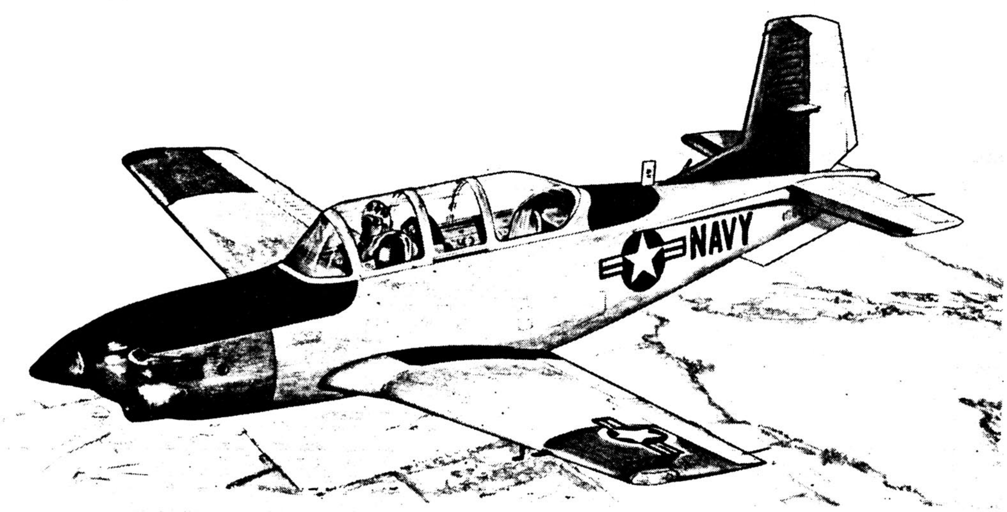
NAVAIR 01-T34AAC-1

# NATOPS
# FLIGHT MANUAL
# NAVY MODEL
# T-34C AIRCRAFT

**THIS PUBLICATION SUPERSEDES NAVAIR 01-T34AAC-1 DATED 1 MARCH 1995 AND CHANGED 1 FEBRUARY 1998.**

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**1 FEBRUARY 2000**

DEPARTMENT OF THE NAVY
CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, D.C. 20350-2000

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization (NATOPS) Program is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft mishap rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative, but rather to aid the commanding officer in increasing the unit's combat potential without reducing command prestige or responsibility.

2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual requirements and procedures is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end, commanding officers of aviation units are authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAVINST 3710.7, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and carried for use in naval aircraft.

J. B. NATHMAN
Rear Admiral, U.S. Navy
Director, Air Warfare

# INTERIM CHANGE SUMMARY

*The following Interim Changes have been cancelled or previously incorporated into this manual.*

| INTERIM CHANGE NUMBER(S) | REMARKS/PURPOSE |
|---|---|
| 1 thru 31 | Previously incorporated. |
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*The following Interim Changes have been incorporated into this Change/Revision.*

| INTERIM CHANGE NUMBER(S) | REMARKS/PURPOSE |
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*Interim Changes Outstanding — To be maintained by the custodian of this manual.*

| INTERIM CHANGE NUMBER | ORIGINATOR/DATE (or DATE/TIME GROUP) | PAGES AFFECTED | REMARKS/PURPOSE |
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# Summary of Applicable Technical Directives

*Information relating to the following recent technical directives has been incorporated in this manual.*

| CHANGE NUMBER | DESCRIPTION | DATE INC. IN MANUAL | VISUAL IDENTIFICATION |
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*Information relating to the following applicable technical directives will be incorporated in a future change.*

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# RECORD OF CHANGES

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# PREFACE

## SCOPE

The NATOPS flight manual is issued by the authority of the Chief of Naval Operations and under the direction of Commander, Naval Air Systems Command in conjunction with the naval air training and operating procedures standardization program. This manual contains information on all aircraft systems, performance data, and operating procedures required for safe and effective operation. However, it is not a substitute for sound judgment. Compound emergencies, available facilities, adverse weather or terrain, or considerations affecting the lives and property of others may require modification of the procedures contained herein. Read this manual from cover to cover. It's your responsibility to have a complete knowledge of its contents.

## OPERATIONAL RISK MANAGEMENT

Operational Risk Management is a means to define, manage, and eliminate risk whenever possible. ORM includes risk assessment, risk decision making, and implementation of effective risk controls. ORM is a program directed by the CNO through OPNAVINST 3500.39. Activities operating the T-34C shall adhere to proper ORM, including the four main principles of ORM:

Accept risk only when the benefits outweigh the cost.

Accept no unnecessary risk.

Anticipate and manage risk by planning.

Make decisions at the right level.

T-34C operation should utilize at least time-critical ORM in the scheduling and conduct of flight operations. Each activity operating the T-34C should ensure the command's operating procedures for the T-34C cover situations requiring deliberate and in-depth ORM.

## APPLICABLE PUBLICATIONS

The following applicable publications complement this manual:

NAVAIR 01-T34AAC-1B (Pilot's Pocket Checklist)

NAVAIR 01-T34AAC-1F (Functional Checkflight Checklist)

## HOW TO GET COPIES

**One-Time Orders.** If this publication is needed on a one–time basis (without future updates), it can be ordered IAW NAVSUP P–409 (MILSTRIP/ MILSTRAP) from NAVICP Philadelphia via DAAS through the local supply system) or the requisition may be submitted to Naval Supply Systems Command, Naval Logistics Library (NLL) web site www.nll.navsup.navy.mil. This publication is also available to view or download from the NATEC web site www.natec.navy.mil.

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### UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, NATOPS review conferences are held in accordance with OPNAVINST 3710.7.

### CHANGE RECOMMENDATIONS

Recommended changes to this manual or other NATOPS publications may be submitted by anyone in accordance with OPNAVINST 3710.7.

Routine change recommendations are submitted directly to the model manager on OPNAV form 3710/6 shown herein. The address of the model manager of this aircraft is:

Commander
Training Air Wing 5, NAS Whiting Field
Milton, Florida 32570-5100

Change recommendations of an URGENT nature (safety of flight, etc.) should be submitted directly to the NATOPS advisory group member in the chain of command by priority message.

### YOUR RESPONSIBILITY

NATOPS flight manuals are kept current through an active manual change program. Any corrections, additions, or constructive suggestions for improvement of its content should be submitted by routine or urgent change recommendation, as appropriate, at once.

### NATOPS FLIGHT MANUAL INTERIM CHANGES

Flight manual interim changes are changes or corrections to the NATOPS flight manuals promulgated by CNO or NAVAIRSYSCOM. Interim changes are issued either as printed pages or as a naval message. The interim change summary page is provided as a record of all interim changes. Upon receipt of a change or revision, the custodian of the manual should check the updated interim change summary to ascertain that all outstanding interim changes have been either incorporated or canceled; those not incorporated shall be recorded as outstanding in the section provided.

### CHANGE SYMBOLS

Revised text is indicated by a black vertical line in either margin of the page, adjacent to the affected text, like the one printed next to this paragraph. The change symbol identifies the addition of either new information, a changed procedure, the correction of an error, or a rephrasing of the previous material. A change symbol in the margin by the chapter number and title indicates a new or completely revised chapter.

### WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to “WARNINGs,” “CAUTIONs,” and “Notes” found throughout the manual.

**WARNING**

An operating procedure, practice, or condition, etc., that may result in injury or death if not carefully observed or followed.

**CAUTION**

An operating procedure, practice, or condition, etc., that may result in damage to equipment if not carefully observed or followed.

**Note**

An operating procedure, practice, or condition, etc., that is essential to emphasize.

## WORDING

The concept of word usage and intended meaning that has been adhered to in preparing this manual is as follows:

"Shall" has been used only when application of a procedure is mandatory.

"Should" has been used only when application of a procedure is recommended.

"May" and "need not" have been used only when application of a procedure is optional.

"Will" has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

"Land as soon as possible" — Land at the nearest site at which a safe landing can be made.

"Land as soon as practicable" — Extended flight is not recommended. The landing site and duration of flight is at the discretion of the pilot in command.

**NATOPS/TACTICAL CHANGE RECOMMENDATION**
**OPNAV 3710/6 (4-90) S/N 0107-LF-009-7900** **DATE** ____________

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

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| TO (Model Manager) | Unit |

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Justification

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| TO | |

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☐ Your change recommendation dated ____________ is acknowledged. It will be held for action of the review conference planned for ____________ to be held at ____________

☐ Your change recommendation is reclassified URGENT and forwarded for approval to ____________ ____________ by my DTG ____________

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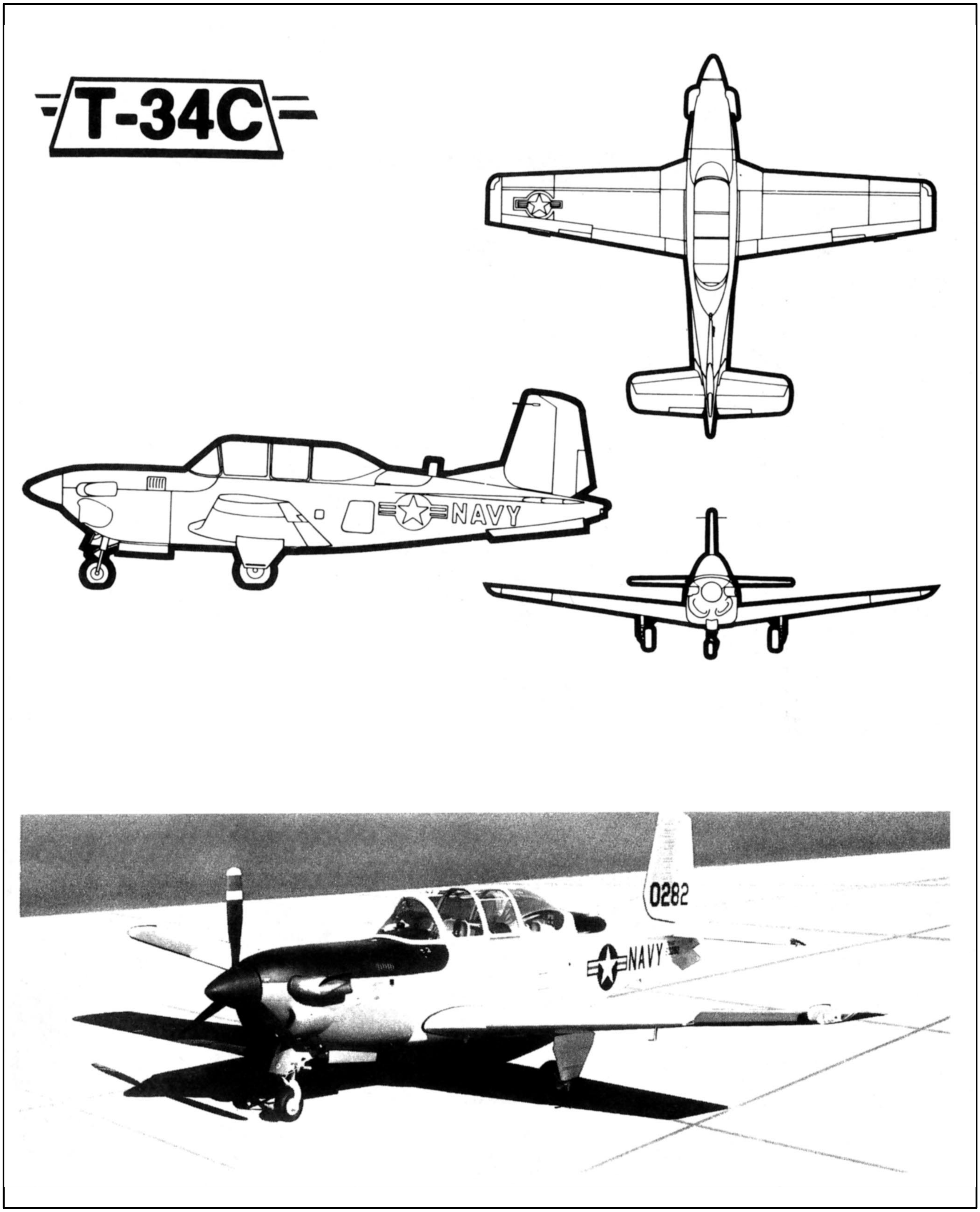
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# PART I

# The Aircraft

# CHAPTER 1

# Aircraft and Engine

## 1.1 AIRCRAFT

The T-34C aircraft is an unpressurized two-place, tandem cockpit, low-wing, single-engine monoplane manufactured by Beech Aircraft Corporation, Wichita, Kansas. Although dual flight controls and instrumentation are provided for student training, solo flight shall be accomplished from the front cockpit only. See Figures 1-1 through 1-9 for general arrangement, instrument panels, and consoles.

## 1.2 AIRCRAFT DIMENSIONS

Overall dimensions of the aircraft are:

Wing span — 33 feet 5 inches.
Length — 28 feet 8 inches.
Height (at rest) — 9 feet 11 inches.
Tread — 9 feet 6 inches.

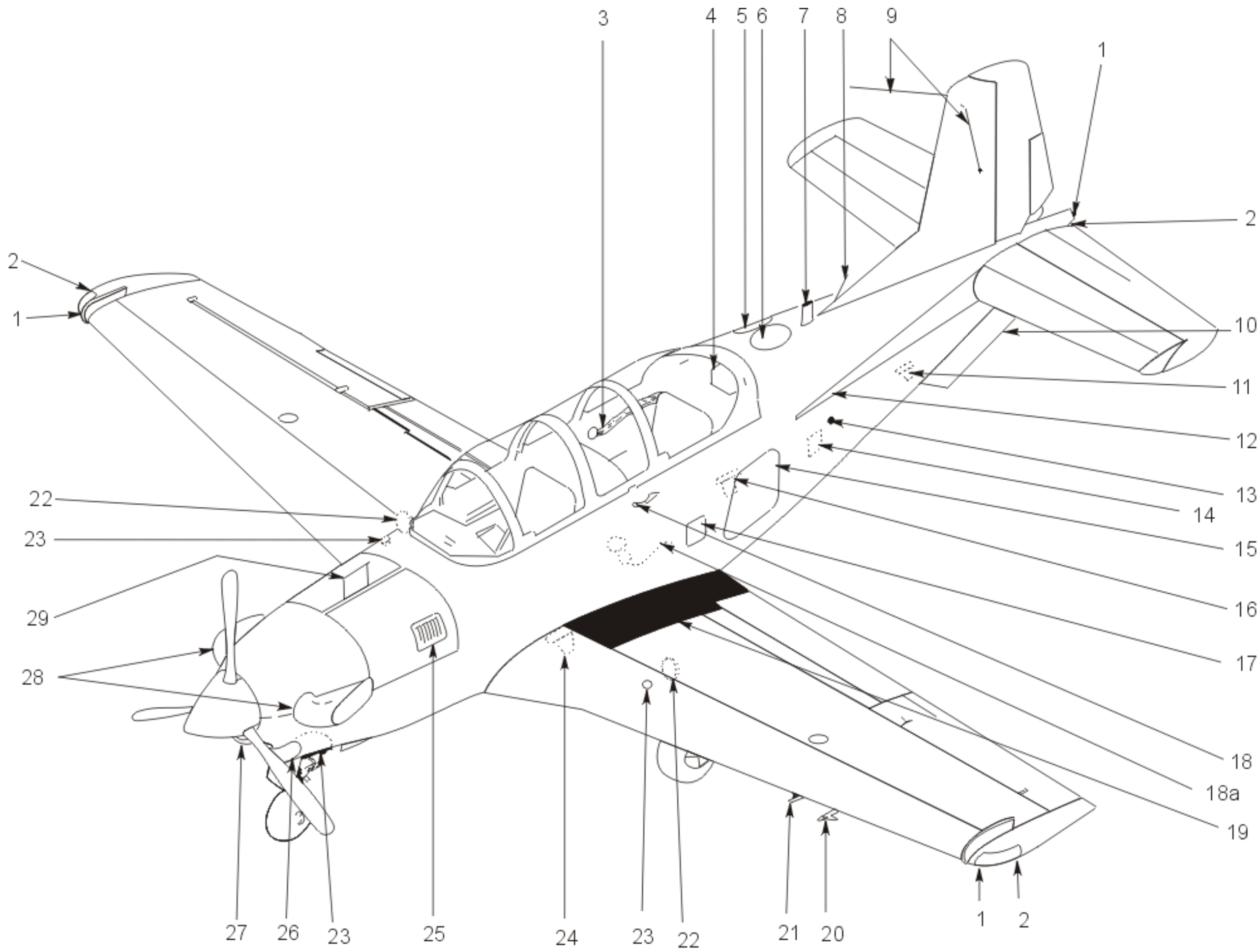
## 1.3 GROSS WEIGHT

Maximum gross weight for:

Maximum ramp weight — 4,425 pounds.
Takeoff and landing — 4,400 pounds.
Maximum aerobatic weight — 4,300 pounds.
Maximum zero fuel weight — 3,650 pounds.
Basic weight (approximately) — 2,970 pounds.

## 1.4 ENGINE

The aircraft is powered by a turboprop engine manufactured by Pratt & Whitney Aircraft of Canada, Model PT6A-25, with inverted flight capabilities. The PT6A-25 engine is flat rated at 550 shp maximum. Normal operation (1,015 ft-lb) is 425 shp.



1. Strobe Light
2. Navigation Light
3. Instrument Hood
4. First Aid Kit
5. GPS Antenna
6. NACWS GPS Antenna
7. UHF Antenna
8. ELT Antenna
9. VOR Antenna
10. Ventral Fin (RH Not Shown)
11. TACAN Antenna
12. Strake (RH Not Shown)
13. Static Air Source (RH Not Shown)
14. NACWS Antenna Lower
15. Avionics Compartment
16. AFT Transponder Antenna
17. AFT Cockpit Assist Step
18. Assist Handle
18a. VHF Antenna
19. Wing Walkway (RH Not Shown)
20. Angle of Attack Probe
21. Pilot Probe
22. Landing Light
23. External Landing Gear Position Indicator Light
24. Forward Transponder Antenna
25. Cooling Air Outlet (RH Not Shown)
26. Oil Cooler Air Intake
27. Engine Air Intake
28. Exhaust Stacks
29. NACWS Antenna, Upper

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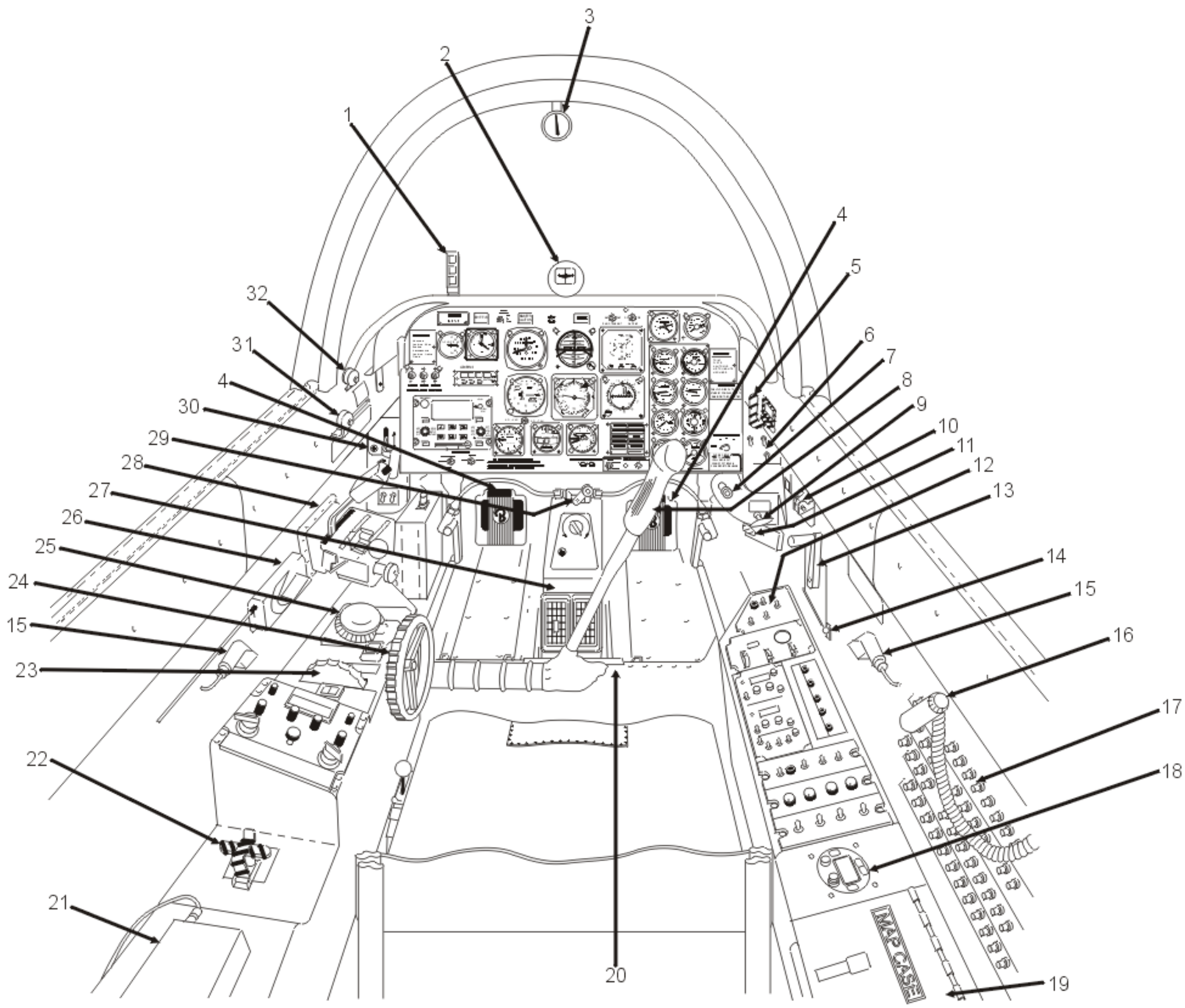
Figure 1-1. General Arrangement




1. AOA Indexer
2. Magnetic Standby Compass
3. Free Air Temperature Gage
4. Rudder Pedals
5. Emergency Canopy Open Handle
6. Starter/Ignition Control Panel
7. Parking Brake Handle
8. Control Stick
9. Engine Air Inlet Bypass
10. Oxygen Control Handle
11. Alternate Static Air Control
12. Electrical Control Command Panel
13. Emergency Landing Gear Extension Handle
14. Landing Gear Hand Crank Clutch Knob
15. Cockpit Flood Lights
16. Cockpit Utility Light
17. Circuit Breaker Panel
18. VHF Radio
19. Map Case
20. Flight Controls Lock Frame
21. Emergency Locator Transmitter (ELT)
22. Emergency Fuel Shut-off Handle
23. Aileron Trim Control
24. Elevator Trim Control
25. Rudder Trim Control
26. Flap Switch
27. Evaporator Unit
28. Engine/Propeller Control Quadrant
29. Rudder Adjustment Handle
30. Left Subpanel
31. Cockpit Environmental Control
32. Windshield Defogger Control

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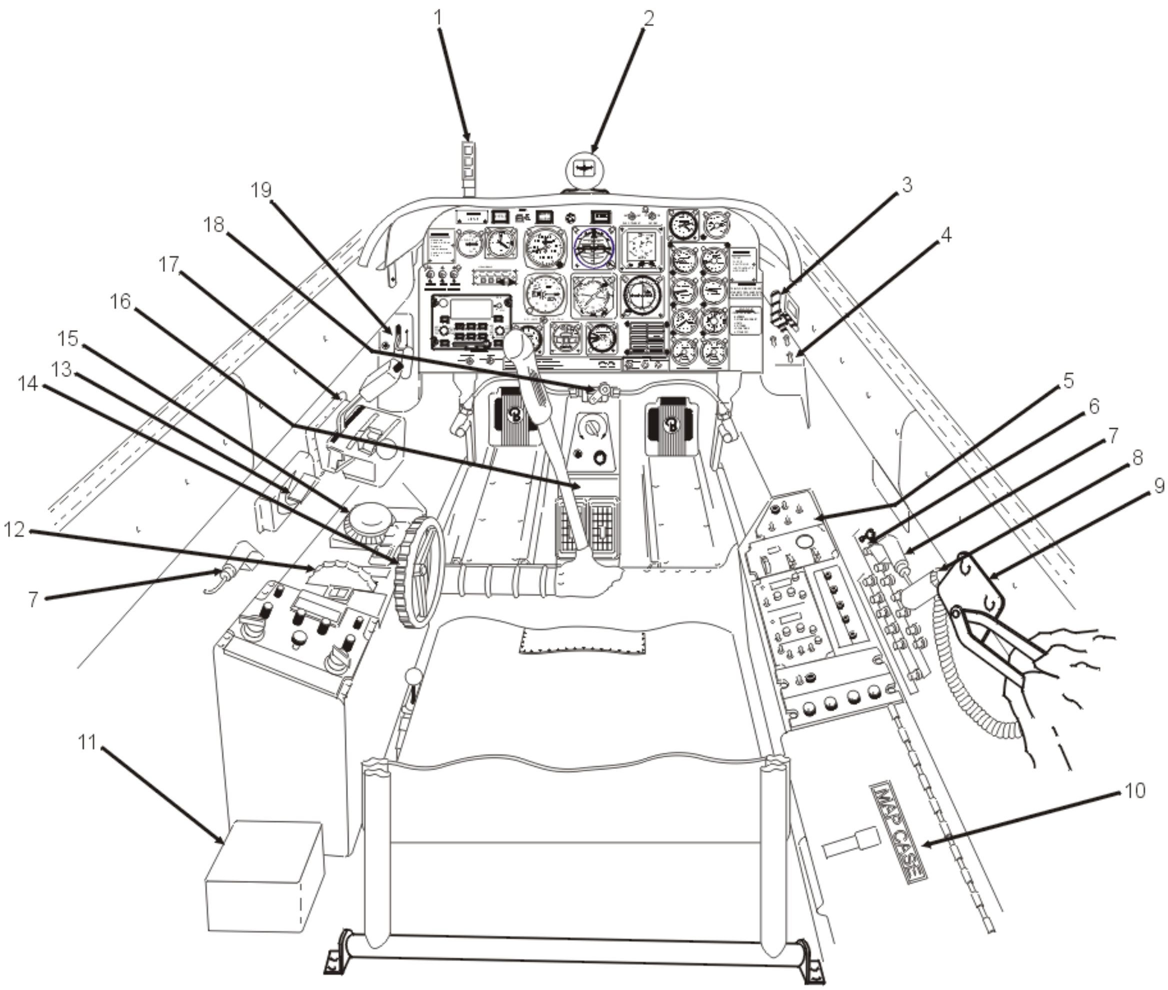
Figure 1-2. Front Cockpit Arrangement




1. AOA Indexer
2. Magnetic Standby Compass
3. Emergency Canopy Open Handle
4. Starter/Ignition Control Panel
5. Electrical Command Control Panel
6. Circuit Breaker Panel
7. Cockpit Flood Lights
8. Cockpit Utility Light
9. Instrument Flight Hood
10. Map Case
11. Vertical Gyro
12. Aileron Trim Control
13. Flap Switch
14. Elevator Trim Control
15. Rudder Trim Control
16. Evaporator Unit
17. Engine/Propeller Control Quadrant
18. Rudder Pedal Adjust Control
19. Left Subpanel

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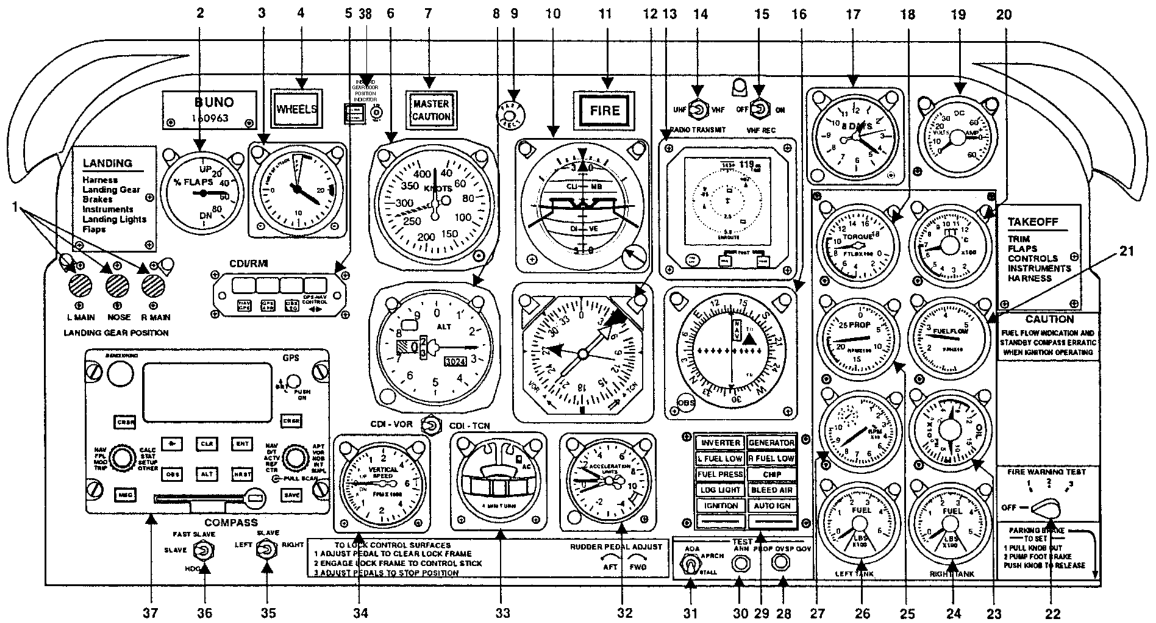
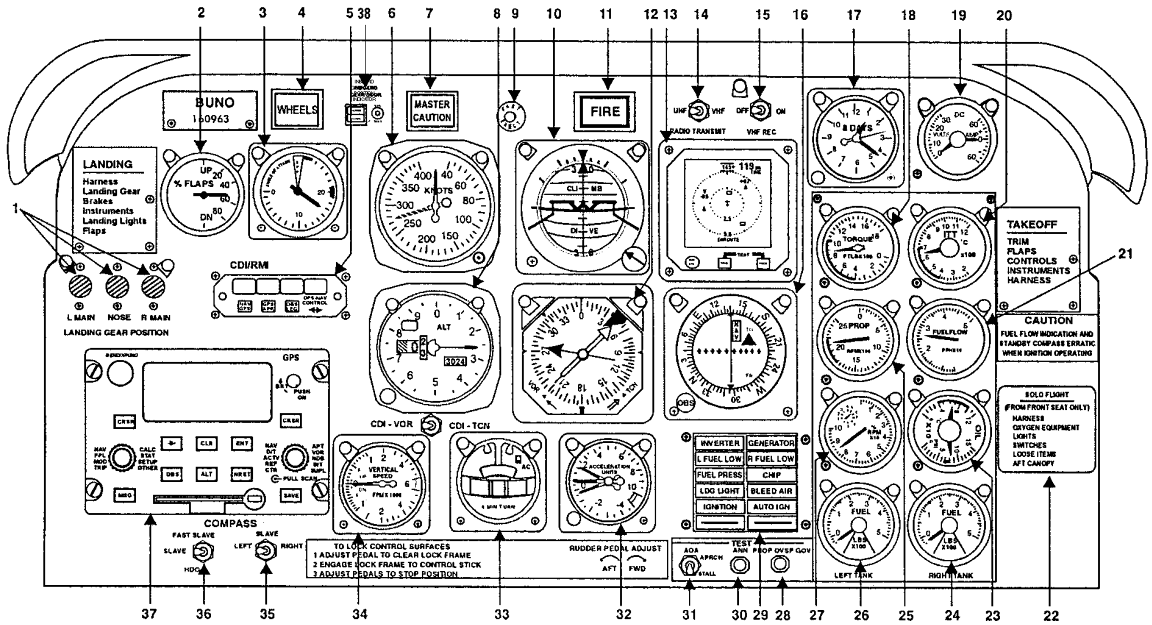
Figure 1-3. Aft Cockpit Arrangement




1. LANDING GEAR POSITION Indicators - (28 V.D.C.)
2. Flap Position Indicator - (28 V.D.C.)
3. Angle-of-Attach (AOA) Indicator - (28 V.D.C.)
4. Landing Gear Warning Light - (28 V.D.C.)
5. GPS/NAV Annunciator/Control Panel - (28 V.D.C.)
6. Airspeed Indicator - (Pitot-Static)
7. MASTER CAUTION Light - (28 V.D.C., Flashing-Amber)
8. Altimeter - (Mode C 28 V.D.C., 28 V.D.C., Vibrator, Static)
9. ATTITUDE GYRO FAST ERECT Switch - (1 Per Minute)
10. Attitude Indicator - (115 V.A.C.)
11. FIRE Warning Light - (28 V.D.C.-Red)
12. Radio Magnetic Indicator (RMI) - (28 V.D.C. & 26 V.A.C.)
13. NACWS - (28 V.D.C. & 26 V.A.C.)
14. VHF/UHF Radio Transmit Switch (28 V.D.C.)
15. VHF Receive Switch (28 V.D.C.)
16. Course Deviation Indicator - (Repeat VOR/Tacan Info From RMI)
17. Clock - (8 Day & Elapsed Time, Self Powered)
18. Torquemeter - (26 V.A.C.)
19. VOLT/AMP Meter - (Reads Minus Amps On G.P.U.)
20. Interstage Turbine Temperature Gage - (Self Powered)
21. Fuel Flow Gage - (26 V.A.C.)
22. FIRE Warning Test Switch - (1. Low ACC. 2. Upper ACC. 3. Engine)
23. Oil Temperature and Pressure Gage - (28 V.D.C.)
24. Fuel Quantity Gage - (28 V.D.C.)
25. Propeller Tachometer - (Self Powered)
26. Fuel Quantity Gage - (28 V.D.C.)
27. Turbine Tachometer - (Self Powered)
28. PROP OVSP TEST Switch - (1950 - 2150 Prop R.P.M.)
29. Annunciator Panel - (28 V.D.C.)
30. Annunciator Panel Test Switch - (28 V.D.C.)
31. A.O.A. Test Switch - (28 V.D.C. - App. 20 Units - Stall Warning 26.5 Units)
32. Accelerometer - (Self Powered By Acceleration Forces)
33. Turn-and-Slip Indicator - (115 V.A.C.)
34. Vertical Speed Indicator - (Static)
35. COMPASS SLAVE Switch - (MANUAL Control in D.G. Position)
36. COMPASS FAST SLAVE Switch - (SLAVE - Auto Align, FAST - Quick Align Card to Flux Det., D.G. - Disconnects Card From Flux Det.)
37. Global Positioning System Unit - (28 V.D.C./26 V.A.C.)
38. Inboard Gear Door Position Indicator (28 V.D.C.)

Figure 1-4. Front Cockpit Instrument Panel (GPS)




1. LANDING GEAR POSITION Indicators - (28 V.D.C.)
2. Flap Position Indicator - (28 V.D.C.)
3. Angle-of-Attach (AOA) Indicator - (28 V.D.C.)
4. Landing Gear Warning Light - (28 V.D.C.)
5. GPS/NAV Annunciator/Control Panel - (28 V.D.C.)
6. Airspeed Indicator - (Pitot-Static)
7. MASTER CAUTION Light - (28 V.D.C., Flashing-Amber)
8. Altimeter - (Mode C 28 V.D.C., 28 V.D.C., Vibrator, Static)
9. ATTITUDE GYRO FAST ERECT Switch - (1 Per Minute)
10. Attitude Indicator - (115 V.A.C.)
11. FIRE Warning Light - (28 V.D.C.-Red)
12. Radio Magnetic Indicator (RMI) - (28 V.D.C. & 26 V.A.C.)
13. NACWS - (28 V.D.C. & 26 V.A.C.)
14. VHF/UHF Radio Transmit Switch (28 V.D.C.)
15. VHF Receive Switch (28 V.D.C.)
16. Course Deviation Indicator - (Repeat VOR/Tacan Info From RMI)
17. Clock - (8 Day & Elapsed Time, Self Powered)
18. Torquemeter - (26 V.A.C.)
19. VOLT/AMP Meter - (Reads Minus Amps On G.P.U.)
20. Interstage Turbine Temperature Gage - (Self Powered)
21. Fuel Flow Gage - (26 V.A.C.)
22. Solo Flight Placard (Aft Cockpit Only)
23. Oil Temperature and Pressure Gage - (28 V.D.C.)
24. Fuel Quantity Gage - (28 V.D.C.)
25. Propeller Tachometer - (Self Powered)
26. Fuel Quantity Gage - (28 V.D.C.)
27. Turbine Tachometer - (Self Powered)
28. PROP OVSP TEST Switch - (1950 - 2150 Prop R.P.M.)
29. Annunciator Panel - (28 V.D.C.)
30. Annunciator Panel Test Switch - (28 V.D.C.)
31. A.O.A. Test Switch - (28 V.D.C. - App. 20 Units - Stall Warning 26.5 Units)
32. Accelerometer - (Self Powered By Acceleration Forces)
33. Turn-and-Slip Indicator - (115 V.A.C.)
34. Vertical Speed Indicator - (Static)
35. COMPASS SLAVE Switch - (MANUAL Control in D.G. Position)
36. COMPASS FAST SLAVE Switch - (SLAVE - Auto Align, FAST - Quick Align Card to Flux Det., D.G. - Disconnects Card From Flux Det.)
37. Global Positioning System Unit - (28 V.D.C./26 V.A.C.)
38. Inboard Gear Door Position Indicator (28 V.D.C.)

REVISION: 7/99

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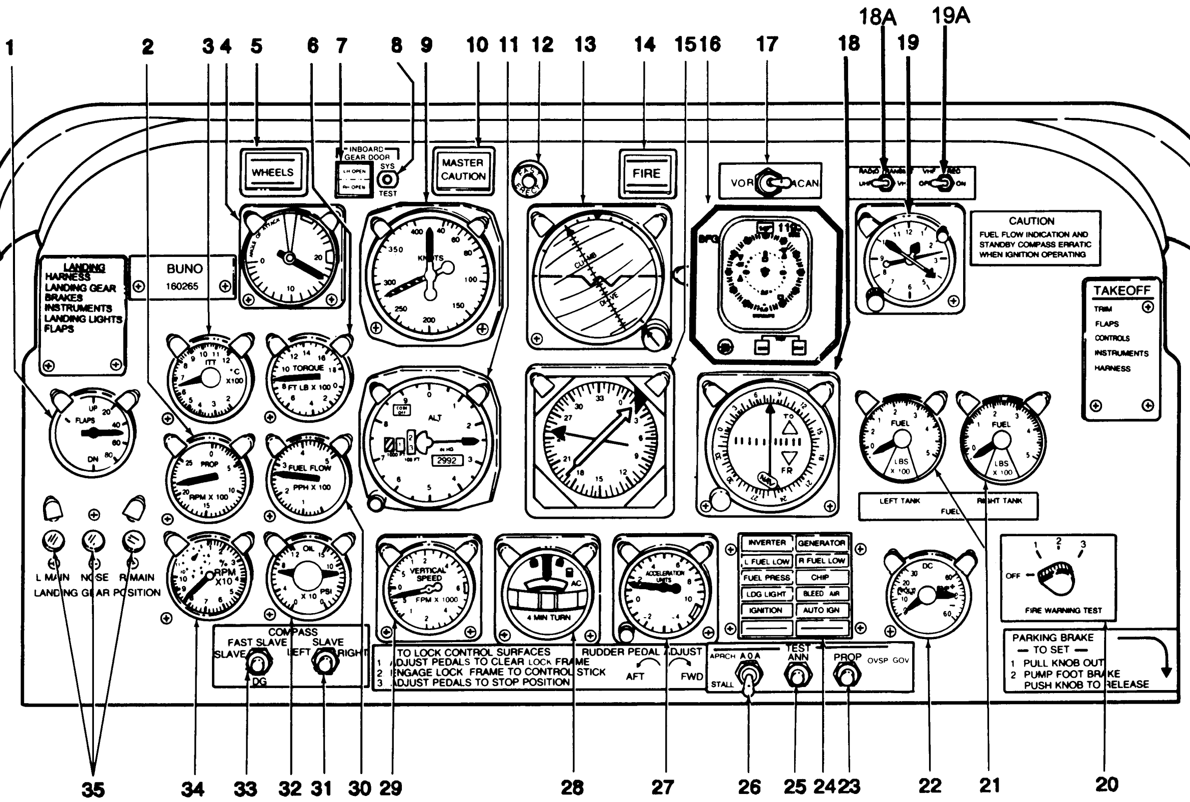
Figure 1-5. Aft Cockpit Instrument Panel (GPS)




1. Flap Position Indicator
2. Propeller Tachometer
3. Interstage Turbine Temperature Gauge
4. Angle-of-Attack (AOA) Indicator
5. Landing Gear Warning Light
6. Torquemeter
7. Inboard Gear Doors Indicator Lights
8. Inboard Gear Doors Indicator Lights Test Switch
9. Airspeed Indicator
10. MASTER CAUTION Light
11. Altimeter
12. ATTITUDE GYRO FAST ERECT Switch
13. Attitude Indicator
14. FIRE Warning Light
15. Radio Magnetic Indicator (RMI)
16. NACWS CDU
17. VOR/TACAN Switch
18. Course Deviation Indicator

18a. Radio Transmit Switch
19. Clock
19a. VHF Receive Switch
20. FIRE Warning Test Switch
21. Fuel Quantity Gauges
22. VOLT/AMP Meter
23. PROP OVSP TEST Switch
24. Annunciator Panel
25. Annunciator Panel Test Switch
26. A.O.A. Test Switch
27. Accelerometer
28. Turn-and Slip Indicator
29. Vertical Speed Indicator
30. Fuel Flow Gauge
31. COMPASS SLAVE Switch
32. Oil Temperatue and Pressure Gauge
33. COMPASS FAST SLAVE Switch
34. Turbine Tachometer
35. LANDING GEAR POSITION Indicators

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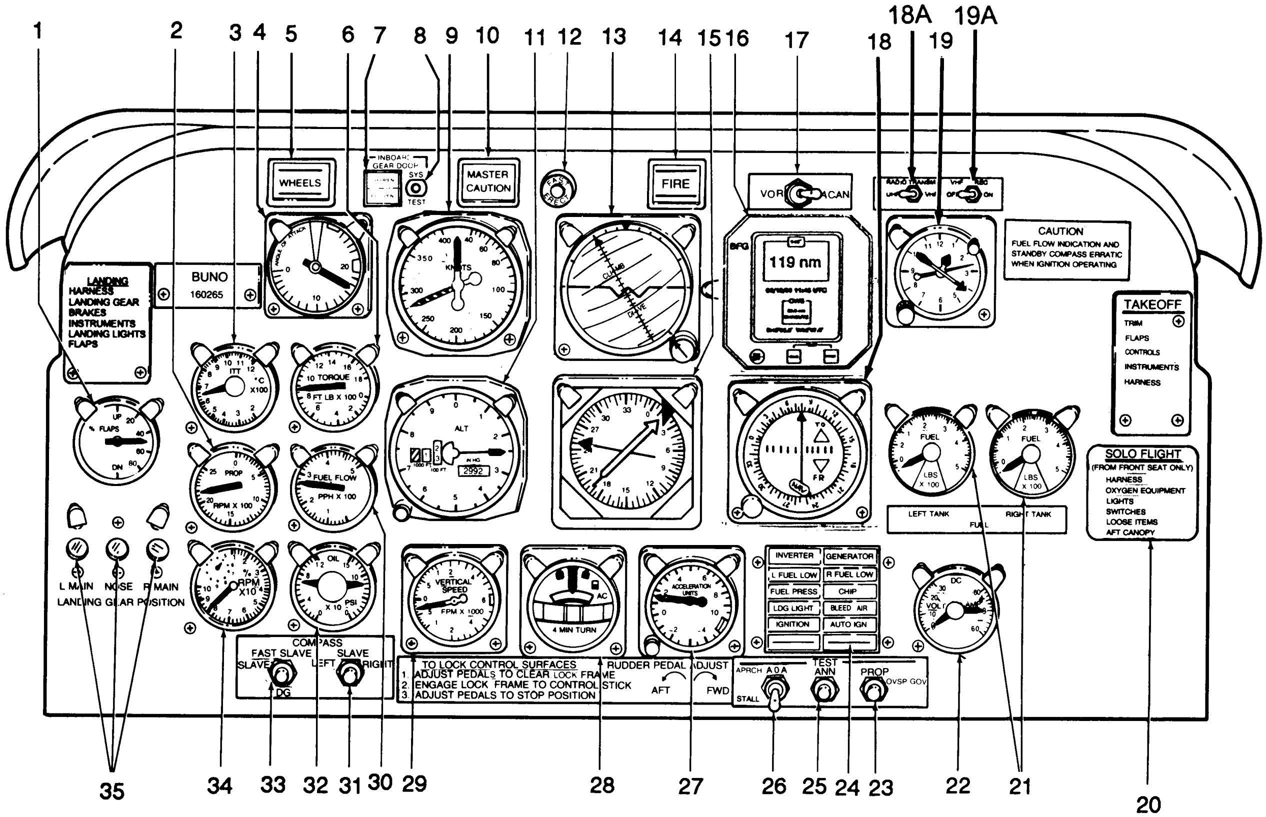
Figure 1-6. Front Cockpit Instrument Panel




1. Flap Position Indicator
2. Propeller Tachometer
3. Interstage Turbine Temperature Gauge
4. Angle-of-Attack (AOA) Indicator
5. Landing Gear Warning Light
6. Torquemeter
7. Inboard Gear Doors Indicator Lights
8. Inboard Gear Doors Indicator Lights Test Switch
9. Airspeed Indicator
10. MASTER CAUTION Light
11. Altimeter
12. ATTITUDE GYRO FAST ERECT Switch
13. Attitude Indicator
14. FIRE Warning Light
15. Radio Magnetic Indicator (RMI)
16. NACWS CDU
17. VOR/TACAN Switch
18. Course Deviation Indicator

18a. Radio Transmit Switch
19. Clock
19a. VHF Receive Switch
20. Solo flight Placard (Aft Cockpit Only)
21. Fuel Quantity Gauges
22. VOLT/AMP Meter
23. PROP OVSP TEST Switch
24. Annunciator Panel
25. Annunciator Panel Test Switch
26. A.O.A. Test Switch
27. Accelerometer
28. Turn-and-Slip Indicator
29. Vertical Speed Indicator
30. Fuel Flow Gauge
31. COMPASS SLAVE Switch
32. Oil Temperature and Pressure Gauge
33. COMPASS FAST SLAVE Switch
34. Turbine Tachometer
35. LANDING GEAR POSITION Indicators

F-0105

Figure 1-7. Aft Cockpit Instrument Panel

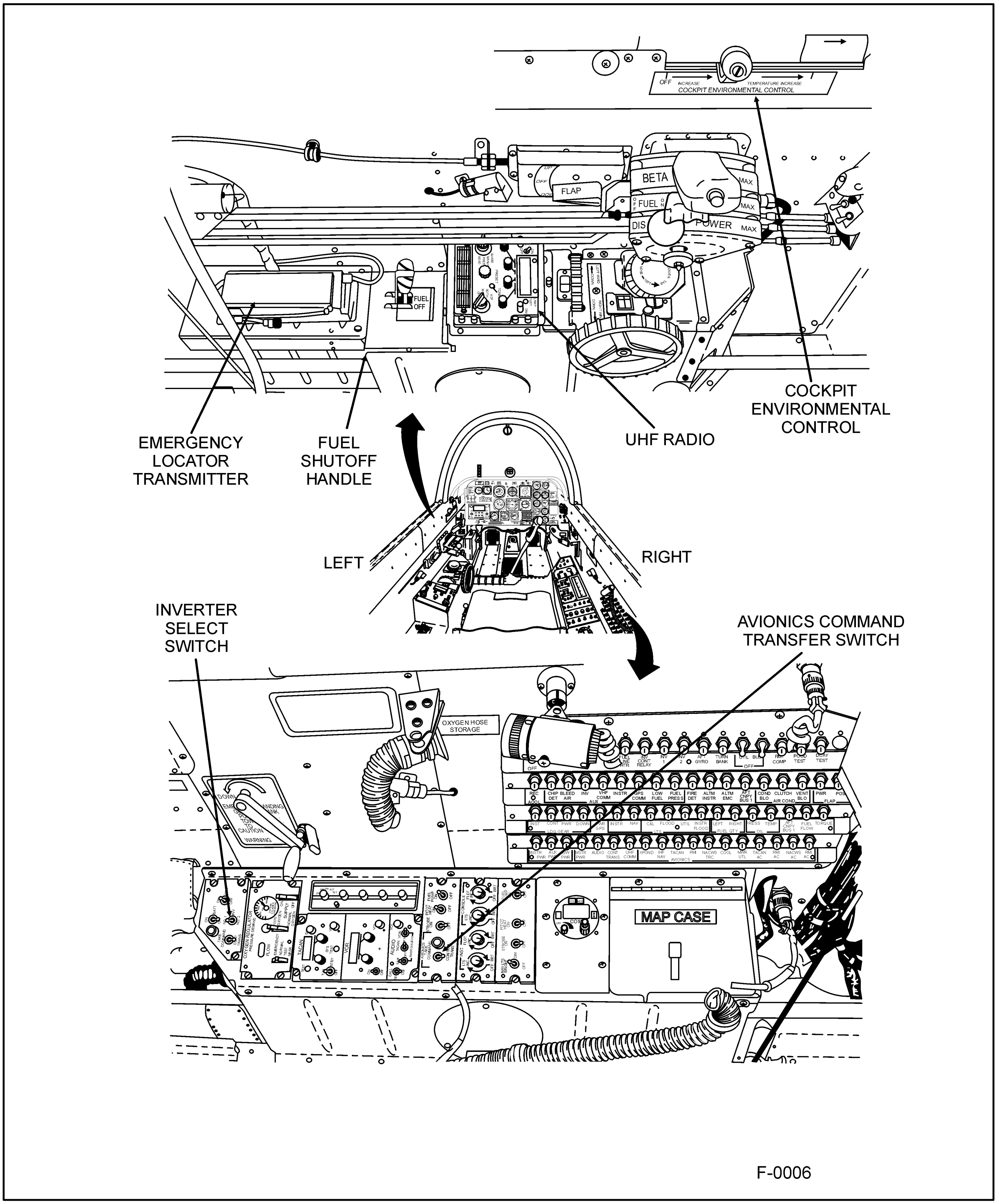



Figure 1-8. Front Cockpit Consoles

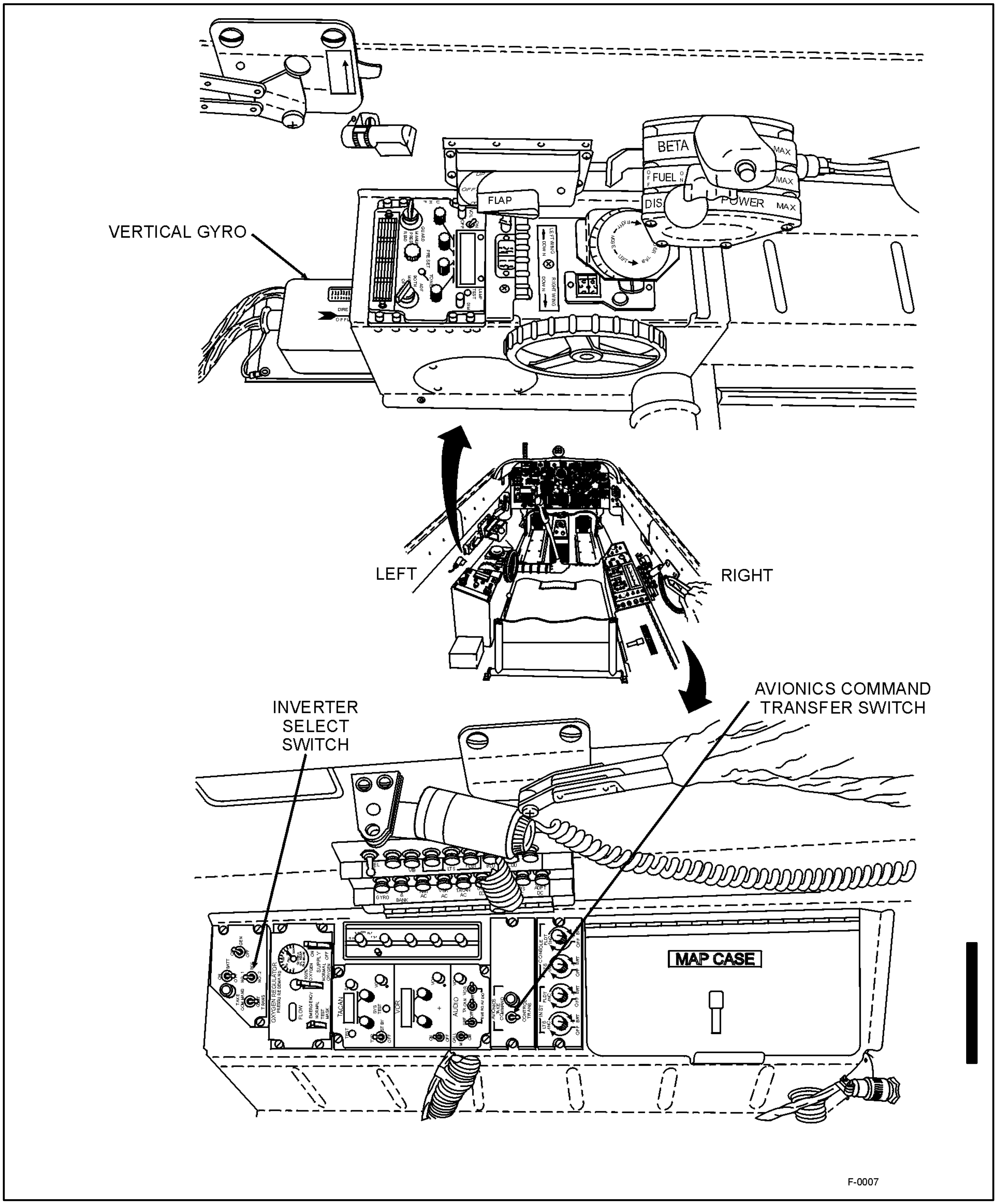



Figure 1-9. Aft Cockpit Consoles

# CHAPTER 2

# Systems

## 2.1 ENGINE

The PT6A-25 turboprop engine (Figure 2-1) has a three-stage axial and single-stage centrifugal compressor driven by a single-stage reaction turbine. Another single-stage reaction turbine, mounted in tandem and counterrotating with the first, drives the reduction gearbox output shaft and flanged propeller shaft. A circular screen around the air intake at the rear of the gas generator case reduces foreign object ingestion by the compressor. The combustion chamber is of the reverse-flow type and consists primarily of an annular heat-resistant steel liner opened at one end. Fuel is sprayed in the annular combustion chamber by 14 individually removable fuel nozzles mounted around the gas generator case. A high-energy ignition unit with two spark igniter plugs is used to initiate combustion. A hydro pneumatic fuel control schedules fuel flow to maintain the gas generator speed set by the power control lever. Engine torque output is controlled by manual actuation of the PCL. A torque limiter bleeds $P_Y$ air to protect the engine from damage because of an inadvertent overtorque (above 1,315 ft-lb) or malfunction of the fuel control unit. The torque limiter is set to a value above the maximum operating limit of 1,015 ft-lb to allow the pilot to control and/or maintain torque at the maximum limit by PCL movement. The engine lubrication system has a two-way valve incorporated at the main pump inlet to provide inverted flight capability.

**2.1.1 Principles of Operations.** Outside air enters the cowling air intake, then flows through a circular plenum chamber formed around the engine compressor section and is screen filtered into the engine at an air inlet opening. Within the engine, air is directed first to the three-stage axial compressor and the centrifugal compressor. A compressor bleed valve automatically opens a port in the gas generator case (compressor housing) to spill interstage compressor air, thereby providing antistall characteristics at low-engine speeds. The port closes gradually as higher engine speeds are attained. Air is then forced through the diffuser vanes, turned 90°, and sent into the combustion chamber. Within the combustion chamber, air is mixed with fuel to form a combustible gas. This gas is ignited initially (during engine start) by two igniter plugs that protrude into the combustion chamber. After starting and upon securing the starter switch, the igniter plugs are switched off and combustion continues as long as the proper fuel-to-air ratio is supplied. Expanding from the combustion chamber, the main volume of burning gases reverses in direction and passes through nozzle guide vanes to reach blades of the compressor turbine. After impinging upon and passing through the blades of the compressor turbine, these gases continue to flow through the engine until the blades of the power turbine are reached. The force of gas expansion drives the power turbine and then is expelled from the engine as exhaust. The compressor and power turbines are positioned near the center of engine mass with power shafts extending in opposite directions. Gas flow through the compressor turbine causes rotation of the axial and centrifugal compressors. This gas then passes through the power turbine blades and imparts torque to the propeller shaft via two-stage planetary reduction gearing. After passing through the power turbine, the expanding gas is discharged as exhaust through stationary guide vanes to the outside atmosphere through exhaust stacks on each side of the engine compartment.

**2.1.2 Air Induction/Compartment Cooling.** The engine receives ram air from an air duct in the lower right section of the engine cowling. Design of the engine induction system serves to protect the powerplant from icing and affords foreign object damage protection. The engine compartment is cooled by air entering around the exhaust stack cutouts and exiting around the spinner. The accessory section is cooled by air-conditioning condenser air as well as air dumped from the starter/generator into the accessory section compartment and then exhausting through aft facing louvers on the center-hinged cowl doors (Figure 2-2).

**2.1.3 Foreign Object Damage.** The engine is protected from FOD by an integral air inlet screen.

**2.1.4 Engine Fuel System.** The fuel control system consists of an engine-driven fuel pump, a fuel control unit, a circular manifold, and 14 fuel spray nozzles. An automatic fuel dump valve and two drain

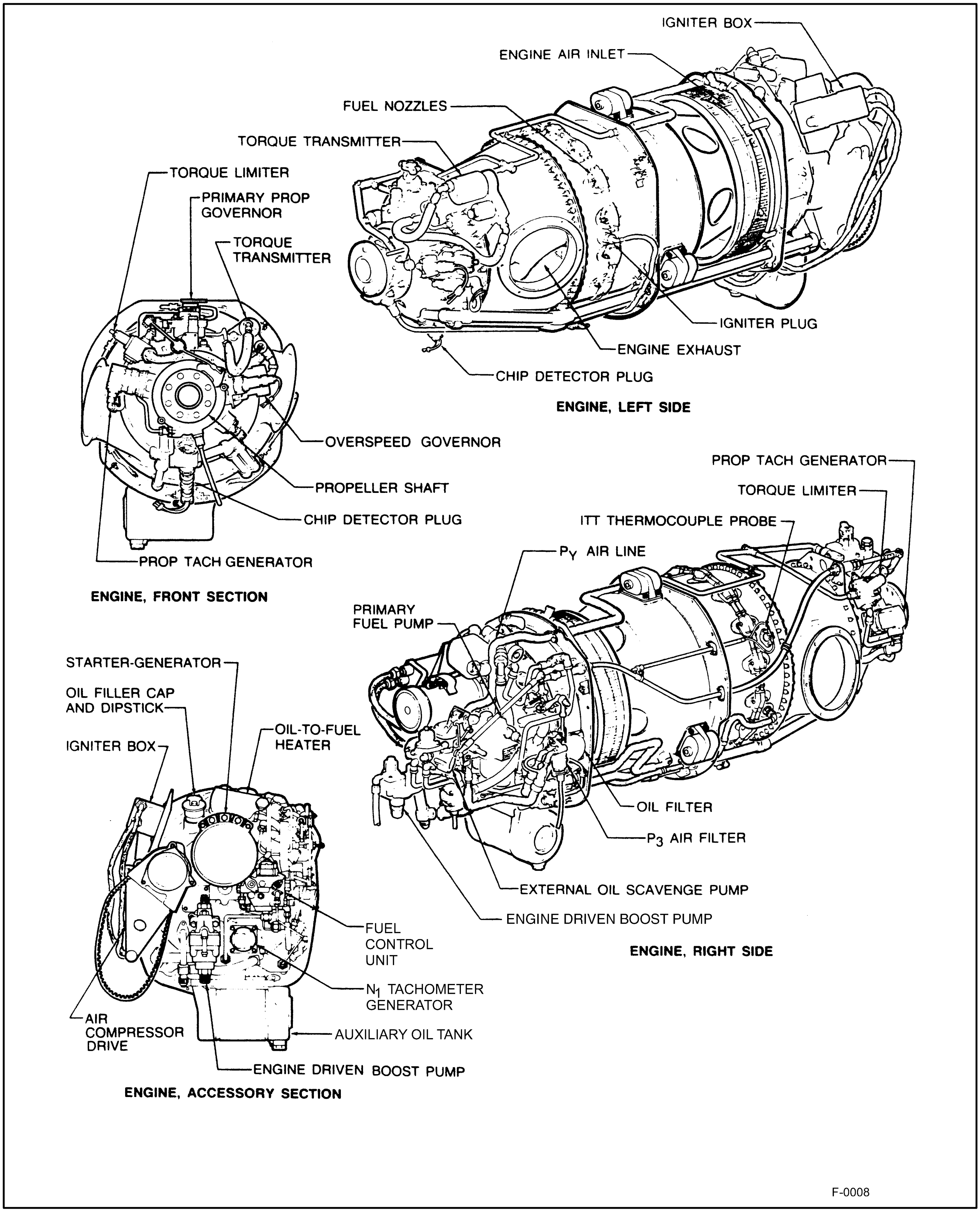



Figure 2-1. PT6A-25 Engine

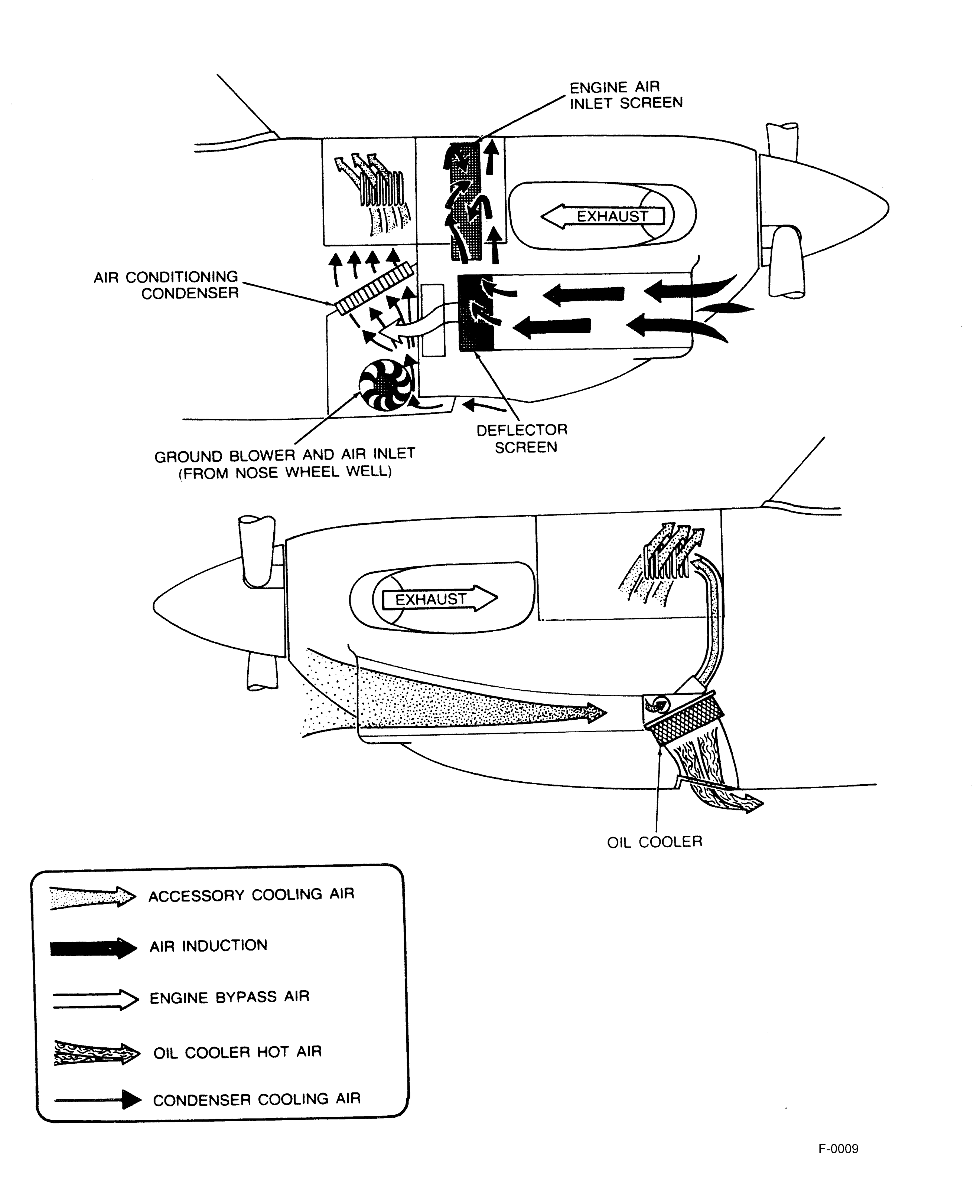



Figure 2-2. Air Induction/Accessory Cooling

valves bleed off residual combustion chamber fuel after engine shutdown.

**2.1.4.1 Fuel Control Unit.** The FCU is located on the accessory case of the engine. This unit determines the proper fuel schedule so that the engine will produce the rpm requested by the relative position of the PCL or the emergency power lever. The control of developed engine power is accomplished by adjusting the engine compressor turbine ($N_1$) speed. $N_1$ speed is controlled by varying the amount of fuel injected into the combustion chamber through the fuel nozzles. All fuel control operations, except engine shutdown, are regulated by manual actuation of the PCL or EPL. Engine shutdown is accomplished by moving the condition lever to the full aft, FUEL-OFF position, which shuts off the fuel supply.

**2.1.4.2 Manual Fuel Control System.** The manual fuel control system consists of a cockpit control that provides the pilot with direct mechanical linkage to the bellows and the fuel metering pin in the FCU. The manual fuel system is a backup system only and is used in the event of a malfunction in the pneumatic section of the FCU. When engaged, the system will bypass all pneumatic failure modes that result in minimum fuel flow and/or lack of engine response to PCL movement. Movement of the EPL toward MAX mechanically depresses the bellows to schedule more fuel to the engine. This system relies on torque tube pretension to reduce power as the EPL is moved toward the idle range. When using the EPL, normal operation of the landing gear warning system is provided. Power loss because of pneumatic failures can be restored by use of the EPL to the desired power setting, then reducing the PCL to IDLE. If the engine is producing low power and PCL is left forward after EPL engagement, subsequent reduction of the EPL setting may return the fuel control unit to PCL control. If both the PCL and EPL are advanced forward of the IDLE position simultaneously, the landing gear warning system will activate (provided the wheels are up) to alert the pilot. Use of the EPL provides no automatic fuel scheduling; metering of fuel to the engine is based solely on lever position, and rapid advance of the EPL may cause compressor stall or engine overtemperature. Idle rpm, when required by the pilot, should be maintained above 65 percent to improve engine response and ensure that the generator stays on line. The manual fuel control system overrides the protective devices relying on pneumatic bleed air as the operational parameter (fuel topping function of the primary propeller governor and the torque limiter). Failure of the FCU to high power cannot be alleviated by this system.

**CAUTION**

- Advancing the EPL will lessen the severity of the low-end fluctuations caused by the activation of the primary governor fuel topping mode. Advancing the EPL beyond the point at which the fluctuations are minimal will result in an overspeed condition.
- Do not attempt to start the engine with the EPL engaged.
- Do not perform jam accelerations with the EPL (compressor stalls and/or engine overtemperature may result if lever is advanced too rapidly).
- Ensure the EPL is in the IDLE range or DISCONNECT before selecting BETA with the PCL.

**Note**

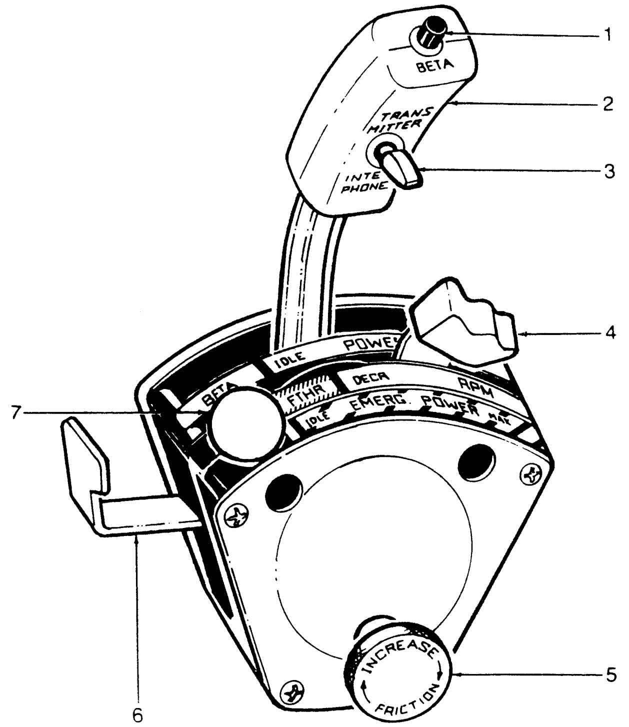
When utilizing the EPL, torque will rise with an increase in altitude and decrease with a decrease in altitude (for a fixed EPL position).

**2.1.5 Power Control Lever.** The PCLs (Figure 2-3) are mechanically interconnected between cockpits and regulate power from idle to maximum. Power control is accomplished through adjustment of the $N_1$ speed governor in the fuel control unit. Power is increased when $N_1$ rpm is increased. The normal engine operating range of 400 to 1,015 ft-lb and up to a maximum limit of 1,015 ft-lb and/or 695°C ITT is controlled by movement of the PCL. Distinct action (depressing the beta switch and pulling aft on the PCL) by the pilot is required to obtain beta range. PCL travel range is placarded BETA, IDLE, POWER, and MAX.

**2.1.6 Condition Lever.** The condition levers (Figure 2-3) combine fuel ON, fuel OFF, feather, and propeller rpm functions and are mechanically interconnected between cockpits. Moving the condition lever aft towards a spring detent will reduce propeller rpm to minimum governed rpm. Further movement aft past the

**Note**

FRICTION LOCK(5) INSTALLED IN FORWARD COCKPIT ONLY




1. BETA Range Switch
2. Power Control Lever (PCL)
3. Radio Transmitter/Interphone Select Switch
4. Condition Lever
5. Friction Lock Knob
6. Fuel Cutoff Stop Lever
7. Emergency Power Lever (EPL)

F-0010

Figure 2-3. Engine/Propeller Control Quadrant

detent to a positive stop will cause the propeller to feather. This mechanical stop can be released by the pilot in either cockpit by raising a spring-loaded lever located on the aft side of the control quadrants. When the stop is released, further movement aft with the condition lever will select the fuel cutoff position of the fuel control. The stop will automatically reset when the condition lever is moved forward out of the fuel cutoff position. The condition lever travel range is placarded alongside the lever slot: OFF FUEL ON, FTHR, DECR RPM INCR.

**2.1.7 Emergency Power Lever.** EPL is mounted on the inboard side of the engine/propeller control quadrant in each cockpit (Figure 2-3). The forward EPL is connected to the engine FCU by a flexible control cable. A control rod interconnects the EPLs between the forward and aft cockpits. Travel range of the EPL is placarded along the lever slot: DISCONNECT, IDLE, EMERG POWER, MAX. A spring holds each EPL in a detent at the DISCONNECT position to prevent inadvertent actuation of the system during normal FCU operation.

**2.1.8 Friction Lock Knob.** A friction lock knob is provided on the forward cockpit pilot's control quadrant to adjust friction drag against PCL and condition levers (Figure 2-3). This knob prevents the levers from creeping when set by the pilot. When rotating clockwise the knob increases the friction and opposes movement of the levers. Counterclockwise rotation will decrease the friction permitting easier movement of the levers.

**2.1.9 Emergency Fuel Shutoff Handle.** A handle placarded FUEL SHUT OFF (Figure 1-2) is provided in the front cockpit only. This handle is located on the left side console and operates the firewall shutoff valve for emergency and fuel system maintenance use. The open (down) position opens the firewall valve, admitting fuel to the engine. In the up position, fuel flow to the engine is cut off, thereby isolating the engine fuel supply.

**Note**

If the pilot elects to shut down the engine with only the emergency fuel shutoff handle, the engine will continue running for as long as 30 seconds after the handle is pulled.

## 2.2 STARTING SYSTEM

**2.2.1 Engine Starter and Generator.** The starter-generator is mounted on the engine accessory drive section and is able to function either as a starter or as a generator. In the starter function, battery or auxiliary dc power is required to power rotation. In the generator function, the unit is rated at 200 amperes dc output. For starter limitations, refer to Chapter 4. In the generator function, the starter-generator provides electrical power to the aircraft electrical system. Failure of the starter-generator to maintain 25 to 27.5 volts, depending on the setting of the solid-state low voltage sensor, will result in illumination of the MASTER CAUTION light and steady illumination of the yellow GENERATOR light on the annunciator panel. For additional description of the starter and generator system, refer to paragraph 2.9, Electrical Supply System.

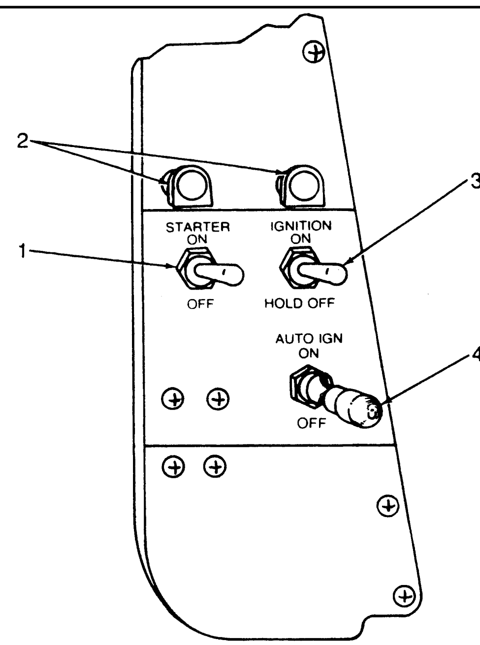
**2.2.1.1 Engine Starter Switch.** A two-position (up — ON, down — OFF) starter switch is located on the starter/ignition control panel (Figure 2-4) in both cockpits. The switch is placarded STARTER ON-OFF. When placed in the ON position, the switch completes the starter circuit for engine rotation, energizes the igniter plugs for fuel combustion, and activates the green IGNITION and yellow GENERATOR annunciator lights as well as the MASTER CAUTION light. If desired, the starter switch will motor the starter only (no ignition) when the IGNITION switch is held to the HOLD OFF position. The starter switch and ignition HOLD OFF may be engaged by either cockpit independent of electrical command.

## 2.3 ENGINE IGNITION SYSTEM

The basic ignition system consists of a spark igniter box, two igniter plugs, two shielded ignition cables, and the pilot-controlled IGNITION and AUTO IGNITION switches. Activation of the system will cause the spark igniter plugs to fire, igniting the fuel sprayed into the combustion chamber by the fuel nozzles.

**Note**

TYPICAL FOR FRONT AND AFT COCKPIT RIGHT SUBPANEL




1. Starter Switch
2. Starter/Ignition Panel Post Lights
3. Ignition Switch (Spring Loaded ON)
4. Autoignition ON-OFF Switch

F-0011

Figure 2-4. Starter/Ignition Control Panel

If "armed," the autoignition system senses engine torque and automatically provides a combustion reignition of the engine should accidental flameout occur. The system is not essential to normal engine operation, but is used to reduce the possibility of power loss because of icing or other conditions.

**2.3.1 Ignition Switch.** The ignition switch (Figure 2-4) is located on the right subpanel adjacent to the starter switch and placarded IGNITION ON-HOLD OFF and is normally spring loaded to the IGNITION ON position. The purpose of the HOLD OFF function of the ignition switch is to bypass the igniters, thereby allowing the engine to be motored without ignition.

**2.3.1.1 Ingition Annunciator Light.** Illumination of the green annunciator light, placarded IGNITION (Figure 2-15), indicates only that the ignition control box is receiving 28-Vdc electrical power.

**2.3.2 Autoignition Switch.** A switch placarded AUTO IGN with positions ON and OFF (Figure 2-4) is located on the right subpanel. The ON position initiates a readiness mode for the autoignition system of the engine and illuminates the green AUTO IGN annunciator light. The OFF position disarms the system. The autoignition system is triggered from a "ready condition" to an "operating condition" when engine torque drops into the 300 to 180 ft-lb torque range. Therefore, with the autoignition system armed, once the system is triggered to an operating condition, the igniters will remain energized continuously until torque is increased above the trigger range. Selection of the ON position by either cockpit arms the system.

**2.3.2.1 Autoignition Light.** When illuminated, the green AUTO IGN annunciator light indicates the autoignition system is in a readiness mode (Figure 2-15). If the autoignition system changes from a "ready condition" to an "operating condition" (energizing the two igniter elements in the engine), the green IGNITION annunciator panel light will illuminate and the green AUTO IGN light will extinguish.

**Note**

Fuel flow and standby compass indications are erratic when ignition system is operating.

## 2.4 ENGINE OIL SYSTEM (FIGURE 2-5)

The engine oil tank is integral with the air inlet casting forward of the accessory gearbox. Oil for propeller operation, lubrication of the reduction gearbox, and engine bearings is supplied by an external line from the oil pressure pump. Scavenge lines return oil to the tank from the reduction gearbox and the bearings. An external noncongealing oil cooler keeps the engine oil temperature within the operating limits. An externally mounted auxiliary oil tank, integral two-way gravity operated breather valve, two-way, inlet valve oil filter, and pressure relief valve comprise the modified oil system for inverted and aerobatic flight capability. Inverted flight capability is achieved by incorporating the two-way gravity-operated inlet and breather valves that allow oil and vent air to be collected from either the top or bottom of the oil tank. The auxiliary oil tank accommodates the oil displaced by these modifications. The oil system capacity is 4.4 U.S. gallons, of which 1.5 U.S. gallons are usable in the upright position. Effective usable oil capacity is reduced to 0.25 U.S. gallon (1 quart) if inverted flight is extended more than 10 seconds. The oil level is indicated by a dipstick attached to the oil filler cap and is marked in hot and cold ranges.

For oil grade, specification, capacities, and servicing point, refer to the servicing diagram (Figures 3-1 and 3-3).

**2.4.1 Oil Pressure Pump.** Pressure oil is circulated from the integral oil tank through the engine lubrication and propeller system by a self-contained gear-type pressure pump located in the lowest portion of the oil tank. The oil pump consists of two gears and is driven by an accessory gearshaft that also drives the internal double-element scavenge pump. Engine oil pressure is regulated by a pressure relief valve that returns all oil in excess of the regulated pressure to the oil tank.

**2.4.1.1 Oil Pressure Transmitter.** Main oil pressure is measured from the delivery side of the oil pump and is transmitted to the indicator by the oil pressure transmitter located on the engine mount forward of the battery box.

**2.4.1.2 Oil to Fuel Heater.** The oil-to-fuel heater assembly is essentially a heat exchanger that utilizes heat from the engine oil system to preheat the engine fuel. A fuel temperature sensing oil bypass valve

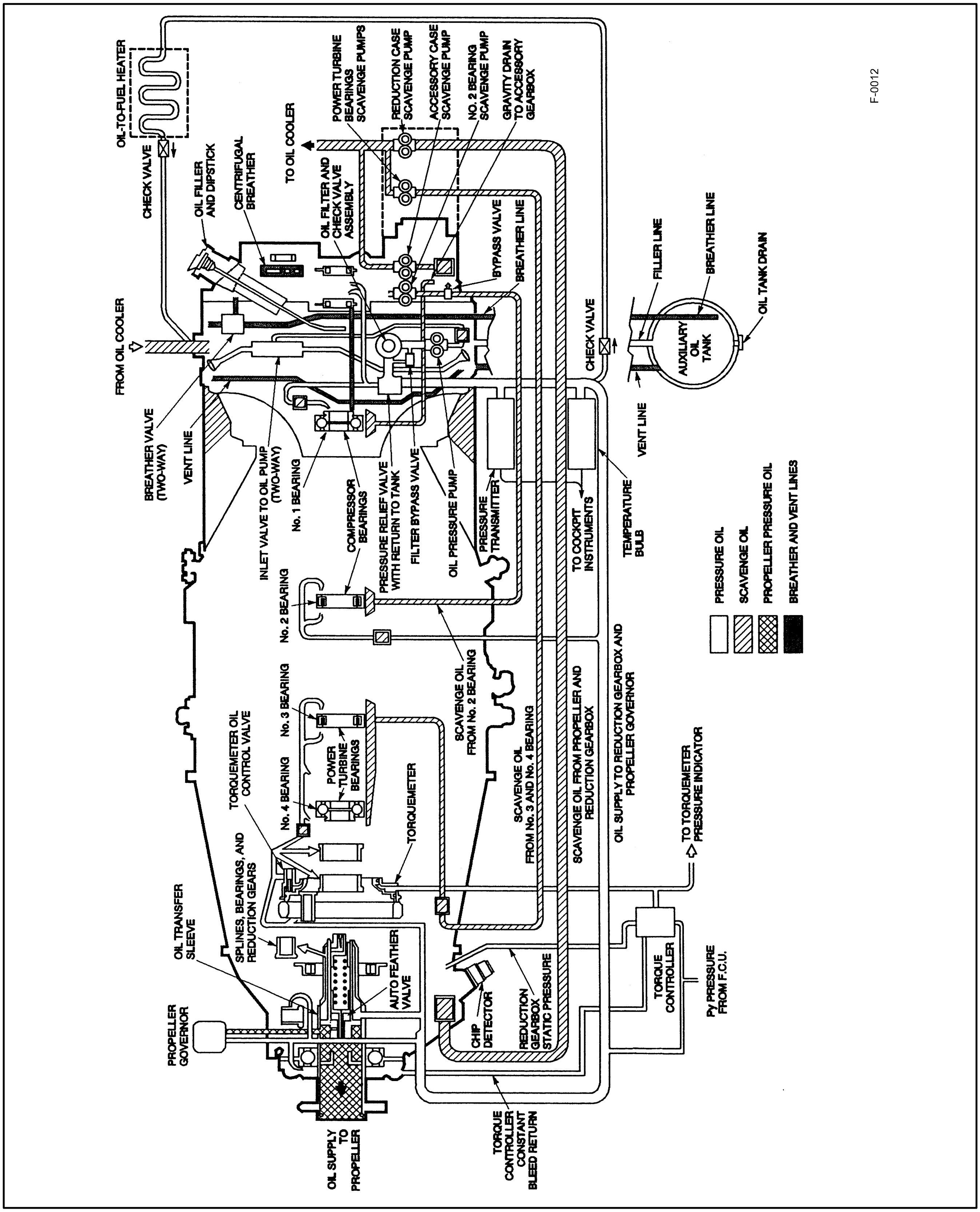



Figure 2-5. Oil System

regulates the fuel temperature by either permitting oil flow through the heater core or bypassing it through the valve to the oil tank.

Fuel temperature is controlled by utilizing a temperature sensing element that consists of a highly expansive material sealed in a metallic chamber. The expansion force is transmitted through a diaphragm and plug to a piston that opens or closes the oil inlet valve. The element senses outlet fuel temperature and at temperatures above 70 °F (21 °C) starts to close the core valve and simultaneously opens the bypass valve. At 90° F (32 °C), the core valve is completely closed and the oil bypasses the heater core.

**2.4.2 Oil Cooling.** Cooling of engine oil is accomplished by utilizing a heat exchanger of fin and tube design and air from the oil cooler duct. As oil is returned from the various integral oil pickups, it is returned via the two dual-element scavenge pumps to the oil cooler located in the left accessory cooling air duct. Air passing through the oil cooler radiator cools the engine oil to the proper temperature range. Normal oil temperature is 10 to 99 °C and is maintained at the proper temperature by a thermal sensor that controls a bypass valve, allowing some oil to bypass the oil cooler. A bypass valve that is fully closed at 71 °C and fully open at 60 °C controls oil flow through the oil cooler, maintaining engine oil temperature between 10 and 99 °C.

**2.4.2.1 Airframe-Mounted Oil Cooler.** A heat exchanger of fin and tube design is mounted in the oil cooler air duct on the fixed lower aft section of the nose section. Air passing over the radiator core cools the oil prior to delivery to the oil tank. The resultant hot air is then dumped overboard.

**2.4.3 Magnetic Chip Detector.** A magnetic chip detector plug is installed in the bottom of the reduction gearbox housing to warn the pilot of oil contamination a nd possible engine failure. The sensor is an electrically insulated gap immersed in the oil, functioning as a normally open switch. If a large metal chip or a mass of small particles bridges the detector gap, a circuit is completed that sends a signal to illuminate the annunciator panel yellow light, placarded CHIP, and the MASTER CAUTION light. The chip detector circuit is protected by a circuit breaker placarded CHIP DET on the forward circuit breaker panel.

## 2.5 ENGINE INSTRUMENTS

Instruments that display engine conditions or state are discussed in the following paragraphs. Identical engine instruments are mounted in the instrument panel in both cockpits.

**2.5.1 Interstage Turbine Temperature Indicators.** The ITT indicators (Figures 1-4, 1-5, 1-6 and 1-7) on the instrument panels are calibrated in degrees Celsius. Each gauge is connected to eight thermocouple probes located in the hot gases between the turbine wheels. The ITT gauges are self-powered and register the temperature present between the compressor turbine and power turbine.

**2.5.2 Engine Torquemeter.** The torquemeter on the instrument panels (Figures 1-4, 1-5, 1-6 and 1-7) indicates torque applied to the propeller shaft. The gauge shows torque by foot-pound measure using 50 foot-pound graduations and is actuated by an electrical signal from a pressure sensing system located in the propeller reduction gearcase. The torquemeter circuit is powered by 26 Vac and is protected by a circuit breaker placarded TORQUE on the forward cockpit circuit breaker panel.

**2.5.3 Turbine Tachometer.** The turbine tachometer on the instrument panels (Figures 1-4, 1-5, 1-6 and 1-7) registers compressor turbine rpm ($N_1$) of the engine. The indicator registers turbine rpm as a percentage of maximum gas generator rpm and is driven by the tachometer generator on the engine.

**2.5.4 Fuel Flow Indicator.** The fuel flow indicator on the instrument panels (Figures 1-4, 1-5, 1-6 and 1-7) registers the rate of flow for consumed fuel as measured by a sensing unit coupled into the fuel supply line to the engine. The fuel flow indicator is calibrated in increments of hundreds of pounds per hour. The fuel flow indicator circuit is powered by 26 Vac and is protected by a circuit breaker placarded FUEL FLOW on the forward cockpit circuit breaker panel.

**2.5.5 Oil Pressure and Oil Temperature.** A combination oil pressure and oil temperature indicator on the instrument panels (Figures 1-4, 1-5, 1-6 and 1-7) indicates oil pressure in psi and oil temperature in degrees Celsius at the delivery side of the oil pump. Each system of the indicator is individually protected by a circuit breaker placarded PRESS-TEMP on the front cockpit circuit breaker panel. The indicators are powered by 28 Vdc.

**2.5.6 Propeller Tachometer.** The propeller tachometer on the instrument panels (Figures 1-4, 1-5, 1-6 and 1-7) indicates actual rpm of the propeller in 50-rpm graduations. The indicators are driven by the propeller tachometer generator mounted on the starboard side of the reduction gearbox.

## 2.6 PROPELLER

A three-bladed aluminum propeller is installed on the engine. The propeller is hydraulically controlled, constant speed, and full feathering. The propeller is controlled by engine oil acting through an engine-driven propeller governor. Feathering is accomplished by feathering springs, assisted by centrifugal force applied to the blade shank counterweights. Governor-boosted engine oil pressure moves the propeller blades to the high-rpm (low-pitch) stop and into beta range. Low-pitch propeller position is determined by a mechanically monitored hydraulic stop. If oil pressure loss is caused by prolonged zero-g flight, insufficient oil quantity, system failure, or an engine flameout, at approximately 10 psi the propeller pitch will go toward feather. With an engine flameout, residual oil pressure caused by the windmilling compressor turbine will not permit the propeller to feather fully. If loss of oil pressure was caused by prolonged zero g's, righting the aircraft or imposing a positive or negative acceleration will restore oil pressure and, approximately 12 seconds later, the propeller will begin to unfeather. A rapid return to full power with the propeller in feather will probably cause two or three oscillations in power as the propeller seeks equilibrium in pitch.

**2.6.1 Propeller Governors.** The propeller system utilizes two governors, a primary and an overspeed, to control propeller rpm. The condition lever establishes rpm for the propeller by altering the setting for the primary governor that is attached to the engine gear reduction housing. It is the primary governor that controls rpm through the entire range. Under normal flight conditions, the primary propeller governor acts as a constant speed unit, maintaining propeller speed selected by the pilot by changing the propeller blade pitch to match the load to the engine torque in response to changing flight conditions. Should the primary governor malfunction, the overspeed governor activates (2,332 ± 40 rpm), immediately bypassing the oil from the propeller pitch change mechanism to the reduction gearbox. This allows the propeller counterweights and feathering springs to increase the propeller pitch, thereby increasing the load on the engine and thus reducing the propeller speed. If a propeller should stick or move too slowly during a transient condition, the overspeed governor would be unable to prevent an overspeed condition. To provide for this contingency, the primary governor provides a fuel topping function. Thus, when the propeller rpm reaches 2,398 rpm, this function pneumatically drives the FCU towards minimum flow (idle) by venting $P_y$ air overboard at the governor.

**2.6.2 Primary Propeller Governor Unit.** The propeller governor unit consists of a single-acting centrifugal governor mounted at the 12-o'clock position on the reduction gearbox and includes an integral gear-type oil pump with a pressure relief valve, a pair of pivoted flyweights mounted on a rotating flyweight head, a spring-loaded pilot valve, and the necessary cored oil passages contained in an aluminum housing and base. The rotating flyweights determine the position of the pilot valve while the speeder spring load can be varied by the condition lever.

The propeller governor function in forward thrust is to utilize boosted engine oil pressure to decrease propeller blade pitch; the centrifugal force of the blade counterweights, assisted by feathering springs, tends to increase the pitch.

To provide the governor with a sensing element, the rotating flyweights are linked mechanically to the engine by a hollow driveshaft. The rotating flyweights, actuated by centrifugal force, position the pilot valve so as to cover or uncover oil ports in the driveshaft and regulate the oil flow to and from the propeller servo piston. The centrifugal force exerted by the flyweights is opposed by the force of the adjustable speeder spring. This determines the propeller rpm required to develop sufficient centrifugal force on the flyweight to center the pilot valve, thereby preventing oil flow.

An added feature of the primary governor unit is the fuel-topping function. The fuel-topping function engages in the event the propeller overspeed governor fails. If propeller rpm reaches 2,398, the fuel-topping function of the primary governor will automatically bleed $P_y$ air, reducing fuel flow in the FCU toward minimum and returning propeller rpm to within safe limits.

**Note**

Corresponding fluctuations in $N_1$, torque, fuel flow, and rpm will occur as propeller rpm resurges to 2,398 and is then reduced again by the fuel-topping function. Engaging the EPL will lessen the severity of low-end fluctuations.

**2.6.3 Propeller Overspeed Governor.** The propeller overspeed governor is installed in parallel with the propeller governor and is mounted at approximately the 10-o'clock position on the reduction gearbox front case. It is provided to control any propeller overspeed condition by immediately bypassing the oil from the propeller pitch-change mechanism to the reduction gearbox. The propeller overspeed governor contains conventional-type flyweights mounted on a rotating hollow-splined shaft. The hollow shaft embodies ports that are normally closed by a pilot valve and held in this position by the speeder spring. The spring tension acts in opposition to the centrifugal force of the rotating flyweights. When a propeller overspeed occurs, the increased centrifugal force sensed by the flyweights overcomes the spring tension, lifts the pilot valve, and bypasses the propeller pitch-change mechanism oil back to the reduction gear through the hollow-splined shaft. This permits the combined forces of the propeller counterweights and feathering return springs to move the blades toward a high-pitch position, absorbing the engine power and preventing further propeller overspeed.

**2.6.4 Propeller Overspeed Governor Test Switch.** Ground test of the propeller overspeed governor is made by employing a ground test solenoid valve in the overspeed governor. The electrically actuated solenoid valve resets the overspeed governor to 10 percent below its normal setting for test purposes. For propeller overspeed governor test procedure, refer to paragraph 10.6, Engine and Propeller Checks. The propeller overspeed test circuit breaker placarded PROP TEST is on the forward cockpit circuit breaker panel.

**2.6.5 Propeller Beta Range Switch.** Upon reaching the IDLE position of the PCL during ground operation, a pushbutton switch on top of the PCL placarded BETA must be depressed before the lever can be moved aft into the beta range. Beta range is for ground use only. By incorporating a safety switch on the nosegear, beta range can be selected only when the aircraft is on the ground. With the safety switch circuit completed and the BETA button depressed, the PCL may then be moved into the beta range. Depressing the BETA button and moving the PCL aft progressively resets the low-pitch (high-rpm) hydromechanical stop. This allows the propeller to move to a maximum –5° pitch position. Care should be taken to avoid excessive use of beta range when operating on surfaces of loose sand, gravel, and dust. Flying gravel and sand will damage the propeller blades and dust may impair the pilot's forward visibility at low speeds.

**CAUTION**

Moving the PCL into beta range without the engine running will damage the linkage mechanism.

**Note**

The PCL may not move into the beta range if held forcibly against the idle stop or retarded rapidly, even with the BETA switch depressed. The BETA solenoid requires a momentary pause in aft PCL pressure to engage.

The beta release system is protected by a circuit breaker placarded BETA REL on the forward cockpit circuit breaker panel.

## 2.7 FUEL SUPPLY SYSTEM

The fuel supply system (Figure 2-6) consists of two interconnected fuel tanks in each wing, a fuel sump in the fuselage center section, the firewall fuel shutoff valve located aft of the firewall, and the associated plumbing lines and drains. Fuel gravity feeds to the fuel sump from each wing tank system simultaneously, making individual tank selection impossible. An electrically powered standby boost pump, mounted externally forward of the fuel sump, is capable of supplying fuel under pressure to the high-pressure pump should the normal boost system fail. A fuel shutoff valve handle on the forward cockpit left-side console isolates the fuel supply system at the firewall. A fuel quantity gauge for each wing tank system is mounted in the instrument panels in both cockpits, and six fuel system drains are provided to drain the system of moisture condensate and sediment. A single defueling plug is also provided in the fuel sump tank bottom.

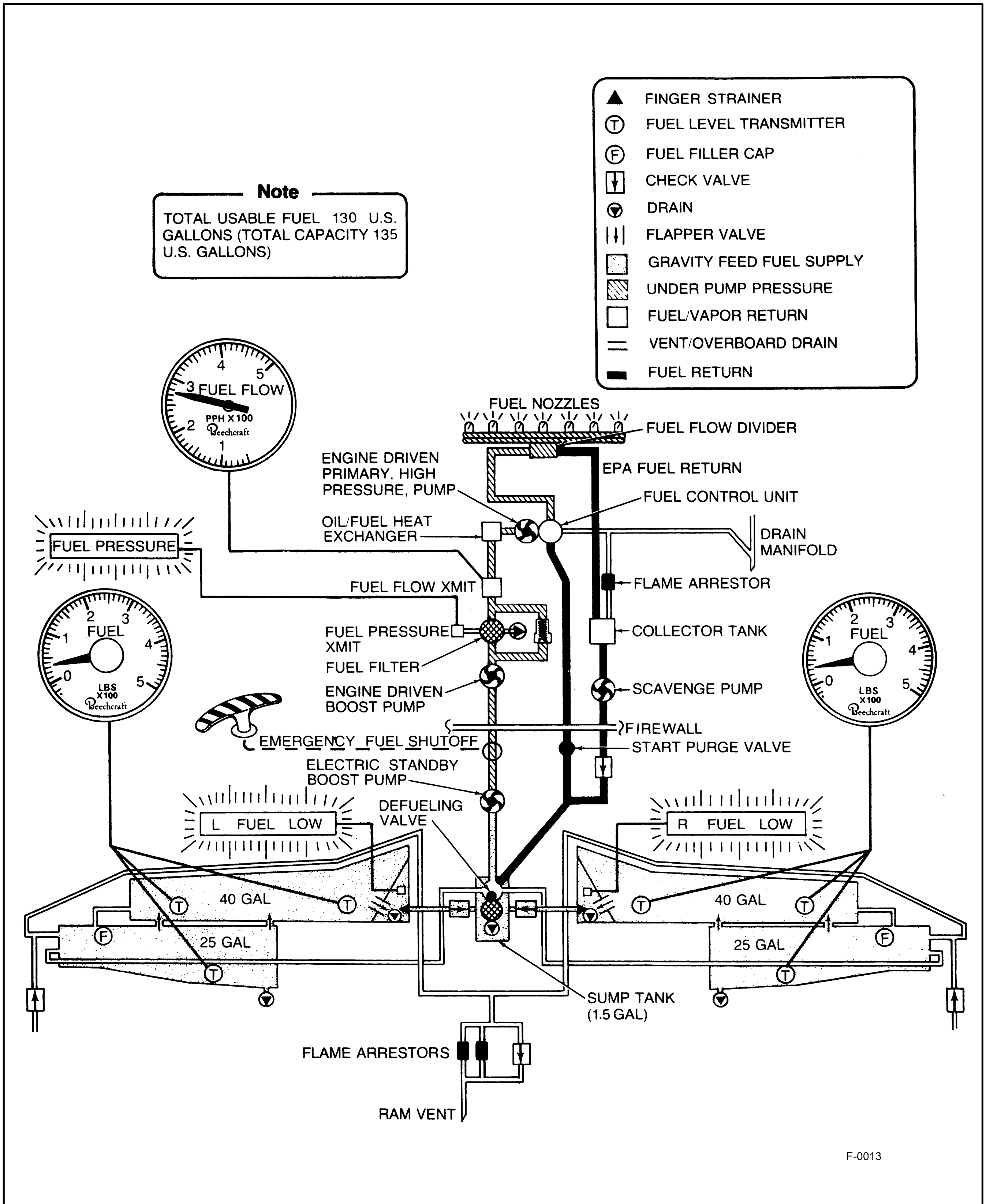



Figure 2-6. Fuel System

**2.7.1 Approved Fuels.** The T-34C aircraft uses JP-5/Jet A (primary), JP-4/Jet B, or JP-8/A1 (alternate) fuels. When commercial jet fuel is used and does not contain anti-ice/fungicide (PFA55MB, MIL-I-27686, or equivalent), it must be added during fueling per approved method to assure proper anti-icing protection and long-term fungus control.

**CAUTION**

Aviation gasoline is not an approved fuel for use in the T-34C aircraft.

**2.7.2 Fuel Tanks.** One 40-gallon tank in each wing leading edge and one 25-gallon tank in the wing panels of each wing provide a total usable fuel capacity of 130 U.S. gallons. The two tanks in each wing are interconnected; fuel gravity feeds from the 25-gallon tank into the 40-gallon tank, then into a 1.5-gallon fuel sump tank in the fuselage center section. Each of the 40-gallon tanks is equipped with a baffle in the inboard fuel outlet portion to prevent the fuel from being drawn away from the fuel outlets during fast ground turns or airborne maneuvers (slips, steep banks, etc.) that could possibly have the same effect. A flapper valve is incorporated in the fuel necks to prevent syphoning. A finger strainer is installed in the outflow point of the left and right fuel cells to reduce the possibility of foreign object damage to the sump tank check valves.

**2.7.3 Fuel Drains.** Five snap-type drains and one firewall fuel filter drain lever are provided to drain moisture condensate and sediment from the fuel system. The firewall fuel filter drain is accessible by opening the left-hinged cowl door and turning the valve handle located on the firewall. Four of the five snap-type drains protrude through the lower wing skin. The fuel sump tank drain is located in the center fuselage section and is accessible through a “D”-shaped door secured with a push-to-release fastener on the underside of the fuselage. A defueling plug is accessible through the same door should draining the fuel system become necessary.

**2.7.4 Fuel Sump.** A 1.5-gallon fuel sump tank is located between the wing tanks in the fuselage center section to permit inverted flight. A gravity-operated vent valve in the sump prevents fuel from dumping through the vent whenever the aircraft is inverted by a sliding ball that blocks off the vent. Vent air is then obtained by utilizing the wing tank vent system.

**2.7.5 Fuel Scavenge Pump.** An electrically operated fuel scavenge pump is located below the accessory section on the firewall. This pump provides the automatic transfer of accumulated fuel dumped from the engine during clearing and shutdown back into the fuel supply. Fuel from the flow divider drains into a collector tank below the accessory section on the firewall. When the collector tank is full, an internal float switch actuates the scavenge pump that returns the fuel to the supply system. Electrical power for the scavenge system is derived from the No. 2 utility bus and the system circuit breaker placarded SCAV PUMP on the forward cockpit circuit breaker panel.

**2.7.6 Low Fuel Warning Lights.** Two yellow lights on the annunciator panels (Figure 2-15), placarded L FUEL LOW and R FUEL LOW, warn the pilot of a low fuel condition in the wing tanks. Illumination of a low fuel light accompanied by a flashing MASTER CAUTION light indicates approximately 90 pounds of usable fuel remaining in that tank. The low fuel warning system consists of a thermistor sensor in the baffled portion of the 40-gallon tanks, an electronic control box, and the necessary wiring to the lights on the annunciator. The system circuit breaker placarded LOW FUEL is on the forward cockpit circuit breaker panel.

**2.7.7 Fuel Quantity Indicators.** The fuel quantity indicating system is comprises six capacitance fuel quantity probes, fuel quantity indicators, and associated wiring. The wing tanks contain six probes (three per wing). The probes are wired into the fuel quantity indicators to indicate the total fuel quantity remaining in the interconnected wing tanks. The gauges are graduated in 10-pound increments, and a left and right indicator (Figures 1-4, 1-5, 1-6 and 1-7) is provided in both cockpits. The system circuit breakers placarded FUEL QTY LEFT and RIGHT are on the circuit breaker panel in the front cockpit only.

**Note**

If only the battery is operating, the fuel gauges will slowly go to zero as the voltage decreases. Fuel gauges are not reliable under these conditions.

## 2.8 FUEL PRESSURE SYSTEM

Fuel is delivered under pressure to the engine-driven primary high-pressure pump by either of two boost pumps. The engine-driven boost pump is bolted to and driven by the external oil scavenge pump. The other, an electrically operated (standby) pump, is externally mounted forward of the fuel sump tank in the fuselage center section. Fuel is normally supplied to the primary pump by the engine-driven boost pump from the fuel sump tank through a firewall shutoff valve. The fuel enters the primary high-pressure pump through a micron screen and then moves to the gear pump chamber from where the fuel is delivered at high pressure to the FCU. The fuel is then delivered to the fuel manifold valve where it is dispensed to the 14 fuel nozzles in the combustion chamber. Should the engine-driven boost pump fail, the electric standby boost pump will, when selected, supply fuel under pressure to the primary pump.

**2.8.1 Engine-Driven Boost Pump.** The engine-driven boost pump delivers fuel from the fuel sump tank under pressure to the fuel inlet of the primary pump. The boost pump is bolted to and driven by the external oil scavenge pump on the accessory gearbox. Failure of this pump is indicated by steady illumination of the yellow FUEL PRESS light on the annunciator panel and the flashing MASTER CAUTION light. In the event of a dual boost pump failure (engine-driven and electric standby) at altitude, a descent may be necessary to maintain engine operation using only the primary pump.

**CAUTION**

Engine operation using only the primary fuel pump without standby (electric) boost pump or engine-driven boost pump pressure is limited to 10 hours. All time in this category must be recorded.

**2.8.2 Electric Standby Boost Pump.** The electrically powered standby boost pump is externally mounted forward of the fuel sump tank and will deliver fuel under pressure to the primary pump should the engine-driven boost pump fail. The standby boost pump circuit breaker type toggle switch placarded FUEL PUMP, ON and OFF is located just forward of the mapcase in the front cockpit.

**2.8.3 Engine-Driven Primary Fuel Pump.** The primary fuel pump is a positive displacement gear-type pump and is driven off the accessory gearbox. Fuel from the boost pump enters the pump through a micron inlet screen into the gear pump chamber from where it is delivered at high pressure to the FCU through a pump outlet filter. The inlet screen is spring loaded and, should it become obstructed, an increase in fuel pressure differential will cause the screen to raise, allowing unfiltered fuel to enter the system. A bypass valve and corded passages in the pump casing enable unfiltered high pressure fuel to flow from the pump to the FCU when the outlet filter is obstructed. This pump is capable of sustaining engine operation without boosted fuel pressure. If this pump fails, flameout will occur.

**2.8.4 Fuel Control Unit.** The FCU is mounted on the primary fuel pump and is driven at a speed proportional to compressor turbine speed. The FCU determines the fuel schedule for the engine to provide the power required as established by the position of the PCL. Engine power output at a given altitude is directly dependent upon compressor turbine speed. The FCU governs compressor turbine speed, thereby controlling the power output of the engine by regulating the amount of fuel supplied to the combustion section. If the automatic fuel scheduling functions of the FCU malfunction, fuel may be manually metered to the engine by use of the emergency power lever.

**2.8.5 Fuel Flow Indicator.** The fuel flow indicator (Figures 1-4, 1-5, 1-6 and 1-7) registers the rate of flow for consumed fuel as measured by a sensing unit coupled into the fuel supply line in series with the primary fuel pump. It is calibrated to show the flow of fuel to the engine in increments of tens of pounds per hour. The fuel flow circuit breaker placarded FUEL FLOW is on the circuit breaker panel in the forward cockpit. This indicator is powered by 26 Vac.

**2.8.5.1 Low Fuel Pressure Light.** A loss of boosted fuel pressure to the primary fuel pump, as sensed by the fuel pressure transmitter that is integral with the firewall fuel filter, is indicated by the steady illumination of the yellow FUEL PRESS light (Figure 2-15) on the annunciator panel and steady flashing of the MASTER CAUTION light on the instrument panel. Activating the electric standby boost pump will restore boosted fuel pressure and extinguish both the MASTER CAUTION and FUEL PRESS lights. The FUEL PRESS indicator light circuit breaker placarded FUEL PRESS is on the circuit breaker panel in the forward cockpit.

## 2.9 ELECTRICAL SUPPLY SYSTEM

The electrical power supply system (Figure 2-7) consists of a nominal 28-Vdc bus system and a single-phase ac inverter system operated by dc power. The electrical power system is a conventional single-wire design, negative ground, with the aircraft structure forming the ground return for all circuits. In the event of a generator failure, all essential electrical equipment can be operated directly from the battery. If the system voltage is below approximately 25 to 27.5 Vdc, the GENERATOR annunciator panel light and flashing MASTER CAUTION light will illuminate. If it is determined that this indication is a result of generator failure, the two utility bus switches on the forward cockpit circuit breaker panel may be turned off to conserve the battery for essential functions.

External power for electrical and avionic ground checks and to assist in starting the engine is applied to the aircraft through an auxiliary power receptacle located in the fuselage forward of the right wing. If battery voltage is not sufficient to activate the external power relay (18 volts minimum), the battery must be recharged or replaced before external power can be applied.

**2.9.1 Command Control Transfer Switch.** A momentary ON toggle switch, located on the right console (Figures 1-8 and 1-9) in both cockpits, is provided to take control of the ac and dc power supply system. The switch is placarded TAKE COMMAND above the switch and CONT TRANS below. For example, to transfer control from the forward to the aft cockpit, the aft cockpit switch is momentarily held to the TAKE COMMAND position. Command of the system is verified by illumination of the green command light. The BATT switch need not be ON to TAKE COMMAND, although illumination of the green command light is not possible until the BATT switch is positioned ON. When electrical power is secured, electrical control will remain in the cockpit that last had control. The command control transfer circuitry is protected by a fuse located on the fuse panel behind the forward cockpit instrument panel, which is not accessible in flight.

**2.9.2 Command Indicator Light.** A green press-to-test command indicator light located above the control transfer switch indicates control of the electrical power supply system when illuminated. The light has a rotate to dim feature that allows the pilot to regulate light intensity.

**2.9.3 AC Power Supply.** Ac electrical power is supplied by two 115-volt, single-phase, solid-state inverters. Power for inverter operation is supplied by the aircraft dc power system. The circuit breakers placarded INV 1, INV 2, INV CONT RELAY, and 115 VAC are on the forward cockpit circuit breaker panel.

**WARNING**

Instrument flight is not possible with a complete loss of ac power.

**2.9.4 Inverter Switch.** Inverter operation is controlled by a single three-position inverter switch on the right console (Figures 1-8 and 1-9) in both cockpits and placarded INV, NO. 1, and NO. 2. The center INV position is off. Should the selected inverter fail, as indicated by illumination of the MASTER CAUTION light and INVERTER annunciator light and loss of all ac-powered instruments and equipment, power may be restored by selecting the other inverter.

**2.9.4.1 INVERTER Annunciator Light.** Failure of the selected inverter will result in illumination of the yellow INVERTER light, flashing of the MASTER CAUTION light (Figure 2-15), and loss of all ac-powered instruments and equipment. Positioning the inverter switch to the remaining operative inverter will restore power and cause both lights to extinguish. If the 26-Vac instruments still operate (not a complete ac-power failure), resetting the 115 Vac circuit breaker may restore power.

**Note**

A popped 115-Vac, 1-amp circuit breaker with inverter No. 1 selected will result in illumination of the INVERTER annunciator light.

**2.9.5 DC Power Supply.** The source of dc power is a 24-volt, 24-ampere sealed lead acid battery, and a single 30-volt starter-generator. Controls associated with the dc system, except for circuit breakers, are located on the right console and consist of a battery switch, generator switch, control transfer switch, and command indicator light. Circuit breakers associated with the dc power supply system but not accessible

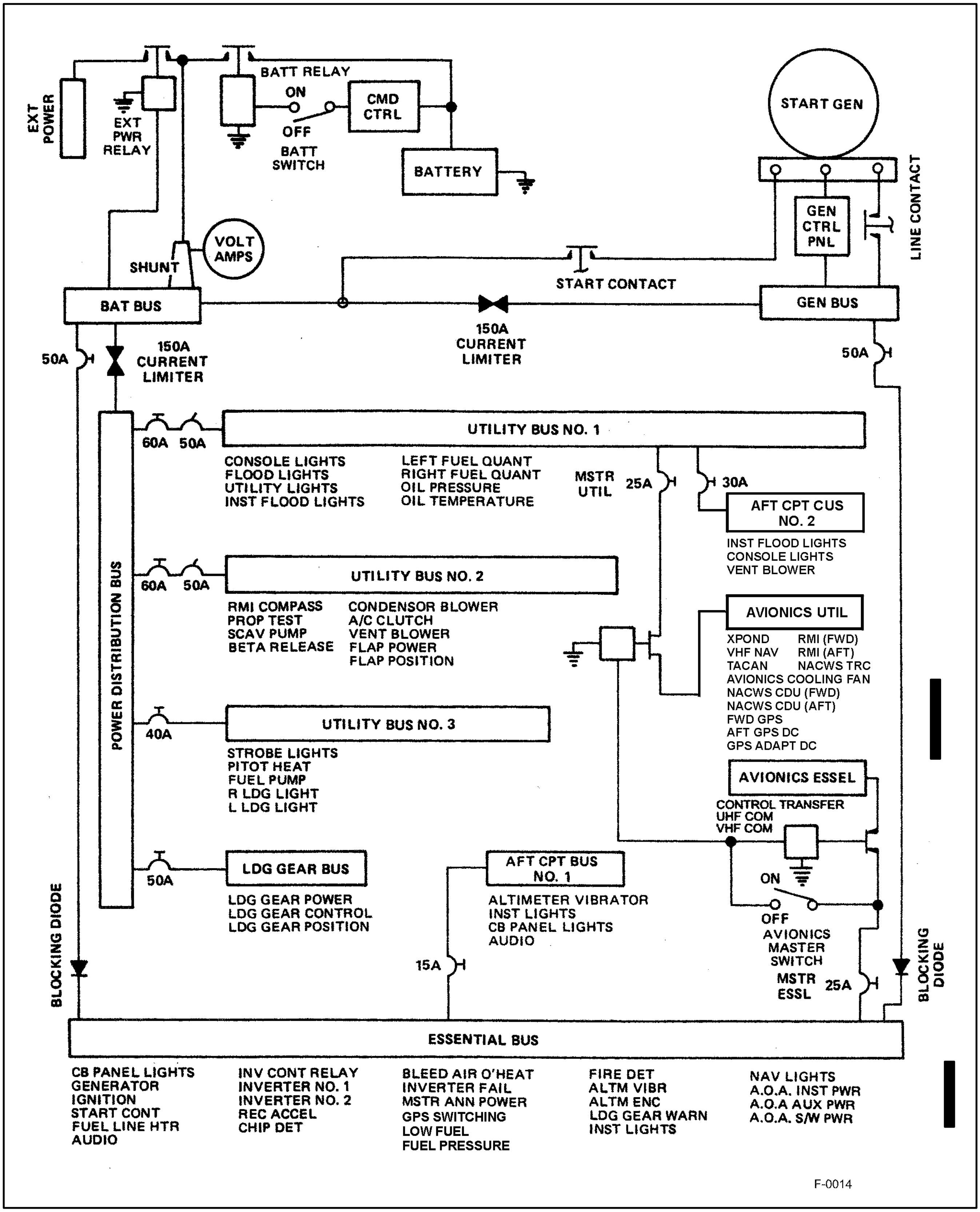



Figure 2-7. Electrical System (Sheet 1 of 2)

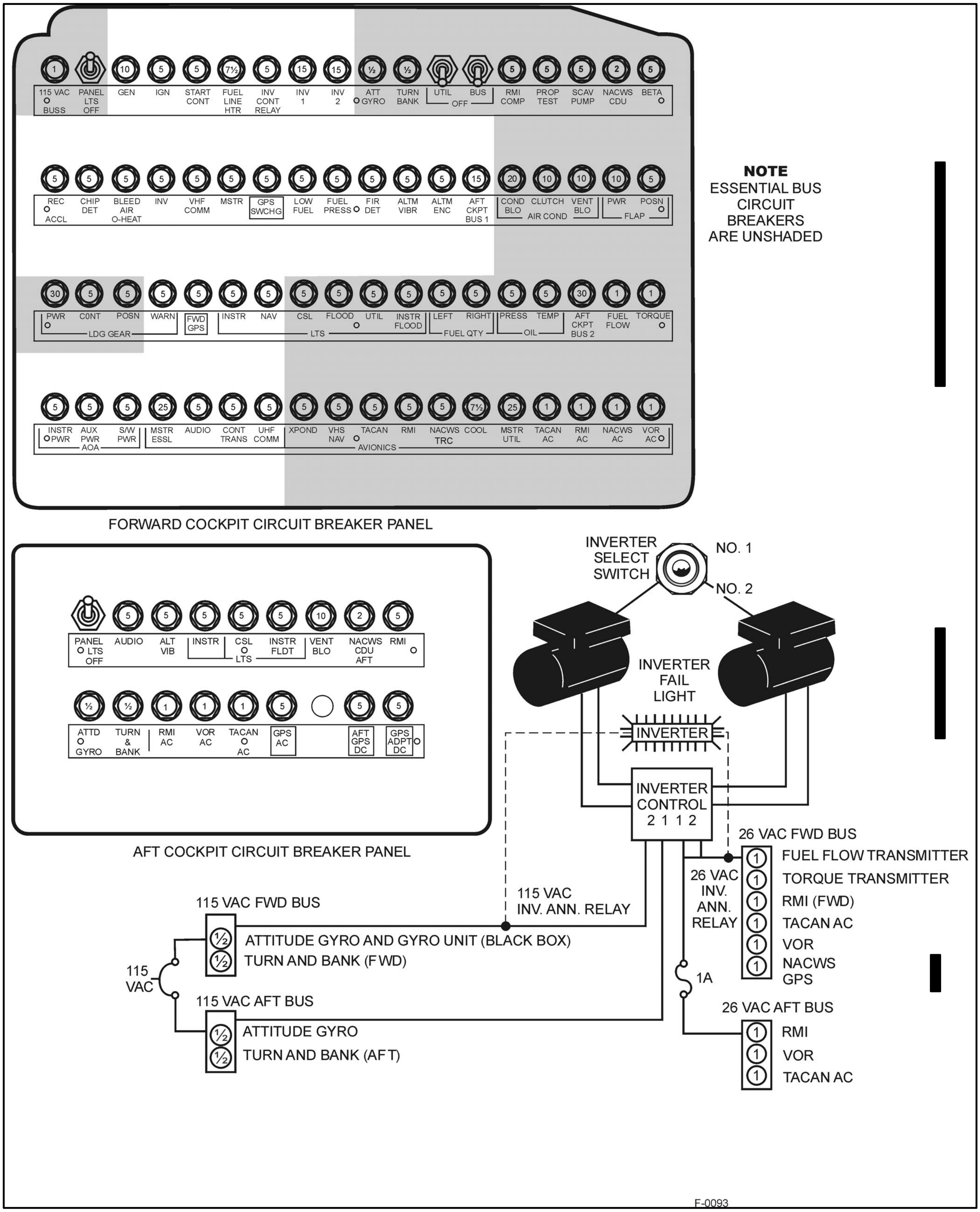



Figure 2-7. Electrical System (Sheet 2)

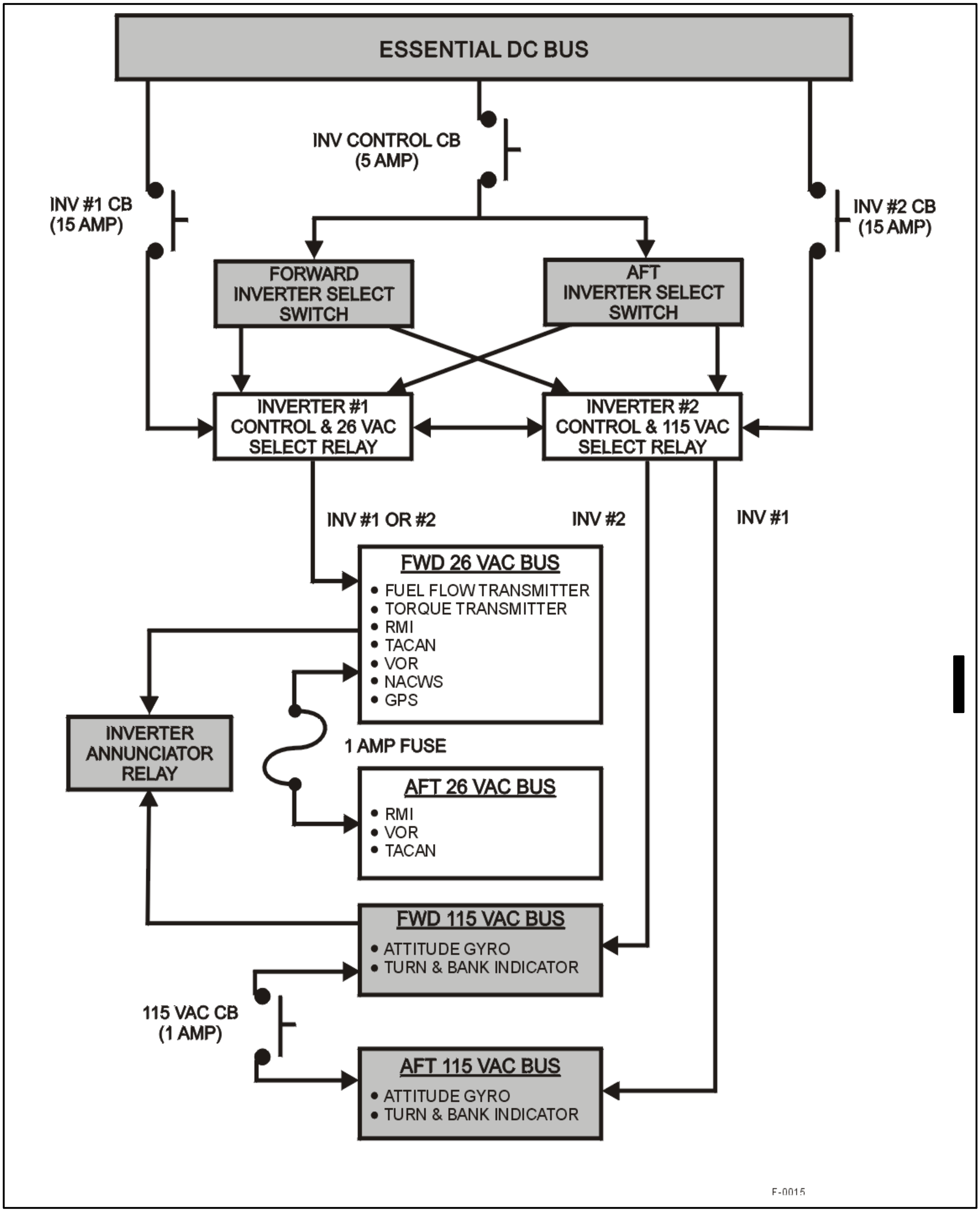



Figure 2-8. Essential DC Bus

during flight are on a circuit breaker panel located behind the front cockpit instrument panel. These circuit breakers include the generator field sense, generator control, generator essential bus feeder, battery essential bus feeder, landing gear bus, and feeder circuit breakers for utility bus Nos. 1, 2, and 3. Utility bus Nos. 1 and 2 are protected additionally by two circuit breaker-type toggle switches on the forward cockpit circuit breaker panel.

**2.9.6 Battery.** A 24-volt, 24-ampere sealed lead acid battery (Figure 3-1) is installed in the battery compartment located on the right side of the fuselage just forward of the canopy and is capable of assuming the complete electrical load for a limited time. The battery is mounted in an aluminum tray that slides out of the battery compartment for easy access and is connected to the battery cables by a quick disconnect built into the battery case. The battery compartment and battery case are vented by air entering through an air-intake scoop in front of the windshield, circulating throughout the battery compartment and battery case, and exiting through a scupper on the battery compartment access door. Two tubes vent the battery case and battery compartment of moisture, spilled acid, and battery case vent air through the battery compartment vent/drain beneath the aircraft.

**2.9.6.1 Battery Switch.** A two-position switch, placarded BAT, ON, and OFF on the right console (Figures 1-8 and 1-9), controls dc power from the battery to the aircraft bus system through the battery relay. Placing the switch to the ON position applies dc power to the system, and the switch must be on for external power to enter the circuit.

**2.9.7 Starter-Generator.** A 30-volt, 200-ampere-rated starter-generator mounted on the accessory section of the engine provides the dc power required for operation of the various systems and provides power for operation of the ac inverters. A voltage regulator maintains normal dc voltage between 27.0 and 29.5 volts.

**2.9.7.1 Generator Switch.** The switch placarded GEN on the right console (Figures 1-8 and 1-9) controls electrical power from the generator to the circuits and bus distribution system. This switch is a three-position switch placarded ON - OFF with a spring-loaded “reset” position forward of the ON position. When the generator is removed from the line because of either fault condition or by placing the generator switch in the OFF position, the switch must be moved to “reset,” then ON to return the generator to service.

**2.9.7.2 Generator Light.** Failure of the dc generating system to maintain system voltage 25 to 27.5 volts, depending on the setting of the solid-state low voltage sensor, is indicated by illumination of the yellow GENERATOR annunciator light (Figure 2-15) and simultaneous flashing of the MASTER CAUTION light. The GENERATOR/MASTER CAUTION lights will also illuminate anytime either starter switch is turned on.

**2.9.7.3 Volt/Ammeters.** A volt/ammeter (Figures 1-4, 1-5, 1-6 and 1-7) displays the voltage and amperage readings. The meter is calibrated in battery amperes and bus volts and indicates both simultaneously. The forward and aft volt/ammeters are protected by fuses located on a fuse holder behind the forward instrument panel and are not accessible in flight. The ammeter indicates rate of current flow to/from the battery and will indicate a discharge with external power applied to the aircraft.

**2.9.8 External Power Receptacle.** External dc power is applied to the aircraft through the external power receptacle (Figure 3-1) installed in the right-side fuselage structure just forward of the right wing. Dc power, after passing through the external power relay, is applied directly to the battery bus. The holding coil circuit of this relay is energized by the battery and is protected by a fuse located on the aft side of the external power receptacle.

**Note**

A minimum of 18 Vdc from the battery is required to activate the external power relay.

**2.9.9 Circuit Breaker Panels.** The electrical wiring circuits are protected by circuit breakers installed on one of three circuit breaker panels. Each cockpit has a circuit breaker panel located above the right console. A third panel not accessible in flight is installed behind the forward cockpit instrument panel.

## 2.10 LIGHTING SYSTEM

**2.10.1 Exterior Lighting.** The exterior lighting consists of conventional navigation lights accompanied by high-intensity strobe lights, two landing lights, and individual external landing gear position lights.

**2.10.1.1 Landing Lights.** The left and right landing lights (Figure 1-1) located on the main landing gear struts are individually operated by two circuit breaker-type toggle switches (Figure 2-10) that are placarded LANDING LIGHTS, LEFT/RIGHT, ON and OFF and located directly below the landing gear handle on the left side of the front cockpit.

**2.10.1.2 Landing Light Annunciator.** The LDG LIGHT annunciator panel light and flashing MASTER CAUTION light will illuminate whenever the landing gear are up and either landing light is on.

**2.10.1.3 Navigation Lights.** The conventional navigation lights (Figure 1-1), red on the left wingtip, green on the right wingtip, and white on the tailcone, are controlled by a three-position switch (Figure 1-8) that is placarded NAV LTS, BRIGHT DIM, and OFF and located on the right console in the front cockpit. The navigation light circuit breaker is placarded NAV and located on front cockpit circuit breaker panel.

**2.10.1.4 Anticollision (Strobe) Lights.** Three high-intensity strobe lights (Figure 1-1), one in each wingtip and one on the tailcone, are controlled by a two-position circuit breaker-type toggle switch (Figures 1-4 through 1-7) on the right console in the forward cockpit. These high intensity flashing lights are visible for a greater distance than a conventional rotating beacon.

**2.10.1.5 External Landing Gear Indicator Lights.** The external landing gear indicator lights (Figure 1-1) are mounted both on the bottom of each wing directly forward of each main gear strut and on the bottom of the fuselage forward of the nosegear strut. The gear down indicator switch is a normally open switch that closes when the landing gear is fully extended. The purpose of the external landing gear indicator lights is to provide a means for ground personnel or other aircraft personnel to check landing gear position.

**2.10.2 Interior Lighting.** Interior Lighting. The interior lighting system consists of individual instrument post lights, utility lights, console lights, glareshield floodlights, and console floodlights.

**2.10.2.1 Instrument Lights.** All instruments are lighted by post lights and glareshield floodlights with intensity controlled by two rheostats on the right console. The post-light and glareshield-light rheostats (Figures 1-8 and 1-9) are located adjacent to each other under a group placarded INST. The rheostats are placarded LTS (post) and FLDT (floodlights) and control lighting from OFF through INC to BRT. A clockwise movement of the rheostat continually brightens the lights to full intensity at the full clockwise position. The instrument lighting in each cockpit is individually protected by two circuit breakers, placarded INSTR and INSTR FLDT, on the circuit breaker panels in both cockpits. The red WHEELS light, the yellow MASTER CAUTION light, the annunciator panel lights, and the AOA indexer are dimmed by turning the instrument light switch to ON.

**2.10.2.2 Console Lights.** The left and right console panels in both cockpits are lighted by individual panel edge lights and a left and right console floodlight. The edge lighting is controlled by a rheostat (Figures 1-8 and 1-9) that is placarded LTS under the CONSOLE placard, and the floodlights are controlled by the rheostat (Figures 1-8 and 1-9), that is placarded FLDT. Both rheostats control the lighting from OFF to BRT by clockwise movement of the respective rheostat. The floodlight circuit breaker, placarded FLOOD, is located in the lights section on the forward cockpit circuit breaker panel. The edge lighting circuit breaker placarded CSL is on the circuit breaker panels (in the lights section) in the respective cockpits.

**2.10.2.3 Utility Lights.** Each cockpit is provided with a special multipurpose utility light. These lights (Figures 1-2 and 1-3) are designed to provide either red or white illumination utilizing a narrow spotlight beam or a wider floodlight beam. They are portable lights with a snap-in permanent mounting base and may be detached by simply pulling the light straight out of the base. Selection of white spot, white flood, red flood, or red spot can be made instantly by turning the front section. The color may be changed by depressing a button on top of the light while turning the front section. This feature also prevents changing color accidentally. The light has a dimming rheostat for controlling beam intensity and an override push button that provides instantaneous full lamp brilliance regardless of rheostat setting. Both cockpit utility lights share a common circuit breaker that is placarded UTIL and located in the

LIGHTS section on the forward cockpit circuit breaker panel.

**2.10.2.4 Circuit Breaker Panel Lights.** The circuit breaker panel edge lights are controlled with a two-position circuit breaker-type toggle switch placarded PANEL LTS on the circuit breaker panel in each cockpit. These lights are constant brilliance.

## 2.11 FLIGHT CONTROL SYSTEM

The primary flight control surfaces (ailerons, rudder, and elevator) may be operated from either cockpit by a conventional stick and rudder pedal control system. Trim tabs on all control surfaces, except the right aileron, are mechanically operated from either cockpit. The rudder pedals that incorporate toe-actuated brakes suspended from the rudder pedal arms are adjustable forward and aft.

**2.11.1 Control Stick.** Two control sticks (Figures 1-2 and 1-3), one in each cockpit, control operation of the ailerons and elevators. The control sticks are interconnected by push-pull tubes and an interconnecting torque tube. Motion of the control sticks is transmitted through linkage and cable systems to move the control surfaces.

**2.11.2 Ailerons.** The ailerons are actuated by the control sticks that are synchronized by an interconnecting torque tube. A push-pull tube attached to the torque tube actuates a bellcrank in the fuselage. From the fuselage bellcrank, separate cables run to actuating bellcranks in the wings. A push-pull tube attached to each wing bellcrank and to the ailerons complete the system. The ailerons control the movement of the aircraft around the longitudinal axis.

**2.11.2.1 Aileron Trim Tabs.** The aileron trim tabs are located on the inboard trailing edge of each aileron. These trim tabs are servo type (i.e., as the aileron deflects from neutral, the tab moves in the opposite direction). The left aileron tab is an adjustable type connected to a control assembly in both cockpits. The control assemblies are interconnected by a cable and chain assembly that drive flexible cables through the console to pulleys on the rear spar. From this point, the cables are routed outboard through the left wing panel trailing edge to the trim tab actuator that actuates the push-pull tube and the tab. The right tab is the fixed type and is not adjustable from the cockpit.

**2.11.2.2 Aileron Trim Wheel and Position Indicator.** The aileron trim tab wheel and trim tab position indicator (Figures 1-2 and 1-3) is located on the left console in each cockpit. Rotation of the wheel clockwise raises the tab on the left aileron and raises the left wing, and counterclockwise rotation lowers the tab that lowers the left wing. The right aileron tab is not affected by rotation of the trim tab wheel. The trim tab position indicator operates as an integral part of the trim tab wheel. As the wheel is turned, the degrees of tab deflection are shown on an indexed scale visible through the window adjacent to the tab control.

**2.11.3 Elevator.** The forward and aft control sticks are interconnected by torque tubes and a push-pull tube that transmits movement by means of cables to the elevator bellcrank in the tail section. A bobweight mounted on the elevator torque tube bellcrank at the aft control stick along with a downspring attached to the elevator bellcrank in the aft fuselage works against the elevator tabs, giving the desired feel to the control. The elevator control cables are connected to the elevator torque tube bellcrank at the aft control stick and are routed through a series of pulleys to the bellcrank in the tail section. The aft bellcrank actuates a push-pull tube attached to the elevator control horn that moves the elevators. The elevators control movement of the aircraft around the lateral axis.

**2.11.3.1 Elevator Trim Tabs.** The elevator trim tabs are located on the trailing inboard ends of the elevators, and a control wheel on the trim tab control assembly in both cockpits operates the tab system. The trim tab control assemblies are interconnected by a cable. A chain and cable assembly connected to the aft tab control is routed aft through the fuselage and outboard through the horizontal stabilizer to the sprocket driveshafts. The driveshafts are connected to the tab actuators located on the aft spar of each horizontal stabilizer, and actuator push-pull tubes are connected to an elevator tab horn to complete the system.

**2.11.3.2 Elevator Trim Tab Wheel and Position Indicator.** The elevator trim tab wheel and position indicator (Figures 1-2 and 1-3) is located on the left console in each cockpit. The trim tab control wheels are interconnected and rotation of the wheel forward raises the trim tab and lowers the nose of the aircraft. Rearward rotation lowers the tab and raises the aircraft nose. As the wheel is turned, the tab position indicator that functions as an integral part of the tab control wheel shows the amount of tab deflection in degrees. The trim tab position indicator is located adjacent to the control wheel and is calibrated to show tab deflection in degrees.

**2.11.4 Rudder.** The rudder control system consists of the rudder pedals in the forward cockpit connected by two push-pull tubes to the aft rudder pedals and cables attached to the aft rudder pedals routed aft through pulleys and fairleads to the rudder bellcrank located in the tail section. The rudder pedals that incorporate toebrakes are adjustable to accommodate pilots of different stature by moving the pedals either forward or aft. Pedal adjustment is accomplished by turning the control handle located at the lower center section of the instrument panel in either cockpit. A “rudder shaker” stall warning device is installed on both of the aft cockpit rudder pedals and causes the rudder pedals in both cockpits to shake or shudder during approach to a stall. The rudder controls the movement of the aircraft about the vertical axis.

**2.11.4.1 Rudder Trim Tab.** The rudder trim tab is located on the lower trailing edge of the rudder. The trim tab is an antiservo type (i.e., as the rudder deflects from neutral the tab moves in the same direction). A trim tab control knob on the left console in both cockpits operates the rudder trim tab. The control knobs are interconnected by a cable and chain assembly. Another cable and chain assembly connected to the aft control knob is routed aft through the fuselage to the trim tab actuator in the tail section. A push-pull tube operating from the actuator transmits the action to the rudder trim tab.

**2.11.4.2 Rudder Trim Tab Knob and Position.** The rudder trim tab knob (Figures 1-2 and 1-3) is located on the left console in each cockpit. Clockwise rotation of the knob moves the tab to the left, thus moving the nose of the aircraft to the right, and counterclockwise rotation moves the tab to the right and the nose to the left. The rudder trim tab position indicator is a part of the rudder trim tab knob. Turning of the trim tab knob directly turns a pointer that moves over an indexed scale to provide a visual reference of the rudder trim tab position. The indexed scale is calibrated to show the tab deflection in degrees.

**2.11.4.3 Rudder Pedal Adjustment Controls.** The rudder pedal adjusting drive is located in both cockpits just below the instrument panel. The drive consists of a “T” drive with a control handle, flexible drive cable, and housing routed from the “T” drive at the lower center of the instrument panel (Figures 1-2 and 1-3) to an angle drive located on the outboard side of each rudder pedal hanger. The pedal adjusting drives in each cockpit are independent units designed to accommodate pilots of different stature by moving the rudder pedals either forward or aft. When the handcrank is rotated, flexible drives from the “T” drive assembly actuate angle drives bolted to the rudder pedal arm assemblies, and the angle drives, in turn, rotate adjusting screws in the rudder pedal hangers. In this manner, the rudder pedal arms remain stationary and the rudder movement is not affected when the hanger assemblies are adjusted fore and aft.

**2.11.5 Flight Control Surfaces Lock.** Positive locking of the elevators, ailerons, and rudder is provided by a flight control lock (Figure 2-9) located in the front cockpit. The control lock consists of a square brace pivoted at two points and held against the floor by a spring-loaded latch assembly. To lock the controls, follow the procedure shown in Figure 2-9. To unlock the control, disengage lock from the pin on control stick and return it to the stowed position.

**CAUTION**

Moving the brake pedals aft against the square brace will not lock the flight controls properly and can result in brake failure.

**2.11.6 Wing Flaps.** Electrically operated slot-type wing flaps extend from the fuselage to the aileron on each wing. The flaps are operable from either cockpit and a flap position indicator is provided on each instrument panel. No emergency system is provided for flap operation in the event of a complete electrical failure.

**2.11.6.1 Wing Flap Lever.** Flap motor operation is controlled by three-position switches located on the left consoles (Figure 1-8). The front and rear cockpit wing flap levers are mechanically connected, permitting flap actuation from either cockpit. The wing flap lever is shaped in the form of an airfoil for easy recognition by feel. Raising the lever to the UP position retracts the flaps; depressing the lever to DN extends them. Placing the lever in the center OFF position will stop flap travel at any intermediate position. Otherwise,

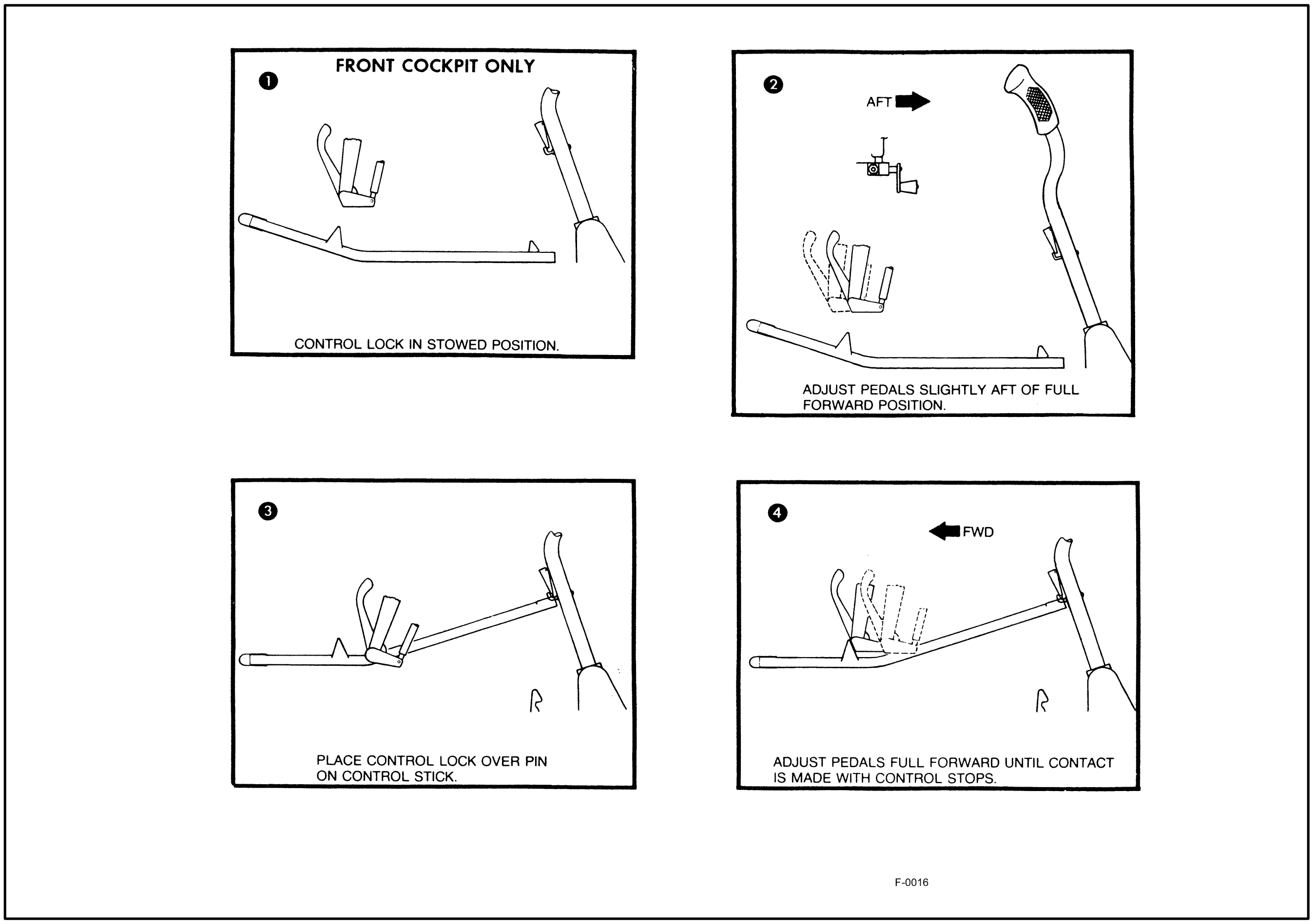



Figure 2-9. Flight Control Lock

the flaps will continue until a fully retracted or fully extended position is reached and limit switches stop the flap motor. The flaps will fully extend or retract in approximately 10 seconds. A circuit breaker placarded PWR in the FLAP section on the forward cockpit circuit breaker panel protects the flap motor circuit.

**2.11.6.2 Wing Flap Position Indicator.** Position of the flaps is indicated in percent of extension (not degrees) on the flap position indicator (Figures 1-4 and 1-5). Full pointer deflection to DN on the indicator indicates 100 percent (30°) of flap extension. The flap position indicator circuit breaker placarded POSN is located on the forward cockpit circuit breaker panel.

## 2.12 LANDING GEAR SYSTEM

The electrically operated tricycle landing gear is fully retractable. The main wheels retract inboard into the wings and the nosewheel retracts aft into the fuselage. Fairing doors, operated by gear movement, fully cover the landing gear when retracted. The main gear inboard doors open during the gear extension and close again when the gear is fully extended. Annunciator lights are provided in each cockpit to indicate when the inboard gear doors are not in the closed and locked position when the respective gear is fully up and locked or fully down and locked. All gears are actuated by a single dc motor and gear mechanism, located under the front cockpit, through a push-pull rod to each main gear side brace and the nosegear drag brace. A 1-second time delay is provided in the landing gear electrical circuit to protect the actuating system from damage in the event of a reversal caused by moving the landing gear handle in the opposite direction while the gear is in transit. Mechanical downlocks lock the gear in the extended position. A downlock is not provided for the nosegear because the overcenter pivot of the linkage provides a geometric locking effect when fully extended. A safety switch on the right main strut prevents accidental gear retraction on the ground. In flight, the gear may be manually extended, but not retracted in an emergency.

**CAUTION**

- Because of minimum tolerances between tires and wheelwell, landing gear retraction must never be attempted with a deflated shock strut.
- The pilot shall not move the gear handle in the opposite direction when the gear is in transit.

**2.12.1 Landing Gear Handle.** The landing gear handle (Figure 2-10) is located on the left subpanel in each cockpit. Moving the handle to UP or DOWN actuates a switch that controls the reversible electric motor that retracts or extends the gear. The handle is made of clear plastic formed in the shape of a wheel with a red warning light installed inside which illuminates during conditions shown in Figure 2-10. The weight of the aircraft on the landing gears actuates a safety switch on the right main strut that renders the gear up control circuit inoperative. A similar switch on the left main strut activates a 1000-Hz tone in the aircraft audio system, sounds a gear warning horn located behind the forward seat, and illuminates the gear warning WHEELS and handle lights if the handle is moved to UP. When the weight of the aircraft is removed from the gears as the aircraft leaves the ground, the gear up circuit is restored.

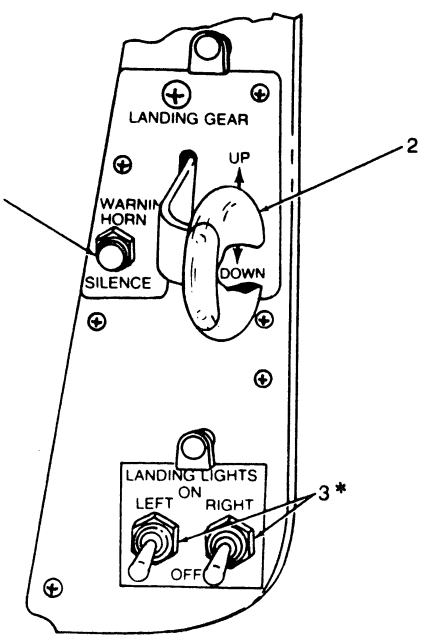
**2.12.1.1 Landing Gear Position Indicators.** Position of the landing gear is shown by three individual indicators (Figures 1-4 and 1-5), one for each gear, located on the instrument panel in both cockpits. Each indicator shows crosshatching if the related gear is in any unlocked condition or whenever the electrical system is not energized. The word UP appears if the gear is up and locked, and a wheel shows on each indicator when the related gear is down and locked. The gear position indicator circuit breaker placarded POSN is located on the LDG GEAR section on the front circuit breaker panel.

**2.12.1.2 Landing Gear Wheels Warning Light.** A red WHEELS light on both instrument panels (Figures 1-4 and 1-5) flashes to warn the pilot of conditions shown in Figure 2-11.

**Note**

TYPICAL FOR FRONT AND AFT COCKPIT LEFT SUBPANEL.

*NOT INSTALLED IN AFT COCKPIT




1. Landing Gear Warning Horn/Audio Tone Silencing Button
2. Landing Gear Control Handle
3. Landing Light Switches*

Figure 2-10. Left Subpanels

| CONDITION | GEAR HANDLE LIGHT | WHEELS WARNING LIGHT | WARNING HORN AND AVOID TONE |
|---|---|---|---|
| GEAR UP, FLAPS EXTENDED | | * | * |
| GEAR UP, PCL AND EPL BELOW 75-PERCENT $N_1$ | * | * | * |
| GEAR UP, PCL AND EPL ABOVE 75-PERCENT $N_1$ | * | * | * |
| GEAR HANDLE UP, AIRCRAFT ON GROUND | * | * | * |
| HANDLE AND LANDING GEAR DO NOT AGREE | * | | |

Figure 2-11. Landing Gear Warning Indications

**2.12.1.3 External Gear Down Indicator Lights.** To aid in determining gear position from outside the aircraft, a white light is installed just forward of each wheelwell. Each light illuminates only when the related gear is down and locked.

**2.12.1.4 Inboard Landing Gear Door Position Annunciator Lights.** An inboard landing gear door position annunciator light (yellow) is located in both the front and rear cockpit between the WHEELS annunciator light and the MASTER CAUTION annunciator light. These annunciator lights, placarded INBOARD GEAR DOOR — LH OPEN and RH OPEN, illuminate when the inboard landing gear doors are not in the closed and locked position when the landing gear is not in transit (fully up or down).

**2.12.1.5 Inboard Landing Gear Door Position Indicator Annunicator Light Test Switch.** An in board landing gear door position annunciator light test switch is located in both the front and rear cockpit adjacent to the inboard landing gear door position indicator lights between the WHEELS annunciator light and the MASTER CAUTION annunciator light. These switches, placarded INBOARD GEAR DOOR — SYS TEST, check the functional integrity of the inboard gear door position indicating system when pressed. Test indications for system faults and for a properly functioning system are shown in Figure 2-12.

**2.12.1.6 Landing Gear Warning Horn, Audio Tone, and Silencing Button.** A warning horn located behind the forward seat will sound and a 1000-Hz audio tone can be heard in the ICS during conditions shown in Figure 2-11. During prolonged flight with reduced power, the 1000-Hz audio tone and the gear warning horn may be silenced by depressing the silencing button placarded WARNING HORN SILENCE (Figure 2-10) and located adjacent to the landing gear handle. Subsequent advancement of the power lever will reset the circuit. The landing gear warning circuit breaker is placarded WARN (in the LDG GEAR group) on the forward cockpit circuit breaker panel. When the flaps are lowered (landing gear up), the warning horn silence button will be inoperative.

**2.12.2 Landing Gear Emergency Handcrank and Handcrank Clutch Knob.** A landing gear emergency handcrank (Figure 1-2), in the front cockpit only, is provided for emergency extension of the gear. The crank, when engaged, drives the normal gear actuation system through a flexible shaft. Approximately 41 turns of the crank are required to fully extend the gear (landing gear PWR and CONT circuit breakers pulled). The gear may be extended manually for demonstration purposes.

**CAUTION**

The landing gear emergency extension system is designed and stressed only for extension and should not be used in an attempt to retract the gear except in an extreme situation.

**2.12.2.1 Landing Gear Safety Switches**

Nosewheel:

3. Enables BETA release on the ground
4. Enables rudder shakers in flight

Left main:

1. Activates the gear warning horn, illuminates the wheels light and light in the gear handle.
2. Enables NACWS Test Mode.

| Landing Gear Position | Left Inboard Gear Door Position | Right Inboard Gear Door Position | Left Inboard Gear Door Annunciator | Right Inboard Gear Door Annunciator | System Test Switch Depressed Left Annunciator | System Test Switch Depressed Right Annunciator |
|---|---|---|---|---|---|---|
| UP & Locked | UP & Locked | UP & Locked | OFF | OFF | ON | ON |
| UP & Locked | UP & Locked | Ajar | OFF | ON | ON | OFF |
| UP & Locked | Ajar | UP & Locked | ON | OFF | OFF | ON |
| UP & Locked | Ajar | Ajar | ON | ON | OFF | OFF |
| DN & Locked | UP & Locked | UP & Locked | OFF | OFF | ON | ON |
| DN & Locked | UP & Locked | Ajar | OFF | ON | ON | OFF |
| DN & Locked | Ajar | UP & Locked | ON | OFF | OFF | ON |
| DN & Locked | Ajar | Ajar | ON | ON | OFF | OFF |

**Note**

While the landing gear are in transit, the inboard gear door UP & Locked position sensing and annunciation system is disabled. Thus, both (left and right) inboard gear door annunciator lights are always OFF while the landing gear are in transit.

Figure 2-12. Inboard Gear Door Indicator Fault Legend

Right main:

1. Disables the gear up circuit on the ground
2. Disables the AOA indexer when on the ground.

The handcrank clutch knob (Figure 1-2) adjacent to the handcrank is pushed DOWN to engage the crank with the flexible driveshaft for emergency extension. The clutch knob is provided with a lock that must be disengaged by moving it aft; this releases the clutch knob for manual operation.

**WARNING**

The handcrank must be disengaged from the driveshaft after extending the gear manually; otherwise, subsequent operation of the gear electrically will cause the crank to spin rapidly with possible injury to personnel and damage to the system.

## 2.13 WHEELBRAKE SYSTEM

The main landing gear wheels are equipped with hydraulic brakes (Figure 2-13) operated by toe pressure on the rudder pedals in either cockpit. Fluid from a reservoir aft of the firewall supplies a master cylinder at each pedal. Toe action on the rudder pedals actuates the cylinder and applies brake pressure to the corresponding wheel.

### 2.13.1 Brake Controls

**2.13.1.1 Parking Brake Handle.** A center-lock button parking brake handle (Figure 1-2) is located on the right subpanel in the front cockpit only. The parking brakes are set by first depressing the center-lock button and pulling out the handle, then applying toebrakes. The parking brakes can be released by pushing the handle in. Pulling the handle out seats a check valve in the system and any brake pressure subsequently applied by the pedals is held. Pushing the handle in unseats the check valve, releasing pressure.

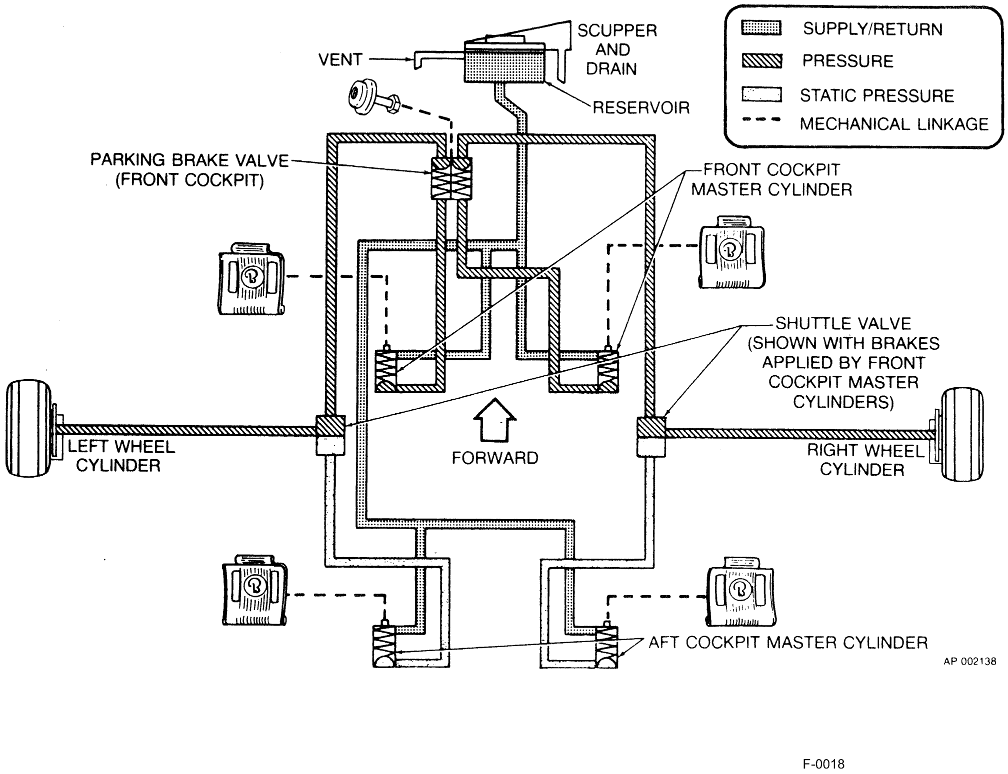



Figure 2-13. Wheelbrake System

**CAUTION**

- To prevent brake disk warpage or other system damage, do not set the parking brake with the disks in an overheated condition.

- Do not set the parking brake in freezing ambient temperatures.

## 2.14 FLIGHT INSTRUMENTS

**2.14.1 Angle-of-Attack System.** The AOA system provides the pilot with accurate angle-of-attack related information. After crosschecking with the airspeed indicator, the AOA system is the primary landing approach indicator. The main objective is to display stall margin information for use during precise landing operations. Visual indications of aircraft AOA are presented on the AOA indicators (Figures 1-2 to 1-7) under all flight conditions and may be used for such purposes as stall warning and establishing maximum endurance flight attitudes. For convenience in controlling airspeed in landing approaches, indicator readings are supplemented by three lights on the AOA indexes (Figures 1-2 and 1-3) that are mounted on the glareshield and operate only when the aircraft is in flight with the landing gear extended or when the AOA test switch is activated. Retracting the gear in flight or actuating the main gear safety switch on the ground disables the indexer lights.

The AOA system consists of a transmitter vane on the left wing, an electronic control unit located between the forward and aft cockpits, an AOA indicator and test switch on the instrument panel, an indexer light unit mounted on the glareshield in each cockpit, and stall warning rudder shakers mounted on the aft cockpit rudder pedals.

The transmitter vane measures the airflow angle in front of the wing. This measurement is electrically transmitted to the control unit where the system changes this measurement to a normalized display on the AOA indicator. The system will adjust the display for inherent stall angle differences resulting from two basic flap positions (zero flaps and full flaps).

**2.14.1.1 Angle-of-Attack Indexer.** The AOA indexer (Figures 1-2 and 1-3) mounts three indexer lights. The indexer light indications are a green chevron (∨) showing too high AOA at the top, a yellow doughnut (O) showing proper AOA in the center, and a red chevron (∧) showing too low AOA at the bottom. Two intermediate conditions are also indicated by showing the (O) with the (∨) or the (∧).

Dimming is provided automatically when the instrument lights are turned ON.

The approach is flown by coordinating PCL and stick movements to establish the desired glidepath at optimum AOA. The stick is used to bring AOA to the optimum value, as indicated by illumination of the indexer circle (doughnut). As AOA goes high or low, with resulting decrease or increase in airspeed, the indexer upper or lower chevron will be illuminated to point the direction in which the nose should be moved to return to the optimum AOA. The PCL is manipulated to control rate of descent so as to establish the desired glidepath.

If the indexer lights fail, the approach may be flown with reference to AOA indicator readings. In this case, attitude is corrected to keep the indicator pointer as close as possible to the center of the 3-o'clock reference index. Indications above and below the index indicate that the approach is being made more than 5 knots slow or fast. The indexer unit circuit breaker placarded AUX PWR is on the forward circuit breaker panel in the AOA section.

**2.14.1.2 Angle-of-Attack Indicator.** The AOA indicators (Figures 1-4, 1-5, and 2-14) are mounted on the upper left portion of the instrument panels. Because the AOA measurement is inherently independent of aircraft weight, a given dial value is assigned that automatically provides the correct airspeed to aircraft weight relationship. The AOA indicators do not display absolute angles of attack, but are arbitrary units grouped around the optimum with specific areas of interest. These areas are stall warning and optimum approach and they are depicted on the face of the instrument as special indices. While on the ground, the AOA system will not represent any particular angle of attack; however, once the aircraft weight is being supported by

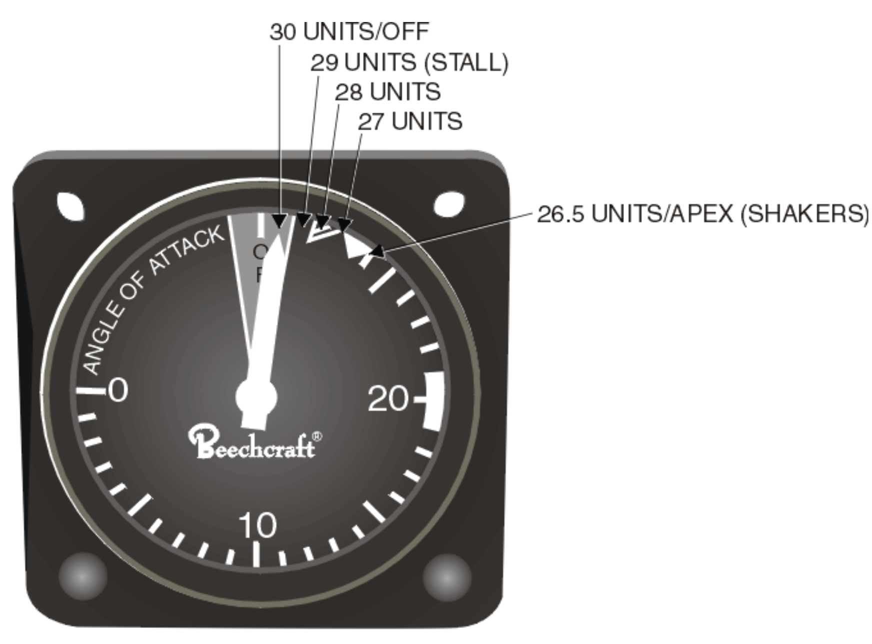



Figure 2-14. Angle-of-Attack Indicator

the wings, the system will provide valid AOA information and the stall warning system will be activated. Should there be a power loss to the system, the AOA indicator pointer will move to the “off” portion of the dial. The indicator circuit breaker, placarded INSTR PWR, is on the forward cockpit circuit breaker panel in the AOA section.

**2.14.1.3 Rudder Shaker.** To prevent inadvertent stalls, a stall warning system is provided via a discrete display point on the AOA indicator and rudder shakers are provided to physically warn the pilot. The display point is depicted on the AOA indicator as the 26.5-unit index point (apex of white triangle). As this point is reached, the rudder shakers will activate to physically warn the pilot of an impending stall. The rudder shakers are essentially electric motors driving an eccentric mass that vibrates the rudder pedals. These shakers are mounted on the aft cockpit rudder pedals and shaker motion is transferred to the forward cockpit pedals via the rudder interconnecting arms. Upon touchdown, the stall warning function is disabled through a shock strut switch on the nosegear. The system may be checked on the ground with the AOA test switch in either cockpit. The rudder shaker circuit breaker placarded S/W PWR is on the forward cockpit circuit breaker panel in the AOA section.

**Note**

Stall warning system is not available with electrical power secured.

**2.14.1.4 Angle-of-Attack Test Switch.** A two-position momentary ON and center OFF switch (Figures 1-4 and 1-5) located below the annunciator lights is used to test the AOA and stall warning system. To test the system, hold the switch in the APRCH (up) position. The AOA indicator pointer will move to the optimum 20-unit position. Depending on the position of the AOA transmitter vane, the red or green chevron may illuminate momentarily, followed by illumination of the yellow optimum-approach doughnut. Moving the switch to the STALL (down) position will cause the approach indicator pointer to move to or beyond the STALL position (crosshatch triangle), the green chevron on the approach indexer to illuminate, and the rudder shakers to operate.

**2.14.2 Pitot-Static Pressure System.** The pitot and static pressure systems supply impact (pitot) pressure and atmospheric (static) pressure to various instruments and system components. Pitot pressure is supplied to the airspeed indicators by an electrically heated pitot tube on the left-wing leading edge. Static or atmospheric pressure is supplied by two static orifices (ports) on the port and starboard side of the aft fuselage. Pressure from the two static ports is transmitted through tubing to the airspeed indicators, vertical speed indicators, altimeters, and the blind encoder (GPS aircraft only). The blind encoder is located in the front cockpit aft of the AC inverters. An encoding altimeter is installed in the forward cockpit and a barometric pressure altimeter is installed in the aft cockpit. Both altimeters are operated by static pressure and are equipped with 28-Vdc internal vibrators to reduce friction within the mechanism.

**2.14.2.1 Pitot Heat.** The pitot tube (Figure 1-1) is electrically heated to prevent icing. The heating element is controlled by a circuit breaker-type toggle switch (Figure 1-8) placarded PITOT HEAT and located on the right console in the front cockpit. When the pitot switch is in the ON (up) position, the heating element in the exposed portion of the pitot tube is activated. In the event of an electrical overload, the circuit breaker-type toggle switch will disconnect the heating circuit and trip the switch to the OFF (down) position. To reset power to the circuit, move the switch to the ON (up) position.

**CAUTION**

Pitot heat should not be used while the aircraft is on the ground except immediately prior to takeoff as required. Overheating because of a lack of cooling airflow will damage the heating element.

**2.14.2.2 Alternate Static Air Source.** The alternate static air source is designed to provide a source of static pressure to the instruments from inside the fuselage should the outside static air ports become blocked. An abnormal reading of the static air supplied instruments could indicate a restriction in the outside static air ports. A spring-guarded switch (Figure 1-2) in the front cockpit below the parking brake handle is placarded NORMAL, ALTERNATE. To use this alternate source of static air, raise the spring and select the ALTERNATE position. Refer to Part XI for the altimeter and airspeed position error correction — emergency charts when using the alternate static air source.

**Note**

Alternate static air source is available for the front cockpit pitot-static instruments only.

**2.14.2.3 Vertical Speed Indicator.** A vertical speed indicator (Figures 1-4 and 1-5) is installed on each instrument panel and indicates the rate of ascent or descent of the aircraft based on the changes in atmospheric pressure. The indicator is calibrated in 500-foot units from 0 to 6,000 feet with 100-foot scale divisions from 0 to 1,000 feet.

**2.14.2.4 Airspeed Indicator.** Two airspeed indicators (Figures 1-4 and 1-5) are provided, one on each instrument panel. The airspeed indicators are pitot-static instruments and are calibrated to show indicated airspeed from 40 to 400 knots. In addition, a maximum allowable airspeed pointer continuously indicates the maximum allowable airspeed for the T-34C aircraft.

**2.14.2.5 Encoder Altimeter (Front Cockpit).** The altimeter (Figure 1-4) is a pressure altimeter with 28-Vdc powered digital encoder that encodes altitude information in 100-foot increments for transmission on mode C of the transponder. Altitude is displayed on the altimeter by a 10,000-foot counter, a 1,000-foot counter, and a 100-foot drum. A single pointer indicates hundreds of feet on a circular scale with 50-foot center graduations. Below 10,000 feet, a diagonal warning symbol appears on the 10,000-foot counter. To minimize friction in the display mechanism, a 28-Vdc powered vibrator in the altimeter is energized whenever aircraft power is on. The barometric pressure setting knob on the altimeter face is provided to allow the pilot to adjust the indicated altitude for the local barometric pressure, while the encoder remains referenced to 29.92 inches of Hg. If dc power to the encoder is lost, the altimeter will continue to operate as a pressure altimeter but a CODE OFF flag will indicate that no altitude signals are being provided to NACWS or to the transponder for transmission on mode C.

The counterdrum-pointer display is designed so that the 100-foot drum and the pointer rotate continuously during altitude changes, while the 10,000-foot and 1,000-foot counter remain in a fixed position. When each 1,000-foot increment is completed, the counter(s) abruptly index to the next digit. However, there is a noticeable pause or hesitation of the pointer caused by the additional friction and inertia loads involved in indexing the counter(s). The momentary pause is followed by a noticeable acceleration as the counter(s) change. The pause and accelerated behavior occur in the 9 to 1 section of the scale and are more pronounced when the 10,000-foot counter changes. It is also more pronounced at high altitudes and high rates of ascent and descent. During normal rates of descent at low altitudes, the effect is minimal.

**Note**

If the altimeter internal vibrator is inoperative, the pause and accelerated effect may be exaggerated. Watch for this behavior when the minimum approach altitude lies within the 8 to 2 sector of the scale (i.e., 800 to 1,200 feet, 1,800 to 2,200 feet, etc.).

When a field elevation check is made, the local barometric pressure is set into the window. The altimeter should then agree within ±75 feet of the field elevation.

**Note**

During normal use of the barometric knob, if momentary locking of the barocounters is experienced, do not force the setting. Application of force may cause internal gear disengagement and result in excessive altitude errors. If locking occurs, rotate the knob a full turn in the opposite direction and approach the setting again with caution.

**2.14.2.6 Barometric Altimeter (Aft Cockpit).** The pressure altimeter (Figure 1-5) indicates the altitude of the aircraft above sea level to a height of 50,000 feet. The dial face is marked in increments of 50 to 100 feet. Each complete revolution of the pointer indicates a change in altitude of 1,000 feet. On the left of the center of the instrument, there are three rotating counters. The inner counter registers altitude in hundreds of feet, while the outer counters register thousands and ten thousands of feet. When the altitude pointer makes 12 revolutions, for instance, the outer counters will indicate 1 and 2, the inner counter will indicate 0, thus showing that the aircraft is at an altitude of 12,000 feet above sea level. Whenever the indicated altitude is below 10,000 feet, a diagonal warning symbol appears in the 10,000-foot counter.

At the extreme right side of the altimeter face is the barometric pressure window. The barometric pressure dial seen through the window is marked from 28.10 to 31.00 inches Hg and is used to correct for variations in sea level barometric pressure by means of a knob on the lower left corner of the instrument case.

**2.14.3 Vertical Gyro System.** The vertical gyro system is powered by the ac power bus and is located in the aft cockpit behind the left console. The vertical gyro system is to provide the pilot with visual indications of aircraft pitch and roll attitudes on the attitude indicators in both the forward and aft cockpits. The gyroscope develops through synchros pitch and roll signals representative of the aircraft attitude through 360° roll and ±82° pitch. The erection system incorporates separate systems for pitch and roll. Vertical reference is established by two gravity-sensitive switches that control a torque motor for each gyro axis. High or low erection rate of the gyro is accomplished by applying high or low voltage to the respective torque motor. A panel-mounted switch placarded FAST ERECT provides fast erection. Pressing the switch will erect the gyro to within 1.0° of pitch and roll within 60 seconds of power application and erect to within 0.5° within 2 minutes.

A power failure flag in the gyro indicator will be visible whenever input power is lost. For training purposes, the aft cockpit attitude indicator may be disabled. The disable switch is located on the forward cockpit avionics panel and is placarded AFT CKPT, ATTD GYRO, ON, and OFF. Placing this switch in the OFF position removes the electrical power to the aft cockpit attitude indicator.

**WARNING**

- A popped 115-Vac, 1-amp circuit breaker will cause the loss of certain 115-Vac instruments depending on the cockpit and the inverter selected. Indications are as follows:

1. Front cockpit: No. 1 inverter selected — Flashing MASTER CAUTION, inverter annunciator light and loss of attitude gyro and turn needle.

   No. 2 inverter selected — No indications.

2. Rear cockpit: No. 1 inverter selected — Flashing MASTER CAUTION, inverter annunciator light and loss of attitude gyro. No. 2 inverter selected — Loss of attitude gyro and turn needle.

   The inverter select switch will still be operable in the cockpit with electrical command.

**Note**

- The rear cockpit attitude gyro will be unreliable when power to the gyro unit is lost. The OFF flag may not appear for up to 15 minutes as the gyro winds down. An OFF flag will immediately appear in the front cockpit VGI.

- A power failure flag will be visible in the aft cockpit gyro indicator whenever the aft cockpit attitude gyro switch is placed to the OFF position. If the vertical gyro system fails under these circumstances, the power failure flag in the forward cockpit gyro indicator will be the only indication.

- If the aft cockpit attitude gyro switch is placed in the OFF position, the fast erect buttons in both cockpits will still function; however, no OFF flags will appear to confirm the slaving process.

**2.14.3.1 Attitude Indicator-Vertical Gyro Indicator.** The VGI (Figures 1-4 and 1-5) provides the pilot with constant visual indication of aircraft pitch and roll. Aircraft attitude indication signals are transmitted to the indicator from the vertical gyro located in the aft cockpit behind the left console. The indicator will accurately and continuously show the aircraft attitude through 360° of roll and 82° of climb or dive (pitch). Pitch-and-roll attitudes are shown on the indicator by the motion of a universally mounted sphere in relation to a miniature reference aircraft mounted on the instrument case. The horizon is represented on the sphere as a white line dividing the top and bottom halves. The upper half of the sphere, labeled CLIMB, is light grey in color to symbolize the sky. The lower half, labeled DIVE, is black to symbolize the Earth. The climb and dive sections of the sphere are graduated every 5°. A pitch trim knob, located on the lower right face of the indicator, is used to center the sphere horizon line in relation to the miniature aircraft. A power failure warning flag displaying the word OFF will be visible if essential ac power is lost. The attitude gyros are protected by circuit breakers placarded ATT GYRO on the circuit breaker panel in the respective cockpit.

**WARNING**

A popped 115-Vac, 1-amp circuit breaker with inverter No. 1 selected will result in illumination of the INVERTER annunciator light and failure of both VGIs. With inverter No. 2 selected, the front cockpit VGI will operate properly, but the INVERTER annunciator light will not illuminate.

**2.14.4 Compass System.** The gyrocompass system consists of four components: radio magnetic indicator, flux detector, slaving accessory, and directional gyro.

The RMI presents the pilots with aircraft magnetic heading and VHF omnidirectional range and tacan bearing to the station. A magnetic heading index at the top of the rotating azimuth indicates the magnetic heading of the aircraft as sensed by the flux detector located in the left wingtip. The flux detector is a saturable metal core reactor that senses direction of the Earth's magnetic field and maintains heading accuracy of the system within ±2°. The transistorized slaving accessory located in the avionics compartment combines flux detector and gyro information for an automatically slaved, gyro-stabilized output to the RMI. Fast slaving is initiated at the moment power is applied to rapidly align the directional gyro/azimuth card with the magnetic flux detector. While the slaving accessory automatically provides fast slaving, manual fast slaving may be selected to rapidly align the directional gyro/azimuth card with the magnetic flux detector and check any deviation or drift. This is accomplished by holding the compass slave switch placarded COMPASS, FAST SLAVE, SLAVE, and DG (Figures 1-4 and 1-5) and located on the lower left portion of each instrument panel to the FAST SLAVE (up) position until the azimuth card stops rotating.

**Note**

- Manual slaving should only be accomplished with the aircraft in an unaccelerated level flight attitude and can only be performed from the cockpit that has avionics command.
- The RMI will be in the free gyro mode (DG mode) when the rear cockpit has avionics command and the rear cockpit RMI is disabled. The front cockpit pilot must continually check the standby magnetic compass to ensure proper aircraft heading is being maintained.
- A red failure flag will appear in the RMI whenever the RMI is not providing accurate heading information. A red failure flag will appear in the aft cockpit RMI whenever the aft cockpit RMI switch in the forward cockpit is placed to the OFF position.
- Failure of the compass system to provide accurate heading information will affect NACWS operation.

A nonslaved gyro mode (DG mode) of operation is incorporated that disables automatic slaving for manually slaving the system. This is accomplished by placing the compass slave switch in the DG (down) position and rotating the azimuth card in the desired direction with the switch placarded SLAVE, LEFT, RIGHT (Figures 1-4 and 1-5) and located adjacent to the FAST SLAVE switch. The DG mode is used when the aircraft is in an area of considerable magnetic disturbance as indicated by a fluctuating azimuth card. Placing the SLAVE switch in the DG position disables the flux valve and allows the system to operate in a free gyro mode.

In addition, the slaving accessory supplies all ac power required by the system. The directional gyro located in the avionics compartment is driven by the 115-volt, 400-cycle power supply within the slaving accessory.

**2.14.4.1 Standby Magnetic Compass.** The standby magnetic compass (Figures 1-2 and 1-3) is used for navigation in case of failure of the gyro compass system. The magnetic compass is a self-contained instrument mounted on the top center of the forward and aft glareshields.

**WARNING**

The suspension fluid for the magnetic compass is highly flammable petroleum distillate, Naptha (MIL-L-5020B), that can cause impairment to pilots in the event of leakage and subsequent inhalation or skin contact.

**Note**

The standby magnetic compass is erratic when the ignition system is operating.

**2.14.5 Acceleration Indicating System.** The acceleration indicating system consists of a recording accelerometer installed on the instrument panels and provisions for a counting accelerometer.

**2.14.5.1 Accelerometer.** The accelerometer (Figures 1-4 and 1-5) in each cockpit, with three indicating hands, registers and records positive and negative g loads imposed upon the aircraft. One hand moves in the direction of the g load being applied while the other two, one for positive g loads and one for negative g loads, follow the indicating pointer to its maximum travel. The recording pointers remain at the respective maximum travel positions of the g's being applied, providing a record of maximum g loads encountered. Depressing the push-to-reset knob at the lower left corner of the instrument allows the recording pointers to return to the normal position.

**CAUTION**

Accelerometers may read as much as one-half g low, possibly lower if acceleration rate is high.

**2.14.5.2 Turn and Slip Indicator.** Two electrically driven turn and slip indicators (Figures 1-4 and 1-5), one on each instrument panel, are provided. The turn indicator consists of an electrically driven gyro linked to a pointer needle. The pointer needle indicates the direction the aircraft is turning and is calibrated so that a single needle-width deflection indicates a 1-1/2° per second rate of turn (4-minute turn). The slip indicator or ball indicates the relationship between the angle of bank and the rate of turn. The ball is in a curved fluid-filled tube (inclinometer). When the aircraft is flying straight and level, the ball will be centered in the tube by its own weight. When the aircraft is making a turn, the ball is acted upon by centrifugal and gravity forces. During a coordinated turn, both forces balance out and the ball will remain centered. Power for the turn and slip indicators is supplied by the 115-Vac essential bus. A power failure warning flag displaying the word OFF will be visible if essential bus power is lost. A circuit breaker placarded TURN BANK is on each cockpit circuit breaker panel.

**WARNING**

A popped 115-Vac, 1-amp circuit breaker with inverter No. 1 selected will result in illumination of the INVERTER annunciator light and failure of the front cockpit turn needle. With inverter No. 2 selected, the rear cockpit turn needle will fail, but the INVERTER annunciator light will not illuminate.

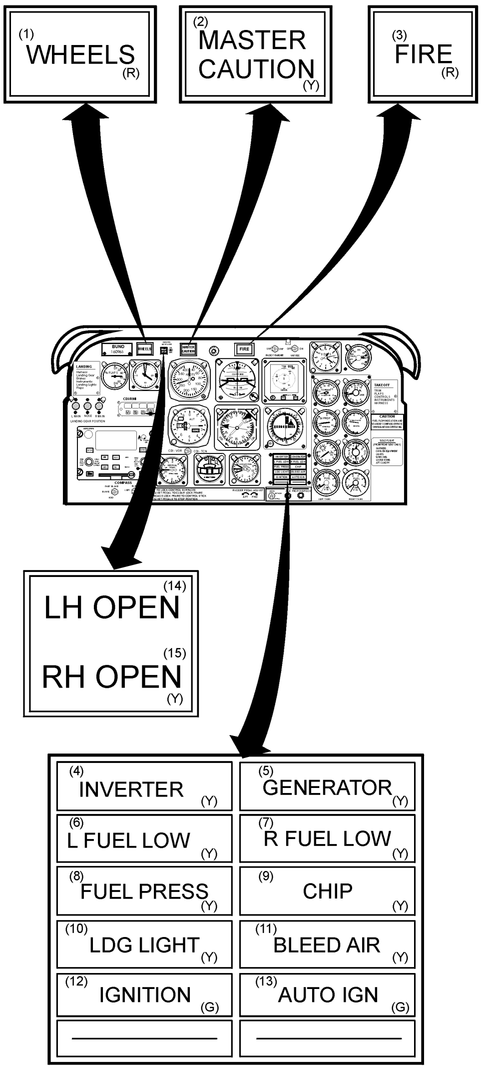
### 2.14.6 Miscellaneous Instruments

**2.14.6.1 Free Air Temperature Indicator.** The free air temperature gauge (Figure 1-2) is installed in the windshield and indicates the free air temperature in degrees.

**2.14.6.2 Elapsed Time Clock.** An 8-day manually wound clock (Figures 1-4 and 1-5) with elapsed time feature is installed on both instrument panels.

## 2.15 WARNING, CAUTION, AND ADVISORY LIGHTS

The warning, caution, and advisory lights (Figure 2-15) provide a visual warning of malfunctions of aircraft equipment, unsafe operating conditions, or notice that a particular system is in operation. A function description of each light is included in the description of the applicable system.




**Note**

REFER TO APPROPRIATE PART OF PART V FOR EMERGENCY PROCEDURES.

**Note**

AFTER NOTING THE FAULTY CONDITION EXTINGUISH THE MASTER CAUTION LIGHT.

| LIGHT ILLUMINATED | MEANING |
|---|---|
| (1) WHEELS | 1. Flaps extended prior to gear.<br>2. PCL and EPL both above or below 75-percent $N_1$ (gear up).<br>3. Gear handle up while aircraft on ground.<br>4. Gear not locked in down position. |
| (2) MASTER CAUTION | Annunciator fault indication. |
| (3) FIRE | Fire detector system activated. |
| (4) INVERTER<br>— Loss of 115-vac or 26-vac power | Determine extent of malfunction; if complete ac power failure, select other inverter. |
| — Failure of the 115-vac, 1-amp cb with inverter No. 1 selected. | If not a complete ac-power failure 928 VAC instruments still operate). Reset 115-Vac circuit breaker. |
| (5) GENERATOR | Starter Switch — ON, low voltage output or generator failure. |
| (6) L FUEL LOW | Left wing fuel quantity below approximately 90 pounds usable. |
| (7) R FUEL LOW | Right wing fuel quantity below approximately 90 pounds usale. |
| (8) FUEL PRESS | Low pressure output from engine-driven fuel boost pump. |
| (9) CHIP | Metal particles present in oil system. |
| (10) LDG LIGHT | Gear retracted with one or both landing lights on. |
| (11) BLEED AIR | Cockpit heating (bleed) air over-temperature condition exists. |
| (12) IGNITION | Ignition control box energized by starter switch or auto ignition. |
| (13) AUTO IGN | Auto ignition switch on, system armed. |
| (14) LH OPEN | Left inboard gear door open with gear not in transit. |
| (15) RH OPEN | Right inboard gear door open with gear not in transit. |

F-0020

Figure 2-15. Caution/Annunciator Lights

**2.15.1 Fault Lights.** If a fault should occur (e.g., generator fault), a signal from the fault sensor is sent to its respective light (in this case, the yellow GENERATOR light) in the annunciator panel. A parallel signal is also directed to activate the flashing MASTER CAUTION light. Correcting the fault condition will extinguish both the MASTER CAUTION and the respective fault light.

**2.15.2 Master Caution Light.** A yellow light located at the top of the instrument panel (Figure 2-15) when flashing provides a visual warning to the pilot that a fault condition exists that requires a corrective action. The light will extinguish after fault correction or may be canceled by depressing the face of the light, resetting the circuit. Resetting the circuit will extinguish the light; however, the respective annunciator will remain illuminated. A second fault will cause the MASTER CAUTION light to illuminate again only if the MASTER CAUTION circuit has reset.

**2.15.2.1 Annunciator Light.** The annunciator panel (Figure 2-15) mounted on each instrument panel provides a visual monitor for various functions of the aircraft and indicates conditions for which corrective action must be taken. The panel presents two rows of small rectangular windows that illuminate as either yellow or green. Word printing on individual windows identifies the monitored function or fault conditions. A function indication is displayed by illumination of the appropriate green light. Fault conditions are shown by illumination of a specific yellow window simultaneously with the flashing yellow MASTER CAUTION light located at the top of the instrument panel.

**Note**

- The flashing MASTER CAUTION light will not illuminate with either the IGNITION or AUTO IGN green lights.

- The annunciator lights are not of the press-to-test or press-to-extinguish type. If the light is accidentally pressed, it will partially pop out and must be completely removed before it can be pushed back in place.

**2.15.2.2 Annunciator Test Switch.** An annunciator test switch button is located immediately below the annunciator panel in both cockpits and when one is depressed it will illuminate in its respective cockpit the entire annunciator panel, flashing MASTER CAUTION light, flashing WHEELS light, and the red light in the gear handle. When both cockpits press their respective buttons simultaneously, the MASTER CAUTION light will extinguish; all other indications will be normal.

## 2.16 ENGINE FIRE DETECTION SYSTEM

A flame surveillance system is installed in the engine compartment to detect engine compartment fire and provide alarm to the pilot. The compartment is monitored by a control amplifier and three detectors. Electrical wiring connects all sensors and control amplifiers to dc power and to the cockpit visual alarm light. One detector monitors forward of the air intake and both exhaust outlets, a second monitors the upper accessory area, and a third the lower accessory area.

**2.16.1 Fire Detectors.** Warning of engine compartment fire is provided as follows: Fire emits an infrared radiation that will be sensed by the detector that monitors the area of origin. Radiation exposure activates the relay circuit of a control amplifier that causes signal power to be sent to cockpit light, then the red FIRE warning light (Figure 2-15) on the instrument panel starts flashing. An activated surveillance system will return to the standby state after the fire is out. The system includes a functional test switch and has circuit protection through the circuit breaker placarded FIRE DET on the forward cockpit circuit breaker panel.

**2.16.1.1 Fire Warning Light.** A red fire warning light (Figure 2-15) on the top center of the instrument panel is placarded FIRE. When illuminated, the light indicates a fire in the engine or engine accessory compartment. The light will return to the standby state when fire is no longer present.

**2.16.1.2 Fire Warning Test Switch.** A rotary switch (Figure 1-4) placarded FIRE WARNING TEST OFF, 1, 2, 3 on the forward instrument panel is provided to test the engine fire detection system. Each numbered switch position will initiate the cockpit indication as follows: Position 1 checks the detector for the lower accessory compartment. Position 2 checks the detector and circuits for the upper accessory compartment. Position 3 checks the detector and circuits for the area forward of the air intake.

During ground test of the engine fire detection system, an erroneous indication of system fault may be encountered if an engine cowling is not closed properly. In this circumstance, close the cowling or change the aircraft heading to enable a valid system check.

## 2.17 ENTRANCE/EGRESS SYSTEM

Entrance to and egress from both cockpits is made from the left wing since canopy handles and the aft cockpit assist step are on the left side only.

**2.17.1 Aft Cockpit Assist Step.** The aft cockpit kick step (Figure 1-1) is located in the fuselage above the trailing edge of the left wing flap. Access to the step is from the wing by kicking in a spring-loaded door which is flush with the aircraft exterior when closed.

**2.17.2 Canopy.** The canopy is in three sections: a manually operated sliding section over each cockpit and a rigid center section. Each sliding section opens aft and can be operated independently.

**WARNING**

Forward canopy will slam shut if not locked in the open position when the rear canopy is opened in flight.

**2.17.2.1 Canopy Assist Handles.** To aid in opening and closing the canopies from inside the cockpit, an additional assist handle (Figure 2-16) is provided on each sliding section.

**2.17.2.2 Canopy Locking Handles.** Interior and exterior canopy locking handles (Figure 2-16) located on the left side of each sliding section are turned to lock or unlock and assist in opening the canopies from either the inside or outside.

**2.17.3 Canopy Pneumatic System (Emergency).** The canopy pneumatic system assures the occupants that in case of emergency the cockpit canopies may be opened to permit escape from the aircraft. For maximum canopy operating speeds, refer to Chapter 4. The system consists of a bottle assembly, actuating cylinder,

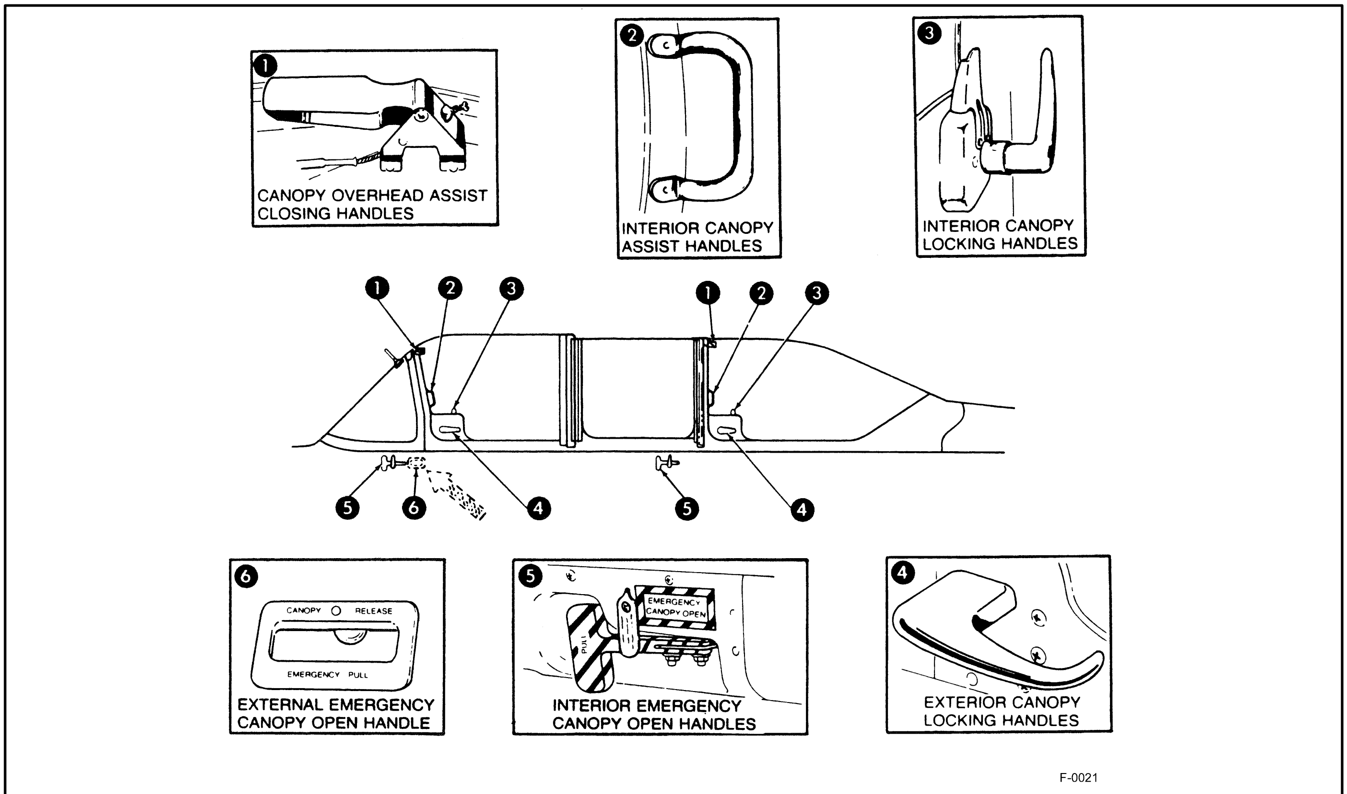



Figure 2-16. Canopy Handles

pressure indicator, canopy assist handles, canopy pull cables, canopy retaining tracks, and canopy slide tracks and stops. The bottle is mounted on the right side panel located in the avionics compartment. The pressure indicator (Figure 3-1) is mounted on the bottle assembly and is visible through a round Plexiglas window on the right side of the aircraft. Emergency canopy open handles are located in the right interior moldings of both cockpits and on the right exterior fuselage. When a handle is pulled, compressed nitrogen is released and the actuating cylinder unlocks and opens both canopies. If the canopies do not fully open, assist handles located on the right-hand side of each canopy will enable the occupant to open the canopies sufficiently to permit escape.

**Note**

- The canopy will be open 2 inches less when operated pneumatically and may take as long as 4 seconds to reach the opened position.
- The canopy, once opened, will remain open under pressure of the system and cannot be closed until the actuator has been bled of pressure on the ground.

**2.17.3.1 Canopy Emergency Open Handles.** Both sections of the canopy may be opened simultaneously in an emergency by pulling the striped canopy emergency open handle (Figure 2-16) that is located on the right side of each cockpit or the exterior handle located on the right side of the fuselage. Operation of either handle actuates the canopy pneumatic system that operates by compressed nitrogen.

**2.17.3.2 Emergency Canopy Bottle.** The emergency canopy bottle retains and furnishes high-pressure nitrogen to operate the actuating cylinder and pulls the cables and slide tracks aft to open both compartment canopies. The bottle is mounted in the avionics compartment and is accessible through the compartment door on the left side of the fuselage.

**Note**

It is required that the nitrogen bottle be fully charged after the system has been actuated. This servicing can be accomplished at the time that system pressure is being bled to enable closing of the canopy after emergency operation.

**2.17.3.3 Emergency Canopy Pressure Indicator.** The emergency canopy pressure indicator (Figure 3-1) is mounted to the bottle assembly and is visible from the exterior of the aircraft through a small round Plexiglas window on the right side of the fuselage. The instrument shows the nitrogen charge remaining in the bottle is psig × 1,000 and is calibrated to show the charge corrected for various temperatures ranging from –65 to +160 °F. The face of the instrument is red with a green vertical band that indicates an acceptable nitrogen charge corrected for temperature.

## 2.18 COCKPIT ENVIRONMENTAL CONTROL SYSTEM

Cockpit environmental comfort is provided by three sources: fresh outside air, air-conditioned (refrigerated) air, and heated (bleed) air. Air for cockpit heating and windshield defogging (Figure 2-17) is supplied by engine bleed air and outside (ambient) air mixed to a desired temperature. Engine bleed air is ducted from the bleed-air band of the engine to the pilot-controlled bleed-air regulator. This regulator unit controls the volume of bleed air taken from the engine from 0 to 6 pounds per minute. After leaving the regulator, the air is inducted to the jet pump assembly where it is mixed with incoming ambient air. After passing through a muffler and firewall gate valve, the air enters a distributor containing the pilot-controlled defogging control valve that directs the air to the windshield defogging outlet. A control knob, placarded WINDSHIELD DEFOGGER (Figure 1-2), is located adjacent to the cockpit environmental control in the forward cockpit. The control knob is used to establish the desired airflow to the windshield from OFF to MAX airflow.

**Note**

Effective windshield defogging requires the cockpit environmental control be set to the desired temperature.

Ventilation is provided by two sources: the cockpit environmental control system (Figure 2-17) and the scoop assembly on the underside of the aircraft that furnishes additional outside fresh air to the aft cockpit only. The cockpit environmental control system is capable of providing fresh outside air or heated air utilizing engine bleed air. Control of cockpit temperature is afforded by a forward cockpit-mounted control (Figure 1-2) placarded COCKPIT ENVIRONMENTAL CONTROL on the left side of the forward cockpit.

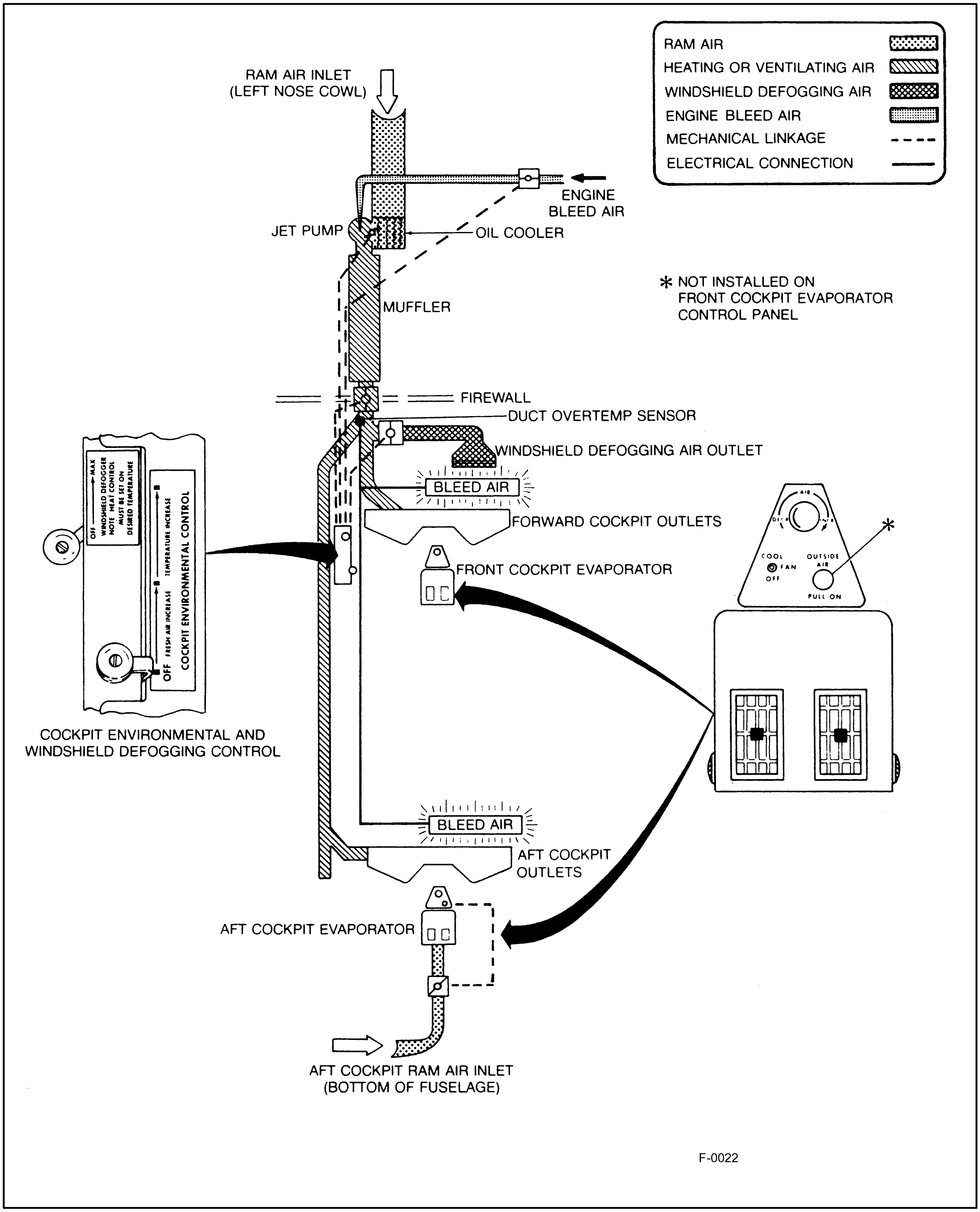



Figure 2-17. Heating/Ventilation System

Ambient air is introduced to the system as it enters the air duct located on the left side of the nose cowl, where it is directed aft to the oil cooler duct assembly. As air enters the oil cooler assembly, it is utilized to cool the engine starter assembly and cool the engine oil as well as being directed to the cockpit through the jet pump assembly, where it either is mixed with bleed air or directed as unheated air to the cockpit outlets. The cockpit outlets are mounted under the instrument panels and direct the flow of air in the desired direction.

**2.18.1 Cockpit Environmental Controls.** A single control in the forward cockpit (Figure 1-2) controls cockpit temperature. The control consists of a slide assembly and three individual control cables that control the bleed-air regulator, butterfly valve in the jet pump assembly, and the firewall gate valve. The control is placarded COCKPIT ENVIRONMENTAL CONTROL, OFF, FRESH AIR INCREASE, and TEMPERATURE INCREASE. When the control is in the OFF position, the firewall gate valve and the bleed-air regulator are closed. As the control is moved forward, the firewall valve progressively opens to allow an increased flow of fresh air. At the temperature increase mark, the bleed-air valve begins to open allowing bleed air to mix with the fresh air, increasing cockpit temperature. As the control is moved to the full forward position, the cockpit will be receiving only bleed air with no fresh air mixed. An overtemperature sensor located in the distributor duct area aft of the firewall provides a warning of an overtemperature in the duct area. An electrical signal from this sensor will cause the MASTER CAUTION and the BLEED AIR annunciator light to illuminate. Placing the environmental control in a cooler temperature range will extinguish the lights. The bleed-air heater shall be off for starting engine and can be tested after start by advancing the environmental control to the full increase position and observing an increase in ITT. A fresh-air duct beneath the aircraft supplies additional ventilation air to the aft cockpit. This air is supplied at the outside air temperature unless the air-conditioner is on in which case the ambient air is also cooled. Control of air from this source is a push-pull control on the aft cockpit evaporator placarded OUTSIDE AIR, PULL ON.

**2.18.2 Air-Conditioning System.** Cockpit air-conditioning is provided by a refrigerant gas vapor cycle system (Figure 2-18) consisting of a belt-driven, engine-mounted compressor (installed on the engine accessory section), refrigerant plumbing, high- and low-pressure protective switches, compressor clutch cutout relay, 7- to 15-second time delay, condenser coil, condenser ground blower, and evaporator units in each cockpit. The refrigerant plumbing from the compressor is routed aft through the condenser to the servicing point in the avionics compartment and to both evaporator

The compressor clutch relay acting through the 7- to 15-second time delay switch serves to activate the air-conditioning system under normal circumstances and to interrupt air conditioning in other circumstances by disengaging the compressor clutch. During normal operation when the air-conditioning mode is selected in either cockpit, the compressor clutch will engage the compressor after a 7- to 15-second time delay. The time delay can be expected every time the system is activated. The circumstance that will cause the clutch relay to disengage is a signal from either the high- or low-pressure protective switches. The electrical circuit of the compressor clutch is protected by a circuit breaker placarded CLUTCH on the forward cockpit circuit breaker panel.

**2.18.2.1 Cockpit Evaporators.** The evaporator units (Figure 2-18) installed between the rudder pedals in both cockpits consist of the blower fans, air-conditioning controls, expansion valves, outlets for air circulation, and evaporator coils. The aft evaporator also contains provisions for additional ventilation (outside) air through a scoop located on the underside of the aircraft.

The blower fans installed in both the forward and aft evaporated units provide circulation of refrigerated and ventilation air and are manually regulated for desired airflow. Placing the fan switch in the COOL or FAN position and regulating the fan speed with the rheostat placarded AIR, INCREASE, DECREASE provides each cockpit with individual control of airflow. Louvered air outlets, two on the front and one on each side of each evaporator, afford control of direction and volume of the airflow. Each blower fan is individually protected by circuit breakers placarded VENT BLO on their respective circuit breaker panels.

**2.18.2.2 Air-Conditioning Controls.** Control of the air-conditioning system, including blower fans, is provided on the control panel mounted on top of each evaporator unit. The common controls are a three-position switch placarded FAN, COOL, and OFF and a rheostat placarded AIR, INCREASE, DECREASE. The center FAN position of the switch activates each

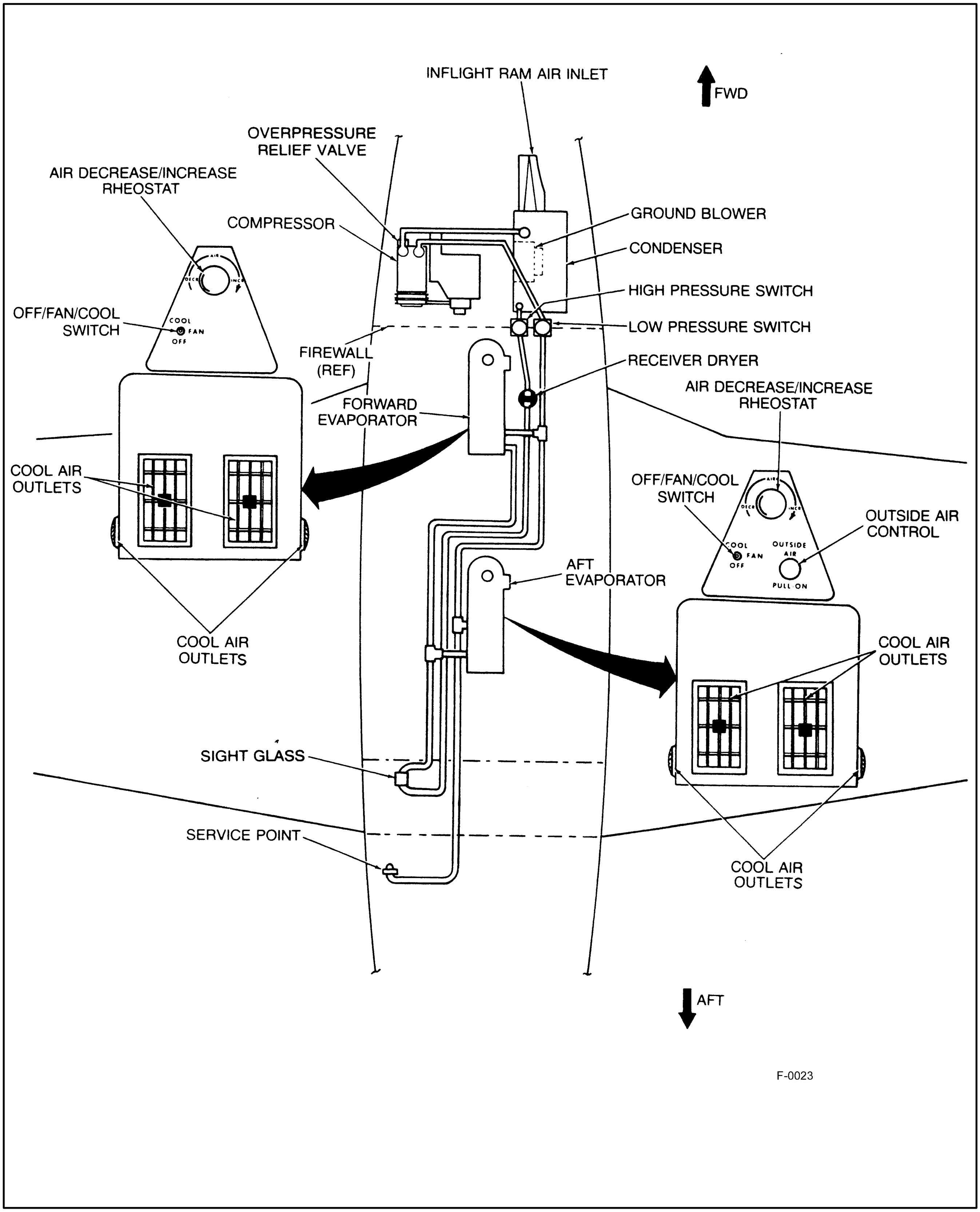



Figure 2-18. Air-Conditioning System

individual blower fan independently and speed of the fan is controlled by the AIR rheostat. Blower fan rpm is increased by rotating the rheostat in a clockwise direction. Placing either FAN switch in the COOL position will activate the compressor clutch and, after a 7- to 15-second delay, refrigerated air will be delivered to each cockpit through the evaporator units. The blower fans are independently operational in the COOL mode, and blower speed is regulated by the AIR rheostat.

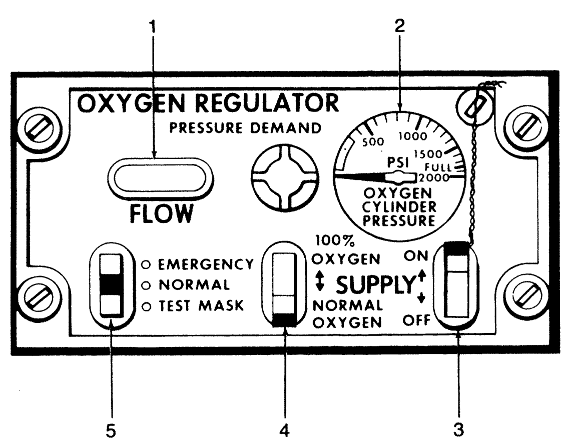
**2.18.2.3 Air-Conditioning Condenser Blower.** A condenser blower located in the engine accessory compartment supplies the necessary air to the air-conditioning condenser that is normally supplied in flight by ducted ram air. This blower permits use of the air-conditioning system while the aircraft is on the deck or in flight with the landing gear extended. The up-lock switch on the left main gear disables the blower circuit when the landing gear is retracted. Placing an air-conditioning control panel mounted FAN switch in the COOL position (landing gear extended) will activate both the air-conditioner compressor and condenser blower. The condenser blower circuit is protected by a circuit breaker placarded COND BLO located in the AIR COND section of the forward cockpit circuit breaker panel.

**2.18.3 Oxygen System.** The pilots receive oxygen from the diluter-demand oxygen supply system (Figure 3-4) that mixes the proper ratio of oxygen and cockpit air for a given altitude. The oxygen supply is provided by a 76-cubic foot pressure cylinder through a 70-psi regulator that is mounted on the supply cylinder to the individual pressure-demand regulator control panels in both cockpits. The oxygen cylinder supply is controlled by a striped push-pull “T”-shaped handle located in a recessed panel placarded OXYGEN EMERGENCY SHUT-OFF on the right side of the forward cockpit. Pushing the handle in to the ON position opens the regulator, allowing oxygen to flow at 70 psi to the cockpit control panels.

**2.18.3.1 Oxygen Supply Cylinder.** The oxygen supply is contained in a 76-cubic foot supply cylinder (charged to 1,850 psi) located beneath the floor in the aft cockpit. A pressure regulator and a blowout disk mounted on the cylinder provide reduced supply pressure and cylinder high-pressure protection. The pressure regulator reduces the cylinder pressure to a working pressure of 70 psi before delivery to the oxygen panels in the cockpit. The blowout disk provides excess pressure protection and when ruptured will dump the entire oxygen supply overboard.

**2.18.3.2 Oxygen Supply Gauges.** Three 2,000-psi pressure gauges placarded OXYGEN SUPPLY PRESSURE provide continuous oxygen cylinder pressure readings. A gauge is located on both oxygen regulator panels and one is located on the oxygen service panel on the right fuselage.

**2.18.3.3 Oxygen Regulator Panels.** A diluter-demand oxygen regulator (Figure 2-19) in each cockpit provides the pilot with individually regulated control of the oxygen system. Each panel contains a blinker-type flow indicator, a 2,000-psi gauge, a red emergency pressure control lever (placarded EMERGENCY, NORMAL, TEST MASK), a white diluter control lever (placarded 100% OXYGEN and NORMAL OXYGEN), and a green supply control lever (placarded ON and OFF). The supply control lever turns the individual regulator on and off. The diluter control lever gives the selection of either NORMAL or 100% OXYGEN, but acts to select only when the emergency pressure control lever is placed in the NORMAL position.




1. FLOW INDICATOR (BLINKER TYPE)
2. SUPPLY PRESSURE GAUGE
3. SUPPLY CONTROL LEVER (GREEN)
4. DILUTER CONTROL LEVER (WHITE)
5. EMERGENCY/NORMAL/TEST LEVER (RED)

F-0024

Figure 2-19. Oxygen Regulator Panel

**CAUTION**

When not in use, the diluter control lever should be left in the 100% OXYGEN position to prevent regulator contamination.

Whenever oxygen is inhaled, a blinker vane slides into view within the flow indicator window, showing that oxygen is being released. During the exhale process, the blinker vane vanishes from view. Outside temperature lowers as an aircraft ascends to higher altitudes, and oxygen cylinders thus cooled by temperature change will show a pressure drop. This type of pressure drop will rise again upon return to a lower or warmer altitude. A valid cause for alarm would be the rapid loss of oxygen pressure when the aircraft is in level flight or descending. Should this condition arise, descend to an altitude that does not require the use of oxygen.

**WARNING**

If any symptoms occur suggestive of the onset of hypoxia, immediately set the emergency pressure control lever to the EMERGENCY position and descend below 10,000 feet. Whenever carbon monoxide or other noxious gas is present or suspected, set the diluter control lever to 100% OXYGEN and continue breathing undiluted oxygen until the danger is past.

The emergency pressure control lever has three positions: two positions control oxygen consumption for the individual using oxygen and the remaining position serves for testing hose and mask integrity. In the EMERGENCY position, the control lever causes 100-percent oxygen to be delivered at a safe positive pressure. In NORMAL position, the lever allows delivery of normal or 100-percent oxygen depending upon the selection of the diluter control lever. In TEST MASK position, 100-percent oxygen at positive pressure is delivered to check hose and mask integrity.

**2.18.3.4 Oxygen Masks.** To connect an oxygen mask into the oxygen system, the individual connects the hose attached to the cockpit sidewall to the mask hose connection. The microphone in the oxygen mask is provided with a cord for connecting to the phonejack cord. To test mask and hose integrity, the pilot shall check that the oxygen shutoff control in the regulator panel levers are ON (safety wire not broken), 100% OXYGEN, and NORMAL; while holding mask away from face, check TEST MASK and EMERGENCY positions; check flow indicator by inhaling (blinker appears) and exhaling (blinker disappears) a minimum of three times.

## 2.19 DEFOGGING SYSTEM

The windshield defogging system, an integral part of the heating and ventilating system (Figure 2-17), consists of the necessary controls and ducting to provide a defogging airflow to the outlet below the windshield. Temperature of the heated air for windshield defogging is regulated by the cockpit environmental control, and airflow is regulated by the windshield defogger control on the left-side rail in the forward cockpit. The defogger control is placarded WINDSHIELD DEFOGGER OFF and MAX. To operate the windshield defogging system, the cockpit environmental control is placed in the desired temperature range and the windshield defogger control is placed in the desired airflow position.

## 2.20 POWERPLANT ICE PROTECTION SYSTEM

Anti-ice protection for the engine is provided by a mechanical system that consists of an engine air inlet bypass door controlled by a push-pull type handle located below the right subpanel of the front cockpit. This system prevents supercooled water droplets and snow from collecting on the engine screen. Protection is based upon the principle of inertial separation and is accomplished within the intake air duct by introducing a sudden turn to the airflow before it reaches the engine air intake screen that covers the inlet to the compressor section. Only low-mass air will make contact with the engine screen when the bypass door is activated. Because water and snow particles are heavier than air, they will continue undeflected by virtue of their momentum to be discharged from the induction system through an open bypass duct at the back of the intake scoop. When the engine air inlet bypass door is open, intake airflow is changed, and a slight decrease in engine torque will occur. When using the bypass door, monitor the position of the door control to assure that it remains in the open position.

- UPPER (LIGHT) FIGURES INDICATE DILUTER DEMAND USAGE
- LOWER (BOLD) FIGURES INDICATE 100% OXYGEN USAGE

HOUR/MINUTES
CREW-TWO

ONE OXYGEN CYLINDER - 76 CUBIC FEET

**Note**

DOUBLE THE DURATION TIME SHOWN WHEN ONE PILOT IS USING OXYGEN.

CYLINDER GAGE PRESSURE ~ PSI

| AIRCRAFT ALTITUDE - FEET | 1850 | 1600 | 1400 | 1200 | 1000 | 800 | 600 | 400 | 200 |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | 5:27 **2:57** | 4:38 **2:30** | 3:58 **2:08** | 3:18 **1:47** | 2:39 **1:25** | 1:59 **1:04** | 1:19 **0:43** | 0:40 **0:21** | 0 **0** |
| 15,000 | 6:38 **2:22** | 5:38 **2:00** | 4:49 **1:43** | 4:01 **1:26** | 3:13 **1:09** | 2:25 **0:51** | 1:36 **0:34** | 0:48 **0:17** | 0 **0** |
| 10,000 | 6:38 **1:54** | 5:38 **1:37** | 4:49 **1:23** | 4:01 **1:09** | 3:13 **0:55** | 2:25 **0:41** | 1:36 **0:27** | 0:48 **0:14** | 0 **0** |
| 5,000 | 6:38 **1:30** | 5:38 **1:16** | 4:49 **1:05** | 4:01 **0:55** | 3:13 **0:44** | 2:25 **0:33** | 1:36 **0:22** | 0:48 **0:11** | 0 **0** |
| SEA LEVEL | 6:38 **1:13** | 5:38 **1:02** | 4:49 **0:53** | 4:01 **0:44** | 3:13 **0:35** | 2:25 **0:26** | 1:36 **0:17** | 0:48 **0:09** | 0 **0** |

F-0025

Figure 2-20. Oxygen Duration

**2.20.1 Engine Air Inlet Bypass Door Control.** A push-pull control placarded ENG AIR INLET BYPASS DOOR PULL OPEN and located on the right lower subpanel (Figure 1-2) allows the pilot to open or close the engine air inlet bypass door as required.

## 2.21 PERSONNEL EQUIPMENT

**2.21.1 Seats.** The seat in each cockpit is adjustable 5 inches vertically in 1-inch increments. The seat is positioned by pulling the spring-loaded handle (Figure 2-21), moving the seat to the desired height, then releasing the handle to lock the seat in position. There are no horizontal adjustments in the seat. Seat-to-pedal adjustments are accomplished with the rudder pedal crank (Figures 1-2 and 1-3). A restraint harness with an inertia reel lock is installed on each seat.

**2.21.1.1 Restraint Harness.** The pilot is held in the seat by an integrated harness assembly (Figure 2-21), consisting of a lap belt, crotch strap, shoulder harness, and an inertia reel lock. The entire assembly is attached to the seat structure. All of the straps lock at one common five-point rotary buckle permanently attached to the crotch strap. The harness straps are simultaneously released with a twist of the buckle release knob.

**2.21.1.2 Inertial Reel Lock.** The shoulder harness inertia reel is locked or unlocked by movement of the inertia reel lock handle (Figure 2-21) at the left of the seat. The handle is spring loaded to either the locked or unlocked position. When the handle is unlocked (aft), the inertia reel maintains a slight tension on the harness but permits the pilot to lean forward to reach the controls. When the handle is moved to the locked (forward) position, the inertia reel locks the harness in successive positions as the pilot leans back. Before the inertia reel can be unlocked, all tension must be removed from the harness by leaning full-back in the seat. The inertia reel locks automatically when the aircraft is under a linear deceleration of 2 g's or more, as in a crash landing.

## 2.22 EMERGENCY EQUIPMENT

Emergency equipment items in the aircraft are a parachute in each cockpit, a first-aid kit, and a portable emergency locator transmitter. The first-aid kit (Figure 1-1) is located in the small recess behind the aft cockpit seat and is accessible from the aft cockpit only. The ELT

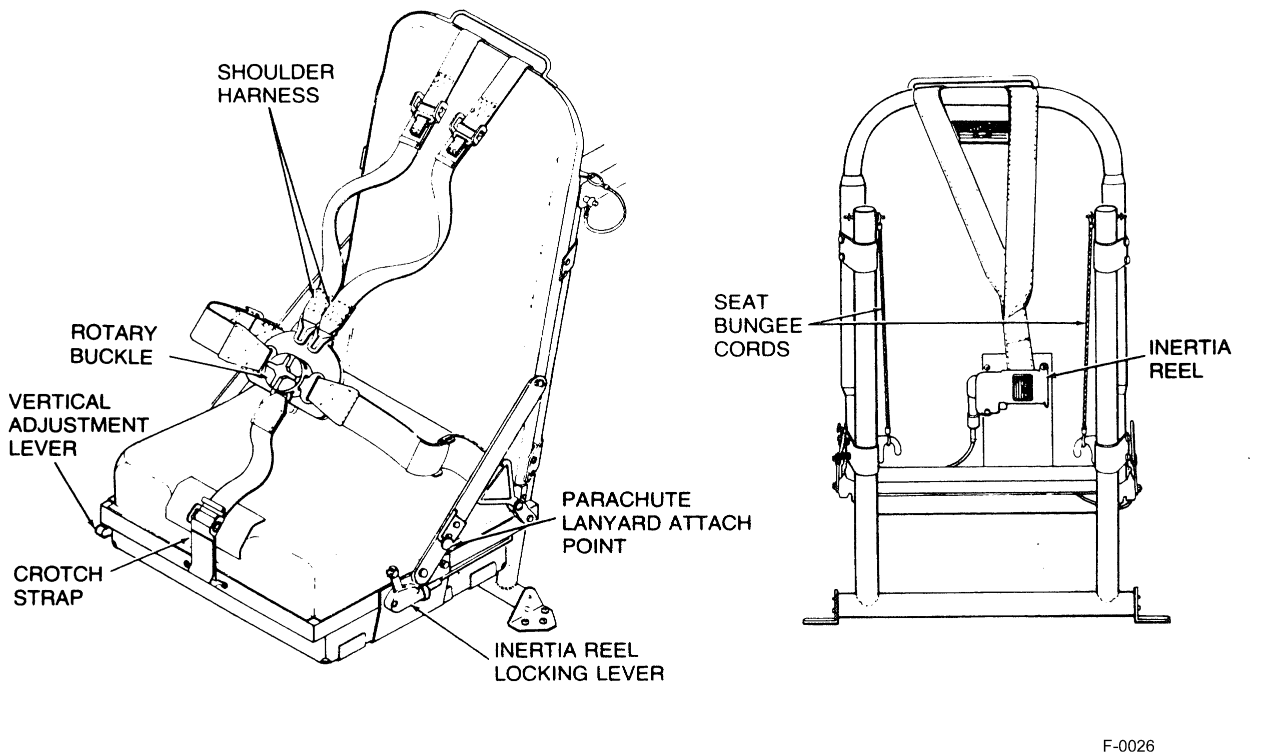



Figure 2-21. Seats and Restraint Harness

is located on the left sidewall beside the seat in the forward cockpit. Refer to Part VII for operation of the ELT.

**2.22.1 Parachute.** An emergency back-pack-type parachute is provided in each cockpit. The parachute has a D-ring ripcord handle that initiates immediate deployment of the parachute when pulled. In the event the pilot is incapacitated and unable to manually activate the parachute, there is an automatic opening device that will initiate parachute deployment after bailout. An approximate 5-foot length of lanyard extends from the device in the bottom left of the parachute and should be checked during preflight for attachment to a stud on the left side of the seat. Upon bailout from below 10,000 feet, the automatic device will activate the parachute after a 2- to 3-second delay from reaching the end of the lanyard. If bailout is above 10,000 feet, the pilot will freefall to 10,000 ± 1,000 feet. In any case, if the pilot pulls the D-ring, parachute deployment is immediate.

## 2.23 MISCELLANEOUS EQUIPMENT

**2.23.1 Mapcase.** A mapcase (Figures 1-2 and 1-3) is provided in each cockpits at the aft end of the right console.

**2.23.2 Instrument Flying Hood.** An instrument flying hood (Figure 1-1) is mounted behind the seat in the aft cockpit and is stowed at the back of the cockpit when not in use. The cockpit can be enclosed for instrument flight training by pulling the hood forward and attaching it to the glareshield with velcro strips.

**2.23.3 Relief Tube.** A relief tube is installed beneath each seat.

# CHAPTER 3

# Servicing and Handling

The following paragraphs include the precautions and procedures necessary to completely service the aircraft.

## 3.1 SERVICING FUEL SYSTEM

The fuel system is comprised of two 40-gallon capacity tanks and two 25-gallon capacity tanks, making a total usable fuel capacity of 130 gallons, of which 65 gallons each side is usable. When servicing the JP-8 or JP-5/Jet A fuel, ensure the aircraft weight remains within the maximum allowable limit. See Figure 24-12.

**3.1.1 Fuel Handling Precautions.** Proper procedures for handling jet fuel cannot be overstressed. Clean, fresh fuel must be used and the entrance of water into the fuel storage or aircraft fuel system must be avoided.

**CAUTION**

When conditions permit, the aircraft should be positioned so that the wind will carry the fuel vapors away from all possible sources of ignition.

1. Shut off all electrical equipment on the aircraft. Do not service battery during the fueling operation. Do not operate any electrical tools, such as drills or buffers, in or near the aircraft during fueling.

2. Refuel aircraft as soon as possible after landing.

3. Keep fuel servicing nozzles free of now, water, and mud at all times.

**WARNING**

Prior to opening the fuel tank filler, the hose nozzle static ground wire must be attached to the grounding lugs that are located outboard of filler openings.

4. Carefully remove snow, water, and ice from the aircraft fuel filler cap area before removing the fuel filler cap. Remove only one aircraft tank filler cap at any one time and replace each one immediately after servicing operation is completed.

5. Wipe all frost from fuel filler necks before servicing.

6. Drain fuel sample from fuel tanks, filter strainer, and sump no sooner than 30 minutes after each servicing and after each removal from heated shelter. Preheat, when required, to ensure free fuel drainage.

7. Insofar as possible, leave only fully serviced aircraft outside.

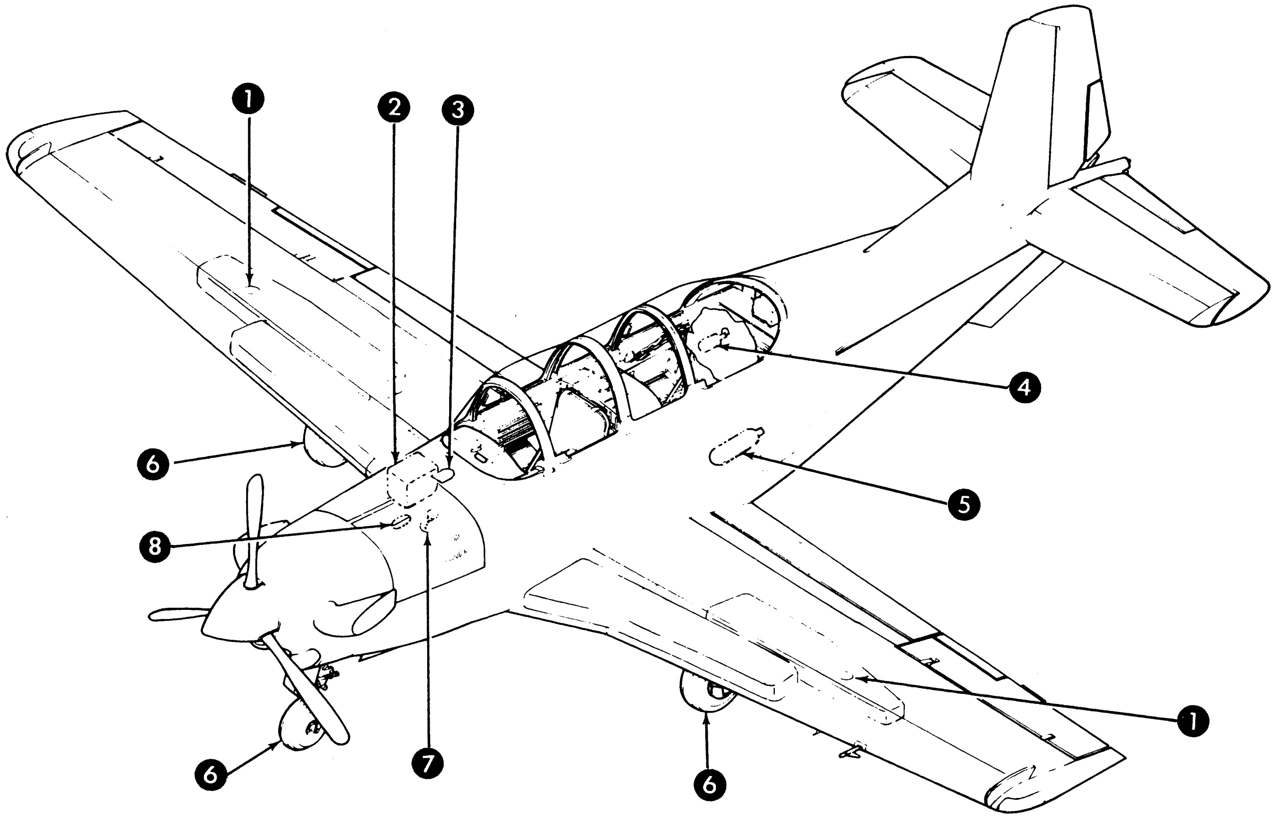
8. Ensure that the aircraft and components being serviced are securely coupled to a low-resistance ground. Connect the static ground cable and the fueler to a grounding stake. When engaged in the fueling operation, discharge the static electricity accumulated by the body and clothing by touching the ground cable or stake before each operation.

9. Observe NO SMOKING precautions.

10. Prior to transferring the fuel, ensure that the hose is grounded to the aircraft.

11. Wash off spilled fuel immediately.

12. Handle the fuel hose and nozzle cautiously to avoid damaging the wing skin.




1 FUEL TANK FILLER CAPS (TYPICAL LEFT & RIGHT)
FUEL SPECIFICATION: MIL-T-5624
JP-5-F-44 (NATO) JET A
JP-4-F-40 (NATO) JET B
JP-8-F-34 (NATO) JET A1
TOTAL USABLE FUEL CAPACITY ........... 65 U.S. GALLONS EACH SIDE

2 BATTERY

3 HYDRAULIC FLUID RESERVOIR (BRAKE)
SPECIFICATIONS: MIL-H-5606, (MIL-H-5606A)
NATO H-515 1 US PINT

4 EMERGENCY CANOPY OPEN BOTTLE AND INDICATOR
DRY NITROGEN

5 OXYGEN SUPPLY CYLINDER
OXYGEN SPECIFICATION: MIL-O-27210
AVIATORS BREATHING OXYGEN
76 CU. FT.

6 TIRES

SIZE
MAIN WHEEL ...................................... 19.5 X 6.75-8 (10 PLY)
NOSEWHEEL ............................................. 500 X 5 (10 PLY)

PRESSURE
MAIN WHEEL ............................................................. 90 ± 2
NOSEWHEEL ............................................................ 70 ± 2

7 OIL FILLER CAP

OIL SPECIFICATION....................................... EXXON 2380
TANK CAPACITY...................................... 2.8 U.S. GALLONS
SYSTEM CAPACITY ................................. 4.4 U.S. GALLONS

8 EXTERNAL POWER RECEPTACLE

MINIMUM BATTERY VOLTAGE (NO LOAD)....... 18 VOLTS

F-0027

Figure 3-1. Servicing Data

13. Do not conduct fueling operations within 100 feet of energized airborne radar equipment or within 300 feet of energized ground radar equipment installation.

14. Wear only nonsparking shoes near aircraft or fueling equipment since shoes with nailed soles or metal heel plates can be the source of sparks

**3.1.1.1 Fuel Handling Precautions for Extreme Weather Conditions.** When fueling is conducted on ice or on sandy or desert terrain or when a satisfactory ground cannot be secured, additional precautions must be taken to avoid the buildup of static electricity. Since draining the static charges is not possible without an adequate ground, reliance must be placed on equalizing the potentials in order to prevent a dangerous sparking discharge as in the following bonding procedure:

1. Connect bonding cable from aircraft to fuel servicing unit. A conductive-type fuel hose is not a satisfactory method of bonding.
2. Connect bonding cable from fuel nozzle to aircraft before fuel tank cover is opened.
3. When disconnecting, reverse the order of steps 1 and 2.

### 3.1.2 Gravity Fueling (Figure 3-2).

1. Attach bonding cables to aircraft.
2. Attach bonding cable from hose nozzle to ground socket adjacent to fuel tank being filled.
3. Open applicable fuel tank filler cap.

**CAUTION**

Care must be taken when placing the refueling nozzle into the wing tank anti-siphoning valve so as not to strike the sides or bottom of the assembly. Striking the sides or bottom of the antisiphon assembly may cause it to weaken and possibly detach from the upper portion of the wing.

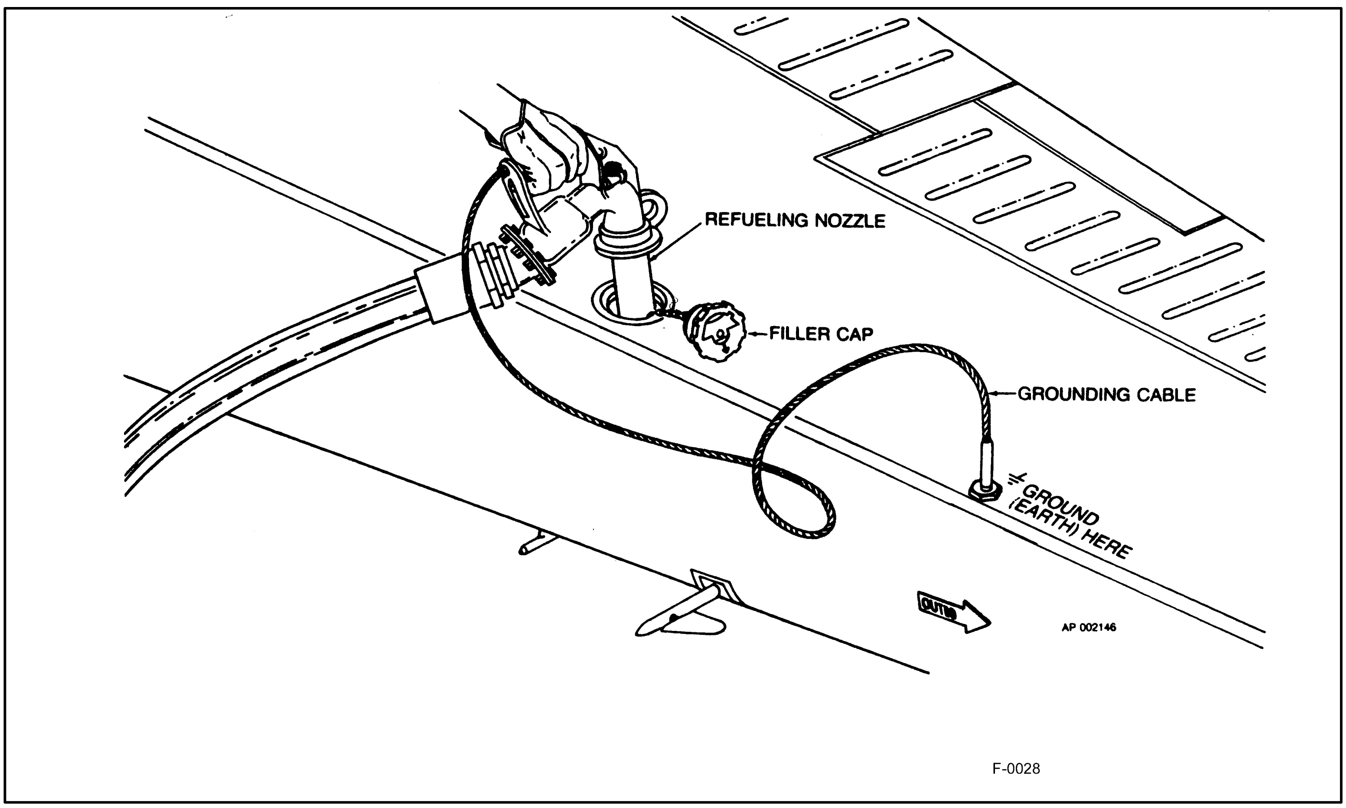



Figure 3-2. Gravity Fueling

4. Fill fuel tank with fuel.

5. Secure applicable fuel tank filler cap.

**CAUTION**

Make sure latch tab on cap is pointed aft.

6. Disconnect bonding cables from aircraft.

**3.1.3 Fuel Types and Specifications.** When commercial jet fuel is used and does not contain anti-ice/fungicide (PFA55MB, MIL-I-27686, or equivalent), it must be added during fueling per approved method to assure proper anti-icing protection and long-term fungus control. Fuels having the same NATO code number are interchangeable. Jet fuels conforming to ASTM D-1655 specification may be used when MIL-T-5624 fuels are not available. This usually occurs during cross-country flights when aircraft using NATO F-40 (JP-4) are refueled with commercial ASTM Type B fuels.

**3.1.4 Draining Moisture From the Fuel System.** To remove moisture and sediment from the fuel system, five snap-type drains and one firewall fuel filter drain are installed. The locations are as follows: one aft of the wheelwell, one forward of the wheelwell on each side, and one on the underside of the aircraft, which is accessible through the "D"-shaped door. Access to the firewall drain handle is made through the upper left-hinged cowl door.

## 3.2 SERVICING OIL SYSTEM (FIGURE 3-3)

An integral oil tank between the accessory gearbox housing and the compressor inlet case and an externally mounted auxiliary oil tank comprise the oil system on the PT6A-25 engine. Use EXXON 2380.

The system's capacity is 4.4 U.S. gallons; the tank capacity is 2.8 U.S. gallons, of which 1.5 U.S. gallons are usable in the upright attitude and 0.25 U.S. gallon

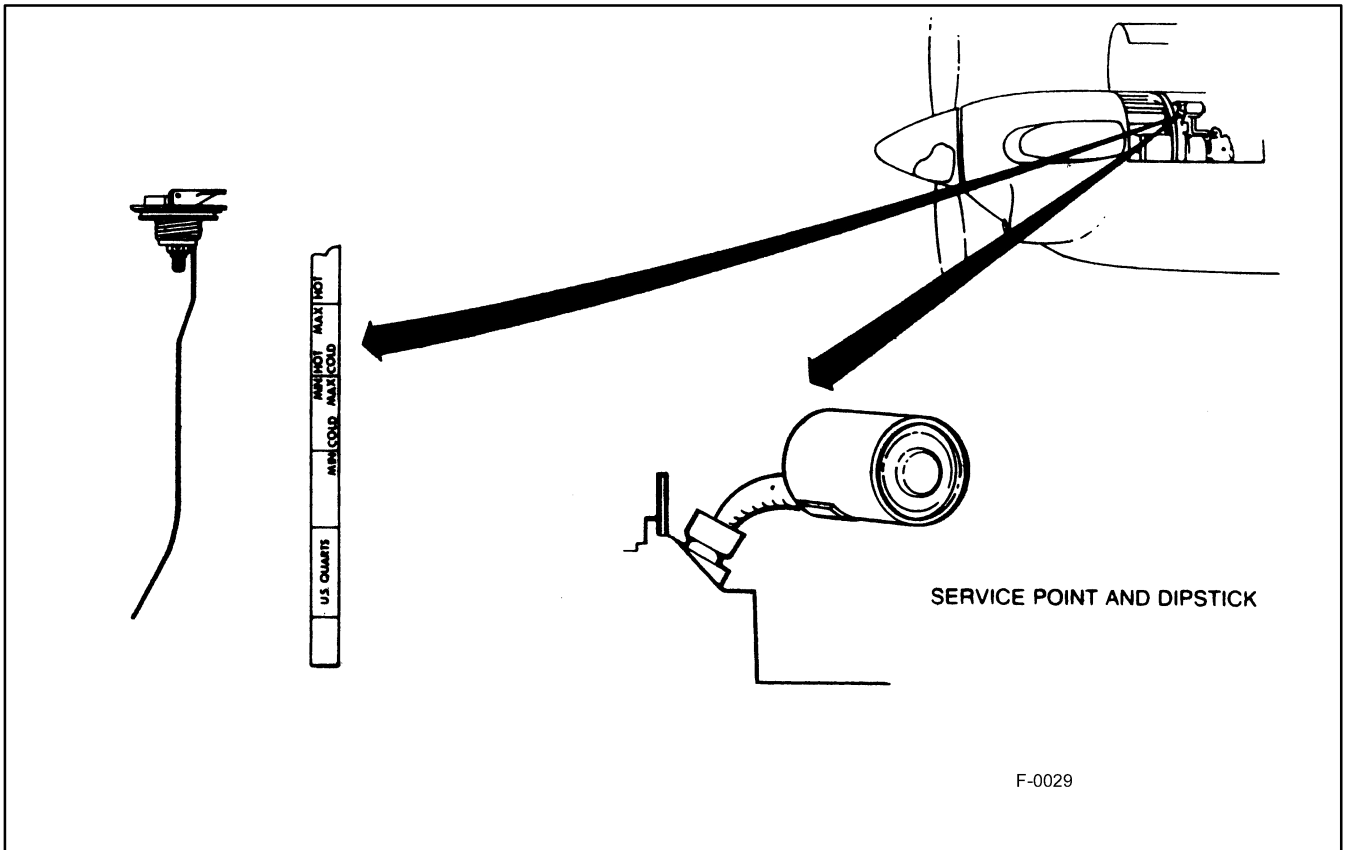



Figure 3-3. Oil System Servicing

(1 quart) is usable in the inverted attitude. The oil dipstick is calibrated in both hot and cold ranges; however, if oil level is below minimum cold line during cold oil check, the motor engine as follows:

1. Condition Lever — FUEL OFF.
2. Battery Switch — ON.
3. Ignition Switch — HOLD OFF.
4. Starter Switch — ON FOR 15 TO 20 SECONDS.
5. Starter Switch — OFF.
6. Battery Switch — OFF.
7. Recheck — ADD OIL AS REQUIRED.

**CAUTION**

Failure to hold ignitors off and/or condition lever in the fuel cutoff position may lead to inadvertent engine lightoff and possible engine damage.

Avoid spilling oil. Any oil spilled must be removed immediately, using a cloth moistened in solvent. Overfilling may cause a discharge of oil through the accessory gearbox breather until a satisfactory level is reached. Service oil system as follows:

1. Open the left-hinged cowling to gain access to the oil filler cap and dipstick.
2. Remove oil filler cap.
3. Add oil as required.
4. Check oil filler cap for damaged reformed packing (“O” ring), general condition, and locking.
5. Check for oil leaks.

## 3.3 SERVICING HYDRAULIC BRAKE SYSTEM RESERVOIR

The hydraulic brake system reservoir (Figure 3-1) is located on the upper aft side of the firewall on the centerline of the aircraft. Access to the reservoir is through a door just forward of the windshield.

1. Remove brake reservoir cap and fill reservoir to within 3/4 inch of the bottom on the reservoir neck.
2. Install brake reservoir cap and secure access door.

## 3.4 SERVICING EMERGENCY CANOPY ACTUATING SYSTEM

The canopy emergency nitrogen bottle (Figure 3-1) with integral gauge and service point is located in the avionics compartment. Service the bottle as follows:

1. Fill with nitrogen to the appropriate mark on the temperature correction scale (green band.)

**Note**

If bottle is being serviced while installed in aircraft, an additional person may be required because of the location of the pressure gauge.

## 3.5 SERVICING OXYGEN SYSTEM

The oxygen system service panel (Figure 3-4) is located on the right fuselage just aft of the wing.

### 3.5.1 Oxygen System Safety Precautions.

**CAUTION**

Keep fire and heat way from oxygen equipment. Do not smoke while working with or near oxygen equipment and take care not to generate sparks with carelessly handled tools when working on the oxygen system.

1. Keep oxygen regulators cylinders gauges, valves, fittings, masks, and all other components of the oxygen system free of oil, grease, fuel, and all other readily combustible substances. The utmost care must be exercised in servicing, handling, and inspecting the oxygen system.
2. Do not allow foreign matter to enter oxygen lines.

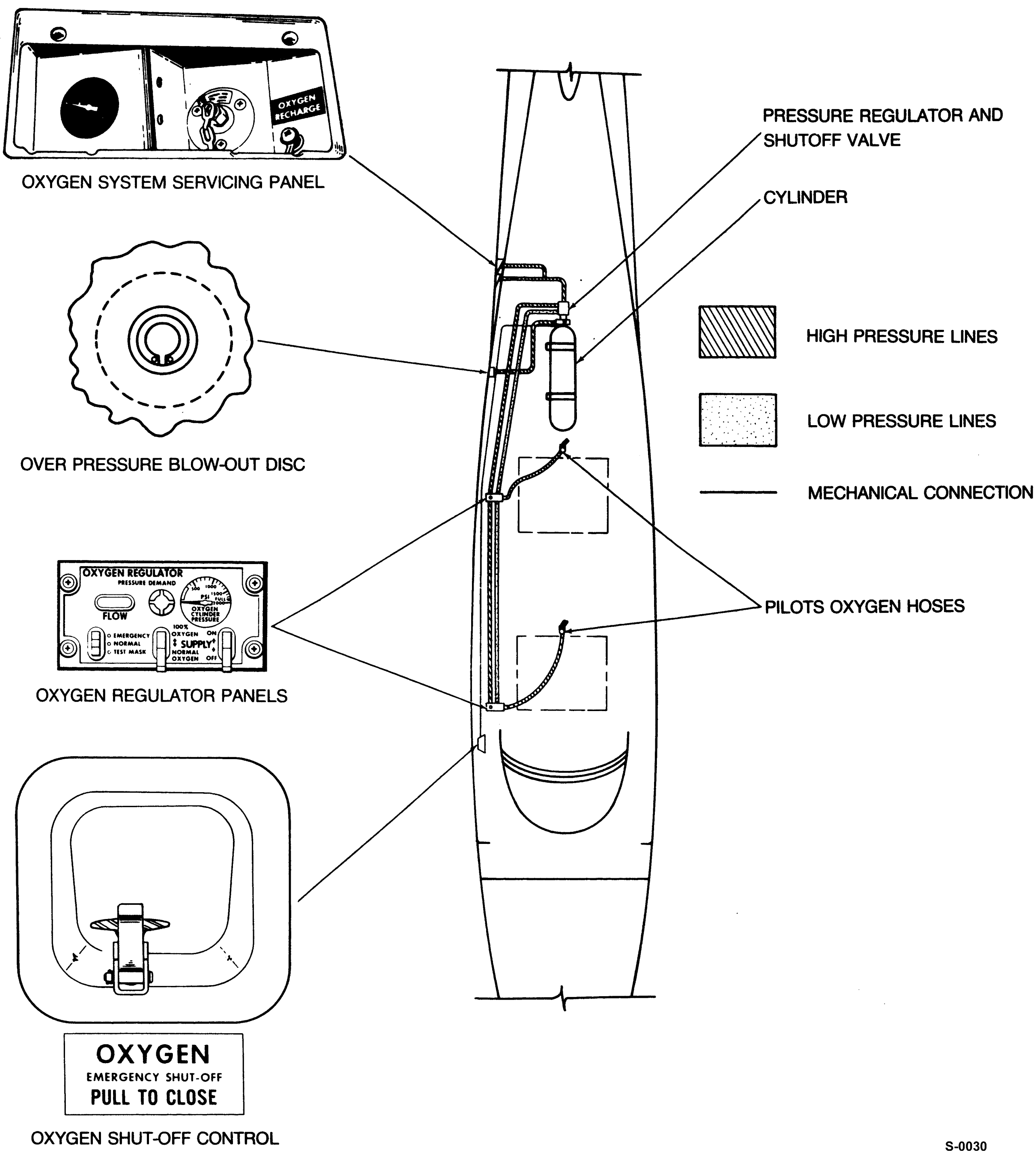



Figure 3-4. Oxygen System Servicing

#### 3.5.1.1 Replenishing Oxygen System.

1. Remove protective cap on oxygen system filler valve.

2. Attach oxygen hose from oxygen servicing unit to filler valve.

**Note**

The oxygen system requires high-pressure servicing units (HPOX) to replenish the system adequately.

3. Fill system slowly to prevent overheating by adjusting recharging rate with pressure regulating valve on oxygen servicing unit.

4. Close pressure regulating valve on oxygen servicing unit when pressure gauge on service panel indicates 1,850 psi maximum.

**Note**

Fill oxygen system to 1,850 psi at 70°F. For every °F above 70°, increase pressure 3.5 psi; and for every °F below 70°, decrease pressure 3.5 psi.

5. Disconnect oxygen hose from oxygen servicing unit and filler valve.

6. Install protective cap on oxygen filler valve.

7. During extended periods on the ground, the oxygen system emergency shutoff handle should be pulled to minimize system leakage.

### 3.6 SERVICING TIRES

Tire pressure should be checked regularly and maintained as follows:

| TIRE SIZE AND RATING | TIRE PRESSURE |
|---|---|
| Nosewheel 500 × 5 (10 ply) | 70 ± 2 psi |
| Main Wheel 19.5 × 6.75–8 (10 ply) | 90 ± 2 psi |

### 3.7 APPLICATION OF EXTERNAL POWER

External power units must be capable of producing 28 volts for service power and 28 volts, 600 amperes for starting. The external dc power receptable is located on the right fuselage just forward of the wing.

**WARNING**

Because of the close proximity of the external power receptacle to the prop arc and exhaust stack, extreme caution must be observed when performing ground starts with external power. Refer to Figure 3-5.

**Note**

Application of external power during start assists in maintaining the high levels of energy required. Use of external power minimizes wear on the starter and engine turbine. If external power is available, it should be used.

### 3.8 NOISE HAZARD LEVELS

Noise hazard sound levels of 85 dB or greater exist within 200 feet of the T-34C when operating at idle or beta power settings and within 400 feet when operating at power settings of 1,015 ft-lb torque or greater. Personnel within these areas are required to wear hearing protection, either ear plugs or ear muffs. Personnel within 75 feet of the T-34C when operating at power settings of 1,015 ft-lb or greater are exposed to sound levels of 115 dB or greater and are required to wear double hearing protection. See Figures 3-6 and 3-7.

### 3.9 TOWING AIRCRAFT

Towing lugs are provided on the lower torque knee fitting of the nose strut. When it is necessary to tow the aircraft with a vehicle, use a suitable vehicle towbar.

**CAUTION**

- The propeller restraint must be installed before towing aircraft.

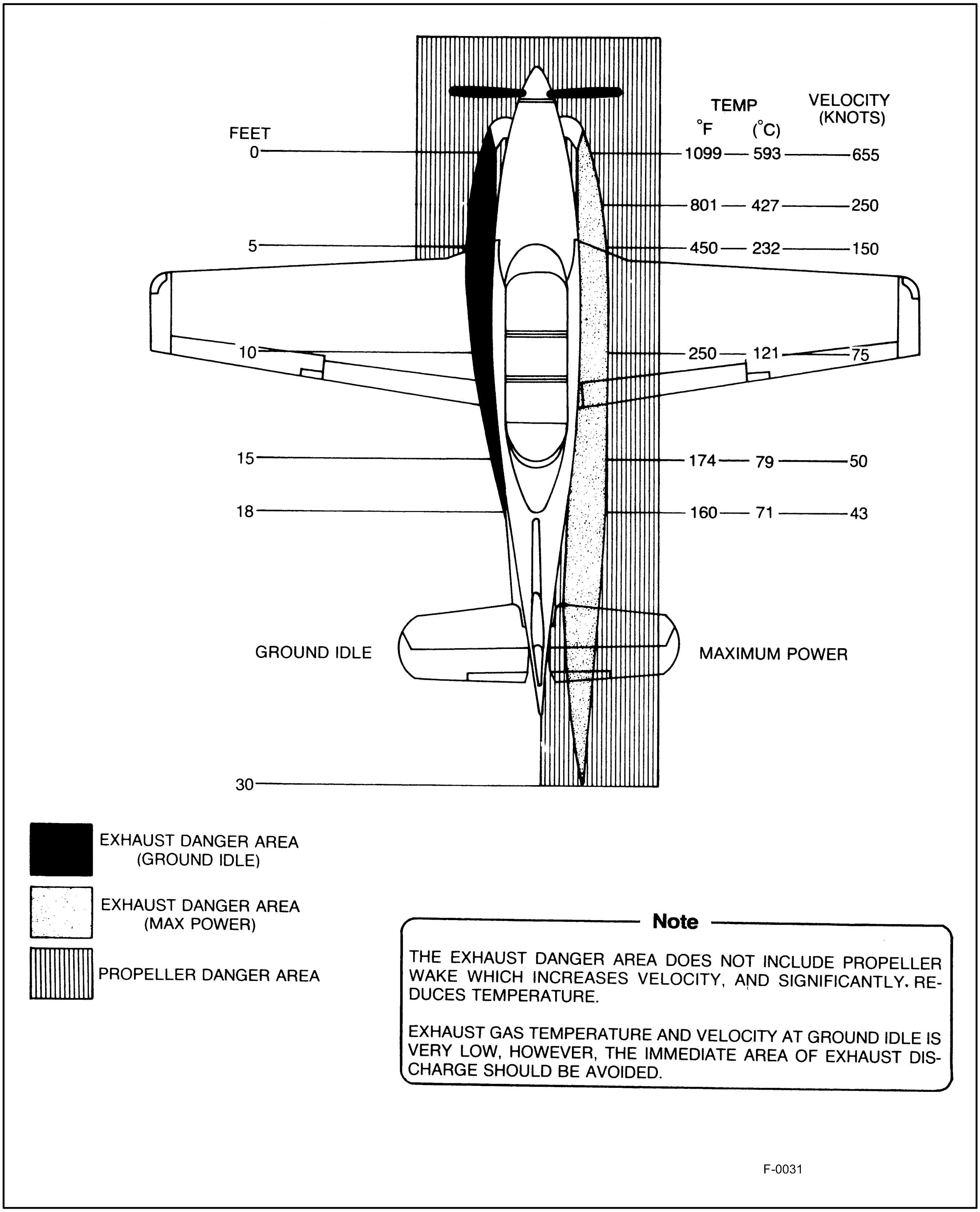
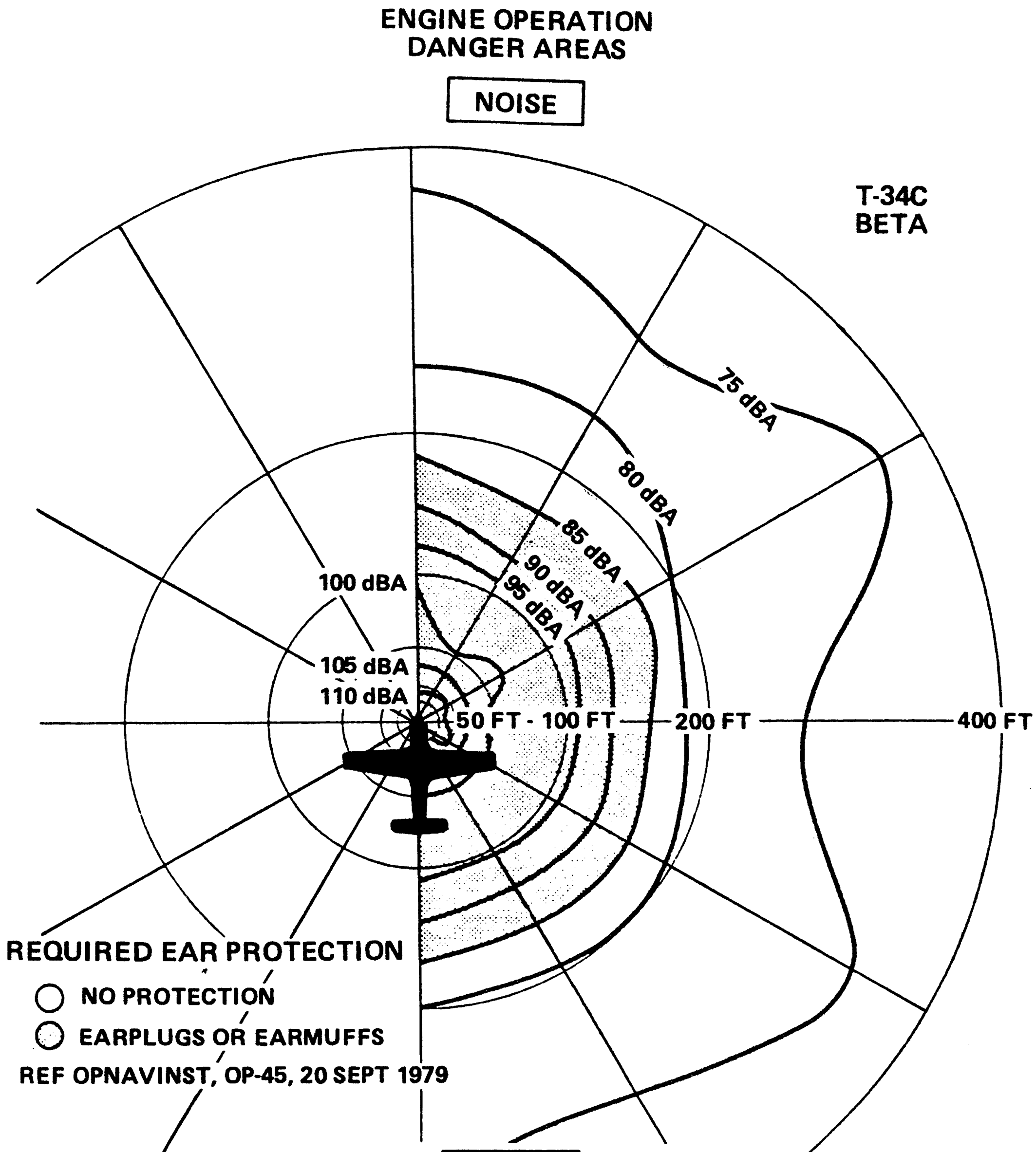



Figure 3-5. Exhaust Danger Area




**NOTE**

NOISE DANGER AREAS SYMMETRICAL ABOUT ENGINE CENTERLINE DURING ENGINE OPERATION AT BETA.

**STATIC CONDITIONS**

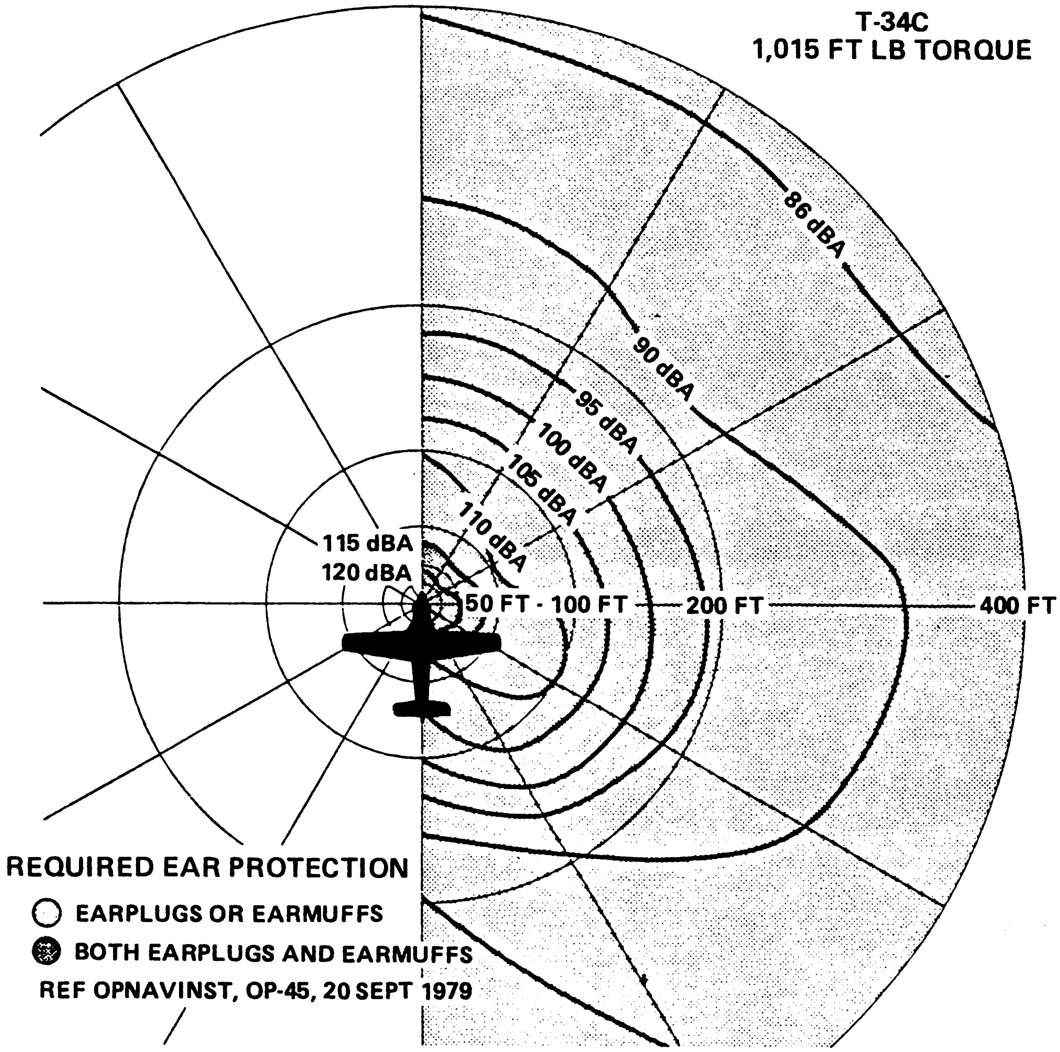
SEA LEVEL
TEMPERATURE: 71°F
BAROMETRIC PRESSURE: 30.130 MHg
WIND: 0 KTS

F-0032

Figure 3-6. “A”-Weighted Sound Level Contours (Beta Power)

**ENGINE OPERATION**
**DANGER AREAS**

**NOISE**




**NOTE**

NOISE DANGER AREAS SYMMETRICAL NE ABOUT ENGINE CENTERLINE DURING ENGINE OPERATION AT 1,015 FT LB TORQUE.

**STATIC CONDITIONS**

SEA LEVEL
TEMPERATURE: 71°F
BAROMETRIC PRESSURE: 30.130 MHg
WIND: 0 KT

F-0033

Figure 3-7. “A”-Weighted Sound Level Contours (1,015 Ft-Lb Power)

**CAUTION**

- When the aircraft is being towed, a qualified person must be in the pilot's seat to maintain control by use of the brakes. When the aircraft is being moved backward, do not apply the brakes abruptly. Tow the aircraft slowly, avoiding sudden stops.
- When towing, do not exceed 30° nosegear turn limits. Avoid short radius turns and always keep the inside or pivot wheel turning during the operation.
- Do not tow or taxi aircraft with deflated shock struts.

## 3.10 SECURING AIRCRAFT

**3.10.1 Parking.** Parking is defined as the normal condition under which the aircraft will be secured while on the ground. This condition may vary from setting the parking brake and chocking the wheels to more elaborate tiedown procedures. The proper steps for securing the aircraft must be based on the time the aircraft will be left unattended, the aircraft weight, the expected wind direction and velocity, and the anticipated availability of ground and aircrews for tiedown or evacuation. When practical, head the aircraft into the wind, especially if strong winds are forecast or it will be necessary to leave the aircraft overnight.

**3.10.1.1 Parking Brake.** The parking brake system for the aircraft incorporates a lever-type valve that retains pressure in the lines. Operate the parking brake as follows:

1. Pull parking brake handle out. This will cause the parking brake valve to lock the hydraulic fluid under pressure in the brake system.
2. Firmly pump toebrake pedals until resistance is felt.

**CAUTION**

Do not set parking brakes when the brakes are hot or during freezing ambient temperatures.

3. To release the parking brakes, push in on the parking brake handle.

**3.10.1.2 Control Lock.** The control lock (Figure 2-9) holds the elevator, rudder, and aileron in neutral position. Install the control lock from the stowed position as follows:

1. Adjust pedals slightly aft of full forward position.
2. With pedals neutral, place control lock over pin on control stick.
3. Adjust pedals full forward until contact is made with control stops.

**3.10.1.3 Tiedown.** The aircraft is tied down to ensure its immovability, protection, and security under various weather conditions. The following paragraphs give in detail the instructions for proper tiedown of the aircraft.

**3.10.1.4 Tiedown Provisions.** Normal tiedown points (Figure 3-9) are provided beneath each wing and the empennage. The nose and main landing gear may also be used as tiedown points when additional aircraft security is required.

1. Use cables of 1/4-inch aircraft cable and clamp (clip-wire rope), chain, or 3/8-inch diameter (minimum) rope. Length of the cable or rope will be dependent upon existing circumstances. Allow sufficient slack in rope, chains, or cable to compensate for tightening action because of moisture absorption of rope or thermal contraction of cable or chain.

**CAUTION**

Do not use slip knots. Use bowline knots to secure aircraft to stakes.

2. One-piece wheel chocks or wood blocks may be used to chock the main landing gear wheels. They

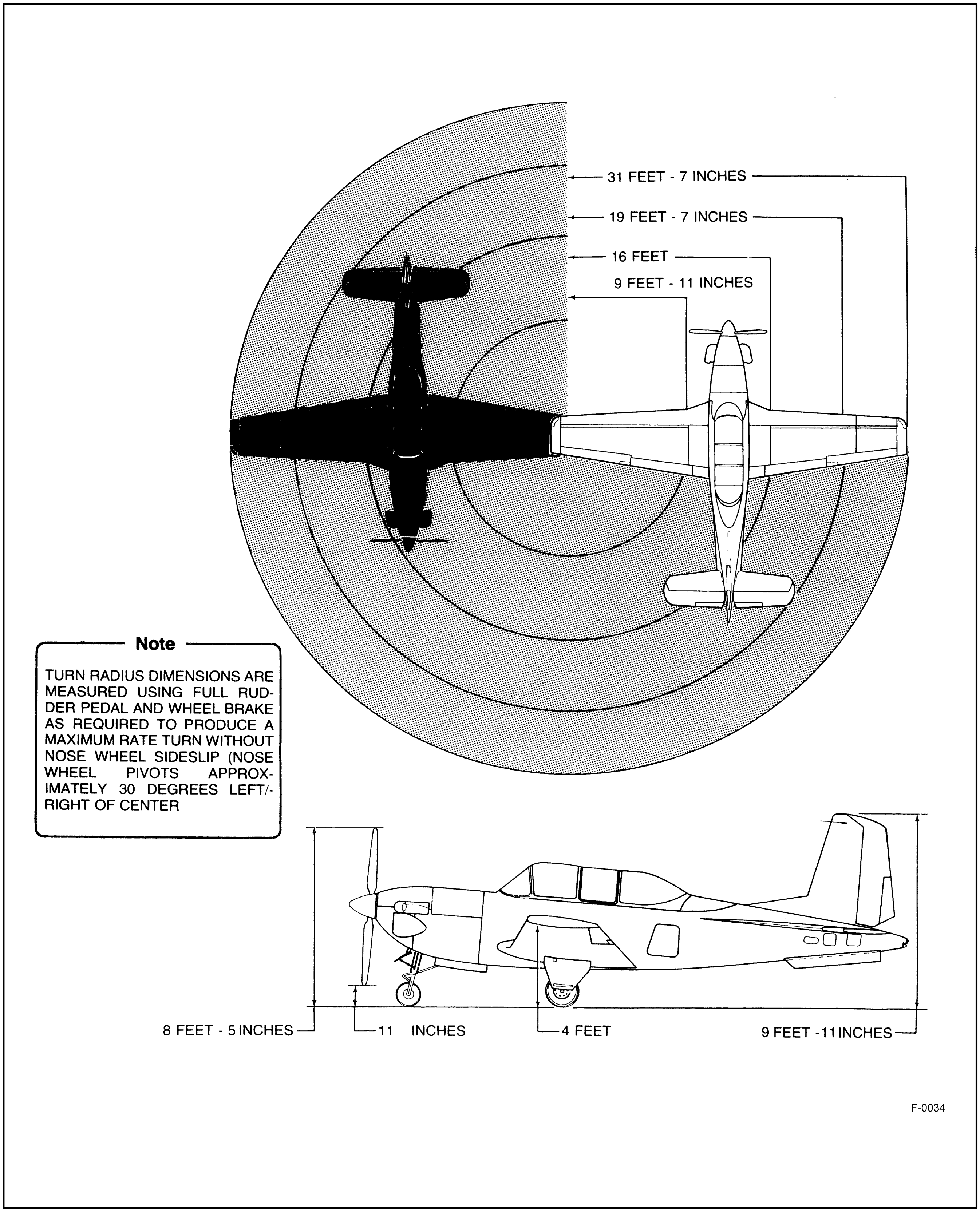
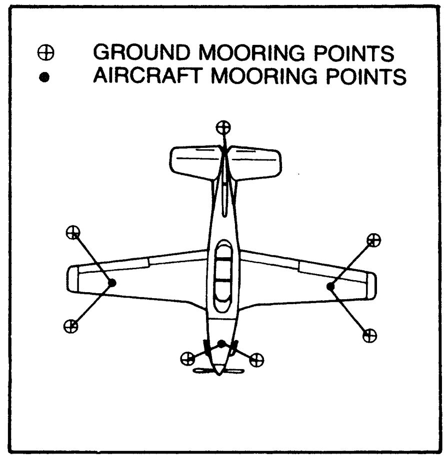
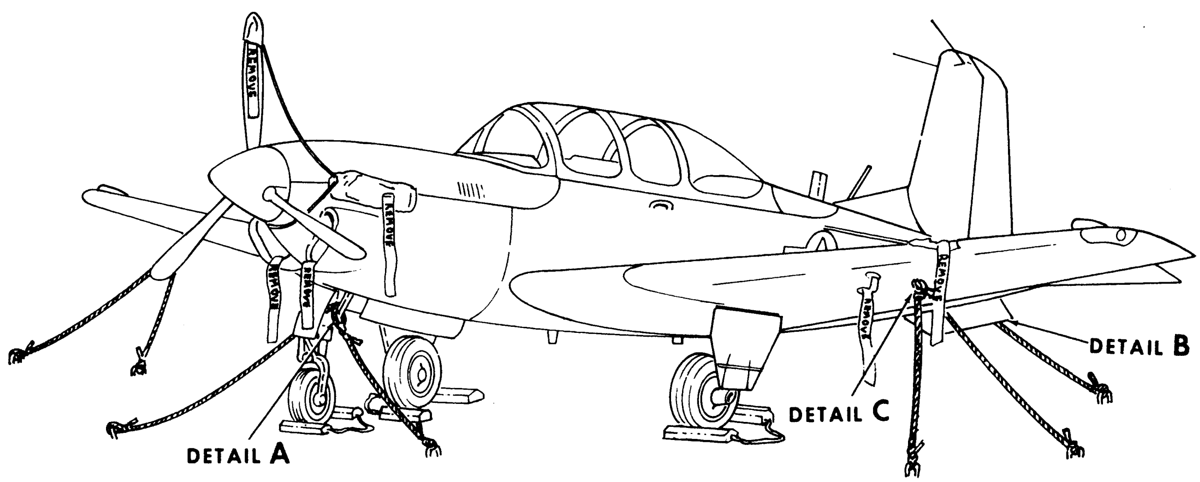


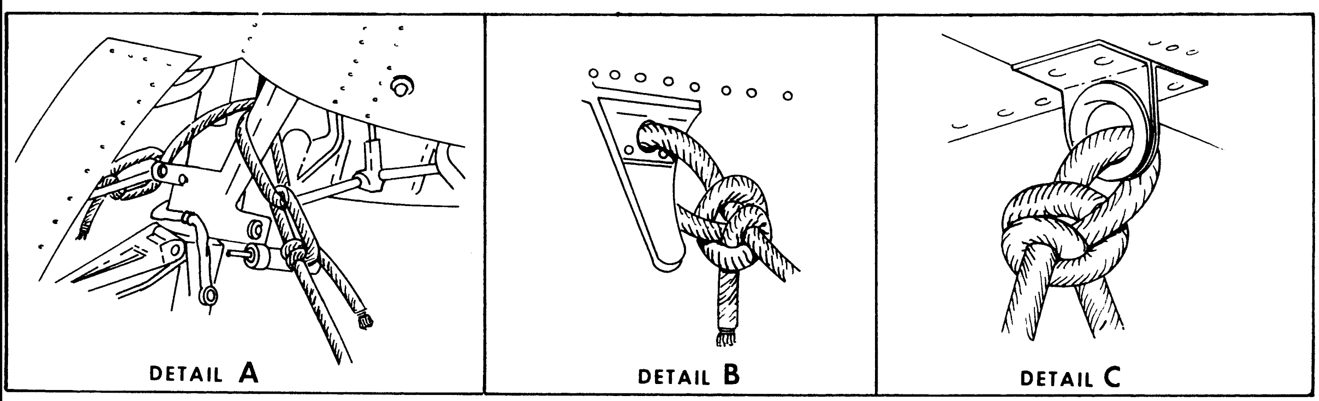

Figure 3-8. Turning Radii/Ground Clearance

**Note**

- IF STRONG WINDS ARE ANTICIPATED, OR AIRCRAFT IS TO BE LEFT UNATTENDED, PROPELLER RESTRAINT, PITOT MAST, AOA PROBE AND INTAKE COVERS MUST BE INSTALLED, AND THE FLIGHT CONTROLS LOCK ENGAGED.
- BEFORE TOWING, THE PROPELLER RESTRAINT MUST BE INSTALLED WITH ONE PROPELLER BLADE IN THE UP POSITION AS SHOWN.
- THE USE OF DOUBLE OR SINGLE MOORING POINTS FOR NOSE (DETAIL A) AND/OR WING (DETAIL C) TIEDOWN IS DETERMINED BY LOCAL OPTION DEPENDING ON TYPE AND AVAILABILITY OF AIRCRAFT SECURING EQUIPMENT.
- USE ROPE ONLY (NYLON TYPE IF AVAILABLE) FOR NOSE TIEDOWN (DETAIL A). ATTACH ROPE(S) TO AIRCRAFT AND GROUND MOORING POINTS IN A MANNER THAT WILL PREVENT ROPE DAMAGE TO AIRCRAFT COMPONENTS.




F-0035

Figure 3-9. Tiedown/Securing Aircraft

must be equipped with rope or wood cleats to retain them against the wheels.

**Note**

In ice or snow conditions, collapsible ice grip wheel chocks should be used. However, sandbags may be used if collapsible chocks are not available or if parking the aircraft on steel mats.

**3.10.1.5 Tiedown Procedures for High Winds.** If an aircraft is to remain secure during high-velocity winds, it is necessary to use the proper size and type of wheel chock.

**CAUTION**

Structural damage can occur from high-velocity winds; therefore, if at all possible, the aircraft should be moved to a safe weather area when winds above 75 knots are expected.

1. After aircraft is properly located, place nosewheel in centered position. Head aircraft into the wind or as nearly so as is possible within limits determined by locations of fixed tiedown rings. When necessary, a 45° variation of direction is considered to be satisfactory. Locate each aircraft at slightly more than wing span distance from all other aircraft. Position nose tiedown point approximately 3 to 5 feet downwind from ground anchor.

2. Deflate nosewheel shock strut to within 3/4 inch of its fully deflated position.

3. Fill all fuel tanks to capacity if time permits.

4. Place wheel chocks fore and aft of main gear wheels and nosewheel. Tie each pair of chocks (wood) together with rope or join together with wooden cleats nailed to chocks on either side of wheels. Tie ice grip chocks together with rope. Use sandbags in lieu of chocks when aircraft is parked on steel mats.

5. Accomplish aircraft tiedown by utilizing tiedown points shown in Figure 3-9. Make tiedown with 1/4-inch aircraft cable, using two wire rope clips, or bolts, or a chain tested for a 3,000-pound pull. Attach tiedowns so as to remove all slack. (Use a 3/4-inch or larger manila rope if cable or chain tiedown is not available). If rope is used for tiedown, use antislip knots such as bowline knot rather than slipknots. In the event tiedown rings are not available on hard-surfaced area, move aircraft to an area where portable tiedowns can be used. Locate anchor rods at points shown in Figure 3-9. When anchor kits are not available, use metal stakes or deadman-type anchors, providing they can successfully sustain a minimum pull of 3,000 pounds.

6. In the event nose position tiedown is considered to be of doubtful security because of existing soil condition, drive additional anchor rods at nose tiedown position and secure.

7. Place control surfaces in locked position and trim tab controls in neutral position. Place wing flaps in the UP position.

8. The requirements for dust excluders, protective covers, and taping of openings will be left to the discretion of the responsible maintenance officer or the pilot.

9. Disconnect battery.

10. During typhoon or hurricane wind conditions, mooring security can be further increased by placing sandbags along the wings to break up the aerodynamic flow of air over the wing, thereby reducing the lift being applied against the mooring by the wind.

**Note**

The sandbags should be placed on the sparcap and should not exceed 20 pounds per inch.

11. After high winds, inspect aircraft for visible signs of structural damage and for evidence of damage from flying objects. Service nose shock strut and reconnect battery.

# CHAPTER 4

# Operating Limitations

## 4.1 INTRODUCTION

This chapter includes all important limits and restrictions that shall be observed during ground and flight operations. The operating limitations set forth are the direct results of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the aircraft. Limits concerning maneuvers, weight, and center-of-gravity limitations are also covered.

**4.1.1 Exceeding Operational Limits.** Anytime an operational limit is exceeded, each occurrence must be properly recorded on an appropriate maintenance action form. Each entry shall state what limit or limits were exceeded, range, time above limits, and any additional data that would aid maintenance personnel in the inspection that may be required.

## 4.2 CREW LIMITATIONS

Crew limitations consist of solo flights only from the front cockpit with the aft cockpit secured in accordance with the Preflight Inspection Checklist in Chapter 7.

## 4.3 ENGINE LIMITATIONS

These conditions that set limits for operation of the PT6A-25 engine are monitored by instruments. An individual instrument will show the torque applied to the shaft which drives the propeller. Other indicators display interstage turbine temperature and gas generator speed in percentage of full rpm. A dual indication instrument displays both oil pressure and oil temperature. The T-34C engine instruments, in particular the $N_1$ (turbine tachometer) and ITT, are provided as an aid to the pilot in gauging the condition of the engine. These instruments should be monitored closely as an active monitoring schedule can provide early indications of impending engine problems. Figure 4-1 shows all normal operating conditions and limits for the engine.

**CAUTION**

Engine operation using only the engine-driven, high-pressure fuel pump without either the electric or engine-driven boost pump fuel pressure is limited to 10 hours. All time in this category must be recorded.

**Note**

- Because of the design and installation of the oil pressure transmitting and indicating system, minor fluctuations of oil pressure may be noted by the pilot with a normally functioning engine oil system. A vibrating needle or minor fluctuations of pressure with a steady mean, where extremes of needle movement remain within the normal range and do not exceed ±5 psi, are acceptable when no secondary indications of engine malfunction are observed. With fluctuations of oil pressure greater than ±5 psi, the pilot shall land as soon as possible using PEL procedures.

- During dynamic aircraft maneuvers, oil pressure transients aas low as 10 psi for as long as five seconds are acceptable provided that oil pressure returns to normal with no unusual or secondary indications of engine failure.

**4.3.1 Overtemperature Limitations.** When ever the limiting temperatures listed in Figure 4-1 are exceeded and cannot be controlled by retarding the power lever, a landing shall be made as soon as possible using PEL procedures. It should be noted that maximum observed ITT of 825 °C is time limited to 2-second duration during engine acceleration.

| POWER RATING | OPERATING LIMITS | | | | | | |
|---|---|---|---|---|---|---|---|
| | MAX TIME | ★ TORQUE [1] FT-LB | ★ MAX OBSERVED ITT °C | $N_1$% [2] | • $N_2$ RPM (PROP) | OIL PRESS PSIG | OIL TEMP °C |
| NORMAL RATED | CONTINUOUS | 1015 | 695 | 1015 | 2200 | 65–80 | 10–99 |
| IDLE (62% $N_1$) | CONTINUOUS | — | 660 [3] | — | — | 40 (MIN) | 10–99 |
| STARTING | — | — | 1090 OR 925 (2 SEC) | — | — | — | –40 (MIN) |
| ACCELERATION | 2 SECONDS | | 825 | 102.6 | — | — | 10–99 |
| MAX CONTINUOUS | CONTINUOUS | 1015 | 695 | 101.5 | 2200 | 65–80 | 10–99 |
| TAKEOFF | CONTINUOUS | 1015 | 695 | 101.5 | 2200 | 65–80 | 10–99 |

**CAUTION**

Changes in ambient conditions such as altitude or temperature affect which engine operating limitation will be reached first as power is increased.

| AEROBATIC FLIGHT LIMITS | |
|---|---|
| FLIGHT CONDITION | TIME LIMIT |
| Inverted flight | 15 seconds |
| Vertical flight, nose up | 15 seconds |
| Vertical flight, nose down | 3 seconds |
| Knife edge, wings vertical | 3 seconds |
| Zero G | Transient only |

★ 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. Those values specify propeller RPMs which correspond to stress limits of the engine power section.

[1] Torque is PCL controlled through the normal operating range or 400 to 1015 ft-lb and up to a maximum limit of 1015 ft-lb.

[2] For every 10 °C below –30 °C ambient temperature, reduce maximum allowable $N_1$ by 2.2 percent.

[3] High ITT may be decreased by reducing accessory load and/or increasing $N_1$ speed.

Figure 4-1. Engine Operating Limitations

During engine starting, the temperatures and time limits listed in Figure 4-1 must be observed. When these limits are exceeded, the incident shall be entered as an engine discrepancy on an appropriate maintenance action form. It is particularly important to record the amount and duration of overtemperature.

**4.3.2 Overspeed Limitations.** Whenever the prescribed engine overspeed limit or engine rpm operating limit is exceeded (Figure 4-1), the incident must be reported as an engine discrepancy on an appropriate maintenance action form. It is particularly important to record the maximum percent of rpm registered by the tachometer and the duration of overspeed.

**4.3.3 Torque Limitations.** The maximum allowable torque for continuous operation is 1,015 ft-lb. Torque above this limitation should be corrected as soon as possible. Torque greater than 1,315 ft-lb is an overtorque and shall be recorded as an engine discrepancy.

**4.3.4 Power Definitions.** Engine power ratings are given in Figure 4-1. A power setting up to the maximum allowable of 1,015 ft-lb may be used for takeoff, climb, and cruise.

## 4.4 AERODYNAMIC LIMITATIONS

Aircraft limits that result from the effects of airflow are listed in Figures 4-2 and 4-3.

### 4.4.1 Acceleration Limitations

1. +4.5g's up to 280 KIAS; –2.3g's up to 220 KIAS; and decreasing to –1.0g at 280 KIAS.

2. With flaps down, +2g's and –1.0g.

### 4.4.2 Takeoff, Landing, Taxi Limitations

For flared landings only:

Maximum sink rate at ground contact — 600 FPM.

**CAUTION**

The following actions may result in aircraft damage and shall be avoided:

- Landing on arresting gear cable
- Nosewheel contact with cable risers above taxi speed
- Braking during cable rollover
- Rollover of arresting gear rigged with tire section cable supports at any speed.

### 4.4.3 Altitude Limitations

Operating altitude (Navy-approved limit) — 25,000 FEET.

## 4.5 SYSTEM LIMITATIONS

**4.5.1 Instrument Markings.** Instruments that display operating limitations are illustrated in Figure 4-4. The operating limitations are color coded on the instrument faces and color coding of each instrument is explained in the illustration. The instrument illustration also denotes in bold type the fuel grade upon which limits are based. RED markings on the dial faces indicate the limit above or below which continued operation is likely to cause damage or shorten life. The GREEN markings indicate the safe or normal range of operation. The YELLOW markings indicate the range where special attention should be given to the operation covered by the instrument. Operation is permissible in the yellow range, but should be avoided.

**4.5.2 Propeller Limitations.** Propeller limitations consist of rpm limits. The normal propeller operating range (green arc) extends from 1,800 to 2,200 rpm, with a red line at 2,200 rpm.

**Note**

- Condition lever should remain full increase with propeller at 2,200 rpm during all normal operations in flight.
- Rpm fluctuations of ±25 rpm with no secondary indications of engine malfunctions are acceptable.

**4.5.3 Starter Limitations.** The starter in this aircraft is limited to an operating period of 40 seconds on, then 60 seconds off for two starting attempts. On the third starting attempt, the starter shall be operated for 40 seconds on, then 30 minutes off.

## 4.6 MISCELLANEOUS LIMITATIONS

Both canopies must be closed before starting engine and must remain closed until after engine shutdown except for short periods of time on the deck with prop in FTHR or in flight with oxygen masks on and diluter in 100 percent.

Autoignition must be in operation for inverted flight.

| AERODYNAMIC LIMITATIONS | | |
|---|---|---|
| AIRCRAFT SPEED LIMITATIONS (CLEAN) | 0 – 20,000 FT MSL<br>20,000 – 25,000 FT MSL | 280 KIAS<br>245 KIAS |
| SMOOTH AIR | GEAR AND FLAPS UP | 280 KIAS (DIVE) |
| | GEAR AND FLAPS DOWN | 120 KIAS |
| TURBULENT AIR | GEAR AND FLAPS UP | 195 KIAS |
| | GEAR AND FLAPS DOWN | 120 KIAS |
| GEAR | EXTENSION | 150 KIAS |
| | EXTENDED | 150 KIAS |
| | RETRACTION | 120 KIAS |
| FLAPS | EXTENSION | 120 KIAS |
| | EXTENDED | 120 KIAS |
| CANOPY | MAXIMUM EMERGENCY OPEN | 250 KIAS |
| | MAXIMUM OPEN | 240 KIAS |
| **ACCELERATION** | | |
| MAXIMUM PERMISSIBLE (4,400 LB GROSS) | CLEAN — LEVEL FLIGHT | +4.5g –2.3g |
| | CLEAN — MAXIMUM BANK | +4.5g –2.3g |
| **ALTITUDE** | | |
| CEILING | NAVY APPROVED LIMIT | 25,000 FT |
| **GROSS WEIGHT** | | |
| MAXIMUM ALLOWABLE GROSS WEIGHT | FIELD TAKEOFF | 4,400 LBS |
| | FIELD LANDING | 4,400 LBS |
| | TOUCH AND GO | 4,300 LBS |

Figure 4-2. Airframe Limitations

1. Maximum inverted flight time — 15 SECONDS.

2. Maximum zero g flight time — 3 SECONDS.

**CAUTION**

Zero g flight will cause a loss of oil pressure resulting in possible engine damage and shall be avoided.

3. Maximum takeoff and landing crosswind components:

   a. No flap — 22 KNOTS.

   b. Full flap — 15 KNOTS.

### 4.6.1 Prohibited Maneuvers

1. Inverted flight above 220 KIAS
2. Night formation flights (except in emergencies)
3. Intentional spins with flaps and/or gear extended
4. Intentional inverted spins
5. Intentional spins with the propeller feathered.
6. Inverted stall maneuvers.

**CAUTION**

Any maneuver that could result in nose-low attitudes shall be performed in a manner to preclude speeds in excess of maximum authorized (280 KIAS). Excessive horizontal stabilizer loads can be encountered at speeds in excess of 280 KIAS.

**4.6.2 Airstart Envelope.** Starter-assisted airstarts may be achieved at altitudes between sea level and 20,000 feet and at airspeeds between 80 and 280 KIAS.

## 4.7 WEIGHT AND BALANCE

**4.7.1 Center-of-Gravity Limitations.** See Figure 24-16 and refer to Manual of Weight and Balance Data. Pilots shall check weight and balance to determine if gross weight, CG limitation, and zero fuel weight are within limits.

### 4.7.2 Weight Limitations

Maximum ramp weight — 4,425 lb
Maximum zero fuel weight — 3,650 lb

Maximum takeoff and landing — 4,400 lb
Maximum aerobatic weight — 4,300 lb.

## 4.8 ENGINE CONDITION INDICATORS

Engine instruments, in particular the $N_1$ (turbine tachometer) and ITT, are provided to assist in determining the general condition of the engine. These instruments should be monitored closely on an active schedule to detect early indications of impending problems. Figure 4-5 shows the normal operating range for engine instruments in chart form from engine idle to full power with subnotes on numbered items.

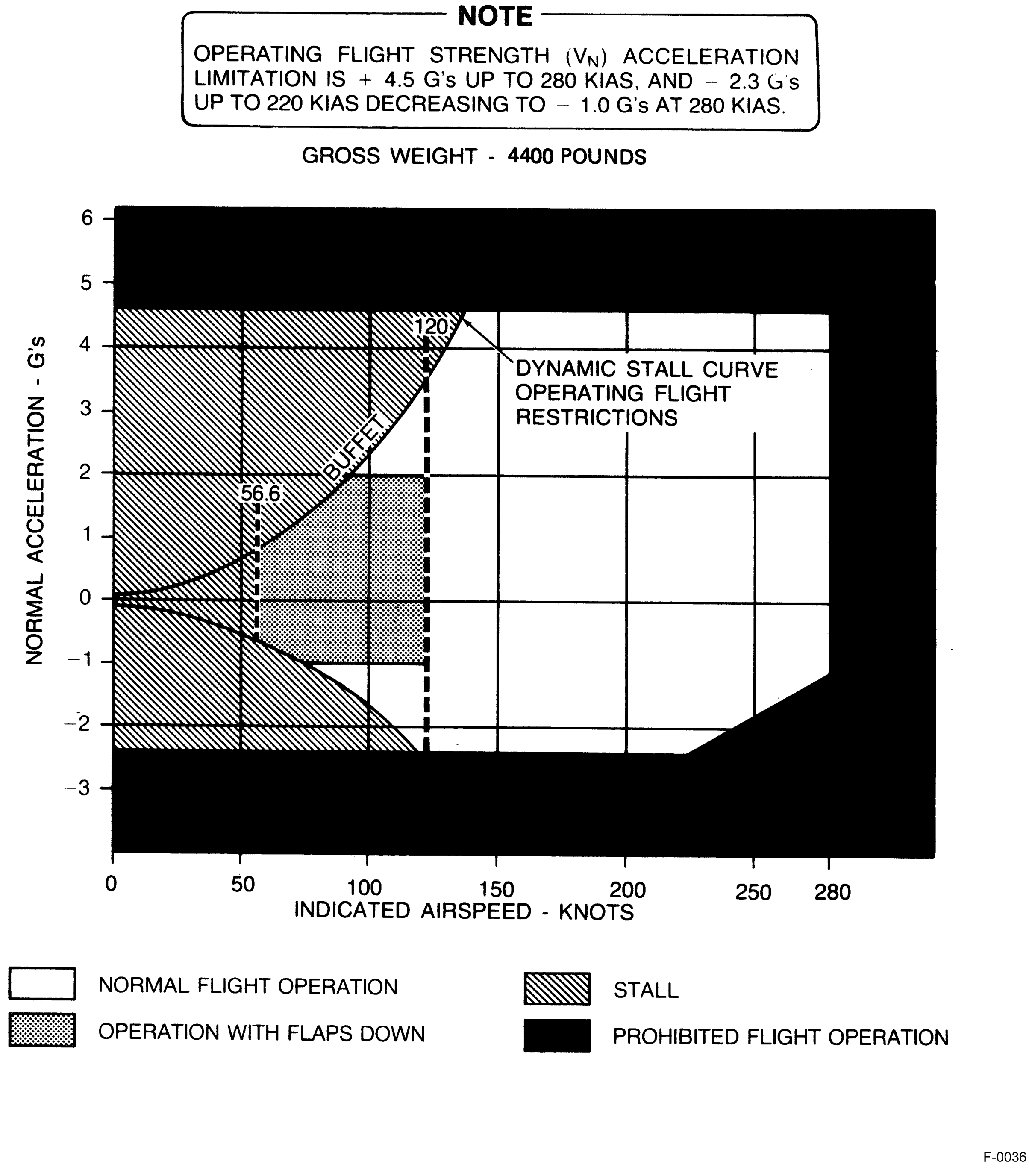
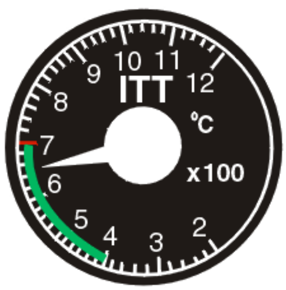



Figure 4-3. Operating Flight Strength ($V_N$)

BASED ON JP-4 FUEL

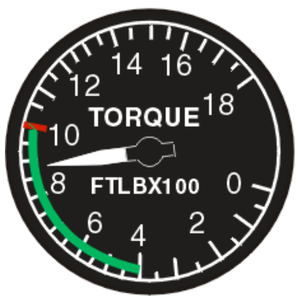
**Note**

APPARENT ERRONEOUS READINGS MAY OCCUR DUE TO PARALLAX.




INTERSTAGE TURBINE TEMPERATURE

- 400-695 °C NORMAL OPERATING RANGE
- 695 °C MAXIMUM (CONTINUOUS)
- 1090 °C MAXIMUM (925 °C FOR 2-SECONDS) STARTING




TORQUE

- 400-1015 FT. LB. NORMAL OPERATING RANGE
- 1015 FT. LB. MAXIMUM


PROPELLER TACHOMETER

- 1800-2200 RPM NORMAL, OPERATING RANGE
- 2200 ± 25 RPM MAXIMUM


TURBINE TACHOMETER ($N_1$ SPEED)

- 101.5% MAXIMUM

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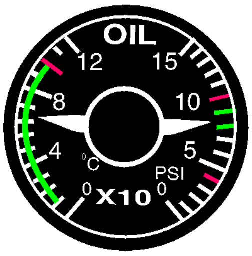
Figure 4-4. Instrument Markings (Sheet 1 of 2)

Note

APPARENT ERRONEOUS READINGS MAY OCCUR DUE TO PARALLAX.




OIL TEMPERATURE AND PRESSURE

OIL TEMPERATURE SCALE

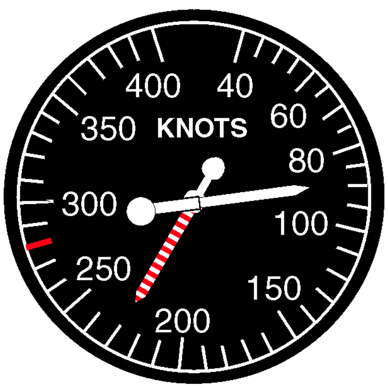
- (Green) 10-99 °C NORMAL OPERATING RANGE USING ENGINE OIL SPEC. MIL-L-23699
- (Red) 100 °C MAXIMUM USING ENGINE OIL SPECIFICATION MIL-L-23699

OIL PRESSURE SCALE

- (Red) 40 PSI MINIMUM
- (Green) 65-80 PSI NORMAL OPERATING RANGE WITH $N_1$ > 75%
- (Red) 100 PSI MAXIMUM

NOTE

- DURING COLD AMBIENT TEMPERATURES, OIL PRESSURE MAY BE BETWEEN 80 AND 100 PSI. THIS CONDITION IS ACCEPTABLE; HOWEVER, THE OIL PRESSURE SHALL BE WITHIN NORMAL LIMITS (65 TO 80 PSI) PRIOR TO TAKEOFF.
- DURING DYNAMIC AIRCRAFT MANEUVERS, OIL PRESSURE TRANSIENTS AS LOW AS 10 PSI FOR AS LONG AS 5 SECONDS ARE ACCEPTABLE PROVIDED THAT OIL PRESSURE RETURNS TO NORMAL WITH NO UNUSUAL OR SECONDARY INDICATIONS OF ENGINE FAILURE

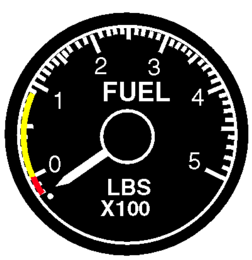



AIRSPEED INDICATOR

- (Red) 280 KIAS MAXIMUM (0 TO 20,000 FT ALTITUDE)
- 245 KIAS MAXIMUM (20,000 TO 25,000 FT ALTITUDE)

NOTE

MAXIMUM ALLOWABLE AIRSPEED (RED STRIPED) POINTER IS SELF ADJUSTING WITH ALTITUDE.




FUEL QUANTITY

- (Red) -20 - 0 LBS. CRITICAL FUEL (FOR FLIGHT)
- (Yellow) 0 - 80 LBS. NO TAKEOFF RANGE


EMERGENCY CANOPY OPENING PRESSURE

| TEMP °F | GAUGE PSI |
|---|---|
| -65 | 1710 - 2232 |
| -20 | 1907 - 2488 |
| 25 | 2103 - 2744 |
| 70 | 2300 - 3000 |
| 115 | 2497 - 3256 |
| 160 | 2693 - 3512 |

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Figure 4-4. Instrument Markings (Sheet 2)

| OPERATING MODE | TORQUE | $N_1$ | ITT | PROPELLER RPM | FUEL FLOW | OIL | |
|---|---|---|---|---|---|---|---|
| | | | | | | TEMP. | PRESS |
| IDLE (GROUND OPS) | APPROX 150 FT-LB | 62 to 65% | 660 °C (MAX) | VARIOUS (1,800 RPM OR LESS) | 125 LB HR (APPROX) | NORM (10 TO 99 °C) | NORM (40 PSI MIN) ❶ |
| FULL POWER ❷ | 1,015 ❺ FT-LB AT SEA LEVEL (DECR. W INCR. ALT) | 89 to 93% (INCR. W INCR. ALT 101.5% MAX) | 400 to 695 °C ❸ | 2200 ±25 RPM (MAX) ❹ | 335 LB/HR OR LESS (SEE FIGURE 24-17 FOR SPECIFIC FUEL FLOW VALUE.) | NORM (10 to 99 °C) NORM | NORM (65 to 80 PSI) ❶ |

❶ In-flight oil pressure may be as low as 40 psi. With $N_1$ above 75%, oil pressure must indicate 65 to 80 psi. During dynamic aircraft maneuvers, oil pressure transients as low as 10 psi for as long as five seconds are acceptable provided that oil pressure returns to normal with no unusual or secondary indications of engine failure.

❷ Torque indications will change possibly up to 1,315 ft-lb depending upon temperature and altitude with the FCU stuck at maximum flow.

❸ Full power at high altitudes may produce ITT in excess of 695 °C. At high cruising altitudes, retard the PCL to bring ITT into limits. (695 °C max. continuously).

❹ If propeller rpm is out of limits, retard the condition lever to bring prop rpm into limits.

❺ Torque is PCL controlled through the normal operating range of 400 to 1,015 ft-lb and up to a maximum limit of approximately 1,315 ft-lb.

Figure 4-5. Engine Condition Indications (Normal Power Range)

# PART II

# Indoctrination

# CHAPTER 5

# Indoctrination

## 5.1 INTRODUCTION

The purpose of this  is to standardize ground and flight training for pilots during initial checkout and familiarization in the T-34C, to establish first-pilot currency requirements, and to list minimum personal flight equipment required.

## 5.2 GROUND TRAINING SYLLABUS

**5.2.1 Introduction.** T-34C currency requirements. Personal flying equipment required. Description of aircraft.

**5.2.2 Engineering and Aircraft Systems.** Engine, propeller, oil, fuel, electrical, oxygen, and hydraulic brake systems, flight controls, instruments, electronic communications/navigation equipment, aircraft operating limitations, servicing requirements.

**5.2.3 NATOPS Procedures.** Normal operating, flight, and emergency procedures. Aircraft flight characteristics and all weather procedures.

**5.2.4 NATOPS Ground Evaluation.** Open and closed book examinations will be given to determine the pilot's understanding of the ground training phase.

## 5.3 FLIGHT TRAINING SYLLABUS

The flight training syllabus shall consist of five NATOPS training flights and a NATOPS flight evaluation for a total flight time of approximately 12.3 hours. Where recent experience in a similar model warrants, unit commanders can waive, by unit instruction, all but 5 hours of dual instruction prior to flight evaluation.

### 5.3.1 NATOPS Flight One, Pilot Under Instruction in Front Cockpit, 2.2 Hours

1. Discuss:

   a. Preaerobatic/Stall Checklist

   b. Fires (Ground and In-flight)

   c. Bailout

   d. Ditching

   e. Local area flying procedures

   f. Unsafe landing gear position indication

   g. Landing gear unsafe emergency landing.

2. Demonstrate:

   a. Intentional feather airborne

   b. Slow flight/stall characteristics

   c. Canopy open flight (effect on glide and rate of descent.

3. Introduce:

   a. Preflight

   b. Start

   c. Checklists

   d. Taxi

   e. Ground runup

   f. Normal takeoff

   g. Power-off stall

   h. Approach-turn stall

   i. Erect spin

   j. Precautionary emergency landing

   k. Precautionary emergency landing (pattern)

   l. Full-flap approach/landings

   m. No-flap approach/landings

   n. Waveoff

   o. Emergency extension

### 5.3.2 NATOPS Flight Two, PUI in Front Cockpit, 2.2 Hours

1. Discuss:
   a. Loss of useful power/Engine malfunctions
   b. Crosswind takeoff and landing
   c. Local area flying procedures.
2. Demonstrate: inverted flight
3. Introduce:
   a. Use of EPL at altitude
   b. High-altitude power loss
   c. Low-altitude power loss
   d. Low-altitude power loss (pattern)
   e. Skidded-turn stall
   *f. Control release spin
   *g. Progressive spin
   h. Inverted flight.
4. Practice: All previously introduced maneuvers.

### **5.3.3 NATOPS Flight Three, PUI in Rear Cockpit (Hooded), 2.0 Hours

1. Discuss:
   a. Propeller governor failure
   b. Fuel system failure
   c. Electrical failure
   d. Instrument departure and arrival
   e. Partial panel flight.

*May be completed on NATOPS Flight Five if weather precludes introduction on this flight.

**NATOPS FLT 3 may be accomplished any time prior to NA 6.

2. Introduce and practice
   a. Instrument departure
   b. Holding (tacan or VOR)
   c. Tacan/VOR/LOC approach
   d. ASR approach
   e. PAR approach
   f. No gyro approach.

### 5.3.4 NATOPS Flight Four, PUI in Front Cockpit, 2.3 Hours

1. Discuss:
   a. Minimum run landing
   b. Aborted takeoff.
   c. Out-of-control flight/unusual attitude recovery
2. Demonstrate:
   a. Minimum run landing
   b. Aborted takeoff
   c. OCF/unusual attitude recovery.
3. Introduce:
   a. Minimum run takeoff
   b. AOA approach, full flap
   c. AOA approach, no flap
   d. Wingover
   e. Aileron roll
   f. Barrel roll
   g. Loop
   h. Immelman
   i. One-half Cuban eight

j. Split S

k. OCF/unusual attitude recovery.

4. Practice:

a. All previously introduced maneuvers as necessary.

#### 5.3.5 NATOPS Flight Five, PUI in Front Cockpit, 1.8 Hours

1. Discuss:

a. Local area flying procedures

b. Inverted spins

c. Aggravated spins

d. Accelerated stalls

e. Low altitude engine failure considerations

f. Ground roll/braking distance for PPEL/ engine failure to paved field.

2. Demonstrate:

***a. Aborted takeoff

***b. Minimum run landing.

3. Introduce:

a. Obstacle clearance takeoff

*b. Control release spin

*c. Progressive spin.

4. Practice:

a. All previously introduced items (as required).

*Must be completed if not introduced on NATOPS Flight Two.

***Must be completed if not demonstrated on NATOPS Flight Four.

#### 5.3.6 NATOPS Flight Six, NATOPS Flight Evaluation, PUI in Front Cockpit, 1.8 Hours

1. Comprehensive check of introduced maneuvers in accordance with Part X of the T-34C NATOPS Flight Manual.

2. Discuss procedures for securing the rear cockpit for solo flight (Figure 5-1).

## 5.4 FLIGHTCREW REQUIREMENTS

**5.4.1 Pilot in Command Currency Requirements.** A pilot must have:

1. Successfully completed a NATOPS evaluation in the last 12 months.

2. A current instrument rating.

3. Made at least five landings (two full stops) within the preceding 90 days. Pilots who fail to meet the above requirements shall be considered no longer currently qualified and are required to requalify in accordance with OPNAVINST 3710.7 and this manual.

## 5.5 PASSENGER REQUIREMENTS

1. Must be familiar with the operation of the interphone, emergency equipment, and bailout procedures.

2. Must have required personal flying equipment.

## 5.6 PERSONAL FLYING EQUIPMENT

The following equipment shall be worn or carried on all flights on T-34C aircraft unless safety or mission considerations or design characteristics of aircraft dictate otherwise:

1. Flame-resistant flight suit

2. Identification tags

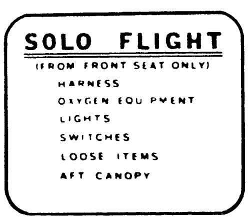
3. Flight gloves

4. Flight safety boots

5. Protective helmet with audio headset

6. Approved life preserver on all overwater flights

1. FASTEN LEG STRAPS THROUGH HELMET BAG HANDLES
2. FASTEN CHEST STRAP
3. WRAP HOSE CORD & CLIP
4. FASTEN LAP BUCKLE
5. RUN THROUGH HOUSING & FASTEN
6. LOCK REEL & TIGHTEN HARNESS
7. COMPLETE SOLO CHECKLIST



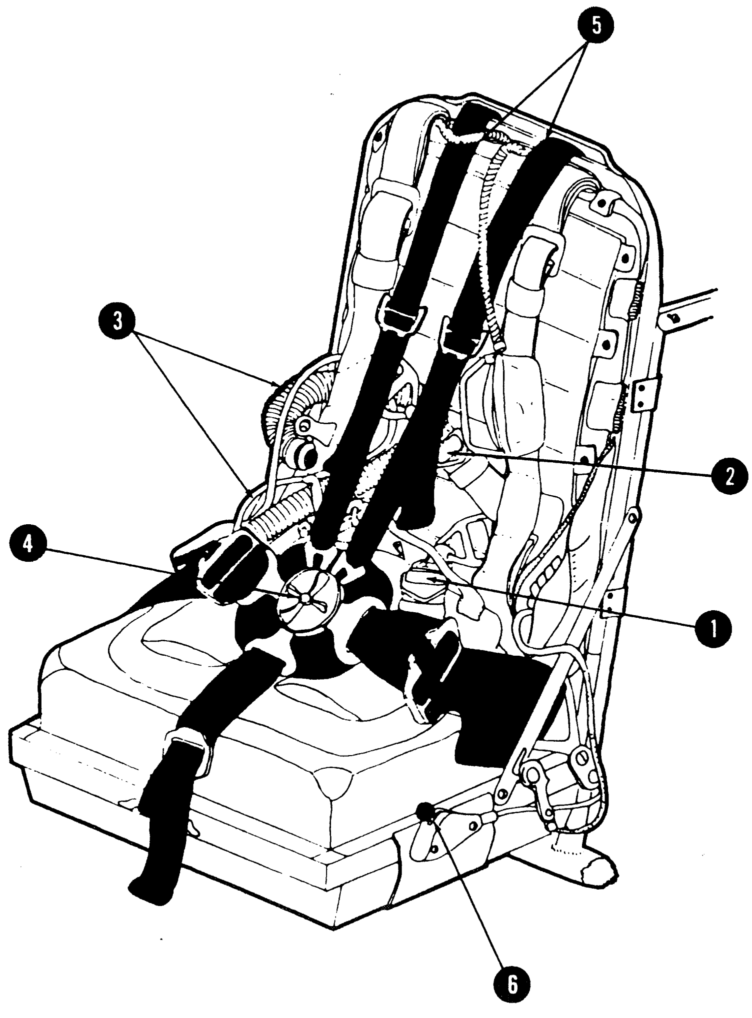




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Figure 5-1. Securing Aft Cockpit for Solo Flight

7. Approved survival knife and sheath

8. Personal survival kit

9. Parachute

10. Oxygen mask

11. Antiexposure suit in accordance with OPNAVINST 3710.7

12. Approved signaling device

13. Flashlight for all night flights

14. NATOPS pilot's pocket checklist (NAVAIR 01-T34AAC-1B).

**Note**

All survival equipment will be secured in such a manner that it is easily accessible and will not be lost during an emergency.

# PART III

# Normal Procedures

# CHAPTER 6

# Flight Preparation

## 6.1 MISSION PLANNING

Mission planning is the responsibility of the first pilot or flight leader and will cover all matters pertinent to the mission to be flown. Every task which can be completed prior to takeoff will contribute to the ease and success with which the actual flight is conducted.

**6.1.1 Weather.** A complete weather briefing and an understanding of the weather picture is a prerequisite of successful mission planning. En route weather will dictate the probable altitude assignments and whether or not those altitudes assigned will be acceptable. Destination weather will determine expected delays in letdown and landing procedures, and a good weather alternate or alternates are a must to save the day in unforeseen circumstances. All of this weather picture affects fuel planning and flight procedures.

**6.1.2 Planning Data.** Data and information required for determining the operational parameters and the mission requirements are found in Part XI.

**6.1.3 Weight Computations.** Mission planning concerning weight and balance should place primary emphasis on aircraft gross weight in order to avoid exceeding the maximum allowable weight limits. The following data are provided to assist the pilot in determining aircraft weight.

Aircraft basic weight (typical) — 3,010 lb
Fuel (JP-5) — 884 lb
Parachute (F/C) — 28 lb
Parachute (R/C) — 28 lb
Personal equipment (F/C)[1] — 25 lb
Personal equipment (R/C)[1] — 25 lb
Total weight before crew and luggage — 4,000 lb

Maximum gross weight for taxi — 4,425 lb
–4,000 lb
Maximum allowable for naked crew plus luggage — 425 lb

If the aircraft is configured for overwater flight (cushions replaced by liferafts) and the pilots wear LPAs, the maximum allowable for crew weight plus luggage is lowered to 295 pounds.

For alternate fuel weights, see Figure 24-12.

**6.1.4 Fuel Planning.** A fuel planning log should be prepared and cross-checked with actual fuel consumption on cross-country flights.

## 6.2 BRIEFING

The success of a flight is a direct measure of the preflight preparations, planning, and briefing. The briefing syllabus should include but is not limited to the following guidelines.

### 6.2.1 Communications and Crew Coordination

1. Frequencies
2. Radio procedures and discipline
3. Change of control of aircraft
4. Navigational aids
5. Identification
6. Lookout procedures.

### 6.2.2 Weather

1. Local area
2. Local area and destination forecast
3. Weather at alternate.

1. Includes flight suit, boots, knife, flare kit, checklists, helmet bag and helmet, flashlight, $O_2$ mask, kneeboard, charts, and approach plates.

### 6.2.3 Navigational and Flight Planning

1. Climbout
2. Mission planning, including fuel/oxygen management
3. Penetration
4. Approach
5. Recovery.

### 6.2.4 Emergencies

1. Aborts
2. Divert fields
3. Minimum and emergency fuel
4. Waveoff pattern
5. Radio failure/ICS failure
6. Loss of visual contact with flight
7. Downed pilot and aircraft
8. Aircraft emergencies and system failures
9. Bailout.

The flight leader will inspect all flight members for the proper flight equipment.

### 6.2.5 Passenger Safety Brief (Minimum Brief Items for Selected Passengers)

1. Safety
   a. Hearing protection
   b. Propeller arc
   c. FOD.
2. Mission
   a. Primary/secondary
   b. Operating area
   c. Sequence of events/flight profile.
3. Weather
4. Lookout doctrine/responsibilities
5. Communications/ICS
   a. Normal
   b. Radio/ICS failure.
6. Change of controls in aircraft
7. Cockpit familiarization
   a. Controls
   b. Instrument
   c. Warning/caution devices
   d. Oxygen system
   e. Harness/restraint system
   f. Preparations for aerobatics/entry into turbulence
   g. Canopy operation
      (1) Normal
      (2) Emergency.
8. Survival equipment
   a. Parachute
   b. SV-2
   c. LPU.
9. Emergency procedures
   a. Downed pilot/aircraft
   b. Aircraft emergencies/system failures
   c. Bailout/ditching
   d. Emergency ground/water egress
   e. Waveoff procedures/pattern.
10. Questions?

## 6.3 DEBRIEFING

Each flight shall be followed with a thorough debriefing by the flight leader or pilot in command as soon as practical. All areas of flight should be covered, paying particular attention to those areas where difficulty was encountered. The debriefing may quite possibly be the most beneficial nonflying portion of the flight because it is here that errors committed are reviewed, the proper techniques discussed, and these associated with past performance.

# CHAPTER 7

# Shore-Based Procedures

## 7.1 LINE OPERATIONS

**7.1.1 Scheduling.** The commanding officer or his designated representative is responsible for the promulgation of the flight schedule. The flight schedule is an order of the commanding officer. It shall be followed rigidly and variations require approval of the commanding officer or his designated representative. Shipboard scheduling is not applicable to this aircraft.

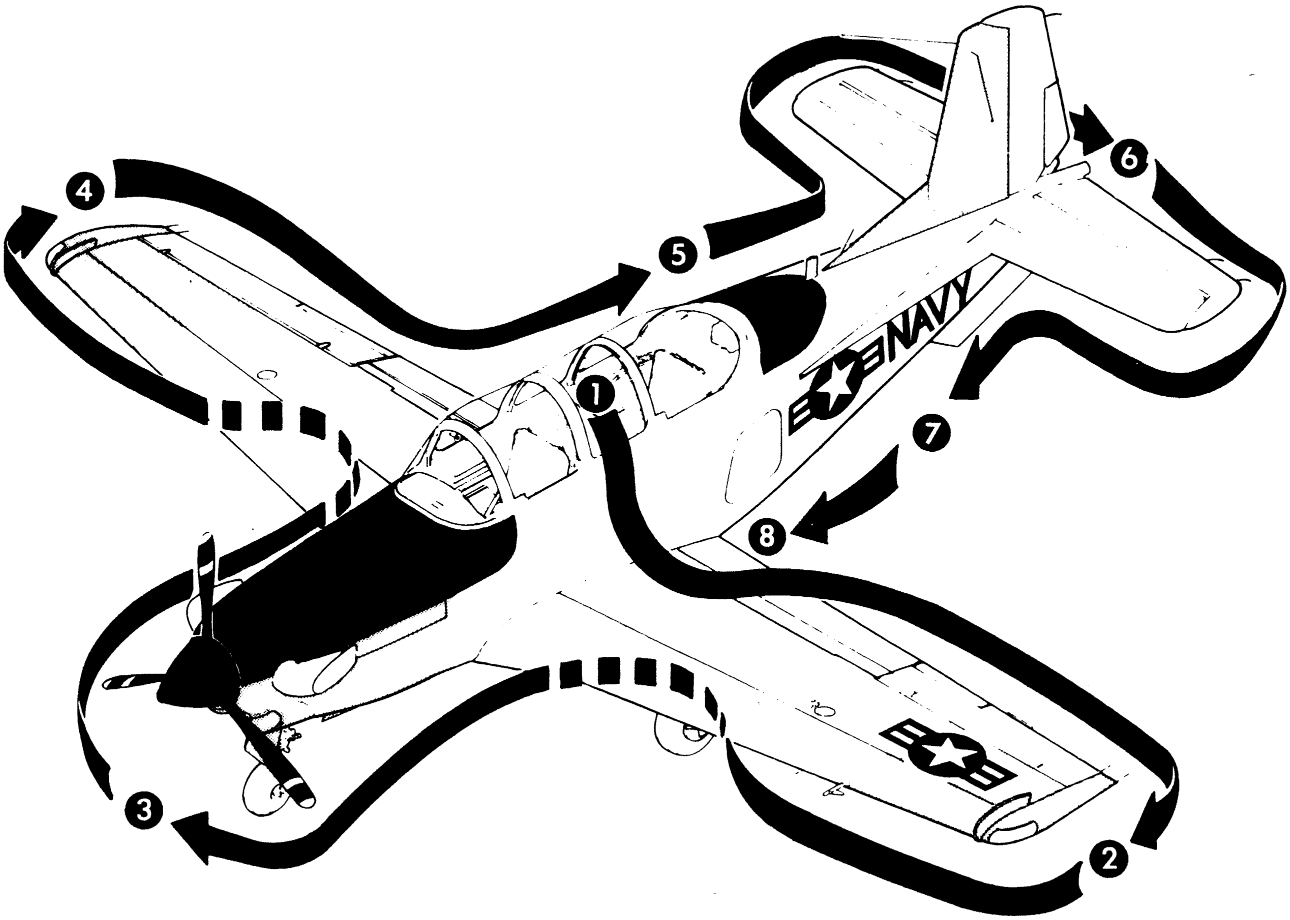
**7.1.2 Aircraft Acceptance.** The discrepancy records of at least the last 10 flights will be made available to the pilot for his examination. The pilot in command shall ensure that a preflight inspection has been conducted and that all servicing entries have been made. When satisfied that all required information has been stated, the pilot in command shall sign for the aircraft.

## 7.2 PREFLIGHT INSPECTION

The pilot in command shall ensure that a proper preflight inspection is accomplished. A satisfactory preflight will consist of completing both the cockpit safety check and the exterior inspection. As the aircraft is approached, observe wheel chocks in place, tiedowns removed, and that no obvious aircraft discrepancies exist. The path to be followed during the exterior inspection is presented in Figure 7-1. The inspection procedure is also included in the NATOPS pocket checklist (NAVAIR 01-T34AAC-1B).

**7.2.1 Cockpits.** The following 14 items shall be inspected prior to the exterior inspection:

1. Canopy/windscreen — CHECK controls, canopy stop-screws, canopy rail screws flush, seals, and cleanliness.
2. First-aid kit — CHECK secured.
3. Free air temperature gauge — CHECK.
4. Parachute — CHECK condition and lanyard connected.
5. ELT — CHECK antenna cable attached.
6. Restraint harness — CHECK.
7. Trim tabs — SET 0 (zero).
8. Landing gear handle — CHECK down.
9. Accelerometer — CHECK within limits (+4.5, –2.3) (both cockpits).
10. Alternate static air source — NORMAL.
11. Starter, autoignition, and all applicable electrical switches — CHECK OFF (both cockpits).
12. Battery — ON, check voltage, fuel quantity and gear position indicators, then battery OFF (if voltage is less than 22 volts, plan for GPU-assisted start; if less than 18 volts, the battery must be replaced).
13. Oxygen system — TEST.
    a. Oxygen supply control — PUSH ON, clip in place.
    b. Supply pressure gauge — CHECK (1,000 to 1,850 psi).
    c. Regulator panel levers — ON, safety wire not broken, 100% OXYGEN, and NORMAL.
    d. Oxygen mask — CONNECT.
    e. Connections — CLEAR/CHECK for leaks. (Hold mask away from face and move emergency/normal/test lever to “TEST MASK” in order to clear mask. Then place mask firmly against face and move emergency/normal/test lever to EMERGENCY and check flow indicator remains black.)




1. Front/Aft Cockpit
2. Left Wing
3. Nose/Propeller
4. Right Wing
5. Right Aft Fuselage
6. Empennage/Tail Cone
7. Left Aft Fuselage
8. Underside of Fuselage

**Note**

THE EXTERIOR INSPECTION HAS BEEN DIVIDED INTO 8 AREAS AS SHOWN. THE INSPECTION BEGINS IN THE FRONT COCKPIT, PROCEEDS TO THE AFT COCKPIT, THEN MOVES CLOCKWISE AROUND THE AIRCRAFT DISCUSSING ONLY THE LEFT WING, NOSE AND PROPELLER. INSPECTION OF THE RIGHT WING (NOT DISCUSSED) IS IDENTICAL EXCEPT FOR ITEMS SPECIFICALLY INSTALLED ONLY ON THE LEFT WING.

F-0039

Figure 7-1. Exterior Inspection

**Note**

Note: Flow indicator movement indicates a system leak and requires maintenance.

f. Flow indicator — CHECK (during inhale, blinker appears and exhale blinker disappears, repeat a minimum of three times).

14. Controls — UNLOCK, lock stowed (front cockpit).

15. Solo flight — SECURE aft cockpit as follows (Figure 5-1):

    a. Seat — LOWER TO FULL DOWN.

    b. Restraint harness, parachute, and oxygen equipment — SECURE.

    c. Cockpit lights — OFF.

    d. Switches — Battery ON, inverter No. 2 ON, all others AS REQUIRED.

    e. Inspect for and secure loose equipment.

**WARNING**

Failure to secure the rear cockpit for solo flight may result in restriction of flight control movement.

    f. Aft canopy — CLOSE/LOCK.

### 7.2.2 Exterior Inspection

#### 7.2.2.1 Left Wing

1. Top of wing for cracks, deep scratches, tears, wrinkes, popped rivets, and bulges.

2. Flap for excessive freeplay, security, and overall condition.

3. Aft fuel tank drain (Figure 7-2) — CHECK for leakage (one for each wing).

4. Left main landing gear (aft portion)

    a. Check general condition of tire and wheel assembly.

    b. Check brakelines and fittings for security and leakage.

    c. Check main landing gear roller bearing for freedom of movement.

5. Aileron for freeplay, servo action of trim tab (tab moves in opposite direction of aileron), trim tab linkages secure, nuts cotterkeyed, aileron hinge points and bonding braids for security, trim tab hinge pins secured, and static wicks secure.

6. Wingtip for cracks, scratches, and condition of navigation and strobe lights; glareshield for security, condition, and holes unobstructed.

7. Underside of wing for leaks, cracks, deep scratches, tears, wrinkles, popped rivets, and bulges.

8. Wing leading edge for breaks, dents, and bulges.

9. Angle-of-attack probe — CHECK cover removed and vane for freedom of movement.

10. Pitot tube — CHECK cover removed and mast unobstructed.

11. Wing tiedown — REMOVED.

12. Fuel cap — CHECK secure and arrows aligned.

13. Left main landing gear

    a. Wheel properly chocked; tread (no cord showing); check tire for cuts, abrasions, proper inflation, and retaining nut cotterkeyed.

    b. Check brake disk for scoring/warpage.

    c. Check brake lining for security and thickness (not less than 0.1 inch).

    d. Oleo 3 inches (approximately four fingers).

    e. Shock strut scissors for proper installation, security, retaining pins cotterkeyed, micro-switch and linkage secure.

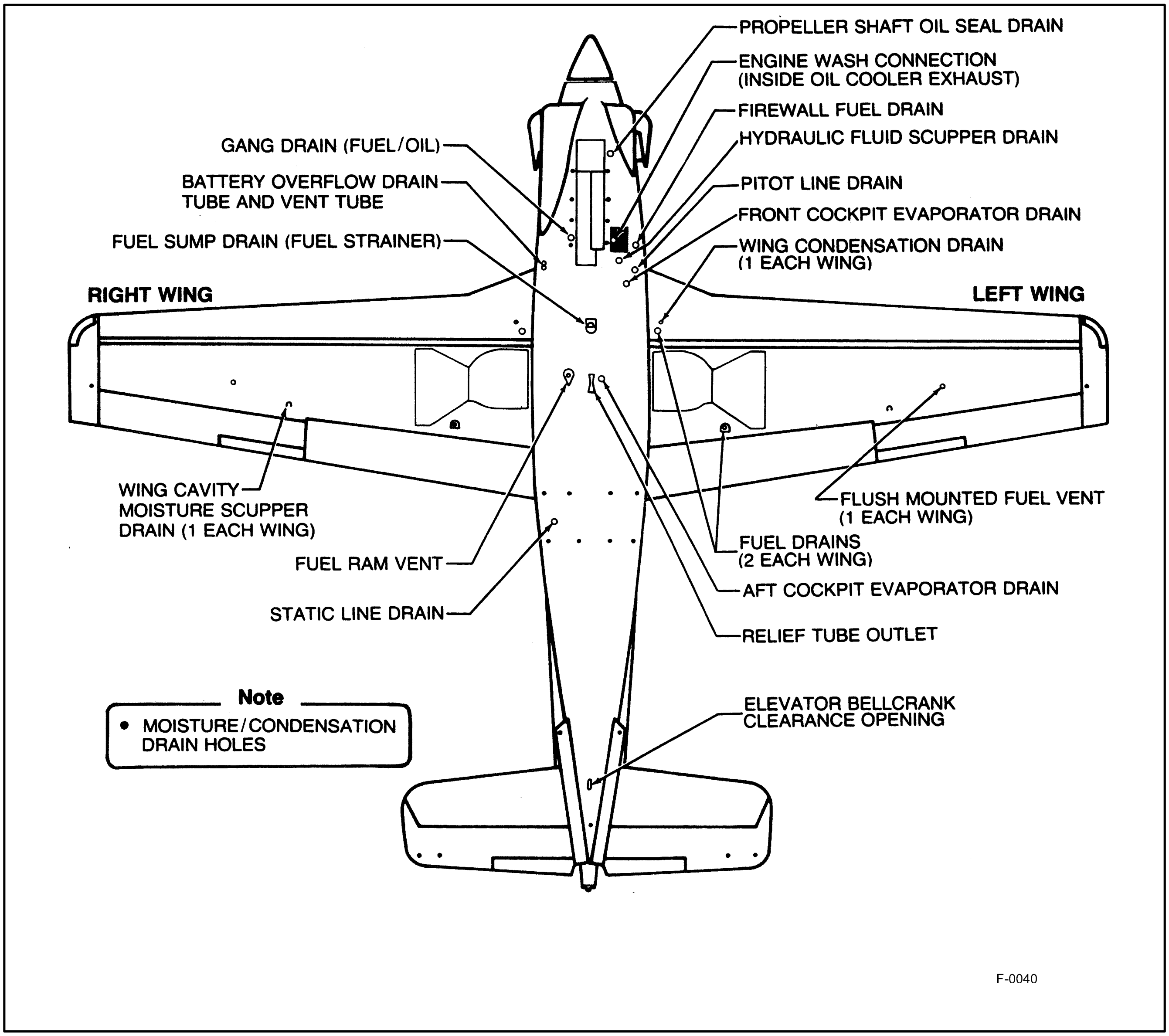



Figure 7-2. Drains/Vents

f. Landing gear fairing for security.

g. Positive downlock cable for security and fraying, mechanical locking device boot snaps securely fastened, and uplock spring tension.

h. Landing light for security.

i. Aileron and trim tab cables and turnbuckles safety wired and no evidence of chaffing or excess slack; fuel lines and fittings for leakage.

j. Wheelwell for foreign objects (Tools, rags, etc.).

k. Landing gear door excess play.

l. Landing gear position, light for security.

14. Forward fuel drain — CHECK for leakage (one for each wing).

15. Underside of fuselage

a. Fuel sump drain — CHECK for leakage.

b. Cabin fresh air intake duct — CLEAR.

c. Check all visible drains for leakage and antennas for condition and security.

**WARNING**

Pitot/Static Line Drains must be securely capped.

### 7.2.2.2 Nose/Propeller

1. Oil cooler exhaust duct — CLEAR.

2. Open engine cowling and check

   a. Firewall fuel filter — CHECK, handle stowed.

   b. Engine oil — CHECK quantity and cap secured.

   c. Check bilges of both engine compartments for foreign objects, leaks and general security.

3. Cowling and engine cowl door latches — SECURE.

4. Propeller restraint — REMOVED.

5. Exhaust stacks (two) — CHECK for cracks and clear.

**Note**

Check fire detector sun shield in place on port stack.

6. Tow cowl locks (four) — SECURED (check screw slots horizontal and center pins protruding into slot).

   a. Upper NACWS antenna — CHECK condition and security.

7. Prop retaining bolts (eight) — CHECK bolts for security and safety wired.

8. Propeller — CHECK for cracks, nicks, or pits. Inspect spinner attachment screws for security.

9. Accessory and engine intake ducts — CLEAR.

10. Nose landing gear and wheelwell

    a. Check tire for proper inflation, cuts, tears, abrasions, tread (no cord showing), and retaining nut cotterkeyed.

    b. Shock strut for leakage and approximately 3 to 5 inches of oleo.

    c. Shock strut scissors for proper installation, security, retaining pins cotterkeyed, towpin straight, microswitch and linkage secure.

**Note**

Reversal of the microswitch actuating arm is possible; ensure correct configuration by noting the position of the linkage. Horizontal microswitch linkage indicates improper position.

    d. Shimmy damper — CHECK for security.

    e. Retainer for nose cowling lockpins — SECURELY FASTENED.

    f. Nosewheel doors — CHECK security and condition.

    g. Nosewheel — CHECK door retraction linkage for attachment and security, and up and downlock microswitches and linkages for security.

11. Air-conditioner intake duct — CLEAR, spring-loaded door closed.

12. Inertial bypass door — CLOSED.

13. Open starboard engine cowling and check for FOD and/or leakage.

14. Cowling and engine cowl door latches — SECURE.

15. Battery compartment

    a. Battery hold down straps — SECURED.

    b. Battery tray retaining pin — SECURE.

    c. Battery access door — LATCHED.

    d. Battery vent scuppers — CLEAR.

16. Emergency canopy release — SECURE.

17. Battery overflow drain tube — CLEAR.

18. Gang drain — CHECK for leakage.

RIGHT WING — Same as left wing with exception of AOA, pitot tube, and aileron trim tab cables.

#### 7.2.2.3 Right Aft Fuselage

1. Examine fuselage for dents, wrinkles, popped rivets, and security of access panels.

2. Oxygen service door — SECURE.

3. Oxygen high pressure relief disk — INTACT.

4. Canopy emergency pressure gauge — GREEN RANGE for temperature.

5. Static port — CLEAR.

6. Aft canopy seal — CHECK condition.

7. UHF, ELT, VOR, VHF, and GPS antennas — CHECK condition and security.

#### 7.2.2.4 Empennage and Tailcone

1. Examine strakes and horizontal and vertical stabilizers for cracks, dents, wrinkles, or popped rivets.

2. Control surfaces for security, freedom of movement, no servo action of the elevator trim tabs (left tab approximately 4.5° down, right tab approximately 4.5° up), check antiservo action of rudder trim tab (tab moves in the same direction as rudder when moved), check trim tab hinge pins secure, rudder and elevator hinge points secure, bonding braids attached, actuator rods secure, nuts cotter-keyed, and condition of static wicks.

3. Condition of tailcone, navigation, and strobe lights.

#### 7.2.2.5 Underside of Fuselage

1. Underside of fuselage for dents, bulges, wrinkles, tears, popped rivets.

2. Tail tiedown — CHECK REMOVED.

3. Ventral fins — Condition and security.

4. Antennas — CHECK condition and security.

#### 7.2.2.6 Left Aft Fuselage

1. Left fuselage for dents, wrinkles, popped rivets, and security of access panels.

2. Aft canopy seal — CHECK condition.

3. Static port — CLEAR.

4. Avionics compartment — Security of electronics equipment, check for loose articles adrift, LATCH and secure compartment door.

## 7.3 PRESTART CHECKLIST

1. Seat and rudder pedals — ADJUSTED.

**WARNING**

Ensure seat locking pins are engaged prior to flight as rapid movement of the seat when encountering positive or negative g loading may result in injury.

2. Parking brakes — SET.

3. Parachute — FASTENED/ADJUSTED.

4. Restraint harness — FASTENED/ADJUSTED.

   a. Attach lap belts and shoulder harness to rotary buckle.

   b. Move hips as far aft as possible into seat.

   c. Place the rotary buckle below both LPA lobes (if used) and against abdomen.

   d. Tighten the lap belts while holding the rotary buckle in place.

   e. Lock the inertial reel and then tighten the shoulder harness.

   f. Remove the slack remaining in the crotch adjustment strap while ensuring rotary buckle remains in its correct position.

**WARNING**

Improper adjustment of the restraint harness may allow the control stick to contact the rotary buckle and result in inadvertent release of the harness.

5. Emergency fuel shutoff handle — DOWN, CLIP IN PLACE.
6. Wing flap lever — UP.
7. PCL — IDLE.

**CAUTION**

Moving the PCL into beta range without the engine running will damage the linkage mechanism.

8. Condition lever — FUEL OFF.
9. EPL — DISCONNECT.
10. Friction lock knob — FULL DECREASE.
11. Cockpit environmental control — OFF.
12. Cockpit defog control — OFF.
13. Gear handle — DOWN.
14. Landing lights — OFF.
15. GPS — OFF.
16. Compass slave switch — SLAVE (both cockpits).
17. Air-conditioner switch — OFF (both cockpits).
18. Fire warning test switch — OFF.
19. NACWS — OFF (both cockpits).
20. Autoignition — OFF (both cockpits).
21. Starter — OFF (both cockpits).
22. Engine air bypass — CLOSED.
23. Emergency landing gear handle crank — DISENGAGED.

**Note**

Ensure clutch knob is up and locked.

24. Inverters — OFF.
25. AVIONICS MASTER — OFF.
26. Aft cockpit attitude gyro and RMI — ON.
27. Navigation and strobe lights — OFF.
28. Pitot heat — OFF.
29. Standby fuel pump — OFF.
30. VHF Radio — OFF.
31. Circuit breakers — IN; UTILITY BUS SWITCHES ON.
32. Helmet — ON.
33. Battery — ON.

**Note**

Check for a minimum of 22 volts.

34. ICS — CHECK.
35. GPU — AS REQUIRED.

**Note**

If GPU is available it should be used.

36. Instrument and console lights — AS DESIRED.
37. Annunciator — TEST.
    a. Check for steady light in gear handle, flashing WHEELS light, flashing MASTER CAUTION light and all annunciator panel lights are illuminated.
38. Inboard gear door position indicator — TEST.
    a. Check the LH OPEN and RH OPEN lights illuminate, then extinguish when switch is released.

39. Fire warning — TEST.

    a. Rotate switch through each test position and verify flashing red FIRE light on each instrument panel, then turn switch OFF.

40. Navigation and strobe lights — REQUIRED.

41. Pitot heat — TEST.

    a. Turn switch ON.

    b. Note drop in ammeter.

    c. Turn switch OFF.

42. Standby fuel pump — TEST.

    a. Turn switch ON.

    b. Check FUEL PRESS light out.

    c. Turn switch OFF.

    d. Check FUEL PRESS light on.

43. Canopy — CLOSED and LOCKED (both cockpits).

**WARNING**

While closing the canopy, adjust seat height to ensure the canopy bow clears the helmet; otherwise, there exists the danger of the canopy bow striking the helmet during emergency opening. Seat height should not be raised thereafter.

**Note**

Both canopies must be closed before starting engine and must remain closed until after engine shutdown except for short periods of time on the deck with the propeller in feather or in flight with the oxygen masks and diluter in 100 percent.

## 7.4 ENGINE START CHECKLIST

1. Fire guard — POSTED.

2. Propeller — CLEAR.

3. Engine —START.

    a. Starter switch — ON (check voltage for minimum of 10 volts, IGNITION light on, FUEL PRES light out, oil pressure indicated).

**CAUTION**

After turning the starter switch on, if any of the above required indications do not exist, discontinue the start attempt by securing the starter. DO NOT introduce fuel. Start attempts without the proper indications may cause severe engine damage.

**Note**

With a significant crosswind component, the propeller may not turn on engine start until the condition lever is advanced from FUEL OFF.

    b. Condition lever — FTHR WHEN $N_1$ REACHES 12 PERCENT.

**CAUTION**

Do not introduce fuel before $N_1$ reaches 12 percent or if $N_1$ begins to decrease. Start attempts with a weak battery are likely to cause overtemperature damage to the engine. Use a GPU if the starter is unable to produce at least 12-percent $N_1$ under battery power.

    c. ITT and $N_1$ — MONITOR.

    d. Starter switch — OFF WHEN $N_1$ REACHES 60 PERCENT.

4. Oil pressure — CHECKED.

    a. Check oil pressure for a minimum of 40 psi.

**Note**

During cold ambient temperatures, oil pressure may be between 80 and 100 psi. This condition is acceptable; however, the oil pressure shall be within normal limits (65 to 80 psi) prior to takeoff.

5. $N_1$ — CHECKED.

**Note**

Idle rpm as low as 60 percent is acceptable. Report idle rpm under 62 percent to maintenance after the flight. Idle rpm above 65 percent is a downing discrepancy.

6. GPU — DISCONNECTED.

**WARNING**

Because of the close proximity of the external power receptacle to the prop arc and exhaust stacks, care must be taken to remain clear when disconnecting the GPU. Extreme caution shall be exercised at night.

7. Condition lever — FULL INCREASE.

8. Generator light — OUT (voltage).

   a. Check voltage between 27.0 to 29.5 volts.

9. Inverters — CHECKED/ON.

   a. Check INVERTER annunciator light out for each inverter.

   b. Turn on desired inverter.

10. Air-conditioner — AS REQUIRED.

11. AVIONICS MASTER — ON.

12. AVIONICS COMMAND — TEST.

13. RMI — ALIGNED AND SLAVED.

14. Angle-of-attack — TEST.

   a. When the AOA test switch is moved to the APPRCH (approach) position, check AOA indicator for 20 units and AOA indexer for illumination of amber doughnut.

   b. When the AOA test switch is moved to the stall position, check AOA indicator for 29 units, AOA indexer for illumination of the green chevron and rudder shakers at greater than 26.5 units.

15. NACWS — ON (both cockpits).

   a. Observe CDU for messages and listen for self-test.

**CAUTION**

Hold position in chocks until off flag in attitude gyro disappears.

16. GPS — ON.

## 7.5 PRETAXI CHECKLIST

1. Beta/Beta stop — CHECKED.

**WARNING**

Exercise extreme caution entering the beta range in close proximity to ground personnel.

2. Friction lock knob — ADJUSTED.

3. Brakes — HOLD.

4. Parking brake — RELEASED.

5. Chocks — REMOVED.

6. Brakes — CHECKED (both cockpits).

7. Environmental control system — TEST/SET.

   a. Place cockpit environmental control full forward.

   b. Check for increase in ITT.

   c. Place cockpit environmental control OFF.

   d. Check for decrease in ITT to previous indication.

   e. Place cockpit environmental control to desired temperature range.

8. Radios and NAVAIDs — CHECKED and SET.

   a. Set UHF radio as required. Press test button to check for operable LED display.

   b. Set transponder to standby.

c. Set Tacan as required.

d. Set VOR as required.

e. Press Multi-function Panel Test button and check for operable LEDs on Tacan and VOR control heads.

f. Press System Test button, check for VOR needle to indicate 000-005, Tacan needle should indicate 180 ± 3.5, DME should indicate 0.0 to 0.1. Tacan must be set transmit and receive and VOR must be on to complete this test.

g. Set mixer switches as required.

h. Rotate transponder knob to test position, observe green reply light, then reset standby.

i. Set VHF radio as required.

j. Set VHF/UHF Transmit and VHF receive switches as required.

k. Set GPS as required. Check for valid self test and valid database. Load local altimeter setting and flight plan as required. Select NAV or GPS mode as required.

9. Altimeter and NACWS — CHECKED and SET.

   a. Set altimeter to 29.92.

   b. Check NACWS altitude within 125 feet of barometric altimeter.

   c. Set altimeter to local barometric setting.

10. Landing lights — AS REQUIRED.

## 7.6 TAXIING

Normal taxi is initiated by a slow, straightahead roll using engine power as required to start forward movement. Steering is accomplished by use of rudder control and individual wheelbraking by using positive brake application in desired turn direction. Taxi speed can be effectively controlled by the use of the PCL and applications of propeller beta range.

**WARNING**

Simultaneous actuation of the same brake pedal in both cockpits may cause the shuttle valve to neutralize, causing loss of braking effectiveness.

**Note**

Use of propeller beta range in surface areas containing loose sand or small stones will cause propeller blade erosion.

### 7.6.1 Taxiing Checklist

1. Turn needle — CHECKED.

## 7.7 GROUND RUNUP CHECKLIST

1. Brakes — HOLD.

2. Propeller overspeed governor — TEST.

   a. OVSP GOV switch — DEPRESS.

   b. PCL — SLOWLY ADVANCE UNTIL PROPELLER RPM STABILIZES.

   c. Check propeller rpm between 1,950 to 2,150.

   d. OVSP GOV switch — RELEASE AND CHECK FOR AN INCREASE IN PROPELLER RPM.

3. Oil pressure — CHECKED.

   a. Check oil pressure 65 to 80 psi.

4. Autoignition — TEST.

   a. Autoignition switch —ON (check AUTO IGN annunciator light ON).

   b. PCL — IDLE (check that IGNITION annunciator light comes on between 180 and 300 ft-lb torque and that AUTO IGN annunciator light goes out).

   c. Autoignition switch — OFF.

5. Propeller feather — TEST.

   a. Check by moving the condition lever aft through the spring detent to FTHR.

   b. After feathering action has stabilized (increased torque, decreased propeller rpm, $N_1$ stabilized between 60 to 65 percent), advance condition lever to FULL INCR RPM.

**CAUTION**

- In the event of inadvertent engine shutdown during the feather check, do not advance the condition lever; forward movement of the condition lever immediately after engine shutdown can result in severe engine overtemperature damage. The pilot shall monitor engine instruments for normal shutdown and perform Abnormal ITT During Shutdown procedure in paragraph 12.4.2 if required.

- Selection of feather with PCL in beta range may result in overtemperature and/or flameout. Indications of this condition include rising ITT and decreasing $N_1$ (toward 40 percent) and decreasing fuel flow. In the event of inadvertent selection of feather with PCL in beta range, the pilot shall perform EMERGENCY ENGINE SHUTDOWN procedure in paragraph 12.2.

## 7.8 TAKEOFF CHECKLIST

1. Trim — SET.

   a. Set 0° rudder, 3° up elevator, 0° aileron.

2. Flaps — CHECKED.

   a. Check for proper extension and retraction of flaps.

3. Controls — FREE and CORRECT (both cockpits).

**WARNING**

Improper adjustment of the restraint harness may allow the control stick to contact the rotary buckle and result in inadvertent release of the harness. If in either cockpit, the control stick can contact the rotary buckle, the aircraft shall not be flown until that harness is readjusted and the buckle repositioned to remain clear of the control stick.

**Note**

If flight controls bind during ground operations, hold light pressure against the binding and call for immediate maintenance inspection.

4. Radios, NAVAIDS, NACWS, GPS — SET.

5. Instruments, fuel quantity — CHECKED.

6. Harness — LOCKED (both cockpits).

Items to be completed just prior to takeoff:

7. Transponder — AS REQUIRED.

8. Pitot Heat — AS REQUIRED.

9. Strobes/Navigation Lights — AS REQUIRED.

## 7.9 TAKEOFF

**7.9.1 Normal Takeoff.** Takeoff roll can begin at idle engine power or the brakes may be applied while the PCL is advanced to takeoff power (note that torque is 1,015 ft-lb). As the takeoff roll progresses, maintain heading with rudder control. At approximately 80 KIAS, apply slight aft stick pressure to raise the nose to takeoff attitude and allow the aircraft to fly itself off the deck. Maintain takeoff attitude until airspeed reaches 120 KIAS, then establish desired climb technique and maintain torque maximum limit of 1,015 ft-lb.

**WARNING**

Wake turbulence or lead aircraft propeller wash (formation flights) may result in severe degradation of trailing aircraft controllability during takeoff.

**7.9.2 Minimum Run Takeoff.** For a minimum run takeoff, apply brakes and slowly advance the PCL to takeoff power. Maintain 1,015 ft-lb, release the brakes. Do not assume a nose-high attitude until reaching approximately 60 KIAS. At this time, smoothly apply aft stick pressure to assume a nose-high (takeoff) attitude so lift-off will occur as soon as minimum flying speed is reached. When positive lift-off has occurred, retract the landing gear and accelerate to climb speed. Continue with normal takeoff and climb procedure. Limit directional control braking as much as possible to reduce takeoff roll.

**7.9.3 Obstacle Clearance Takeoff.** Use minimum run takeoff procedure to the point of assuming a nose-high attitude. Do not assume the nose-high takeoff attitude until reaching approximately 70 KIAS. When positive lift-off has occurred, retract the landing gear and accelerate and maintain $V_x$ (best angle of climb airspeed) until the obstacle is cleared.

**7.9.4 Crosswind Takeoff.** In a crosswind takeoff, directional control may be more difficult to maintain. Advance the power lever and maintain directional control with light braking and rudder control. Use of the brakes should be avoided as much as possible after takeoff roll is underway since every brake application will lengthen takeoff run. Hold the nosewheel on the surface and apply upwind aileron to maintain a wings-level attitude. Firmly pull the aircraft off the runway when flying speed is reached to avoid side skipping. Initial drift correction is made by turning into the wind with a shallow bank to counteract drift, then rolling the wings level. Continue to climb straightahead, maintaining drift correction. Refer to Figure 25-2 to determine recommended crosswind takeoff speed for a specific crosswind component.

## 7.10 NORMAL CLIMB

Normal climb at sea level is 120 KIAS with takeoff power and full INCR RPM. More efficient climb may be required immediately after takeoff for obstacle clearance or specific climb commitments. Consult Figure 26-1 to determine optimum aircraft rate of climb and gradient. $V_x$ (best angle of climb) is 75 KIAS; $V_y$ (best rate of climb) is 100 KIAS.

## 7.11 CRUISE

Generally, cruise power settings are dependent on the flight conditions and the type of mission being flown. Refer to the cruise charts in Part XI for flight planning.

**7.11.1 Fuel Management.** Fuel from the wing tanks gravity feeds into the 1.5-gallon sump tank. Prolonged unbalanced flight, slips, steep banks, etc., may result in uneven transfer. Fuel imbalance should be limited to 100 pounds. Fuel tank quantity may be balanced by using a slip (heavy wing high). Although the fuel tanks are baffled to prevent fuel from being drawn away from the fuel outlets during such maneuvers, care should be exercised during low fuel states and balanced flight maintained if possible. If precise fuel management cannot be maintained because of fuel flow or fuel quantity indicator failure, plan landing with a conservative fuel reserve.

### 7.11.2 Cruise Checklist.

1. Instruments — CHECKED.
2. Fuel quantity — CHECKED.
3. Oxygen — CHECKED.

## 7.12 DESCENT

**7.12.1 Normal Descent.** Reduce power to approximately 300 ft-lb and maintain airspeed not to exceed the maximum allowable.

**CAUTION**

During descent, retard the PCL to maintain the allowable torque limits (torque increases as airspeed is increased or with an altitude change).

**7.12.2 Rapid Descent.** A rapid rate of descent may be obtained using the following procedure:

1. PCL — IDLE.
2. Condition lever — FULL INCR RPM.
3. Landing gear — DOWN (maximum gear extension 150 KIAS).
4. Flaps — UP.
5. Airspeed — 150 KIAS MAXIMUM.

**7.12.3 Instrument Descent.** Refer to Chapter 17 for instrument descent procedures.

**7.12.4 Instrument Approaches.** Refer to paragraph 17.3.6 for typical instrument approach procedures.

## 7.13 LANDING (FIGURE 7-3)

**7.13.1 Normal Break Entry.** Approach the break in a wings-level attitude. At the break, roll into the desired angle of bank and reduce power. Extend the landing gear at 150 KIAS, flaps at 120 KIAS. Adjust angle of bank to rollout within a wingtip distance from landing runway. Adjust attitude as required to maintain desired angle of attack/airspeed. Use power as necessary to control rate of descent.

### 7.13.2 Landing Checklist

1. Harness — LOCKED (both cockpits).
2. Landing gear — DOWN and LOCKED (both cockpits).
3. Brakes — PARKING BRAKE OFF, BRAKES FIRM.
4. Instruments — CHECKED.
5. Landing lights — AS REQUIRED.
6. Flaps — AS REQUIRED.

**7.13.3 Normal Landing.** Normal landings are accomplished by maintaining rate of descent and the desired angle of attack/airspeed until 5 to 10 feet above the runway. Then reduce the power toward idle and raise the nose slightly (flare) to check the rate of descent. As the main gear contacts the runway, continue reducing the power. As the airspeed is reduced, lower the nosewheel to the runway and maintain directional control with rudder and slight brake pressures. Utilize beta and smooth, increasing brake pressure to continue decelerating.

Refer to the landing distance chart (Figure 31-1) to determine landing roll when beta is not used.

**WARNING**

- Wake turbulence or lead aircraft propeller wash (formation flights) may result in severe degradation of trailing aircraft controllability during landing.
- Retarding the PCL to idle may result in engine spool-up delay of as much as 5 seconds upon power addition.

To reduce maintenance difficulties and possible accidents because of wheelbrake failure, it is absolutely necessary that the brake system be used properly. Careful application of the brakes immediately after touchdown or at any time there is considerable lift on the wings will prevent skidding the tires and causing flat spots. A heavy brake pressure can result in locking the wheel more easily if brakes are applied immediately after touchdown than if the same pressure is applied after the full weight of the aircraft is on the wheels. A wheel once locked in this manner will not become unlocked as the load is increased as long as brake pressure is maintained. Full braking action cannot be expected until the tires are carrying the full weight of the aircraft.

Normally, a full landing roll should be utilized to take advantage of aerodynamic braking. However, if maximum braking is required after a touchdown, lift should first be decreased as much as possible by raising the flaps and lowering the nose before applying the brakes. This procedure will improve braking action by increasing the frictional force between the tires and the runway. For short landing rolls, a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable.

If the brakes have been used excessively for an emergency stop and are in an overheated condition, taxi

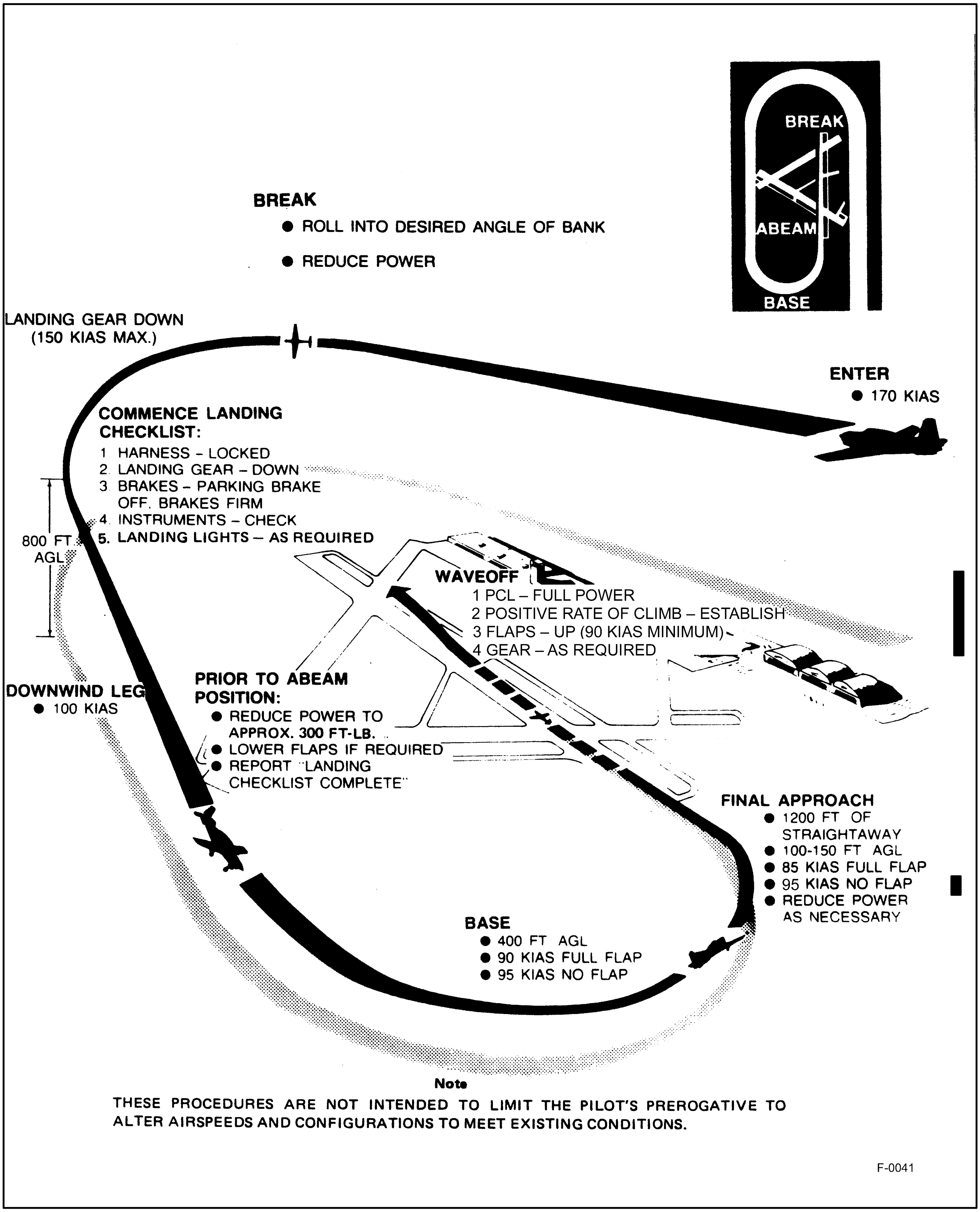



Figure 7-3. Landing Pattern

operations should be conducted cautiously and at a reduced speed, especially in or around a congested parking area since possible brake fading may occur.

**7.13.4 Touch-and-Go Landing.** After touchdown, take off in normal manner and climb out at 100 KIAS. Flaps will be retracted when safely airborne and 90 KIAS or greater.

**WARNING**

During touch-and-go landings, rapid over-rotation of nose attitude prior to engine spool-up may result in aircraft becoming airborne with insufficient airspeed and/or engine thrust to maintain flight. Spool-up delay of as much as 5 seconds may be encountered after power addition.

**7.13.5 Crosswind Landing.** No unusual technique is required in a crosswind landing. Use the wing-low method. Velocity and wind direction will determine the flap setting to be used for the landing since flaps increase the weather cocking tendency on the ground. Use of no-flap configuration is mandatory when crosswind component is above 15 knots. Refer to Figure 25-2 for minimum nosewheel touchdown speed.

1. Allow for drift while turning on final approach so that you will not overshoot or undershoot the approach leg.

2. Establish drift correction as soon as drift is detected.

3. Use ailerons as necessary to maintain wing-low attitude during final, flare, and touchdown; use rudder as necessary to maintain heading.

4. Recommended touchdown technique: low main-mount touching the runway first followed by the other main; immediately lower the nosewheel to the runway to aid in directional control. Aileron should be held into the wind during the initial part of the rollout to hold the wing down.

**7.13.6 Minimum Run Landing.** After reducing power to initiate descent, extend full flaps and establish the airspeed required to maintain the desired approach path. Pitch attitude will be higher than for a normal approach. Adjust power slowly to avoid a high rate of sink. Touch down at the lowest safe speed to shorten the landing roll. Since this is a maximum performance maneuver, with the aircraft just above stalling airspeed, care must be exercised in handling the flight controls. Abrupt stick movement could cause a stall and allow the aircraft to yaw that will increase the tendency to roll with the stall. Retard power lever to IDLE after touchdown and lower the nosewheel to the runway. Apply maximum braking and propeller beta range. Raise the flaps and smoothly apply forward stick as necessary to increase the weight on the main landing gear for enhanced braking effectiveness.

**7.13.7 Night Landing.** Night landing procedures are the same as used during a day landing. Instrument and console light intensity should be kept as low as possible to aid night vision. Avoid using landing and/or strobe lights in thick haze, smoke, or fog as reflected light from the particles in the air may reduce visibility.

**7.13.8 Angle-of-Attack Approach.** The angle-of-attack approach may be flown in either the full or no-flap configuration by utilizing the AOA indexer and indicator to maintain a constant 20 units AOA (optimum) until commencing the landing transition. Maintaining 20 units AOA and a yellow doughnut will result in an airspeed 35 percent above stall speed.

## 7.14 WAVEOFF

The waveoff is a mandatory signal and will be executed immediately upon receipt; whether it is a red light from the tower, the runway wheels watch by interphone or radio. Pilots should initiate their own waveoff anytime a safe landing is not possible. The decision should be made as soon as possible during the approach to provide a safe margin of airspeed and altitude. Complete the following procedure as applicable.

**WARNING**

Engine spool-up delays of as much as 5 seconds may be encountered after power addition.

1. PCL — FULL POWER.

2. Positive rate of climb — ESTABLISHED.

3. Flaps — UP (90 KIAS minimum)

4. Gear — AS REQUIRED.

## 7.15 AFTER LANDING CHECKLIST

1. Flaps — UP.

2. Landing lights — AS REQUIRED.

3. Transponder — STANDBY.

4. Pitot heat — OFF.

5. Navigation and strobe lights — AS REQUIRED.

## 7.16 ENGINE SHUTDOWN CHECKLIST

1. Brakes — HOLD.

2. Parking brake — SET.

3. NACWS — OFF (both cockpits).

4. GPS — OFF.

5. PCL — IDLE.

6. Inverter — OFF.

7. VHF Radio — OFF.

8. Avionics master — OFF.

9. Landing lights — OFF.

10. Air conditioner — OFF (both cockpits).

11. Friction lock — FULL DECREASE.

12. Condition lever — FUEL OFF.

**CAUTION**

Ensure ITT is below 610 °C.

13. ITT — MONITOR.

**CAUTION**

During engine shutdown from either cockpit, the possibility of incomplete shutdown exists. The pilot shall monitor engine instruments for normal shutdown and perform Abnormal ITT During Shutdown procedure if required in paragraph 12.4.2.

14. Navigation lights and strobe lights — OFF.

15. Diluter control lever — 100 percent (both cockpits).

16. Battery switch — OFF.

## 7.17 POSTFLIGHT CHECKLIST

1. Control lock — INSTALLED.

2. Accelerometer — CHECK (both cockpits).

3. Trim tabs — NEUTRAL.

4. Wheels — CHOCK.

5. Parking brake — RELEASE.

**Note**

Parking brakes are primarily intended for short-term use. Temperature changes or system leakage may cause the brakes to release during extended parking.

6. FOD — CHECKED.

7. Oxygen T-handle — PULL (as required).

8. Canopy — AS REQUIRED.

9. Walkaround inspection — COMPLETE.

10. Covers and tiedowns — AS REQUIRED.

## 7.18 POSTFLIGHT RECORDS

Immediately following each flight, the pilot shall complete all items on the postflight records. To aid in analysis of the discrepancies, specific information such as position or movement of controls, results, instrument readings, etc., shall be included on the aircraft maintenance discrepancy form. Maintenance troubleshooters will normally be available for consultation. The pilot will ensure that he has conveyed his complete knowledge of the discrepancy both orally and in writing.

# CHAPTER 8

# Ship-Based Procedures

This chapter is not applicable to T-34C aircraft.

# CHAPTER 9

# Special Procedures

## 9.1 FORMATION FLYING

The following discussion of formation fundamentals will provide a foundation for formation flying that will meet most T-34C mission requirements. The signal for a change in formation may be made by radio or by in-flight visual communication as outlined in Figure 19-12. It is imperative that each aviator in the flight be thoroughly briefed as to his particular part in the flight.

The elements of a formation are a section of two aircraft and a division consisting of three or four aircraft (two sections). Two or more divisions form a flight.

**WARNING**

Formation flight between dissimilar aircraft can result in unintentional out-of-control flight or midair collision. Dissimilar formation shall not be conducted without thorough prebriefing, coordination, and communication between the participants.

**9.1.1 Parade Formation.** Parade formation requires aircraft to fly a fixed bearing in close proximity. It will be the only basic formation discussed here. The recommended parade position is a stable position on the 45° bearing with 10 feet of stepdown.

**9.1.2 Formation Takeoff/Landing.** After the leader begins his takeoff roll, the wingman delays his takeoff roll a sufficient amount of time to allow adequate separation between aircraft.

**9.1.3 Running Rendezvous.** The leader will depart maintaining a prebriefed airspeed while the wingman uses power, airspeed, and radius of turn as applicable to join up as briefed.

**9.1.4 Parade Turns.** In parade turns, the wingman matches the leader's rate of roll. For turns into the wingman, the wingman rotates about the leader's longitudinal axis. For turns away from the wingman, the wingman normally rotates about his own longitudinal axis.

**9.1.5 Crossunders.** Crossunders are performed to move the wingman from the parade position on one side of the leader to the parade position on the opposite side. After appropriate signaling, the wingman increases step-down. While maintaining adequate nose to tail separation, cross under the leader to a point directly beneath the new parade position. Decrease stepdown to rejoin the parade position.

**9.1.6 Lead Changes.** The lead change is normally accomplished with the wingman in the starboard parade position. Once the appropriate signal has been given and acknowledged, the original leader becomes wingman and has the responsibility of maintaining adequate separation. After increasing lateral separation, increase step-down, slide aft, then execute a crossunder. The responsibility of the new leader is to maintain a constant heading, altitude, and airspeed throughout the lead change.

**9.1.7 Night Formation.** Except in emergency situations, formation flights shall not be conducted at night.

## 9.2 AEROBATIC FLIGHT

Prior to starting aerobatic maneuvers (Figure 9-1), intentional stalls, spins, unusual attitudes, or out-of-control flight, complete clearing turns and the Preaerobatic Checklist. The maneuvers listed in 9-1 shall be completed above 5,000 feet AGL.

| MANEUVERS | RECOMMENDED ENTRY SPEED |
|---|---|
| WINGOVER | 180 KIAS |
| STEEP TURNS | 180 KIAS |
| BARREL ROLL | 180 KIAS |
| AILERON ROLL | 180 KIAS |
| LOOP | 200 KIAS |
| ONE-HALF CUBAN EIGHT | 200 KIAS |
| IMMELMANN | 200 KIAS |
| SPLIT “S” | 120 KIAS |
| INVERTED FLIGHT | 150 KIAS |

**Note**

- INVERTED FLIGHT IS LIMITED TO 15 SECONDS.
- INVERTED STALL MANEUVERS ARE PROHIBITED.
- MAXIMUM ALLOWABLE AIRSPEED POINTER IS SELF-ADJUSTING WITH ALTITUDE.

Figure 9-1. Aerobatic Maneuvers

### 9.2.1 Preaerobatic Checklist

1. Bilges — CLEAR AND CONTROL LOCK STOWED.
2. Restraint harness — ADJUSTED, TIGHT AND LOCKED.

**WARNING**

Improper adjustment of the restraint harness may allow the control stick to contact the rotary buckle and result in inadvertent release of the harness.

3. Autoignition — ON.
4. Engine instruments — CHECKED.

**WARNING**

Failure to secure the rear cockpit for solo flight may result in restriction of flight control movement.

**Note**

Certain flight conditions (i.e., aerobatic, stalls, and spins) may lead to the presence of fuel fumes in the cockpit. Any fumes so occurring should be transient. If fumes persist, execute the appropriate fume elimination or fuel leak procedures.

**9.2.2 Barrel Roll.** Barrel roll entry airspeed is 180 knots. When inverted and after 90° of heading change, airspeed is approximately 100 knots. Recover on original heading with 180 knots.

**9.2.3 Aileron Roll.** Aileron roll entry airspeed is 180 knots. The nose is raised 15° above the level flight attitude and a coordinated 360° roll is completed to recover on original heading and altitude.

**9.2.4 Wingover.** Wingover entry airspeed is 180 knots. The airspeed should be 90 knots after completing 90° of turn. Recover 180° from the original heading with 180 knots.

**9.2.5 Loop.** Loop entry and recovery airspeed is 200 knots. Make a 3-l/2g pullup.

**9.2.6 Immelmann.** Immelmann entry airspeed is 200 knots. Make a 3-1/2g pullup and recover with approximately 90 knots in level flight.

**9.2.7 One-Half Cuban Eight.** One-half Cuban eight entry airspeed is 200 knots. Make a 3-l/2g pullup. Recover on the entry altitude and 180° from the original heading.

**9.2.8 Split S.** Entry airspeed is 120 KIAS (PCL IDLE). Roll in either direction with aileron and rudder to the inverted position. Once inverted, neutralize the controls and apply back stick pressure to pull the nose through the horizon as in the last half of a loop.

**9.2.9 Inverted Flight.** Establish the aircraft at recommended entry airspeed of 150 to 170 KIAS in the clean configuration. Raise the nose 15° above the level-flight attitude and roll the aircraft in either direction using rudder and aileron to the inverted position (approximately the OAT gauge on the horizon in front cockpit and middle canopy bow on horizon in rear cockpit). Once inverted, neutralize aileron and rudder and utilize forward stick pressure to maintain altitude. Prior to 15 seconds, utilize coordinated aileron and rudder to roll the aircraft back to the upright position.

**WARNING**

Incorrect application of elevator can quickly result in nose-low attitudes and rapid airspeed acceleration above 220 KIAS. If this occurs, recover immediately using the nose-low procedure in paragraph 11.12, Unusual Attitude Recovery

## CHAPTER 10

# Functional Checkflight Procedures

## 10.1 GENERAL

**10.1.1 Check Pilots.** Pilots shall be fully qualified pilots in accordance with this manual and OPNAVINST 3710.7.

**10.1.2 Crewmembers.** Crewmembers of checkflights shall be qualified to conduct such tests as may be required.

**10.1.3 Safety.** Safety shall be the governing factor on all postmaintenance checkflights. The following general rules shall apply:

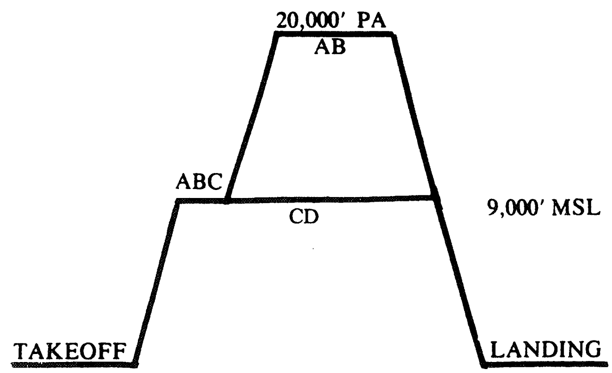
1. The flight shall be governed by the requirements of this manual and OPNAVINST 3710.7.
2. Radio communications shall be maintained with the control tower or other appropriate agency at all times.
3. Checkflights should be flown in a designated area, and those portions of the checkflight that are considered critical shall be conducted in the vicinity of a suitable landing area.

**10.1.4 Forms.** Functional checkflight checklists are published separately. The results of the checks shall be entered on the checklists with appropriate remarks if necessary and returned to Quality Assurance at the completion of the checkflight.

**10.1.5 Checkflights.** Checkflights are required to determine whether the airframe, powerplant, accessories, and items of equipment are functioning in accordance with predetermined requirements while subjected to the intended operating environment. Checkflights shall be flown as required by OPNAVINST 4790.2 or such other times as may be directed by the commanding officer or other competent authority.

## 10.2 CONDITIONS REQUIRING CHECKFLIGHT

Perform applicable flight profile and associated checks in accordance with the following checkflight conditions:




F-0102

1. On aircraft acceptance from the factory or rework facility. Minimum checks required are prefixed by the letter A.
2. After the installation of an engine, propeller, or engine fuel control, or any components that cannot be checked in ground operation. Minimum checks required are prefixed by letter B.
3. When fixed or movable flight surfaces or flight control system components have been installed, reinstalled, adjusted, or rerigged and improper adjustment or replacement of such components could cause an unsafe operating condition. Minimum checks required are prefixed by the letter C.
4. Gyro replacement. Minimum checks required are prefixed by the letter D.

## 10.3 PROCEDURES

**10.3.1 Briefing.** Prior to the checkflight, Quality Assurance shall brief pilots on the maintenance performed on the aircraft, pertinent aircraft history, and the checkflight requirements for the particular flight. The briefmg should include the expected results, troubleshooting recommendations, and, when appropriate, corrective or emergency action to be taken if required.

**10.3.2 Functional Checkflight.** NATOPS procedures shall apply during the entire checkflight unless specific deviation is required by the functional check to record data or ensure proper operation within the approved aircraft envelope. The following items provide a detailed description of the functional checks sequenced in the order in which they should be performed. In order to complete the checks in the most efficient and logical order, a flight profile has been established for each checkflight condition and identified by the letter corresponding to the purpose for which the checkflight is being flown. The applicable letter identifying the profile prefixes each check, both in the following text and in the functional checkflight checklist. Checkflight personnel shall familiarize themselves with these requirements prior to the flight.

PROFILE

## 10.4 PRESTART

A B C D

1. Exterior Inspection

The exterior inspection shall be conducted with considerably more attention to detail than the normal preflight. Considering the nature of the maintenance performed on the aircraft, appropriate access panel cowling doors should be opened, and the areas that were worked on closely scrutinized for proper assembly, leaks, correct rigging, tools, rags, and other foreign objects. During the exterior inspection, check specifically for and record evidence of hydraulic/fuel/oil leaks; condition of tires, pitot tube, angle of attack (AOA), static ports, antennas; emergency canopy open gauge pressure, missing/worn fasteners, security of access panels, popped/loose rivets, trim tab aligmnent, skin irregularities, and general aircraft condition. Check all external lights.

If a downing discrepancy is discovered during the preflight, the complete exterior inspection should be completed and ALL discrepancies recorded on the checklist and aircraft maintenance discrepancy form.

A B C D

2. Interior Inspection

a. Check operation of switches, rheostats, cockpit and instrument lights. Check for missing hardware, decals, instruction plates, frequency and compass cards. Note condition of windshield and all sections of the canopy. Check rudder pedals, seat, and restraint harness adjustments.

b. Verify that oxygen pressure regulator is normal — 100% lever operates and that “blinker” is functional. The two cockpit regulator pressure gauges should agree within 50 psig.

c. Ensure that TAKE COMMAND control shift is operable from both cockpits (dual flights only).

d. Pull the air inlet bypass handle. Check that the door will open and close without undue force.

A C

3. Flight Controls and Trim System

Trim tabs shall be operated through the full range of travel without any excessive friction or binding.

Trim tab indication should be the same in both cockpits.

A B

4. Fuel System Check

The standby pump and firewall valve will be checked as follows:

a. Electrical command control: Actuate TAKE COMMAND momentarily.

b. Battery switch — ON.

c. Fuel shutoff valve closed (pull to close).

d. Standby boost pump — ON.

PROFILE

e. Low fuel pressure light — ON for 10 seconds minimum.

f. Fuel shutoff valve — OPEN.

g. Low fuel pressure light — OUT.

h. Standby boost pump — OFF.

## A 10.5 PRETAXI

5. Generator light/voltmeter

   Check voltmeter for 28.25 (± 1.0) Vdc.

A D 6. Inverters

   Use each inverter for half the flight.

A 7. Flaps

   a. Check flap actuation through full range of travel, movement shall be free.

   b. Check for movement of AOA indicator when flaps are actuated.

   c. Check positions of flaps with panel indicator.

A 8. Angle-of-attack test

   a. Move the AOA test switch to APRCH: the AOA indicator should move to the approach position (20 ± 1/4 unit). The red chevron on the indexer should momentarily illuminate, followed by illumination of the yellow optimum approach doughnut.

   b. Move the AOA test switch to STALL. The AOA indicator should move to the stall position (29 ± 1/4 unit). The green chevron on the indexer should illuminate and the rudder shakers should actuate. Ensure both pedal shakers are actuating either by reaching behind the seat or by placing one foot at a time on the front cockpit pedals.

A 9. Brakes

   Check the brakes for proper operation. There should be no sponginess, uneven braking action, grabbing, or pulsating.

**Note**

Brake checks should be performed dual, with no more than two stops from 50 knots without beta assist. After acceleration to 50 knots, reduce PCL to IDLE and apply smooth, even brake pressure. Allow 10 to 15 minutes for brake cooling prior to additional high-speed braking.

PROFILE

## 10.6 ENGINE AND PROPELLER CHECKS

A B

10. Engine Instrument Check

Check all instruments within limits and indicating proper operation.

A B C

11. System Checks

a. Propeller overspeed governor check

(1) Depress propeller overspeed governor test switch.

(2) Advance PCL slowly until propeller rpm stabilizes (between 400 and 500 ft-lb torque).

(3) Propeller should govern between 1,950 and 2,150 rpm.

(4) Release prop overspeed switch.

(5) Retard PCL to idle.

b. Autoignition checks

(1) Autoignition switch — ON.

(2) Check AUTO IGN annunciator light illuminated when autoignition switch is on.

(3) Retard PCL and check IGNITION light on and AUTO IGN light out when torque is between 180 and 300 ft-lb.

(4) Retard PCL to IDLE.

(5) Autoignition switch — OFF.

c. Manual feathering check

(1) Move the condition lever aft through the spring detent to FTHR.

(2) Move lever to FULL INCR RPM after feathering action.

**CAUTION**

In the event of inadvertent engine shutdown during the feather check, do not advance the condition lever; forward movement of the condition lever immediately after engine shutdown can result in severe engine overtemperature damage. The pilot shall monitor engine instruments for normal shutdown and perform Abnormal ITT During Shutdown procedure if required in paragraph 12.4.2.

PROFILE

d. Observe and record $N_1$ rpm at idle with air-conditioner and environmental control OFF.

e. Turn air-conditioning and environmental control ON one at a time and check that $N_1$ stabilizes above 62 percent.

A B

12. Acceleration Check

a. Check pressures/temperatures normal for runup. Battery charge rate below 10 amps.

b. Air-conditioner — OFF.

c. Cockpit environmental control — AFT OF TEMPERATURE INCREASE RANGE (heater OFF).

d. Set 65-percent $N_1$ with PCL.

e. Reset clock to zero.

f. Rapidly advance PCL to maximum as clock is started.

g. When torque passes 950 ft-lb. stop the clock and reduce PCL to IDLE. Note the time (limit is 2.5 to 5 seconds).

A B

13. Propeller Tachometer

Observe 2,200 rpm limit with 950 ft-lb torque set. Observe and record $N_1$ rpm, fuel flow, and ITT.

A B

14. Primary Low-Pitch Blade Angle Setting Checks

Check the low-pitch blade angle by positioning the aircraft crosswind. Place propeller control to full increase rpm and increase power to obtain 2,000 rpm, then record torque. Record pressure altitude at 29.92 and OAT.*

**Note**

With significant winds (15 knots and above), it may be necessary to check the torque with the wind from the right and the left and average the readings in order to get an accurate value.

A B

15. Manual Fuel Control System Check

a. PCL — IDLE.

b. EPL — Engage, smoothly advance to 955 ft-lb. and check engine instruments normal.

c. EPL — Retard to DISCONNECT and ensure it is stowed in the detent position.

* Check OAT gauge for normal operation; compare to reported temperature if available (± 1 °C). In flight, the OAT needle should not oscillate.

PROFILE

## 10.7 TAKEOFF

A B

16. Engine Performance

    Advance PCL to set a maximum of 1,015 ft-lb. During takeoff roll or after lift-off, observe ITT, fuel flow, oil pressure, and temperature for normal readings.

## 10.8 CLIMB

Climb using takeoff power until reaching a high key position (A and B profiles).

A B

17. Engine Performance

    During climb, observe torque, ITT, fuel flow, oil pressure, and temperature indicators for normal readings.

A

18. Altimeters

    Check front and rear cockpit altimeters for proper operation.

A

19. Vertical Speed Indicator

    Check the front and rear VSI for proper calibration against the clock and a sensitive altimeter during the climb ($\pm 50$ feet at an indicated 500 fpm).

## 10.9 LEVEL

A B C D

20. Aircraft Performance

    a. Maintain 180 KIAS and trim the aircraft. Record aileron, elevator, and rudder trim settings. All trim axes shall have remaining travel.

    b. Inverted flight — Check engine performance in inverted flight for 15 seconds.

A B

21. Systems Check

    a. Check AUTO IGN annunciator light on when autoignition switch is ON. Slowly retard PCL until torque drops below 150 ft-lb. AUTO IGN light should extinguish and IGNITION light should illuminate at 300 to 180 ft-lb.

    b. At the same time, check that the gear warning horn, audio tone, flashing light, and gear handle light all activate between 73- and 77-percent $N_1$. It may be necessary to reposition the head and gap the left ear cup in order to determine whether the cockpit horn (behind the pilot's left shoulder) is sounding. Check for same values using EPL.

    c. Check propeller feathering action by retarding the condition lever to the FTHR position. Torque should increase while rpm decreases. Set 100 KIAS, record rate of descent. After confirming normal engine operation in feather, smoothly advance condition lever to full INCR. The propeller should unfeather in approximately 15 seconds. Set 100 KIAS, adjust and record torque to establish rate of descent recorded during feather check.

A

22. Noise Level

    Check canopy seal; there shall be no undue air noise in the forward or aft cockpit.

PROFILE

A B

23. Air-Conditioning System

Check cooling airflow from front and aft evaporators and rotate fan blower rheostat to check variation in blower speed.

A B

24. Heating and Ventilation System

a. Place respective vent blower — OFF.

b. Check environmental control for proper rigging.

(1) Move control to FRESH AIR. INCREASE and check that the air supplied to the front cockpit is ambient.

**Note**

Front cockpit air can be felt forward of the rudder adjustment assembly.

(2) Move cockpit environmental control toward full TEMPERATURE INCREASE and determine that the air supplied is heated.

(3) Check windshield defogger control is in MAX position.

(4) Move environmental control to OFF and verify no airflow.

c. Check aft cockpit outside air control is operative.

A D

25. Flight Instruments

a. Directional gyro — Check for precession. Maximum drift rate shall be $\pm 7.5°$ per 15 minutes with compass switch in DG mode.

b. Gyro horizon — The gyro horizons shall immediately indicate changes in aircraft attitude. Bank and pitch indications shall agree within approximately 2° when both gyros are compared. Power OFF flags shall appear when power is removed and be completely out of sight when gyro is operating.

c. Radio magnetic indicator — Check that RMI indicators in both cockpits operate properly. They shall display magnetic heading and bearing with an accuracy of $\pm 2°$.

d. Magnetic compass — Check that the magnetic compass indicates within $\pm 2°$ of correction card. All equipment required for night operation should be on for test.

e. Turn and bank — Make left and right standard rate turns for 60 seconds with a tolerance of $\pm 10°$. In straight and level flight, the turn needle shall be centered within a tolerance of 1/64 inch.

f. Alternate static air (forward cockpit) — In level cruise flight, note altitude and then switch pilot's alternate static air switch to ALTERNATE. The altimeter should indicate increased altitude. Turn switch to NORMAL. The altimeter should indicate initial altitude.

g. Accelerometer — The accelerometer should indicate 2 ($\pm 0.1$) g's in a 60° banked, level turn and a 1g indication at rest in chocks.

PROFILE

A

26. Radio Equipment

a. Avionics command transfer — Check for proper operation in both cockpits.

b. Intercommunications — Check the switches and controls which operate cockpit interphone and external transmission modes.

c. Course deviation indicators — Check both forward and aft cockpit indicators provide accurate bearing and range display for VOR and tacan operation. CDI and RMI bearing indicators should agree.

d. VOR-localizer — Magnetic bearings should be accurate to within ±2° through 360° (take one bearing in each 90° sector). The localizer-receiver shall provide positive left or right indications with no needle oscillations occurring at the approach end of the runway.

e. Tacan — Verify distance measuring accuracy to be within ±0.5 mile or ±3 percent of known distances, whichever is greater.

f. Transponder — Check altitude reporting by transmitting on mode 3/A and C throughout a 360° turn. Range should be 100 nm and at an altitude commensurate with line-of-sight transmission (normally minimum of 5,000 feet AGL). Reported altitude must be within 125 feet of altitude displayed on encoding altimeter.

g. NACWS — Verify that primary DME screen is displayed on CDU when NACWS is turned ON and no TAs have been issued. Press the PROX pushbutton and verify that display changes to the proximity screen.

h. VHF radio — Select frequency and verify transmit and receive.

i. GPS — Check for proper operation.

A B

27. Engine Performance

Engine performance shall be checked from 10,000-foot to 20,000-foot pressure altitude (altimeter set at 29.92 inches Hg). Stabilized point runs for maximum level flight airspeed and torque shall be made at 10,000, 15,000, and 20,000 feet. A climbing jam acceleration shall be performed at 15,000 feet to check for stall-free operation. Vary airspeed and/or altitude to allow $N_1$ to stabilize for at least 20 seconds at idle before the jam acceleration. After the nose is smoothly raised to the 120-KIAS climbing attitude (approximately 10° nose up), rapidly advance the PCL full forward as the airspeed decreases to 120 KIAS. If compressor stall occurs at any time, record pressure altitude, maximum ITT, $N_1$, and OAT at stall. Also record any other symptoms (noise, thump in pedals, smoke, fireballs, cowling vibrations) and perform a PEL.

**CAUTION**

At high altitudes, the engine is operating at or near maximum allowable $N_1$ and ITT. Exercise extreme caution during level runs and jam accelerations to avoid engine overspeed or overtemperature.

PROFILE

**Note**

Air-conditioning and bleed air must be off for level runs and jam accelerations. Allow at least 2 minutes for airspeed to stabilize for level runs and 20 seconds for $N_1$ to stabilize for jam accelerations.

a. 10,000-foot PA — Perform maximum-power level-flight run (stabilize in maximum-power level flight; record ITT, torque, fuel flow, $N_1$, OAT, and KIAS).

b. 15,000-foot PA.

(1) Perform maximum-power level-flight run.

(2) Perform climbing jam acceleration (stabilize at idle, initiate 120-KIAS maximum-power climb; if engine stall is encountered, record PA, maximum ITT, $N_1$, OAT, and any other symptoms).

c. 20,000-foot PA — Perform maximum-power level-flight run.

A 28. Landing Gear

a. Check that the gear extends and retracts properly, taking a minimum of 3 seconds and maximum of 6 seconds in either direction. Check for proper operation of gear handle light and gear indicators (up, down, and barberpoles).

b. Manually extend the landing gear using the following procedures:

(1) Pull out landing gear control and power circuit breakers.

(2) Move landing gear handle to DOWN position.

(3) Unlock clutch knob (right side forward cockpit only).

(4) Push knob down to engage handcrank.

(5) Rotate handcrank counterclockwise until handle cannot be moved farther.

(6) Check gear down indication — three wheels, light out in handle.

c. Retract landing gear electrically.

(1) Disengage emergency extend mechanism.

(2) Push in landing gear control and power circuit breakers.

(3) Move landing gear handle to UP position.

(4) Check gear up indication.

(5) Landing light warning — Turn landing lights on with gear retracted. Check for master caution and landing light warning illumination.

PROFILE

A C D 29. Flight Performance

a. Establish 100 KIAS with gear and flaps down. Record the aileron, elevator, and rudder trim settings. All trim axes shall have remaining travel.

b. Check for free and smooth flap operation throughout full range of operation at maximum airspeed of 120 KIAS for full down. Aircraft rolling tendency with flap extension shall be minimal. The gear warning horn, flashing wheels light, and audio tone should activate and should not extinguish until flaps are retracted. Flaps should extend in 10 to 12 seconds and retract in 7 to 9 seconds.

c. AOA system

(1) With gear and flaps down, torque set at 300 ft-lb, trim the aircraft for an 80 KIAS descent. The yellow doughnut should illuminate on the indexer and the needle indicate 20 ± 1/4 units.

(2) At the stall, the green chevron should illuminate and the needle should indicate 29 ± 1/4 units.

d. Stalls

Check power idle stalling characteristics with both gear and flaps retracted, then extended. Approach to a stall shall be made by reducing airspeed 1 knot per second. In all stalls, roll shall be controllable up to the time the aircraft pitches down.

e. Spins

When releasing the controls after reaching a stabilized spin mode (at least two turns), the rudders should float near a neutral position, the stick will float near the full aft position, and the aircraft should continue spinning. After recovery controls are initiated, the aircraft should recover in one and one-half to two additional turns.

## 10.10 DESCENT

A 30. Descent Checks

a. Air inlet bypass door will open at 200 KIAS without undue force and will remain in open position. Look for a drop in torque.

b. Gear security check — Accelerate to approximately 220 KIAS and verify no gapping (barberpole) of the gear doors.

c. Altimeters — Check forward and aft cockpit altimeters for proper operation.

d. Vertical speed indicators — Check the front and rear VSI for proper calibration against the clock and a sensitive altimeter during the descent ( ± 50 feet at an indicated 500 fpm).

## 10.11 LANDING

A 31. Check power control lever rigging. On landing rollout, pull the PCL to full beta. A definite deceleration should be felt.

PROFILE

## 10.12 POSTFLIGHT

A B C D

32. Walkaround — A walkaround postflight check should be accomplished. Discrepancies that developed should be recorded on the aircraft maintenance discrepancy form. Particular attention should be given to oil, fuel, and hydraulic leaks.

## 10.13 CARBON MONOXIDE (CO) CHECKS

33. If required, carbon monoxide checks should be accomplished during runup, high-power (climb), cruise, and idle (glide) conditions in all configurations with vents open and closed and heater on and off. Maximum CO content is 0.005 percent.

# PART IV

# Flight Characteristics

## CHAPTER 11

# Flight Characteristics

### 11.1 INTRODUCTION

The flight characteristics described in this chapter are based on actual flight test data. Although interconnected dual flight controls and dual instrumentation are provided, solo flight is accomplished from the front cockpit only.

### 11.2 FLIGHT CONTROLS

**11.2.1 Ailerons.** The ailerons provide aircraft roll control. During airspeed changes, considerable lateral retrimming is required because of the aeroelastic effect of the aileron trim tabs.

**11.2.1.1 Aileron Float.** If the control stick is laterally displaced slightly from neutral at airspeeds greater than approximately 130 KIAS, the stick may continue in the direction of the disturbance until it reaches the lateral stop, establishing a roll with no control input. This characteristic may occur to the left, right, or both.

**11.2.1.2 Low Roll Rates at High Airspeeds.** The T-34C has a low roll rate at high airspeeds because of rigging design and control cable stretch. Above 220 KIAS, lateral control forces necessary to roll the T-34C aircraft may become excessive.

**11.2.2 Elevators.** The elevators provide aircraft longitudinal control. Operation of the landing gear, wing flaps, and canopy as well as minor changes in power settings affects longitudinal stability. During major power and airspeed changes, as in a waveoff, retrimming will be required to maintain the desired attitude or airspeed.

**11.2.3 Rudder.** The rudder system provides directional control at all airspeeds; however, significant rudder forces or changes in rudder trim are required with changes in airspeed.

**11.2.4 Trim Surfaces.** Although the aircraft requires significant changes in elevator and rudder trim with airspeed changes during stabilized flight, it can be trimmed to zero control force throughout most of its airspeed range.

**11.2.5 Flaps.** Lowering the wing flaps causes a slight nosedown trim change that is easily overcome by use of elevator or by retrimming.

### 11.3 CLIMB CHARACTERISTICS

The stick and rudder forces resulting from climb attitudes and power settings are easily trimmed off. For climb performance, refer to Figure 26-1.

### 11.4 LEVEL-FLIGHT CHARACTERISTICS

**11.4.1 Low Speed.** Recommended speeds for takeoff, approach, and landing are given in the appropriate charts in Part XI. At low speeds, flight characteristics are conventional with normal control effectiveness and aircraft response.

**Note**

During low-speed flight when power is changed to takeoff power, as in a waveoff, there is a noseup tendency. Trim should be used after power is applied to assist in maintaining desired attitude.

**11.4.2 Cruise Speed.** Longitudinal and lateral controls are sensitive in cruise and very little pilot effort is required to effect a change in aircraft attitude.

### 11.5 GLIDE PERFORMANCE

Several of the many factors that affect power-off glide performance can usually be controlled to some degree by the pilot. Primary among these controllable factors are airspeed, aircraft configuration (gears, flaps, canopy), propeller condition, angle of bank, and balanced or unbalanced flight. Maximum range power-off glide airspeed ($V_{BEST\ GLIDE}$) differs with changes in aircraft configuration. Power-off glide performance at any particular $V_{BEST\ GLIDE}$ will be optimized with a closed canopy, feathered propeller, and level wings in balanced flight.

| Aircraft Configuration | | Propellor Condition | $V_{BEST\ GLIDE}$ | Sink Rate at 100 KIAS (FPM) | Glide Ratio at 100 KIAS |
|---|---|---|---|---|---|
| Gear | Flaps | | | | |
| Up | Up | Feathered | 100 KIAS | 800 | 12 to 1 |
| Down | Up | Feathered | 87 KIAS | 1,200 | 8 to1 |
| Up | Down | Feathered | 93 KIAS | 1,250 | 8 to1 |
| Down | Down | Feathered | 88 KIAS | 1,650 | 6 to 1 |
| Up | Up | Unfeathered | 117KIAS | 2,400 | 3 to 1 |

- The configurations shown include canopy closed, level, and balanced flight. With both canopies open, the sink rate typically increases by 300 FPM.
- Rate of sink changes as altitude changes. The sink rate and glide ratio values shown are for comparison purposes only.

Figure 11-1. Glide Performance

Figure 11-1 summarizes $V_{BEST\ GLIDE}$ for various configurations and shows typical values for sink rates and glide ratios L\D to be expected at 100 KIAS (the airspeed called for in the emergency landing pattern).

## 11.6 ZERO-THRUST TORQUE SETTING

The zero-thrust torque setting for the T-34C is 205 ft-lb at $V_{BEST\ GLIDE}$ of 100 KIAS with gear and flaps up. This power setting approximates the performance of the aircraft with the propeller feathered.

## 11.7 INTENTIONAL FEATHER WHILE AIRBORNE

For demonstration purposes, the propeller may be feathered while airborne if the following procedures are used:

1. Maintain an altitude of at least 5,000 feet AGL over a hard surface runway.
2. PCL — IDLE.
3. Condition lever — FTHR.

To return to normal propeller operating speed:

4. Condition lever — FULL INCR RPM.

**Note**

The propeller should unfeather in approximately 15 seconds.

5. PCL — NORMAL OPERATING RANGE AFTER PROPELLER RPM RISES TO A STABILIZED RPM.

## 11.8 MANEUVERING FLIGHT

Maneuvering flight control forces are approximately 10 pounds per g.

Maneuvering speed ($V_a$) is the maximum speed at which full control deflection can be abruptly applied without overstressing the aircraft. $V_a$ depends upon aircraft weight and at maximum gross weight with flaps up is 135 KIAS.

## 11.9 STALL CHARACTERISTICS

**11.9.1 Stalls.** Stalls at idle power with landing gear and flaps retracted are characterized by a nosedown pitch with a controllable rolling tendency at near full aft stick. This is accompanied by airframe buffet at the stall break.

The effect of landing gear position is negligible on stall characteristics.

The effect of flap extension is to aggravate stall characteristics by increasing the roll tendency at stall break.

The effect of increased power is to degrade stall characteristics by increasing noseup stall attitude, buffet amplitude, and roll tendency. If full aft stick is sustained after stall break with takeoff power, an abrupt wing rock is likely to occur, particularly with flaps extended.

**11.9.2 Stall Warning.** Except for accelerated stalls, there is essentially no aerodynamic stall warning in the form of buffet in any configuration. Approach to the stall is indicated 5 to 10 knots above the actual stall when rudder shakers cause the rudder pedals to shudder. For stall speeds, refer to Figure 11-2 or Figure 24-13.

**11.9.3 Accelerated Stalls.** Accelerated stalls are preceded or accompanied by pronounced stall warning in the form of airframe buffet. This stall can be demonstrated in medium turns by gradually increasing back stick force.

**11.9.4 Stall Recovery.** Misapplication of stall recovery controls may result in poststall gyration or incipient spin. Stall recovery is accomplished in the conventional manner as follows:

1. Lower nose immediately by reducing stick back pressure.
2. Use aileron and rudder, as required, to regain straight and level flight.
3. At the same time, advance power smoothly.
4. After the nose is lowered, speed will increase rapidly. When safe flying speed is attained, raise the nose with steady back pressure on the stick, taking care not to bring about a secondary accelerated stall.
5. Reset power is required.

**11.9.5 Practice Stalls.** Clearing turns and the Preaerobatic Checklist shall be accomplished prior to initiating practice stalls. The maneuver shall be completed above 5,000 feet AGL.

**11.9.5.1 Approach-Turn Stall.** The approach-turn stall is practiced in the landing configuration by establishing the aircraft in a simulated landing approach and simultaneously raising the nose toward the landing attitude and reducing the power toward idle. When the aircraft stalls, recover in accordance with stall recovery procedures.

**11.9.5.2 Power-Off Stall.** The power-off stall is initiated and recovered while simulating a dead-engine glide in the clean configuration as follows:

1. Raise the nose above the horizon. Maintain wings level until the aircraft stalls.
2. Recover without power by lowering the nose to return to a dead-engine glide.

## 11.10 OUT-OF-CONTROL FLIGHT

OCF is the seemingly random motion of the aircraft about one or more axes. OCF originates from a stalled condition where the inertial forces on the aircraft exceed the aerodynamic control authority. It is for this reason that OCF initially cannot be halted by any application of controls; in fact, certain control applications may intensify the motions. OCF usually results from stalls in accelerated or out-of-balanced flight or stalls where improper recovery control inputs are applied. OCF, in general, can be divided into three categories.

**11.10.1 Poststall Gyrations.** Poststall gyrations are the random motions of the aircraft about one or more axes immediately following a stall. A poststall gyration can occur at normal flying speed (from an accelerated stall) or at low speed following a normal stall. The poststall gyration can be extended through continued application of prostall controls or misapplication of stall recovery controls. At normal flying speeds, the poststall gyration will dissipate kinetic energy so that the aircraft tends to slow to a potential incipient spin condition. At low airspeeds, the poststall condition is accompanied by flight controls that are ineffective compared to the inertial forces present. Poststall gyrations may be violent and disorienting. The intuitive response of rapidly applying controls in all axes in an attempt to stop the poststall gyration motion is generally ineffective or exacerbates the random motions. Poststall gyrations are aggravated by maintenance of aft stick and rapid cycling of the rudder pedals. A pilot can usually identify a poststall gyration by noting an uncommanded (and often rapid) aircraft motion about any axis, an immediate feeling of lost control authority, stalled or near-stalled angle of attack, random (usually transient) airspeed, and random turn needle deflection.

MODEL: T-34C
DATE: 29 OCT 1976
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25
PROPELLER: T10173-I1R
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

**TAKEOFF/CRUISE**

POWER: IDLE
FLAPS: UP
LANDING GEAR: UP OR DOWN

| GROSS WEIGHT | STALL SPEEDS — KNOTS IAS ANGLE OF BANK | | | |
|---|---|---|---|---|
| | 0° | 30° | 45° | 60° |
| 3100 | 63 | 68 | 75 | 89 |
| 3500 | 67 | 72 | 79 | 94 |
| 3900 | 70 | 76 | 83 | 99 |
| 4300 | 74 | 79 | 88 | 104 |

NOTE: POWER WILL REDUCE STALL SPEEDS.

**APPROACH/LANDING**

POWER: IDLE
FLAPS: 100%
LANDING GEAR: DOWN

| GROSS WEIGHT | STALL SPEEDS — KNOTS IAS ANGLE OF BANK | | | |
|---|---|---|---|---|
| | 0° | 30° | 45° | 60° |
| 3100 | 63 | 68 | 75 | 89 |
| 3500 | 67 | 72 | 79 | 94 |
| 3900 | 70 | 76 | 83 | 99 |
| 4300 | 74 | 79 | 88 | 104 |

NOTE: POWER WILL REDUCE STALL SPEEDS.

**WAVEOFF**

POWER: 955 FT-LBS
FLAPS: 100%
LANDING GEAR: DOWN

| GROSS WEIGHT | STALL SPEEDS — KNOTS IAS ANGLE OF BANK | | | |
|---|---|---|---|---|
| | 0° | 30° | 45° | 60° |
| 3100 | 40 | 43 | 47 | 56 |
| 3500 | 42 | 45 | 50 | 60 |
| 3900 | 45 | 48 | 53 | 63 |
| 4300 | 47 | 51 | 56 | 67 |

NOTE: POWER WILL REDUCE STALL SPEEDS.

Figure 11-2. Stall Speeds

**11.10.2 Incipient Spin.** The motion that occurs between a poststall gyration and a fully developed spin is called an incipient spin. Any stall can progress to an incipient spin if steps are not taken to recover the aircraft at either the stall or poststall gyration. An incipient spin is a spinlike motion in which the aerodynamic and inertial forces are not yet in balance, but where there is sustained, unsteady yaw rotation. As a result, an incipient spin is characterized by oscillations in pitch, roll, and yaw attitudes and rates. In an incipient spin, the nose attitude will likely fluctuate from the horizon to the vertical (nose down), the yaw rate will increase toward the steady-state value, and the wings will rock about a nearly level attitude. The incipient phase lasts approximately two turns. A pilot can usually identify an incipient spin by noting stalled AOA, airspeed that is accelerating or decelerating towards a steady-state spin value, and fully deflected turn needle. Visual indications are misleading and may lead to the false impression of a steady-state spin.

**11.10.3 Steady-State Spin.** The steady-state spin motion is considered OCF because a control input in any one of the three axes does not effect an immediate response about that axis. Steady-state spin characteristics and recovery techniques are discussed separately later in this chapter.

**11.10.4 Practice Out-of-Control Flight.** Intentional OCF maneuvers are conducted to enhance pilot proficiency in OCF recovery. OCF training shall only be conducted on NATOPS training flights (NA1-6), NATOPS checkflights, or as part of an approved curriculum training flight authorized by unit commanding officers or higher authority. All intentional departures shall be done with ground reference and clear of clouds. Clearing turns and the Preaerobatic Checklist shall be accomplished prior to initiating any practice OCF maneuver. All maneuvers shall be completed above 5,000 feet AGL.

**CAUTION**

Rapid airspeed buildup may occur during OCF recovery. Care must be taken when performing maneuvers with the landing gear extended and the flaps down to avoid overspeeds.

**11.10.4.1 Cross-Control Departures.** The cross-control departure is a basic flight departure maneuver designed to demonstrate how a high AOA, angle of bank, and excessive yaw rate can lead to an inadvertent loss of control. Once a stalled AOA is realized, the aircraft will depart with a rapid roll in the direction of applied rudder. Several more rapid rolls may result and a spin will develop if control inputs are maintained. Minimum entry altitude for cross-control departure is 8,000 feet AGL.

**CAUTION**

The possibility of overstressing the aircraft at airspeeds less than 135 KIAS exists because of asymmetrical loading combined with lower gross weights. Airspeed in excess of 120 KIAS should be avoided.

**11.10.4.2 Zero Airspeed Departure.** The zero airspeed departure demonstrates the departure from controlled flight associated with an unusually high pitch attitude. The airspeed will decrease to zero and upon departure, the nose will fall forward or backward, depending on the exact attitude at the top of the maneuver. The zero airspeed departure shall be flown in such a manner as to avoid tail-slides or prolonged exposure to ZERO-G conditions. Minimum altitude for the zero airspeed departure entry is 7,500 feet AGL.

**CAUTION**

Reverse airflow over the control surfaces will cause significant feedback to the controls. Failure to maintain neutral controls can result in damaged controls and control stops.

**11.10.4.3 Aggravated Approach Turn Stall.** This maneuver demonstrates the rapid and disorienting divergence to departed flight that may occur following a rough application of stall recovery control inputs while practicing approach turn stalls at altitude. The aircraft will be flown through a normal approach turn stall and, during recovery, control inputs will be initiated to induce a secondary stall. The aircraft will depart by rolling in the direction of the applied rudder. Minimum entry altitude for the aggravated approach turn stall is 6,500 feet AGL.

**CAUTION**

- Do not apply excessive or full rudder as a spin may develop.
- Care must be taken not to overspeed the flaps and/or landing gear.

**11.10.4.4 Skidded-Turn Stall.** The effect of a stall in an out-of-balance flight condition is for the aircraft to break sharply toward an inverted attitude in the direction in which the excessive rudder is applied. It is recommended that the skidded-turn stall be practiced gear down/flaps up to avoid possible flap over-speed/ over-stress during recovery.

1. Establish the aircraft in a turn.
2. Enter the stall by raising the nose toward the landing attitude, reducing the power toward idle, and adding excessive rudder in the direction of turn while maintaining the desired angle of bank.
3. Recover in accordance with out-of-control flight recovery procedures.

**11.10.5 Out-of-Control Flight Recovery.** Recovery from poststall gyrations and incipient spins (including the reversal phase of the progressive spin) is accomplished through the prompt, positive neutralization of flight controls in all axes. Patience and the maintenance of neutral controls is vital since an immediate aircraft response to neutralizing may not be apparent to the pilot and cycling the controls or applying antispin controls prematurely can aggravate the aircraft motions and prevent recovery. Recovery from a steady-state spin by maintaining neutral controls is unlikely. Consequently, after neutralizing the flight controls, if cockpit indications are that a steady-state spin has developed, the appropriate antispin control inputs must be made to ensure recovery from the spin.

If an out-of-control condition is encountered, accomplish the following procedures:

*1. Controls — POSITIVELY NEUTRALIZE.

*2. PCL — IDLE.

*3. Altitude — CHECK.

**WARNING**

If recovery from out-of-control flight cannot be accomplished by 5,000 feet AGL, bail out.

*4. AOA, airspeed, turn needle — CHECK.

**WARNING**

Application of spin recovery controls when not in a steady-state spin (as verified by AOA, airspeed, and turn needle) may further aggravate the OCF condition.

If in a steady state spin:

*5. Gear/flaps — UP.

*6. Rudder — FULL OPPOSITE TURN NEEDLE.

*7. Stick — FORWARD OF NEUTRAL (erect spin)<br>— NETRAL (inverted spin).

**WARNING**

Application of power when not actually in a steady-state spin will result in a rapid increase in rate of descent and airspeed.

*8. Controls — NEUTRALIZE WHEN ROTATION STOPS.

When aircraft regains controlled flight:

*9. Recover from unusual attitude.

**WARNING**

Lower power settings reduce torque effect, restrict onset of rapid airspeed buildup, and enhance controllability. However, departures from controlled flight in close proximity to the ground may require rapid power addition upon OCF recovery.

## 11.11 SPINS

**11.11.1 Spin Avoidance.** A spin requires simultaneous fulfillment of two conditions: stalled angle of attack and yaw. If either of these conditions is absent, the aircraft will not enter a spin. For erect stalls, angle-of-attack information is available directly by reference to the angle-of-attack indicator and indirectly through the rudder pedal shaker. Maintaining angle of attack below that required to activate rudder pedal shaker (26.5 units) is an effective means of avoiding a stall. For a poststall gyration/incipient spin, prompt neutralization of controls will normally prevent progression into a spin.

**11.11.2 Spin Characteristics.** The following discussion of spin and spin recovery characteristics is based on Naval Air Test Center flight test results. Refer to paragraph 4.6.1, Prohibited Maneuvers, for restrictions.

**WARNING**

Erect spins with the propeller feathered are prohibited. If propeller feathering action is noted during spin, initiate recovery immediately.

The aircraft has satisfactory spin characteristics with the gear and flaps up with any power condition and is cleared for intentional erect spins only with gear and flaps up. A spin may be entered from stall by applying full back stick and simultaneously applying full rudder in the desired direction of the spin.

**11.11.2.1 Erect Spins.** At application of spin controls (full aft stick and full rudder), the aircraft yaws and rolls in the direction of the applied rudder. The first turn is characterized by a barrel roll-type maneuver. At about the third turn, the aircraft will stabilize in a steady-state spin with the aircraft at approximately 45° nose down and a spin rate of about 110° to 170° per second. In a typical spin, the aircraft will lose between 375 to 500 feet/turn and will be descending at 9,000 to 12,000 fpm. Steady-state spin motion is smooth with only minor pitch-and-roll oscillations. Spins to the right are typically faster and more oscillatory than spins to the left. Erect steady-state spin indications typically are 80 to 100 KIAS (stabilized), 30 units AOA (pegged), and turn needle fully deflected in direction of the spin. During spin, left and right fuel caution lights may illuminate regardless of fuel state.

**11.11.2.2 Progressive Spins.** Reversing the rudder direction during a steady-state spin while maintaining full aft stick will result in a progressive spin. A progressive spin is characterized by an initial increase in nosedown pitch attitude and spin rate, followed by reversal in spin direction. The reversal phase of the progressive spin is the motion between the steady-state spins in opposite directions. The reversal phase is similar to the incipient spin phase in that the motions become oscillatory and the airspeed is not at the steady-state spin value. The airspeed may go as high as 125 KIAS during the reversal phase and then decrease again as the spin becomes fully developed in the opposite direction. The number of turns required before spin direction reverses will vary depending on initial spin direction and cg location. Left spins typically reverse after fewer rotations. The reversals are disorienting with a reversal from left to right being the most intense. The reversal phase lasts about three turns after reversal of spin direction. Because the reversal phase is essentially an incipient spin, neutral controls may be used as a recovery technique for up to two turns after the reversal. Progressive spins can result from misapplication of recovery controls.

**11.11.2.3 Aggravated Spins.** An aggravated spin may result by pushing the stick forward while maintaining prospin rudder. Neutralizing rudder while advancing the stick forward of neutral could also be sufficient to enter an aggravated spin. Aggravated spins are characterized by an uncomfortable increase in nosedown pitch and spin rate. In addition, aggravated spins tend to induce severe pilot disorientation and are a direct result of misapplication of recovery controls.

**WARNING**

An aggravated spin may result in propeller feathering action as indicated by an audible change in propeller noise level accompanied by decaying propeller rpm as noted on cockpit gauges. If propeller feathering action is noted during spin, initiate recovery immediately.

**11.11.2.4 Inverted Spins.** Inverted spins are difficult to achieve and easily recoverable. Steady-state inverted spins are flatter than erect spins with the nose of the aircraft approximately 25° below the horizon. Inverted steady-state spin indications are typically zero airspeed, 2 to 3 units AOA, and turn needle fully deflected in the direction of spin. Additionally, the pilot will experience a load factor of approximately –1g. In a typical inverted spin, the average spin rate is 140° per second. The aircraft will lose approximately 310 feet/turn and will be descending at about 8,700 fpm. Because of the unusual attitude required to enter an inverted spin and the initial spin gyrations, inverted spin direction is easily misinterpreted by the pilot when relying on outside reference alone. The turn needle deflects fully in the direction of spin, erect or inverted, and is the only reliable indicator of spin direction.

**WARNING**

Intentional inverted spins are prohibited.

**11.11.3 Spin Recovery (Figure 11-3).** When executing a spin recovery, rapid application of recovery controls will minimize spin turns to recovery. It is essential that the controls be maintained in their optimum recovery position until spin cessation. To avoid delay in spin recovery, do not neutralize or cycle the controls until the aircraft regains controlled flight. Misapplication of recovery controls may result in an aggravated or progressive spin.

| Spin Recovery Controls | | | |
|---|---|---|---|
| **Type of Spin** | **Rudder** | **Longitudinal Stick** | **Aileron** |
| Erect | Full Opposite Turn Needle | Forward of Neutral | Neutral |
| Inverted | Full Opposite Turn Needle | Neutral | Neutral |

Figure 11-3. Spin Recovery Controls

**11.11.3.1 Erect Spin Recovery.** Initially the spin rate will increase following application of recovery controls; however, the aircraft will consistently recover to a steep, nosedown attitude with proper recovery controls applied. During steady-state erect spins, the rudders, if released, will float near the neutral position, thus a positive force must be exerted to maintain proper rudder position. The control stick will float near the full aft position. As a result, maintaining a proper stick position during recovery requires a positive displacement. In recovering from an erect spin, expect a push force of approximately 40 pounds to keep the stick forward of the neutral position. With the stick aft of neutral, recovery from erect spins will be delayed significantly. If the stick is maintained full aft, recovery from erect spins may not occur. If recovery from an erect spin does not occur within two turns after applying recovery controls, verify cockpit indications of AOA, airspeed, and turn needle for a steady-state spin and visually confirm proper spin recovery controls are applied. If no indication of recovery is evident, adding maximum allowable power while maintaining proper spin recovery controls will enhance recovery from an erect steady-state spin in either direction. Spin recoveries using antispin controls and power will not appreciably increase rate of descent. However, significant altitude loss will result during the ensuing nose-low recovery. Power application to recover from spins should be used in emergency situations only. Upon recovery, controls should be neutralized expeditiously and power reduced to idle to minimize altitude loss and rapid airspeed buildup. Recovery from erect spins shall be accomplished in the following manner:

**WARNING**

Application of power when not actually in a steady-state spin will result in a rapid increase in rate of descent and airspeed.

1. Landing gear and flaps — CHECK UP.

2. Verify spin indications by checking AOA, airspeed, and turn needle.

**WARNING**

Application of spin recovery controls when not in a steady-state spin (as verified by AOA, airspeed, and turn needle) may further aggravate the OCF condition.

3. Apply full rudder opposite the turn needle.

4. Position stick forward of neutral (ailerons neutral).

5. Neutralize controls as rotation stops.

6. Recover from the ensuing unusual attitude.

**11.11.3.2 Inverted Spin Recovery.** During the inverted spin, the control stick will float near the full forward position. In recovering from an inverted spin, expect a pull force of approximately 30 pounds to place the stick in the neutral position. Average pitch attitude on recovery from inverted spins is steeper than from erect spins with accompanying rapid increase in airspeed. Positive indications of recovery from an inverted spin are airspeed 120 KIAS and accelerating, AOA approximately 10 to 20 units, and cessation of spin rotation.

To effect recovery from unintentional inverted spins, proceed as follows:

1. PCL — IDLE.

2. Gear and flaps — CHECK UP.

3. Verify spin indications by checking airspeed, AOA, and turn needle.

4. Apply full rudder opposite the turn needle.

5. Position the stick to the neutral position (elevator and ailerons neutral).

6. Neutralize controls as rotation stops.

7. Recover from the ensuing unusual attitude.

**11.11.4 Practice Spins.** Clearing turns and the Preaerobatic Checklist shall be accomplished prior to initiating practice spins. The maneuver shall be completed above 5,000 feet AGL. Spins may be practiced as follows:

1. Reduce the power to idle and raise the nose approximately 30° above the horizon.

2. Lead the stall with rudder application in the desired direction of spin. At the stall, apply full rudder and full aft stick, maintaining ailerons in the neutral position.

3. Recover in accordance with erect spin recovery procedures in paragraph 11.11.3.1.

## 11.12 UNUSUAL ATTITUDE RECOVERY

Recovery from unusual attitudes shall be accomplished as smoothly and expeditiously as possible. To recover from an unusual attitude, the pilot must first determine aircraft attitude by use of visual references. To determine the attitude of the aircraft and thus the proper recovery technique, the pilot should immediately check the position of the nose. While maintaining this attitude, he should check the position of the wings. If inverted, roll in the shortest direction to the upright position and then complete the recovery as follows:

NOSE LOW

1. Power — IDLE TO MINIMIZE ALTITUDE LOSS AND AIRSPEED BUILDUP.

2. Level wings.

3. Commence a smooth pullout. Do not exceed 24 units AOA or aircraft g limits.

NOSE HIGH

1. Using aileron and rudder, roll towards, but not necessarily to 90° angle of bank.

2. Using bottom rudder, fly the nose of the aircraft through the horizon.

3. As the nose passes through the horizon, roll the wings level.

4. Once the wings are level, raise the nose as in a nose-low unusual attitude.

## 11.13 DIVE CHARACTERISTICS

**11.13.1 Altitude Loss in Dive Recovery.** The altitude lost during dive recovery is determined by four independent factors: angle of dive, altitude at start of pullout, airspeed at start of pullout, and acceleration maintained during pullout. Because these factors must be considered collectively in estimating altitude for recovery from any dive, their relationship is best presented in Figure 11-4.

## 11.14 HIGH SPEED SPIRAL

**Spiral Characteristics.** A high-speed spiral is a flight regime characterized by rapidly increasing airspeed, decreasing AOA, a rapid turn rate, and extremely high descent rates. A spiral condition is likely to be encountered if the entry controls for a practice spin are misapplied. If full backstick is not held throughout the entire post-stall gyration and incipient spin phase, the aircraft can transition from a stalled condition into a lift-producing flight condition. Additionally, lateral stick displacement at the stall break will sometimes cause the aircraft to enter a spiral flight regime. The wings producing lift, coupled with the high turn rate associated with an incipient spin will result in a very steep, nose down, tight turn. The airspeed will build rapidly, and the aircraft will descend at rates well in excess of those observed in a spin. The high-speed spiral condition must be recognized quickly and corrected due to the rapid airspeed buildup, which makes it likely that $V_{ne}$ will be exceeded. Aircraft structural limits may also be exceeded, causing the aircraft to break up in flight. When recovering from a high-speed spiral, it is imperative to recognize and set the recovery as quickly as possible to minimize airspeed buildup and altitude loss.

**WARNING**

Application of spin recovery controls when the aircraft is in a high-speed spiral condition may further aggravate the spiral condition.

AIRCRAFT CONFIGURATION:

GEAR UP FLAPS 0%

MODEL: T-34C

DATE: 19 FEB 1977

DATA BASIS: CALCULATED

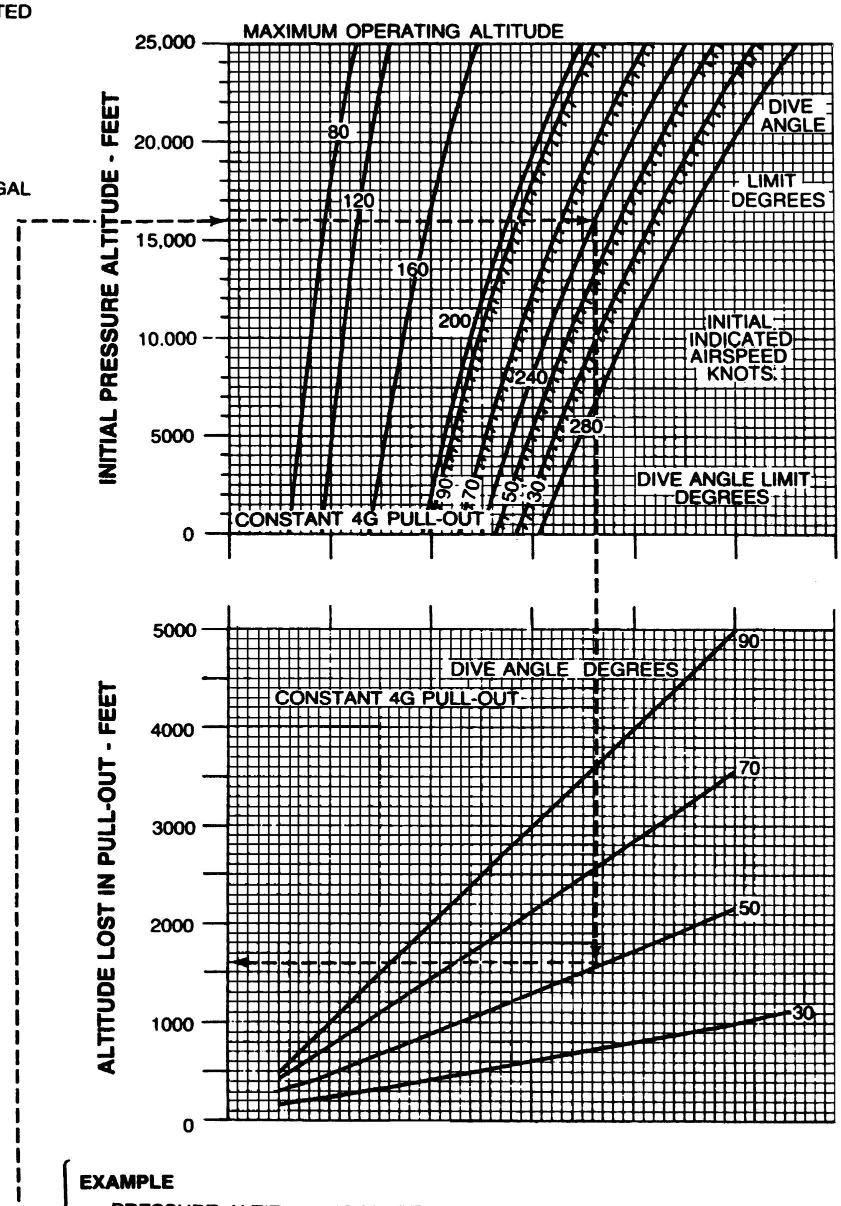
STANDARD DAY

ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL

THE AIRCRAFT MAXIMUM AIRSPEED LIMIT WILL BE EXCEEDED DURING DIVE RECOVERY IF APPROPRIATE DIVE ANGLE LIMIT FROM ENTRY ALTITUDE IS SURPASSED OR A 4-G PULL-OUT IS NOT MAINTAINED.




**EXAMPLE**

PRESSURE ALTITUDE 16,000 FT, INDICATED AIRSPEED 240 KNOTS, DIVE ANGLE 50 DEGREES, ALTITUDE LOST IN PULLOUT = 1590 FT

**HOW TO USE CHART**

ENTER LEFT SIDE OF UPPER CHART AT INITIAL PRESSURE ALTITUDE, TRACE RIGHT TO INITIAL INDICATED AIRSPEED, TRACE DOWN TO DIVE ANGLE AND TRACE LEFT TO READ ALTITUDE LOST IN PULLOUT

F-0042

Figure 11-4. Dive Recovery

## PART V

# Emergency Procedures



INTRODUCTION Procedures indicated by an aasterisk (*) are considered critical. The steps must be performed immediately, without reference to the checklist. Time permitting, review/complete the procedures utilizing the PCL to ensure completeness. The Pilot in Command must evaluate all the factors involved in an emergency situation to determine landing site and duration of flight.

**Note**

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is aircraft control. The following is a gueline for all emergencies.

1. Aircraft Control — MAINTAIN

2. Precise nature of problem — DETERMINE

3. Applicable Emergency procedures — EXECUTE.

4. Appropriate Landing Criteria — DETERMINE AND EXECUTE.

EXPLANATION OF TERMS:

1. The term LAND AS SOON AS POSSIBLE means to execute a landing at the first site at which a safe landing can be made.

2. The term LAND AS SOON AS PRACTICABLE means extended flight is not recommended. The landing site and duration of flight is at the discretion of the Pilot in Command.

CHAPTER 12

# Ground Emergencies

## 12.1 ABNORMAL STARTS

Monitor ITT during normal start. If the ITT rate of increase appears likely to exceed 925 °C (hot start), the normal $N_1$ increase is halted (hung start), or no rise of ITT is evident within 10 seconds after selecting FTHR with the condition lever (no start), proceed as follows:

*1. Condition lever — FUEL OFF.

*2. Ignition switch — HOLD OFF (starter continue engaged).

*3. Starter — OFF (after 20 seconds).

*4. Ignition switch — RELEASE.

**CAUTION**

Do not release the ignition switch prior to securing the starter.

Do not attempt another normal start until the cause of the abnormal start is determined and appropriate maintenance action is taken. Note and report to maintenance the degree and duration of any overtemperature.

## 12.2 EMERGENCY ENGINE SHUTDOWN

If emergency situation dictates discontinuation of engine operation because of chip detector light, abnormal engine noises/vibrations, oil system failure, prop failure, or strike of ground object, proceed as follows:

*1. Condition lever — FUEL OFF.

*2. Emergency fuel shutoff handle — PULL.

**Note**

After the emergency fuel shutoff handle is pulled, do not reset on the ground until the cause of the emergency shutdown is determined and corrected.

## 12.3 EMERGENCY EXIT

*1. Canopy — OPEN (emergency open, as required).

*2. Battery — OFF.

*3. Harness, cords, mask — RELEASE.

*4. Parachute — UNFASTENED.

*5. Aircraft — EVACUATE

**WARNING**

If the aircraft is evacuated on the ground while wearing the parachute with the lanyard connected, the parachute will deploy, possibly inflating and dragging the pilot in windy conditions. Should a postcrash fire occur, this can be extremely hazardous because the pilot may be dragged into the fireball.

## 12.4 FIRE

**12.4.1 Fire On the Ground.** If indication of fire is observed, proceed as follows:

*1. Starter — OFF (as required).

*2. Emergency Engine Shutdown — EXECUTE.

*3. Emergency Exit — EXECUTE.

**CAUTION**

Do not attempt engine restart until the cause of the fire is determined and corrected.

**12.4.2 Abnormal ITT During Shutdown.** Indications of abnormal ITT may include rapidly rising ITT and smoke and/or flames from the exhaust stacks.

*1. Condition lever — FUEL OFF.

*2. Emergency fuel shutoff handle — PULL.

*3. Ignition switch — HOLD OFF.

*4. Starter —ON (monitor for normal shutdown).

If condition persists or engine fire light illuminates:

*5. Starter —OFF.

*6. Emergency Exit — EXECUTE.

## 12.5 BRAKE FAILURE

When a wheelbrake failure is experienced, proceed as follows:

*1. Aircraft — STOP.

**WARNING**

Simultaneous actuation of the same brake pedal in both cockpits may cause the shuttle valve to neutralize, causing loss of braking effectiveness.

**Note**

- Maintain directional control and stop aircraft utilizing Beta, rudder, and remaining brakes.
- Pumping the brake(s) may restore enough braking action to stop or better control the aircraft.
- If the brakes in one cockpit fail, the brakes in the other cockpit may still function normally.

If going into imprepared terrain:

*2. Emergency Engine Shutdown — EXECUTE.

When aircraft comes to rest:

*3. Emergency Exit — EXECUTE.

**WARNING**

Do not attempt to taxi with a brake failure or suspected failure in either cockpit. Do not shut down engine until wheels are chocked if holding position by using Beta.

## 12.6 HOT BRAKES

Hot brakes may be caused by excessive braking action. If hot brakes are suspected, stop the aircraft if possible and allow the wheels and brakes to cool. If immediate takeoff is required, leave the landing gear extended for 3 to 5 minutes to provide cooling of the wheel and brake assemblies.

CHAPTER 13

# Takeoff Emergencies

## 13.1 ABORTING TAKEOFF

When aborting a takeoff, proceed as follows:

*1. PCL — FULL BETA.

*2. Wheelbrakes — AS REQUIRED.

**WARNING**

Simultaneous actuation of the same brake pedal in both cockpits may cause the shuttle value to neutralize, causing loss of braking effectiveness.

**Note**

When maximum braking is required, lower the nosewheel to the deck before applying the brakes. For maximum braking, use a single, smooth application of the brakes with constantly increasing pedal pressure as speed is lost. Use as much braking pressure as possible without sliding the tires. Beta is not available with an engine failure.

If going into unprepared terrain:

*3. Canopy — EMERGENCY OPEN.

*4. Emergency Engine Shutdown — EXECUTE.

When aircraft comes to rest:

*5. Emergency Exit — EXECUTE.

## 13.2 TIRE FAILURE

While still on runway:

*1. Aborting Takeoff — EXECUTE.

If airborne:

*2. Landing gear — REMAIN DOWN.

3. Get visual confirmation.

4. Land aircraft on good tire side of runway.

5. Maintain directional control with rudder as necessary and brakes as required. Use beta and brakes to aid in deceleration.

6. Do not taxi with blown tire.

CHAPTER 14

# In-Flight Emergencies

## 14.1 ENGINE FAILURE INDICATIONS

Engine instruments, in particular the $N_1$ (turbine tachometer) and ITT, are provided to assist in determining the condition of the engine. These instruments should be monitored closely on an active schedule to detect early indications of impending engine problems. The following tabulation (Figure 14-1) does not address every possible contingency, but does list engine failure indications for some of the more common situations. Some deviation from these "typical" readings may be noted between individual aircraft.

An indication of impending engine failure or flame-out may be preceded by unstable engine operation. One or a combination of symptoms may prevail such as fluctuating turbine rpm, torque, and ITT; illumination of fuel system warning lights; dropping oil pressure; loss of thrust; unusual engine-related vibrations; etc. In the event engine failure or unexpected flameout occurs, an airstart may be accomplished provided time and altitude permit. If engine failure can be attributed to (1) a mechanical malfunction, (2) was accompanied by an explosion, overheating condition, vibration, strong fuel fumes in the cockpit, or fire, or (3) if the $N_1$ tachometer indicates zero rpm, do not attempt engine restart. A flameout condition is indicated by a drop in ITT, torque, and turbine rpm. Propeller rpm will remain at the rpm selected with the condition lever as long as the airspeed is maintained above 110 KIAS. If flame-out was caused by fuelflow interruption, restart may be spontaneous within 10 seconds because of residual heat retention in the combustion chamber.

## 14.2 LOSS OF USEFUL POWER

Engine malfunction may result in a loss of useful power where the power available is insufficient to prevent the high rates of descent associated with low power/low propeller blade pitch situations. To determine whether or not the propeller should be feathered, check the VSI while descending at 100 KIAS clean. A descent rate in excess of 600 to 800 ft/min will require the propeller to be feathered. The best glide performance power setting at 100 KIAS, aircraft clean, is 205 ft-lb torque.

**14.2.1 Fuel Control Stuck at Minimum Flow (Rollback).** Reduced fuel flow (rollback) is typical of a fuel control unit pneumatic sensing system malfunction. If engine will not respond to PCL movements and ITT and $N_1$ indicate the engine is running at a very low power setting (Figure 14-1), advance the EPL in an attempt to regain control of engine power by use of the manual fuel control system.

If $N_1$ and ITT indicate that a rollback condition exists (fuel control unit stuck at minimum flow), proceed as follows:

*1. Condition lever — FULL INCREASE RPM.

*2. EPL — ADVANCE TO DESIRED POWER SETTING.

**Note**

When using EPL maintain $N_1$ above 65 percent to improve engine response and ensure generator stays on line.

If the resultant power available is insufficient to execute a PEL:

*3. EPL — DISCONNECT.

*4. Engine failure — EXECUTE.

**WARNING**

When the engine is so underpowered that high rates of descent occur, any delay in feathering the propeller may result in insufficient altitude to reach a suitable landing site. It is not recommended to delay feathering the propeller in the landing configuration below landing pattern altitude.

| CONDITION | TORQUE | $N_1$ | ITT | PROPELLER RPM | FUEL FLOW | OIL TEMP | OIL PRESS |
|---|---|---|---|---|---|---|---|
| FUEL CONTROL STUCK AT MIN. FLOW | LOW | $N_1$ WILL BE BELOW FLIGHT IDLE AND LIKELY ABOVE 40 PERCENT [1] | | AIRSPEED DEPENDENT (DECAYING BELOW 2200) | APPROX 80 TO 100 LB/HR | NORM. | NORM. |
| FLAMEOUT | ZERO | DECR'G AS LOW AS 10 TO 12 PERCENT | DECR'G TWD 200 °C | AIRSPEED DEPENDENT [2] (BELOW 110 KIAS RPM WILL EVENTUALLY DECR. TO APPROX. 200 RPM) | LESS THAN 50 LB/HR | DECR. | VARIOUS (WINDMILLING ENGINE MAY MAINTAIN OIL PRESS ABOVE 10 PSI) |
| COMPRESSOR STALL | FLUCT. | FLUCT. (POSSIBLE FLAMEOUT OR OVESPEED) | FLUCT. (POSSIBLE FLAMEOUT OR OVERTEMP) | MINOR SURGES | FLUCT. | NORM. | NORM. |

[1] $N_1$ AND ITT WILL VARY WITH ALTITUDE, TEMPERATURE, AND MINIMUM FUELFLOW SETTING.

[2] PLACING THE CONDITION LEVER TO FTHR POSITION WILL CAUSE PROPELLER TO FEATHER AND ROTATION MAY CEASE.

Figure 14-1. Engine Failure Indicators

**Note**

If resultant power is sufficient to maintain a rate of descent less than the feathered condition (600 to 800 fpm clean), consideration should be given to allowing the engine to operate until the field is made.

If sufficient power is restored:

*5. PCL — IDLE.

*6. PEL — EXECUTE.

**CAUTION**

Use of beta is not recommended when performing a landing using the manual fuel control system. If the use of beta is required, ensure the EPL is in the IDLE range or DISCONNECT before selecting BETA with the PCL.

If application of power results in compressor stall indications (possible compressor bleed valve malfunction/failure), execute the Compressor Stalls procedure in paragraph 14.2.2.

**14.2.2 Compressor Stalls.** Compressor stalls may be characterized by an audible change in engine noise (a loud bang or backfire) with fluctuations in torque, ITT, $N_1$, and fuel flow. Additionally, flames and smoke may be visible from the engine exhaust stacks. A severe compressor stall may result in engine damage and/or flameout. Compressor stalls may be caused by damaged or degraded compressor or turbine blades, disrupted airflow, or compressor bleed valve malfunction.

If compressor stalls occur, proceed as follows:

*1. PCL — SLOWLY RETARD TO JUST BELOW STALL THRESHOLD TO CLEAR STALL.

*2. Cockpit environmental control — FULL FORWARD.

**WARNING**

Avoid unnecessary PCL movement. Advancing the PCL may result in further compressor stalls and engine flameout. Retarding the PCL further may limit maximum power available.

*3. PCL — SLOWLY ADVANCE (as required).

If sufficient power is available:

*4. PEL — EXECUTE.

If the resultant power available is insufficient to execute a PEL:

*5. Engine Failure Procedures — EXECUTE.

**WARNING**

- Use of manual fuel control will only aggravate compressor stalls and could lead to flameout.
- When the engine is so underpowered that high rates of descent occur, any delay in feathering the propeller may result in insufficient altitude to reach a suitable landing site.

**Note**

- If the situation permits, record the altitude, OAT, maximum ITT, and duration of compressor stall.
- If resultant power is sufficient to maintain a rate of descent less than the feathered condition (600 to 800 fpm clean), consideration should be given to allowing the engine to operate until the field is made.

## 14.3 ENGINE FAILURE

In the event of an engine failure, a decision to make a forced landing, a ditch, or a bailout must be made. For bailout, refer to the BAILOUT PROCEDURE in paragraph 16-1. The altitude at which the engine fails will determine the time available to perform the following procedures and if it is possible to enter the emergency landing pattern (Figure 14-2) at high key. In the event of engine failure below high-key altitude, it may be possible to intercept the pattern at or below low-key position. If engine failure should occur at a very low altitude, priority shall be given to accomplishing the first five of the following steps immediately. Engine failure at very low altitude will require immediate reaction and steps may be performed concurrently, such as selecting and turning toward a landing site while performing the other critical steps simultaneously.

*1. Flying speed — MAINTAIN (100 KIAS minimum)

*2. Landing gear and flaps — UP.

*3. Engine instruments — CHECK.

**WARNING**

If $N_1$ and ITT indicate a rollback condition (FCU stuck at minimum flow), execute the LOSS OF USEFUL POWER procedure in paragraph 14.2. If application of power results in compressor stalls (possible compressor bleed valve malfunction/failure), execute Compressor Stalls procedure in paragraph 14.2.2.

*4. Condition lever — FEATHER (as required).

*5. Landing site — SELECT.

*6. Harness — LOCKED.

*7. Airstart — PERFORM (if situation permits).

If airstart is not attempted or is unsuccessful:

*8. No landing site available and altitude permits — BAIL OUT.

If forced landing is to be continued:

*9. Condition lever — FUEL OFF.

*10. Emergency fuel shutoff handle — PULL.

*11. MAYDAY/7700 — BROADCAST.

*12. ELP — INTERCEPT.

*13. Gear and flaps — AS REQUIRED.

*14. Canopy — EMERGENCY OPEN.

**Note**

Dirt and loose objects propelled by the air-blast may restrict visibility.

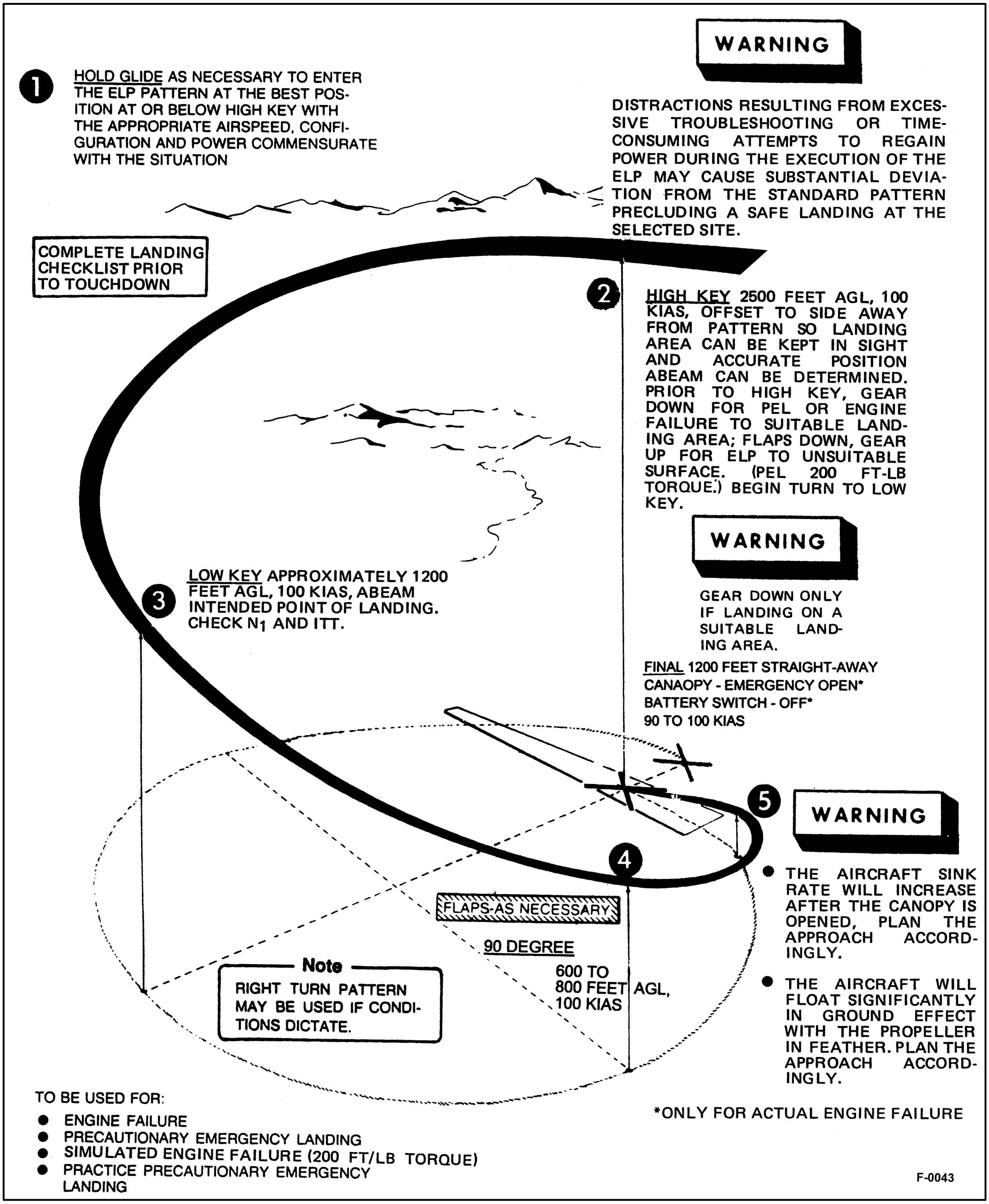



Figure 14-2. Emergency Landing Pattern

*15. Battery switch — OFF.

**Note**

Consideration should be given to leaving the battery on at night.

## 14.4 AIRSTART

Airstarts may be achieved at altitudes from the surface to 20,000 feet and airspeeds from 80 to 280 KIAS if sufficient time is available and precluding mechanical malfunctions or other symptoms described in paragraph 14.1, Engine Failure Indications Restart procedures should be initiated as soon as possible after flameout while high $N_1$ and ITT are available to assist the restart. Airstarts below 1,500 feet AGL are not recommended. Full power will not be available immediately after relight because of the slow spool-up time and the propeller coming out of feather. $N_1$ and ITT are the only reliable engine instrument indications of a successful airstart. After a successful airstart when the condition lever is in the FULL INCR position, if the PCL is in a reduced power setting, the aircraft will experience a high sink rate because of the flat propeller pitch, even with a satisfactorily operating engine. $N_1$ and ITT must be checked, and, if they indicate the engine is running, power should be used as necessary to execute a precautionary emergency landing.

Proceed as follows:

*1. PCL — IDLE.

*2. Emergency fuel shutoff handle — DOWN.

*3. Standby fuel pump — ON.

*4. Starter — ON.

*5. $N_1$ and ITT — MONITOR FOR START INDICATIONS.

*6. Starter — OFF WHEN ITT PEAKS OR NO INDICATIONS OF START.

*7. Standby fuel pump — OFF IF START UNSUCCESSFUL.

**Note**

If an airstart is attempted and unsuccessful, sufficient battery power may not be available to lower the flaps or gear electrically.

If start is successful:

*8. Condition lever — FULL INCR.

*9. PCL — ADVANCE AS REQUIRED.

*10. PEL — EXECUTE.

*11. Autoignition — ON.

## 14.5 PRECAUTIONARY EMERGENCY LANDING

The purpose of the PEL is to maneuver the aircraft to intercept the emergency landing pattern (ELP) as soon as possible. The ELP profile is designed to position the aircraft for a safe landing should power become unavailable or insufficient to sustain flight. A PEL will be made anytime engine reliability is questionable or there are indications of impending engine failure. Indications of impending engine failure include, but are not limited to: chip-detector light, abnormal engine noises, engine vibrations, oil system failure, or propeller failure. Execute the following procedure for a PEL.

**WARNING**

- If established on any portion of the emergency landing pattern, and able to safely land the aircraft, ensure landing gear is down, remain on the ELP and land. Maneuvering off the ELP in an attempt to reenter at a higher altitude may preclude the possibility of reaching a suitable landing site if an engine failure occurs.

- Should engine failure occur at low altitude (below 2,500 feet AGL and before established on the ELP), any delay in transitioning to engine failure procedures may result in high rates of descent and/or inability to reach a suitable landing site.

**Note**

In the landing environment, the nearest suitable runway may include runway remaining during climbout.

*1. Select nearest suitable runway.

*2. Climb at 100 KIAS or accelerate to a position within dead engine glide distance of the runway.

*3. Landing gear and flaps — UP (as appropriate).

*4. Aircraft and engine instruments — CHECK.

*5. ELP — INTERCEPT.

## 14.6 UNCONTROLLABLE HIGH POWER

The bearings or shaft in the FCU could fail without prior fluctuations, causing fuel flow to go to maximum, resulting in a very high-power condition that will be unresponsive to PCL movements. If torque, $N_1$, and fuel flow go to maximum and the engine is unresponsive to PCL movements, proceed as follows:

*1. PEL — EXECUTE.

**WARNING**

Certain failures can cause wide power surges from maximum to as low as minimum fuel flow. Engagement of the EPL in this case will have no effect on the high end of the power fluctuations, but may raise the low end of the surges, thus reducing the magnitude of the fluctuations.

*2. Friction lock knob — FULL DECREASE.

*3. Condition lever — Rapidly retard to FUEL OFF.

**CAUTION**

When retarding the condition lever, do not hesitate in the FEATHER detent because high power from the engine with the propeller in FEATHER may cause severe airframe vibration and very high torque applied to the propeller and reduction gearbox.

**Note**

Altitude permitting, the pilot may elect to shut down the engine with the emergency fuel shutoff handle. The engine may continue running for as long as 30 seconds after the handle is pulled.

*4. Engine Failure — EXECUTE.

## 14.7 IN-FLIGHT FIRE

Fire in flight is a critical emergency, requiring the pilot to assess, diagnose, and take prompt corrective action. If the fire or resultant structural damage exceeds the capability of the pilot, bailout is recommended.

**14.7.1 Engine Fire.** Illumination of the FIRE warning light is usually the first indication of engine compartment fire. However, illumination of a fire warning light alone does not by itself confirm the existence of a fire.

*1. Fire — CONFIRM.

If fire is confirmed:

*2. Emergency Engine Shutdown — EXECUTE.

*3. Cockpit Environmental Control/Aft Cockpit Outside Air — OFF.

**Note**

Under varying conditions of altitude, fire, smoke, or fumes, the pilot has the option of using 100-percent oxygen, opening canopy, and/or closing the oxygen cylinder valve as dictated by judgment.

If fire persists,

*4. Bailout — EXECUTE.

If fire extinguishes,

*5. Engine Failure — EXECUTE.

If no fire indications,

*6. PEL — EXECUTE.

### 14.7.2 Electrical/Unknown Origin Fire

Attempt to locate/isolate source of fire/fumes. If unsuccessful, continue with VMC/IMC conditions.

#### 14.7.2.1 Visual Meteorological Conditions

*1. Battery and generator switches — OFF.

*2. Airspeed — REDUCE (as required).

*3. 100-percent oxygen — DON (as required).

**Note**

Under varying conditions of altitude, fire, smoke, or fumes, the pilot has the option of using 100-percent oxygen, opening canopy, and/or closing the oxygen cylinder valve as dictated by judgment.

*4. Cockpit environmental control/aft cockpit outside air — OFF.

If fire persists:

*5. Execute ENGINE FIRE procedure.

If fire extinguishes:

*6. Land as soon as possible.

7. Execute RESTORING ELECTRICAL POWER procedure (if required).

**Note**

Should the pilot elect to initiate an emergency landing with electrical power secured, additional consideration should be given to the landing approach; allow additional time to handcrank the landing gear down and plan for a no-flap landing with maximum runway length, since beta will not be available.

#### 14.7.2.2 Instrument Meteorological Conditions

*1. Utility bus switches — OFF.

**Note**

The following items will be lost when securing the utility bus switches: Oil pressure and temperature, flap power and position indicator, RMI compass and cards, NACWS CDU's and TRC, transponder, VHF nav, TACAN, GPS, fuel quantity, Beta release, utility lights, console lights, console flood lights, instrument flood lights, vent blowers, scavenge pump, prop test, condenser blower, AC clutch, and avionics cooling fan.

*2. All other nonessential equipment — OFF.

*3. Airspeed — REDUCE (as required).

*4. 100-percent oxygen — DON (as required).

**Note**

Under varying conditions of altitude, fire, smoke, or fumes, the pilot has the option of using 100-percent oxygen, opening canopy, and/or closing the oxygen cylinder valve as dictated by judgment.

*5. Cockpit environmental control/aft cockpit outside air — OFF.

If fire persists:

*6. Bail out (altitude permitting).

If fire extinguishes:

*7. Land as soon as possible.

**Note**

If landing with utility bus switches secured, additional consideration should be given to the landing approach. Plan for a no-flap landing using maximum runway length since BETA will not be available.

**14.7.2.3 Restoring Electrical Power.** If fire extinguishes, use the following procedure to activate essential circuits, allowing sufficient interval to isolate the faulty circuit.

1. Utility bus switches — OFF.
2. Essential bus circuit breakers — PULL (refer to Figure 2-7).
3. All electrical and avionics equipment — OFF.
4. Battery switch — ON.
5. Generator switch — ON (reset).
6. Avionics Master — ON.
7. Avionics equipment critical to continue flight — ON.

## 14.8 SMOKE OR FUME ELIMINATION

**WARNING**

Prior to accomplishing any procedure that will create a draft in the cockpit, determine the source of smoke. A sudden draft may cause a smouldering fire to burst into flame.

*1. 100-percent oxygen — DON.

*2. Airspeed — REDUCE (as required).

*3. Cockpit environmental control/aft cockpit outside air — FRESH AIR INCREASE/ON.

If smoke or fumes cannot be eliminated and so restricts vision that a safe landing cannot be made or excessive heat buildup requires more ventilation:

*4. Canopy — EMERGENCY OPEN.

**WARNING**

Do not activate the flaps or the landing gear electrically with fuel fumes present in the cockpit; electrical arcing may cause an explosion.

## 14.9 BLEED AIR WARNING LIGHT ILLUMINATION

1. Cockpit environmental control lever — FRESH AIR INCREASE.

**Note**

If the light remains illuminated with cool air coming out of the fresh air ducts the warning light is giving a false indication.

2. If the light remains illuminated with hot air coming out of the fresh air ducts, land as soon as practical using normal procedures.

## 14.10 IN-FLIGHT DAMAGE/BINDING CONTROLS

If the aircraft should sustain damage because of a midair collision, bird strike, or overstress, the single most important concern is maintaining or regaining aircraft control. If the aircraft is controllable, monitor engine instruments for unusual indications and flight controls for free and correct response. Existing conditions may warrant consideration of an airborne visual check.

*1. Maintain control of aircraft, if not controllable, BALL OUT.

*2. Climb — AS REQUIRED.

*3. Check flight characteristics above 5,000 feet AGL in the landing configuration, decreasing airspeed in increments of 10 KIAS to an airspeed at which a safe landing can be made (no slower than 80 KIAS).

**WARNING**

Because of unknown flight characteristics of a damaged aircraft, a stall may result in uncontrolled flight from which recovery is impossible. If out-of-control flight occurs, immediately execute OUT-OF-CONTROL RECOVERY procedures in accordance with paragraph 14.8. If recovery does not appear imminent and/or cannot be accomplished by 5,000 feet AGL, **BAIL OUT**.

4. Fly a wide or straight-in approach and land as soon as possible.

## 14.11 OUT-OF-CONTROL RECOVERY

If an out-of-control condition is encountered, accomplish the following procedures:

*1. Controls — POSITIVELY NEUTRALIZE.

*2. PCL — IDLE.

*3. Altitude — CHECK.

**WARNING**

If recovery from out-of-control flight cannot be accomplished by 5,000 feet AGL, bail out.

*4. AOA, airspeed, turn needle — CHECK.

**WARNING**

Application of spin recovery controls when not in a steady-state spin (as verified by AOA, airspeed, and turn needle) may further aggravate the OCF condition.

If in a steady state spin:

*5. Gear/flaps — UP.

*6. Rudder — FULL OPPOSITE TURN NEEDLE.

*7. Stick — FORWARD OF NEUTRAL (erect spin) — NEUTRAL (inverted spin).

**WARNING**

Application of power when not actually in a steady-state spin will result in a rapid increase in rate of descent and airspeed.

*8. Controls — NEUTRALIZE WHEN ROTATION STOPS.

When aircraft regains controlled flight:

*9. Recover from unusual attitude.

**WARNING**

Lower power settings reduce torque effect, restrict onset of rapid airspeed buildup, and enhance controllability. However, departures from controlled flight in close proximity to the ground may require rapid power addition upon OCF recovery.

## 14.12 OIL SYSTEM MALFUNCTIONS

**14.12.1 Oil System Malfunction.** A vibrating needle or minor fluctuations of pressure with a steady mean, where extremes of needle movement remain within the normal range and do not exceed ±5 psi, are acceptable when no secondary indications of engine malfunction are observed. With fluctuations greater than plus or minus 5 psi or outside the normal range, oil pressure drops below 65 psi at power settings above 75-percent $N_1$, rises above 80 PSI, or oil temperature exceeds 100 °C, accomplish the following procedures:

*1. PEL — EXECUTE (utilize a maximum of 850 ft-lb torque and avoid unnecessary PCL movements).

### 14.12.2 Chip Detector Caution Light Illuminated in Flight

*1. PEL — EXECUTE (utilize a maximum of 850 ft-lb torque and avoid unnecessary PCL movements).

**WARNING**

Torque indications may be erroneous because of reduction gearbox failure. Careful attention should be given to rate of descent (see Figure 11-1), and to rate of climb (see note below), setting PCL as required to maintain proper PEL profile.

**Note**

For comparison purposes only, an 850 ft-lb/100 knot climb on a standard day should yield an approximate minimum rate of climb of 1,200 fpm (clean), 700 fpm (gear down). If indicated climb rates are significantly lower, suspect erroneous torque indications and increase power cautiously to achieve proper airspeed/VSl combination. Closely monitor engine instruments for secondary indications of rising ITT, high oil temperature, and/or fluctuating oil pressure. If secondary indications of engine failure occur while on or above ELP profile, consideration shall be given to securing engine.

If engine failure/mechanical malfunction occurs:

*2. Emergency engine shutdown — EXECUTE.

*3. Engine Failure — EXECUTE.

**Note**

Illumination of the magnetic CHIP detector light indicates that metal particles are present in the propeller reduction gearbox.

## 14.13 FUEL SYSTEM FAILURE

**14.13.1 Engine-Driven or Electric (Standby) Fuel Boost Pump Failure.** The engine-driven primary fuel pump will sustain engine operation after failure of the engine-driven boost pump and the electric-driven standby fuel pump. In normal operations, the standby fuel pump is OFF, so illumination of the fuel pressure annunciator and master caution light indicates probable failure of the engine-driven boost pump. Illumination of the fuel pressure annunciator and master caution light may also indicate failure of the engine oil scavenge system. If the engine oil scavenge system has failed, engine failure because of cessation of lubricating oil circulation will occur, and the pilot should be prepared to land as soon as possible.

### 14.13.2 FUEL PRESS and Master Caution Annunciator Illuminated

*1. PEL — EXECUTE.

*2. Standby fuel pump switch — ON.

If lights remain illuminated:

3. Descend below 15,000 feet, avoid high power settings.

**Note**

Log time of illuminated FUEL PRESS light as solitary operation of the engine-driven primary pump.

**14.13.3 Fuel Leaks or Syphoning.** If fuel leakage or syphoning from the wing fuel tanks is detected, proceed as follows:

*1. PEL — EXECUTE.

Time permitting:

2. Secure the switches (landing lights, navigation light, strobe light, pitot heat) and the circuit breakers (LOW FUEL, LDG GEAR POSN, LDG GEAR WARN, FUEL QTY LEFT and/or RIGHT, AOA INST PWR, RMI COMP) that control power to the wing.

If fuel fumes are present in the cockpit:

3. Accomplish the SMOKE OR FUME ELIMINATION procedures — AS REQUIRED.

**WARNING**

Do not activate the flaps or landing gear electrically; electrical arcing may cause an explosion.

**14.13.4 Fuel Quantity Indicator Failure.** Normal flight may be continued, but plan the landing with a calculated conservative fuel reserve. With a fuel quantity indicator failure, if a FUEL LOW annunciator should illuminate, land as soon as possible using PEL procedures because less than 90 pounds of fuel remains in the respective fuel tank.

**14.13.5 Fuel Quantity Imbalance.** The importance of close, continuous monitoring of fuel flow and fuel quantity during flight cannot be overemphasized, since an active and judicious monitoring schedule will alert the pilot quickly to any fuel feed difficulties. Sound in-flight procedures dictate that it is prudent to maintain a balanced fuel load. However, should a fuel split on the order of 100 pounds develop, attempt to balance the fuel load as follows using the wing-low method:

1. Use rudder trim as necessary to establish a slip so that the balance ball is displaced towards the lower quantity wing tanks (i.e., trim the balance ball into the tank containing the least amount of fuel).

2. Use aileron as necessary to maintain heading.

3. If normal fuel balance is restored, continue flight.

4. Land as soon as possible using PEL procedures if either of the following imbalance conditions develop during level, balanced flight:

   a. If the fuel load cannot be brought into balance and the split exceeds 100 pounds with either tank indicating less than 200 pounds

   b. If the fuel load cannot be brought into balance and the split exceeds 200 pounds.

**WARNING**

If unable to transfer any noticeable fuel from a wing tank or if unable to balance the fuel load, discontinue the wing-low balancing procedure as failure to do so may result in engine failure because of fuel starvation.

## 14.14 ELECTRICAL SYSTEM FAILURE

**CAUTION**

Circuit breakers should not be reset more than once until the cause of circuit malfunction has been determined and corrected.

**14.14.1 Generator Failure.** If the generator becomes inoperative, indications will be flashing MASTER CAUTION light and an illuminated GENERATOR annunciator.

Proceed as follows:

*1. Starter switch — OFF (both cockpits).

*2. Generator switch — ON (reset).

If annunciator remains illuminated:

3. Electrical Control — TAKE COMMAND.

4. Generator switch — ON (reset).

If generator does not return to line:

5. Electrical load — REDUCE.

**WARNING**

Instrument flight with a complete loss of electrical power is not possible. Operations with battery power only, even with reduced electrical loads, will likely be limited to less than 20 minutes.

6. Land as soon as practical.

**14.14.2 Inverter No. 1 or Inverter No. 2 Failure.** Failure of inverter No. 1 or inverter No. 2 will be indicated by a flashing MASTER CAUTION light, illumination of the INVERTER annunciator light, and loss of all ac-powered instruments and equipment.

**Note**

If the 115-Vac, 1-amp circuit breaker pops, resetting this circuit breaker will provide power to the FWD and AFT cockpit attitude instruments regardless of inverter selected. If the 115-Vac, 1-amp circuit breaker cannot be reset, the front cockpit attitude instruments will operate normally when inverter No. 2 is selected.

Proceed as follows:

*1. Other inverter — SELECT

If annunciator remains illuminated:

*2. Electrical control — TAKE COMMAND.

*3. 115-Vac, 1-amp circuit breaker — IN.

*4. Inverter control relay circuit breaker — IN.

**WARNING**

- A popped 115-Vac, 1-amp circuit breaker will cause the loss of certain 115-Vac instruments depending on the cockpit and the inverter selected. Indications are as follows:

a. Front cockpit: No.1 inverter selected — Flashing MASTER CAUTION, INVERTER annunciator lights and loss of attitude gyro and turn needle.

No. 2 inverter selected — No indications.

b. Rear cockpit: No. 1 inverter selected — Flashing MASTER CAUTION, INVERTER annunciator lights and loss of attitude gyro.

No. 2 inverter selected — Loss of attitude gyro and turn needle.

The inverter select switch will still be operable in the cockpit with electrical command.

**WARNING**

Instrument flight is not possible with a complete loss of ac power.

Proper analysis and determination of the malfunction is critical when operating in or above IMC. Through inverter selection and manipulation of the 115-Vac, 1-amp circuit breaker, the pilot in command will be able to control the location of operable attitude instruments.

**14.14.3 Battery Failure — Low-Voltage Reading.** If the generator is functioning normally, battery failure may be indicated by smoke and fumes emitting from the battery box or abnormal, high charging rates. There is no remedial action the pilot may take to restore battery power. Proceed as follows.

#### 14.14.3.1 Battery Failure on Ground

*1. Battery switch — OFF.

2. Return to parking spot and secure.

#### 14.14.3.2 Battery Failure in Flight

*1. Battery switch — OFF.

2. Until landing, maintain normal flight procedures. Land as soon as practicable.

**14.14.4 Interior Light Failure.** With the lights extinguished:

1. Activate and use utility/emergency light.

2. Check corresponding circuit breakers — IN.

3. Check corresponding switches — ON.

## 14.15 PROPELLER FAILURE

Normally, the primary and overspeed governors and fuel topping function will act in sequence to hold propeller rpm within suitable range to continue flight or to reach a suitable repair facility. If the propeller is being governed by the fuel topping governor alone, expect moderate surges in propeller rpm, $N_1$, torque, and fuel flow as fuel topping activates and deactivates. Depending upon the type of failure proceed as follows.

### 14.15.1 Propeller Rpm Out of Limits

*1. Condition lever — ATTEMPT TO ADJUST PROP RPM TO NORMAL OPERATING RANGE.

If conditions persist:

*2. PEL — EXECUTE.

If normal indications are restored:

*3. Land as soon as practicable using normal procedures.

**WARNING**

Advancing the EPL beyond the point at which the fluctuations are minimized will aggravate the overspeed condition, which could result in catastrophic failure of the power turbine.

**Note**

If activation of the primary fuel-topping governor has occurred, $P_y$ air will be bled automatically and fuel flow will be reduced towards minimum, causing corresponding fluctuations in $N_1$, torque, fuel flow, and rpm as propeller rpm resurges to 2,398 and is then reduced again by the fuel-topping function. Engaging the EPL will lessen the severity of low-end fluctuations.

### 14.15.2 Uncommanded Propeller Feathers

*1. Condition lever — FULL INCREASE RPM.

If propeller remains feathered:

*2. PCL — ADVANCE (as required).

**Note**

In the event of a primary governor shaft failure, the propeller will move toward feather; however, unboosted engine oil pressure alone may be sufficient to maintain propeller pitch between feather and normal governing rpm range at high-power settings. Resultant power may be sufficient to maintain level flight.

If the resultant power does not improve performance:

*3. PCL — IDLE.

*4. Engine Failure — EXECUTE.

**Note**

Because it is possible for the propeller to unfeather and restore useful power, consideration should be given to leaving the condition lever at FULL INCREASE RPM until intercepting the emergency landing pattern.

*5. PEL — EXECUTE.

**14.15.3 Propeller Rpm Fluctuations.** Propeller rpm fluctuations caused by fluctuating blade angle will be accompanied by a corresponding torque flux and will be audible. Propeller rpm fluctuations may be caused by a faulty propeller overspeed governor test circuit or a malfunctioning primary governor. A malfunctioning primary governor may be caused by metal particles in the oil system and may therefore be the precursor to a chip light. Proceed as follows:

*1. PROP TEST circuit breaker — PULL.

If fluctuations cease, continue flight. If fluctuations continue:

*2. PEL — EXECUTE.

## 14.16 TORQUE SENSING SYSTEM FAILURE

If erroneous torque indications are suspected or torquemeter reads zero, fly known combinations of other available engine indications, rate of climb or descent, attitude, and airspeed, and land as soon as practical using normal procedures.

CHAPTER 15

# Landing Emergencies

## 15.1 HARD LANDINGS

In the event of a hard landing where possibility of gear or structural damage is suspected, proceed as follows:

If on the runway:

*1. Full stop — EXECUTED.

If airborne:

*2. Landing gear — LEAVE DOWN.

3. Airborne landing gear inspection — EXECUTE.

If visual damage is confirmed:

4. Execute appropriate landing gear emergency procedure.

If visual damage is not confirmed:

5. Execute normal landing.

**CAUTION**

Minimize use of brakes to avoid additional loads that may collapse gear. Do not attempt to taxi.

## 15.2 LANDING GEAR EMERGENCIES

**15.2.1 Unsafe Landing Gear Indication.** If a landing gear problem is encountered or suspected, the gear should never by cycled because reextending the gear could aggravate the problem.

**Note**

Should the nosegear fail to extend fully with both main gear down and locked, landing should be attempted with both main gear down and locked using the appropriate procedures.

If one or more main gear fail to extend, a gear up landing is preferred to landing with one main gear retracted. Execute the appropriate procedure. If gear position does not match the position of the landing gear handle, or the red (in transit) light is illuminated, proceed as follows:

1. Landing gear emergency extension — EXECUTE.

If unsafe condition persists:

2. Airborne landing gear inspection — EXECUTE.

If visual check confirms gear unsafe:

3. Unsafe gear procedure — EXECUTE.

If visual check confirms gear down and locked:

4. Land with caution. Roll out straight ahead using brakes and beta only as necessary. Stop on runway until gear is inspected.

**15.2.2 Landing Gear Emergency Extension.** Regardless of electrical power availability, the landing gear crank should be operated until it cannot be moved farther. Check the landing gear position indicators for fully extended indications if electrical power is available.

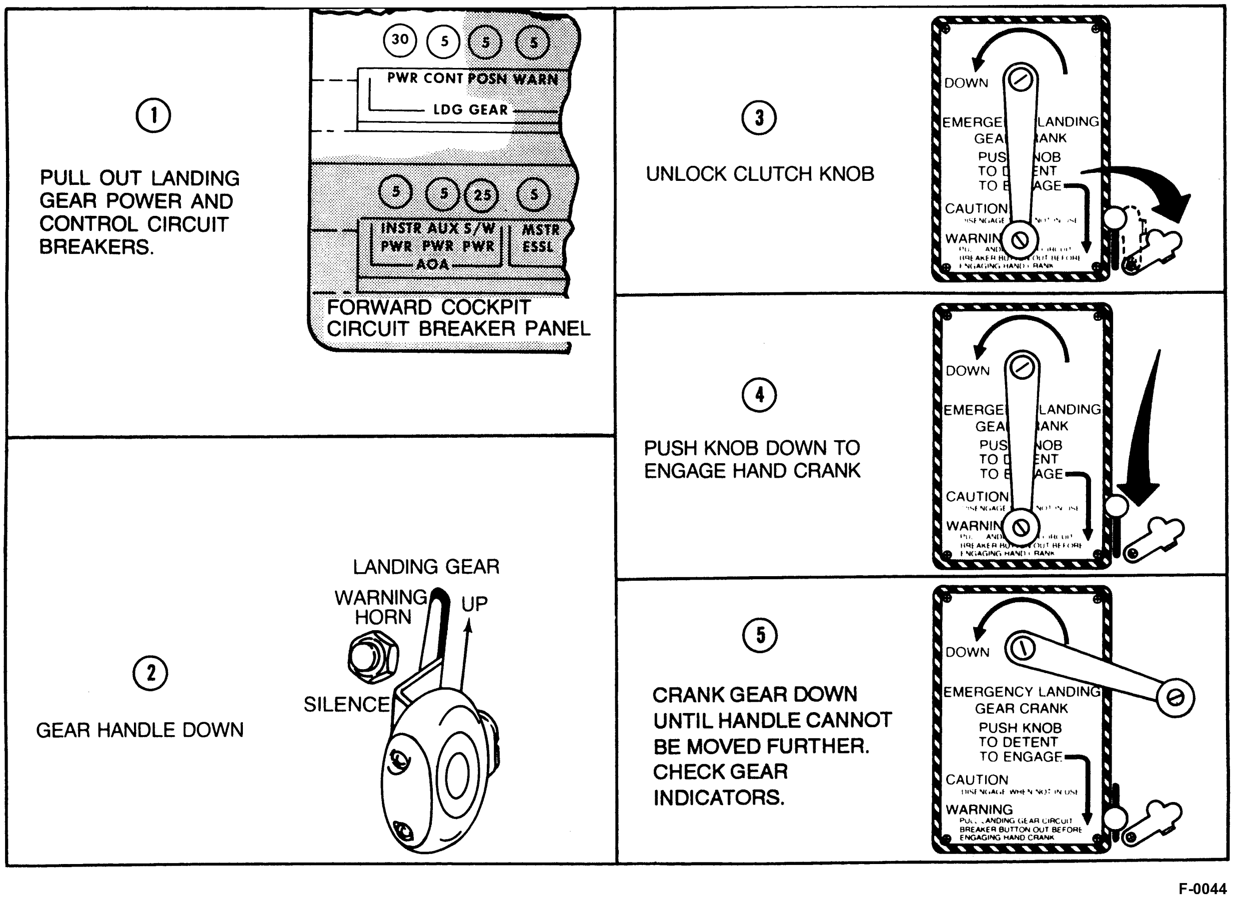



Figure 15-1. Emergency Landing Gear Extension

1. LDG Gear PWR and CONT circuit breakers — PULL.

2. Gear Handle — DOWN.

3. Clutch Knob — UNLOCK.

4. Clutch Knob — ENGAGE.

**Note**

If difficulty is experienced engaged/ disengaging clutch knob, rotate crank handle slightly fore and aft, then re-attempt.

5. Gear — Crank down until handle stops.

**WARNING**

The handcrank must be disengaged from the driveshaft after extending the gear manually; otherwise, subsequent operation of the gear electrically will cause the crank to spin rapidly with possible injury to personnel and damage to the system. Any spinning of handcrank shall be reported to maintenance personnel.

6. Gear indicators — CHECK. (as required)

CAUTION

The landing gear emergency extension system is designed and stressed only for extension and should not be used to retract the gear except in an extreme situation.

#### 15.2.3 Airborne Landing Gear Inspections

In the event an airborne visual inspection is required on a T-34C aircraft, proceed as follows:

1. Climb to at least 2,000 feet AGL.

WARNING

Below 2,000 feet AGL, insufficient altitude may preclude a successful bailout in the event of a midair collision. If conditions preclude VFR operations at or above 2,000 feet AGL, an airborne visual check is not recommended. Obtain a visual check from tower if possible.

2. Conduct sufficient cockpit-to-cockpit communications to coordinate joinup, inspection, and separation.

WARNING

Abrupt changes in airspeed, attitude, and altitude shall be avoided.

3. Inspecting aircraft should check the following:

   a. General condition of the landing gear

   b. Tire inflation and condition

   c. Mechanical downlock in extended position

   d. Inboard landing gear doors for any gapping

   e. Struts for visible hydraulic fluid

   f. Illumination of external landing gear position lights.

**15.2.4 Landing Gear Unsafe Emergency Landing.** If unsafe landing gear position indication persists with the gear handle down and a visual check confirms landing gear unsafe, proceed as follows:

Note

Should the nosegear fail to extend fully with both main gear down and locked, landing should be attempted with both main gear down. If one main gear fails to fully extend, a gear up landing is preferred to landing with one main gear retracted.

**15.2.4.1 Should the Nosegear Fail to Extend Fully.** If the nosegear should fail to extend fully and is free swinging, it may be possible to achieve an overcenter locked position by using the following procedures:

1. Flaps — DOWN.

2. Airspeed — SLOW TO 80 KIAS.

3. Make gentle pitching oscillations using positive g’s to swing the nosegear into the locked position.

4. Land using LANDING WITH NOSEGEAR RETRACTED procedures.

5. If the nosegear supports the aircraft, smoothly apply full forward stick to maintain pressure on the nosegear and do not allow the nosewheel to bounce on the runway.

#### 15.2.4.2 Landing with Nosegear Retracted

1. Oxygen mask — DON.

2. Loose items in cockpit — SECURE.

3. Parachute — UNFASTENED.

4. Harness — LOCKED.

5. Make normal approach with full flaps.

6. Canopy — EMERGENCY OPEN.

Note

Dirt and loose objects propelled by the airblast may restrict visibility.

7. Condition lever — FUEL OFF JUST PRIOR TO TOUCHDOWN.

8. Emergency fuel shutoff handle — PULL.

9. Battery switch — OFF.

10. After the main gear touches down, hold the nose up with aft stick. As the stick approaches full aft and elevator authority is lost during the rollout, lower the nose gently to deck while pitch control is still available.

When aircraft comes to rest:

11. Harness, Cords, Mask — RELEASE.

12. Aircraft — EVACUATE.

**15.2.4.3 Landing With Gear Up.** If the gear fails to extend, a wheels-up landing can be made on either hard or soft ground; however, a hard surface is preferable since sod tends to roll up into chunks, damaging the underside of the fuselage. To accomplish a gear-up landing, proceed as follows:

1. Oxygen mask — DON.

2. Loose items in cockpit — SECURE.

3. Parachute — UNFASTENED.

4. Harness — LOCKED.

5. Make normal approach, full flaps.

**Note**

If crosswind component is out of full-flap limitations (15 knots or greater), consideration shall be given to making a no-flap approach.

6. Canopy — EMERGENCY OPEN.

**Note**

Dirt and loose objects propelled by the airblast may restrict visibility.

7. Condition lever — FUEL OFF JUST PRIOR TO TOUCHDOWN.

**Note**

The aircraft will float significantly in ground effect with the gear up and the propeller in feather. Plan the approach accordingly.

8. Emergency fuel shutoff handle — PULL.

9. Battery switch — OFF.

When aircraft comes to rest:

10. Harness, Cords, Mask — RELEASE.

11. Aircraft — EVACUATE.

**15.2.4.4 Landing With One Main Gear Retracted.** A gear-up landing is preferred to a landing with one main gear retracted. However, if such a landing cannot be avoided, proceed as follows:

1. Oxygen mask — DON.

2. Loose items in cockpit — SECURE.

3. Parachute — UNFASTENED.

4. Harness — LOCKED.

5. Make a normal approach with full flaps. Plan to land on the extended gear side of the runway.

6. Canopy — EMERGENCY OPEN.

**Note**

Dirt and loose objects propelled by the airblast may restrict visibility.

7. Condition lever — FUEL OFF JUST PRIOR TO TOUCHDOWN.

8. Emergency fuel shutoff handle — PULL.

9. Battery switch — OFF.

10. Touch down smoothly on the extended main gear and hold the opposite wing up with aileron as long as possible after the nosewheel touches down.

11. When the wingtip strikes the ground, apply maximum opposite brake pressure.

When aircraft comes to rest:

12. Harness, Cords, Mask — RELEASE.

13. Aircraft — EVACUATE

**15.2.5 Inboard Landing Gear Door Position Annunciator Light Illuminated.** Aerodynamic pressures may cause gapping on the inboard gear doors illuminating the LH or RH OPEN light. Proceed as follows:

1. Reduce airspeed. If safe indication is obtained, do not exceed speed at which indication changed to safe. Note occurrence in appropriate maintenance form.

2. If light remains illuminated with airspeed below 150 KIAS, land as soon as practicable using normal procedures.

**CAUTION**

Once gear has been lowered, raising the gear may aggravate the problem.

## 15.3 WING FLAP FAILURE

There are no provisions for emergency flap operation. If wing flaps become inoperative and function cannot be restored, land the aircraft in the existing flap configuration.

### 15.3.1 Split-Flap Condition

*1. Reset flap lever to prior position.

2. Pull FLAP PWR circuit breaker.

3. Land as soon as practicable.

**Note**

The aircraft is fully controllable in the split-flap configuration. With use of full available aileron trim, control pressures are light. Consideration should be made for using increased landing speeds to enhance controllability.

**15.3.2 Flap Limit Switch Failure.** If either flap limit switch should fail, the resultant torque overload on the flap motor may trip the FLAP PWR circuit breaker. Do not attempt to reset the FLAP PWR circuit breaker. Land the aircraft in the existing flap configuration.

## 15.4 TIRE FAILURE

**15.4.1 Tire Failure on Landing Roll (Main or Nose).** If a tire blowout occurs during normal landing roll, use rudder as necessary and brakes as required to maintain directional control. Use beta and brakes to aid in deceleration. When the aircraft comes to a complete stop, perform the Engine Shutdown Checklist in paragraph 7.16 and have the aircraft towed clear of the landing area. Do not taxi with a flat tire.

## 15.5 EMERGENCY ENTRANCE

Emergency entrance to the forward or aft cockpit is through the normal canopy openings, after the external canopy emergency release handle on the right side of the fuselage just below the foward end of the front canopy rail (Figure 15-2) is pulled.

**Note**

If canopy emergency opening system is actuated, the canopy, once opened, will remain open under pressure of the system and cannot be closed until the actuator valve has been bled of pressure on the ground.

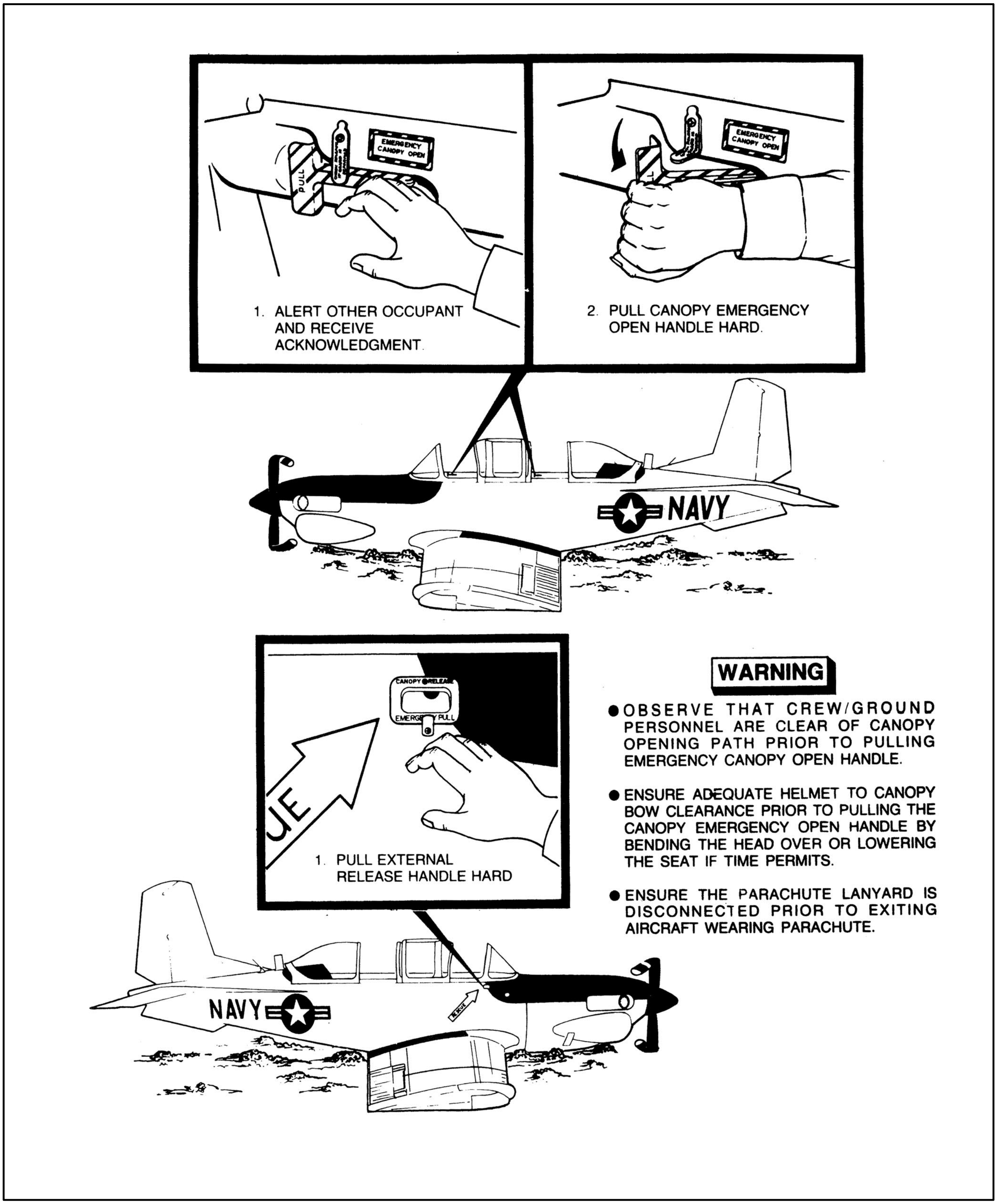



Figure 15-2. Emergency Exit/Entrance

# CHAPTER 16

# Bailout/Ditching

## 16.1 BAILOUT PROCEDURE

In the event of a severe emergency in which a forced landing cannot be accomplished safely, bailout procedures should be initiated as soon as possible. The recommended bailout airspeed range is 90 to 120 KIAS; above 200 KIAS, survivability is marginal as air velocity tends to hold a body against the aircraft. During a spin or out-of-control flight, bail out opposite the direction of the turn needle to minimize the danger of being struck by the aircraft. Minimum recommended altitudes for bailout are as follows:

a. Day VMC — 1,200 FEET AGL.

b. Day IMC — 2,000 FEET AGL.

c. Night VMC/IMC — 2,000 FEET AGL.

d. Out-of-control flight — 5,000 FEET AGL.

If bailout is elected, the following six steps should be accomplished.

*1. Notify crewmember.

*2. Canopy — EMERGENCY OPEN.

**Note**

The canopy will open 2 inches less when operated pneumatically and may take as long as 4 seconds to reach the opened position.

*3. Radio cords and oxygen hose or mask — DISCONNECT.

*4. Harness — RELEASE.

From a crouched position:

*5. DIVE toward the trailing edge of either wing.

When clear of the aircraft:

*6. PULL parachute D-ring.

Additional items to complete before bailout if time and aircraft controllability permit:

*Airspeed — SLOW TO 90 TO 120 KIAS.

*Seat — LOWER PRIOR TO OPENING CANOPY.

*MAYDAY/7700 — BROADCAST.

*Condition lever — FUEL OFF.

*Emergency fuel shutoff handle — PULL.

*Turn toward unpopulated area.

## 16.2 ENGINE FAILURE OVER WATER/ DITCHING

When possible, plan to ditch into the wind if the seas are calm. In the event of moderate swells and minimum winds, ditch parallel to the swells. With moderate to high swells and 25 knots of wind or more, ditch into the wind and attempt to land on the upwind side of the swell (avoid the face of the swell). Ditching from very low altitude will require immediate reaction and simultaneous completion of critical items.

*1. Flying speed — MAINTAIN (100 KIAS minimum).

*2. Landing gear and flaps — UP (flaps down for immediate ditch).

*3. Engine instruments — CHECK.

**WARNING**

If $N_1$ and ITT indicate a rollback condition (FCU stuck at minimum flow), execute the Loss of Useful Power procedure in paragraph 14.2. If application of power results in compressor stalls (possible compressor bleed valve malfunction/failure), execute Compressor Stalls procedure in paragraph 14.2.2.

*4. Condition lever — FTHR

*5. Landing direction — SELECT.

*6. Harness — LOCKED.

*7. Airstart — PERFORM (if situation permits).

If airstart is not attempted or is unsuccessful, altitude permitting:

*8. BAIL OUT — AS DESIRED.

If ditch is to be continued:

*9. Condition lever — FUEL OFF.

*10. Emergency fuel shutoff handle — PULL.

*11. Flaps — DOWN.

*12. Canopy — EMERGENCY OPEN.

Additional items to complete (prior to water entry if time permits):

*MAYDAY/7700 — BROADCAST.

*Parachute — UNFASTENED.

*Oxygen mask — REMOVE.

*Battery switch — OFF.

**Note**

Consideration should be given to leaving the battery on at night.

As soon as all motion stops:

*13. Emergency exit procedure — EXECUTE.

*14. LPU — INFLATE WHEN CLEAR OF AIRCRAFT.

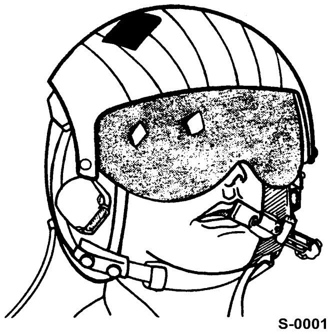
**WARNING**

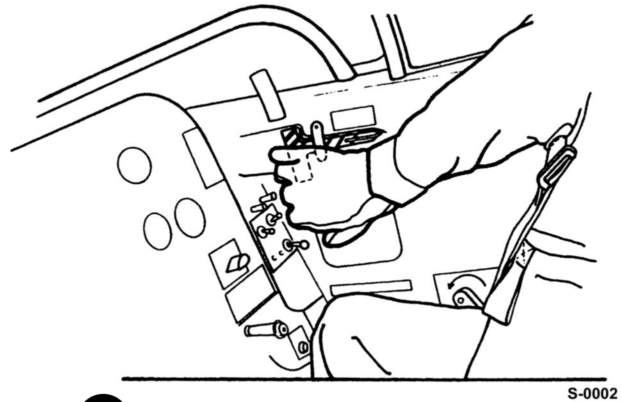
Do not inflate the LPU prior to exiting the aircraft as it may inhibit cockpit egress. If the aircraft is evacuated in the water while wearing the parachute with the lanyard connected, the parachute will deploy and severely restrict the ability to clear the aircraft and remain safely afloat.

**Note**

If time permits, retrieve the first-aid kit from the aft cockpit.

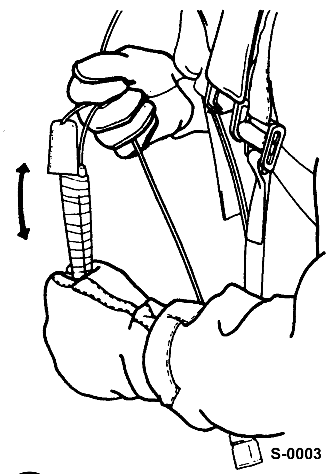
# BAILOUT

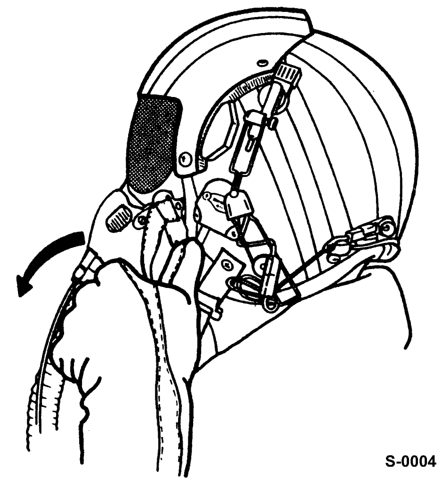



1 **Notify crewmember.**

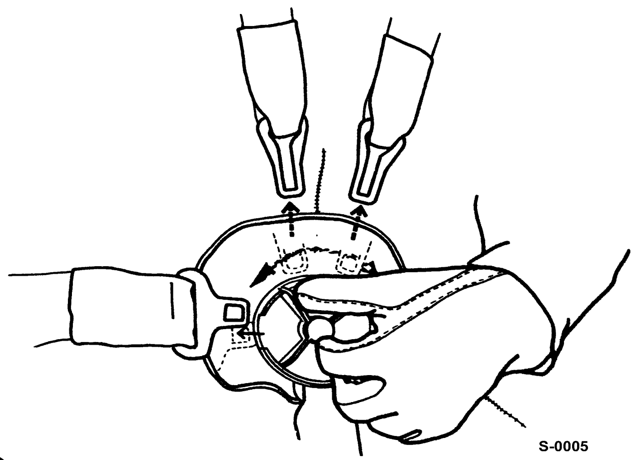
2 **Open canopy using EMERGENCY CANOPY OPEN RELEASE HANDLE.**




3 **Disconnect radio cords and . . .**

**. . . remove oxygen mask, if worn.**




4 **Release harness (1/8 turn in either direction).**

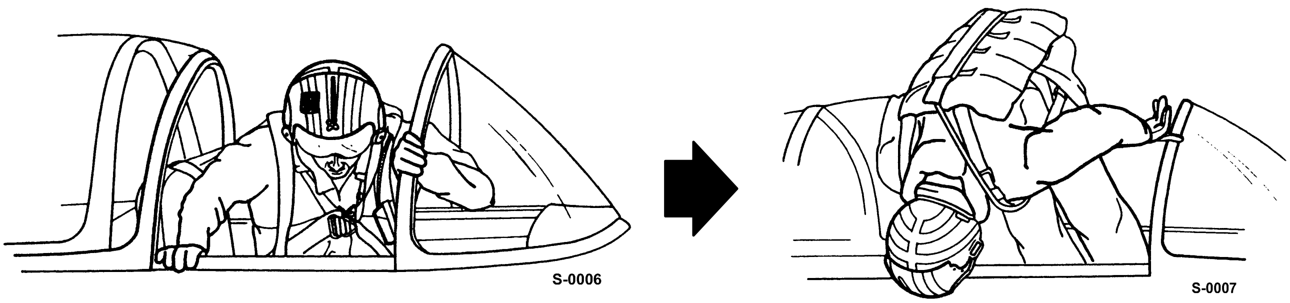
Figure 16-1. Emergency Egress (Sheet 1 of 16)

## BAILOUT — CONT

**5** **Bail out.**

**WARNING**

**If the aircraft is in a spin, both pilots should bail out to the outside of the spin to minimize the danger of being struck by the aircraft.**




**a. Assume crouched position.**

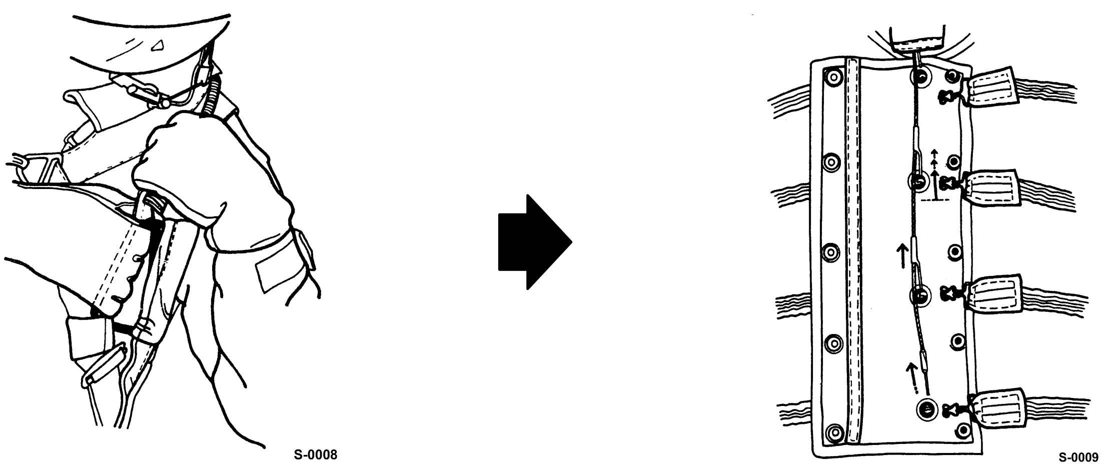
**b. DIVE toward trailing edge of either wing.**

**WARNING**

**If the automatic opening device fails to deploy the parachute canopy, the crewmember must manually initiate deployment by pulling the parachute ripcord handle.**

**Note**

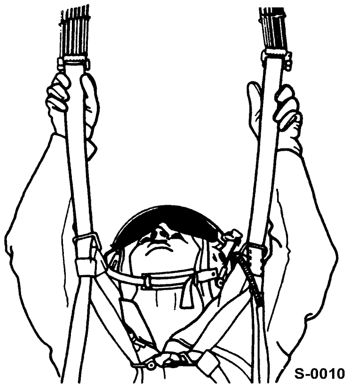
**The parachute assembly incorporates an automatic opening device, barometrically set to deploy the parachute canopy at 10,000 feet altitude or below. An arming lanyard attached to the crewmember's seat arms the device during bailout. If bailout occurs above 10,000 feet altitude and the automatic opening device is armed, the crewmember will free fall to the preset altitude and the canopy will automatically be deployed. If bailout occurs below the preset altitude of 10,000 feet, the canopy will automatically be deployed immediately after arming of the opening device.**

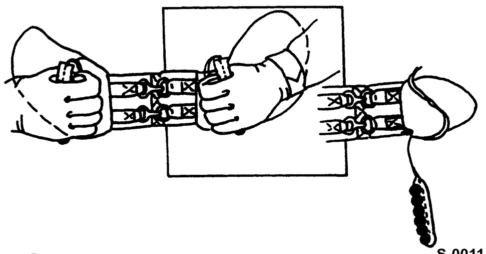


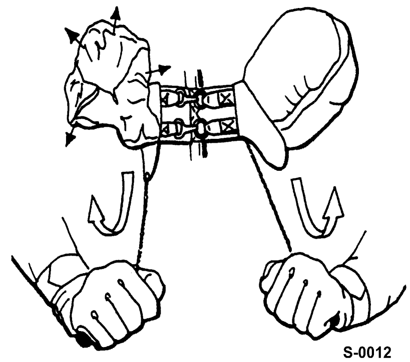

**6** **When clear of aircraft, pull parachute ripcord handle maximum length of travel to allow for complete release of pins from parachute pack.**

Figure 16-1. Emergency Egress (Sheet 2)

# POST-BAILOUT PROCEDURES



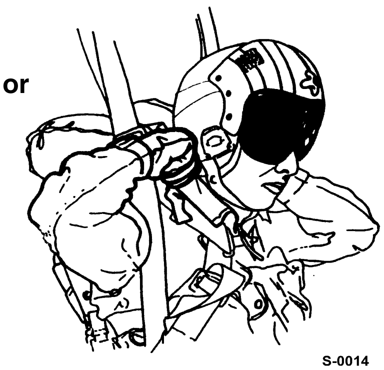

**1** Immediately following opening shock, check the condition of the parachute. If no damage or malfunction exists . . .

**2** . . . locate beaded handles on LPU.

**3** Pull beaded handles down and straight out to inflate. If beaded handle inflation fails, use oral inflation tube.


**Note**

The procedures outlined apply to overland or overwater ejections.



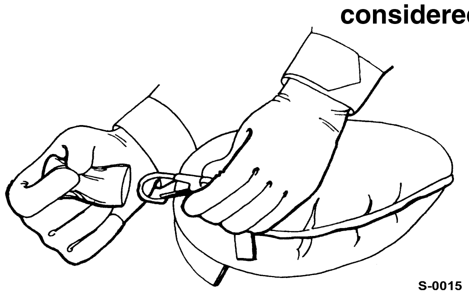

**4** Squeeze LPU waist lobes together to help release hook and pile tape (velcro) on collar lobe, or manually release velcro on collar, if necessary, to achieve complete collar lobe inflation.

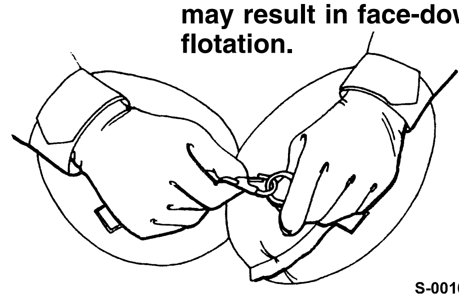
**OPTIONS**

If time and altitude permit or rescue is not imminent, the following options may be considered.

**WARNING**

Failure to snap waist lobes before water entry may result in face-down flotation.




**1** Remove chaffing material from waist lobe snaps.

**2** Snap LPU waist lobes together

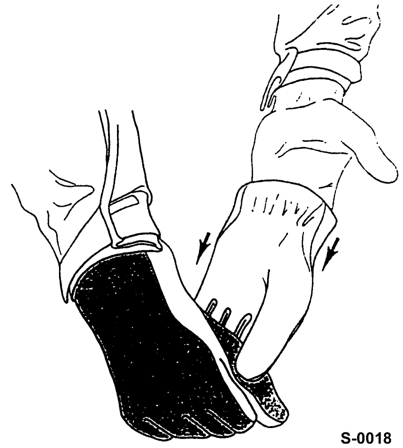
Figure 16-1. Emergency Egress (Sheet 3)

## POST-BAILOUT PROCEDURES — CONT.


**3** Raise visor (if water entry is anticipated).

**Note**

- Removal of gloves may facilitate subsequent release of parachute harness fittings.
- Stow gloves in a safe place to prevent loss.




**4** Remove gloves.

## LANDING PREPARATION

**1** When nearing the surface, assume proper body position.

**Note**

Minimal steering capability is available by pulling down on the appropriate riser in accordance with the direction you wish to turn.

- Feet together.
- Knees slightly bent.
- Toes pointed slightly downward.
- Eyes on the horizon.
- Prepare to release parachute harness fittings.
- Prior to contact, tuck elbows in.

**Note**

If a tree landing is anticipated: lower visor, place hands in armpits with palms down, tuck chin down, and turn head to the side.

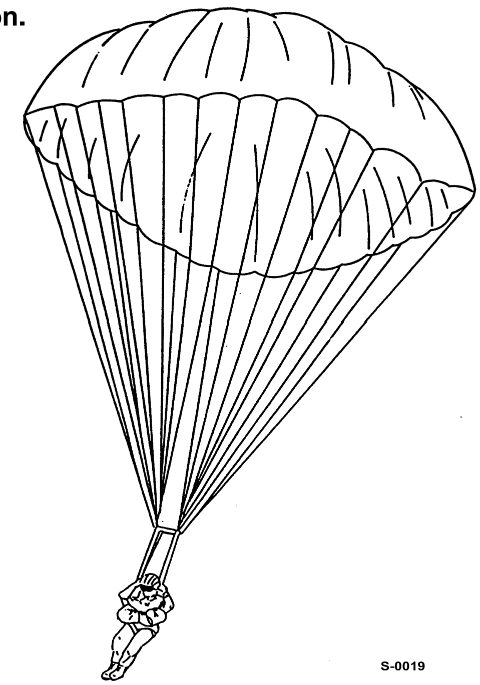



Figure 16-1. Emergency Egress (Sheet 4)

## LANDING PREPARATION — CONT.

**2** **Release parachute harness fittings.**


**a. With right hand, grasp left main sling webbing. With left hand, reach in and release chest quick-ejector snap.**


**b. With left hand, locate and release left leg quick-ejector snap.**

**WARNING**

**Do not unsnap right leg quick-ejector snap or release chest main sling webbing until feet touch water because of unreliable depth perception.**


**c. WIth left hand, grasp right main sling webbing. With right hand, locate right leg quick-ejector snap.**

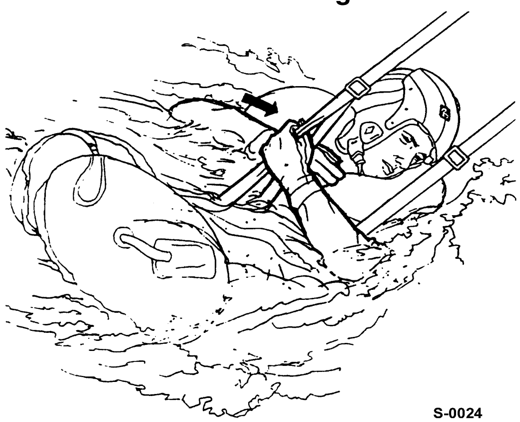

**d. Upon water entry, unsnap right leg quick-ejector snap.**

Figure 16-1. Emergency Egress (Sheet 5)

# LANDING PREPARATION — CONT.

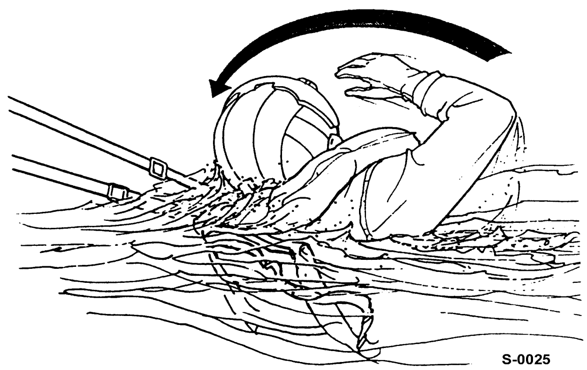
**WARNING**

**To prevent entanglement during harness removal, pass right arm underneath BOTH shoulder webbing and chest webbing of the harness.**



S-0024

**e. Place right hand between body and right main sling.**

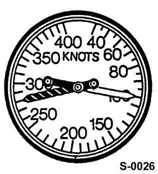


S-0025

**f. Push arm through and turn 90 ~~to the left,~~ rolling out of the harness.**

# DITCHING

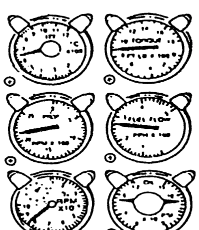
**When possible, plan to ditch into the wind if the seas are calm. In the event of moderate swells and minimal winds, ditch parallel to swells. With moderate to high swells and 25 knots of wind or more, ditch into the wind and attempt to land on upwind side of the swell (avoid the face of the swell). Ditching from very low altitudes will require immediate reaction and simultaneous completion of critical items.**




S-0026

**1 Flying speed — MAINTAIN (100 KIAS minimum).**

**2 Landing gear and a flaps — UP (Flaps down for immediate ditch).**

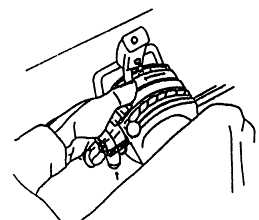


S-0027

**3 Engine Instruments — CHECK.**

**WARNING**

**If $N_1$ and ITT indicate a rollback condition (FCU stuck at minimum flow), execute the LOSS OF USEFUL POWER procedure in paragraph 14.2 If application of power results in compressor stalls (possible compressor bleed valve malfunction/ failure), execute COMPRESSOR STALLS procedure in paragraph 14.2.2.**

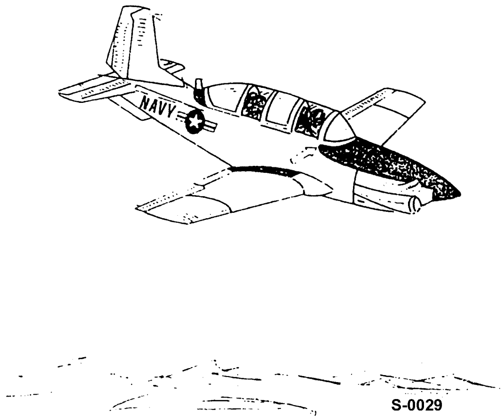


S-0028

**4 Condition lever — FTHR.**

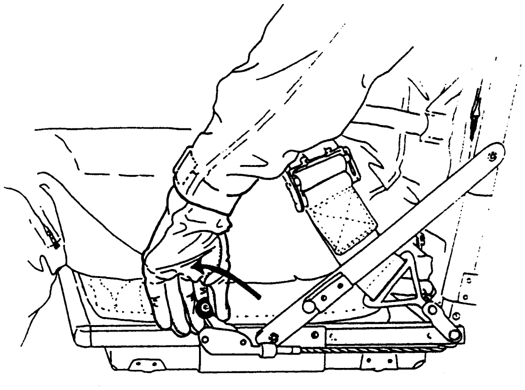
Figure 16-1. Emergency Egress (Sheet 6)

# DITCHING — CONT.



S-0029

5 **Select landing direction.**



S-0033

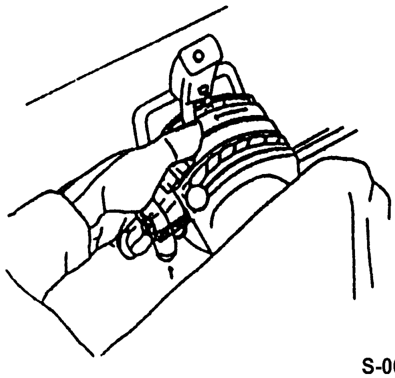
6 **Harness — LOCKED.**

7 **Airstart — PERFORM (if situation permits).**

**If start is not attempted or is unsuccessful, altitude permitting:**

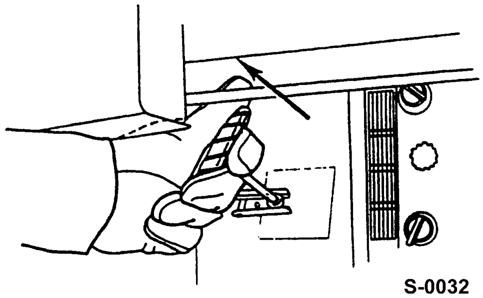
8 **Bail out — AS DESIRED.**

**If ditch is to be continued:**



S-0028

9 **Condition lever — FUEL OFF.**

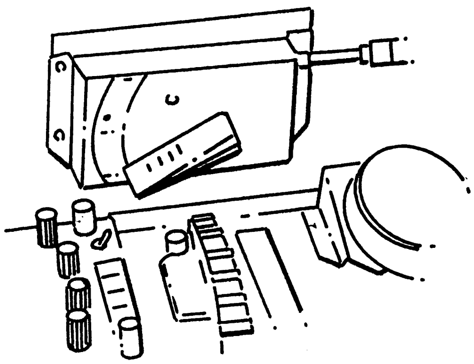


S-0032

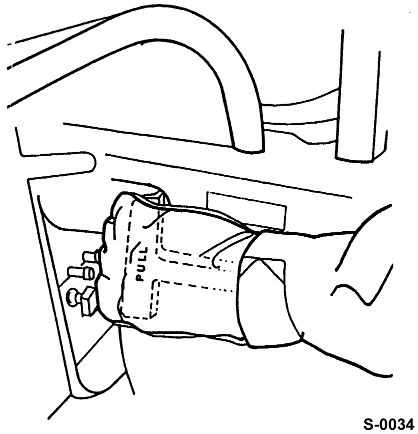
10 **Emergency fuel shutoff handle — PULL.**

Figure 16-1. Emergency Egress (Sheet 7)

## DITCHING — CONT.


S-0033

**11** Flaps — DOWN.



S-0034

**12** Canopy — EMERGENCY OPEN.

Additional items to complete (prior to water entry if time permits):

*MAYDAY/7700 — BROADCAST

*Parachute — UNFASTENED

*Oxygen Mask — REMOVE

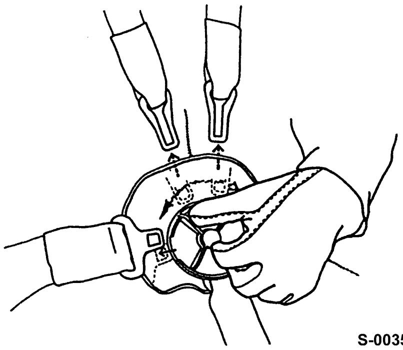
*Battery switch — OFF.

Note

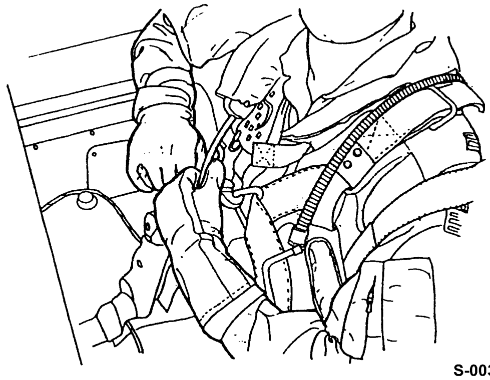
Consideration should be given to leaving the battery on at night.

As soon as all motion stops:

**13** Execute emergency exit procedure.


S-0035

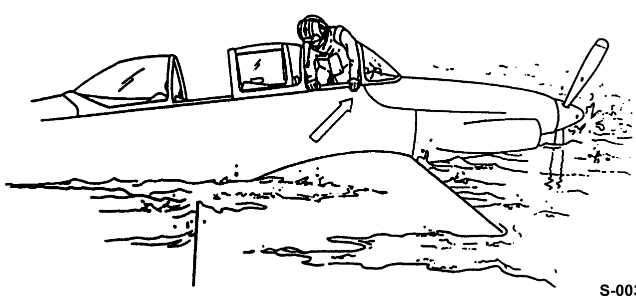
a. Harness — RELEASE.


S-0036

b. Parachute — REMOVE.

Figure 16-1. Emergency Egress (Sheet 8)

## DITCHING — CONT.



S-0037

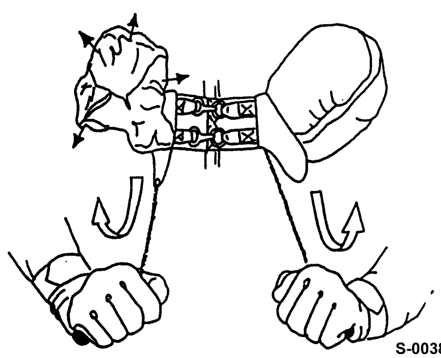
c. Evacuate aircraft

**WARNING**

**If the aircraft is evacuated in the water while wearing the parachute with the automatic ripcord release lanyard connected, the parachute will deploy and severely restrict the ability to clear the aircraft and remain safely afloat.**

**Note**

**If time permits, retrieve the first-aid kit from the aft cockpit.**



S-0038

**13 LPU — INFLATE WHEN CLEAR OF AIRCRAFT.**

**WARNING**

**Do not inflate the LPU prior to exiting the aircraft as it may inhibit cockpit egress. If the aircraft is evacuated in the water while wearing the parachute with the lanyard connected, the parachute will deploy and severely restrict the ability to clear the aircraft and remain safely afloat.**

**Note**

**If time permits, retrieve the first-aid kit from the aft cockpit.**

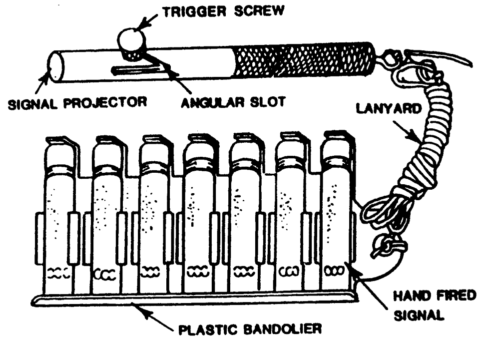
Figure 16-1. Emergency Egress (Sheet 9)

# SIGNALING DEVICES

**The following information describes the use of signaling devices and is not intended to prescribe any given order or priority which would be dictated by the immediate situation.**

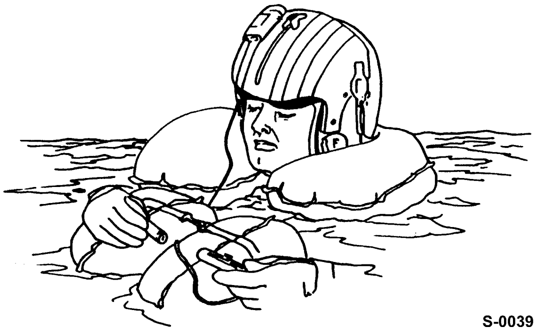
## MK-70 MOD 0 ILLUMINATION SIGNAL KIT

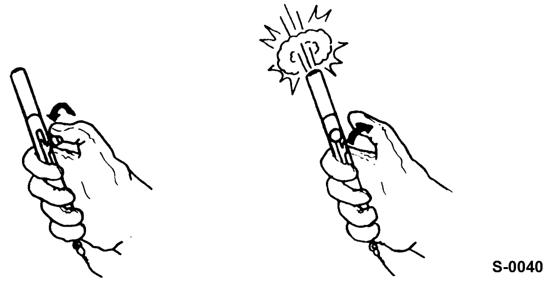
**Mk–79 Mod 0 illumination signal kit uses a pencil-type launcher and cartridge flare to attract attention of SAR.**




**WARNING**

**Prior to securing cartridge into pencil-type launcher, ensure launcher is in cocked position.**

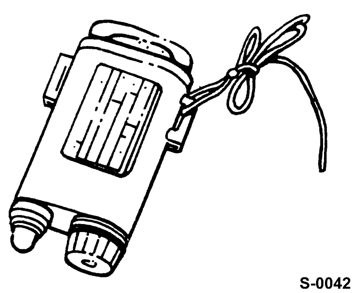



**1** **Screw launcher into the cartridge flare while keeping the flare pointed in a safe direction**

**2** **Hold launcher directly overhead. Pull back on trigger and release. Cartridge flare has a minimum 4-1/2 second duration and can be launched to about 200 feet.**

## SDU-5/E DISTRESS MARKER LIGHT


**SDU-5/E distress marker light can be attached to helmet by mating velcro tape. Depress on/off switch on bottom of light.**

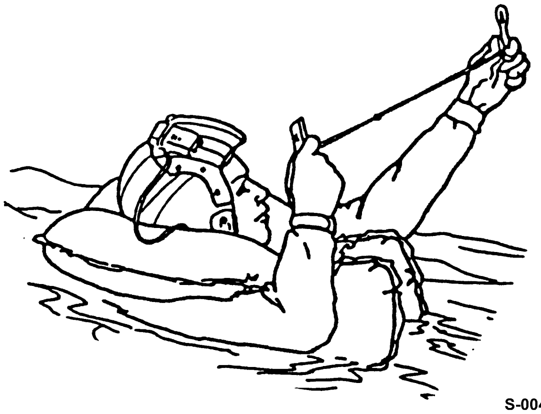
**Note**

**Turn light off if rescue helicopter approaches to avoid possible flicker vertigo.**

Figure 16-1. Emergency Egress (Sheet 10)

# SIGNALING DEVICES — CONT.

## EMERGENCY SIGNALING MIRROR



S-0043

**Note**

**Mirror flashes reflect light with a brilliance of up to 8 million candle power, which can be seen 45 to 50 miles on a clear day from an altitude of 5000 feet.**

1. While holding foresight in left hand, align foresight with target.
2. With the right hand, place the back of the mirror in front of either eye and align the two holes on the target.
3. Rock mirror until cross lines appear on foresight; the beam should then be on the target.
4. Even if no aircraft or ships are in sight, continue to sweep horizon. Mirror flashes can be seen for many miles even in hazy weather.

## MK 124 MOD 0 MARINE SMOKE AND ILLUMINATION

**WARNING**

- **Prior to pulling the lever downward, position all fingers below the top of the signal.**
- **Both ends shall never be ignited simultaneously.**

S-0050

1. Remove the protective cap from the end to be ignited.

S-0052

2. Slide the firing lever horizontally to the fully extended position.

S-0049

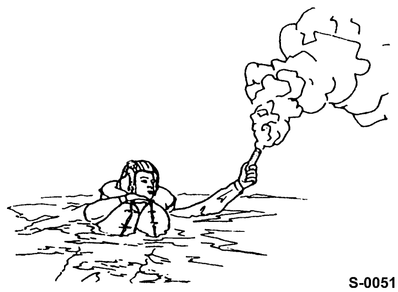
3. Pull the lever downward, applying steady pressure, until the firing pin is released.

**Note**

**If the smoke end flames, briefly immerse it in water or hold it against a solid, nonflammable object.**

Figure 16-1. Emergency Egress (Sheet 11)

# SIGNALING DEVICES — CONT.



S-0051

4. Hold the signal firmly with your arm fully extended overhead at a 45 angle.

**CAUTION**

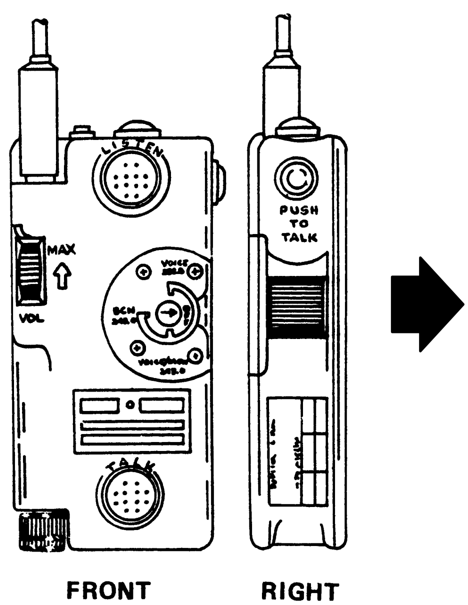
Ignited smoke/illumination signal must be held at arm's length downwind to prevent damage to flotation device from hot residue.

**Note**

- The night end is highly visible at night or during overcast daytime conditions.
- The day end may be used at night, but is considerably less visible than the night end.

5. After using one end, douse the signal in water to cool it, or, if on land, place the signal on a noncombustible surface to cool. Save the other end in case it is needed.

**AN/PRC-90 RADIO SET**




S-0053

The AN/PRC-90 radio set is a dual-channel transmitter/receiver capable of transmitting up to 60 nm (line of sight, depending on receiving aircraft's altitude). It operates on guard (243.0 MHz) or SAR primary operating frequency (282.8 MHz) with a mode for swept-tone signal on 243.0 MHz only. Transmission of beacon or code can be up to 80 nm.

Radio is equipped with external earphone jacks to assist pilot in hearing radio transmissions with helmet on.

Figure 16-1. Emergency Egress (Sheet 12)

# RESCUE

**If survivor pickup is to be conducted by rescue helicopter, the following procedures should be followed.**

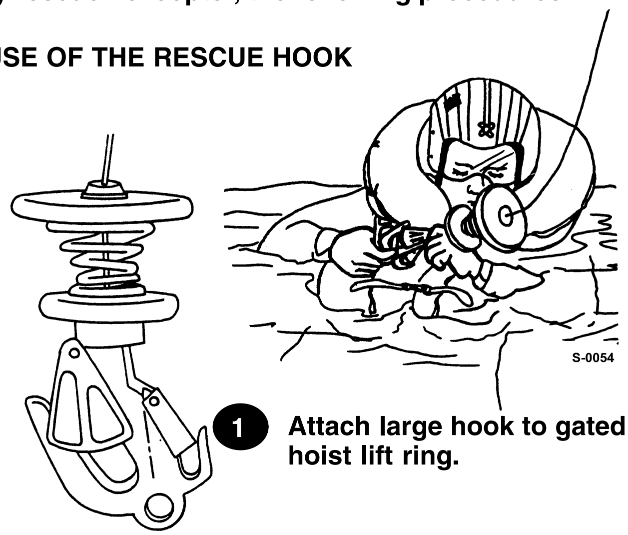
## PROCEDURES FOR USE OF THE RESCUE HOOK

**WARNING**

- **To allow discharge of static electricity and prevent electrical shock, do NOT touch helo-hoist cable or rescue devices until it has made contact with water/ground.**
- **To avoid severe injury, keep hands clear of gated helo-hoist left ring and rescue hook after hooking up.**

**CAUTION**

**Upon approach of rescue helicopter, lower visor.**



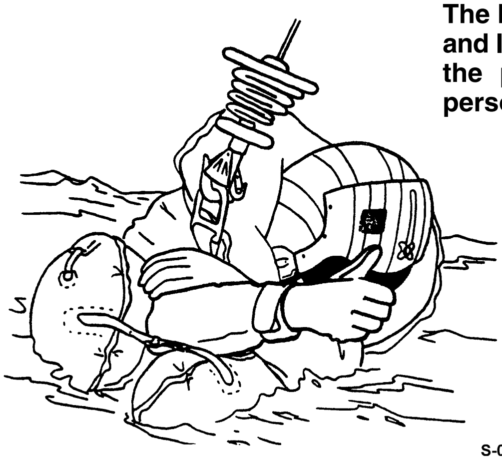

**1** **Attach large hook to gated helo-hoist lift ring.**

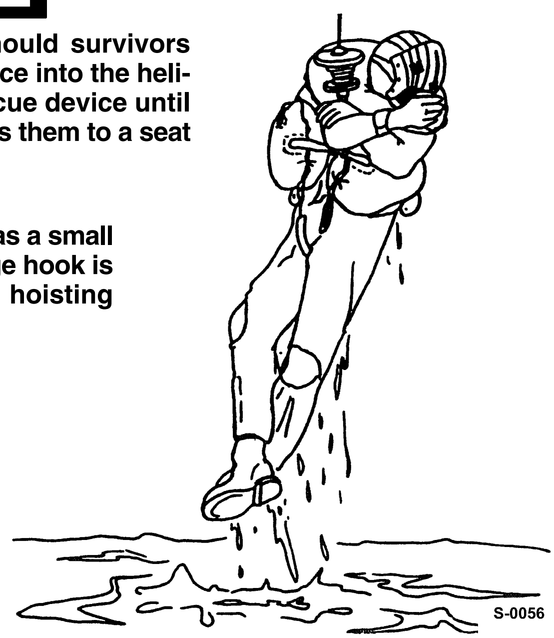
**WARNING**

**Under no circumstances should survivors attempt to assist their entrance into the helicopter or move from the rescue device until helicopter aircrewman assists them to a seat in the aircraft.**

**Note**

**The helo rescue hook has a small and large hook. The large hook is the primary hook for hoisting personnel.**



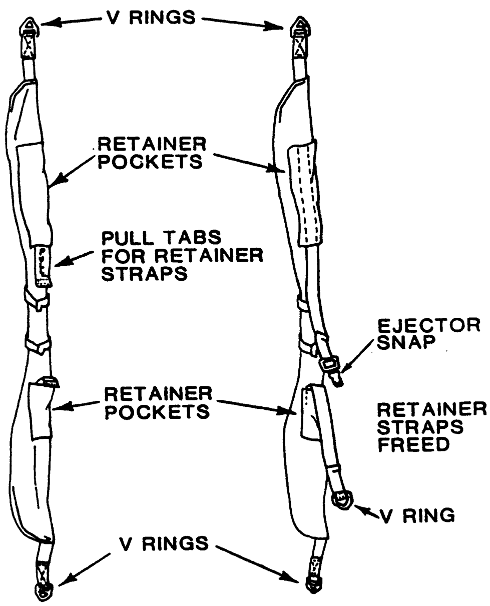

**2** **Cross arms in front of chest and place head down and to the left. Give thumbs up signal to helo-hoist operator.**

**3** **Position of aircrewman during helo-hoist. Upon clearing ground/water, cross feet.**

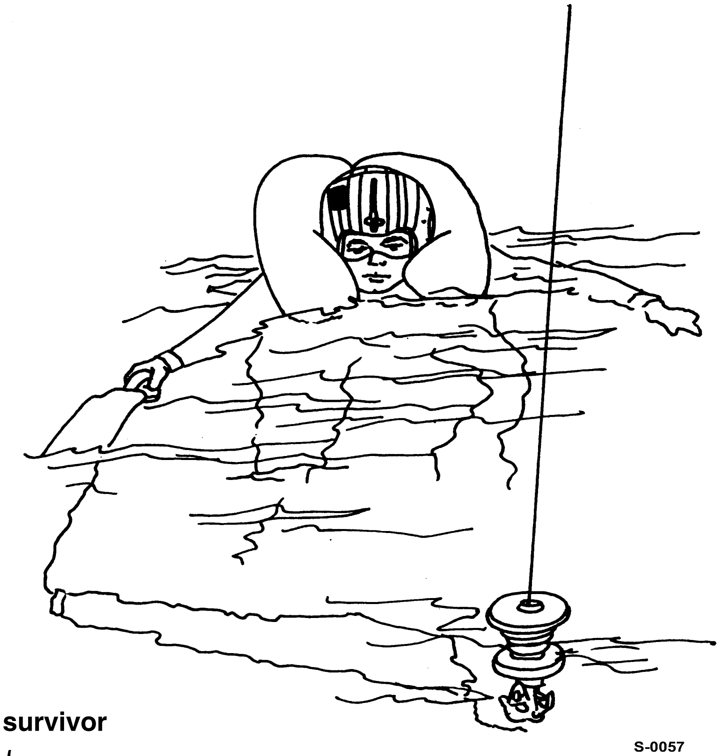
Figure 16-1. Emergency Egress (Sheet 13)

# RESCUE — CONT.

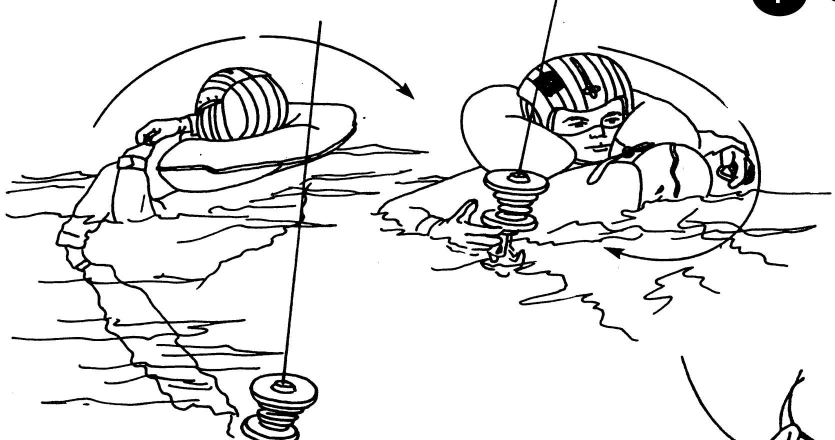
## PROCEDURES FOR USE OF THE RESCUE STRAP



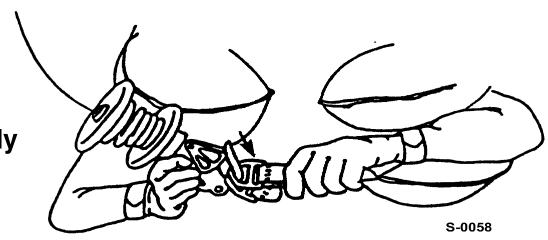

**Rescue strap (designed to accommodate one survivor at a time).**




**1** **Grasp free end of rescue strap.**



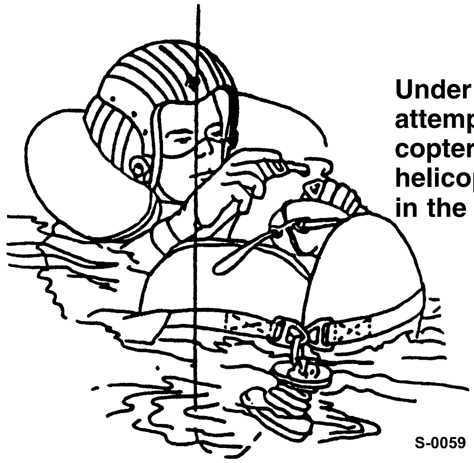
**2** **Swim in a circle toward rescue hook completely encircling body with rescue strap.**




**3** **Attach free end of strap to large hook.**

Figure 16-1. Emergency Egress (Sheet 14)

## RESCUE — CONT.



S-0059

**WARNING**

**Under no circumstances should survivors attempt to assist their entrance into the helicopter or move from the rescue device until helicopter aircrewman assists them to a seat in the aircraft.**

**4** **Pull both retainer straps free and connect ejector snap to V-ring of other retainer strap. Pull tight.**

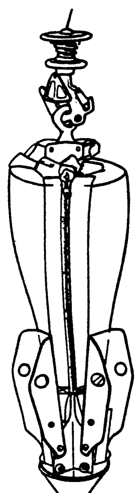
S-0060

**5** **Ensure rescue strop is above LPU waist lobes and high on back. Wrap arms around strop and place hands in armpits. Keep head down and give thumbs up signal to helo-hoist operator.**

S-0061

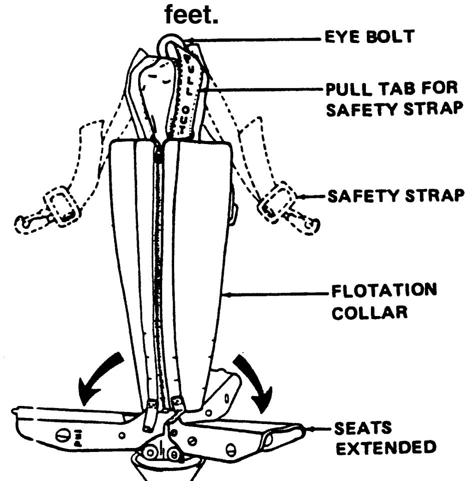
**6** **Position of aircrewman during hoist. Upon clearing water, cross feet.**

**PROCEDURES FOR USE OF THE FOREST PENETRATOR**



S-0062

**Forest penetrator with flotation collar and seats retracted (safety straps omitted to show connection of rescue hook to eyebolt).**

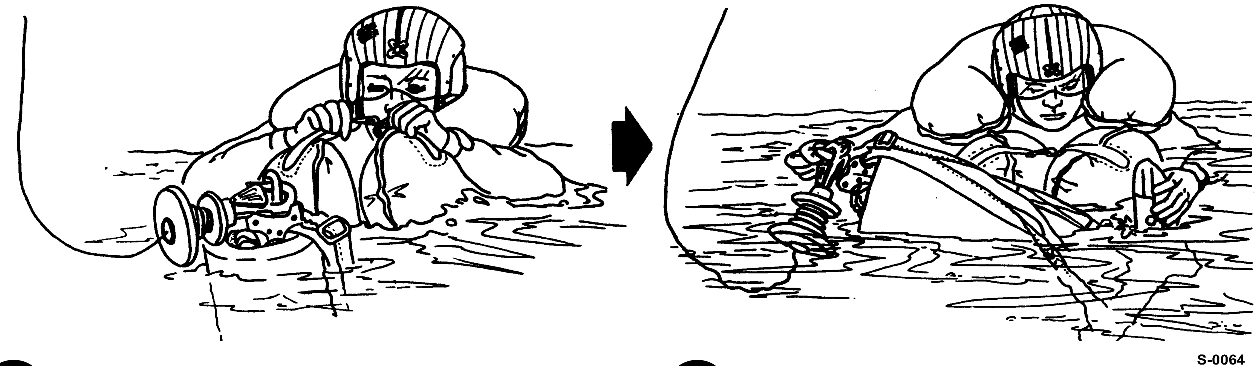



S-0063

**Forest penetrator with flotation collar and seats extended.**

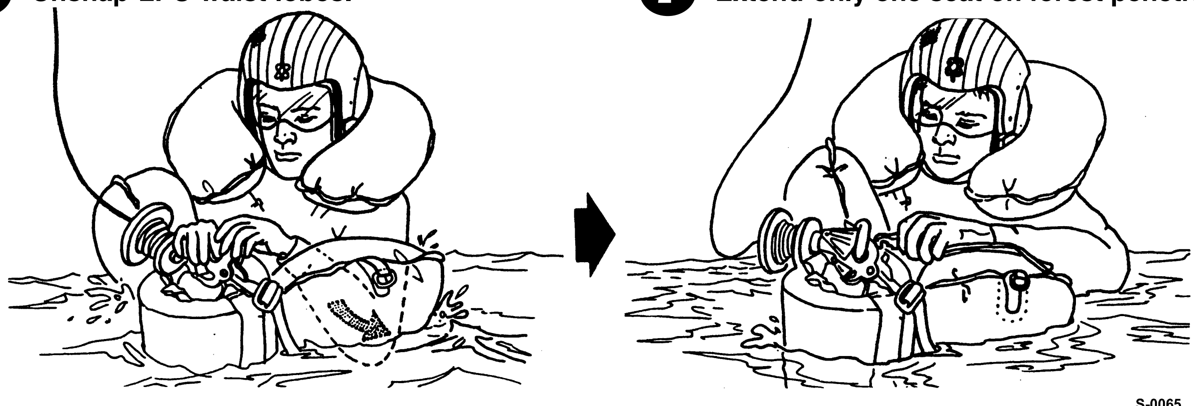
Figure 16-1. Emergency Egress (Sheet 15)

## RESCUE — CONT.



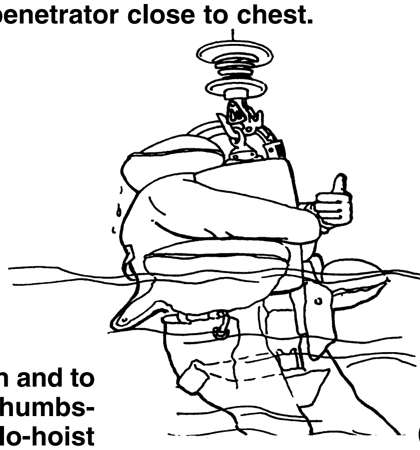

1 Unsnap LPU waist lobes.

2 Extend only one seat on forest penetrator.

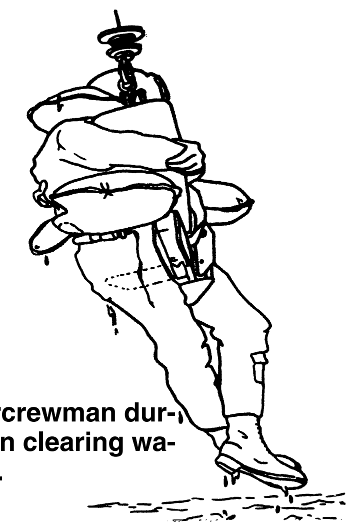



3 Sit on seat facing flotation collar. Using elbows, separate LPU waist lobes and pull shaft of penetrator close to chest.

4 Pass safety strap under arm, around back and under other arm. Connect safety strap and tighten.



5 Turn head down and to the left, give thumbs-up signal to helo-hoist operator.




6 Position of aircrewman during hoist. Upon clearing water, cross feet.

**While it is difficult to predict the probable mode of rescue, the survivor must be alert for modes of rescue that have not been practiced or briefed. It is impossible to formulate procedures to cover every contingency. The key is to develop a survival attitude. Readiness and survival start with your preparation.**

Figure 16-1. Emergency Egress (Sheet 16)

## PART VI

# All Weather Operation

CHAPTER 17

# Instrument Flight Procedures

## 17.1 INTRODUCTION

This chapter contains only those procedures that differ from or are in addition to the normal operating procedures in Part III. Refer to the NATOPS Instrument Flight Manual (NAVAIR 00-80T-112) for standard instrument flight procedures.

## 17.2 SIMULATED INSTRUMENT PROCEDURES

The aft cockpit is equipped with a hood to simulate instrument flight conditions. Switches are provided in the front cockpit to disable the aft cockpit attitude gyro and RMI during simulated instrument procedures.

**CAUTION**

When positioning instrument hood, the hood fabric may contact the canopy locking handle and rear cockpit canopy could open inadvertently when the hood is raised.

## 17.3 INSTRUMENT FLIGHT PROCEDURES

**WARNING**

- Flight into or during icing conditions is prohibited.
- Instrument flight is not possible without ac power.
- Landing and strobe lights may contribute to pilot disorientation during IMC. Strobe lights should be off when instrument conditions are encountered. Landing lights may be used as weather conditions dictate.

**Note**

On the ground, the free air gauge may be affected by exhaust gases passing over the outside probe.

**17.3.1 Instrument Takeoff.** Refer to paragraph 7.10 for normal climb procedures. If takeoff is to be made in visible moisture, pitot heat should be ON.

**17.3.2 Instrument Climb.** Refer to paragraph 7.10 for normal climb procedures.

**17.3.3 Instrument Cruising Flight.** Refer to paragraph 7.11 for normal cruise procedures.

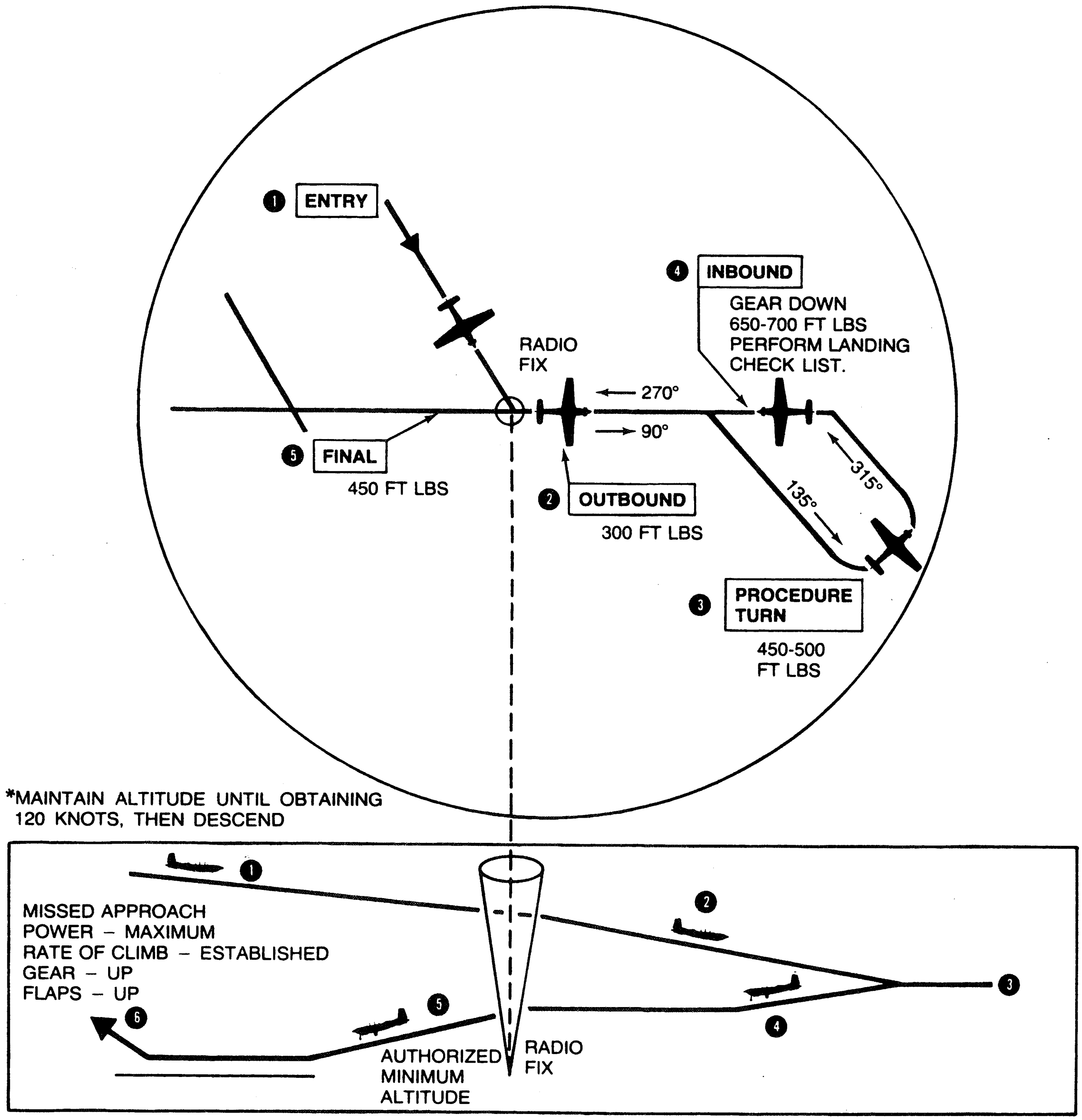
**17.3.4 Holding.** Slow the aircraft to 120 KIAS, clean configuration, and use standard rate turns.

**17.3.5 Instrument Descent.** Reduce power and adjust airspeed as necessary to obtain the desired rate of descent.

### 17.3.6 Instrument Approaches (Figure 17-1)

1. Descend at 120 KIAS, 300 ft-lb torque.
2. Level off, use 450 to 500 ft-lb to maintain altitude.
3. Inbound to final approach fix, lower landing gear, adjust power to maintain 120 KIAS (650 to 700 ft-lb level, 450 ft-lb descending).
4. At final approach fix, reduce power to 450 ft-lb and descend at 120 KIAS.
5. Prior to landing, flaps as desired. Ensure Landing Checklist is completed.

**17.3.7 GCA Approaches.** Power settings and aircraft configurations for downwind, base, and final legs are shown in Figure 17-2.



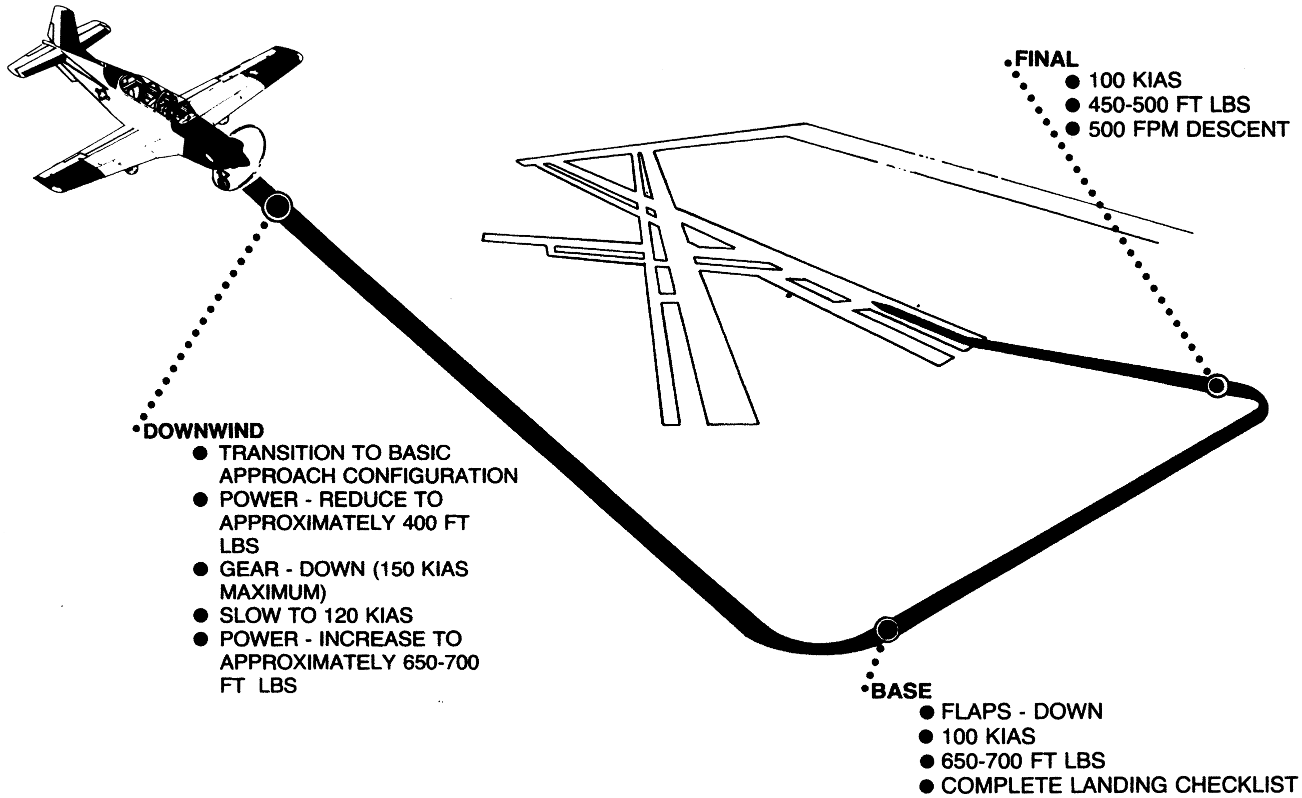

| NORMAL APPROACH AIRSPEED – KIAS | ENTRY 1 | *OUTBOUND 2 | PROCEDURE TURN 3 | INBOUND 4 | FINAL 5 | MISSED APPROACH 6 |
|---|---|---|---|---|---|---|
| | AS DESIRED | 120 | 120 | 120 | 120 | 120 |

**Note**

- FOR TACAN ARCING APPROACH, INTERCEPT ARC AT CRUISE AIRSPEED. WITHIN 30° OF FAC, REDUCE AIRSPEED TO 120 KIAS. AFTER INTERCEPTING FAC, LOWER LANDING GEAR AND MAINTAIN 120 KIAS.
- THESE PROCEDURES ARE NOT INTENDED TO LIMIT THE PILOT'S PEROGATIVE TO ALTER AIRSPEEDS AND CONFIGURATIONS TO MEET EXISTING CONDITIONS.

F-0047

Figure 17-1. Typical Instrument Approach




**Note**

THESE PROCEDURES ARE NOT INTENDED TO LIMIT THE PILOT'S PEROGATIVE TO ALTER AIRSPEEDS AND CONFIGURATIONS TO MEET EXISTING CONDITIONS.

F-0048

Figure 17-2. GCA Pattern

#### 17.3.8 Missed Approach

1. Advance PCL to maximum.

2. Establish a climbing attitude and positive rate of climb.

3. Landing gear — UP.

4. Flaps — UP, ACCELERATE TO 120 KIAS.

5. Comply with published instructions.

### 17.4 NIGHT FLYING PROCEDURES

Night flight is accomplished using normal procedures. All interior and exterior lighting shall be checked for proper operation prior to night flight.

# CHAPTER 18

# Extreme-Weather Operation

## 18.1 ICE, RAIN, AND SNOW

The aircraft is not equipped with deicing equipment; therefore, intentional flight into or during icing conditions is prohibited. Flight in rain or snow is permitted; however, extreme caution must be observed to avoid entering icing conditions.

**18.1.1 Before Entering Aircraft.** Remove all ice, snow, and frost from wings, empennage, control surfaces and hinges, propeller, windshield, pitot tube, and vents. Use deicing fluid as necessary.

**18.1.2 Taxiing.** Avoid taxiing through slush and water if possible. Water and slush splashed on the wings

and possibly limiting control surface movement.

**18.1.3 In Flight.** If in-flight icing conditions are inadvertently encountered, attempt to fly the aircraft away from such conditions or land as soon as possible. Accomplish the following:

1. Pitot heat switch — ON.
2. Cockpit environmental control and windshield defogger — AS REQUIRED.
3. Engine air inlet bypass door — OPEN.

**Note**

Pitot heat should be used and the engine air inlet bypass door opened (if the possibility of in-flight icing exists) prior to flight into visible moisture. The bypass door cannot be closed above 150 KIAS because of airloads. Continue flight with the door open after exiting visible moisture until the airspeed can be reduced. If erroneous altitude and airspeed indications are suspected, the pilot may select the ALTERNATE STATIC AIR SOURCE, which will affect the front cockpit instruments only.

4. Autoignition switch — ON.

**18.1.4 Approach.** If icing conditions are inadvertently encountered during approach, increase approach speed as necessary to maintain positive control of the aircraft.

**18.1.5 Landing.** Refer to normal landing procedure in Chapter 7. Watch for ice on the runway and avoid braking in these areas. Be extremely careful when utilizing beta on a wet runway. Full beta may be used, but it must be applied smoothly and slowly. Rapid application of full beta may aggravate directional control problems. Use of beta may also inhibit visibility during landing rollout as it tends to project precipitation and standing water in a spray forward of the aircraft. The pilot should not neglect the use of beta on a wet runway, since wheelbraking may be marginally effective; however, it must be used carefully and judiciously.

## 18.2 THUNDERSTORMS AND TURBULENCE

Intentional flight through severe or extreme turbulence and thunderstorms is prohibited. Before entering turbulence, prepare the aircraft as follows:

1. Airspeed — 195 KIAS (maximum gear and flaps up); 120 (gear and flaps down).
2. Restraint harness — TIGHT.
3. Inertia reel — LOCKED.
4. Loose gear — STOWED.
5. Cockpit lights (at night) — FULL BRT (to minimize the blinding effects of lightning).
6. Autoignition switch — ON.

**Note**

Limit maneuvers to +3g's to minimize the possibility of overstressing the aircraft as a result of combined effects of gust and maneuvering loads.

## 18.3 COLD WEATHER

Normal operating procedures in Part III are to be followed during cold-weather operation with emphasis on the following:

1. Use external power for starting when possible.
2. Monitor torque and ITT limits. Refer to engine operating limitations in Chapter 4.

## 18.4 HOT WEATHER

The normal operating procedures in Part III are to be followed during hot weather operation with emphasis on ITT and torque limits. Refer to engine operating limitations in Chapter 4.

## 18.5 DESERT OPERATIONS

Desert operations require that special caution be exercised to minimize dust and sand entry into the aircraft and engine. Monitor ITT closely. Refer to engine operating limitations in Chapter 4.

## 18.6 ARCTIC OPERATIONS

Follow the normal procedures in Part III with the cold-weather operation emphasis in Arctic operations.

# PART VII

# Communications/Navigation

# CHAPTER 19

# Communication/Navigation Equipment and Procedures

## 19.1 INTRODUCTION

This chapter provides the operating procedures for aircraft communication, navigation, transponder, emergency locator transmitter system, and collision warning systems.

## 19.2 MULTIFUNCTION CONTROL PANEL (255Y-1)

The forward and aft cockpits have a multifunction control panel (Figures 19-1 and 19-2) located on the right console assemblies. Each panel is identical and contains operating controls for tacan and VHF omnidirectional range receivers, interphone audio, UHF transmissions, and TACAN and VOR audio control to the headsets. The controls for each panel are detailed within the coverage for the respective systems.

## 19.3 MASTER AVIONICS SWITCH

A MASTER AVIONICS toggle switch (Figure 19-2) with placarded positions ON and OFF is located on the right console assembly of the forward cockpit. This switch must be placed to ON position in order for aircraft avionic systems to receive operating power, regardless of other control settings which affect the avionic systems.

## 19.4 CONTROL TRANSFER SWITCHES AND INDICATOR LIGHTS

Each cockpit has an individual toggle switch (Figure 19-2) placarded AVIONICS — TAKE COMMAND and CONTROL TRANS, and located on the right console assemblies. Both are springloaded to return to center position when released. An interlock circuit couples both switches that, if the MASTER AVIONICS switch is ON, enables the last AVIONICS switch moved "up" to transfer the command of all aircraft avionics to the corresponding cockpit. Avionics control may be transferred between cockpits by this procedure. A green indicator light adjacent to the AVIONICS switch will illuminate in the cockpit having command of aircraft avionics. Neither light will illuminate if the AVIONICS MASTER switch is OFF. Control transfer circuits are protected by a 5-ampere circuit breaker placarded CONT TRANS on the forward circuit breaker panel (Figure 2-7).

**Note**

- Each audio control panel operates independently and is not affected by avionic command changes.
- The VOR, TACAN, and UHF frequency indicators within both cockpits will always read the same because avionic command circuits slave all indicators to display the frequencies set on control panels of the cockpit having avionics command.

## 19.5 COMMUNICATIONS

The primary communication equipment consists of an interphone system between cockpits and a UHF as well as a VHF radio communications set for voice reception and transmission over normally used frequencies and also over an emergency guard channel frequency. An emergency locator transmitter is also provided.

**19.5.1 AN/ARC-159V UHF Communications Set.** The UHF communications unit provides line-of-sight transmission and reception of amplitude-modulated signals in the ultra high frequency range of 225.00 to 399.95 MHz for a range of approximately 50 miles. Audio signals are applied through the selector switches to the respective headsets.

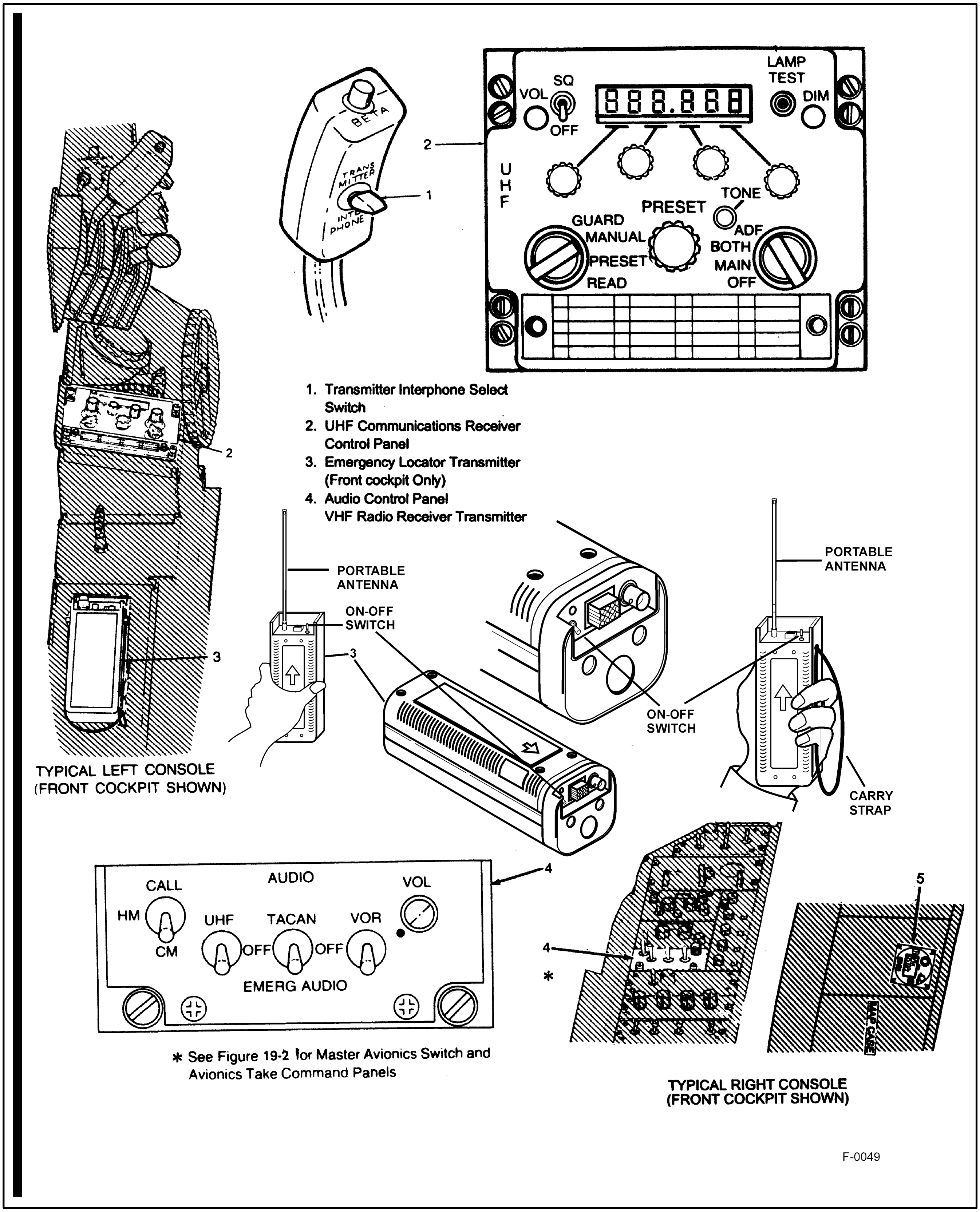



Figure 19-1. Communications Equipment

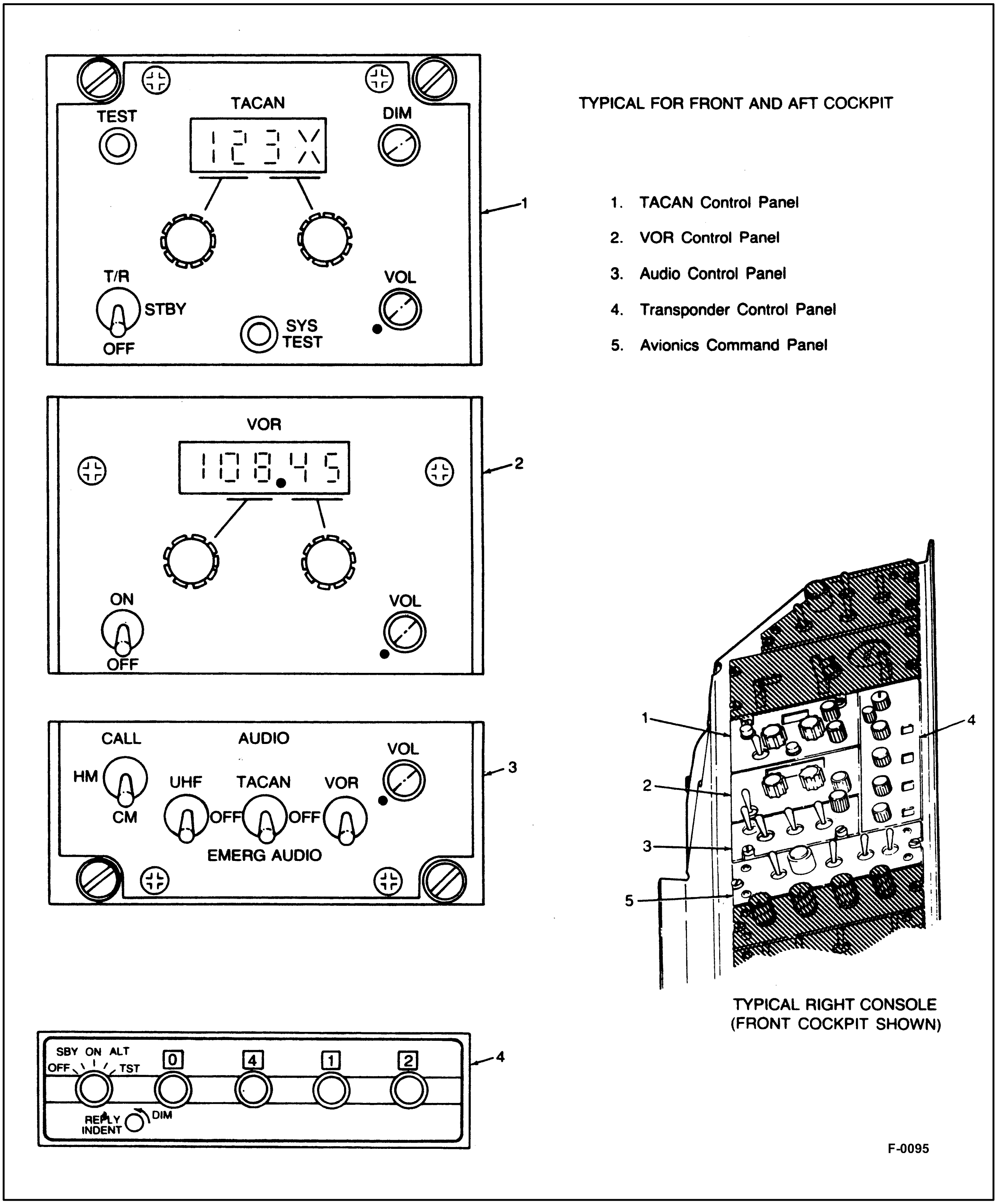



Figure 19-2. Navigation Equipment (Sheet 1 of 2)

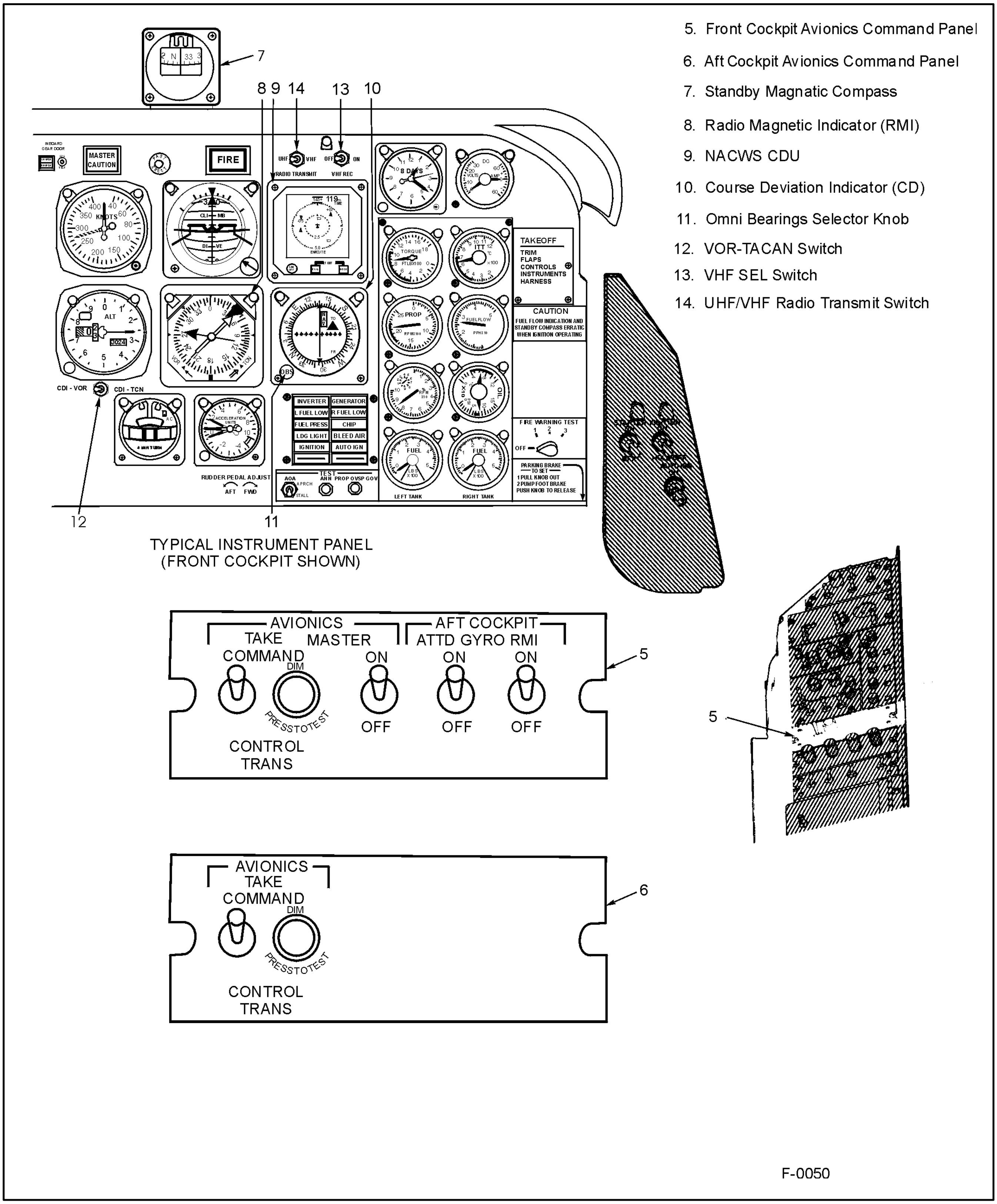



Figure 19-2. Navigation Equipment (Sheet 2)

#### 19.5.1.1 UHF Control Panel Switch Functions

| CONTROL | FUNCTION |
|---|---|
| VOL control | Adjusts volume. |
| SQ switch | Turns squelch circuit on and off. |
| Manual frequency selectors | Select the operating frequency when the mode selector is in the MANUAL position |
| Frequency/ channel indicator | Indicates the operating frequency of the UHF receiver and transmitter when the mode selector is in the MANUAL or READ position. |
| | Indicates the number of the preselected channel in use for UHF reception and transmission when the mode selector switch is in the PRESET position. |
| LAMP TEST pushbutton | Tests illumination of frequency/ channel indicator. |
| DIM control | Adjusts light intensity of frequency/channel indicator. |
| TONE pushbutton | When pushed, keys the set to produce a 1020-Hz tone through UHF communication set circuits that confirms operation. |
| Function selector | Selects type of operation and turns set on and off. |
| ADF | Not used in this installation. |
| BOTH | Enables guard receiver in addition to normal operation. |
| MAIN | Turns set on for normal operation. |
| OFF | Turns set off. |
| Selectable preset channels list | Numbered list of available preselected channels. |
| PRESET channel selector | Permits the selection of 20 preset channels. |
| Mode selector | Selects operating mode. |
| GUARD | Turns set to guard frequency for both transmission and reception and displays guard frequency on indicators. |
| MANUAL | Permits frequency selection by means of manual frequency selector controls. Frequency indicators will display selected frequency. |
| PRESET | Permits selection of 20 preset channels. Displays selected channel number on frequency indicators. |
| READ | Displays frequency of selected preset channel on indicator. |

#### 19.5.1.2 UHF Operation

##### 19.5.1.2.1 Turn-On Procedure

1. Function switch (UHF control panel) — SET AT MAIN OR BOTH POSITION AS REQUIRED.

**Note**

If function selector is at MAIN setting, only the normal UHF communications will be received. If selector is at the BOTH position, emergency communications on the guard channel and normal UHF communications both will be received.

##### 19.5.1.2.2 Receive Operating Procedure

1. Select mode and frequency as follows:

   a. Preset frequency

      (1) Mode selector — PRESET POSITION.

      (2) PRESET channel selector — ROTATE TO CHANNEL DESIRED, CONFIRMED BY CHANNEL READOUT ON INDICATOR.

**Note**

To confirm frequency of selected channel, place mode selector at READ, observe frequency displayed on indicator readout, then return mode selector to PRESET.

b. Nonpreset frequency

(1) Mode selector — MANUAL POSITION.

(2) Manual frequency selectors (four) — ROTATE TO SET DESIRED FREQUENCY AS DISPLAYED ON INDICATOR READOUT.

**Note**

The PRESET channel selector and manual frequency selectors are inoperative when the mode selector is set to GUARD position.

2. Volume — ADJUST.

**Note**

To adjust volume when audio is not being received, turn squelch switch OFF, adjust volume for comfortable noise level, then turn squelch switch ON.

3. Squelch — AS REQUIRED.

#### 19.5.1.2.3 Transmit Operating Procedure

1. Call switch (audio control panel, Figure 19-1) — CM POSITION.

   a. Radio transmit selector switch (instrument panel) — UHF.

2. Microphone switch (either PCL) — TRANSMITTER POSITION, HOLD TO TRANSMIT.

#### 19.5.1.2.4 Shutdown Procedure

1. Function switch — OFF.

### 19.5.1.3 UHF Emergency Operation

**Note**

Transmission on emergency frequency (guard channel) shall be restricted to emergencies only.

1. CALL switch (audio control panel, Figure 19-1) — CM POSITION.

   a. Radio transmit selector switch (instrument panel) — UHF.

2. Mode selector (UHF control panel) — GUARD POSITION.

**Note**

The PRESET channel selector and manual frequency selectors are inoperative when the mode selector is set to GUARD position. The receiver-transmitter will be set to emergency frequency only.

3. MICROPHONE switch (either PCL) — TRANSMITTER POSITION, HOLD TO TRANSMIT.

**19.5.2 Audio Control Panel.** A separate audio control panel (Figure 19-1) is part of the multifunction panel at each cockpit position. Both audio control panels are identical, having controls and switches that enable the selection and volume control of audio delivered to the respective headsets from UHF, TACAN, NACWS, and VOR receivers. Interphone audio volume may be controlled by the respective headsets and UHF transmission may be disabled from either cockpit.

#### 19.5.2.1 Audio Conrol Panel Switch Functions (Figure 19-1)

| CONTROL | FUNCTION |
|---|---|
| CALL switch | Selects CALL, HM, or CM mode. |
| HM | Enables interphone communication only between cockpits without need to use microphone select switch on PCL. |
| CM | Enables interphone communication between cockpits or UHF voice transmission from either junction with the microphone switch selection. |
| CALL | Enables interphone communication between cockpits by overriding but not deleting UHF communications. |
| AUDIO switches | Enable normal or emergency audio reception to respective headsets from UHF, TACAN, and VOR. |
| UHF, TACAN, and AUDIO switches | At “up” position, each switch directs the amplified audio signal to the respective audio headset. |
| | At OFF position, each switch prevents the respective audio signals. |
| | At EMERG AUDIO position, each switch directs the audio signal without amplification to the respective headset. |
| VOL switch | Adjusts volume of amplified interphone, TACAN, VOR, NACWS, and UHF audio. |

#### 19.5.2.2 Audio Panel Operation

**19.5.2.2.1 Turn-On Procedure.** Both audio control panels (amplifiers) are on whenever electrical power is applied to aircraft circuits if respective AUDIO circuit breakers are in.

#### 19.5.2.2.2 Receiver Operating Procedure

1. UHF, TACAN, and VOR switches — AS REQUIRED.

2. VOL control — ADJUST VOLUME CONTROL OF INDIVIDUAL SYSTEMS BEING MONITORED TO OBTAIN UNIFORM LEVELS. ADJUST ALL LEVELS WITH VOLUME CONTROL ON AUDIO PANEL.

#### 19.5.2.2.3 Transmit Operating Procedure

1. CALL switch — CALL, CM (cold mic), OR HM (hot mic) POSITION.

2. MICROPHONE switch — TRANSMITTER POSITION, HOLD WHILE TALKING.

**Note**

Either pilot may transmit regardless of whom has control (command) of radio.

#### 19.5.2.2.4 Intercommunication Procedure

1. CALL switch — CALL, HM, OR CM POSITION.

2. MICROPHONE switch (either) — INTERPHONE POSITION AND HOLD WHILE TALKING (only if CALL switch at CM position).

3. VOL switch (audio panel) — ADJUST AUDIO LEVEL IF DESIRED.

**Note**

In CALL position, any other audio signal is reduced and the interphone audio is increased.

**19.5.2.2.5 Shutdown Procedure.** The audio is on whenever power is on the aircraft. To shut down audio control panel amplifiers, shut off power to aircraft circuits or pull out respective AUDIO circuit breakers.

**19.5.3 Emergency Audio.** If audio panel amplifier fails, adequate signal levels may be directed to the headsets as follows:

1. UHF, TACAN, VOR switches (audio panel) — EMERG AUDIO POSITION.

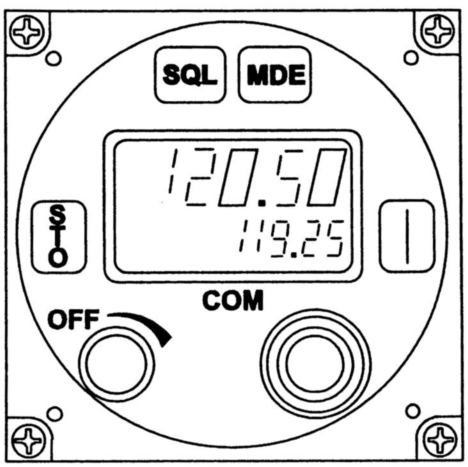
2. UHF, TACAN, VOR control panels — ADJUST INDIVIDUAL VOL CONTROLS AS DESIRED.

**19.5.4 BECKER AR4201 VHF Communication Set.** The VHF transceiver enables voice communication on 760 channels between 118.000 MHz and

136.975 MHz. Channel spacing is 25 kHz with a range of approximately 50 miles. Audio signals are applied through the VHF REC selector switch to the respective headset.

### 19.5.4.1 VHF Transceiver Functions

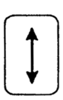
#### 19.5.4.1.1 Controls and Indicators




S-0067

Meaning of symbols on controls and indicators


Function Key — Selection of mode



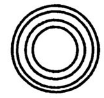
Exchange key

Mode 1:
Exchange of preset frequency and active frequency.

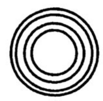
Mode 3:
Switching between temperature and operating voltage indication.


Store Key — Storage of set frequency or in Mode 2 a change between the channel section mode and scan mode.


Squelch key — Switching the squelch on or off. When the key is pressed, the bottom line indicated ON or OFF



Frequency selector switch (outer rotary switch) — Switching the indicated frequency in 1-MHz steps or the storage channel by 1 step in each case upwards or downwards, in steps of 10.



Frequency selector switch (inner rotary switch) — Switches the indicated frequency in 25-kHz steps or the storage channel by 1 step in each case upwards or downwards, without carry over.


ON/OFF switch, combined with volume control — Adjustment of volume

120.50 (top line) — Indication of active transmission/ reception frequency (active frequency)

(top line) — Transmission indication (transmission button is pressed)

119.25 (bottom line) — Indication of preset transmission/reception frequency (preset frequency).

CH99 (bottom line) — CH indication steady: Indicates the storage channel.


(bottom line) — CH indication flashes; if the initiated storage operation is not completed by pressing the store key.

On (bottom line) — Indication ON.

OFF (bottom line) — Indication OFF.

**Note**

The LCD display is backlit and is controlled by the console lighting rheostat. Flood light over the transceiver is increased by switching the circuit breaker panel lights on.

### 19.5.4.2 VHF Operating Instructions

#### 19.5.4.2.1 Switching on the Unit

**CAUTION**

Do not switch on the VHF transceiver when engines are being started or shutdown.

Switch on the VHF transceiver using the ON/OFF switch (rotate volume control clockwise).

Both LCDs must show the numbers 188.88 flashing (unit test approximately 2 seconds). If the test is positive, the UHF transceiver automatically switches to the mode that was selected before switch-off. If the test is negative, the LCD flashes for approximately 5 seconds. A fault report can be called up by pressing the store key. After approximately 5 seconds the VHF transceiver automatically switches to the mode that was selected before switch-off.

The following fault signals are possible:

| | |
|---|---|
| E1 | Processor defective |
| E2 | Synthesizer failed |
| E3 | Fault in EE-PROM |
| E4 | Controller (PIC) audio board defective |

**19.5.4.2.2 Transmit/Receive Mode.** Set the frequency of the local ground station in the preset display and press the exchange key. Rotate the VOL control to the center position. Operate the transmit button and call the ground station. Hold the microphone close to the lips for optimum speech transmission.

**Note**

- The arrow in the top line of the display indicates transmit mode. During transmission a protective circuit prevents a frequency change or frequency channel change even if the frequency selector switch is rotated. The keying functions on the control panel are also inhibited.
- If the error message E2 appears in the top line during operation, the synthesizer is not latching and further transmit/receive operation is no longer possible. The VHF transceiver must be checked for service.

Set the correct reception volume using the VOL control whilst the ground station is answering.

Switch on the squelch (muting) (press SQL key again). Weak reception signals and reception noises are suppressed. The switch-on threshold of the squelch can be set in the service mode.

**Note**

When changing the mode or the frequencies (PRESET-ACTIVE frequency) the change is automatically stored 2 seconds after the last change took place. Because of this delay, changes that were made immediately before switching off the transceiver will not be memorized. Exception: Memory actions as storage by pressing the STO key.

**19.5.4.2.3 Operation of the Various Modes.** The VHF transceiver performs various functions that are covered by individual operating modes.

The mode is selected by briefly pressing the MDE key. If it is pressed for a long time (more than 1 second) this selects mode 1.

Modes:

| | |
|---|---|
| 1 | Standard mode (display of active and preset frequency), setting the preset frequency and storing frequencies in the storage channels. |
| 2 | Display of the storage frequencies in the storage channels or calling up the scan function. |

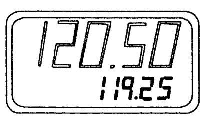
3 Display of active frequency, power supply voltage and temperature (option).

4 Service mode, for maintenance personnel.

**Note**

When changing the mode or the frequencies (PRESET-ACTIVE frequency) the change is automatically stored 2 seconds after the last change took place. Because of this delay, changes that were made immediately before switching off the transceiver will not be memorized. Exception: Memory actions as storage by pressing the STO key.

**19.5.4.2.4 Mode 1 (Standard Mode).** The last displayed active and preset frequencies appear in the LCD display.




The preset frequency (bottom line) is set using the MHz and kHz frequency selector switches.

When the exchange key is pressed, a change from the active to the preset frequency occurs. A further operation of the key cancels the frequency change.

Storage Operation. Pressing the STO key. The active frequency remains displayed in the top line. The VHF transceiver is ready to transmit and receive on this frequency. The preset frequency appears flashing in the bottom line. The required frequency can be set using the kHz frequency selector (steps of 1) or the MHz frequency selector (steps of 10). Pressing the STO key. The next free channel is shown flashing “ch” and the letter F (free channel) appears in the bottom line before CH. A no memory channel is free, the highest assign memory channel is selected automatically.

Press the STO key. The selected frequency is stored in the free channel and the storage process is ended.

or

Select the channel to be overwritten using the MHz/ kHz frequency selector and press the STO key. This means that this channel will be overwritten with the new frequency and the storage process ended.

**Note**

If no input takes place within approximately 7 seconds, the VHF transceiver switches to the previously set mode.

**19.5.4.2.5 Leaving the Mode.** To leave the mode, press the MDE key.

**19.5.4.2.6 Mode 2 (Display of Fixed Frequencies in the Various Channels).** Channel selection mode.

**Note**

If in mode 2 the scan function is switched on in the service mode, no storage operation can be activated in this mode.

Select mode 2 using the MDE key. The last indicated storage channel appears in the bottom line of the LCD and the stored frequency is shown in the top line. The VHF transceiver is ready to transmit and receive on this frequency.

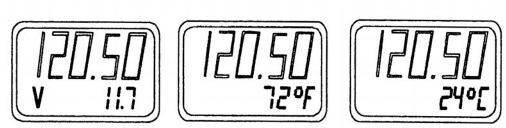

The required channel can be selected using the kHz frequency selector (steps of 1) or the MHz frequency selector (steps of 10). Free channel (no frequency stored) will be skipped when selected.

Exit from mode 2 is achieved by pressing the MDE key.

**19.5.4.2.7 Mode 3 Indication of Operating Voltages.** When the exchange key is pressed, a change from the supply voltage and temperature indication occurs.

**Note**

If no temperature is connected, this mode is skipped when the exchange key is pressed.



The operating voltage and temperature are continuously measured. Indication takes place in mode 3. The mode is selected by briefly pressing the MDE key once or several times (depending on the previous state). The active frequency on which the VHF transceiver is ready for operation appears in the top line and the bottom line shows the measured voltage.

The active frequency can be changed using both frequency selector switches. A storage operation is activated using the STO key. This procedure is described in Mode 1.

**19.5.4.3 VHF Selector Switch Operation.** The radio transmit switch, located above the clock in each cockpit, selects which radio will transmit when the PCL transmitter/interphone switch is pushed up. VHF REC switch when selected will apply the VHF audio signal to the headset in that cockpit.

**Note**

UHF Frequency 243.0 Guard must be monitored at all times.

## 19.6 NAVIGATION

**19.6.1 VIR-30A VOR Receiver.** This unit receives and interprets VOR and localizer signals in the frequency range of 108.00 to 117.95 MHz. Indications of the VOR system are displayed on RMI, CDI, and frequency indicators in each cockpit. Audio signals from the selected VOR station are fed through the separate audio control panels to the headsets. The VOR receiver cannot obtain power unless the AVIONICS MASTER switch is ON, which in turn receives power from the MASTER UTIL circuit breaker on the forward circuit breaker panel (Figure 1-2). VOR antennas are shown in Figure 1-1.

### 19.6.1.1 VOR Control Panel Switch Functions (Figure 19-2)

| CONTROL | FUNCTION |
|---|---|
| Frequency Indicator | Indicates the operating frequency. |
| Manual frequency selector | Used to select operating frequency of VOR. |
| VOL control | Adjusts volume. |
| Power Switch | |
| ON | Turns on VOR receiver and control circuit to RMIs. |
| OFF | Turns off VOR receiver and control circuit to RMIs. |
| SYS TEST | Applies self-test signals to VOR receiver (switch located on TACAN control panel). |

### 19.6.1.2 VOR Receiver Operation

**Note**

VOR operation is controlled from the cockpit position having avionics command only. Controls of the other cockpit are deactivated. Indicators within the deactivated cockpit (VOR needle and operating frequency) are slaved to read the same as indicators within the command cockpit. The CDIs receive information from the command cockpit using the VOR-TACAN select switch set to VOR. OBS adjustment on the CDI indicators, however, must be accomplished individually. With GPS in GPS mode, CDI will show GPS information only.

1. Turn-on procedure: Power switch — ON.
2. Test button (on TACAN control panel) — DEPRESS. Read 188.88 in VOR frequency display.
3. SYS TEST button (on TACAN control panel) — DEPRESS. VOR bearing needle in RMI should indicate 000° to 005°.
4. VOR receiver operating procedure
   a. Frequency selectors (2) — SELECT.
   b. VOL control — AS REQUIRED.
   c. VOR-TACAN switch (instrument panel, Figure 19-2) — VOR
   d. OBS control (CDI, Figure 19-2) — SET TO REQUIRED COURSE.
   e. CDI — READ LATERAL DEVIATION FROM SELECTED COURSE.
   f. To determine course to station on CDI (Figure 19-2):

(1) OBS control — ROTATE KNOB UNTIL COURSE DEVIATION POINTER IS CENTERED AND TO-FROM FLAG READS TO.

(2) Course index — READ COURSE TO STATION.

g. To determine bearing from station from CDI:

(1) OBS control — ROTATE KNOB UNTIL COURSE DEVIATION POINTER IS CENTERED AND TO-FROM FLAG READS FROM.

(2) Course index — READ BEARING FROM STATION.

h. To determine course to station on RMI (Figure 19-2):

(1) VOR-TACAN switch (instrument panel, Figure 19-2) — VOR.

(2) Yellow, single-width needle on RMIs — READ COURSE TO STATION (not applicable to localizer).

**Note**

- The VOR-TACAN switch does not affect the RMI. However, it is recommended that this switch be in the VOR position when navigating with the VOR, since the red "NAV" flag in the IND-350 provides the only positive visual indication of an unreliable VOR signal.
- When a localizer frequency is tuned, the VOR parks at the 3- and 9-o'clock positions on the RMI. The OBS knob and TO-FROM indicators are disabled. (Course selection does not affect the CDI and both TO-FROM flags disappear from view.)

5. Shutdown procedure: Power switch — OFF.

**19.6.2 TCN-40 TACAN Radio.** The TACAN radio is an airborne navigational unit that operates in conjunction with TACAN ground stations to provide bearing and distance to a selected station. Visual indications to station are displayed on the course deviation indicators and the radio magnetic indicators (Figure 19-2). Distance to station is displayed on the two NACWS Control Display Units (CDUs) located in the forward and aft cockpits. Application of power, channel, and mode selection is provided by the TACAN control panel (Figure 19-2). TACAN operates on any one of 126 preset channels. An audio tone is applied through the separate audio control panels to the headsets indicating TACAN signal reception. The TACAN radio set cannot obtain power unless the AVIONICS MASTER switch is ON, which in turn receives power from the 25-ampere MASTER UTIL circuit breaker on the forward circuit breaker panel (Figure 2-7). In addition, a 5-ampere TACAN circuit breaker and a 1-ampere TACAN ac circuit breaker are on the forward circuit breaker panel. The aft circuit breaker panel also has a 1-ampere TACAN ac circuit breaker. The associated antenna is illustrated in Figure 1-1.

#### 19.6.2.1 TACAN Control Panel Switch Functions (Figure 19-2)

| CONTROL | FUNCTION |
|---|---|
| TEST pushbutton | Checks digital readouts on VOR. |
| Channel indicator | Indicates operating channel. |
| Channel selector | Enables manual selection of 126 preset TACAN channels for receiving and transmitting. |
| Mode selector | Determines operating mode. |
| OFF | Turns set off. |
| STBY | Turns set on and allows reception of course information only. |
| T/R | Selects transmit and receive function of receiver-transmitter for course and distance information. |
| VOL | Adjust volume. |
| SYS TEST pushbutton | Applies self-test signals to TACAN receiver-transmitter and associated components. |

#### 19.6.2.2 TACAN Radio Operation

**Note**

TACAN operation is controlled by the cockpit position having avionics command only. Controls of the other cockpit are deactivated. Indicators within the deactivated cockpit (RMI, CDI, operating frequency) are slaved to read the same as indicators in the command cockpit. OBS adjustment on the CDI indicators, however, must be accomplished separately.

#### 19.6.2.2.1 TACAN Test

1. Test pushbutton — DEPRESS. LED readout should display “188X.”

2. SYS TEST pushbutton — DEPRESS. TACAN bearing needle on RMI should point to approximately 180°. TACAN needle will indicate 180° ±3.5°. VOR needle will indicate 000° to 005°.

#### 19.6.2.2.2 TACAN Turn-On Procedure

1. Mode selector — T/R.

2. VOL control — AS REQUIRED.

**19.6.2.2.3 TACAN Operating Procedure.** To determine course and range to a selected ground station:

1. Channel selector — AS REQUIRED.

2. Mode selector — T/R.

3. VOR-TACAN switch — TACAN.

4. Double needle on RMIs (Figure 19-2) — READ COURSE.

5. Distance display (DME, Figure 19-3) — READ RANGE.

**Note**

NACWS must be turned ON in order for the DME display to function.

6. The procedures for using the CDI during tacan operation are the same as those used with the VOR.

**19.6.2.2.4 TACAN Distance Display — DME (Figure 19-3).** Each cockpit has a DME display that indicates the distance in nautical miles to the selected TACAN station. DME distance is displayed on the NACWS CDU located in each cockpit. The CDU is capable of displaying a number of different screens and DME distance is displayed on all of them. In order for the DME indicator to be operational, NACWS must be turned ON and the TACAN mode selector must be set to T/R. Figure 19-3 shows the NACWS primary DME screen (default screen).

**19.6.3 IND-350 Course Deviation Indicator.** Each cockpit station has a course deviation indicator (CDI, Figure 19-2) to indicate the aircraft’s actual course of flight relative to a course selected with the OBS knob. The CDI in each cockpit is individually set to a desired course heading with the respective OBS selector to or from the selected NAVAID. The NAVAID for both CDIs is determined by the cockpit having avionics command. The CDI needle of the cockpit selecting a center vertical position will deflect left or right of center if the flight course drifts. The VOR-TACAN selector switch and the OBS selector knob on one cockpit CDI do not affect operation of the other CDI. The amount of drift will be indicated in degrees of course deviation to the right or left of centered alignment, 2° per mark. To correct for a course deviation drift, proper sensing is determined and the aircraft is turned toward the direction of needle deflection. When course alignment is reestablished, the CDI needle will be at the center vertical position for the cockpit from which the correction is being made. The TO/FROM indicators in the CDI will indicate whether

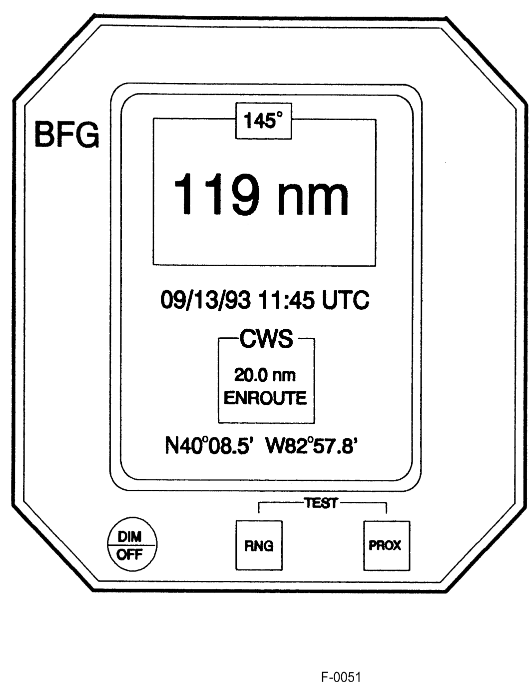



Figure 19-3. NACWS CDU Primary DME Screen

the course selected by the OBS knob will take the aircraft to or from the selected NAVAID. The VOR-TACAN switch above each NACWS CDU selects which navigation system and power source will control the respective indicator. A red off flag will appear in the CDI anytime the respective NAVAID selected is not strong enough to lock on and indicates an unreliable signal.

**Note**

With the VOR tuned to a localizer frequency and the VOR-TACAN switch in the VOR position, the CDI indicates 0.5° of deviation per mark. When a back course localizer frequency is tuned, the CDI will give reverse-sensing indications.

**19.6.4 VOR-TACAN Select Switch.** Each cockpit has a VOR-TACAN toggle switch (Figure 19-2). This switch selects either the VOR or the tacan navigation system as the source of control for the respective CDI indicator.

**19.6.5 332C-10B Radio Magnetic Indicator.** Each cockpit has a radio magnetic indicator (Figure 19-2) that shows the relationship between actual aircraft heading and the Earth's magnetic field. The compass function is stabilized by directional gyros. A single needle points toward the magnetic course to a VOR station if the VOR system is in use. A double needle points toward the magnetic course to a tacan station if tacan is in use. A 5-ampere RMI circuit breaker protects dc circuits, and 1-ampere tacan ac, VOR ac, and RMI ac circuit breakers protect ac RMI circuits.

**19.6.5.1 RMI Disable Switch.** In the forward cockpit, an RMI—ON/OFF toggle switch controls activation of the aft cockpit RMI indicator. At the ON position, the aft RMI is activated; at the OFF position, it is disabled leaving only the forward RMI functioning.

**Note**

The RMI will be in the free gyro (DG mode) when the rear cockpit has avionics command and the rear cockpit RMI is disabled. The front cockpit pilot must continually check the standby magnetic compass to ensure proper aircraft heading is being maintained.

**19.6.6 TDR-950 Transponder.** The transponder is an identification, position tracking, altitude reporting, and emergency tracking device. An operating transponder responds to interrogations by search radar. Dual transponders are installed: one located in each cockpit (Figure 19-2). Each transponder is an independent unit; however, only the unit controlled from the cockpit position having avionics command will operate at one time. Both transponders receive power from a 5-ampere XPOND circuit breaker on the forward circuit breaker panel (Figure 2-7).

#### 19.6.6.1 Transponder Control Panel Switch Functions

| CONTROL | FUNCTION |
|---|---|
| Function Selector | |
| OFF | Turns set off. |
| STBY | Engages set,but disables usage. |
| ON | Turns set on to reply to mode 3/A (position) Interrogations, but disables altitude transmission. |
| ALT | Adds mode C (altitude) pulses to the mode 3/A pulse group. |
| TST | Illuminates REPLY lamp to confirm transponder operation. |
| REPLY, IDENT, DIM | This is a single control for engaging three functions. In ON or ALT mode, REPLY lamp will flash on and off when responding to radar interrogations. |
| | In ON or ALT mode, pressing IDENT button will transmit an identification pulse and REPLY. |
| | Rotating IDENT button controls intensity of REPLY lamp by a rheostat. |
| Code selector switches | Used to select desired code. |

#### 19.6.6.2 Transponder Operating Procedure

**Note**

Transponder control is limited to the cockpit having avionics command.

#### 19.6.6.2.1 Transponder Turn-On and Test Operating Procedure

1. Function selector — SBY.

2. Code selector switches — SET ASSIGNED FREQUENCY.

3. Function selector (after 20 seconds wait) — TST.

**Note**

REPLY lamp will illuminate and remain on while switch is at TST position if transponder is operational.

#### 19.6.6.2.2 Identification and Altitude Transmission Operating Procedure

1. Code selector switches — SET ASSIGNED FREQUENCY.

2. Function selector — ALT.

**Note**

- REPLY lamp will flash on and off when responding to ATC radar interrogations.

- If ATC should request aircraft to “squawk ident,” momentarily press IDENT button. The REPLY lamp will remain on for about 20 seconds after the IDENT button is released.

#### 19.6.6.2.3 Shutdown Procedure

1. Function selector — OFF.

### 19.6.6.3 Transponder Emergency Operation

1. Code selector switches — SET ASSIGNED EMERGENCY CODE.

2. Function selector — ALT OR ON.

**19.6.7 Encoding Altimeter.** An encoding altimeter (Figure 1-4) is located on the instrument panel of the forward cockpit. A similar altimeter is located on the instrument panel of the aft cockpit. Both instruments provide a visual indication of altitude. The forward unit sends coded present altitude information to NACWS and to the operating transponder to ground air traffic control. To minimize function error, a vibrator element is incorporated within each altimeter. Both altimeters have self-contained units that consist of a precision pressure altimeter with pneumatic-driven counter-drums and needle pointer. The forward altimeter includes an altitude encoder that is protected by a 5-ampere ALTM ENC circuit breaker located on the forward circuit breaker panel (Figure 2-7). The circuits of both altimeters are protected by a 5-ampere ALTM VIBR circuit breaker on both circuit breaker panels (Figure 2-7).

**Note**

Manually adjusting the barometric set knob will not vary the mode C signal received by the monitoring radar.

### 19.6.7.1 Encoding Altimeter Control-Indicator Functions (Figure 1-4)

| CONTROL | FUNCTION |
|---|---|
| Barometric set knob | Adjusts barometric pressure setting in inches Hg. |
| 10,000-foot counterdrum | Indicates aircraft altitude in ten thousands of feet. |
| 1,000-foot counterdrum | Indicates aircraft altitude in thousands of feet |
| 100-foot counterdrum | Indicates aircraft altitude in hundreds of feet |
| SIngle needle pointer | Indicates aircraft altitude in hundreds of feet in 50-foot increments. |
| Diagonal warning symbol | Appears on the 10,000-foot counter when aircraft is below an altitude of 10,000 feet. |
| CODE OFF flag (red) | Presence in upper left portion of instrument face indicates altitude encoder is inoperative and the system is not operating or the code flag has failed. |
| IN. HG. window | Indicated barometric pressure in inches of mercury as adjusted by the barometric set knob. |

### 19.6.7.2 Encoding Altimeter Operation

#### 19.6.7.2.1 Turn-On Procedure

1. Battery switch — ON.

2. Transponder — SBY, WAIT 20 SECONDS, THEN ALT (for in-flight altitude reporting).

#### 19.6.7.2.2 Operating Procedure

1. Barometric set knob — SET BAROMETRIC PRESSURE IN IN. HG. WINDOW.

**Note**

- The altimeter can be set at any time, power ON and OFF, but the needle will not be entirely accurate until the vibrator has been on for at least 1 minute.
- During normal use of the barometric knob, if momentary locking of the barocounters is experienced, do not force the setting. Application of force may cause internal gear disengagement and result in excessive altitude errors. If locking occurs, rotate the knob a full turn in the opposite direction and approach the setting again with caution.
- Manually adjusting the barometric set knob will not vary the mode C signal received by the monitoring radar.

2. CODE OFF flag — CHECK (not visible).

**Note**

If the CODE OFF flag is visible, either dc power is off, the circuit breaker is not set, or there is an internal altimeter encoder failure, since the CODE OFF flag monitors only the encoder function of the altimeter and not transponder condition. The altitude reporting function may be inoperative without the CODE OFF flag showing in case of transponder failure or improper control settings. It is also possible to get a good altitude transmission test on the transponder control with the CODE OFF flag showing. If the CODE OFF flag remains visible, radio contact should be made with a ground radar site to determine if the altitude reporting function is operative.

3. Single-needle pointer — CHECK OPERATION.

**Note**

- The altimeter is equipped with a dc-powered internal vibrator that is required to overcome friction and assure accuracy. If the vibrator becomes inoperative because of internal failure or dc power failure, the pointer may momentarily hang up when passing from "9" through "0" while climbing, or from "0" through "9" while descending. This hangup will cause lag, the magnitude of which will depend on the vertical speed of the aircraft and the friction in the altimeter. Pilots should be especially watchful for this type of failure when the minimum approach altitude lies within the "8" to "2" part of the scale, 800 to 1,200, 1,800 to 2,200, etc.
- If the altimeter does not read within 75 feet of field elevation when the correct local barometric setting is used, the altimeter needs rezeroizing or internal failure has occurred. An error of greater than 75 feet also nullifies use of the altimeter for IFR flight.

#### 19.6.7.2.3 Encoding Altimeter Emergency Operation

1. Altimeter circuit breakers — PULL (if encoder fault occurs).

**19.6.8 Emergency Locator Transmitter.** The ELT (Figure 19-1) is a self-contained transmitter designed to send location homing signals over a special emergency channel during times of emergency usually associated with a downed aircraft. This transmitter is affixed within a holding bracket located at the aft end of the left side panel assembly in the forward cockpit position. It is designed to be triggered into automatic transmission whenever an impact force exceeds a preset threshold. The ELT is also provided with manual controls to enable the pilot to initiate operation, terminate operation, or reset the unit to an armed mode. Self-contained batteries provide operation for a minimum of 48 hours. During operation, the ELT radiates an omnidirectional RF signal on the international distress frequencies of 121.5 and 243.0 MHz. The radiated signal is modulated with an audio A9 swept tone.

#### 19.6.8.1 Emergency Locator Transmitter Switch Functions (Figure 19-1)

| CONTROL Function switch | FUNCTION |
|---|---|
| OFF | Establishes “readiness” state to start automatic emergency signal transmissions when force of impact exceeds a preset threshold. |
| ON | Turns set on initiating emergency signal transmissions. |

#### 19.6.8.2 Use of Emergency Locator Transmitter

1. Turn switch — ON.

**Note**

UHF voice communications capability could be lost if the ELT is turned on while attached to the aircraft’s ELT antenna or with the ELT placed within 100 feet of the aircraft. Should homing capability and UHF communication be desired simultaneously, the two transmitters must be physically separated by 100 feet.

2. If possible, verify ELT signal transmission by following procedure:

   a. If aircraft UHF communication radio still functions — Establish voice contact with closest ATC or aircraft.

   b. Request contact to set VHF radio to 121.5 MHz frequency and listen for ELT signal.

   c. Turn selector of ELT ON and OFF, as required, while in voice contact to aid other party in identification of your ELT signal from other possible ELT signals.

**Note**

- If the aircraft is located in a valley, it is suggested to transport ELT to a clearing on top of a knoll, top of a hill, or other high place to achieve greater transmission range. The antenna must point upward for best results.
- Under normal temperature conditions, 60 to 80 °F (16 to 27 °C), the ELT will continue to emit signals for over 100 hours, although not at full output power. For extended operation, turn the ELT off intermittently as this will extend the battery life.
- The ELT will operate in temperatures of –40 to +132 °F (–40 to 56 °C); however, at the extremes some performance is lost.
- The ELT is water resistant and is not affected if submerged for up to 20 hours. The shock of an emergency landing (ground or water) will activate the unit. Should a water landing be made, attempt to retrieve the ELT as soon as possible before the aircraft is submerged.

## 19.7 NAVAL AIRCRAFT COLLISION WARNING SYSTEM (NACWS 991)

**19.7.1 Description.** NACWS alerts the pilot to the presence of aircraft that pose a collision threat. Its prime objective is to assist the pilot in visually acquiring aircraft, allowing him to make collision avoidance decisions. NACWS simultaneously tracks up to 50 transponder-equipped aircraft to a maximum distance of 20 nm. NACWS is unable to detect and track aircraft that do not have an operating air traffic control transponder.

The NACWS system consists of an avionics bay-mounted transmitter/receiver computer (TRC), a TRC remote rack, two cockpit-mounted control display units, two L-band monopole antennas, and a global positioning system antenna. NACWS operates in conjunction with aircraft navigation equipment from which it receives heading, altitude, and DME data. Additionally, NACWS monitors ATC Secondary Surveillance Radar (SSR) interrogations and aircraft transponder replies. DME data is processed for display on the CDU but is not required for NACWS operation. NACWS circuits are protected by 5-ampere and 1-ampere circuit breakers on the forward circuit breaker panel. In addition, the NACWS forward and aft CDUs are protected by 2-ampere circuit breakers on the forward and aft circuit breaker panels, respectively. CDU is powered by 28 Vdc and the TRC is powered by 28 Vdc and 26 Vac.

**19.7.2 Collision Warning.** The host aircraft is surrounded by a cylinder-shaped volume of airspace known as the protection zone. If an intruder is on a course to penetrate the protection zone, NACWS issues a traffic advisory. TAs flash associated symbols on the CDU and broadcast warning tones over the headset. When a threat has been established, visual acquisition and avoidance procedures are used to avoid the threat. Two modes of operation are supported: passive and active.

The passive detection mode is the NACWS primary operating mode. In passive detection mode, NACWS monitors secondary surveillance radar (SSR) interrogations and other aircraft replies. It correlates SSR rotation rate data with interrogation/reply elapsed time to compute other aircraft position (in azimuth) relative to the SSR. By combining other aircraft position and mode C data with its own aircraft latitude/longitude, heading, and altitude data, NACWS computes range, bearing and relative altitude of nearby aircraft. While in the passive mode, NACWS monitors a 20-nm radius of airspace.

In active detection mode, ground-based radars are not required. NACWS transmits its own interrogations of aircraft transponders and listens for replies. The elapsed time between interrogation and reply determines other aircraft range. If the other aircraft is transmitting mode C data, relative altitude is also determined. While in the active mode, NACWS monitors a 6-nm radius of airspace.

NACWS also allows the pilot to display and monitor proximate (nonthreat) traffic within a cylinder-shaped volume of airspace known as the proximity zone. The zone can extend up to 20 nm horizontally and ± 2,700 feet vertically around the host aircraft. The size of the zone is selectable in ranges to account for the traffic volume and to reduce display clutter. Traffic in the proximity zone is graphically displayed on the CDU. It indicates the range, bearing, and relative altitude of up to 20 aircraft within the zone and distinguishes between threat and nonthreat aircraft. Threat aircraft are displayed on the CDU regardless of the proximity zone range selected.

**19.7.3 Detection Characteristics.** There are four characteristics that affect target detection: radar environment, antenna shadowing, invalid data, and misleading data.

1. Radar environment — The passive mode requires valid SSR interrogations. If interrogations are not detected or are invalid, passive mode will be inoperative.

2. Antenna shadowing — Both passive and active modes require valid replies to interrogations. If an intruder is positioned such that it blocks its own transponder transmissions, it will not be detected.

3. Invalid data — Both passive and active modes require valid own altitude input. Additionally, the passive mode requires valid position (latitude/longitude) and heading inputs.

4. Misleading data — Both passive and active modes require valid mode C data in order to display relative altitude of an intruder. If mode C data is missing or invalid, NACWS assumes the intruder to be at its altitude.

**19.7.4 Limitation.** NACWS is an aid in detecting other aircraft and provides a means for the pilot to visually acquire and avoid aircraft that pose a collision threat. It is not a replacement for ATC, nor for see-and-avoid procedures.

NACWS relies on information from transponders in nearby aircraft. NACWS does not detect or track aircraft that are not equipped with an operating ATC transponder.

When flying in formation, the lead aircraft or the aircraft with an operating ATC transponder should be the only one with NACWS turned ON.

#### 19.7.5 Controls and Indicators. (Figure 19-4)

| CONTROL | FUNCTION |
|---|---|
| DIM/OFF switch | Controls power to the TRC and CDU. Power is applied by rotating the knob clockwise past the detent. Continued rotation in creased display brightness. |
| RNG pushbutton | Selects display range. Each press cycles the range to its next setting (20, then 10, 5, 3, and 1.5 nm). |
| PROX pushbuttons | Displays traffic information. The traffic display will remain on the CDU as long as the PROX pushbutton is depressed and for 45 seconds after it is released. |

**Note**

To initiate a system test, press and hold the RNG pushbutton and then press the PROX pushbutton. This feature is only available when the aircraft is on the ground.

#### 19.7.6 NACWS Operation

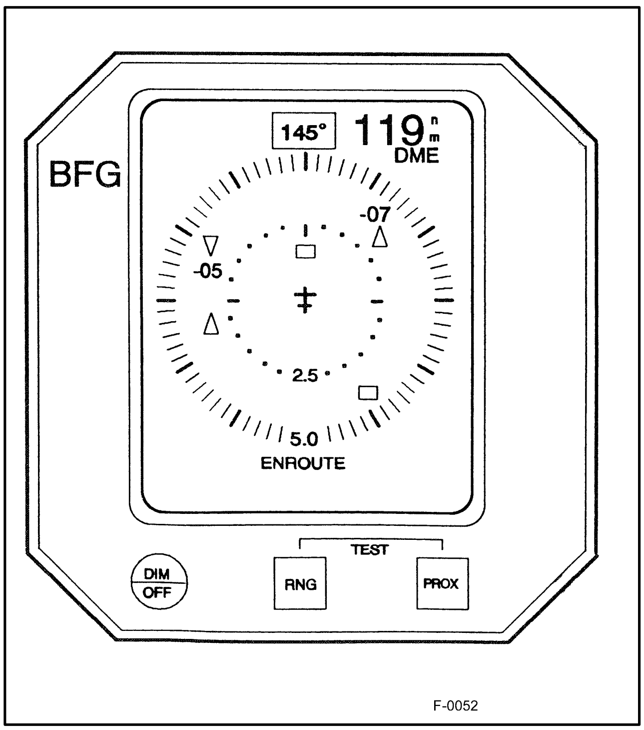



Figure 19-4. Proximity Screen

**19.7.6.1 Turn-on Procedure.** When turned on, NACWS will initialize and run a self-test.

1. Turn the DIM/OFF switch to ON.
2. Observe the CDU primary DME screen for the correct date and the current Greenwich mean time to within ±15 minutes. If not correct, reset per paragraph 19.7.6.2.
3. Listen to headset for TA tones (six tones in 2 seconds) and observe CDU for messages as NACWS acquires valid GPS satellite signals and determines current position.
4. If the initialization checks and system test are not successful, the system will display a CWS FAILED message on the primary DME screen. NACWS is inoperative, but the DME display is still functional.

**19.7.6.2 Setting Date, Time, and GPS Position.** NACWS requires the correct date and current GMT time to synchronize with GPS satellite signals and determine current position. Use the following procedures to set the correct date, the current GMT time, and the current GPS position.

a. Turn the DIM/OFF switch to OFF.

b. While pressing the RNG and PROX pushbuttons, turn the DIM/OFF switch to ON. The system will display the GMT time screen.

c. Press the RNG pushbutton to select the line to be edited and the PROX pushbutton to change the line data. Repeat for all lines to be edited.

d. When finished editing GMT time, select the SET TIME line and press the PROX pushbutton. The system will accept the changes and display the UPDATED message.

e. Press the PROX pushbutton to display the GPS position screen.

f. Press the RNG pushbutton to select the line to be edited and the PROX pushbutton to change the line data. Repeat for all lines to be edited.

g. When finished editing GPS position, select the SET POSITION line and press the PROX pushbutton. The system will accept the changes and display the UPDATED message.

h. Press the PROX pushbutton and continue with the turn-on procedure.

**19.7.6.3 System Test.** Perform the system test prior to the first flight of the day. The system test is enabled only when the aircraft is on the ground.

1. Set the pilot's encoding altimeter to 29.92 and observe the indicated pressure altitude.

2. With NACWS turned ON, press and hold the RNG pushbutton and then press the PROX pushbutton.

3. Confirm that the altitude displayed on the CDU is within ±125 feet of the altitude indicated on the pilot's encoding altimeter. If the displayed altitude is not within limits, turn NACWS off and service as soon as possible.

4. Confirm that the heading displayed on the CDU corresponds with the compass/directional gyro reading to within ±5°. If not within limits, the displayed heading and the passive mode will be unreliable. Service the system as soon as possible.

5. Confirm that the DME distance displayed on the CDU corresponds with the distance to the selected tacan station. If valid tacan signals are not received, the DME distance will be displayed as a series of dashes.

6. Confirm that urgent TA tones (12 tones in 2 seconds) are broadcast over the headset. If tones are not broadcast, service the system as soon as possible.

7. At the conclusion of the test, listen to the headset and observe the CDU for messages.

   a. If the "CWS TEST PASSED" message is broadcast over the headset and the primary DME screen is displayed on the CDU, the test is successful.

   b. If the "CWS TEST FAILED" message is broadcast over the headset, NACWS is inoperative, but the DME display is still functional

8. Reset the pilot's encoding altimeter to the current barometric setting.

**19.7.6.4 Primary DME Screen.** The primary DME screen (Figure 19-3) is displayed on the CDU when there are no TAs. This screen displays the following information from top to bottom on the CDU: heading, DME distance, current date and time, selected range (20, 10, 5, 3, or 1.5 nm), operating mode (ENROUTE or LANDING), and current latitude/longitude position.

**19.7.6.5 Range Selection.** After turn-on, the system automatically selects the 1.5-nm range. Select a different display range by pressing the RNG pushbutton on the CDU. Each press of the RNG pushbutton cycles the range to its next setting (20, then 10, 5, 3, and 1.5 nm). Changing the selected range defines the radius of the proximity zone and also determines the operational mode of the system. When a 20-, 10-, 5-, or 3-nm range is selected, the system operates in en route mode. When the 1.5-nm range is selected, the system operates in landing mode.

Threat aircraft are displayed regardless of the proximity zone range setting. NACWS always monitors a full 20-nm radius of airspace in passive mode; the range setting only determines the area that is displayed on the CDU.

**19.7.6.6 En Route Mode.** En route mode provides larger proximity and protection zones around the aircraft. Larger zones are used because of the predominantly higher airspeeds and lower traffic volume while en route. The proximity zone radius is determined by the selected range. Its height extends ±2,700 feet from the aircraft. The protection zone radius extends 1 nm horizontally and ±500 feet vertically around the aircraft. While in the en route mode, NACWS will issue an initial TA when an intruder is 20 seconds from the protection zone.

**19.7.6.7 Landing Mode.** Landing mode reduces the size of the proximity and protection zones. Smaller zones are used because of the predominately lower airspeeds and increased traffic while in the pattern. The proximity zone radius extends 1.5 nm horizontally and its height is reduced to ±500 feet. The protection zone height remains at ±500 feet, but its radius is reduced to 0.1 nm. While in the landing mode, NACWS will provide TAs only when the traffic is 10 seconds from the protection zone to reduce the number of distractions during landing.

**19.7.6.8 Display Traffic.** Traffic within the selected range is displayed on the CDU when the PROX pushbutton is pressed. When NACWS issues a TA, intruders are displayed regardless of the selected range. The display will remain on the CDU as long as there is a valid TA or as long as the PROX pushbutton is depressed. The display returns to the primary DME screen 45 seconds after the TA is lifted or 45 seconds after the PROX pushbutton is released.

Under normal conditions, the system operates in the passive and active detection modes simultaneously. As long as the passive detection mode is functional, the system will display the proximity screen to show nearby traffic. If the passive mode becomes inoperative, the system will use the active-only screen to display TAs.

**19.7.6.9 Passive Mode Proximity Screen.** The proximity screen (Figure 19-5) shows the most complete information about nearby traffic. At the center of the display is the host aircraft symbol surrounded by two range rings. The outer ring represents the selected range and defines the radius of the proximity zone. The inner ring radius is one-half of the selected range. Current heading is displayed at the top of the screen. DME distance is displayed in the upper right corner. The current operational mode (ENROUTE or LANDING) is displayed near the bottom of the screen.

Traffic within the selected range is displayed on the screen with appropriate relative altitude symbols. The symbols include upward and downward pointing triangles, a rectangle, a circle, and a relative altitude data tag. Symbol locations on the screen correspond with bearing and range from the host aircraft. Upward and downward pointing triangles represent aircraft 900 to 2,700 feet above or below the host. A rectangle represents aircraftwithin ± 300 feet of the host, considered to be at the same altitude. A circle represents aircraft whose altitude is unknown. An aircraft 400 to 900 feet above or below the host is indicated by a relative altitude data tag displayed with the appropriate upward or downward pointing triangle. Aircraft more than 2,700 feet above or below the host will not be displayed unless they generate TAs.

NACWS cannot determine relative altitude for aircraft not transmitting valid mode C data. In this case, NACWS displays the aircraft with an unknown altitude

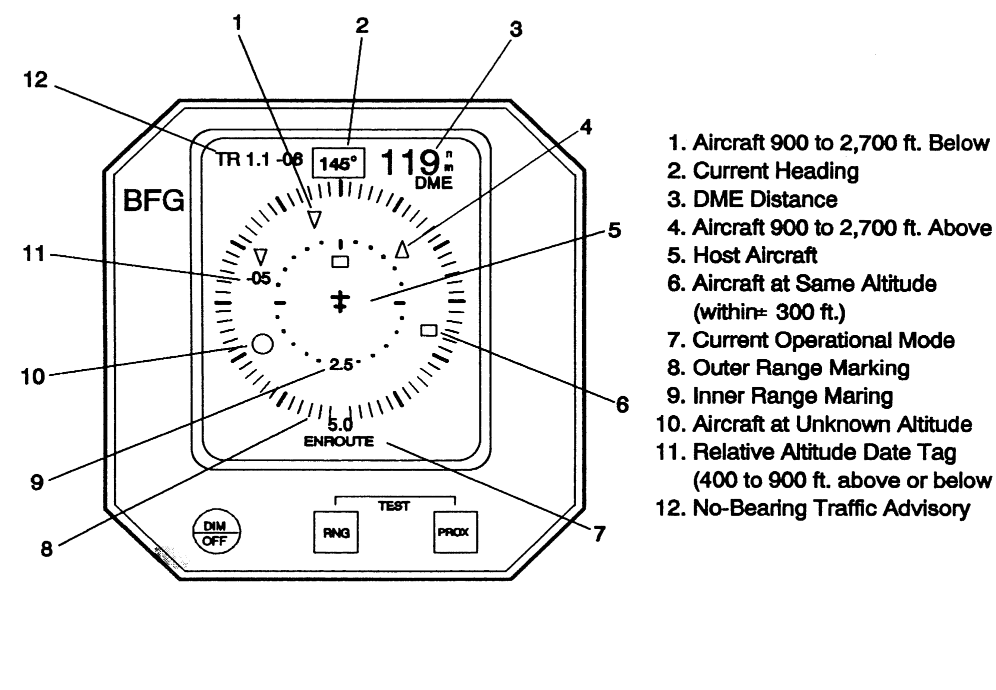



Figure 19-5. Proximity Screen Symbols

symbol. For the purposes of threat calculations, however, NACWS treats the aircraft as though it is at the same altitude.

**19.7.6.9.1 Traffic Advisories.** A TA is indicated by a flashing relative altitude symbol. The symbol will continue to flash as long as the intruder poses a collision threat. TAs are displayed regardless of the selected proximity zone range. In en route mode, intruders within 20 seconds of penetrating the protection zone will generate a TA tone (six tones in 2 seconds). In landing mode, intruders within 10 seconds of the protection zone will generate urgent TA tone (12 tones in 2 seconds).

**19.7.6.9.2 Relative Altitude Data Tags.** Data tags will be displayed with the relative altitude symbol if the intruder is transmitting altitude information and is between 400 and 900 feet above or below the host. Traffic with a relative altitude greater than ±900 feet will not display an associated data tag.

Data tags show the relative altitude in hundreds of feet above or below the host aircraft. If the intruding aircraft is above, its data tag will be displayed above its relative altitude symbol. If the intruder is below, the data tag will appear below its relative altitude symbol.

**19.7.6.9.3 No-Bearing Traffic Advisories.** If the bearing of intruder aircraft cannot be determined, NACWS will display potential collision threats as no-bearing TAs. No-bearing TAs are digitally displayed in the upper left corner of the proximity screen and include range data and, if available, relative altitude data. As many as three no-bearing TAs can be displayed at one time, with the highest priority TA listed first.

**19.7.6.10 Active Mode Active-Only Screen.** When the passive detection mode is not available, NACWS will continue to provide traffic advisories through the active-only screen (Figure 19-6). The screen shows a prioritized list of up to eight TAs, with the highest priority TA listed first. The list includes the appropriate intruder relative altitude symbol, intruder range, and, if available, relative altitude. Intruders not transmitting mode C data will be listed with an UNKNOWN altitude. Near the bottom of the screen, the system displays the current operational mode (ENROUTE or LANDING). Although range selection does not affect the active mode, pressing the RNG pushbutton several times will cycle through the range selections and select ENROUTE or LANDING mode. The active-only screen lists TAs only. Nonthreat proximate traffic is excluded from this display. Additionally, the active-only screen does not display the relative bearing of intruders.

**19.7.6.11 Response to Traffic Advisories.** Respond to TAs by attempting to establish visual contact with the intruder aircraft. If visual contact cannot be established, ATC can be contacted for additional traffic information.

**WARNING**

Maneuvers based solely on NACWS displays are not recommended. Information shown on the displays is an aid to visually acquire traffic only.

When the intruder is visually acquired, normal right-of-way procedures should be used to maintain separation. Initiate collision avoidance maneuvers in response to visual acquisition of conflicting traffic.

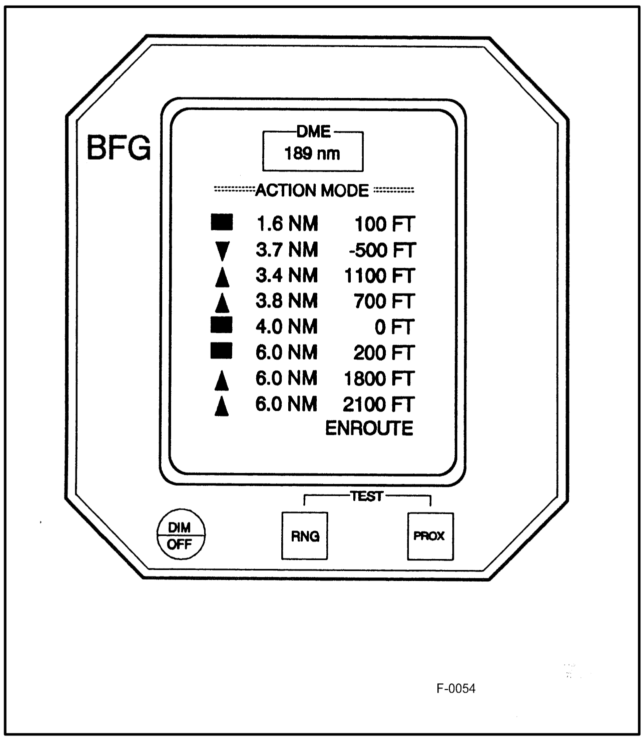



Figure 19-6. Active-Only Screen

**19.7.6.12 Ground Operation.** NACWS remains fully functional in the passive detection mode while on the ground. However, to eliminate distractions caused by other ground traffic, the system disables warning tones for TAs with relative altitude less than 330 feet. When NACWS senses that it is on the ground, it disables active detection mode and TA warning tones and enables the system test.

**19.7.6.13 System Messages.** This section lists the NACWS system messages that may be encountered and the appropriate pilot responses. System messages are displayed in the center of the primary DME screen in the area normally reserved for current time display.

**19.7.6.13.1 Acquiring Satellites.** NACWS is attempting to receive and verify signals from GPS satellites to confirm present location.

**RESPONSE**: No action required — Normal operation. After approximately 1.5 minutes, NACWS will acquire the satellite information and display current latitude/longitude position.

**19.7.6.13.2 Altitude Invalid.** The altitude input from the aircraft's encoding altimeter is missing or invalid.

**RESPONSE:** Leave NACWS turned ON. If the system is able to acquire valid altitude information, normal operation will resume. If altitude remains invalid, both passive and active detection will be inoperative and the CWS FAILED message will be displayed.

**19.7.6.13.3 Compass Invalid.** The heading input from the aircraft's compass/directional gyro is missing or invalid.

**RESPONSE:** Leave NACWS turned ON. If the system is able to acquire valid heading information, normal operation will resume. If heading remains invalid, passive detection will be inoperative and the NO LOCKED RADARS message will be displayed. Active mode is unaffected.

**19.7.6.13.4 CWS Failed.** The built-in test feature has detected a system failure and displays a CWS FAILED message on the primary DME screen.

**RESPONSE:** Leave NACWS turned ON. The DME feature is operational. NACWS is inoperative.

**19.7.6.13.5 No-Locked Radars.** NACWS cannot detect or verify radar sites. This message also appears on the CDU during power-up and may remain displayed until the aircraft is airborne.

**RESPONSE:** Leave NACWS turned ON. The message will be removed when the aircraft acquires and locks radars. Passive mode is inoperative while the message is displayed. Active mode is unaffected.

**19.7.6.13.6 Dead Reckoning.** NACWS is temporarily unable to determine present position and is "dead reckoning" along the last known course.

**RESPONSE:** Leave NACWS turned ON. The system will continue to dead reckon for approximately 30 seconds as it attempts to reacquire position. While dead reckoning, the passive detection mode will continue to operate normally. After 30 seconds, the system displays the POSITION INVALID message and passive mode will be inoperative. Active mode is unaffected.

**19.7.6.13.7 Own Position Invalid.** The position information from the internal GPS receiver is missing or invalid.

**RESPONSE:** Leave NACWS turned ON. Passive detection mode will be inoperative. Active mode is unaffected.

**19.7.6.14 Maintenance Codes.** NACWS continuously monitors its performance during flight. If one of the detection modes (passive or active) should fail, the system will continue to operate and predict collision threats as a single-mode detection system. When the flight is over, a maintenance code will be displayed at the bottom of the primary DME screen. Maintenance codes are displayed only when the aircraft is on the ground and may also appear at the conclusion of a self-test. If a maintenance code is displayed, the system should be serviced as soon as possible. The maintenance codes and the indicated problems are shown below:

| CODE | INDICATION |
|---|---|
| POSITION | Indicates the internal GPS receiver has failed. |
| HVPS | Indicates the high-voltage power supply, which controls the active detection mode transmitter, has failed. |
| HEADING | Indicates the signal or circuitry between the aircraft compass/ directional gyro and a the NACWS TRC has failed. |
| RADAR DB | Indicates the NACWS radar data base has been corrupted. |

## 19.8 GLOBAL POSITIONING SYSTEM (GPS)

Some T-34C aircraft have the KLN900 Global Positioning System(GPS) installed. The KLN900 is a satellite-based, long-range navigation system. It is FAA certified for IFR en route, terminal, and non-precision approach operations. It incorporates an extensive database updated every 28 days that includes most information about the national airspace system.

**Note**

Do not use the KLN900 as the sole navigation source under IMC conditions.

The system incorporates two panel mounted, eight-channel receiver/control/display units (Figures 1-4 and 1-5), one located on the left side of the instrument panel in each cockpit. Each unit includes a battery for non-volatile memory for flight plans and other user data. Both AC and DC power are required for operation.

**Note**

The front unit must be on and functioning properly for either unit to be used for navigation. The last input from either cockpit has priority for system control.

**19.8.1 System Components.** The KLN900 System includes two KLN900 Display/Control Panels, two KA41 Annunciator/Control Panels, one KA90 Slaving Accessory, and one blind encoding altimeter and one GPS antenna. Both the KLN900 and Annunciator/Control panels are mounted on the left side of the instrument panel. The slaving accessory is located on the top shelf in the avionics compartment. The GPS antenna is mounted adjacent to the NACWS GPS antenna aft of the canopy. The blind encoding altimeter is located in the forward cockpit, mounted aft of the inverters on the left kick panel. Both AC and DC circuit breakers are provided for the security of the system, with two circuit breakers (GPS AC, AFT GPS,) located on the front cockpit panel and three circuit breakers(GPS AC, AFT GPS DC, and GPS ADPT DC) located on the rear cockpit circuit breaker panel.

**19.8.2 KA41 Panel Display and Controls.** Figure 19-7 depicts the KA41 Annunciator/Control panel. The NAV and GPS annunciators indicate the slaving source for the double needle on the RMI and the CDI. The white NAV light indicates the double needle on the RMI is slaved to the TACAN and the CDI is slaved according to the position of the VOR/TACAN toggle switch located beneath the altimeter. The green GPS light indicates the double needle and CDI are slaved to the KLN900. The GPS/NAV button is used to select the navigation source as desired. The OBS(white)/ LEG(green) annunciators repeat the mode setting of the KLN900 indicated on the display screen. The mode may be set using the OBS/LEG button on the KA41 panel. The ARM(white)/ACTV(green) annunciators indicate the terminal mode setting of the KLN900. The GPS APR button may be use to manually ARM or de-ARM the KLN900. The ACTV mode may only be initiated by the KLN900 during a properly loaded and executed GPS approach procedure. The amber MSG annunciator duplicates the message indicator on the KLN900 display. The amber WPT annunciator duplicates the waypoint alerting function of the KLN900.

### 19.8.3 KLN900 Panel Display, Controls and Data Entry

**19.8.3.1 Display.** Figure 19-8 depicts the KLN900 panel. The panel is dominated by a monochromatic, adjustable brightness CRT display screen. The screen is normally divided into five sections defined by horizontal and vertical lines on the screen. Some special use pages utilize the full screen area. In normal display, the left and right sections are the primary display areas. The bottom left and right corner sections display the page name for the respective primary display. The bottom center section displays the current operating mode of the KLN900.

**19.8.3.2 Controls.** The KLN900 controls include buttons for the DIRECT TO, CLEAR, ENTER, OBS/LEG mode, ALTIMETER (setting), NEAREST (airport), SAVE (present position), and MESSAGE

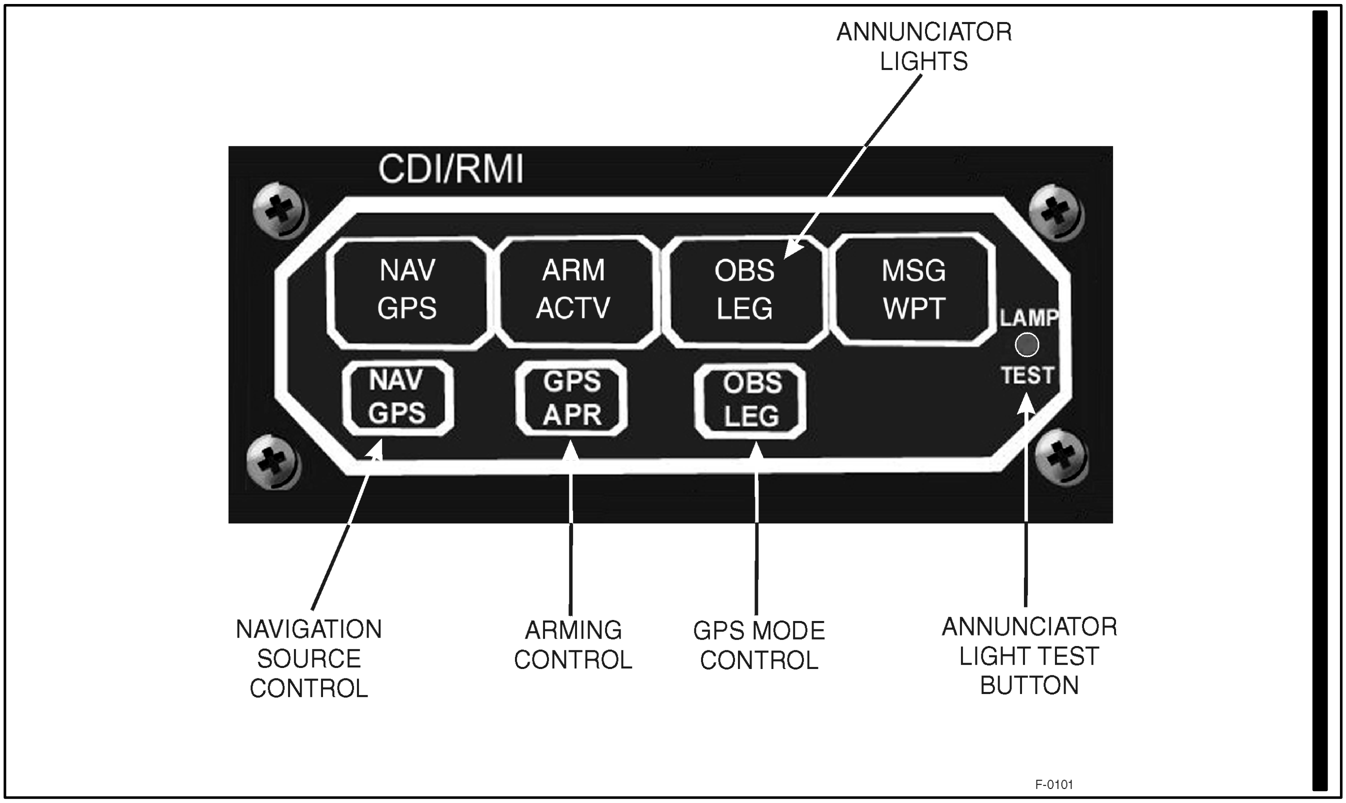



Figure 19-7. KA41 Annunciator/Control Panel

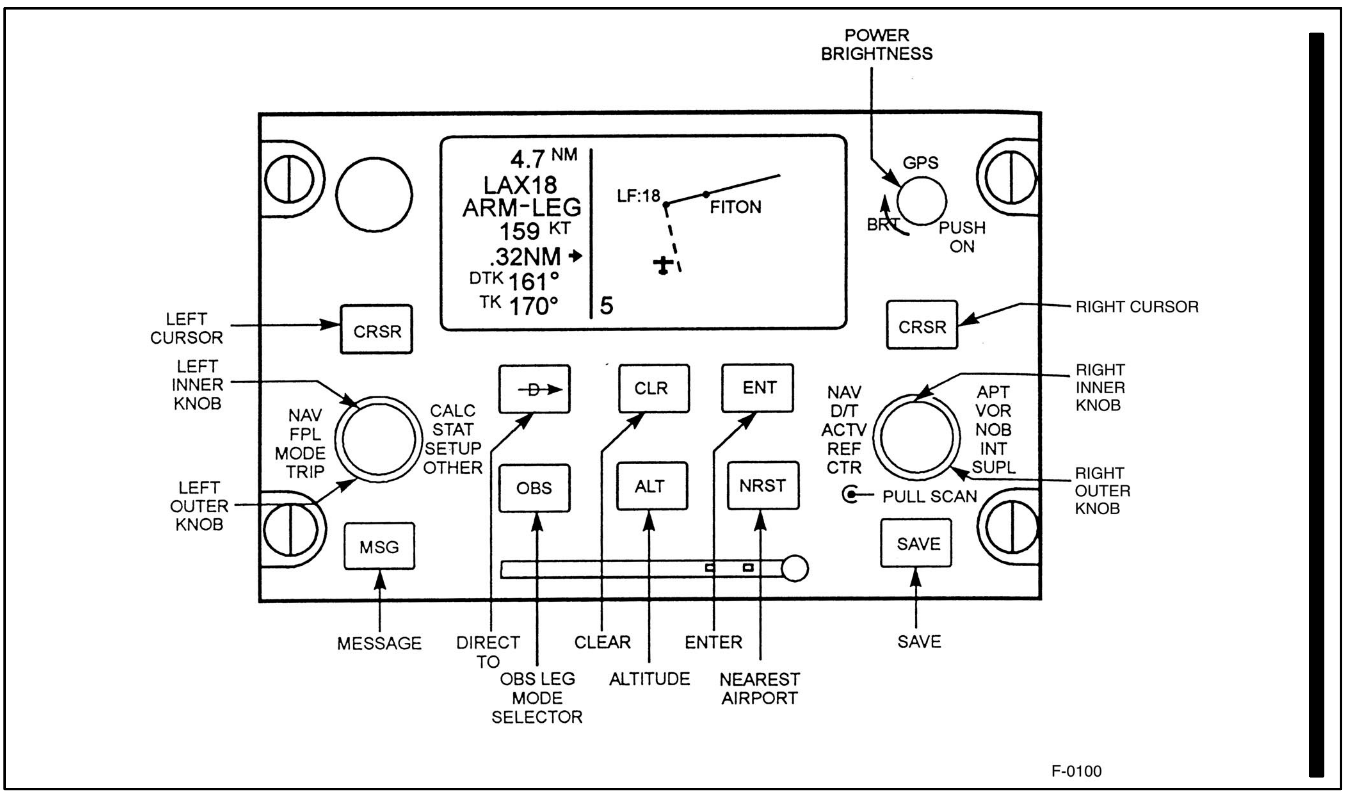



Figure 19-8. KLN900 GPS

functions. Data entry and some control function are enabled by left and right concentric knobs and respective cursor buttons. The right hand inner knob also has a PULL SCAN function to facilitate access to data on certain pages by scanning the database alphabetically. The functions provided by each side of the panel are placarded around the circumference of the respective knob. The outer knob is used to select the desired function. After selecting the desired function, a specific component, or “Page”, of the complex function may be selected using the inner knob. Each component is labeled as a “Page” of the function and will be indicated in the bottom corner of the respective side of the display. For example, “APT 4” indicates the fourth page of the airport data function. There are eight selectable pages available on the left side and ten pages on the right side. Figure 19-9 lists the pages, knob annunciations, abbreviations and number of pages available. If a page contains more information than can be shown on a single screen, a “+” is displayed next to the page number.

**19.8.3.3 Data Entry and Confirmation.** The second function of the knobs is data entry. Many pages/functions require data manipulation using the cursor. When required, the cursor may be activated on the appropriate side of the display by pressing the respective CRSR button, which creates an area of inverse video on the display. When the cursor is active, the page label in the bottom corner is replaced with a CRSR annunciation in inverse video. The outer knob then controls the position of the cursor within the page. The inner knob controls the data within the cursor. By manipulating the appropriate concentric knobs the cursor may then be used to edit the desired field. Once the data is entered, it must be confirmed. The confirmation prompt is normally a flashing “ENT” in the bottom center section of the screen, which requires the user to press the ENT button. For some complex operations the word CONFIRM or APPROVE may flash in the lower portion of the left or right page. Confirmation is completed by using the cursor to highlight CONFIRM or APPROVE and then hit the ENT button. This is the fundamental technique for all data entry and manipulation for the KLN900.

### 19.8.4 Navigation Modes

**19.8.4.1 OBS/LEG Modes.** The KLN900 has two unique modes of operation when navigating between waypoints: LEG and OBS. The mode can be set as desired by pressing either the OBS button on the KLN900 panel or the LEG/OBS button on the annunciator/control panel. When in LEG mode, the KLN900 provides navigation to the active waypoint by great circle route, the shortest distance between two points on the globe. Navigation is then referenced to Desired Track (DTK) and actual Track (TK). The DTK is defined by the active flight plan or the use of the DIRECT TO function. Also provided with the LEG mode are Automatic Waypoint Sequencing and Turn Anticipation through the active flight plan. When in OBS mode, the KLN900 provides navigation to the active waypoint by the magnetic course selected on the appropriate CDI. The course selected on the CDI is indicated on certain KLN900 displays. Waypoint sequencing and turn anticipation are not provided when in OBS mode.

**Note**

During Non-Precision Approaches, the KLN 900 must be placed in LEG mode prior to the FAF.

| Control | Type | Operation | Function |
|---|---|---|---|
| 1. Power/Brightness | Knob/switch | Push to turn on. Rotate to adjust display brightness. Pull to turn off. | Display brightness changes with knob position. |
| 2. CRSR (left side) | Pushbutton | Press to activate/deactivate left cursor. | Cursor field displays in inverse video. |
| 3. CRSR (right side) | Pushbutton | Press to activate/deactivate right cursor. | Cursor field displays in inverse video. |
| 4. Left Outer Knob | Outer concentric knob | Rotate to select mode:<br>CALC<br>STAT<br>SETUP<br>OTHER<br>TRIP<br>MODE<br>FPL<br>NAV<br>Rotate to select left cursor position | Display:<br>Calculator pages<br>Status pages<br>Setup pages<br>Other pages<br>Trip planning page<br>Mode<br>Flight plan pages<br>Navigation pages<br>Left cursor field moves |
| 5. Left Inner Knob | Inner concentric knob | Rotate to select page.<br>Rotate to set left cursor field values | Select page if more than one page is available.<br>Increment/decrement value of left cursor field. |
| 6. Right Outer Knob | Outer concentric knob | Rotate to select mode:<br>APT<br>VOR<br>NDB<br>INT<br>SUPL<br>CTR<br>REF<br>ACTV<br>D/T<br>NAV<br>Rotate to select right cursor position | Display:<br>Airport pages<br>VOR waypoint<br>NDB waypoint<br>Intersection waypoint<br>Supplemental waypoint<br>Center waypoint pages<br>Reference waypoint<br>Active waypoint<br>Distance/time pages<br>Navigation pages<br>Right cursor field moves |
| 7. Right Inner Knob | Inner concentric knob | Rotate to select page.<br>Rotate to set right cursor field values<br>Pull knob out to scan waypoints. | Select page if more than one page is available.<br>Increment/decrement value of right cursor field.<br>Unit scans for nearby waypoints. |

Figure 19-9. GPS Control Functions (Sheet 1 of 2)

| Control | Type | Operation | Function |
|---|---|---|---|
| 8. Direct To | Pushbutton | Press to activate direct to navigation | DIRECT TO page is displayed |
| 9. CLR | Pushbutton | Press to clear entry. | Current entry will be cleared. |
| 10. ENT | Pushbutton | Press to enter. | Display or entry is approved. |
| 11. OBS | Pushbutton | Press to toggle between OBS and LEG mode. | Select OBS or LEG mode. |
| 12. ALT | Pushbutton | Press to select altitude page. | Altitude page will be displayed. |
| 13. NRST | Pushbutton | Press to display nearest airport waypoint page. | Waypoint page for nearest airport will be displayed. |
| 14. MSG | Pushbutton | Press to display message page. | Message page will be displayed. |
| 15. SAVE | Pushbutton | Press to create a user waypoint at present position. | Supplemental waypoint page will be displayed for new waypoint at present position. |
| 13. NRST | Pushbutton | Press to display nearest airport Waypoint page for nearest air-way-point page. | port will be displayed. |
| 14. MSG | Pushbutton | Press to display message page. | Message page will be displayed. |
| 15. SAVE | Pushbutton | Press to create a user waypoint at Supplemental waypoint page present position. | will be displayed for new waypoint at present position. |

Figure 19-9. GPS Control Functions (Sheet 2)

**19.8.4.2 CDI Deviation Display.** Regarding the CDI function and deviation bar, when in LEG mode the course selected on the CDI is for reference only and has no effect on the sensing or indication of the deviation bar. The bar will always indicate the proper deflection towards the desired course. However, when in OBS mode, the course selected with the CDI OBS knob does effect the sensing and indication of the deviation bar and TO/FROM flag, providing a function similar to a normal VOR navaid. Essentially the active waypoint becomes a simulated navaid and the CDI functions accordingly. CDI sensitivity provides full deflection of 5 nm during en route operations and 1 nm during terminal operations. Once the KLN900 is in the Active mode during an approach procedure, sensitivity is increased to 0.3-nm full deflection.

**19.8.4.3 Receiver Autonomous Integrity Monitoring (RAIM).** The KLN900 System is equipped with a self-monitoring circuit, which enables the system to check its own navigation solution. The Receiver Autonomous Integrity Monitoring (RAIM) circuit uses an extra satellite, other than those required to calculate the navigation solution, to validate the accuracy of the solution. In order for the KLN900 to commence the final approach portion of an approach procedure, the system must have a RAIM check. Lack of RAIM will prevent the system from providing the required accuracy to complete the approach and will cause the system to abort the approach. Also, the message RAIM NOT AVAILABLE APR MODE INHIBITED PREDICT RAIM ON STA 5 will be displayed.

**Note**

Illumination of the RAIM integrity light indicates the KLN900 is unable to resolve the aircraft's position within the tolerances required for the selected navigation mode. If the RAIM light illuminates, inform ATC as required and: (1) If executing an approach with the KLN 900, abort the approach. (2) Select another navigation source and monitor the KLN900 system.

**19.8.4.4 Avionics Command and GPS Slaving.** The KLN900 units are installed in tandem. The front cockpit unit contains the database and must be on and operating in order to use the rear cockpit unit. The front cockpit unit is considered the master unit. The display is duplicated in both cockpits and reflects the last input from either cockpit. Each RMI is slaved independently according to the cockpit configuration, NAV or GPS. When GPS mode is selected the double needle on the RMI in the respective cockpit become the

GPS needle and points towards the active waypoint as defined by the KLN900.

The KLN900 receives input from the CDI during navigation. The CDI that provides input to the KLN900 is determined by the avionics command and GPS mode selection. When the cockpit with avionics command is in GPS mode, the respective CDI provides the input to the KLN900. If both cockpits are in NAV mode, the KLN900 will maintain the last CDI input received. If both cockpits are in GPS mode, the KLN900 receives the CDI input from the cockpit that has avionics command. In so doing, the cockpit providing the input to the KLN900 system controls the CDI display in both cockpits. When both cockpits are in GPS mode, the cockpit which does not have avionics command can select the desired course by using the MODE page on the left side and manually entering the course with the KLN 900 controls.

### 19.8.5 Operation

**19.8.5.1 Initialization and Self Test.** To initialize the KLN 900, push the power/brightness knob placarded BRT/PUSH ON. After a warm-up of a few seconds, the screen will show the Turn-On Page with SELF TEST IN PROGRESS displayed at the bottom. Set the desired brightness by rotating the power/brightness knob as required. After the KNL900 has completed its internal self-test, the Self-Test Page will be displayed. It is important to verify the information on both sides of the display for accuracy.

The left side display indicates navigation system integration information. Line 1 should indicate 34.5 nm. Line 2 is a digital CDI display and should indicate half deflection to the right. When the cockpit is in GPS mode, the CDI from flag should duplicate this display with half deflection to the right. Line 3 indicates the selected course indicated on the CDI. If neither cockpit is in GPS mode, the OBS IN field will indicate three dashes. When in GPS mode, the OBS IN field will reflect the course selected on the appropriate CDI. Line 4 should indicate OUT 315. Line 5 should indicate RMI 130. If the cockpit is in GPS mode, the GPS needle should slave on the RMI card to indicate 130. Line 6 should indicate ANNUN ON. Correspondingly, all the annunciator lights on the KA41 Annunciator/Control Panel should be on to indicate proper operation. If a fault is detected in any of the associated circuitry, a flashing TEST FAIL will be indicated on this line. Should this occur, recycle the power to the KLN900 and recheck the Self-Test. If TEST FAIL is indicated again, the system should not be used for navigation.

The right side display indicates the date, time, altitude and altimeter setting followed by APPROVE on the last line. The date and time should be verified for accuracy and edited as required. The time zone may also be adjusted as required. The current altimeter setting is required in order to compensate the input from the blind encoder altimeter. The altitude should then be verified within 100 feet of field elevation. Once verification of the Self-Test parameters is complete, the test must be confirmed by highlighting APPROVE with the cursor and pressing ENT.

To approve the Self-Test, position the cursor over APPROVE and press ENT to approve the self-test page. The screen will then automatically display the Database page. The expiration date for the database will be displayed. Press the ENT button to acknowledge the currency date of the database.

**WARNING**

The database information is accurate only if it is used before the expiration date. Use of out of date database information may cause navigation errors and hazards. Maintenance personnel use a PCMCIA card to periodically update the database.

Once the GPS system has acquired sufficient satellites for navigation, the left side display will switch to the NAV 2 page automatically. Present latitude/longitude and radial and distance to the nearest VOR will be displayed. The right side will display the waypoint page for the last active waypoint, or the APT 4 airport communications page if the last active waypoint was an airport.

#### 19.8.5.2 Initialization Sequence

1. Power/Brightness knob — Push on.

**Note**

The front cockpit unit must be on in order to use the KLN900 system. Once the front unit is on, the remaining sequence may be accomplished from either cockpit as desired.

TURN ON PAGE

2. Power/Brightness knob – Rotate to set brightness as required.

SELF TEST PAGE (Left Side)

3. Distance — Check 34.5 nm.

4. Digital CDI — Check half deflection right.

5. GPS/NAV button — Press to place cockpit in GPS Mode.

6. Cockpit CDI — Check from flag and half deflection right.

7. OBS IN/CDI — Check selected course on CDI is displayed after OBS IN.

8. OUT — Check 315.

9. RMI — Check display indicates 130 and GPS needle indicates 130°.

10. Annunciators – On. Check all annunciator lights on KA41 Annunciator/Control Panel are operative. Green GPS and amber NAV lights will be independent.

**Note**

If TEST FAIL is indicated at the bottom of the left side, the internal test and/or system circuitry has failed. Recycle the power to the KLN900 and recheck the Self-Test. Should the system fail a second time, do not use the KLN900 for navigation.

SELF TEST PAGE (Right Side)

11. Date — Edit as required.

12. Time — Edit as required.

13. Time Zone — Set UTC or select as desired.

14. Altimeter — Set. Press ENT once.

**Note**

Do not APPROVE at this time. Complete Step 15, then APPROVE.

15. Altitude — Check within 100 ft.

16. APPROVE — Highlight with cursor. Press ENT.

DATABASE PAGE

17. Database coverage/expiration date — Acknowledge by pressing ENT.

**WARNING**

The database information is accurate only if it is used before the expiration date. Use of out of date database information may cause navigation errors and hazards. Do not use the KLN900 with an expired database for IFR navigation. It is the pilot's responsibility to verify navigational accuracy using other sources of information as required.

NAV 2 PAGE (Left Side)

18. Present position — Check.

IF USING THE KLN900 FOR IFR NAVIGATION PROCEED AS FOLLOWS:

SYSTEM TEST (Direct to nearest VOR)

1. Right Side — Select VOR Page indicating the reference VOR from NAV 2 on the left side, using the cursor and knob controls as required.

2. DIRECT TO — Press.

3. Confirm — Confirm DIRECT TO operation by verifying the waypoint in the DIRECT TO line on the left side and the waypoint on the right side. Press ENT.

4. Right Side (NAV 1) — Check that navigation information to the reference VOR on NAV 1 concurs with position information on NAV 2 (left side), ±5°.

5. RMI – Check GPS needle points to course required to reference VOR as indicated on NAV 1.

**Note**

If any of the checks in the sequence should fail to indicate properly, the KLN900 should not be used for primary navigation.

This KLN900 is now ready for navigation.

**19.8.5.3 Entering Waypoints.** Each waypoint is stored and called up by a three- to five-character international civil aviation organization (ICAO) identifier. Airport identifiers, which contain no numbers and are identical to a three-character VOR name will have four characters. Four character airport identifiers will begin with a K in the contiguous US, a P in Alaska, or a C in Canada. An example is Monroe County Airport, Alabama, which has the identifier KMVC. The Monroe County VOR identifier is MVC. The prefix is not used if the identifier contains both letters and numbers. An example is Brewton Field, Alabama, which has the identifier 12J.

**19.8.5.4 Duplicate Waypoint Page.** Some waypoints have identifiers, which are not unique. When a waypoint identifier is not unique, a Duplicate Waypoint page appears on the left side. The Duplicate Waypoint page is used to select which waypoint is actually desired. The waypoint identifier is displayed on the top left of the page. To the right of the identifier will be the number of other waypoints with the same identifier. Below the identifier is the waypoint type (APT, VOR, NDB, INT, SUP) and the associated countries which use that identifier. Use the cursor to select to desired waypoint.

**19.8.5.5 Direct to Navigation.** The Direct To button is used to initiate direct to navigation, which provides navigation cues from the present position direct to a selected waypoint. Upon activation of Direct To navigation, the Direct To page is displayed with a flashing cursor over the waypoint identifier. The desired waypoint may be selected by using the following rules. The KLN900 will adhere to these priorities in providing Direct To navigation:

1. During normal operation from the SuperNAV 5 moving map display, the current Active Waypoint will be selected. Navigation to the Active Waypoint is reset from the present position and the CDI will be centered by the KLN900.

2. If the scanning feature of the SuperNAV 5 page is used, the waypoint in the scan window will be selected for Direct To navigation.

3. If there is any waypoint page (APT 1-8, VOR page, NDB page, INT page, SUP page, or ACT page) displayed on the right side when the Direct To button is pressed, that waypoint will be selected.

4. If the Flight Plan 0 page is displayed on the left side and the cursor is activated over one of the waypoints in Flight Plan 0, that waypoint will be selected.

5. If there is no active waypoint, the Direct To page will display blanks. The only means to have no Active Waypoint is if there is no Flight Plan 0 and there has been no previous Direct To navigation.

To proceed Direct To another waypoint, use any of the above methods to select another waypoint. To cancel Direct To navigation, press the Direct To button, then press the CLR button, and then press the ENT button. The KLN900 will revert back to the sequenced waypoint in the Flight Plan 0.

**19.8.5.6 Navigation Pages.**

The GPS system has seven navigation (NAV) pages. The NAV pages are the only pages that can be viewed on both sides of the screen. The NAV pages available are the NAV 1, Super NAV 1, NAV 2, NAV 3, NAV 4, NAV 5, and Super NAV 5.

NAVIGATION 1 (NAV 1) PAGE. The NAV 1 page displays the active navigation leg. When using Direct To navigation, the Direct To symbol is displayed. For a leg of a flight plan, both the from and the active to waypoint identifiers are displayed. The active waypoint is identified with an arrow in front of the identifier. The NAV 1 page also features a course deviation indicator (CDI). In en route navigation, each dot is equal to one nautical mile deviation from the desired track. The center triangle on the CDI bar indicates TO/FROM the active waypoint by the direction it points. An up triangle is TO and a down triangle is FROM. Distance to the active waypoint (DIS), groundspeed (GS), estimated time en route (ETE) and bearing to active waypoint (BRG) are also displayed.

SUPER NAVIGATION 1 (SUPER NAV 1) PAGE. The Super NAV 1 page contains the same information as the NAV 1 page, but is displayed across both left and right sides of the screen to improve readability. Select NAV 1 on both sides to activate the Super NAV 1 mode.

NAVIGATION 2 (NAV 2) PAGE. The NAV 2 page displays present position in both latitude and longitude format and VOR relative format. VOR relative format presents position data in relationship to the nearest VOR in terms of distance and radial.

**Note**

Terminal VORs, although in the database, are not displayed on the NAV 2 page since most aeronautical charts do not include a compass rose for orientation purposes.

NAVIGATION 3 (NAV 3) PAGE. The NAV 3 page displays additional navigation information when in the normal en route-leg mode. Information displayed includes desired track (DTK), which is referenced on NAV 1 for the CDI display, and actual track (TK), which is the present track over the ground. Also displayed are minimum safe altitude (MSA) for present position, and minimum en route safe altitude (ESA). Cross track correction, a text instruction that provides direction and distance for getting back on course, is also provided. For example, if the GPS cross track correction displays FLY L 2.7 NM, the correction to get back on course is to fly left, 2.7 nautical miles.

NAVIGATION 4 (NAV 4) PAGE. The NAV 4 page provides vertical navigation (VNAV) advisory and altitude alerting. NAV 4 can be brought up by scrolling through the NAV pages, or by pressing the ALT button. Descent profiles may be programmed based on descent rate or descent angle. The GPS will then display a time to descent counter, or the appropriate descent angle or ground speed to fly, to achieve the planned descent.

NAVIGATION 5 (NAV 5) PAGE. The NAV 5 page provides navigation information graphically. The four available map display orientations are North Up, Desired Track Up, actual Track Up, or Heading Up. To select map orientation, press the left or right CRSR button. The cursor will appear over the map range scale. Rotate the respective outer knob to position the cursor over the map orientation field. Rotate the inner knob to select N for North Up, DTK for Desired Track Up, TK for actual Track Up, and HDG for Heading Up. When the cursor is turned off or moved to the map scale field, the actual value will replace the orientation annunciation. When an active waypoint is displayed on the NAV 5 page, the active waypoint is marked with a “+.”

SUPER NAVIGATION 5 (SUPER NAV 5) PAGE. The Super NAV 5 page provides a full moving map display of present position and route of flight, in relation to nearby navaids and airports. Super NAV 5 is selected by setting both left and right sides to NAV 5. The left side displays distance to active waypoint, active waypoint identifier, mode of operation and groundspeed. Additionally, the left side can be configured to display any three of the following: estimated time en route, cross track correction, VNAV status, desired track, actual track bearing to active waypoint, radial from the active waypoint, and actual track. The three selectable items are chosen using the left CRSR button and left outer knob. The right side of the Super NAV 5 page displays a moving map. To change the map scale, use the left CRSR button to select the map scale, and the left inner knob to set the scale. When map scale is at 2 nm, the longest runway designations are displayed. All runway designations are displayed when map scale is set to 1 nm.

In order to manipulate the Super NAV 5 display and minimize clutter, a pull-down menu is provided on the right side. Waypoint types on the display can be selected according to user preference. Pressing the right CRSR button displays the pull-down menu, allowing the selective display of APT, NDB, and VOR waypoints. The menu begins with the VOR field, from which TLH, LH, H, or OFF may be selected. The TLH setting displays all VOR station classifications: terminal (T), low altitude (L), and high altitude (H). The LH setting displays only low and high altitude VORs. The H setting displays only high altitude VORs. The OFF setting displays no VORs. The APT and NDB selections allow only ON or OFF options. Use the right outer knob to select the APT, NDB or VOR field, and then use the right inner knob to set the desired display. The pull-down menu also includes the map orientation options, as previously discussed, for the Super NAV 5 display.

The Super NAV 5 page also allows for scanning through the waypoints of the active flight plan. To scan through the active flight plan waypoints, pull the right inner knob to the out position. A window, which contains the active waypoint in reverse video, will be displayed in the lower right corner of the screen. Rotate the right inner knob clockwise to scroll through the flight plan waypoints towards the end of the flight plan. Rotate the right inner knob counterclockwise to scroll through the flight plan waypoints towards the beginning of the flight plan. If the Direct To button is pressed while scrolling through the flight plan waypoints, the waypoint in the scroll window will be the default Direct To waypoint.

**19.8.5.7 Message Page.** The message page (Figure 19-10) alerts the pilot to specific information. Some messages are for information, while others require corrective action. When a message is waiting, the MSG prompt flashes in inverse video next to the mode display. Press the MSG button to view the message page. It may be necessary to press the MSG button several times to view a long message or a series of messages. To return to the page previously being viewed before the message, press the MSG button again. Information Messages will no longer be annunciated after viewing. Messages requiring pilot action will continue to be annunciated on the display with inverse video, but no longer flashing.

**19.8.5.8 Special Use Airspace Alerting.** The GPS system database contains the name, location, type and affected altitudes for areas of special use airspace (SUA). The abbreviations used to identify SUAs are: CL B for Class B airspace, CL C for Class C, CTA for a control area, TMA for a terminal area, ALRT for an alert area, CAUT for a caution area, DNGR for a danger area, MOA for a military operations area, PROH for a prohibited area, REST for a restricted area, TRNG for a training area, and WARN for a warning area. The GPS will generate an alert prior to entering an SUA area with a message on the message page. When the message page is viewed, the message page will display AIRSPACE ALERT, along with the name and type of special use airspace. If the SUA is a Class B, Class C, CTA or TMA, the message page instructs selection of the APT 4 page for the primary airport to determine correct communications frequencies.

The SUA alert is three dimensional, and all SUA areas are stored with regard to actual altitude to prevent nuisance alerts when flying above or below an SUA. If SUA altitudes are in AGL as opposed to MSL, or when the SUA is Class B, Class C, CTA, or TMA, the GPS treats all altitudes below the SUA ceiling as special use.

The SUA alert occurs when the aircraft present course will penetrate an SUA within 10 minutes, or when the aircraft is flying within 2 nautical miles of an SUA whether or not projected course will penetrate the SUA. If one of the SUA areas is penetrated, the INSIDE SPC USE AIRSPACE message will be displayed.

**WARNING**

The GPS SUA alerting feature requires accurate altitude information. Incorrect GPS baro corrections may lead to navigation errors. To prevent erroneous safe indications or false SUA penetration alerts, set GPS baro correction whenever other aircraft altimeters are set.

**19.8.5.9 Waypoint Pages.** The GPS system keeps waypoint data on waypoint pages. The right side of the panel contains all the waypoint pages. Waypoints are stored by type and include airport (APT), VOR, non-directional beacon (NDB), intersection (INT), and supplemental (SUP). Supplemental waypoints are user-defined waypoints, which have not been defined as any of the other types listed. Airport waypoints have up to eight pages of data, while the others all have one page each.

There are two methods for selecting a specific waypoint. The first method is to edit the data fields using the cursor. Selecting the waypoint can be achieved by entering the identifier. For airports, VORs, and NDBs the name of the waypoint on the second line may be entered to select the waypoint. The second method is to pull the right inner knob to the out position and scan through the waypoints alphabetically by rotating the knob. Once the desired waypoint is selected, press the right inner knob back to the in position.

AIRPORT 1 (APT 1) PAGE. The APT 1 page contains the airport identifier, name, SUA area if applicable, and latitude and longitude of the airport reference point. Also displayed is the airport type: MLTRY for military, PRIVAT for private, and HELIPT for heliport.

AIRPORT 2 (APT 2) PAGE. The APT 2 page contains the airport identifier, the city where the airport is located, the state, province or country where the airport is located, airport elevation, and time in relationship to UTC (Zulu). Also displayed is instrument approach information such as ILS for an ILS approach, MLS for an MLS approach, ILS/MLS for both approaches, NP APR for a non-precision approach, and NO APR if no instrument approach is available. The symbol R indicates the airport is serviced by a radar equipped Approach/Departure facility.

| Page Annunciation | Knob Annunciation | Page Name | Page Numbers |
|---|---|---|---|
| LEFT SIDE PAGES | | | |
| TRI | TRIP | Trip Planning | 0-6 |
| MODE | MODE | Mode | None |
| FPL | FPL | Flight Plan | 0-25 |
| NAV | NAV | Navigation | 1-5 |
| CALC | CALC | Calculator | 1-7 |
| STA | STAT | Status | 1-5 |
| SET | SETUP | Setup | 0-9 |
| OTH | OTHER | Other | 1-4 |
| RIGHT SIDE PAGES | | | |
| CTR | CTR | Center Waypoint | 1-2 |
| REF | REF | Reference Waypoint | None |
| ACT | ACTV | Active Waypoint | * |
| D/T | D/T | Distance/Time | 1-4 |
| NAV | NAV | Navigation | 1-5 |
| APT | APT | Airport Waypoint | 1-8 |
| VOR | VOR | VOR Waypoint | None |
| NDB | NDB | NDB Waypoint | None |
| INT | INT | Intersection Waypoint | None |
| SUP | SUPL | Supplemental Waypoint | None |

* Varies with types of waypoints on active flight plan

Figure 19-10. GPS Pages

AIRPORT 3 (APT 3) PAGE. The APT 3 page contains the airport identifier, runway number, runway length in feet, and a north up runway display. Runway lighting is displayed with L for sunset to sunrise lighting, LPC for pilot controlled lighting, LPT for part time or on request lighting, and blank for no runway lighting. The surface type of the runway is presented with HRD for hard surface, TRF for turf, GRV for gravel, CLY for clay, SND for sand, DRT for dirt, ICE for ice, MAT for steel matting, SHL for shale, SNW for snow, and blank if the runway surface is unknown.

AIRPORT 4 (APT 4) PAGE. The APT 4 page displays the airport identifier and airport frequencies. Frequencies are shown for automatic terminal information service (ATIS), pre-taxi clearance (PTAX), clearance delivery (CLR), ground control (GRND), ramp/taxi control (RAMP), tower (TWR), unicom (UNIC), multicom (MCOM), common traffic advisory frequency (CTAF), mandatory frequency (MF), aerodrome traffic frequency (ATF), aerodrome flight information service (AFIS), Class B VFR frequency (CL B), Class C VFR frequency (CL C), terminal radar service area VFR frequency (TRSA), control area VFR frequency (CTA), terminal area VFR frequency (TMA), approach control (APR), departure control (DEP), center (CTR), arrival (ARVL), radio (RDO), radar only frequency (RDR), director (DIR), automated surface observation system (ASOS), automatic weather observing station (AWOS), aeronautical advisory service (AAS), and pilot controlled lighting (PCL).

AIRPORT 5 (APT 5) PAGE. The APT 5 page stores user-entered remarks. Up to 100 airports may contain remarks. Remarks may include up to 3 lines of 11 characters each. To enter a remark, select the APT 5 page for the desired airport and press the right CRSR button. Rotate the right outer knob until the cursor is over the entire third line of the display. Enter data as desired. Press the ENT button to approve the first line, and the cursor will move to the second line. Repeat the procedure to enter data into the second, and if necessary, third lines. Press the CRSR button to deactivate the cursor function when entry is complete.

OTHER 4 (OTH 4) PAGE. The OTH 4 page lists airport remarks. To delete an airport remark, select the OTH 4 page, position the left cursor over the desired airport identifier, press the CLR button, and then press the ENT button.

AIRPORT 6 (APT 6) PAGE. The APT 6 page displays aeronautical services available, such as customs, fuel types, oxygen availability, and fees (if any), for the selected airport. Full customs service (CUSTMS-FULL), no customs facilities (NO CUSTMS), prior request or permission customs (CUSTMS-PR), restricted customs (CUSTMS-REST), and advance notice through flight plan or ADCUS customs (CUSTMS-ADCS) are displayed. Also displayed are fuel types such as 80 for 80 octane, 100 for 100 octane, 100LL for 100 octane, low lead, MOGAS for automotive fuel, JET for jet fuel of any kind, and NO FUEL if fuel is not available. Oxygen service is presented, such as H for high-pressure oxygen, HB for high-pressure bottled oxygen, L for low-pressure oxygen, LB for low-pressure bottled oxygen, and ALL if all oxygen services are available. LANDING FEE indicates there is a landing fee at the airport, NO LDG FEE indicates there is no landing fee, and NO FEE INFO indicates that the database does not contain landing fee information for the specified airport.

AIRPORT 7 (APT 7) PAGE. The APT 7 page is used to select standard instrument departure (SID) or standard terminal arrival route (STAR) procedures for the specified airport.

AIRPORT 8 (APT 8) PAGE. The APT 8 page is used to select non-precision approaches for the specified airport.

VOR WAYPOINT (VOR) PAGE. The VOR page contains the VOR identifier, frequency (MHz), published magnetic variation, latitude and longitude, and the name of the VOR. If the VOR has DME capability, a D follows the identifier. The class of the VOR is also displayed with T for terminal, L for low altitude, H for high altitude, and U for undefined.

NDB WAYPOINT (NDB) PAGE. The NDB page contains the NDB identifier, the name of the NDB, the NDB frequency (kHz) and the latitude and longitude of the NDB. NDBs which are combined with outer markers (outer compass locator NDBs) are stored with intersections on the intersection (INT) pages, not the NDB pages.

INTERSECTION (INT) PAGE. The INT page contains low altitude, high altitude, approach, and SID/STAR intersections as well as outer markers and outer compass locators. The name, location in terms of radial and distance from the closest VOR, and latitude and longitude are displayed. A REF field is available for entry and storage of a nearby waypoint, which will provide radial and distance to the supplemental waypoint. Data in the REF field is lost when the INT page is not the active page.

SUPPLEMENTAL WAYPOINT (SUP) PAGE. The SUP page is used to enter, edit, use, and delete user-defined waypoints. Data entry is similar to other pages. The SUP page displays the name or identifier of the supplemental waypoint, the location in terms of radial and distance to the nearest VOR, and the latitude and longitude of the waypoint. A REF field is available for entry and storage of a nearby waypoint providing radial and distance to the supplemental waypoint. Data in the REF field is lost when the SUP page is not the active page.

**19.8.5.10 Nearest Airports, VORS, and NDBS.** The GPS constantly computes the nine nearest airports, VORs, and NDBs. To view the nearest waypoints, select APT, VOR, or NDB as desired. Use the scan function to scan backwards through the list of waypoints. The nearest list is at the front. The nearest waypoints are indicated by NR 1 through NR 9 in the top right portion of the page. The latitude/longitude field on the waypoint page is replaced by the bearing and distance to the nearest waypoints. Nearest airport pages also display the length, surface and lighting of the longest runway. Press the right inner knob to the in position to scroll through the APT 2 through APT 8 pages for the selected airport.

To call up the nearest airports in an emergency, press the NRST button. The waypoint page for the nearest airport is automatically displayed on the right side. Use the scan function to view the other nearest airports, or use the knob in the in position to view all eight airport pages for the selected airport.

For continuous display of the nearest airport, press the NRST button to activate nearest airport mode. Once the nearest airport page is in view, use the CRSR to highlight the NR 1 field. The page will automatically update as the flight progresses, so long as the cursor remains in the NR 1 field.

SETUP 3 (SET 3) PAGE. The SET 3 page is used to set nearest airport criteria such as runway surface and length. Select the SET 3 page on the left side. Use the left CRSR to select runway length, between 1,000 and 5,000 feet, and select runway surface, either HRD, SFT, or both.

**19.8.5.11 Creating User Waypoints.** The GPS can store up to 250 user-defined waypoints. User-defined waypoints can be set at the present position, at a radial and distance from an existing waypoint, or by latitude and longitude.

To create a new waypoint at the present position, press the SAVE button. The SAVE page will appear on the right side. If a unique identifier has been entered, the unique identifier will remain; otherwise, the first unused waypoint identifier from the list USR01 – USR99 and US100 – US250 will be displayed. Press the ENT button to accept the waypoint (and the SUP page will display). Pressing the CLR button at any time will cancel the save operation and return to the page, which was displayed before the save function was initiated. If there are already 250 user-defined waypoints when the ENT button is pressed, the USR DB FULL message will appear and one existing user-defined waypoint must be deleted for each waypoint to be added. When a new waypoint is entered, the REF field will contain radial and distance to the nearest non-terminal VOR. Pressing the Direct To, ALT, NRST, or right CRSR buttons will cancel the save operation and then proceed to the requested page. Pressing the SAVE button while on the save page returns to the previously active page.

To create a new waypoint at a radial and distance from an existing waypoint, begin by selecting the SUP page. Use the CRSR to enter the new identifier. If the identifier is unused, the display will now prompt CREATE NEW WPT AT: USER POS?, PRE POS? Select USER POS. With a User waypoint page displayed, enter the identifier of the reference waypoint in the REF field. Press the ENT button to see the waypoint page for the reference waypoint. Press the ENT button again to approve the reference waypoint. The display will return to the new waypoint page. Enter the radial from the reference waypoint in the RAD field. Confirm the data by pressing the ENT button. Enter and confirm the data in the Distance (DIS) field. After confirming the distance, the KLN900 will calculate and display the latitude and longitude of the new User waypoint.

To create a new waypoint at a latitude and longitude position, proceed as described above, then skip the RAD and DIS fields to enter the latitude and longitude. After confirming the data, the KLN900 will determine and display the radial and distance from the nearest VOR of the new User waypoint.

**19.8.5.12 Deleting User Waypoints.** OTHER 3 (OTH 3) PAGE. The OTH 3 page contains the complete list of all user-defined waypoints. All user-defined waypoints are divided into types: airports (A), VORs (V), NDBs (N), intersections (I), and supplemental (S). The waypoints are listed alphabetically within each of these categories. If a waypoint is currently part of a flight plan, the flight plan number is displayed to the right of the waypoint type. If there are more than five user-defined waypoints, use the CRSR and outer knob to scroll through the list.

To delete a user-defined waypoint, select the OTH 3 page. Select and highlight the waypoint identifier to be deleted. If the waypoint is contained in a flight plan, the waypoint must first be deleted from the flight plan, or the flight plan must be deleted. If the waypoint is not in a flight plan, press the CLR button and then the ENT button. The waypoint is then deleted.

**19.8.5.13 Creating and Modifying Flight Plans.** The GPS can store up to 25 flight plans, with up to 30 waypoints in each flight plan. Stored flight plans (numbered flight plans) are numbered FPL 1 through FPL 25; the active flight plan is displayed as FPL 0. Unless operating in Direct To mode, the active flight plan must contain at least two waypoints, or the GPS will be flagged as inoperative.

To create a flight plan, select the Flight Plan (FPL) pages on the left side. Select the first empty flight plan page. If no empty pages are available, an existing flight plan must be deleted. With an available flight plan page, use the CRSR to enter and edit waypoints as desired. The first waypoint should be the departure point. After entering a waypoint identifier and pressing ENT, the respective page for the waypoint will be displayed on the right side for confirmation. Confirm the waypoint by pressing ENT a second time. If the waypoint is incorrect, press the CLR button to delete the choice and begin again. If a non-defined waypoint has been entered, the Create Waypoint page will be displayed. After confirmation, the cursor will move to the next waypoint. Waypoints may also be selected directly from the Waypoint pages on the right side. Use the left CRSR to highlight the desired waypoint in the flight plan. Then select the desired waypoint page and identifier on the right side. Press ENT to add the selected waypoint to the flight plan. Press ENT a second time to confirm the data. Repeat the above procedures as needed to complete the flight plan. To activate the flight plan, use the CRSR to highlight USE? at the top of the flight plan. Press ENT to complete the activation. Deactivate the cursor function when complete.

To select a numbered flight plan, use the inner knob to scroll through the flight plan list to the desired flight plan, FLP 1 – 25. Use the CRSR to activate the flight as described above. To use the flight plan but in reverse order, use the CRSR to select both USE? and INVRT? before pressing the ENT button. The selected flight plan is now FPL 0, the active flight plan for navigation. Any changes made to the selected flight plan while in FPL 0 will not be transferred or stored in the original numbered flight plan.

To add a waypoint to a flight plan, use the CRSR to select the waypoint that will follow the added waypoint. Enter the identifier of the waypoint to be inserted and confirm the data by pressing ENT as required. Alternately, waypoints may inserted directly from the right side waypoint pages as described above. Press ENT to confirm the data as required. The other waypoints will be renumbered automatically after the new waypoint is accepted. Deactivate the cursor function when complete.

To delete a waypoint from a flight plan, select the undesired waypoint using the CRSR. Press the CLR button and a delete (DEL) prompt will appear. If the waypoint entered is not the one to be deleted, press the CLR button again. If the waypoint is correct, press the ENT button again to delete the waypoint. The other waypoints will be renumbered automatically after the waypoint is deleted.

To delete a flight plan, select and display the flight plan to be deleted. Verify that the left cursor function is not active. Press the CLR button. The DELETE FPL? prompt will appear. If the flight plan entered is not the one to be deleted, press the CLR button again. If the flight plan selection is correct, press the ENT button to delete the flight plan. To store FPL 0 as a numbered flight plan, select an empty numbered flight plan. Use the CRSR to select the LOAD FPL 0? prompt. Press the ENT button to load the active flight plan into the numbered flight plan list.

**19.8.5.14 Operating From the Active Flight Plan.** When operating from the active flight plan (FPL 0), any of the other pages such as APT, NAV, VOR, NDB, SUP, or INT are selectable, as are the distance/time (D/T 1, D/T 2, D/T 3 and D/T 4) pages. The FPL 0 page may be displayed on the left side, and the NAV 5 or D/T page displayed on the right side. When operating in the en route leg mode on FPL 0, the active leg of the flight plan is designated with the active leg symbol. The head of the arrow in the active leg symbol points to the active to waypoint, and the tail is positioned next to the from waypoint. As flight plan waypoints are reached, the active leg symbol automatically shifts to and from the appropriate waypoints.

If a flight plan contains more waypoints than can be displayed on the screen, the bottom waypoint on the display is the final waypoint in the flight plan. The top four waypoints will scroll as the flight progresses along the flight plan so that the active leg is always displayed. Use the CRSR to manually scroll through the waypoints of the flight plan as desired.

The GPS can be set to provide turn anticipation when the aircraft is approaching a waypoint where a course change is to be made. Turn anticipation provides for a smoother transition between the two course legs by providing a curved flight path between the two legs. The GPS computes the transition course based upon actual groundspeed and the amount of course angle change between the two legs. The active leg symbology and the WPT annunciator will flash 20 seconds prior to the beginning of turn anticipation.

The waypoint page(s) for the active waypoint on the flight plan may be viewed by selecting the Active Waypoint (ACT) page on the right side. Use the scan function to scroll forward or backward through the waypoints on the flight plan. To scroll through the airport pages for an airport waypoint, insure the right inner knob is pushed in to deactivate the scan function.

Direct To operation can be combined with flight plan operation by selecting Direct To mode for a flight plan waypoint as described previously. Once the Direct To waypoint is reached, the GPS will resume normal operation from the flight plan. If Direct To operation is initiated to a waypoint not on the active flight plan, the GPS will not revert to the active flight plan upon reaching the Direct To waypoint. Direct To operation can be cancelled while in the flight plan mode as described previously.

**19.8.5.15 Distance/Time (D/T) Pages.** The GPS calculates time and distance for a variety of waypoint relationships along the flight plan. Time and distance information is displayed on the Distance/Time 1-4 (D/T 1-4) pages.

DISTANCE/TIME 1 (D/T 1) PAGE. The D/T 1 page displays the distance (DIS) and estimated time en route (ETE). When the FPL 0 page is on the left side, distance and time are displayed for each of the active flight plan waypoints. The distance displayed is the total distance from the present position to each waypoint along the flight plan route. If a numbered flight plan is displayed on the left side, the distance displayed is from the first waypoint in the flight plan and is not related to present position. No ETE will be shown. If no flight plan page is displayed, the D/T 1 page displays distance and ETE for the active waypoint and the last waypoint in the flight plan.

DISTANCE/TIME 2 (D/T 2) PAGE. The D/T 2 page displays distance and estimated time of arrival (ETA) for each of the flight plan waypoints on the right side when the FPL 0 page is displayed on the left side. Distance values are calculated the same as for the D/T 1 page. The time zone for the estimated time of arrival is displayed in the upper right corner of the D/T 2 page. If a numbered flight plan page is displayed on the left side, no ETA is displayed. If no flight plan page is displayed, the D/T 2 page displays distance and ETA for the active waypoint and the last waypoint in the flight plan.

DISTANCE/TIME 3 (D/T 3) PAGE. The D/T 3 page displays the distance and desired track (DTK) between two waypoints when any flight plan page is displayed on the left side. If no flight plan page is displayed, the D/T 3 page displays distance and DTK for the active waypoint and the next waypoint in the flight plan.

DISTANCE/TIME 4 (D/T 4) PAGE. The D/T 4 page displays the destination waypoint, selected time zone, departure time (DEP), present time (TIME), estimated time of arrival (ETA) to destination waypoint, flight time (FLAT), and estimated time en route (ETE) to destination waypoint.

**19.8.5.16 Calculator (CALC) Pages.** There are seven Calculator pages, which may be used to calculate a variety of flight related information such as pressure and density altitude, true airspeed, winds aloft, VNAV angle, sunrise/sunset information, and time zone conversions. The Calculator pages allow you to make "what if" calculations for conditions other than the present situation. Therefore, the Calculator pages rely on you to make manual inputs of air data parameters such as altitude and true airspeed.

**19.8.5.17 Status (STAT) Pages.** The STAT Page provides satellite and software information to include: satellite number, signal-to-noise ratio, and elevation above the horizon, estimated aircraft position error, and Receiver Autonomous Integrity Monitoring (RAIM) updates. The Status 1 and Status 2 pages display information pertaining specifically to the GPS receiver while Status 3 and Status 4 pages display supplementary information pertaining to the KLN 900.

**19.8.5.18 Setup Pages.** The SETUP Page enables the user to manipulate information and parameters within the system. Functions include the manipulation of the following data or operations: position, date, time, time zone, magnetic variation, nearest airport criteria, flight timer, turn anticipation, altitude, distance and velocity units, airspace alerting, and database management.

**19.8.5.19 Other Pages.** The OTHER Page provides miscellaneous but useful information including: Flight Service Station (FSS) and Air Route Traffic Control Center (ARTCC) communication VHF frequencies based on the aircraft's present position, an alphabetical list of user-defined waypoints, and an alphabetical list of airports with user-defined remarks.

**19.8.5.20 Trip Pages.** There are seven Trip Planning pages (TRI) that can be displayed on the left side of the screen. The TRI 1 and TRI 2 pages team together to provide trip planning from your present position to any waypoint of your choice. The TRI 3 and TRI 4 pages provide trip planning between any two waypoints, and the TRI 5 and TRI 6 pages provide an analysis of any of the 26 flight plans stored in the Flight Plan pages. The TRI 0 page is used to enter estimates of your true airspeed and the winds so that the KLN 900 can perform wind triangle calculations for use on the other Trip Planning pages. You may perform trip planning without disturbing ongoing navigation.

After entering the appropriate parameters, the information provided includes: bearing, distance, groundspeed, ETE, fuel required, Emergency Safe Altitude, and Special Use Airspace on the route of flight.

**19.8.5.21 Mode Page** The MODE Page displays the navigation mode of the KLN900, either LEG or OBS, as well as the current scale of the CDI. From this page, the scale can be manually selected as desired.

**19.8.6 GPS Non-Precision Approach/ Departure Procedures (DPs)/Standard Terminal Arrival Route (STAR) Operations).** The GPS provides non-precision approach capability as well as standard instrument departure (SID) and standard terminal arrival route (STAR) procedures for airports in the database coverage area. For non-precision approaches, the GPS provides an Approach Arm mode and an Approach Active mode.

**WARNING**

GPS non-precision approach, SID and STAR procedures are safe for use only when a valid database is loaded. To avoid possible navigation errors due to incorrect information, do not perform non-precision approaches, SIDs, or STARs using an out of date database.

**Note**

Non-precision approaches, SIDs, and STARs are automatically deleted from the Flight Plan 0 page (active flight plan) in non-volatile memory 5 minutes after the GPS is turned off. Desired approaches, SIDs and STARs must be loaded again to be used.

As a part of the system integrity, the GPS receiver monitors and predicts satellite orbital position and geometry. The process of monitoring and predicting satellite position is known as receiver autonomous integrity monitoring (RAIM). RAIM verifies that the predicted orbital position of the satellite or satellites used for a particular approach matches the actual orbital position(s). If the positions do not match, the accuracy of the GPS position data may not meet non-precision approach requirements, and the GPS receiver will generate a message notifying the pilot that GPS data should not be used for the approach.

The Approach Arm mode is activated either automatically when the aircraft passes within 30 nm of an airport with a non-precision approach if the approach is loaded in the active flight plan, or by pressing the GPS APR button on the annunciator panel. When in Approach Arm mode, the course deviation indicator (CDI) scale changes from the en route scale of ± 5 nm to ± 1 nm when the aircraft is less than 30 nm from the airport. If the GPS APR switch is pressed when the aircraft is more than 30 nm from the airport, the Approach Arm mode is activated but the CDI scale remains in en route (± 5 nm) until the aircraft is within 30 nm of the airport. Pressing the GPS APR switch when the GPS is in Approach Arm mode will deselect Approach Arm, and return the system to En route mode and CDI scale (± 5 nm). To return to Approach Arm mode, press the GPS APR switch again.

The Approach Active mode is activated automatically approximately 2 nm from the final approach fix (FAF) with an approach loaded into the active flight plan. Additionally, the pilot must select LEG mode, adequate integrity monitoring must be available to complete the approach, RAIM must be available at the FAF and MAP, the aircraft must be heading towards the FAF, and the FAF or co-located IAF/FAF must be the active waypoint. Activation of the Active Approach mode is indicated by the green annunciator ACTV on the annunciator panel.

When the GPS is in Approach Active mode, the CDI scale changes to ± 0.3 nm. If the GPS APR switch is pressed when the GPS is in Approach Active mode, the GPS will deselect Approach Active and return the system to Approach Arm mode and CDI scale (± 1 nm). Once past the FAF, it is not possible to return to the Approach Active mode without conducting a missed approach and flying back to the FAF.

**Note**

There are non-precision approaches, SIDs and, STARs that are not suited to the GPS operational characteristics. Approaches, SIDs, and STARs that are not suited to the

GPS characteristics, are not included in the database. Verify the database contains desired approaches, SIDs, or STARs for desired airports prior to flight.

**19.8.6.1 Selecting and Loading GPS Non-Precision Approaches.** In order to use an approach, the approach must be loaded into the active flight plan. The APT 8 page is used to select approaches for the desired airport. The following example uses the VOR or GPS 25R approach to Los Angeles International Airport (KLAX) with the ELMOO initial approach fix (IAF).

1. Turn to any APT page and select KLAX.
2. Select APT 8 page.
3. Using the CRSR, select the desired approach (VOR 25R).
4. With flashing cursor over desired approach (VOR 25R), press ENT.
5. The GPS will now display available IAFs. Position cursor over ELMOO and press ENT.

**Note**

If only one IAF is available for the selected approach, the GPS will proceed from step 4 to step 6.

6. The GPS will now display the waypoints, which comprise the approach. Review to verify the correct approach is selected.
7. Position cursor over LOAD IN FPL and press ENT.

**Note**

The GPS will check the active flight plan to verify that the airport that corresponds to the selected approach is in the active flight plan. If the airport is not in the active flight plan, the GPS will prompt PRESS ENT TO ADD KLAX AND APPR TO FPL 0 APPROVE? Press ENT to add approach and corresponding airport to the active flight plan.

8. The GPS will automatically sequence to the FPL 0 page and insert the approach waypoints in front of the airport waypoint.

**Note**

Only one approach may be entered into FPL 0. If the GPS is turned off for more than 5 minutes, the approach is deleted from FPL 0 when power is reapplied.

**19.8.6.2 General Procedure for GPS Non-precision Approaches.** The following procedure is provided as an example of the general flow of a non-precision approach and is not representative of any specific approach.

Certain important waypoints in a non-precision approach will include a dash and a small letter at the end of the waypoint name. These suffixes are intended to assist the pilot in recognizing certain points during the approach, and are visible on the FPL 0, Super NAV 5 and Super NAV 1 pages. The initial approach fix (IAF) is denoted by (-i), for example FREBY-i. The final approach fix is denoted by (-f), for example ELMOO-f. The missed approach point (MAP) is denoted by (-m), for example MA25B-m. The missed approach holding point is denoted by (-h), for example FITON-h.

**WARNING**

The GPS always displays distance to the active waypoint. During GPS approaches, this distance may not be the same as the published DME distance on the instrument approach procedure.

1. Select and load desired approach into the flight plan.

**Note**

Approaches can only be entered in FPL 0, the active flight plan, and must be loaded prior to the final approach fix.

2. As aircraft gets to within 30 nm of an airport with a loaded approach, the GPS automatically switches to approach arm and CDI changes to ± 1 nm over a 30-second transition period

When the Approach Arm mode is activated, the annunciator panel will indicate arm and the GPS will cue the pilot to press ALT to update the barometer setting. If the barometer setting is not correct, the vertical navigation capabilities of the GPS should not be used. GPS course guidance is unaffected.

3. Transition to final approach course will require using one of the following methods:

   a. NoPT arrival route (LEG mode). Follow waypoint sequencing to the MAP. For example, a GPS “T” approach or a VOR/DME/GPS Straight-In approach.

   b. Radar vectors (OBS mode). When given radar vectors to the FAF, select OBS mode on the GPS and select the FAF as the active waypoint using Direct To navigation. Set the final approach course on the CDI. Once established on the inbound course and prior to 2 nm from the FAF, select LEG mode. Follow waypoint sequencing to the MAP.

**Note**

Delaying the switch from OBS to LEG mode compresses the scale factor change. This will make the transition more abrupt. If the switch from OBS to LEG is delayed too long, it will not be possible for the GPS to switch to the approach active mode.

   c. Procedure turn or holding pattern (OBS mode) with the NAVAID not at the airfield. For example, a holding pattern or procedure turn on an intermediate approach course followed by a final approach course to the field. For these types of approaches requiring a course reversal (holding in lieu of, procedure turn, or holding pattern), select OBS mode prior to reaching the IAF. If OBS is not selected, the GPS will automatically sequence to the missed approach point. Once OBS has been selected and the course reversal is complete, set the inbound course on the CDI. Once established on the inbound course, select LEG mode. When LEG mode is selected, the FAF is automatically made the active waypoint. Follow waypoint sequencing to the MAP.

   d. Procedure Turn (OBS Mode) with the NAVAID at the airfield. In order for the GPS to activate the final approach navigation it must identify a FAF, which theoretically does not exist with a true Procedure Turn to the field co-located with a NAVAID. Consequently a unique and sometimes unpublished FAF is built into the approach in the database. To fly the approach, select OBS Mode only after completing the initial turn outbound from the NAVAID/airfield. This allows the GPS to sequence to the FAF as the Active waypoint. After completing the course reversal and established inbound, select LEG Mode prior to 2 nm to the FAF. Follow waypoint sequencing to the MAP.

**Note**

Delaying the switch from OBS to LEG mode compresses the scale factor change. This will make the transition more abrupt. If the switch from OBS to LEG is delayed too long, it will not be possible for the GPS to switch to the approach active mode.

   e. DME arc. DME arc procedures flown with the GPS are significantly different than traditional VOR/DME or TACAN arcing approaches. DME arc approaches are flown in the LEG mode. Selecting an approach with an arc segment will result in IAFs being displayed that are not intuitively obvious. An example is the IAF D220L. In this case, the D stands for DME arc, 220 is the radial the waypoint lies on, and L indicates the distance of the arc. L is the 12th letter in the alphabet, and indicates a 12 DME arc. Once an IAF is selected for an arcing approach, the GPS determines which radial of the reference VOR the aircraft is presently located on. A waypoint is created that is located at the intersection of the present radial and the DME arc. This waypoint is then loaded into the approach with the nomenclature described above as the IAF.

**CAUTION**

The GPS does not take the geometry of the active flight plan (FPL 0) into account when determining the arc intercept point. This point is defined solely on the present radial and the defined arc distance from the reference VOR. For this reason, it is better to delay selecting DME arc approaches until the aircraft is closer to the destination.

**Note**

If the present track does not intercept the DME arc, NO INTRCPT will be displayed on the GPS screen.

f. Once established on the arc, the CDI will display left/right guidance relative to the curved arc. Distance to the active waypoint (the end of the arc) is the direct distance from the present position to end of the arc, not the distance along the curve of the arc. The GPS displays ARC XXX (the XXX will be the radial from the reference VOR the aircraft is presently on) in the bottom line of the Super NAV 5 page. This is important if there are any step down altitudes defined by a radial passage. Follow waypoint sequencing to the MAP.

4. At 2 nm from FAF, the GPS automatically switches to approach active mode if:

   a. The LEG mode is selected.

   b. The aircraft is heading towards the FAF.

   c. The FAF or a co-located IAF/FAF is the active waypoint.

   d. GPS confirms adequate integrity monitoring is available to complete the approach.

   e. RAIM is available at FAF and missed approach point (MAP).

**WARNING**

If any of the above conditions are not met, and conditions do not change prior to FAF, the GPS will not transition to Approach Active (ACTV) and a missed approach must be performed.

**Note**

Transitioning to the Approach Active mode may be recognized on GPS Annunciator panel by the green APR ACTV replacing white APR ARM annunciation.

5. Once conditions for the Approach Active mode are met, the GPS automatically switches to the Approach Active mode, and CDI scale changes to ± 0.3 NM at the FAF

**WARNING**

The final approach portion of a GPS nonprecision approach is only approved when the GPS is operating properly from a valid database while in the approach Active mode.

**Note**

The Approach Active mode can only be engaged automatically by the GPS. To cancel the Approach Active mode, press the GPS APR button on the GPS Annunciator panel, or select OBS or Direct To operation. Any of these actions will change the mode to APR ARM. Once past the FAF, it is not possible to return to the approach active mode without conducting a missed approach and flying back to the FAF.

6. Fly to MAP, and if required, fly the missed approach procedure.

Once an approach has been added to the active flight plan, a new entry is placed following the missed approach point. The new line entry reads *NO WPT SEQ, and stands for no waypoint sequencing. Because many missed approach procedures require certain specific actions to be completed prior to proceeding to the missed approach holding point, the GPS will not automatically sequence past the missed approach point. To call up the missed approach procedure, press the Direct To button once past the missed approach point. The first waypoint in the missed approach procedure will be the active waypoint. To confirm the missed approach procedure waypoint, press ENT.

**19.8.6.3 Selecting and Loading GPS Standard Instrument Departure (SID) Procedures.** The GPS database includes standard instrument departure (SID) procedures to provide the pilot with a quick means of loading a potentially large number of waypoints into the active flight plan. SID procedures are accessed through the APT 7 page for the corresponding airport. The following example for selecting and loading a SID uses the PORTE NINE departure, runway

01B and the Fellows transition from San Francisco International (KSFO).

1. Turn to any APT page and select KSFO.

2. Select APT 7 page.

3. Select the desired departure (PORTE9).

4. With flashing cursor over desired departure (PORTE9), press ENT.

5. The GPS will now display available runways. Select RW01B and press ENT.

6. The GPS will now display available transitions. Select FLW and press ENT.

7. The GPS will now display the waypoints, which comprise the SID. Review to verify that correct departure is selected.

8. Position cursor over LOAD IN FPL and press ENT.

**Note**

The GPS will check the active flight plan to verify that the airport that corresponds to the selected departure is in the active flight plan. If the airport is not in the active flight plan, the GPS will prompt PRESS ENT TO ADD KSFO TO FPL 0 APPROVE? Press ENT to add departure and corresponding airport to the active flight plan.

9. The GPS will automatically sequence to the FPL 0 page and insert the departure waypoints after the airport waypoint.

**19.8.6.4 General Procedure for GPS Standard Instrument Departure (SID).** The following procedure is provided as an example of the general flow of a standard instrument departure. For illustrative purposes, a difficult procedure was selected (the PORTE NINE departure from the SID loading example above).

1. Select and load desired departure into the flight plan

**Note**

Although the departure can be loaded at any time, it is recommended the pilot select and load the departure prior to takeoff.

2. The published departure procedure states "Intercept and proceed via SFO R-350, cross the 4 DME fix at or above 1600'...." Select OBS mode on the GPS with SF004 as the active waypoint, and 350... as the selected course. Following takeoff, climb to 1600 feet MSL on the SFO 350 radial, towards the SF004 waypoint.

3. Passing SF004, turn left to a heading of 200..., and manually select the PORTE waypoint as the active waypoint on the FPL 0 or Super NAV 5 page. Once PORTE is selected, press the Direct To button.

4. Press ENT to confirm PORTE as the desired direct to waypoint 5. Change selected course to 135... for a course to PORTE as directed in the SID.

5. Prior to reaching PORTE, select the LEG mode on the GPS to enable normal sequencing of waypoints. Once the aircraft passes PORTE, the GPS will automatically sequence to the next waypoint (PESCA).

6. Passing PESCA, follow procedure and fly 090... until intercepting the OSI 116 radial. Select OBS mode, change selected course to 116..., and proceed to the WAGES waypoint.

7. Prior to reaching WAGES, select the LEG mode to enable normal sequencing of waypoints. Once the aircraft passes WAGES, the GPS will automatically sequence to the next waypoint (26FLW).

**Note**

On the chart, an x appears, indicating an altitude restriction of at or above FL240 or at assigned lower altitude/flight level. Make sure to meet any altitude requirements prior to reaching this waypoint.

8. Passing FLW, proceed with the flight plan as required.

**19.8.6.5 General and Loading GPS Standard Terminal Arrival Route (STAR) Procedures.** Like a SID, a STAR must be loaded into the active flight plan through the APT 7 page. The following example for selecting and loading a STAR uses the ACTION FOUR Arrival and the WINK Transition for the Dallas/Fort Worth International Airport (KDFW).

1. Turn to any APT page and select KDFW.

2. Select APT 7 page.

3. Select the arrival(AQN4).

4. With flashing cursor over desired arrival (AQN4), press ENT.

5. The GPS will now display available transitions. Position cursor over INK and press ENT.

6. The arrival procedure may require a runway selection; however, because the ACTION FOUR Arrival does not require a runway selection, no entry is required and the GPS will automatically sequence to the next step.

7. The GPS will now display the waypoints that comprise the arrival. Review to verify correct arrival is selected.

8. Position cursor over LOAD IN FPL and press ENT.

**Note**

The GPS will check the active flight plan to verify that the airport that corresponds to the selected arrival is in the active flight plan. If the airport is not in the active flight plan, the GPS will prompt PRESS ENT TO ADD KDFW TO FPL 0 APPROVE? Press ENT to add arrival and corresponding airport to the active flight plan.

9. The GPS will automatically sequence to the FPL 0 page and insert the arrival waypoints in front of the airport waypoint.

**19.8.6.6 General Procedure for Standard Terminal Arrival Route (STAR).** The following procedure is provided as an example of the general flow of a standard terminal arrival route. The procedure is based on the ACTION FOUR Arrival from the STAR-loading example above.

1. Select and load the desired STAR into the flight plan.

2. The GPS will automatically sequence through the STAR until the AQN VOR waypoint.

**Note**

During flight planning, verify that a desired arrival is available in the database for the desired airport. Check required charts/ pubs to ensure arrival route is correct for aircraft type (i.e., non-turbojet aircraft). If a turbojet arrival is loaded, modify the arrival by deleting the turbojet route and entering the non-turbojet route from the published arrival.

3. The ACTION FOUR Arrival includes two routes, one for turbojet aircraft and one for non-turbojet aircraft. The GPS database only includes the turbojet arrival route.

4. To alter the arrival to include the non–turbojet RENDY intersection, delete the MARKUM, BRYAR, HULEN, FLATO, and CREEK waypoints.

5. Add the JERRY, CRESN and RENDY waypoints to the arrival in FPL 0.

6. Follow waypoint sequencing through the arrival route.

| Message | Reason/Action |
|---|---|
| ADJ NAV IND CRS TO ____ | This message will appear if the GPS is suggesting a course to be selected on the CDI prior to the beginning of a turn to a waypoint if the course change is greater than 5°. This message will also appear if there is a difference of more than 5° between the GPS desired track (DTK) and the selected CDI course. |
| ADJ NAV IND CRS | This message will appear if there is a difference of more than 5° between the GPS desired track (DTK) and the selected CDI course. |
| AIRSPACE ALERT | This message will appear when present course is projected to enter a special use airspace in approximately 10 minutes or when distance from special use airspace is less than 2 nm. |
| ALTITUDE ALERT ANNUNCIATOR FAIL | This message indicates that the altitude alert annunciator drive circuitry has a failure and altitude alerting is only available on the GPS display. |
| ALTITUDE FAIL | This message indicates the altitude input has failed and GPS altitude related features are disabled. |
| APT ELEVATION UNKNOWN | This message indicates that airport field elevation is unknown, which disables the height above airport alert function. |
| ARINC TRANSMITTER FAIL | This message indicates the failure of the GPS system ARINC transmitter, and GPS output to the CDI/RMI system should not be used. |
| ARINC 561/568 IND CTRL OUTPUT FAIL | This message indicates the failure of the ARINC 561/568 indicator control output drive circuitry. GPS output to the CDI/RMI system should not be used. |
| ARM GPS APPROACH | This message indicates that the GPS approach arm mode has been disarmed, and must be armed when 3 nm from the final approach fix (FAF) if a GPS approach is to be flown. |
| BAD SATELLITE GEOMETRY AND RAIM NOT AVAILABLE | This message indicates that GPS is in approach active mode, receiver autonomous integrity monitoring (RAIM) is unavailable, and satellite geometry has degraded to the point that aircraft position is unsure. Be prepared for a NAV flag, indicating GPS NAV failure. |
| BAD SATELLITE GEOMETRY SEE EPE ON STA 2 PAGE | This message will appear after a RAIM NOT AVAILABLE message, and means that satellite geometry allows a greater position error than is acceptable for IFR use and cross checking of position is recommended. |
| BATTERY LOW: SERVICE REQUIRED TO PREVENT LOSS OF USER DATA | This message indicates the internal battery is low and should be replaced within a week to prevent loss of all user-defined data. |
| CHECK ARINC 561/568 IND CTRL OUTPUT | This message indicates an over current condition exists on the ARINC 561/568 indicator control output. GPS output to the CDI/RMI should not be used. |
| CROSS-TALK RS 232 IN DATA ERROR | This message indicates there is an error in the data received over the cross-talk RS-232 in channel |
| database CHECKSUM ERR | This message indicates that the database has failed an internal test when the GPS unit was powered up. Most likely cause is a failed database cartridge. The GPS is flagged as failed. |
| database OUT OF DATE ALL DATA MUST BE CONFIRMED BEFORE USE | This message indicates the database is out of date and not suitable for navigation due to the date entered on the SET 2 page or on the self-test page, or due to the pilot- entered date being overridden by the date from the GPS receiver. |
| EEPROM FAILURE: EXTERNAL D-BAR INVALID | This message indicates the GPS has failed an internal test. Do not use GPS input to CDI/RMI. CDI on GPS panel is still valid, as are all other GPS functions. |

Figure 19-11. GPS Message Abbreviations (Sheet 1 of 3)

| Message | Reason/Action |
|---|---|
| GENERAL RS-232 DATA INPUT ERROR | This message indicates that an error has been detected in the data from the air data system. |
| GENERAL RS-232 OUTPUT ERROR | This message indicates the RS-232 output has failed an internal test. CDI/RMI data from the GPS should not be used for navigation. |
| IF REQUIRED SELECT OBS | This message indicates the aircraft is 4 nm from a waypoint that might be used for a procedure turn or holding pattern. Select OBS mode when flying a procedure turn or holding pattern; otherwise, no action is required. |
| INSIDE SPC USE AIRSPACE | This message indicates the aircraft is inside a special use airspace area. Name, type, responsible ATC and vertical boundaries will be displayed if available. |
| LATERAL SUPERFLAG FAILURE | This message indicates a lateral NAV flag output has failed an internal test. The GPS is still usable, but GPS input to the CDI/RMI should not be used. |
| MAGNETIC VAR INVALID ALL DATA REFERENCED TO TRUE NORTH | This message indicates that magnetic variation is invalid due to operating outside database magnetic variation area without a pilot-entered magnetic variation. |
| NAV IND CRS FAIL ENTER OBS CRS ON GPS | This message indicates a failure of incoming OBS data from the CDI. OBS information should be entered into the GPS manually. |
| NAV IND CRS FAIL ADJ NAV IND CRS TO | This message indicates a failure in the incoming selected course data from the CDI. Selected course on the CDI should be adjusted manually to the suggested course on the GPS display. |
| NO GPS RCVR DATA | This message indicates the GPS receiver has failed an internal test. No NAV data will be available. |
| NO GENERAL RS-232 IN DATA | This message indicates no data is available to the GPS from the air data system. |
| OBS WPT > 200NM | This message indicates that the active waypoint for OBS operation is more than 200 nm away. The CDI will be very sensitive to course changes. |
| OTHER KLN 900 NOT RESPONDING | This message indicates that the other GPS unit is not providing any data. The unit displaying the message is still usable. |
| OTHER WAYPOINTS DELETED | This message indicates that more than 10 waypoints are deleted. |
| POSITION DIFFERS FROM LAST POSITION BY > 2NM | This message indicates that position at power up differs from last position at power down by more than 2 nm. |
| POSITION OF WPT HAS CHANGED | This message indicates that a waypoint position has changed more than 0.33 minutes due to updating of the database. For fewer than 10 waypoints, each changed waypoint will generate this message. |
| POSITION OF OTHER WAYPOINTS HAVE CHANGED | This message is the same as above, except it applies only for more than 10 waypoints. |
| PRESS ALT TO SET BARO | This message indicates a need to set Baro correction to determine correct altitude. |
| PRESS GPS APR FOR NAV | This message indicates the NAV flag has been tripped by a RAIM error, and pressing GPS APR will reset the unit for a missed approach on GPS positioning alone. |
| RAIM NOT AVAILABLE APR MODE INHIBITED PREDICT RAIM ON STA 5 | This message indicates RAIM is predicted to be unavailable at the FAF or the MAP. The GPS will not operate in active approach mode until conditions improve. See the STA 5 page for predicted time to RAIM availability. |

Figure 19-11. GPS Message Abbreviations (Sheet 2)

| Message | Reason/Action |
|---|---|
| RAIM POSITION ERROR CROSS CHECK POSITION | This message indicates that position can not be determined within IFR limits. Crosscheck position against another navaid every 15 minutes to verify position accuracy. |
| RAIM NOT AVAILABLE CROSS CHECK POSITION | This message indicates that position can not be determined with RAIM. Crosscheck position against another navaid every 15 minutes to verify position accuracy. |
| RCVR HARDWARE ERROR: | This message indicates the GPS has failed an internal test. Record the fail code. GPS is unavailable for navigation. |
| RECYCLE POWER TO USE CORRECT database DATA | This message indicates the date set on the self-test page is before the effective date of the database and the SET 2-page date is after the effective date or vice versa. Turn the GPS unit off, and then back on so that the correct database data is used. |
| REDUNDANT WPTS IN FPL EDIT ENROUTE WPTS AS NECESSARY | This message indicates a SID/STAR or approach has been entered and the GPS has determined some of the waypoints on the active flight plan are no longer needed. Examine the active flight plan and remove waypoints occurring both in the en route and approach or SID/SDTAR sections of the flight plan. |
| SATELLITE COVERAGE INADEQUATE FOR NAV | This message indicates that position cannot be determined within 3.8 nm. GPS is unusable. |
| SERIAL SUPERFLAG FAIL | This message indicates a serial flag output has failed an internal test. The GPS is still usable. |
| SYSTEM TIME UPDATED TO GPS TIME | This message indicates that GPS system time has been updated by more than 10 minutes to match satellite system time. |
| UNIT OPERATING STAND ALONE | This message indicates that no serial data is being received from the other GPS unit. The GPS unit displaying this message is still usable for navigation. |
| USER DATA LOST | This message indicates that battery or other internal failure has caused all user-entered data to be lost. |
| VNV ALERT | This message indicates position is 90 seconds from beginning of ascent or descent from a VNAV program set on NAV 4 page. |
| WAYPOINT ____ DELETED | This message indicates that the displayed waypoint has been deleted from the database and all flight plans due to a database update. |

Figure 19-11. GPS Message Abbreviations (Sheet 3)

## 19.9 VISUAL COMMUNICATIONS

Communications between aircraft will be conducted visually whenever practical, provided no sacrifice in operational efficiency is involved. Flight leaders shall ensure that all pilots in the formation receive and acknowledge signals when given. The visual communications section of Aircraft Signals NATOPS Flight Manual (NAVAIR 00-80T-113) must be reviewed and practiced by all pilots. For ease of reference, visual signals applicable to flight operations are contained in Figure 19-12, ground handling signals are contained in Figure 19-13, and traffic control light signals are contained in Figure 19-14.

**GENERAL CONVERSATION**

| MEANING | SIGNAL | RESPONSE |
|---|---|---|
| Affirmative (I understand). | Thumb up, or nod of head. | |
| Negative (I do not know). | Thumb down, or turn of head from side to side. | |
| Question (repeat). Used in conjunction with another signal is interrogatory. | Hand cupped behind ear as if listening. | As appropriate. |
| Wait. | Hand held up with palm outward. | |
| Ignore last signal. | Hand waved in an erasing motion in front of face, with palm turned forward. | |
| Numerals, as indicated. | With forearm in vertical position, employ fingers to indicate desired numerals 1 through 5. With forearm and fingers horizontal, indicate number which, added to 5, gives desired number from 6 through 9. A clenched fist indicates zero. | A nod of the head (I understand). To verify numerals, addressee repeats. If originator nods, interpretation is correct. If the originator repeats numerals, addressee should continue to verify them until they are understood. |

**CONFIGURATION CHANGES**

| MEANING | SIGNAL | RESPONSE |
|---|---|---|
| Lower landing gear. | Rotary movement of hand in cockpit, as if cranking wheel. | Execute. |
| Extend or retract flaps as appropriate. | Open and close four fingers and thumb. | |

**FUEL**

| MEANING | SIGNAL | RESPONSE |
|---|---|---|
| How much fuel have you? | Raise fist with thumb extended in a drinking position. | Indicate fuel in tens of gallons or hundreds of pounds by finger numbers. |

**FORMATION**

| MEANING | SIGNAL | RESPONSE |
|---|---|---|
| 1 — I have completed my takeoff Checklist and am, in all respects ready for takeoff;<br>2 — I have completed my takeoff checklist and am, in all respects, ready for a section takeoff;<br>3 — take-off path is clear, I am commencing takeoff. | 1 — Section takeoff leader raises arm (either) over head;<br>2 — wingman raises arm over head;<br>3 — leader lowers arm. | 1 — Stands by for reply from wingman, holding arm over head until answered;<br>2 — wingman lowers arm and stands by for immediate section takeoff;<br>3 — executes section takeoff. |
| Leader shifting lead to wingman. | Leader pats self on head points to wingman. | Wingman pats head and assumes lead. |
| Leader shifting lead to division designated by numerals. | Leader pats self on head points to wingman and holds up two or more fingers. | Wingman relays signal; division leader designated assumes lead. |

Figure 19-12. In-Flight Visual Communication (Sheet 1 of 2)

| | | |
|---|---|---|
| Take cruising formation. | Thumb waved backward over the shoulder. | Execute. |
| I am leaving formation. | Any pilot blow kiss. | Nod (I understand). |
| Aircraft pointed out leave formation. | Leader blows kiss and points to aircraft. | Execute. |
| Directs plan to investigate object or vessel. | Leader beckons wing plane, then points to eye, then to vessel or object. | Wingman indicated blows kiss and executes. |
| Refers to landing of aircraft, generally used in conjunction with another signal;<br>1 — I am landing;<br>2 — directs indicated aircraft to land. | Landing motion with open hand;<br>1 — followed by patting head;<br>2 — followed by pointing to another aircraft. | 1 — Execute;<br>2 — execute. |
| a. Join up or break up, as appropriate.<br>b. On GCA/CCA final: Leader has runway in sight. | Flashing external lights. | a. Comply.<br>b. Wingman repeats, indicating runway/ship in sight.<br>Ship: Leader waves-off wingman lands.<br>Field: When runway conditions preclude a safe section landing, leader will wave-off. |
| Wingman takes the lead. | Leader shines flashlight on hardhat, then shines light on wingman. | Wingman shines flashlight at leader, then on his hardhat. Turns navigation lights to DIM and assumes lead. |

**FORMATION SIGNALS MADE BY AIRCRAFT MANEUVER**

**FREE CRUISE**

| MEANING | SIGNAL | RESPONSE |
|---|---|---|
| Single aircraft cross under in direction of wing dip. | Single wing dip. | Execute. |
| Section cross under. | Double wing dip. | Execute. |
| Close up. | Series of small zooms. | Execute. |
| Join up; join up on me. | Series of pronounced zooms | Expedite join-up. |

Figure 19-12. In-Flight Visual Communication (Sheet 2)

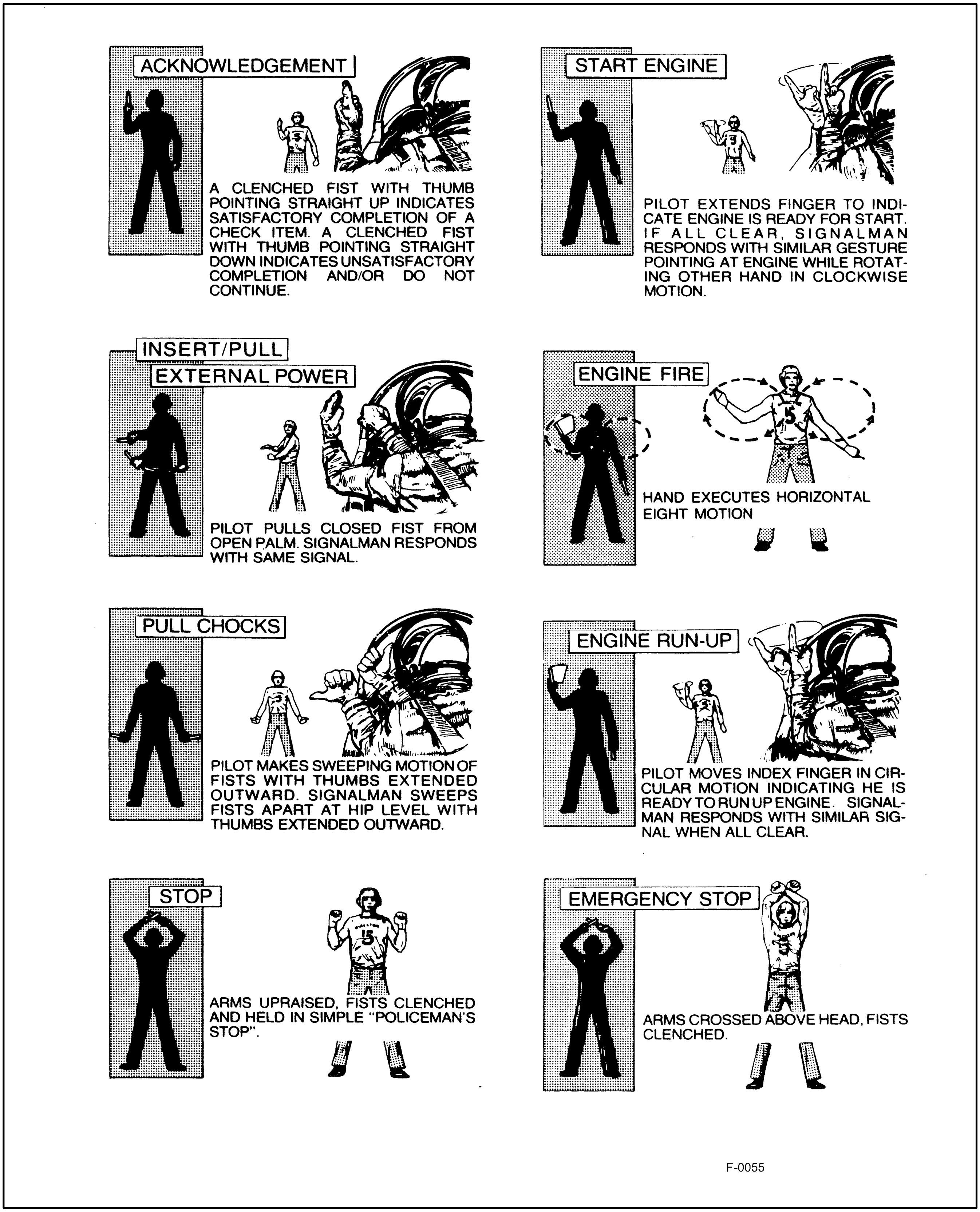



Figure 19-13. Ground Handling Signals (Sheet 1 of 2)

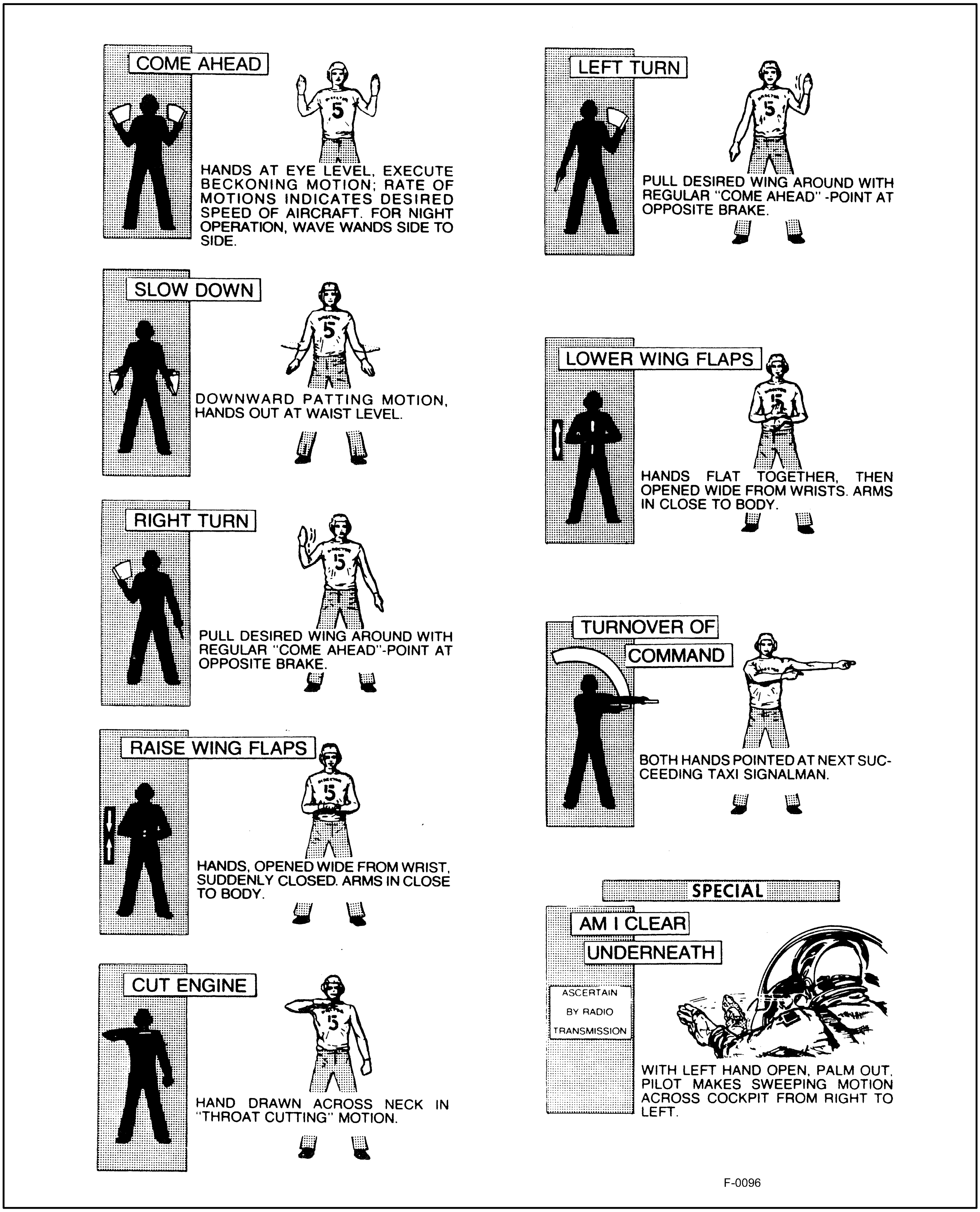



Figure 19-13. Ground Handling Signals (Sheet 2)

| COLOR AND TYPE OF SIGNAL | ON THE GROUND | IN FLIGHT |
|---|---|---|
| **STEADY GREEN** | Cleared for takeoff | Cleared to land |
| **FLASHING GREEN** | Cleared to taxi | Return for landing (to be followed by steady green at proper time) |
| **STEADY RED** | Stop | Give way to other aircraft and continue circling |
| **FLASHING RED** | Taxi clear of landing area (runway) in use | Airport unsafe — do not land |
| **FLASHING WHITE** | Return to starting point on airport | |
| **ALTERNATING RED & GREEN** | General Warning Signal — Exercise Extreme Caution | |

Figure 19-14. Traffic Control Light Signals

# PART VIII

# Weapon Systems

# CHAPTER 20

# Weapon Systems

This is not applicable to T-34C aircraft.

# PART IX

# Flightcrew Coordination

# CHAPTER 21

# Flightcrew Coordination

## 21.1 INTRODUCTION

The many and varied missions of the T-34C dictate special consideration be given to the subject of aircrew coordination. Missions of the T-34C include but are not limited to primary and intermediate maritime and helicopter syllabus, basic and intermediate SNFO syllabus, and flying qualities testing at the Naval Air Test Center. While frequent reference is made to checklists, the contents of this chapter are designed to be utilized as a basis for squadron and unit ground training syllabuses. So utilized, this chapter will enhance the successful and safe completion of each unit's mission through intelligent and proper compliance with all NATOPS procedures and other applicable aviation directives. In each syllabus, flight safety and mission success rely on aircrew coordination regardless of crew composition.

## 21.2 SPECIFIC RESPONSIBILITIES

### 21.2.1 Description of Aircrew Positions

1. Formation leader — Responsible for the safe and orderly conduct of the formation.

2. Pilot in command — Responsible for the safe control of the aircraft throughout the entire flight.

   a. Instructor — Will be pilot in command on all dual student syllabus flights. He must be NATOPS and instructor qualified by parent command. This instructor, although pilot in command, will assume the duties as copilot in the majority of the CNATRA primary and intermediate SNA syllabus flights. The instructor may also assume the duties as pilot as he deems appropriate.

   b. Student — Will be pilot in command on solo flights. He is not required to be NATOPS qualified but must have completed the syllabus requirements designating him as safe for solo. On dual flights, the student will perform the duties of pilot or copilot as directed by the instructor.

3. Copilot — When mission requirements dictate the T-34C be flown by two NATOPS-qualified pilots, one will be designated the pilot in command, and the other designated the copilot. The copilot assists the pilot in command, as directed, in accomplishing the mission. He assists the pilot in operating controls and equipment on the ground and in flight and assumes the duties of the pilot when the pilot is incapable of performing them himself. He also assists the pilot in navigating the aircraft.

4. Other crewmembers — NFO, SNFO, flight surgeon or any other non-NATOPS-qualified aircrew. They are expected to perform appropriate duties as defined and directed by the pilot in command.

### 21.2.2 Flight Planning

#### 21.2.2.1 Pilot in Command

1. Responsible for planning all phases of the assigned mission.

#### 21.2.2.2 Copilot/Other Crewmember

1. Assist the pilot in command as directed.

#### 21.2.2.3 Formation Leader

1. Responsible for planning all phases of formation flight.

### 21.2.3 Brief

#### 21.2.3.1 Pilot in Command

1. Responsible for ensuring all crewmembers are briefed on all aspects of the mission and conduct of flight.

#### 21.2.3.2 Formation Leader

1. Responsible for ensuring all crewmembers are briefed on all aspects of the mission and conduct of formation flight.

#### 21.2.3.3 Other Pilots in Command (Formation Flight)

1. Have a thorough understanding of the conduct of the flight and be prepared to assume formation lead.

### 21.2.4 Preflight

#### 21.2.4.1 Pilot in Command

1. Review aircraft discrepancies from the previous 10 flights (minimum requirement).

2. Ensure daily and turnaround maintenance inspections are completed.

3. Be responsible for accepting the aircraft assigned.

4. Ensure a complete preflight of the aircraft is performed in accordance with NATOPS and OPNAVINST 3710.7.

#### 21.2.4.2 Copilot/Other Crewmember

1. Assist the pilot in command as required/directed.

### 21.2.5 Prestart

#### 21.2.5.1 Pilot

1. Execute Prestart Checklist in accordance with NATOPS.

2. Receive a clear to start signal from the plane captain while ensuring security of the aircraft and adjacent area.

#### 21.2.5.2 Copilot/Other Crewmember

1. Execute prestart checks as required.

2. Acknowledge pilot's intent to start

### 21.2.6 Start

#### 21.2.6.1 Pilot

1. Start engine in accordance with NATOPS.

2. Remain alert for any emergency indications from instrumentation, groundcrew, or copilot/crewmember.

#### 21.2.6.2 Copilot/Other Crewmember

1. Notify the pilot of any emergency signals noted from the groundcrew or any unusual occurrences observed.

### 21.2.7 Poststart

#### 21.2.7.1 Pilot

1. Complete all pretaxi checks in accordance with NATOPS.

2. Inform copilot/crewmember when ready to taxi.

#### 21.2.7.2 Copilot/Other Crewmember

1. Complete all pretaxi checks as required.

2. Acknowledge pilot's intent to taxi.

### 21.2.8 Taxi

#### 21.2.8.1 Pilot

1. Check brakes once aircraft starts to roll.

2. Exercise control of aircraft while taxiing; remain attentive for obstructions, taxi directions, and foreign object damage.

#### 21.2.8.2 Copilot/Other Crewmember

1. Check brakes as applicable.

2. Remain attentive for obstructions and taxi signals and inform pilot.

### 21.2.9 Pretakeoff

#### 21.2.9.1 Pilot

1. Complete pretakeoff checks in accordance with NATOPS prior to crossing the hold short.

2. Inform copilot when ready for takeoff.

#### 21.2.9.2 Copilot/Other Crewmember

1. Acknowledge pilot's intent for takeoff.

### 21.2.10 Takeoff/Departure Mission

#### 21.2.10.1 Pilot

1. Verify minimum acceptable engine performance.

2. Execute takeoff.

3. Report "Gear up" and "Fuel caps secure," to the copilot.

4. Comply with departure routing.

5. Communicate as required with controlling agencies.

6. Monitor and manage fuel as required.

#### 21.2.10.2 Copilot/Other Crewmember

1. Verify engine performance with pilot.

2. Maintain a diligent lookout doctrine.

3. Monitor the clearance departure procedures and challenge the pilot on any deviations.

4. Assist the pilot in managing fuel as required.

### 21.2.11 Approach/Landing

#### 21.2.11.1 Pilot

1. Determine weather at destination.

2. Determine fuel required for divert as required.

3. Execute approach in accordance with published directives.

4. Complete Landing Checklist and execute landing.

#### 21.2.11.2 Copilot/Other Crewmember

1. Maintain diligent lookout doctrine.

2. Monitor airspeed, altitude, and adherence to clearances during holding and approach.

3. Challenge pilot on any deviation from published or assigned procedures.

4. Confirm completion of the Landing Checklist.

### 21.2.12 Postlanding

#### 21.2.12.1 Pilot

1. Exercise control of aircraft while taxiing; remain attentive for obstructions, taxi directions, and FOD.

2. Complete appropriate checklists prior to securing the engine.

3. Shut down the engine when properly parked and chocked.

4. Monitor instruments to ensure proper shutdown.

#### 21.2.12.2 Copilot/Other Crewmember

1. Backup pilot in lookout for obstructions and taxi signals

2. Monitor instruments on shutdown

### 21.2.13 Postflight

#### 21.2.13.1 Pilot

1. Conduct thorough postflight

2. Ensure completion of appropriate postflight documentation.

3. Debrief maintenance personnel on aircraft status.

4. Debrief crew.

#### 21.2.13.2 Copilot/Other Crewmember

1. Assist pilot in command as directed

### 21.2.14 Functional Checkflight

#### 21.2.14.1 Pilot in Command

1. Maintain physical control of the aircraft and fly the appropriate FCF profile.

#### 21.2.14.2 Copilot

1. Record instrument readings and take control of the aircraft only as directed by the pilot in command.

### 21.2.15 Emergency Situations

#### 21.2.15.1 Pilot in Command

1. Assume physical control of the aircraft and execute the appropriate emergency procedures.

#### 21.2.15.2 Copilot

1. Remain free of the flight controls unless otherwise directed by the pilot in command.

2. Assist the pilot in command as directed by reading checklist emergency procedures and/or maintaining a lookout doctrine.

# PART X

# NATOPS Evaluation

# CHAPTER 22

# NATOPS Evaluation

## 22.1 CONCEPT

The standard operating procedures prescribed in this manual represent the optimum method of operating T-34C aircraft. The NATOPS evaluation is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatibility with various operational commitments and missions of both Navy and Marine Corps units. The prime objective of the NATOPS evaluation program is to assist the unit commanding officer in improving unit readiness and safety through constructive comment. Maximum benefit from the NATOPS program is achieved only through the vigorous support of the program by commanding officers as well as flightcrew members.

## 22.2 DEFINITIONS

The following terms, used throughout this part, are defined as to their specific meaning within the NATOPS program.

1. NATOPS evaluation — A periodic evaluation of individual flight crewmember standardization consisting of an open book examination, a closed book examination, an oral examination, and a flight evaluation.

2. NATOPS reevaluation — A partial NATOPS evaluation administered to a flight crewmember who has been placed in an Unqualified status by receiving an Unqualified grade for any of his ground examinations or the flight evaluation. Only those areas in which an unsatisfactory level was noted need be observed during a reevaluation.

3. Qualified — That degree of standardization demonstrated by a very reliable flight crewmember who has a good knowledge of standard operating procedures and a thorough understanding of aircraft capabilities and limitations.

4. Conditionally qualified — That degree of standardization demonstrated by a flight crewmember who meets the minimum acceptable standards. He is considered safe enough to fly as a pilot in command or to perform normal duties without supervision but more practice is needed to become Qualified.

5. Unqualified — That degree of standardization demonstrated by a flight crewmember who fails to meet minimum acceptable criteria. He should receive supervised instruction until he has achieved a grade of Qualified or Conditionally Qualified.

6. Area — A routine of preflight, flight, or postflight.

7. Subarea — A performance subdivision within an area that is observed and evaluated during an evaluation flight.

8. Critical area — Any area or subarea that covers items of significant importance to the overall mission requirements, the marginal performance of that would jeopardize safe conduct of the flight.

9. Emergency — An aircraft component, system failure, or condition that requires instantaneous recognition, analysis, and proper action.

10. Malfunction — An aircraft component or system failure or condition that requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

## 22.3 IMPLEMENTATION

The NATOPS evaluation program shall be carried out in every unit operating Naval aircraft. Pilots desiring to attain/retain qualification in the T-34 shall be evaluated initially in accordance with OPNAVINST 3710.7 and at least once during the 12 months following initial and subsequent evaluations. Individual and unit NATOPS evaluations will be conducted annually; however, instruction in and observation of adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS coordinators, evaluators, and instructors shall administer the program as outlined in OPNAVINST 3710.7 series. Evaluees who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a reevaluation. A maximum of 60 days may elapse between the date the ground evaluation was commenced and the date the flight evaluation is satisfactorily completed.

## 22.4 GROUND EVALUATION

Prior to commencing the flight evaluation, an evaluee must achieve a grade of Qualified on the open and closed book examinations. The oral examination is also part of the ground evaluation but may be conducted as part of the flight evaluation. To assure a degree of standardization between units, the NATOPS instructors may use the bank of questions contained in this chapter in preparing portions of the written examinations.

**22.4.1 Open Book Examination.** Up to 50 percent of the questions used may be taken from the question bank. The number of questions on the examination will not exceed 40 or be less than 20. The purpose of the open book examination portion of the written examination is to evaluate pilot knowledge of appropriate publications and the aircraft. A maximum of 2-1/2 hours will be allowed to complete the exam.

**22.4.2 Closed Book Examination.** Up to 50 percent of the closed book examination may be taken from the question bank and shall include questions concerning normal procedures and aircraft limitations. The number of questions on the examination will not exceed 40 or be less than 20. Questions designated critical will be so marked. An incorrect answer to any question in the critical category will result in a grade of Unqualified being assigned to the examination. A maximum of 60 minutes will be allowed to complete the exam.

**22.4.3 Oral Examination.** The questions may be taken from this manual and drawn from the experience of the instructor/evaluator. Such questions should be direct and positive and should in no way be opinionated.

**22.4.4 Grading Instruction.** Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualified or Unqualified.

**22.4.4.1 Open Book Examination.** To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.5.

**22.4.4.2 Closed Book Examination.** To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.3.

**22.4.4.3 Oral Examination.** A grade of Qualified or Unqualified shall be assigned by the instructor/evaluator.

## 22.5 FLIGHT EVALUATION

The number of flights required to complete the flight evaluation should be kept to a minimum, normally one flight. The areas and subareas to be observed and graded on an evaluation flight are outlined in the grading criteria with critical areas marked by an asterisk (*). Subarea grades will be assigned in accordance with the grading criteria. These subareas shall be combined to arrive at the overall grade for the flight. Area grades, if desired, shall also be determined in this manner. As a minimum, all the subareas listed that are applicable to the T-34C must be evaluated with the exception of the precision approach radar. If a PAR cannot be evaluated because of inability to fly such an approach in the local area, but all other subareas were evaluated, the NATOPS flight evaluator/instructor may add any additional subareas that, based upon his experience, he finds appropriate.

**22.5.1 Flight Evaluation Grade Determination.** A grade of Unqualified in any critical area or critical subarea will result in an overall grade of Unqualified for the flight. Evaluation flight (or area) grades shall be determined by assigning the following: UQ (Unqualified), CQ (Conditionally Qualified), or Q (Qualified) for each subarea. All areas graded less than Q (Qualified) shall be justified in the evaluator's/instructor's remarks. An overall grade of less than Q (Qualified) for the flight shall be justified in the evaluator's/instructor's remarks.

## 22.6 FINAL GRADE DETERMINATION

The final NATOPS evaluation grade shall be the same as the grade assigned to the evaluation flight. An evaluee who receives an Unqualified on any ground examination or the flight evaluation shall be placed in an Unqualified status until he achieves a grade of Conditionally Qualified or Qualified on a reevaluation.

Evaluation reports for flights resulting in an overall grade of less than Q (Qualified) shall contain the unit commander's remarks concerning the qualifications of the individual evaluated.

## 22.7 RECORDS AND REPORTS

A NATOPS evaluation report (OPNAV Form 3710/7) (Figure 22-1) shall be completed for each evaluation and forwarded to the evaluee's commanding officer.

This report shall be filed in the individual flight training record and retained therein for 5 years. In addition, an entry shall be made in the pilot's flight logbook under "Qualifications and Achievements" as follows:

| QUALIFICATION | | DATE | SIGNATURE | |
|---|---|---|---|---|
| NATOPS EVAL | T-34C Pilot | (DATE) | (Authenticating Signature) | (Unit which administered Eval.) |

In addition to the NATOPS evaluation report, a NATOPS flight evaluation worksheet, OPNAV Form 3710/10 (Figure 22-2), is provided for use by the evaluator/instructor during the evaluation flight. All of the flight areas and subareas are listed on the worksheet with space allowed for related notes.

## 22.8 FLIGHT EVALUATION GRADING CRITERIA

Only those subareas provided or required will be graded. The grades assigned for a subarea shall be determined by comparing the degree of adherence to standard operating procedures with adjectival ratings listed. Momentary deviations from standard operating procedures should not be considered as unqualifying provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action.

### 22.8.1 Mission Planning

#### 22.8.1.1 Personal Flying Equipment

QUALIFIED — Possessed all required flying clothing, dog tags, and survival equipment, as listed in Part II of this manual and the current edition of OPNAVINST 3710.7, and had a good knowledge of its use.

CONDITIONALLY QUALIFIED — Possessed the necessary equipment, checked presence, readiness, and security of all other required safety equipment, and had satisfactory knowledge of its use.

UNQUALIFIED — Lacked necessary equipment or was not familiar with use of equipment.

#### 22.8.1.2 Flight Preparation

QUALIFIED — Possessed sound working knowledge and use of flight publications, NOTAMs, weather, departure routes, and airport facilities available in the selection of route, altitude, destination, and alternate and/or emergency airports. Correctly completed flight plan log and DD-175.

CONDITIONALLY QUALIFIED — Possessed limited knowledge and use of flight publications, NOTAMs, weather, departure procedures, and airport facilities available in selection of route, altitude, destination, and alternate airports. Minor errors in flight plan log and DD-175.

UNQUALIFIED — Definite lack of knowledge and use of flight publications, NOTAMs, weather, departure procedures, and airport facilities available in the selection of route, altitude, destination, and alternate airports resulted in planning and unsafe flight.

#### 22.8.1.3 Crew/Passenger Briefing

QUALIFIED — Conducted a thorough, detailed, and professional briefing for the dual pilot/passenger, covering route, altitude, destination, weather factors, use of personal and emergency equipment and emergency procedures, smoking privileges, etc., in accordance with current directives.

UNQUALIFIED — Conducted no briefing or failed to cover emergency procedures to the extent necessary to assure effective action during emergencies.

**22.8.1.4 Aircraft Takeoff Data.** Not applicable to T-34C aircraft.

**NATOPS EVALUATION REPORT**
**OPNAV 3710/7 (4-90) S/N 0107-LF-009-8000**

**REPORT SYMBOL OPNAV 3710-21**

| NAME (Last, first, initial) | GRADE | SERVICE NUMBER |
|---|---|---|
| | | |

| SQUADRON/UNIT | AIRCRAFT MODEL | CREW POSITION |
|---|---|---|
| | | |
| TOTAL PILOT/FLIGHT HOURS | TOTAL HOURS IN MODEL | DATE OF LAST EVALUATION |
| | | |

**NATOPS EVALUATION**

| REQUIREMENT | DATE COMPLETED | GRADE | | |
|---|---|---|---|---|
| | | Q | CQ | U |
| OPEN BOOK EXAMINATION | | | | |
| CLOSED BOOK EXAMINATION | | | | |
| ORAL EXAMINATION | | | | |
| | | | | |
| *EVALUATION FLIGHT | | | | |

| FLIGHT DURATION | AIRCRAFT BUNO | OVERALL FINAL GRADE |
|---|---|---|
| | | |

REMARKS OF EVALUATOR/INSTRUCTOR

☐ CHECK IF CONTINUED ON REVERSE SIDE

| GRADE, NAME OF EVALUATOR/INSTRUCTOR | SIGNATURE | DATE |
|---|---|---|
| | | |
| GRADE, NAME OF EVALUEE | SIGNATURE | DATE |
| | | |

REMARKS OF UNIT COMMANDER

| RANK, NAME OF UNIT COMMANDER | SIGNATURE | DATE |
|---|---|---|
| | | |

*WST, OFT, COT, or cockpit check in accordance with OPNAVINST 3710.7 (effective edition)

F-0056

Figure 22-1. NATOPS Evaluation Report (OPNAV Form 3710/7)

VT PILOT NATOPS EVALUATION WORKSHEET

OPNAV 3510/10 (REV. 10-73)

*Asterisk (*) denotes a critical area*

| NAME | GRADE | SSN |
|---|---|---|
| SQUADRON/UNIT | AIRCRAFT MODEL | PILOT |
| TOTAL PILOT HOURS | TOTAL HOURS IN MODEL | DATE OF LAST EVALUATION |

NATOPS EVALUATION

| REQUIREMENT | DATE COMPLETED | GRADE | | |
|---|---|---|---|---|
| | | Q | CQ | U |
| OPEN BOOK EXAMINATION | | | | |
| CLOSED BOOK EXAMINATION | | | | |
| ORAL EXAMINATION | | | | |
| | | | | |
| FLIGHT EVALUATION | | | | |

| FLIGHT DURATION | AIRCRAFT BUNO | OVERALL FINAL GRADE |
|---|---|---|
| GRADE, NAME OF EVALUATOR/INSTRUCTOR | | DATE |

REMARKS

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Figure 22-2. VT NATOPS Evaluation Worksheet (Sheet 1 of 4)

OPNAV 3510/10 (REV. 10-73)

*Asterisk (*) denotes a critical area*

| 1. MISSION PLANNING | | ADJECTIVE AREA GRADE | | | | REMARKS |
|---|---|---|---|---|---|---|
| SUB-AREAS | | Q | CQ | U | POINTS | |
| A. PERSONAL FLYING EQUIP. | | | | | | |
| B. FLIGHT PREPARATION | | | | | | |
| *C. CREW/PASSENGER BRIEFING | | | | | | |
| *D. AIRCRAFT TAKEOFF DATA | | | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | | | |
| 2. PREFLIGHT | | ADJECTIVE AREA GRADE | | | | |
| SUB-AREAS | | Q | CQ | U | POINTS | |
| A. AIRCRAFT INSPECTION | | | | | | |
| B. CHECKLISTS | | | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | | | |
| 3. PRE-TAKEOFF | | ADJECTIVE AREA GRADE | | | | |
| SUB-AREAS | | Q | CQ | U | POINTS | |
| A. START | | | | | | |
| B. CHECKLISTS | | | | | | |
| C. TAXI | | | | | | |
| *D. ENGINE RUNUP | | | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | | | |
| 4. TAKEOFF | | ADJECTIVE AREA GRADE | | | | |
| SUB-AREAS | | Q | CQ | U | POINTS | |
| *A. TAKEOFF PROCEDURES | | | | | | |
| *B. TRANSITION | | | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | | | |

F-0097

Figure 22-2. VP NATOPS Evaluation Worksheet (Sheet 2)

OPNAV 3510/10 (REV. 10-73)

*Asterisk (*) denotes critical area*

| 5. BASIC AIRWORK | | ADJECTIVE AREA GRADE | | | | REMARKS |
|---|---|---|---|---|---|---|
| SUB-AREAS | | Q | CQ | U | POINTS | |
| A. | | | | | | |
| B. | | | | | | |
| C. | | | | | | |
| D. | | | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | | | |

| *6. EMERGENCIES | | ADJECTIVE AREA GRADE | | | |
|---|---|---|---|---|---|
| SUB-AREAS | | Q | CQ | U | POINTS |
| *A. ENGINE FAILURE | | | | | |
| *B. FIRE INFLIGHT | | | | | |
| *C. SYSTEM FAILURE | | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | | |

| 7. INSTRUMENT PROCEDURES | | ADJECTIVE AREA GRADE | | | |
|---|---|---|---|---|---|
| SUB-AREAS | | Q | CQ | U | POINTS |
| A. HOLDING | | | | | |
| B. APPROACH/PENETRATION | | | | | |
| C. PRECISION RADAR APPROACH | | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | | |

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Figure 22-2. VT NATOPS Evaluation Worksheet (Sheet 3)

OPNAV 3510/10 (REV. 10-73)

*Asterisk (*) denotes a critical area*

| 8. LANDING | ADJECTIVE AREA GRADE | | | |
|---|---|---|---|---|
| SUB-AREAS | Q | CQ | U | POINTS |
| *A. CHECKLISTS | | | | |
| *B. DESCENT | | | | |
| *C. PATTERN | | | | |
| *D. LANDING AND ROLLOUT | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | |

REMARKS

| 9. POSTFLIGHT | ADJECTIVE AREA GRADE | | | |
|---|---|---|---|---|
| SUB-AREAS | Q | CQ | U | POINTS |
| A. ENGINE SHUTDOWN | | | | |
| B. CHECKLIST (NA TO JETS) | | | | |
| C. POSTFLIGHT INSPECTION | | | | |
| D. MISSION DEBRIEF | | | | |
| NUMERICAL AREA GRADE | | TOTAL POINTS | | |

| | |
|---|---|
| A. TOTAL ALL SUB-AREA POINTS | |
| B. TOTAL NO. SUB-AREAS GRADED | |
| C. FLT. EVAL. NUMERICAL GRADE $\frac{A}{B}$ | |
| **EVALUATION ADJECTIVE GRADE | |

*** See OPNAVINST 3510.9E*

F-0099

Figure 22-2. VT NATOPS Evaluation Worksheet (Sheet 4)

### 22.8.2 Preflight

#### 22.8.2.1 Aircraft Inspection

QUALIFIED — Completed inspection thoroughly and effectively.

CONDITIONALLY QUALIFIED — Completed inspection with omissions in minor areas that did not affect the safety of the proposed flight.

UNQUALIFIED — Failed to conduct inspection properly and omitted several important items.

#### 22.8.2.2 Checklist

QUALIFIED — Used NATOPS checklist in an accurate manner with no omissions.

CONDITIONALLY QUALIFIED — Made minor omissions to the checklist or hurried through without making adequate inspection of each item.

UNQUALIFIED — Did not use checklist or failed to make complete check.

### 22.8.3 Pretakeoff

#### 22.8.3.1 Start

QUALIFIED — Possessed complete knowledge and proficiency in normal and emergency procedures during engine start, including proper operational sequence and limitations.

CONDITIONALLY QUALIFIED — Knowledge and proficiency in normal and emergency procedures during engine start was limited. Unsure of operation sequence and limitations. Did not jeopardize crew and aircraft safety.

UNQUALIFIED — Lacked knowledge and proficiency in normal procedures and emergency procedures during engine start.

#### 22.8.3.2 Checklist

QUALIFIED — Demonstrated thoroughness in completion of Pretaxi Checklist. Completely checked and properly set the communication/navigation equipment that was required for the successful completion of the flight.

CONDITIONALLY QUALIFIED — Omitted minor items in Pretaxi Checklist. Check and set the minimal communication/navigation equipment required for successful completion of the flight. Limited knowledge of proper operation.

UNQUALIFIED — Omitted major items of the Pretaxi Checklist. Failed to check or set the communication/navigation equipment.

#### 22.8.3.3 Taxi

QUALIFIED — Handled aircraft safely with proper technique in the use of power, rudder, and brakes. Followed hand signals.

CONDITIONALLY QUALIFIED — Handled aircraft roughly with improper use of brakes. Did not follow hand signals. Taxied fast.

UNQUALIFIED — Taxied too fast, did not maintain proper lookout. Dangerous.

#### 22.8.3.4 Ground Runup*

QUALIFIED — Safely positioned aircraft for runup. Complete knowledge of runup procedures, limitations, and required checks. Completed Runup and Takeoff Checklists.

CONDITIONALLY QUALIFIED — Carelessly positioned aircraft for runup (i.e., nosewheel checked, etc.). Limited knowledge of runup procedures and limitations. Completed Runup and Takeoff Checklists.

UNQUALIFIED — Unsafely positioned the aircraft for runup. Did not know runup procedures, limitations, or checks. Doubtful if malfunctions serious enough to abort aircraft flight would have been recognized. Failed to complete Runup and Takeoff Checklists.

#### 22.8.4 Takeoff*

##### 22.8.4.1 Takeoff Procedures*

QUALIFIED — Properly aligned aircraft with runway. Applied power properly and maintained directional control with proper use of rudder. Assumed proper takeoff attitude and flew aircraft smoothly into air.

CONDITIONALLY QUALIFIED — Had erratic directional control but able to correct with rudder. Rough rotational technique. Aircraft in unbalanced flight and drifted off runway track.

UNQUALIFIED — Had to use brakes to correct swerve. Dangerous rotational technique. Aircraft allowed to settle after lift-off or aircraft assumed excessive nose-high attitude.

##### 22.8.4.2 Transition*

QUALIFIED — Maintained the proper climbing attitude. Operated gear/flaps in accordance with NATOPS procedures.

CONDITIONALLY QUALIFIED — Overcorrected nose attitude with erratic airspeed control. Late with gear retraction.

UNQUALIFIED — Had excessive nose-high attitude with resultant slow airspeed or nose-low attitude with loss of altitude. Forgot gear and would have exceeded limits.

#### 22.8.5 Basic Airwork

##### 22.8.5.1 Climb

QUALIFIED — Maintained airspeed within 10 knots and heading within 5°.

CONDITIONALLY QUALIFIED — Maintained airspeed within 15 knots and heading within 10°.

UNQUALIFIED — Deviated greater than 10° or 15 knots.

##### 22.8.5.2 Level Flight

QUALIFIED — Aircraft in balanced flight. Altitude held within 100 feet, heading within 10°, and airspeed within 5 knots.

CONDITIONALLY QUALIFIED — Altitude within 200 feet, heading within 15°, and airspeed within 10 knots.

UNQUALIFIED — Aircraft not in balanced flight. Deviation from altitude in excess of 200 feet, heading in excess of 15°, and airspeed in excess of 10 knots.

##### 22.8.5.3 Out-of-Control Flight (OCF)/Unusual Attitude Recoveries*

QUALIFIED — Good procedural knowledge. Timely and safe recovery of aircraft.

CONDITIONALLY QUALIFIED — Good procedural knowledge. Poor execution of recovery procedures.

UNQUALIFIED — Poor procedural knowledge. Unsafe execution of recovery procedures.

#### 22.8.6 Emergencies*

##### 22.8.6.1 Engine Failure*

QUALIFIED — Followed correct procedures as listed in Part V and NATOPS Pocket Checklist. Demonstrated ability to effect a safe landing.

CONDITIONALLY QUALIFIED — Did not follow correct procedures but demonstrated ability to effect safe landing.

UNQUALIFIED — Not able to effect safe landing.

##### 22.8.6.2 Fire In Flight*

QUALIFIED — Followed correct emergency procedure as listed in Part V. Demonstrated complete knowledge of system.

CONDITIONALLY QUALIFIED — Did not follow correct emergency procedures but covered all items.

UNQUALIFIED — Did not follow correct emergency procedure and would have jeopardized flight safety.

#### 22.8.6.3 Systems Failure*

QUALIFIED — Followed correct procedures as listed in Part V and NATOPS Pocket Checklist.

CONDITIONALLY QUALIFIED — Did not follow correct procedures but demonstrated ability to effect desired results.

UNQUALIFIED — Did not use correct procedures, did not effect desired results. Jeopardized crew or aircraft safety.

**22.8.7 Instrument Procedures.** Members who possess a current instrument rating accomplished in the T-34C are not required to accomplish these items.

#### 22.8.7.1 Holding*

QUALIFIED — Had proper entry and holding procedures with slight deviation and maintained airspeed within 5 knots, altitude within 100 feet. Met fix departure time within 20 seconds. Displayed adequate knowledge of wind corrections.

CONDITIONALLY QUALIFIED — Knew procedures, but displayed erratic tracking. Stayed within limits of holding pattern. Held altitude within 200 feet, airspeed within 10 knots, and met fix departure time within 30 seconds.

UNQUALIFIED — Unqualified with procedures, could not maintain aircraft within limits of holding pattern. Could not maintain altitude, airspeed, or timing within limits stated under Conditionally Qualified.

#### 22.8.7.2 Approach/Penetration*

QUALIFIED — Followed procedures as published in appropriate terminal charts. Complied strictly with approach control instructions. Maintained airspeed within 10 knots, altitude within safe limits, and did not descend below published approach altitudes. Maintained field minimum altitude within plus 150 feet and indicated that aircraft was over the field within 15 seconds of published time. Executed missed approach as published.

CONDITIONALLY QUALIFIED — Deviated slightly from procedures. Did not jeopardize crew or aircraft. Maintained airspeed within 15 knots. Did not descend below minimum altitude and indicated that aircraft was over the field within 30 seconds of published time. Executed missed approach as published.

UNQUALIFIED — Unsafe procedures, failed to comply with approach control instructions, or failed to meet airspeed, altitude, and time criteria. Deviated from missed approach procedure to the extent that safety of crew and aircraft were jeopardized.

#### 22.8.7.3 Precision Radar Approach*

QUALIFIED — Complied strictly with instructions. Maintained airspeed within 10 knots. Altitude held within 100 feet when altitude assigned. Minor deviations in glideslope and alignment.

CONDITIONALLY QUALIFIED — Complied with all instructions. Maintained airspeed within 15 knots. Assigned altitudes held within 200 feet. Erratic in glideslope and alignment, but did not jeopardize safety of aircraft or crew.

UNQUALIFIED — Lacked knowledge of procedures. Failure to comply with instructions, made completion of safe landing impossible. Exceeded limitations.

### 22.8.8 Landing

#### 22.8.8.1 Checklist

QUALIFIED — Landing Checklist completed.

CONDITIONALLY QUALIFIED — Hurried through the checklist without making adequate inspection of each item.

UNQUALIFIED — Did not use checklist or failed to make complete check.

#### 22.8.8.2 Descent*

QUALIFIED — Planned and executed descent so as to arrive at the desired entry point at the proper altitude with only minor deviations that did not restrict the effectiveness of the procedure.

CONDITIONALLY QUALIFIED — Slow to react to instructions and/or directives. Arrived at pattern entry point with incorrect altitude and/or airspeed.

UNQUALIFIED — Ignored instructions and/or directives. Arrived at pattern entry point with incorrect altitude and/or airspeed.

#### 22.8.8.3 Pattern*

QUALIFIED — Conformed to field traffic pattern within 100-foot deviation in altitude, within 5-knot airspeed.

CONDITIONALLY QUALIFIED — Deviation in pattern but not sufficient to interfere with safety of flight. Within 200-foot deviation in altitude, within 10-knot airspeed.

UNQUALIFIED — Serious deviations in pattern that interfered with normal traffic or other deviations jeopardized flight safety. Exceeded 200-foot deviation in altitude and 10-knot airspeed.

#### 22.8.8.4 Landing and Rollout*

QUALIFIED — Aircraft aligned within runway limits throughout final approach. Slight variations in rate of descent and airspeed. Smooth flareout and touchdown in first third of runway. Maintained directional control through proper use of aileron and rudder. Reduced to safe speed prior to clearing runway

CONDITIONALLY QUALIFIED — Had difficulty aligning aircraft with runway, rough handling of aircraft, and used poor technique throughout final and touchdown. Landed on first third of runway. Erratic directional control but able to correct with rudder. Aircraft slightly fast on turnoff.

UNQUALIFIED — Did not align aircraft with runway, erratic rate of descent. Allowed airspeed to go below minimum safe approach speed. Touchdown dangerously short/long (past the one-third runway mark) or to the extreme side of runway. Erratic directional control through improper use of aileron, rudder, or brakes. Aircraft not slowed sufficiently prior to turnoff.

### 22.8.9 Postflight

#### 22.8.9.1 Engine Shutdown

QUALIFIED — Secured engine and aircraft in accordance with NATOPS procedures.

UNQUALIFIED — Failed to properly secure engine and aircraft.

**22.8.9.2 Checklist.** Not applicable to T-34C.

#### 22.8.9.3 Postflight Inspection

QUALIFIED — Conducted inspection thoroughly and effectively.

CONDITIONALLY QUALIFIED — Completed inspection with omissions in minor areas.

UNQUALIFIED — Failed to conduct inspection properly and omitted several important items.

**22.8.9.4 MIssion Debrief.** Not applicable to T-34C.

## 22.9 NATOPS EVALUATION QUESTION BANK

1. Evaluees who receive a grade of Unqualified on a flight evaluation shall be allowed __________ days in which to complete a reevaluation.

2. What flight instruments utilize both pitot and static pressure for operation?

3. The normal engine oil pressure limits are __________ to __________.

4. Maximum airspeed for lowering the landing gear is __________.

5. The minimum oxygen system pressure for flight is __________.

6. The MASTER CAUTION advisory light will illuminate when __________.

7. What is the total fuel capacity of the T-34C?

8. What is the recommended oleo strut extension of the main gear?

9. What is the optimum airspeed and altitude for bailout?

10. Where is the fuel sump tank drain?

11. Is it necessary to have control of the AN/ARC-159V in order to change frequencies?

12. During start, if no light-off within __________ seconds or if ITT exceeds __________, secure the engine and investigate.

13. With both cockpit VHF NAV control panel power switches ON, is it possible to receive two stations simultaneously?

14. To set a course in the IND-350 (course deviation indicator), is it necessary to have control of the VIR-30A (VOR receiver)?

15. With loss of both inverters, is it possible to fly partial panel instruments?

16. The GCA final should be flown at __________ knots with __________ flaps.

17. Can canopy normal operation be resumed after selection of the emergency position?

18. What precaution has been taken to prevent accidental gear retraction on the deck?

19. The emergency fuel shutoff handle shuts off fuel at the __________.

20. How many fuel pumps are there in the T-34C?

21. Where is the fuel sump tank and how does it receive fuel from the wing tanks?

22. The T-34C has __________ Vdc electrical system powered by a __________________ ampere starter-generator and a ________ volt __________ ampere-hour lead acid battery.

23. Is it necessary to switch inverters when the generator fails in order to conserve power?

24. Is it possible to operate the TCN-40 (tacan) with the No. 2 inverter inoperative?

25. Is it possible to select different inverters from each cockpit simultaneously?

26. With loss of dc power, is it possible to use the cockpit environmental control?

27. An external emergency canopy handle is provided on the __________ side of the fuselage.

28. In preparation for solo flight, what items must the pilot check in the rear cockpit?

29. Where is the battery located in the T-34C?

30. Oil pressure below 65 psig is undesirable at power setting above __________ percent $N_1$. Oil pressure below __________psig requires landing as soon as possible.

31. List the items that are transferred on operation of the intercockpit electrical control shift switch.

32. What is the best power-off glidespeed to obtain maximum distance with gear and flaps retracted?

33. In the event of complete electrical failure in flight, what alternate means of lowering the flaps are available?

34. The flaps will not be lowered at speeds in excess of __________ knots.

35. The minimum battery voltage for start is __________ volts.

36. List the flight instruments that would be lost in the event of an ac power failure.

37. When starting the engine utilizing a GPU, the battery switch should be in the __________ position.

38. Can exterior lights be controlled from the rear cockpit?

39. Inverted flight in the T-34C is limited to __________ seconds.

40. Normal oil temperature for flight is __________ to __________.

41. Maximum engine rpm ($N_1$) is __________.

42. Maximum recommended indicated airspeed in severe turbulence is _____________.

43. In the emergency landing pattern, the desired straightaway should be __________ feet.

44. What is the proper trim tab settings for takeoff?

45. Failure of the starter-generator to maintain __________ volts will result in illumination of the __________ and __________ light.

46. What does illumination of the AUTO IGN annunciator light indicate?

47. Engine oil pressure is used to __________ propeller blade pitch.

48. What is the purpose of the fuel topping function of the primary propeller governor?

49. Minimum battery voltage necessary for acceptance of external power into the aircraft is __________ volts.

50. The beta safety switch is located on the __________.

51. Moving the PCL into beta range without the engine running will damage the __________.

52. Which aviation fuels are approved for use in the T-34C?

53. Engine operation using only the primary fuel pump is limited to __________ hours.

54. Loss of the primary fuel pump will cause the engine to __________.

55. What action should be taken when the yellow FUEL PRESS light on the annunciator panel illuminates?

56. Does the battery have the capability of assuming the complete electrical load of the aircraft?

57. Is it necessary to have the navigation lights on in order for the external landing gear indicator lights to operate with the gear fully extended?

58. The aileron trim tabs are __________ type.

59. What trim tabs can be mechanically operated from the cockpit?

60. What conditions will cause the landing gear WHEELS warning light to illuminate?

61. Approximately __________ turns of the landing gear emergency handcrank are required to fully extend the gear.

62. Is the landing gear emergency extension system designed and stressed for retraction of the gear?

63. When is the angle-of-attack system operative?

64. What type of engine fire detection system is installed in the T-34C?

65. What source of air is used for cockpit heating?

66. What type of system is used for engine anti-ice protection?

67. During start, the condition lever should be placed to INC RPM at __________percent $N_1$ minimum.

68. Oil pressure after start should be __________ psi minimum.

69. Normal propeller rpm is ___________ to __________ .

70. Normal operating torque range is __________ to __________ .

71. The maximum operating torque red line is __________ .

72. Maximum operating ITT is __________ .

73. Navy-approved altitude limit is __________ feet.

74. Maximum g limitation on the T-34C is __________ and __________.

# PART XI

# Performance Data

# CHAPTER 23

# Introduction

## 23.1 INTRODUCTION

The purpose of this part is to present performance data necessary for preflight and in-flight mission planning and includes explanatory text on the use of the charts. The part is arranged as follows: glossary of terms, abbreviations, example problem, explanation of performance charts, performance charts. The performance charts and explanatory text are arranged in a sequence (divided into Chapters 24 to 33) for the purpose of optimum preflight planning. The charts are designed to enable the pilot to determine the capability of the T-34C aircraft for takeoff, climb, cruise, and landing. The charts can also be used when an objective is changed or when an emergency situation develops. Aircraft performance may vary from pilot to pilot; however, these variations can be minimized by establishing preferred operating procedures and basing the calculation of performance data on the assumptions that these procedures will be followed. Normal and emergency operating procedures have been established and are provided in Parts III and V, respectively.

## 23.2 GLOSSARY OF TERMS

1. Air density ratio — Ratio of local air density to sea level standard air density.
2. Airspeed position error correction — Correction added to indicated airspeed to obtain calibrated airspeed.
3. Altimeter position error correction — Correction added to indicated pressure altitude to obtain true pressure altitude.
4. Ambient temperature — Local temperature of undisturbed air.
5. Angle of attack — Angle between the chord line of the wing and the relative wind.
6. Best angle of climb airspeed — The airspeed that results in the greatest gain in altitude relative to horizontal distance traveled ($V_x$).
7. Best rate of climb airspeed — The airspeed that results in the greatest gain in altitude per unit of time ($V_y$)
8. Bingo range — Distance from operating area to landing site.
9. Calibrated airspeed — Indicated airspeed of the aircraft corrected for position and instrument error.
10. Center of gravity — The point at which an aircraft would balance longitudinally if suspended.
11. Climb gradient — The ratio of the change in height during a portion of a climb to the horizontal distance transversed in the same time interval.
12. Data basis — Type of information used in preparation of performance chart.
13. Temperature deviation from standard — Difference at a pressure altitude between the ambient temperature and the standard day temperature.
14. Equivalent airspeed — Calibrated airspeed corrected for adiabatic compressible flow for the particular altitude.
15. Fuel density — Fuel mass per gallon.
16. Fuselage station — Location on aircraft fuselage from an imaginary vertical reference plane.
17. Gross weight — Momentary weight of aircraft.
18. Indicated airspeed — Airspeed as shown on the airspeed indicator. Indicated airspeeds shown in this manual assume zero instrument error.
19. Interstage turbine temperature — Gas temperature measured at inlet of second stage turbine stator assembly.

20. Mach number — Ratio of true airspeed to local speed of sound.

21. Maneuvering speed — The airspeed below which full deflection of the controls can be abruptly applied without overstressing the aircraft.

22. Maximum cruise power — The maximum power setting approved for cruise.

23. Maximum endurance power — Power setting for minimum fuel flow (greatest time).

24. Maximum range power — Power setting for maximum distance per pound of fuel.

25. Maximum, takeoff, full, cruise power — The maximum allowable power setting for a torque red line of 1,015 ft-lb and a maximum ITT of 695°.

26. Outside air temperature — Temperature value read from cockpit indicator.

27. Percent mean aerodynamic chord — Center-of- gravity location in reference to MAC.

28. Pressure altitude — Altitude measured from standard sea level pressure (29.92 in Hg) from a pressure altimeter.

29. Service ceiling — Maximum altitude at which a 100 ft/min rate of climb is obtainable.

30. Specific gravity — Ratio of the weight of a fixed volume of liquid to an equal volume of water.

31. Specific weight — Weight per unit volume (gallon) of a liquid.

32. Torque — A measurement that is proportional to the power output of the engine for a constant rpm.

33. True airspeed — Airspeed of the aircraft relative to undisturbed air that is the calibrated airspeed corrected for compressibility to equivalent airspeed, then corrected for altitude and temperature.

34. Wind angle — Angle between wind direction and runway heading.

## 23.3 ABBREVIATIONS

°C ...................... Degrees Celsius
CAS .................. Calibrated airspeed
CG ..................... Center of gravity
°F .................. Degrees Fahrenheit
FT ............................... Feet
GAL ...................... U.S. gallons
HR ................................ Hour
IAS .................. Indicated airspeed
ITT .......... Interstage turbine temperature
LB ............................. Pounds
MAC ............ Mean aerodynamic chord
MIN ........................... Minutes
MRT ............... Minimum radius turn
NM ...................... Nautical miles
RPM ............. Revolutions per minute
SEC ............................ Second
SL ............................ Sea level
STD ........................... Standard
$V_a$ ......................... Maneuvering speed
$V_x$ .................. Best angle of climb speed
$V_y$ .................... Best rate of climb speed

## 23.4 SAMPLE PROBLEM

### 23.4.1 Takeoff

ASSUME

Takeoff gross weight .............. 4,150 lb
Runway pressure altitude ........... 3,200 ft
Runway ambient temperature ......... 28 °C
Headwind ......................... 12 kt
Runway length .................. 4,500 ft
Obstacle height ..................... 70 ft
Obstacle distance from end of runway ................ 2,100 ft

FROM FIGURE 25-3:

Normal ground run ................ 1,380 ft
Total distance to clear obstacle ....... 2,650 ft
Rotation indicated airspeed ............ 78 kt

### 23.4.2 Cruise

ASSUME

Cruise pressure altitude . . . . . . . . . . . . 16,000 ft
Cruise altitude ambient temperature . . . . –2 °C
Cruise altitude headwind . . . . . . . . . . . . . . 30 kt
Distance to base . . . . . . . . . . . . . . . . . . 461 nm

FROM FIGURE 24-4:

Cruise altitude . . . . . . . . . . . . . . . . . . . . +15 °C
Deviation from standard . . . . . . . . . . . . +19 °C

FROM FIGURE 26-3:

Time to climb to cruise altitude . . . . . . 11 min
Fuel to climb to cruise altitude . . . . . . . . . 46 lb
Distance to climb to cruise altitude . . . . . 26 nm

FROM FIGURE 30-1:

Time to descend . . . . . . . . . . . . . . . . . . 4.8 min
Distance to descend . . . . . . . . . . . . . . . . . 15 nm
Fuel to descend . . . . . . . . . . . . . . . . . . . . . 11 lb

FROM FIGURE 27-6:

Maximum range cruise
True airspeed . . . . . . . . . . . . . . . . . . . . . . 176 kt
Maximum range cruise ground speed . . . 146 kt
Maximum range cruise time . . . . . . . . 190 min

FROM FIGURE 27-7:

Maximum range cruise fuel flow . . . . 181 lb/hr
Maximum range cruise fuel required . . . 535 lb
Maximum range cruise
specific range . . . . . . . . . . . . . . . . . 1.30 lb/nm

Time, Fuel, and Distance for Mission

| | Time min | Fuel lb | Distance nm |
|---|---|---|---|
| Climb | 11 | 46 | 26 |
| Cruise | 176 | 535 | 420 |
| Descent | 4.8 | 11 | 15 |
| Total | 191.8 | 592 | 461 |

### 23.4.3 Landing

ASSUME

Runway pressure altitude . . . . . . . . . . . 4,100 ft
Runway ambient temperature . . . . . . . . . 28 °C
Landing gross weight . . . . . . . . . . . . . 3,558 lb
Runway headwind component . . . . . . . . . 20 kt
Runway uphill slope . . . . . . . . . . . . 1.2 percent
Runway condition reading . . . . . . . . . . . . . . 16
Flaps position . . . . . . . . . . . . . . . . 100 percent
Runway length . . . . . . . . . . . . . . . . . . . 3,100 ft

FROM FIGURE 31-1:

Ground roll distance . . . . . . . . . . . . . . . . . . 650
Total distance to clear
50-foot obstacle . . . . . . . . . . . . . . . . . 1,860 ft
Approach indicated . . . . . . . . . . . . . . . . . . 71 kt
Touchdown indicated airspeed . . . . . . . . . 65 kt

# CHAPTER 24

# Standard Data

## 24.1 U.S. STANDARD ATMOSPHERE (FIGURE 24-1)

This table gives the standard day conditions at various altitudes for density ratio, temperature, speed of sound, pressure, and pressure ratio. To find the value of any item, read right of the altitude in the appropriate column.

## 24.2 AIR DENSITY RATIO (FIGURE 24-2)

This chart is used to obtain the air density ratio that is of importance in determining true airspeed.

## 24.3 TEMPERATURE CONVERSION/ CORRECTION (FIGURE 24-3)

The temperature conversion/correction chart is used to determine the ambient temperature knowing the true airspeed and the outside air temperature reading taken from the cockpit instrument. A secondary scale is provided for Fahrenheit temperatures.

## 24.4 TEMPERATURE DEVIATION FROM STANDARD (FIGURE 24-4)

This chart shows the temperature for a given pressure altitude at several deviations from standard temperature conditions.

## 24.5 ALTIMETER POSITION ERROR CORRECTION (FIGURE 24-5)

The altimeter position error correction is used to correct the pressure altimeter reading for deviations that are related to the ability of the static system to sense true outside pressure.

## 24.6 ALTIMETER POSITION ERROR CORRECTION (EMERGENCY) (FIGURE 24-6)

The altimeter position error correction is used to correct the pressure altimeter reading for deviations that are related to the ability of the emergency static system to sense true outside pressure.

## 24.7 AIRSPEED CONVERSION (FIGURE 24-7)

This chart gives true Mach number and true airspeed from the calibrated airspeed, pressure altitude, and ambient temperature.

## 24.8 AIRSPEED POSITION ERROR CORRECTION (FIGURE 24-8)

This chart shows the error in the airspeed indicator pitot static system for the flaps 0-percent and flaps 100-percent configurations (landing gear position has no effect). The correction is added to the indicated airspeed to obtain calibrated airspeed. Indicated airspeed assumes a zero instrument error.

## 24.9 AIRSPEED POSITION ERROR CORRECTION (EMERGENCY) (FIGURE 24-9)

This chart shows the error in the emergency airspeed indicator pitot static system. The correction is added to the indicated airspeed to obtain calibrated airspeed. Indicated airspeed assumes a zero instrument error.

## 24.10 COMPRESSIBILITY CORRECTION TO CAS (FIGURE 24-10)

The compressibility correction is subtracted from the calibrated airspeed to obtain the equivalent airspeed. True airspeed is found by dividing equivalent airspeed by the square root of the density ratio.

## 24.11 STANDARD UNITS CONVERSION (FIGURE 24-11)

This chart is used for conversion of units presented in the performance charts into other commonly used units.

## 24.12 FUEL DENSITY/WEIGHT VERSUS TEMPERATURE (FIGURE 24-12)

Specific weight for JP-4, JP-5 (Jet A, Jet B), and JP-8 fuels are shown on this chart showing the variation with temperature. This chart shows average specific weight and is subject to a variation of 0.2 lb/gal. For accurate results, a hydrometer should be used to find the specific gravity of the fuel that can be multiplied by 8.35 to get specific weight in lb/gal.

## 24.13 STALL SPEEDS (FIGURE 24-13)

This chart gives the indicated stall speed for various flap settings and bank angles. Gross weights from 3,000 to 4,500 pounds are presented.

## 24.14 ANGLE OF ATTACK (FIGURE 24-14)

This chart shows the relation between indicated airspeed and angle of attack. Indicated airspeed assumes zero instrument error.

## 24.15 AIRCRAFT GROSS WEIGHT VERSUS CG POSITION (FIGURE 24-16)

The gross weight, center-of-gravity envelope is shown in this chart from the forward to aft limitations on the center of gravity and up to the maximum takeoff weight.

### 24.15.1 CG Computation

1. Obtain basic aircraft weight and moment from aircraft weight and balance manual (NAVAIR 01-1B-40; DD Form 365F).
2. Obtain applicable moment figures for crew weights from Figures 24-15 (this includes naked weight and parachute).

**Note**

If LPAs are used, add 10 pounds to each crew weight and 8.6 lb/in to forward moment of 21.5 lb/in and an aft moment of 34.3 lb/in. Approximate parachute weight is 28 pounds each.

3. Obtain fuel quantity weight and moment values from Figure 24-15.
4. Add values obtained in step 1 to 3 to obtain uncorrected takeoff condition.
5. Subtract taxi fuel weight and moment from step 4. These are corrected values for takeoff.

**Note**

Normal taxi fuel is 25 pounds with a moment of 23 lb/in.

6. Divide takeoff moment by takeoff weight to obtain cg location.
7. Enter aircraft gross weight versus cg position (Figure 24-16) to verify cg within limits.
8. Repeats steps 1 to 7 for landing cg location (omit step 5).

**TAKEOFF CG**

| | | WT | MOMENT |
|---|---|---|---|
| 1. Basic aircraft | | 2,996.9 | 2,556 |
| 2. Naked crew and parachute | (fwd)<br>(aft) | 200<br>200 | 175<br>277 |
| Personal flight equipment | (fwd)<br>(aft) | 25<br>25 | 21.5<br>34.3 |
| LPA | (fwd)<br>(aft) | 10<br>10 | 8.6<br>13.7 |
| 3. Fuel (130 gal) JP-4 at 6.5 lb/gal) | | 845 | 739 |
| 4. Uncorrected takeoff | | 4,311.9 | 3,825.1 |
| 5. Taxi fuel corrected takeoff | | –25<br>4,286.9 | –23<br>3,802.1 |

6. $\frac{3,802.1}{4,286.9}$ = 0.887 X 100 = 88.7 inches (takeoff cg location)

**LANDING CG**

| | | WT | MOMENT |
|---|---|---|---|
| 1. Basic aircraft | | 2,996.9 | 2,556 |
| 2. Naked crew and parachute | (fwd)<br>(aft) | 200<br>200 | 175<br>277 |
| Personal flight equipment | (fwd)<br>(aft) | 25<br>25 | 21.5<br>34.3 |
| LPA | (fwd)<br>(aft) | 10<br>10 | 8.6<br>13.7 |
| 3. Fuel (30 gal) JP-4 at 6.5 lb/gal) | | 195 | 160 |
| 4. Landing | | 3,661.9 | 3,246.1 |

5. $\frac{3,246.1}{3,661.9}$ = 0.886 X 100 = 88.6 inches (landing cg location)

## 24.16 FUEL FLOW (FIGURE 24-17)

This chart shows fuel flow for a torque setting at a given ambient temperature and pressure altitude and allows comutation of range for power settings other than those presented in the cruise charts.

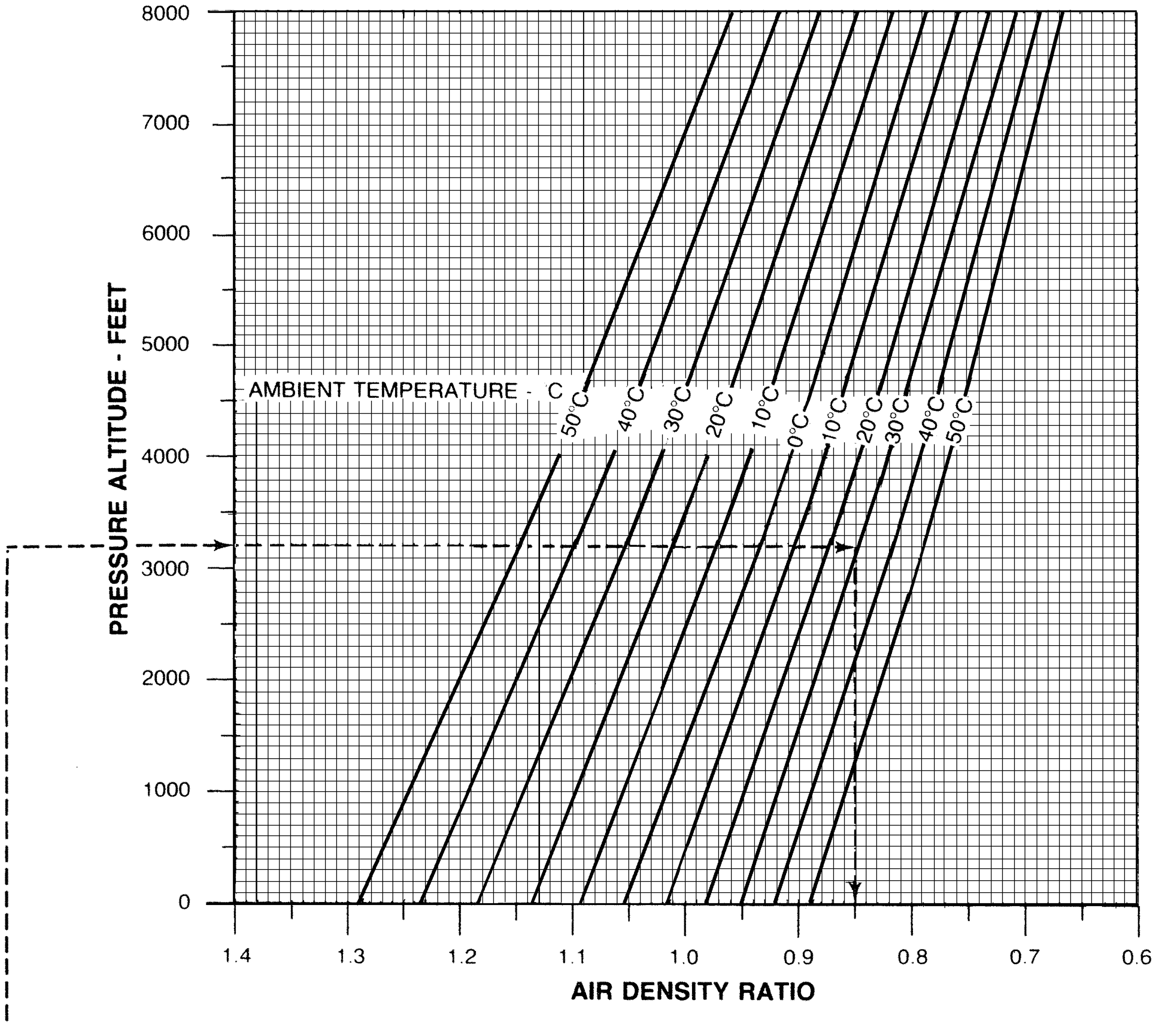
**ICAO STANDARD DAY**

**STANDARD SL CONDITIONS:**
TEMPERATURE — 15°C (59F)
PRESSURE — 29.921 IN. Hg; 2116.216 LB/SQ FT
DENSITY — .0023769 SLUGS/CU FT
SPEED OF SOUND — 1116.89 FT/SEC; 661.7 KNOTS

**CONVERSION FACTORS:**
1 IN. Hg — 70.727 LB/SQ FT
1 IN. Hg — 0.49116 LB/SQ IN
1 KNOT — 1.151 MPH
1 KNOT — 1.688 FT/SEC

| ALTITUDE FEET | DENSITY RATIO $\sigma$ | $\frac{1}{\sqrt{\sigma}}$ | TEMPERATURE °C | TEMPERATURE °F | SPEED OF SOUND KNOTS | PRESSURE IN Hg | PRESSURE RATIO $\delta$ |
|---|---|---|---|---|---|---|---|
| 0 | 1.0000 | 1.0000 | 15.000 | 59.000 | 661.7 | 29.921 | 1.0000 |
| 1,000 | 0.9711 | 1.0148 | 13.019 | 55.434 | 659.5 | 28.856 | 0.9644 |
| 2,000 | 0.9428 | 1.0299 | 11.038 | 51.868 | 657.2 | 27.821 | 0.9298 |
| 3,000 | 0.9151 | 1.0454 | 9.056 | 48.302 | 654.9 | 26.817 | 0.8962 |
| 4,000 | 0.8881 | 1.0611 | 7.076 | 44.735 | 652.6 | 25.842 | 0.8637 |
| 5,000 | 0.8617 | 1.0773 | 5.094 | 41.169 | 650.3 | 24.896 | 0.8320 |
| 6,000 | 0.8359 | 1.0938 | 3.113 | 37.603 | 648.7 | 23.978 | 0.8014 |
| 7,000 | 0.8106 | 1.1107 | 1.132 | 34.037 | 645.6 | 23.088 | 0.7716 |
| 8,000 | 0.7860 | 1.1279 | –0.850 | 30.471 | 643.3 | 22.225 | 0.7248 |
| 9,000 | 0.7620 | 1.1456 | –2.831 | 26.905 | 640.9 | 21.388 | 0.7148 |
| 10,000 | 0.7385 | 1.1637 | –4.812 | 23.338 | 638.6 | 20.577 | 0.6877 |
| 11,000 | 0.7155 | 1.1822 | –6.793 | 19.772 | 636.2 | 19.791 | 0.6614 |
| 12,000 | 0.6932 | 1.2011 | –8.774 | 16.206 | 633.9 | 19.029 | 0.6360 |
| 13,000 | 0.6713 | 1.2205 | –10.756 | 12.640 | 631.5 | 18.292 | 0.6113 |
| 14,000 | 0.6500 | 1.2403 | –12.737 | 9.074 | 629.0 | 17.577 | 0.5875 |
| 15,000 | 0.6292 | 1.2606 | –14.718 | 5.508 | 626.6 | 16.886 | 0.5643 |
| 16,000 | 0.6090 | 1.2815 | –16.699 | 1.941 | 624.2 | 16.216 | 0.5420 |
| 17,000 | 0.5892 | 1.3028 | –18.680 | –1.625 | 621.8 | 15.569 | 0.5203 |
| 18,000 | 0.5699 | 1.3246 | –20.662 | –5.191 | 619.4 | 14.942 | 0.4994 |
| 19,000 | 0.5511 | 1.3470 | –22.643 | –8.757 | 617.0 | 14.336 | 0.4791 |
| 20,000 | 0.5328 | 1.3700 | –24.624 | –12.323 | 614.6 | 13.750 | 0.4595 |
| 21,000 | 0.5150 | 1.3935 | –26.605 | –15.889 | 612.1 | 13.184 | 0.4406 |
| 22,000 | 0.4976 | 1.4176 | –28.587 | –19.456 | 609.6 | 12.636 | 0.4223 |
| 23,000 | 0.4806 | 1.4424 | –30.568 | –23.022 | 607.1 | 12.107 | 0.4046 |
| 24,000 | 0.4642 | 1.4678 | –32.549 | –26.588 | 604.6 | 11.597 | 0.3876 |
| 25,000 | 0.4481 | 1.4938 | –34.530 | –30.154 | 602.1 | 11.103 | 0.3711 |
| 26,000 | 0.4325 | 1.5206 | –36.511 | –33.720 | 599.6 | 10.627 | 0.3552 |
| 27,000 | 0.4173 | 1.5480 | –38.492 | –37.286 | 597.1 | 10.168 | 0.3398 |
| 28,000 | 0.4025 | 1.5762 | –40.474 | –40.852 | 594.6 | 9.725 | 0.3250 |
| 29,000 | 0.3881 | 1.6052 | –42.455 | –44.419 | 592.1 | 9.297 | 0.3107 |
| 30,000 | 0.3741 | 1.6349 | –44.436 | –47.985 | 589.5 | 8.885 | 0.2970 |
| 31,000 | 0.3605 | 1.6654 | –46.417 | –51.551 | 5.86.9 | 8.488 | 0.2837 |
| 32,000 | 0.3473 | 1.6968 | –48.398 | –55.117 | 584.4 | 8.106 | 0.2709 |
| 33,000 | 0.3345 | 1.7291 | –50.379 | –58.683 | 581.8 | 7.737 | 0.2586 |
| 34,000 | 0.3220 | 1.7623 | –52.361 | –62.249 | 579.2 | 7.382 | 0.2467 |
| 35,000 | 0.3099 | 1.7964 | –54.342 | –65.816 | 576.6 | 7.041 | 0.2353 |
| 36,000 | 0.2981 | 1.8315 | –56.323 | –69.382 | 574.0 | 6.712 | 0.2243 |
| 36,089 | 0.2971 | 1.8347 | –56.500 | –69.700 | 573.7 | 6.683 | 0.2234 |
| 37,000 | 0.2843 | 1.8753 | | | | 6.397 | 0.2138 |
| 38,000 | 0.2710 | 1.9209 | | | | 6.097 | 0.2038 |
| 39,000 | 0.2583 | 1.9677 | | | | 5.811 | 0.1942 |
| 40,000 | 0.2462 | 2.0155 | | | | 5.538 | 0.1851 |

Figure 24-1. U.S. Standard Atmosphere




**EXAMPLE**

PRESSURE ALTITUDE 3200 FEET, AMBIENT TEMPERATURE 28°C
AIR DENSITY RATIO = 0.850

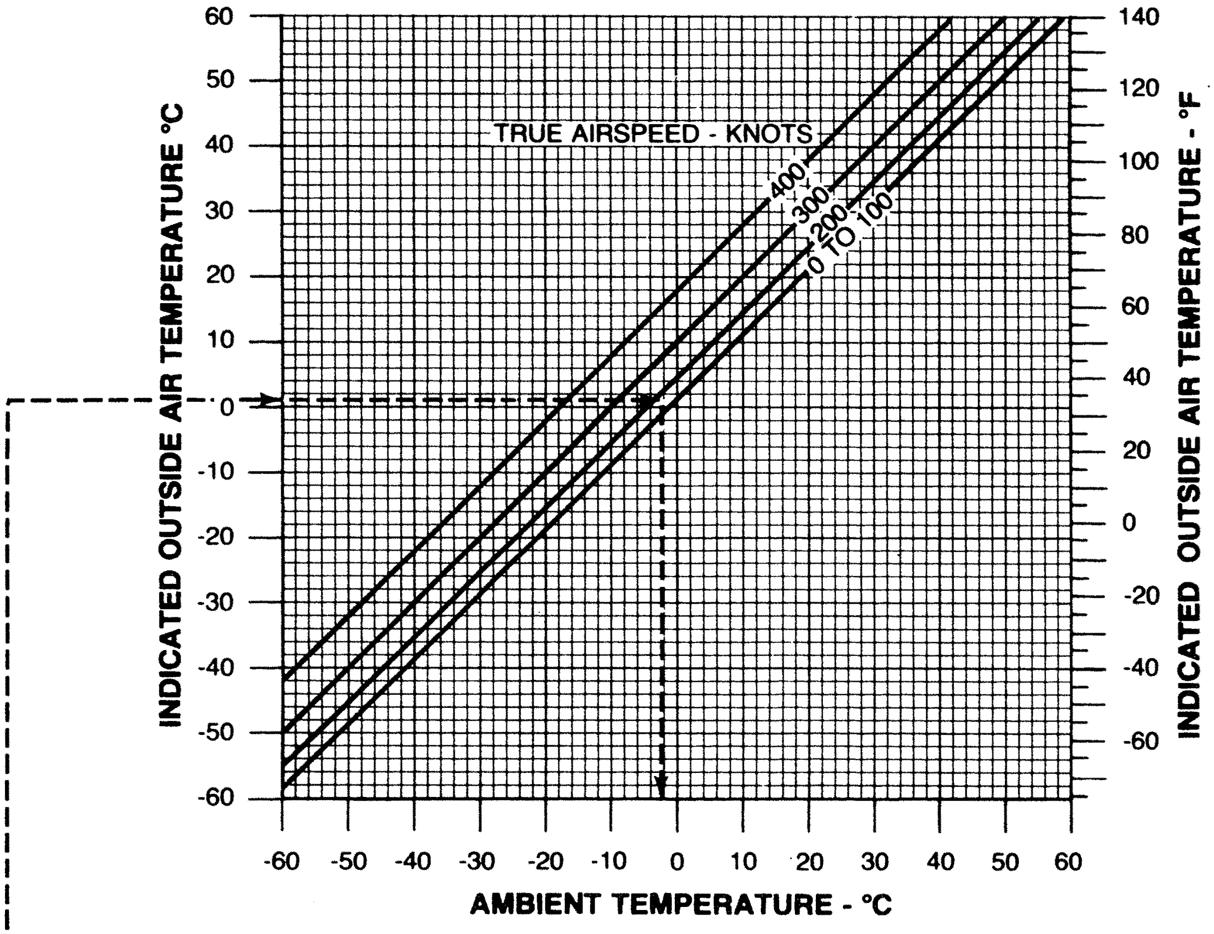
**HOW TO USE CHART**

ENTER LEFT SIDE OF CHART AT PRESSURE ALTITUDE, TRACE RIGHT TO AMBIENT TEMPERATURE AND TRACE DOWN TO READ AIR DENSITY RATIO

F-0058

Figure 24-2. Air Density Ratio

MODEL - T-34C
DATE: 3 DEC 1976
DATA BASIS: FLIGHT TEST




**EXAMPLE**

OUTSIDE AIR TEMPERATURE 1°C; TRUE AIRSPEED 176 KNOTS; AMBIENT TEMPERATURE -2°C

**HOW TO USE CHART**

ENTER LEFT SIDE AT OUTSIDE AIR TEMPERATURE AND TRACE RIGHT TO TRUE AIRSPEED, TRACE DOWN AND READ AMBIENT TEMPERATURE.

F-0059

Figure 24-3. Temperature Conversion/Correction for Compressibility

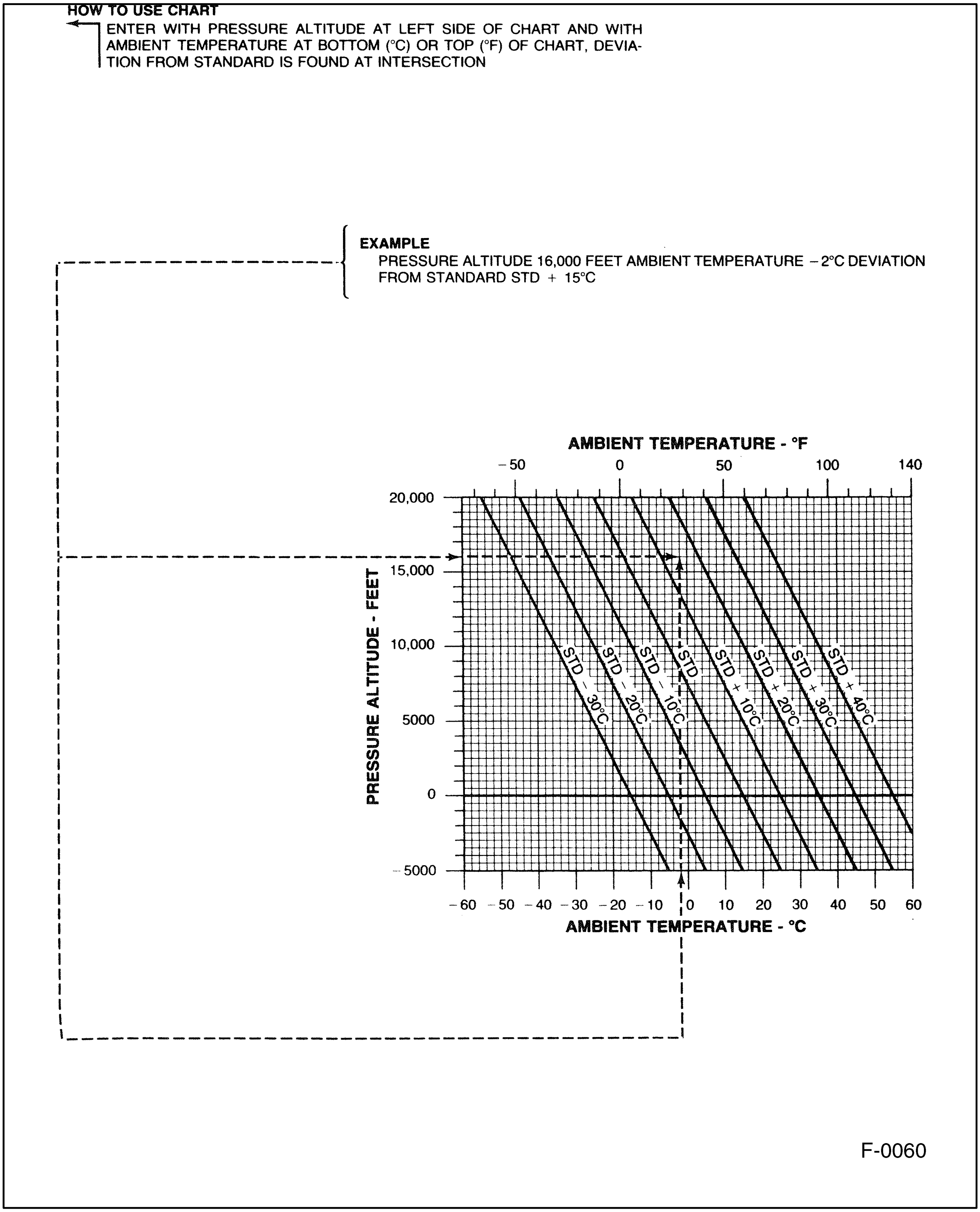



Figure 24-4. Temperature Deviation From Standard Chart

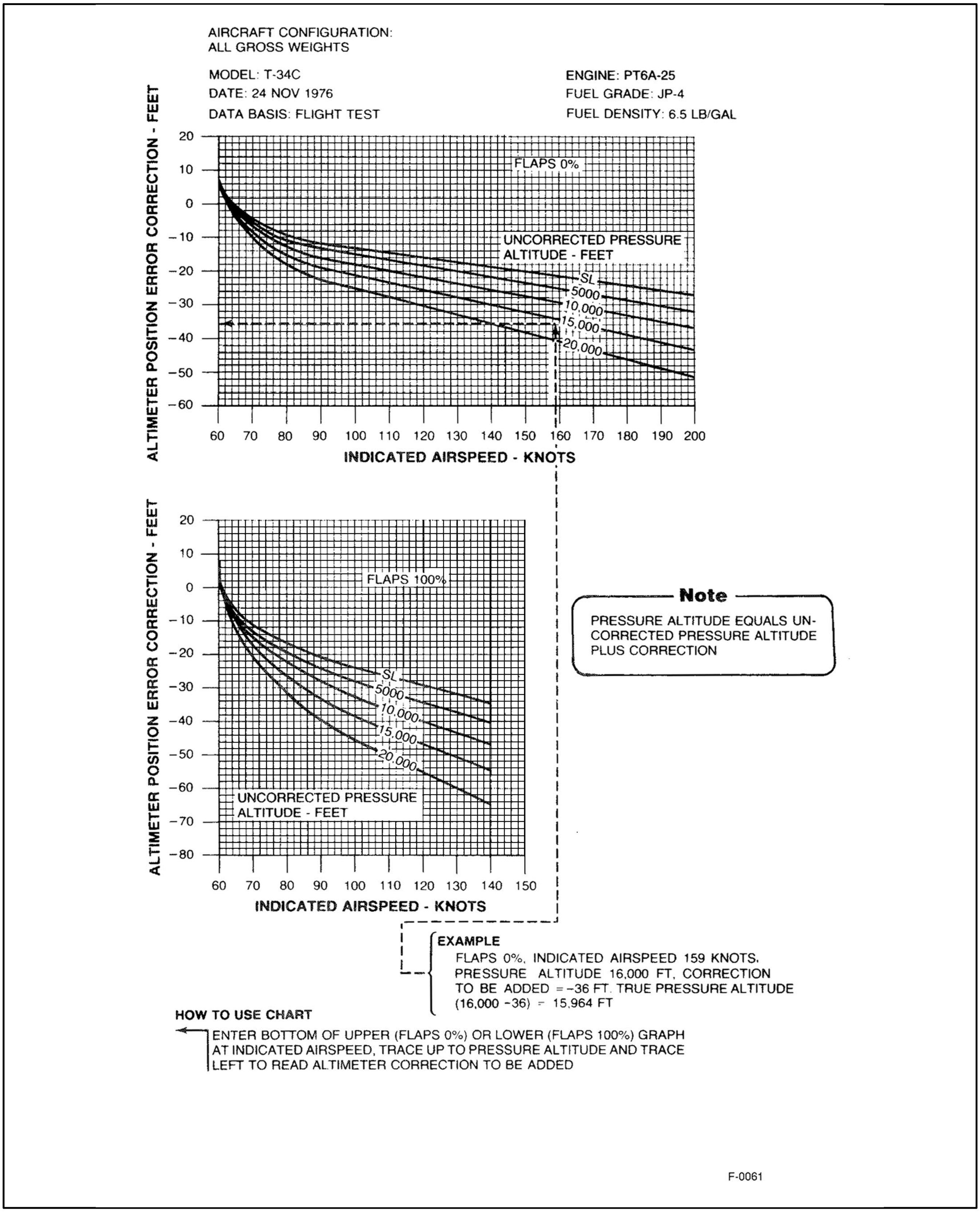



Figure 24-5. Altimeter Position Error Correction

AIRCRAFT CONFIGURATION:
ALL GROSS WEIGHTS AND FLAP SETTINGS

MODEL: T-34C

DATE: 24 NOV 1976

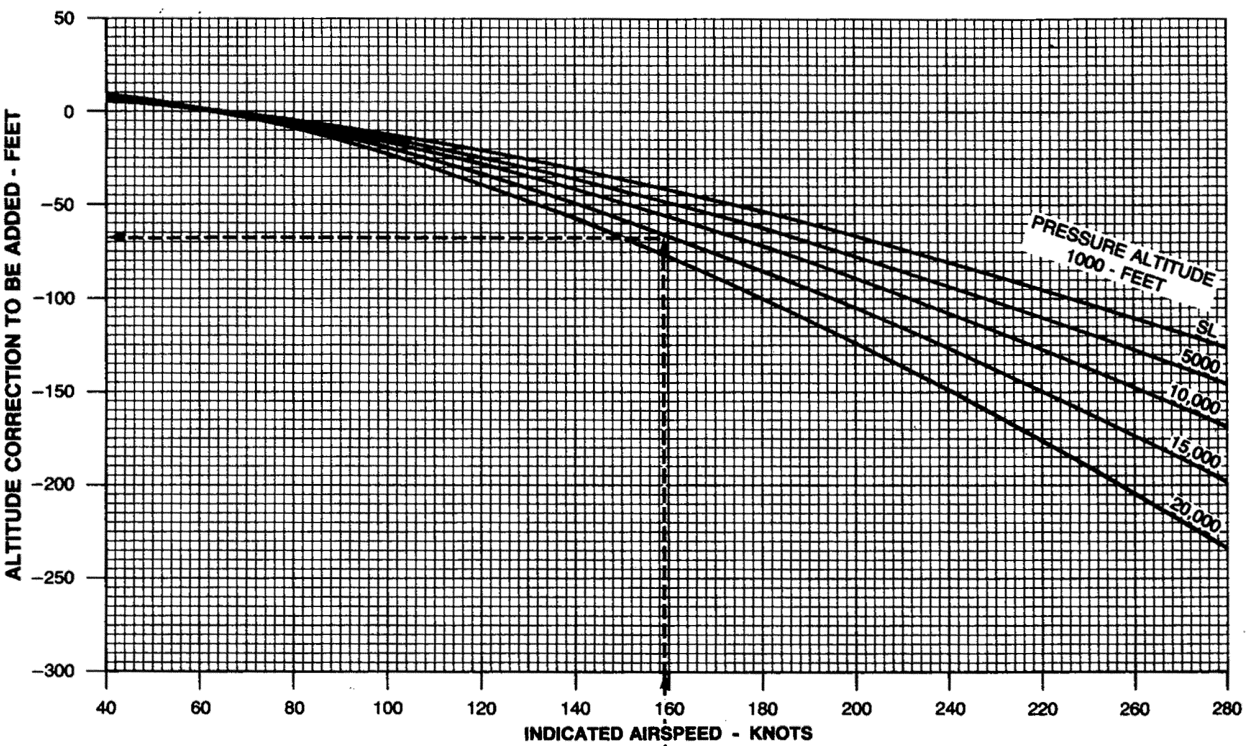
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL

**REMARKS**
ADD CORRECTION TO INDICATED ALTITUDE




**EXAMPLE**
INDICATED AIRSPEED 159 KNOTS
PRESSURE ALTITUDE 16,000 FEET
CORRECTION TO BE ADDED =−68 FEET
TRUE PRESSURE ALTITUDE = 16,000 −68 = 15,932 FT

**HOW TO USE CHART**
ENTER BOTTOM OF CHART AT INDICATED AIRSPEED, TRACE UP TO PRESSURE ALTITUDE AND TRACE LEFT TO READ ALTIMETER CORRECTION TO BE ADDED

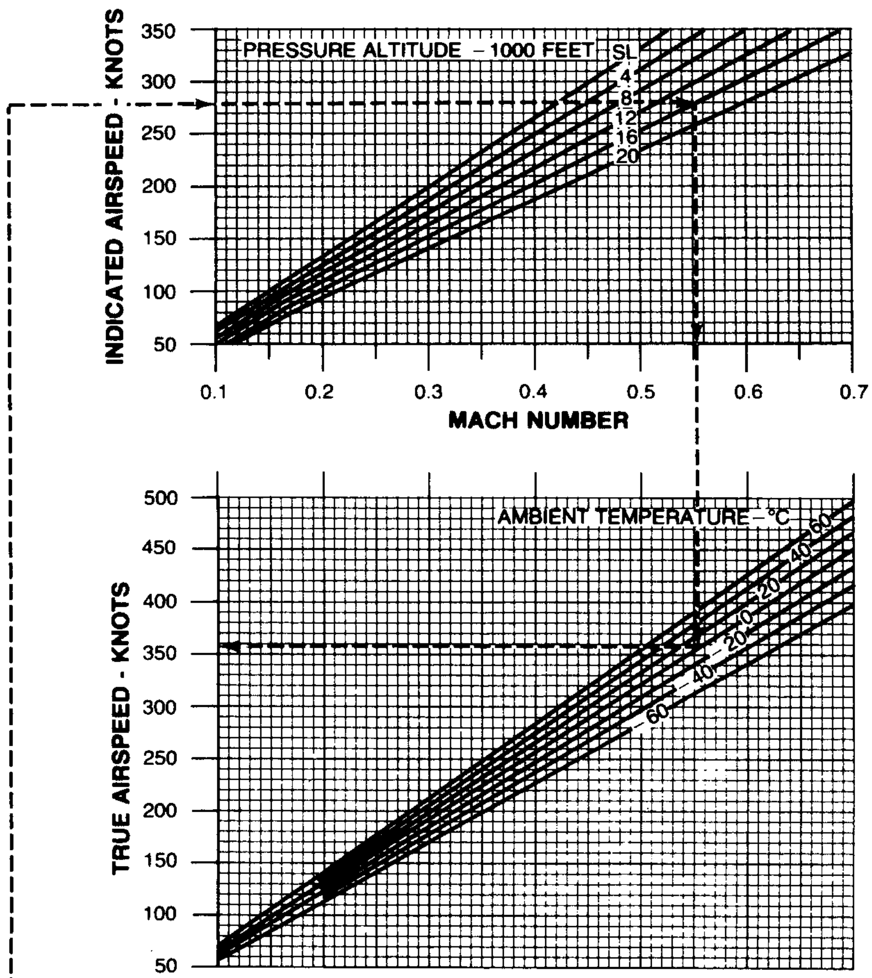
F-0062

Figure 24-6. Altimeter Position Error Correction — Emergency

MODEL: T-34C

DATE: 7 DEC 1976

DATA BASIS: FLIGHT TEST




**EXAMPLE**

INDICATED AIRSPEED 280 KNOTS, PRESSURE ALTITUDE 16,000 FT MACH NUMBER = 0.553, AMBIENT TEMPERATURE –2°C TRUE AIRSPEED = 358 KNOTS

**HOW TO USE CHART**

ENTER LEFT SIDE OF UPPER CHART AT INDICATED AIRSPEED AND TRACE RIGHT TO PRESSURE ALTITUDE, TRACE DOWN TO READ MACH NUMBER AND CONTINUE TRACING DOWN TO AMBIENT TEMPERATURE, TRACE LEFT TO READ TRUE AIRSPEED

F-0063

Figure 24-7. Airspeed Conversion

AIRCRAFT CONFIGURATION:
ALL GROSS WEIGHTS

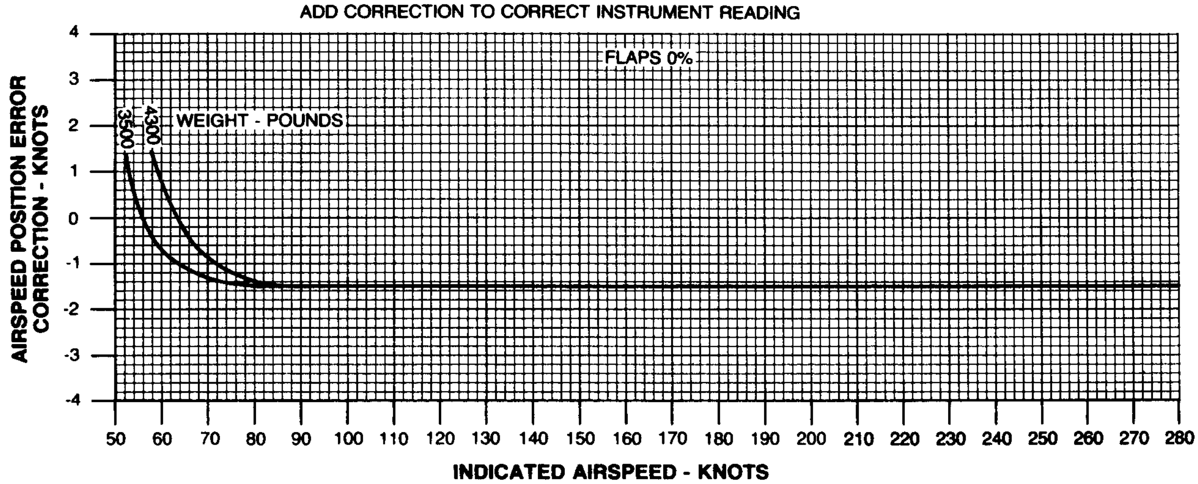
MODEL: T-34C
ENGINE: PT6A-25

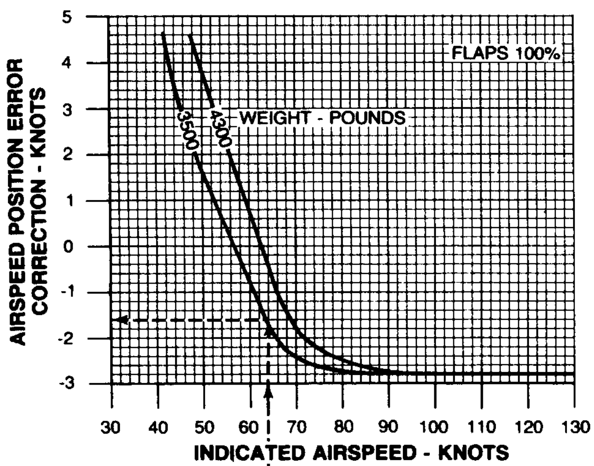
DATE: 23 NOV 1976
FUEL GRADE: JP-4

DATA BASIS: FLIGHT TEST
FUEL DENSITY: 6.5 LB/GAL

**REMARKS**

ADD CORRECTION TO CORRECT INSTRUMENT READING




**Note**

CALIBRATED AIRSPEED = INDICATED AIRSPEED PLUS CORRECTION

**EXAMPLE**

FLAPS 100%, INDICATED AIRSPEED 64 KNOTS, WEIGHT 3540 LBS, AIRSPEED POSITION ERROR – 1.6 KNOTS, CALIBRATED AIRSPEED (64 – 1.6) = 62.4 KNOTS

**HOW TO USE CHART**

ENTER AT BOTTOM OF LOWER (FLAPS 100%) OR UPPER (FLAPS 0%) GRAPH AT INDICATED AIRSPEED, TRACE UP TO WEIGHT AND LEFT TO AIRSPEED POSITION ERROR CORRECTION, ADD AIRSPEED POSITION ERROR TO INDICATED AIRSPEED TO OBTAIN CALIBRATED AIRSPEED

F-0064

Figure 24-8. Airspeed Position Error Correction

AIRCRAFT CONFIGURATION:
ALL GROSS WEIGHTS AND FLAP SETTINGS

MODEL: T-34C

DATE: 23 NOV 1976

DATA BASIS: FLIGHT TEST

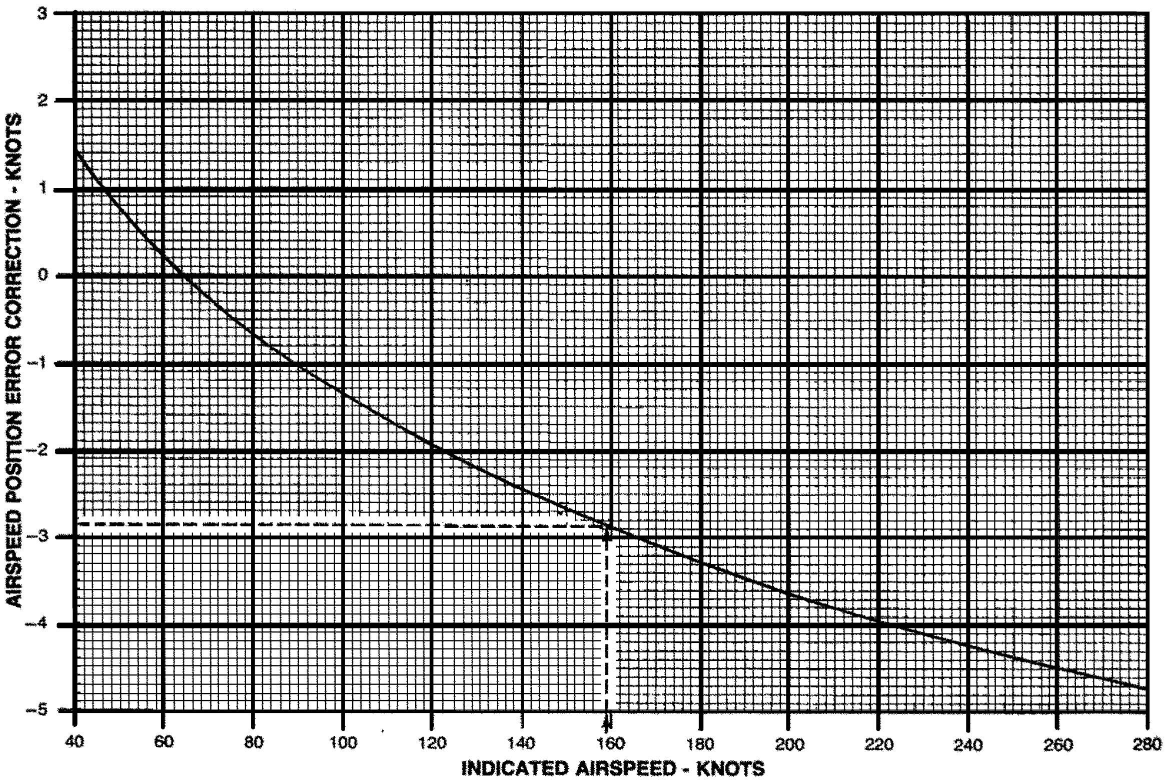
ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL

**REMARKS**

ADD CORRECTION TO CORRECT INSTRUMENT READING




**EXAMPLE**
INDICATED AIRSPEED 159 KNOTS AIRSPEED POSITION
ERROR CORRECTION = -3 KNOTS, CALIBRATED AIRSPEED
(159 − 3) = 156 KNOTS

**HOW TO USE CHART**
ENTER AT BOTTOM OF CHART AT INDICATED AIRSPEED,
TRACE UP TO CURVE AND LEFT TO AIRSPEED POSITION
ERROR CORRECTION

F-0065

Figure 24-9. Airspeed Position Error Correction — Emergency

MODEL: T-34C

DATE: 24 OCT 1978

DATA BASIS: ESTIMATED

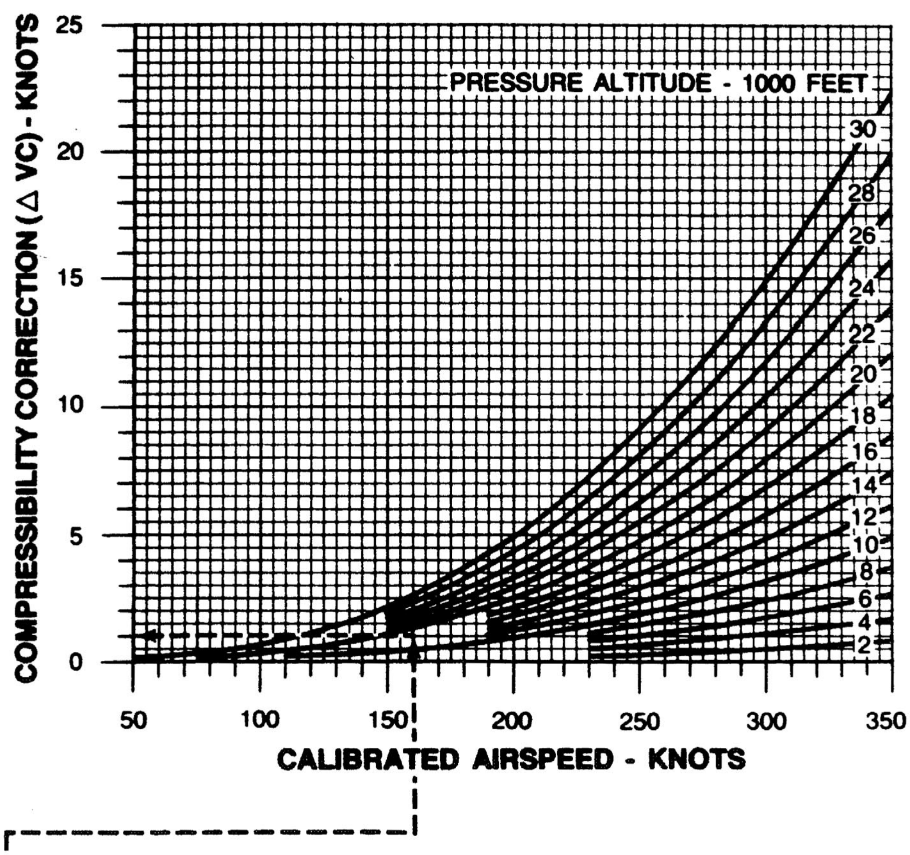
ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL

**Note**

SUBTRACT COMPRESSIBILITY CORRECTION FROM CALIBRATED AIRSPEED TO OBTAIN EQUIVALENT AIRSPEED.




EXAMPLE
CALIBRATED AIRSPEED 160 KNOTS, PRESSURE ALTITUDE 17,000 FEET, $\Delta V_C$ = 1.0 KNOT, EAS = 160 − 1 = 159 KNOTS

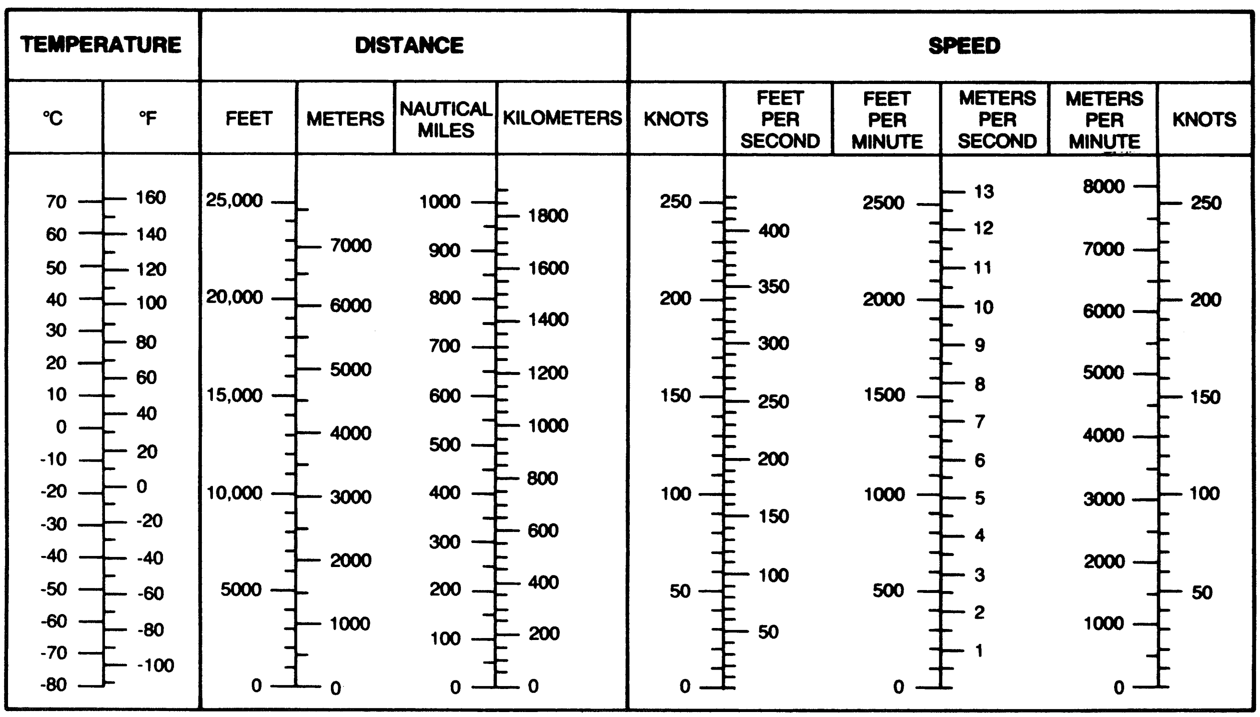
HOW TO USE CHART
ENTER BOTTOM WITH CALIBRATED AIRSPEED, TRACE UP TO PRESSURE ALTITUDE, TRACE RIGHT OR LEFT TO READ $\Delta V_C$

F-0066

Figure 24-10. Compressibility Correction to CAS

**Note**

TO OBTAIN US GALLONS MULTIPLY LITERS BY 0.264
TO OBTAIN IMPERIAL GALLONS MULTIPLY LITERS BY 0.220
TO OBTAIN INCHES OF MERCURY MULTIPLY MILLIBARS BY 0.0295
TO OBTAIN POUNDS MULTIPLY KILOGRAMS BY 2.20




F-0067

Figure 24-11. Standard Unit Conversion

MODEL: T-34C

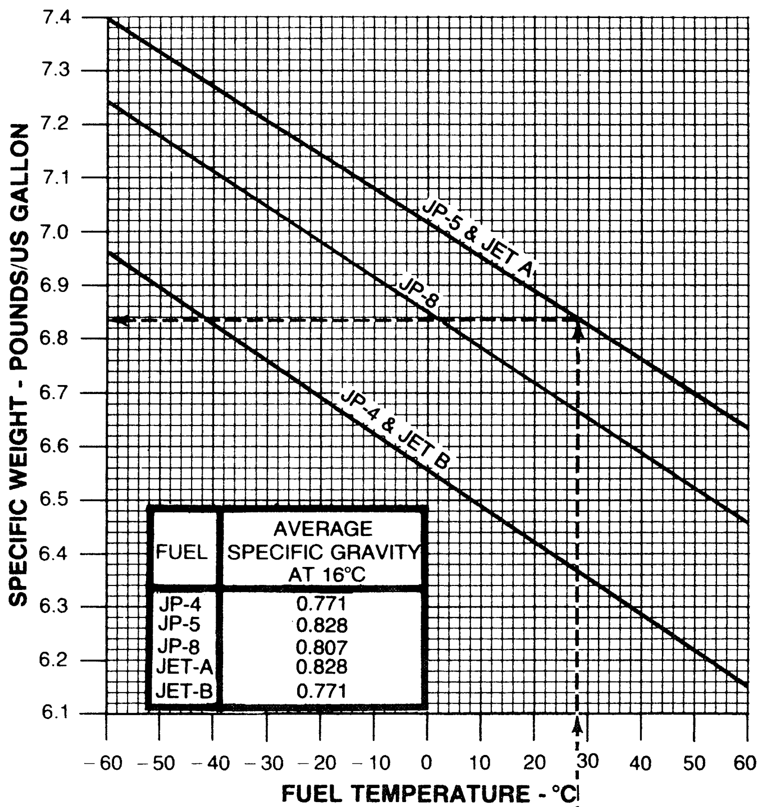
ENGINE: PT6A-25

DATE: 22 NOV 1976

DATA BASIS: MIL-J-5624D

**Note**

MULTIPLY SPECIFIC GRAVITY BY 8.35 TO OBTAIN SPECIFIC WEIGHT IN LB/US GAL




| FUEL | AVERAGE SPECIFIC GRAVITY AT 16°C |
|---|---|
| JP-4 | 0.771 |
| JP-5 | 0.828 |
| JP-8 | 0.807 |
| JET-A | 0.828 |
| JET-B | 0.771 |

**EXAMPLE**

FUEL TEMPERATURE 28°C FUEL GRADE JP-5 SPECIFIC WEIGHT = 6.83 LB/US GAL, FUEL QUANTITY 130 US GAL, FUEL WEIGHT (6.83 x 130) = 888 LBS

**HOW TO USE CHART**

ENTER AT BOTTOM OF CHART AT FUEL TEMPERATURE, TRACE UP TO FUEL GRADE AND THEN LEFT TO READ SPECIFIC WEIGHT. TO OBTAIN FUEL WEIGHT MULTIPLY SPECIFIC WEIGHT BY FUEL QUANTITY IN GALLONS

F-0068

Figure 24-12. Fuel Density/Weight Versus Temperature

CONFIGURATION
ALL GROSS WEIGHTS
OUT OF GROUND EFFECT

MODEL: T-34C

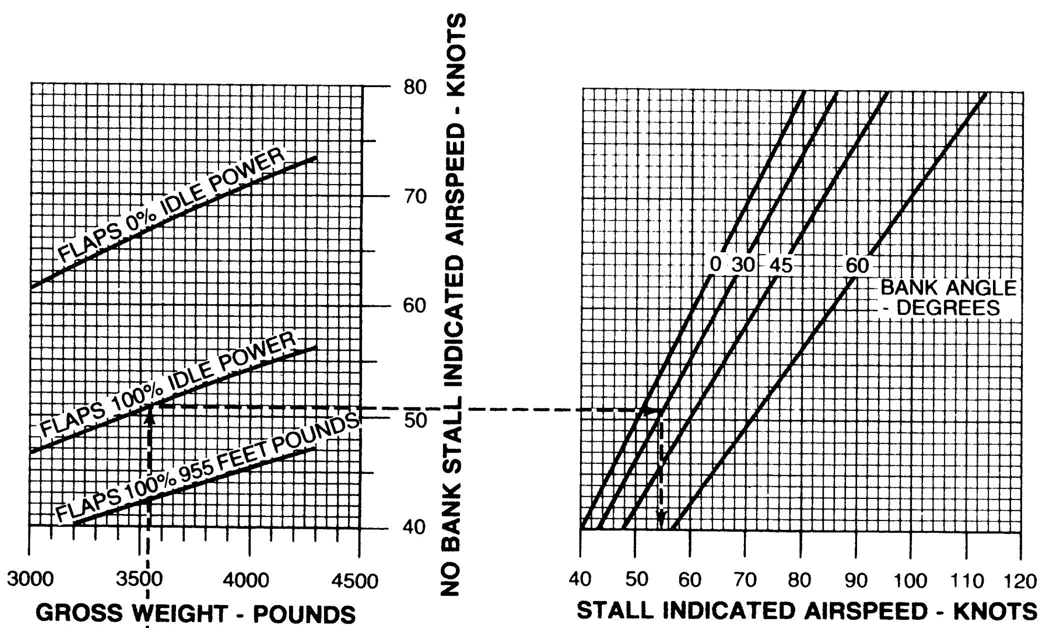
DATE: 23 NOV 1976

DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**
WEIGHT 3540 LB, FLAPS 100% IDLE POWER, NO BANK STALL INDICATED AIRSPEED = 51 KNOTS, BANK ANGLE 30 DEGREES, STALL INDICATED AIRSPEED = 55 KNOTS

**HOW TO USE CHART**
ENTER BOTTOM OF LEFT GRAPH AT GROSS WEIGHT AND TRACE UP TO CONFIGURATION, TRACE RIGHT TO READ NO BANK INDICATED STALL SPEEDS AND CONTINUE TRACING RIGHT TO BANK ANGLE, TRACE DOWN TO READ INDICATED STALL SPEED AT BANK ANGLE

AP 002159

Figure 24-13. Stall Speeds

AIRCRAFT CONFIGURATION:
STRAIGHT AND LEVEL FLIGHT
PROPELLER RPM 2200

MODEL: T-34C

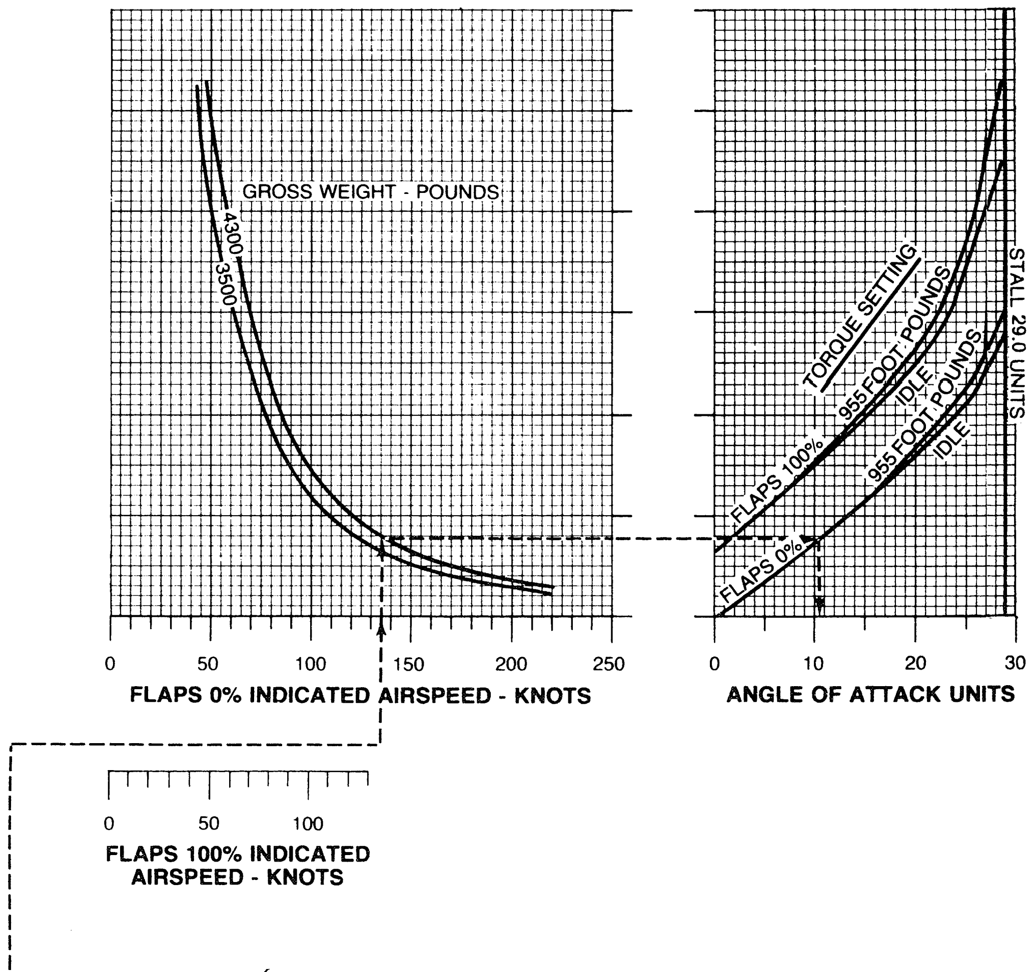
DATE: 24 NOV 1976

DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**

FLAPS 0% INDICATED AIRSPEED 136 KNOTS, WEIGHT 4150 LB ANGLE OF ATTACK = 10.5 UNITS

**HOW TO USE CHART**

ENTER BOTTOM OF LEFT CHART AT INDICATED AIRSPEED TRACE UP TO WEIGHT, TRACE RIGHT TO FLAP SETTING AND TORQUE SETTING AND TRACE DOWN TO READ ANGLE OF ATTACK UNITS

F-0070

Figure 24-14. Angle of Attack

**USABLE FUEL**

| | 6.76 LB/GAL (JP-5 AT 40 °C) | | 6.92 LB/GAL (JP-5 AT 15 °C) | | 7.08 LB/GAL (JP-5 AT –10 °C) | |
|---|---|---|---|---|---|---|
| GALLONS | WEIGHT (LB) | MOMENT 100 (IN/LB) | WEIGHT 100 (LB) | MOMENT 100 (IN/LB) | WEIGHT (LB) | MOMENT 100 (IN/LB) |
| 10 | 68 | 55 | 69 | 56 | 71 | 57 |
| 20 | 135 | 110 | 138 | 113 | 142 | 116 |
| 30 | 203 | 167 | 208 | 171 | 212 | 175 |
| 40 | 270 | 225 | 277 | 230 | 283 | 235 |
| 50 | 338 | 284 | 346 | 291 | 354 | 298 |
| 60 | 406 | 343 | 415 | 351 | 425 | 359 |
| 70 | 473 | 404 | 484 | 413 | 496 | 423 |
| 80 | 541 | 463 | 554 | 474 | 566 | 485 |
| 90 | 608 | 524 | 623 | 536 | 637 | 549 |
| 100 | 676 | 585 | 692 | 598 | 708 | 612 |
| 110 | 744 | 645 | 761 | 660 | 779 | 676 |
| 120 | 811 | 707 | 830 | 724 | 850 | 740 |
| 130 | 879 | 768 | 900 | 787 | 920 | 805 |

Fuel table based on usable fuel capacity of 130 gallons. Fuel is contained in four wing fuel cells interconnected to gravity feed to the sump tank in the fuselage. The engine is fed from the sump tank.

**CREW (INCLUDING BACK PACK PARACHUTE)**

| WEIGHT (LB) | MOMENT/100 (LB/IN)* | |
|---|---|---|
| | FORWARD | AFT |
| 150 | 132 | 209 |
| 160 | 141 | 223 |
| 170 | 150 | 236 |
| 180 | 158 | 250 |
| 190 | 167 | 264 |
| 200 | 175 | 277 |
| 210 | 184 | 291 |
| 220 | 193 | 305 |
| 230 | 201 | 319 |
| 240 | 210 | 332 |
| 250 | 218 | 346 |
| 260 | 227 | |
| 266 | 232 | |

*Moment/100 is based on centers of gravity as follows:

| LOCATION | CREWMEMBER (INCLUDING PERSONAL EQUIPMENT) | PARACHUTE (27.8 LB) |
|---|---|---|
| Forward | F.S. 86.1 | F.S. 97.6 |
| Aft | F.S. 137.1 | F.S. 148.6 |

Figure 24-15. Useful Load Weights and Moments

AIRCRAFT CONFIGURATION:
ALL

MODEL: T-34C

MODIFIED 13 MAY, 1999

DATA BASIS: FLIGHT TEST

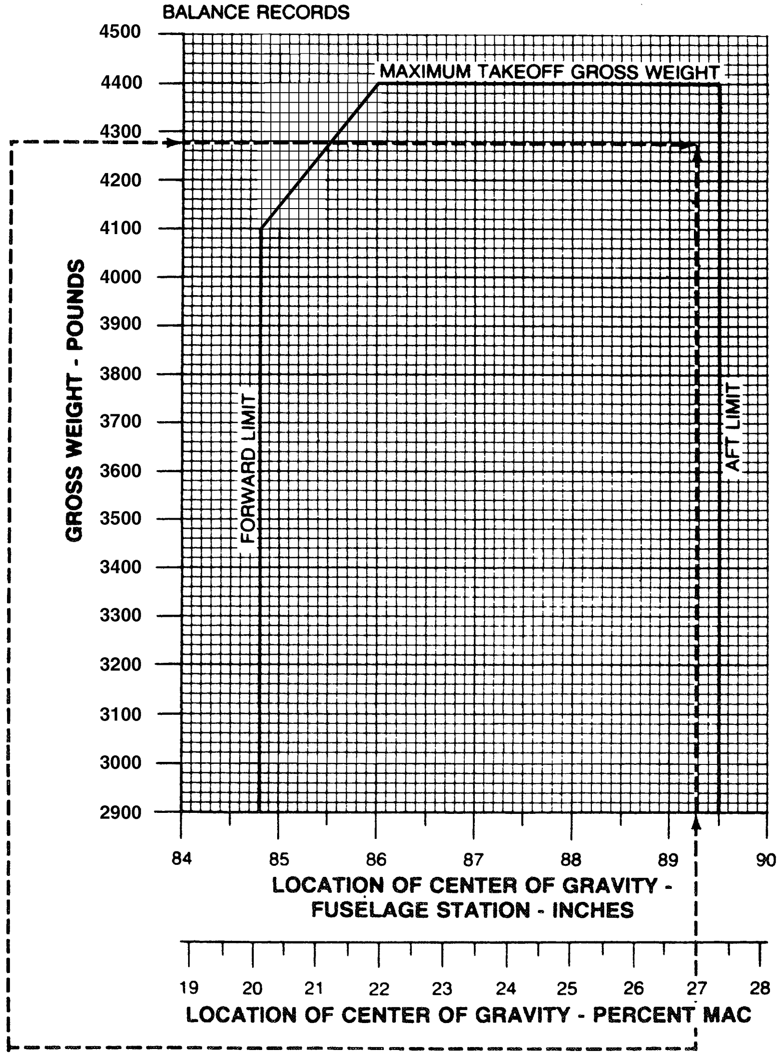
ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL

**Note**

- MAXIMUM RAMP WEIGHT IS 4425 POUNDS
- FUSELAGE STATION (F.S.) IN INCHES, OR MOMENT ARM FOR AIRCRAFT LOADING, IS DETERMINED FROM THE AIRPLANE DIAGRAM (CHART E) CONTAINED IN THE AIRCRAFT WEIGHT AND BALANCE RECORDS




**EXAMPLE**

WEIGHT 4275 LB, FUSELAGE STATION MOMENT ARM 89.29 INCHES LOADING IS WITHIN LIMITS

**HOW TO USE CHART**

FIND INTERSECTION POINT OF GROSS WEIGHT FOUND ON LEFT SIDE OF CHART AND FUSELAGE STATION MOMENT ARM FOUND ON BOTTOM OF CHART AND CHECK TO SEE IF LOADING IS WITHIN LIMITS

F-0071

Figure 24-16. Aircraft Gross Weight Versus CG Position

AIRCRAFT CONFIGURATION:
PROPELLER RPM 2200

MODEL: T-34C

ENGINE: PT6A-25

DATE: 23 NOV 1976

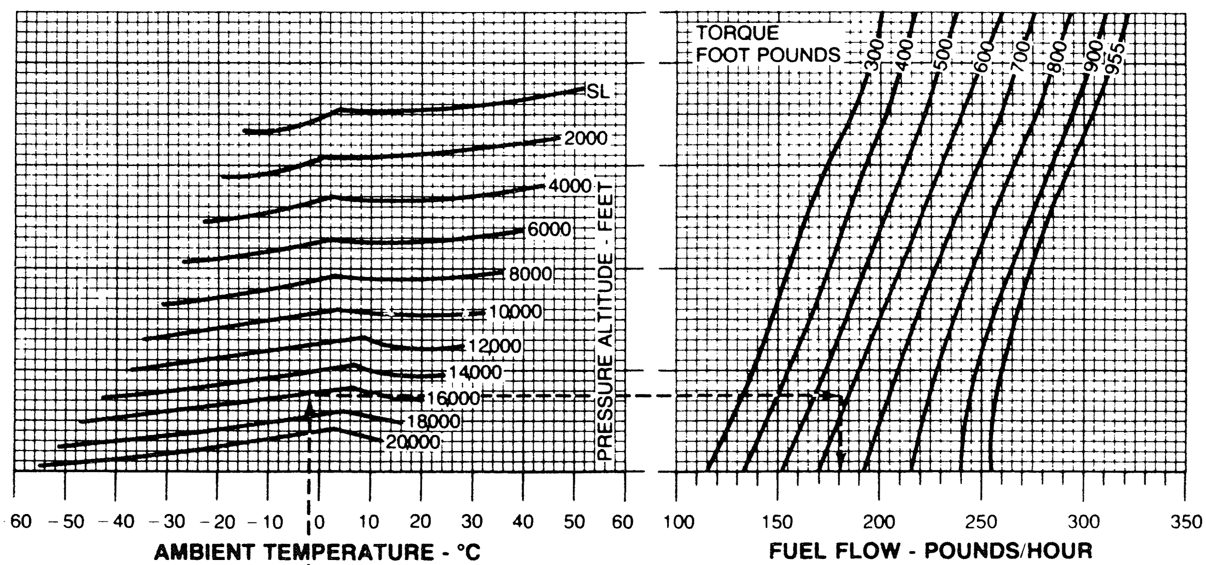
FUEL GRADE: JP-4

DATA BASIS: FLIGHT TEST

FUEL DENSITY: 6.5 LB/GAL

**Note**

IF JP-5 FUEL IS USED, INDICATED FUEL FLOW WILL BE APPROXIMATELY 6% LESS




**EXAMPLE**

AMBIENT TEMPERATURE −2°C, PRESSURE ALTITUDE 16,000 FT.
TORQUE 580 FT LBS, FUEL FLOW 181 LB/HR

**HOW TO USE CHART**

ENTER BOTTOM OF LEFT GRAPH AT AMBIENT TEMPERATURE. TRACE UP TO PRESSURE ALTITUDE, TRACE RIGHT TO TORQUE AND TRACE DOWN TO READ FUEL FLOW

F-0072

Figure 24-17. Fuel Flow

# CHAPTER 25

# Takeoff

## 25.1 MINIMUM POWER FOR TAKEOFF (FIGURE 25-1)

The minimum torque that should be available without exceeding the ITT limit of 695 °C at zero airspeed is shown on this chart as a function of pressure altitude and ambient temperature.

## 25.2 TAKEOFF/LANDING CROSSWIND CHART (FIGURE 25-2)

This chart shows the headwind and crosswind components of the wind on the runway and shows minimum nosewheel lift-off or touchdown indicated airspeed. Wind angle is found by subtracting wind direction from the runway angle. To determine headwind component, utilize steady winds; to determine crosswind component if both steady winds and gusts are given, utilize maximum gust velocity.

## 25.3 TAKEOFF DISTANCE (FIGURE 25-3)

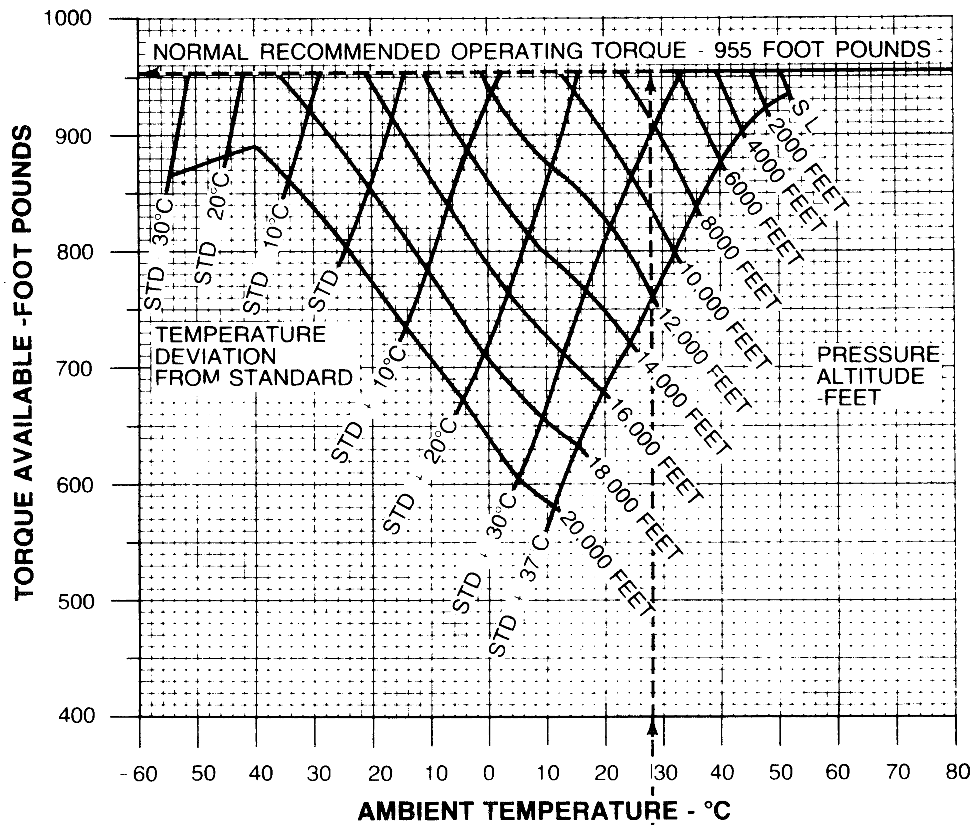
This chart shows takeoff ground roll distances for a level dry runway and total distance to clear an obstacle height. Rotation and 50-foot obstacle indicated airspeeds are constant regardless of weight and assume zero instrument error.

AIRCRAFT CONFIGURATION:
PROPELLER RPM 2200
ZERO AIRSPEED

MODEL: T-34C
ENGINE: PT6A-25

DATE: 25 OCT 1976
FUEL GRADE: JP-4

DATA BASIS: ENGINE SPECIFICATION
FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**
AMBIENT TEMPERATURE 28°C, PRESSURE ALTITUDE 3200 FEET,
MINIMUM TORQUE AVAILABLE IS 955 FT LBS.

**HOW TO USE CHART**
ENTER FROM BOTTOM AT AMBIENT AIR TEMPERATURE, TRACE UP TO PRESSURE ALTITUDE, TRACE LEFT TO MINIMUM TORQUE AVAILABLE FOR TAKEOFF.

F-0073

Figure 25-1. Minimum Power for Takeoff

AIRCRAFT CONFIGURATION:
GEAR DOWN

MODEL: T-34C
DATE: 12 OCT 1976
DATA BASIS: FLIGHT TEST

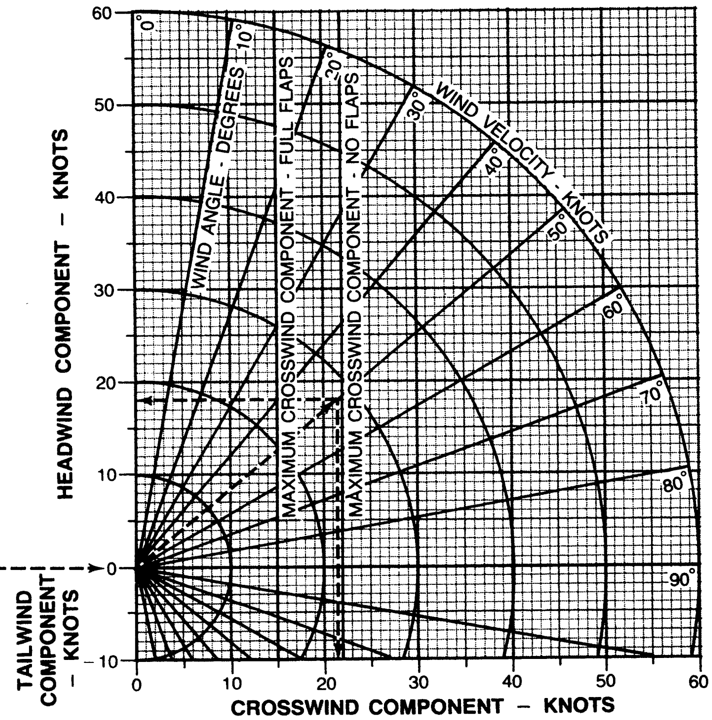
ENGINE: PT6A-25
PROPELLER: T10173-11R
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

**EXAMPLE:**

WIND VELOCITY 28 KNOTS, WIND DIRECTION 150°, RUNWAY DIRECTION 200°, WIND ANGLE = 200° − 150° = 50°, HEADWIND = 18 KNOTS CROSSWIND = 21.5 KNOTS.

**HOW TO USE CHART:**

SUBTRACT WIND DIRECTION FROM RUNWAY DIRECTION TO OBTAIN WIND ANGLE. ENTER CHART AT WIND ANGLE AND WIND VELOCITY. MOVE LEFT TO FIND HEADWIND. TRACE DOWN FROM INITIAL POINT TO OBTAIN CROSSWIND.




## *MINIMUM NOSE WHEEL LIFTOFF OR TOUCHDOWN SPEED*

**EXAMPLE:**

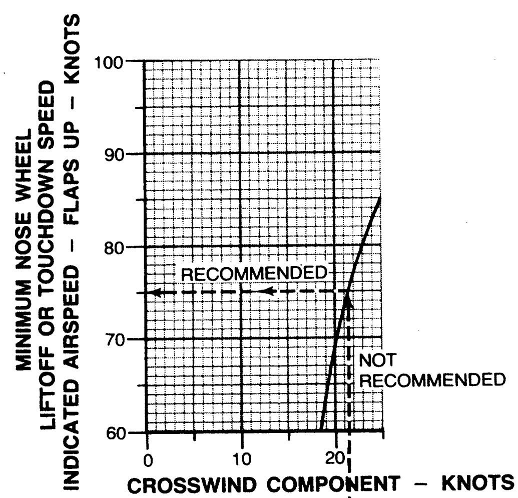
CROSSWIND COMPONENT 21.5 KNOTS THE MINIMUM NOSE WHEEL LIFTOFF SPEED. IAS = 75 KNOTS.

**HOW TO USE CHART:**

TRACE UP FROM THE CROSSWIND COMPONENT TO RECOMMENDED NOT RECOMMENDED LINE, MOVE LEFT TO MINIMUM NOSE WHEEL LIFTOFF OR TOUCHDOWN AIRSPEED.

**CAUTION:**

LANDING OR TAKEOFF IS NOT RECOMMENDED IN FLAPS DOWN CONFIGURATION WHEN MAXIMUM CROSSWIND COMPONENT EXCEEDS 15 KNOTS DUE TO WEATHERCOCKING TENDENCY ON THE GROUND.




F-0074

Figure 25-2. Takeoff/Landing Crosswind

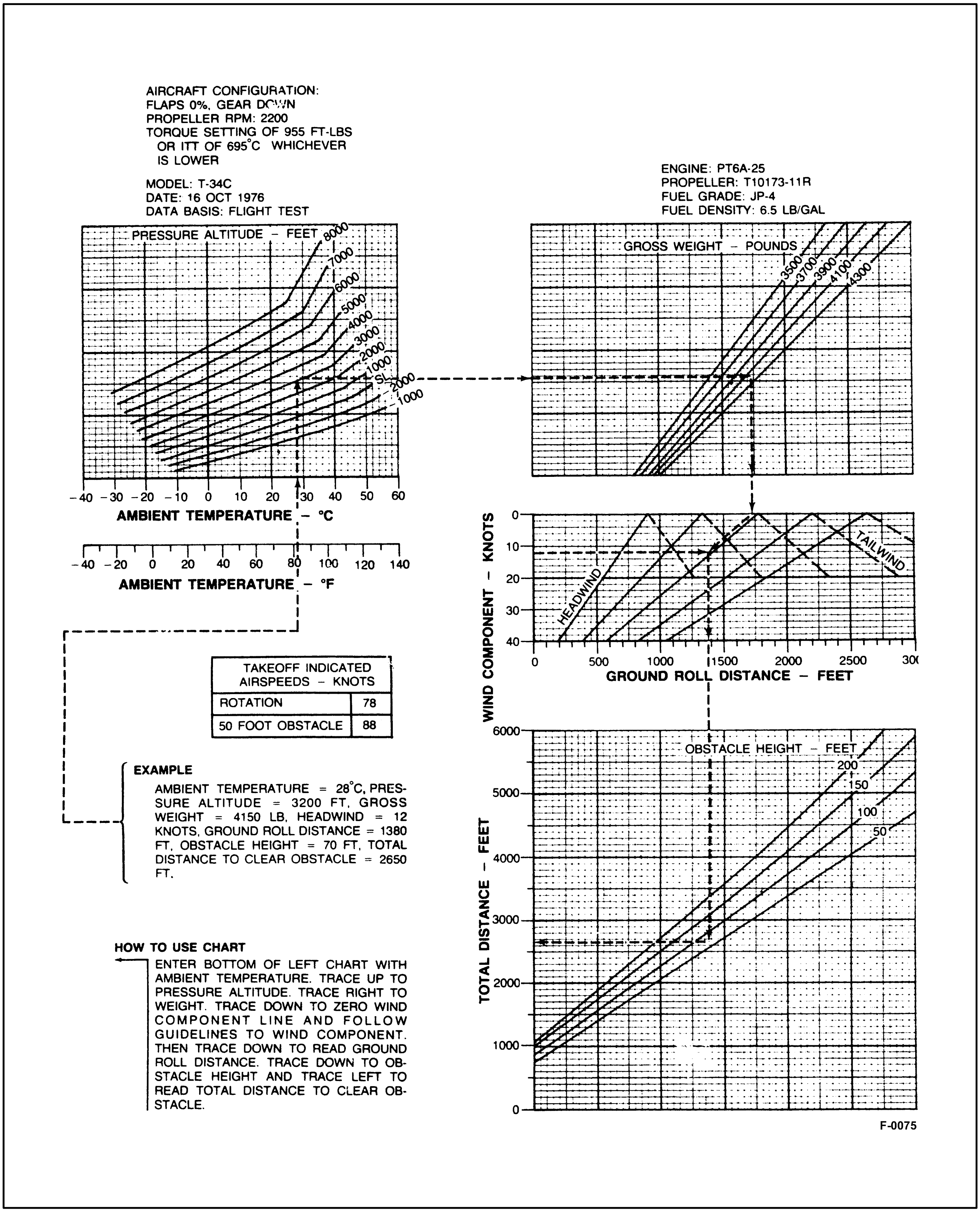



Figure 25-3. Takeoff Distance (Normal)

# CHAPTER 26

# Climb

## 26.1 MAXIMUM CLIMB RATE/GRADIENT (FIGURE 26-1)

Maximum climb rate for 98.5 knots calibrated airspeed (best rate-of-climb airspeed) is shown for variation in ambient temperature, pressure altitude, and weight. An additional scale showing approximate climb gradient is also given.

## 26.2 SERVICE CEILING (FIGURE 26-2)

The maximum altitude to obtain a 100 ft/min rate of climb for all weights and temperature conditions is above the maximum operating altitude of 25,000 feet.

## 26.3 TIME/FUEL/DISTANCE TO CLIMB (FIGURE 26-3)

This chart shows time fuel and distance to climb at normal-rated power from an initial to a final altitude at a constant climb calibrated airspeed of 118.5 knots.

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
INDICATED AIRSPEED 100 KNOTS
PROPELLER RPM 2200
TORQUE SETTING 955 FT LBS OR ITT
OF 695°C WHICHEVER OCCURS FIRST

MODEL: T-34C

DATE: 23 NOV. 1976

DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL

**EXAMPLE**

AMBIENT TEMPERATURE 28°C PRESSURE ALTITUDE 3200 FT WEIGHT 4150 LB, CLIMB RATE = 1480 FT/MIN, CLIMB GRADIENT = 10.7 PERCENT

**HOW TO USE CHART**

ENTER LEFT SIDE OF UPPER GRAPH AT AMBIENT TEMPERATURE AND TRACE RIGHT TO PRESSURE ALTITUDE, TRACE DOWN TO GROSS WEIGHT AND TRACE LEFT TO READ CLIMB RATE AND CLIMB GRADIENT

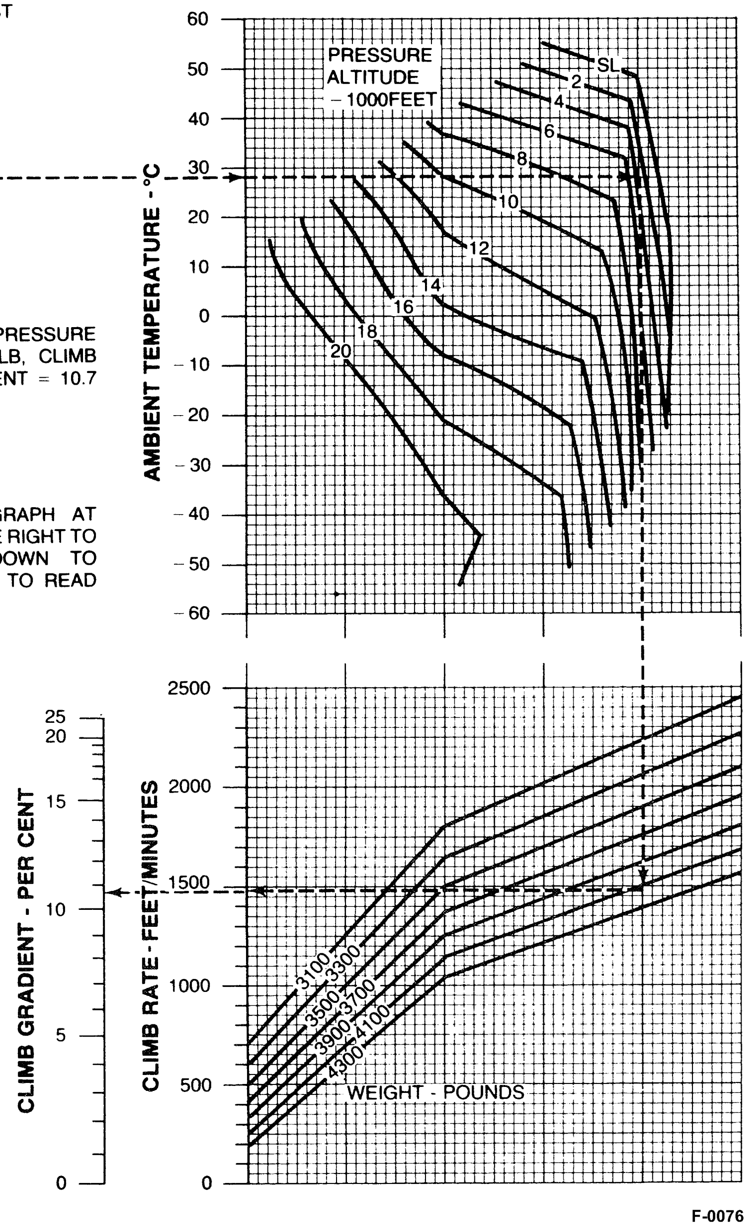



Figure 26-1. Maximum Climb Rate/Gradient

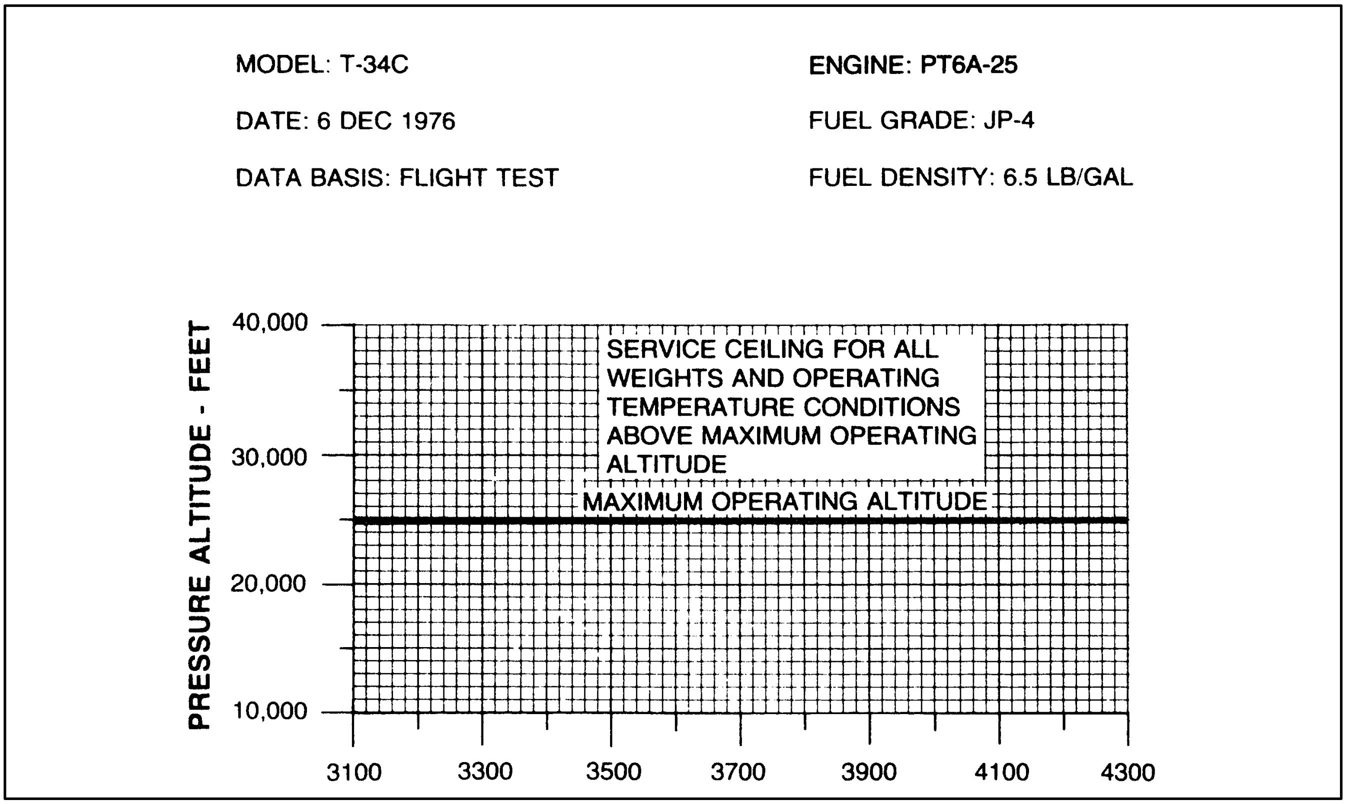



Figure 26-2. Service Ceiling

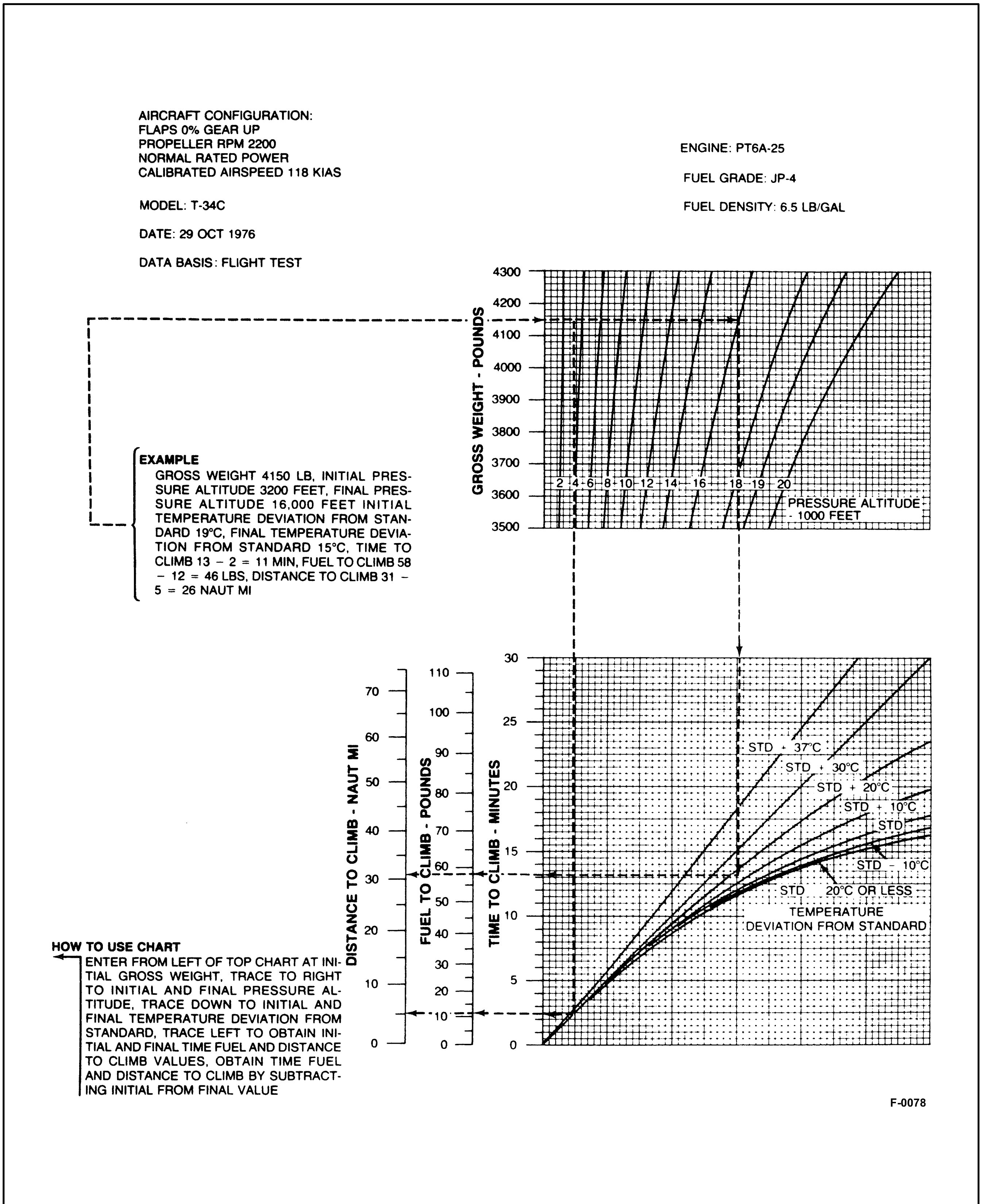



Figure 26-3. Time/Fuel/Distance to Climb

# CHAPTER 27

# Range

## 27.1 TORQUE AT MAXIMUM CRUISE POWER (FIGURE 27-1)

This chart shows the torque settings for cruise at maximum cruise power for a pressure altitude and the outside air temperature shown on the cockpit instrument.

## 27.2 INDICATED AIRSPEED AT MAXIMUM CRUISE POWER (FIGURE 27-2)

This chart shows the indicated airspeed obtained from using the torque on the previous chart. The indicated airspeed assumes zero instrument error.

## 27.3 MAXIMUM CRUISE POWER TIME AND TRUE AIRSPEED (FIGURE 27-3)

Time, groundspeed, and true airspeed are shown for an initial gross weight, cruise pressure altitude, ambient temperature at cruise pressure altitude, wind component, and range. The chart is valid in the operation envelope up to 955 ft-lb torque or ITT of 695 °C whichever occurs first.

## 27.4 MAXIMUM CRUISE POWER FUEL REQUIRED (FIGURE 27-4)

This chart shows the fuel flow, fuel required, and pounds of fuel per nautical mile for an initial gross weight, cruise pressure altitude, ambient temperature at cruise pressure altitude, range, and cruise time obtained from the time and true airspeed chart. The chart is valid in the operation envelope to 955 ft-lb.

## 27.5 MAXIMUM RANGE POWER TIME AND TRUE AIRSPEED (FIGURE 27-5)

This chart is used for a maximum range power setting of 580 ft-lb and is of the same format as the maximum cruise power time and true airspeed chart.

## 27.6 MAXIMUM RANGE POWER FUEL REQUIRED (FIGURE 27-6)

This chart is used for a maximum range power setting of 580 ft-lb and is of the same format as the maximum cruise power fuel required.

## 27.7 MISSION PROFILE — MAXIMUM RANGE (FIGURE 27-7)

This chart presents data for a standard day with no wind, full fuel, and maximum gross weight of 4,300 pounds. The chart shows time to climb to and cruise at a specified altitude, speed to fly, and fuel remaining over destination.

## 27.8 BINGO RANGE (FIGURE 27-8)

This table shows time and fuel required to fly a specified distance at a maximum range cruise altitude or sea level. The chart presents data for a standard day with no wind.

## 27.9 USE OF CHARTS

**27.9.1 Power Setting.** Range data are given for two power settings: maximum cruise power and maximum range power. For maximum range power, to simplify operation, the same torque setting has been selected that results in airspeeds about 35 knots less than optimum at sea level and near optimum at high altitude. The loss in range because of flying at the same torque setting for all altitudes rather than for optimum speed is negligible.

**Note**

Time, distance, and fuel values assume constant altitude.

**27.9.2 Fuel Required for a Given Distance.** To determine fuel required fly a given distance at cruise altitude, use the charts as follows:

1. The time and true airspeed chart yields time to fly the desired distance.

2. The fuel required chart yields fuel required to fly the time determined above.

**27.9.3 Distance With Available Fuel.** To determine how much distance can be flown at cruise altitude on an available amount of fuel, use the chart as follows:

1. Assume a value of distance.

2. The time and true airspeed chart yields time to fly the assumed distance.

3. The fuel required chart yields fuel required to fly the time determined above.

4. If required fuel is not equal to available fuel, assume a new value of distance and rework the problem.

5. Repeat procedure until fuel required is equal to fuel available.

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
PROPELLER RPM 2200

MODEL: T-34C

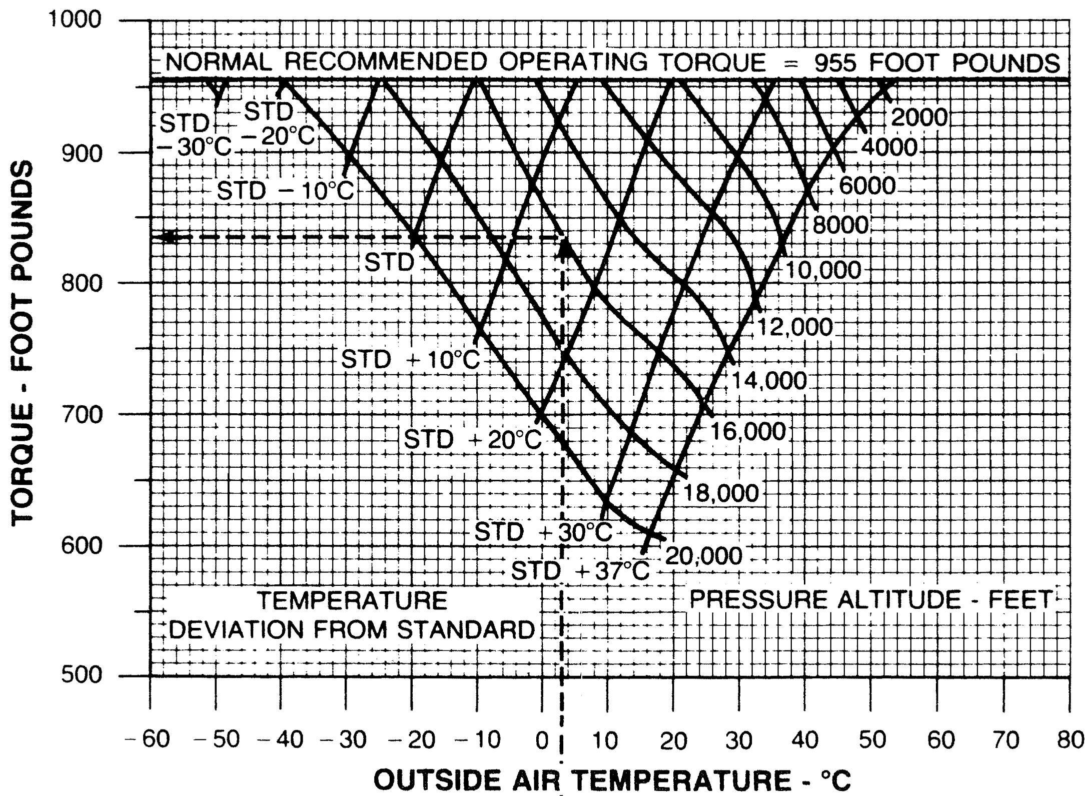
DATE: 26 OCT 1976

DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**

OUTSIDE AIR TEMPERATURE 3°C PRESSURE ALTITUDE 16,000 FT, TORQUE SETTING 835 FT LBS

**HOW TO USE CHART**

ENTER BOTTOM AT OUTSIDE AIR TEMPERATURE FROM COCKPIT INDICATOR, TRACE UP TO PRESSURE ALTITUDE, TRACE LEFT TO TORQUE SETTING

F-0079

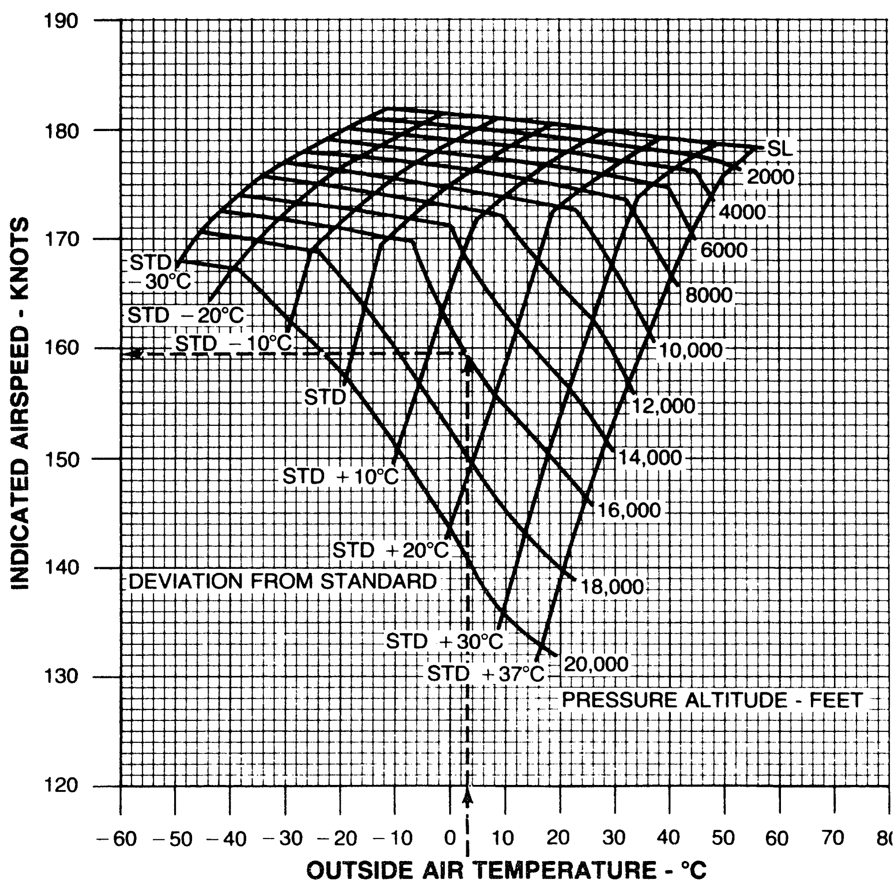
Figure 27-1. Torque at Maximum Cruise Power

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
PROPELLER RPM 2200
WEIGHT 4100 LB
TORQUE SETTING 955 FT LBS OR ITT TEMPERATURE OF 695° WHICHEVER OCCURS FIRST

MODEL: T-34C  ENGINE: PT6A-25

DATE: 26 OCT 1976  FUEL GRADE: JP-4

DATA BASIS: FLIGHT TEST  FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**

OUTSIDE AIR TEMPERATURE 3°C, PRESSURE ALTITUDE 16,000 FT, INDICATED AIRSPEED 159 KNOTS

**HOW TO USE CHART**

ENTER FROM BOTTOM AT OUTSIDE AIR TEMPERATURE FROM COCKPIT INDICATOR, TRACE UP TO PRESSURE ALTITUDE, TRACE LEFT TO INDICATED AIRSPEED

F-0080

Figure 27-2. Indicated Airspeed at Maximum Cruise Power

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
PROPELLER RPM 2200
TORQUE SETTING 955 FT LBS
OR ITT TEMPERATURE OF 695°
WHICHEVER OCCURS FIRST

MODEL: T-34C

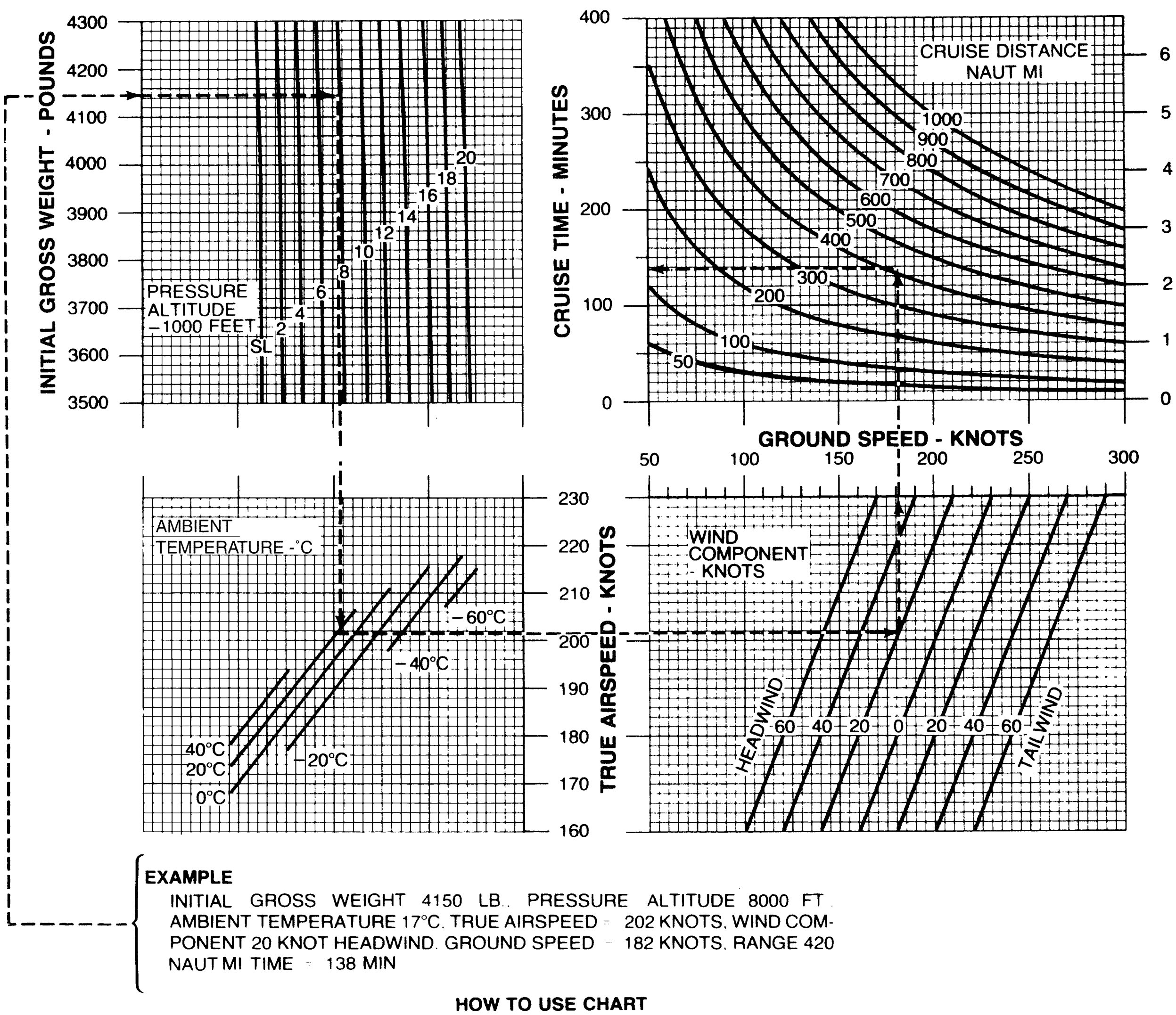
DATE 17 NOV 1976

DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**

INITIAL GROSS WEIGHT 4150 LB., PRESSURE ALTITUDE 8000 FT., AMBIENT TEMPERATURE 17°C, TRUE AIRSPEED = 202 KNOTS, WIND COMPONENT 20 KNOT HEADWIND, GROUND SPEED = 182 KNOTS, RANGE 420 NAUT MI TIME = 138 MIN

**HOW TO USE CHART**

ENTER LEFT SIDE OF UPPER LEFT CHART AT INITIAL GROSS WEIGHT AND TRACE RIGHT TO PRESSURE ALTITUDE, TRACE DOWN TO AMBIENT TEMPERATURE, TRACE RIGHT TO READ TRUE AIRSPEED AND CONTINUE TRACING RIGHT TO WIND COMPONENT. TRACE UP TO READ GROUND SPEED AND CONTINUE TRACING UP TO RANGE. TRACE RIGHT TO READ TIME IN HOURS OR LEFT TO READ TIME IN MINUTES

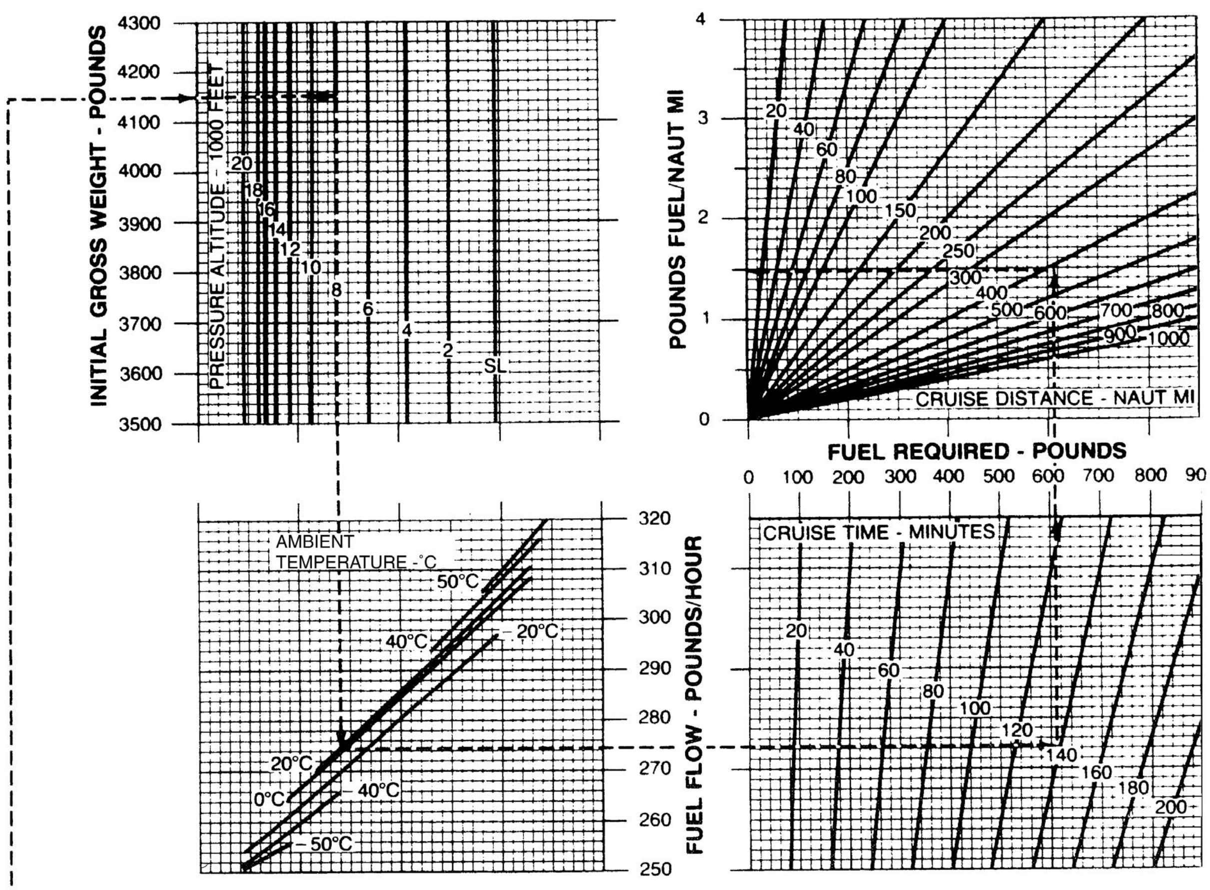
F-0081

Figure 27-3. Maximum Cruise Power Time and True Airspeed

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
PROPELLER RPM 2200
TORQUE SETTING 955 FT LBS
OR ITT TEMPERATURE OF 695°C
WHICHEVER OCCURS FIRST

MODEL: T-34C
DATE: 17 NOV 1976
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**
INITIAL GROSS WEIGHT 4150 LB PRESSURE ALTITUDE 8000 FT. AMBIENT TEMPERATURE 17°C, FUEL FLOW = 274 LB/HR, TIME 138 MIN, FUEL REQUIRED = 610 LB, RANGE 420 NAUT MI = 1.48 LB FUEL/NAUT MI

**HOW TO USE CHART**
ENTER LEFT SIDE OF UPPER LEFT CHART AT INITIAL GROSS WEIGHT AND TRACE RIGHT TO PRESSURE ALTITUDE, TRACE DOWN TO AMBIENT TEMPERATURE, TRACE RIGHT TO READ FUEL FLOW AND CONTINUE TRACING RIGHT TO TIME IN MINUTES, TRACE UP TO READ FUEL REQUIRED AND CONTINUE TRACING UP TO RANGE AND THEN TRACE LEFT TO READ POUNDS FUEL NAUT MI

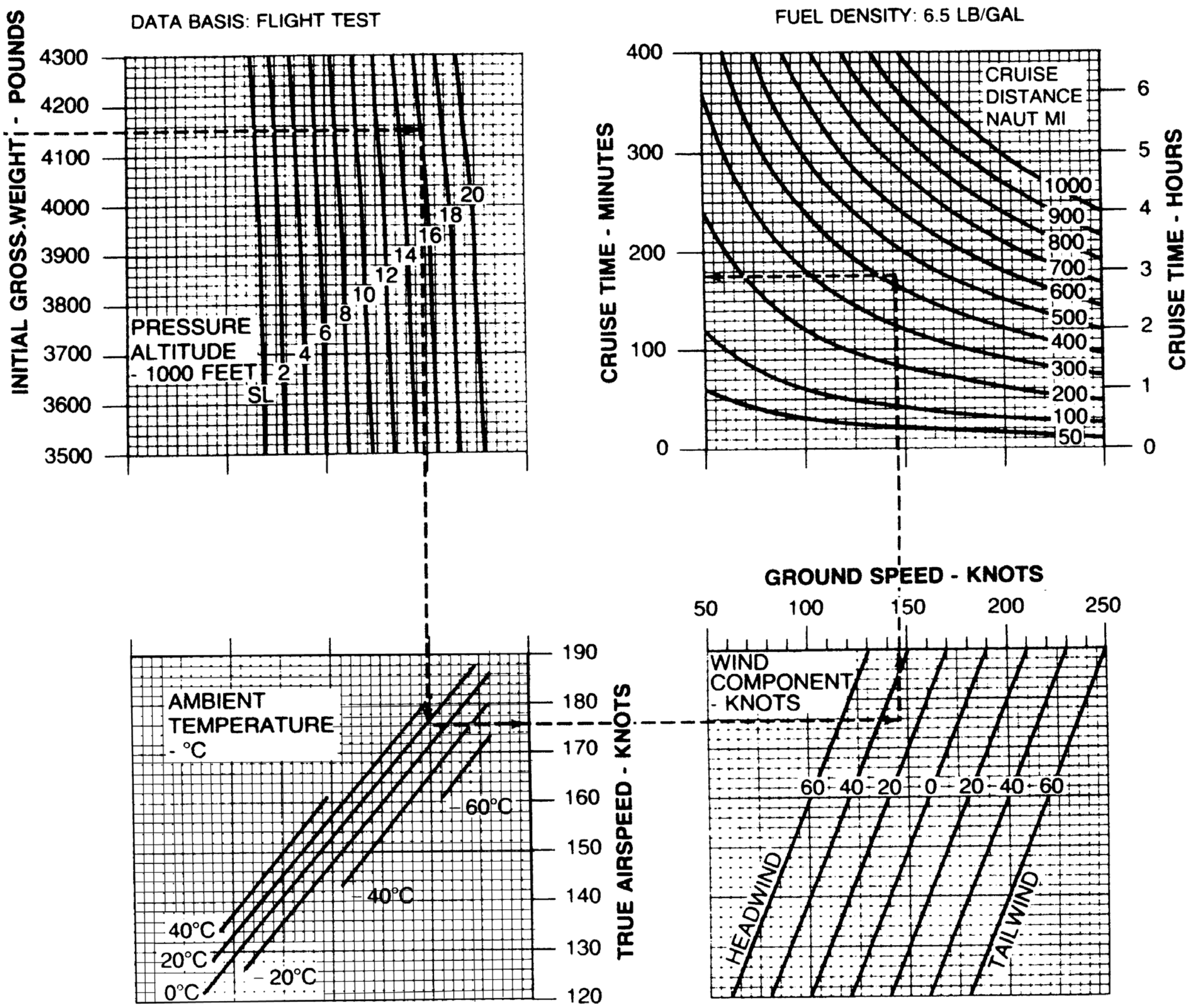
F-0082

Figure 27-4. Maximum Cruise Power Fuel Required

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
PROPELLER RPM 2200
TORQUE SETTING 580 FT LBS

MODEL: T-34C
DATE: 12 NOV 1976
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**
INITIAL GROSS WEIGHT 4150 LB. PRESSURE ALTITUDE 16,000 FT. AMBIENT TEMPERATURE 2 C. TRUE AIRSPEED 176 KNOTS. WIND COMPONENT 30 KNOT HEADWIND. GROUND SPEED 146 KNOTS. RANGE 461 NAUT MI. TIME = 190 MIN

**HOW TO USE CHART**
ENTER LEFT SIDE OF UPPER LEFT CHART AT INITIAL GROSS WEIGHT AND TRACE RIGHT TO PRESSURE ALTITUDE. TRACE DOWN TO AMBIENT TEMPERATURE, TRACE RIGHT TO READ TRUE AIRSPEED AND CONTINUE TRACING RIGHT TO WIND COMPONENT. TRACE UP TO READ GROUND SPEED AND CONTINUE TRACING UP TO RANGE. TRACE RIGHT TO READ TIME IN HOURS OR LEFT TO READ TIME IN MINUTES

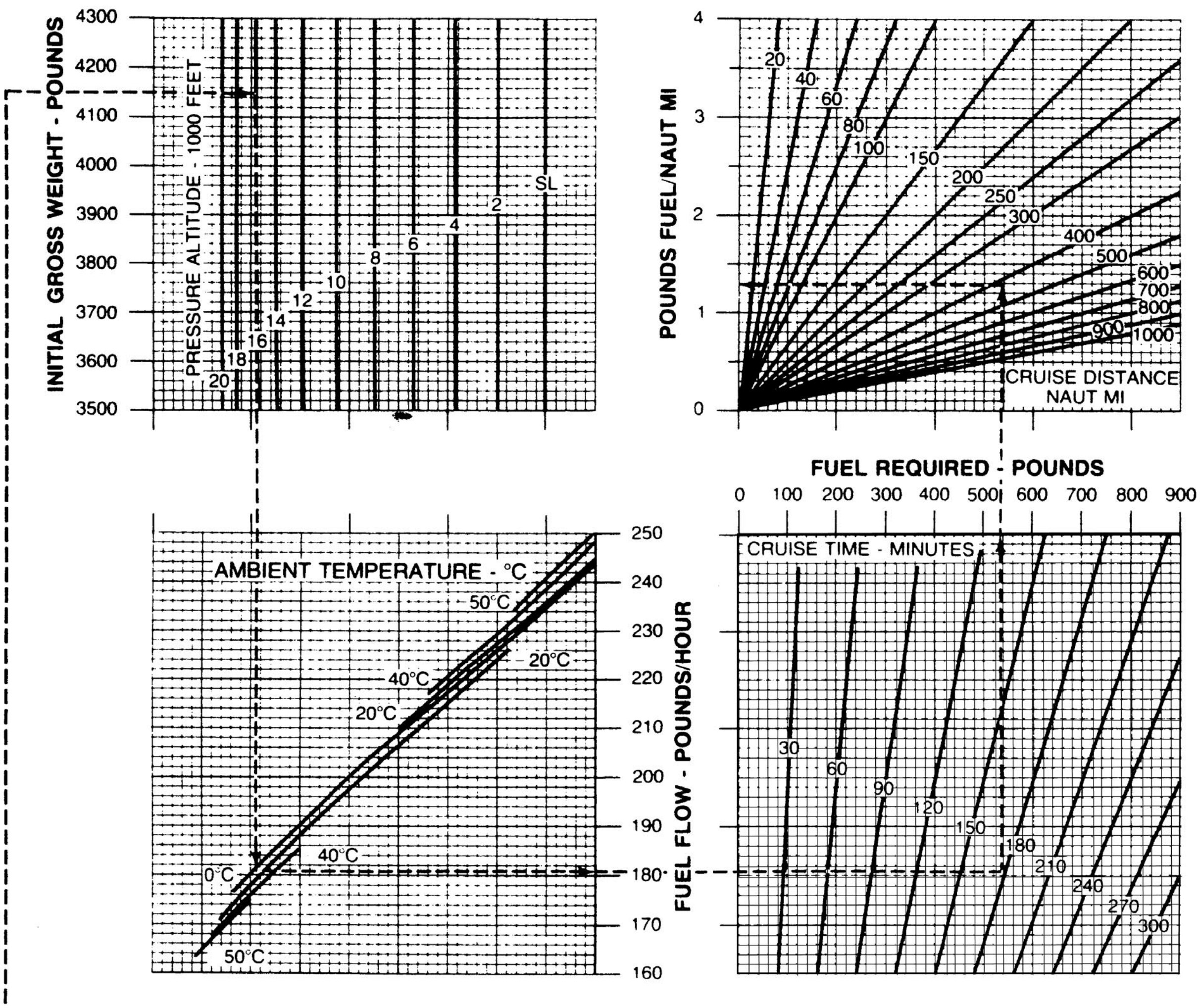
F-0083

Figure 27-5. Maximum Range Power Time and True Airspeed

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
PROPELLER RPM 2200
TORQUE SETTING 580 FT LBS

MODEL: T-34C
DATE: 12 NOV 1976
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**
INITIAL GROSS WEIGHT 4150 LB. PRESSURE ALTITUDE 16,000 FT AMBIENT TEMPERATURE -2°C. FUEL FLOW = 181 LB/HR. TIME 176 MINUTES. FUEL REQUIRED = 535 LB. RANGE 420 NAUT MI. = 1.30 LB FUEL/NAUT MI

**HOW TO USE CHART**
ENTER LEFT SIDE OF UPPER LEFT CHART AT INITIAL GROSS WEIGHT AND TRACE RIGHT TO PRESSURE ALTITUDE. TRACE DOWN TO AMBIENT TEMPERATURE. TRACE RIGHT TO READ FUEL FLOW AND CONTINUE TRACING RIGHT TO TIME IN MINUTES. TRACE UP TO READ FUEL REQUIRED AND CONTINUE TRACING UP TO RANGE AND THEN TRACE LEFT TO POUNDS FUEL/NAUT MI

F-0084

Figure 27-6. Maximum Range Power Fuel Required

AIRCRAFT CONFIGURATION:

GEAR UP

FLAPS 0%

PROPELLER 2200 RPM

TORQUE SETTING 580 FT LBS

ITT NOT TO EXCEED 695°C

ENGINE START GROSS WEIGHT 4300 LBS

STANDARD DAY

NO WIND

MODEL: T-34C

DATE: 26 OCT 1976

DATA BASIS: FLIGHT TEST

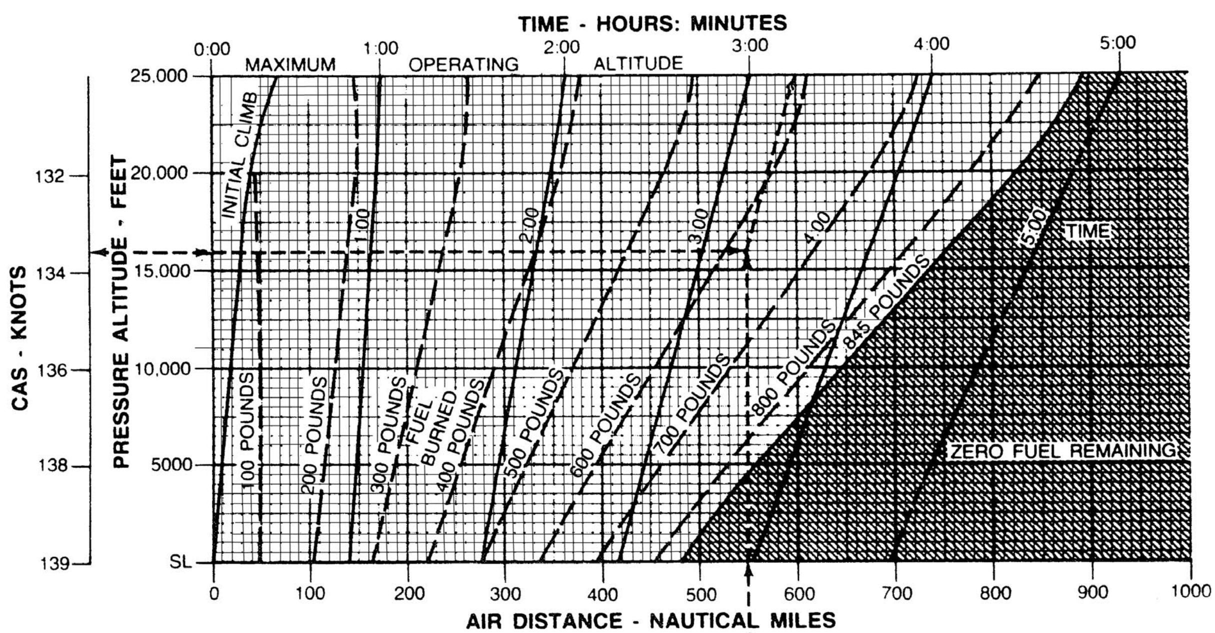
**Note**

- 25 POUNDS FUEL ALLOWANCE FOR ENGINE START, TAXI AND TAKEOFF
- NO ALLOWANCE OR RESERVE FOR LOITER, DESCENT OR LANDING
- MAXIMUM RANGE OVER 40 NAUTICAL MILES IS ATTAINED AT 20,000 FEET PRESSURE ALTITUDE
- INITIAL CLIMB AT 110 KCAS, PROPELLER 2200 RPM, TORQUE 955 FT LBS (NOT TO EXCEED 695°C ITT) GEAR UP, FLAPS 0%

ENGINE: PT6A-25

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**

DISTANCE 550 NAUTICAL MILES, CRUISE ALTITUDE 16,000 FEET PRESSURE ALTITUDE, FUEL REMAINING 625 POUNDS, TIME 3 HOURS 15 MINUTES, CALIBRATED AIRSPEED 134 KNOTS

**HOW TO USE CHART**

ENTER CHART AT BOTTOM WITH AIR DISTANCE, TRACE UP TO CRUISE ALTITUDE FOR POUNDS OF FUEL REMAINING FROM FULL FUEL AT TAKEOFF. TRACE ALONG TIME LINE FOR TIME ALOFT OR TRACE LEFT TO CALIBRATED AIRSPEED.

AP00:

Figure 27-7. Mission Profile — Maximum Range

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
PROPELLER RPM 2200
TORQUE SETTING 580 FT LBS
TAKEOFF GROSS WEIGHT 4300 LB
FUEL REQUIRED LEAVES 113
POUNDS RESERVE
STANDARD DAY NO WIND

MODEL: T-34 °C
DATE: 22 NOV 1976
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25
FUEL GRADE:JP-4
FUEL DENSITY: 6.5 LB/GAL

| SEA LEVEL CRUISE | | DISTANCE TO BASE — NAUTICAL MILES | MAXIMUM RANGE CRUISE | | | | |
|---|---|---|---|---|---|---|---|
| FUEL RQUIRED — POUNDS | TIME REQUIRED — MINUTES | | FUEL REQUIRED — POUNDS | TIME REQUIRED — MINUTES | CRUISE ALTITUDE — FEET | CRUISE IAS — KNOTS | DESCENT DISTANCE — NAUTICAL MILES |
| 199 | 22 | 50 | 184 | 20 | 10,000 | 136 | 21 |
| 285 | 44 | 100 | 239 | 38 | 18,000 | 132 | 39 |
| 371 | 66 | 150 | 287 | 55 | 20,000 | 131 | 43 |
| 456 | 87 | 200 | 336 | 72 | 20,000 | 131 | 43 |
| 542 | 109 | 250 | 384 | 89 | 20,000 | 131 | 43 |
| 627 | 131 | 300 | 431 | 106 | 20,000 | 131 | 42 |
| 713 | 152 | 350 | 479 | 122 | 20,000 | 131 | 42 |
| 797 | 174 | 400 | 527 | 139 | 20,000 | 131 | 42 |
| | | 450 | 575 | 156 | 20,000 | 131 | 41 |
| | | 500 | 622 | 172 | 20,000 | 131 | 41 |
| | | 550 | 668 | 189 | 20,000 | 131 | 41 |
| | | 600 | 716 | 206 | 20,000 | 131 | 41 |
| | | 650 | 764 | 222 | 20,000 | 131 | 40 |
| | | 700 | 810 | 239 | 20,000 | 131 | 40 |
| CRUISE IAS = 139 KNOTS | | | INITIAL ALTITUDE IS SEA LEVEL<br>CLIMB TORQUE IS 955 FOOT POUNDS OR ITT OF 695 °C, WHICHEVER OCCURS FIRST<br>CLIMB IAS 120 KNOTS DESCENT IAS 150 KNOTS<br>DESCENT TORQUE 300 FOOT POUNDS | | | | |

Figure 27-8. Bingo Range

## CHAPTER 28

# Endurance

### 28.1 INTRODUCTION

Use the charts presented in this part to determine fuel, time, and distance at altitude with the maximum endurance power setting.

### 28.2 MAXIMUM ENDURANCE POWER TIME AND TRUE AIRSPEED (FIGURE 28-1)

This chart is used for a maximum endurance power setting of 420 ft-lb and is of the same format as the maximum cruise power time and true airspeed chart.

### 28.3 MAXIMUM ENDURANCE POWER FUEL REQUIRED (FIGURE 28-2)

This chart is used for a maximum endurance power setting of 420 ft-lb and uses the same format as the maximum cruise power fuel required chart.

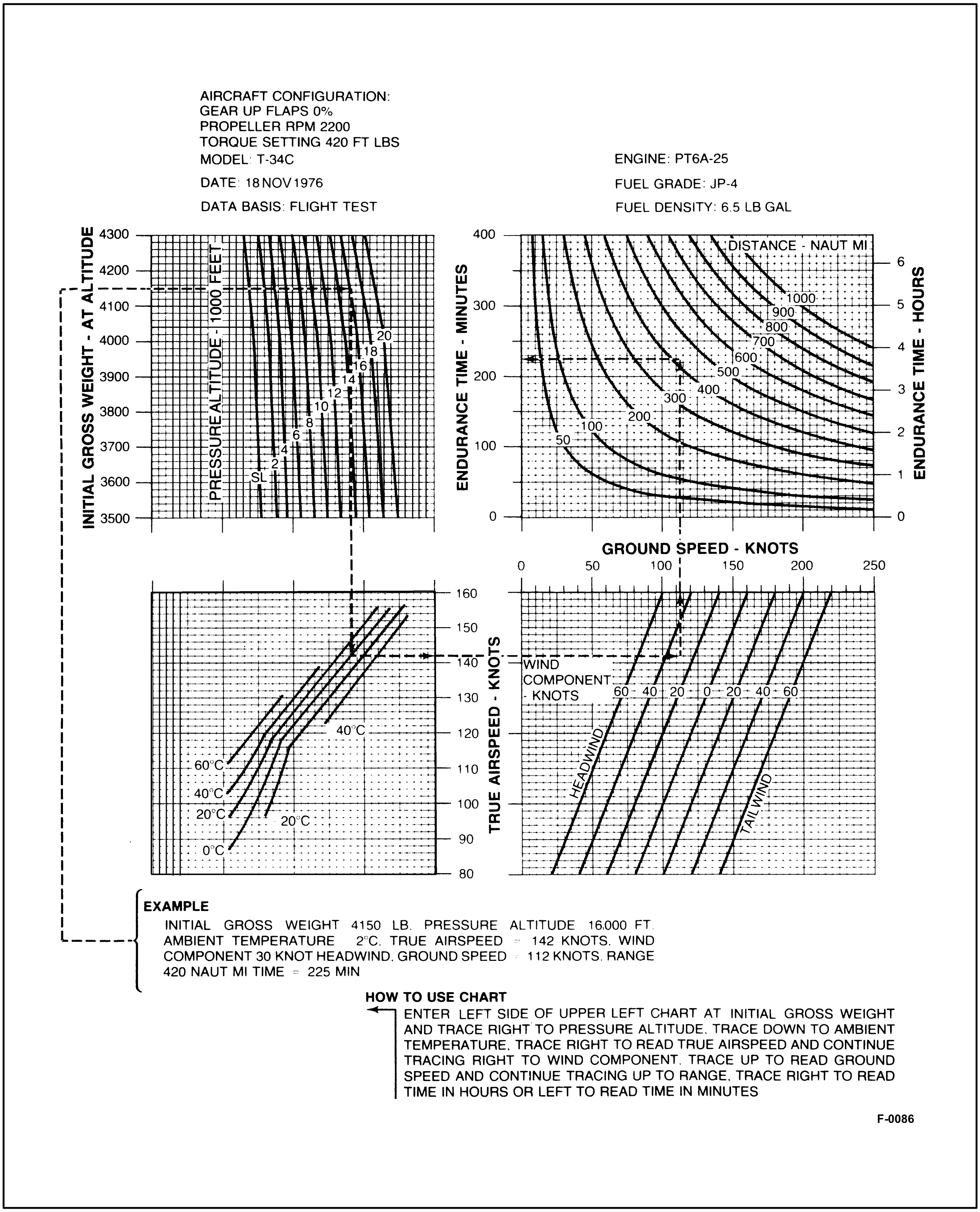
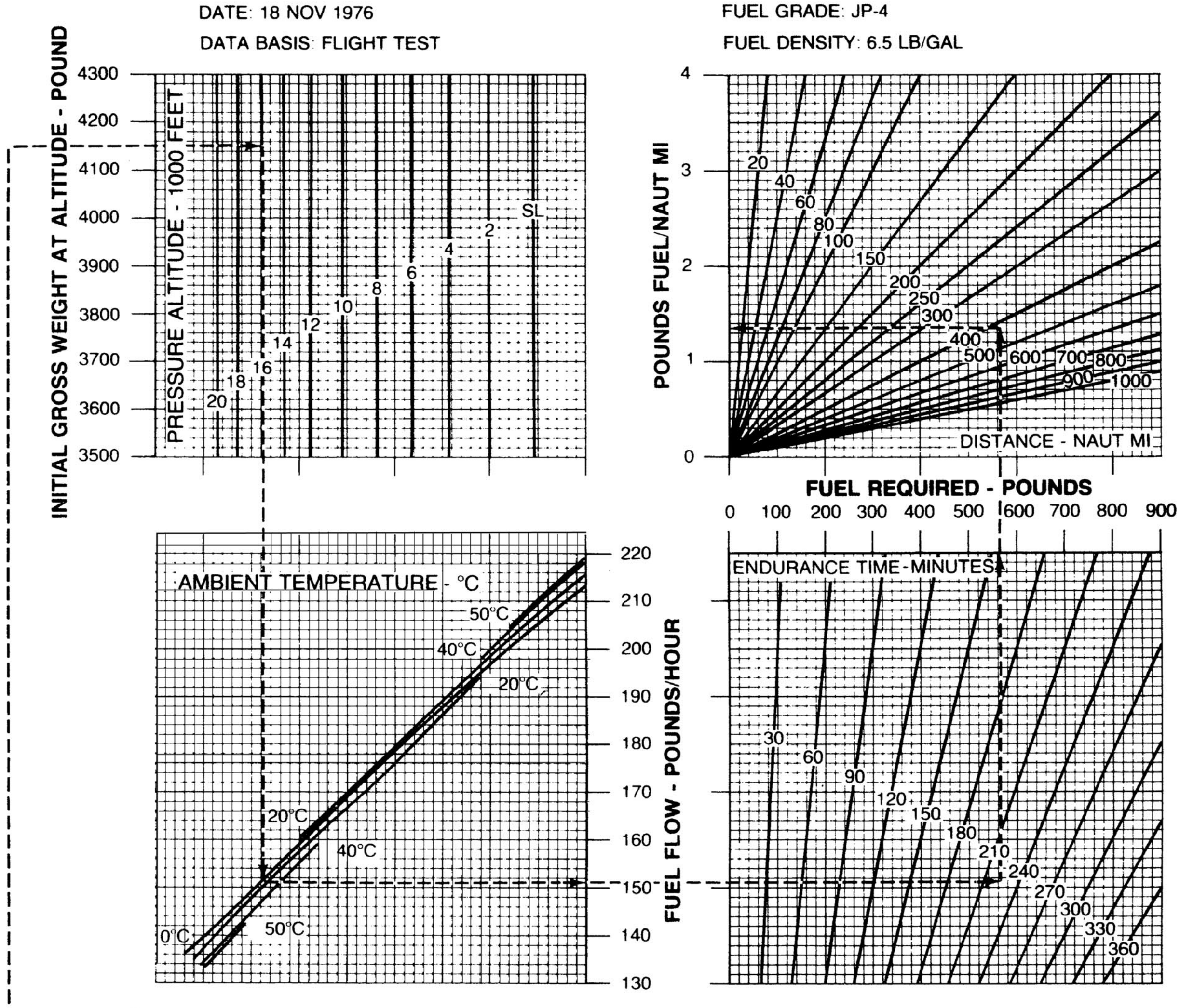



Figure 28-1. Maximum Endurance Power Time and True Airspeed

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
PROPELLER RPM 2200
TORQUE SETTING 420 FT LBS

MODEL: T-34C
DATE: 18 NOV 1976
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**

INITIAL GROSS WEIGHT 4150 LB, PRESSURE ALTITUDE 16,000 FT, AMBIENT TEMPERATURE − 2°C, FUEL FLOW = 151 LB/HR, TIME 225 MIN, FUEL REQUIRED = 565 LB, RANGE 420 NAUT MI, = 1.35 LB FUEL/NAUT MI

**HOW TO USE CHART**

ENTER LEFT SIDE OF UPPER LEFT CHART AT INITIAL GROSS WEIGHT AND TRACE RIGHT TO PRESSURE ALTITUDE, TRACE DOWN TO AMBIENT TEMPERATURE, TRACE RIGHT TO READ FUEL FLOW AND CONTINUE TRACING RIGHT TO TIME IN MINUTES, TRACE UP TO READ FUEL REQUIRED AND CONTINUE TRACING UP TO RANGE AND THEN TRACE LEFT TO READ POUNDS OF FUEL/NAUTICAL MILE

F-0087

Figure 28-2. Maximum Endurance Power Fuel Required

## CHAPTER 29

# In-Flight Refueling

Not applicable to T-34C aircraft.

# CHAPTER 30

# Descent

## 30.1 NORMAL DESCENT (FIGURE 30-1)

Time, distance, and fuel to descend for a calibrated airspeed of 170 knots and a torque setting of 250 ft-lb at 2,200 rpm is shown for the gear-up, flaps 0-percent configuration.

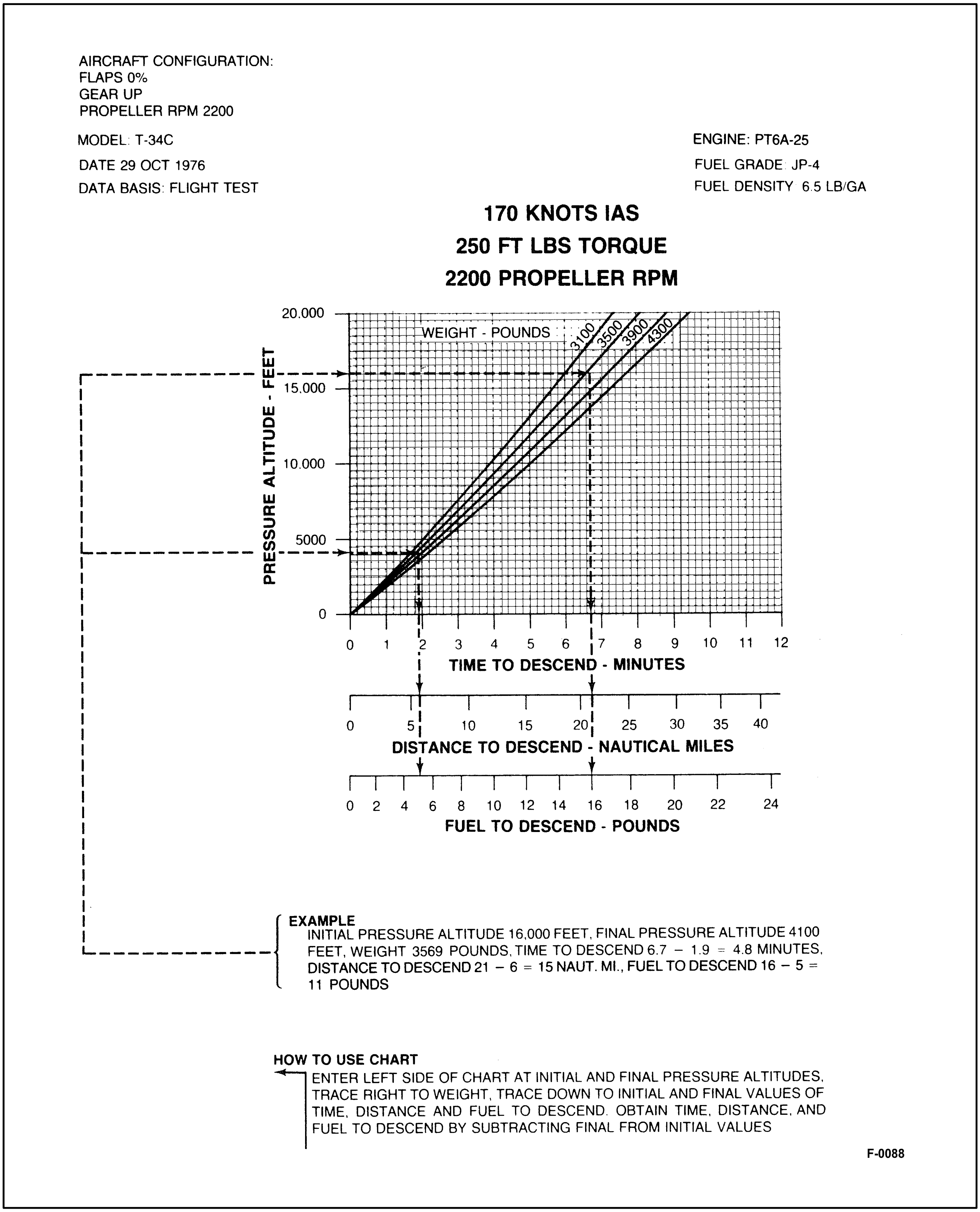



Figure 30-1. Normal Descent

# CHAPTER 31

# Landing

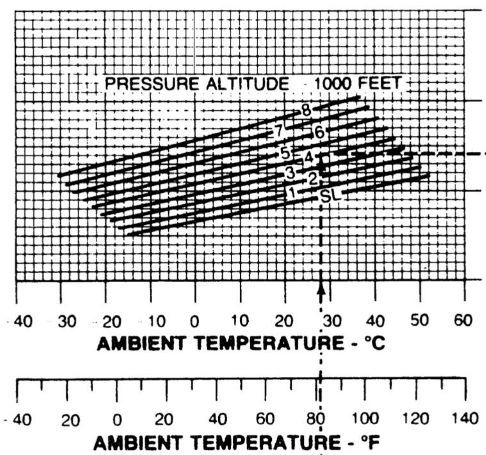
## 31.1 LANDING DISTANCE (FIGURE 31-1)

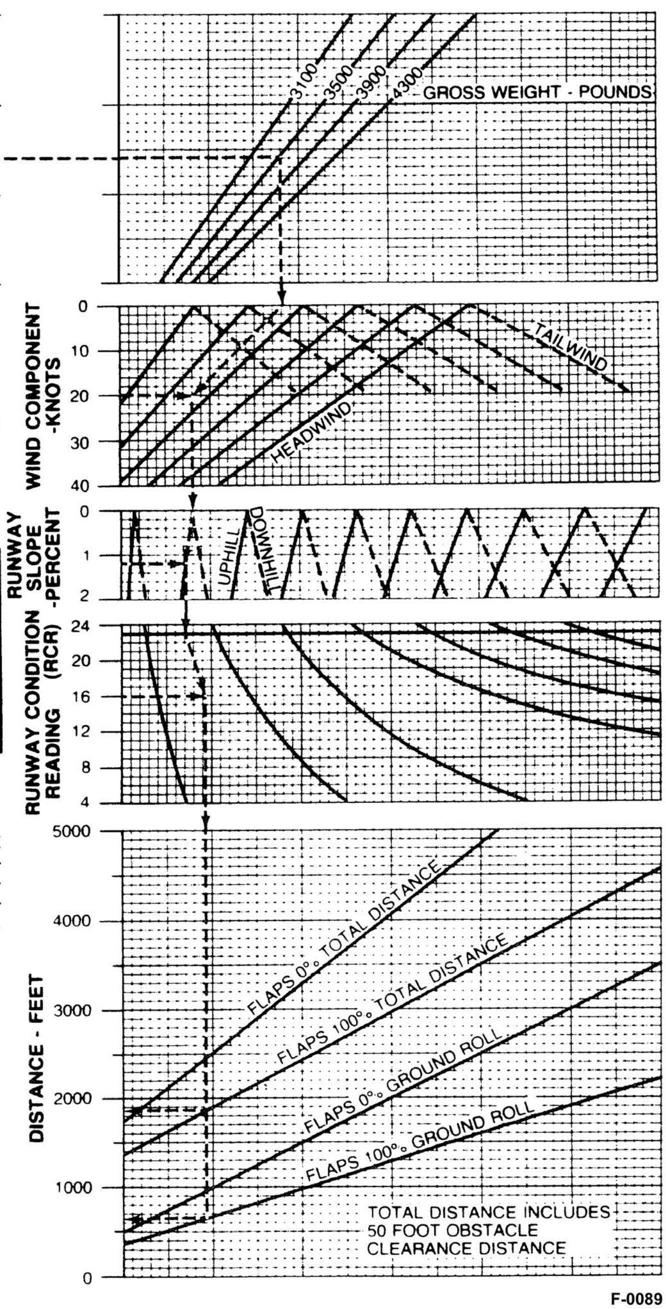
Ground roll distance and total distance to clear a 50-foot obstacle is shown for the flaps 0-percent and flaps 100-percent configurations. Approach and touchdown indicated airspeeds as a function of weight and flap settings are shown in the accompanying table.

AIRCRAFT CONFIGURATION:
GEAR DOWN
DESCENT RATE 300 FT/MIN

MODEL: T-34C
DATE: 6 DEC 1976
DATA BASIS: FLIGHT TEST
NO BETA NORMAL BRAKING

ENGINE: PT6A-25
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL




| WEIGHT - POUNDS | FLAPS 100% | | FLAPS 0% | |
|---|---|---|---|---|
| | APPROACH IAS -KNOTS | TOUCHDOWN IAS -KNOTS | APPROACH IAS -KNOTS | TOUCHDOWN IAS -KNOTS |
| 4300 | 78 | 72 | 96 | 89 |
| 3900 | 75 | 69 | 91 | 84 |
| 3500 | 71 | 65 | 87 | 80 |
| 3100 | 67 | 61 | 82 | 75 |

**EXAMPLE**

AMBIENT TEMPERATURE 28°C, PRESSURE ALTITUDE 4100 FT GROSS WEIGHT 3558 LB, 20 KNOT HEADWIND, 1.2% UPHILL RUNWAY SLOPE, RUNWAY CONDITION READING OF 16, FLAPS 100%, TOTAL DISTANCE TO CLEAR 50 FOOT OBSTACLE = 1860 FT, GROUND ROLL DISTANCE = 650 FT

**HOW TO USE CHART**

ENTER BOTTOM OF LEFT GRAPH AT AMBIENT TEMPERATURE AND TRACE UP TO PRESSURE ALTITUDE, TRACE RIGHT TO GROSS WEIGHT, TRACE DOWN TO ZERO WIND COMPONENT LINE, FOLLOW GUIDE LINES TO WIND COMPONENT, TRACE DOWN TO ZERO RUNWAY SLOPE FOLLOW GUIDE LINES TO RUNWAY SLOPE, TRACE DOWN TO RCR = 23 REFERENCE LINE, FOLLOW GUIDE LINES TO RUNWAY CONDITION READING, TRACE DOWN TO FLAP SETTING AND TOTAL DISTANCE AND GROUND ROLL DISTANCE REFERENCE LINES, TRACE LEFT AND READ DISTANCE

Figure 31-1. Landing Distance

# CHAPTER 32

# Mission Planning

## 32.1 TURN RATE VERSUS AIRSPEED (FIGURE 32-1)

Turn rate at constant angle of attack or sustained minimum radius turn for constant altitude is shown for the gear-up, flaps 0-percent configuration at the maximum takeoff gross weight.

## 32.2 TURN RADIUS VERSUS AIRSPEED (FIGURE 32-2)

Turn radius for the associated turn rate on the previous graph is shown for the same configuration.

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
AIRCRAFT WEIGHT 4300 LB

MODEL: T-34C

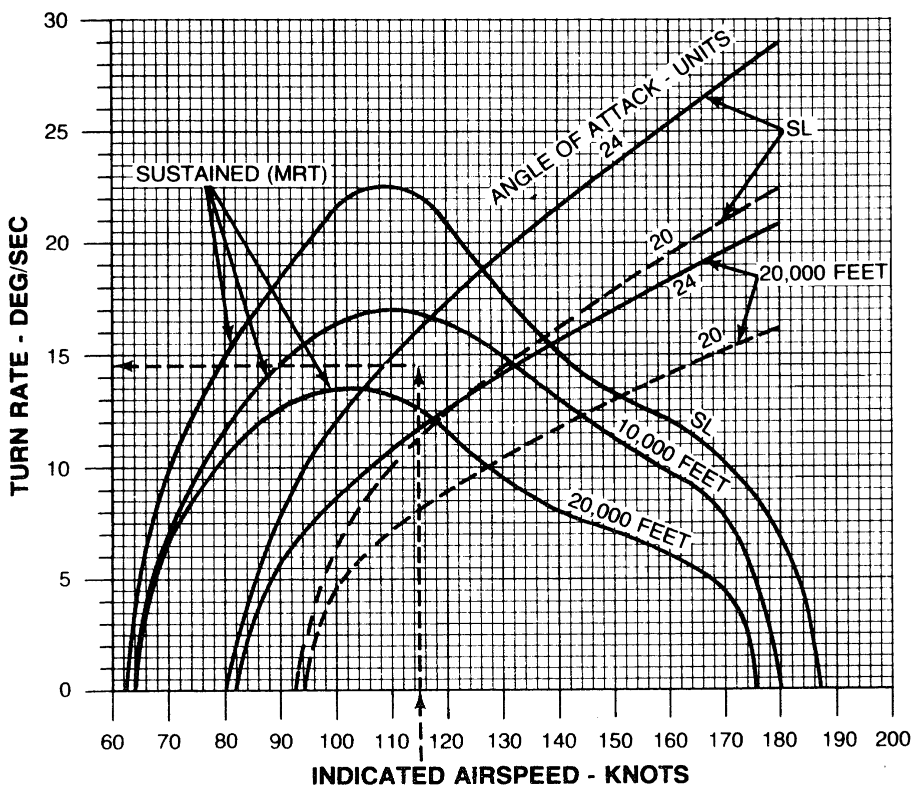
ENGINE: PT6A-25

DATE: 29 NOV 1976

FUEL GRADE: JP-4

DATA BASIS: FLIGHT TEST

FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**
INDICATED AIRSPEED 115 KNOTS, SUSTAINED MINIMUM RADIUS TURN, PRESSURE ALTITUDE 16,000 FEET, TURN RATE – 14.5 DEG/SEC

**HOW TO USE CHART**
ENTER AT BOTTOM OF CHART AT INDICATED AIRSPEED AND TRACE UP TO FLIGHT CONDITION (SUSTAINED MINIMUM RADIUS TURN OR CONSTANT ANGLE OF ATTACK) AND PRESSURE ALTITUDE AND TRACE LEFT TO TURN RATE.

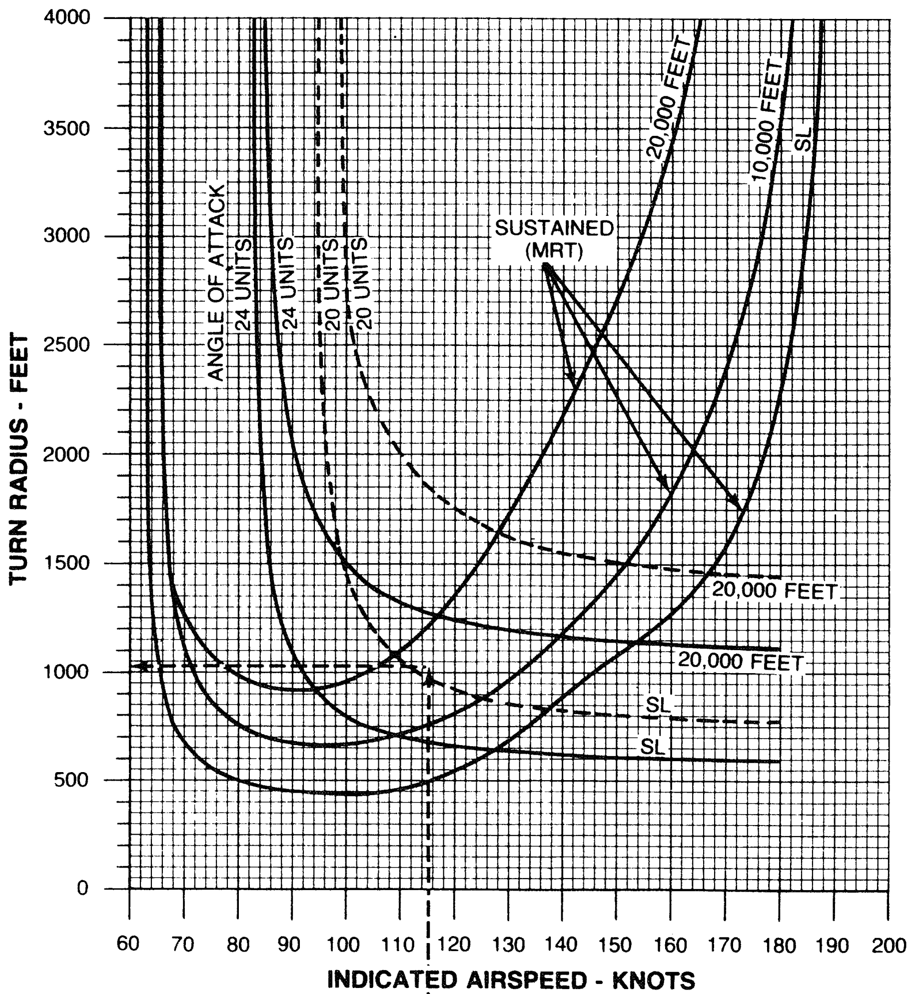
F-0090

Figure 32-1. Turn Rate Versus Airspeed

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0%
AIRCRAFT WEIGHT 4300 LB

MODEL: T-34C
DATE: 24 NOV 1976
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-25
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**

INDICATED AIRSPEED 115 KNOTS, SUSTAINED MINIMUM RADIUS TURN, PRESSURE ALTITUDE 16,000 FT, TURN RADIUS = 1025 FT

**HOW TO USE CHART**

ENTER AT BOTTOM OF CHART AT INDICATED AIRSPEED AND TRACE UP TO FLIGHT CONDITION (SUSTAINED MINIMUM RADIUS TURN OR CONSTANT ANGLE OF ATTACK) AND PRESSURE ALTITUDE AND TRACE LEFT TO TURN RADIUS

F-0091

Figure 32-2. Turn Radius Versus Airspeed

## CHAPTER 33

# Emergency Operation

### 33.1 GLIDE (FIGURE 33-1)

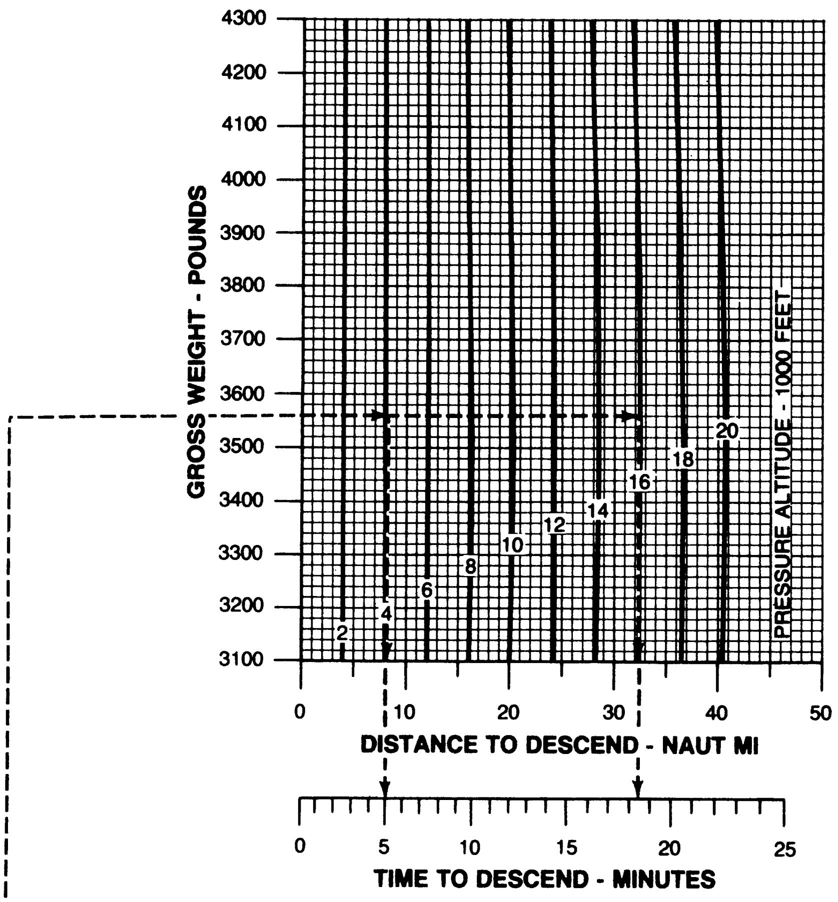
Distance and time to glide for the gear-up, flaps 0-percent, prop-feathered configuration at a glide indicated airspeed of 100 knots are shown on the following chart. Glide airspeed is optimized to provide maximum range and will also provide approximate maximum endurance.

AIRCRAFT CONFIGURATION:
GEAR UP FLAPS 0% PROP FEATHERED
**INDICATED AIRSPEED 100 KNOTS**

MODEL: T-34C — ENGINE: PT6A-25

DATE: 22 NOV 1976 — FUEL GRADE: JP-4

DATA BASIS: FLIGHT TEST — FUEL DENSITY: 6.5 LB/GAL




**EXAMPLE**

GROSS WEIGHT 3560 LB, FINAL ALTITUDE 4100 FT, INITIAL ALTITUDE 16,000 FT, FINAL DISTANCE = 8.2 NAUT MI, INITIAL DISTANCE = 32.4 NAUT MI, FINAL TIME = 5 MIN, INITIAL TIME = 18.5 MIN, DISTANCE TO DESCEND (32.4 − 8.2) = 24.2 NAUT MI TIME TO DESCEND (18.5 − 5) = 13.5 MIN

**HOW TO USE CHART**

ENTER LEFT SIDE OF CHART AT GROSS WEIGHT AND TRACE RIGHT TO INITIAL AND FINAL PRESSURE ALTITUDES, TRACE DOWN TO READ INITIAL AND FINAL DISTANCE TO DESCEND AND TIME TO DESCEND. TO OBTAIN DISTANCE TO DESCEND AND TIME TO DESCEND SUBTRACT INITIAL FROM FINAL VALUE

F-0092

Figure 33-1. Glide

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