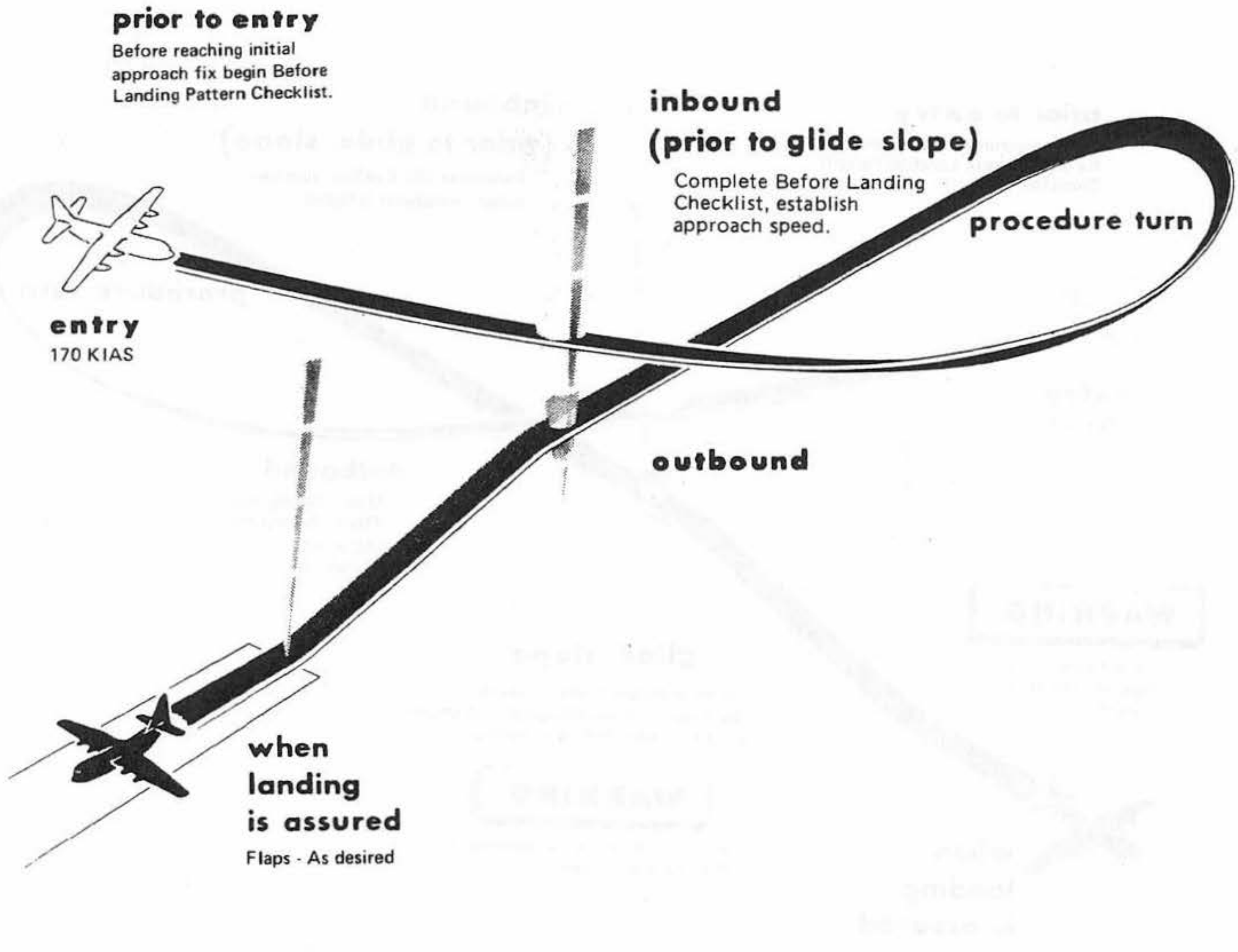


Figure 9-5.

typical ils two engines

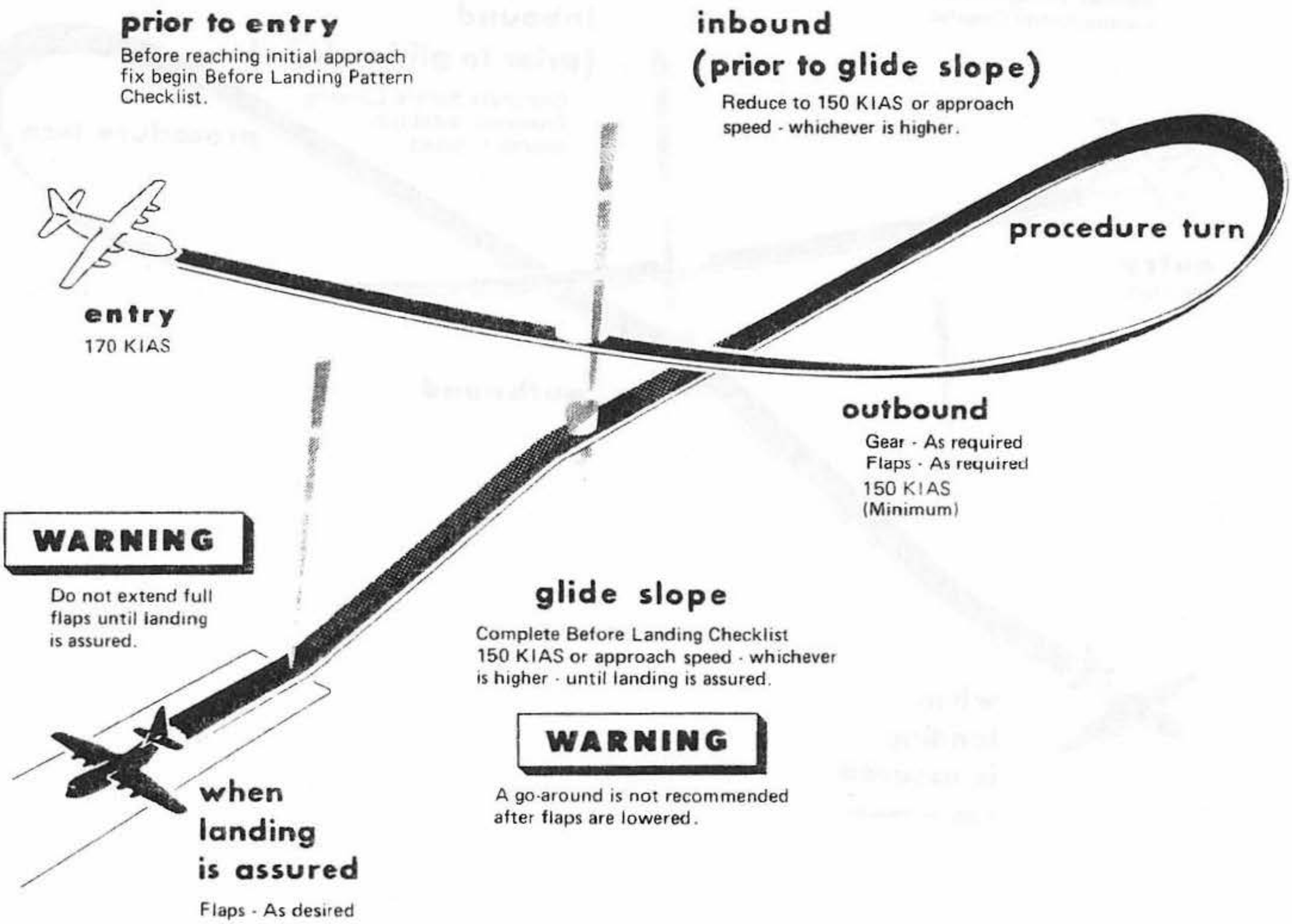


Figure 9-6.

typical radar approach pattern - four or three engines

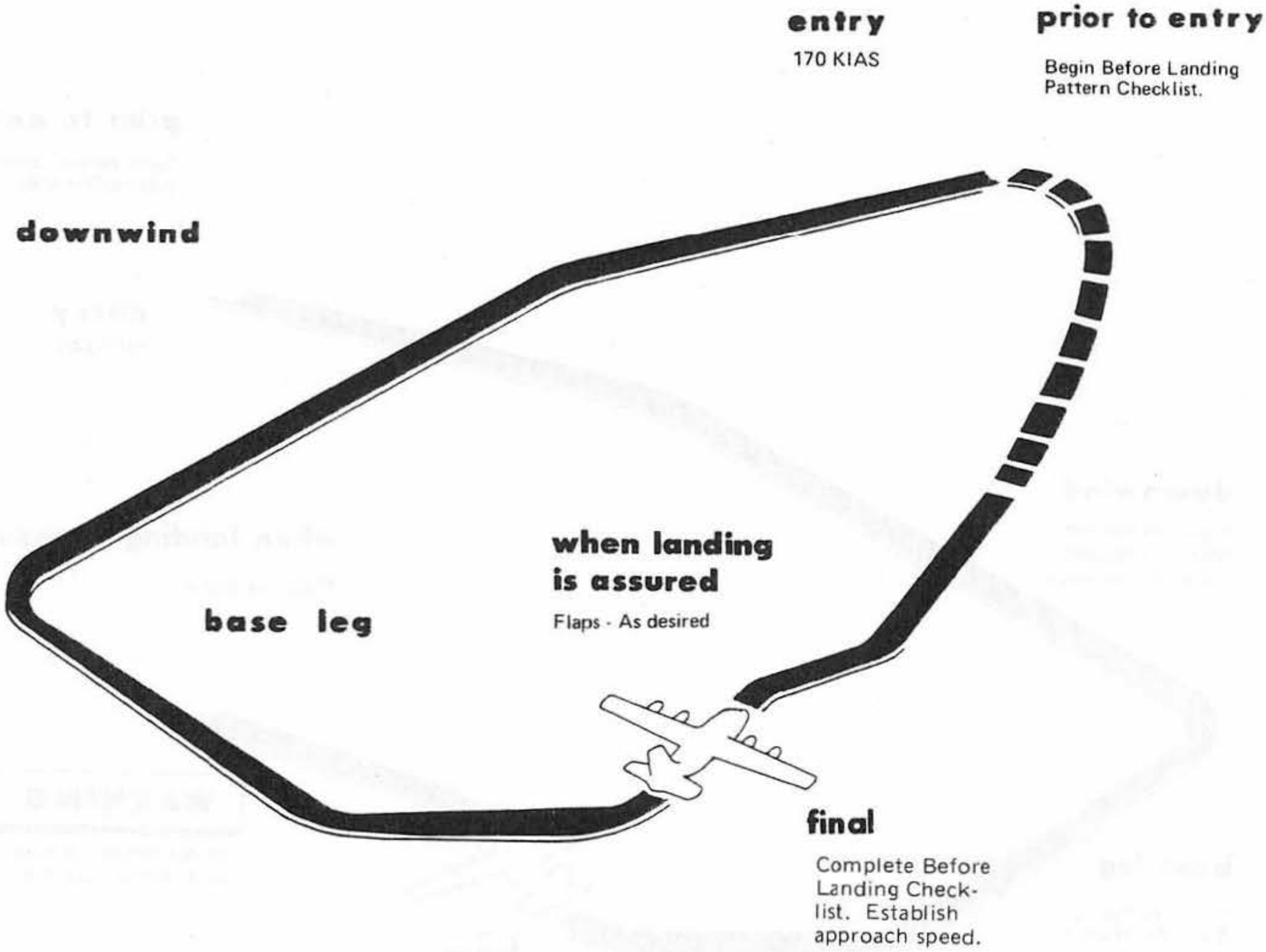


Figure 9-7.

typical radar approach pattern - two engines

prior to entry

Begin Before Landing Pattern Checklist.

entry

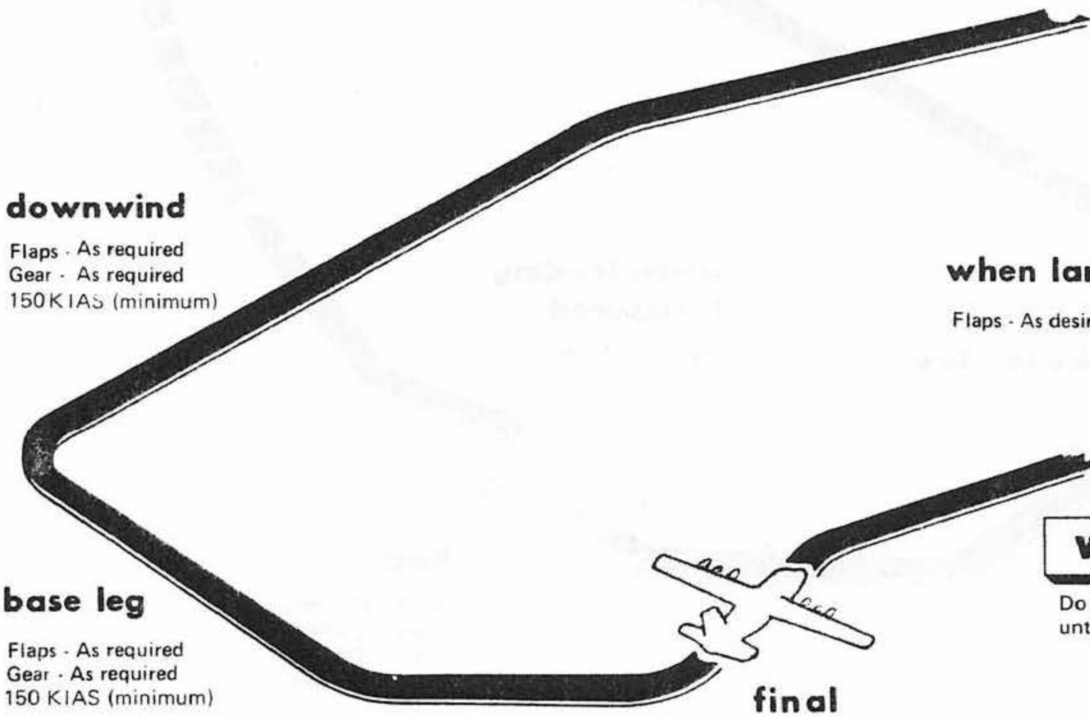
170 KIAS

downwind

Flaps - As required
Gear - As required
150 KIAS (minimum)

when landing is assured

Flaps - As desired



WARNING

Do not extend full flaps until landing is assured.

base leg

Flaps - As required
Gear - As required
150 KIAS (minimum)

final

Complete Before Landing Checklist
150 KIAS or approach speed whichever is higher until landing is assured.

turn to final

Reduce to 150 KIAS or approach speed whichever is higher.

WARNING

A go-around is not recommended after flaps are lowered.

Figure 9-8.

typical tacan pattern - four or three engines

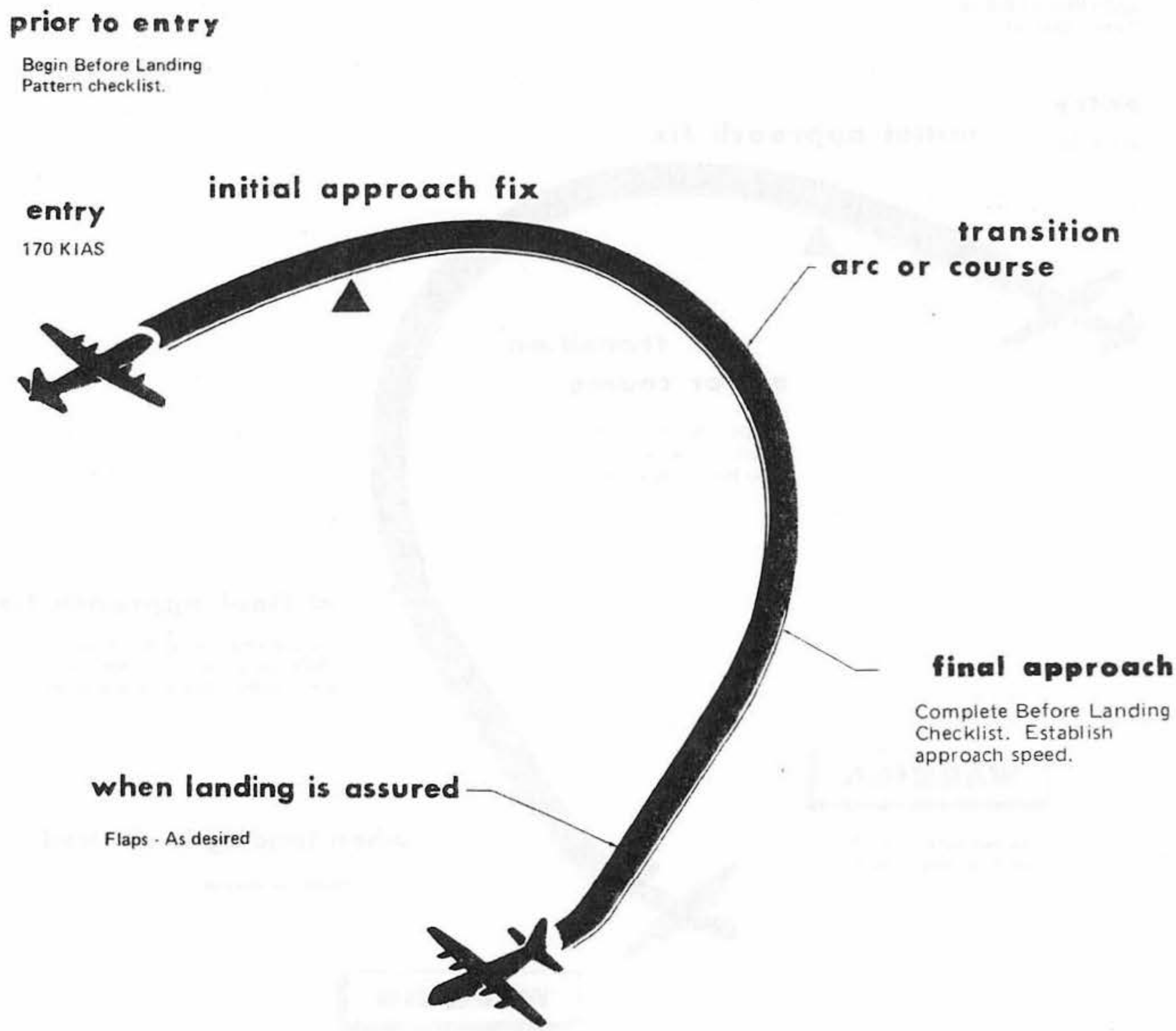


Figure 9-9.

typical tacan pattern - two engines

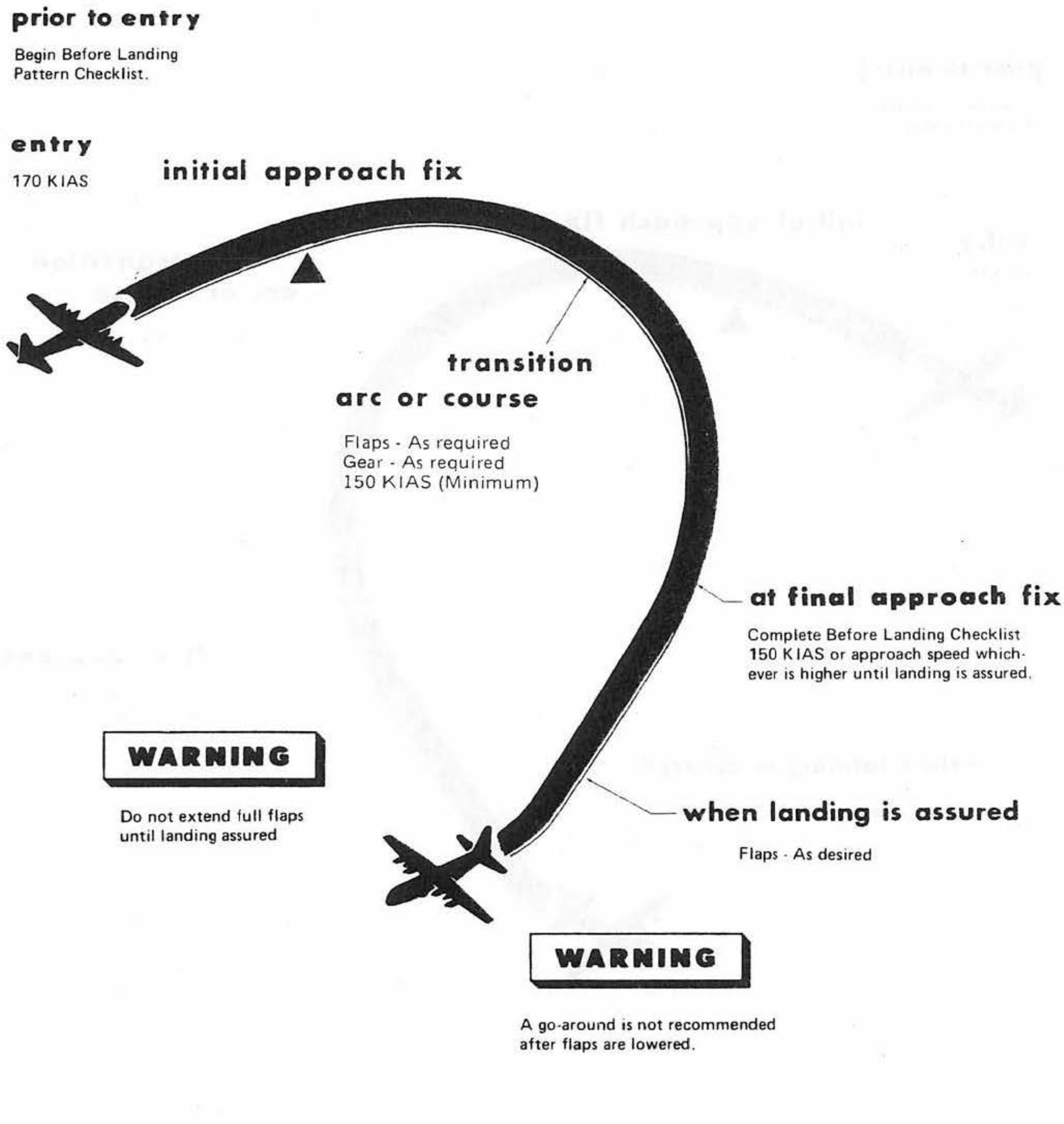


Figure 9-10.

icing conditions

Avoid icing conditions whenever possible. The biggest danger caused by ice accumulation is the reduced aerodynamic efficiency of the airplane. Specifically, ice accumulation may have the following effects:

Higher takeoff, landing, and stall speeds.
Reduces rate-of-climb.
Increases power requirement, thus increasing fuel consumption and decreasing range and endurance.
Impairs control response.
Reduces engine power by obstructing the engine inlet air duct.

If cruises must be made in icing conditions, consideration must be given to the effect of using bleed air from the engines for the anti-icing system. Use of bleed air for anti-icing will reduce speed, thereby reducing range, for any power setting. Additional power or a descent to a lower altitude may be necessary to maintain cruise speed. Refer to T.O. 1C-130 (A)A-1-2 for cruise performance with anti-icing bleed systems in operation. When possible, change altitude to prevent icing. If climbing to a non-icing altitude is not possible, a check of fuel flow versus ground speed should be made to determine if range or radius of action will permit completing the mission. The airplane can penetrate icing condition if the procedure given below is followed:

1. Consider outside air temperature, nature of clouds, type of icing (rime, clear) anticipated or being encountered, and duration of icing and select the least-severe icing altitude.

WARNING

Operation in the freezing range in visible moisture may cause icing that will prevent air start of shut-down engines.

2. Ensure that all anti-icing systems are on and operating.

3. Use de-icing systems as required.

WARNING

When ice forms on the airplane and the automatic ice detection system fails, place the prop and engine anti-icing master switch to the manual position. A delay could result in ice collecting in the inlet scoop and partial or complete loss of engine power.

Note

When the warning icing condition ON light illuminates, the propeller and engine anti-icing systems, and radome anti-icing will automatically be turned on by the ice detection system. If wing and empennage anti-icing is required, the switch must be manually placed in the ON position.

Note

There are no anti-icing provisions for the periscopic sextant mounting area. If use of the periscopic sextant is anticipated, it should be installed in the mount prior to flight in icing conditions to preclude the possibility of ice forming over the opening, preventing installation.

4. At temperatures above freezing, increase airspeed 10 to 15 knots above normal to reduce the possibility of engine inlet icing. If actual icing is encountered (visible on wings), reduce airspeed if practicable, to minimize rate of ice buildup.

5. Delay extension of flaps and landing gear until absolutely necessary. This will help avoid excessive ice accumulation on flaps and landing gear. While flying through icing conditions, watch the leading edge anti-icing temperature indicators and the propeller system deicing current indicators, to make certain that anti-icing equipment is working properly. Visual observation should be made for icing that has not been removed by the automatic system. Make frequent visual checks of wing leading edges, engine inlet air duct leading edges, and propeller spinners. If leading edge anti-icing is seen to be inadequate for preventing ice accumulation, seek a non-icing or less severe icing level.

CAUTION

If possible, avoid prolonged flight in freezing rain, particularly at low airspeeds with corresponding higher angles of attack, as there is a possibility of ice accretion on the upper inside surface of the engine inlet air ducts which are not anti-iced.

When icing conditions no longer exist, turn the PROP and ENG anti-icing master switch to the RESET position; all anti-icing systems, except the wing and empennage, are automatically turned off. The wing and empennage anti-icing switch must be manually turned to the OFF position.

CLEAR-AIR ICING.

Engine inlet air duct icing in clear air is possible in some combinations of temperature and humidity depending on the engine power setting and the airspeed. This icing is caused by the sudden drop in temperature resulting from pressure loss in the engine inlet air duct. Such icing is indicated by a falling torquemeter indication. If torquemeter indication falls for no apparent reason, assume that engine inlet air duct icing is occurring.

1. Turn the prop and eng anti-icing master switch to the MANUAL position, place the engine inlet air duct anti-icing switch in the ON position, and take the following action immediately.

2. To increase ram pressure in the air duct, increase airspeed to the maximum consistent with continuous operation.

3. Seek an altitude that is less likely to produce air duct icing.

turbulence and thunderstorms

Rain has no adverse aerodynamic effects on the airplane. At cruise speeds, however, visibility through the windshields will be reduced by streaking, as the windshield wipers are ineffective at speeds above approximately 180 KIAS.

Flying under conditions of extreme turbulence, such as through thunderstorms, should be avoided. When flying under conditions of low visibility, clear passage around or between thunderstorms can usually be found with the navigation and search radar The possibility remains, however, that a storm cannot be avoided, or that flight through a storm may be a matter of military necessity.

Recommended airspeed for penetration into severe turbulence is 65 knots above power-off stall speed. A comfortable speed in light to moderate turbulence is 180 KIAS.

The autopilot may be used, and in some cases is desirable. The altitude hold mode should be disengaged and the autopilot should not be either assisted or overpowered in the autopilot mode. If autopilot cannot control attitude, disengage and fly manually.

Prior to entering areas of known turbulence or thunderstorms, ensure that cockpit lights are set, crew and passengers are briefed, seat belts fastened, and all loose equipment secured. Airplane trim should be set prior to entry and adjustments avoided during flight through turbulence or thunderstorms.

night flying

To avoid spatial disorientation, it is recommended that the anti-collision light(s) be turned off during flight in clouds.

cold weather procedures

Note

Cold weather procedures are generally considered to be applicable when the temperature is 0° C (32° F) or below.

WARNING

At low temperatures, the possibility exists of fuel freezing. Refer to Section V for the freeze points of usable fuels.

Extreme cold causes general bad effects on airplane materials. Rubber, plastic, and fabric materials stiffen and may crack, craze, or even shatter when loads are applied. Oils congeal and greases stiffen. Metals contract differentially. Moisture, usually from condensation or melted ice, freezes in critical areas. Tire, landing gear strut, modulator, fire extinguisher bottle, and accumulator air pressures decrease with temperature decreases. Extreme diligence on the part of both ground and flight crews is required to ensure successful cold-weather operation. The procedure and precautions outlined here pertain to operating unhangared airplanes in cold weather and are in addition to the normal procedures given in Section II.

Note

Arrange the preheating period, whether by portable ground heaters or the gas turbine compressor, so that airplane components will be warmed and inspected prior to starting the engines.

BEFORE ENTERING THE AIRPLANE.

Perform a normal preflight inspection of the airplane as outlined in Section II. In particular, check the following:

1. Check for removal of all exterior protective covers and shields.

2. Check for removal of ice, snow, and frost from entire airplane.

WARNING

Do not attempt to take off with ice, snow, or frost on the wings and empennage. The roughness caused by ice and snow on the flight surfaces varies the airfoil shape with a resulting loss of efficiency. Take-off run is increased and rate of climb is decreased. Stall speed is increased, and stall characteristics are unpredictable.

CAUTION

Ensure that moisture from melted ice is not allowed to remain in critical areas where it may refreeze.

CAUTION

Do not attempt to scrape or chip ice from flight surfaces or fuselage. Exercise care to prevent injury to personnel from slipping and falling.

Note

If anti-icing compound has not been used on the crew door telescoping rod, frozen condensation may prevent full opening until the rod is heated.

3. Check that fuel tank vents, static ports, and pitot tubes are free of ice and snow.

4. Check for proper inflation of landing gear struts, tires, and hydraulic accumulators. Cold weather may cause deflation.

5. Check that landing gear strut extensions have been wiped with a hydraulic-fluid soaked cloth to remove ice and dirt.

6. Check that a warm well-charged battery has been installed.

7. Check dry bays free of hydraulic fluid and fuel seepage.

BEFORE STARTING ENGINES.

In addition to the normal procedures outlined in Section II, perform the following checks:

1. If isopropyl alcohol has been used to remove frost from the airplane, check the interior of the airplane for alcohol leaks and fumes. This condition may create a fire hazard.

2. If external AC and DC power is available, energize the Nesa windshields. Bring temperature up gradually to prevent cracking glass. As ice and frost begin to melt, operate the windshield wipers to help clear the windshields. Other windows may be cleared by portable ground heaters.

Note

Either portable ground heaters or the gas turbine compressor may be used to heat the interior of the airplane during the interior inspection. In extreme cold weather it may be necessary to preheat the gas turbine compressor before it can be started. During starting, torching may be observed. After starting, allow approximately 4 minutes warmup before applying load.

3. After the gas turbine compressor has been started and warmed up, start the air turbine motor. With the ATM running, check operation of the emergency brake system. Operate brake pedals with light pressure several times before locking the parking brake. Have an inspection made of each main wheel for evidence of hydraulic leakage after full pressure has been applied to the brake pedals. Seeps and moderate leaks caused by hardened O-rings can often be stopped by direct application of hot air from a ground heater for a few minutes.

CAUTION

Do not attempt to taxi if evidence of hydraulic leakage is found in any main landing gear area. Danger of fire and loss of brakes exists when hydraulic fluid contacts hot brakes.

4. Use nacelle preheat if necessary. Turn off before starting engines.

CAUTION

Nacelle preheat should be used only when ambient temperature is below 0° F and only when necessary to remove frost or ice from equipment in the nacelle to facilitate engine starting. The air dumped into the nacelle by a preheat valve is at approximately 600° F if an engine is running, or at approximately 350° F if the gas turbine compressor is supplying bleed air. Air at this temperature can quickly bake electrical cables and damage electronic components in the nacelle. Engine bleed air will be used only when GTC bleed is not available. Refer to Section IV for operation of the nacelle preheat system.

5. Before starting engines, remove all ground heater ducts from the airplane.

CAUTION

Do not statically change the blade angle of a propeller which has been exposed to prolonged temperatures of 0°C (32°F) or below. Warm the propeller hub oil by using warm air or by running the engine at ground idle until engine oil temperature is within 60°C to 80°C. Propeller blade seal damage and oil leakage may occur if this is not observed.

Note

This static feathering check is a safety of flight requirement and its continuity is required during prolonged cold weather operations. When adequate pre-heating equipment is not available and engine run is not practical, a static feather check will be performed prior to the Before Leaving the Airplane Checklist. An AFTO Form 781 notation is required when these procedures are implemented.

STARTING ENGINES.

Start the engines as outlined in Section II.

CAUTION

When attempting a start with JP-5 and kerosene type fuels at ambient temperatures below approximately -37° C (-35° F), the TIT and RPM should be closely monitored since stall and over-temperature may be experienced during the start.

BEFORE TAXI.

1. Check operation of leading edge anti-icing and propeller deicing and anti-icing systems (maximum duration is 30 seconds for the leading edge anti-icing system and two complete cycles for the propeller deicing and anti-icing systems).

CAUTION

Do not overheat anti-icing systems on the ground. Do not operate propeller anti-icing and deicing systems unless engines are running.

2. If not already accomplished with external power, energize the Nesa windshields, bringing temperature up gradually to prevent cracking glass. As ice and frost begin to melt, operate the windshield wipers to help clear the windshield. Other windows may be cleared by air blast from the defogging ducts.

3. At ambient air temperature of 0° C (32° F) or below, the following procedure should be used to minimize the possibility of damaging propeller seals.

a. After allowing adequate time for all engine operating temperatures to enter the normal operating range and prior to any large movement of the throttles, exercise the throttles forward and aft of the ground idle detent until a torque increase is indicated in each direction. Movement of the throttles approximately six times in each direction should insure the fluid will be warm throughout the propeller assembly.

b. The propeller reversing check should be pulled after engine run up and a normal reverse check should be made.

TAXIING INSTRUCTIONS.

CAUTION

To avoid damage to the seals in the propellers, use momentary reverse only. Do not make a full reverse check until the propeller fluid is warm.

Note

In cold weather when taxiing in conditions where visible moisture is present (ice fog or super cooled water droplets), use the engine inlet duct anti-icing.

The combination of increased engine power at low temperatures and slippery ramp surfaces due to ice and snow require that utmost caution be used during taxiing operations. Ground handling characteristics of the airplane on loose or compacted snow at temperatures below 0°F are good and braking action is fair to good. However, as temperatures rise toward freezing, snow-covered surfaces become more slippery and increasing caution must be exercised. Use of anti-skid is recommended during all taxiing on ice or snow.

WARNING

In cold weather, make sure that all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

CAUTION

Nose wheel steering becomes ineffective when abrupt turns are attempted on slippery surfaces. Use nose wheel steering, differential braking, and differential power for best directional control. Maintain safe taxi speeds by use of brakes and partial application of reverse thrust. Excessive reverse thrust will cause loss of visibility when taxiing over loose snow.

When operating on snow or slushy surfaces, use Nesa and pitot heat prior to and during propeller reversing.

GROUND TESTS.

Select the area that has the best available surface for braking and conduct the engine and propeller checks outlined in Section II. Avoid parking airplanes close together or near obstructions when performing ground tests.

Note

Surfaces covered with loose snow generally provide better braking than surfaces covered with compacted snow.

A modification of normal procedures may be required when making run-up on slippery surfaces. Check engines and propellers in symmetrical pairs while using reverse thrust on the other pair to prevent the airplane from sliding forward.

When runup must be conducted on snow-covered surfaces, do not attempt to make full power checks until the airplane is lined up on the runway and ready for take-off.

TAKE-OFF.

CAUTION

Prop and engine anti-icing and deicing should be on during take-off and climb if temperature is 32°F or lower and any visible moisture is present. If ice is allowed to build up in the engine inlet duct, severe compressor damage and flame-out can occur if the ice accumulation breaks free and enters the compressor.

If the airplane starts to slide before take-off power is reached, release the brakes and begin the take-off run. Continue the power check during the early part of the run.

CAUTION

Under low ambient temperature conditions, never place throttles in TAKE-OFF position without monitoring the torquemeters. At temperatures below freezing it is possible to exceed maximum allowable shaft horsepower without exceeding the maximum allowable turbine inlet temperature. In addition, increasing ram effect during the take-off will increase shaft horsepower for any fixed turbine inlet temperature. This means either that torque must be set below the maximum allowable when setting power for take-off or that power must be reduced as airspeed builds up.

After take-off from slushy runways, cycle the landing gear to reduce the possibility of jackscrews freezing.

Note

During operation of the propeller anti-icing system there is a possibility that an indicator "jitter" may occur in the turbine inlet temperature indicators, the torquemeters, and fuel flow gages. This needle "jitter" may make monitoring the affected instruments difficult. If this condition occurs, momentarily turn the propeller and engine anti-icing master switch to RESET, then read the indicators.

LANDING.

Make a normal pattern and land as outlined in Section II. Use nose wheel steering gently. Use reverse thrust during the early part of the landing roll. As forward speed decreases, decrease reverse power. If reverse thrust is used at slow speeds on snow or slush-covered surfaces, complete loss of visibility may occur. Be prepared to turn on windshield wipers.

Note

During use of maximum braking on slippery surfaces, cycling of the anti-skid system will be felt on the brake pedals.

LANDING ON ICY RUNWAY.

Refer to Landing on Icy Runways as outlined in Section II.

ENGINE SHUTDOWN.

Note

Under sustained daily operations where no adequate pre-heating equipment is available, the flight crew will perform the static feathering check listed in Section II while the engines are warm. Upon completion, a 781 notation is required. Maintenance action on propeller systems will require reaccomplishment of the static feather check during this interim operation.

Make a normal engine shutdown, as outlined in Section II. As soon as the airplane is parked, chock the wheels and release the brakes.

BEFORE LEAVING THE AIRPLANE.

Perform normal Before Leaving the Airplane checklist as outlined in Section II and:

1. Remove ice and dirt from shock struts.

2. Install all exterior protective covers and shields.

3. If the airplane is to remain outside for more than 4 hours at temperature below -20°F, remove the battery and store it in a heated area.

4. Close all doors and hatches.

hot weather procedures

Hot weather operation, as distinguished from desert operation, generally means operation in a hot, humid atmosphere. High humidity usually results in the condensation of moisture throughout the airplane. Possible results include malfunctioning of electrical equipment, fogging of instruments, rusting of steel parts, and the growth of fungi in vital areas of the airplane. Further results may be pollution of lubricants and hydraulic fluids, and deterioration of nonmetallic materials. The procedures essential to operation and maintenance under such conditions are given in the following paragraphs.

BEFORE ENTERING THE AIRPLANE.

Perform a normal preflight inspection, as outlined in Section II. Give special attention to the following:

1. Cool the flight station and cargo compartments with portable coolers, if available.

2. Inspect for freedom of corrosion or fungus at joints, hinge points, and similar locations.

3. Check for hydraulic leaks, as heat and moisture may cause seals and packings to swell.

4. Inspect the shock struts for cleanliness.

5. Inspect tires for proper inflation.

6. Remove all protective covers and shields.

BEFORE STARTING ENGINES.

Continue the normal preflight inspection, as outlined in Section II, giving special attention to the following:

1. If instruments, equipment, and controls are moisture coated, wipe them dry with a clean, soft cloth.

STARTING ENGINES.

Continue the normal preflight inspection, as outlined in Section II, giving special attention to the following:

Note

When attempting a start under conditions of low air density, refer to Section VII for BATTERY ENGINE START.

TAXIING INSTRUCTIONS.

Taxi the airplane as directed in Section II. Use brakes as little as possible to avoid overheating.

TAKE-OFF.

Execute normal take-off and climb, as outlined in Section II.

WARNING

Take-off run is considerably increased, and rate of climb decreased, in high temperatures. Refer to the appropriate charts in T.O. 1C-130(A)A-1-2.

CRUISE.

Follow normal procedures for the operation of the airplane, as outlined in Section II.

WARNING

Fuel densities will decrease as the ambient temperature rises, resulting in a decrease in operating range. In addition, the boil-off rate will increase and it may be necessary to restrict rate of climb of the airplane at altitude. Refer to FUEL, Section V.

LANDING.

Execute normal approach and landing, as outlined in Section II.

ENGINE SHUTDOWN.

Make a normal engine shutdown, as outlined in Section II. As soon as the airplane is parked, chock wheels and release brakes in order to avoid possible damage to brake components from excessive heat generated while taxiing.

BEFORE LEAVING THE AIRPLANE.

Make a normal postflight inspection, as outlined in Section II, and:

1. Have appropriate protective covers installed for protection from the sun.

2. When weather conditions permit, leave flight station windows and cargo compartment doors open to ventilate the airplane.

desert procedures

Desert operation generally means operation in a very hot, dry, dusty, often-windy atmosphere. Under such conditions, sand and dust will often be found in vital areas of the airplane, such as hinge points, bearings, landing gear shock struts, and engine cowling and intakes. Severe damage to the affected parts may be caused by the dust and sand. Position the airplane so that propwash will not expose other aircraft, personnel, and ground equipment to blown sand or dust. The necessary operations under such conditions are given in the following paragraphs.

BEFORE ENTERING THE AIRPLANE.

Perform a normal preflight inspection, as outlined in Section II. Give special attention to the following:

1. Cool the flight station and cargo compartments with portable coolers, if available.

Note

Use of the GTC for ground air conditioning may pull in quantities of sand and dust.

2. Inspect all control surface hinges and actuating linkage for freedom of sand and dust.

3. Inspect tires for proper inflation.

4. Inspect shock struts for cleanliness.

5. Remove all protective covers and shields.

BEFORE STARTING ENGINES.

Continue the normal preflight inspection of the airplane, as outlined in Section II. Give special attention to the following:

1. Inspect instrument panels, switches, and controls for freedom of sand and dust.

2. Operate all controls through at least two full cycles to ensure unrestricted operation.

TAXIING INSTRUCTIONS.

Taxi the airplane as directed in Section II, using care to avoid blowing sand or dust on other aircraft, personnel, or equipment. Use brakes as little as possible to prevent overheating. The use of reverse thrust may blow sand and dust into the air directly in front of the engine intakes. In deep sand, use differential power rather than nose wheel steering, for directional control. Minimize ground operation to avoid excessive sand and dust intake by the engines.

TAKE-OFF.

Execute normal take-off and climb, as outlined in Section II. Avoid take-off during sand or dust storms, if possible. Sand and dust will cause damage to internal engine parts. Take-off run is considerably increased and rate of climb decreased in high atmospheric temperatures. Refer to the appropriate charts in T.O. 1C-130(A)A-1-2.

CRUISE.

Follow normal procedures for the operation of the airplane, as outlined in Section II. Avoid flying through dust or sand storms, when possible. Excessive dust and grit in the air will cause considerable damage to internal engine parts.

LANDING.

Execute a normal approach and landing, as outlined in Section II. On very hot days, follow traffic and landing procedures strictly, and anticipate a longer landing roll. Avoid the use of reverse thrust, since reverse thrust may blow sand and dust into the air directly in front of the engine intakes.

ENGINE SHUTDOWN.

Make a normal engine shutdown, as outlined in Section II. As soon as the airplane is parked, chock the wheels and release the brakes to avoid damage to brake components due to excessive heat generated while taxiing.

BEFORE LEAVING THE AIRPLANE.

Make a normal Before Leaving the Airplane inspection, as outlined in Section II, giving special attention to the following:

1. Have all protective covers and shields installed.

2. Except in dusty or rainy weather, leave flight station windows and cargo compartment doors open to ventilate the airplane.

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