NAVAL AIR TRAINING COMMAND

NAS CORPUS CHRISTI, TEXAS **CNATRA P-563 (New 4-10)**

STUDENT HANDOUT BOOKLET

T-44A SYSTEMS COURSE

2010

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Subj: STUDENT HANDOUT BOOKLET, T-44A SYSTEMS COURSE

1. CNATRA P-563 (New 04-10) PAT, "Student Handout Booklet, T-44A Systems Course" is issued for information, standardization of instruction and guidance to all flight instructors and student aviators within the Naval Air Training Command.

2. This publication shall be used as an explanatory aid to the Advanced Multi-Engine Flight Training curriculum. It will be the authority for the execution of all flight procedures and maneuvers herein contained.

3. Recommendations for changes shall be submitted via CNATRA TCR form 1550/19 in accordance with CNATRAINST 1550.6 series.

4. CNATRA P-563 (New 04-10) PAT is a new publication.

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Chief of Staff

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STUDENT HANDOUT BOOKLET

FOR

T-44A SYSTEMS

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INTERIM CHANGE SUMMARY

The following changes have been previously incorporated in this manual:

CHANGE NUMBER	REMARKS/PURPOSE

The following interim changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER	REMARKS/PURPOSE	ENTERED BY	DATE

INTRODUCTION

THIS STUDENT BOOKLET IS NOT INTENDED TO REPLACE THE T-44A NATOPS. THE STUDENT BOOKLET MAY BE USED IN CONJUNCTION WITH THE T-44A SYSTEMS FAMILIARIZATION COURSE.

NOT INTENDED FOR INFLIGHT USE

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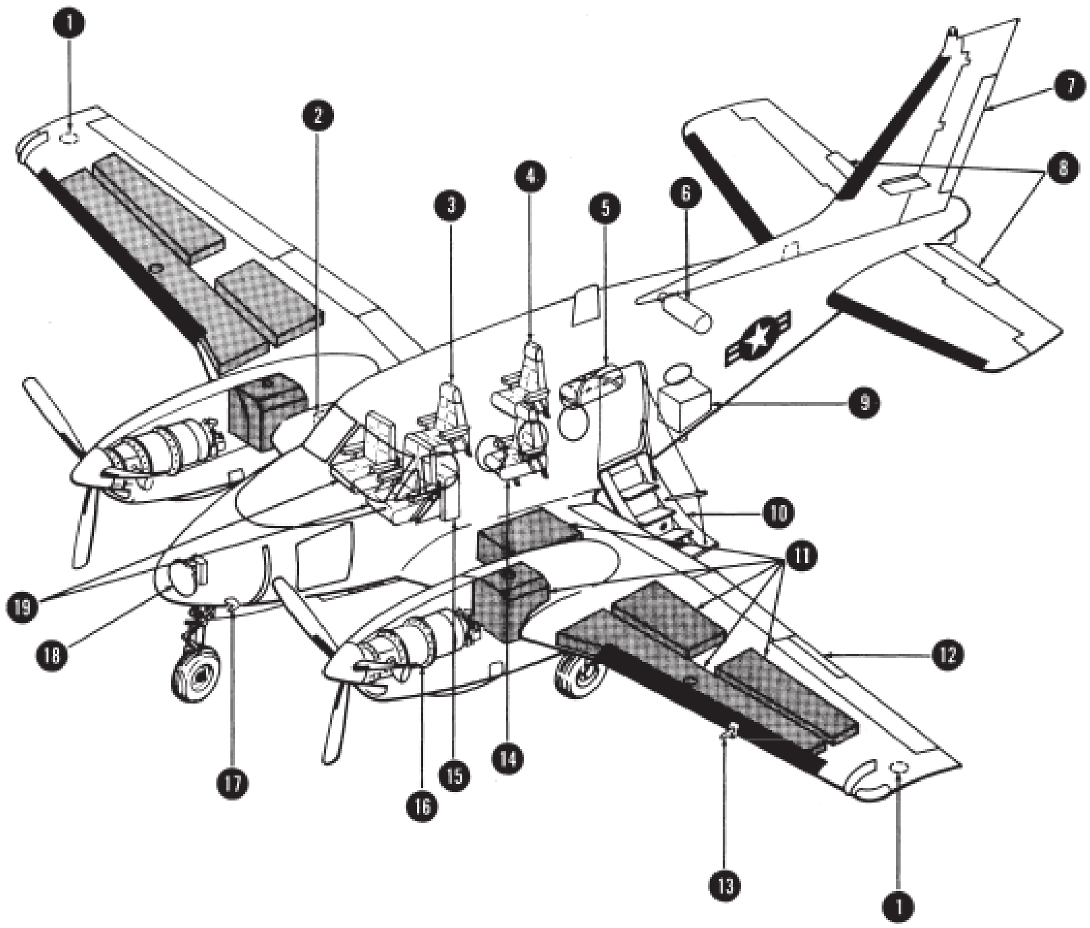
LESSON ONE
GENERAL AIRCRAFT

100. OBJECTIVES

At the end of this lesson, you should be able to:

1. State the type and manufacturer of the T-44A aircraft.
2. State the mission of the T-44A aircraft.
3. List the features of the T-44A aircraft.
4. State the dimensions of the T-44A aircraft.
5. State the maximum weight limitations for the T-44A aircraft.
6. State the airspeed limitations for the T-44A aircraft.
7. State the acceleration limitations for the T-44A aircraft.
8. State the altitude limitations for the T-44A aircraft.
9. State the landing limitations for the T-44A aircraft.
10. State the maximum cabin pressure differential.
11. List the prohibited maneuvers for the T-44A aircraft.
12. State the crew limitations for the T-44A aircraft.
13. Describe the personal equipment provided in the T-44A aircraft.
14. List and describe the rescue equipment aboard the T-44A aircraft.
15. Describe the location of the T-44A hand-held fire extinguishers.
16. Describe the location of the T-44A first-aid kit.
17. Describe the location and operation of the T-44A emergency locator transmitter.
18. Describe how to check that the main cabin door is properly locked.
19. Describe the location and operation of the emergency exit.

NOTES



1. FLUX DETECTORS
2. BATTERY BOX
3. COCKPIT OBSERVERS SEAT
4. PASSENGER SEAT
5. LIFE RAFT
6. OXYGEN SUPPLY CYLINDER
7. RUDDER TRIM TAB
8. ELEVATOR TRIM TABS
9. LAVATORY
10. AIRSTAIR DOOR
11. FUEL SUPPLY TANKS
12. AILERON TRIM TAB (LEFT WING ONLY)
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15. STORAGE CABINET AND MAP CASE
16. PT6A-34B ENGINE
17. PILOTS PITOT MAST
18. WEATHER RADAR ANTENNA
19. PILOTS SEATS (2)

T44A-F002

Figure 1-1 General Arrangement

101. T-44A AIRCRAFT DESCRIPTION

Manufacturer

Beech Aircraft Corporation in Wichita, Kansas

Mission

The primary mission of the T-44A is to train student aviators to fly multi-engine turboprop aircraft. The secondary mission of the T-44A is to transport passengers and/or cargo.

Features

Deicing/anti-icing system, instrumentation, and navigation equipment which allow flight under instrument and icing conditions.

Interior seats for instructor pilot, student pilot, student observer and up to two additional passengers. (More than 3 seats can be added but a new Weight and Balance form must be completed.)

Student observer audio control panel allows the student observer to monitor all radio communications.

Non-flushing toilet with privacy curtain and relief tube.

Dimensions

Length = 35 feet 6.0 inches

Height = 14 feet 2.6 inches

Prop to ground clearance = 11.5 inches

Cabin door width = 26.75 inches

Cabin door height = 51.5 inches

Wing span = 50 feet 2.9 inches

Prop arc = 7 feet 9.0 inches

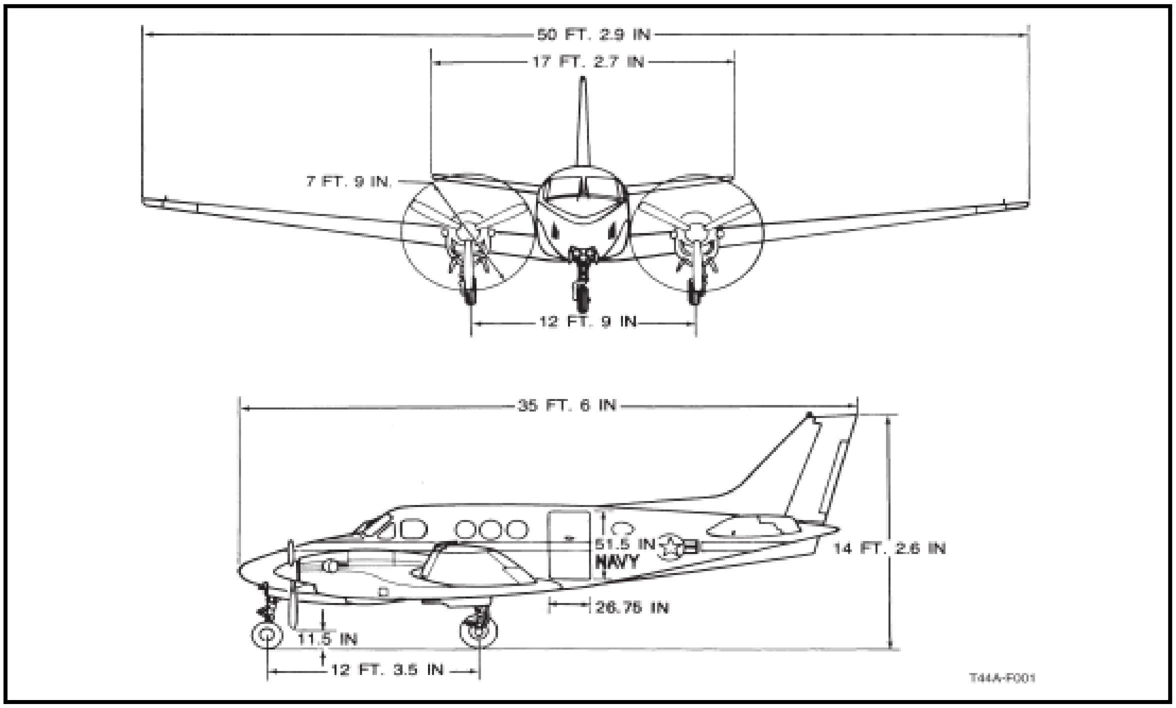

Figure 1-2 Aircraft Dimensions

102. T-44A AIRCRAFT LIMITATIONS

Weight Limitations

Maximum ramp weight: 9710 lbs.

Maximum take-off weight: 9650 lbs.

Maximum landing weight: 9168 lbs.

Airspeed Limitations

Maximum dive/maximum level flight (V_{MO}) = 227 KIAS

Decreasing 4 KIAS per 1000 feet above 15,500 feet MSL

Maneuvering speed (V_A) = 153 KIAS

Maximum gear extension/extended (V_{LE}) = 155 KIAS

Maximum gear retraction speed (V_{LO}) = 145 KIAS

Maximum airspeed for extended flaps (V_{FE}) depends on the flap position

Maximum flaps approach (flaps extended 35%) = 174 KIAS

Maximum full flap (flaps extended 100%) = 140 KIAS

Minimum safe one engine inoperative (V_{SSE}) = 91 KIAS

Minimum controllable airspeed (V_{MCA}) = 86 KIAS

One engine inoperative best rate of climb (V_{YSE}) = 110 KIAS

One engine inoperative best angle of climb (V_{XSE}) = 102 KIAS

Landing Limitations

Flared landings only

Maximum sink rate at ground contact of 600 FPM

Maximum crosswind component of 20 knots

Prohibited Maneuvers

Intentional spins

Aerobatics

103. CREW AND PERSONAL EQUIPMENT

Crew Limitations

Minimum crew for the T-44A is a pilot in command (left seat when not training) and a copilot.

Minimum crew when carrying passengers is an aircraft commander and one of the following: second pilot, third pilot, instructor under training, or student aviator.

Personal Equipment

The NATOPS lists seats and headsets as personal equipment in the T-44A aircraft.

Pilot and Copilot Seats

The pilot and copilot seats are adjustable fore and aft using the inboard handle.

The pilot and copilot seats are vertically adjustable using the outboard handle.

The armrests stow up for easier access to the seats.

Passenger Seats

Up to three passenger seats can be installed in the T-44A without completing a new weight and balance form. More than three passenger seats require a new weight and balance form. These seats are easily removed to make room for additional cargo.

Passenger seats are adjustable fore and aft BY MAINTENANCE PERSONNEL ONLY.

The backs of the passenger seats recline for individual comfort.

WARNING

THE SEATBACKS MUST BE IN THE FULLY UPRIGHT POSITION FOR TAKEOFF AND LANDING.

Headsets

Headsets with boom mikes are provided for the pilot, copilot and observer.

Pilot and copilot phone jacks are located on the respective sides of the instrument panel.

The observer has a phone jack on the right sidewall by the observer audio panel.

Water Survival Equipment

The T-44A has two types of water survival equipment:

1. Life Preservers

2. Life Raft

Pilot and Copilot Life Preservers

One AV-8 life preserver is provided with each pilot and copilot seat. They are stored in the seatback pockets.

Passenger Life Preservers

Passenger life preservers are stored under the passenger seats. The handle on the life preserver is placarded “Life Vest Pull.”

Life Raft

The type II seven man life raft is located on the seat tracks across from the main cabin door. To release the raft press the “T” fitting.

Emergency Equipment

The NATOPS lists three kinds of emergency equipment found on the T-44A.

1. Hand Fire Extinguisher

2. First-Aid Kit

3. Emergency Locator Transmitter

Fire Extinguishers

The T-44A has two 2.5 pound hand-held fire extinguishers. They contain Halon 1211. One extinguisher is stored beneath the copilot seat. The other extinguisher is stored on the seat riser, just forward of the main cabin door.

First-Aid Kit

The aircraft first-aid kit is stored on the forward side of the partition in the aft cabin.

Emergency Locator Transmitter

The Emergency Locator Transmitter (ELT) is located in the lower right rear section of the fuselage, aft of the pressure bulkhead.

The ELT is designed to transmit a beeping tone on the emergency frequencies, 121.5 (VHF) and 243.0 (UHF), whenever the aircraft contacts the ground with a 5 to 7g force.

A self-contained battery powers the ELT. The ELT will transmit continually for at least 48 hours.

A particularly hard landing could actuate the ELT. There are NO controls in the cockpit that allow the pilot or copilot to turn the ELT on or off.

The maintenance crew or pilot may manually turn on, turn off, or reset the unit with the ELT switch. This ON/OFF/RESET switch is located through a small circular hole in the lower right rear fuselage area.

104. AIRCRAFT EXITS

The T-44A has two exits:

1. Main Entrance Door

2. Emergency Exit Hatch

Main Cabin Door

The main cabin door is a swing-down door, hinged at the bottom. This provides positive cabin security when the aircraft is in flight, and it provides a stairway for normal and emergency entrance or exit.

A plastic-encased cable provides a stop support for the door in the open position and an easy pull for closing the door.

An inflatable rubber seal expands to seat the door in flight. Engine bleed air provides the source of pressure to inflate the seal.

When the handle is rotated, two latches hook the door to the frame at the top, and two lock bolts on each side of the door frame lock into the side frame.

When the door is locked, two micro switches are closed and the red CABIN DOOR OPEN light on the annunciator panel in the cockpit is extinguished.

Emergency Exit Hatch

The emergency exit hatch is located at the third cabin window on the right side of the fuselage.

Adjacent to the hatch is a striped access door. Inside the door is a flush-mounted handle that can be pulled to open the hatch.

Instructions for opening the hatch are placarded on the access door.

CAUTION

DO NOT OPEN THE EMERGENCY EXIT HATCH WHILE THE AIRCRAFT IS PRESSURIZED.

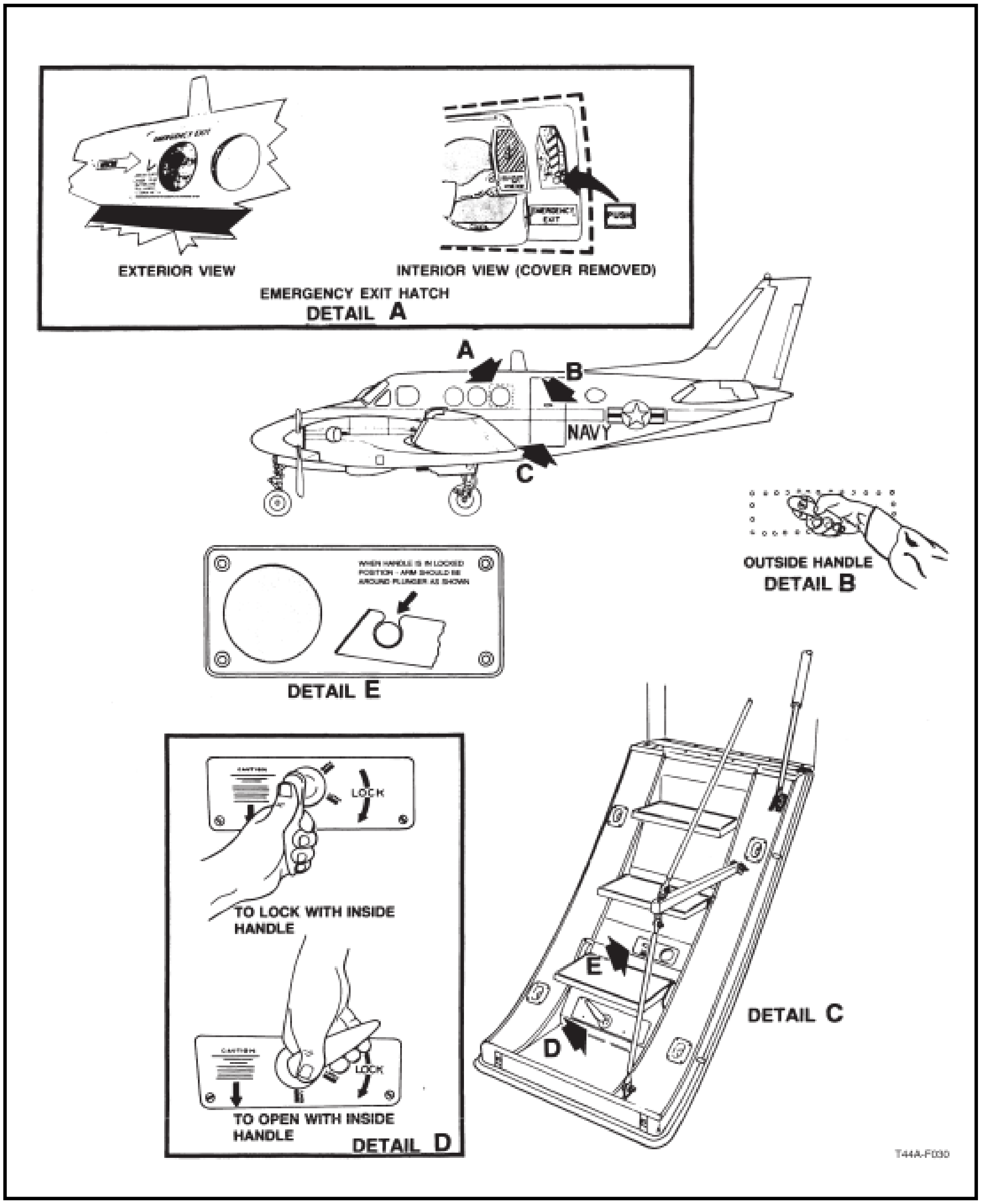

Figure 1-3 Entrance and Exit Procedures

AIRCRAFT SYSTEMS QUIZ

1. Complete the following statements concerning the landing limitations for the T-44A.

a. You should make ______________ landings in the T-44A.

b. The maximum sink rate at ground contact is _______FPM.

c. The maximum crosswind component is __________knots.

2. The minimum crew for flight is a _________________and a ___________________. The minimum crew when carrying a passenger is an _________________________ and a ____.

3. The prohibited maneuvers in the T-44A are ________________and_______________.

4. The hand held fire extinguishers contain ______ lbs. of __________________________ and are located ____ and ____.

5. The emergency locator transmitter (ELT) is located on the __________side of the fuselage aft of the pressure bulkhead. The ELT will transmit continuously for ______ hours on both the UHF guard frequency of _________ Mhz. and the VHF guard frequency of ________ Mhz. The ELT is powered by a ___________ ____________ battery.

6. The T-44 aircraft is manufactured by ________________ Aircraft Corporation, located in Wichita, Kansas.

7. The primary mission of the T-44A is to train student aviators to fly ___________ turboprop aircraft.

8. The second student/observer audio control panel has the capability to transmit on the V/UHF radio.

TRUE FALSE

9. Fill in the following:

a.	Max ramp weight	________________	f.	Max takeoff weight	___________
b.	Max altitude	_________________	g.	Max gear extended speed	___________
c.	G-limits	_________________	h.	Max speed at approach flaps	___________
d.	Maneuver speed	_________________	i.	Max speed at full flaps	___________
e.	Vmca	_________________	j.	Decel Gs to lock shoulder harness	_______

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LESSON TWO
ELECTRICAL SYSTEM

200. OBJECTIVES

At the end of this lesson, you should be able to:

1. Describe the function and characteristics of the three (3) DC power supplies.

2. Label the ten (10) DC busses, items powered by the Hot Battery Bus and Dual Powered items.

3. Label and describe the function of the DC busses and their components.

4. Describe the function of the inverters.

5. Describe the functions of the AC gauges.

6. Describe the function of the AC system and its components.

7. Label and describe the function of the annunciator panel and its components.

8. Label and describe the function of the interior lighting controls.

9. Describe the function of the exterior lighting controls.

10. Recognize the indications and potential results of a generator malfunction.

11. State the emergency procedure to be used during a single- or dual-generator failure.

12. Recognize the indications and potentials results of a current limiter failure.

13. Recognize the indications and potential results of an inverter malfunction.

14. Describe which circuit breakers may be reset and which circuit breakers must never be reset.

NOTES

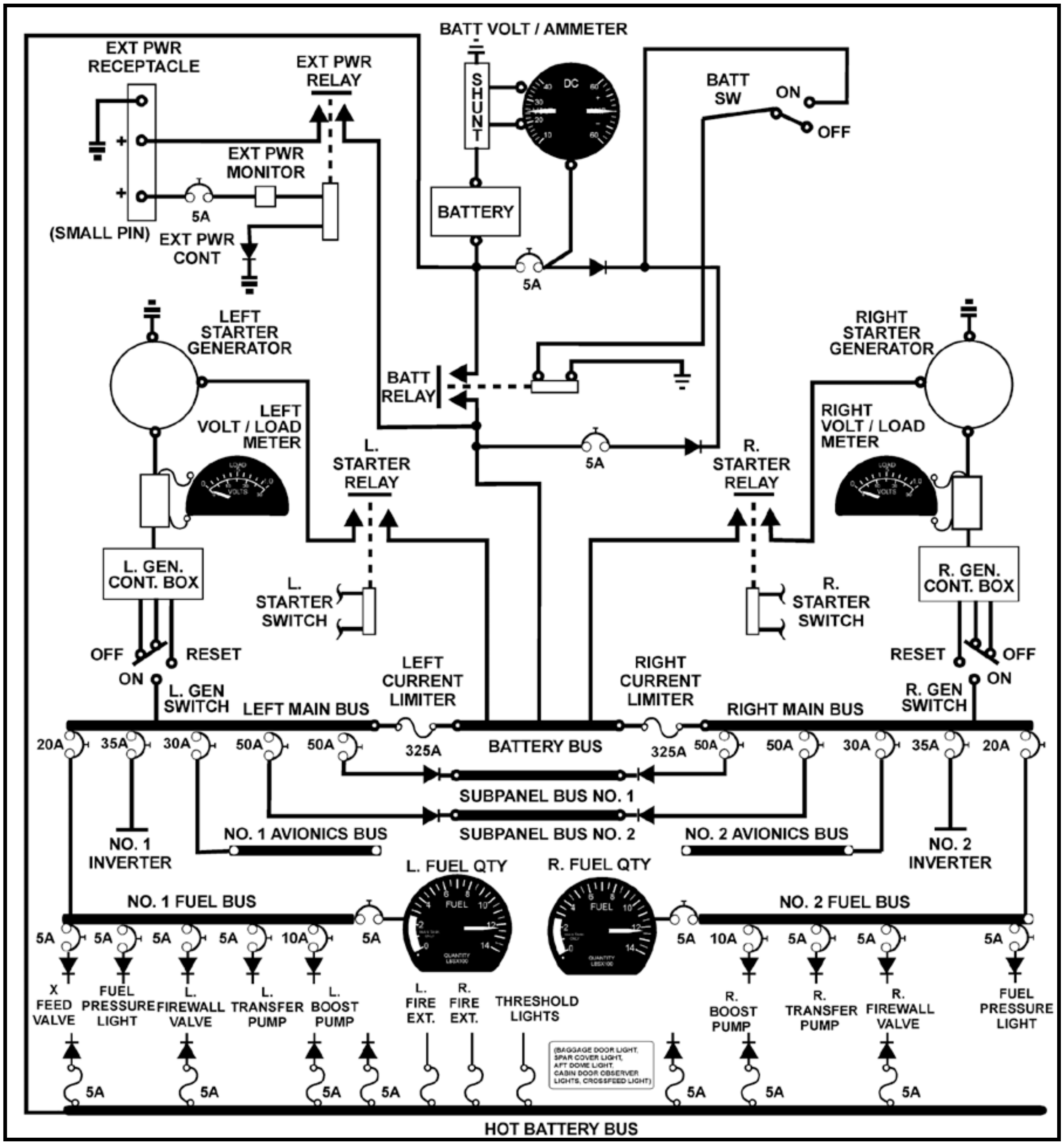

Figure 2-1 DC Electrical System

201. DC ELECTRICAL SYSTEM

DC Generators

The DC Electrical System supplies the basic power for the T-44A. DC power energizes most of the aircraft's circuits.

The three sources of DC power are:

1. 24-volt, 42-amp hour lead acid battery

2. 250 ampere starter-generator (left)

3. 250 ampere starter-generator (right)

One starter-generator is mounted on the accessories section of each engine.

Each generator provides 28 Vdc and has a rated output of 250 amps.

Generator Control Switches

On the Control Pedestal, there are two generator control switches, GEN NO. 1 and GEN NO. 2.

These are three position switches: ON, OFF and RESET.

To bring a generator on line, set the appropriate switch to OFF, RESET momentarily, then ON.

To take a generator off-line, set the appropriate switch to OFF.

Engine Start Switches

The IGN & ENG START switches are on the Control Pedestal. When activated, the Left and Right Starter switches will deenergize the respective generator.

The starters are limited to an operating period of 40 seconds on, 60 seconds off for two cycles. Then 40 seconds on, 30 minutes off following the third attempt.

Generator Control Boxes

Each generator has a Generator Control Box located under the cabin floor just aft of the main wing spar in the center aisle.

Each control box provides:

1. Voltage regulation at 28.25 +/- 0.8 Vdc
2. Automatic paralleling

3. Overvoltage protection at 31 Vdc
4. Undervoltage protection at 18 Vdc
5. Reverse current protection

Generator Loadmeters

The generator output is displayed on the left or right generator voltmeters. These meters are located on the pilots subpanel.

The current load is measured as a percentage of total output. Thus, 1.0 on the meter equals a 100% load (or 250 amps).

Generally the load should indicate 0.3 to 0.6.

Spring loaded pushbuttons below the generator voltmeters allow bus voltage to be displayed when manually depressed.

Normal bus voltage will be 28.25 +/- 0.8 Vdc.

Generator Warning Lights

There are two lights LH GEN OUT or RH GEN OUT on the annunciator panel. These lights will illuminate when the respective generator is offline. A FAULT WARN light will flash with the illumination of either LH GEN OUT or RH GEN OUT light.

Battery

The battery is a 24 volt lead acid battery mounted in the right wing root and is controlled by a switch located on the control pedestal.

The battery can supply power to all the DC powered equipment.

The three functions of the battery are to:

1. Provide emergency power
2. Provide power to start the engines
3. Act as a damper by absorbing power surges

DC External Power

External DC power can be applied by an auxiliary power unit (APU) to the aircraft through an external power receptacle in the right-engine nacelle. The APU must NOT exceed 28 Vdc and must be capable of delivering a continuous load of 300 amperes with bursts up to 1,000 amperes for 0.1 second, if required.

- 22 volts are required for a battery start.
- 20 volts are required for an APU start.
- 18 volts are required to allow the APU to charge the battery.
- If voltage is below 18, the battery must be replaced.

DC Busses

There are a total of ten (10) DC busses, they are:

1. Battery Bus
2. Subpanel Bus No. 1
3. Subpanel Bus No. 2
4. Left Main Bus
5. Right Main Bus
6. No. 1 Avionics Bus
7. No. 2 Avionics Bus
8. No. 1 Fuel Bus
9. No. 2 Fuel Bus
10. Hot Battery Bus (Battery Emergency Bus)

Hot Battery Bus

Items powered exclusively by the Hot Battery Bus are considered singularly powered. These items are:

LH and RH fire extinguishers
Baggage door light
Threshold light
Spar cover light
Aft dome light
Cabin door observer light

Dual Powered Items

Items powered by the Hot Battery Bus and their respective fuel bus are considered dual powered. These items include:

1. LH and RH boost bumps
2. LH and RH firewall shut-off valves
3. Crossfeed valve

Current Limiters

The current limiters are sometimes called “bus ties.” They connect the Left and Right Main Busses to the Battery Bus.

Should one of the generators malfunction, the Current Limiters allow the busses to receive power from the remaining generator.

Another important function of the Current Limiters is to isolate a major short from the rest of the system.

Each current limiter is rated as a 325 amp slow-blow fuse.

202. AC ELECTRICAL SYSTEM

Inverters

AC electrical power is supplied by two 750 volt-amp, single phase inverters. These inverters are designated No. 1 and No. 2, and are DC powered. Each inverter supplies 26 Vac power, at 400 Hz for torquemeters. Each inverter also supplies 115 Vac, at 400 Hz to AC Bus No. 1 and AC Bus No. 2, respectively, for the avionics.

Inverter Select Relays

When both inverters are functioning, the No. 1 Inverter supplies the AC Bus No. 1 and the No. 2 Inverter supplies the AC Bus No. 2.

However, if a total or partial inverter failure occurs, the four Inverter Select Relays adjust the electrical flow so that both AC busses and both torquemeters are energized by the opposite inverter.

Inverter Select Relay Fuses

Two Inverter Select Relay Fuses protect the avionics on the AC busses from power surges.

If one Inverter Select Relay Fuse breaks, the avionics on the respective AC bus will be lost.

AC Gauges

The No. 1 and No. 2 AC Bus Voltmeters are located on the pilot left subpanel.

Each meter is equipped with a spring-loaded push-button switch.

Each meter normally shows bus frequency in hertz. Normal bus frequency is 400 +/- 6 Hz. When the push-button is depressed each meter will show bus voltage. Normal bus voltage is 114 +/- 7 volts.

203. LIGHTING SYSTEMS

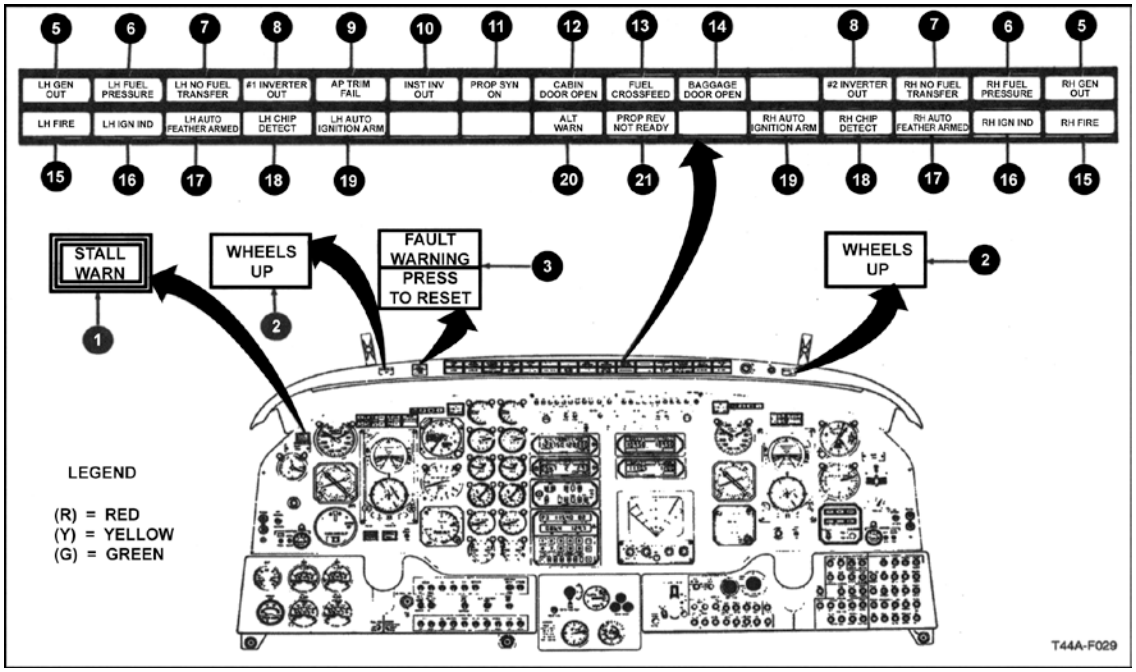

Figure 2-2 Caution/Annunciator Lights

Annunciator Panel

The annunciator panel is mounted across the top of the instrument panel. It provides a visual monitor for all the critical functions of the aircraft and indicates conditions for which corrective action must be taken.

The lights are color coded as follows:

Red = critical fault lights (warning), **Yellow** = cautionary lights, **Green** = advisory lights

The FAULT WARN light flashes for all critical faults. The FAULT WARN may be reset by pressing it. Resetting the FAULT WARN does not also cancel the critical annunciator.

When the FAULT WARN illuminates, the annunciator defaults to maximum brightness. When the FAULT WARN light is reset, all lights will dim to the previous level set by the dim control.

The annunciator lights Press-to-Test switch tests all the annunciator panel lights. Note that all the lights turn on when the Press-to-Test button is pressed.

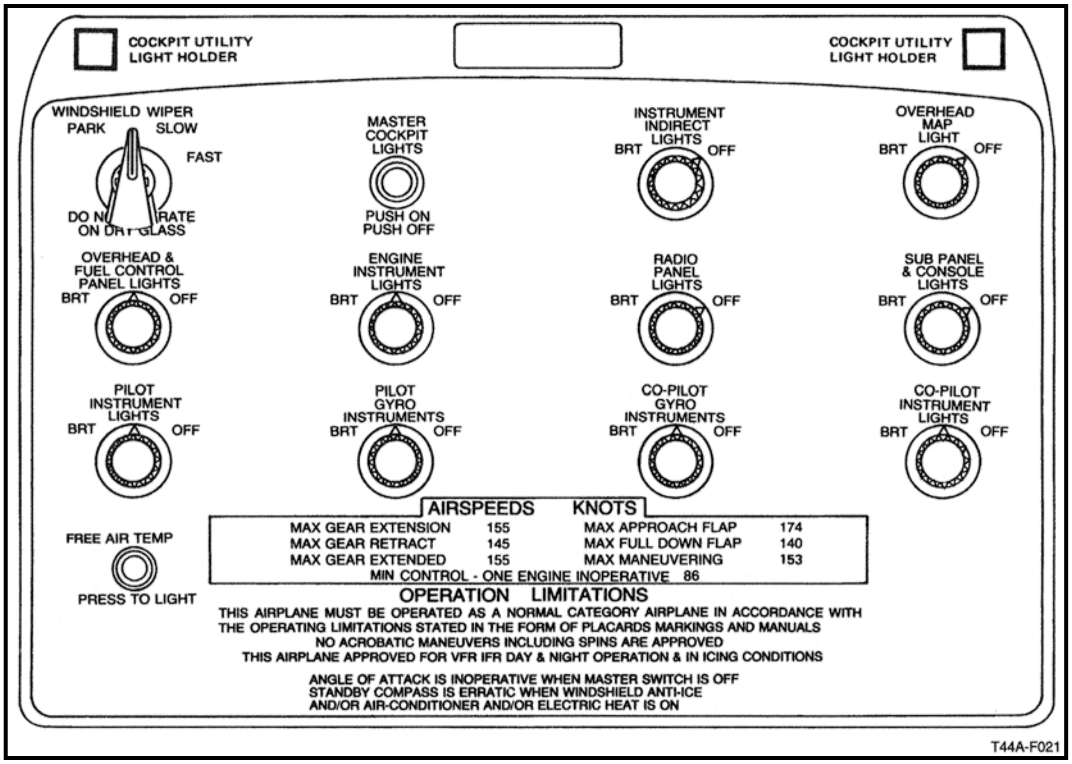

Figure 2-3 Overhead Control Panel

Interior Lights

The aircraft interior lights are controlled by either rheostats or press-to-light switches located on the Overhead Control Panel.

The Master Cockpit Lights switch controls ON/OFF for all of the interior lights except:

1. Indirect instrument lighting
2. Cockpit utility lights
3. Cabin reading lights
4. Threshold/Spar Cover lights
5. Cabin door locking mechanism observation light.
6. Cabin sign
7. Aft Compartment Light

Interior Lights

The GYRO INST circuit breaker protects the pilot and copilot's gyro instrument lights.
If the Master Cockpit Lights switch fails, pull the Gyro Instrument circuit breaker.

Pulling the Gyro Instrument circuit breaker will restore all the interior lights controlled by the Master Cockpit Lights switch except the gyro instrument lights.

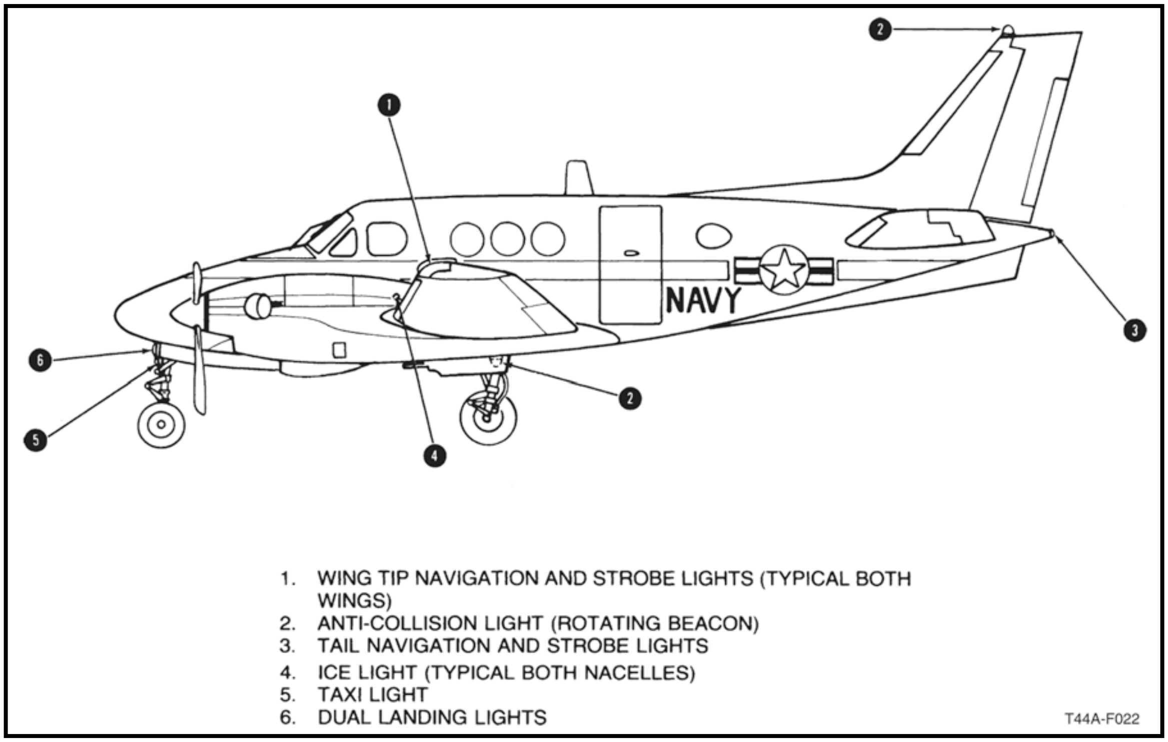

Figure 2-4 Exterior Lighting

Exterior Lights

All exterior lights are controlled by a series of ON/OFF circuit breaker switches located on the pilot's right subpanel.

- Navigation Lights
- Strobe Lights
- Anti-collision Lights
- Ice Lights
- Taxi Lights
- Landing Lights

In the event the landing and taxi lights are inadvertently left on, they will automatically be switched off when the landing gear is retracted. This function is intended as a backup system to prevent heat damage.

204. ELECTRICAL MALFUNCTIONS

Generator Malfunctions

The first indication you will have that the left or right generator has malfunctioned is the illumination of a LH GEN OUT or RH GEN OUT with a flashing FAULT WARN.

Single Generator Failure

In the event of a single generator failure:

- Turn the generator OFF.
- RESET momentarily.
- Then turn to ON.

NOTE

Normal voltage in the RESET position indicates a failure of the generator control rather than the generator.

Dual Generator Failure

If both GEN OUT lights turn on, then you may have a dual generator failure and, if neither generator will reset, the aircraft is operating on battery power exclusively.

Refer to the NATOPS and ensure AUX BATT is in the on position. Consideration should be given to reducing the load on the battery.

The battery will provide power for approximately 42 amp hours which could be as few as 10 minutes.

Current Limiter Failure

If the LH or RH fuel quantity gauge on your fuel management panel indicates zero, with only the battery switch ON, then the respective current limiter is bad. This assumes the No. 1 Fuel bus circuit breaker (20A) and the left fuel quantity circuit breaker (5A) are set, the fuel gauge is operative, and the aircraft is fueled.

With both generators online, a current limiter failure may be indicated by a loadmeter split of 0.2 or greater. (Normal heat and air-conditioning obtains power from the left main bus.) The 0.2 increase would typically be higher on the left main bus. (This assumes that the air conditioning or the electric heater is operating)

Dual Current Limiter Failure

All equipment will still be powered with both current limiters failed, as long as the respective generators are functioning normally. A split in the loadmeters may occur depending on what equipment is operating.

Generator Failure with Opposite Side Current Limiter Failure

No equipment is lost initially, but the battery is being discharged. It may be necessary to secure the battery switch to conserve battery power. Consult NATOPS for specific procedures.

Generator Failure with Same Side Current Limiter Failure

The buses and equipment associated with the failed side are inoperative and will remain so. The battery is not being discharged. Monitor the operating generator electrical load. A same side current limiter failure results in the loss of the respective main, fuel, and avionics buses.

Inverter Malfunction

An inverter failure is indicated by a FAULT WARN accompanied by either the #1 INVERTER OUT or #2 INVERTER OUT annunciator.

When an inverter fails:

1. Turn the failed inverter OFF
2. Check that the AC Bus has switched over
3. Land as soon as practicable

Either inverter is capable of supplying the full amount of single phase, alternating current power normally required.

NOTES

1. After a total AC power failure, the following will be inoperative; GPS, compasses, attitude gyro, needles, torque meters. (GCANT)

2. After a total AC power failure, only the following items are available: fuel flow, oil pressure, pilot and copilot turn and bank indicators, oil temperature, pitot static instruments, N1, ITT, propeller rpm, clocks, NCS-31A, AOA indexers, radio altimeter, standby compass, DME, radar, marker beacons, VOR (audio), ADF/LF (audio), UHF, and VHF.

Circuit Breakers

A blown circuit breaker may indicate a short.

If an essential circuit breaker blows during flight, the circuit breaker may be reset once.

Do NOT reset these circuit breakers:

1. Subpanel Feeder Circuit Breakers
2. Non-essential Circuit Breakers

ELECTRICAL SYSTEM QUIZ

1. In the T-44A, DC power is produced by two engine-driven 28-Vdc__________-amp starter-generators.

2. To obtain bus voltage readings you need to depress the spring-loaded switch on the Load Voltmeter.

TRUE FALSE

3. The T-44A main aircraft battery is rated at ____ and ____.

a. 28 V, 38 amp-hours
b. 24 V, 42 amp-hours
c. 28 V, 34 amp-hours
d. 34 V, 24 amp-hours
e. 34 V, 28 amp-hours

4. Which of the following is NOT provided by the generator control panels?

a. Overvoltage protection
b. Reverse current protection
c. Current limiting
d. Automatic paralleling

5. A loadmeter reading of 0.4 would indicate an output current of ______________.

a. 40 amps
b. 100 amps
c. 28 amps
d. 42 amps

6. During an interior preflight you notice that the battery voltage reads 20 volts. What is your best course of action?

a. Notify maintenance to replace the battery
b. Notify maintenance to bring an APU to charge the battery
c. Notify maintenance to bring an APU to assist with starting the engines
d. No action is required for a normal engine start

7. External power can be applied through a receptacle in the _______ wing just outboard of the nacelle.

8. Which of the following DC busses are always powered if the battery is connected?

a. Left Main Bus
b. Right Main Bus
c. Battery Bus
d. Hot Battery Bus
e. Subpanel Bus No. 1

9. Which of these items on the Hot Battery Bus are NOT dual powered?

a. Crossfeed Valve
b. RH Firewall Valve
c. RH Fire Extinguisher
d. RH Boost Pump
e. LH Firewall Valve

10. The FAULT WARN light will flash _______.

a. Only when a green annunciator light illuminates
b. Only when a yellow annunciator light illuminates
c. Only when a red annunciator light illuminates
d. Only when a yellow or red annunciator light illuminates
e. When any annunciator light illuminates

11. While flying on a night mission a LH GEN OUT light illuminates full bright and the FAULT WARN light starts flashing. In order to dim the LH GEN OUT light, you should first ________________________________.

a. Rotate the dim knob to a lower setting
b. Reset the left generator
c. Turn the battery off
d. Press the FAULT WARNING light
e. Do nothing. It is not possible to dim the light

12. Which of the following interior lights would extinguish if the MASTER COCKPIT LIGHTS switch was set to the OFF position?

a. Radio Panel Lights
b. Threshold Lights
c. Indirect Instrument Lights
d. Utility Lights
e. Cabin Reading Light

13. Flying on a dark and stormy night, the Cockpit Master Lights switch fails, leaving you in the dark. Which circuit breaker can you pull to restore the cockpit lighting?

a. Master Power
b. Interior Lighting
c. Flight Instrument
d. Engine Instrument
e. Gyro Instrument Lights

14. Which of the following exterior lights are NOT installed on the T-44A?

a. Anti-Collision Lights
b. Strobe Lights
c. Landing Lights
d. Running Lights
e. Navigation Lights

15. The landing and taxi lights will be automatically switched off if the landing gear is retracted with the lights on.

TRUE FALSE

16. If the AVIONICS MASTER switch fails, pulling the MASTER POWER circuit breaker will bypass the switch energizing the avionics busses.

TRUE FALSE

17. If the Master Cockpit Light switch fails, pulling the GYRO INST circuit breaker will restore all interior lighting controlled by the Master Cockpit Lights switch, except the pilot and copilot Gyro Instrument Lights.

TRUE FALSE

18. A blown current limiter would _____________.

a. Prevent two generators from operating in parallel
b. Illuminate a CURR LMTR OUT light
c. Cause a loss of the main bus on that side
d. Prevent the starter on that side from operating

19. With the 26 Vac step-down transformer failed in the No. 1 inverter, the torquemeter for the left engine will be operative.

TRUE FALSE

20. Given a LH GEN OUT light illuminated, a normal generator voltage, and the generator switch in the RESET position, a __________ failure is indicated.

a. Generator
b. Generator Control
c. Battery
d. Current Limiter
e. Generator Switch

21. Following a generator failure, you notice a slight charge (5 amps) on the battery volt/ammeter and no other equipment failures are noted. This indicates ____________.

a. Both current limiters are failed
b. Both current limiters are intact
c. The current limiter opposite the failed generator is blown
d. The current limiter on the failed generator side is blown

22. With a failed right generator and a failed left current limiter which of the following busses would be deenergized?

a. Right main bus
b. Left main bus
c. Subpanel bus No. 1
d. Subpanel bus No. 2
e. No buses will be deenergized

23. Given a left generator load of 0.7, a right generator load of 0.5, and the air conditioning in AUTO, which statement is most correct?

a. Abnormal generator paralleling exists
b. One of the current limiters has failed
c. This is a normal indication
d. Either A or B is possible

24. Which of the following items would NOT be available if a total AC power failure occurred?

a. Fuel Flow Indicators
b. Oil Pressure Gauges
c. Pilot Turn and Slip Indicator
d. Torquemeters
e. AOA Indexers

25. Subpanel feeder circuit breakers should never be reset in flight.

TRUE FALSE

26. Essential circuit breakers may be reset a maximum of _________ time(s) in flight.

27. List the functions of the battery.

____
____
____

28. List the functions of the generator control box/panel.

____
____
____
____
____

29. A generator has failed and will not reset. No other failures are noted. You notice that the battery volt/ammeter is sowing a slight (5 amp) charge. What is the status of the current limiters? ____
What is powering the boost pumps? ____

30. A generator has failed and will not reset. No other failures are noted. You notice that the battery volt/ammeter is showing a discharge. What does this say about the current limiter status?
____
What is powering the boost pumps? ____

31. A generator has failed and will not reset. You notice that the battery volt/ammeter is showing a slight charge but one of your fuel quantity indicators is pegged (zero), an inverter out light on the same side has illuminated, on of your flight directors and one of your compass systems has failed. What is the status of the current limiter?
____
What is powering the boost pumps? ____

32. The battery is located in the __________ __________ center section and is accessible through a panel on the top of the wing.

33. You turn the right generator on after starting the right engine to charge the battery. Why do you turn it off prior to starting the left engine? ____
____
The right generator is turned on again during the start of the left engine and then off again after the left engine start is complete. Why?
____

34. What is the minimum battery voltage for a battery start of the right engine? _____________
For and APU start? ____. For APU charging? ___.

35. List the items powered by both the fuel bus and the hot battery bus.

36. What flight and engine instruments require AC power?
________________, _________________, _____________, ______________, _________________

37. List the items that would work following a total DC power failure.

LESSON THREE
POWER PLANT AND RELATED SYSTEMS

300. OBJECTIVES

At the end of this lesson, you should be able to:

1. State the PT6A-34B engine characteristics.
2. Label and describe the function of the reduction gear box and its components.
3. State any limitations for the reduction gear box and its components.
4. Label and describe the function of the combustion chamber and its components.
5. Label and describe the function of the compressor and its components.
6. Describe the fuel control system.
7. Describe the function of the fuel drain collector system and its components.
8. State the engine operating limits.
9. Label and describe the operation of the power levers.
10. Label and describe the operation of the condition levers.

NOTES

301. ENGINES

At the end of this topic you should be able to describe the characteristics of the PT6A-34B engines. You should be able to describe the location and function of the compressor, combustion chamber, turbine section, reduction gear box, fuel control system, and fuel drain collector system.

302. ENGINE OPERATION

The T-44A has two (2) Pratt and Whitney PT6A-34B turboprop engines. Each is rated at 550 shp (shaft horsepower). The PT6A-34B engine is a reverse flow, free turbine type engine, employing a three stage axial and a single stage centrifugal compressor.

Flow through the Engine

Air enters through the cowling air intake.

Passes the ice vanes, preventing supercooled water droplets and snow from collecting on the engine screen.

Flows through a plenum chamber around the engine compressor section, through the screen into the engine.

Directed to the 3-stage axial compressor.

Then directed to the centrifugal compressor.

Forced through diffuser vanes.

Turned 90 degrees into the combustion chamber.

Once in the combustion chamber, the air is mixed with fuel and ignited by igniter plugs that operate during engine start or during autoignition. After start, combustion continues as long as the fuel-to-air ratio is correct.

Expanding, the burning gases are reversed through nozzle guide vanes.

Through compressor turbine blades to drive the axial and centrifugal compressors.

Then through power turbine blades to drive the reduction gearbox.

Expelled as exhaust.

Compressor

The compressor section is comprised of a 3-stage axial compressor and a single stage centrifugal compressor. The compression ratio is 7:1.

N1, or gas generator, compresses the air and drives the accessories section.

When the N1 gauge reads 100%, the gas generator/compressor speed is 37,500 rpm.

When the N1 gauge reads 101.5%, the gas generator/compressor speed is 38,000 rpm.

Combustion Chamber

The combustion chamber is located forward of the compressor section.

In the combustion section, high pressure air is mixed with fuel to form a combustible gas. Approximately 25% of the intake air is mixed with fuel and burned.

It is comprised of a circular chamber with **14 fuel nozzles** (10 primary and 4 secondary) and **2 igniter plugs**. The 14 fuel nozzles provide a symmetrical fuel spray pattern for efficient combustion.

Turbine Section

The turbine section is located forward of the combustion section. The two turbines are driven by the exhaust gasses from the combustion chamber.

The compressor turbine drives the compressors and accessories case.

The power turbine drives the reduction gear box which in turn drives the prop governors through their spline gears. The compressor and power turbines are independent of each other.

They are NOT physically connected together.

303. REDUCTION GEAR BOX

The reduction gear box is located forward of the turbine section and is directly connected to the power turbine. It is comprised of a two stage planetary reduction gearbox system.

The reduction gear box provides a 15:1 reduction ratio from the power turbine to the propeller.

When the power turbine is turning at 33,000 rpm, the reduction gear box reduces this to a propeller speed of 2200 rpm.

When the power turbine is turning at 28,500 rpm, the reduction gearbox reduces this to a propeller speed of 1900 rpm

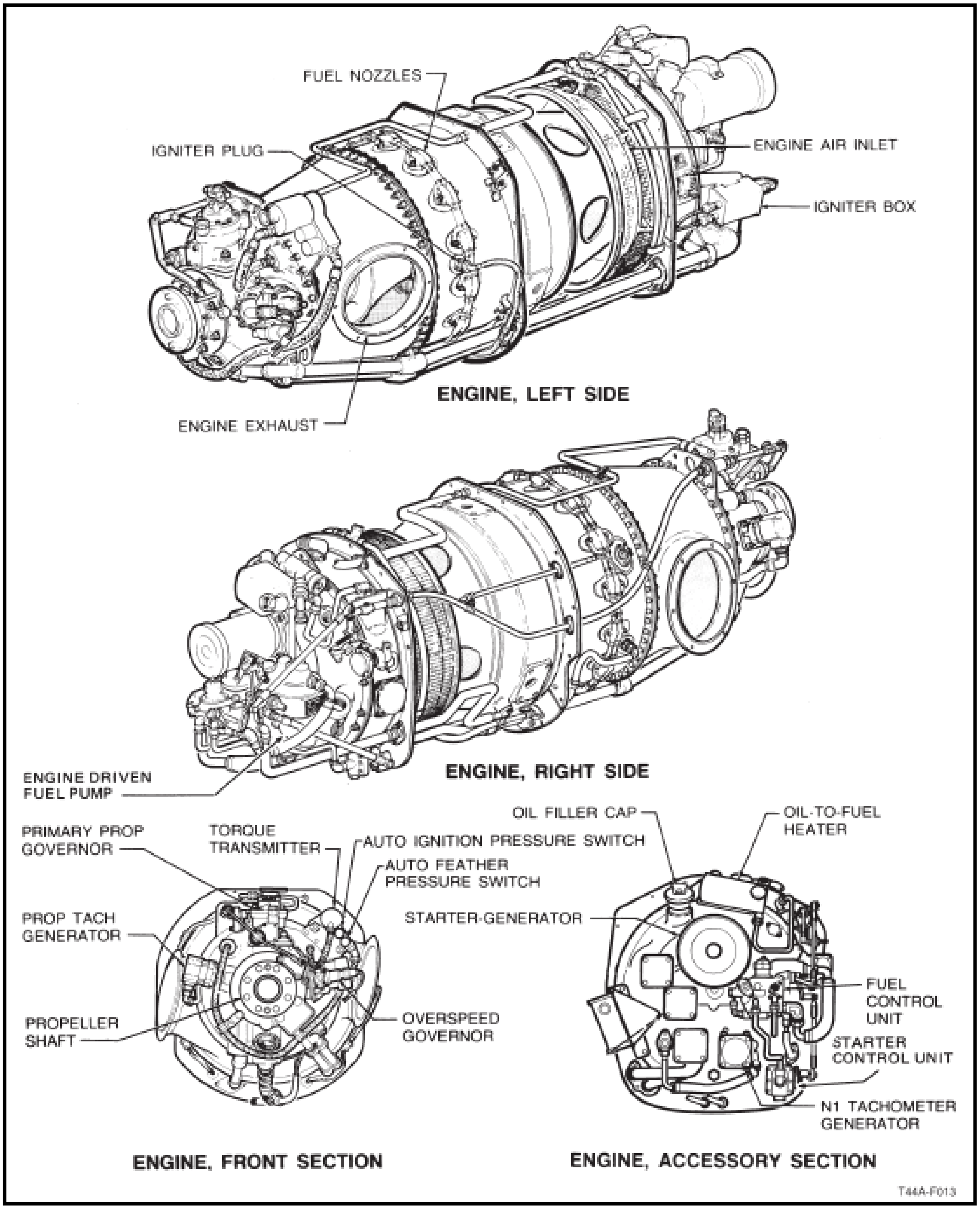

Figure 3-1 PT6A-34B Engine

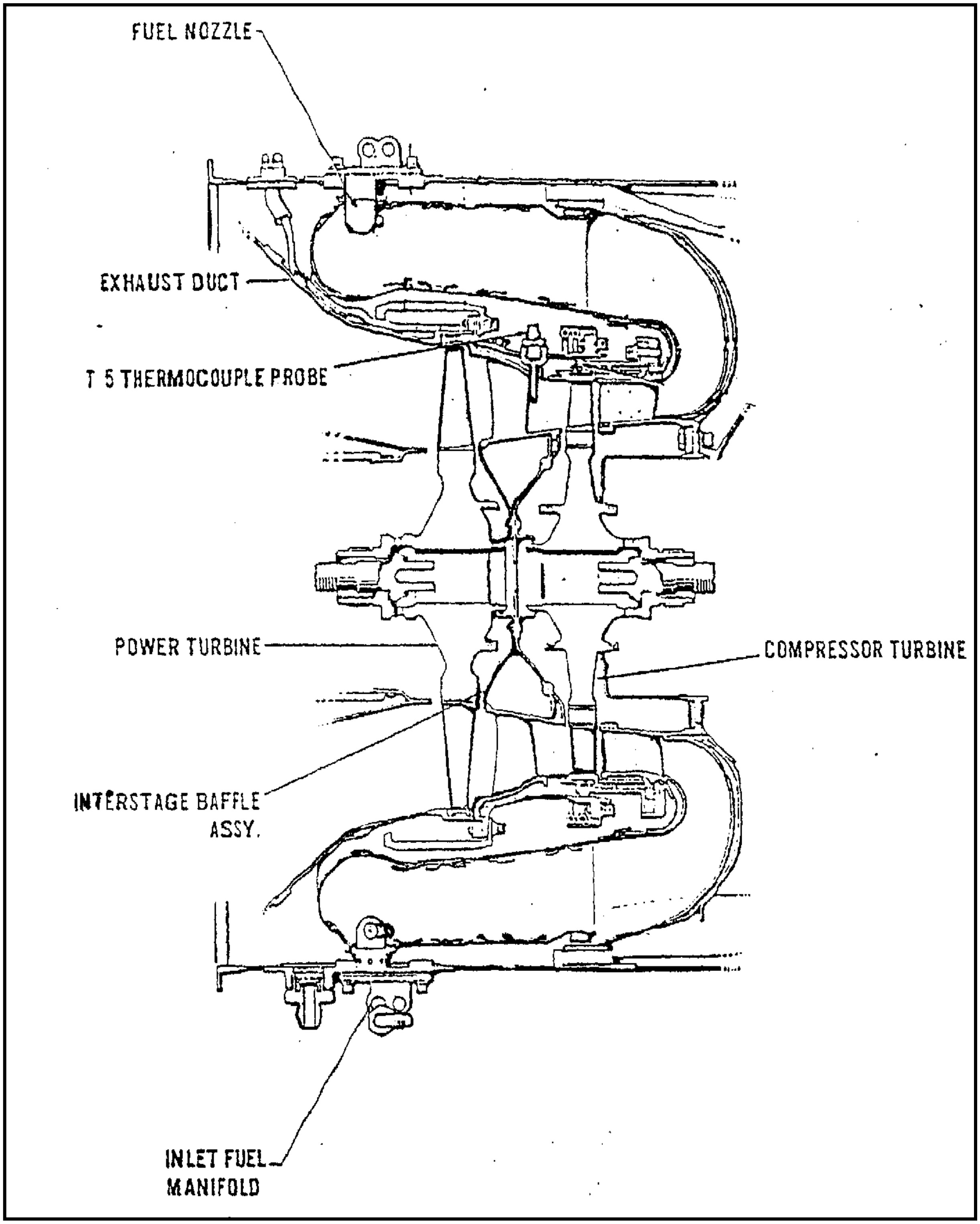

Figure 3-2 Compressor and Power Turbine – Cross Section

304. FUEL SYSTEM

Most of the fuel system components are located in the accessory section of the engine. It is composed of the engine driven fuel pump, fuel control unit, start control unit, fuel nozzles, oil to fuel heater, and fuel drain collector system.

Engine-Driven Fuel Pump

The engine-driven fuel pump is mounted on the accessory section of the engine. This pump operates anytime the compressor is turning. It is required for engine operation and a failure results in a flameout.

Fuel Control Unit

The fuel control unit is located in the accessory section of the engine. Using inlet temperatures and relative position of the power levers, it computes and meters the proper fuel flow to the engine. Adjusting the fuel flow allows the control unit to adjust the compressor (N1) speed which in turn controls the amount of power produced by the engine.

Start Control Unit

The start control unit is a mechanical fuel control valve operated by the condition levers. As the levers move out of the FUEL CUTOFF position, the valve opens allowing fuel to enter the primary fuel manifold. When the levers are in the FUEL CUTOFF position, the valve closes cutting off fuel to the fuel manifold.

Fuel Spray Nozzles

Fourteen (14) fuel spray nozzles are located in the combustion chamber. They provide a symmetrical fuel spray pattern for efficient combustion.

Oil to Fuel Heater

The oil-to-fuel heater is located on the top of the accessory section and uses heat from engine oil to preheat the engine fuel.

A fuel temperature sensing bypass valve allows oil to flow into the heater core when the fuel temperature is low. When fuel temperature increases to 70° F the valve begins to close and restricts the amount of oil entering the core. At 90° F the valve closes completely and the oil bypasses the heater core.

305. FUEL DRAIN COLLECTOR SYSTEM

The fuel collector system is also located in the accessories section and is composed of a tank and a pump.

Fuel Collector Tank

The fuel collector tank collects residual fuel from the flow divider. The tank is located below the engine accessory section.

Fuel Drain Collector Pump

The pump automatically transfers residual fuel back to the nacelle tank. The fuel drain collector pump is powered by the No. 1 or No. 2 Subpanel Feeder Buses.

NOTE

The battery switch must be ON for the pump to activate.

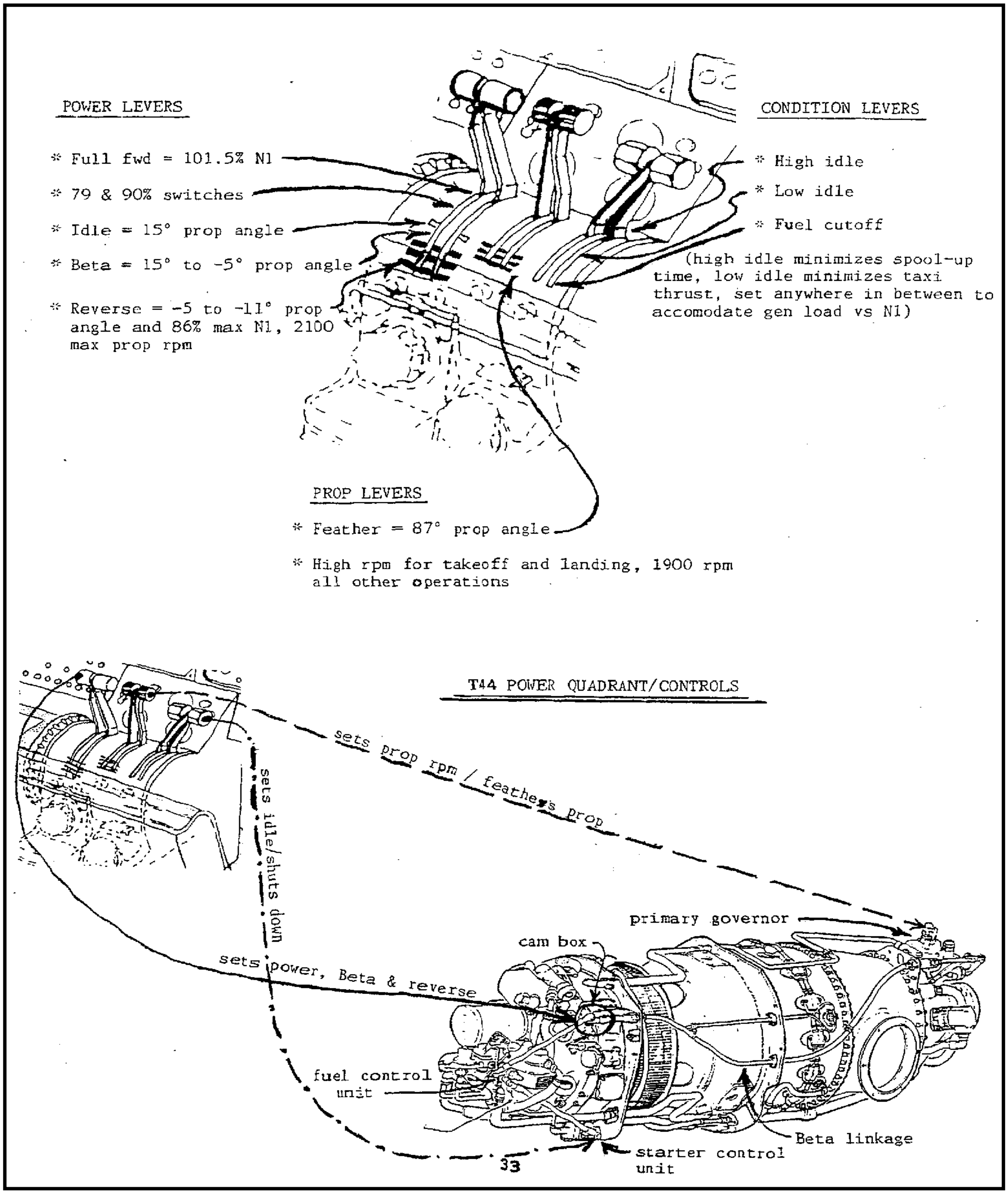

Figure 3-3 Power Quadrant Controls

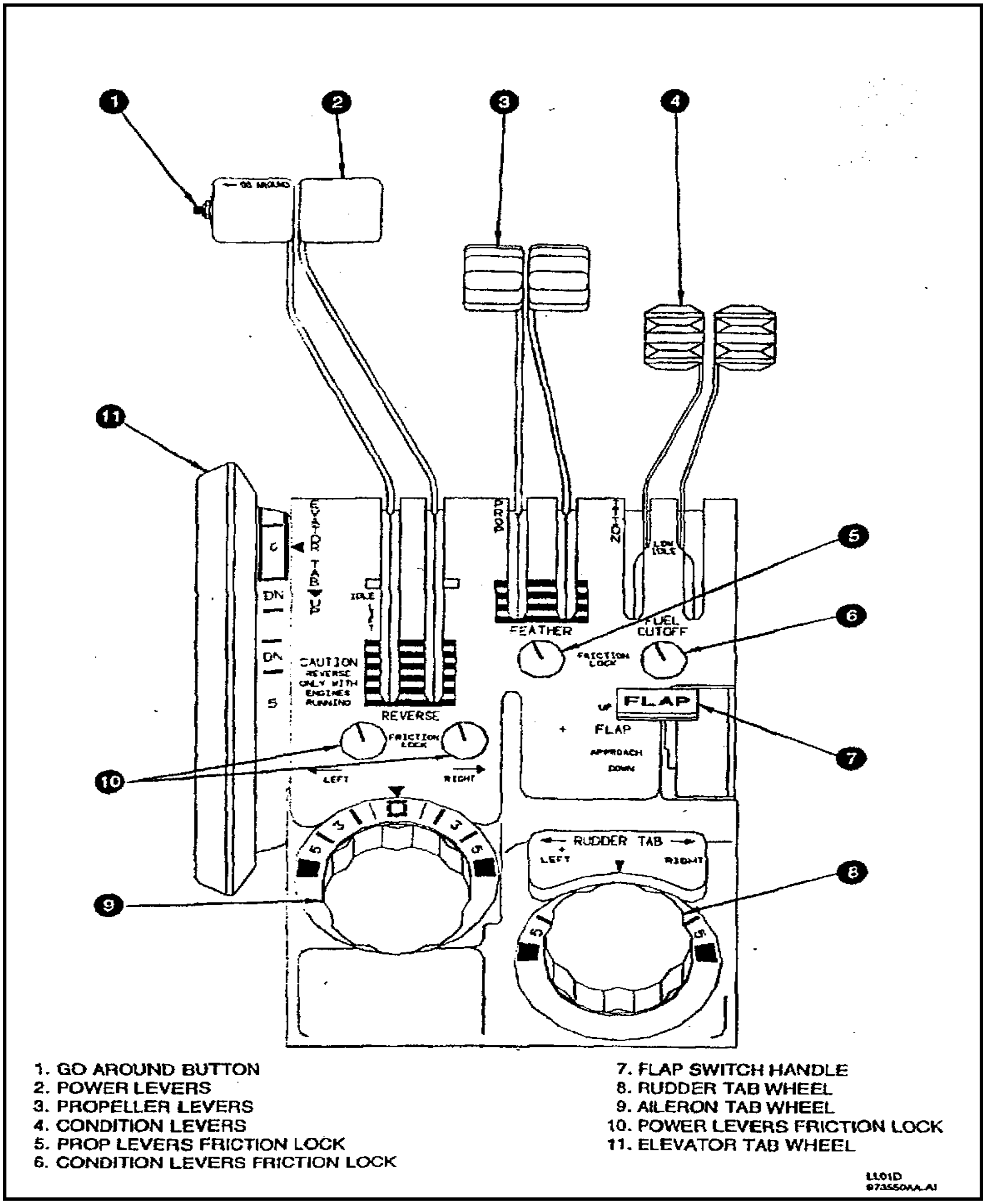

Figure 3-4 Control Pedestal

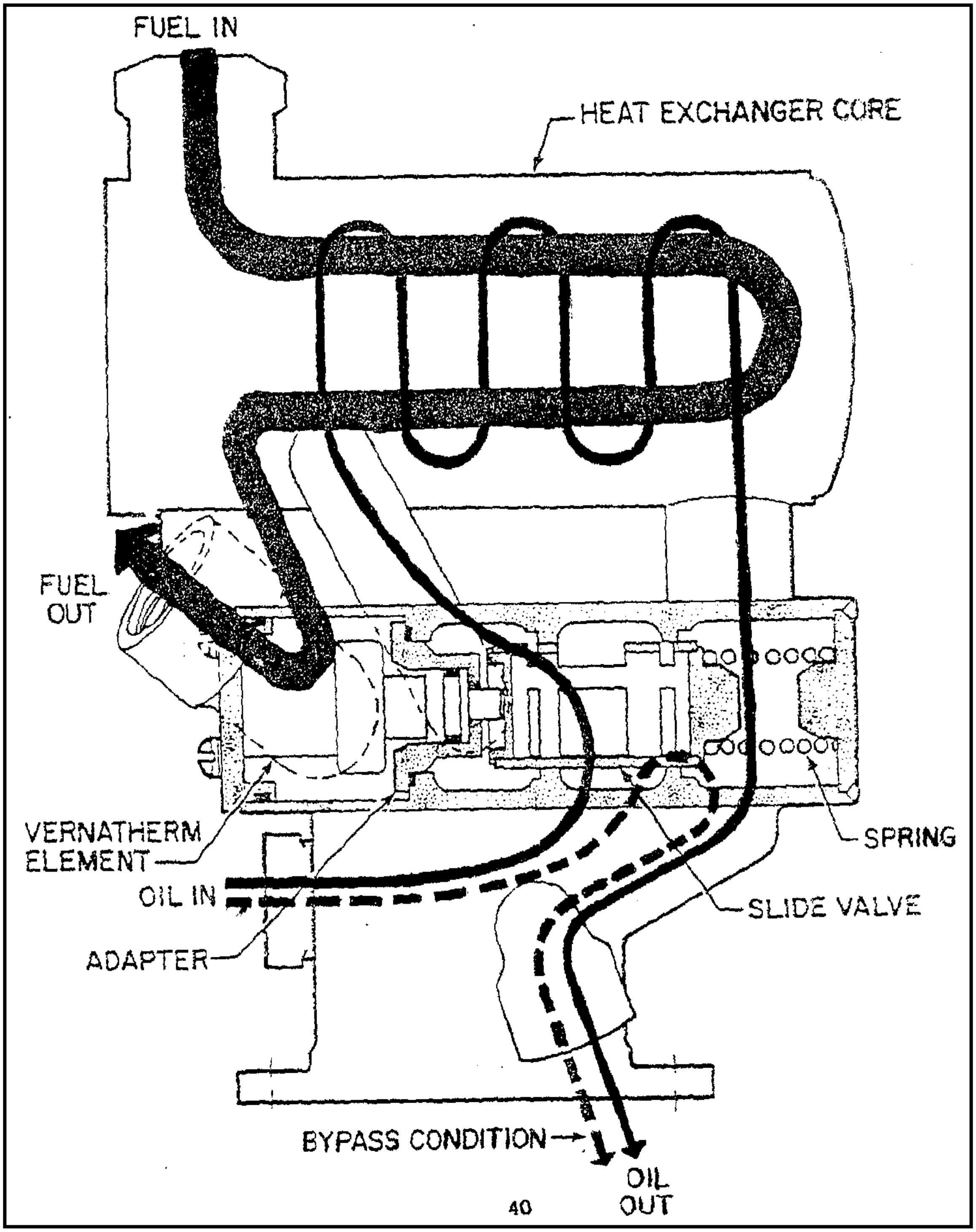

Figure 3-5 Oil-to-Fuel Heater

OPERATING CONDITION	OPERATING LIMITS							
	MAX TIME	★TORQUE FT LB (9) RPM 2,200	★TORQUE FT LB (9) RPM 1,900	★MAX OBSERVED ITT	(5) N_1%	• N_2 RPM (PROP)	(3) OIL PRESS PSI	OIL TEMP °C
MAX. ALLOWABLE	5 MINUTES	1,315		790	101.5	2,200	85 - 100	10 - 99
MAX. CONTINUOUS (8)	CONTINUOUS	1,315	1,520	790	101.5	2,200	85 - 100	10 - 99
CRUISE CLIMB	CONTINUOUS	1,315	1,520	765	101.5	2,200	85 - 100	10 - 99
CRUISE	CONTINUOUS	1,315	1,520	740	101.5	2,200	85 - 100	10 - 99
HI-IDLE (1)	CONTINUOUS	---	---	---	---	---	---	-40 - 99
LO-IDLE (2)	CONTINUOUS	---	---	685 (6)	---	--- (10)	40 (MIN)	-40 - 99
STARTING	40 SECONDS	---	---	1,090 (4)	---	---	Indication	-40 (MIN)
ACCELERATION (7)	2 SECONDS	2,100		850	102.6	2,420	---	10 - 99
MAX. REVERSE	1 MINUTE	---	---	790	86	2,100	85 - 100	10 - 99

Engine torque and ITT limits are determined by ambient temperature. During operations requiring maximum engine performance, be aware o whether torque, or ITT limits govern. Remember, cold temperature or low altitude - torque limited, hot temperature or high altitude is ITT limited.

★ Each column is a separate limitation. The stated limits do not necessarily occur simultaneously.

• The limit values within the N_2 RPM (PROP) column are not propeller limitations.
These values specify propeller RPMs which correspond to stress limits of the engine power section.

(1) N_1 64-67%.

(2) N_1 50-53%. Ground operations above 3,500-foot pressure altitude (PA) may produce idle speeds as high as 83-percent N1 with condition levers at low idle.

(3) Normal oil pressure is 85-100 PSIG at power settings above 27,000 RPM (72%) N_1, oil pressure below 85 PSIG is undesirable, and may be used only for completion of a flight, and then at a reduced power setting. Low oil pressure should be corrected prior to next light. During ground operations, oil pressures below 40 PSIG require engine shutdown; during flight, oil pressure below 40 PSIG is unsafe and requires either engine shutdown or use of minimum power until a landing can be made.

(4) This value is time limited to two seconds. If ITT is likely to exceed 925°C, discontinue start.

(5) For every 10°C below -30°C ambient temperature, reduce maximum allowable N_1 by 2.2%.

(6) High ITT may be decreased by reducing accessory load and/or increasing N_1 speed.

(7) High generator loads at low N_1 speeds may cause the ITT acceleration temperature limit to be exceeded. Observe the generator load limits.

(8) This power rating is intended for emergency use at the discretion of the pilot.

(9) Torque limits between 1,900 and 2,200 RPM vary linearly between 1,315 and 1,520 ft-lbs.

(10) If propeller RPM does not read between 900 and 1,100 RPM with the power levers at idle and condition levers at low idle, perform a low pitch torque check to ensure propeller flight idle stops are correctly adjusted.

GENERATOR LOAD VS MINIMUM N_1

GENERATOR LOAD	GROUND OPERATION	5000 FT	25,000 FT	30,000 FT
.0 to .25	50%	50%	58%	60%
.25 to .5	50%	60%	67%	70%
.5 to .75	57%	65%	74%	78%
.75 to .9	60%	68%	78%	82%
.9 to 1.0	63%	69%	80%	85%

Figure 3-6 Engine Operating Limits

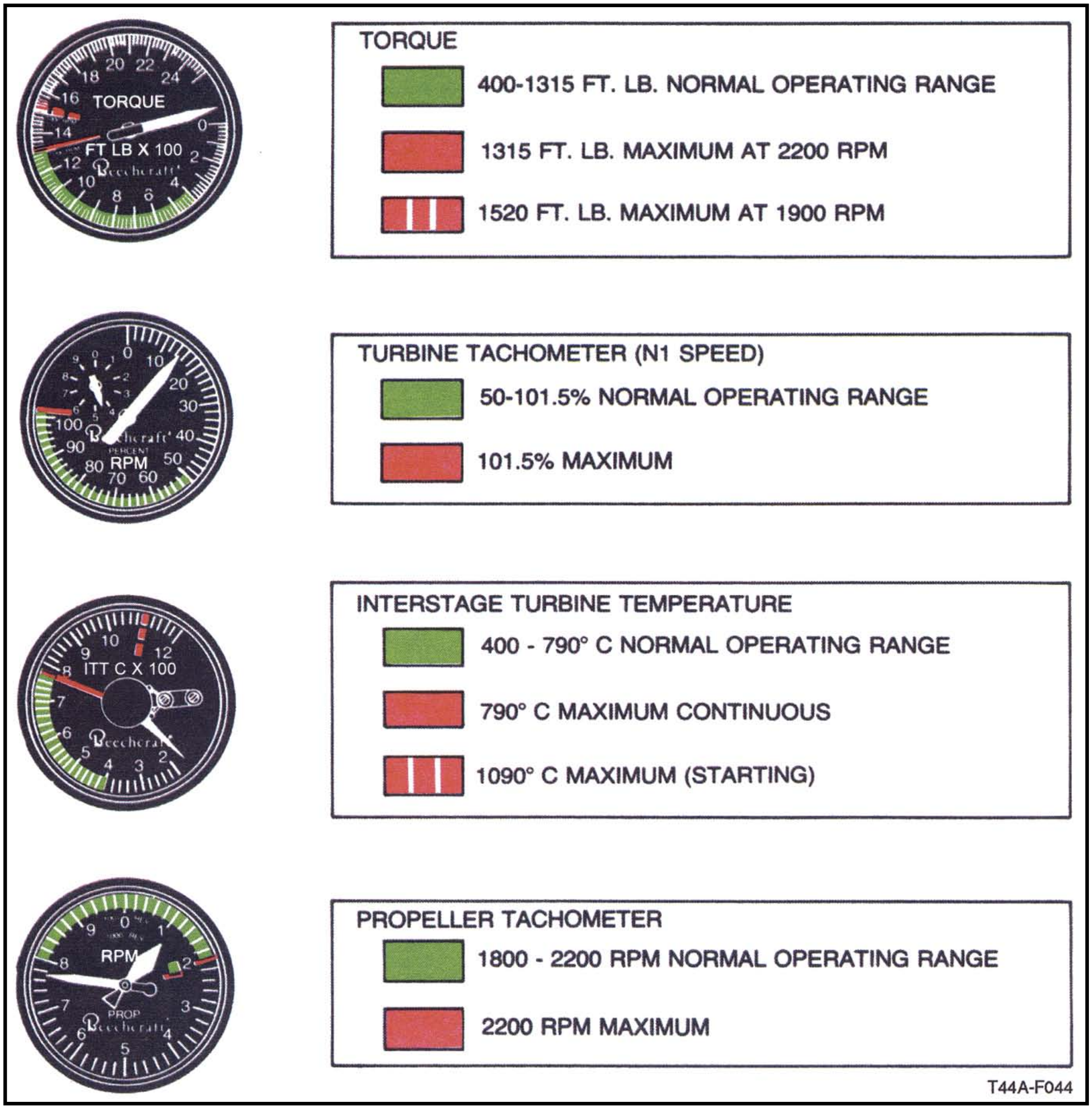

Figure 3-7 Instrument Markings 1

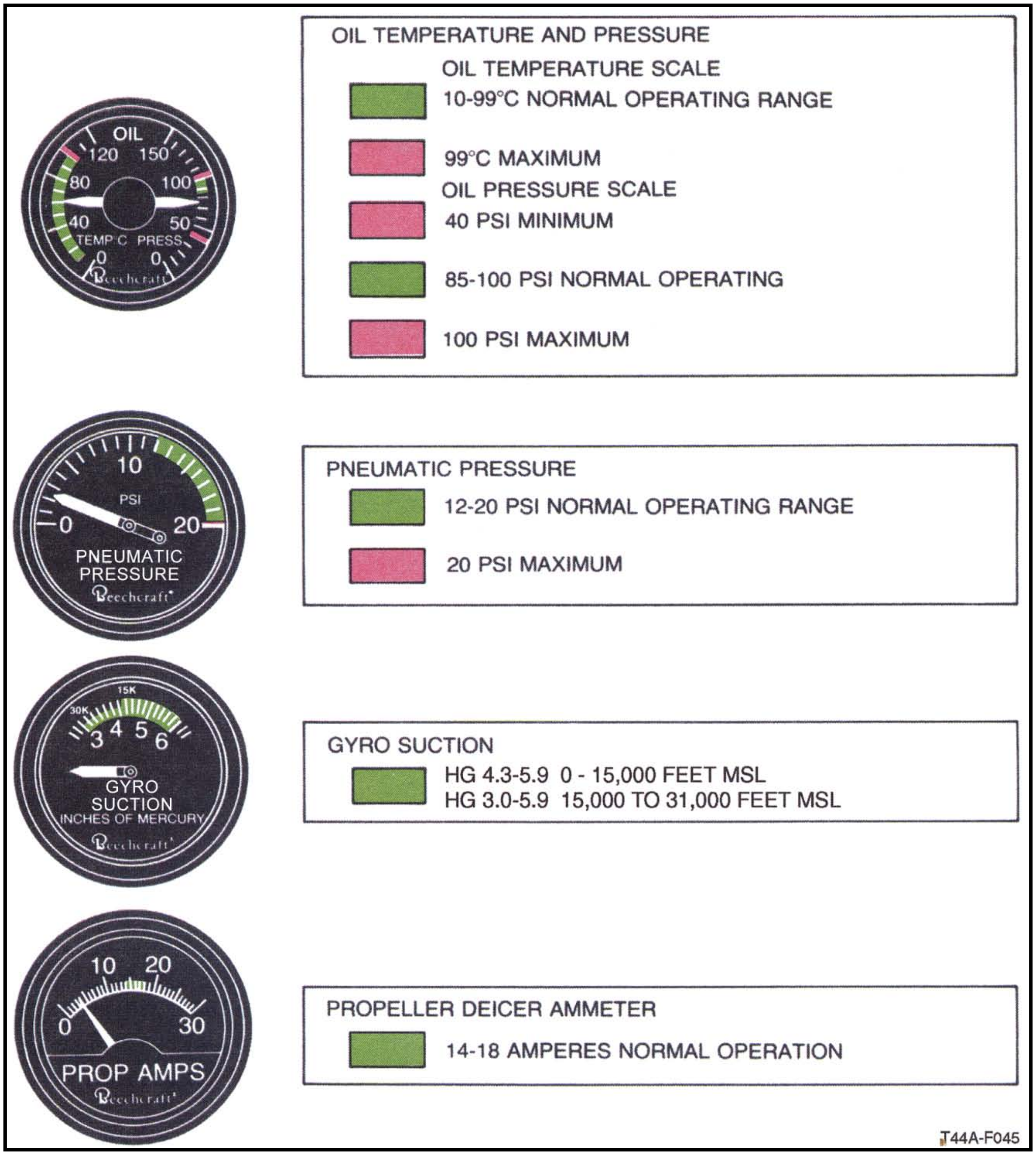

Figure 3-8 Instrument Markings 2

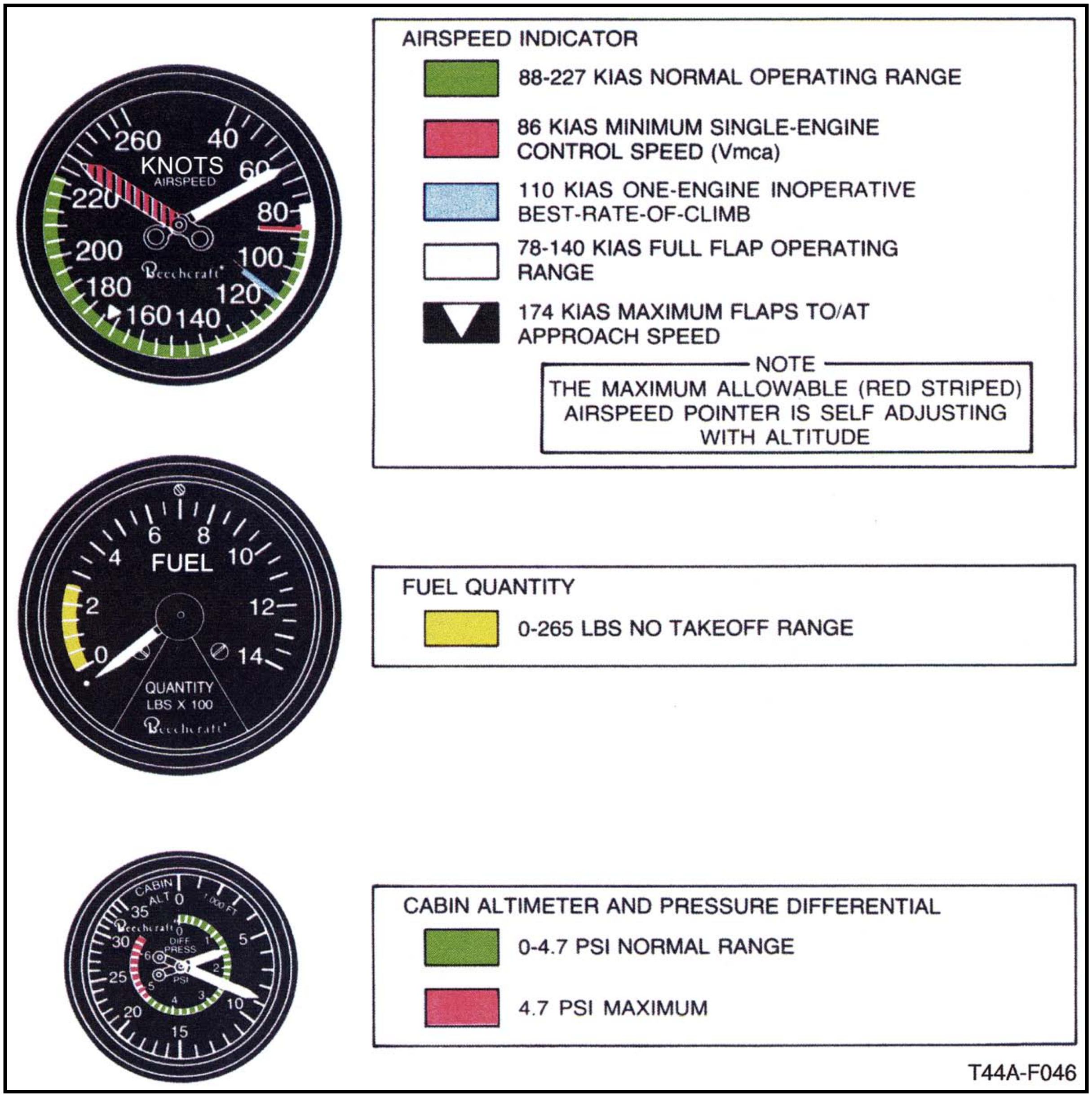

Figure 3-9 Instrument Markings 3

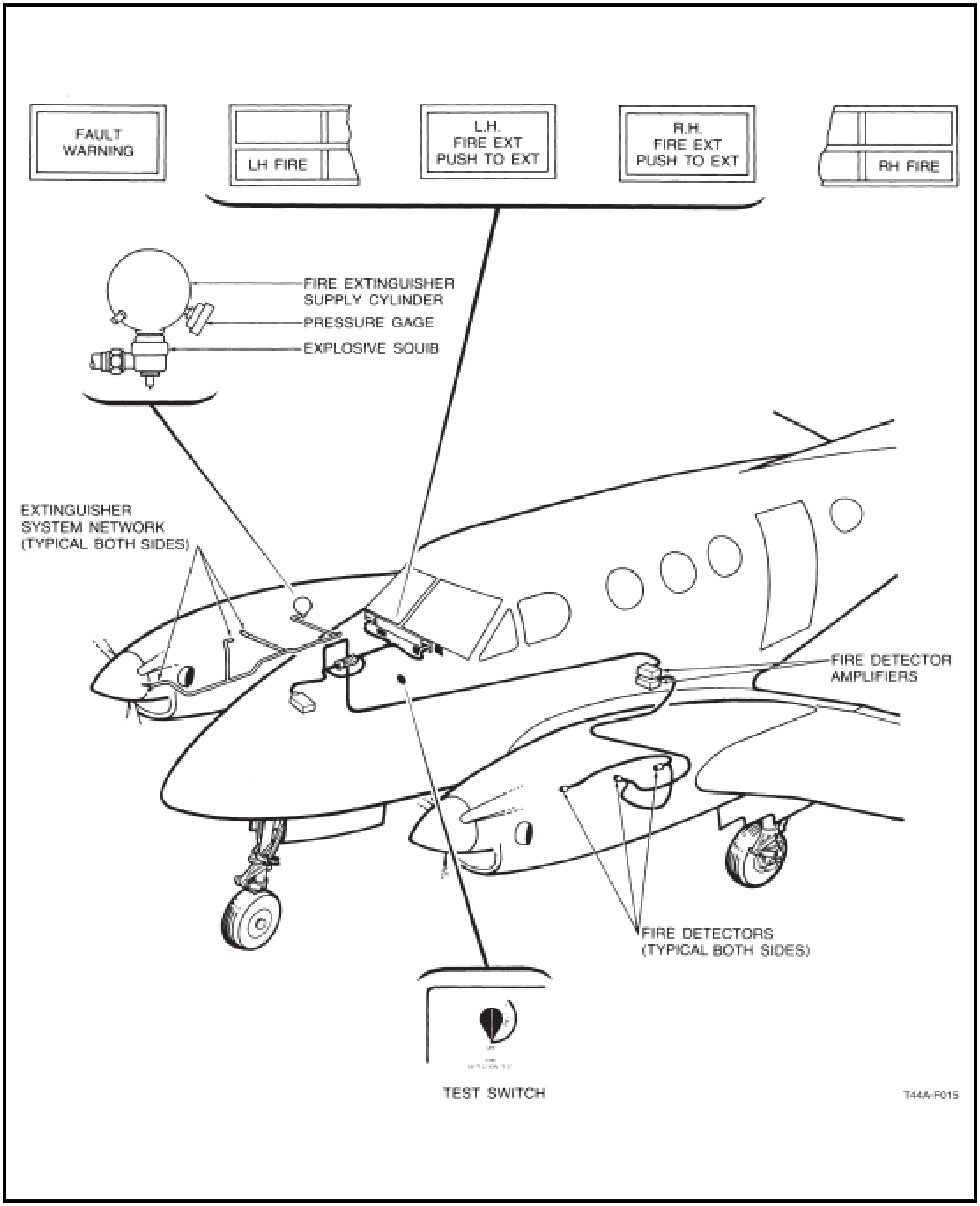

Figure 3-10 Engine Fire Detection / Extinguisher System

POWER PLANT QUIZ

1. The PT6A-34B Engine is rated at _________ shp.

2. The compressor is connected to the power turbine by a common shaft.

TRUE FALSE

3. The compressor section is comprised of a ______ stage axial compressor and a _____ stage centrifugal compressor.

a. 4 and 2
b. 3 and 1
c. 1 and 3
d. 2 and 4
e. 1 and 4

4. The speed of the compressor is _______ rpm at 100%.

a. 28,500
b. 33,000
c. 37,500
d. 38,000
e. 38,500

5. The combustion chamber contains ____ fuel spray nozzles.

a. 10
b. 11
c. 12
d. 13
e. 14

6. The power turbine is directly connected to the reduction gear box, which turns the propeller.

TRUE FALSE

7. With the prop rotating at 2200 rpm the speed of the power turbine is _____ rpm.

a. 28,500
b. 33,000
c. 37,500
d. 38,000
e. 38,500

8. The reduction gear box uses a _______stage planetary type reduction system.

9. The reduction gear box provides a reduction ratio of ___:___.

a. 13:1
b. 14:1
c. 15:1
d. 16:1
e. 17:1

10. Which of the following fuel control system components acts as a shutoff valve for the fuel entering the fuel manifold?

a. Engine driven fuel pump
b. Engine start control unit
c. Fuel control unit
d. Purge solenoid valve
e. Fuel drain collector pump

11. The oil to fuel heater senses the fuel temperature and starts to bypass the oil at 70° F, at 90° F the oil totally bypasses the heater core.

TRUE FALSE

12. The fuel collector pump returns fuel to the nacelle tank any time ________.

a. there is fuel in the fuel drain collector tank.
b. the fuel drain collector tank is full.
c. the battery is on.
d. Both a & c
e. Both b & c

13. The fuel drain collector system collects residual fuel from the fuel manifold flow divider after engine shutdown.

TRUE FALSE

14. The power turbine is directly connected to the reduction gear box, which turns the propeller.

TRUE FALSE

15. The minimum voltage required for a battery only start is ______________ volts.

16. The PT6A-34B turboprop engine is rates at _________ SHP and this is obtained with _______ ft-lbs of torque at 2200 prop rpm and ________ft-lbs of torque at 1900 prop rpm.

17. The power lever is connected to the ___________ box which is connected to the _______________ unit and the _______________ linkage.

18. The oil-to-fuel heater starts to bypass oil at ________ °F and completely bypasses oil at _________ °F.

19. The condition levers adjust ________ N1 rpm. Low idle is ______ to ______ % N1. High idle is ______ to _______ % N1. Idle rpm is adjusted during ground operations to accommodate high generator _________, and prior to flight to control engine _________________ time.

20. Normally, on takeoff at Navy Corpus the first engine limitation reached as you advance the power levers will be _____________. As you climb the engine will become_____________ limited.

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LESSON FOUR
PROPELLER SYSTEM

400. OBJECTIVES

At the end of this lesson, you should be able to:

1. Label the components of the propeller system.

2. Label and describe the function of the propeller control system and its components.

3. State the three (3) RPM limitations on the propeller governors.

4. Recognize the indications and potential results of a propeller governor failure.

5. Recognize the indications and potential results of a propeller linkage failure.

6. Label and describe the function of the overspeed governor.

7. Label and describe the function of the autofeather system and its components.

8. Label and describe the function of the synchrophaser system and its components.

NOTES

401. PROPELLER SYSTEM

At the end of this topic, you should be able to label and describe the operation of the components of the propeller system and its limitations.

402. SYSTEM COMPONENTS & OPERATION

Each prop lever sets the rpm for its respective propeller by adjusting the speeder spring tension on top of the primary governor. The prop system is hydraulically controlled, constant speed, full-feathering, and reversible. Engine oil provides the hydraulic control in the propeller system. It is driven through the primary governor by the governor pump.

The primary governor controls the prop rpm for the entire normal range of rpm by sensing the flyweight rotation against the speeder spring and metering oil through the pilot valve.

If a primary governor malfunctions and the prop exceeds 2200 rpm by more than 4%, the overspeed governor limits high pressure oil to maintain propeller speed at 2288 rpm +/- 40.

A pneumatic section of the primary governor acts as a fuel topping governor if the overspeed governor fails and propeller speed exceeds 2332 rpm.

Attached to the overspeed governor is the autofeather solenoid which automatically dumps oil to feather the propeller in the event of a severe power loss.

The propellers consist of three aluminum blades with over-center bladeshank counterweights. The blades are twisted to maintain even thrust.

The feathering spring and bladeshank counterweights will normally feather the propeller any time there is loss of boosted propeller governor oil pressure.

Blade Angles

Typical blade angles are given below:

Feather at 87°

Low Pitch Stop at 15°

Zero Thrust at -5°

Reverse at -11°

Approx. Cruise at 25 to 35 degrees

Propeller Levers

The primary governors are controlled by two propeller levers located on the control pedestal between the power control and condition levers. The levers are placarded PROP. The full forward position is placarded TAKEOFF, LANDING AND REVERSE, and HIGH RPM. The full aft position is placarded FEATHER.

Each propeller lever controls a primary governor that regulates propeller speeds within normal operating range 1800-2200 rpm.

At HIGH RPM, the propeller may attain an rpm of 2200.

At FEATHER, the propeller will feather.

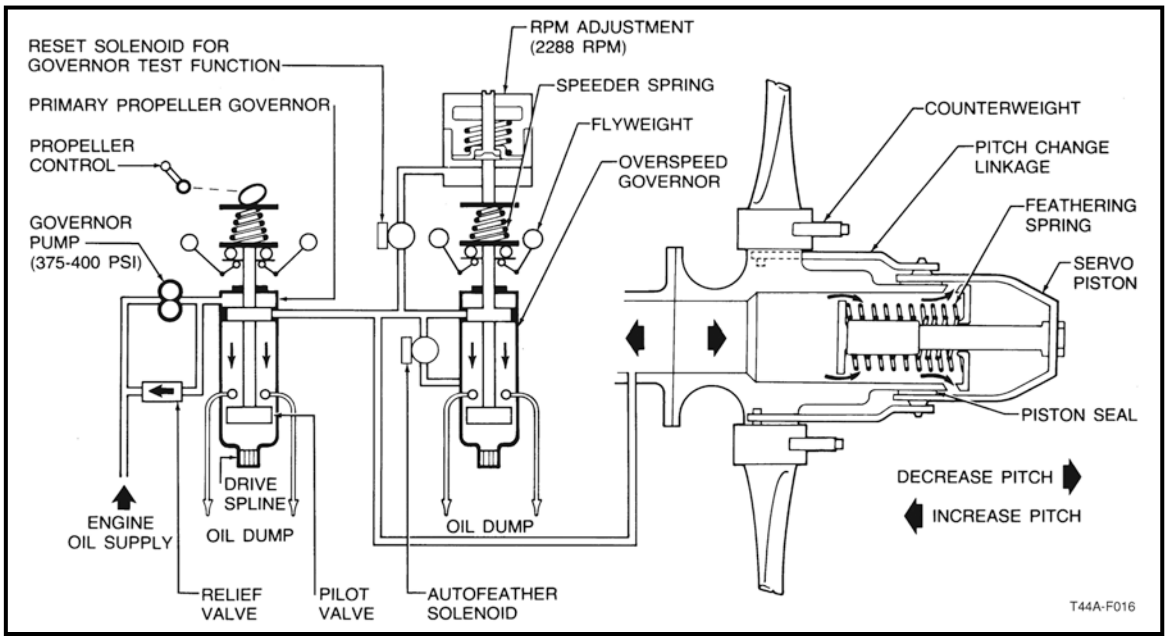


Figure 4-1 Propeller Control System

403. PRIMARY GOVERNOR

Each propeller is controlled by two governors, the Primary Governor and the Overspeed Governor. The pitch and speed of each propeller are controlled by engine oil, boosted by a governor pump (375-400 psi) acting through the engine driven Primary Governor. Higher oil pressure decreases the blade angle which, in turn, increases the propeller speed. A loss of oil pressure results in the propeller feathering.

404. OVERSPEED GOVERNOR

In the event of primary governor malfunction, the overspeed governor cuts in and dumps oil from the propeller dome to prevent rpm from exceeding safe limits. Primary governor failure can be detected by propeller N2 speeds of 2288 +/- 40 (overspeed), or uncommanded propeller feather.

Propeller Governor Test Switch

The PROP GOV TEST switch is located on the pilot subpanel. The PROP GOV TEST switch provides an operational test of the propeller systems. In the TEST position, the switch resets the overspeed governor to maintain between 1900 to 2100 rpm.

405. PROPELLER REVERSING

To reverse the propellers, position the propeller control levers at HIGH RPM.

Then lift the power control levers aft, over the IDLE detent to REVERSE with the engine running.

Propeller blade angles can be reversed up to a maximum of -11° blade angle

In reverse, N2 will be limited by the pneumatic section of the primary governor to 2100 rpm.

CAUTION

Moving the power levers aft of IDLE without the engine running will result in damage to the reverse linkage mechanism. To prevent damage to reversing linkage, propeller levers must be in HIGH RPM position prior to propeller reversing.

Propeller Reverse Not-Ready Annunciator Light

One yellow caution light placarded PROP REV NOT READY, on the annunciator panel, alerts the pilot NOT to reverse the propellers. It illuminates when the landing gear selector handle is down and the propeller levers are NOT at the HIGH RPM position.

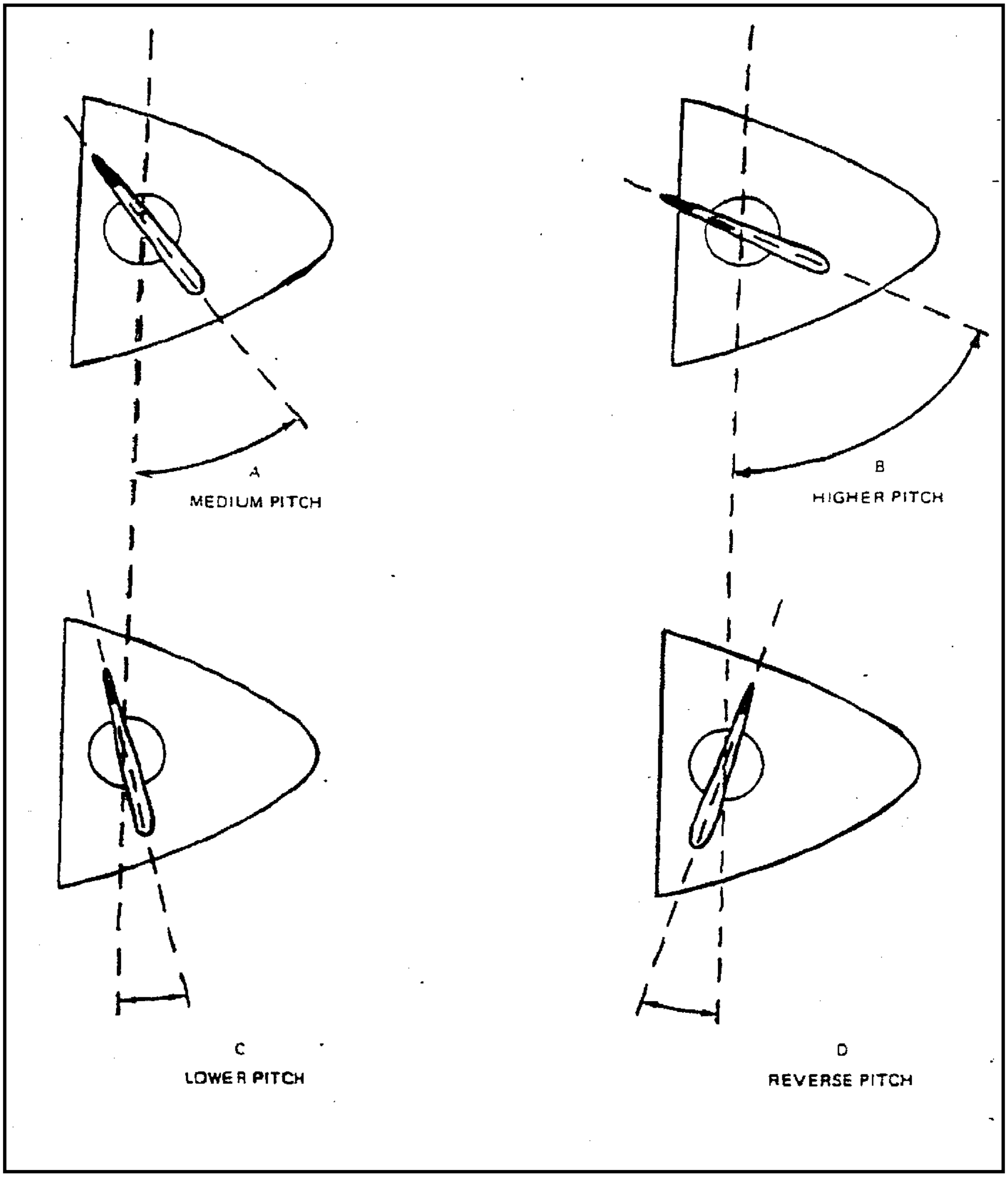


Figure 4-2 Propeller Blade Angles

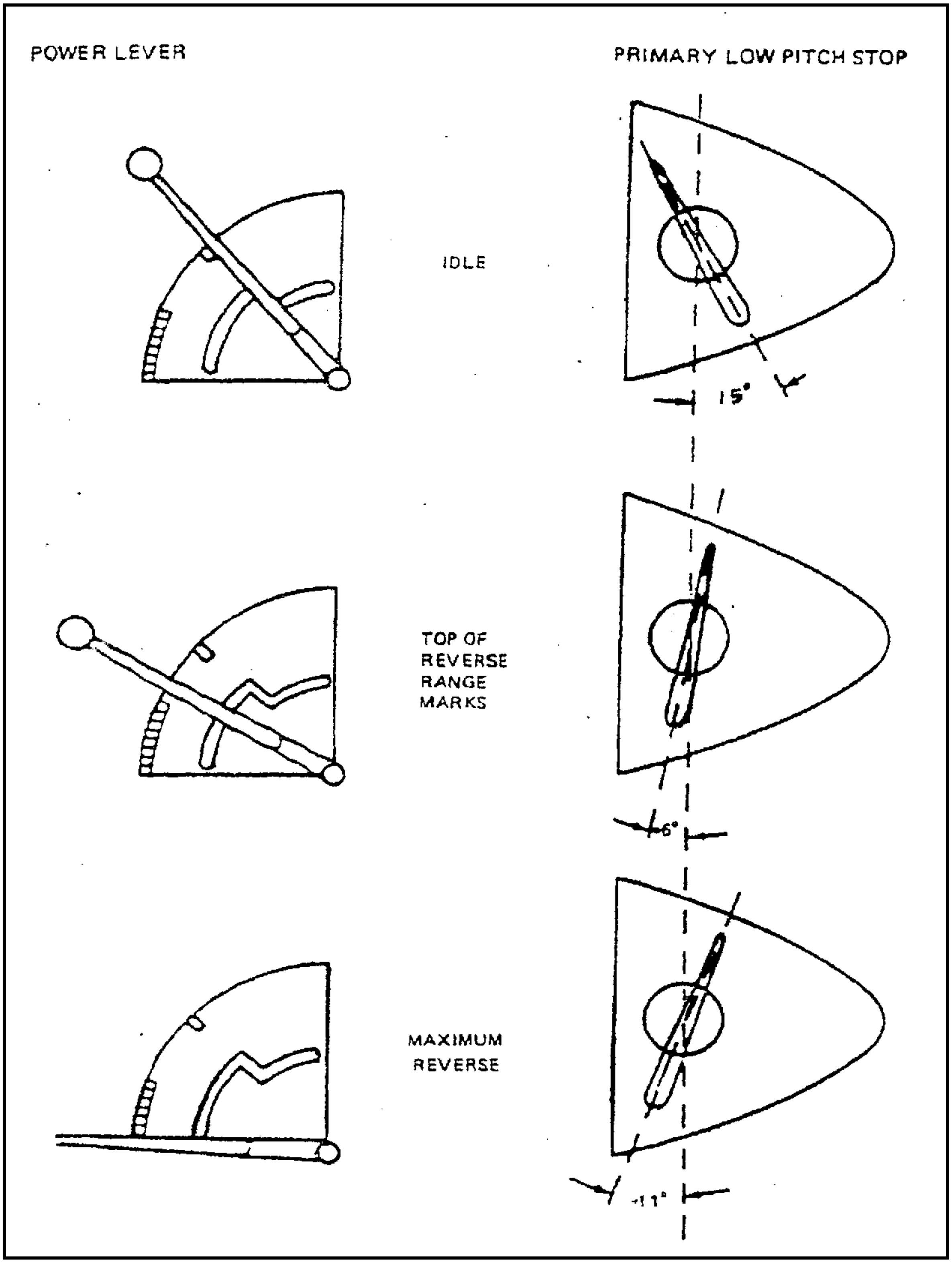


Figure 4-3 Propeller Low Pitch Stop

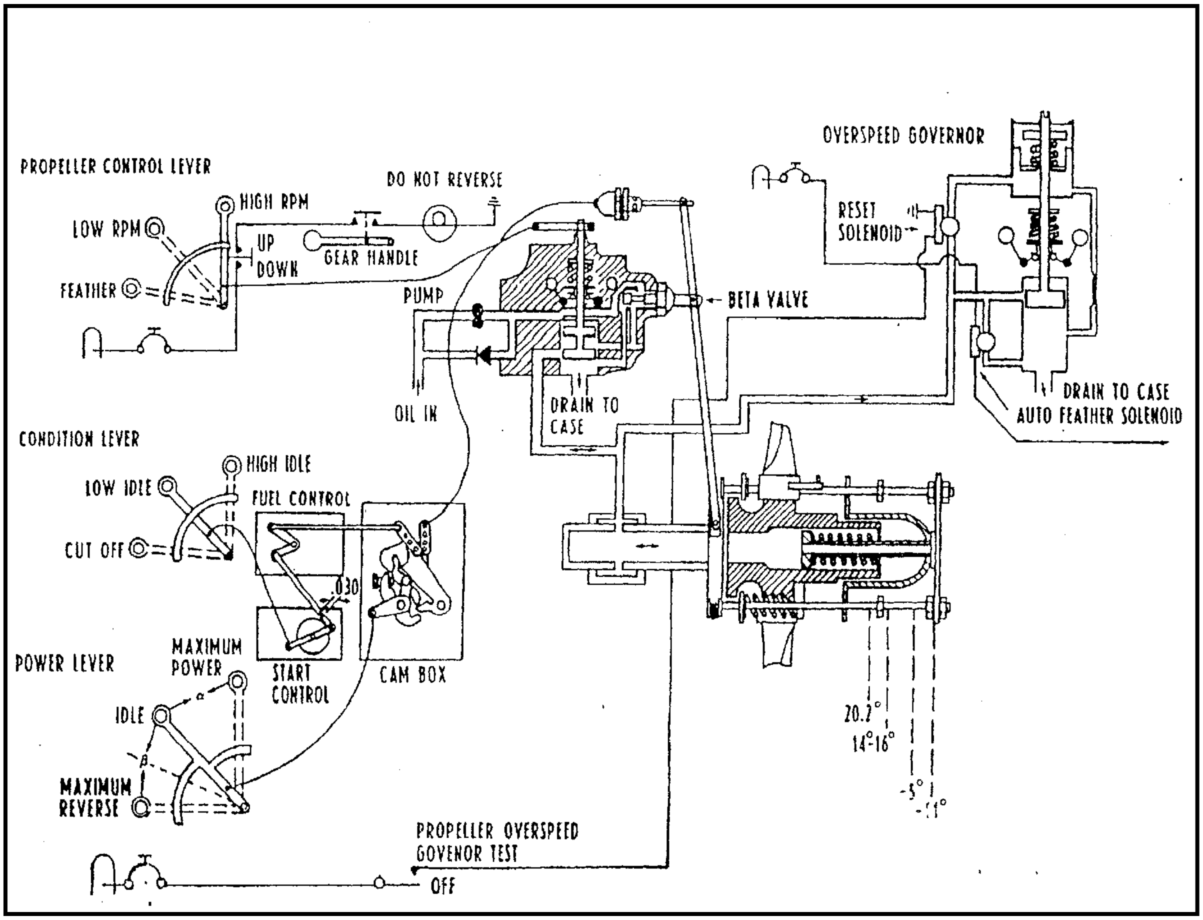


Figure 4-4 Propeller Reversing Schematic

406. AUTOFEATHER SYSTEMS

The autofeather system assists the pilot in the event of an engine or prop malfunction.

If an engine loses power, with the system armed and the power levers at or above a position corresponding to 90 (+/-2) percent N1, two torque-sensing switches are actuated resulting in the affected engine's propeller feathering.

NOTE

The right propeller may not fully feather if the prop sync is on.

When the affected engine drops below 410 (+/- 50) ft-lbs. torque, the first torque sensing switch turns off the autofeather system for the opposite engine and deenergizes the opposite engine's autofeather light.

When the affected engine drops below 260 (+/- 50) ft-lbs. torque, the second torque sensing switch causes the autofeather system to activate, completing the circuit to the solenoid.

Autofeather is normally used in the terminal area, on low levels, and as an alternate means to feather the prop in an emergency.

Propeller Autofeather Switch

Autofeathering is controlled by a propeller AUTOFEATHER switch on the pilot subpanel. This switch is a three position switches placarded ARM, OFF, and TEST.

The ARM position is used during takeoff, landing, and when required by the mission.

The TEST position of the switch allows the pilot to check the readiness of the autofeather system. The TEST position of the autofeather system allows the 90% N1 power lever micro-switch to be bypassed to facilitate ground testing of the autofeather system. Autofeather and Autoignition systems are tested in conjunction during the Engine Runup Checklist.

Autofeather Lights

Two green annunciator lights LH AUTO and RH AUTO indicate that the autofeather system is armed.

407. SYNCHROPHASER SYSTEM

The Synchrophaser System is designed only for inflight use. The system reduces the interior noise level and minimizes stress on the fuselage.

The Synchrophaser System provides two functions:

1. One function is to synchronize the propellers to the same rpm (N2). This lowers the ambient noise level in the cabin.

2. The other is to phase the blades so that no two blades pass the fuselage at the same time, which reduces airframe stress.

The left propeller is the master and the right propeller is the slave. Both props have a magnetic speed pickup mounted in their overspeed governor and three magnetic phase pickups mounted on their de-ice slip ring which transmits electronic pulses to a control unit. The control unit converts any pulse rate differences into correction commands and these correction commands are then transmitted to an actuator motor mounted on the right engine. The actuator motor then trims the right propeller governor assembly to match the left propeller rpm while leaving the left propeller control lever position constant.

The synchrophaser is limited to +/- 30 rpm from the normal governor setting. This is to prevent the slave propeller from losing excessive rpm if the master propeller is feathered while the synchrophaser system is on.

Propeller Synchronization Switch

The synchrophaser system is controlled by a two-position switch located on the control quadrant and is placarded PROP SYNC ON-OFF. The switch completes the circuit for propeller synchronization.

When the propeller sync switch is OFF, the propeller synchrophaser actuator will recenter.

PROP SYNC ON Annunciator Light

If the synchrophaser system is in use and the right landing gear is extended, a yellow annunciator light placarded PROP SYNC will illuminate.

The right propeller may not fully feather with the propeller sync switch on.

** PLUS OR MINUS 30 RPM IS THE LIMIT OF THE ACTUATOR AUTHORITY

** INPUTS TO THE ACTUATOR:

PHASING OF BLADE POSITION – DEICER SLIP RING SCREW LOCATION RT AND LT

SYNCHRONIZING RPM – OVERSPEED GOVERNOR MAG TACH INFO RT AND LT

** OUTPUT FROM THE ACTUATOR:

LINKAGE GOING TO THE RIGHT PRIMARY GOVERNOR (LT PROP IS MASTER, RT IS THE SLAVE)

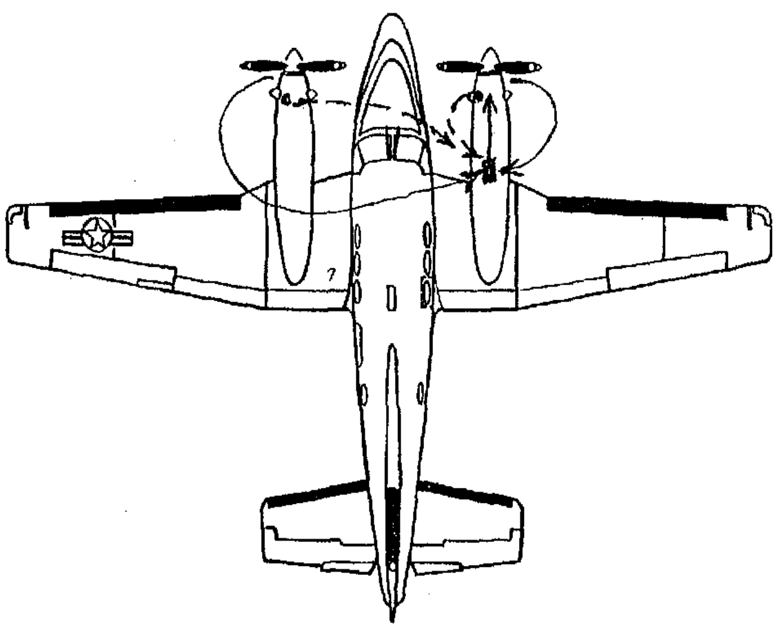


Figure 4-5 T44 Synchrophaser System

408. ABNORMAL CONDITIONS

Prop Governor Failure

If the propeller governor fails, the propeller will either feather or overspeed. For example, an uncommanded and uncontrollable propeller overspeed greater than 2200 rpm indicates failure of the primary governor.

If a primary governor malfunctions and its respective propeller exceeds 2200 rpm, then the overspeed governor limits N2 to 2288 +/- 40 rpm dumping oil from the propeller to prevent rpm from exceeding safe limits.

If a propeller sticks or moves too slowly during a transient condition (like a rapid increase of power), and the propeller speed exceeds 2332 rpm, then the over speed governor has failed, and the pneumatic section of the primary governor will act as fuel topping governor. To do this, the pneumatic section limits the fuel flow into the engine, thereby reducing the power driving the propeller.

WARNING

> Propeller rpm exceeding 2420 may result in reduction gearbox failure and/or N2 turbine damage.

NOTE

> The engine with the disabled propeller may be operated to provide electrical power. The right propeller may not fully feather with the propeller sync on.

Emergency Procedure for Prop Governor Failure

If propeller rpm is out of the normal governing range (over 2200 rpm), proceed as follows:

*1. Attempt to adjust propeller rpm to normal operating range by manipulating the propeller lever. If normal rpm limits are restored, continue operation. If normal governing range cannot be maintained:

†*2. Power lever -- IDLE.

†*3. Propeller lever -- FEATHER.

*4. Emergency Shutdown Checklist -- AS REQUIRED.

Prop Linkage Failure

If the propeller governor control linkage fails, the affected propeller will remain at its current setting or increase to 2200 rpm.

Emergency procedure for Prop Linkage Failure

If a propeller linkage failure is suspected, proceed as follows:

Manipulate the propeller lever to positively determine if the cockpit propeller control is lost. If cockpit propeller control is lost and rpm remains within safe limits, match the opposite propeller's speed with the uncontrolled one and land as soon as practicable.

CAUTION

Reversing without the propellers being in high rpm may damage the reversing linkage.

PROPELLERS QUIZ

1. While conducting a routine training flight the right propeller suddenly advances to 2288 rpm. Your first action should be to?

a. Feather the propeller
b. Power lever to IDLE
c. Condition lever to FUEL CUTOFF
d. Firewall valve to CLOSED
e. Attempt to adjust propeller rpm

2. If the primary governor fails the propeller will either feather or remain at the current rpm setting.

TRUE FALSE

3. If the propeller linkage fails the propeller will

a. Overspeed
b. Feather
c. Advance to 2200 rpm
d. Remain at the current rpm
e. Answers c or d are correct

4. A propeller linkage failure will result in the propeller either remaining at the last rpm setting or advancing to__________ rpm.

5. Which propeller system components drive the propeller toward feather pitch?

a. Flyweights
b. Bladeshank counterweights
c. Feathering spring
d. Both b and c
e. Increased oil pressure in the propeller dome

6. The propellers are hydraulically controlled __________ speed, full-feathering, and reversible.

7. While on short final for landing, the pilot advances the propeller levers to the full forward position. Which of the following statements is most correct?

a. Oil pressure will be released from the propeller dome and blade angle will decrease
b. Oil pressure will be increased in the propeller dome and blade angle will decrease
c. Oil pressure will be released from the propeller dome and blade angle will increase
d. Oil pressure will be increased in the propeller dome and blade angle will increase

8. The full aft position on the propeller levers is placarded FEATHER and positions the propeller to __________ degree(s) of blade angle.

9. The PROP GOV TEST switch resets the propeller governor to maintain rpm from 1900 to 2100 for test purposes.

TRUE FALSE

10. During flight the right propeller rpm increases to 2332 rpm. This indicates a failure of which of the following?

a. Primary governor
b. Overspeed governor
c. Fuel topping governor
d. Both a and b
e. All of the above

11. The normal operating range for the propeller is from _______ to _______ rpm.

12. The pneumatic section of the primary governor begins to act as a fuel topping governor when the propeller rpm exceeds?

a. 2420
b. 2200
c. 2288
d. 2332

13. Which condition is not a requirement for the autofeather system to feather an inoperative engine's propeller?

a. The propeller levers full forward.
b. Power on the inoperative engine must be below 260 +/- 50 ft/lbs torque.
c. The autofeather switch must be in the ARM position.
d. The power levers must be above the 90 % N1 position.

14. The TEST position of the autofeather switch allows which of the following switches to be bypassed?

a. 410 +/- 50 ft/lb
b. 260 +/- 50 ft/lb
c. 79 % N1
d. 90 % N1
e. Main cabin door

15. The__________ propeller may not fully feather with the propeller sync switch on.

16. The propeller synchrophaser actuator will re-center when?

a. The propeller rpm's are matched to within +/- 30 rpm's
b. The actuator will automatically re-center when it reaches the maximum travel limit
c. The propeller sync switch is moved to the OFF position
d. The propeller sync switch is moved to the ON position

17. The three unique items on the overspeed governor are

____
____
____

18. If the primary governor fails the propeller will

____
____

19. With a propeller linkage failure the affected propeller will

____
____

20. The propeller can be feathered by ____

21. List the steps required for the autofeather system to operate.

____
____

22. 410 +/- 50 ft lbs. torque de-arms the ________________ engine's autofeather system.

23. 260 +/- 50 ft lbs. torque activates the autofeather solenoid on the failed engine's __________ governor.

24. Propeller RPM exceeding 2420 RPM may result in _________________________ failure and/or __________________________ damage.

LESSON FIVE
FUEL SYSTEM

500. OBJECTIVES

At the end of this lesson, you should be able to:

1. Label the components of the fuel system.
2. List the approved fuels for the T-44A aircraft.
3. Describe the functions of all system components that assist fuel flow from the tanks into the engine.
4. Recognize the indications and potential results of a transfer pump malfunction.
5. Recognize the indications and potential results of a boost pump malfunction.
6. State two limitations for using suction lift.
7. Label and describe the operation of the crossfeed system and its components.

NOTES

501. FUEL SYSTEM

At the end of this topic, you should be able to label and describe the operation of the components of the fuel system. You should also be able to list the approved fuels for the T-44A.

502. FUEL SYSTEM COMPONENTS & OPERATION

The fuel system consists of two identical systems sharing a common fuel management panel and a continuous stainless steel crossfeed line.

The components of the fuel system are:

- Wing Tanks
- Nacelle Tanks
- Fuel Transfer Pumps
- Boost Pumps
- Purge Valves
- Fuel Tank Sump Drains
- Fuel Vents
- Firewall Shutoff Valves
- Fuel Crossfeed Valve

Approved Fuels

There are five (5) fuels approved for use on the T-44A:

1. Jet A1
2. Jet B
3. Jet 4
4. JP-5
5. JP-8

Jet A and F42 are alternate fuels.

AVGAS grades 80/87/100LL through 115/145 may also be used (**Emergency Use Only**). However, continuous use of AVGAS is limited to 150 hours between overhaul periods. Reference NATOPS Servicing and Handling for specifics.

CAUTION

JP-8 +100 shall never be used in the T-44A as it can clog the fuel filter.

503. WING TANKS

Wing tanks are of the rubberized bladder type, snapped into place and interconnected to each other for supplying fuel or venting of the tanks.

Fuel is gravity fed into the fuel tanks through four fuel filler caps: one on each wing and one on each nacelle.

Fuel is gravity fed from outboard tanks to the center section (inboard) tank.

- The fuel capacity of the wing tanks is 132 gallons.
- The fuel capacity of the nacelle tanks is 61 gallons.
- The total fuel capacity is 387.6 gallons of which 384 gallons are usable.

504. FUEL TRANSFER SYSTEM

The fuel transfer pump is located in the center section tank. It pumps at a rate of 1 1/4 GPM or 500 PPH (approx. 75 GPH).

The transfer pump can be electronically controlled from the fuel management panel to run continuously (OVERRIDE position), or it can be automatically controlled (AUTO position) by float switches in the nacelle tank.

In the **AUTOMATIC** mode, each transfer pump is controlled by three float switches: upper-level, middle-level, and lower-level.

- The lower-level switch is set at approximately 42 gallons (turns pump on).
- The middle-level switch is set at approximately 51 gallons (turns pump off).
- The upper-level switch is set at approximately 59 gallons (turns pump off if the 51 gallon switch fails).

Normally, the fuel in the nacelle tank will drop to 42 gallons as the engine consumes fuel. Then the transfer pump will activate to fill the nacelle tank to the 51-gallon level at which point it cuts off. This cycle continues until the fuel in the center section tank is depleted.

The float switch operation is automatic and requires no action by the pilot.

In the **OVERRIDE** mode, the transfer pump runs continuously, and the float switches are bypassed.

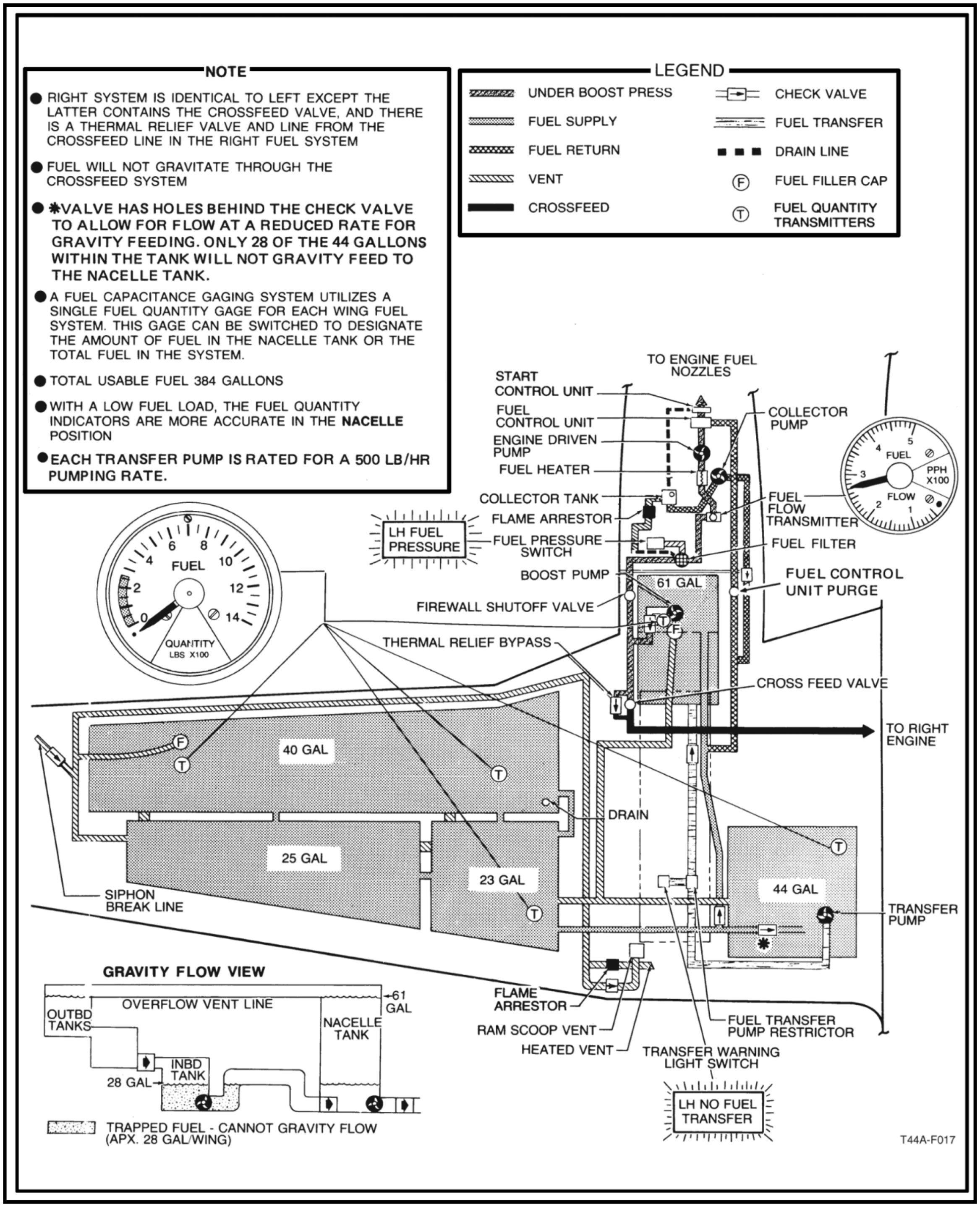


Figure 5-1 Fuel System

505. FUEL TRANSFER SYSTEM MALFUNCTIONS

If the RH/LH NO FUEL TRANSFER light illuminates (transfer pump switch in auto): Check total fuel and nacelle fuel quantities.

1. If total fuel quantity equals nacelle fuel quantity, then no fuel remains in the wing tanks to transfer. Turn transfer pump off.

2. If total fuel quantity is greater than nacelle fuel quantity, then determine if the 28 gallons of trapped fuel are necessary.

   a. If the 28 gallons are necessary then position transfer pump switch to override.

      i. If the NO FUEL TRANSFER annunciator extinguishes, then pump operation may continue.

      ii. If the NO FUEL TRANSFER annunciator extinguishes, then the pump has failed. Turn transfer switch to off. A maximum of 28 gallons of fuel will be unusable in the respective wing tank.

   b. If the 28 gallons are not necessary, then turn the pump off.

   In both cases, land as soon as practicable.

3. If there is fuel in the wings but the nacelle quantity is in the yellow arc, and there is no associated annunciator light, the one of the following may have occurred.

   a. Transfer pump switch could be in the off position.

   b. Transfer pump circuit breaker is out. Pump operation and annunciator light operation will be inhibited.

   c. 42 gal float switch is inoperative. If fuel is needed select override and monitor fuel quantity.

NOTES

1. When the transfer pump switch is in the AUTO position, power will automatically be removed from the pump when the NO FUEL TRANSFER light illuminates.

2. Unlike boost pump warnings, transfer pump warning circuit logic involves not just a simple pressure switch; otherwise, the pilot would be warned every time the float switch turns off the pump automatically. The warning occurs if the pressure switch detects < 3 psi for 30 seconds **and** the pump is told to run.

506. BOOST PUMPS

The fuel boost pumps are located in the left and right nacelle tanks. The boost pumps provide approximately 30 psi head pressure fuel to the engine-driven high pressure pump inlet and provide fuel pressure for crossfeeding during continued single engine operations.

The boost pumps are dual powered by their respective fuel busses and the hot battery bus.

When a boost pump fails, the respective FUEL PRESSURE light flickers and the CROSSFEED annunciator remains illuminated. The crew must then turn the crossfeed switch off to determine which sides boost pump has failed. Then a decision must be made to crossfeed or to suction lift the fuel.

NOTE

For descent for landing, crossfeed should be selected to guarantee boosted pressure in case of waveoff.

CAUTION

Engine-Driven fuel pump operaton without boost pump fuel pressure is limited to 10 hours.

507. PURGE VALVE

The purge valve is a solenoid valve in the fuel return line along the right side of each nacelle.

The purge valve allows fuel vapor and excess residual fuel to be purged from the fuel control and high-pressure engine driven fuel pump through a small valve opening to prevent premature starts. This purged vapor/fuel is directed to the nacelle fuel tank.

The purge valve is electronically connected to the ignition system and is open when the igniters are operated, either during engine start via the start and ignition switch or through the auto-ignition system. The purge valve is spring loaded closed when the igniters are not in use.

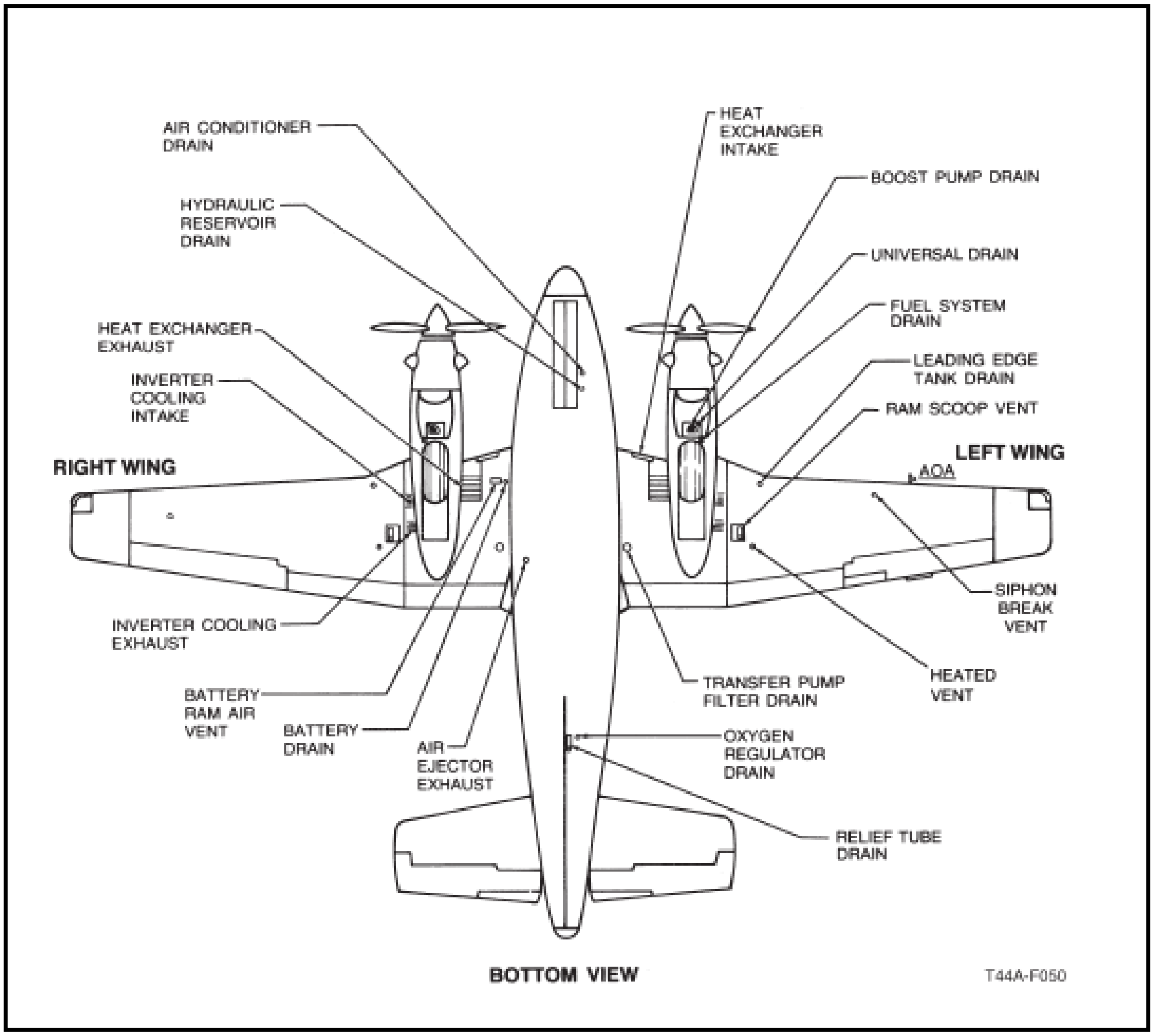


Figure 5-2 Aircraft Vents and Drains

508. SUMP DRAINS

The **fuel tank sump drains** drain moisture and sediment at the fuel system low points on the nacelle tanks, wing tanks, wheel well sumps, transfer pumps, and at the fuel strainers in the engine compartment.

There are four sump drains and one filter drain in each wing.

1 The **leading edge tank sump** is located on the underside of the outboard wings just forward of the main spar.

2. The **boost pump sump drain** is located at the bottom center of the nacelle, forward of the wheel well.

3. The **transfer pump sump drain** is just outboard of the wing root, forward of the flap.

4. The **low point fuel drain** is inside of the wheel well, which is the lowest point in the fuel system.

5. The **firewall fuel filter drain** is opened by pulling the ring on the engine firewall located under the cowling.

509. FUEL VENT SYSTEM

The fuel system is vented through a heated extended vent that is coupled to a recessed ram scoop vent. They are located on the underside of the wing, adjacent to the nacelle. The recessed ram scoop acts as a backup vent should the heated extended vent become blocked.

Both vents are connected to the same vent line and provide ram air pressure to prevent the tanks from collapsing as they lose fuel to the engines.

The extended (external) vent is electrically heated by a wrapped wire coil.

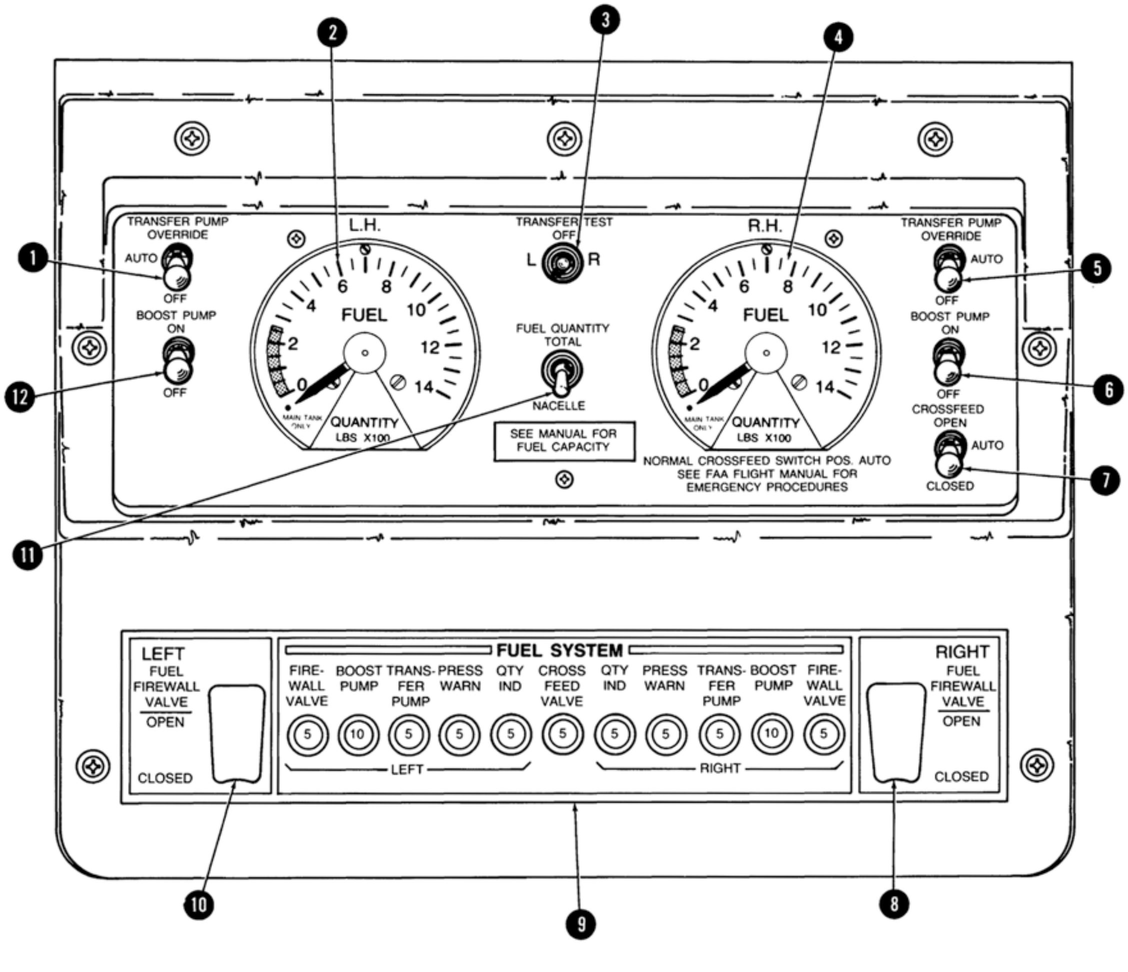
The fuel vent system incorporates a siphon-break valve feature, which opens when a negative pressure is sensed in the vent system. Introducing air into the vent system breaks the siphoning action. Thermal expansion is normal as fuel is warmed and to prevent fuel tank rupture, the fuel will vent through the vent system and flow overboard out of the heated vent.

510. FIREWALL SHUTOFF VALVES

The last component of the fuel system is the firewall shutoff valves. These valves are on the border between the fuel tanks and the engine fuel systems. These valves are to be used only in the event of an emergency.

The firewall shutoff valves receive power from the No. 1 and No. 2 Fuel Buses, respectively. However, in the event of a fuel bus failure, the firewall shutoff valves are also powered by the hot battery bus.

The firewall shutoff valve circuitry is protected by the FIREWALL VALVE circuit breaker located on the fuel management panel and a fuse on the hot battery bus.



1. LEFT TRANSFER PUMP SWITCH
2. LEFT FUEL QUANTITY INDICATOR
3. TRANSFER TEST SWITCH
4. RIGHT FUEL QUANTITY INDICATOR
5. RIGHT TRANSFER PUMP SWITCH
6. RIGHT BOOST PUMP SWITCH
7. CROSSFEED SELECTOR SWITCH
8. RIGHT FUEL FIREWALL VALVE SWITCH
9. FUEL SYSTEM CIRCUIT BREAKER PANEL
10. LEFT FUEL FIREWALL VALVE SWITCH
11. FUEL QUANTITY TOTAL/NACELLE SELECTOR SWITCH
12. LEFT BOOST PUMP SWITCH

T44A-F018

Figure 5-3 Fuel Management Panel

511. FUEL MANAGEMENT PANEL

The fuel system is monitored and controlled from the cockpit through the fuel management panel. The fuel management panel is located to the left of the pilot. On this panel you will find:

Fuel Quantity Indicators

There are two (2) fuel quantity indicators, one for each engine. Each indicator is calibrated from 0 to 14 in hundreds of pounds with a yellow arc marked to indicate 265 pounds.

Each of the five tanks (per side) has a single capacitance-type probe extending into the fuel to measure the quantity.

Fuel Quantity Total/Nacelle Selector Switch

Between the fuel quantity indicators is the fuel quantity total/nacelle selector switch placarded TOTAL and NACELLE.

With the selector switch set to TOTAL, the indicators display the fuel quantity located in the nacelle and wing tanks.

With the selector switch set to NACELLE, the indicators display the fuel quantity in only the nacelle tanks.

Transfer Test Switch

Above the fuel quantity selector switch is the transfer test switch. As discussed before, the switch allows the pilot to check the operation of either the left or right fuel transfer system.

The transfer pump test switch labeled TRANSFER TEST is a three-position toggle unit spring-loaded to the center OFF position.

Transfer Pump Switches

From the cockpit, the pilot can control the transfer pump through transfer pump switches. The left and right transfer pump switches are located on the upper corners of the fuel management panel. Each has three positions: OFF, AUTO and OVERRIDE.

Fuel transfer from the center section to the nacelle tanks is initiated when the **TRANSFER PUMP** switches are placed in the **AUTO** position unless the tank is full.

Automatic transfer cycles will then maintain the nacelle quantity between 42 and 51 gallons until all wing fuel is depleted.

When all wing tank fuel has been used, a pressure sensing switch will sense the drop in fuel pressure in the transfer line and, after a 30-second delay, will terminate transfer pump operation, and a red NO FUEL TRANSFER annunciator light will illuminate.

The NO FUEL TRANSFER light also functions as an operation indicator for the transfer pump. If the light should illuminate before the wing fuel is depleted, the transfer pump has stopped transferring fuel to the nacelle tank. Extinguishing the NO FUEL TRANSFER light is accomplished by placing the transfer switch to OFF.

In the OVERRIDE position, the transfer pump is continuously energized. The float switches in the nacelle tank are bypassed and the 3 psi pressure switch is reset.

Boost Pump Switches

The boost pump switches located on the fuel management panel controls the boost pumps. The boost pump switches are two position, toggle and lever-lock type switches. The switches are placarded BOOST PUMP ON and OFF. During normal operations both boost pump switches are set to ON.

When the boost pump switches are set to OFF, the engines use suction lift to pull fuel from the nacelle tank into the engine.

Fuel System Circuit Breaker Panel

The circuit breaker panel is located immediately below the fuel management panel. It contains all associated circuit breakers and switches for the fuel system:

- Fire Wall Valves
- Boost Pumps
- Transfer Pumps
- Pressure Warning
- Quantity Indicators
- Crossfeed Valve

Firewall Shutoff Valve Switches

The firewall shutoff valve switches are two guarded switches located on the fuel management panel. They give the pilot an electrical fuel shutoff capability at each engine firewall.

Each firewall shutoff valve switch is a two position switch controlling the corresponding valve located aft of the engine firewall. In the CLOSED position, fuel flow to its respective engine is completely cut off.

During normal operation, the firewall shutoff valve switch is in the OPEN position to allow fuel to reach the engine from the fuel tanks.

A hinged, red-colored guard prevents the switch from being inadvertently moved from the OPEN to CLOSED position.

CAUTION

Do NOT use the fuel firewall shutoff valve to shut down an engine except in an emergency. The engine-driven high pressure fuel pump obtains essential lubrication from fuel flow. When an engine is operating, this pump may be severely damaged while cavitating if the firewall valve is closed before the condition lever is moved to FUEL CUTOFF position.

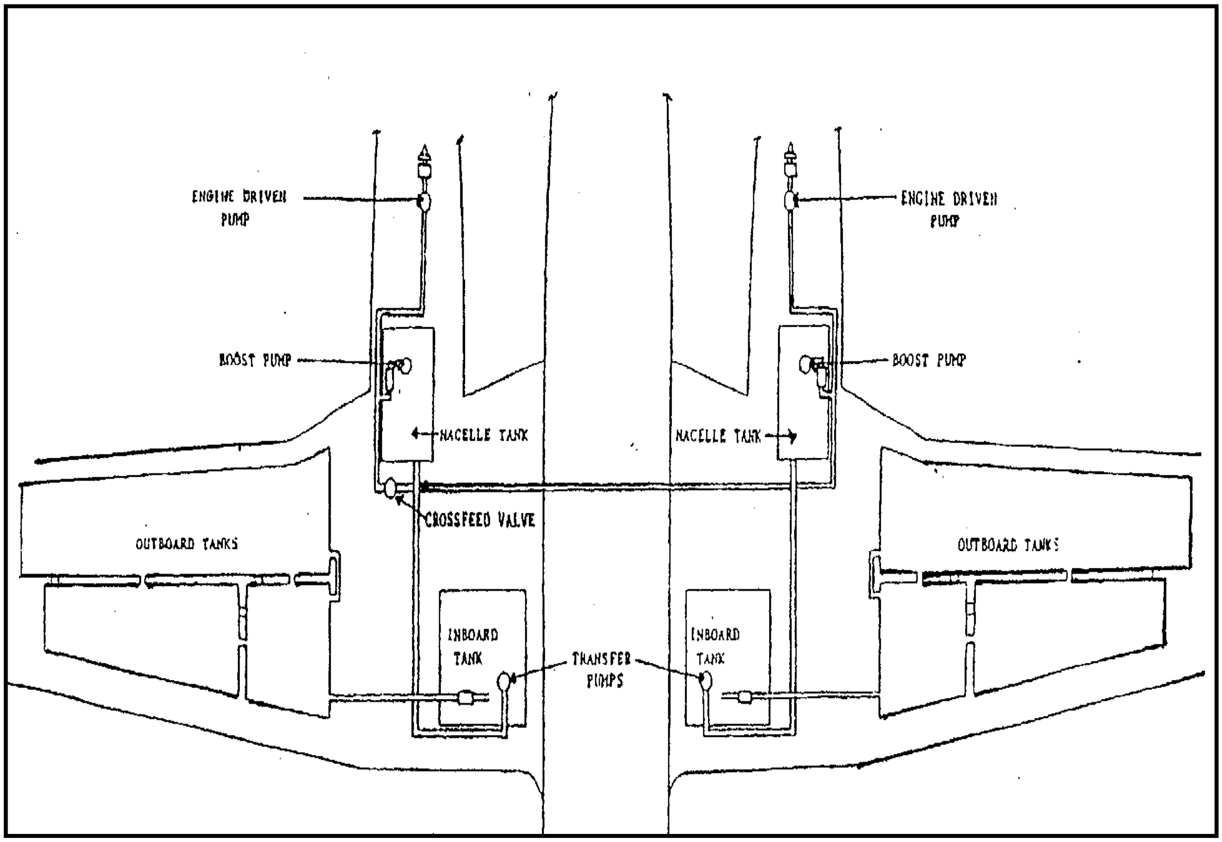


Figure 5-4 Crossfeed Section

512. CROSSFEED SYSTEM

The crossfeed system is used to transfer fuel from fuel tanks on one side of the aircraft to the engine on the opposite side of the aircraft. The crossfeed system cannot be used to transfer fuel from one nacelle to the other nacelle. Generally, crossfeeding is used when a boost pump fails or an engine fails.

Crossfeed Valve

The crossfeed valve is located on the outboard side of the left wheel well.

The crossfeed valve is dual powered. It normally receives electrical power from the No. 1 fuel bus. However, in the event of a fuel bus failure, the crossfeed valve is also connected to the hot battery bus.

The crossfeed valve circuit is protected by a circuit breaker placarded CROSSFEED VALVE located on the fuel management panel.

Normally, the crossfeed valve is automatically controlled by a pressure sensor in the fuel supply line. However, it can also be manually opened or closed by a switch on the fuel management panel.

Crossfeed Switch

From the cockpit, the Crossfeed Switch located on the fuel management panel controls the crossfeed valve. It is a three-positioned toggle-type switch placarded **OPEN**, **CLOSED**, and **AUTO**.

With the crossfeed switch in the **OPEN** position, the crossfeed valve is open.

With the crossfeed switch in the **CLOSED** position, the crossfeed valve is closed.

Under normal flight the crossfeed switch is left in **AUTO** position.

With the crossfeed switch in the **AUTO** position, the crossfeed control circuitry is connected to the boost pump pressure sensing switches. If these sensing switches detect a pressure drop from a nominal 30 psi to below 5 psi, the system automatically opens the crossfeed valve.

FUEL SYSTEM QUIZ

1. Which of the following fuel system components are not dual powered?

a. Boost pumps
b. Transfer pumps
c. Crossfeed valve
d. Firewall shutoff valves

2. The total fuel system capacity is ________ gallons, of which_______ gallons are usable.

3. Which of the following float switches will deenergize the transfer pump?

a. 42 gallon
b. 51 gallon
c. 59 gallon
d. 61 gallon
e. Both b and c

4. The transfer pump is located in the nacelle tank and transfers fuel from the center section tank to the nacelle tank.

TRUE FALSE

5. Which of the following actions does not occur when the transfer pump switch is placed in the OVERRIDE position?

a. Power is continuously supplied to the transfer pump
b. The float switches in the nacelle are bypassed
c. The 3 psi pressure switch is reset
d. The output rate of the pump is increased
e. All of these actions will occur

6. The purge valve opens to vent air and excess fuel any time the starter switch is placed in the IGNITION and START position.

TRUE FALSE

7. How many fuel drains are on each wing?

a. 2
b. 3
c. 4
d. 5
e. 6

8. The boost pumps provide a pressure of approximately __________psi to the engine driven high pressure pump.

9. The boost pump is used to ___________________ & _______________________.

10. The transfer pump is used to ____.

11. What are the cockpit indications if the transfer pump is NOT transferring fuel?

____

12. How is a transfer pump failure noted?

____

13. How do you turn off the no fuel transfer light?

____

14. The steps for the single engine crossfeed procedure are

(bp) ____
(tp) ____
(xf) ____
(bp) ____

15. If the transfer pump circuit breaker pops, what light (s) will illuminate on the annunciator panel?

____

16. If the transfer pump is inoperative, how many gallons of fuel are unavailable?

____

17. What items on the left fuel bus are operational if the fuel panel circuit breaker is popped?

____
____
____

18. Can you crossfeed from the left nacelle tank to the right engine with the left firewall valve closed?

____

LESSON SIX
FLIGHT CONTROLS

600. OBJECTIVES

At the end of this lesson, you should be able to:

1. Label and describe the operation of the primary flight controls.
2. State the items incorporated on the control wheel.
3. Describe the rudder pedal functions.
4. Describe the operation of the nose wheel steering system.
5. State the function of the elevator trim system.
6. Describe the operation of the manual elevator trim tab.
7. Describe the operation of the electric elevator trim system.
8. Describe the operation of the aileron trim tab system.
9. Describe the function of the aileron trim control knob.
10. Describe the operation of the rudder trim tab system.
11. State the function of the rudder trim tab control knob.
12. List all of the components of the flight control lock system.
13. State the function of the flap motor.
14. Match flap positions to the percentage of travel.
15. Describe the selection of flap positions.

NOTES

601. FLIGHT CONTROLS

At the end of this topic, you should be able to label and describe the operation of the primary flight controls of the T-44A aircraft.

602. PRIMARY FLIGHT CONTROLS

The primary flight control system consists of the following control surfaces:

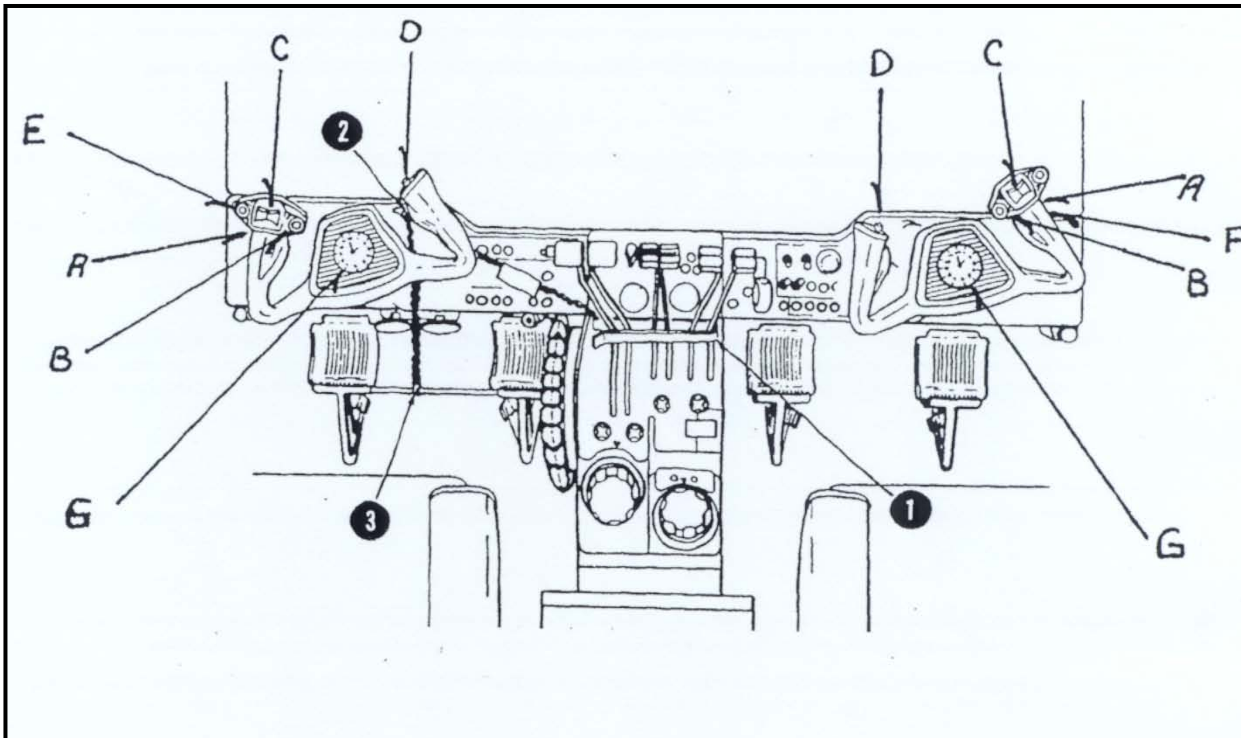
- Rudder
- Elevator
- Ailerons

The pilot or copilot manually operates them from the cockpit through mechanical linkages.

The control wheel controls the ailerons and elevator.

The adjustable rudder/brake pedals control the rudder.

Trim control for the rudder, elevator, and ailerons is accomplished through a manually actuated cable-drum system for each set of control surfaces. These controls are discussed in the section on secondary flight controls.



Flight Control Lock

1. ENGINE CONTROL LOCK
2. AILERON/ELEVATOR LOCK PIN
3. RUDDER LOCK PIN

PILOTS CONTROL WHEEL

A. MICROPHONE SWITCH
B. AP/YD TRIM DISCONNECT SWITCH
C. ELEVATOR TRIM SPLIT THUMB SWITCH
D. MAP LIGHT SWITCH
E. PITCH SYNC/CWS SWITCH
G. EIGHT DAY CLOCK

CO-PILOTS CONTROL WHEEL

A. MICROPHONE SWITCH
B. AP/YD TRIM DISCONNECT SWITCH
C. ELEVATOR TRIM SPLIT THUMB SWITCH
D. MAP LIGHT SWITCH
F. GO AROUND SWITCH
G. EIGHT DAY CLOCK

Figure 6-1 Flight Controls

Control Wheel

The elevator and aileron control surfaces are manually controlled through the pilot or copilot control wheel. The control wheel contains the following:

- Microphone Switch
- AP/YD/Trim Disconnect Switch

- Elevator Trim Split-Thumb Switch
- Map Light Switch
- Pitch Sync & Control Wheel Steering (CWS) Switch
- Go Around Switch (copilot only) Eight Day Clock

Rudder Pedals

The aircraft rudders and nosewheel steering are controlled with the pilot or copilot rudder pedals.

603. CONTROL LOCK

The control lock is a removable lock assembly consisting of two (2) pins and an elongated U-shaped strap interconnected by a chain.

The control lock ensures positive locking of the rudder, elevator, aileron control surfaces, and engine controls including power levers, propeller levers and condition levers.

To install the control lock:

1. Insert the strap over the aligned engine control levers from the copilot's side.

2. Insert the aileron elevator locking pin through the guide hole in the top of the pilot's control column assembly. This locks the control wheels in a forward left aileron position.

3. Insert the large pin horizontally through both of the pilot's rudder pedals. This locks the rudder pedals in the neutral position.

CAUTION

DO NOT tow the aircraft with the rudder control lock installed as serious steering linkage damage can result.

604. SECONDARY FLIGHT CONTROLS

Secondary flight controls consist of trim tabs and wing flaps.

605. TRIM

Trim tabs are provided for all flight control surfaces on the aircraft. They are manually activated and mechanically controlled by a cable-drum and jackscrew actuator system. The purpose of the trim tabs is to minimize the force required to keep the aircraft in balanced flight.

Elevator Trim

Elevator trim helps control rotational forces about the pitch axis.
Normally, the pilot or copilot controls elevator trim with the electric elevator trim switches and a trim disconnect switch on the pilot and copilot control wheels. However, elevator trim can also be controlled manually using the elevator trim wheel.

The elevator trim tab is a little different from other trim tabs. It incorporates an anti-servo action. That is, as the elevator is displaced from the neutral position, the trim tab moves in the same direction as the applied control surface. This increases the effective control surface area and the manual force required to further deflect the elevator.

Electric Elevator Trim Switches

The electric elevator trim switches are dual element, thumb switches.

The pilot's electric elevator trim switch takes priority over the copilot's should both be simultaneously activated.

Trim Disconnect Switches

The trim disconnect switch is a bi-level, momentary push-type switch located on the outboard grip of the each control wheel.

Push the switch to the first level to disconnect the autopilot and yaw damper.

Push the switch to the second level to disconnect the electric trim system.

Manual Elevator Trim Wheel

The manual elevator trim wheel controls the trim tab for each elevator. The elevator trim tab control wheel is placarded ELEVATOR TAB UP or DOWN.

A position arrow on the control wheel indicates the amount of elevator tab deflection in degrees from neutral.

Aileron Trim

The aileron trim tab helps to reduce control forces on the roll axis.

The ailerons are controlled with the pilot or copilot control wheels.

Aileron Trim Tab Control

The aileron trim tab deflects the left aileron trim tab from a neutral setting. A position arrow on the aileron trim tab control indicates the relative deflection. The wheel is NOT marked in degrees.

Full travel of the aileron trim tab is equal to 15 degrees of up and down movement. Once adjusted to a new position the aileron trim tab stays in its adjusted position.

Rudder Trim

The rudder trim helps to reduce control forces about the yaw axis.

You control the rudder through the pilot and copilot rudder pedals. However, you can fine tune the rudders using the rudder trim tab.

Rudder Trim Tab Control

The rudder trim tab control located on the far right side of the control pedestal. A position arrow on the rudder trim tab control indicates the amount of rudder trim tab deflection in degrees from neutral.

Once adjusted to a new position, the rudder trim tab stays in the adjusted position.

Turning the rudder trim tab control to the right will deflect the trim tab to the left side of the aircraft. Turning the rudder trim tab control to the left will deflect the trim tab to the right side of the aircraft.

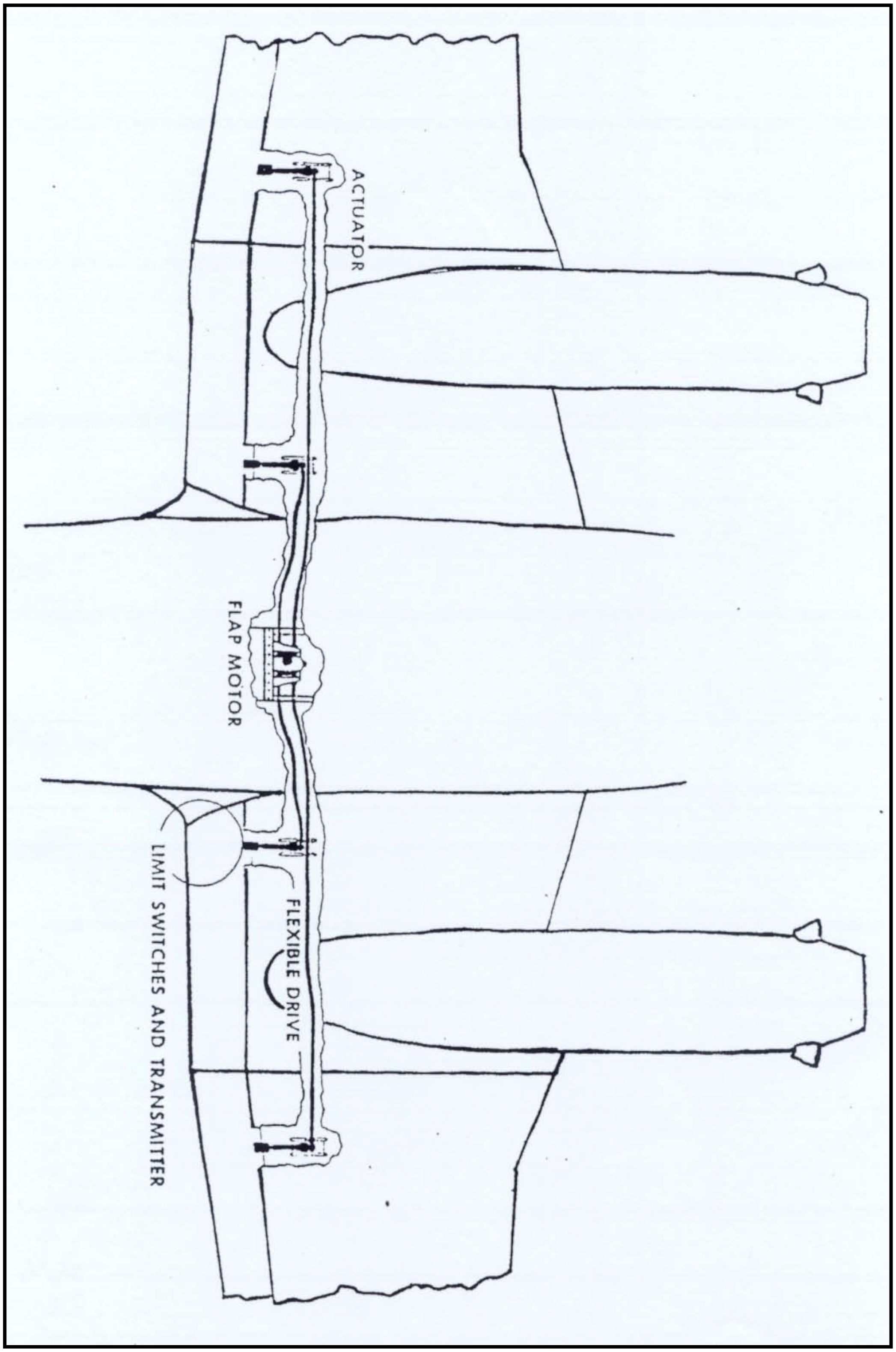


Figure 6-2 Wing Flap System

606. WING FLAPS

The purpose of the wing flaps is to increase lift allowing the aircraft to be flown at a slower speed.

The wing flaps are all-metal, slot-type, and are electrically operated.

The flaps consist of two sections for each wing. However, they are operated as a single unit during extension or retraction.

A separate jackscrew actuator actuates each section. The actuators are driven through flexible shafts by a single reversible electric motor mounted on the forward side of the rear spar. The motor incorporates a dynamic braking system through the use of two sets of motor windings.

Flap Switch Handle

The flap switch controls flap operations. The flap switch is a three-position lever, with a flap-shaped handle on the control pedestal. It is placarded UP, APPROACH, and DOWN.

Flap Position Indicator

Flap position is noted in percent of travel from 0 to 100 percent. It is shown on the Flap Position Indicator, placarded FLAPS, and located on the panel above the power control quadrant.

The flap positions are as follows:

When the flaps are set to UP, the flap indicator reads 0% and the flaps are extended 0 degrees.

When the flaps are set to APPROACH, then the flap indicator reads 35% and the flaps are extended 15 degrees.

When the flaps are set to DOWN, then the flap indicator reads 100% and the flaps are extended 43 degrees.

Flap Control & Motor Circuit Breakers

The flap position indicator and flap control circuits are protected by a circuit breaker placarded FLAP INDICATOR located on the copilot right outboard subpanel.

The flap motor is protected by a circuit breaker on the center console placarded WING FLAP MOTOR.

FLIGHT CONTROLS QUIZ

1. Which of the following flight controls is NOT a primary flight control?

a. Ailerons
b. Elevator
c. Rudder
d. Wing flaps
e. These are all primary flight controls

2. The primary flight controls are normally ___________ operated but can also be operated by electric servo motors in the autopilot/yaw damping mode.

MECHANICALLY HYDRAULICALLY

3. Which of the following yoke switches can ONLY be found on the pilot's yoke?

a. Microphone switch
b. Map light switch
c. Pitch sync/control wheel steering (CWS) switch
d. AP/YD/Trim disconnect switch
e. Elevator trim split thumb switch

4. A go-around button is located on both the pilot's and the copilot's yokes.

TRUE FALSE

5. The nosewheel is steered with the ________ .

a. Steering wheel
b. Rudder pedals
c. Yoke
d. Nothing (nosewheel steering is NOT provided)

6. Which of the following secondary controls are NOT installed on the T-44A?

a. Spoilers
b. Wing flaps
c. Rudder trim tab
d. Aileron trim tab
e. Elevator trim tabs

7. The rudder pedals are adjustable to an infinite number of positions to accommodate any size pilot.

TRUE FALSE

8. On the T-44A, wing flaps are considered a secondary flight control.

TRUE FALSE

9. The elevator trim tab incorporates ________ action to increase the effective surface area thereby increasing the manual force required to deflect the elevator.

a. Servo
b. Anti-servo
c. Neutral
d. Fixed
e. Reverse polar

10. In the event that both electric trim switches are activated simultaneously which switch would take priority?

PILOT COPILOT

11. Aileron trim tabs are located on both ailerons to reduce the control pressure in the roll axis.

TRUE FALSE

12. The aileron trim tab is adjusted by the trim wheel on the control pedestal with the amount of deflection indicated in relative units. Full travel of the control wheel is equivalent to _________degrees of up and down tab movement.

13. With the left engine inoperative, which direction should the rudder trim control wheel be turned?

LEFT RIGHT

14. When the rudder trim control wheel is turned to the left which side of the rudder will the trim tab move to?

LEFT RIGHT

15. The two circuit breakers required to be in for operation of the flaps are

____

____

16. The APPROACH position on the flap handle is equivalent to _____ percent of flap travel.

a. 15
b. 35
c. 45
d. 55
e. 65

17. The DOWN position on the flap handle is equivalent to _____ degrees.

a. 13
b. 33
c. 43
d. 53
e. 63

18. The aircraft should never be towed with the _____________control lock installed as serious steering linkage damage can result.

19. Which of the following items is NOT positively locked by the flight control lock?

a. Ailerons
b. Elevator
c. Rudder
d. Wing flaps
e. Condition levers

20. The motor for the flap system is ________Vdc.

LESSON SEVEN
LANDING GEAR SYSTEMS

700. OBJECTIVES

At the end of this lesson, you should be able to...

1. Label and describe the operation of the landing gear and its components.

2. Label and describe the operation of the landing gear control switch.

3. Label and describe the operation of the wheels-up warning system and its components.

4. Label and describe the operation of the squat switches.

5. Label and describe the operation of the downlock and uplock switches.

6. Label and describe the operation of the components of the emergency landing gear system.

7. Label and describe the operation of the rudder brake system.

NOTES

701. LANDING GEAR

At the end of this topic, you should be able to label and describe the operation of the landing gear, its components and its controls. You should also be able to locate and describe the operation of the squat switches, downlocks, uplocks, and motor limit switches.

702. LANDING GEAR SYSTEMS

The landing gear is a retractable, tricycle type system. Located forward on the main wing spar and under the copilot seat is the landing gear motor (a single, split-field, reversible, 28-Vdc motor) that operates the landing gear.

A dynamic braking system and motor limit switches prevent coasting and over travel of the gear during extension/retraction. Limit switches are located forward of the main wing spar and under the pilot seat.

Torque shafts drive the main gear actuators. The duplex-chains drive the nose gear actuator.

Spring-loaded locks secure the main gear in the down position, while the jackscrew in the actuator secures the nose gear in an over center down position.

A jackscrew in each actuator, along with the dynamic brake holds the gear in the up position.

The landing gear system is protected by three (3) circuit breakers. The LANDING GEAR MOTOR CB located on the control pedestal circuit breaker panel, the LDG GR CB located adjacent to the gear handle, and the indicator CB placarded GEAR on the copilot’s subpanel.

Landing Gear Control Handle

The Landing Gear Control Handle located on the copilot left subpanel controls landing gear system operation. The landing gear control handle is a manually actuated wheel shaped switch placarded LDG GEAR CONTROL UP and DOWN.

Gear retraction time is 5 to 7 seconds.

Gear extension time is 4 to 6 seconds.

Landing Gear Indicator Lights

When the landing gear is down, the three green landing gear down indicator lights illuminate. These indicator lights are located on the center subpanel, above the power quadrant.

Landing Gear Warning Lights

Located inside the plastic grip of the landing gear control handle are two red bulbs. If the two red bulbs illuminate, they indicate one of the following:

- Gear is in transit.
- When depressing the HD LT TEST switch
- When the Wheels Warning system is activated

Landing Gear Warning Lights Test Switch

Located on the copilot left subpanel, the landing gear warning lights test switch is placarded HD LT TEST. Press the test switch to test the two bulbs in the landing gear handle and the landing gear warning circuitry.

703. WHEELS UP WARNING SYSTEM

The warning horn, located behind the instrument panel, will sound intermittently, the red WHEELS UP light on each side of the glareshield will flash, and the red lights in the landing gear handle will illuminate when any of the three landing gear struts are not down and locked and either:

- Both power levers retarded below a position which normally corresponds to 79% (+/-2%) N1 rpm position.

- Flaps are extended beyond the approach position.

Landing Gear Warn Horn Silence Button

The WARN HORN SILENCE button is located on the copilot left subpanel and will not function in any flaps are extended.

WARNING

The landing gear warning horn shall NOT be overridden in the traffic pattern or during final segment of an instrument pattern/approach where the intent or potential for landing exists.

NOTE

Cancellation of the wheels warning horn shall be at the direction of the pilot flying.

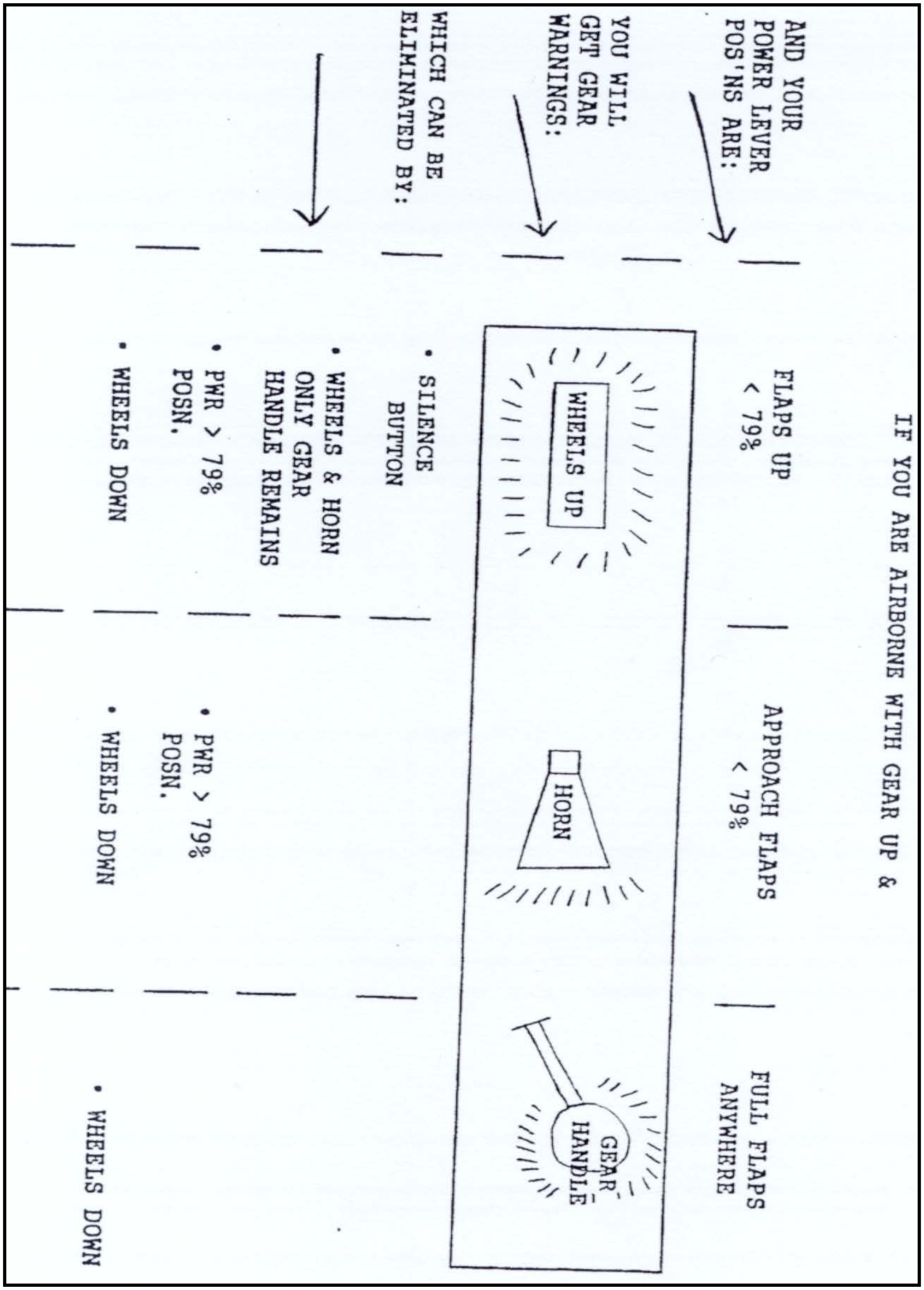


Figure 7-1 Wheels Warnings

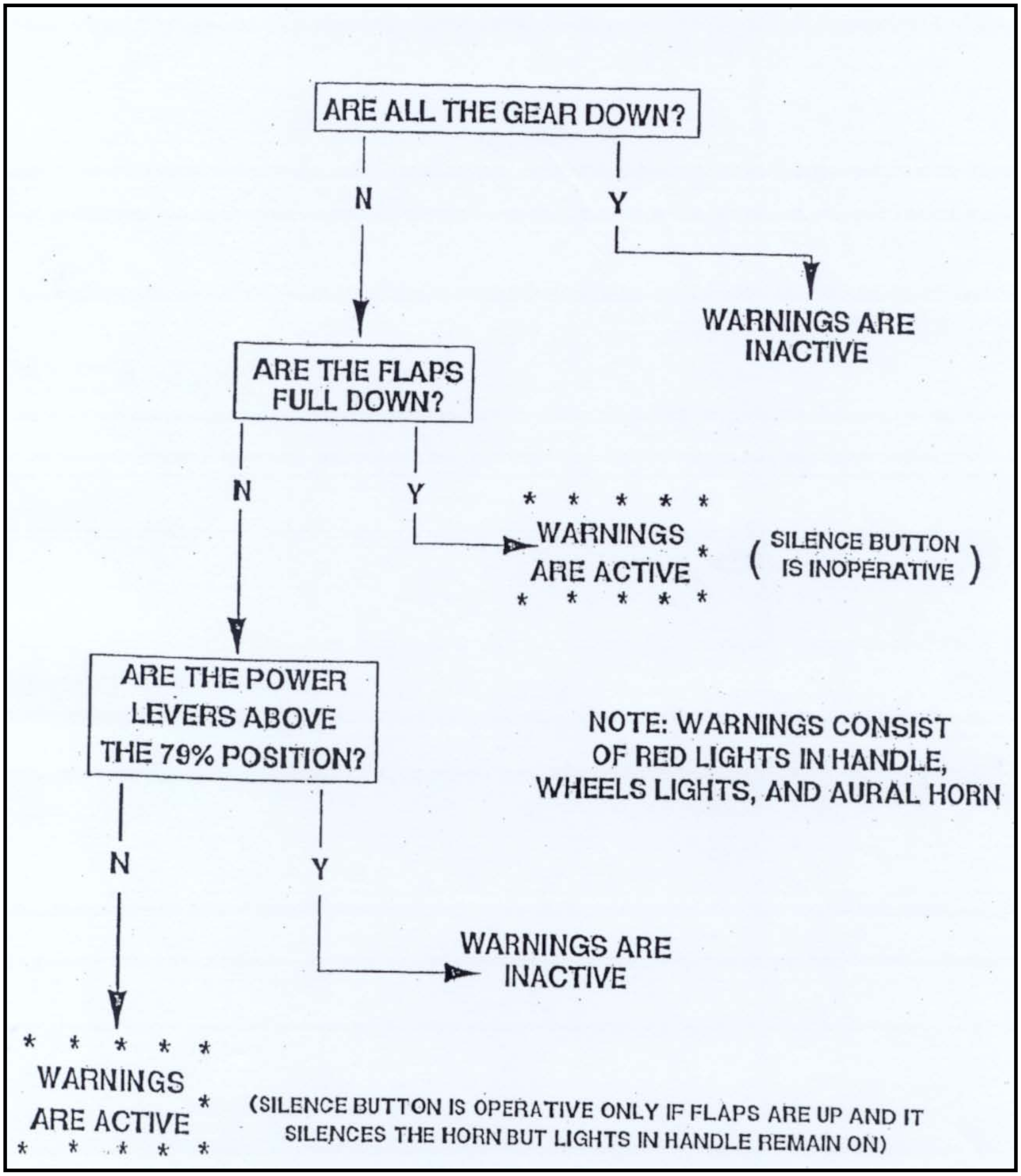


Figure 7-2 Landing Gear Warning System Logic Tree

704. LANDING GEAR SQUAT SWITCHES

A squat switch on each main landing gear shock strut controls the operation of various aircraft systems that function only during flight or only during ground operations.

These switches are mechanically actuated whenever the main landing gear shock struts are extended after takeoff or compressed after landing.

Right Squat Switch (GFISH)

When the right strut is compressed (weight on wheels) the right squat switch:

1. Makes the landing **g**ear circuit inoperative & activates the landing gear downlock hook
2. **F**light Hour meter is INOP
3. Deactivates AOA **i**ndexer lights (pilot and copilot)
4. Deactivates the **s**tall warning
5. Deactivates the right-engine inlet lip **h**eat inoperative

WARNING

During runway operations, the landing gear handle downlock J-hook may NOT prevent you from raising the handle because of insufficient weight on the right main landing gear squat switch.

Right Gear Squat Switch (HHHAP)

When the left strut is compressed (weight on wheels), the left squat switch:

1. Makes the left-engine inlet lip **h**eat inoperative
2. Allows the electric **h**eater switch to remain in the GRD MAX position (8 elements)
3. Reduces AOA **h**eat from 28 VDC to 14 VDC when activated
4. Closes the **a**mbient air solenoid
5. **P**ressurization:

    Closes the preset solenoid

    Opens the dump solenoid

    Closes the cabin door seal solenoid (if installed)

705. LANDING GEAR DOWNLOCK & UPLOCK SWITCHES

Downlock Switches

Each landing gear strut/wheel assembly has a downlock switch that is closed when the strut/wheel assembly reaches its fully extended position.

As each downlock switch is closed, the GEAR DOWN light for the corresponding landing gear illuminates. When all three downlock switches are closed, the wheels up warning system is deactivated.

Uplock Switches

Each landing gear strut has an uplock switch that is closed when each strut is fully retracted.

If one or more of the wheel assemblies does not retract fully, the red light in the gear handle will not extinguish.

The crew may use the uplock to troubleshoot landing gear position.

Check the right gear by checking the PROP SYNC light. If the right uplock is closed (the right gear is fully retracted) the PROP SYNC light will remain extinguished when the prop sync switch is activated.

Check the nose gear by checking the landing lights. If the nose wheel uplock is closed, the landing lights will not illuminate. If the generator load does not increase after turning on the landing/taxi lights they are not illuminated, thus the nose gear must be closed.

Check the left gear by checking the electric heater. Normally, when the left uplock switch closes the electric heater will prevent the use of the 4 additional heater elements. To check the left uplock switch in the air, set the electric heater to NORM and note the generator loading. Then set the heater to GRD MAX while monitoring the generator loading. If the loading only fluctuates slightly or shows no significant difference, the left uplock switch is closed and the left gear is fully retracted. If the generator load increases with the electric heater switch set to GRD MAX the left landing gear assembly is NOT fully retracted.

706. LANDING GEAR MOTOR LIMIT SWITCHES

Two limit switches are located on the landing gear drive train assembly underneath the floor of the cabin and prevent over travel of the gear during extension/retraction.

Up Limit

- Deactivates the motor.
- Activates the g-meter when the gear is retracted.

Down Limit

- Deactivates the motor
- Activates the AOA indexer lights (on the ground the right main squat switch deactivates them)

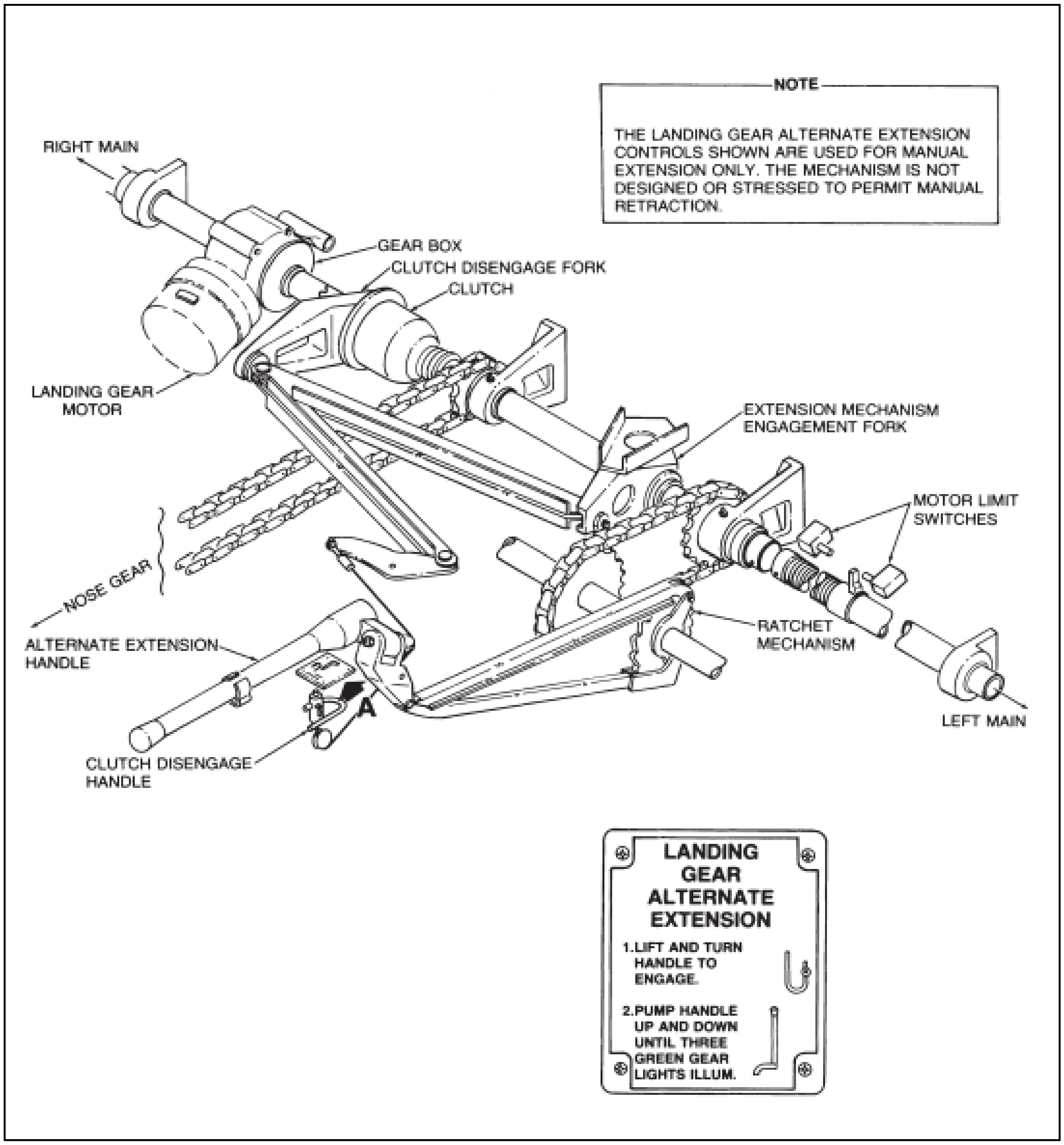


Figure 7-3 Landing Gear Alternate Extension Controls

707. ALTERNATE EXTENSION SYSTEM

The landing gear may be manually extended if the electrical mechanism should fail. However, the gear CANNOT be manually retracted and no provision is made for gear extension with a mechanical linkage failure.

CAUTION

If a mechanical malfunction is known or suspected, do NOT attempt a manual gear extension.

The landing gear alternate extension handle is located on the cockpit floor to the right of the pilot seat. It is used to manually extend the landing gear.

Next to the alternate extension handle is the clutch disengage handle. During manual extension, the landing gear motor must be disengaged from the landing gear drive mechanism. To disengage the motor, you must lift the clutch handle up and turn it clockwise.

To manually extend the landing gear, follow this procedure:

1. Airspeed -- 120 KIAS RECOMMENDED. (155 KIAS Maximum)
2. Autopilot -- AS REQUIRED.
3. Landing gear relay circuit breaker (LDG GEAR) -- PULL.
4. Landing gear handle -- DOWN.
5. Clutch disengage lever -- LIFT AND TURN CLOCKWISE.
6. Manual extension handle -- PUMP until three (3) green indicator lights illuminate. (Approximately **50** strokes are required to fully extend the landing gear.)

CAUTION

For Practice manual extension, reduce handle stroke length when nose gear indicates safe. Do NOT pump handle after all GEAR DOWN position indicator lights (3) are illuminated. Further movement of the handle could damage the drive mechanism, precluding normal retraction.

For Emergency manual extension, continue pumping after 3 green lights, until significant resistance is encountered. Do not stow handle or move any landing gear controls, reset any landing gear controls, switches, or circuit breakers until aircraft is on the ground and the cause of the malfunction has been determined and corrected.

7. Gear position (visual) – Check (Emergency extension only)

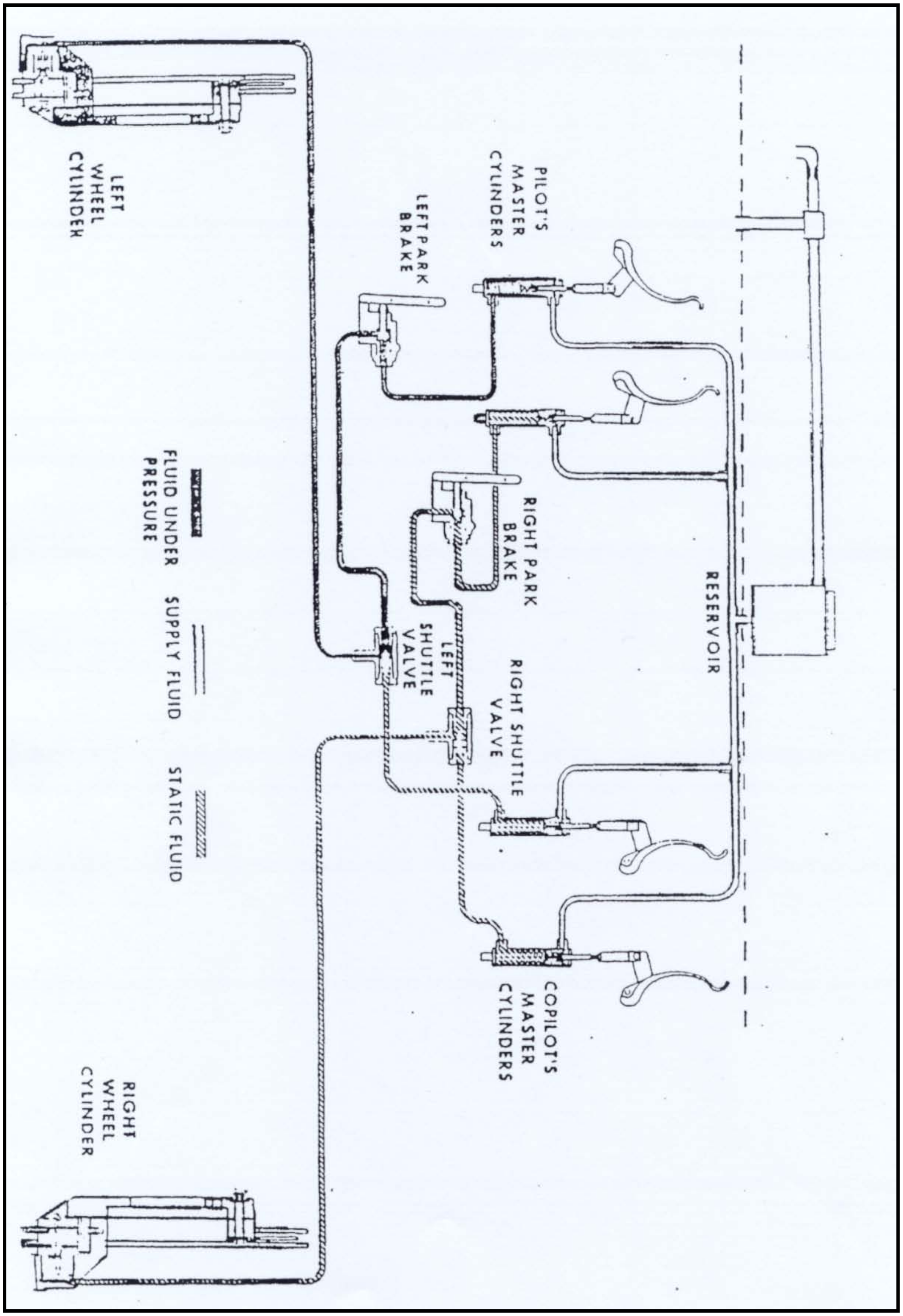


Figure 7-4 Brake System

708. BRAKE SYSTEM

The main landing wheels are equipped with multi-disc hydraulic brakes actuated by master cylinders and attached to the pilot and copilot rudder pedals.

A shuttle valve, adjacent to each set of pedals, permits braking action change over from one set of pedals to the other.

Dual parking brake valves are installed adjacent to the rudder pedals between the master cylinders of the pilot rudder pedals and the wheel brakes.

Brake fluid is supplied to the system from the hydraulic brake system reservoir in the nose compartment.

The toe brake sections of the rudder pedals are connected to the master cylinders which actuate the system for the corresponding wheels.

NO emergency brakes are provided.

Parking Brake Handle

The Parking Brake Handle is located on the pilot right subpanel. It is placarded PARKING BRAKE.

Pulling the handle full OUT sets the check valves in the system and any pressure subsequently applied by the toe brakes is maintained.

Pushing the handle IN releases the parking brakes.

The parking brakes CANNOT be set using the copilot brake pedals.

CAUTION

The parking brake shall NOT be set during flight.

Wheel Brake Failure

In the event of a wheel brake failure:

- Maintain directional control with rudder, nosewheel steering or differential power.
- Use propeller reverse or beta to assist in deceleration.
- If possible, maneuver into an open area and allow the aircraft to stop. Do NOT attempt to taxi.

A brake shuttle valve occasionally sticks which results in loss of brakes. After the aircraft has stopped, attempt to reset the shuttle valve by pulling aft on the top of the brake pedals.

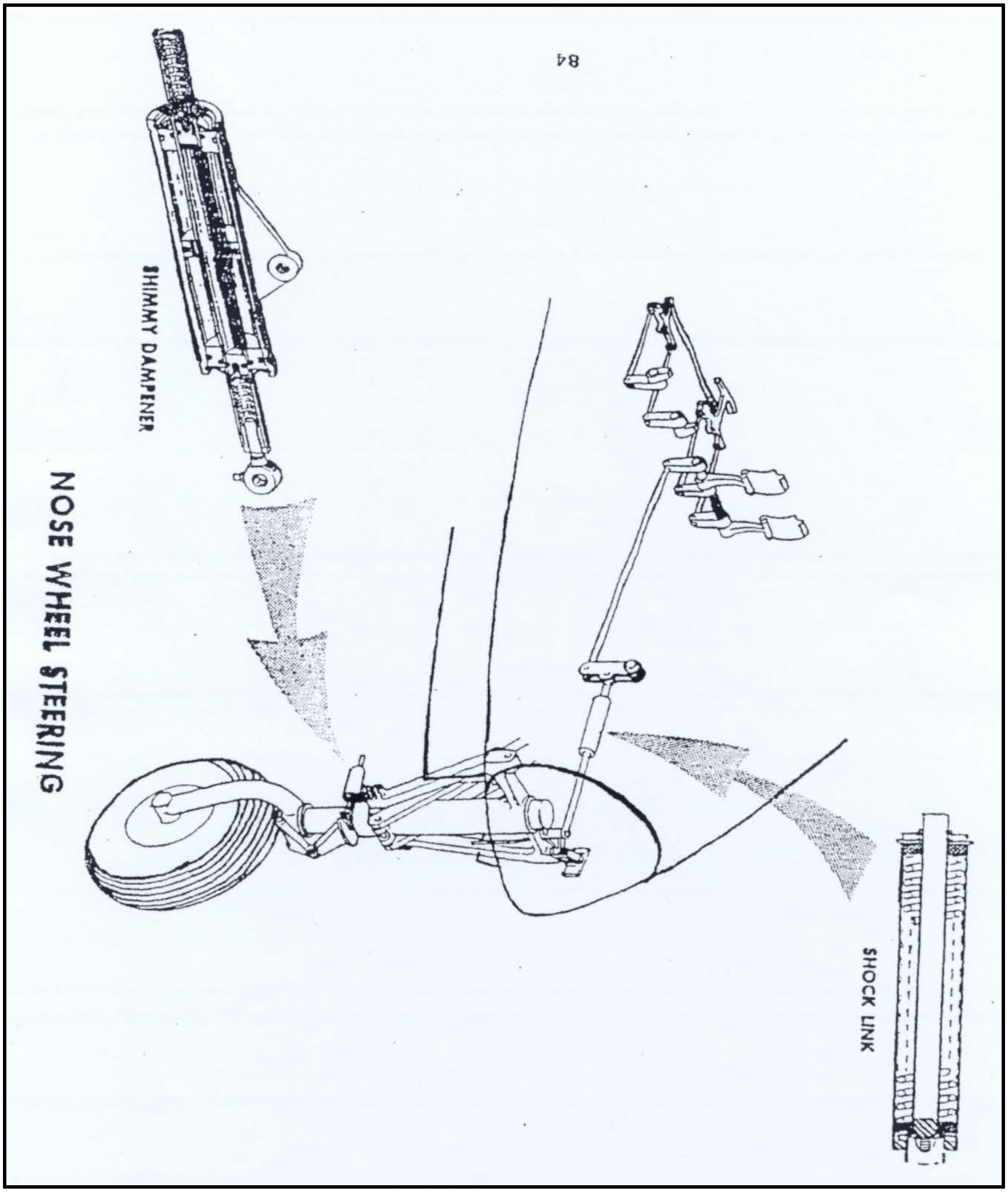


Figure 7-5 Nose Wheels Steering

709. NOSE WHEEL STEERING

The aircraft can be maneuvered on the ground by the steerable nose wheel system. Direct linkage from the rudder pedals to the nose wheel steering linkage allows the nose wheel to be turned 12 degrees left of center and 14 degrees right.

When rudder pedal action is augmented by main wheel braking action, the nose wheel can be deflected up to 48 degrees either side of center.

Retraction of the landing gear automatically centers the nose wheel and disengages the steering linkage.

LANDING GEAR QUIZ

1. The recommended airspeed for manually extending the landing gear is________ KIAS.

2. The landing gear system is retractable, tricycle type and __________ operated.

HYDRAULICALLY ELECTRICALLY

3. To prevent coasting and over travel of the landing gear, the T-44A uses which of the following?

a. Mechanical braking
b. Dynamic braking
c. Limit switches
d. Both b and c
e. All of the above

4. Which of the following situations will NOT illuminate the two red bulbs in the landing gear control handle?

a. Landing gear is in transit
b. Power levers above the 79% switches, gear up, and approach flaps
c. HD LT TEST switch depressed
d. Activation of the landing gear warning system
e. Power levers above the 79% switches, gear up, and full flaps

5. Normal landing gear extension time is_______ to _______ seconds?

6. Under which of the following conditions will the red WHEELS UP light and the light in the gear handle illuminate simultaneously?

a. Both power levers below the 79% N1 switch with the gear up
b. Flaps extended beyond the approach position with the gear up
c. HD LT TEST button is depressed
d. Both a and b
e. All of the above

7. Which of the following switches prevents the landing gear from being retracted on the ground?

a. Left squat switch
b. Right squat switch
c. Landing gear downlock switches
d. Landing gear uplock switches
e. Landing gear motor limit switches

8. Which of the following switches open the ambient air solenoids in flight and allow the cabin to pressurize?

a. Left squat switch
b. Right squat switch
c. Landing gear downlock switches
d. Landing gear uplock switches
e. Landing gear motor limit switches

9. If the PROP SYNC annunciator light illuminates when the propeller sync switch is placed to the ON position, which landing gear switch is OPEN?

a. Right main uplock switch
b. Right main downlock switch
c. Left main uplock switch
d. Left main downlock switch
e. Nose gear uplock switch

10. While holding the electric heater switch in the GRD MAX position, the generator load remains the same as the generator load with the switch in the NORM position. This is an indication of the left main gear in the up position.

TRUE FALSE

11. The landing gear up limit switch does which of the following functions?

a. Illuminates the PROP SYNC annunciator light
b. Disables the GRD MAX position of the electric heater switch
c. Deactivates the g-meter when the landing gear is extended
d. Deactivates the landing gear motor and prevents over travel during extension

12. The landing gear down limit switch does which of the following functions?

a. Illuminates the PROP SYNC annunciator light
b. Disables the GRD MAX position of the electric heater switch
c Deactivates the landing gear motor and prevents over travel during extension
d. Deactivates the g-meter when the landing gear is extended

13. With a loss of brakes while attempting to taxi the pilot should activate the emergency air brake system to bring the aircraft to a stop.

TRUE FALSE

14. The amount of nose wheel steering available by using the rudder pedals only (no brakes) is _______ degrees left and ______ degrees right.

15. Which of the following steps is NOT a proper procedure to be performed in the event of a wheel brake failure?

a. Maintain directional control with the rudders
b. Activate the emergency braking system
c. Use propeller reversing or beta as required
d. Do NOT attempt to taxi
e. Pull aft on the top of the rudder pedals after the aircraft has stopped

16. While in flight, pressing the rudder pedals will move the nose wheel slightly within the wheel well.

TRUE FALSE

17. The motor for the T-44A landing gear is _______Vdc.

18. The two circuit breakers required to be in for the operation of the landing gear are

______________________________, ______________________________

19. With the gear up, power below 79% N1, and the flaps in the approach position, what cockpit indications will be seen and heard?

_______________________, ____________________, ________________________

20. How can you silence the landing gear warning horn?

________________________________, ____________________________________

21. When does the red light in the landing gear handle illuminate?

_______________________, ____________________, ________________________

22. List the items on the squat switches.

Right	Left
(G) ________________________	(H) ________________________
(F) ________________________	(H) ________________________
(I) ________________________	(H) ________________________
(S) ________________________	(A) ________________________
(H) ________________________	(P) ________________________

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LESSON EIGHT
FLIGHT INSTRUMENTS

800. OBJECTIVES:

At the end of this lesson, you should be able to...

1. Label and describe the operation of the components of the angle of attack system.

2. Label and describe the operation of the pitot-static system.

3. Label and describe the operation of the airspeed indicator.

4. Label and describe the operation of the pilot’s encoding altimeter.

5. Label and describe the operation of the copilot’s barometric altimeter.

6. Label and describe the operation of the vertical airspeed indicator.

7. Label and describe the operation of the turn and slip indicator.

8. Label and describe the operations of the components of the vertical gyro system.

9. Label and describe the operations of the components of the horizontal situation system

10. Recognize the indications and potential results of a loss of power to the RMI.

11. Label and describe the operation of the stand-by magnetic compass.

12. Label and describe the operation of the radio altimeter system.

13. State three (3) causes of a red flag in the radio altimeter.

14. Recognize the indications and potential result of a loss of AC power to the flight instruments.

15. Recognize the indications and potential result of a loss of DC power to the flight instruments.

NOTES

801. ANGLE OF ATTACK SYSTEMS

At the end of this topic, you should be able to label and describe the operation of the components of the angle of attack system.

Angle of Attack System

The angle of attack (AOA) system provides the pilot with accurate angle of attack information.

The AOA system consists of:

- Heated Transmitter Vane (on the left wing)
- AOA Indicator
- AOA Test Switch
- Indexer Units
- Stall Warning Horn
- Stall Warning Light

The heated transmitter vane measures the airflow angle in front of the wing. This measurement is electrically transmitted to an electronic control unit.

The control unit changes the measurement to a normalized display on the AOA Indicator. The system adjusts the display for inherent stall angle differences resulting from two basic flap positions, UP and FULL.

AOA Test Switch

The AOA test switch checks the stall warning system. It has three positions:

OFF (center position).

APPROACH (spring loaded, lower position). The AOA indicator pointer moves to 17 units AOA, and the YELLOW indexer donut illuminates.

STALL (spring loaded, upper position). The AOA indicator points between 29 to 31 units AOA, the GREEN chevron on the indexer illuminates, the stall warning horn sounds, and the STALL WARNING light flashes.

802. FLIGHT INSTRUMENTS

At the end of this topic, you should be able to label and describe the operation of the pitot-static system, airspeed indicators, pilot encoding altimeter, copilot barometric altimeter, vertical speed indicator, turn and slip indicator, radio altimeter, and vertical gyro system.

Pitot-Static System

The Pitot and Static Air System provides two (2) separate sources of static and ram air to operate pilot and copilot flight instruments (airspeed, altimeter, and vertical speed indicators).

The Pitot-Static System includes:

Two internally heated pitot masts mounted on either side of the nose.

Four static air pressure ports, two on the aircraft exterior skin on each side of the aft fuselage. Associated plumbing.

The port pitot tube provides a reference for the pilot airspeed indicator.

The starboard pitot tube provides a reference for the copilot airspeed indicator.

Alternate Static Air Source

An alternate static air source terminates aft of the rear pressure bulkhead. It provides static air to the pilot instruments if the normal source of static air should fail.

A control valve on the right side panel is placarded PILOTS EMERGENCY STATIC AIR SOURCE NORMAL ALTERNATE.

When the normal source of static air becomes blocked, an alternate static air source is required. Static air may be obtained from the alternate source by turning the control valve to ALTERNATE.

WARNING

Instrument error may be significant with emergency static air selected. Refer to the altimeter charts in NATOPS Chapter 25.

Airspeed Indicators

Airspeed indicators are conventional indicators with the addition of an aneroid operated maximum allowable airspeed pointer (striped Vne needle). The Vne needle indicates maximum allowable airspeed at any particular altitude.

Allowable airspeeds are

- 88-227 KIAS is normal operating range (green arc).
- 86 KIAS is minimum single engine control speed (red line).
- 110 KIAS is one engine inoperative best rate of climb (blue line).
- 78-140 KIAS is full flap operating range (white arc).

- 174 KIAS maximum flaps to/at approach speed (white triangle).

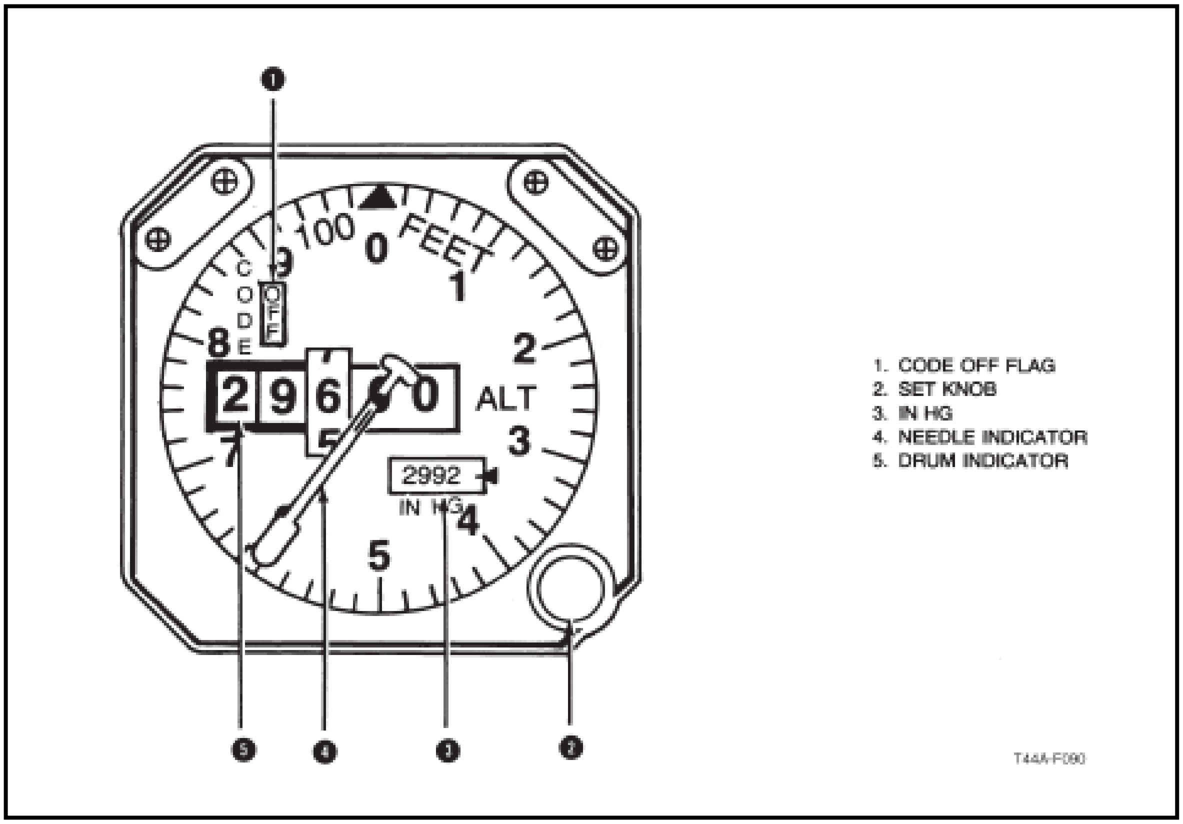


Figure 8-1 Encoding Altimeter

Pilot Encoding Altimeter

The pilot encoding altimeter is located on the upper left side of the instrument panel.

The pilot encoding altimeter is a self-contained unit that consists of a precision barometric altimeter combined with an altitude encoder. The display indicates the altitude above sea level. Simultaneously, the encoder sends pressure altitude reporting signals to the transponder, RNAV computer and to the AUTOPILOT.

A barometric pressure setting knob allows you to insert the desired barometric pressure in inches of mercury (Hg).

Pilot Encoding Altimeter

The altimeter is equipped with a DC vibrator to overcome friction and ensure accuracy. If DC power is lost, a warning flag, placarded CODE OFF, appears in the upper left portion on the instrument face. This flag indicates that the altitude encoding function of the altimeter is inoperative.

The altimeter portion of the pilot encoding altimeter requires NO electrical power to operate.

Copilot Barometric Altimeter

The copilot barometric altimeter is located on the upper right side of the instrument panel. A knob allows you to reset local barometric pressure shown in inches of mercury (Hg).

The copilot barometric altimeter requires NO electrical power to operate.

Vertical Speed Indicators

A vertical speed indicator (VSI) is mounted on both the pilot and copilot side of the instrument panel. The VSI's require NO electrical power to operate.

Copilot Vertical Speed Indicator

The copilot vertical speed indicator (VSI) is a standard static air pressure instrument. It is placarded VERTICAL SPEED, UP and DOWN. The range of the instrument is from 0 to 4000 feet per minute (fpm), up or down. The indicator is graduated in 100 fpm increments between 0 and 2000 fpm. Then it is graduated in 250 fpm increments from 2000 to 4000 fpm.

Pilot Vertical Speed Indicator

The pilot side has an instantaneous vertical speed indicator (IVSI).

IVSI instantly indicates changes in altitude. It incorporates an accelerometer device to reduce the lag, which is present in a standard vertical speed indicator. Because of this accelerometer, a slight nose up indication is given when entering a level turn and a slight nose down indication is given when rolling out.

The range of the IVSI is from 0 to 4000 feet per minute (fpm), up or down. The indicator is graduated in 100 fpm increments between 0 and 1000 fpm. Then it is graduated in 500 fpm increments from 1000 to 4000 fpm.

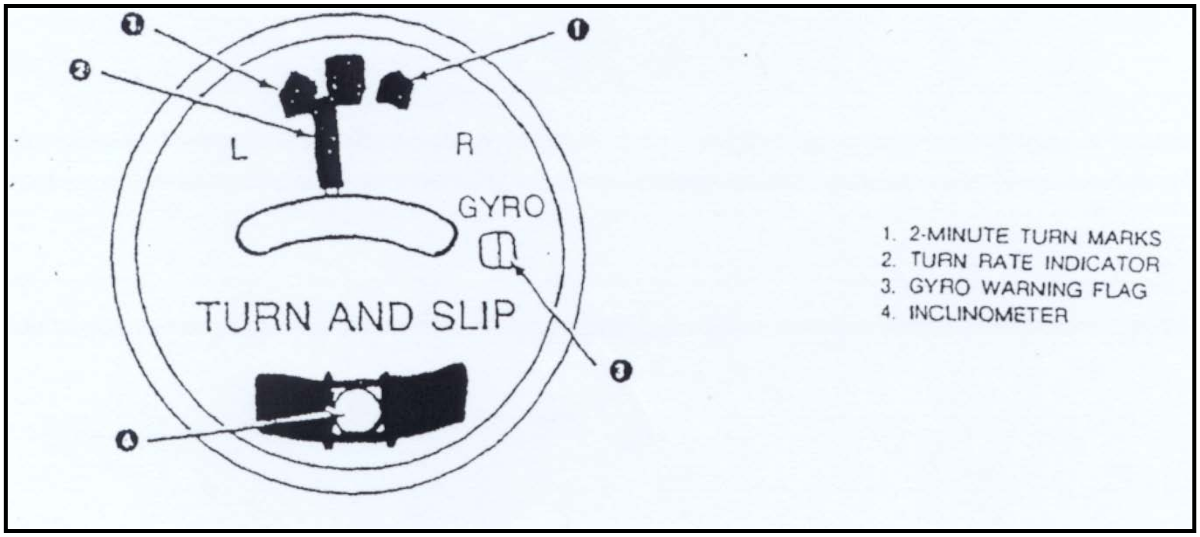


Figure 8-2 Turn and Slip Indicator

Turn and Slip Indicator

Two (2) turn and slip indicators are installed separately on the pilot and copilot sides of the instrument panel. The turn and slip indicators are gyroscopically operated.

Two needle widths on the pilot turn and slip indicator indicates a standard rate turn.

One needle width on the copilot turn and slip indicator indicates a standard rate turn.

The pilot indicator is DC operated from the No. 1 Subpanel Bus.

The copilot indicator is vacuum operated using engine bleed air pressure (pneumatic air).

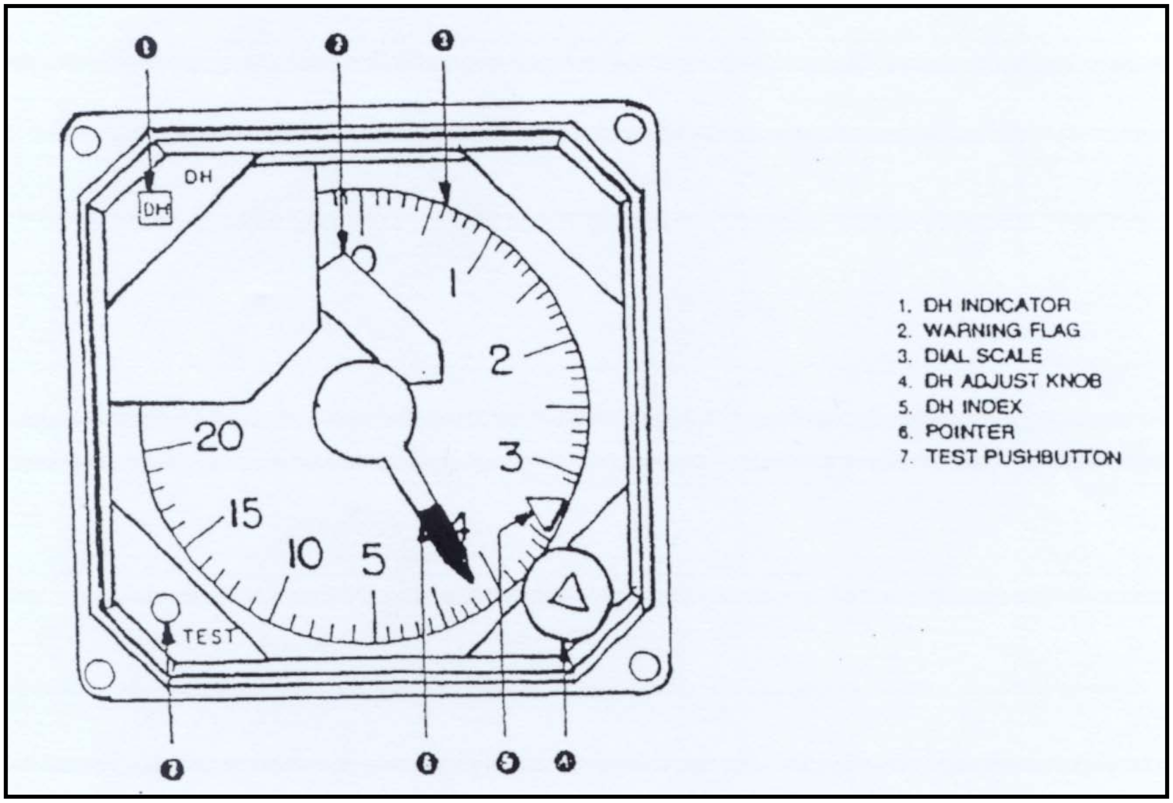


Figure 8-3 Radio Altimeter

Radio Altimeter

The radio altimeter is located on the copilot instrument panel. The radio altimeter system is designed to indicate the aircraft height above the terrain during the critical approach phase of the flight.

The radio altimeter **dial scale** displays altitudes above terrain between **-20** and **+2000** feet. A **pointer** indicates the current aircraft altitude on the scale.

To set the radio altimeter to a specific altitude, adjust the **DH (decision height) index** to the desired altitude with the **DH adjustment knob**. An external **DH indicator** illuminates when the aircraft has descended to the preset altitude.

The radio altimeter also has a **warning flag**, which indicates a loss of power.

The T44-A has three (3) DH indicators, one on the pilots side and 2 on the copilots.

Radio Altimeter Test

To test the system, press the TEST push-button.

When the test push-button is pressed with ~ 100 feet set

- The pointer will indicate an altitude of 50 (+/-5) feet.
- The warning flag will appear.
- The glideslope bug should indicate on the right side of both attitude gyros.
- The DH indicator will illuminate.

Select < 50 feet

- Lights should go out
- The glideslope bug should still indicate

Release the test button

- Both lights should come back on
- The glideslope bug should disappear.

803. VERTICAL GYRO SYSTEM

The vertical gyro system provides the pilot with visual indications of aircraft pitch and roll attitudes on the Flight Director Indicators. Two (2) independent vertical gyro systems are located in the nose avionics compartment. The AC power bus powers them.

Through synchros, the gyroscopes develop pitch and roll signals that represent the aircraft attitude. Two gravity-sensitive switches establish vertical reference. These switches control a torque motor for each gyro axis.

Attitude Gyro Fast Erect Switch

The FAST ERECT switch is on the left side of the pilot instrument panel. The FAST ERECT switch will erect the gyro to within 1.0 degree of pitch and roll within 60 seconds of power application. It will erect the gyro to within 0.5 degrees within 2 minutes of power application.

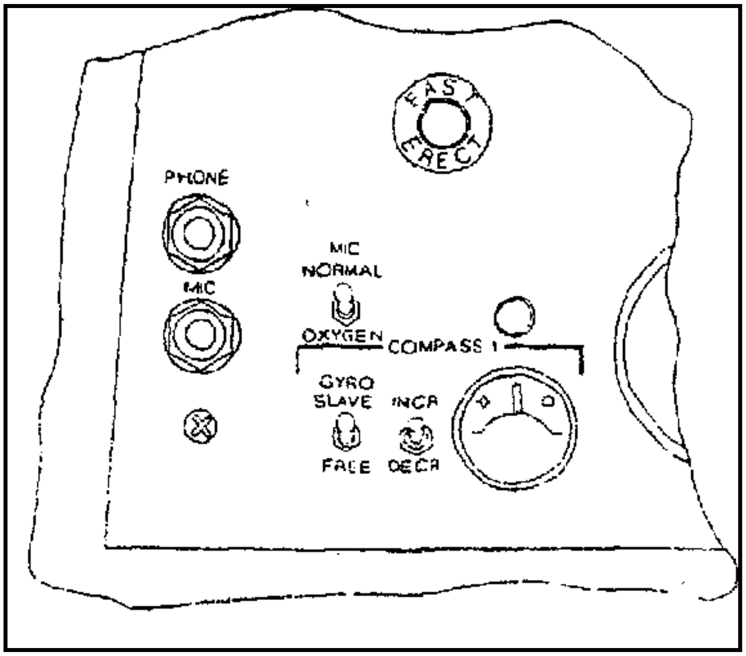


Figure 8-4 Gyro Slave Switches

Gyro Slave Switches

On the lower corners of the instrument panel are the gyro slave switch, INCR/DECR switch, and compass slave annunciator.

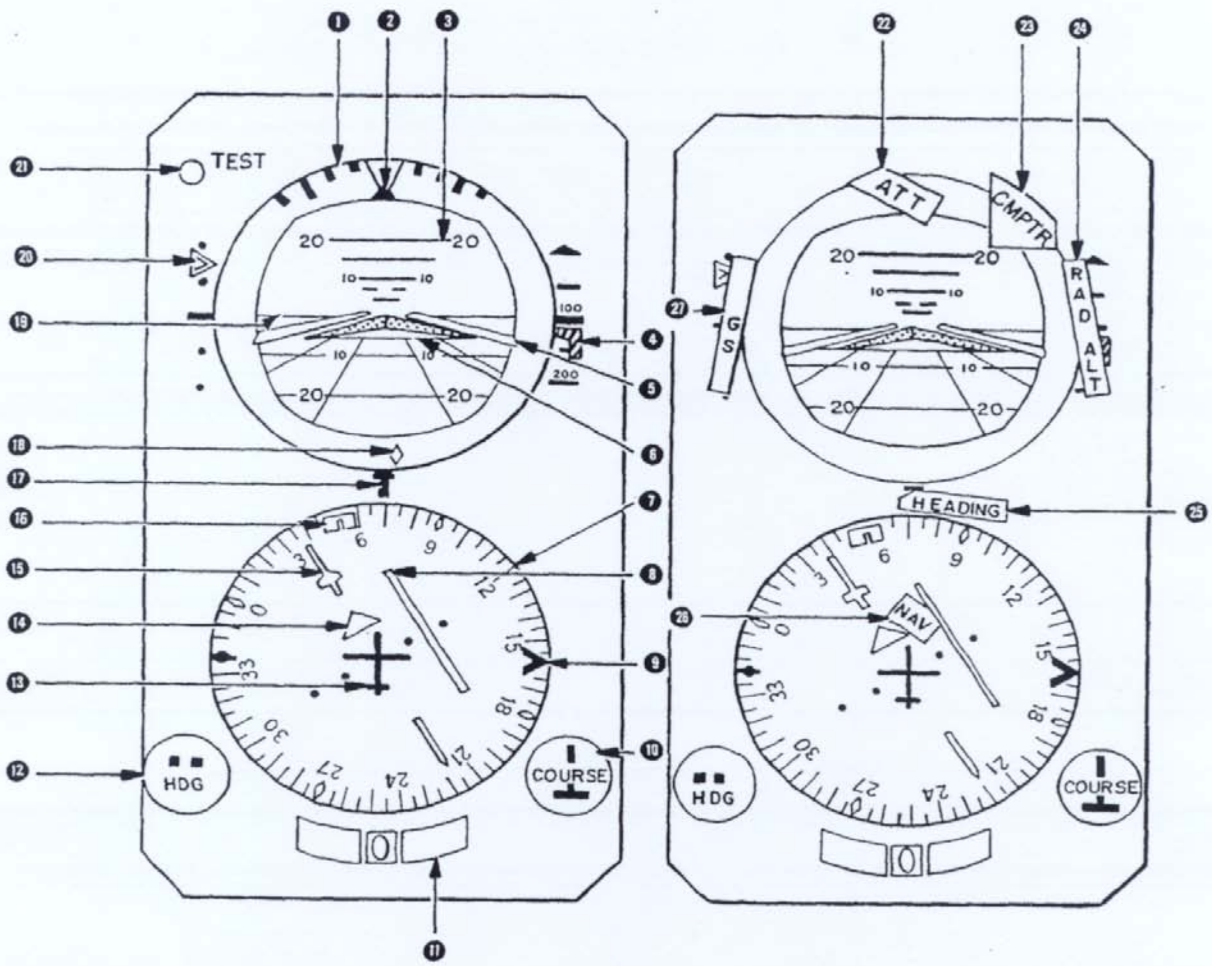
The gyro slave switch controls the two (2) operation modes of the RMI:

- FREE (Directional Gyro). A free gyro mode is used in regions of large magnetic disturbances. The pilot provides heading input through use of the gyro synchronization (INCR/DECR) switch.

- SLAVE. The slaved mode is the normal mode of operation for the RMI. The flux valves provide heading input to the RMI.

The INCR/DECR switch provides manual fast synchronization for the system.

The **Compass Slave Annunciator** presents a visual indication of system synchronization operation.



1. ROLL INDEXES
2. BANK INDICATOR TOP
3. ATTITUDE TAPE
4. RADIO ALTITUDE POINTER AND SCALE
5. COMMAND BARS
6. AIRCRAFT REFERENCE SYMBOL
7. AZIMUTH CARD
8. LATERAL DEVIATION BAR
9. TACAN BEARING POINTER
10. COURSE SELECT KNOB
11. SLIP INDICATOR
12. HDG SELECT KNOB
13. AIRCRAFT SYMBOL
14. TO-FROM POINTER
15. COURSE ARROW
16. HEADING MARKER
17. LUBBER LINE
18. BANK INDICATOR BOTTOM
19. HORIZON REFERENCE LINE
20. GLIDESLOPE POINTER AND SCALE
21. TEST PUSHBUTTON
22. ATT FLAG
23. CMPTR FLAG
24. RAD ALT FLAG
25. HEADING FLAG
26. NAV FLAG
27. GS FLAG

Figure 8-5 Flight Director Indicator

804. COMPASS SYSTEM

NOTE

Pay particular attention to indications and potential results of loss of power to the RMI.

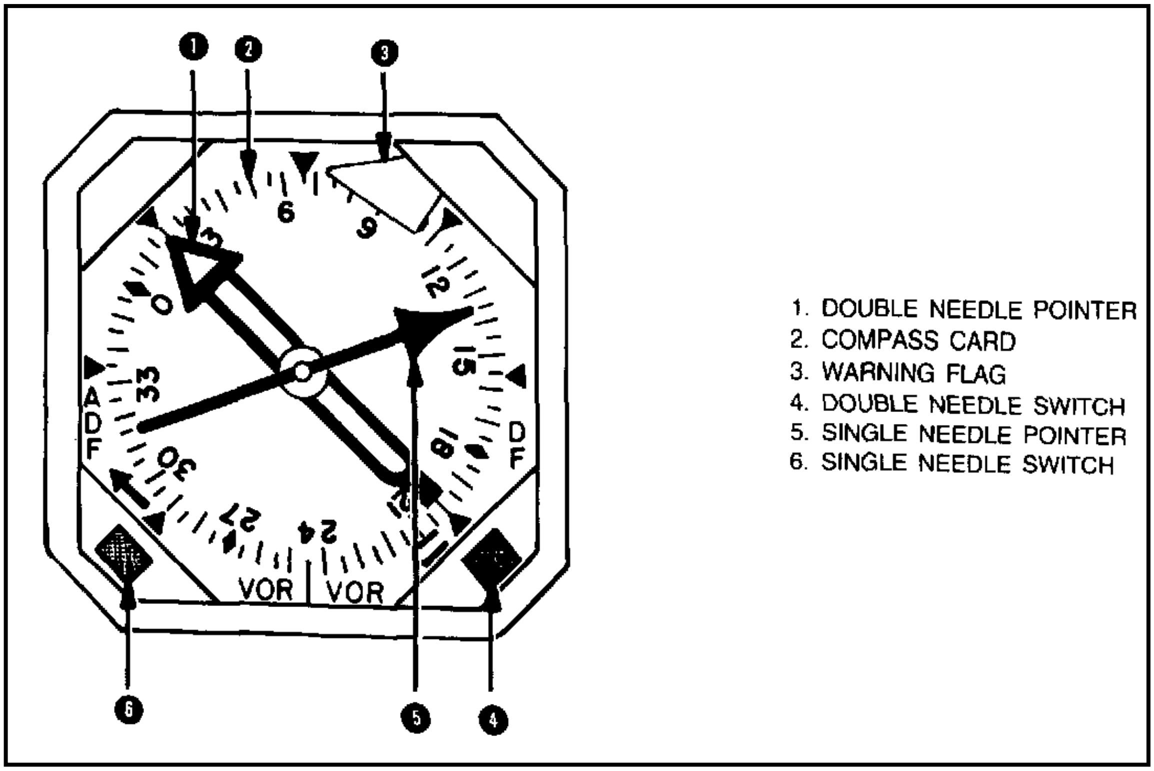


Figure 8-6 Radio Magnetic Indicator

Radio Magnetic Indicator

Both the pilot and the copilot have a radio magnetic indicator (RMI). The RMI displays:

- Aircraft magnetic heading
- Automatic direction finder (ADF) bearing
- VOR1 & VOR2 bearing
- UHF bearing to the station

The compass card indicates the aircraft heading. A magnetic heading index at the top of the rotating azimuth indicates the magnetic heading of the aircraft as sensed by the flux valve located at each wingtip. The flux valve is a saturable metal core reactor, which senses direction of the Earth’s magnetic field.

The pilot RMI compass card is driven by the No. 2 gyro compass system; the copilot compass card is driven by the No. 1 gyro compass system.

The **double needle pointer** indicates a specific bearing as set by the **double needle switch.** The needle switch sets which signal is to be displayed. The switch has two (2) positions:

- In the **DF** position, the switch selects UHF-DF bearing information.
- In the **VOR** position, the switch selects VOR No. 2 bearing information.

The **single needle pointer** indicates a specific bearing as set by the **single needle switch**. The needle switch sets which signal to be displayed. The switch has two (2) positions:

- In the **ADF** position, the switch selects LF-ADF bearing information.
- In the **VOR** position, the switch selects VOR No. 1 bearing information.

The presence of the **warning flag** indicates the loss of the heading signal and the bearing information is unreliable.

Horizontal Situation Indicator

Both the pilot and the copilot have a horizontal situation indicator (HSI) as part of the flight director indicators on the instrument panel. The HSI provides heading and navigation information.

The rotating azimuth card displays heading information from a gyro-stabilized magnetic compass. The magnetic compass heading of the aircraft is read on the card beneath the lubber line.

The lateral deviation bar represents the centerline of the selected VOR, TACAN, RNAV or localizer course. The fixed aircraft symbol represents the position of the aircraft with respect to the selected course.

The aircraft is considered on course when the lateral deviation bar is lined up with the course arrow. The course arrow is set to a specific bearing by rotating the COURSE select knob.

The TACAN bearing pointer indicates the relative bearing of the TACAN transmitter from the aircraft heading.

The slip indicator monitors aircraft slip or skid. It is used as an aid to coordinate turns.

The heading marker rotates with the azimuth card. The marker represents the selected heading. In heading mode, the flight control system flies to and maintains this heading. The heading marker is set to a specific heading by rotating the HDG select knob.

The to-from pointers indicate the direction to or from the VOR, TACAN, or RNAV station. The top pointer disappears and the bottom pointer appears upon station or waypoint passage. The pointers are NOT visible when the receiver is tuned to a localizer frequency.

The HEADING and NAV flags indicate loss of or an unreliable signal at the indicator.

The pilot's HSI compass Card is driven by the number 1 compass system (CMP-1) and the copilot's HSI Compass Card is driven by the number 2 compass system (CMP-2).

Standby Magnetic Compass

The standby magnetic compass is located on top of the windshield divider. The standby magnetic compass can be used in the event of compass failure or for instrument cross check.

It will not yield accurate information in a turn because of the inherent lead and lag factor all magnetic compasses possess. Because of the lead lag factor during turns through North, the actual magnetic heading will lead the current heading displayed on the compass. The opposite will occur on turns through South.

In order to get an accurate reading, you must turn off:

Windshield heat, windshield wipers, vent blower, cabin temp mode, and electric heat.

805. ABNORMAL CONDITIONS

Loss of AC Power

If you lose AC power, you will lose the following flight instruments:

- RMI
- HSI
- Vertical Gyro

Loss of AC Power

At this point you will be flying partial panel, using turn needle and ball to maintain level flight. You can use your magnetic compass to determine your heading.

Loss of DC Power

If you lose DC power, you will lose the following flight instruments:

- AOA System
- Encoder Portion of the Pilot Altimeter
- Pilot Turn and Slip Indicator

- Radio Altimeter
- RMI
- HSI
- Vertical Gyro

Loss of DC Power

At this point, in IMC, the copilot will have to be flying partial panel. The copilot's turn needle and ball will be used to maintain level flight and the magnetic compass to determine your heading.

FLIGHT INSTRUMENTS QUIZ

1. The pilot instantaneous vertical speed indicator incorporates an accelerometer that requires DC power to operate.

TRUE FALSE

2. While rolling into a level turn to the left, what sort of indication would you expect to see on the pilot instantaneous vertical speed indicator?

a. Slight nose up indication
b. Slight nose down indication
c. Large nose up indication
d. Large nose down indication
e. No movement in the IVSI will occur

3. The AOA indicator works anytime DC power is on line.

TRUE FALSE

4. The stall warning works anytime DC power is on line.

TRUE FALSE

5. The AOA indexer works only when airborne with the gear down.

TRUE FALSE

6. The pitot tube on the left side of the aircraft provides an input to which of the following instruments?

a. Pilot's airspeed indicator
b. Copilot's airspeed indicator
c. Pilot's vertical speed indicator
d. A and B only
e. All of the above

7. When the ALTERNATE position is selected on the pilot's emergency static air selector, the aircraft will be flying lower and slower than indicated on the pilot's instruments.

TRUE FALSE

8. The static instruments are the:

____

____

9. Pitot and static pressure is used by the ________________ & __________________.

10. The IVSI is made instantaneous by a/an ______________which is/are powered by gravity.

11. The pilot's altimeter incorporates a DC vibrator but is still a safe altimeter with a total DC power failure.

TRUE FALSE

12. It will take 4 minutes to complete a 360 degree turn while holding one needle width on the pilot turn and slip indicator.

TRUE FALSE

13. The pilot's turn needle is ______ powered and the co-pilot's turn needle is __________ powered.

14. Which of the following is required for the copilot turn and slip needle to function properly?

a. DC power
b. 114 VAC power
c. 26 VAC power
d. Pitot static air
e. Engine bleed air pressure

15. The white arc on the airspeed indicator begins at_______ kts and ends at ________ kts. The arc represents the full flap operating range.

16. The red line on the airspeed indicator, indicates which of the following airspeeds?

a. 78 knots
b. 86 knots
c. 110 knots
d. 174 knots
e. 227 knots

17. The CODE OFF flag in the upper left portion of the pilot encoding altimeter indicates which of the following conditions?

a. The DC vibrator is inoperative
b. The altimeter encoder is inoperative
c. The altimeter is inoperative
d. A and B only
e. All of the above

18. The pilot encoding altimeter will be unusable when the CODE OFF flag is displayed in the upper left portion.

TRUE FALSE

19. Which of the following power sources is required for the copilot barometric altimeter to function properly?

a. 28 VDC
b. 26 VAC
c. 114 VAC
d. 28 VAC
e. No power required.

20. The fight director radar altimeter indicators work from __________feet to touchdown.

21. The RADALT is _________ powered and the indicator range altitude range is from ______feet to ___________ feet.

22. Which of the following statements is NOT true about the radio altimeter?

a. When the indicated altitude is below the preset altitude marker a DH light will illuminate
b. Radio altimeter indications below 200 feet will be displayed on the flight director
c. A TEST button, when depressed, will cause the indicator to display 50 feet and illuminate the DH light
d. The Scale of the radio altimeter is from -20 to +2000 feet
e. All of the statements are correct

23. Which of the following axis does the vertical gyro system display to the pilot on the flight director?

a. Pitch
b. Roll
c. Yaw
d. A & B only
e. All of the above

24. The FAST ERECT switch will erect the gyro to within 1.0 degree of pitch and roll within______ seconds of power application and .5 degrees within _____ minutes.

25. Which of the following is NOT displayed on the radio magnetic indicators?

a. Aircraft magnetic heading
b. VHF omnidirectional range bearing
c. TACAN bearing
d. Low frequency Bearing (LFADF)
e. UHF (UHFADF) bearings

26. The flux detectors sense the direction of the Earth' magnetic field and are located in the aircraft's____________________.

27. If the azimuth card fails on the horizontal situation indicator the____________ flag will be displayed.

28. Which navigation radio displays bearing information on the horizontal situation indicator?

a. LOC
b. VOR
c. TACAN
d. Automatic direction finder (ADF)
e. UHF

29. The number 1 compass system (CMP-1) drives which compass cards?

a. Pilot's HSI and RMI
b. Pilot's HSI and copilot's HSI
c. Pilot's HSI and copilot's RMI
d. Pilot's RMI and copilot's HSI

30. The standby magnetic compass will NOT yield accurate readings while the aircraft is in a turn.

TRUE FALSE

31. During turns through North the actual magnetic heading will _______ the current heading displayed on the standby magnetic compass.

LEAD LAG

32. Which of the following flight instruments would NOT be inoperative with a loss of AC power?

a. Radio Magnetic Indicator
b. Horizontal Situation Indicator
c. Vertical Gyro
d. Radio Altimeter
e. None of the above

33. After a total loss of AC power the only heading source would be the standby magnetic compass.

TRUE FALSE

34. Which of the following flight instruments would be operative with a total loss of DC power?

a. Radio altimeter
b. Horizontal situation indicator
c. AOA system
d. Copilot turn and slip indicator
e. Radio magnetic indicator

35. With a total loss of DC power, only the pitot static flight instruments, standby compass and copilot's turn needle will be operative.

TRUE FALSE

36. The equipment requiring AC power is

G ______________________
C ______________________
A ______________________
N ______________________
T ______________________

CHAPTER NINE
ENVIRONMENTAL SYSTEM

900. OBJECTIVES

At the end of this lesson, you should be able to...

1. Label the components of the environmental system.

2. Label and describe the operations of controls that affect cabin temperature.

3. List three (3) items which, when turned on, turn on the electric heater lockout system.

4. Label and describe the operation of the flow control unit.

5. Label and describe the operation of the controls which affect cabin pressure.

6. Label and describe the operation of the anti-icing and de-icing system and its components.

7. Label and describe the operation of the oxygen system and its components.

8. List five (5) items that, when in use, cause the wet compass to be erratic.

NOTES

901. PRESSURIZATION CONTROL SYSTEM

The pressurization control system of the T-44A aircraft is strictly to allow high altitude flying without use of an oxygen mask.

Components

The components, which affect cabin pressure, are:

- Cabin Pressure Controller
- Dual Cabin Altimeter
- Cabin Rate of Climb Indicator
- Outflow Valve
- Safety Valve
- Flow Control Unit

Cabin Pressure Controller

The cabin pressure controller is located on the center console, and pneumatically controls the outflow of air from the cabin.

The cabin pressure control switch is a three-position toggle switch:

In the DUMP position, opens safety valve completely to relieve all pressure differential.

In the TEST position, the safety valve closes giving control of the outflow valve to the controller.

The PRESS position is the normal position for this switch. When the LH squat switch is up (airborne, not activated) and the pressure control switch is set to PRESS, power is removed from a NORMALLY OPEN (N.O.) preset solenoid and a NORMALLY CLOSED (N.C.) safety (dump) solenoid. This action allows the cabin to begin pressurizing at the rate selected on the controller via vacuum forces through the preset solenoid.

The controller has two knobs, a rate knob and an altitude knob.

The rate knob allows you to control cabin rate of climb from 50 fpm to 2,000 fpm.

The altitude knob allows you to select the desired cabin pressure altitude from 1,000 feet below sea level to 10,000 feet mean sea level (msl).

The dual cabin altimeter is located on the center instrument subpanel.

The long (big) needle indicates actual cabin altitude and the short (small) needle indicates pressure differential.

Cabin Rate of Climb Indicator

Next to the dual cabin altimeter is the **cabin** rate of climb indicator. The cabin rate of climb indicator displays actual cabin rate of climb or descent from 0 to 6,000 fpm.

Altitude Warning Annunciator Light

A pressure sensor switch is mounted on the forward pressure bulkhead. When that switch senses that the cabin altitude is at 9,500 to 10,000 ft. MSL, it completes the circuit, which illuminates the ALT WARN annunciator light.

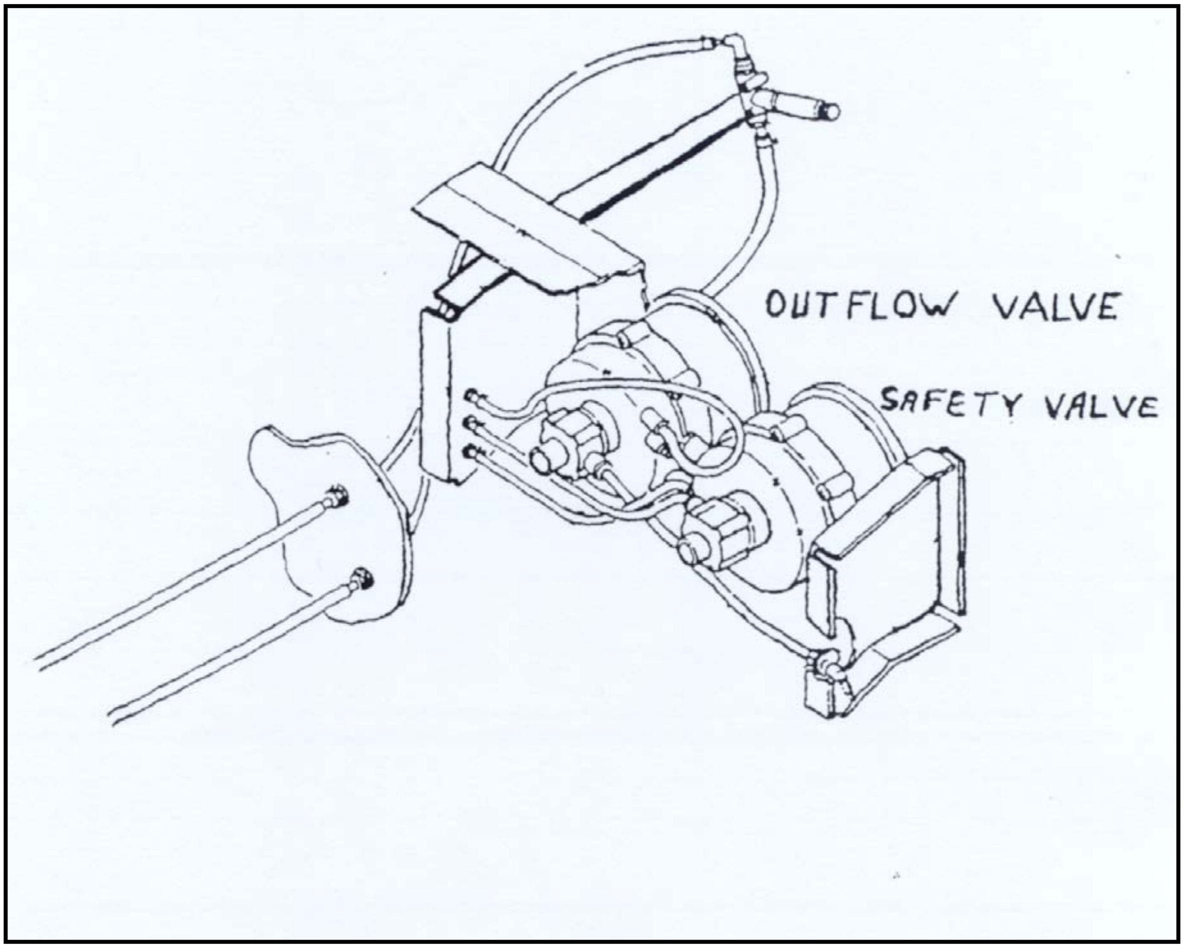


Figure 9-1 Pressurization Valves

Outflow Valve

The outflow valve is located on the aft pressure bulkhead. It does three (3) things:

1. Meters the outflow of cabin air in response to vacuum control forces from the controller.

2. Contains a pre-adjusted relief valve set to ensure that the cabin differential does not exceed 4.7 PSID.

3. Incorporates a negative pressure differential relief diaphragm which prevents the pressure differential from becoming negative. (This means, the cabin altitude cannot be higher than the aircraft altitude.)

Safety Valve

The safety valve is also located on the aft pressure bulkhead near the outflow valve.

The safety valve is connected to the cabin pressure control switch and is wired through the left landing gear squat switch.

When the control switch is set to DUMP (or the LH squat switch is down and the switch is set to PRESS), the safety valve serves as a dump valve. This means it completely opens to relieve the entire pressure differential between the external air pressure and the cabin air pressure.

A second function of the safety valve is to back up the outflow valve. The safety valve also contains a pre-adjusted relief valve. This valve is set to ensure that differential pressure does not exceed 4.9 psi. *(Careful, this is easy to confuse with the pre-adjusted valve in the outflow valve.)*

It also incorporates a negative pressure differential relief diaphragm, which prevents the pressure differential from becoming negative. (This means, the cabin altitude cannot be higher than the aircraft altitude.)

The safety valve will close when the:

- landing gear strut extends
- cabin pressure switch is set to TEST
- vacuum source is lost
- electrical power is lost

Flow Control Unit

A flow control unit is located forward of the firewall in each nacelle. The flow control unit has two functions:

- Controls the bleed air from the engine to make it usable for pressurization, heating, and ventilation.

- Draws ambient air into a venturi to mix with the bleed air.

Operation

Before takeoff with the engines not running, the safety valve is closed, the outflow valve is closed, and cabin altitude equals aircraft altitude.

After the engine(s) are started, the compressor bleed air is tapped off the manifold at a T-fitting as pneumatic air and passed through a venturi to produce a low pressure vacuum. This vacuum holds the safety valve open until take off.

On take-off, the dump solenoid closes and releases the compressor bleed air vacuum, which closes the safety valve. The preset solenoid opens and a time delay relay is actuated which allows the left engine to commence pressurization sequencing six seconds before the right. The time delay prevents an excessive pressure bump. (A pressure bump occurs when the aircraft pressurizes too quickly.)

The flow control unit then mixes engine bleed and ambient air.

The mixture of engine bleed and ambient air will go through (to cool) or by-pass (for heat retention) a heat exchanger in the wing center section before entering the cabin.

As the aircraft climbs, the outflow valve begins modulating outflow of air in accordance with the cabin pressure controller to maintain the selected rate of climb and cabin altitude until the maximum cabin differential of 4.7 psid is reached.

Once the maximum cabin pressure differential is reached, the outflow valve will release air to maintain the maximum cabin differential rather than the setting of the cabin pressure controller. After this point, the cabin altitude begins to climb at approximately the same rate as the aircraft.

Electric Heater

Heating System Components

- Compressor Bleed Air
- Ambient Air
- Flow Control Unit
- Heat Exchanger
- Electric Heater
- Duct Work
- Outlets

Air-Conditioner

Cooling System Components

The components of the cooling system are:

- Compressor Bleed Air
- Ambient Air
- Flow Control Unit
- Heat Exchanger
- Condenser

- Receiver Dryer
- Evaporator
- Vent Blower
- Duct Work
- Cabin Ceiling Outlet

Controls

The controls for the heating and cooling systems are located on the environmental control panel. These controls include:

- Bleed Air Valve Switches
- Vent Blower Switch
- Electric Heat Switch
- Manual Temperature INCR/DECR Control
- Cabin Temperature Control Switch
- Cabin Temperature Mode Selector Switch

Bleed Air Valve Switches

Bleed air is the warm, compressed air from the compressor section of the engine. It is the primary source of environmental air.

The bleed air valve switches are placarded BLEED AIR VALVES OPEN - CLOSED. The switches actuate the electric solenoids in the flow control units of their respective engine to send bleed air from the engine to the cabin.

Vent Blower Switch

The vent blower switch is placarded VENT BLOWER HIGH - LOW - AUTO. It controls blower fan speed.

Electric Heat Switch

The electric heat switch is placarded ELEC HEAT. The switch has three (3) positions: GRD MAX, NORM, and OFF.

When in the GRD MAX position and the aircraft is on the ground, the system uses eight (8) heating elements to provide the maximum amount of electrical heat. This setting is used to initially warm up the cabin.

However, the switch is solenoid held in the GRD MAX position. Once the aircraft takes off, the switch will automatically drop to NORM because the left squat switch de-energizes the solenoid on liftoff.

In the NORM position, up to four (4) heating elements are automatically turned on and off in conjunction with the cabin thermostat to supplement bleed air heating.

In the OFF position, all electric heat is turned off and cabin heating is solely provided by bleed air.

Cabin Temperature Mode Selector Switch

The cabin temperature mode selector switch has three positions: AUTO, MANUAL HEAT, and MANUAL COOL.

In the AUTO position, the temperature sensing units in the cabin initiate heat or cool commands to bring the cabin environment to the desired temperature as set by the cabin temperature control switch.

In the MANUAL HEAT position, cabin temperature is manually controlled by the pilot through the manual temperature INCR/DECR control.

In the MANUAL COOL position, cabin temperature is manually controlled by the pilot through the manual temperature INCR/DECR control.

Manual Temperature INCR/DECR Control

Manual temperature INCR/DECR control is a spring loaded switch placarded MANUAL TEMP INCR - DECR. Whenever the cabin temperature mode selector switch is set to MANUAL HEAT or MANUAL COOL, the INCR/DECR switch controls the motor-driven bypass valves in the wing center sections.

Cabin Temperature Control Switch

When the cabin temperature mode selector switch is set to AUTO, the cabin temperature control switch allows you to set the cabin temperature level. The switch works with the temperature sensing units in the cabin to automatically initiate heating or cooling commands to reach the designated cabin temperature. The temperature control switch is marked in units.

If the automatic temperature control box malfunctions, the CABIN TEMP mode switch can be placed in the MANUAL position and the temperature may be regulated with the INCR/DECR switch. INCR/DECR switch does not operate when the CABIN TEMP mode switch is in AUTO.

Operation

After generators are operating (or an APU of sufficient capacity is connected), the CABIN TEMP mode switch is set to AUTO, and the cabin temperature control is set to a comfortable temperature.

With the vent blower switch set to AUTO, the vent blower automatically begins continuous operation.

With the electric heat switch set to NORM, the air-conditioner or electric heater will function as needed, based on the cabin temperature control switches commands to the bypass valve.

After the air enters the cabin, it is distributed though the duct system and is recirculated.

Operation of Heating System

On a very cold day, the best heating can be obtained by:

- Setting the electric heat switch to GND MAX.
- Setting the vent blower switch to HIGH.
- Open Bleed Air Valves.
- Closing all overhead outlets.
- Turn the CABIN TEMP knob from Full Cold to INCR Heat.
- Setting the CABIN TEMP MODE to AUTO.
- This will force all the air through the heater.

Operation of Cooling System

On a hot day, the maximum cooling occurs by:

- Closing one or both bleed air valves (if on the ground close BOTH).
- Setting the vent blower switch to HIGH.
- Setting the CABIN TEMP MODE to MAN COOL
- Opening all overhead air outlets.
- This will allow cool air conditioning air to cool top down. If the overhead outlets remain closed, cool air will be vented through the lower heat vents.

The air conditioner evaporator is mounted in the nose. It is electrically driven and has a rated capacity of (16,000) BTU. The air conditioner uses freon.

Electric Heater Lockout

To prevent electrical system overload, the electric heater is locked out when any one of the following items is turned on:

- Windshield Heat
- Prop De-ice
- Engine Lip Boot Heat

902. OXYGEN SYSTEM

At the end of this topic, you should be able to label and describe the operation of the oxygen system and its components.

Components

The oxygen system is designed primarily as an emergency use system, but may also be used to provide supplemental oxygen at cabin altitudes above 10,000 feet.

The oxygen system consists of:

- Oxygen Supply Cylinder
- Pressure Regulator Control Valve
- Oxygen Supply Pressure Gauges
- Outlets
- Oxygen Masks

Oxygen Supply Cylinder

The 49 cu. ft. oxygen supply cylinder is installed behind the aft bulkhead. A full cylinder contains oxygen at a pressure of 1850 psi +/- 50 psi at a temperature of 70 degrees Fahrenheit.

Pressure Regulator Control Valve

Connected to the oxygen supply cylinder is the pressure regulator control valve. This valve is controlled by a remote push-pull knob located on the overhead panel in the cockpit.

Oxygen Supply Pressure Gauges

An OXYGEN SUPPLY PRESSURE gauge is located on the oxygen service panel on the right side of the fuselage. The gauge is next to the filler valve.

In the cockpit, you can monitor the oxygen cylinder pressure through the OXYGEN SUPPLY PRESSURE gauge on the copilot right side panel.

Oxygen Masks

Diluter-Demand Oxygen Masks are available for the pilot, copilot and observer.

The oxygen masks are diluter-demand/100% regulator masks. They provide the proper dilution of oxygen with cabin air to conserve oxygen at lower altitudes.

Each diluter-demand mask has a pressure detector/indicator in the oxygen system line to provide a visual indication of oxygen flow.

A green signal indicates adequate oxygen flow.

A red signal in the window of the detector indicates low or no oxygen flow.

Diluter Control Lever

The diluter control lever allows you to control the mix of oxygen and air in the mask.

In the NORMAL position, the regulator automatically schedules a proportional increase in oxygen as the altitude increases.

In the 100% position, 100% oxygen will be provided upon inhalation, regardless of altitude.

At cabin altitudes below 20,000 ft., the lever should be placed in the NORMAL position to conserve oxygen if used for supplemental O2.

When not in use, the masks should be stowed with the diluter lever in the 100% position.

EMER control setting, like the 100% setting, provides 100% oxygen at a positive pressure to the mask.

Microphone

Each diluter-demand mask has a microphone incorporated in the mask assembly.

To use the microphone while wearing the mask, set the MIC NORMAL - OXYGEN switch to OXYGEN.

903. ANTI-ICE/DE-ICE SYSTEM

At the end of this topic, you should be able to label and describe the operation of the anti-icing and de-icing system and its components. You will also be able to list four (4) items that cause the wet compass to be erratic.

Components

The anti-ice and the de-ice system includes:

- Windshield Wiper System
- Windshield Anti-ice
- Power Plant Ice Protection System
- Fuel System Anti-ice
- Propeller Electrothermal De-icer System
- Pitot and AOA Anti-ice Systems
- Surface De-icer System

Windshield Wiper System

The windshield wiper system has two electrically operated windshield wipers that are provided for flight and ground operations.

CAUTION

Do not operate on dry glass.

Windshield Anti-Ice

To prevent the formation of ice on the windshields, windshield heat is provided for both the pilot and copilot windshields. A controller with a temperature sensing unit maintains the temperature on the windshield surface at 95 degrees Fahrenheit.

Windshield heat is controlled with the windshield anti-ice switch located on the pilot subpanel. The switch is placarded WSHLD ANTI-ICE BOTH, OFF, PILOT.

An electric heater lockout will disable the electric heater when windshield heat is in use.

CAUTION

Unreliable operation of the magnetic compass will occur during use of windshield anti-ice.

Power Plant Ice Protection System

Anti-ice protection for each engine is provided by two systems: the mechanically activated engine ice vanes and the electrical lip boot heat.

Engine Ice Vanes

The mechanical system consists of an adjustable push-pull handle for each engine located directly under the pilot's control column. When pushed in the inertial ice vane is retracted in the up position for flight under normal conditions. When pulled out, the vane is extended and locked in the down position.

When potential icing conditions are encountered, the pilot can extend the vanes by pulling the two controls placarded: PULL FOR ENGINE ICE PROTECTION, LEFT ENG, RIGHT ENG.

When the movable vane is extended, lighter air turns abruptly to enter the engine plenum while heavier air (snow, water, ice) rushes past the plenum entrance and is discharged through the bypass duct.

- Engine Torque decreases
- ITT may increase approximately 40-60 ft-lbs
- Range will be reduced 10-12%

Engine Lip Boot Heat

The electrical anti-ice system consists of an electrothermal boot attached to the air intake lip of each engine.

Engine lip boot heat is controlled by respective switches on the pilot subpanel placarded ENG LIP BOOT.

Fuel System Anti-Ice

The fuel system is protected from ice in three areas:

- With the fuel additive PRIST
- With the oil-to-fuel heater which automatically heats the fuel
- Electrical heating elements (or jackets) protect the external fuel vent from ice. This fuel vent is located in each wing and serves both the nacelle and wing tanks.

The pilot controls the fuel vent, electrical heat jackets with the FUEL VENT switches on the pilot subpanel.

The pilot controls the fuel control unit pneumatic line, electrical heat jackets with the FUEL CONTROL switches on the pilot subpanel.

The fuel line heaters are powered by the No. 1 and No. 2 Subpanel Buses.

CAUTION

> To prevent overheat damage to electrically heated anti-ice jacket, FUEL VENT HEAT and FUEL CONTROL HEAT switches should NOT be turned ON unless cooling air will soon pass over the jackets.

Propeller Electrothermal De-Ice System

To remove ice from the propellers, electrothermal deicing boot**s** are attached to each propeller blade.

Each thermal boot consists of one outboard heating element and one inboard heating element.

The boots receive electrical power through the de-ice timer, slip ring and brush block.

The pilot controls the propeller deicing boots with the propeller heat switch. The switch is placarded PROP and is located on the right hand pilot subpanel.

The pilot monitors current consumption through the propeller ammeter on the left hand pilot subpanel.

Propeller De-Ice Timer

The propeller de-ice timer cycles power to the heating elements in this order:

- **RH** propeller, outboard segments (all 3 blades)
- **RH** propeller, inboard segments (all 3 blades)
- **LH** propeller, outboard segments (all 3 blades)
- **LH** propeller, inboard segments (all 3 blades)

All above segments are heated 34 +/-6 seconds. Normally, this requires more than two minutes to complete all four segments of one cycle.

Each propeller blade boot draws approximately 5 to 6 amps of current. Thus, with three blades drawing power, the propeller amperage should read between 14 to 18 amps.

Pitot and AOA Warning Anti-Ice Systems

To prevent icing, the pitot tubes and AOA have electrical heating elements.

On the deck, electrical power to the AOA heating elements is reduced to 28 Vdc to 14 Vdc.

Pitot heat can be used on the deck for short periods to check their operation. Prolonged heating on the deck would cause damage to the pitot tubes.

The pilot controls these heating elements through the PITOT and AOA switches located on the anti-ice/de-ice control panel

In the event of an electrical overload, the circuit breaker will disconnect the heating circuit and trip the toggle switches to the down position.

CAUTION

> Except during takeoff roll, pitot heat should NOT be used while the aircraft is on the ground. Overheating because of lack of cooling airflow will damage the heating elements.

Surface De-Ice System

De-ice boots protect the leading edges of each wing, both horizontal stabilizers and the vertical stabilizer. They are pneumatically actuated and flex to break ice accumulation on these surfaces.

Engine bleed air, from the engine compressor, is used to supply air pressure to inflate the de-ice boots and to supply a vacuum through the distribution valve to hold the boots down during flight.

The de-ice boots are controlled by the three position DEICE CYCLE switch.

In the SINGLE position, the de-ice boots inflate for 7 to 8 seconds and then automatically return to the deflated position.

In the MANUAL position, the de-ice boots inflate for as long as the switch is in the MANUAL position.

In the OFF position, the de-ice boots are deflated.

Standby Compass

The wet (standby) compass will give erratic reading when any of the following are activated:

- Windshield Anti-ice
- Windshield Wipers
- Air-conditioner
- Electric Heat
- Vent Blower

ENVIRONMENTAL SYSTEM QUIZ

1. How many heating elements are activated inflight with the Electric Heat Switch in the NORM position?

a. 2
b. 4
c. 6
d. 8
e. 10

2. The switch that actuates a solenoid in the flow control unit of the engine to bring warm compressed air to the cabin is?

a. Mode Selector switch
b. Vent Blower switch
c. Cabin Pressure Control switch
d. Bleed Air Valve switch
e. Temperature INCR/DECR switch

3. With the Mode Selector switch in the AUTO position, moving the cabin temperature INCR/DECR switch will have no effect on the cabin temperature.

TRUE FALSE

4. On a very cold day, maximum heating while on the ground may be obtained by positioning the electric heat switch to which of the following positions?

a. AUTO
b. NORM
c. GRD MAX
d. OFF
e. INCR

5. While operating on a cold winter morning with the electric heat on, your aircraft encounters icing conditions. Which of the following items, when turned on, will secure the electric heater?

a. Pitot heat
b. Surface deicer system
c. AOA heat
d. Windshield heat
e. All of the above

6. To prevent electrical system overload from occurring, the Electric Heater will be locked out if either the windshield heat, prop deice, and engine lip boot heat are operated simultaneously with the electric heater.

TRUE FALSE

7. When not in use the diluter demand regulator masks should be stowed with the regulator lever in which of the following positions?

a. Normal
b. 100%
c. Off
d. On
e. Oxygen

8. Air used to pressurize the main cabin is taken from which of the following areas?

a. Ambient outside air
b. Bleed air from the compressor section
c. Engine exhaust air
d. Bleed air from the turbine section
e. Oxygen bottles

9. Which of the following components contain a preadjusted valve to ensure that the cabin pressure differential does not exceed 4.9 PSID?

a. Cabin pressure controller
b. Outflow valve
c. Safety valve
d. Flow control unit
e. Rate of climb indicator

10. Which of the following components incorporate a negative relief valve to ensure that the cabin pressure differential remains positive?

a. Cabin pressure controller
b. Outflow valve
c. Safety valve
d. Flow control unit
e. Both b and c are correct

11. Moving the cabin pressure controller switch to the DUMP position will open the safety valve and completely relieve all cabin pressure.

TRUE FALSE

12. The rate knob on the cabin pressure controller allows the operator to control the cabin rate of climb from ________ fpm to _______ fpm.

13. Which of the following components incorporate a negative relief valve to ensure that the cabin pressure differential remains positive?

a. Cabin pressure controller
b. Outflow valve
c. Safety valve
d. Flow control unit
e. Both b and c are correct

14. Prior to takeoff, with both engines operating, the safety valve is in the ______ position, and the outflow valve is in the ______ position.

a. Closed, Closed
b. Closed, Open
c. Open, Closed
d. Open, Open

15. To avoid excessive pressure bump after takeoff, the _____ Landing Gear Squat Switch opens to remove electrical power from the Preset and Safety Valve Solenoid and actuates a time delay relay.

LEFT RIGHT

16. Which of the following indications will you notice on the engine instruments when the ice vanes are extended in flight?

a. Increase in torque, increase in ITT
b. Increase in torque, decrease in ITT
c. Decrease in torque, increase in ITT
d. Decrease in torque, decrease in ITT
e. No noticeable change will occur

17. During the propeller deice ground test, you notice during the third cycle, that the deice amperage is 6 amps. Assuming that the first cycle powered the RH propeller outboard segments, which of the following statements is correct?

a. 1 outboard segment on the LH prop is inoperative
b. 2 inboard segments on the LH prop are inoperative
c. 1 outboard segment on the RH prop is inoperative
d. 2 inboard segments on the RH prop are inoperative
e. 2 outboard segments on the LH prop are inoperative

18. When the windshield heat is activated, a controller will maintain a windshield surface temperature of _______ degrees Fahrenheit.

19. Which of the following items when activated will NOT cause the standby compass to display invalid magnetic headings?

a. Propeller de-ice
b. Windshield anti-ice
c. Windshield wipers
d. Air conditioner
e. Electric heat

20. The windshield wipers must be secured while flying partial panel in order for the standby compass to provide accurate heading information.

TRUE FALSE

LESSON TEN
AVIONICS

1000. OBJECTIVES

At the end of this lesson, you should be able to...

1. Label and describe the operation of the TACAN.

2. Label and describe the operation of the UHF.

3. Label and describe the operation of the radios tuned through the NCS-31.

4. Label and describe the operation of the components of the audio control panel.

5. Label and describe the function of the automatic flight control system.

6. Recognize the indications and potential results of a loss of AC power to the Avionics System.

7. Recognize the indications and potential results of a loss of DC power to the Avionics System.

NOTES

1001. NCS-31

NCS-31 Components and Operations

The NCS-31 area navigation control system combines a digital area navigation (RNAV) computer and avionics management system into a single, lightweight unit with a memory for storage.

In the cockpit, you will control and monitor the NCS-31 through these panels:

- Control Data Processing Unit (CDPU)
- Mode Select Unit (MSU)
- Progress Remote Readout Unit
- Communication Set 1 Remote Readout Unit
- Navigation Remote Readout Unit
- ADF-XPDR Remote Readout Unit

Control/Data Processor Unit (CDPU)

The CDPU, or scratch pad, allows the crew to enter and verify the desired comm/nav frequencies, ATC code, and RNAV settings.

Up to 10 preset navigation frequencies may be saved for NAV1 and 1 preset may be saved for NAV2.

COM 2 is inoperative and the TACAN must be tuned by the TACAN Control on the center pedestal.

The CDPU displays the information related to the key that is selected. (NAV1 frequency with NAV1 selected, ATC code with ATC selected)

Mode Select Unit

ADF- Allows the crew to activate and test the ADF

COM- Allows the crew to select or deselect squelch on COM1

DME HOLD- Commands DME to remain tuned to present frequency

NAV TEST- Allows the crew to test VOR and ILS

XPDR- Allows the crew to put transponder in standby or active mode, select altitude repeat, and IDENT

121.5 EMER- When depressed, this button sets the VHF set to the emergency frequency 121.5 MHz and the center light is illuminated

Remote Readout Units

The top four (4) display panels are remote readout units. These panels allow you to monitor the current setting of the navigation computer and various receivers.

1002. VHF COMMUNICATIONS

The VHF Communications set is fully solid state and controlled by the NCS-31 Navigation System. VHF set operates in the frequency range of 116.000 and 151.975 MHz. Through the CDPU, you can set one (1) active frequency and one (1) preset frequency. The MSU controls squelch disable and emergency tuning of the VHF transceiver. The VHF system is DC powered.

The VHF transceiver is located in the forward baggage compartment.

The VHF blade antenna is located on the topside of the fuselage.

You are already familiar with the NCS-31 controls and indicators involved in tuning the VHF set. They are:

- PRE Pushbutton
- USE Pushbutton
- COM 1 Pushbutton
- Data Entry Keyboard
- Frequency Display (Scratch Pad)
- ACTIVE Display
- PRESET Display
- TUNE Frequency Reverse Pushbutton

1003. VOR NAVIGATION SYSTEM

The VOR Navigation System includes VOR, LOC, glide slope and marker beacon systems. It receives and displays automatic VOR information and provides signals to display ILS and manual VOR data transmitted from VOR/LOC and ILS ground stations for enroute and terminal navigation.

Signal reception is limited to line of sight and also by power of the ground transmitter with a maximum range of 120 miles.

VOR/LOC frequencies are between 108.00 and 117.95 MHz. The system supports:

- 160 VOR channels
- 40 LOC channels
- 40 glideslope channels

Marker beacons are used to mark key locations along an ILS approach. They are set to a frequency of 75 MHz and their volume can be selected through the HI/LO switch on the audio control panel.

The marker beacon provides a visual signal on one of three indicator lights.

- O or blue when the outer marker is reached.
- M or yellow when the middle marker is reached.
- I or white when the inner marker is reached.

Operation (DUD)

To use the VOR 1 system to change the pilot flight director's lateral deviation marks from linear deviation (nautical miles) to angular deviation (degrees), you will use the DME HOLD-USE-DME HOLD principle, sometimes called the D-U-D principle.

The DUD process follows this pattern:

1. Press DME HOLD on the MSU.
2. Press USE on the CDPU.
3. Press DME HOLD on the MSU.

The DME HOLD inhibits changing the DME receiver frequency. Disengaging DME HOLD and then selecting a new waypoint forces the NCS-31 into either a conventional VOR or LOC mode of operation according to the newly selected frequency.

If you continue to enter in the station elevation on the CDPU, the VOR 1 system will automatically go into the RNAV mode operation.

To use VOR 1 or TACAN navigation systems in the RNAV mode on the CDPU, select the WPT button before entering in the waypoint data.

To use the VOR 2 navigation system, select the NAV 2 button.

ADF Navigation System

The Automatic Direction Finding (ADF) is an airborne radio direction finder which operates in the frequency range of 190 to 1749 KHz. This system provides a visual indication of your aircraft bearing in relation to a selected ground station. The range of the ADF system varies greatly with the type of transmitting station, time of day, altitude, and atmospheric conditions.

The ADF system is totally solid state and is electronically tuned through the NCS-31 CDPU. It receives its power from the No. 1 Avionics Bus.

The ADF antenna is a common loop and sense antenna located on the bottom of the fuselage.

If you lose the signal or if the signal is too weak to use, the ADF needle will go to the 270 degree (park) position.

1004. TRANSPONDER

The transponder (XPDR) is an identification, position tracking, altitude reporting, and emergency tracking device. It operates at two frequencies 1090 MHz and 1030 MHz.

The XPDR is totally solid state. It is tuned through either the NCS-31 or remote control panel on the lower center pedestal. The system is powered by the No. 2 Avionics Bus.

The XPDR transceiver is located on the aft electronics rack.

The XPDR antenna is on the bottom of the fuselage.

1005. TACAN

TACAN Controls and Indicators

The TACAN radio set is an airborne navigational system that operates in conjunction with selected TACAN ground stations. The TACAN is tuned through the TACAN control panel on the center console.

The following controls and indicators are used with the TACAN system:

- TACAN Control Panel
- DME Indicator
- Pilot HSI

TACAN Control Panel

TACAN channel display shows the active TACAN channel.

X-Y switch allows you to select either the X or Y channel for use.

Channel select knob allows you to select a desired TACAN channel for operation.

Test pushbutton, when pressed, initiates a self-test of the TACAN and DME systems. This test is considered satisfactory, when the pilot course TO indicator centers on 180 degrees (+/- 2 degrees), and when FD SEL TACAN is selected and the TACAN bearing indicators on both course indicators reads 180 degrees (+/-2 degrees).

1006. DME INDICATOR

Dim control (DIM)- varies the intensity of the DME miles and knots/minute displays.

DME miles display (DME MILES)- shows the slant-range distance from your aircraft to the selected ground station in nautical miles.

Test pushbutton (TEST)- this switch selects either the KTS or MIN position and initiates a self-test of the TACAN and DME systems. When the DME system is satisfactory, the DME miles display shows a 0.0 or 0.1 and the knots/minute display shows 888. Additionally the TACAN needle on the pilot and copilot HSI will read 180 (+/- 2) degrees.

Knots/minutes display- When the function selector switch is in the MIN position, this display shows the time to the selected ground station in minutes. When the function selector switch is in the KTS position, the display shows the ground speed of the aircraft in knots. Information for knots/minutes is only accurate if aircraft is flying directly toward or away from the ground station.

1007. MISCELLANEOUS CONTROLS & INDICATORS

FD SEL pushbutton

The flight director select located below the pilot flight director instruments, TACAN and VOR/ILS. The TACAN position connects TACAN signals to the flight director indicators. The VOR/ILS position connects VOR/ILS signals to the flight director indicators.

TACAN SEL pushbutton

Located below the pilot flight director instruments. In the NORMAL position, TACAN is restricted to normal operation mode. In the RNAV position, TACAN is coupled for use with the area navigation system.

VOL knob- found on the Dual Audio Control Panel. This knob allows you to control the amplitude (volume level) of the TACAN/DME audio.

1008. UHF RADIO

The UHF communication set is a line-of-sight radio transceiver which provides transmission and reception of amplitude modulated signals in the ultra-high frequency range of 225.000 to 399.975 MHz for a distance of up to 100 miles.

The UHF set has 7000 available channels for normal operations, plus guard channel 243.000 MHz. Up to 20 channels may be preset for ready access.

Two antennas are connected to the receiver:

- UHF/VHF on top of the fuselage
- UHF-DF on the bottom of the fuselage

Controls and Indicators

Most of the controls and indicators for the UHF radio are on the center console. Normal operation is to have the left knob set to PRESET and the right knob set to BOTH.

Operation

To transmit and receive on UHF ensure that:

- UHF audio switch (Audio Control Panel) - ON.
- VHF/UHF selector (Audio Control Panel) - UHF.

Now you can monitor UHF frequencies.

To transmit on UHF, hold down the MIC switch while talking.

To navigate using the UHF:

- Select ADF on the function selector knob
- Manually tune the desired frequency
- Set the double needle on the RMI to DF
- Now the RMI is using the UHF signals to navigate

1009. AUDIO CONTROL PANELS

Dual Audio Control Panel

A dual audio control panel on the instrument panel serves both the pilot and copilot. This panel is equipped with dual controls and shared controls. The top section allows the pilot and copilot to select audio on/off for all radios and navigational aids. The middle row lets the pilot or copilot select which radio to transmit on, speaker or headphone, marker beacon

Observer Audio Control Panel

The observer position, behind the copilot seat, is equipped with a separate audio control panel. The observer audio control panel contains the MIC OXY/NORM switch and the ability to monitor intercom, radios, and navaids. The observer cannot transmit on any radios.

1010. MICROPHONES

Microphones are installed within each headset and oxygen mask for the pilot, copilot and observer. All microphones are connected to the aircraft interphone system. However, only the pilot and copilot microphones will connect into the system for radio transmission.

The pilot and copilot microphone are controlled by the AUDIO SPKR/PHONE switches on the dual audio control panel and by the MIC pushbuttons on the respective yoke. The observer microphone is controlled by the AUDIO SPKR/PHONE and MIC OXY/NORM switches on the Observer Audio Control Panel.

AUDIO SPKR/PHONE and MIC OXY/NORM switches- covered in the Dual Audio Control Panel and Observer Audio Control Panel sections.

MIC pushbutton**-** when pressed activates the selected microphone for use. The microphone audio is routed to the system selected by the respective transmitter selector switch.

1011. AUTOMATIC FLIGHT CONTROL SYSTEM

The automatic flight control system is an integrated autopilot/flight director/compass system. The system controls and monitors several lateral modes of operation:

- Heading (HDG)
- Navigation (NAV)
- Approach with automatic glide slope (APPR)
- Back course localizer (B/C).

It also controls and monitors several vertical hold modes of operation:

- Altitude hold (ALT)
- Indicated airspeed hold (IAS)
- Pitch (The pitch hold mode is automatically used when none of the other vertical modes are selected.)

The automatic flight control system is comprised of several controls and indicators:

- Pilot Autopilot Mode Selector Panel
- Pitch/Turn Control Panel
- Copilot Flight Director Mode Selector Panel

  (Copilots Flight Director not used in Automatic Flight Control System.)
- Flight Director Panel
- Flight Director Annunciator Panels

Additional controls and indicators are also involved with the automatic flight control system:

- DIS-TRIM Switch
- PITCH SYNC/CWS Pushbutton
- Electric Trim Switch **(If used, it will disconnect the AFCS)**
- Go-around Switch
- Pilot and Copilot Turn and Slip Indicators

Pilot Autopilot Mode Selector

The pilot autopilot mode selector works with both the autopilot and flight director systems.

Pitch/Turn Control

The Pitch/Turn Control panel provides the pilot with a method to input flight control commands while the autopilot is engaged.

Turn Control Knob- This control supplies roll rate commands to the autopilot. The knob is spring loaded to the center detent.

YAW DAMP Switch/Indicator- When pressed, this switch engages the yaw damp system. When the yaw damp system is active, the indicator illuminates.

Pitch Control Thumbwheel- This control supplies pitch rate commands to the autopilot. The knob is spring loaded to the center detent.

Copilot Mode Selector

This panel is similar to the pilot autopilot mode selector panel; however, these selectors only affect the copilot flight director. These controls have no effect on the autopilot system.

Flight Director Indicators

The FD-112V flight director combines a flight director indicator and a horizontal situation indicator (HSI) in one instrument.

Remember, only the pilot flight director is tied to the autopilot system.

The copilot flight director is controlled by the copilot flight director mode selector.

The flight director indicator (top unit) displays the aircraft attitude and flight control system steering commands. It also displays the glide slope deviation and radio altitude from 200 feet to touchdown.

The bank indicators work with the roll indexes to indicate the degree of right or left bank. The roll indexes are marked at 10, 20, 30 and 45 degrees from center.

The pitch and roll attitude of the aircraft is displayed by the relationship of the fixed aircraft reference symbol and the movable attitude tape. The attitude tape is colored blue (for sky) or brown (for ground). The horizontal reference line is marked in white. The attitude tape is marked off. The tape displays up to 90 degrees pitch-up or 90 degrees pitch-down attitude. A full 360 degree roll presentation about the horizon is also possible.

The radio altitude pointer displays the radio altitude on the radio altitude scale from 200 feet to touchdown. When NOT in use, the radio altitude pointer is hidden from view.

The command bars display the computed bank and pitch commands. The bars move up or down to indicate climb or descent commands. They rotate clockwise or counterclockwise to indicate right or left bank commands. "Fly into" the command bars. Either you or the autopilot should maneuver the aircraft until the aircraft symbol fits snugly into the command bars.

The glide slope pointer represents the center of the glide slope beam. The relationship of the pointer to the center line on the scale indicates the vertical displacement of the aircraft from the beam. When the pointer is deflected up, the aircraft is below the glide slope beam. When the pointer is deflected down, the aircraft is above the glide slope beam. The pointer is only visible when the navigation receiver is tuned to an ILS frequency.

When the TEST pushbutton is pressed:

- The attitude display changes by 10 degrees (+/- 3 degrees) roll left and 10 degrees (+/- 3 degrees) pitch-down.
- The ATT flag appears.
- The HEADING flag appears.
- The HSI azimuth card rotates 10 degrees (+/- 3 degrees) counterclockwise.
- If the autopilot is engaged, the azimuth card will not rotate and the HEADING flag will not appear on the pilot flight indicator.

Warning Flags

Warning flags cover the appropriate displays to indicate possible equipment malfunctions. Presence of any of the following flags indicate a loss or unreliable signal at the indicator. The flight director indicator has four associated flags:

- ATT flag
- CMPTR flag
- RAD ALT flag
- GS flag

Pilot Flight Director Annunciator Panel

The flight director annunciators indicate the selected autopilot and flight director modes of operation.

The pilot flight annunciator has the following indicators:

NL ARM Indicator- Illuminates when the computer is armed to accept navigation signals

NL CAP Indicator- Illuminates when a selected radial is captured

GS ARM Indicator- Illuminates when approach (APPR) mode is selected and NL CAP has been accomplished

GS CAP Indicator- Illuminates when the glide slope beam is captured

ALT HOLD Indicator- Illuminates when the altitude hold (ALT HOLD) mode is selected

BACK LOC Indicator- Illuminates when the backcourse (B/C) mode is selected

AP DISC Indicator- Illuminates when the autopilot is disconnected

GA Indicator- Illuminates when go-around (GA) mode is selected

AP ENG Indicator- Illuminates when the autopilot is engaged

IAS HOLD Indicator- Illuminates when airspeed hold (AS HOLD) is selected

HDG Indicator- Illuminates when heading (HDG) mode is selected

DR Indicator- Illuminates when autopilot switches to dead reckoning

LINEAR DEVIATION Indicator- Illuminates when linear deviation information is displayed on the lateral deviation bar on the pilot flight director

Copilot Flight Director Annunciator Panel

The copilot flight annunciator is limited to only the following indicators:

- GA Indicator
- GS ARM Indicator
- GS CAP Indicator
- AP ENG Indicator
- AP DISC Indicator

Control Wheel

Located on the control wheel are two additional controls that are connected to the automatic flight control system.

DIS-TRIM Switch- When pressed to the first detent, the DIS-TRIM switch disconnects the autopilot and/or yaw damp system. At the second detent, the electric trim is disconnected.

PITCH SYNC/CWS Pushbutton- When pressed and the autopilot is disengaged, this button sets the flight director command bars to the current aircraft attitude. If the autopilot is engaged, this button can be used instead of the pitch/turn control to set the aircraft to the desired attitude.

When the CWS button is pressed, the autopilot pitch and roll servos are disengaged, and you can manually control the aircraft with the control wheel. Releasing the CWS button, re-engages the autopilot servos and the system maintains the new attitude.

Miscellaneous Controls

These controls are also connected to the automatic flight control system.

Go-Around Button- When the pilot's GO AROUND is pressed, the autopilot system disconnects and the flight director indicator is set with the wings level and a 7 degree nose up attitude. You can manually initiate the command or you can re-engage the autopilot to initiate the command. When the copilot's GO AROUND is pressed it will only cause the command bars to go to 7 degree nose up.

Electric Trim Switch- This switch allows you to set the trim of the aircraft electrically.

Turn and slip indicators- Two (2) turn and slip indicators are installed separately on the pilot and copilot sides of the instrument panel. The pilot unit is operated by DC power; the copilot indicator is a vacuum instrument operated by engine bleed air pressure. The pilot turn and slip indicator is used to provide automatic yaw damping information to the autopilot.

Limitations

Remember these six (6) limitations of the autoflight system:

1. During autopilot operation, the pilot must be seated at the controls with the seatbelts fastened.
2. Maximum allowable calibrated airspeed for autopilot operation is 227 KIAS.
3. Do NOT use autopilot under 200 feet above terrain.
4. Autopilot and yaw damper must NOT be used during take-off and landing.
5. Do NOT use propeller in the range of 1750 to 1850 rpm during ILS approach.
6. Autopilot preflight check must be conducted and found satisfactory prior to each flight on which the autopilot is to be used.

1012. ABNORMAL CONDITIONS

Loss of AC Power

Your first indication of an AC power failure will be the Heading and Attitude flags appearing in the Flight Director Indicator. If you lose AC power, you will lose all of the avionics **EXCEPT**:

- NCS-31A
- Standby Compass
- DME
- VOR (audio)
- ADF (audio)
- Transponder (mode C)
- Marker Beacons
- UHF Communications
- VHF Communications

Loss of DC Power

A total loss of DC power will be indicated by heading and attitude flags appearing in the Flight Director Indicator, as well as the NCS-31 going blank.

With a dual generator failure, the battery can still power the inverters for AC power if required.

With a total loss of DC power you will have the following instruments:

- Copilot Turn and Slip
- Pilot and Copilot VSI
- Altimeters
- Airspeed Indicators
- Standby Compass
- ITT Indicators
- N1 and N2 Tachometers
- Clocks

NOTE

The cabin will depressurize because the bleed air valves are spring loaded to the closed position.

1013. WEATHER RADAR

Weather Radar System - Primary Function

The primary function of the weather radar system is to aid the pilot in avoiding thunderstorms and associated turbulence.

Weather Radar System - Secondary Function

The secondary function of the weather radar system is to gather and present terrain data.

The weather radar system consists of three basic components:

- Receiver-Transmitter
- Antenna
- Radar Indicator

The weather radar receiver-transmitter emits short, very intense (8-kW), energy pulses.

The energy from the transmitter is accepted by the antenna and converted into a narrow, microwave beam.

Some of these pulses are reflected back to the aircraft by weather turbulence or terrain contours. The antenna receives these pulses and passes them to the receiver - transmitter for amplification.

The radar indicator then converts the amplified signals into a visual display which indicates the range and relative bearing of any turbulence or contour within the antenna scan angle and selected range.

The maximum range of the weather radar is 160 nautical miles. The system provides a visual span of 90 degrees +/- 45 degrees on each side of the longitudinal axis of the aircraft.

WARNING

Do NOT turn radar on within 18 feet of ground personnel or containers holding flammable or explosive material. The radar should never be operated during fueling operations.

Weather Radar Indicator and Controls

The weather radar indicator and controls are located on the copilot side of the instrument panel.

Radar Indicator Display

The radar indicator provides a constant, non-fading display of any targets within the antenna scan angle and the selected range. It is divided by four (4) concentric **range marks**. Each mark represents one quarter of the selected maximum range.

The display also has an **update line** which sweeps across the screen each update cycle.

Function Switch

The function switch selects the type of operation and turns the weather radar set on and off. It has several settings:

- OFF removes power from the system
- STBY applies power to the system, but inhibits power to the transmitter, antenna scan, and indicator
- TEST applies drive to the antenna and activates the test circuit and indicator display
- 5 energizes the transmitter and sets the maximum range to 5 nautical miles with marks at 1.25 mile intervals
- 10 sets the maximum range to 10 nautical miles with range marks at 2.5 mile intervals
- 20 sets the maximum range to 20 nautical miles with range marks at 5 mile intervals

Wx GAIN/Wx ALERT Mode Selector Switch

The Wx GAIN/Wx ALERT switch selects the type of information to be displayed on the radar indicator. It has three positions:

- Wx GAIN places the indicator in GAIN mode and activates manual gain control. Notice that in GAIN mode, the storm cell or terrain contour is shown as one of three different shades of green. The shade depends on the gain setting selected.

- Wx places the indicator in automatic contour mode.

  Notice that in automatic contour mode, the storm cell or terrain contour is shown as a dark shape surrounded by areas of lighter green.

- Wx ALERT cycles the indicator between GAIN and automatic contour mode. This allows you to verify if a dark hole is a contour or storm cell.

  Notice that the dark hole flashes about four times per scan. This flashing indicates that the dark shape is a storm cell rather than a terrain contour.

Brightness Control

The BRT knob controls the brightness of the radar indicator display.

Hold/Scan Selector Switch

In the HOLD position, the HOLD/SCAN knob freezes the display indicator until the function switch is changed or power is removed from the system.

In the SCAN position, the antenna is placed in 90 degree scan mode.

Tilt Control

The tilt knob adjusts the antenna tilt up or down to allow the best indicator presentation.

Operation

The primary purpose of the weather radar system is to track weather disturbances. In the weather mapping mode, the radar transmits pulses and analyzes the echoes of these pulses as they reflect off storms or terrain contours. These echoes are divided into three (3) separate levels, dependent upon the strength of the respective echo.

On the radar indicator, you will see three (3) echo levels as three (3) distinct levels of brilliance:

The dark hole represents a contour or storm area. This indicates the center of a storm and the strongest level of turbulence. The severe turbulence in this region is capable of destroying an aircraft.

WARNING

Severe turbulence may be found in a dark hole or storm area and in adjacent areas. All areas are capable of destroying an aircraft.

The brightest shade surrounding the storm center in WX mode represents the intermediate strength turbulence. This area should be considered severe and avoided.

The lighter shade on the display represents the lowest echo strength and lower in rainfall and turbulence levels.

NOTE

Even though no echo is being received from an area adjacent to an indicated storm, severe turbulence should be expected in this area. Areas adjacent to the narrow edge of the storm should always be avoided.

AVIONICS SYSTEM QUIZ

1. Which of the following navigation radios are not tuned through the NCS-31?

a. TACAN
b. LFADF
c. ILS
d. VOR
e. All of the above are tuned through the NCS-31.

2. Which of the following NCS-31 units are used to enter the required VOR navigation frequencies?

a. Control/Data Processor Unit
b. Mode Select Unit
c. Progress Remote Readout Unit
d. Navigation Remote Readout Unit
e. VOR cannot be tuned through the NCS-31

3. TACAN frequencies may be set through the Control/Data Processor Unit of the NCS-31.

TRUE FALSE

4. When TEST is selected on either the DME indicator or the TACAN control panel, the bearing pointer on the HSI will read ___degrees (+/-2 degrees) and the DME display indicates _._ or _._.

5. The UHF communications set is a line of sight radio transceiver which operates for a distance up to ___ miles.

6. Which of the following procedures is not required to use the UHF transceiver as a navigation radio?

a. Select READ on the mode select switch
b. Select ADF on the function select switch
c. Manually tune the frequency with the frequency selectors
d. Select DF on the RMI double needle switch
e. All of the steps are required

7. Which of the following switches on the audio control panel will filter voice transmissions on the ADF radio?

a. INTPH
b. NORM/EMER
c. V Filter
d. R Filter
e. UHF

8. Positioning the TACAN OPER/STBY switch to the STBY position will park the TACAN bearing pointer at the 9 o'clock position and remove the DME from the indicator window.

TRUE FALSE

9. To use the autopilot to intercept and track ILS inbound, which of the following switches should be selected on the Autopilot Mode Selector?

a. APPR
b. B/C
c. HDG
d. IAS
e. NAV

10. Which of the following actions will disconnect the Autopilot?

a. Gang bar in off position
b. Depressing the Autopilot ENG/DIS switch to DIS
c. Push the DIS/TRIM switch on the yoke
d. Select the go-around switch on the left power lever
e. All of the above will disconnect the autopilot

11. Which of the following flight director system(s) are tied to the autopilot system?

PILOT COPILOT BOTH

12. Which of the following flight director annunciator lights would you expect to see during an ILS approach using the flight director?

a. NL CAP
b. BACK LOC
c. GA
d. LINEAR DEVIATION
e. DR

13. With a total loss of AC power which of the following would NOT be available?

a. NCS-31A
b. DME
c. TACAN
d. Transponder
e. UHF radio

14. With a total failure of the AC system you will still be able to communicate normally on both the VHF and UHF radios.

TRUE FALSE

15. With a dual generator failure which of the following items would NOT be available?

a. NCS-31A
b. DME
c. TACAN
d. Transponder
e. All of the above will be available

16. With a total loss of DC power the Transponder must be switched to manual to operate properly.

TRUE FALSE

17. The primary function of the weather radar system is to aid the pilot in avoiding thunderstorms and associated turbulence.

TRUE FALSE

18. A secondary objective of the weather radar system is to aid the pilot in ____________.

a. Avoiding thunderstorms and associated turbulence
b. Gathering and presenting terrain data
c. Transponder interrogation
d. Air to air traffic avoidance
e. Navigation display

19. The maximum range of the weather radar system is approximately ______ nautical miles and provides a visual span of 90 degrees (45 degrees on each side of the aircraft longitudinal axis).

a. 120
b. 130
c. 140
d. 150
e. 160

20. The weather radar system consists of three (3) basic components, consisting of the receiver-transmitter, _________ and antenna.

21. The receiver-transmitter generates a(n) __-KW energy pulse that is then routed through the antenna.

22. The ________ accepts energy from the receiver-transmitter and transforms the energy into a narrow, radiated beam.

a. Antenna
b. Radar indicator
c. Receiver-transmitter
d. Flux detector
e. None of the above

23. Which of the following statements is NOT true about radar echo levels?

a. Radar echoes received from storms are divided into three separate levels, dependent upon the strength of the respective echo
b. The dark hole represents the strongest of the echo levels
c. Echo levels are presented on the radar indicator as three distinct levels of brilliance
d. The brighter of two shades displayed in Wx mode represent strongest level of echo strength turbulence
e. The lighter of two shades displayed in Wx mode represents the lowest level of echo strength turbulence

24. A dark hole on the radar presentation is a representation of a _________.

a. Lake
b. Clear area
c. Non-Contour cell
d. Contour or storm area
e. All the above

25. In the ________ position, the indicator will cycle to verify if a dark hole is a contour or a storm cell and not a lake or some other terrain feature.

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