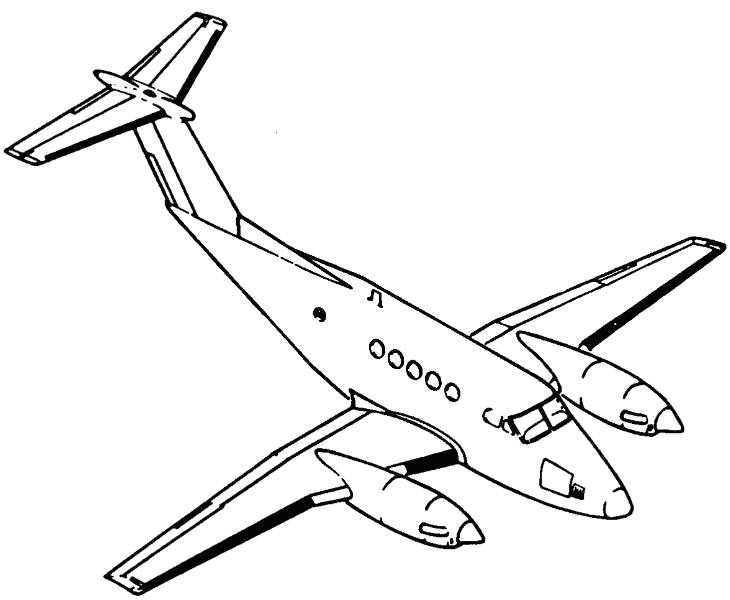
*TM 1-1510-218-10

TECHNICAL MANUAL

OPERATOR'S MANUAL FOR ARMY C-12C AIRCRAFT NSN 1510-01-070-3661

ARMY C-12D AIRCRAFT NSN 1510-01-087-9129

ARMY C-12T AIRCRAFT NSN 1510-01-470-0220



Distribution statement A: Approved for public release, distribution is unlimited.

***This manual supersedes TM-1-1510-218-10 dated 4 September 2001.**

HEADQUARTERS DEPARTMENT OF THE ARMY

1 OCTOBER 2009

WARNING PAGE

Personnel performing operations, procedures, and practices that are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause serious injury or loss of life.

NOISE LEVELS

Sound pressure levels in this aircraft during some operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TB MED 501. Hearing protection devices, such as a headset or ear plugs, shall be worn by all personnel in and around the aircraft during its operation.

STARTING ENGINES

Operating procedures or practices defined in this technical manual must be followed correctly. Failure to do so may result in personal injury or loss of life.

Exposure to exhaust gases shall be avoided since exhaust gases are an irritant to eyes, skin, and respiratory system.

HIGH VOLTAGE

High voltage is a potential hazard around AC inverters, ignition exciter units, and strobe beacons.

USE OF FIRE EXTINGUISHERS IN CONFINED AREAS

Monobromotrifluoromethane (CF_3Br) is very volatile, but is not easily detected by its odor- Although non toxic, it must be considered to be about the same as other refrigerants and carbon dioxide, causing danger to personnel primarily by reduction of oxygen available for proper breathing. During operation of the fire extinguisher, ventilate personnel areas with fresh air. The liquid shall not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns because of its very low boiling point

VERTIGO

The strobe beacon lights should be turned off during flight through clouds to prevent sensations of vertigo, as a result of reflections of the light on the clouds.

CARBON MONOXIDE

When smoke, suspected carbon monoxide fumes, or symptoms of lack of oxygen (hypoxia) exist, all personnel shall immediately don oxygen masks, and activate the oxygen system.

FUEL AND OIL HANDLING

Turbine fuels and lubricating oils contain additives that are poisonous and readily absorbed through the skin. Do not allow them to remain on skin.

SERVICING AIRCRAFT

When conditions permit, the aircraft shall be positioned so that the wind will carry fuel vapors away from all possible sources of ignition. The fueling unit shall maintain a distance of 20 feet between unit and filler point. A minimum of 10 feet shall be maintained between fueling unit and aircraft. Prior to refueling, the hose nozzle static ground wire shall be attached to the grounding lugs.

SERVICING BATTERY

Improper service of the nickel-cadmium battery is dangerous and may result in both bodily injury and equipment damage. The battery shall be serviced in accordance with applicable manuals by qualified personnel only.

Battery electrolyte (potassium hydroxide) is corrosive. Wear rubber gloves, apron, and face shield when handling batteries. If potassium hydroxide is spilled on clothing, or other material, wash immediately with clean water. If spilled on personnel, immediately start flushing the affected area with clean water. Continue washing until medical assistance arrives.

JET BLAST

Occasionally, during starting, excess fuel accumulation in the combustion chamber causes flames to be blown from the exhausts. This area shall be clear of personnel and flammable materials.

RADIOACTIVE MATERIAL

Instruments contained in this aircraft may contain radioactive material (TB 55-1510-314-25). These items present no radiation hazard to personnel unless seal has been broken due to aging or has accidentally been broken. If seal is suspected to have been broken, notify Radioactive Protective Officer.

RF BURNS

Do not stand near the antennas when they are transmitting.

OPERATION OF AIRCRAFT ON GROUND

Engines shall be started and operated only by authorized personnel. Reference AR 95-1. LCCS contractor personnel are authorized IAW the Contract and Statement of Work. Ensure that landing gear control handle is in the DN position.

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGE PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for original and change pages are:

Original . . . . . 0 . . . . . 1 October 2009

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 943, CONSISTING OF THE FOLLOWING:

Page No.	*Change No.
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TECHNICAL MANUAL

NO. 1-1510-218-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 1 OCTOBER 2009

OPERATOR'S MANUAL FOR ARMY C-12C, C-12D, C-12T1, AND C-12T2 AIRCRAFT

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms) located in the back of this manual directly to: Program Executive Office – Aviation, ATTN: SFAE-AV-AS-FW (C-12), Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also send your comments electronically to our e-mail address, troy.brown@redstone.army.mil or by fax 256-955-0887/DSN 645-0887. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hard copy 2028.

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

TABLE OF CONTENTS

***This manual supercedes TM 1-1510-218-10, dated 4 September 2001, with all changes.**

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TABLE OF CONTENTS
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CHAPTER 1
INTRODUCTION

1-1. GENERAL.

These instructions are for use by the operator. They apply to the C-12C, C-12D1, C-12D2, C-12T1, and C-12T2 model aircraft.

1-2. WARNINGS, CAUTIONS, AND NOTES.

Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., which is essential to highlight.

1-3. DESCRIPTION.

This manual contains the best operating instructions and procedures for the aircraft under most circumstances. The observance of limitations, performance, and weight/balance data provided is mandatory. The observance of procedures is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. Basic flight principles are not included. THIS MANUAL SHALL BE CARRIED IN THE AIRCRAFT AT ALL TIMES. Manuals printed from CD must be on standard 8 1/2 x 11 paper.

Users are authorized to remove the chapters/sub-chapters that are not applicable to their aircraft model and are not required to carry those chapters/sub-chapters on-board.

1-4. APPENDIX A, REFERENCES.

Appendix A is a listing of official publications cited within the manual applicable to and available for flight crews.

1-5. APPENDIX B, ABBREVIATIONS AND TERMS.

Appendix B is a listing of abbreviations and terms used throughout the manual.

1-6. INDEX.

The index lists, in alphabetical order, every titled paragraph, figure, and table contained in this manual.

1-7. ARMY AVIATION SAFETY PROGRAM.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-8. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

For information concerning destruction of Army materiel to prevent enemy use, refer to TM 750-244-1-5.

1-9. FORMS AND RECORDS.

Army aviators' flight records and aircraft maintenance records, which are to be used by crewmembers, are prescribed in AR 95-1 and DA PAM 738-751 respectively. Weight and balance requirements are prescribed in AR 95-1 with procedures found in TM 55-1500-342-23.

1-10. EXPLANATION OF CHANGE SYMBOLS.

a. General. Change symbols show current changes only. Change symbols are not used to indicate changes in the following: introductory material; indexes and tabular data where the change cannot be identified; blank space resulting from the deletion of text, an illustration or a table; or correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless correction changes the meaning of instructive information and procedures.

b. Text and Table Changes. Changes to text and tables, including new material on added pages, are indicated by a vertical line in the outer margin extending close to the entire area of the material affected.

c. Illustration Changes. A miniature pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than miniature pointing hands, is used when there have been extensive changes made to an illustration.

1-11. AIRCRAFT DESIGNATION SYSTEM.

a. Example C-12C:

C – Basic mission and type symbol (Cargo)

12 – Design number

C – Series symbol

1-12. AIRCRAFT EFFECTIVITY DESIGNATORS AND SERIALIZATION.

The aircraft effectivity for content within this manual will be designated by the following symbols: C, D, D1, D2, T, T1, and T2. These symbols may be used individually or in groups.

C All C-12C aircraft.

D All C-12D aircraft.

D1 C-12D aircraft with serial numbers prior to 84-24375.

D2 C-12D aircraft with serial numbers 84-24375 and subsequent.

T All C-12T1 and C-12T2 aircraft.

T1 C-12T1 aircraft with serial numbers 85-51262 through 85-51268 and 85-51270 through 85-51272 modified with the cockpit and digital engine instrument upgrade.

T2 C-12T2 aircraft with serial numbers 86-60084 through 86-60089, 87-70160, and 87-70161 modified with the cockpit and digital engine instrument upgrade.

The effectivity symbols listed are used in conjunction with paragraph titles, text content, performance charts and graphs, tables, figure titles, and specific items on illustrations to show proper effectivity of the material as applicable. If the material applies to all models within the manual, no effectivity designators are used. Where practical, to avoid duplication, descriptive information is written to apply to all models and split series effectivities. Table 2-1 lists the most significant differences between models including the split series effectivities.

Aircraft serial numbers are used only where needed for clarification. Paragraphs, figures, tables, and charts that apply to specific model(s) have the corresponding model designator(s) placed following the paragraph or figure title. Model and serial effectivity designators are also placed within tables, charts, and text where applicable. No effectivity designator is used if a paragraph, figure, table, or chart is common to all models.

1-13. USE OF WORDS SHALL, SHOULD, AND MAY.

Within this technical manual, the word "shall" is used to indicate a mandatory requirement. The word "should" is used to indicate a nonmandatory, but preferred, method of accomplishment. The word "may" is used to indicate an acceptable method of accomplishment.

1-14. PLACARD ITEMS.

Placard items (switches, controls, etc.) are shown throughout this manual in boldface capital letters.

1-15. AVIONICS CHAPTERS.

This manual contains four Avionics chapters entitled as follows.

Chapter 3 Avionics – Avionics common to all C-12C C-12D1/D2, and C-12T1/T2 Aircraft

Chapter 3A Avionics – C-12C and C-12D1 Aircraft

Chapter 3B Avionics – C-12D2 Aircraft

Chapter 3C Avionics – C-12T1/T2 Aircraft

1-16. PERFORMANCE CHARTS/GRAPHS.

This manual contains two performance data chapters entitled as follows.

Chapter 7 Performance Data – C-12C and C-12D1 Aircraft

Chapter 7A Performance Data – C-12D2 and C-12T1/T2 Aircraft

1-17. NORMAL PROCEDURES.

This manual contains two Normal Procedures chapters entitled as follows.

Chapter 8 Normal – C-12C and C-12D1/D2 Aircraft Procedures

Chapter 8A Normal – C-12T1/T2 Aircraft Procedures

CHAPTER 2
AIRCRAFT AND SYSTEMS DESCRIPTIONS AND OPERATION

Section I. AIRCRAFT

2-1. INTRODUCTION.

The purpose of this chapter is to describe the aircraft and its systems and controls which contribute to the physical act of operating the aircraft. It does not contain descriptions of avionics and mission equipment covered elsewhere in this manual. This chapter contains descriptive information and does not describe procedures for operation of the aircraft. These procedures are contained within appropriate chapters in the manual. This chapter also contains the emergency equipment installed. This chapter is not designed to provide instructions on the complete mechanical and electrical workings of the various systems. Therefore, each system is described only in enough detail to make comprehension of that system sufficiently complete to allow for its safe and efficient operation.

NOTE T2

C-12T2 aircraft incorporate Aviator Night Vision Imaging (ANVIS) compatible interior lighting in the following areas: all cockpit, except emergency lighting; all cabin lights, except reading, spar cover, no smoking, fasten seat belt, and emergency lighting.

2-2. GENERAL.

The C-12 is a pressurized, low wing, all metal aircraft, powered by two PT6A turboprop engines and has all-weather capability. Refer to Figure 2-1, Sheets 1 through 3, and Figure 2-2. Distinguishable features of the aircraft are the slender, streamlined engine nacelles, square-tipped wing and tail surfaces, a T-tail and dual aft body strakes below the empennage. The basic mission of the aircraft is to provide a transport service supporting staff in the conduct of command and control functions, administration, liaison, and inspection. Cabin entrance is made through a stair-type door on the left side of the fuselage. The pilot and copilot seats are separated from the cabin by a removable partition. Table 2-1 lists main differences between models.

2-3. DIMENSIONS.

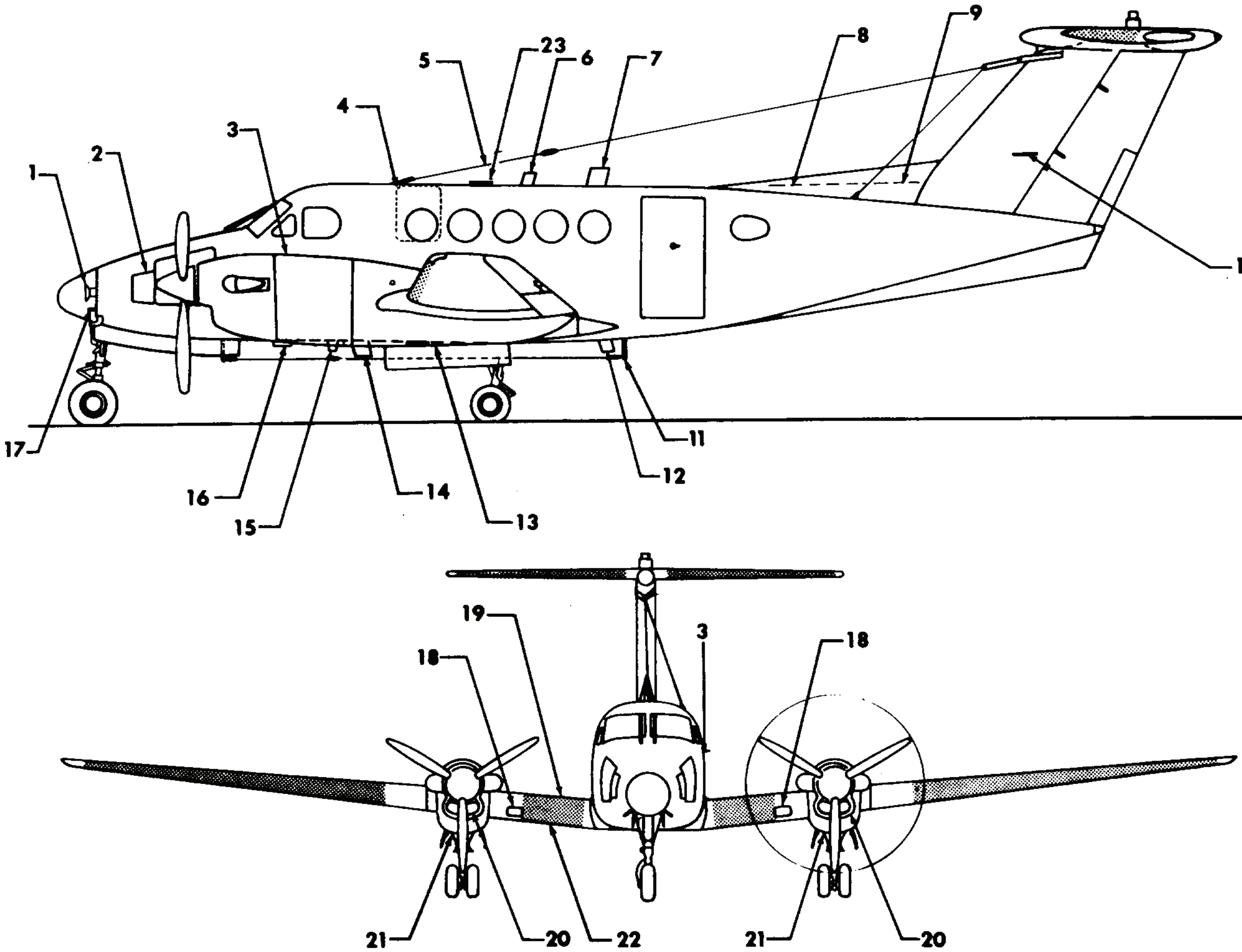
Overall aircraft dimensions are shown in Figure 2-3, Sheets 1 and 2.

2-4. GROUND TURNING RADIUS.

Minimum ground turning radius of the aircraft is shown in Figure 2-4.

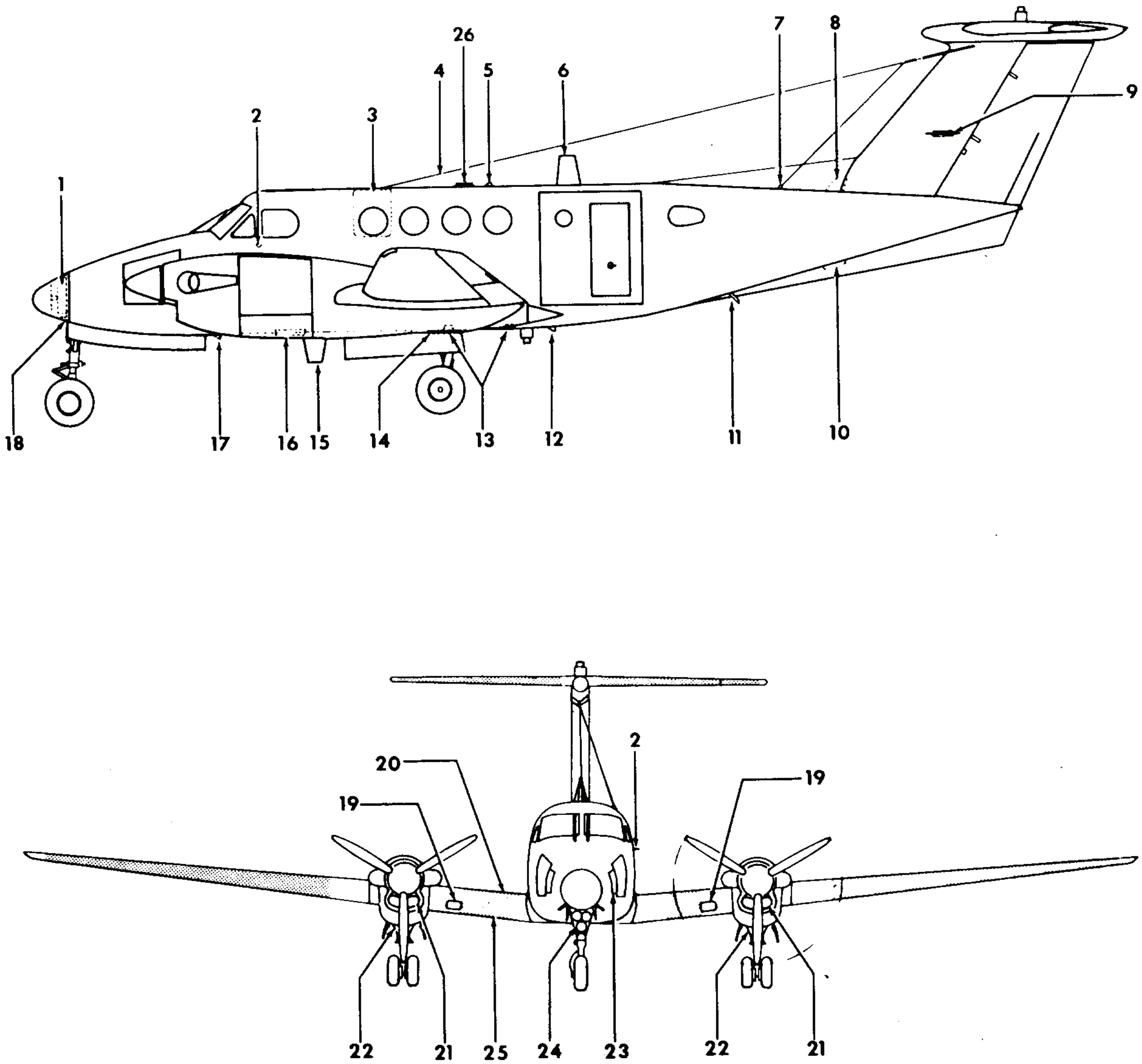
Table 2-1. Main Differences Between Models

ITEM	C-12C	C-12D	C-12T1/T2
Wing span	54 ft. 6 in.	55 ft. 6.5 in.	55 ft. 6.5 in.
Ground turning radius	39 ft. 10 in.	40 ft. 4 in.	40 ft. 4 in.
Cargo door	Not installed	Height – 52 in. Width – 52 in.	Height – 52 in. Width – 52 in.
Engines	PT6A-41	PT6A-41 D1 PT6A-42 D2	PT6A-42
Oxygen system	Passenger masks stowed for use	Auto-deployment system	Auto-deployment system
Landing/taxi lights	Located on nose gear	Located on nose gear	Located on nose gear
High flotation landing gear	Not installed	Installed	Installed
Hydraulic landing gear	Not installed	Installed D2	Installed
ANVIS lighting	Not installed	Not installed	Installed T2



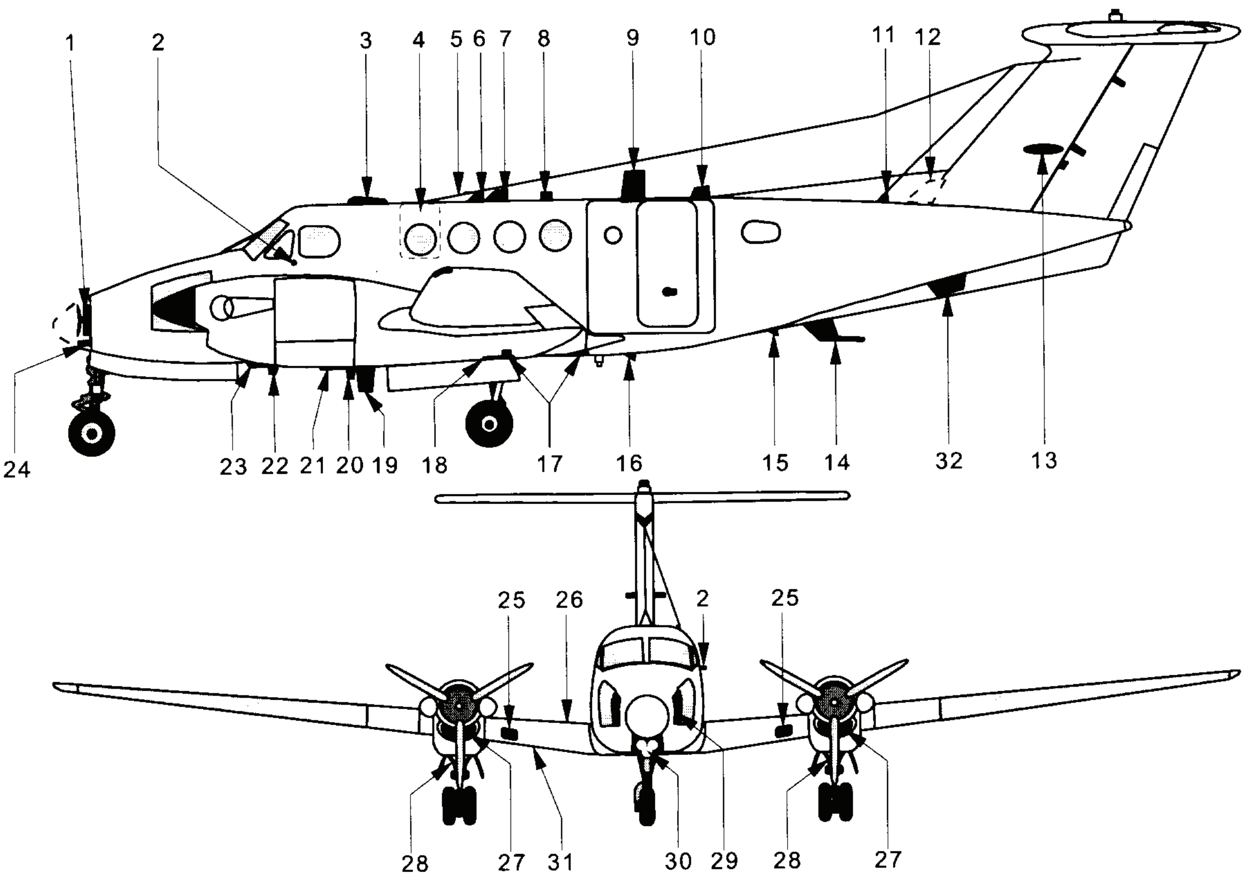
1. Radar Antenna
2. Condenser Air Inlet (Right) Air Exhaust (Left)
3. Free Air Temperature Sensor
4. Emergency Escape Hatch (Right)
5. HF Comm Antenna
6. Upper Transponder Antenna
7. VHF No. 1 and UHF Comm Antenna
8. ADF No. 2 Sense Antenna
9. ELT Antenna
10. VOR No. 1 and No. 2 Antennas (2)
11. ADF No. 1 Sense Antenna
12. Lower Transponder Antenna
13. ADF No. 1 and No. 2 Loop Antennas (2)
14. VHF No. 2 and UHF Comm Antenna
15. DME Antenna
16. Marker Beacon Antenna
17. Glideslope Antenna
18. Heat Exchanger Inlet
19. Battery Exhaust Louvers
20. Engine Air Inlet
21. Engine Air Bypass Door
22. Battery Ram Air Inlet
23. GPS

Figure 2-1. General Exterior Arrangement C D1 *(Sheet 1 of 3)*



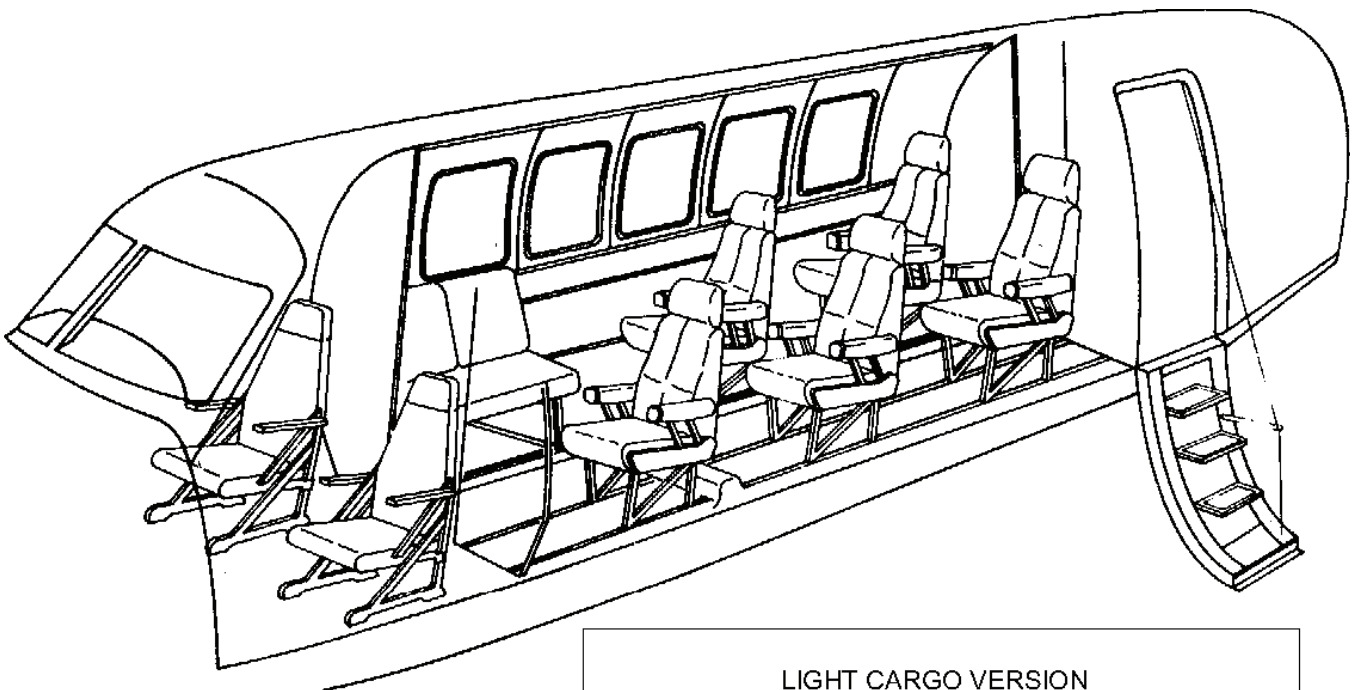
1. Radar Antenna
2. Free Air Temperature Sensor
3. Emergency Escape Hatch (Right)
4. HF Comm Antenna
5. Upper Transponder Antenna
6. VHF No. 1 and UHF Comm Antenna
7. ADF No. 2 Sense Antenna
8. ELT Antenna
9. VOR No. 1 and No. 2 Antennas (2)
10. Fit Management Antenna
11. ADF No. 1 Sense Antenna
12. Lower Transponder Antenna
13. Radio Altimeter Antennas
14. ADF No. 1 and No. 2 Loop Antennas (2)
15. VHF No. 2 and UHF Comm Antenna
16. Marker Beacon Antenna
17. TACAN DME Antenna
18. Glideslope Antenna
19. Heat Exchange Inlet
20. Battery Exhaust Louver
21. Engine Air Inlet
22. Engine Air Bypass Door
23. Battery Ram Air Inlet
24. Condenser Air Inlet (Right) Air Exhaust (Left)
25. Battery Ram Air Inlet
26. GPS Antenna

Figure 2-1. General Exterior Arrangement **D2** *(Sheet 2 of 3)*



1. Radar Antenna
2. Free Air Temperature Sensor
3. Top TCAS Antenna
4. Emergency Escape Hatch (Right)
5. HF Comm Antenna
6. FMS-800 GPS Antenna
7. GPS Antenna (KLN90B)
8. Upper Transponder Antenna
9. VHF No. 1 and UHF Comm Antenna
10. Top-Mode-S Transponder Antenna
11. ADF No. 2 Sense Antenna
12. ELT Antenna
13. VOR/NAV No. 1 and No. 2 Antennas (2)
14. ARC-210 Antenna
15. ADF No. 1 Sense Antenna
16. Lower Transponder Antenna
17. Radio Altimeter Antennas
18. ADF No. 1 and No. 2 Loop Antennas (2)
19. VHF No. 2 and UHF Comm Antenna
20. Bottom Mode-S Transponder Antenna
21. Marker Beacon Antenna
22. Bottom TCAS Antenna
23. TACAN-DME Antenna
24. Glideslope Antenna
25. Heat Exchanger Inlet
26. Battery Exhaust Louvers
27. Engine Air Inlet
28. Engine Air Bypass Door
29. Condenser Air Inlet (Right) Air Exhaust (left)
30. Landing/Taxi Lights
31. Battery Ram Air Inlet
32. Flight Management Antenna

Figure 2-1. General Exterior Arrangement **T** *(Sheet 3 of 3)*



LIGHT CARGO VERSION
CONVERSION TO LIGHT CARGO VERSION CONSISTS OF REMOVING THE EXISTING STAFF SEATING INSTALLATIONS. NO CARGO LOADING OR UNLOADING EQUIPMENT IS PROVIDED. REF TO CHAPTER 6 WEIGHT/BALANCE AND LOADING FOR CARGO HANDLING INFORMATION AND INSTRUCTIONS.

Figure 2-2. Typical General Interior Arrangement

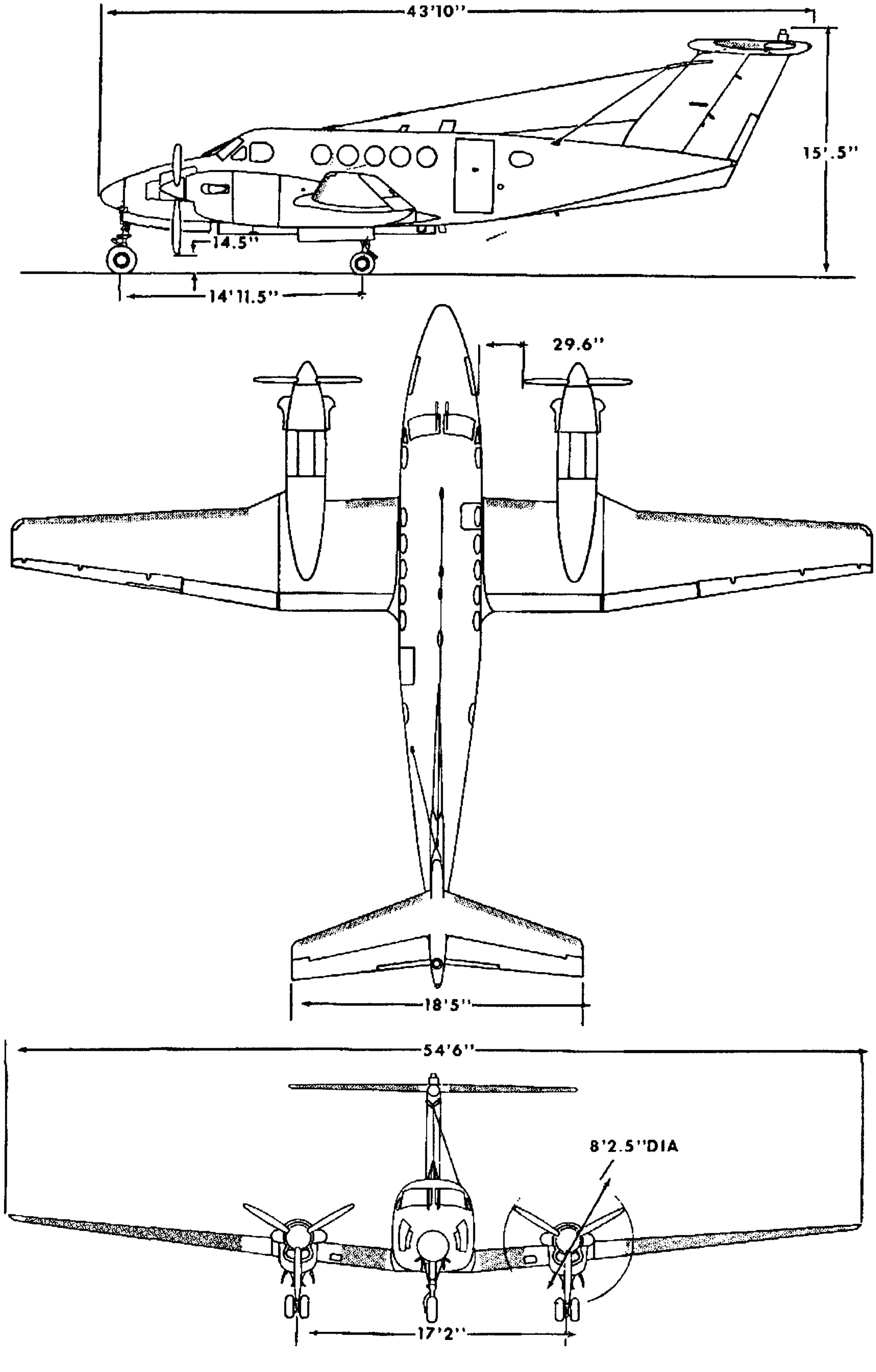


Figure 2-3. Principal Dimensions **C** *(Sheet 1 of 2)*

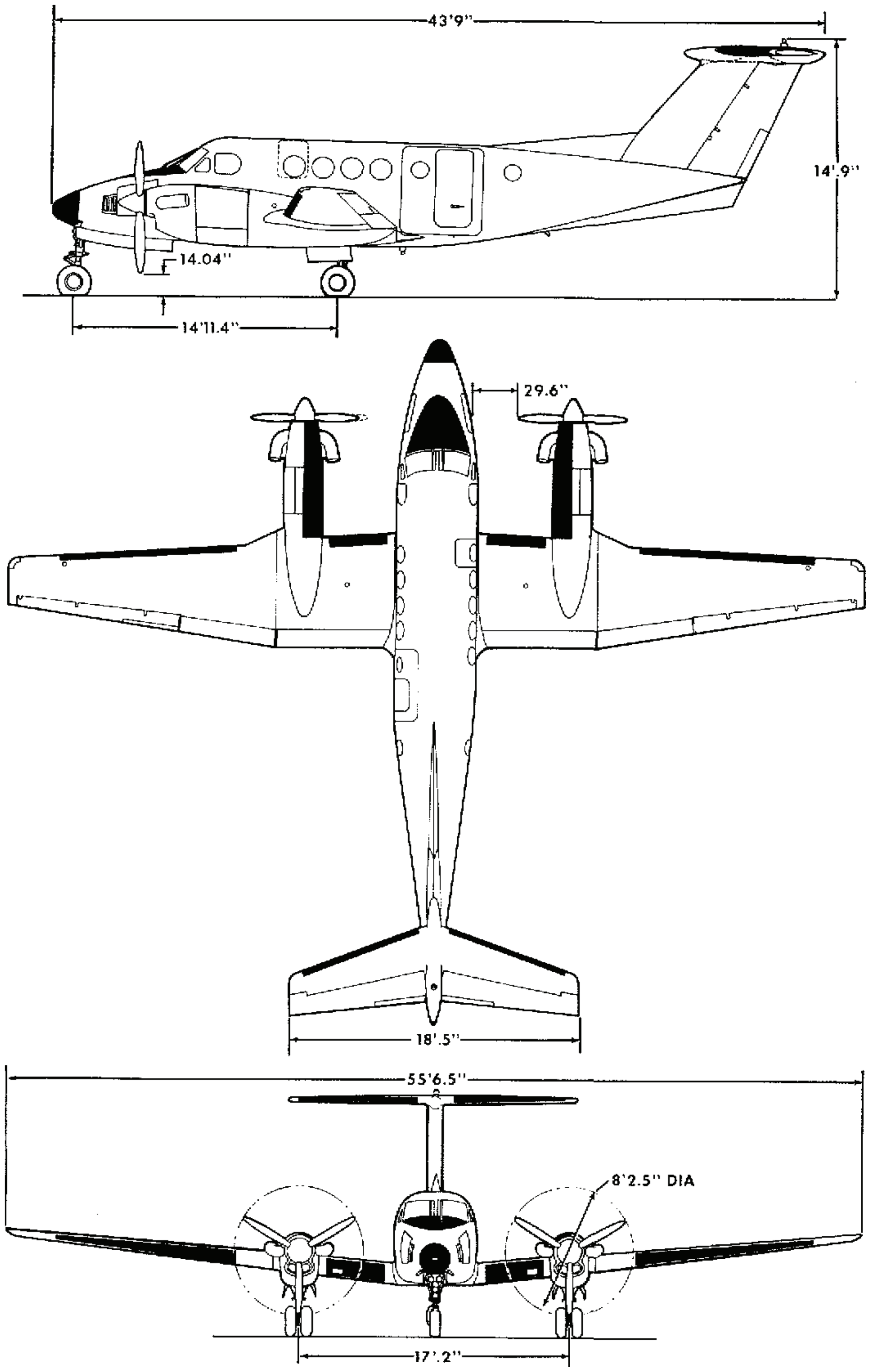
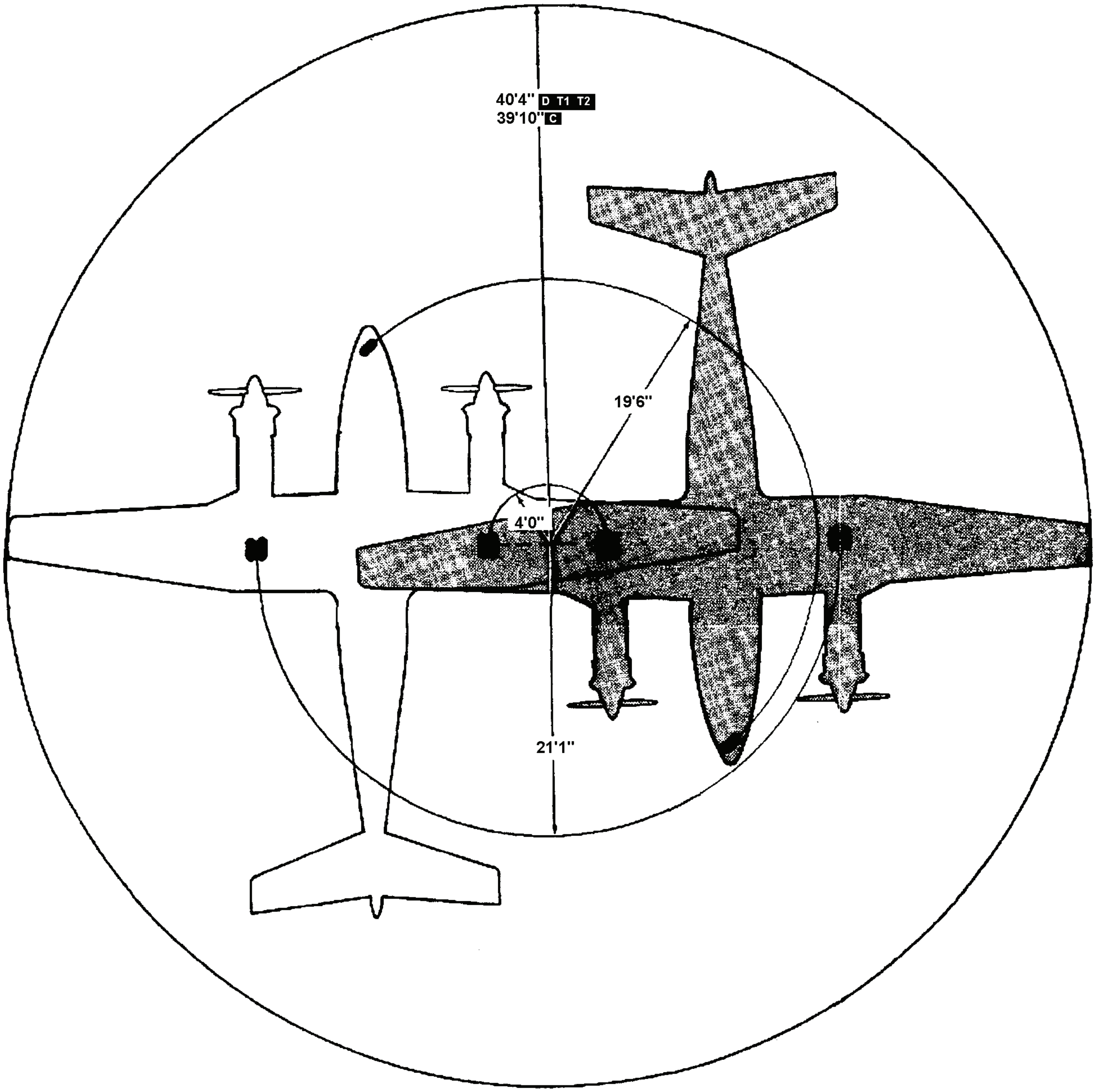


Figure 2-3. Principal Dimensions D T (Sheet 2 of 2)



RADIUS FOR INSIDE GEAR………………………….. .4 FEET

RADIUS FOR NOSE WHEEL………………………… 19 FEET 6 INCHES

RADIUS FOR OUTSIDE GEAR………………………. 21 FEET 1 INCH

RADIUS FOR WING TIP C…………..………………... 39 FEET 10 INCHES

RADIUS FOR WING TIP D T …...………..……..… 40 FEET 4 INCHES

TURNING RADII ARE PREDICATED ON THE USE OF PARTIAL BRAKING ACTION AND DIFFERENTIAL POWER.

Figure 2-4. Typical Turning Radius

2-5. MAXIMUM WEIGHTS.

a. Operations At or Below 12,500 Pounds.

(1) Takeoff. Maximum Gross Takeoff Weight (GTOW) is 12,500 pounds.

(2) Landing. Maximum gross landing weight is 12,500 pounds.

(3) Maximum Ramp Weight. Maximum ramp weight is 12,590 pounds.

(4) Maximum Zero Fuel Weight. Maximum zero fuel weight is 11,000 pounds.

(5) Altitude.

(a) At least 75% of total missions shall be flown at altitudes above 5,000 feet above ground level when operating at or below 12,500 pounds GTOW.

(b) At least 50% of total missions shall be flown at altitudes above 10,000 feet above ground level when operating at or below 12,500 pounds GTOW.

b. Operations Over 12,500 Pounds Gross Takeoff Weight C D1.

(1) Requirements.

(a) Takeoffs. Takeoff should only be performed on a smooth paved runway. Takeoffs should not be performed with a tailwind.

(b) Landing. Maximum landing weight is 12,500 pounds, unless required by an emergency. If it is necessary to land with a weight over 12,500 pounds, the landing shall be made on a smooth, paved runway at a sink rate of 500 feet per minute or less, if possible.

(c) Flight Duration. All missions with over 12,500 pounds GTOW shall be planned and flown at or above 10,000 feet above ground level and be a minimum of 60 minutes in duration unless restricted by Air Traffic Control, turbulence, or other weather conditions, or emergencies.

(d) Takeoff. All missions with over 12,500 pounds GTOW shall be flown from a smooth, paved runway. Takeoffs shall not be performed with a tailwind.

(e) Center of Gravity (CG) Limits. The CG limits shall be IAW with Figure 6-7.

1 The aft CG limit above 12,500 pounds is 196.4 ARM inches.

2 The forward CG limit at 13,500 pounds is 188.3 ARM inches. Intermediate values to 12,500 vary linearly to 185.0 ARM inches.

(f) Wing Spar. Authorization to operate above 12,500 is applicable to the following aircraft, only after the original wing spars have been replaced after 10,000 hours of service.

C12C	73-22250		
	73-22252	Through	73-22264
	73-22267	Through	73-22269

(2) Maximum Weight Operation.

(a) Takeoff. Maximum GTOW is 13,500 pounds.

(b) Landing. Maximum gross landing weight is 12,500 pounds.

(c) Maximum Ramp Weight. Maximum ramp weight is 13,590 pounds.

(d) Maximum Zero Fuel Weight. Maximum zero fuel weight is 11,000 pounds.

c. Operations Over 12,500 Pounds Gross Takeoff Weight D2 T.

(1) Requirements.

WARNING

Artificial stall warning systems may only provide a 1 to 5 knot stall warning.

Maximum GTOW charts must be strictly followed to ensure climb capability in the event of an engine failure.

(a) Aircraft shall be equipped with Raisbeck Engineering dual aft body strakes and engine ram air recovery system with PT6A-42 engines.

(b) Landing. Maximum landing weight is 12,500 pounds, unless required by an emergency. If it is necessary to land with a weight over 12,500 pounds, the landing shall be made on a smooth, paved runway at a sink rate of 500 feet per minute or less, if possible.

(c) Flight Duration. All missions with over 12,500 pounds GTOW shall be planned and flown at or above 10,000 feet above ground level and

be a minimum of 60 minutes in duration unless restricted by Air Traffic Control, turbulence, other weather conditions, or emergencies.

(d) Takeoff. All missions with over 12,500 pounds GTOW shall be flown from a smooth, paved runway. Takeoffs shall not be performed with a tailwind.

(2) Maximum Weight Operation.

(a) Takeoff. Maximum GTOW is 14,000 pounds.

(b) Landing. Maximum gross landing weight is 12,500 pounds.

(c) Maximum Ramp Weight. Maximum ramp weight is 14,090 pounds.

(d) Maximum Zero Fuel Weight. Maximum zero fuel weight is 11,000 pounds.

2-6. EXHAUST AND PROPELLER DANGER AREAS.

Exhaust and propeller danger areas to be avoided by personnel while aircraft engines are being operated on the ground are depicted in Figure 2-5. Distance to be maintained with engines operating at idle are also shown. Temperature and velocity of exhaust gases at varying locations aft of the exhaust stacks are shown for maximum power. The danger area extends to 40 feet aft of the exhaust stack outlets. Distances to be maintained with engines operating at idle and propeller danger areas are also shown.

2-7. LANDING GEAR SYSTEM C D1.

The landing gear is a retractable, tricycle type, electrically operated by a single dc motor. This motor drives the main landing gear actuators through a gear box and torque tube arrangement, and also drives a chain mechanism which controls the position of the nose gear. Positive down-locks are installed to hold the drag brace in the extended and locked position. The down-locks are actuated by over-travel of the linear jackscrews and are held in position by a spring-loaded over-center mechanism. The jackscrew in each actuator holds all three gears in the UP position, when the gear is retracted. A friction clutch between the gearbox and the torque shafts protects the motor from electrical overload in the event of a mechanical malfunction. A 150-ampere current limiter, located on the dc distribution bus under the center floorboard, protects against electrical overload. Gear doors are opened and closed through a mechanical linkage connected to the landing gear. The nose wheel steering mechanism is automatically centered and the rudder pedals relieved of the steering load when the landing gear is retracted. Air-oil type shock struts, filled with compressed air and hydraulic fluid, are incorporated with the landing gear. Gear retraction or extension time is approximately 6 seconds.

a. Landing Gear Control Switch. Landing gear system operation is controlled by a manually actuated wheel-shaped switch, placarded **LDG GEAR CONTR UP / DN**, on the left subpanel, Figure 2-6. The control switch and associated relay circuits are protected by a 5-ampere circuit breaker, placarded **LANDING GEAR RELAY**, on the overhead circuit breaker panel.

b. Landing Gear Down Position-Indicator Lights. Landing gear down position is indicated by three green lights on the left subpanel, placarded **GEAR DOWN**. These lights may be checked by operating the **ANNUNCIATOR TEST** switch. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR IND**, on the overhead circuit breaker panel.

c. Landing Gear Position Warning Lights. Two red bulbs, wired in parallel and activated by microswitches independent of the landing **GEAR DOWN** position indicator lights, are positioned inside the clear plastic grip on the landing gear control handle. These lights illuminate whenever the landing gear handle is in either the **UP** or **DN** position and the gear is in transit. Both bulbs will also illuminate should either or both power levers be retarded below approximately 81% N_1 when the landing gear is not down and locked. To turn the handle lights off during single-engine operation, the power lever for the inoperative engine must be advanced to a position which is higher than the setting of the warning horn microswitch. Extending the landing gear will also turn the lights off. Both red lights indicate the same warning conditions, but two are provided for a fail-safe indication in the event one bulb burns out. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR IND**, on the overhead circuit breaker panel.

d. Landing Gear Warning Light Test Button. A test button, placarded **HDL LT TEST**, is located on the left subpanel. Failure of landing gear handle to illuminate red when this button is pressed indicates two defective bulbs or a circuit fault. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR RELAY CONTROL**, on the overhead circuit breaker panel.

NOTE

The danger areas include the resultant increase in velocity and significant reduction in temperature due to propeller wake.

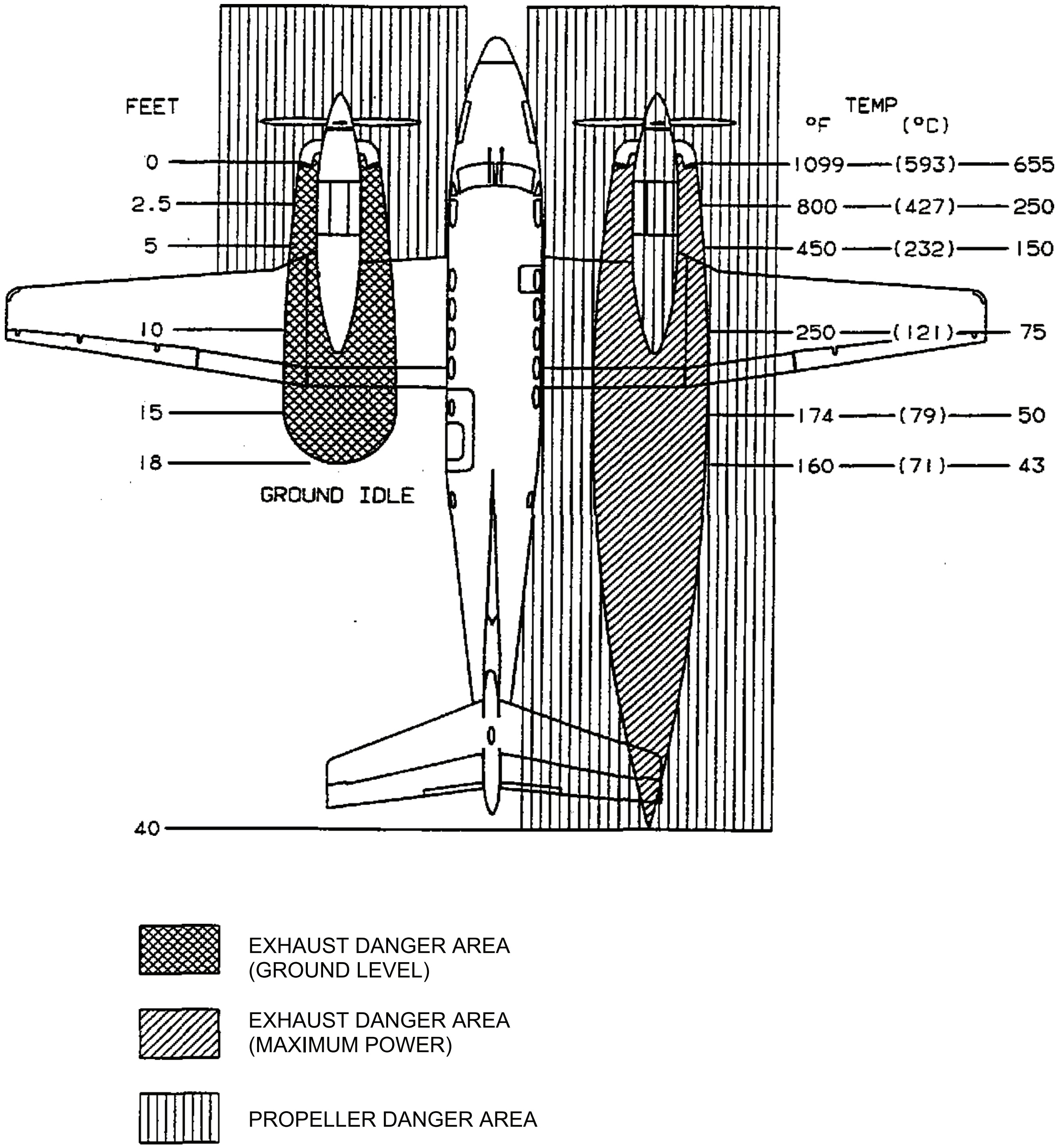
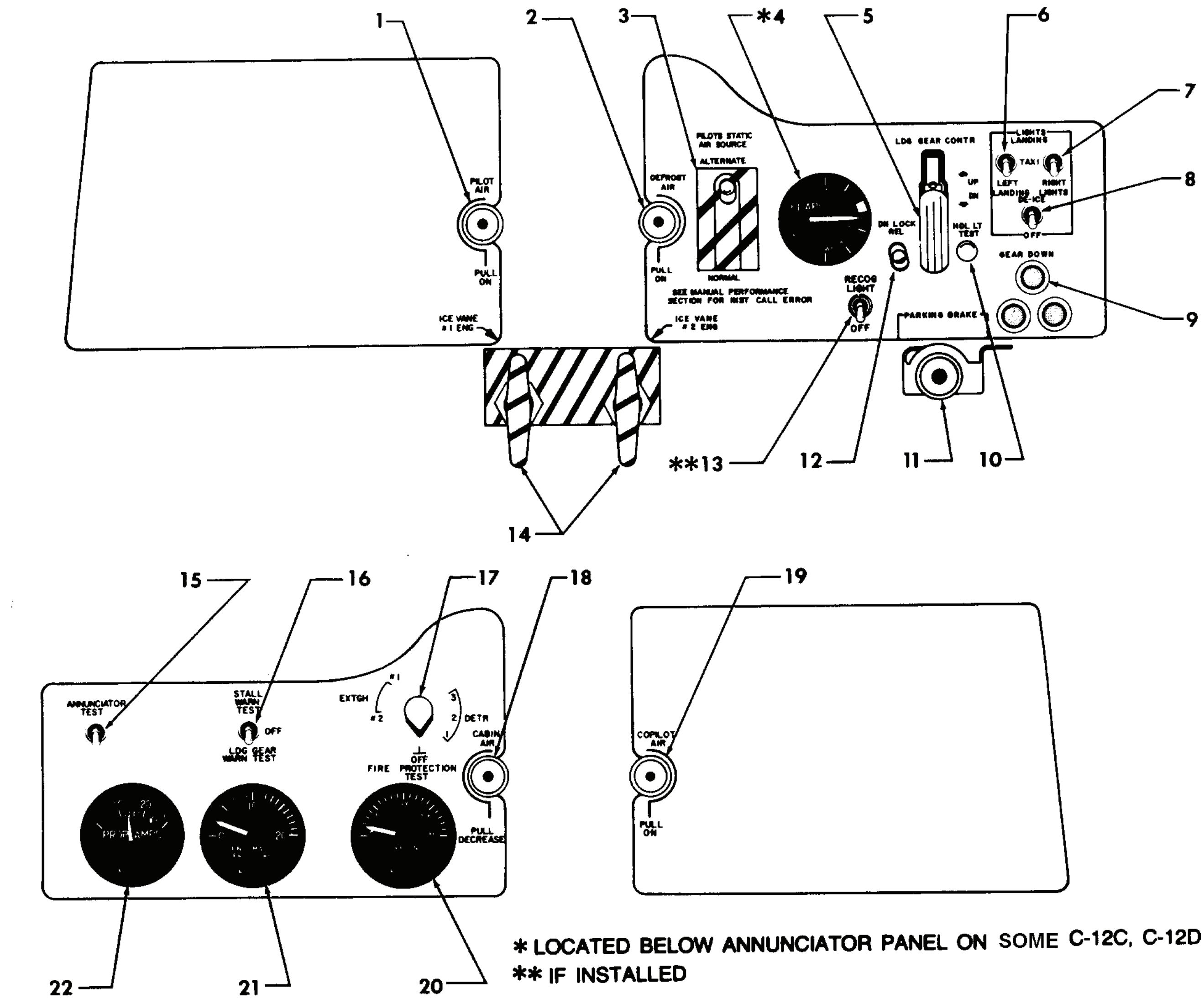


Figure 2-5. Exhaust and Propeller Danger Areas



* LOCATED BELOW ANNUNCIATOR PANEL ON SOME C-12C, C-12D
** IF INSTALLED

1. PILOT AIR Inlet Control
2. DEFROST AIR Control
3. PILOT'S STATIC AIR SOURCE Control
4. Flap Position Indicator
5. Landing Gear Control Handle
6. Left Landing/Taxi Light Switch
7. Right Landing/Taxi Light Switch
8. Landing Light Deice Switch
9. GEAR DOWN Indicator Lights (3)
10. Landing Gear Handle Light Test Switch (Light Inside Handle)
11. PARKING BRAKE Control
12. Landing Gear Handle Down Lock Release
13. Recognition Lights Switch
14. Manual Engine ICE VANE Controls
15. ANNUNCIATOR TEST Switch
16. Stall Warning/Landing Gear Warning Test Switch
17. Fire Detection System Test Switch
18. CABIN AIR Control
10. COPILOT AIR Inlet Control
11. OXYGEN Pressure Gauge
12. Pneumatic Pressure Gauge
13. Propeller Ammeter

Figure 2-6. Subpanels **C D1**

e. Landing Gear Warning Horn. When either power lever is retarded below approximate 79% N_1, or when the landing gear is not down and locked; or if the flaps are extended beyond 40%, a warning horn, located in the overhead control panel, will sound intermittently. To prevent the horn from sounding during long descents or an ILS approach, a pressure differential "Q" switch is connected into the copilot's static line. This switch prevents the warning horn from sounding until airspeed drops below 140 KIAS. The warning horn circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR WARN,** on the overhead circuit breaker panel.

f. Landing Gear Warning Horn Test Switch. The landing gear warning horn may be tested by a test switch on the right subpanel. The switch, placarded **STALL WARN TEST / OFF / LDG GEAR WARN TEST**, will sound the landing gear warning horn and illuminate the landing position warning lights when moved to the momentary **LDG GEAR WARN TEST** position. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR WARN**, on the overhead breaker panel.

g. Landing Gear Safety Switches. A switch on each main landing gear shock strut controls the operation of various aircraft systems that function only during flight or during ground operation. These switches are mechanically actuated whenever the main landing gear shock struts are extended (normally after takeoff) or compressed (normally after landing). The safety switch on the right main landing gear strut deactivates the landing gear control circuits, cabin pressurization circuits, and the flight hour meter when the strut is compressed. This switch also deactivates a down-lock hook, preventing the landing gear from being raised while the aircraft is on the ground. The hook, which unlocks automatically after takeoff, can be manually overridden by pressing the red button, placarded **DN LOCK REL**, located adjacent to the landing gear handle. If the override is used and the landing gear control switch is raised, power will be supplied to the warning horn circuit and the horn will sound. The safety switch on the left main landing gear strut activates the left and right engine ambient air shut-off valves when the strut is extended.

h. Alternate Landing Gear Extension Handle.

CAUTION

Continued pumping of handle after GEAR DOWN position indicator lights are illuminated could damage the drive mechanism and prevent subsequent retractions.

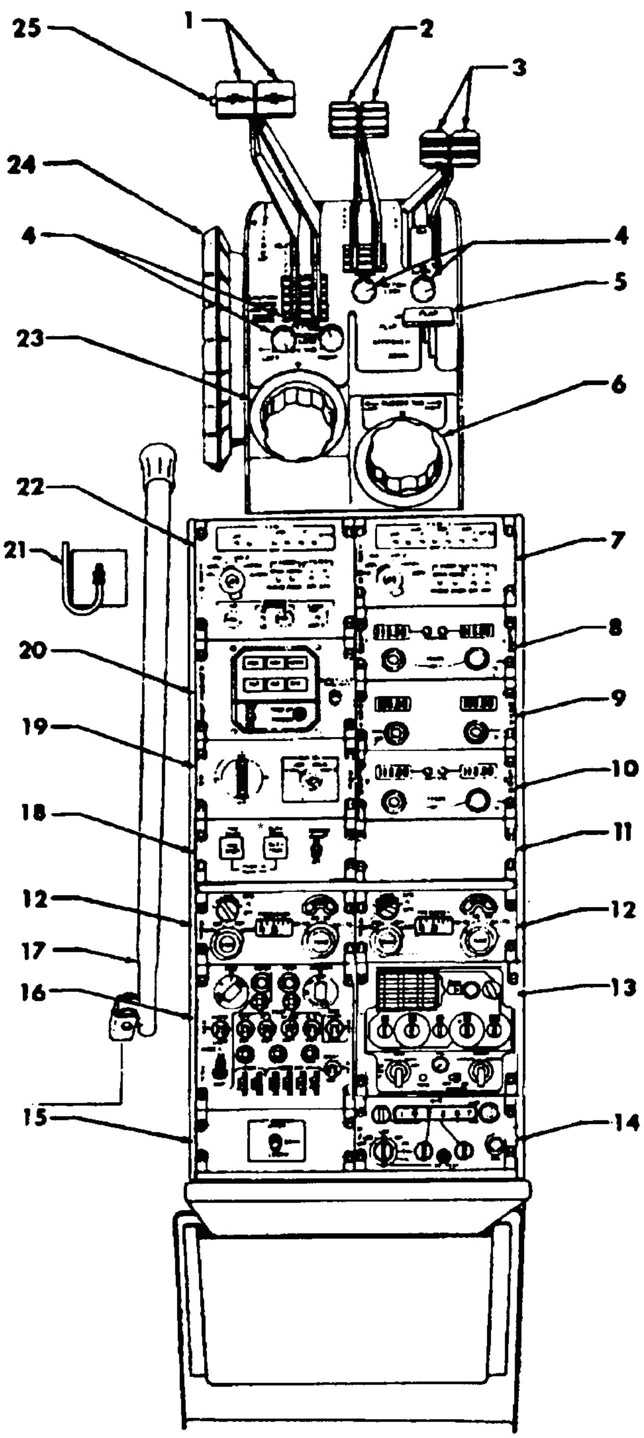
Manual landing gear extension is provided through a manually powered system as a backup to the electrically operated system. Before manually extending the gear, make certain that the landing gear switch handle is in the down position with the **LANDING GEAR RELAY** circuit breaker pulled. Pulling up on the alternate engage handle located on the floor, and turning it clockwise will lock it in that position. When the alternate engage handle is pulled, the motor is electrically disconnected from the system and the alternate drive system is locked to the gearbox and motor. When the alternate drive is locked in, the chain is driven by a continuous actuation ratchet, which is activated by pumping the alternate landing gear extension handle adjacent to the alternate engage handle. Refer to Figure 2-7.

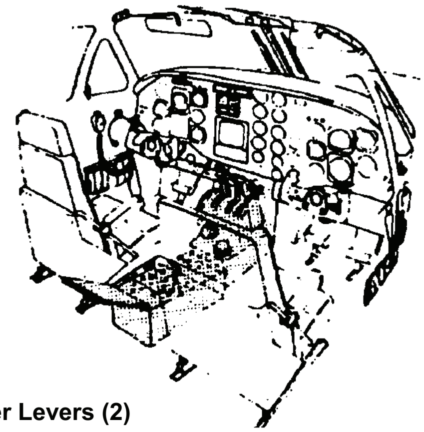
CAUTION

After a manual landing gear extension has been made, do not stow the handle, move any landing gear controls, or reset any switches or circuit breakers. The gear cannot be retracted manually.

After a practice manual extension, the alternate handle may be stowed and the landing gear retracted electrically. Rotate the alternate engage handle counterclockwise and push it down. Stow the handle, push in the **LANDING GEAR RELAY** circuit breaker on the overhead circuit breaker panel, and retract the gear in the normal manner with the landing gear handle switch. Refer to Chapter 9 for emergency gear extension procedures.

i. Landing Gear Alternate Engage Handle. During manual landing gear extension, the landing gear motor must be electrically disconnected from the system and the alternate drive system locked to the gearbox and motor. This is accomplished by a manually operated alternate engage handle located adjacent to the landing gear alternate extension handle. Pulling up on the alternate engage handle and turning it clockwise will lock the manual landing gear extension system in the engage position. To disengage the system, turn the alternate engage handle counterclockwise as far as it will go and release.





1. Power Levers (2)
2. Propeller Levers (2)
3. Condition Levers (2)
4. FRICTION LOCK Knobs
5. WING FLAP Switch
6. RUDDER TAB Control and Position Indicator
7. ICS #2 Control Panel
8. COMM 1 Control Panel
9. COMM 2 Control Panel
10. NAV 1/NAV 2 Control Panel
11. Blank Panel
12. ADF Control Panel
*13. UHF Control Panel
14. HF Control Panel
* * 15. IFF Antenna Select Panel
16. Transponder Control Panel
17. Alternate Landing Gear Extension Handle
18. YAW DAMP/RUDDER BOOST Control Panel
19. AP/DME Control Panel
20. AUTOPILOT Mode Selector Panel
21. Landing Gear Alternate Engage Handle
22. ICS #1 Control Panel
23. Aileron Tab Control and Position Indicator
24. ELEVATOR Tab Control and Position Indicator
25. Autopilot Go-Around Button

* PROVISIONS ONLY ARE INSTALLED. EITHER OF TWO SETS MAY BE INSTALLED.

* * INSTALLED ONLY IF APX-101 TRANSPONDER IS INSTALLED

Figure 2-7. Control Pedestal **C D1**

2-8. LANDING GEAR SYSTEM D2 T .

The retractable tricycle landing gear is electrically controlled and hydraulically actuated. The landing gear assemblies are extended and retracted by a hydraulic power pack, located in the left wing center section, forward of the main spar. The power pack consists primarily of a hydraulic pump, a 28 Vdc motor, a gear selector valve and solenoid, a two section fluid reservoir, filter screens, gear up pressure switch and low fluid level sensor. Engine bleed air, regulated to 18 to 20 psi, is plumbed into the power pack reservoir, and the system fill reservoir to prevent cavitation of the pump. The fluid level sensor activates a yellow caution light, placarded **HYD FLUID LOW**, on the annunciator panel, whenever the fluid level in the power pack is low. The annunciator is tested by pressing the **HYD FLUID SENSOR TEST** switch located on pilot's subpanel. Refer to Figure 2-8.

Power for the power pack is supplied from the No. 5 dual fed buss, through a landing gear motor relay and a 60-ampere circuit breaker located under the floor board forward of the main spar. The motor relay is energized by power furnished through a 2-ampere **LANDING GEAR CONTROL** circuit breaker located on the overhead circuit breaker panel, and the downlock switches. The power pack motor is protected by a time delay module, which senses operation voltage through a 5-ampere circuit breaker. Both are located beneath the aisle way floorboards forward of the main spar. Landing gear extension or retraction is normally accomplished in 5 to 6 seconds. Voltage to the power pack is terminated after the fully extended or retracted position is reached (approximately 23 seconds). If electrical power has not terminated after the normal extension or retraction time lapse, a relay and 2-ampere landing gear circuit breaker will open and electrical power to the system power pack will be interrupted.

The landing gear system utilizes folding braces, called drag legs that lock in place when the gear is fully extended. The nose landing gear actuator incorporates an internal down-lock to hold the gear in the fully extended position. However, the two main landing gears are held in the fully extended position by mechanical hook and pin locks. The landing gear is held in the up position by hydraulic pressure.

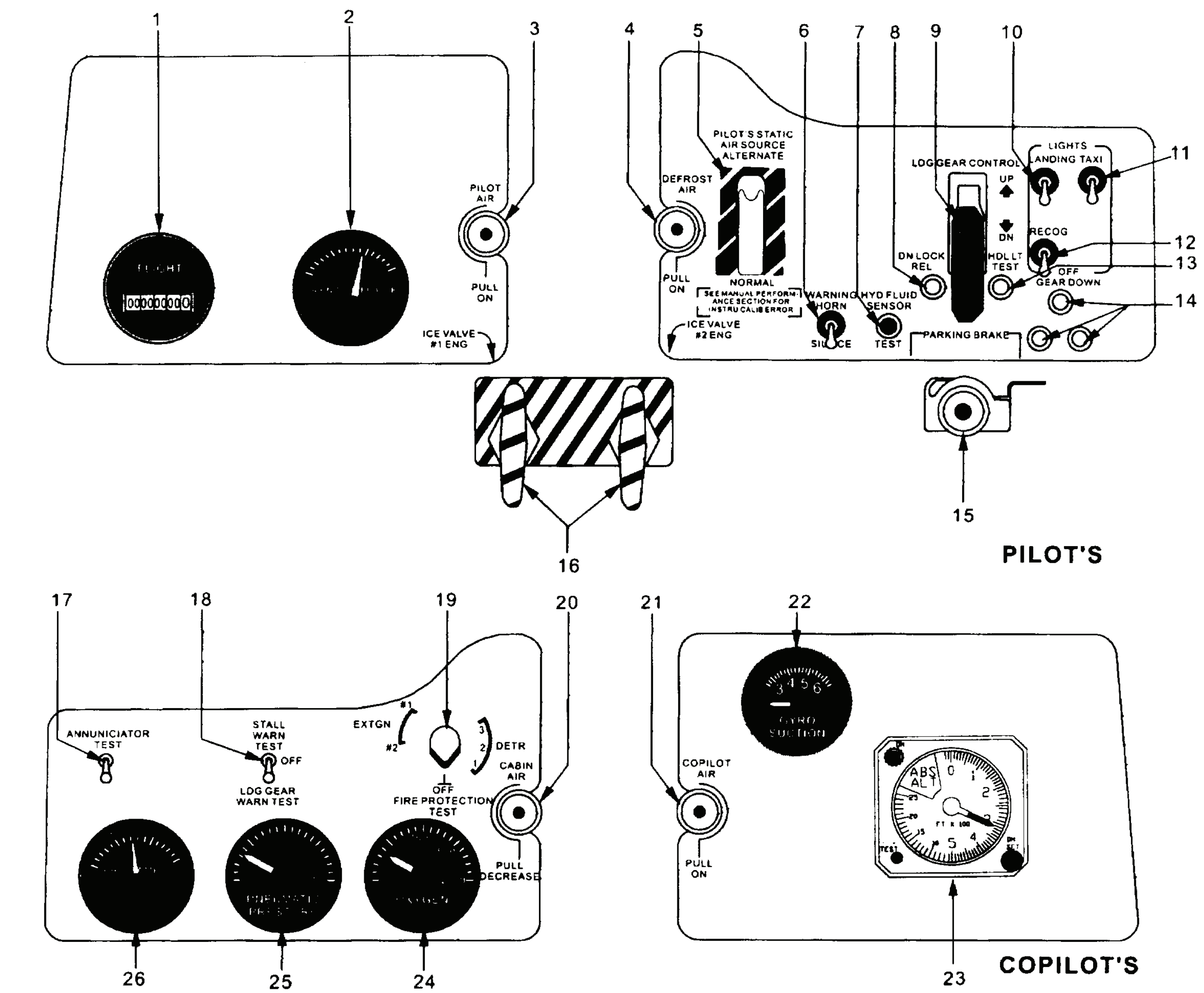
The pressure is controlled by the power pack pressure switch and an accumulator that is pre-charged with nitrogen to 800 ± 50 psi. Gear doors are opened and closed through a mechanical linkage connected to the landing gear. The nose wheel steering mechanism is automatically centered and the rudder pedals relieved of the steering load when the landing gear is retracted. Air-oil type shock struts, filled with compressed air and hydraulic fluid, are incorporated with the landing gear.

a. Landing Gear Control Switch. Landing gear system operation is controlled by a manually actuated wheel-shaped switch, placarded **LDG GEAR CONTROL UP / DN** on the left subpanel. The control switch and associated relay circuits are protected by a 2-ampere circuit breaker, placarded **LANDING GEAR CONTROL**, located on the overhead circuit breaker panel.

b. Landing Gear Down Position-Indicator Lights. Landing gear down position is indicated by three green lights on the left subpanel, placarded **GEAR DOWN** D2 T1 . Refer to Figure 2-8, Sheets 1 and 2. Visual indication of the landing gear position is provided by individual green **GEAR DOWN** indicator lights, placarded **NOSE L / R**, on the left subpanel. T2 . Refer to Figure 2-8, Sheet 3. Testing of the indicator lights is accomplished by pressing the annunciator test switch. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR IND**, on the overhead circuit breaker panel.

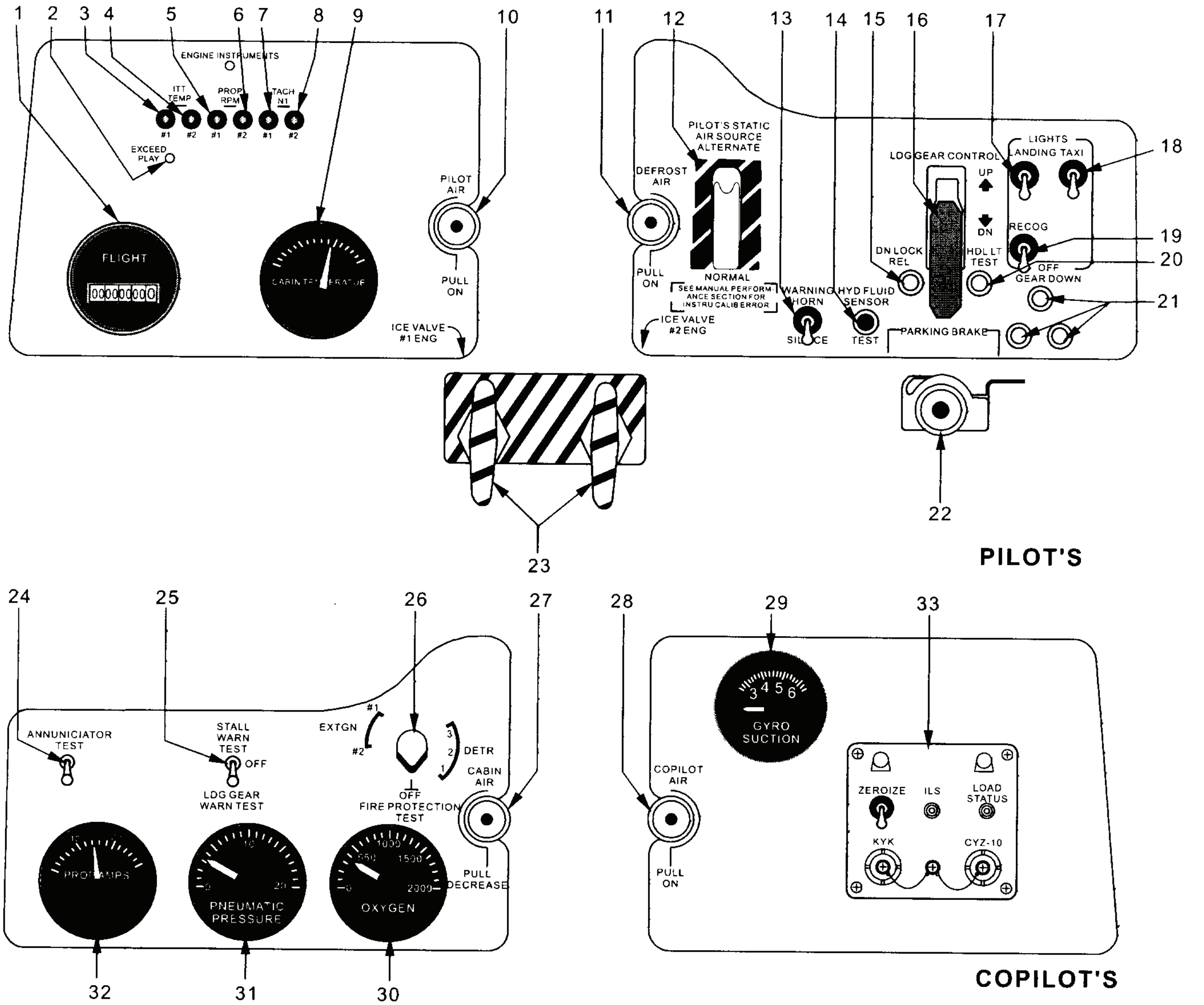
c. Landing Gear Position Warning Lights. Two red parallel-wired indicator lights located in the **LDG GEAR CONTROL** D2 T1 or **LDG GEAR CONTR** T2 switch handle illuminate to show that the gear is in transit or unlocked. The red lights in the handle also illuminate when the landing gear warning horn is actuated. Both red lights indicate the same warning conditions, but two are provided for a fail-safe indication in the event one bulb burns out. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR IND**, on the overhead circuit breaker panel.

d. Landing Gear Warning Light Test Switch. A test switch, placarded **HDL LT TEST**, is located on the left subpanel. Failure of the landing gear handle to illuminate red when this test switch is pressed indicates two defective bulbs or a circuit fault. The circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR WARN**, on the overhead circuit breaker panel.



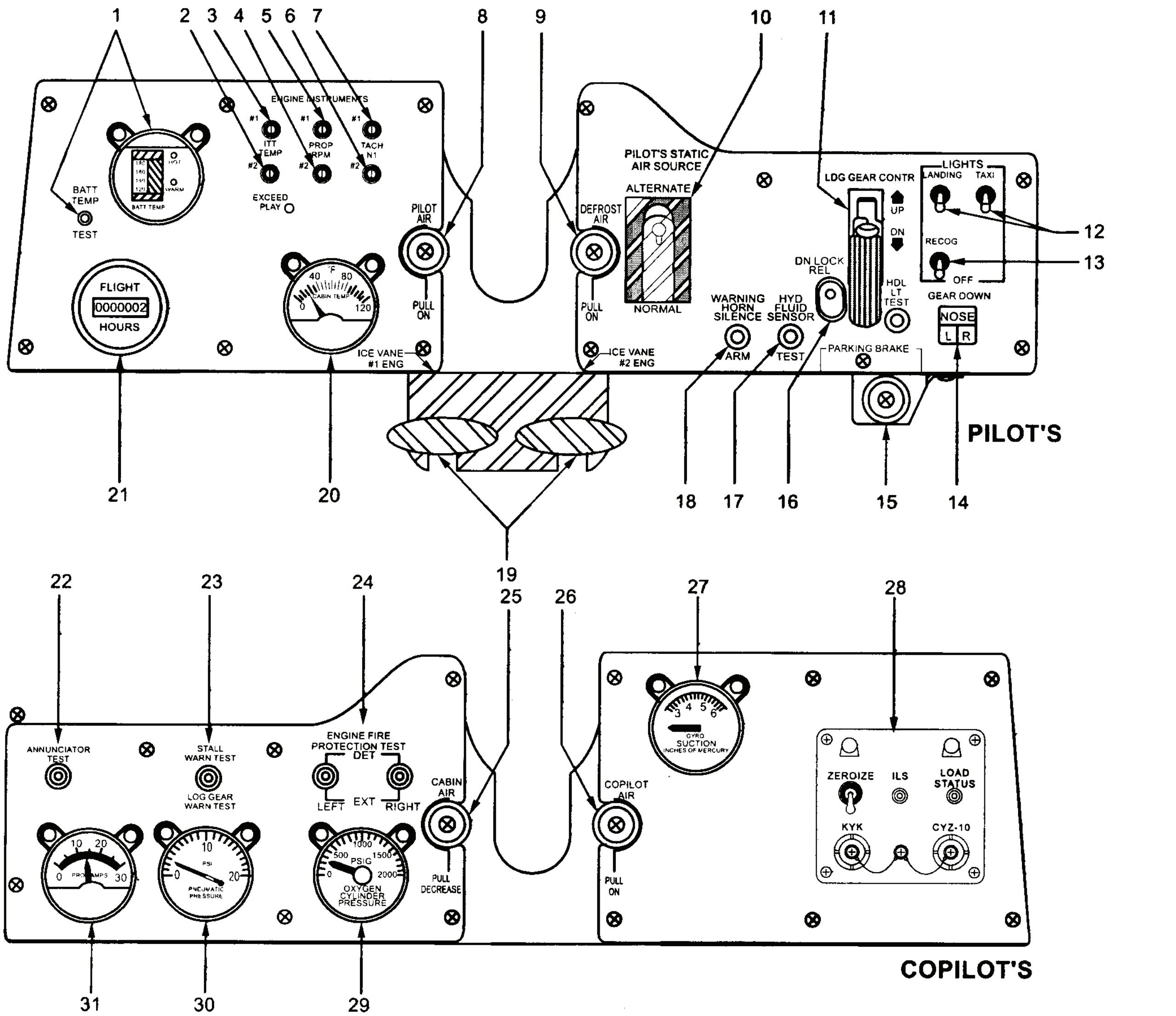
1. FLIGHT Hour Indicator
2. CABIN TEMP Indicator
3. PILOT AIR Inlet Control
4. DEFROST AIR Control
5. PILOT'S STATIC AIR SOURCE Control
6. WARNING HORN SILENCE Switch
7. HYD FLUID SENSOR TEST Switch
8. DN LOCK REL (Landing Gear Handle Down Lock Release)
9. LDG GEAR CONTROL Handle
10. LANDING LIGHT Switch
11. TAXI LIGHT Switch
12. RECOG (Recognition) Lights Switch
13. HDL LT TEST Switch (Light Inside Landing Gear Control Handle)
14. GEAR DOWN Indicator Lights (3)
15. PARKING BRAKE Control
16. Manual Engine Ice Vane Control
17. ANNUNCIATOR TEST Switch
18. STALL/LDG GEAR WARN TEST Switch
19. FIRE PROTECTION TEST Switch
20. CABIN AIR Control
21. COPILOT AIR Inlet Control
22. GYRO SUCTION Gauge
23. Radio Altimeter
24. OXYGEN Pressure Gauge
25. PNEUMATIC PRESSURE Gauge
26. PROP AMPS Meter

Figure 2-8. Subpanels D2 (Sheet 1 of 3)



1. FLIGHT Hour indicator
2. Push Button Switch
3. ITT Temperature Circuit Breaker #1
4. ITT Temperature Circuit Breaker #2
5. PROP RPM Circuit Breaker #1
6. PROP RPM Circuit Breaker #2
7. TACH NI Circuit Breaker #1
8. TACH NI Circuit Breaker #2
9. CABIN TEMPERATURE Indicator
10. PILOT AIR Inlet Control
11. DEFROST AIR Control
12. PILOT'S STATIC AIR SOURCE Control
13. WARNING HORN SILENCE Button
14. HYD FLUID SENSOR TEST Button
15. DN LOCK REL (Landing Gear Handle Down Lock Release)
16. LDG GEAR CONTROL Handle
10. LANDING LIGHT Switch
11. TAXI LIGHT Switch
12. RECOG (Recognition) Lights Switch
13. HDL LT TEST Switch (Light Inside Landing Gear Control Handle)
14. GEAR DOWN Indicator Lights (3)
15. PARKING BRAKE Control
16. Manual Engine Ice Vane Control
17. ANNUNCIATOR TEST Switch
18. STALL/LDG GEAR WARN TEST Switch
19. FIRE PROTECTION TEST Switch
20. CABIN AIR Control
21. COPILOT AIR Inlet Control
22. GYRO SUCTION Gauge
23. OXYGEN Pressure Gauge
24. PNEUMATIC PRESSURE Gauge
25. PROP AMPS Meter
26. SAS Panel

Figure 2-8. Subpanels T1 (Sheet 2 of 3)



1. Battery Temperature Test Switch and Indicator
2. ITT Temperature Circuit Breaker #2
3. ITT Temperature Circuit Breaker #1
4. PROP RPM Circuit Breaker #1
5. PROP RPM Circuit Breaker #2
6. TACH N I Circuit Breaker #1
7. TACH NI Circuit Breaker #2
8. PILOT AIR Inlet Control
9. DEFROST AIR Control
10. PILOT'S STATIC AIR SOURCE Control
11. LANDING GEAR CONTR Handle
12. LANDING / TAXI Light Switches
13. RECOG Light Switch
14. Landing Gear Position Lights
15. PARKING BRAKE Control
16. Landing Gear Handle Down Lock Release
17. HYD FLUID SENSOR TEST Switch
18. Landing Gear WARNING HORN SILENCE Switch
19. Engine Ice Vane Manual Control
20. CABIN TEMP Indicator
21. FLIGHT HOURS Meter
22. ANNUNCIATOR TEST Switch
23. STALL / LDG GEAR WARN TEST Switch
24. ENGINE FIRE PROTECTION TEST Switches
25. CABIN AIR Control
26. COPILOT AIR Inlet Control
27. GYRO SUCTION Gauge
28. SAS Panel
29. OXYGEN CYLINDER PRESSURE Gauge
30. PNEUMATIC PRESSURE Gauge
31. Propeller Deice Ampere Gauge

Figure 2-8. Subpanels **T2** *(Sheet 3 of 3)*

e. Landing Gear Warning System D2 . The landing gear warning system is provided to warn the pilot that the landing gear is not down and locked during specific flight regimes. Various warning modes result, depending upon the position of the flaps. With the flaps in the UP or **APPROACH** position, refer to Figure 2-9, Sheet 1, and either or both power levers retarded below approximately 79% N_1, the warning horn will sound intermittently and the landing gear switch handle lights will illuminate. The horn can be silenced by pressing the **WARNING HORN SILENCE** switch adjacent to the landing gear switch handle; the light in the landing gear switch handle cannot be canceled. The landing gear warning system will be rearmed if the power lever(s) are advanced. Retarding the second power lever below 79% N_1 will activate the landing gear horn even though the silence system has been activated.

To prevent the warning horn sounding during long descents or an ILS approach, a pressure differential "Q" switch is connected into the copilot's static line. This switch prevents the warning horn from sounding until airspeed drops below 140 KIAS.

With the flaps beyond the **APPROACH** position, the warning horn and landing gear switch handle lights will be activated regardless of the power setting. The horn cannot be silenced in this case.

T The landing gear warning system is provided to warn the pilot that the landing gear is not down and locked during specific flight regimes. Various warning modes result depending upon the position of the flaps.

At airspeeds above 140 KIAS with flaps in up or **APPROACH** position and either or both power levers retarded below approximately 79% N_1, the warning horn, located in the overhead control panel, will sound and the landing gear switch handle lights will illuminate. The horn is automatically silenced by a "Q" switch; however, the gear switch handle lights cannot be extinguished. The pressure differential "Q" switch is connected into the static line. This switch prevents the warning horn from sounding steadily until airspeed drops below 140 KIAS.

At airspeeds below 140 KIAS with flaps in the up or **APPROACH** position with either or both power levers retarded below approximately 79% N_1 the warning horn will sound and the landing gear switch handle lights will illuminate. The horn can be silenced by actuating the **WARNING HORN SILENCE** switch, located adjacent to the landing gear switch handle to the up position. However, the lights in the landing gear switch handle cannot be canceled. The gear warning silence switch is a magnetically held switch. Once actuated, it will stay in the up position until both power levers are advanced above 81% N_1 and/or airspeed increases above 140 KIAS.

In either case (speeds above or below 140 KIAS), the landing gear warning system will be rearmed if both power levers are advanced above 81% N_1.

With the flaps beyond the **APPROACH** position, the warning horn and landing gear switch handle lights will be activated regardless of the power setting. The horn cannot be silenced in this case until either the landing gear is lowered, or the flaps are retracted to the up or **APPROACH** position and the **WARNING HORN SILENCE** switch is actuated to the up position.

f. Landing Gear Warning Horn Test Switch. The warning horn and gear handle lights can be tested by placing the switch, placarded **STALL WARN TEST / OFF / LDG GEAR WARN TEST**, to the **LDG GEAR WARN TEST** position. The gear handle lights will illuminate and warning horn will sound. Releasing the **LDG GEAR WARN TEST** switch to the **OFF** position will extinguish the gear handle lights and silence the warning horn. The landing gear warning horn circuit is protected by 5-ampere circuit breaker, placarded **LANDING GEAR WARN**, located on the overhead circuit breaker panel.

g. Landing Gear Safety Switches. A safety switch on each main landing gear shock strut controls the operation of various aircraft systems that function only during flight or only during ground operation. These switches are mechanically actuated whenever the main landing gear shock struts are extended (normally after takeoff) or compressed (normally after landing). The safety switch on the right main landing gear strut deactivates the landing gear control circuits, cabin pressurization circuits, and the flight hour meter when the strut is compressed. This switch also activates a down-lock hook, preventing the landing gear from being raised while the aircraft is on the ground. The hook, which unlocks automatically after takeoff, can be manually overridden by pressing down on the red button, placarded **DN LOCK REL**, located adjacent to the landing gear handle. If the over-ride is used, the landing gear warning horn will sound intermittently and two red, parallel-wired indicator lights, located in the landing gear control switch handle, will illuminate, provided the battery switch is on. The safety switch on the left main landing gear strut activates the left and right engine ambient air shut-off valves when the strut is extended.

h. Landing Gear Alternate Extension. An extension lever, placarded **LANDING GEAR ALTERNATE EXTENSION**, is located on the floor between the crew seats. The pump is located under the floor and is used when an alternate extension of the gear is required. Refer to Figure 2-10.

To engage the system, pull the **LANDING GEAR CONTROL** circuit breaker, located on the overhead circuit breaker panel, and ensure that the **LDG GEAR CONTROL** D2 T1 or **LDG GEAR CONTR** T2 handle is in the **DN** position. Remove the extension lever from the securing clip and pump the lever up and down until the three green D2 T1 or **NOSE / L / R** T2 gear down indicator lights illuminate. As the handle is moved, hydraulic fluid is drawn from the hand pump suction port of the power pack and routed through the hand pump pressure port to the actuators. After an alternate extension of the landing gears, ensure the extension lever is in the full down position prior to stowing the pump handle in the retaining clip. When the pump handle is stowed, an internal relief valve is actuated to relieve the hydraulic pressure in the pump.

WARNING

After an emergency landing gear extension has been made, do not move any landing gear controls, or reset any switches or circuit breakers until the aircraft is on jacks, since the failure may have been in the gear-up circuit and the gear might retract on the ground.

NOTE

If for any reason the green NOSE-L-R GEAR DOWN indicators do not illuminate (e.g., in case of an electrical system failure), continue pumping until sufficient resistance is felt to ensure that the gear is down and locked. Do not stow the extension lever, but leave it in the full up position.

After a practice alternate extension, stow the extension handle, reset the **LANDING GEAR CONTROL** circuit breaker, and retract the gear in the normal manner with the landing gear control handle.

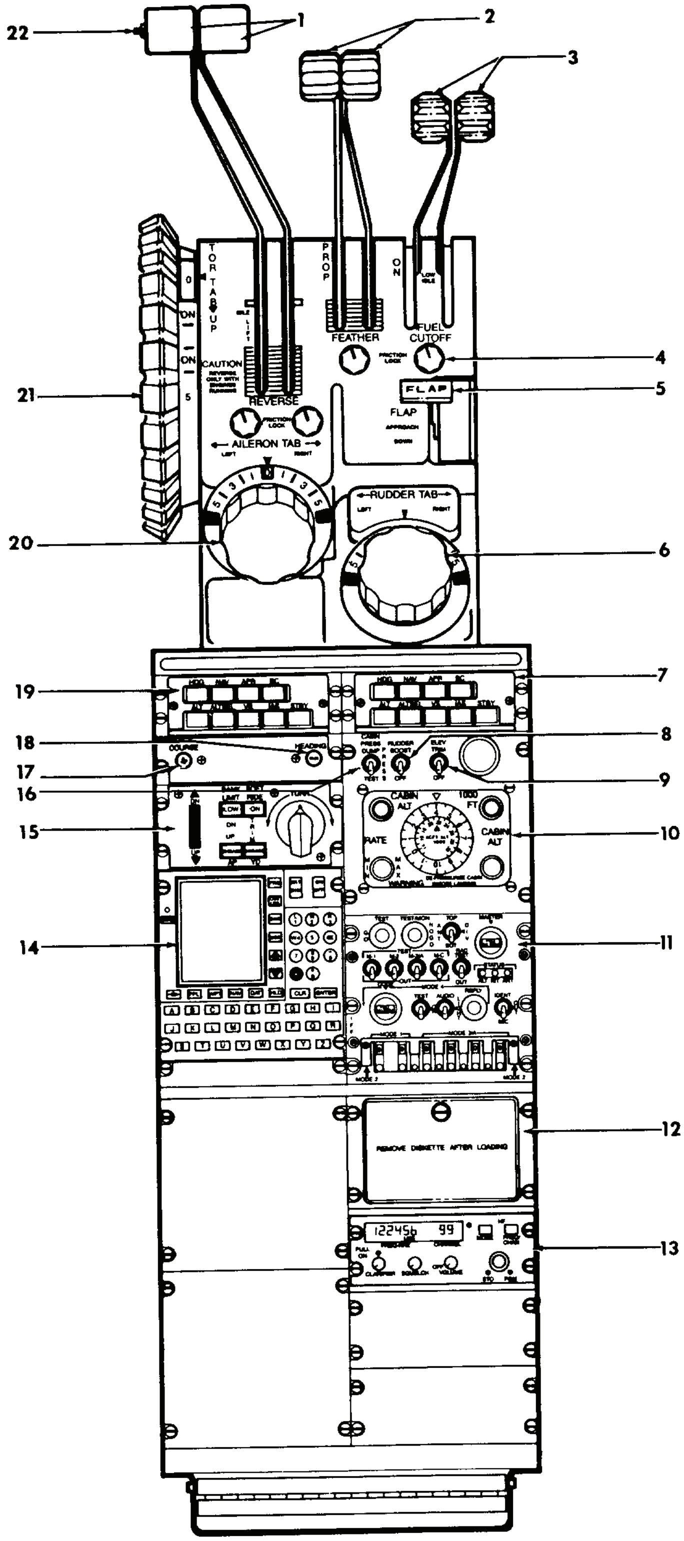
i. Tires.

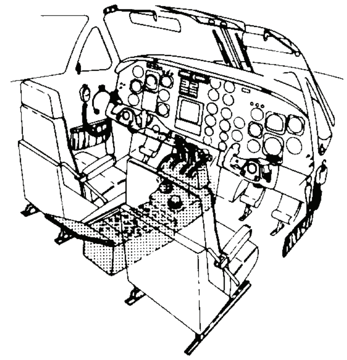
(1) C C-12C aircraft are equipped with dual 18 x 5.5, 8 ply rating tubeless rim inflation tires on each main gear and a 6.50 x 10, 6 ply rating tubeless tire on the nose wheel.

(2) D T The C-12D/T1/T2 aircraft are equipped with dual 22 x 6.75 x 10, 8-ply rated tubeless rim inflation tires on each main gear and a 22 x 6.75 x 10, 8-ply rated tubeless tire on the nose wheel.

2-9. STEERABLE NOSE WHEEL.

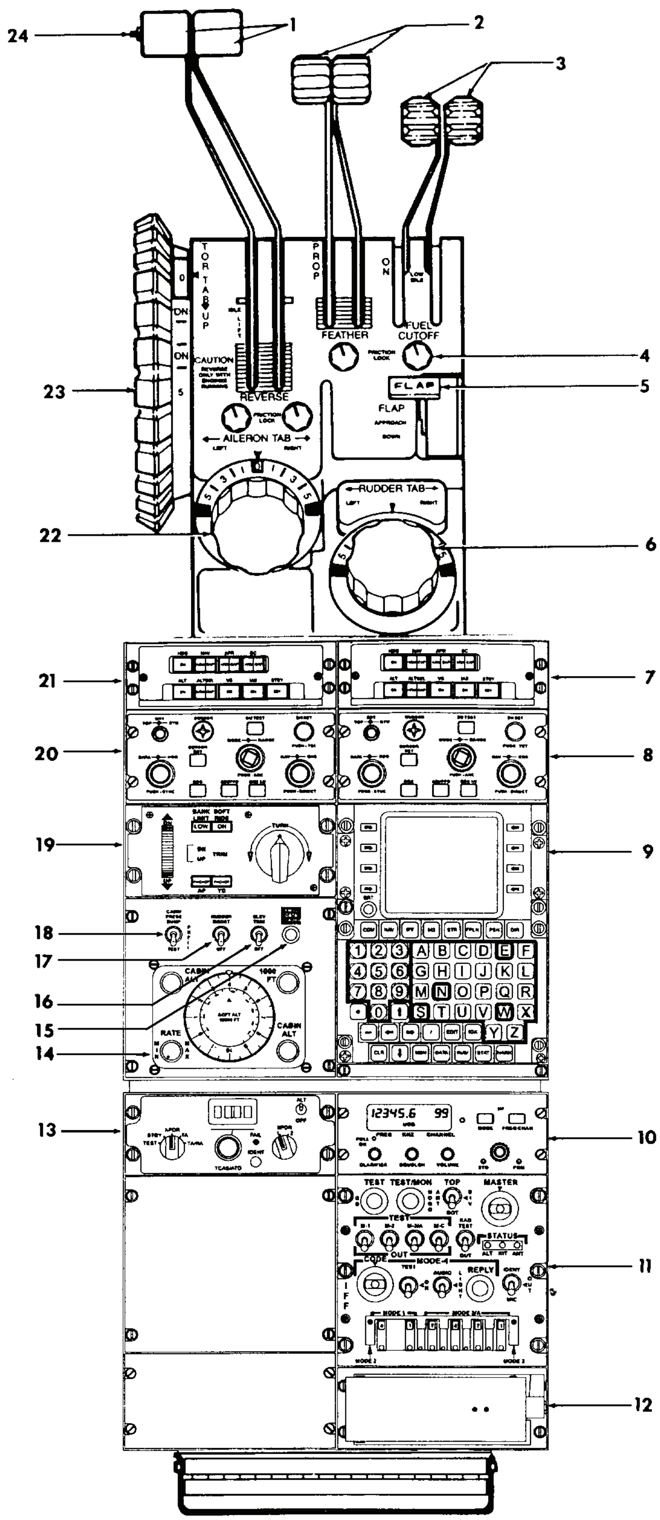
The aircraft can be maneuvered on the ground by the steerable nose wheel system. Direct linkage from the rudder pedals to the nose wheel steering linkage allows the nose wheel to be turned 12° to the left of center or 14° to the right. When rudder pedal steering is augmented by the main wheel braking action, the nose wheel can be deflected up to 48° either side of center. Shock loads, which would normally be transmitted to the rudder pedals, are absorbed by a spring mechanism in the steering linkage. Retraction of the landing gear automatically centers the nose wheel and disengages the steering linkage from the rudder pedals. Refer to Figure 2-10.





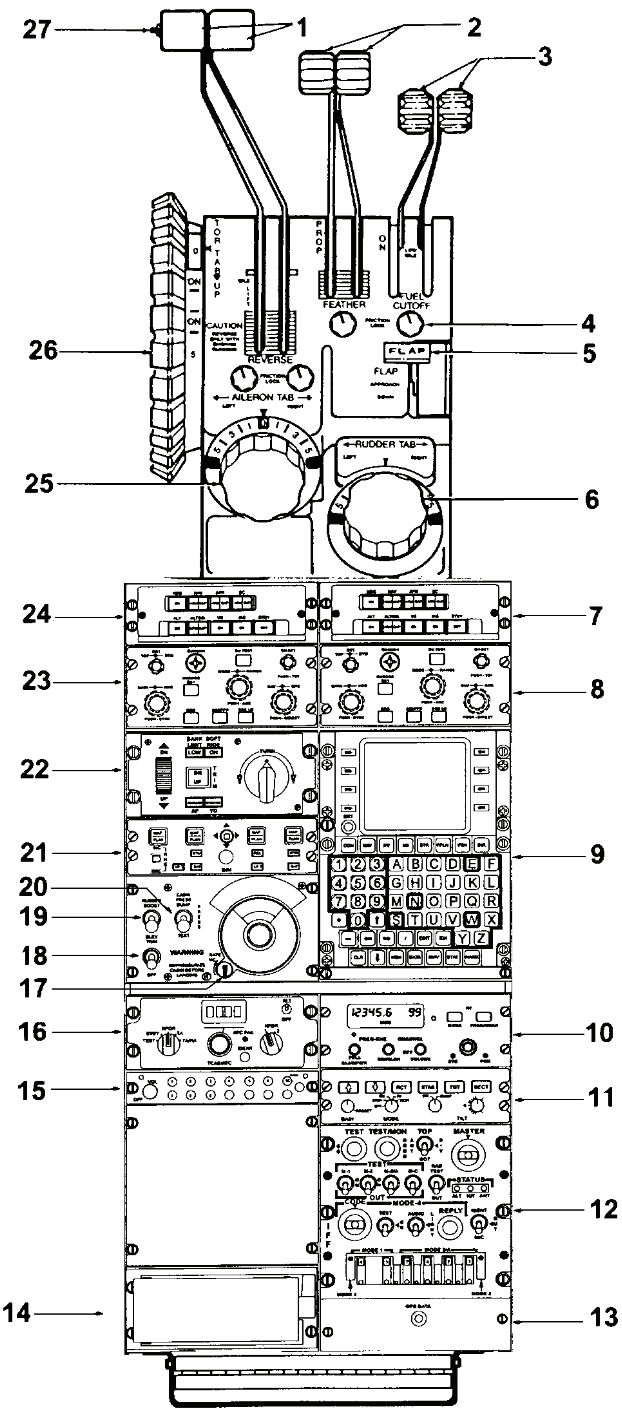
1. Power Levers (2)
2. Propeller Levers (2)
3. Condition Levers (2)
4. Friction Lock Knobs (4)
5. FLAP Switch
6. RUDDER TAB Control and Position Indicator
7. #2 Flight Director Model Select Panel
8. RUDDER BOOST Switch
9. ELEV TRIM Switch
10. Pressurization Controller
11. Transponder Control Panel
12. Flight Management System Data Loader
13. HF Control Panel
14. Flight Management System Control and Display
15. Autopilot Control
16. Pressure Dump Switch
17. #1 HSI COURSE Knob
18. #1 HSI HEADING Knob
19. #1 Flight Director Mode Select Panel
20. AILERON TAB Control and Position Indicator
21. Elevator Tab Control and Position Indicator
22. Go-Around Button

Figure 2-9. Control Pedestal **D2** *(Sheet 1 of 3)*



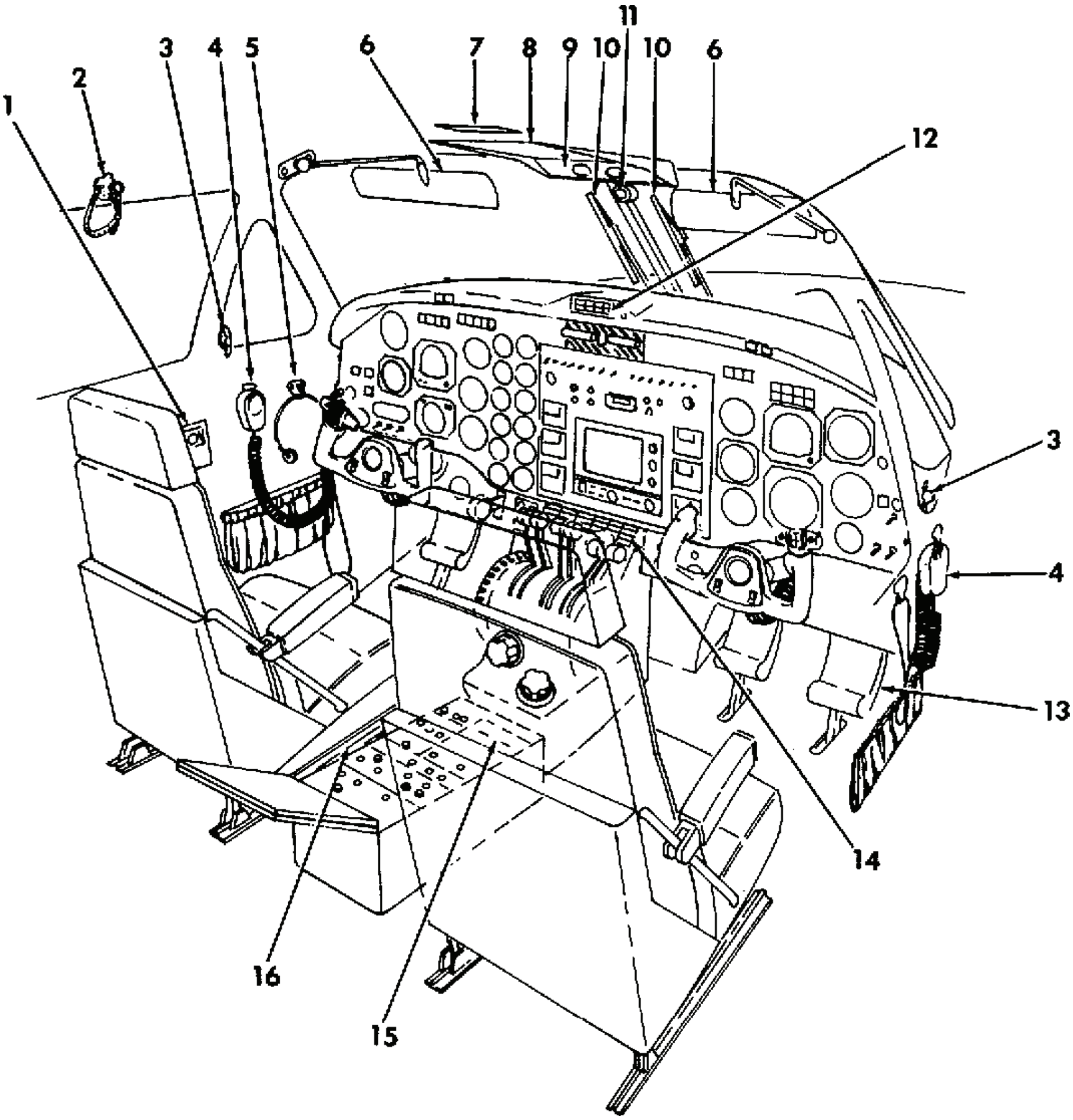
1. Power Levers (2)
2. Propeller Levers (2)
3. Condition Levers (3)
4. Friction Lock Knobs (4)
5. FLAP Switch
6. RUDDER TAB Control and Position Indicator
7. No. 2 Flight Director Mode Select Panel
8. No. 2 EFIS Control Panel
9. Flight Management System FMS-800
10. HF Radio Control Panel
11. Transponder APX-100
12. Flight Management System Data Loader
13. TCAS II Control Panel
14. Cabin Pressurization Control
15. FMS 2 Data Loading Jack (KLN-90B)
16. Elevator Trim Switch
17. RUDDER BOOST Switch
18. Cabin Pressure Dump Switch
19. Auto Pilot Control
20. No 1 EFIS Control Panel
21. No 1 Flight Director Mode Select Panel
22. AILERON TAB Control and Position Indicator
23. Elevator Tab Control and Position Indicator
24. Go-Around Button.

Figure 2-9. Control Pedestal **T1** *(Sheet 2 of 3)*



1. Power Levers (2)
2. Propeller Levers (2)
3. Condition Levers (3)
4. Friction Lock Knobs (4)
5. FLAP Switch
6. RUDDER TAB Control and Position Indicator
7. No 2 Flight Director Mode Select Panel
8. No 2 EFIS Control Panel
9. Flight Management System FMS-800
10. HF Radio Control Panel
11. Weather Radar Control Panel
12. Transponder Control Panel
13. FMS 2 Data Loading Jack (KLN-90B)
14. Flight Management System No 1 Data Loader
15. Volume Control Panel
16. TCAS II Control Panel
17. Pressurization Controller
18. Elevator Trim Switch
19. RUDDER BOOST Switch
20. Cabin Pressure Dump Switch
21. MFD Control Panel
22. Auto Pilot Control Panel
23. No 1 EFIS Control Panel
24. No 1 Flight Director Mode Select Panel
25. AILERON TAB Control and Position Indicator
26. Elevator Tab Control and Position Indicator
27. Go-Around Button

Figure 2-9. Control Pedestal **T2** *(Sheet 3 of 3)*



1. Free Air Temperature Gauge
2. Oxygen Mask
3. Storm Window Lock
4. Microphone
5. Headset
6. Sun Visor
7. Oxygen Control Panel
8. Overhead Circuit Breaker and Control Panel
9. Fuel Management Panel
10. Windshield Wipers
11. Magnetic Compass
12. Warning Annunciator Panel
13. Rudder Pedals
14. Caution Annunciator Panel
15. Pedestal Extension
16. Alternate Landing Gear Extension Handle

Figure 2-10. Cockpit – Typical **D T**

2-10. WHEEL BRAKE SYSTEM.

The main landing wheels are equipped with multiple-disc hydraulic brakes actuated by master cylinders attached to the rudder pedals at the pilot's and copilot's position. Braking is permitted from either set of rudder pedals. Brake fluid is supplied to the system from the reservoir in the nose compartment. The toe brake sections of the rudder pedals are connected to the master cylinders, which actuate the system for the corresponding wheel. No emergency brake system is provided. Repeated and excessive application of brakes, without allowing sufficient time for cooling to accumulate between applications, will cause loss of braking efficiency, possible failure of brake or wheel structure, possible blowout of tires, and, in extreme cases, may cause the wheel and brake assembly to be destroyed by fire.

2-11. PARKING BRAKE HANDLE.

Dual parking brake valves are installed below the cockpit floor. Both valves can be closed simultaneously by pressing both brake pedals on the pilot's side to build up pressure and then pulling out the handle, placarded **PARKING BRAKE**, on the left subpanel, Figures 2-6 and 2-8. The parking brake can be set by both the pilot and the copilot on the D and T models only. Pulling the handle full out sets the check valves in the system and any pressure being applied by the toe brakes is maintained. Parking brakes are released when the brake handle is pushed in. Parking brakes shall not be set during flight.

2-12. ENTRANCE AND EXIT PROVISIONS.

CAUTION

Structural damage may be caused if more than one person, or a maximum weight of 300 pounds, is on the entrance door at a time.

NOTE

Two keys are provided in the loose tools and equipment bag. Both keys will fit the locks on the cabin door, emergency hatch, aft belly access door, and the right and left nose avionics doors. These keys will fit all Army C-12 series aircraft. Avoid inadvertently locking the cabin entrance door prior to entering the aircraft.

a. Cabin Door C . A swing-down door, hinged at the bottom, provides positive cabin security for flight and a convenient stairway for entry and exit, Figure 2-11. Two of the three steps are movable and automatically fold flat against the door in the closed position. A plastic encased cable provides support for the door in the open position, a handhold for passengers, and a convenience for closing the door from the inside. A hydraulic damper permits the door to lower gradually during opening. An inflatable rubber door seal around the door expands to positively seal the pressure vessel while the aircraft is in flight. Engine bleed air provides the pressure to inflate the seal. The door locking mechanism is operated by the handle in the center of the door. The inside and outside handles are mechanically interconnected. When the handle is rotated per placard instructions, two latches hook into the door frame at the top, and two lock bolts on each side of the door lock into the frame on the sides. There are four sight openings on the inner facing of the door; one opening over each locking bolt. A green stripe painted on the locking bolt aligns with a black pointer in the sight opening when the door is in a locked condition. A **CABIN DOOR** annunciator light in the caution/advisory panel will illuminate if the door is not fully locked. The cabin door may be removed for flight by installing Beech Aircraft Corporation Kit 100-4006. Flights with the door removed must be in accordance with the FAA approved flight manual supplement, which accompanies this kit.

(1) A button adjacent to the door handle, both inside and outside the cabin, must be pressed before the handle can be rotated to open the door. This acts as an aid to preventing accidental opening.

(2) A small round window just above the second step permits observation of the pressurization safety lock bellows. A placard adjacent to the window instructs the operator to make certain the safety lock arm is in position around the bellows shaft. Pushing the red button switch adjacent to the window illuminates the mechanism inside the door.

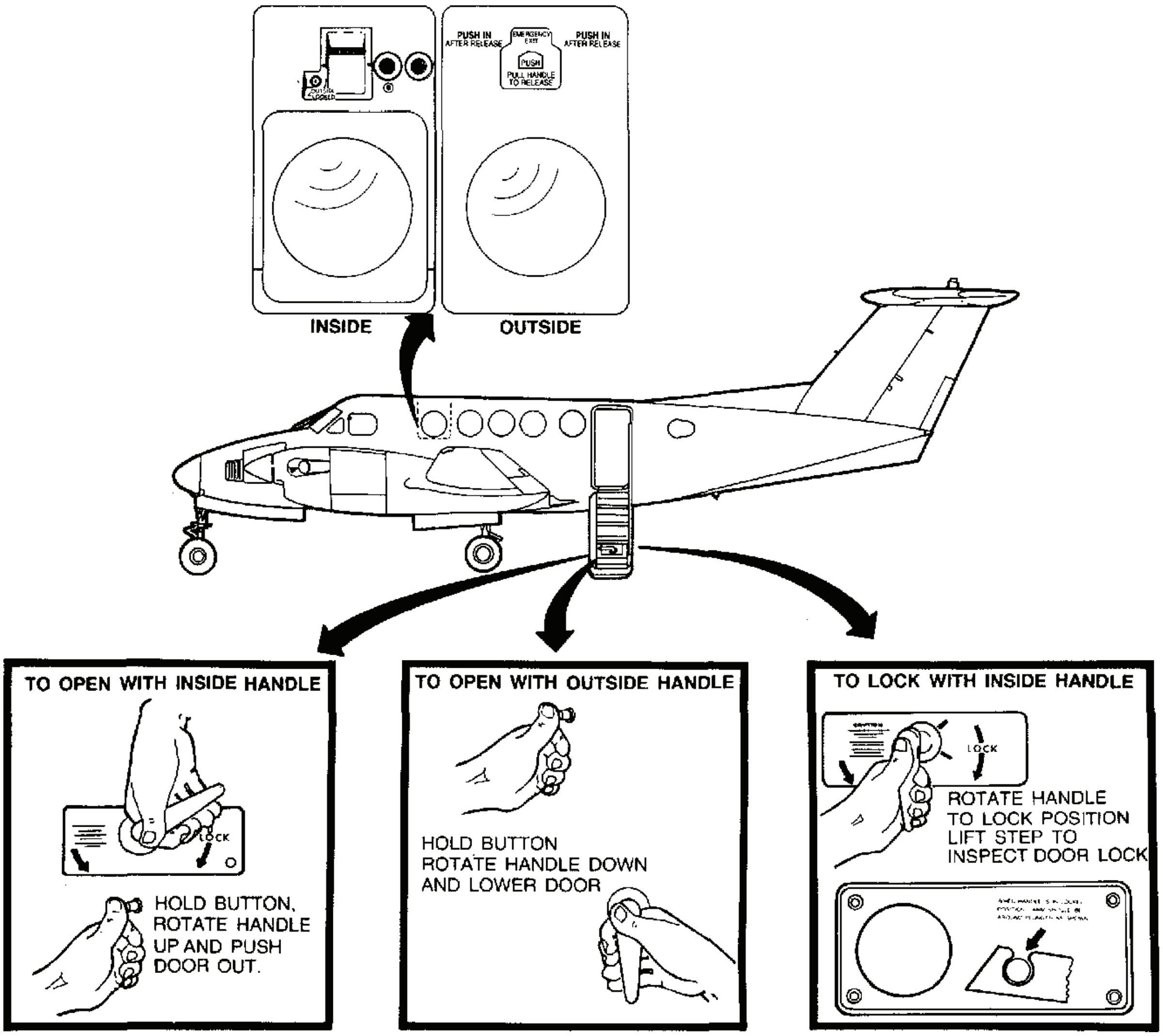


Figure 2-11. Cabin Door and Cabin Emergency Hatch C

b. Cabin Door D T . A swing-down door, hinged at the bottom, provides a stairway for normal and emergency entry and exit. Refer to Figure 2-12. Two of the steps are movable and fold flat against the door in the closed position. A step folds down over the doorsill when the door opens to provide a platform (step) for door seal protection. A plastic encased cable provides support for the door in the open position, a handhold, and a convenience for closing the door from inside. A hydraulic damper permits the door to lower gradually during opening. A rubber seal around the door seals the pressure vessel while the aircraft is in flight. The door locking mechanism is operated by either of the two mechanically interconnected handles, one inside, and the other outside the door. When either handle is rotated, three rotating-cam-type latches on either side of the door capture posts mounted on the cargo door. In the closed position, the door becomes an integral part of the cargo door. A button adjacent to the door handle must be pressed before the handle can be rotated to open the door. A bellows behind the button is inflated when the aircraft is pressurized to prevent accidental unlatching and/or opening of the door. A small round window just above the second step permits observation of the pressurization safety bellows. A placard adjacent to the window instructs the operator to ensure the safety lock arm is in position around the bellows shaft, which indicates a properly locked door. Pushing the red button switch adjacent to the window will illuminate the inside door mechanism. A **CABIN DOOR** annunciator light in the caution/advisory panel will illuminate if the door is not closed and all latches fully locked. The cabin door may be removed for flight by installing Beech Aircraft Corporation Kit 100-4006. Flights with the door removed must be in accordance with the FAA approved flight manual supplement, which accompanies this kit.

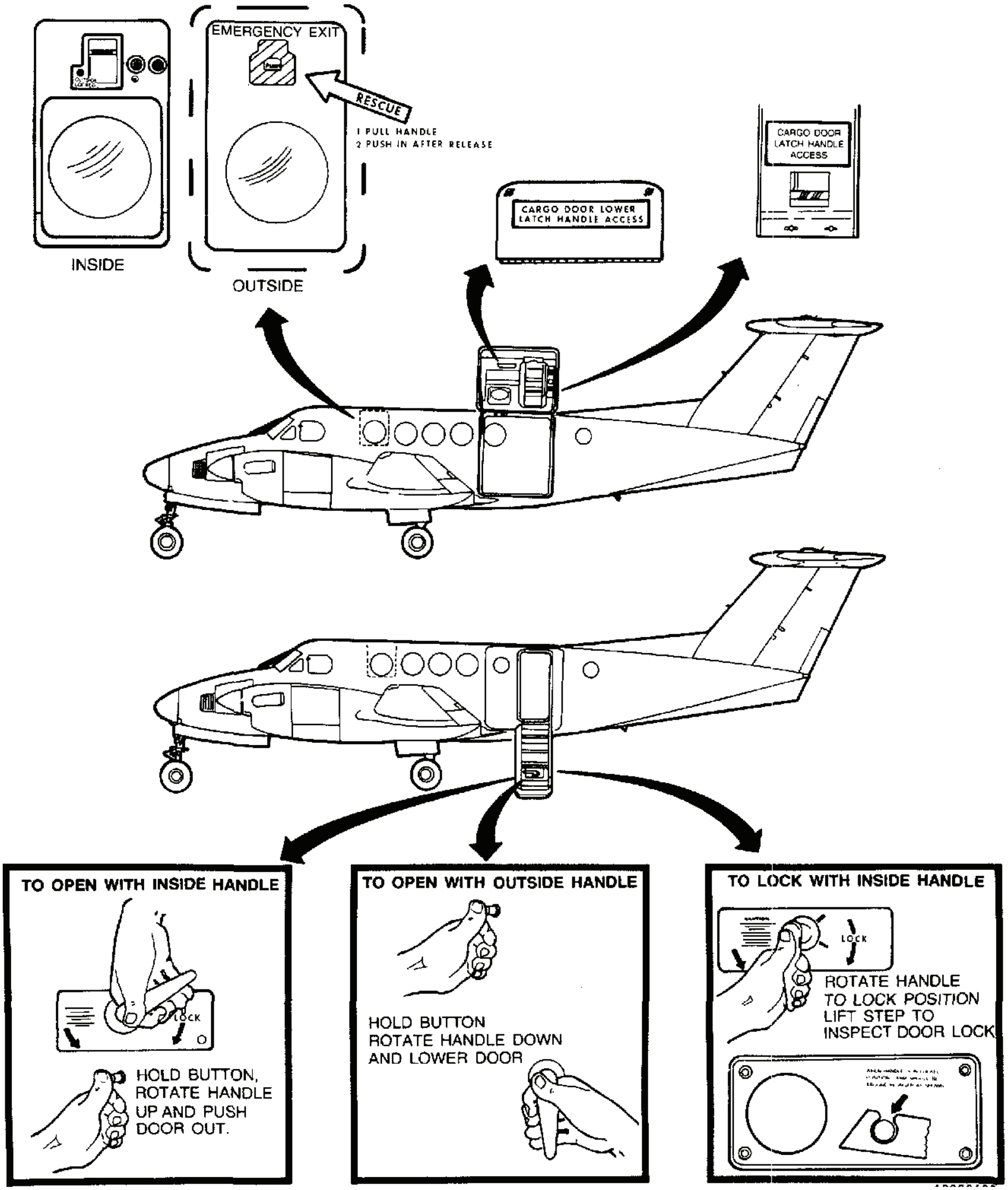


Figure 2-12. Cabin Door and Cabin Emergency Hatch **D T**

WARNING

The cargo door is a structural panel and shall be closed for flight.

c. Cargo Door D T . A swing-up door, hinged at the top, provides cabin access for loading cargo or bulky items. After initial opening force is applied, gas springs will completely open the cargo door automatically. The door is counterbalanced and will remain in the open position. A door support assembly rod is used to hold the door in the open position and to aid in overcoming the pressure of the gas spring assemblies when closing the door. Once closed, the gas springs apply a closing force to assist in latching the door. A rubber seal around the door seals the pressure vessel while in flight. The door locking mechanism is operated only from inside the aircraft and is operated by two handles, one in the bottom forward portion of the door and the other in the upper aft portion of the door. When the upper aft handle is operated per placard instructions, two rotating cam-type latches on the forward side of the door and two on the aft side rotate capturing posts mounted on the fuselage side of the door opening. The bottom handle, when operated per placard instructions, actuates four pin lug latches across the bottom of the door. A button on the upper aft handle must be pressed before the handle can be released to open or latch the door. A latching lever on the bottom handle must be lifted to release the handle before the lower latches can be opened. These act as additional aids in preventing accidental opening or unlatching of the door. The cabin and cargo doors are equipped with dual sensing circuits to provide the crew remote indication of cabin/cargo door security. An annunciator light, placarded **CABIN DOOR**, will illuminate if the cabin or cargo door is open and the **BATT** switch is **ON**. If the battery switch is **OFF**, the annunciator will illuminate only if the cargo door is not closed and securely latched. The cargo door sensing circuit receives power from the hot battery bus.

CAUTION

Ensure the cabin door is closed and locked. Operating the cargo door while the cabin door is open may damage the door hinges and adjacent structure.

Avoid side loading of the gas springs to prevent damage to the mechanism.

(1) To open the cargo door, unfasten and open the handle access door at the lower forward corner of the door. Lift hook and move the handle to the **OPEN** position. Secure the access door. Unfasten and open the handle access door at the upper aft corner of the door. Press the button and lift the handle to the **OPEN** position. Latch handle in place. Secure the access door. Attach one end of the door support assembly to the cargo door ball stud on the forward side of the door. Ensure the support rod detent pin is in place. Push out on the cabin doorsill step, and allow the cargo door to swing open. The gas springs will automatically open the door. Attach the free end of the support rod to the ball stud on the forward fuselage doorframe.

(2) To close the cargo door, detach the door support rod from the fuselage doorframe ball stud. Firmly grasp the free end of the door support rod while exerting a downward force to overcome the pressure of the gas spring assemblies. Remove the support rod from the door as the gas spring assemblies pass the over center position. The internal pressure of the springs is reversed forcing the door to the closed position. Using the finger hold cavity in the fixed air stair doorstep, pull the door closed to permit the latching mechanism to engage. Press the button in the center of the handle at the upper aft corner of the door and pull the handle down until the handle latches into position. Pull aft on the handle to assure it is locked in place. Close and fasten access door. Move the handle at the bottom forward corner of the door to the full forward position. Ensure the safety hook locks the handle in position by pulling aft on the handle.

d. Emergency. The cabin emergency hatch, placarded **EXIT – PULL**, is located on the right cabin sidewall just aft of the copilot's seat. The hatch may be released from the inside with a pull-down handle. A flush mounted pull out handle allows the hatch to be released from the outside. The hatch is of the non-hinged plug type, which removes completely from the frame when the latches are released. The hatch can be key locked from the inside to prevent opening from the outside. The inside handle will unlatch the hatch whether or not it is locked by overriding the locking mechanism. The key lock should be unlocked prior to flight to allow removal of the hatch from the outside in the event of an emergency. The key remains in the lock when the hatch is locked and can be removed only when the hatch is unlocked. The key slot is in the vertical position when the hatch is unlocked. Removal of the key from the lock before flight assures the pilot that the hatch can be removed from the outside if necessary.

(1) A wiper type disconnect for the air duct that supplies the air to the eyeball outlet in the cabin emergency hatch is located on the upper aft edge of the door. As the hatch is removed, the duct is disconnected since it is an integral part of the hatch.

(2) An electrical disconnect located on the lower forward edge of the hatch will unplug as the

hatch is being removed. On reinstalling the hatch, the electrical disconnect should be reconnected before moving the hatch into the closed position.

2-13. CABIN DOOR CAUTION LIGHT.

As a safety precaution, two illuminated **MASTER CAUTION** lights on the glare shield and a steady illuminated **CABIN DOOR** yellow caution light on the annunciator panel indicate the cabin door is not closed and locked. This circuit is protected by two 5-ampere circuit breakers, placarded **ANN PWR** and **ANN IND**, located on the overhead circuit breaker panel.

2-14. WINDOWS.

WARNING

Do not look directly at the sun through the polarized windows. Possible eye damage could result.

a. Cockpit Windows. The pilot and copilot have side windows, a windshield, and storm windows, which provide visibility from the cockpit. The storm windows may be opened on the ground or during flight. Lighting and visibility are provided in the cabin by windows on each sidewall and by a pair of smaller windows aft of the cabin entrance door.

b. Cabin Windows C . The outer cabin windows of two-ply construction are the pressure type and are integral parts of the pressure vessel. Inboard of each pressure cabin window are two inner windows of bonded laminate construction. Each consists of a tinted neutral gray polarized film between two pieces of clear acrylic. These windows are designed into a sealed unit. The innermost window that faces the inside of the cabin has a protruding knob near the edge and turns freely in its frame. By rotating this window the polarized windows may be so aligned as to permit varying degrees of light to pass, thereby regulating light intensity.

c. Cabin Windows D T . The outer cabin windows of two-ply construction are the pressure type, and are integral parts of the pressure vessel. Each cabin window has a vertical sliding curtain to regulate light through the window.

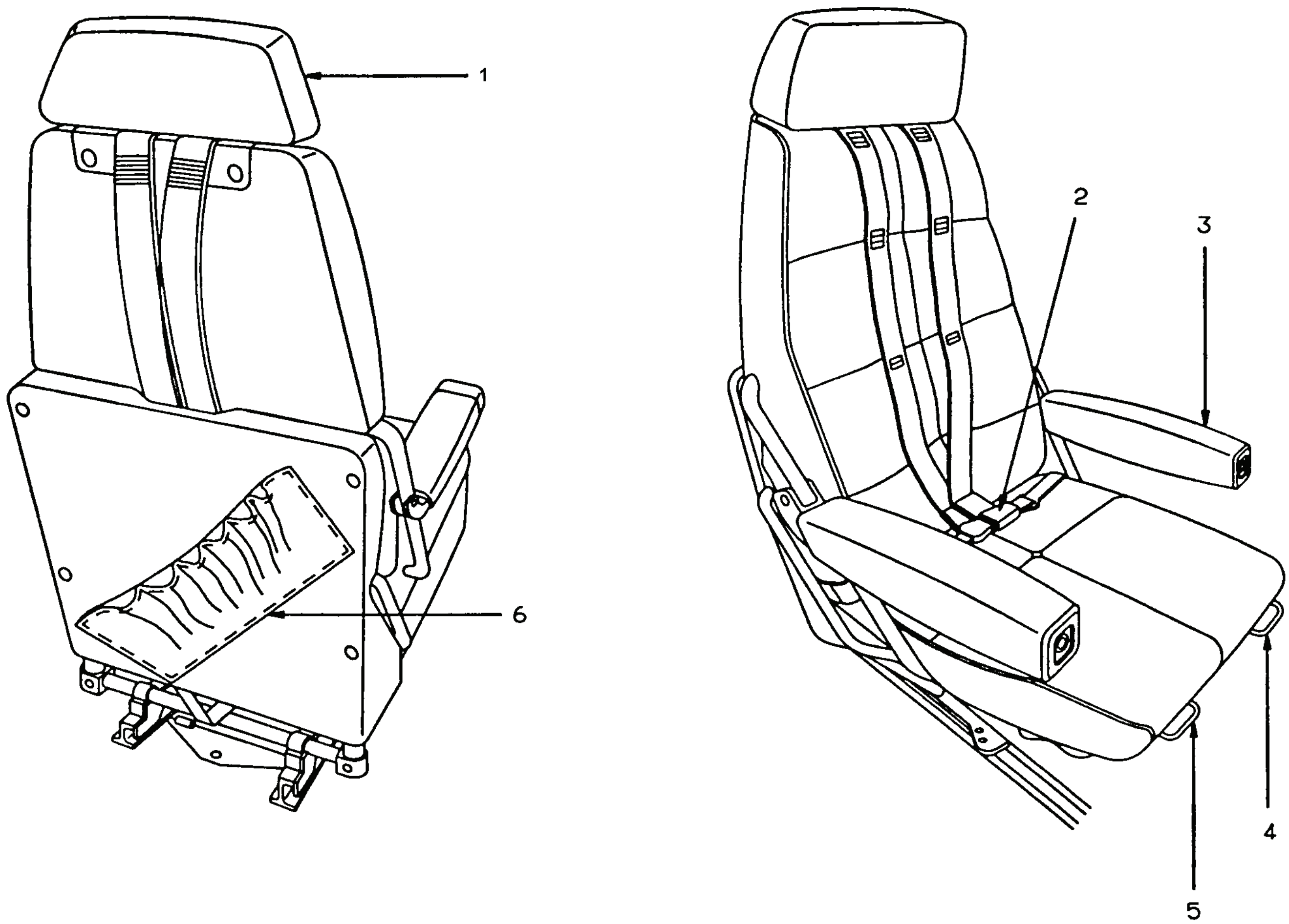
2-15. SEATS.

a. Pilot and Copilot Seats. The pilot's and copilot's seats are separated from the cabin by a removable partition with lockable sliding doors. Refer to Figure 2-13. The controls for vertical height adjustment and fore and aft travel are located under each seat. The fore and aft adjustment handle is located beneath the bottom front inboard corner of each seat. Pulling up on the handle(s) releases the seat position lock allowing the seat to move as desired. Both seats have adjustable headrests and armrests, which will raise and lower for access to the cockpit. Handholds on either side of the overhead panels and a fold away protective pedestal step are provided for pilot and copilot entry into the cockpit. For the storage of maps and the operator's manual, pilot and copilot seats have an expandable pocket affixed to the lower portion of the seat back. Pocket openings are held closed by shock cord tension.

CAUTION

Depending upon individual seat adjustment, certain controls and switches may become inaccessible with the harness locked. Each pilot and copilot should determine for himself to what extent a locked shoulder harness would interfere with aircraft and systems control.

Each pilot and copilot seat is equipped with a lap-type seat belt and shoulder harness connected to an inertia reel. The shoulder harness belt is in the "Y" configuration with the single strap being contained in an inertia reel attached to the base of the seatback. The two straps are worn with one strap over each shoulder and fastened by metal loops into the seat belt buckle. The spring loading at the inertia reel keeps the harness snug but will allow normal movement required during flight operations. The inertia reel is designed with a locking device that will secure the harness in the event of sudden forward movement or an impact action.



1. Adjustable Headrest
2. Seat Belt/Shoulder Harness Buckle
3. Moveable Armrest
4. Seat Height Adjustment (Pilot) Fore and Aft Adjustment (Copilot)
5. Seat Fore and Aft Adjustment (Pilot) Height Adjustment (Copilot)
6. Expandable Map Pocket

Figure 2-13. Pilot's and Copilot's Seats

Section II. EMERGENCY EQUIPMENT

2-16. DESCRIPTION.

The equipment covered in this section includes all emergency equipment, except that which forms part of a complete system. For example, landing gear system, etc. Chapter 9 describes the operation of emergency exits and location of all emergency equipment.

2-17. FIRST AID KITS.

Three first aid kits are installed.

2-18. HAND-OPERATED FIRE EXTINGUISHER.

WARNING

Repeated or prolonged exposure to high concentrations of CF_3Br gas or decomposition products should be avoided. The liquid shall not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns because of its very low boiling point.

One hand-operated fire extinguisher is mounted below the pilot's seat and a second extinguisher is mounted beneath the aft left seat. They are of the CF_3Br gas type. The extinguisher is charged to a pressure of 150 to 170 psi, and emits a forceful stream. Use an extinguisher with care within the limited area of the cabin to avoid severe splashing.

NOTE

Engine fire extinguisher systems are described in Section III.

2-19. SURVIVAL KITS.

There are two different survival kits authorized for installation in the aircraft. Depending on the anticipated mission, either an over water or overland kit may be installed. The kit is carried in the aft baggage area of the cabin.

2-20. SURVIVAL RADIOS.

Provisions are installed for installation of two AN/PRC-90 Radio Sets: one on the partition aft of the pilot's seat and one adjacent to the cabin entrance door. Each radio is equipped with a placard giving specific operating instructions.

Section III. ENGINES AND RELATED SYSTEMS

2-21. DESCRIPTION.

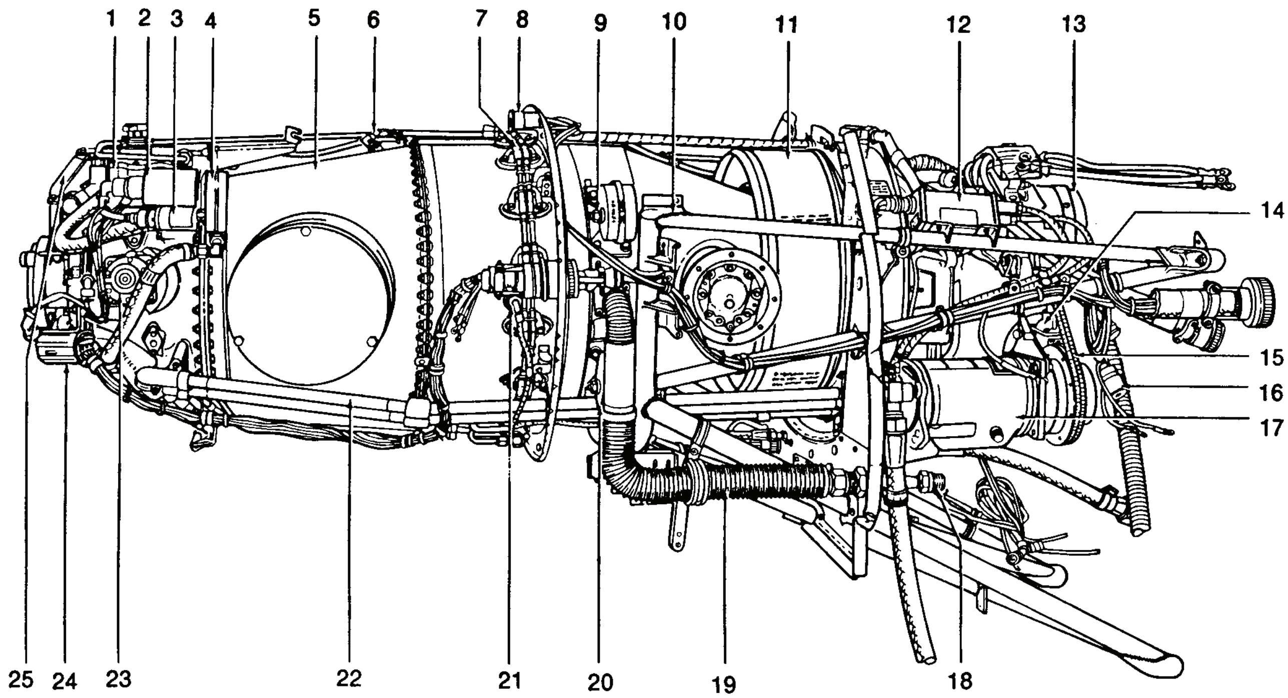
The aircraft is powered by two PT6A turboprop engines. Refer to Figure 2-14. The engine has a three stage axial, single stage centrifugal compressor, driven by a single stage reaction turbine. The power turbine, a two-stage reaction turbine, counter-rotating with the compressor turbine, drives the output shaft. Both the compressor turbine and the power turbine are located in the approximate center of the engine with their shafts extending in opposite directions. Being a reverse flow engine, the ram air supply enters the lower portion of the nacelle and is drawn in through the aft protective screens. The air is then routed into the compressor. After it is compressed, it is forced into the annular combustion chamber and mixed with fuel that is sprayed in through 14 nozzles mounted around the gas generator case. A capacitance discharge ignition unit and two spark igniter plugs are used to start combustion. After combustion, the exhaust passes through the compressor turbine and two stages of power turbines then is routed through two exhaust ports near the front of the engine. A pneumatic fuel control system schedules fuel flow to maintain the power set by the gas generator power lever. The accessory drive at the aft end of the engine provides power to drive the fuel pumps, fuel control, the oil pumps, the refrigerant compressor (right engine), the starter/generator, and the tachometer transmitter. The reduction gearbox, forward of the power turbine, provides gearing for the propeller and drives the propeller tachometer transmitter, the propeller overspeed governor, and the propeller governor.

2-22. ENGINE COMPARTMENT COOLING.

The forward engine compartment, including the accessory section, is cooled by air entering around the exhaust stub cutouts, the gap between the propeller spinner and forward cowling, and exhausting through ducts in the upper and lower aft cowling.

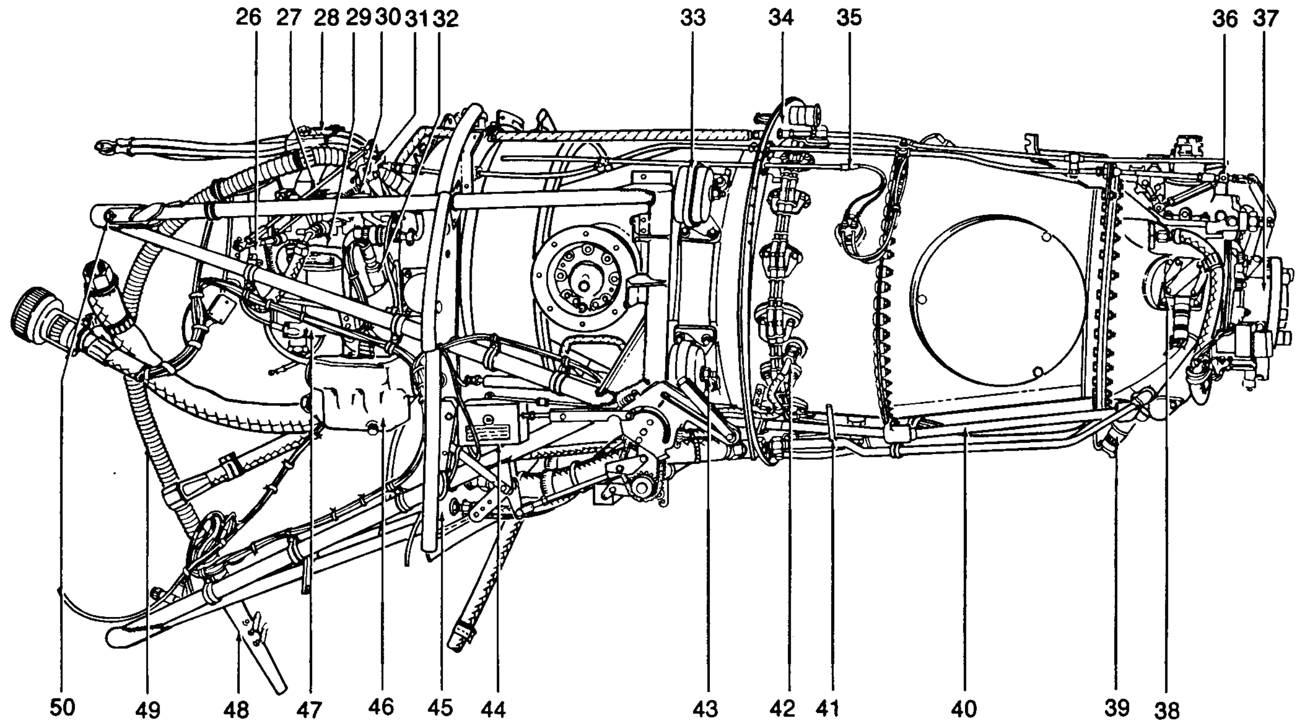
2-23. AIR INDUCTION SYSTEMS – GENERAL.

Each engine and oil cooler receives ram air dueled from an air scoop located within the lower section of the forward nacelle. Special components of the engine induction system protect the power plant from icing and foreign object damage.



1. Primary Prop Governor
2. Torque Pressure Transmitter
3. Torque Pressure Switch
4. Torque Pressure Manifold
5. Exhaust Duct
6. ITT Temperature Probe
7. Fuel Flow Divider Manifold
8. Fire Detector
9. Engine Mount Bolt
10. Engine Mount Truss Assembly
11. Engine Air Intake Screen
12. Ignition Exciter
13. Starter-Generator
14. Fuel Boost Pump
15. Air Conditioner Compressor Drive Belt (#2 Engine Only)
16. Fire Detector
17. Air Conditioner Compressor (#2 Engine Only)
18. Bleed Air Adapter
19. Bleed Air Line
20. Engine Mount
21. Ignition Exciter Plug
22. Oil Scavenge Tubes
23. Overspeed Governor
24. Prop Device Brush Block Bracket
25. Prop Reverse Linkage Lever

Figure 2-14. Engine (Sheet 1 of 2)



26. Fuel Control Unit
27. Fuel Control Unit Control Rod
28. Starter Generator Leads
29. Engine Driven Fuel Pump
30. Power Control Lever
31. Prop Interconnect Linkage (Aft)
32. Oil Pressure Transducer
33. Engine Mount
34. Fireshield
35. Trim Resistor Thermocouple
36. Prop Interconnect Linkage (Fore)
37. Prop Shaft
38. Tach Generator
39. Chip Detector
40. Oil Pressure Tube
41. Fire Extinguisher Line
42. Ignition Exciter Plug
43. Engine Mount Bolt
44. Linear Actuator
45. Engine Baffle and Seal Assy
46. Fuel/Oil Heater
47. Tach-Generator (Aft)
48. Drain Manifold
49. Overhead Breather Tube
50. Engine Truss Mounting Bolt

Figure 2-14. Engine (Sheet 2 of 2)

2-24. FOREIGN OBJECT DAMAGE CONTROL.

The engine has an integral air inlet screen designed to obstruct objects large enough to damage the compressor.

NOTE

The engine anti-ice system (ice vanes) should be on (extended) for all ground operations to minimize ingestion of ground debris. It may be necessary to turn off engine anti-ice (retract ice vanes) in warm ambient conditions to preclude exceeding engine gas temperature limits.

2-25. ENGINE ICE PROTECTION SYSTEMS.

CAUTION

After the vanes have been manually extended, they may be mechanically actuated only. No electrical extension or retraction shall be attempted as damage to the electric actuator will result. Linkage in the nacelle area must be reset prior to operation of the electric system.

a. Inertial Separator. An inertial separation system is built into each engine air inlet to prevent moisture particles from entering the engine inlet plenum under icing conditions. A movable vane and a by-pass door are lowered into the air stream when operating in visible moisture at +5°C or colder, by energizing electrical actuators with the switches, placarded **ICE VANE RETRACT/EXTEND** C D T1 and **ICE VANE CONTROL/ON** T2 , located on the overhead control panel. Refer to Figure 2-15. A mechanical backup system is provided, and is actuated by pulling the T-handles just below the pilot's subpanel, placarded **ICE VANE #1 ENG** and **ICE VANE #2 ENG** C D1 T2 and **ICE VALVE # 1 ENG** and **ICE VALVE # 1 ENG** T1 . Decrease airspeed to 160 knots or less to reduce forces for manual extension. Normal airspeed may then be resumed.

(1) The vane deflects the ram air stream slightly downward to introduce a sudden turn in the air stream to the engine, causing the moisture particles to continue on undetected, because of their greater momentum, and to be discharged overboard.

(2) While in the icing flight mode, the extended position of the vane and by-pass door is indicated by green annunciator lights, **#1 VANE EXT** and **#2 VANE EXT**.

(3) In the non-ice protection mode, the vane and by-pass door are retracted out of the air stream by placing the ice vane switches in the **RETRACT** position. The green annunciator lights will extinguish. Retraction should be accomplished at +15°C and above to assure adequate oil cooling. The vanes should be either extended or retracted; there are no intermediate positions.

(4) If for any reason the vane does not attain the selected position within 15 seconds, a yellow **#1 VANE FAIL** or **#2 VANE FAIL** light illuminates on the caution/advisory panel. In this event, the manual backup system should be used. When the vane is successfully positioned with the manual system, the yellow annunciator lights will extinguish. During manual system use, the electric motor switch position must match the manual handle position for a correct annunciator readout.

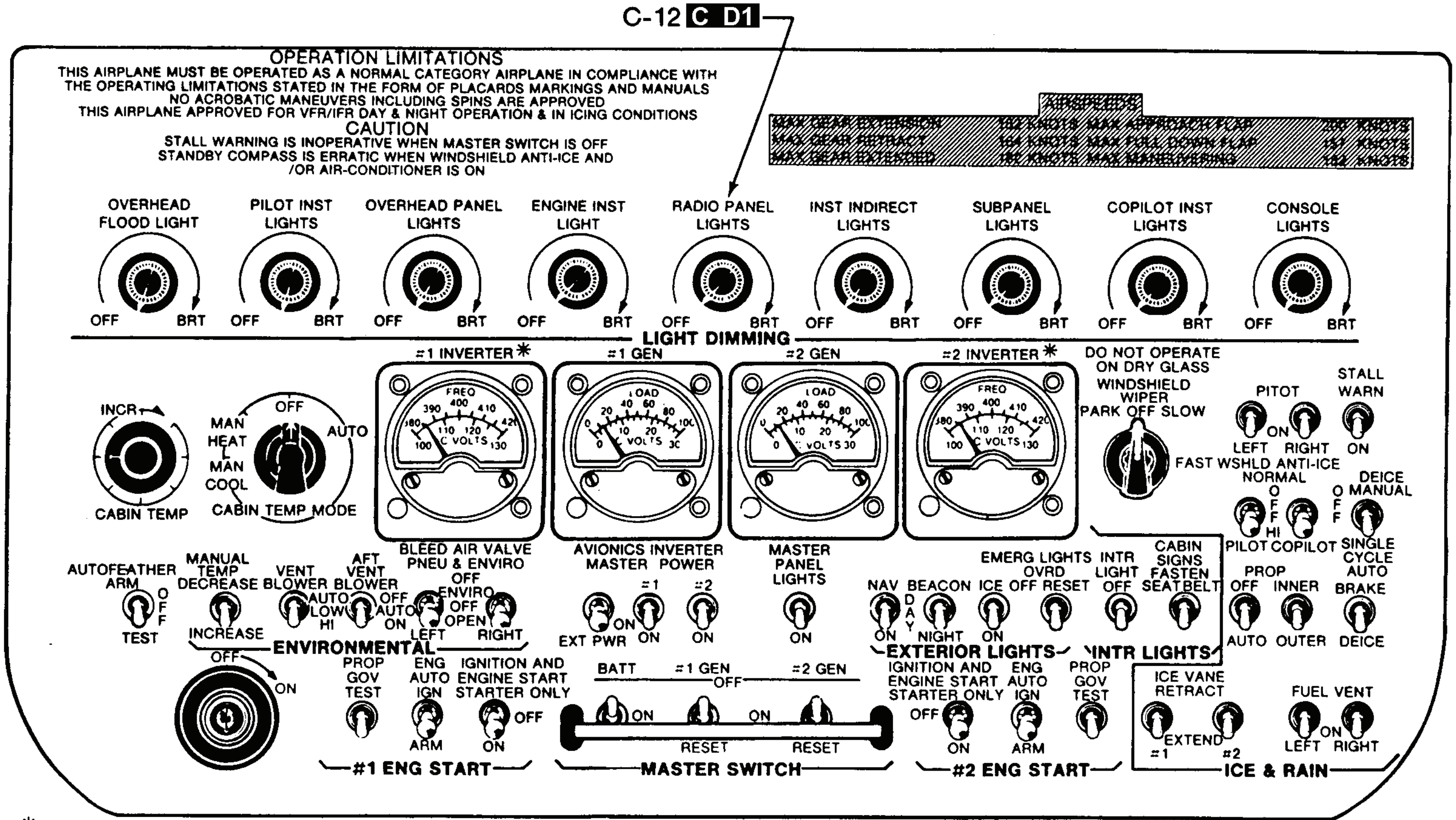
b. Engine Air Inlet Deice C D. Engine exhaust heat is utilized for heating the engine air inlet lips. Hot exhaust is picked up by a scoop inside each engine exhaust stack and plumbed downward to connect into each end of the inlet lip. Exhaust flows through the inside of the lip downward to the bottom where it is plumbed out through the bottom of the nacelle. No shut-off or temperature indicator is necessary for this system.

c. Engine Air Inlet Deice T . A small duct, facing into the exhaust flow of the engine's left exhaust stack, diverts a small portion of the engine exhaust gases to the engine air inlet anti-ice lip. The gases are circulated through the engine air inlet anti-ice lip and then exhausted through a duct to the engine's right exhaust stack. The continuous flow of hot engine exhaust gases heats the engine air inlet anti-ice lip, preventing the formation of ice.

d. Fuel Heater. An oil-to-fuel heat exchanger, located on the engine accessory case, operates continuously and automatically to heat the fuel sufficiently to prevent ice from collecting in the fuel control unit. Each pneumatic fuel control line is protected against ice. Fuel control heat is automatically turned on for all engine operations.

2-26. ENGINE FUEL CONTROL SYSTEM.

C D The basic engine fuel system consists of an engine driven fuel pump, a fuel control unit, a fuel flow divider, a dual fuel manifold and 14 fuel nozzles. The fuel flow divider acts as a drain valve to clear residual fuel after engine shutdown.



* #1 AC BUS; #2 AC BUS ON C-12 C D

Figure 2-15. Overhead Control Panel C D T1 *(Sheet 1 of 2)*

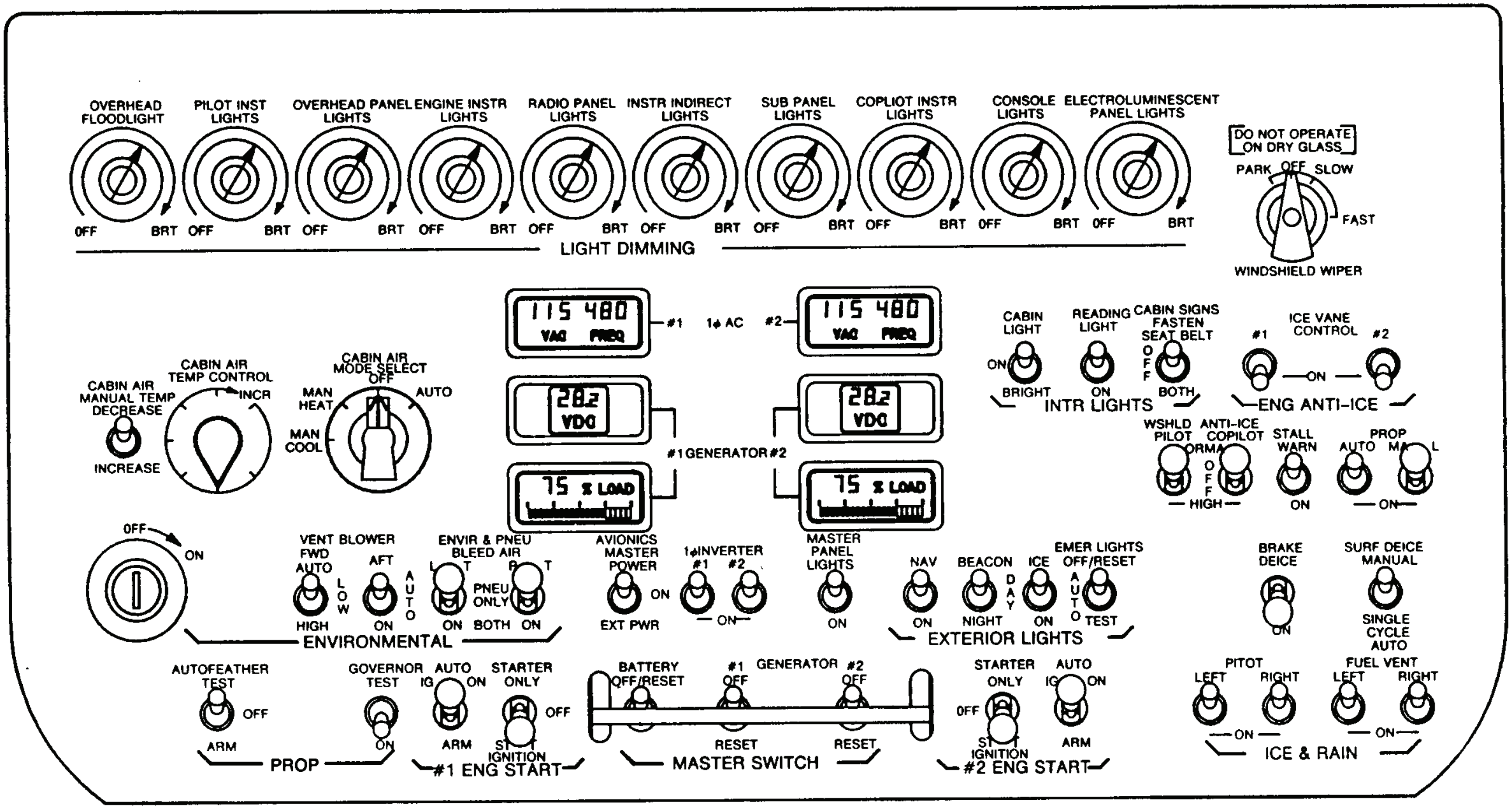


Figure 2-15. Overhead Control Panel **T2** *(Sheet 2 of 2)*

T The basic engine fuel system consists of an engine driven fuel pump, a fuel control unit, a dual fuel manifold, 14 fuel nozzles, and a fuel purge system. The fuel purge system forces residual fuel from the manifolds to the combustion chamber, where it is consumed.

a. One fuel control unit is on the accessory case of each engine. This unit is a hydro-mechanical metering device, which determines the proper fuel schedule for the engine to produce the amount of power requested by the relative position of its 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. Engine shutdown is accomplished by moving the appropriate condition lever to the full aft, **FUEL CUTOFF** position, which shuts off the fuel supply.

2-27. POWER LEVERS.

CAUTION

Moving the power levers into reverse range without the engines running may result in damage to the reverse linkage mechanisms.

Two power levers are located on the control pedestal, Figures 2-7 and 2-9. These levers regulate power in the reverse, idle, and forward range, and operate so that forward movement increases engine power. 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 power levers also control propeller reverse pitch. Distinct movement (pulling up and then aft on the power lever) by the pilot is required for reverse thrust. Placard beside the lever travel slots reads **POWER**. Upper lever travel range is designated **INCR** (increase), supplemented by an arrow pointing forward. Lower travel range is marked **IDLE** / **LIFT** and **REVERSE**. A placard below the lever slots reads, **CAUTION – REVERSE ONLY WITH ENGINES RUNNING**.

2-28. CONDITION LEVERS.

Two condition levers are located on the control pedestal. Each lever starts or stops the fuel supply, and controls the idle speed for its engine. The levers have three placarded positions: **FUEL CUTOFF**, **LO IDLE**, and **HIGH IDLE**. In the **FUEL CUTOFF** position, the condition lever controls the cutoff function of its engine-mounted fuel control unit. From **LO IDLE** to **HIGH IDLE**, they control the governors of the fuel control units to establish minimum fuel flow levels. **LO IDLE** position sets the fuel flow rate to attain 52% ± 2% C D ; 56-58% T, (at sea level) minimum N_1 and **HIGH IDLE** position sets the rate to attain 70% minimum N_1. The power lever for the corresponding engine can select N_1 from the respective idle setting to maximum power. An increase in low idle N_1 will be experienced at high field elevation.

2-29. FRICTION LOCK KNOBS.

Four friction lock knobs are located on the control pedestal to adjust friction drag. Refer to Figures 2-7 and 2-9. One knob is below the propeller levers, one below the condition levers, and two under the power levers. When a knob is rotated clockwise, friction restraint is increased opposing movement of the affected lever as set by the pilot. Counterclockwise rotation of a knob will decrease friction drag thus permitting free and easy lever movement. Two **FRICTION LOCK** placards are located on the pedestal adjacent to the knobs.

2-30. ENGINE FIRE DETECTION SYSTEM C D T1 .

A flame surveillance system is installed on each engine to detect external engine fire and provide alarm to the pilot. Both nacelles are monitored, each having a control amplifier and three detectors. Electrical wiring connects all sensors and control amplifiers to dc power and to the cockpit visual alarm units. In each nacelle, one detector monitors the forward nacelle, a second monitors the upper accessory area, and a third the lower accessory area.

a. Fire emits an infrared radiation that will be sensed by the detector, which monitors the area of origin. Radiation exposure activates the relay circuit of a control amplifier, which causes signal power to be sent to cockpit warning systems. An activated surveillance system will return to the standby state after the fire is out. The system includes a functional test switch.

b. Warning Of Internal Nacelle Fire.

(1) The red **MASTER WARNING** light on the glare shield illuminates accompanied by the illumination of a red warning light in the appropriate fire control T-handle, placarded **FIRE PULL**. Fire detector circuits are protected by a single 5-ampere circuit breaker, placarded **FIRE DETR** located on the overhead circuit breaker panel, Figure 2-16.

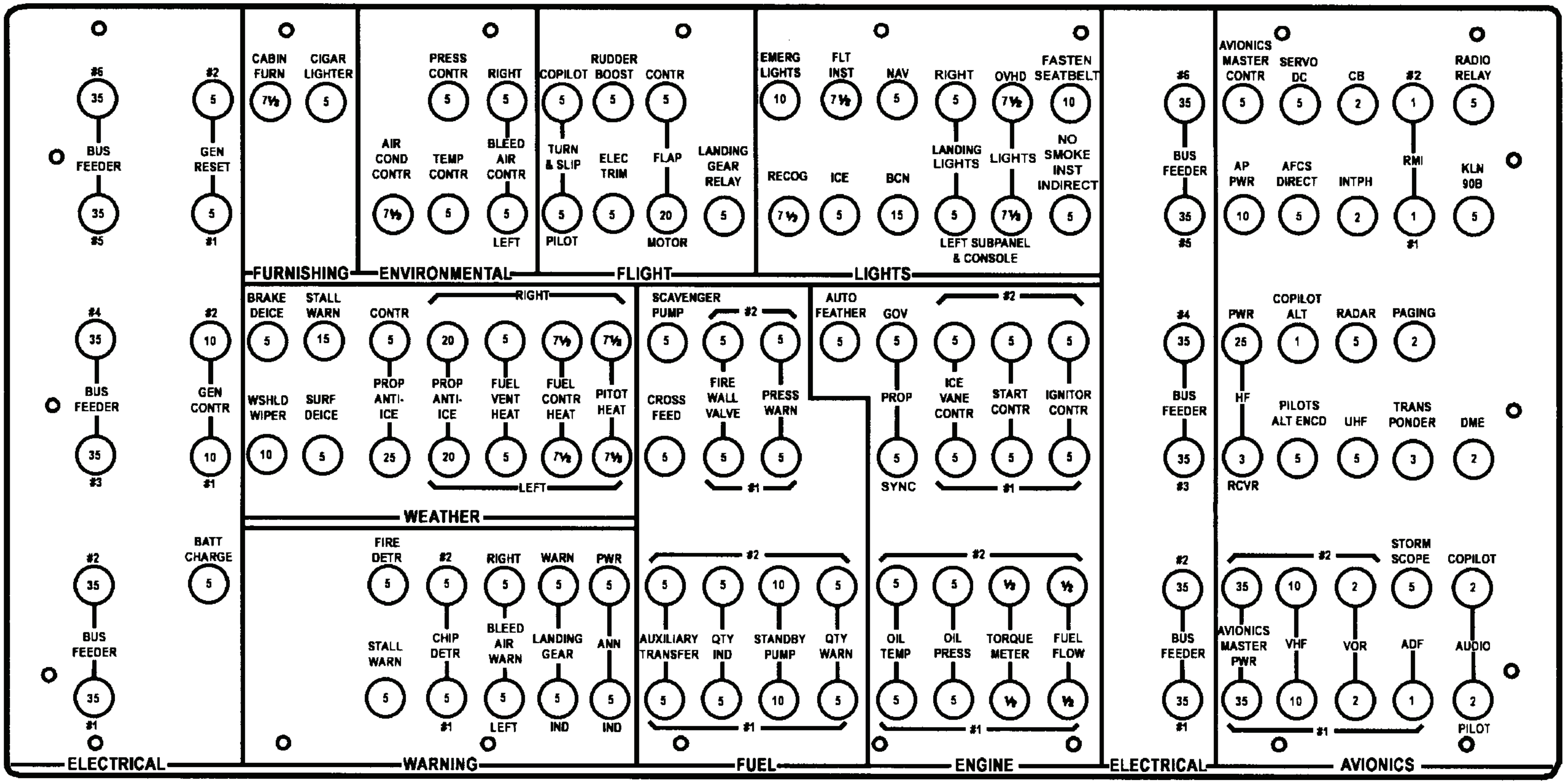


Figure 2-16. Overhead Circuit Breaker Panel **C** *(Sheet 1 of 4)*

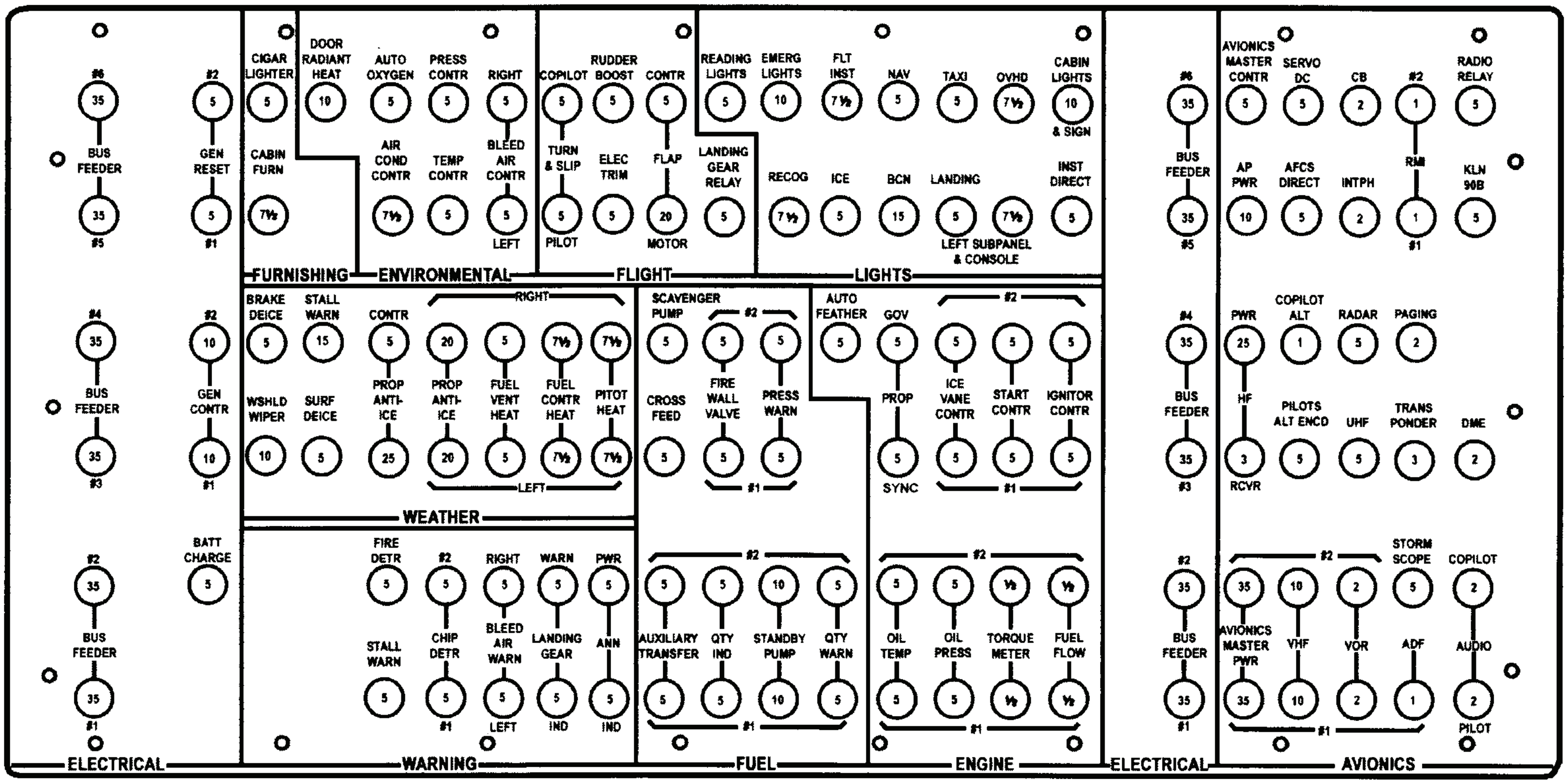


Figure 2-16. Overhead Circuit Breaker Panel D1 (Sheet 2 of 4)

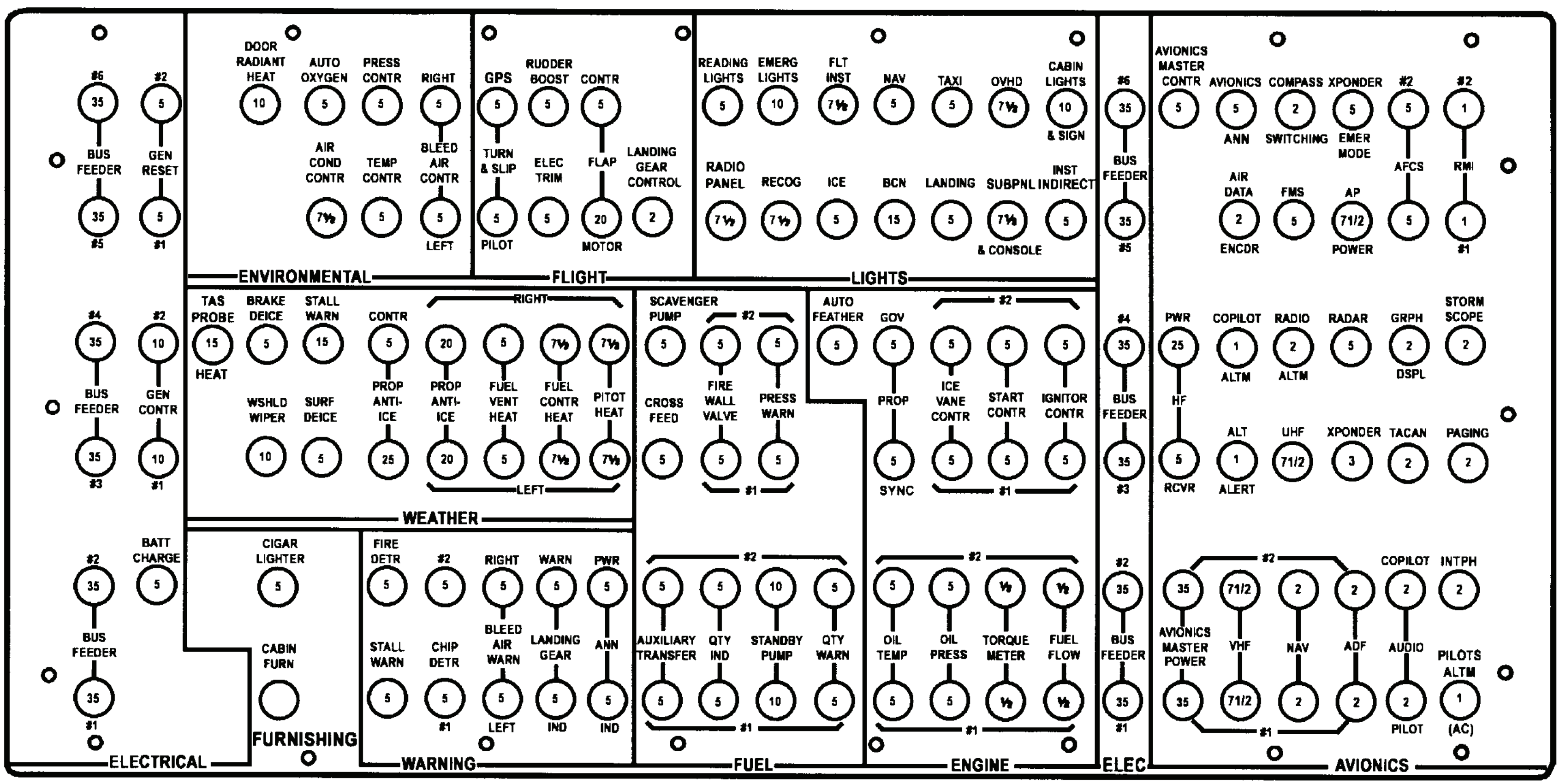


Figure 2-16. Overhead Circuit Breaker Panel D2 (Sheet 3 of 4)

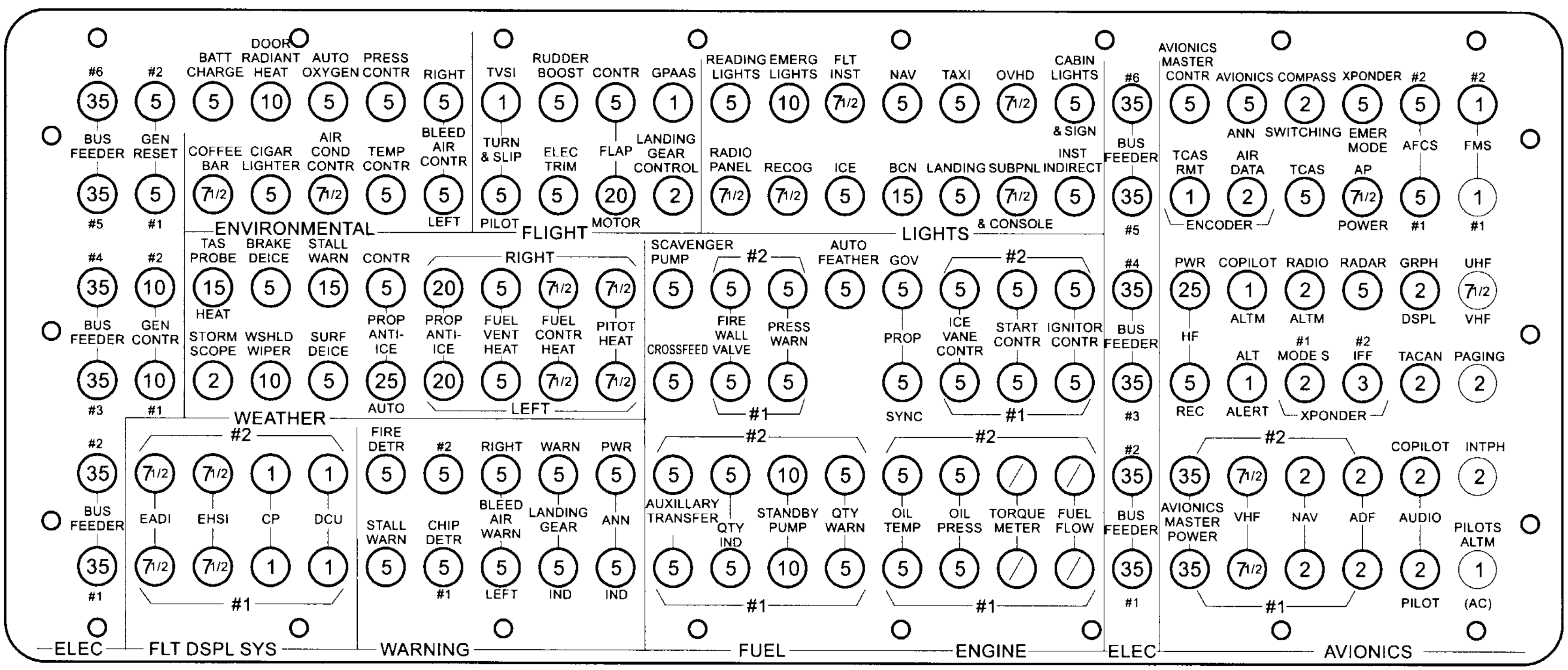


Figure 2-16. Overhead Circuit Breaker Panel T1 (Sheet 4 of 4)

(2) 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, or if the aircraft is headed toward a strong external light source. In this circumstance, close the cowling and/or change the aircraft heading to enable a valid system check.

(3) One rotary switch, placarded **FIRE PROTECTION TEST,** on the copilot's subpanel is provided to test the engine fire detection system, Figures 2-6 and 2-8. Before checkout, battery power must be on and the **FIRE DETR** circuit breaker must be closed. Switch position **DETR 1** checks the area forward of the air intake of each nacelle, including circuits to the cockpit alarm and indication devices. Switch position **DETR 2** checks the circuits for the upper accessory compartment of each nacelle. Switch position **DETR 3** checks the circuits for the lower accessory compartment of each nacelle. Each numbered switch position will initiate the cockpit indications previously described.

2-31. ENGINE FIRE DETECTION SYSTEMS T2 .

a. A pneumatic fire detection system is installed to provide an immediate warning in the event of a fire or over temperature in the engine compartment. The main element of the system is a temperature sensing cable routed continuously throughout the engine compartment, terminating in a responder unit. The responder unit is mounted in the accessory area on the upper left-hand engine truss just forward of the engine firewall. The responder unit contains two sets of contacts, a set of integrity switch contacts for continuity test functions of the fire detection circuitry and a set of alarm switch contacts that completes the circuit to activate the fire warning system when the detector cable senses an over temperature condition in critical areas around the engine.

b. The sensor cable consists of an outer tube filled with an inert gas and an inner hydride core that is filled with an active gas. The gas within the tube forms a pressure barrier that keeps the responder integrity switch contacts closed for fire alarm continuity test functions. As the temperature around the sensing cable increases, the gases within the tube begin to expand. When the pressure from the expanding gases reaches a preset point, the contacts of the responder alarm switch close, activating the respective fire warning system.

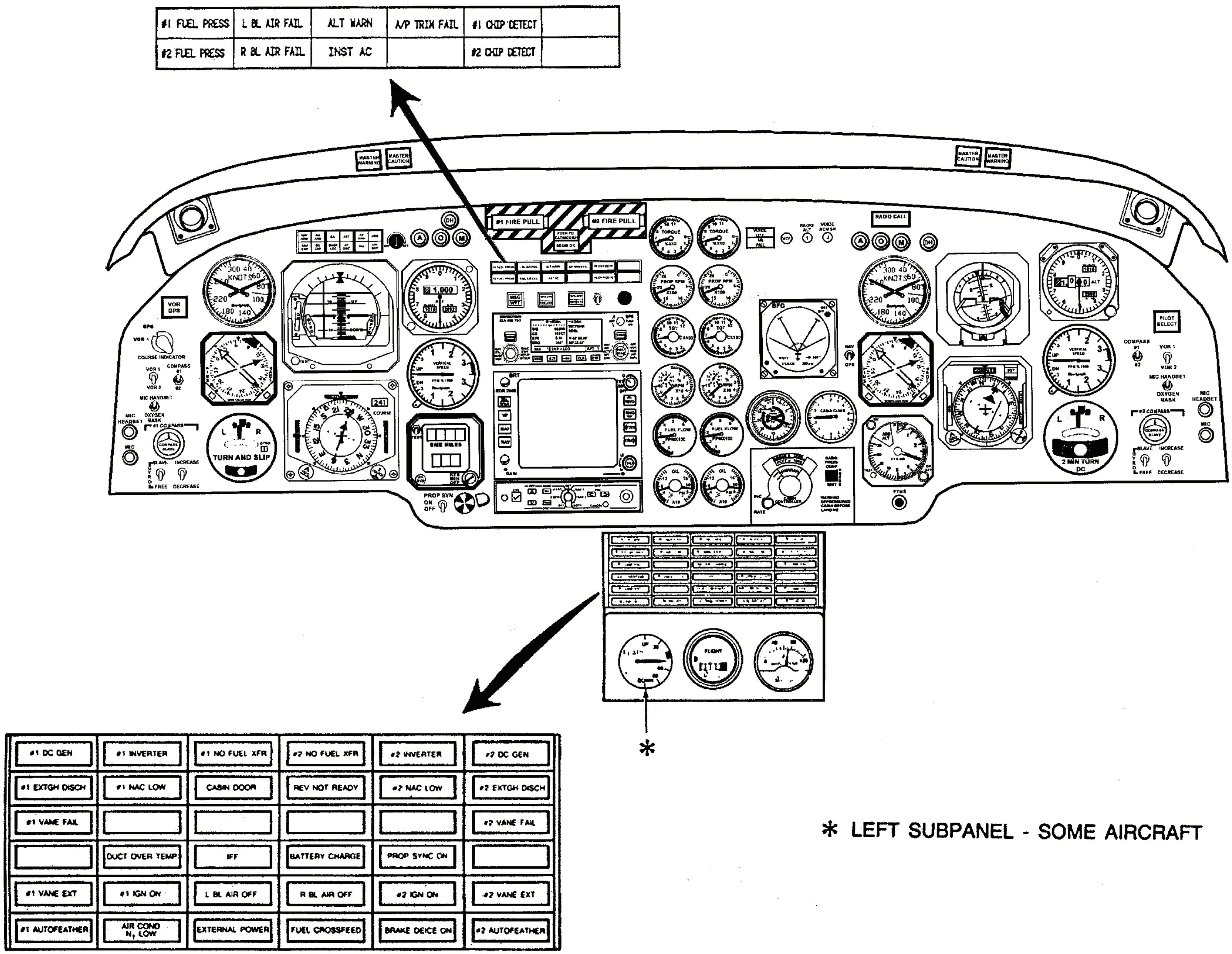
c. The fire warning portion of the system consists of two annunciators, placarded **#1 FIRE PULL** and **#2 FIRE PULL**, located below the glareshield, two **MASTER WARNING** annunciators located on opposite sides of the glareshield, and two responder units with pneumatic sensors in the engine compartments. Refer to Figure 2-17.

d. An integrity switch that monitors the system is held in the closed position. If the detector should develop a leak, the loss of gas pressure would allow the integrity switch to open and signal a lack of detector integrity. The system then will not operate during the system test function.

e. Testing the systems integrity, availability of power, and the alarm annunciators (**#1** and **#2 FIRE PULL** and **MASTER WARNING**) is accomplished through two switches located on the copilot's left subpanel. The switches are placarded **ENGINE FIRE PROTECTION TEST LEFT DET / EXT** and **RIGHT DET / EXT**. When either the **LEFT** or the **RIGHT** switch is placed in the **DET** position, electrical current flows through a 5-ampere circuit breaker, placarded **FIRE DETR,** located on the overhead circuit breaker panel and the engine fire detector circuitry to the integrity switch contacts in the respective responder unit causing the respective alarm annunciators to illuminate. If the circuit breaker opens, the system will not operate during a test, or activate the annunciator lights, if the detector cable should sense an overtemperature condition. The system may be tested either pre/post flight, or in flight as desired.

2-32. ENGINE FIRE EXTINGUISHER SYSTEM.

a. The fire extinguisher system utilizes an explosive squib and valve which, when opened, allows the distribution of the pressurized extinguishing agent through a plumbing network of spray nozzles strategically located in the fire zones of the engines.



* LEFT SUBPANEL - SOME AIRCRAFT

Figure 2-17. Instrument Panel CD1 (Sheet 1 of 4)

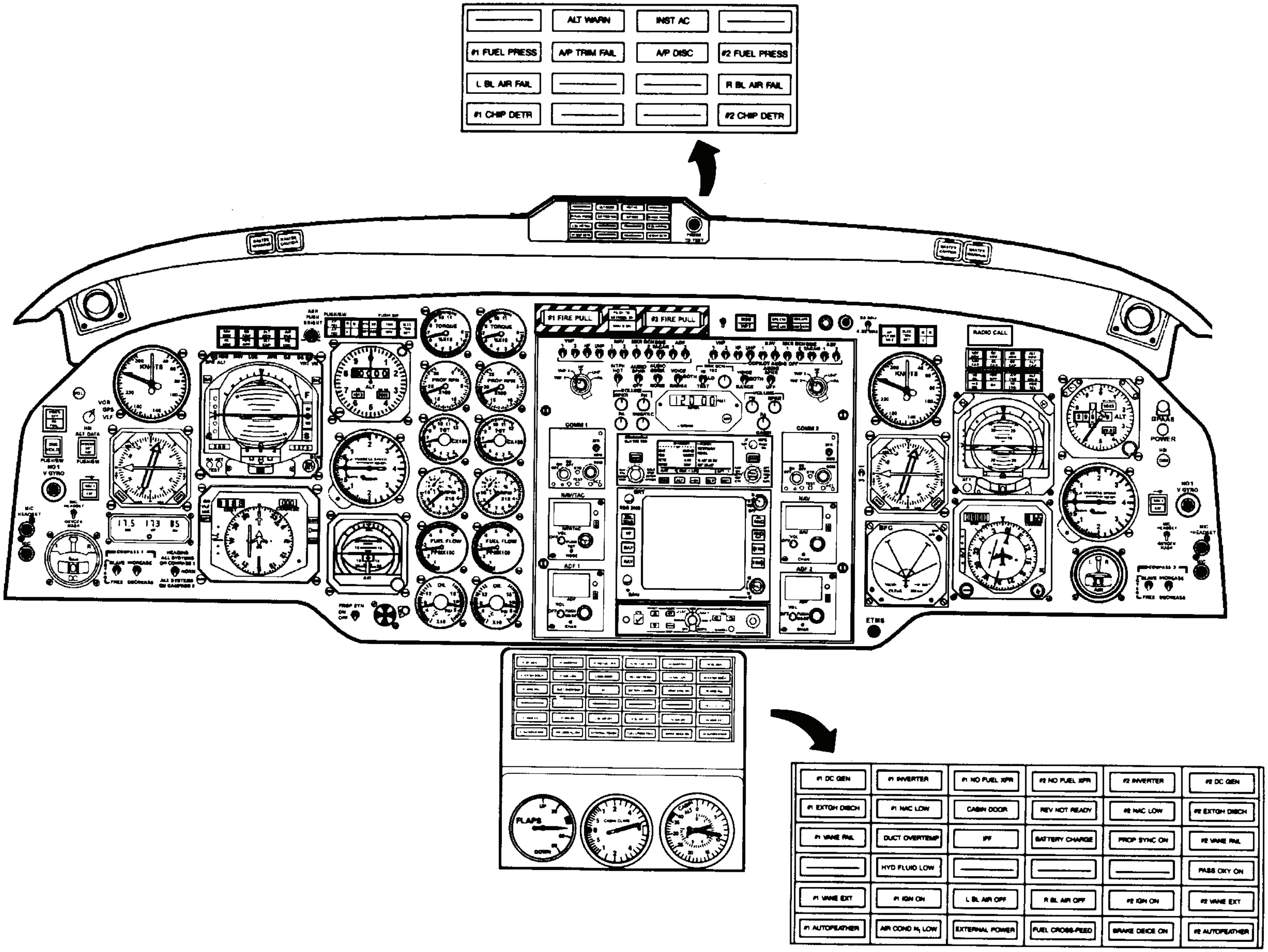


Figure 2-17. Instrument Panel **D2** *(Sheet 2 of 4)*

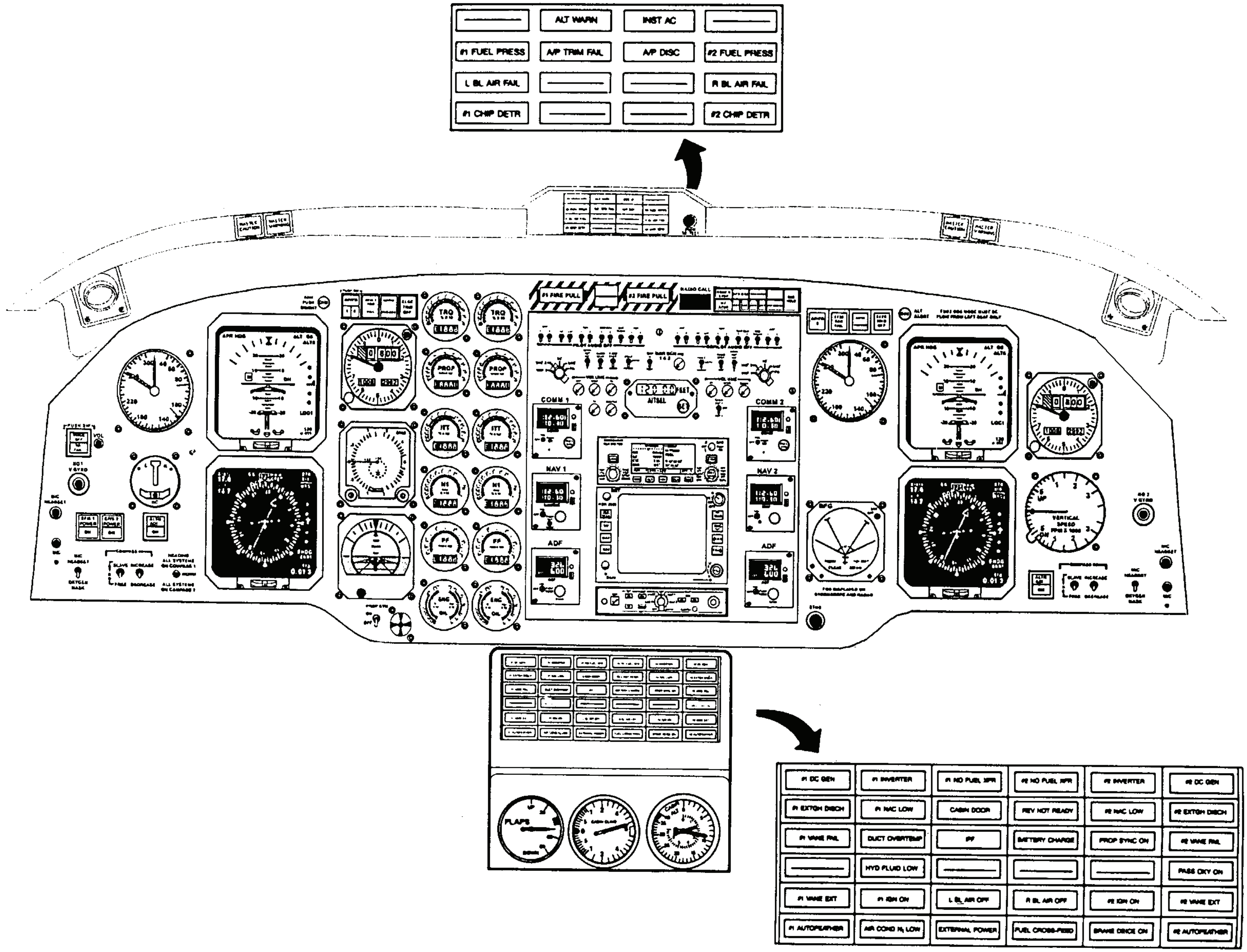
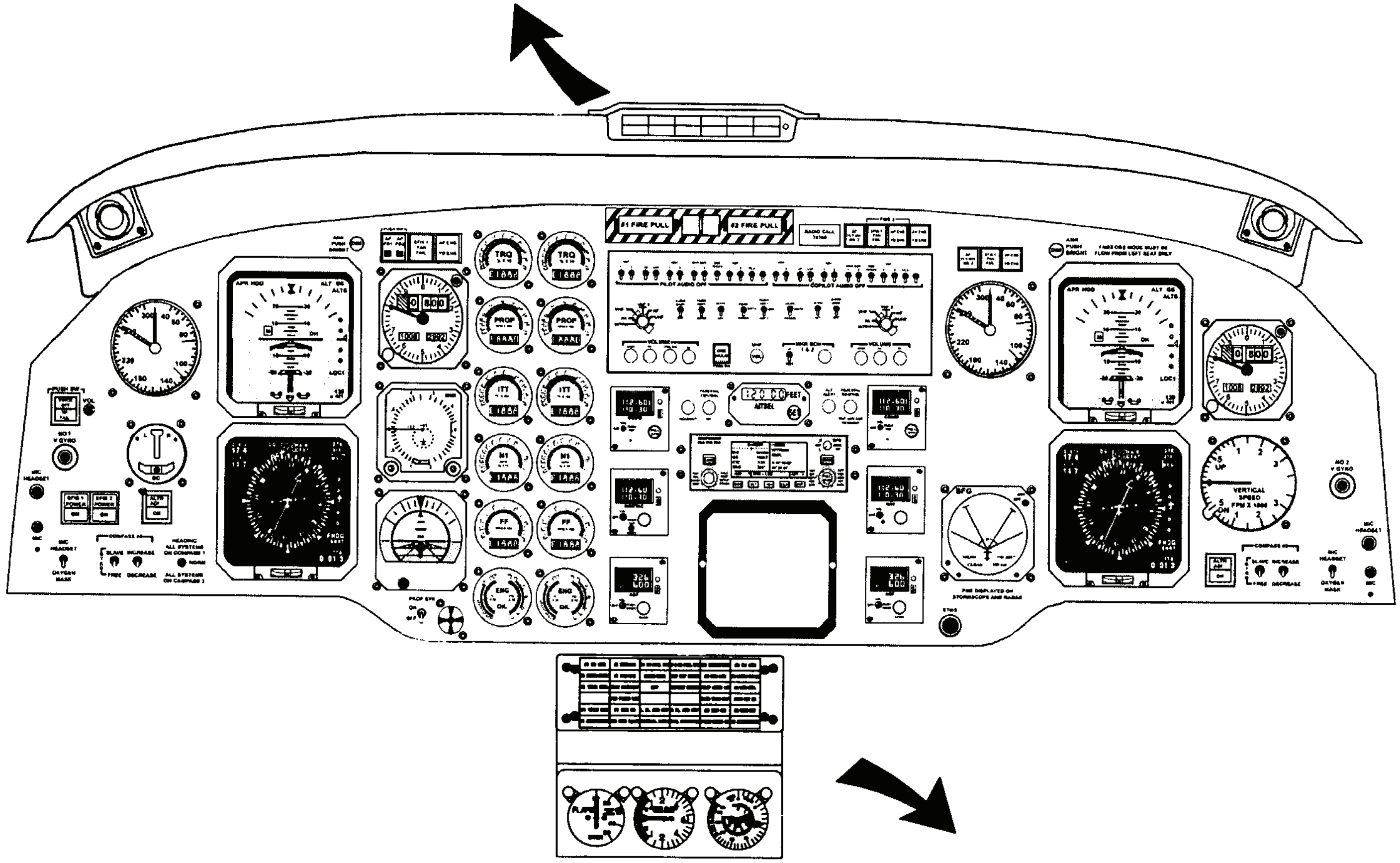


Figure 2-17. Instrument Panel T1 (Sheet 3 of 4)

#1 FUEL PRESS	L BL AIR FAIL	ALT WARN	INST AC	R BL AIR FAIL	#2 FUEL PRESS
#1 CHIP DETECT		A/P TRIM FAIL	A/P DISC		#2 CHIP DETECT



#1 DC GEN	#1 INVERTER	#1 NO FUEL XFR	# 2 NO FUEL XFR	#2 INVERTER	#2 DC GEN
#1 EXTGH DISCH	#1 NAC LOW	CABIN DOOR	REV NOT READY	#2 NAC LOW	#2 EXTGH DISCH
#1 VANE FAIL	DUCT OVERTEMP	IFF	BATTERY CHARGE	PROP SYNC ON	#2 VANE FAIL
	HYD FLUID LOW			ELEC TRIM OFF	PASS OXY ON
#1 VANE EXT	#1 IGN ON	L BL AIR OFF	R BL AIR OFF	#2 IGN ON	#2 VANE EXT
#1 AUTOFEATHER	AIR COND N1 LOW	EXTERNAL POWER	FUEL CROSSFEED	BRAKE DEICE ON	#2 AUTOFEATHER

Figure 2-17. Instrument Panel T2 (Sheet 4 of 4)

b. The fire control handles used to arm the extinguisher system are centrally located on the pilot's instrument panel immediately below the glareshield. These controls receive power from the hot battery bus. The fire detection system will indicate an engine fire by illuminating the master fault warning light on the copilot's glareshield and the respective #**1** or #**2 FIRE PULL** lights in the fire control handles. Pulling the fire control handle will electrically arm the extinguisher system and close the firewall shutoff valve for that particular engine. This will cause the red light in the **PUSH TO EXTINGUISH** switch and the respective red #**1** or #**2 FUEL PRESS** light in the warning annunciator panel to illuminate. Pressing the lens of the **PUSH TO EXTINGUISH** switch, after lifting one side of its spring-loaded clear plastic guard, will fire the squib, expelling all of the agent in the cylinder at one time. The respective yellow caution light, placarded **#1** or #**2 EXTGH DISCH**, on the caution/advisory annunciator panel and the **MASTER CAUTION** lights on the glareshield will illuminate and remain illuminated, regardless of the master switch position, until the squib is replaced. The **MASTER CAUTION** light may be reset.

c. A test switch, placarded **FIRE PROTECTION TEST**, is located on the copilot's subpanel, Figures 2-6 and 2-8. The test functions, placarded **EXTGH #1 / #2** C D T1 **or EXT LEFT / RIGHT** T2 , provide a test of the pyrotechnic cartridge circuitry. During preflight, the pilot should move the test switch through the two positions and verify the illumination of the green **SQUIB OK** light on the **PUSH TO EXTINGUISH** switch and the corresponding yellow **#1** or **#2 EXTGH DISCH** light on the caution/advisory annunciator panel.

d. A gauge, calibrated in psi, is mounted on each supply cylinder for determining the level of charge and should be checked during preflight. Refer to Table 2-2.

2-33. OIL SUPPLY SYSTEM.

a. The engine oil tank is integrated with the air-inlet casting located forward of the accessory gearbox. Oil for propeller operation, lubrication of the reduction gearbox, and engine bearings is supplied through an external line from the high-pressure pump. Two scavenge lines return oil to the tank from the propeller reduction gearbox. A non-congealing external oil cooler keeps the engine oil temperature within the operating limits. The capacity of each engine oil tank is 2.3 U.S. gallons. The total system capacity for each engine, which includes the oil tank, oil cooler, lines, etc., is 3.5 U.S. gallons. A dipstick attached to the oil filler cap indicates the oil level. Oil grade, specification and servicing points, are described in Section XII, Servicing.

b. The oil system of each engine is coupled into a heat exchanger unit (radiator) of fin-and-tube design. These exchanger units are the only airframe mounted part of the oil system and are attached to the nacelles below the engine air intake. Each heat exchanger incorporates a thermal bypass, which assists in maintaining oil at the proper temperature range for engine operation.

2-34. ENGINE CHIP DETECTION SYSTEM.

A magnetic chip detector is installed in the bottom of each engine nose gearbox to warn the pilot of oil contamination and possible engine failure. The sensor is an electrically insulated gap immersed in the oil functioning as a normally open switch. If a large metal clip or a mass of small particles bridge the detector gap, a circuit is completed sending a signal to illuminate an annunciator panel red indicator light, placarded #**1 CHIP DETR** or #**2 CHIP DETR**, Figure 2-17, Sheets 2 and 3 D2 T1 or #**1 CHIP DETECT** or #**2 CHIP DETECT**, Figure 2-17, Sheets 1 and 4 C D1 T2 , and the **MASTER WARNING** light. Chip detector circuits are protected by two 5-ampere circuit breakers, placarded **CHIP DETR #1** and **CHIP DETR #2**, on the overhead circuit breaker panel, Figure 2-16.

Table 2-2. Engine Fire Extinguisher Gauge Pressure

Temp °C	-40	-29	-18	-06	04	16	20	38	48
PSI	190 to 240	220 to 275	250 to 315	290 to 365	340 to 420	390 to 480	455 to 550	525 to 635	605 to 730

2-35. ENGINE IGNITION SYSTEM.

a. The basic ignition system consists of a solid-state ignition exciter unit, two igniter plugs, two shielded ignition cables, pilot-controlled **IGNITION AND ENGINE START** switches, and the **ENG AUTO IGN** switch. Refer to Figure 2-15. Placing an **IGNITION AND ENGINE START** switch to **ON** will cause the respective igniter plugs to spark, igniting the fuel/air mixture sprayed into the combustion chamber by the fuel nozzles. The ignition system is activated for ground and air starts, but is switched off after combustion light up.

b. One three-position toggle switch, located on the overhead control panel, for each engine will initiate starter motoring and ignition in the **ON** position or will motor the engine in the **STARTER ONLY** position. The switches are placarded **#1 ENG START** and **#2 ENG START** to designate the appropriate engine. The **ON** switch position completes the starter circuit for engine rotation, energizes the igniter plugs for fuel combustion, and activates the **#1** or **#2 IGN ON** light on the annunciator panel. At center position, the switch is **OFF**. Ignition circuits are protected by two 5-ampere circuit breakers, placarded **IGNITOR CONTR #1** and **IGNITOR CONTR #2**, located on the overhead circuit breaker panel. Starter control circuits are protected by two 5-ampere circuit breakers, placarded **START CONTR #1** and **START CONTR #2**, located on the overhead circuit breaker panel, Figure 2-16.

2-36. AUTOIGNITION SYSTEM.

If armed, the autoignition system automatically provides combustion re-ignition of either engine should accidental flameout occur. The system is not essential to normal engine operation, but is used to reduce the possibility of power loss due to icing or other conditions. Each engine has a separate autoignition control switch and a green indicator light, placarded **#1 IGN ON** or **#2 IGN ON**, on the annunciator panel. Autoignition is accomplished by energizing the two igniter plugs in each engine.

NOTE

The system should be turned OFF during extended ground operation to prolong the life of the igniter plugs.

a. Autoignition Switches. Two switches, placarded **#1 ENG START ENG AUTO IGN** and **#2 ENG START ENG AUTO IGN**, with positions **ARM** and OFF, are located on the overhead control panel, Figure 2-15. The **ARM** position initiates a readiness mode for the autoignition system of the corresponding engine. The OFF position disarms the system. Each switch is protected by a corresponding 5-ampere circuit breaker, placarded **START CONTR #1** or **START CONTR #2**, located on the overhead circuit breaker panel, Figure 2-16.

b. Autoignition Lights. If an armed auto-ignition system changes from a ready condition to an operating condition energizing the two igniter plugs in an engine, a corresponding green annunciator panel light will illuminate. The annunciator panel light, placarded **#1 IGN ON** or **#2 IGN ON**, indicates that the igniters are energized. The auto-ignition system is triggered from a ready condition to an operating condition when engine torque drops below 20%. Therefore, when an auto-ignition system is armed, the igniters will be energized continuously during the time an engine is operating at a level below 20% maximum torque. Auto-ignition lights are protected by two 5-ampere circuit breakers, placarded **IGNITOR CONTR #1** or **IGNITOR CONTR #2**, on the overhead circuit breaker panel.

2-37. ENGINE STARTER GENERATORS.

One starter-generator is mounted on each engine accessory drive section. Each is able to function either as a starter or as a generator. In starter function, 28 Vdc is required to power rotation. In generator function, each unit is capable of 250 amperes dc output. When the starting function is selected, the starter control circuits receive power through the respective 5-ampere **START CONTR** circuit breakers on the overhead circuit breaker panel from either the aircraft battery or an external power source. When the generating function is selected, the starter-generator provides electrical power. For additional description of the starter-generator system, refer to Section IX.

2-38. ENGINE INSTRUMENTS C D.

Engine instruments are vertically mounted near the center of the instrument panel, Figure 2-17.

a. Turbine Gas Temperature Indicators. Two **TGT** gauges on the instrument panel are calibrated in degrees Celsius. Each gauge is connected to thermocouple probes located in the hot gases between the turbine wheels. The gauges register the temperature present between the compressor turbine and power turbine for the corresponding engine.

b. Engine Torquemeters. Two torquemeters on the instrument panel indicate torque applied to the propeller shafts of the respective engines, Figure 2-14. Each gauge shows torque in percent of maximum using 2% graduations and is actuated by an electrical signal from a pressure sensing system located in the respective propeller reduction gear case. Torquemeters are protected by individual 0.5 ampere circuit breakers, placarded **TORQUEMETER #1** or **TORQUEMETER #2**, on the overhead circuit breaker panel.

c. Turbine Tachometers. Two tachometers on the instrument panel register compressor turbine RPM (N_1) for the respective engine. These indicators register turbine RPM as a percentage of maximum gas generator RPM. Each instrument is slaved to a tachometer generator attached to the respective engine.

d. Oil Pressure/Oil Temperature Indicators. Two gauges on the instrument panel register oil pressure in psi and oil temperature in °C. Oil pressure is taken from the delivery side of the main oil pressure pump. Oil temperature is transmitted by a thermal sensor unit, which senses the temperature of the oil as it leaves the delivery side of the oil pressure pump. Each gauge is connected to pressure transmitters installed on the respective engine. Both instruments are protected by 5-ampere circuit breakers, placarded **OIL PRESS # 1**, **OIL PRESS # 2**, **OIL TEMP #1**, and **OIL TEMP #2**, located on the overhead circuit breaker panel.

e. Fuel Flow Indicators. Two gauges on the instrument panel, Figure 2-17, register the rate of flow for consumed fuel as measured by sensing units coupled into the fuel supply lines of the respective engines. The fuel flow indicators are calibrated in increments of hundreds of pounds per hour. Both circuits are protected by 0.5-ampere circuit breakers, placarded **FUEL FLOW #1** or **FUEL FLOW #2**, located on the overhead circuit breaker panel.

2-39. ENGINE INSTRUMENTS T .

a. Turbine Gas Temperature Indicators. Two Interstage Turbine Temperature (ITT) gauges on the instrument panel are calibrated in degrees Celsius. Each gauge is connected to thermocouple probes located in the hot gases between the turbine wheels. The gauges register the temperature present between the compressor turbine and power turbine for the corresponding engine. The indicator display is a 1 alphabetic, 3½ numeric character digital display and a 41-segment bar graph display. The bar graph display is nonlinear. The indicator has a display range of 0 to 1200 °C while displaying current ITT and 0 to 1372 °C while displaying exceedence ITT. The bar graph display ranges from 0 to 1200 °C. The display will contain dashes (----) when the measured ITT is greater than 1200 °C. When the exceedence ITT value is displayed the actual measured value, not the dashes, will be displayed up to 1372 °C.

The indicator is equipped with a Built In Test (BIT) display that will display all active LCD segments for three seconds on power up. If the BIT test detects a failed ROM or RAM, the BIT indicator will have a blank display. If the BIT failure is the input signal, a "0" will be displayed on both the digital and bar graph displays. If the failed BIT is caused by the EEPROM an "F" will prefix the display. BIT failures will not be stored in EEPROM. Once power is reapplied the previous failures detected will not affect the display.

When a limit is exceeded, an exceedence event will be stored in the EEPROM memory. All event records will consist of two words. One word will contain the peak temperature measured during the event with a resolution of 1 °C. The other word will contain the event duration in seconds with a resolution of 1 second. A maximum of 50 events will be recorded. If more than 50 events are recorded, the new event will be recorded and the oldest event shall be discarded. The prefix "E" will be displayed when an event is being or has been recorded and not played back. The digital display will start flashing whenever a temperature limit has been exceeded. The flashing will cease and the display prefixed with an "E" when the time/temperature combination is exceeded and an exceedence is being recorded.

The event display will take precedence over normal digital display. The bar graph will continue to display current ITT data. To activate the event display, hold the **EXCEEDENCE DISPLAY** switch for 0.2 seconds or longer. The events will be displayed in reverse chronological order (most recent event first). All event displays will consist of the following cycle:

(1) A two-digit event number display for 2 seconds.

(2) The event peak temperature values in degrees Celsius displayed for 2 seconds.

(3) The event duration, in seconds, displayed for 2 seconds.

All three data items displayed during playback shall be prefixed with a "P" if the event was recorded in a non-start mode or an "S" if the event was recorded in the start mode.

Once an event playback sequence has been performed the "E" prefixed to the digital display will be removed. All event data is still available for playback until the data is erased. The display will be prefixed with an "E" again on the next power up cycle if the old data has not been erased or if another event is recorded.

NOTE

Pressing the EXCEEDENCE ERASE switch for 0.2 seconds or longer will cause all events to be erased from non-volatile memory in all engine instruments. There is no provision for erasing individual events from individual system gauges.

The ITT gauges are each protected by a 1.0-ampere circuit breaker located on the pilot's left subpanel, placarded **ITT TEMP #1** and **ITT TEMP #2**, Figure 2-8, Sheets 2 and 3.

b. Percentage Engine Torquemeters. The indicator displays the measured torque concurrently in a 1 alphabetic, 3½ numeric character digital display, and a 1-segment bar graph display.

The indicator has a digital display range of 0 to 123%. The bar graph display range is 0 to 120%.

The digital display is accurate to 1% and the bar graph is accurate to one-half the segment resolution in each dial scale range.

The display will contain dashes (----) when the measured torque is greater than 124%. The dashes will be prefixed with an "F" if an EEPROM failure has been detected and with an "E" if an event has been stored and not played back. The "F" display shall take precedence over the "E" display.

The indicator has a BIT test for the LCD display, ROM (program memory), RAM (volatile data memory), EEPROM (non-volatile memory), and the signal input path. The display BIT will consist of displaying all active LCD segments for three seconds on power up. If the RAM or ROM BIT fails the indicator display shall be blanked. If the input signal fails BIT the indicator shall display "0" on both the digital and bar graph displays. BIT failures are NOT stored in EEPROM. Once the power is cycled the display is not affected unless the failure is again detected.

Exceedence events will be stored in EEPROM memory. Each event record will consist of two 16-bit words. One word will contain the peak torque measured during the event and the other word shall contain the event duration in seconds. A maximum of 50 events shall be recorded. If more than 50 events are recorded, only 50 will be stored. As new events are recorded, the oldest events shall be discarded. The indicator will prefix the digital display with an "E" when an event is being or has been recorded and not played back.

The indicator digital display will start flashing whenever indicated torque exceeds 100%. The flashing shall cease and digital torque display shall be prefixed with an "E" when the time/torque combination is exceeded and the indicator begins recording an exceedance.

Event display will take precedence over normal digital display. The bar graph will continue to display current engine torque data. The event display is initiated by pressing the **EXCEEDENCE DISPLAY** switch for 0.2 seconds or longer. The event display will consist of the following:

(1) The event number will be displayed for 2 seconds.

(2) The event peak torque percentage value will be displayed for 2 seconds.

(3) The event duration, in seconds, will be displayed for 2 seconds.

All three data items displayed during playback will be prefixed with a "P" unless an EEPROM BIT failure has been detected in which case the display will be prefixed with an "F".

Once an event playback sequence has been performed, the "E" prefixed to the digital display shall be removed. All event data is still available for playback until the data is erased. The display will be prefixed with an "E" again on the next power up cycle if the old data has not been erased or if another event is recorded.

NOTE

Pressing the EXCEEDENCE ERASE switch for 0.2 seconds or longer will cause all events to be erased from non-volatile memory. There is no provision for erasing individual events.

The engine torquemeter gauges are protected by 0.5-ampere circuit breakers, placarded **TORQUE METER #1** and **#2**, located on the overhead circuit breaker panel.

c. Turbine Tachometers. The indicator displays the measured N_1 concurrently in a 1 alphabetic, 3½ numeric character digital display and a 39-segment bar graph for erasing individual events.

The indicator has a digital display range of 0 to 110.0% RPM while displaying current N_1 and 0 to 199.9% RPM while displaying exceedence N_1. The bar graph display range is 0 to 150.0% RPM.

The digital display shall contain dashes (----) when the measured N_1 is greater than 110.0% RPM.

When displaying exceedence N_1 values the actual measured value, not "----", shall be displayed, up to 199.0% RPM.

The indicator shall perform BIT on the LCD display, ROM (program memory), RAM (volatile memory), display BIT will consist of displaying all active LCD segments for three seconds on power up. If the ROM or RAM fails BIT the indicator will display "0" on both the digital and bar graph displays. If the EEPROM BIT fails the indicator will prefix the digital display with "F". BIT failures shall not be stored in EEPROM. Failures detected will not affect the display after power is cycled unless the failure is again encountered.

The indicator shall prefix the digital display with an "E" when an event is being or has been recorded and not played back.

The indicator will start recording an event immediately when the indicator has measured percent RPM greater than 102.6 or when the indicator has measured percent RPM above 101.5 continuously for ten seconds. The indicator will end recording and store the event when the measured percent RPM drops to 101.5 or lower.

Event display will be initiated by pressing the **EXCEEDENCE DISPLAY** switch for 0.2 seconds or longer. Each event display will consist of the following cycle:

(1) The event number will be displayed for 2 seconds.

(2) The event peak percent RPM will displayed for 2 seconds.

(3) The event duration, in seconds, will be displayed for 2 seconds.

All three data items displayed during playback shall be prefixed with a "P" unless an EEPROM BIT failure has been detected in which case the display will be prefixed with an "F."

Once an event playback sequence has been performed, the E prefixed to the digital display will be removed. All event data is still available for playback until the data is erased. The display will be prefixed with an "E" again on the next power up cycle if the old data has not been erased or if another event is recorded.

NOTE

Pressing the EXCEEDENCE ERASE switch for 0.2 seconds or longer will cause all events to be erased from non-volatile memory. There is no provision for erasing individual events.

The Turbine Tachometers are protected by 1.0-ampere circuit breakers, placarded **TACH N_1 #1** and **#2**, located on the pilot's left sub-panel.

d. Engine Oil Pressure and Temperature Indicator. The indicator displays the measured engine oil pressure and engine oil temperature on two separate 23-segment nonlinear bar graph displays. The oil pressure indicator has a bar graph range of 0 to 200 psi. The engine oil temperature portion of the gauge has a range of 0 to 120 °C.

The segment display resolution for the oil pressure is 20 psi in the 0 to 60 psi range, 5 psi in the 60 to 140 psi range, and 20 psi in the 140 to 200 psi range.

The indicator has a BIT on the LCD display, ROM (program memory) RAM (volatile memory), and the signal input path. The display BIT consists of displaying all active LCD segments for three seconds on power up. If the ROM or RAM BIT fails the indicator display will be blank. If the input signal fails BIT, the indicator shall display 0 psi.

The Engine Oil pressure and Temperature Indicators are protected by 5-ampere circuit breakers, placarded **OIL PRESS** and **OIL TEMP #1** and **#2**, located on the overhead circuit breaker panel.

e. Fuel Flow Indicator. The indicator shall display the measured fuel flow concurrently in a 1 alphabetic, 3½ numeric character display and a 41-segment bar graph display.

The indicator has a digital display range of 0 to 600 pounds per hour. The bar graph displays a range of 0 to 600 pounds per hour. The digital display will contain dashes (----) when the measured fuel flow is greater than 600 pounds per hour.

The indicator shall perform BIT testing on the LCD display, ROM (program memory), RAM (volatile data memory), and the signal input path. The display BIT consists of displaying all active LCD segments for three seconds on power up. The signal input BIT verifies the range of the incoming signal.

If the ROM or RAM fails BIT the indicator display will be blanked. If the input signal fails BIT the indicator shall display "0" on both the digital and bar graph display.

The Fuel Flow Indicators are protected by 0.5-ampere circuit breakers, placarded **FUEL FLOW #1** and **#2**, located on the overhead circuit breaker panel.

2-40. ENGINE TREND MONITOR.

a. General Description. The Engine Trend Monitor (ETM) is a monitoring system that monitors and records data on engine and airframe parameters, e.g., fuel used, cycle counts, total hours, and engine and airframe exceedences. It provides automatic cycle and engine start counting and automatic data collection. The ETM provides maintenance personnel with a complete, accurate, and detailed record of the engine and airframe use. At the time of first installation of the ETM in the aircraft, the data in the ETM is revised with the current pertinent statistical data concerning the airframe and engines. The ETM can also serve as a log that will contain detailed records of each event in a flight from power on, engine starts to engine stops, and power off.

NOTE

When the ETM system is inoperative, pilots are responsible for manually recording engine trend data.

b. System and Related Components.

(1) The ETM Processor. The processor contains the main computer, and is the collection point for data received from the various engine transducers.

(2) The Airdata Computer. The Airdata computer provides airdata calculations and is the interface to the KLN 90B GPS receiver.

(3) The Display & Key Recorder. The Display and Key Recorder is a cabin mounted display that houses both the key recorder equipment and display interface.

(4) Indicator Light. An indicator light, labeled **ETMS**, is located on the right side of the instrument panel below the stormscope. The **ETMS** indicator light illuminates when the ETM is recording data and for 10 seconds after the master switch is turned on.

c. Normal Operations. When the master switch is turned on, power is applied to the ETM causing the **ETMS** indicator light to illuminate and the ETM to perform a self-test. It is vital that the pilot follows certain procedures when starting up and shutting down the aircraft.

(1) When starting the aircraft, wait a full 10 seconds before starting the engines after turning on the master switch to allow the ETM to complete its startup procedures.

(2) If the engines are started before the ETM has completed its startup sequence, the system will not record any engine starts. This will result in inaccurate cycle counts, engine start counting, and trend analysis.

(3) When shutting down the engines, wait until the gas generator speeds of both engines drop below 10% prior to turning off the master switch.

(4) During aircraft operation, the ETM monitors and records data on the engine and airframe parameters and notifies maintenance personnel when the established limits of those parameters are exceeded. This data is, in turn, used for later trend analysis. The ETM has a secure feature that prevents unauthorized changes to the retained statistical data being recorded.

Section IV. FUEL SYSTEMS

2-41. FUEL SUPPLY SYSTEM.

The engine fuel supply system, Figure 2-18, consists of two separate, identical systems, connected by a valve-controlled line, that share a common fuel management panel. Each fuel system consists of five interconnected wing tanks, a nacelle tank, an engine driven boost pump mounted on each engine, a standby fuel pump located within the nacelle tank, a fuel heater (engine oil-to-fuel heat exchange unit), a tank vent system, a tank vent heating system and interconnecting wiring and plumbing. The aircraft are equipped with auxiliary (inboard wing) fuel tanks with a fuel transfer pump located within each tank.

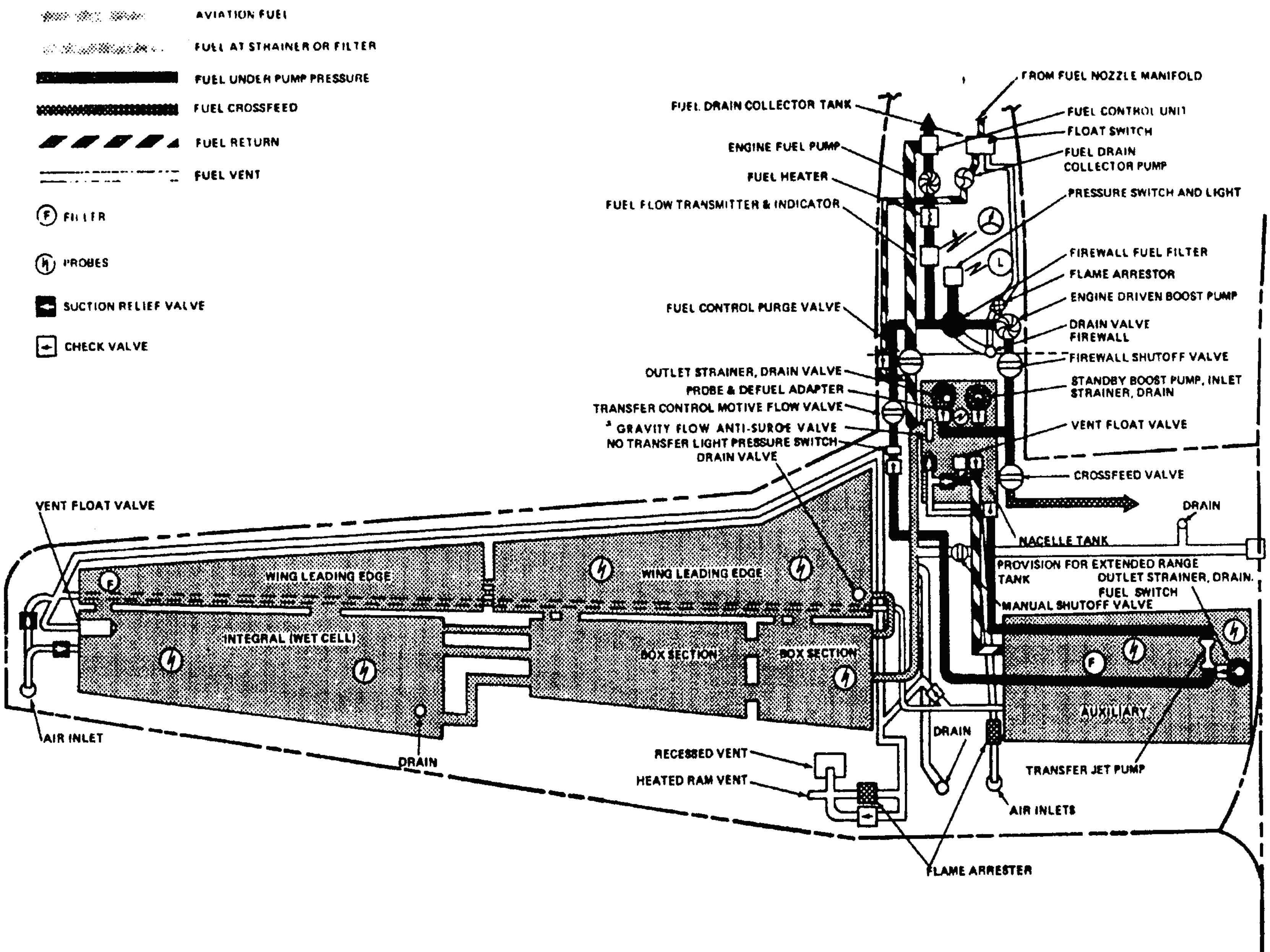


Figure 2-18. Fuel System

CAUTION

Engine operation using only the engine-driven primary (high-pressure) fuel pump without standby fuel pump or engine-driven boost pump fuel pressure is limited to 10 cumulative hours. This condition is indicated by illumination of either #1 or #2 FUEL PRESS lights on the warning annunciator panel and simultaneous illumination of the master warning light on the glare shield. Refer to Chapter 9. All time in this category shall be entered on DA Form 2408-13-1 for the attention of maintenance personnel.

a. Fuel Tanks. The main wing tanks consist of two leading edge tanks, two box section bladder tanks, and an integral (wet cell) tank all interconnected to flow into the nacelle tank by gravity. This system of tanks is filled from the filler located near the wing tip. The auxiliary fuel system consists of a center section tank, located in the inboard wing, with its own filler opening and an automatic fuel transfer system to transfer the fuel into the nacelle tank. An anti-siphon valve is installed at each filler port to prevent loss of fuel or collapse of a fuel cell bladder in the event of improper securing or loss of the filler cap. The nacelle tank is located directly behind the engine and contains a submerged, electrically operated standby fuel pump. The fuel from the nacelle tank is fed directly into the engine by either the engine-driven primary fuel pump or, as backup, the standby fuel pump. The quantity of fuel for the tanks is detailed in Table 2-3.

b. Engine Driven Boost Pumps. A gear-driven boost pump mounted on each engine supplies fuel, under pressure, from the nacelle tank to the inlet of the engine-driven primary high-pressure pump for engine starting and all normal operations. Either the engine-driven boost pump or stand by fuel pump is capable of supplying sufficient pressure to the engine-driven primary high-pressure pump and thus maintain normal engine operation.

c. Standby Fuel Pumps. A submerged, electrically operated standby fuel pump, located within each nacelle tank, serves as a backup unit for the engine-driven boost pump. The standby pumps are switched off during normal system operations. A standby fuel pump will be operated during crossfeed to pump fuel from one system to the other. The correct pump is automatically selected when the **CROSSFEED** switch is activated. Each standby fuel pump has an inertia switch included in the power supply circuit. When subjected to a 5 to 6 G shock loading, as in a crash situation, the inertia switch will remove electrical power from the standby fuel pump. The standby fuel pumps are protected by two 10-ampere circuit breakers, placarded **STANDBY PUMP 1** or **2**, located on the overhead circuit breaker panel, and four 5-ampere circuit breakers wired (two each in parallel) on the hot battery bus.

Table 2-3. Fuel Quantity Data

	TANKS	NUMBER	GALLONS	**POUNDS
LEFT ENGINE	Wing tanks	5	136	924.8
	Nacelle tank	1	57	387.6
	Auxiliary tank	1	79	537.2
	(Ferry tank) ***	(1)	(120)	(816.0)
RIGHT ENGINE	Wing tanks	5	136	924.8
	Nacelle tank	1	57	387.6
	Auxiliary tank	1	79	537.2
	(Ferry tank) ***	(1)	(120)	(816.0)
	*TOTALS	14	544	3699.2
	*(TOTALS with Ferry tanks installed)	(16)	(784)	(5331.2)

*	Unusable fuel quantity and weight (4 gallons, 26 pounds not included in totals).
**	Fuel weight is based on standard day conditions at 6.8 pounds per U.S. gallon. Total fuel system capacity, without ferry fuel, is 548 gallons.
***	Data for ferry tanks is included when they are installed.

CAUTION

In turbulence or during maneuvers, the NO FUEL XFR light may momentarily illuminate after the auxiliary fuel has completed transfer.

d. Fuel Transfer Pumps. The auxiliary tank fuel transfer system automatically transfers the fuel from the auxiliary tank to the nacelle tank without pilot action. Motive flow to a jet pump mounted in the auxiliary tank sump is obtained from the engine fuel plumbing system downstream from the engine driven boost pump and routed through the transfer control motive flow valve. The motive flow valve is energized to the open position by the control system to transfer auxiliary fuel to the nacelle tank to be consumed by the engine during the initial portion of the flight. When an engine is started, pressure at the engine driven boost pump closes a pressure switch which, after a 30 to 50-second time delay to avoid depletion of fuel pressure during starting, energizes the motive flow valve. When auxiliary fuel is depleted, a low level float switch de-energizes the motive flow valve after a 30 to 60-second time delay provided to prevent cycling of the motive flow valve due to sloshing fuel. In the event of a failure of the motive flow valve or the associated control circuitry, the loss of motive flow pressure when there is still fuel remaining in the auxiliary fuel tank is sensed by a pressure switch and a float switch, respectively, which illuminates a light, placarded **#1** or **#2 NO FUEL XFR,** on the annunciator panel. During engine start, the pilot should note that the **NO FUEL XFR** lights extinguish 30 to 50 seconds after engine start. The **NO FUEL XFR** lights will not illuminate if auxiliary tanks are empty. A manual override is incorporated as a backup for the automatic transfer system. This is initiated by placing the **AUX TRANSFER** switch, located in the fuel management panel, to the **OVERRIDE** C D T1 position or the **AUX XFER** switch to the **OVRD** position T2 . Refer to Figure 2-19. This will energize the transfer control motive flow valve. The transfer system is protected by 5-ampere circuit breakers, placarded **AUXILIARY TRANSFER #1** or **#2**, located on the overhead circuit breaker panel, Figure 2-16.

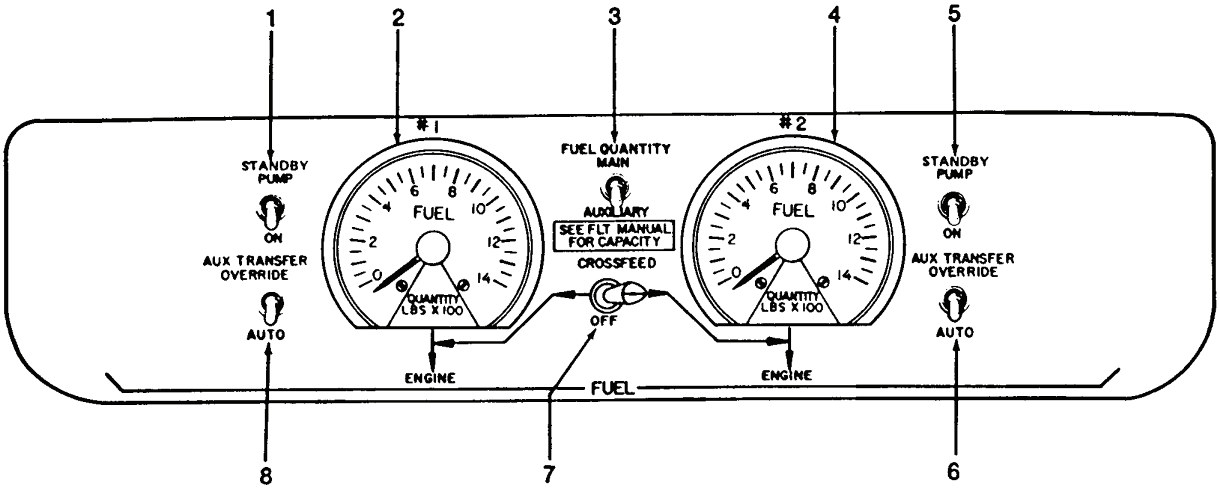
e. Fuel Gauging System. The total fuel quantity in the left or right main system or left or right auxiliary tank is measured by a capacitance type fuel gauging system. Two fuel gauges, one for the left and one for the right fuel system, read fuel quantity in pounds. Refer to Section XII for fuel capacities and weights. The system is compensated for fuel density changes due to temperature excursions. In addition to the fuel gauges, yellow **#1** or **#2 NAC LOW** lights on the caution/advisory annunciator panel illuminate when there is approximately 153 pounds C or 247 pounds D T of usable fuel per engine remaining. The fuel gauging system is protected by individual 5-ampere circuit breakers, placarded **QTY IND** and **QTY WARN #1** or **#2**, located on the overhead circuit breaker panel.

f. Fuel Management Panel. The fuel management panel is located on the cockpit overhead between the pilot and copilot. It contains the fuel gauges, standby fuel pump switches, crossfeed valve switch, fuel gauging system control switch and transfer control switches. Refer to Figure 2-19.

(1) Fuel Gauging System Control Switch. A switch on the fuel management panel, placarded **FUEL QUANTITY MAIN / AUXILIARY**, controls the fuel gauging system. When in the **MAIN** position, the fuel gauges read the total fuel quantity in the left and right wing fuel system. When in the **AUXILIARY** position, the fuel gauges read the fuel quantity in the left and right auxiliary tanks only.

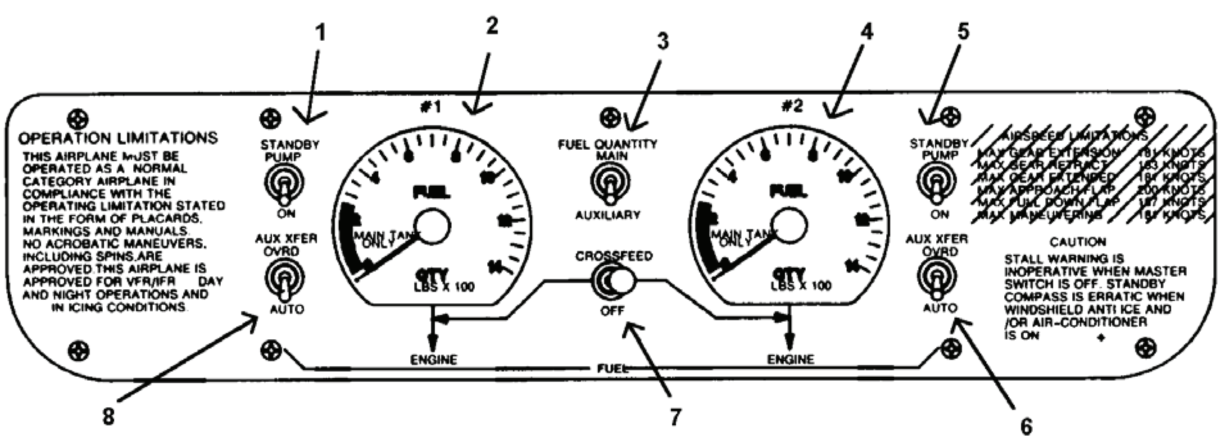
(2) Standby Fuel Pump Switches. Two switches, placarded **STANDBY PUMP ON** located on the fuel management panel, control a submerged fuel pump located in the corresponding nacelle tank. During normal aircraft operation, both switches are off so long as the engine-driven boost pumps function and during crossfeed operation. The loss of fuel pressure, due to failure of an engine-driven boost pump, will illuminate the **MASTER WARNING** light on the glareshield and will illuminate the **#1 FUEL PRESS** or **#2 FUEL PRESS** on the warning annunciator panel, Figure 2-17. Turning **ON** the **STANDBY PUMP** will extinguish the **FUEL PRESS** lights. The **MASTER WARNING** light must be manually cleared.

(3) Each ferry fuel tank has a 10-foot 1/4-inch flex hose with a quick drain installed in the aft end. When the ferry fuel system is in use, the preflight inspection also includes draining a small amount of fuel from these drains to drain off any moisture that may have been inadvertently introduced into the tanks. Place the aft end of the hoses out through the cabin entrance door, hold a fuel-proof container under the ends, and drain about a pint of fuel out of each line.



1. Standby Fuel Pump Switch (#1 Engine) Override
2. Fuel Quantity Indicator (#1 Engine)
3. Fuel Quantity Gauging System Control Switch
4. Fuel Quantity Indicator (#2 Engine)
5. Standby Fuel Pump Switch (#2 Engine)
6. Auxiliary Fuel Transfer Pump Override Switch (#2 Engine)
7. Crossfeed Valve Switch
8. Auxiliary Fuel Transfer Pump Override Switch (#1 Engine)

Figure 2-19. Fuel Management Panel **C D T1** *(Sheet 1 of 2)*



1. Standby Fuel Pump Switch (#1 Engine) Override
2. Fuel Quantity Indicator (#1 Engine)
3. Fuel Quantity Gauging System Control Switch
4. Fuel Quantity Indicator (#2 Engine)
5. Standby Fuel Pump Override Switch (#2 Engine)
6. Auxiliary Fuel Transfer Pump Override Switch (#2 Engine)
7. Crossfeed Valve Switch
8. Auxiliary Fuel Transfer Pump Override Switch (#1 Engine)

Figure 2-19. Fuel Management Panel **T2** *(Sheet 2 of 2)*

NOTE

Both switches shall be off during crossfeed operation.

(4) Fuel Transfer Control Switches. Two switches, placarded **AUX TRANSFER OVERRIDE / AUTO** **C D T1** and **AUX XFER OVRD / AUTO** **T2** , on the fuel management panel control operation of the fuel transfer pumps. During normal operation, both switches are in **AUTO,** which allows the pump to be automatically actuated by fuel flow to the engine. If either transfer system fails to operate, the fault condition is indicated by two illuminated **MASTER CAUTION** lights on the glareshield and a steady illuminated yellow **#1** or **#2 NO FUEL XFR** light on the caution annunciator panel.

(5) Fuel Crossfeed Switch. The fuel crossfeed valve is controlled by a 3-position switch located on the fuel management panel, placarded **CROSSFEED OFF**. Under normal flight conditions the switch is left in the **OFF** position. During single engine operation, it may become necessary to supply fuel to the operative engine from the fuel system on the opposite side. The crossfeed system is placarded for fuel selection with a simplified diagram on the overhead fuel control panel. Place the standby fuel pump switches in the off position when crossfeeding. A lever lock switch, placarded **CROSSFEED**, is moved from the center **OFF** position to the left or to the right, depending on direction of fuel flow, to energize the crossfeed valve and energize the standby pump on the side from which crossfeed is desired. During crossfeed operation, auxiliary tank fuel will not crossfeed if the **FUEL FIREWALL** valve is closed. When the crossfeed mode is energized, a green **FUEL CROSSFEED** light on the caution/advisory panel, Figure 2-17, will illuminate. Crossfeed system operation is described in Chapter 9. The crossfeed valve is protected by a 5-ampere circuit breaker, placarded **CROSSFEED VALVE**, located on the overhead circuit breaker panel.

g. Firewall Shutoff Valves.

CAUTION

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

The fuel system incorporates a fuel line shutoff valve on each engine firewall. The firewall shutoff valves close automatically when the fire extinguisher T handles on the instrument panel are pulled out. The firewall shutoff valves receive electrical power from the main buses and also from the battery bus, which is connected directly to the battery. The valves are protected by circuit breakers, placarded **FIREWALL VALVE #1** or #**2**, on the overhead circuit breaker panel, Figure 2-16, and **FIREWALL SHUTOFF #1** or #**2** on the hot battery bus circuit breaker board.

h. Fuel Tank Sump Drains. A sump drain wrench is provided in the aircraft loose tools to simplify draining a small amount of fuel from the sump drain.

(1) There are five sump drains and one filter drain in each wing. Refer to Table 2-4 for their locations.

Table 2-4. Drains and Their Locations

DRAIN	LOCATION
Leading edge tank	Outboard of nacelle underside of wing
Integral tank	Underside of wing forward of aileron
Firewall fuel filter	Underside of cowling forward of firewall
Sump strainer	Bottom center of nacelle forward of wheel well
Gravity feed line	Aft of wheel well
Aux tank	At wing root just forward of the flap

(2) An additional drain for the extended range fuel system line extends through the bottom of the wing center section adjacent to the fuselage. Anytime the extended range system is in use, a part of the preflight inspection would consist of draining a small amount of fuel from this drain to check for fuel contamination. Whenever the extended range system is removed from the aircraft and the fuel line is capped off in the fuselage, the remaining fuel in the line shall be drained.

(3) Each ferry fuel tank has a 10-foot 1/4-inch flex hose with a quick drain installed in the aft end. When the ferry fuel system is in use, the preflight inspection also includes draining a small amount of fuel from these drains to drain off any moisture that may have been inadvertently introduced into the tanks. Place the aft end of the hoses out through the cabin

entrance door, hold a fuel-proof container under the ends, and drain about a pint of fuel out of each line.

i. Fuel Drain Collector System C D . Each engine is provided with a fuel drain collector system to return fuel, dumped from the engine during clearing and shutdown operations, back into its respective nacelle tank. The system draws power from the 4 feeder bus and fuel transfer is completely automatic. Fuel from the engine flow divider drains into a collector tank mounted below the aft engine accessory section. An internal float switch actuates an electric scavenger pump, which delivers the fuel to the fuel purge line just aft of the fuel purge shutoff valve. A check valve in the line prevents the backflow of fuel during engine purging. The circuit breaker for both pumps is located in the fuel section of the overhead circuit breaker panel, placarded **SCAVENGER PUMP**. A vent line, plumbed from the top of the collector tank, is routed through an inline flame arrester and then downward to a drain manifold on the underside of the nacelle.

j. Fuel Purge System T . Each engine is provided with a fuel purge system. The system is designed to ensure that any residual fuel in the fuel manifolds is consumed during engine shutdown. During engine operation, compressor discharge air is routed through a filter and check valve, pressurizing a small air tank mounted on the engine truss mount. During engine shutdown, the pressure differential between the air tank and fuel manifolds causes air to be discharged from the air tank through a check valve and into manifolds out through the nozzles and into the combustion chamber. The fuel forced into the combustion chamber is consumed causing a momentary rise in engine speed.

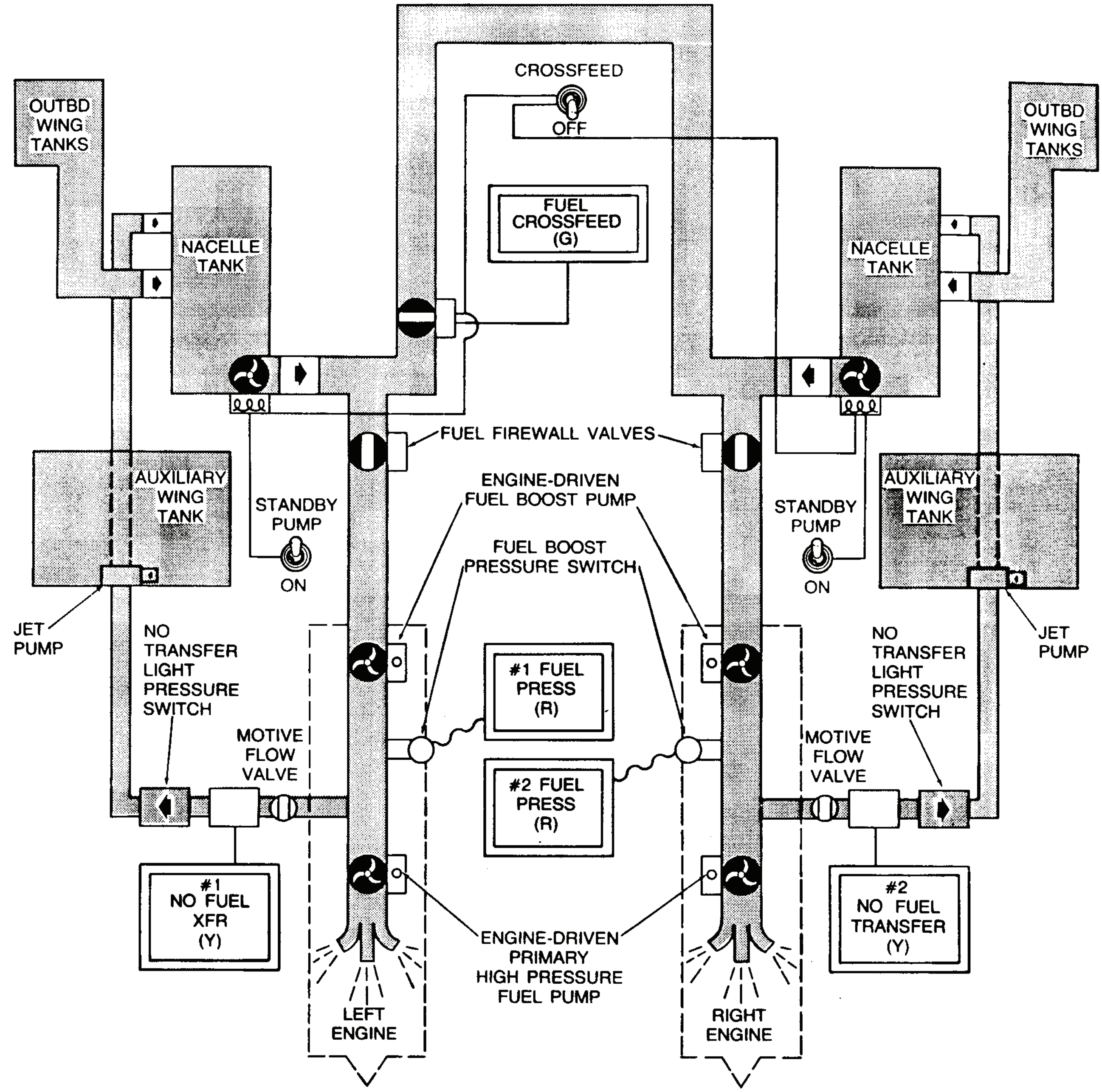
k. Fuel Vent System. Each fuel system is vented through two ram vents located on the underside of the wing adjacent to the nacelle. To prevent icing of the vent system, one vent is recessed into the wing and the backup vent protrudes out from the wing and contains a heating element. The vent line at the nacelle contains an inline flame arrester.

l. Engine Oil-to-Fuel Heat Exchanger. An engine oil-to-fuel heat exchanger, located on each engine accessory case, operates continuously and automatically to heat the fuel delivered to the engine sufficiently to prevent the freezing of any water, which the fuel might contain. The temperature of the delivered fuel is thermostatically regulated to remain between +21 °C and +32 °C.

2-42. FUEL SYSTEM MANAGEMENT.

a. Fuel Transfer System. Fuel in the auxiliary tanks will be used first. During transfer of auxiliary fuel, which is automatically controlled, the nacelle tanks are maintained full. A swing check valve in the gravity feed line from the outboard wing prevents reverse fuel flow. Normal gravity transfer of the main wing fuel into the nacelle tanks will begin when auxiliary fuel is exhausted. The system will gravity feed fuel only to its respective side, i.e. left or right. Refer to Figure 2-20. Fuel will not gravitate through the crossfeed system.

b. Operation with Failed Engine-Driven Boost Pump or Standby Pump. Two pumps in each fuel system provide inlet head pressure to the engine-driven primary high-pressure fuel pump, and if crossfeed is used, a third pump, the standby fuel pump from the opposite system, will supply the required pressure. Refer to Figure 2-21. Operation under this condition will result in an unbalanced fuel load as fuel from one system will be supplied to both engines while all fuel from the system with the failed engine driven and standby boost pumps will remain unused. A triple failure, which is highly unlikely, would result in the engine driven primary pump operating without inlet head pressure. Should this situation occur, the affected engine can continue to operate from its own fuel supply on its engine-driven primary high-pressure fuel pump.



NOTE

IN THE EVENT THAT AN ENGINE DRIVEN BOOST PUMP FAILS, PRESSURE CAN BE MAINTAINED BY PLACING THE RESPECTIVE STANDBY PUMP SWITCH TO ON.

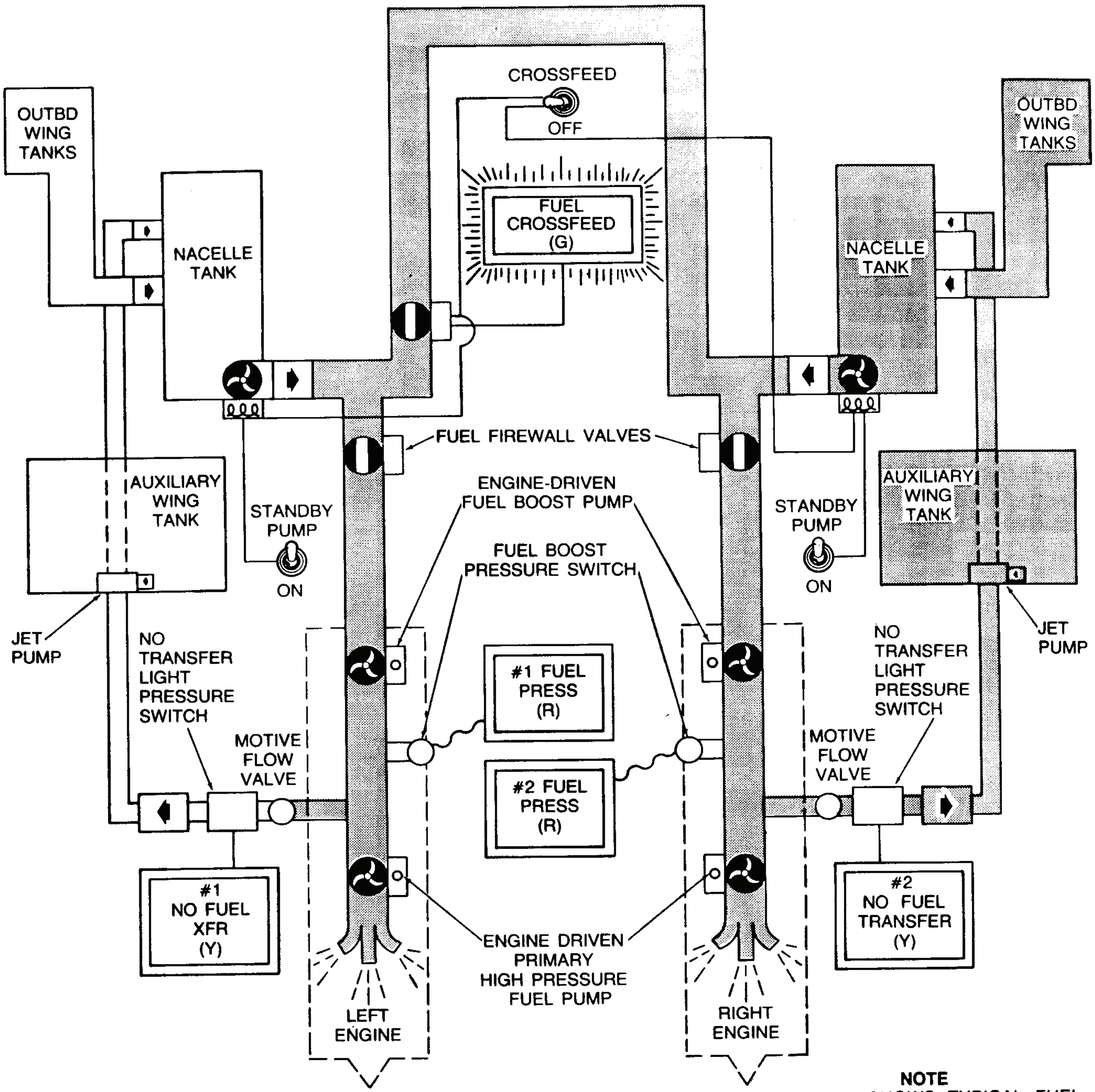
NOTE

THE ENGINE-DRIVEN PRIMARY (HIGH PRESSURE) FUEL PUMP IS LIMITED TO 10 HOURS OF OPERATION, THROUGHOUT ITS TBO PERIOD, WITHOUT STANDBY FUEL PUMP OR ENGINE-DRIVEN BOOST PUMP FUEL PRESSURE.

NOTE

THE SYSTEM WILL GRAVITY FEED FUEL ONLY TO ITS RESPECTIVE BOOST PUMP, I.E., LEFT OR RIGHT. FUEL WILL NOT GRAVITY FEED THROUGH THE CROSSFEED SYSTEM.

Figure 2-20. Gravity Feed Fuel Flow



NO FUEL FLOW FROM LEFT WING TANKS

NORMAL PRESSURIZED FUEL FLOW FROM RIGHT WING TANKS

NOTE

BOTH STANDBY PUMP SWITCHES WILL BE OFF DURING CROSSFEED OPERATION.

NOTE

THE ENGINE-DRIVEN PRIMARY (HIGH PRESSURE) FUEL PUMP IS LIMITED TO 10 HOURS OF OPERATION THROUGHOUT ITS TBO PERIOD WITHOUT STANDBY FUEL PUMP OR ENGINE-DRIVEN BOOST PUMP FUEL PRESSURE.

NOTE

DIAGRAM SHOWS TYPICAL FUEL CROSSFEED SITUATION WITH RIGHT WING FUEL SYSTEM SUPPLYING BOTH ENGINES (ALL BOOST AND STANDBY PUMPS OPERABLE). FOR SELECTION OF LEFT WING FUEL FOR CROSSFEED REVERSE CROSSFEED SWITCH POSITION. EITHER CONFIGURATION WILL SUPPLY EITHER ENGINE DURING SINGLE-ENGINE OPERATIONS. FUEL WILL NOT CROSSFEED BETWEEN TANK SYSTEMS.

Figure 2-21. Crossfeed Fuel Flow

2-43. FERRY FUEL SYSTEM.

NOTE

The ferry fuel system is installed in the aircraft for the specified ferry flight only.

a. Ferry Fuel System. The ferry fuel system consists of two 120-gallon aluminum fuel tanks, a ferry fuel system control assembly, and a 115-cubic foot oxygen bottle. The ferry fuel tanks each contain an electric rotary pump and a manual wobble pump for pumping fuel to the nacelle tank. The fuel tanks are mounted on the left and right side seat tracks on each side of the cabin, the fuel control assembly is mounted across the aisle directly behind the pilot and copilot seats, and the add on oxygen bottle is mounted on the aft baggage compartment floor. Permanently installed provisions for connecting the ferry fuel system to the nacelle tank are included in the fuel system. The provisions consist of manually operated shutoff valves in each wheel well, a fuel drain, and fuel lines which are routed from each wing to the nacelle tank. The fuel drain, located on the underside of the wing center section adjacent to the fuselage, should be drained after each use of the ferry fuel system. The ferry tanks are connected to fuel lines that lead to the nacelle tank.

b. Ferry Fuel Transfer.

CAUTION

When ferry fuel is transferred with the aircraft pressurized, the ferry fuel will be transferred rapidly due to the cabin pressure differential. The rapid transfer of fuel occurs when any ferry fuel tank selector valve and any aircraft fuel tank selector valve is open and doesn't require operating either the electric fuel pumps or the manual wobble pump. The one-way check valve in the surge tank, marked IN, equalizes the cabin pressure and the air pressure over the fuel in the ferry fuel tanks. Opening the selector valves, as noted above, opens a path for the fuel to the main aircraft fuel tanks, which have only ambient pressure over the fuel. Cabin pressure will force the fuel out of the ferry fuel tanks into the aircraft main fuel tanks, i.e., from the pressurized area into the unpressurized area.

NOTE

Transfer of fuel from either of the ferry fuel tanks first will not affect the aircraft center of gravity.

(1) In preparation for transfer of fuel from the ferry fuel tanks to the nacelle fuel tanks, use fuel from both nacelle fuel tanks until each is about half full. Open the desired ferry fuel selector valve and open either or both fuel tank selector valve(s).

CAUTION

If either of the aircraft fuel tanks seems to be nearing the full mark before the other, discontinue fuel transfer and level the tanks in accordance with the approved Pilots' Operating Handbook before resuming fuel transfer again.

(2) Turn on either or both ferry fuel pump(s) to transfer fuel to the nacelle fuel tank(s). Monitor the quantity of fuel in the nacelle fuel tanks and discontinue ferry fuel transfer when the nacelle fuel tanks near the full mark to prevent venting fuel overboard.

(3) Observe the fuel-flow sight gauge in the line from the ferry fuel pump to the fuel tank selector valves for air bubbles. When air bubbles begin to appear in the sight gauge, you may assume that the selected ferry fuel tank is empty. As each ferry fuel tank reaches empty, close that selector valve and either select the other tank and/or turn off the transfer pump(s). When the ferry fuel system is depleted, securely close all selector valves and turn off the transfer pumps.

Section V. FLIGHT CONTROLS

2-44. DESCRIPTION.

The aircraft's primary flight control system consists of conventional rudder, elevator and aileron control surfaces. These surfaces are manually operated from the cockpit through mechanical linkage using control wheels for the ailerons and elevators, and adjustable rudder/brake pedals for the rudder. Both the pilot and copilot have flight controls. Trim control for the rudder, elevator and ailerons is accomplished through a manually actuated cable-drum system for each set of control surfaces. The autopilot has provisions for controlling the position of the ailerons, elevators, elevator trim tab, and rudder. Chapter 3 describes operation of the autopilot system.

2-45. CONTROL WHEELS.

a. Elevator And Aileron Control Surfaces C D1 . Elevator and aileron control surfaces are operated by manually actuating either the pilot's or copilot's control wheel. Electric switches are installed in the outboard grip of each wheel to operate the elevator trim tabs. These control wheels are installed on each side of the instrument subpanel. A microphone switch is incorporated in each control wheel. A manual wind 8-day clock is installed in the center of each wheel. A map light switch is mounted adjacent to the clock in each wheel. Refer to Figure 2-22, Sheet 1.

b. Elevator And Aileron Control Surfaces D2 . Elevator and aileron control surfaces are operated by manually actuating either the pilot's or copilot's control wheel, or through the automatic flight control system. Electric switches are installed in the grips of the control wheels to operate the elevator trim tabs; to disengage the autopilot yaw damp; to activate the go-around mode (copilot only); press to talk microphone switch; touch control steering and checklist line advancement. A manual wind 8-day clock is installed in the center of each wheel. A map light switch is mounted adjacent to the clock in each wheel. Refer to Figure 2-22, Sheet 2.

c. Elevator And Aileron Control Surfaces T1. Elevator and aileron control surfaces are operated by manually actuating either the pilot's, or copilot's control wheel, or through the automatic flight control system. Electric switches are installed in the grips of the control wheels. The microphone, electric elevator trim, and autopilot/yaw damp disconnect switches are located on the outboard grip of each control wheel. Only a line advance switch is located on the inboard grip of the pilot's wheel. A line advance switch, and a touch control steering switch is located on the inboard grip of the copilot's wheel. A touch control steering switch is located on the outboard grip of the pilot's control wheel. A manually wound 8-day clock is installed in the center of the pilot's wheel, whereas a DC powered digital clock/timer is installed in the center of the copilot's wheel. A map light switch is mounted adjacent to the clock in each wheel, Figure 2-22, Sheet 3.

d. Elevator And Aileron Control Surfaces T2 . Elevator and aileron control surfaces are operated by manually actuating either the pilot's or copilot's control wheel, or through the automatic flight control system. Electric switches are installed in the grips of the control wheels. The microphone, electric elevator trim, touch control steering (pilot's control wheel), go-around (copilot's control wheel), and autopilot/yaw damp disconnect button/switches are located on the outboard grip of each control wheel. An ident button (pilot's control wheel), map button, and touch control button (copilot's control wheel) are located on the inboard grip. Both control wheels contain identical DC powered digital clock/timers. Each control wheel incorporates a bracket to allow mounting a chart holder, Figure 2-22, Sheet 4.

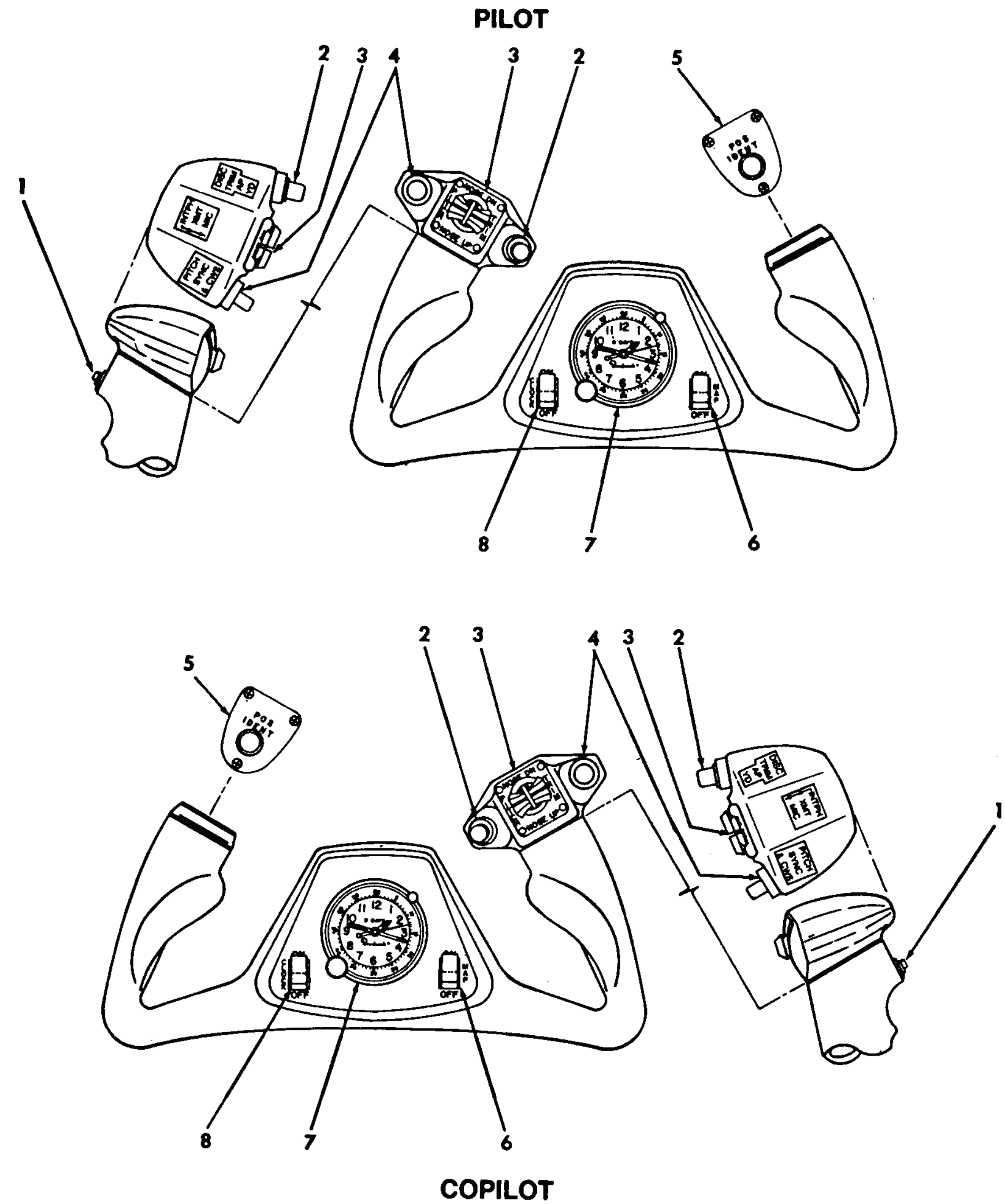
e. Control Wheel Chart Holder T2 . An illuminated, quick release chart holder is provided and can be installed on either the pilot's or copilot's control wheel. The chart holder provides a means of securing charts, maps, or small handbooks in an easily accessible and visible location. An L-shaped bracket assembly with a stud-type latch fastener secures the control wheel chart holder to the control wheel. Illumination for reading charts, maps, or handbooks is provided by an adjustable lightbar mounted on the left side of the chart holder. Lights for reading the two digital clocks are located above each clock. Lightbar and clock lights are illuminated by pressing the control wheel map light switch.

When the chart holder is installed the control wheel clock is not visible. However, a battery powered clock/stopwatch and digital timer are provided as part of the chart holder assembly. The clock/stopwatch, located on the upper left portion of the chart holder, indicates 12 (AM/PM) or 24 hour time/date/month/ and may also be used as a stopwatch. The 12 hour time is indicated by an AM or PM flag located on the left side of the display. The digital timer, located on the upper right, serves as a digital stopwatch/elapsed time timer. Pressing the mode select button on the back of the chart holder clamp initiates the clock set, and 12 or 24 hour mode. The **SELECT** and **SET** buttons on the chart holder face are used to set the time, date, and month.

The **START/STOP** button on the chart holder face is used to start and stop the digital timer. The **RESET/LAP** button is used to reset the timer to zero, and/or to read elapsed time. Rheostat-type dimmer switches, located behind the clock and timer, regulates light intensity for the lightbar and clocks. The left rheostat controls the lightbar intensity, whereas the right rheostat controls illumination for the clocks.

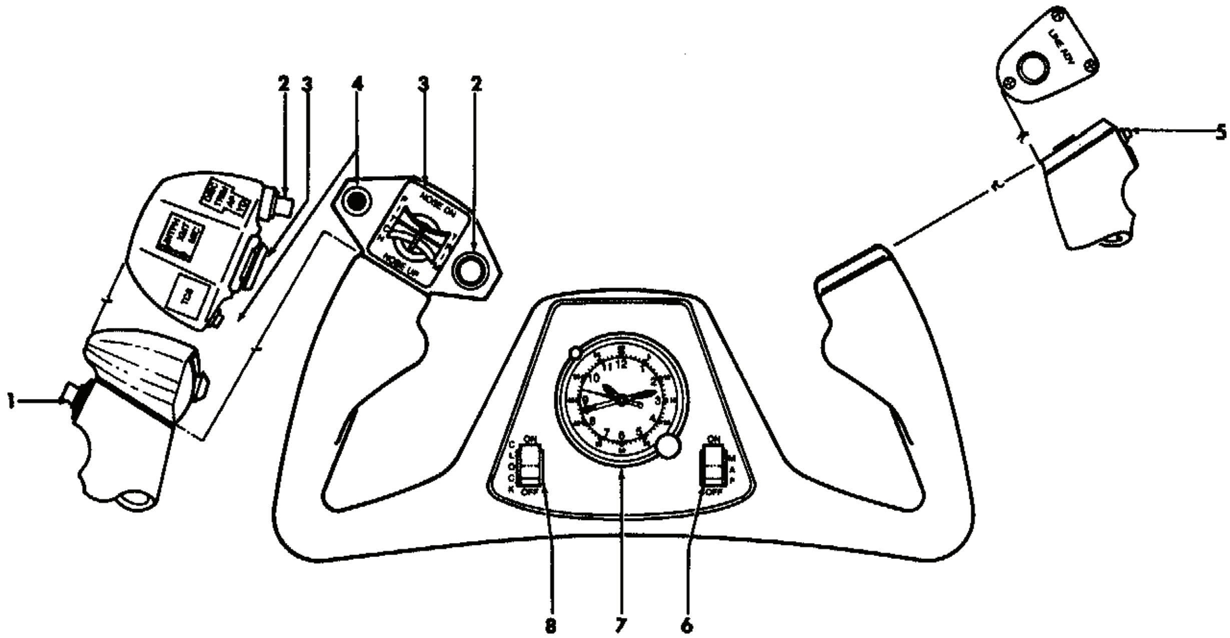
A power cable supplies electrical power to the chart holder lights when the power cable plug is inserted in the power outlet on either the pilot's or copilot's control wheel. The chart holder electrical circuit is protected through a circuit breaker, placarded **SUBPNL & CONSOLE**, located on the overhead circuit breaker panel. The clocks operate separately from aircraft power.

The chart holder may be removed from the control wheel and stored as required, however, the mounting brackets remain secured to the control wheels.



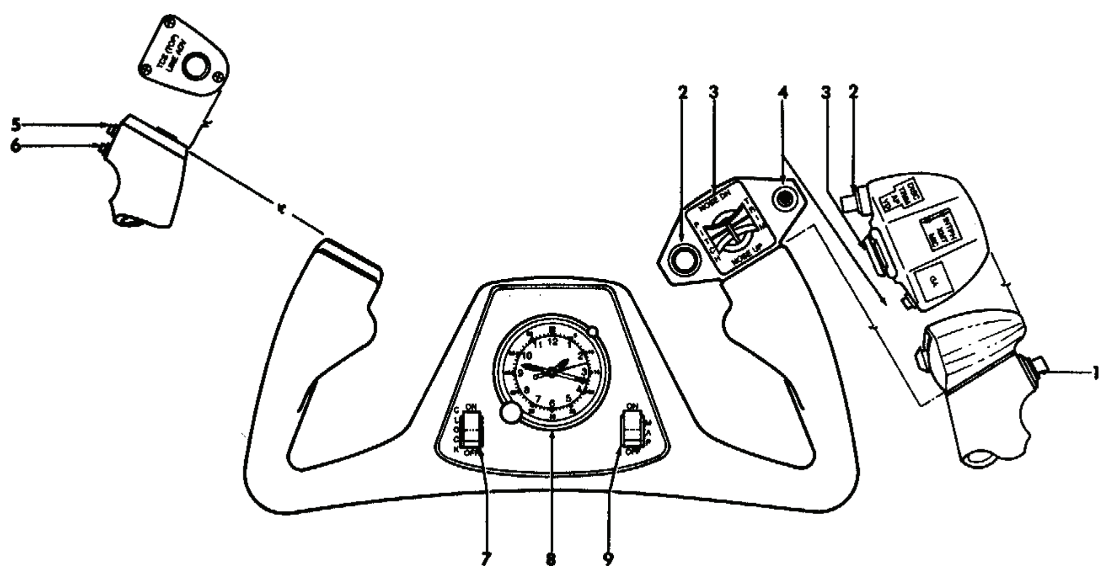
1. Microphone Switch
2. Autopilot/Yaw Damp Disconnect
3. Electric Trim Control Switches
4. Pitch Sync and Control Wheel Steering Switch
5. Transponder Indent Switch
6. Map Light Switch
7. 8-Day Clock
8. Clock Light Switch

Figure 2-22. Control Wheels **C D1** *(Sheet 1 of 4)*



PILOT

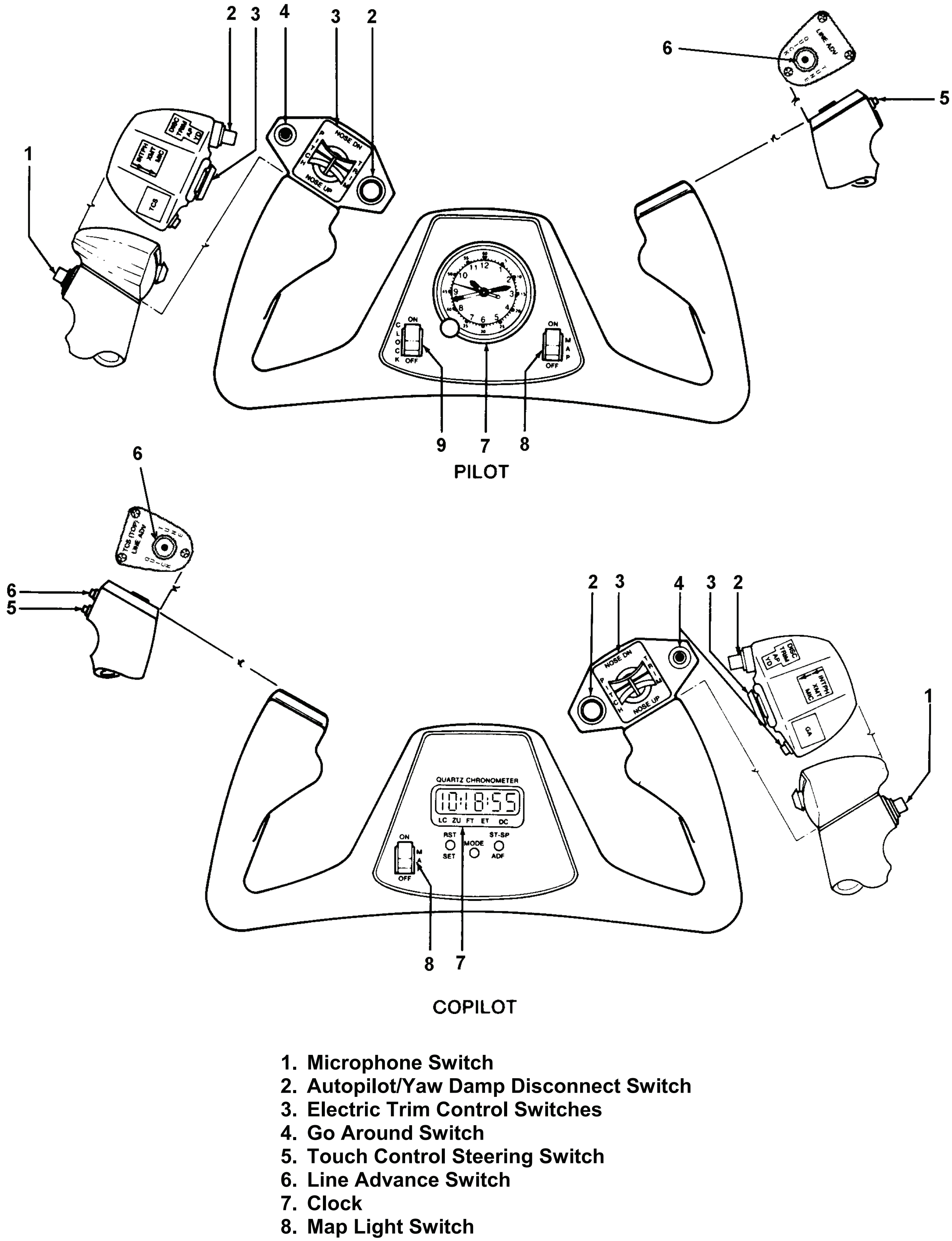
1. Microphone Switch
2. Autopilot/Yaw Damp Disconnect Switch
3. Electric Trim Control Switches
4. Touch Control Steering Switch
5. Line Advance Switch
6. Map Light Switch
7. 8-Day Clock
8. Clock Light Switch



COPILOT

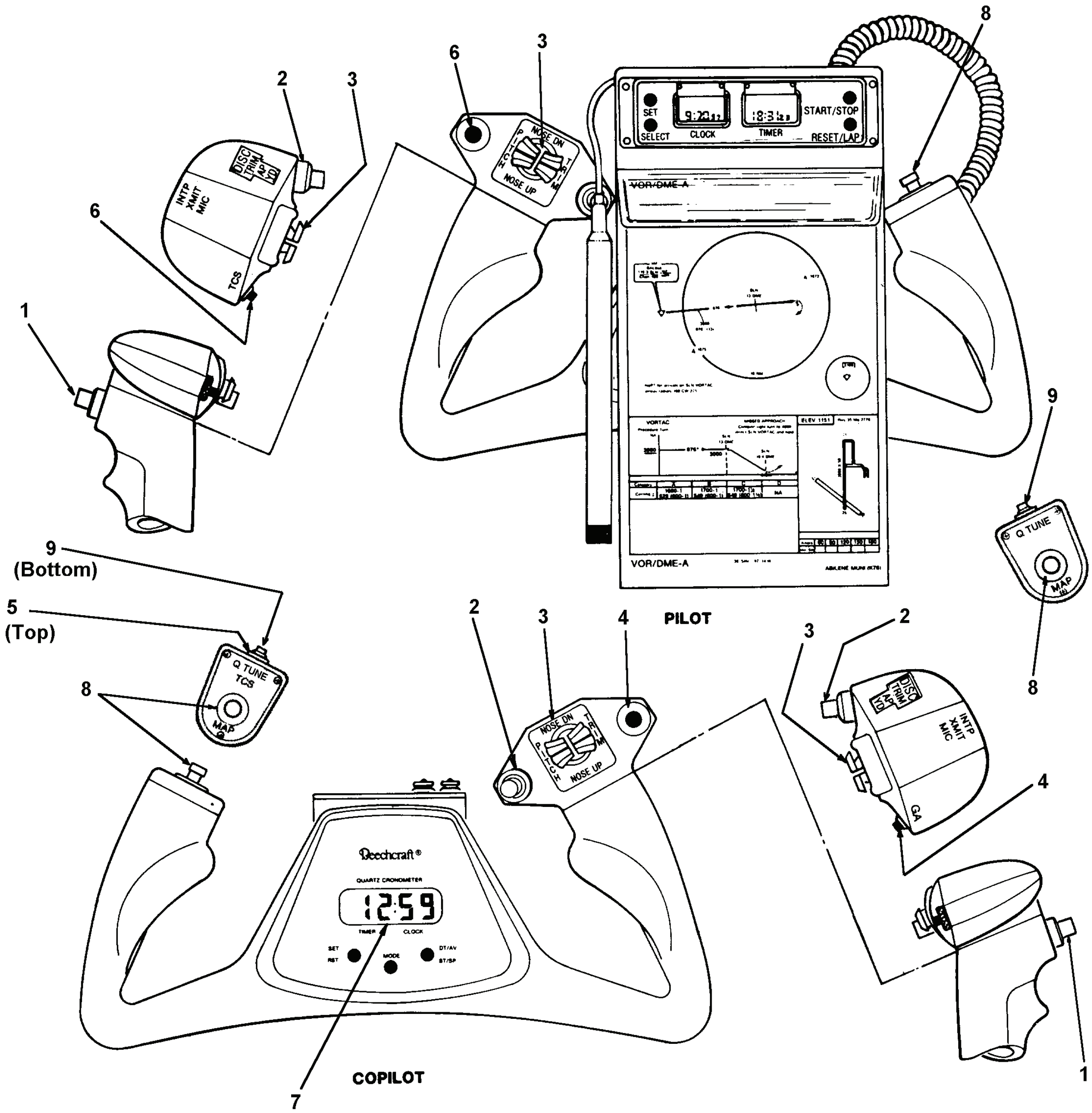
1. Microphone Switch
2. Autopilot/Yaw Damp Disconnect Switch
3. Electric Trim Control Switches
4. Go Around Switch
5. Touch Control Steering Switch
6. Line Advance Switch
7. Clock Light Switch
8. 8-Day Clock
9. Map Light Switch

Figure 2-22. Control Wheels **D2** *(Sheet 2 of 4)*



1. Microphone Switch
2. Autopilot/Yaw Damp Disconnect Switch
3. Electric Trim Control Switches
4. Go Around Switch
5. Touch Control Steering Switch
6. Line Advance Switch
7. Clock
8. Map Light Switch
9. Clock Light Switch

Figure 2-22. Control Wheels **T1** *(Sheet 3 of 4)*



1. Microphone Switch
2. Autopilot/Yaw Damp Disconnect Switch
3. Electric Trim Control Switches
4. Go Around Switch
5. Touch Control Steering Switch
6. Line Advance Switch
7. Clock
8. Map Light Switch
9. Quick Tune Switch

Figure 2-22. Control Wheels **T2** *(Sheet 4 of 4)*

2-46. RUDDER SYSTEM.

a. Rudder Pedals. Aircraft directional control and nose wheel steering is accomplished by actuation of the rudder pedals from either pilot's or copilot's station, Figure 2-10. The rudder pedals may be individually adjusted in either a forward or aft position to provide adequate legroom for the pilot and copilot. Adjustment is accomplished by pressing the lever alongside the rudder pedal arm and moving the pedal forward or aft until the locking pin engages in the selected position. Toe brake coverage, is provided in Paragraph 2-9.

b. Yaw Damper. A yaw damper system is provided to aid the pilot in maintaining direction stability and increase ride comfort. The system may be used at any altitude and is required for flight above 17,000 feet for aircraft without dual aft body strakes. It must be deactivated for takeoff and landing and below 200 feet above terrain. The yaw damper system is a part of the autopilot. Operating instructions for this system are contained in Chapter 3. The system is controlled by a yaw damp switch adjacent to the **ELEV TRIM** switch on the extended pedestal.

c. Rudder Boost. Rudder boost is provided to aid the pilot in maintaining directional stability resulting from an engine failure or a large variation of power between the engines. Incorporated in the rudder cable system are two pneumatic rudder boosting servos that actuate the cables to provide rudder pressure to help compensate for asymmetrical thrust. Rudder boost is not required for flight.

NOTE

Rudder boost may be inoperative when brake deice is on.

(1) During operation, a differential pressure valve accepts bleed air pressure from each engine. When the pressure varies between the bleed air systems, the shuttle in the differential pressure valve moves toward the low pressure side. As the pressure difference reaches a preset tolerance, a switch closes on the low pressure side which activates the rudder boost system. This system is designed only to help compensate for asymmetrical thrust. Appropriate trimming is to be accomplished by the pilot. Moving either or both of the **BLEED AIR VALVE** switches on the overhead control panel to **PNEU & ENVIRO - OFF** **C D T1** and the **ENVIR & PNEU BLEED AIR** **T2** to the off position will disengage the rudder boost system.

NOTE

Condition levers must be in LOW IDLE position to perform rudder boost check.

(2) The system is controlled by a switch located on the extended pedestal below the rudder trim wheel, placarded **RUDDER BOOST / OFF**, and is to be turned on before flight. A preflight check of the system can be performed during the run up by retarding the power on one engine to idle and advancing power on the opposite engine until the power difference between the engines is great enough to activate the switch to turn on the rudder boost system. Movement of the appropriate rudder pedal (left engine idling, right rudder pedal moves forward) will be noted when the switch closes, indicating the system is functioning properly for low engine power on that side. Repeat the check with opposite power settings to check for movement of the opposite rudder pedal. The system is protected by a 5-ampere circuit breaker on the overhead circuit breaker panel, placarded **RUDDER BOOST**.

2-47. FLIGHT CONTROL LOCK.

CAUTION

Remove control locks before towing the aircraft or starting engines. Serious damage could result in the steering linkage if towed by a tug with the rudder lock installed.

Positive locking of the rudder, elevator and aileron control surfaces, and engine controls (power levers, propeller levers and condition levers) is provided by a removable lock assembly, Figure 2-23, consisting of two pins and an elongated U-shaped strap interconnected by a chain. Installation of the controls lock is accomplished by inserting the U-shaped strap around the aligned control levers from the copilot's side; then the aileron-elevator locking pin is inserted through a guide hole in the pilot's control column assembly, thus locking the control wheel. The rudder is held in a neutral position by an L-shaped pin, which is installed through a guide hole in the floor aft of the pilot’s rudder pedals. The rudder pedals must be centered to align the hole in the rudder bellcrank with the guide hole in the floor. Remove the locks in reverse order, i.e., rudder pin, control column pin, and power control clamp.

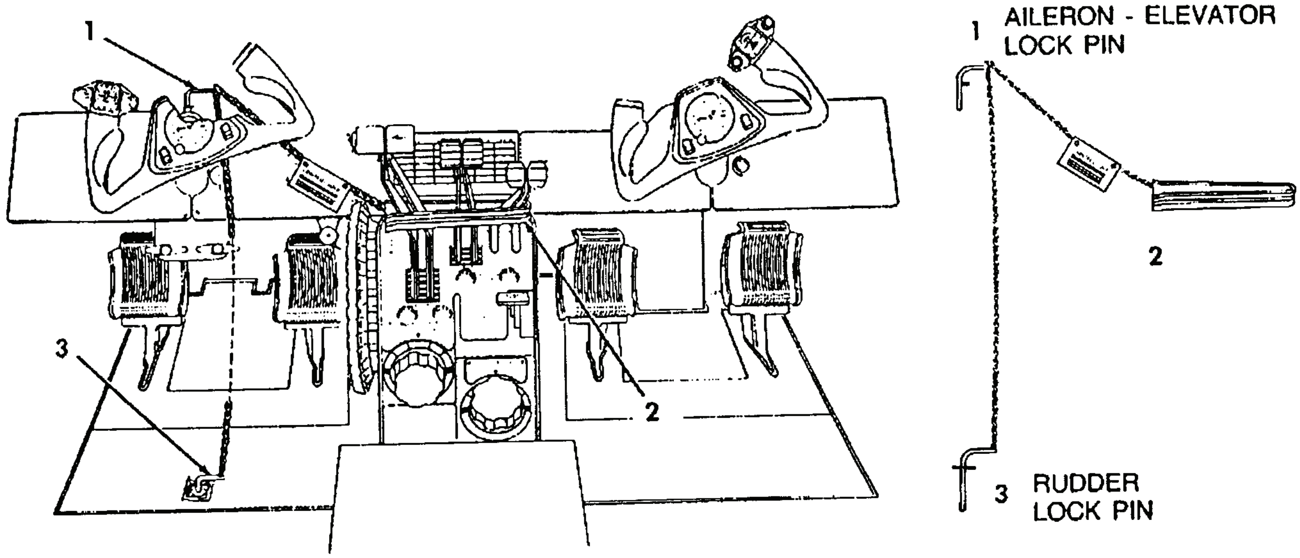


Figure 2-23. Control Lock Installation Typical

2-48. TRIM TABS.

Trim tabs are provided for all control surfaces. These tabs are manually activated and are mechanically controlled by a cable-drum and jack screw actuator system, except the right aileron tab, which is of the fixed bendable type. Elevator and aileron trim tabs incorporate neutral, non-servo action, i.e., as the elevators or ailerons are displaced from the neutral position, the trim tab maintains an "as adjusted" position. The rudder trim tab incorporates anti-servo action, i.e., as the rudder is displaced from the neutral position the trim tab moves in the same direction as the control surface. This action increases control pressure as rudder is deflected from the neutral position.

a. Elevator Trim Tab Control. The elevator trim tab control wheel, placarded **ELEVATOR TAB / DOWN / UP**, is on the left side of the control pedestal and controls a trim tab on each elevator, Figures 2-7 and 2-9. The amount of elevator tab deflection, in degrees from a neutral setting, is indicated by a position arrow.

b. Electric Elevator Trim. The electric elevator trim system is controlled by an **ELEV TRIM PUSH ON / PUSH OFF** switch located on the pedestal, dual element thumb switches on the control wheels, a trim disconnect switch on each control wheel and a circuit breaker on the overhead circuit breaker panel. The **PUSH ON / PUSH OFF** switch must be in the **ON** position to operate the system. The dual element thumb switch is moved forward for trimming nose down, aft for nose up, and when released returns to the center (off) position. Any activation of the trim system through the copilot's trim switch can be cancelled by activation of the pilot's switch. Operating the pilot's and copilot's switches in opposing directions simultaneously results in no trim action. Operating the pilot's and copilot's switches in opposing directions simultaneously results in the pilot having priority (D2 T Series only). A preflight check of the switches should be accomplished before flight by moving the switches individually on both control wheels. No one switch alone should operate the system; operation of elevator trim should occur only by movement of pairs of switches. The trim system disconnect is a bi-level, push button, momentary type switch, located on the outboard grip of each control wheel. Pressing the switch to the first of two levels disconnects the autopilot and yaw damp system, and the second level disconnects the electric trim system. The system can be reset by pressing the **ON / OFF** switch on the pedestal to **ON** again. The manual trim control wheel and the electric trim system cannot be used simultaneously.

c. Aileron Trim Tab Control. The aileron trim tab control, placarded **AILERON TAB LEFT / RIGHT**, is on the control pedestal and will adjust the left aileron trim tab only. The amount of aileron tab deflection, from a neutral setting, as indicated by a position arrow, is relative only and is not in degrees. Full travel of the tab control moves the trim tab 7½° up and down.

d. Rudder Trim Tab Control. The rudder trim tab control knob, placarded **RUDDER TAB / LEFT / RIGHT**, is on the control pedestal, and controls adjustment of the rudder trim tab, Figures 2-7 and 2-9. The amount of rudder tab deflection, in degrees from a neutral setting, is indicated by a position arrow.

2-49. WING FLAPS.

The all-metal slot-type wing flaps are electrically operated and consist of two sections for each wing. These sections extend from the inboard end of each aileron to the junction of the wing and fuselage. During extension, or retraction, the flaps are operated as a single unit, each section being actuated by a separate jackscrew actuator. The actuators are driven through flexible shafts by a single, reversible electric motor. Wing flap movement, either up or down, is indicated in percent of travel by a flap position indicator on the subpanel. Full flap extension and retraction time is approximately 11 seconds. The flap control switch is located on the control pedestal. No emergency wing flap actuation system is provided. With flaps extended beyond **APPROACH** position regardless of power setting, the landing gear warning horn will sound, and the landing gear switch handle lights will illuminate unless the landing gear is down and locked. The circuit is protected by a 20-ampere circuit breaker, placarded **FLAP MOTOR**, located on the overhead circuit breaker panel, Figure 2-16.

a. Wing Flap Control Switch. Flap operation is controlled by a three-position switch with a flap-shaped handle on the control pedestal, Figure 2-7 and 2-9. The handle of this switch is placarded **FLAP** and switch positions are placarded **FLAP UP / APPROACH / DOWN**. The amount of downward extension of the flaps is established by position of the flap switch, and is as follows: **UP** – 0%, **APPROACH** – 40%, and **DOWN** – 100%. Limit switches, mounted on the right inboard flap, control flap travel. The flap control switch, limit switch, and relay circuits are protected by a 5-ampere circuit breaker, placarded **FLAP CONTR**, located on the overhead circuit breaker panel, Figure 2-16. Flap positions between **UP** and **APPROACH** cannot be selected. For intermediate flap positions between **APPROACH** and **DOWN**, the **APPROACH** position acts as an off position. To return the flaps to any position between full **DOWN** and **APPROACH** place the flap switch to **UP** and when desired flap position is obtained, return the switch to **APPROACH** detent. In the event that any two adjacent flap sections extend 3° to 5° out of phase with the other, a safety mechanism is provided to discontinue power to the flap motor.

b. Wing Flap Position Indicator. Flap position in percent of travel from "0" (**UP**) to 100% (**DOWN**), is shown on an indicator, placarded **FLAPS**, below the instrument panel, Figure 2-17. The **APPROACH** and full **DOWN** or extended flap position is 14° and 34°, respectively. The flap position indicator is protected by a 5-ampere circuit breaker, placarded **FLAP CONTR**, located on the overhead circuit breaker panel.

Section VI. PROPELLERS

2-50. DESCRIPTION.

A three-bladed aluminum propeller is installed on each engine. The propeller is of the full feathering, constant speed, counter-weighted, reversing type, controlled by engine oil pressure through single action, engine driven propeller governors. The propeller is flange mounted to the engine shaft. Centrifugal counterweights, assisted by a feathering spring, move the blades toward the low RPM (high pitch) position and into the feathered position. Governor boosted engine oil pressure moves the propeller to the high RPM (low pitch) hydraulic stop and reverse position. The propellers have no low RPM (high pitch) stops; this allows the blades to feather after engine shutdown. Low pitch propeller position is determined by the low pitch stop which is a mechanically actuated, hydraulic stop. Beta and reverse blade angles are controlled by the power levers in the beta and reverse range.

2-51. FEATHERING PROVISIONS.

The aircraft are equipped with both manual and automatic propeller feathering. Manual feathering is accomplished by pulling the corresponding propeller lever aft past a friction detent. To unfeather, the propeller lever is pushed forward into the governing range. An automatic feathering system will sense loss of torque oil pressure and will feather an unpowered propeller. Feathering springs will feather the propeller when it is not turning.

a. Automatic Feathering. The automatic feathering system provides a means of immediately dumping oil from the propeller servo to enable the feathering spring and counterweights to start feathering action of the blades in the event of an engine failure. Although the system is armed by a switch on the overhead control panel, placarded **AUTOFEATHER ARM / OFF / TEST**, the completion of the arming phase occurs when both power levers are advanced above 90% N_1 – at which time both indicator lights on the caution/advisory annunciator panel indicate a fully armed system. The annunciator panel lights are green and are placarded **1 AUTOFEATHER** (left eng) and **2 AUTOFEATHER** (right eng). The system will remain inoperative as long as either power levers is retarded below 90% N_1 position, unless **TEST** position of the **AUTOFEATHER** switch is selected to disable the power lever limit switches. The system is designed for use only during takeoff and landing and should be turned off when establishing cruise climb. During takeoff or landing, should the torque for either engine drop to an indication between 16-21 %, the autofeather system for the opposite engine will be disarmed. Disarming is confirmed when the **AUTOFEATHER** light of the opposite engine becomes extinguished. If torque drops further, to a reading between 9-14%, oil is dumped from a servo of the affected propeller allowing a feathering spring to move the blades into feathered position. Feathering also causes the **AUTOFEATHER** light of the feathered propeller to extinguish. At this time both annunciator **AUTOFEATHER** lights are extinguished, the propeller of the defective engine has feathered, and the propeller of the operative engine has been disarmed from the autofeathering capability. Only manual feathering control remains for the second propeller.

b. Propeller Autofeather Switch. Autofeathering is controlled by an **AUTOFEATHER** switch on the overhead control panel, Figure 2-15. The three position switch, placarded **ARM / OFF / TEST**, is spring-loaded from **TEST** to **OFF**. The **ARM** position is used only during takeoff and landing. At **ARM**, if engine torque drops below 16-21%, two torque-sensing switches of the affected engine are actuated by loss of torque pressure. Switch actuation applies current through an autofeather relay, to a corresponding dump valve, causing the release of oil pressure which held an established pitch angle on the blades of the affected propeller. Following the release of oil pressure, feathering movement is accomplished by the feathering springs assisted by centrifugal force applied to the blade shank counterweights. The **TEST** position enables the pilot to check readiness of the autofeather systems, below 88% to 92% N_1, and is for ground checkout purposes only. Chapter 8 contains normal operating information.

c. Autofeather Lights. Two green lights on the caution/advisory annunciator panel, placarded **AUTOFEATHER #1** and **#2**, when illuminated indicate that the autofeather system is armed. Both lights will be extinguished if either propeller has been autofeathered or if the system is disarmed by retarding a power lever. Autofeather circuits are protected by one 5-ampere circuit breaker, placarded **AUTOFEATHER**, located on the overhead circuit breaker panel, Figure 2-16.

2-52. PROPELLER GOVERNORS.

Two governors, a constant speed (primary) governor, and an overspeed governor, control the propeller RPM. The constant speed governor, mounted on top of the reduction housing, control the propeller through its entire range. The propeller control lever operates the propeller by means of this governor. If the constant speed governor should malfunction and request more than 2000 RPM, the overspeed governor activates at 2080 RPM and dumps oil from the propeller to keep the RPM from exceeding approximately 2120 RPM. A solenoid, actuated by the **PROP GOV TEST** **C D T1** and **GOVERNOR TEST / ON** **T2** switch located on the overhead control panel, is provided for resetting the overspeed governor to approximately 1830 to 1910 RPM for test purposes. If the propeller sticks or moves too slowly during a transient condition causing the propeller governor to act too slowly to prevent an overspeed condition, the power turbine governor, contained within the constant speed governor housing, acts as a fuel topping governor. When the propeller RPM reaches 2120, the fuel topping governor limits the fuel flow to the gas generator, thereby reducing the power driving the propeller. During operation in the reverse range, the power turbine governor is reset to approximately 95% propeller RPM before the propeller reaches a negative pitch angle. This ensures that the engine power is limited to maintain a propeller RPM somewhat less than that of the constant speed governor setting. The constant speed governor therefore, will always sense an underspeed condition and direct oil pressure to the propeller servo piston to permit propeller operation in Beta and reverse ranges.

2-53. PROPELLER TEST SWITCHES.

Two-position propeller governor test switches on the overhead control panel, Figure 2-15, are provided for operational test of the propeller systems. The switches control test circuits for the corresponding propeller. In the **TEST** position, the switches are used to test the function of the corresponding overspeed governor. Refer to Chapter 8 for test procedures. Propeller test circuits are protected by one 5-ampere circuit breaker, placarded **PROP GOV**, located on the overhead circuit breaker panel.

2-54. PROPELLER SYNCHROPHASER SYSTEM.

a. Description **C D**. The propeller synchrophaser automatically matches the RPM of the right propeller (slave propeller) to that of the left propeller, (master propeller) and maintains the blades of one propeller at a predetermined relative position with the blades of the other propeller. To prevent the right propeller from losing excessive RPM if the left propeller is feathered while the synchrophaser is on, the synchrophaser has a limited range of control from the manual governor setting. Normal governor operation is unchanged but the synchrophaser will continuously monitor propeller RPM and reset the governor as required. A magnetic pickup mounted in each propeller overspeed governor and adjacent to each propeller deice brush block transmits electric pulses to a transistorized control box installed forward of the pedestal. The right propeller RPM and phase will automatically be adjusted to correspond to the left. To change RPM, adjust both propeller controls at the same time. This will keep the right governor setting within the limiting range of the left propeller. If the synchrophaser is on but is unable to adjust to the right propeller to match the left, the actuator has reached the end of its travel. To recenter, turn the switch off, synchronize the propellers manually, and turn the switch back on.

(1) Control Box. The control box converts any pulse rate differences into correction commands, which are transmitted to a stepping type actuator motor mounted on the right engine cowl forward support ring. The motor then trims the right propeller governor through a flexible shaft and trimmer assembly to exactly match the left propeller. The trimmer installed between the governor control arm and the control cable, screws in or out to adjust the governor while leaving the control lever setting constant. A toggle switch installed adjacent to the synchroscope turns the system on. With the switch **OFF**, the actuator automatically runs to the center of its range of travel before stopping to assure normal function when used again. To operate the system, synchronize the propeller in the normal manner and turn the synchrophaser **ON**. The system is designed for in-flight operations and is placarded to be **OFF** for take-off and landing. Therefore, with the system on and the landing gear extended, the caution flashers and a yellow light on the caution/advisory annunciator panel, **PROP SYNC ON**, will illuminate.

b. Description T . The propeller synchrophaser automatically matches the RPM of both propellers, and maintains a preset phase angle relationship between the left and right engine. Input signal pulses, occurring once per revolution, are obtained from magnetic pickups (located on brackets bolted to the front of the engine) when the target (mounted on the aft side of the spinner bulkhead) passes the magnetic pickup. A control box converts this signal pulse rate difference into correction commands, which are transmitted to the appropriate governor. Speed trim is accomplished by pulse width modulation of an electromagnetic coil in each governor. The electromagnetic coil can increase, but not decrease, the speed set by the propeller control level. The RPM of one engine will follow the changes in RPM of the other engine over a predetermined range (approximately 20-RPM). A toggle switch, placarded **PROP SYN ON / OFF**, installed near the synchroscope, turns the system on. To operate the system, synchronize the propellers in the normal manner and turn the synchrophaser **ON**. To change RPM, adjust both propellers at the same time. This will keep the setting within the limited range of the system. The propeller synchrophaser may be used on takeoff at the pilot's option. However, the limited range of the synchrophaser will be reduced near maximum propeller RPM.

2-55. SYNCHROSCOPE.

A propeller synchroscope, located on the pilot's instrument panel, provides an indication of synchronization of the propellers. If the right propeller is operating at a higher RPM than the left, the face of the synchroscope, a black and white cross pattern, spins in a clockwise rotation. Left, or counterclockwise, rotation indicates a higher RPM of the left propeller. This instrument aids the pilot in obtaining complete synchronization of propellers. The system is protected by a 5-ampere circuit breaker, placarded **PROP SYNC**, located on the overhead circuit breaker panel.

2-56. PROPELLER LEVERS.

Two propeller levers on the control pedestal, Figures 2-7 and 2-9, placarded **PROP**, are used to regulate propeller speeds. Each lever controls a primary governor, which acts to regulate propeller speeds within the normal operation range. The full levers forward position is placarded **TAKEOFF, LANDING AND REVERSE** and also **HIGH RPM**. Full levers aft position is placarded **FEATHER**. When a lever is placed at **HIGH RPM**, the propeller may attain a static RPM of 2000, depending upon power lever position. As a lever is moved aft, passing through the propeller governing range, but stopping at the feathering detent, propeller RPM will correspondingly decrease to the lowest limit. Moving a propeller lever aft past the detent into **FEATHER** will feather the propeller.

2-57. PROPELLER REVERSING.

CAUTION

Do not move the power levers into reverse range without the engine running. Damage to the reverse linkage mechanism will occur.

CAUTION

Propeller reversing on unimproved surfaces should be accomplished carefully to prevent propeller erosion from reversed airflow and, in dusty conditions, to prevent obscuring the operator's vision.

The propeller blade angle may be reversed to shorten landing roll. To reverse, propeller levers must be positioned at **HIGH RPM** (full forward), and the power levers are lifted up to pass over an **IDLE** detent, then pulled aft into **REVERSE** setting. Power levers must be pulled back through normal idle speed range before being positioned in **REVERSE**. One yellow caution light, placarded **REV NOT READY**, on the caution/advisory annunciator panel, Figure 2-17, alerts the pilot not to reverse the propellers. This light illuminates only when the landing gear handle is down, and if propeller levers are not at **HIGH RPM** (full forward). This circuit is protected by a 5-ampere circuit breaker, placarded **LANDING GEAR RELAY** **C D1** and **LANDING GEAR CONTROL** **D2 T**, located on the overhead circuit breaker panel.

2-58. PROPELLER TACHOMETERS.

a. Propeller Speed Indicator (N_2) C D . Two tachometers on the instrument panel register propeller speed in hundreds of RPM, Figure 2-26. Each indicator is slaved to a tachometer generator unit attached to the corresponding engine.

b. Propeller Speed Indicator (N_2) T . Two digital/bar graph propeller tachometers located on the center of the instrument panel display the measured N_2 concurrently in a 1 alphabetic, 3½ numeric character digital display and a 38-segment bar graph display.

The indicator has a digital range of 0 to 2500 RPM while displaying current N_2 and 0 to 4000 while displaying exceedence N_2. The bar graph display has a range of 0 to 2500 RPM.

The digital display will contain dashes (----) when the measured N_2 is greater than 2500 RPM. When displaying exceedence N_2 values the actual measured value, not "----", will be displayed up to 4000 RPM.

The dashes will be prefixed with an "F" if an EEPROM failure has been detected and with and "E" if an event has been stored and played back.

The indicator performs BIT on the LCD display, ROM (program memory), RAM (volatile data memory), and EEPROM (Non-volatile data memory), and input signal. The display BIT shall consist of displaying all active LCD segments for three seconds on power up. If the ROM or RAM fails BIT the indicator display will be blank. If the input signal fails BIT the indicator will prefix the digital display with "F".

BIT failures are not stored in EEPROM. Failures detected shall therefore not affect the display after power is cycled unless the failure is encountered again.

Each exceedence event will consist of two 16-bit words. One word will contain the peak RPM measured during the event and the other word contains the event duration in seconds.

A maximum of 50 events can be recorded. If more than 50 events are recorded, only 50 will be stored. As new events are recorded, the oldest events will be discarded.

The indicator will prefix the digital display with an "E" when an event is being or has been recorded and not played back.

The indicator will start recording an event immediately when the indicator has measured RPM greater than 2200 or when the indicator has measured RPM exceeds 2081. The flashing will cease and digital display will be prefixed with an "E" when the indicator begins recording an exceedence. The indicator will end exceedence recording and store the event when the measured RPM drops to 2080 or lower.

The even display takes precedence over normal digital display. The bar graph will continue to display current N_2 data. To activate the event display press the **EXCEEDENCE DISPLAY** switch for 0.2 seconds or longer. The most recent event will be displayed first. Each event display contains the following cycle:

(1) The event number will be displayed for 2 seconds.

(2) The event peak RPM will be displayed for 2 seconds.

(3) The event duration in seconds will be displayed for 2 seconds.

All three data items displayed during playback will be prefixed with a "P" unless an EEPROM BIT failure has been detected in which case the display will be prefixed with an "F".

The event display will be terminated after all of the recorded events have been displayed. Once the playback sequence has been performed the "E" prefixed to the digital display will be removed. All event data is still available for playback until the data is erased. The display will be prefixed with an "E" again on the next power up cycle if the old data has not been erased or if another event is recorded.

NOTE

Pressing the EXCEEDENCE ERASE switch for 0.2 seconds or longer will cause all events to be erased from non-volatile memory. There are not provisions for erasing individual events.

The Propeller Speed Tachometers are each protected by 1.0-ampere circuit breakers located on the pilot's left subpanel and placarded **PROP RPM #1** and **#2**.

Section VII. UTILITY SYSTEMS

2-59. DEFROSTING SYSTEM.

a. Description. The defrosting system is an integral part of the heating and ventilation system. The system consists of two warm air outlets connected by ducts to the heating system. One outlet is just below the pilot's windshield and the other is below the copilot's windshield. A push-pull control, placarded **DEFROST AIR**, on the pilot's subpanel, Figures 2-6 and 2-8, manually controls airflow to the windshield. When pulled out, defrosting air is ducted to the windshield. As the control is pushed in, there is a corresponding decrease in airflow.

b. Automatic Operation.

1. Vent blower switches – As required.
2. Cabin Air Mode switch – **AUTO**.
3. Cabin Air Temp control – As required.
4. Cabin air, copilot air, pilot air, and defrost air controls – As required.

c. Manual Operation.

1. Pilot air, copilot air – In.
2. Cabin air and defrost air controls – Out.
3. Cabin air mode switch – **MAN HEAT**.
4. Cold air outlets – As required.
5. Cabin air manual temp switch – As required.

2-60. SURFACE DEICER SYSTEM.

a. Description. Ice accumulation is removed from each inboard and outboard wing leading edge, and both horizontal stabilizers by the flexing of deicer boots which are pneumatically actuated. Engine bleed air, from the engine compressor, is used to supply air pressure to inflate the deicer boots, and to supply vacuum, through the ejector system, for boot hold down during flight. A pressure regulator protects the system from over inflation. When the system is not in operation, a distributor valve applies vacuum to the boots for hold-down.

b. Operation.

(1) Deice boots are intended to remove ice after it has formed rather than prevent its formation. For the most effective deicing operation, allow at least 1/2 inch of ice on the boots to form before attempting ice removal. Very thin ice may crack and cling to the boots instead of shedding.

NOTE

Never cycle the system rapidly, this may cause the ice to accumulate outside the contour of the inflated boots and prevent ice removal.

(2) A three position switch on the overhead control panel, placarded **DEICE MANUAL / OFF / SINGLE CYCLE AUTO**, **C D T1** and **DEICE MANUAL SINGLE CYCLE AUTO** **T2** controls the deicing operation. The switch is spring loaded to return to the off position from **SINGLE CYCLE AUTO** or **MANUAL**. When the **SINGLE CYCLE AUTO** position is selected, the distributor valve opens to inflate the wing boots. After an inflation period of approximately 6 seconds, an electronic timer switches the distributor to deflate the wing boots and a 4-second inflation begins in the horizontal stabilizer boots. When these boots have inflated and deflated, the cycle is complete.

(3) If the switch is held in the **MANUAL** position, the boots will inflate simultaneously and remain inflated until the switch is released. The switch will return to the off position when released. After the cycle, the boots will remain in the vacuum hold down condition until again actuated by the switch.

(4) Either engine is capable of providing sufficient bleed air for all requirements of the surface deicer system. Check valves in the bleed air and vacuum lines prevent backflow through the system during single-engine operation. Regulated pressure is indicated on a gauge, placarded **PNEUMATIC PRESSURE**, located on the copilot's subpanel, Figures 2-6 and 2-8.

2-61. PROPELLER ELECTROTHERMAL DEICER SYSTEM C D T1 .

a. Description. Electrothermal deicer boots are cemented to each propeller blade to prevent ice formation or to remove ice from the propellers. Each thermal boot consists of one outboard and one inboard heating element, and receives electrical power from the deicer timer. This timer sends current to all propeller thermal boots and prevents the deicers from overheating by limiting the time each element is energized. Four intervals of approximately 30 seconds each complete one cycle. Current consumption is monitored by a propeller ammeter on the copilot's subpanel, Figures 2-6 and 2-8. Two 20-ampere circuit breakers, placarded **PROP ANTI-ICE LEFT** and **RIGHT**, on the overhead circuit breaker panel, protect the propeller electrothermal deicer system.

b. Normal Operation. A control switch on the overhead control panel, placarded **PROP OFF / AUTO**, is provided to activate the automatic system. A deice ammeter on the right subpanel registers the amount of current (14 to 18-amperes) passing through the system being used. During **AUTO** operation, power to the timer will be cut off if the current rises above 20-amperes. Current flows from the timer to the brush assembly and then to the slip rings installed on the spinner backing plate. The slip rings carry the current to the deice boots on the propeller blades. Heat from the boots reduces the grip of the ice, which is then thrown off by centrifugal force, aided by the air blast over the propeller surfaces. Power to the two heating elements on each blade, the inner and outer element, is cycled by the timer in the following sequence: right propeller outer element, right propeller inner element, left propeller outer element, left propeller inner element. Loss of one heating element circuit on one side does not mean that the entire system must be turned off. Proper operation can be checked by noting the correct level of current usage on the ammeter. An intermittent flicker of the needle each approximately 30 seconds indicates switching to the next group of heating elements by the timer.

c. Alternate Operation. The manual prop deice system is provided as a backup to the automatic system. A control switch located on the overhead control panel, placarded **PROP INNER / OUTER**, controls the manual override relays. When the switch is in the **OUTER** position, the automatic timer is overridden and power is supplied to the outer heating elements of both propellers simultaneously. The switch is of the momentary type and must be held in position until the ice has been dislodged from the propeller surface. After deicing with the outer elements, the switch is to be held in the **INNER** position to perform the same function for the inner elements of both propellers. The loadmeters will indicate approximately a 5% increase of load per meter when manual prop deice is operating. The prop deice ammeter will not indicate any load in the manual mode of operation.

2-62. PROPELLER ELECTRIC DEICE SYSTEM T2 .

a. Description. The propeller electric deicer system consists of electrically heated single element deice boots, slip ring and brush block assemblies, prop ammeter, a timer for automatic operation, three power distribution panel circuit breakers, two prop deice control circuit breakers, and two system switches. The system utilizes a metal foil type, single heating element energized by dc voltage. Heat from the elements dislodges the ice formed on the blades and the ice is thrown off by centrifugal force.

CAUTION

Propeller deice should not be operated when the propellers are not turning. Static operation may damage the brushes and slip ring.

b. Automatic Operation. The automatic deice system is controlled by a two position toggle switch, placarded **PROP AUTO / ON**, located on the overhead control panel. When the switch is placed in the **ON** position, the propeller ammeter, located on the copilot's inboard subpanel, indicates the current (14 to 18-amperes load) passing through the system, per propeller cycle.

Direct current (dc) flows from the automatic timer to the brush block assembly mounted on the front of the engine case. The brush assembly conducts the current to the slip rings installed on the propeller spinner bulkhead. The slip rings distribute the current to all heating elements on one propeller. The timer then diverts the current to all heating elements on the other propeller for the same length of time. The timer switches every 90 seconds, resulting in a complete cycle of approximately 3 minutes. The cycles will continue as long as the **AUTO** switch is in the **ON** position. The **AUTO** deice switch is protected by a 5-ampere circuit breaker, placarded **PROP ANTI-ICE / CONTR**, located on the overhead circuit breaker panel. The auto mode circuit is protected by a circuit breaker located on the dc power distribution panel.

c. Manual Operation. The manual deice system is provided as a backup to the automatic system. The control switch for the manual system is located in the **ICE & RAIN** group of the overhead control panel and is placarded **PROP MANUAL / ON**. This switch is a momentary spring-loaded type, and must be held to the **ON** position until the ice has been dislodged from the propeller. When the switch is held to the **ON** position the automatic timer is overridden, and power is supplied to all elements of both propellers simultaneously. During use of the manual mode, the **PROP AMMETER** will not indicate any load; however, both aircraft loadmeters will indicate an approximate 0.5 load increase. The manual deice switch is protected by a 5-ampere circuit breaker, placarded **PROP ANTI-ICE CONTR**, located on the overhead circuit breaker panel. The manual deice circuits are protected by two circuit breakers, located on the dc power distribution panel.

2-63. PITOT AND STALL WARNING HEAT SYSTEM.

CAUTION

Pitot heat should not be used for more than 15 minutes while the aircraft is on the ground. Overheating may damage the heating elements.

a. Pitot Heat. Heating elements are installed in the pitot masts located on the nose. Each heating element is controlled by an individual switch, placarded **PITOT LEFT ON** or **PITOT RIGHT ON**, located on the overhead control panel, Figure 2-15. It is not advisable to operate the pitot heat system on the ground except for testing or for short intervals of time to remove ice or snow from the mast. Circuit protection is provided by two 7.5-ampere circuit breakers, placarded **PITOT HEAT**, on the overhead circuit breaker panel.

CAUTION

The heating elements protect the lift transducer vane and faceplate from ice, however, a buildup of ice on the wing may change or disrupt the airflow and prevent the system from accurately indicating an imminent stall.

b. Stall Warning Heat. The lift transducer is equipped with anti-icing capability on both the mounting plate and the vane. The heat is controlled by a switch located on the overhead control panel, placarded **STALL WARN / ON**. The level of heat is minimal for ground operation but is automatically increased for flight operation through the landing gear safety switch. Circuit protection is provided by a 15-ampere circuit breaker, placarded **STALL WARN**, on the overhead circuit breaker panel.

2-64. STALL WARNING SYSTEM.

The stall warning system consists of a transducer, a lift computer, a warning horn, and a test switch. Angle of attack is sensed by aerodynamic pressure on the lift transducer vane located on the left wing leading edge. When a stall is imminent, the output of the transducer activates a stall warning horn. The system has preflight test capability through the use of a switch, placarded **STALL WARN TEST / OFF / LDG GEAR WARN TEST**, on the right subpanel, Figures 2-6 and 2-8. Holding this switch in the **STALL WARN TEST** position actuates the warning horn by moving the transducer vane. The circuit is protected by a 5-ampere circuit breaker, placarded **STALL WARN**, on the overhead circuit breaker panel.

2-65. BRAKE DEICE SYSTEM.

a. Description. A heated-air brake deice system may be used on the ground or in flight with gear retracted or extended. When activated, hot air is diffused by means of a manifold assembly over the brake discs in each wheel. Manual and automatic controls are provided. There are two primary occasions, which require brake deicing. The first is when an aircraft has been parked in a freezing atmosphere allowing the brake systems to become contaminated by freezing rain, snow or ice, and the aircraft must be moved or taxied. The second occasion is during flight through icing conditions with wet brake assemblies presumed to be frozen, which must be thawed prior to landing to avoid possible tire damage and loss of directional control. Hot air for the brake deice system comes from the compressor stage of both engines obtained by means of a solenoid valve attached to the bleed air system which serves both the surface deice system and the pneumatic systems operation.

b. Operation. A switch on the overhead control panel, placarded **BRAKE DEICE**, controls the solenoid valve by routing power through a control module box under the aisle floorboards. When the switch is on, power from a 5-ampere circuit breaker on the overhead circuit breaker panel is applied to the control module. A 10-minute timer limits operation and avoids excessive wheel well temperatures when the landing gear is retracted. The control module also contains a circuit to the green **BRAKE DEICE ON** annunciator light, and has a resetting circuit interlocked with the gear up-lock switch. When the system is activated, the **BRAKE DEICE ON** light should be monitored and the control switch selected off after the light extinguishes otherwise, on the next gear extension the system will restart without pilot action. The control switch should also be selected off, if deice operation fails to self-terminate after about 10 minutes. If the automatic timer has terminated brake deicer operation after the last retraction of the landing gear, the landing gear must be extended in order to obtain further operation of the system.

(1) **BL AIR FAIL** lights may momentarily illuminate during simultaneous operation of the surface deice and brake deice systems at low N_1 speeds. If lights immediately extinguish, they may be disregarded.

(2) During certain ambient conditions, use of the brake deice system may reduce available engine power, and during flight will result in a TGT rise of approximately 20°C. Appropriate performance charts should be consulted before brake deice system use. If specified power cannot be obtained without exceeding limits, the brake deice system must be selected off until after take-off is completed. TGT limitations must also be observed when setting climb and cruise power. The brake deice system is not to be operated above 15°C ambient temperature. The system is not to be operated for longer than 10 minutes (one deicer cycle) with the landing gear retracted. If operation does not automatically terminate after approximately 10 minutes following gear retraction, the system must be manually selected off. During periods of simultaneous brake deice and surface deice operation, maintain 85% N_1 or higher. If inadequate pneumatic pressure is developed for proper surface deicer boot inflation, select the break deice system off. Both sources of pneumatic bleed air must be in operation during brake deice system use. Select the brake deice system off during single-engine operation. Circuit protection is provided by a 5-ampere circuit breaker, placarded **BRAKE DEICE**, on the overhead circuit breaker panel.

2-66. FUEL SYSTEM ANTI-ICING.

a. Description. An oil-to-fuel heat exchanger, located on each engine accessory case, operated continuously and automatically to heat the fuel sufficiently to prevent freezing of any water in the fuel. No controls are involved. Two external fuel vents are provided on each wing. One is recessed to prevent ice formation; the other is electrically heated and is controlled by two toggle switches on the overhead control panel, placarded **FUEL VENT LEFT / ON / RIGHT,** Figure 2-15. They are protected by two 5-ampere circuit breakers, placarded **FUEL VENT HEAT / RIGHT** or **LEFT**, located on the overhead circuit breaker panel. Each fuel governing line is protected against ice by an electrically heated jacket. A 7.5-ampere circuit breaker located on the overhead circuit breaker panel, placarded **FUEL CONTR HEAT / LEFT** or **RIGHT** protects the heater. The bleed air pneumatic line is protected against ice by wrap insulation.

CAUTION

To prevent overheat damage to electrically heated anti-ice jackets, FUEL VENT heat switches should not be turned ON unless cooling air will soon pass over the jackets.

b. Normal Operation. For normal operation, switches for the **FUEL VENTS** anti-ice circuits are turned **ON** as required during the Before Takeoff procedures. Chapter 8 contains normal operations.

2-67. WINDSHIELD ELECTROTHERMAL ANTI-ICE SYSTEMS.

a. Description. Both pilot and copilot windshields are provided with an electrothermal anti-ice system. Each windshield is part of an independent electrothermal anti-ice system. Each system is comprised of the windshield assembly with heating wires sandwiched between glass panels, a temperature sensor attached to the glass, an electrothermal controller, two relays, a control switch, and two circuit breakers. Two switches, placarded **FAST WSHLD ANTI-ICE PILOT / COPILOT NORMAL / OFF / HI** **C D T1** and **WSHLD ANTI-ICE PILOT / COPILOT NORMAL / OFF / HIGH** **T2** , are located on the overhead control panel, Figure 2-15. Each switch controls one electrothermal windshield system. The **NORMAL** position energizes only the low power mode. The high position energizes the high power mode. When energized, the system cycles on at 94 ± 6°F and off at 105 ± 5°F. The circuits of each system are protected by a 5-ampere circuit breaker, which are not accessible to the flight crew. The 50-ampere circuit breakers are located in the power distribution panel under the floor ahead of the main spar. The 5-ampere circuit breakers are located on panels forward of the instrument panel.

b. Normal Operation. Two levels of heat are provided through the three position switches placarded **NORMAL** in the aft position, **OFF** in the center position, and **HIGH** after lifting the switch over a detent and moving it to the forward position. In the **NORMAL** position, heat is provided for the major portion of each windshield. In the **HIGH** position, heat is provided at a higher watt density to a smaller portion of the windshield. The lever lock feature prevents inadvertent switching to the **HI** position during system shutdown.

NOTE

Erratic operation of the magnetic compass may occur while windshield heat is being used.

2-68. PRESSURIZATION SYSTEM.

a. Description. A mixture of bleed air from the engines, and ambient air, is available for pressurization to the cabin at a rate of approximately 10 to 17 pounds per minute. Approximately 75% N_1 is required for normal pressurization. Approximately 85% N_1 C D is required when operating with one engine. The flow control unit of each engine controls the bleed air from the engine to make it usable for pressurization, by mixing ambient air with the bleed air depending upon aircraft altitude and ambient temperature. On take-off, excessive pressure bumps are prevented by landing gear safety switch actuated solenoids incorporated in the flow control units. These solenoids, through a time delay, stage the input of ambient air flow by allowing ambient air flow introduction through the left flow control unit first, then 4 seconds later, air flow through the right flow control unit.

b. Pressure Differential C D T1 . The pressure vessel is designed for a normal working pressure differential of 6.0 psi, which will provide a cabin pressure altitude of 3870 feet at an aircraft altitude of 20,000 feet, and a nominal cabin altitude of 9840 feet at an aircraft altitude of 31,000 feet.

c. Pressure Differential T2 . The pressure vessel is designed for a normal working pressure differential of 6.5 psi, which will provide a cabin pressure altitude of 8,000 feet at an aircraft altitude of 29,700 feet, and a cabin altitude of 10,000 feet at an aircraft altitude of 34,000 feet. At an altitude of 35,000 feet the aircraft will have a 10,400-foot cabin.

d. Cabin Altitude and Rate-of-Climb Controller C D1 . A control panel is installed on the copilot's side of the instrument panel for operation of the system. A knob, placarded **INCR RATE**, controls the rate of change of pressurization. A control, placarded **CABIN CONTROLLER**, is used to set desired cabin altitude. The selected altitude is displayed on a mechanically coupled dial above the control, placarded **CABIN ALT / FT**. Mechanically coupled to the cabin altitude dial is a second dial, placarded **ACFT X 1000**. This dial indicates the maximum altitude the aircraft may be flown to maintain the desired cabin altitude without exceeding the design pressure differential. A switch, placarded **CABIN PRESS DUMP / PRESS / TEST**, is provided to control pressurization. The switch is spring loaded to the **PRESS** position. In the **DUMP** position, the safety valve will be opened and the cabin will be depressurized to the aircraft altitude. In the **PRESS** position, cabin altitude is controlled by the **CABIN CONTROLLER** control. In the **TEST** position, the landing gear safety switch is bypassed to enable testing of the pressurization system on the ground. Operating instructions are contained in Chapter 8.

e. Cabin Altitude And Rate-of-Climb Controller D2 T1 . A control panel is installed on the pedestal for operation of the system. A knob, placarded **RATE MIN / MAX**, controls pressurization rate of change. A control, placarded **CABIN ALT** is used to set desired cabin altitude. The selected altitude is displayed on a mechanically coupled dial above the control, placarded **CABIN ALT 1000 FT**. Mechanically coupled to the cabin altitude dial is a second dial, placarded **ACFT ALT 1000**. This dial indicates the maximum altitude the aircraft may be flown to maintain the desired cabin altitude without exceeding the design pressure differential. A switch, placarded **CABIN PRESS DUMP / PRESS / TEST**, is provided to control pressurization. The switch is spring loaded to the **PRESS** position. In the **DUMP** position, the safety valve will be opened and the cabin will be depressurized to the aircraft altitude. In the **PRESS** position, cabin altitude is controlled by the **CABIN ALT** control. In the **TEST** position, the landing gear safety switch is bypassed to enable testing of the pressurization system on the ground. Operating instructions are contained in Chapter 8.

f. Pressurization Controller T2 . The pressurization controller, located on the pedestal extension, provides a display of the selected altitude; an altitude selector, and a rate control selector. The cabin and aircraft altitude display is a mechanically coupled dial. The outer scale, (CABIN ALT) of the display, indicates the selected cabin altitude; the inner scale (ACFT ALT) indicates the corresponding altitude at which the maximum differential pressure would occur. The indicated value on each scale is read per placard **ALT-FT X I000**. The rate control selector, placarded **RATE INC**, regulates the rate at which cabin pressure ascends or descends to the selected altitude. The rate change selected may be from 200 to 2000 feet per minute.

g. Cabin Rate-Of-Climb Indicator C D1 . An indicator, placarded **CABIN CLIMB**, is installed in the instrument panel, Figure 2-17, above the cabin altitude and rate-of-climb controller. It is calibrated in thousands-of-feet per-minute change in cabin altitude.

h. Cabin Rate-Of-Climb Indicator D2 T . An indicator, placarded **CABIN CLIMB**, is installed just ahead of the control quadrant. It is calibrated in thousands-of-feet per-minute change in cabin altitude.

i. Cabin Altitude Indicator C D1. An indicator, placarded **CABIN ALT**, is installed in the instrument panel, Figure 2-17, above the cabin rate-of climb indicator. The longer needle indicates aircraft altitude in thousands-of-feet on the outside dial. The shorter needle indicates pressure differential in psi (pounds-per-square-inch) on the inner dial. Maximum differential is 6.1 psi, Figure 2-17.

j. Cabin Altitude Indicator D2 T . An indicator, placarded **CABIN ALT**, is installed just ahead of the control quadrant. The longer needle indicates aircraft altitude in thousands-of-feet on the outside dial. The shorter needle indicates pressure differential in psi (pounds-per-square-inch) on the inner dial. Maximum differential is 6.1 psi D2 T1 and 6.5 ± psi T2.

k. Outflow Valve. A pneumatically operated outflow valve, located on the aft pressure bulkhead, maintains the selected cabin altitude and rate-of-climb commanded by the cabin rate-of-climb and altitude controller. As the aircraft climbs, the controller modulates the outflow valve to maintain a selected cabin rate of climb and increases the cabin differential pressure until the maximum cabin pressure differential is reached. At a cabin altitude of 12,500 feet, a pressure switch mounted on the back of the overhead control panel completes a circuit to illuminate a red warning annunciator light, placarded **ALT WARN**, to warn of operation requiring oxygen.

l. Safety Valve. Before take-off, the safety valve is open with equal pressure between the cabin and the outside air. The safety valve closes on lift off if the **CABIN PRESS DUMP** switch is in the **PRESS** mode. The safety valve adjacent to the outflow valve provides pressure relief in the event of a failure of the outflow valve. This valve is also used as a dump valve and is opened by vacuum, which is controlled by a solenoid valve operated by the **CABIN PRESS DUMP** switch adjacent to the controller. It is also wired through a landing gear safety switch. If either of these switches is open, or the vacuum source or electrical power is lost, the safety valve will close to atmosphere except at maximum pressure differential of 6.1 psi D2 T1 and 6.5 ± psi T2.

A screen in the safety valve should be cleaned at 1000-hour intervals. A negative pressure relief diaphragm is also incorporated into the outflow and safety valves to prevent outside atmospheric pressure from exceeding cabin pressure during rapid descent.

m. Drain. A drain in the outflow valve static control line is provided for removal of accumulated moisture. The drain is located behind the lower sidewall upholstery access panel in the baggage section of the aft compartment.

n. Flow Control Unit. A flow control unit forward of the firewall in each nacelle controls bleed air flow and the mixing of ambient air to make up the total air flow to the cabin for pressurization, heating, and ventilation. This unit is fully pneumatic except for an integral electric solenoid firewall shutoff valve controlled by the **BLEED AIR VALVE** switches on the overhead control panel, Figure 2-15, and a normally open solenoid operated by the landing gear safety switch which controls the introduction of ambient air flow to the cabin on take off.

(1) The unit receives bleed air from the engine into an ejector, which draws ambient air into the venturi of the nozzle. The mixed air is then forced into the bleed air-line routed to the cabin.

(2) Bleed airflow is controlled automatically. When the aircraft is on the ground, circuitry from the landing gear safety switch prevents ambient air from entering the flow control unit to provide maximum heating.

(3) The bleed air firewall shutoff valve in the control unit is a spring loaded, bellows operated valve that is held in the open position by bleed air pressure. When the electric solenoid is shut off, or when bleed air diminishes on engine shutdown (in both cases the pressure to the firewall shutoff valve is cut off), the firewall valve closes.

2-69. OXYGEN SYSTEM C.

WARNING

Do not smoke while oxygen is in use.

a. Description. The oxygen system provides a sufficient supply of oxygen for the pilot, copilot, and nine cabin outlets to permit a descent from 31,000 feet down to 13,000 feet pressure altitude. The system is a constant flow-type for the nine passenger outlets. The pilot and copilot utilize diluter-demand 100% masks. A 49-cubic foot lightweight supply cylinder is installed behind the aft pressure bulkhead. The oxygen gauge on the copilot's subpanel gives direct readout of cylinder pressure. The pressure regulator and control valve are adjacent to the supply cylinder and are activated by a remote push-pull knob located in the cockpit, immediately aft of the overhead circuit breaker panel. Pulling the **SYSTEM / PULL ON / CREW READY** knob supplies oxygen to the pilot, copilot, and aft toilet compartment outlets. Adjacent to the system control knob is another push-pull knob, placarded **CABIN / PULL ON / PASS READY**. This actuates the on-off valve supplying oxygen to the eight cabin outlets. The cabin and aft toilet compartment outlets are located on individual overhead service panels at each seat station. A placard on the overhead oxygen control panel indicates that all masks must be plugged in and immediately available for flights above 25,000 feet. An exception to this is the pilot and copilot masks, which shall be plugged in and hung on the cockpit sidewall hooks at all times, ready for immediate use. The filler fitting is located behind a panel externally accessible on the right side of the empennage.

WARNING

Due to the possibility of the oxygen valve control cable freezing, the crew oxygen valve shall be kept open during flight.

NOTE

INPH must be selected on individual Audio Control Panels when using oxygen mask to provide intercommunications between pilots through the headsets.

b. Pilot and Copilot Masks. The pilot and copilot oxygen masks are diluter-demand 100% regulator masks, which provide the proper dilution of oxygen with cabin air to conserve oxygen at lower cabin pressure altitudes. Placing the diluter control lever on the mask regulator in the **NORMAL** position permits the regulator to automatically schedule a proportional increase in oxygen as the cabin pressure altitude increases. When not in use the masks should be stowed with the lever in the 100% position. While in use at altitudes below 20,000 feet, the lever may (at the crew's discretion) be placed in the **NORMAL** position to conserve oxygen. Each diluter-demand mask has a pressure detector in the oxygen supply line to provide a visual indication of oxygen pressure. A red signal viewed in the window of the detector indicates low pressure and a green signal indicates adequate pressure.

c. Passenger Masks. The passenger masks are kept in sidewall and seat back pockets in the cabin and in the sidewall pocket in the toilet compartment. All masks are easily connected by pushing the plug firmly into the outlet and turning clockwise approximately one-quarter turn. Unplugging is accomplished by reversing the motion. When stowing the mask, coil the breathing line around the mask to avoid any sharp bends in the line.

d. Oxygen Duration. The oxygen duration depends upon the amount of oxygen available and the demand. The amount of useable volume available is 1,222 Liters (L), as measured at 21 °C, 760 mm of pressure and no water vapor. These conditions are referred to as "Normal Temperature, Pressure, Dry" or NTPD. The rated or 100% capacity of the cylinder is available at 1,850 psig and 21 °C. A percentage of the capacity at other stabilized cylinder temperatures and pressure may be obtained from Figure 2-24. The demand upon this amount depends upon the number of crew and passenger masks in use and the flow of oxygen from the masks. Planning flow rates may be found in Table 2-5. The duration or amount divided by demand, of various combinations of passengers and altitude, is found in Table 2-6. For other conditions or configurations, the duration may be readily calculated with the data provided.

e. Emergency Operation. A control is provided on the masks for the pilot and copilot. The control may be set at **100% OXY** when required.

2-70. OXYGEN SYSTEM D T .

WARNING

Do not smoke while oxygen is in use.

a. Description. The oxygen system is provided primarily as an emergency use system; however, the system may be used to provide supplemental (first aid) oxygen. A 49-cubic foot 1,222 (L) usable oxygen supply cylinder charged with aviators breathing oxygen is installed in the unpressurized portion of the aircraft behind the aft pressure bulkhead. The oxygen pressure gauge on the copilot's subpanel gives a direct reading of cylinder pressure. The pressure regulator and control valve are located adjacent to the supply cylinder and are actuated by a push-pull control knob, placarded **PULL ON SYS READY**, located immediately aft of the overhead circuit breaker panel. The control knob operates a cable, which opens and closes the shutoff valve on the supply cylinder, Figure 2-25. Opening the shutoff valve charges the primary oxygen supply line, which in turn delivers oxygen to the pilot, copilot, first aid oxygen mask outlets, and to the passenger oxygen system control valve. Adjacent to the system control knob is another push-pull knob, placarded **PASSENGER MANUAL O'RIDE**. This activates the passenger masks when the **PULL ON SYS READY** knob is pulled on. Any time the primary oxygen supply line is charged, oxygen will be available from the first aid oxygen outlet by manually opening the overhead access door, placarded **FIRST AID OXYGEN-PULL**, and opening the **ON / OFF** valve inside. The first aid oxygen is located in the aft portion of the aircraft containing the life raft, toilet etc. A placard inside the door reads **NOTE: CREW SYS MUST BE ON** as a reminder that the **PULL ON SYS READY** knob in the cockpit must be pulled on before oxygen will be available at the first aid mask.

NOTE

Due to the possibility of the oxygen valve control cable freezing, The crew oxygen valve shall be kept open during flight.

b. Pilot and Copilot Masks. The pilot and copilot masks are diluter demand, quick donning, masks equipped with a carbon microphone, and are stowed on the partition aft and outboard of the pilot and copilot. The masks are held in the armed position by spring tension clips, and can be donned immediately with one hand. The diluter demand masks deliver oxygen only upon inhalation.

(1) **C** **D1** There is no loss of oxygen when the masks are plugged in and the **PULL ON SYS READY** control knob is pulled on. The masks are diluter demand 100% regulator masks, which provide the proper dilution of oxygen with cabin air to conserve oxygen at lower altitudes. Placing the small diluter control lever on the mask regulator to the **NORMAL** position permits the regulator to automatically schedule a proportional increase in oxygen as the altitude increases. Each mask has a pressure detector in the supply line. A red signal indicates low pressure, a green signal indicates adequate pressure. The masks will be plugged in and hung on the sidewall at all times.

(2) **D2** **T** *Use of Pilot and Copilot Oxygen Masks*. To don the mask, grasp the red levers protruding from the stowage compartment and pull the mask down. Inflate the mask harness by pressing the red lever on the left side of the regulator and then don the mask and release the lever. Three modes of operation are available which are controlled by a selector lever located on the bottom right side of the regulator:

(a) ***NORMAL*** *Mode*. When the selector lever is placed in the **NORMAL** position, oxygen is automatically mixed with the proper amount of air at the aircraft's altitude. The **NORMAL** mode may be selected at the discretion of the user at any altitude.

(b) ***100%*** *Mode*. When the selector lever is placed in the **100%** position, pure undiluted oxygen is supplied to the mask. The **100%** mode may be selected at the discretion of the user at any altitude.

*(c) Emergency (**EMERG**) Mode*. Turning the **EMERG** knob, located on the bottom of the regulator, places the mask in the emergency mode. In the **EMERG**, mode the regulator will supply 100% undiluted oxygen to the user under a positive pressure to the facemask. The emergency mode should be used if smoke or fumes are present in the aircraft. The emergency mode may be selected at the discretion of the user at any altitude.

c. Passenger Oxygen. The auto-deployment passenger oxygen system is of the constant-flow type. When in use, the oxygen is delivered through the masks at a rate of flow of approximately 3.7 LPM-NTPD (Liters Per Minute Normal Temperature Pressure Dry). If the cabin altitude exceeds approximately 12,500 feet, a barometric pressure switch will energize a solenoid, which automatically opens the passenger oxygen system shut-off valve. The oxygen will charge the passenger oxygen system supply line and extend a plunger against each of the passenger mask dispenser doors, forcing the door open. The oxygen masks will then drop down about 9 inches below the dispenser. A lanyard pin at the top of each oxygen mask must be pulled for oxygen to flow to the mask, and must be reinserted to stop oxygen flow when the mask is no longer needed. There are four auto-deployment mask dispensers in the aircraft. Three of the dispensers contain three masks each and the other contains a single unit. The shut-off valve can also be opened by pulling the **PASSENGER MANUAL O'RIDE** knob located adjacent to the **PULL ON SYS READY** knob. After the passenger system has been opened, either automatically or manually, a pressure sensitive switch in the supply line will activate to illuminate the green **PASS OXY ON** annunciator legend on the caution/advisory panel. Additionally, all cabin lights will illuminate in the full bright mode, regardless of the **CABIN LIGHTS** switch position. The passenger oxygen may be shut off and the remaining oxygen isolated to the pilot, copilot and first aid masks by pulling the **AUTO OXYGEN** circuit breaker in the **ENVIRONMENTAL** group on the overhead circuit breaker panel (provided the **PASSENGER MANUAL O'RIDE** knob is on the off position).

d. Oxygen Duration. Each passenger oxygen position has its own regulating orifice. The Oxygen Duration Table is based on a flow rate of 3.70 NLPM (Normal Liters Per Minute). The only exception is the diluter-demand pilot/copilot mask when used in the 100% mode.

e. Emergency Operation. A control is provided on the masks for the pilot and copilot. The control may be set to **100% OXY** when required.

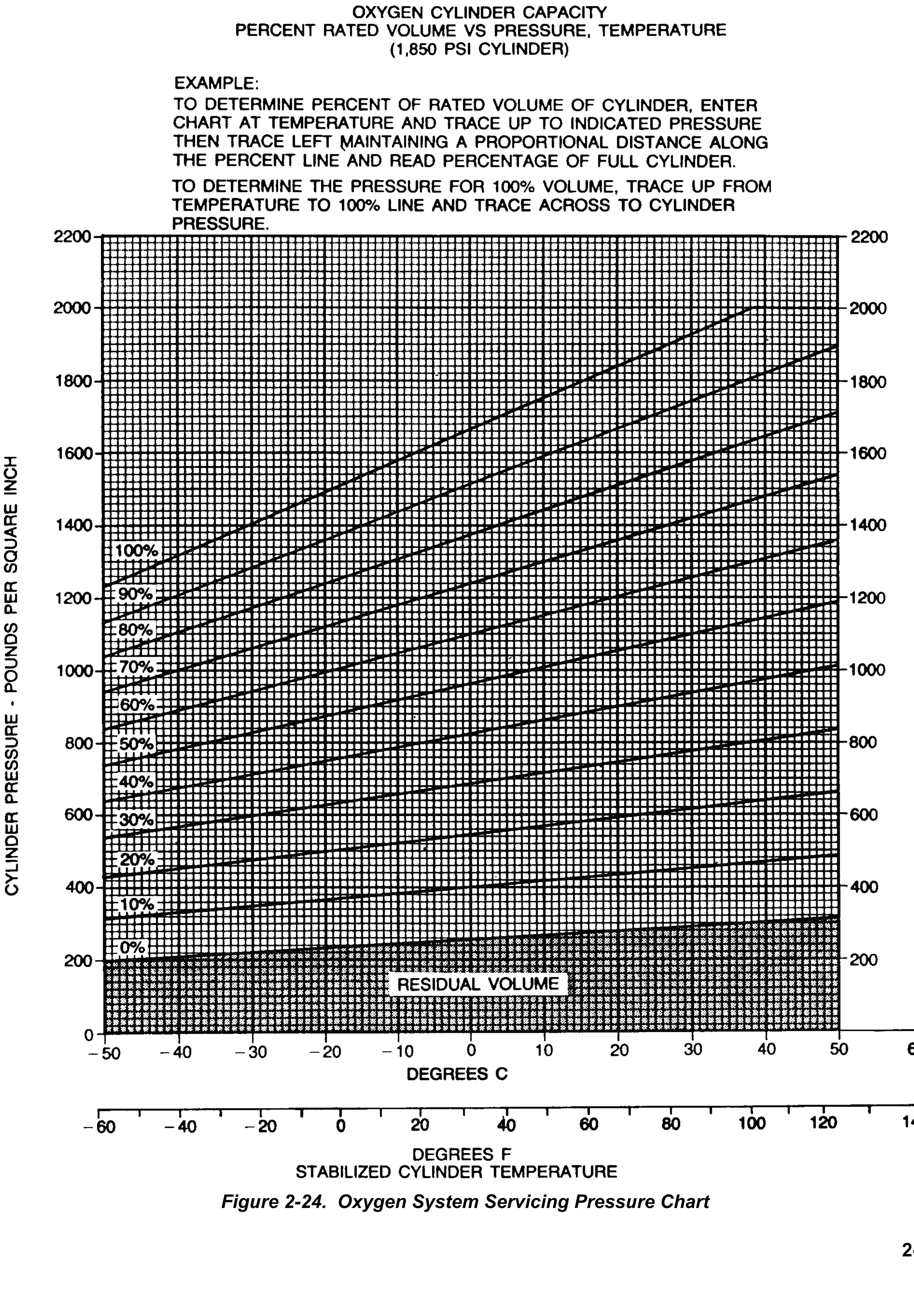


Figure 2-24. Oxygen System Servicing Pressure Chart

Table 2-5. Oxygen Flow Planning Rates vs Altitude

NOTE

All flows in LPM per mask at NTPD

If average climb or descent flows are desired, add the values between altitudes and divide by the number of values used. This method is preferred over averaging the extremes as some flow characteristics vary in such a way as to yield an incorrect answer.

CABIN PRESSURE ALTITUDE IN FEET	CREW MASK NORMAL (DILUTER DEMAND) (1)	CREW MASK 100% OXYGEN (1)	PASSENGER MASK
31,000	0 (2)	4.2	3.7 (3)
30,000	0 (2)	4.4	3.7 (3)
29,000	0 (2)	4.7	3.7 (3)
28,000	0 (2)	5.0	3.7 (3)
27,000	0 (2)	5.3	3.7 (3)
26,000	0 (2)	5.6	3.7 (3)
25,000	0 (2)	5.9	3.7
24,000	0 (2)	6.2	3.7
23,000	0 (2)	6.6	3.7
22,000	0 (2)	6.9	3.7
21,000	0 (2)	7.2	3.7
20,000	3.6	7.6	3.7
19,000	3.9	7.9	3.7
18,000	4.2	8.3	3.7
17,000	4.5	8.7	3.7
16,000	4.8	9.1	3.7
15,000	5.1	9.5	3.7
14,000	5.4	10.0	3.7
13,000	5.8	10.4	3.7
12,000	6.1	10.9	3.7
11,000	6.5	11.3	3.7
10,000	6.9	11.9	3.7

(1) Based on minute volume of 20 LPM-BTPS (Body Temperature and Pressure, Saturated).
(2) Use 100% oxygen above 20,000 feet.
(3) Not recommended for other than emergency descent use above 25,000 feet.

Table 2-6. Oxygen Duration in Minutes for 49 Cubic Foot System

	CABIN PRESSURE ALTITUDE	CREW MASK CONDITION	TOTAL FLOW LPM-NTPD	DURATION IN MINUTES (1)
NOTE When operating with a 100% cylinder capacity, read the duration in minutes directly from the table. However, if operating with less than a 100% cylinder capacity pressure (reference Figure 2-25), perform the following computation: Total crew (2) LPM usage at cabin pressure altitude; Total passenger LPM usage at cabin pressure altitude; Total LPM usage of both crew and passengers. Multiply 1222 liters times the percent of rated capacity at NTPD and divided by total crew and passenger LPM usage to obtain total (oxygen remaining) duration in minutes.				
TWO MAN CREW	31,000	100%	8.4	145.5
	20,000	100%	15.2	80.4
	20,000	NORMAL	7.2	169.7
	15,000	100%	19.0	64.3
	15,000	NORMAL	10.2	119.8
	10,000	100%	23.8	51.3
	10,000	NORMAL	13.8	88.6
TWO MAN CREW PLUS ONE PASS	31,000	100%	12.1	101.0
	20,000	100%	18.9	64.7
	20,000	NORMAL	10.9	112.1
	15,000	100%	22.7	53.8
	15,000	NORMAL	13.9	87.9
	10,000	100%	27.5	44.4
	10,000	NORMAL	17.5	69.8
TWO MAN CREW PLUS TWO PASS	31,000	100%	15.8	77.3
	20,000	100%	22.6	54.1
	20,000	NORMAL	14.6	83.7
	15,000	100%	26.4	46.3
	15,000	NORMAL	17.6	69.4
	10,000	100%	31.2	39.2
	10,000	NORMAL	21.2	57.6
TWO MAN CREW PLUS THREE PASS	31,000	100%	19.5	62.7
	20,000	100%	26.3	46.5
	20,000	NORMAL	18.3	66.8
	15,000	100%	30.1	40.6
	15,000	NORMAL	21.3	57.4
	10,000	100%	34.9	35.0
	10,000	NORMAL	24.9	49.1

Table 2-6. Oxygen Duration in Minutes for 49 Cubic Foot System (Continued)

	CABIN PRESSURE ALTITUDE	CREW MASK CONDITION	TOTAL FLOW LPM-NTPD	DURATION IN MINUTES (1)
TWO MAN CREW PLUS FOUR PASS	31,000	100%	23.2	52.7
	20,000	100%	30.0	40.7
	20,000	NORMAL	22.0	55.5
	15,000	100%	33.8	36.2
	15,000	NORMAL	25.0	48.9
	10,000	100%	38.6	31.7
	10,000	NORMAL	28.6	42.7
TWO MAN CREW PLUS FIVE PASS	31,000	100%	26.9	45.4
	20,000	100%	33.7	36.3
	20,000	NORMAL	25.7	47.5
	15,000	100%	37.5	32.6
	15,000	NORMAL	28.7	42.6
	10,000	100%	42.3	28.9
	10,000	NORMAL	32.3	37.8
TWO MAN CREW PLUS SIX PASS	31,000	100%	30.6	39.9
	20,000	100%	37.4	32.7
	20,000	NORMAL	29.4	41.6
	15,000	100%	41.2	29.7
	15,000	NORMAL	32.4	37.7
	10,000	100%	46.0	26.6
	10,000	NORMAL	36.0	33.9
TWO MAN CREW PLUS SEVEN PASS	31,000	100%	34.3	35.6
	20,000	100%	41.1	29.7
	20,000	NORMAL	33.1	36.9
	15,000	100%	44.9	27.2
	15,000	NORMAL	36.1	33.8
	10,000	100%	49.7	24.6
	10,000	NORMAL	39.7	30.8
TWO MAN CREW PLUS EIGHT PASS	31,000	100%	38.0	32.2
	20,000	100%	44.8	27,3
	20,000	NORMAL	36.8	33.2
	15,000	100%	46.6	25.1
	15,000	NORMAL	39.6	30.7
	10,000	100%	53.4	22.9
	10,000	NORMAL	43.4	28.2

Table 2-6. Oxygen Duration in Minutes for 49 Cubic Foot System (Continued)

	CABIN PRESSURE ALTITUDE	CREW MASK CONDITION	TOTAL FLOW LPM-NTPD	DURATION IN MINUTES (1)
TWO MAN CREW PLUS NINE PASS	31,000	100%	41.7	29.3
	20,000	100%	48.5	25.2
	20,000	NORMAL	40.5	30.2
	15,000	100%	52.3	23.4
	15,000	NORMAL	43.5	28.1
	10,000	100%	57.1	21.4
	10,000	NORMAL	47.1	25.9

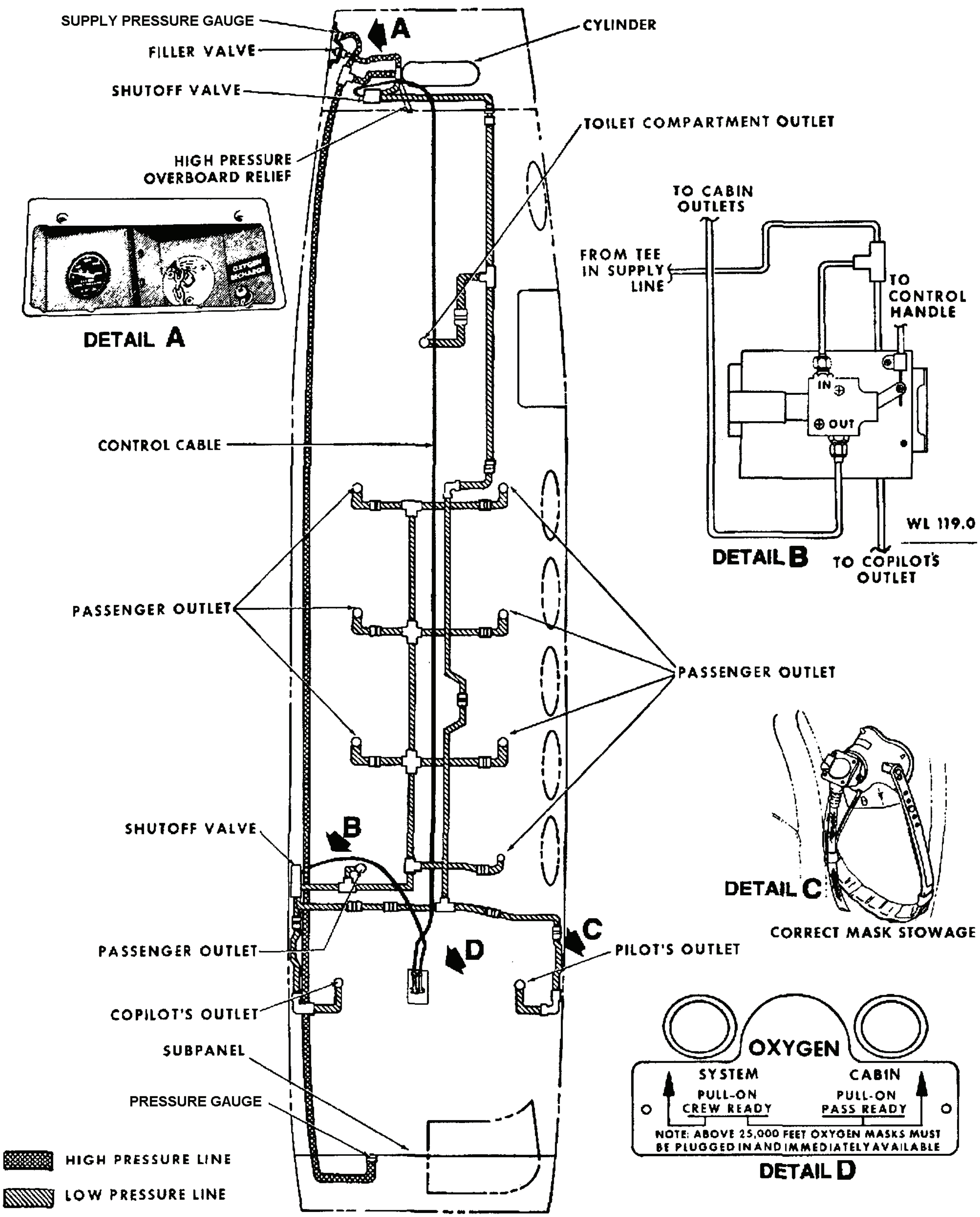


Figure 2-25. Oxygen System C (Sheet 1 of 2)

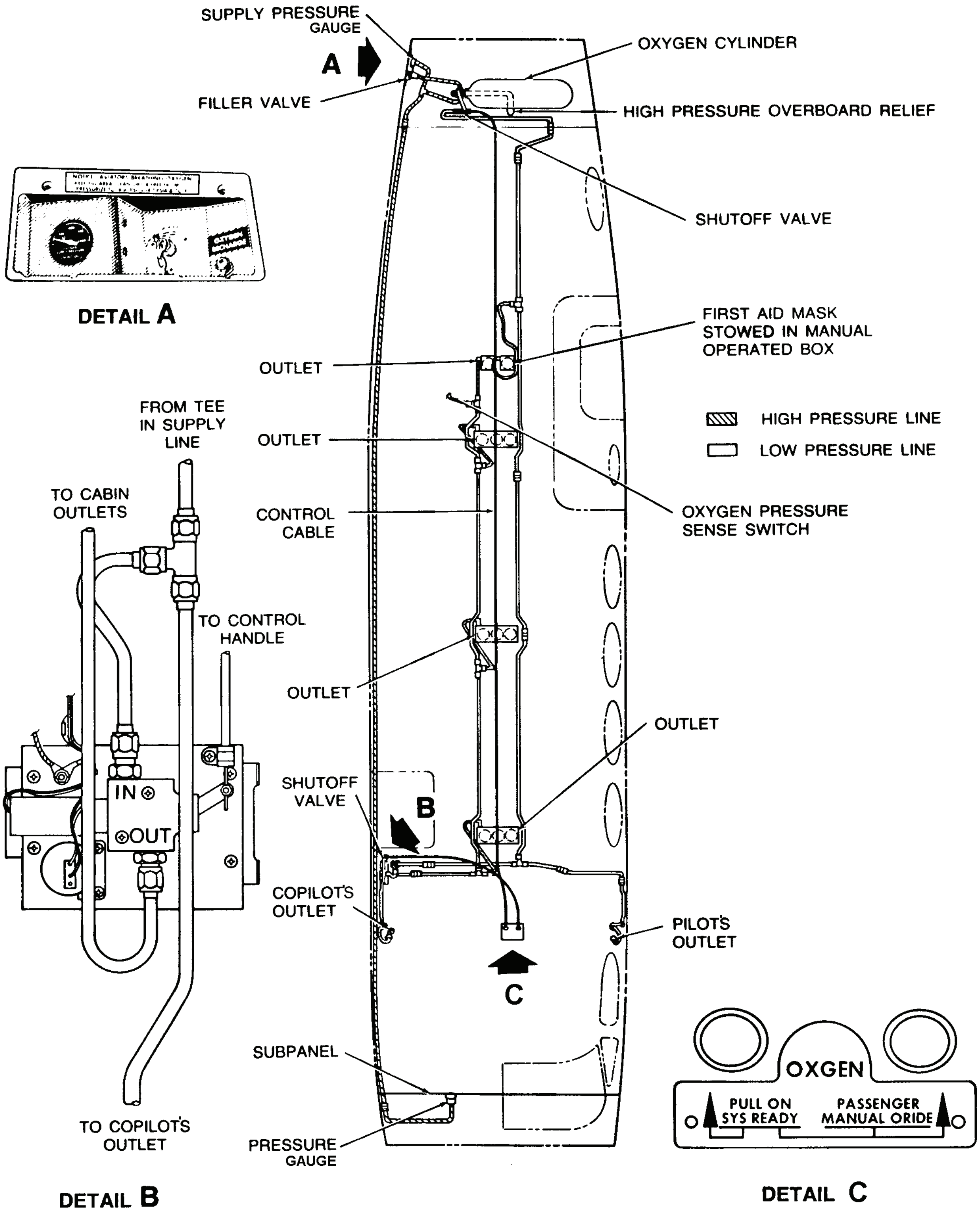


Figure 2-25. Oxygen System D T (Sheet 2 of 2)

2-71. WINDSHIELD WIPERS.

a. Description. Two electrically operated windshield wipers are provided for use at takeoff, cruise, and landing speed. A rotary switch, placarded **WINDSHIELD WIPER**, located on the overhead control panel, Figure 2-15, selects mode of windshield wiper operation. An information placard above the switch states: **DO NOT OPERATE ON DRY GLASS**. Function positions on the switch, as read clockwise, are: **PARK / OFF / SLOW / FAST**. When the switch is held in the spring-loaded **PARK** setting, the blades will return to their normal inoperative position on the glass; then, when released, the switch will return to **OFF** position terminating windshield wiper operation. The **FAST** and **SLOW** switch positions are separate operating speed settings for wiper operation. The windshield wiper circuit is protected by one 10-ampere circuit breaker, placarded **WSHLD WIPER**, located on the overhead circuit breaker panel.

CAUTION

Do not operate windshield wipers on dry glass. Such action can damage the linkage as well as scratch the windshield glass.

b. Normal Operation. To start, turn **WINDSHIELD WIPER** switch to **FAST** or **SLOW** speed, as desired. To stop, turn the switch to the **PARK** position and release. The blades will return to their normal inoperative position and stop. Turning the switch only to the **OFF** position will stop the windshield wipers without returning them to the normal inactive position.

2-72. CABIN FURNISHINGS.

a. Cabin Area Interior. The cabin has seating arrangements for seven passengers. Seating consists of five executive chairs and one two-place couch attached to floor mounted rails. Track mounting accommodates quick seat removal and spacing adjustment. Five seats face forward. On the right side of the aisle, the couch faces towards the aisle. On a horizontal leg crossbar, each seat is placarded as **FWD FACING** or **AFT FACING**. All chairs and each place on the couch are equipped with lap-type seat belts. All chairs have adjustable headrests and reclining backs, which can be adjusted by a lever on the side for individual comfort. Adjustable armrests, adjacent to the aisle, may be lowered to allow ease of entry. All seat backs shall be in full upright position for takeoff and landing.

b. Aft Cabin Area Interior C. The aft cabin area has two parts: a toilet area (fwd part) opposite to the aircraft entry door, and a storage area that extends from the aft side of the doorway to the back of the pressurized compartment. A partition wall, with lockable internal sliding doors at the aisle, separates the passenger area from the toilet area. A mirror is mounted on the right forward partition and a removable low profile electric toilet faces the aisle. A garment hang cable extends between the forward and back partitions above the toilet. A seat belt is provided and allows approved seating of one passenger in the toilet area. This area also has lighting, ventilation air, and oxygen provisions. The toilet and aft storage areas are separated by a partial partition from the right fuselage wall to the aisle. A garment hang cable extends from this partition to the aft bulkhead of the pressurized compartment. The storage area encompasses the full width of the fuselage and is illuminated by two lights in the headliner. The floor has tiedowns. This area is for the storage of crew and passenger baggage, a life raft and survival gear (up to 410 pounds). Webbing is installed across the storage area to secure baggage/gear.

c. Aft Cabin Area Interior D T. The aft cabin area has two parts: a lavatory (fwd part) opposite to the main entrance door, and a storage area that extends from the aft side of the cargo door to the back of the pressurized compartment. A privacy curtain separates the removable, low profile, electric toilet from the passenger area.

NOTE T2

A non-electric, chemical toilet is provided in C-12T2 aircraft.

A seat belt is provided and allows approved seating of one passenger in the toilet area. A garment hang cable extends between the forward and back partitions above the toilet. This area also has lighting, ventilation air, and oxygen provisions. The toilet and aft storage areas are separated by a partial partition from the right fuselage wall to the aisle. A high garment hang cable extends from this partition to the aft bulkhead of the pressurized compartment. The storage area encompasses the full width of the fuselage and is illuminated by two lights in the headliner. The floor has tiedowns. This area is for the storage of crew and passenger baggage, (up to 410 pounds). Webbing is installed across the storage area to secure baggage/gear.

NOTE T2

On C-12T2 aircraft, a baggage/utility compartment area containing 53.3 cubic feet of space provides for storage of 550 pounds of baggage including one survival raft and kit.

d. Cargo Configuration. The cabin area can be quickly converted for combination passenger/cargo or all cargo use by removing the seats and partial partition. Cargo containers are secured with tiedown fittings attached to the seat tracks. No cargo loading or unloading equipment is provided. Chapter 6, Aircraft Loading, provides cargo handling information and instructions.

e. Ferry Fuel Configuration. The cabin area may be converted to accommodate ferry missions by removing the passenger seats and floor panels. The tank platforms and ferry fuel tanks are secured with seat rail cargo rings. The fuel tanks are connected to the provisions already installed in the fuel system. Chapter 6, Weight/Balance and Loading, provides fuel loading restrictions.

2-73. CIGARETTE LIGHTERS AND ASH TRAYS.

The pilot and copilot have individual cigarette lighters and ash trays mounted in escutcheons outboard of their seats. The cigarette lighters are protected by a 5-ampere circuit breaker, placarded **CIGAR LIGHTER**, on the overhead circuit breaker panel. In the cabin area, individual ashtrays are mounted in escutcheons along the cabin sidewall upholstery adjacent to each seat. No cigarette lighters are installed in the cabin area.

2-74. ELECTRIC TOILET C D T1 .

a. Description. An electric toilet is installed in the aft cabin area. A sliding door or privacy curtain closes between the two aft partitions for privacy. The door can be locked from the aft side. On some aircraft, a relief tube is incorporated in the mounting assembly for the toilet. The circuit is protected by a 10-ampere circuit breaker located in the power distribution panel under the floor ahead of the main spar.

b. Operation. A switch, placarded **PRESS TO FLUSH**, is mounted on the seat assembly for operation of the toilet. Pressing the switch applies dc power to the motor, which drives the pump. The pump applies flushing fluid through a nozzle in the upper rim and washes the inner surface of the bowl. Waste is carried to the waste tank mounted below the bowl. When desired, the removable waste tank may be removed from the toilet for servicing. Section XII contains servicing instructions.

2-75. CHEMICAL TOILETS T2 .

a. Description. A quick-removable side-facing toilet with seat belt is located in the aft cabin area. Stub partitions and a privacy curtain are provided. The chemical toilet contains an inner liner, which holds a plastic disposable bag. The inner liner and disposable bag are removed for disposal of waste. Refer to Section XII for servicing instructions.

2-76. SUN VISORS.

CAUTION

When adjusting the sun visors, grasp only by the top metal attachment to avoid damage to the fragile plastic shield.

Two sun visors are provided for the pilot and copilot respectively. Each visor is manually adjustable. When not needed as a sun shield, each visor may be manually rotated to a position flush with the top of the cockpit so that it does not obstruct view through the windows.

Section VIII. HEATING, VENTILATION, COOLING, AND ENVIRONMENTAL CONTROL SYSTEM

2-77. HEATING.

Bleed air is extracted from both engines and combined with ambient air through the pressurization and heating flow control unit in each nacelle. The tempered air is then ducted into the cabin. Refer to Figure 2-26. On the ground, a solenoid actuated portion of the flow control unit closes off the ambient air to provide only warm bleed air to the cabin. The landing gear safety switch allows the solenoid valve to open during flight, providing a mixture of bleed air and ambient air up to an altitude of approximately 19,000 to 20,000 feet where only bleed air is used. If the mixed bleed air is too warm for cabin comfort, it is further cooled by routing it through the air-to-air heat exchanger located in each wing center section. An air intake of the leading edge of the inboard wing brings ram air into the heat exchanger to cool the bleed air. After leaving the heat exchanger, the ram air is ducted overboard through louvers on the underside of the wing. After the bleed air passes through (or around) the heat exchangers, it is ducted to a mixing plenum where it is mixed with cabin re-circulated air. The air is then ducted to the pilot and copilot outlets, defroster, and through the main ducting system to the floor outlets.

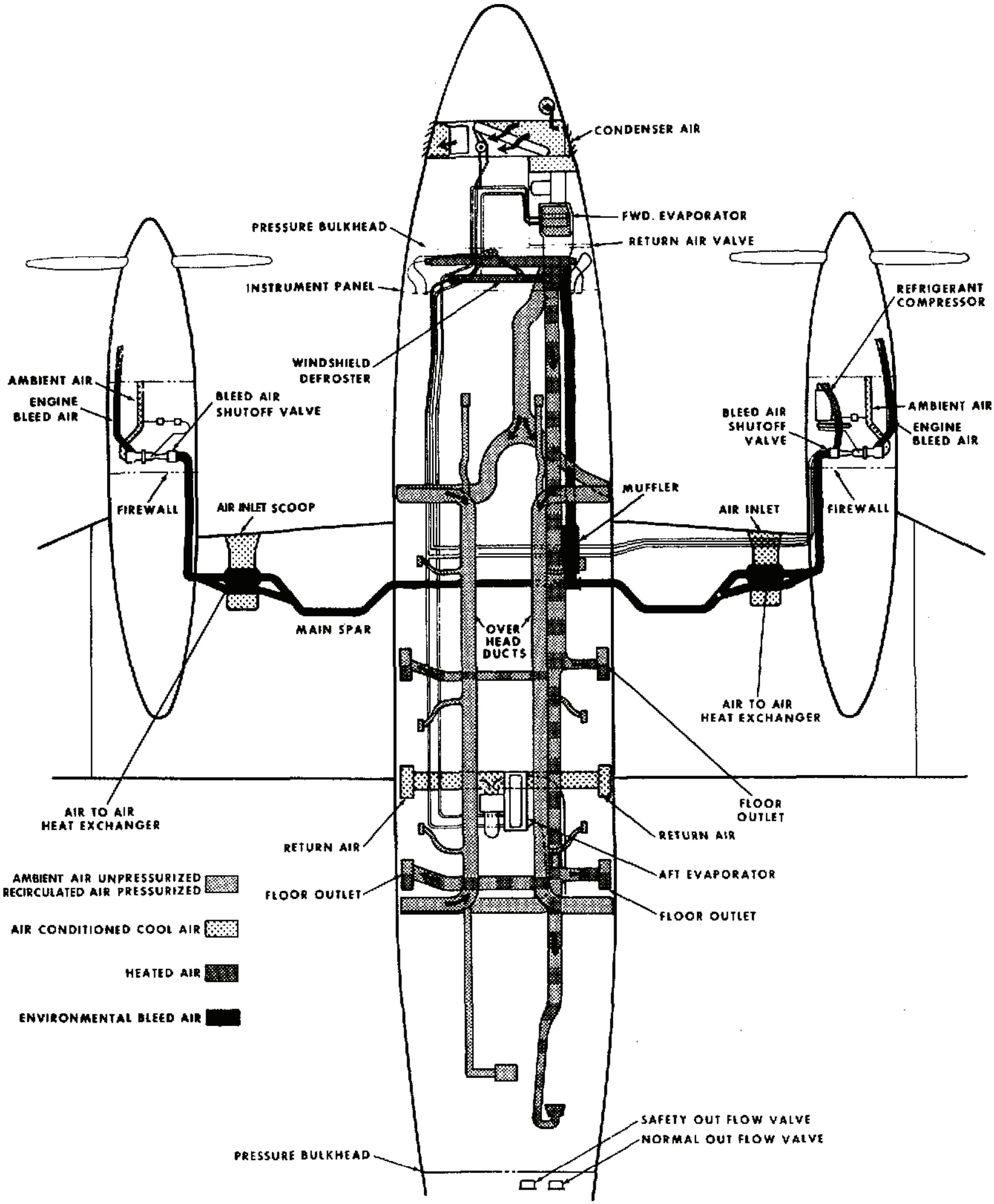


Figure 2-26. Environmental System

2-78. AIR CONDITIONING.

a. Cabin air conditioning is provided by a refrigerant gas vapor cycle refrigeration system consisting of a belt driven engine mounted compressor, installed on the #2 engine accessory pad, refrigerant plumbing, N_1 speed switch, high and low pressure protection switches, condenser coil, condenser blower, forward and aft evaporator, receiver dryer, expansion valve, and a bypass valve. The plumbing from the compressor is routed through the right inboard wing leading edge to the fuselage and then forward to the condenser coil, receiver dryer, expansion valve, bypass valve, and forward evaporator which are located in the nose of the aircraft. The high and low-pressure limit switches, and N_1 engine speed switch, are provided to prevent compressor operation beyond required operational limits. The N_1 speed switch will prevent electrical power from being delivered to the compressor clutch when engine RPM is below 65% RPM. When the N_1 speed switch is open and there is a demand for refrigeration, a green light on the caution/advisory annunciator panel, **AIR COND N_1 LOW**, will illuminate.

b. The system incorporates over-pressure and under-pressure protect switches. Activation of the over-pressure or under-pressure protect switches will discontinue compressor clutch and condenser blower operation, illuminate its respective lockout light/reset switch located in the nose wheel well, and trip a 7.5-ampere circuit breaker, placarded **AIR COND CONTR**, located in the overhead circuit breaker control panel. When a system shutdown occurs due to overpressure or underpressure protect switch actuation, the system should be thoroughly checked before returning it to operation.

c. A second evaporator and blower installation is located in the fuselage center aisle equipment bay aft of the rear spar. Environmental air is circulated through each evaporator automatically in either manual or automatic control mode. The forward evaporator blower has a high speed, which can be selected by the **VENT BLOWER** switch on the overhead control panel. A 33 °F thermal sense switch is installed on the forward evaporator. This sense switch actuates a hot gas bypass valve, which bleeds off a portion of the refrigerant from the forward evaporator, thereby preventing icing of the evaporator. The forward evaporator and blower will supply the cockpit, forward ceiling outlets, and forward floor outlets; while the rear evaporator and blower supply the aft ceiling outlets, rear floor outlets and toilet compartment. Both blower circuit breakers are located in the dc power distribution panel in the lower equipment bay. A vane-axial blower draws air through the condenser on the ground. A 50-ampere circuit breaker for this blower is located on the dc distribution panel in the lower equipment bay.

d. When operating under very hot, humid conditions, where maximum air conditioning is required, the bleed air valves may be left in **ENVIRO OFF** until airborne and sufficient altitude is gained.

2-79. UNPRESSURIZED VENTILATION.

Ventilation is provided by two sources. One source is through the bleed air heating system in both the pressurized and unpressurized mode. The second source of ventilation is obtained from RAM air through the condenser section in the nose through a check valve in the vent blower plenum. Ventilation from this source is in the unpressurized mode only with **CABIN PRESS** switch in the **DUMP** position. The check valve closes during pressurized operation. Ram air ventilation is distributed through the main dueling system to all outlets. Ventilation air ducted to each individual eyeball cold air outlet can be directionally controlled by moving the ball in the socket. Volume is regulated by twisting the outlet to open or close the valve.

2-80. ENVIRONMENTAL CONTROLS.

An environmental control section on the overhead control panel provides for automatic or manual control of the system. This section contains all the major controls of the environmental function including bleed air valve switches, a vent blower control switch, an aft vent blower switch, a manual temperature switch for control of the heat exchanger valves, a cabin temperature level control, and the cabin temp mode selector switch for selecting automatic heating or cooling or manual heating or cooling. Four additional manual controls on the main instrument subpanels may be utilized for partial regulation of cockpit comfort when the cockpit partition door is closed and the cabin comfort level is satisfactory.

a. Heating Mode.

(1) If the cockpit is too cold:

1. **PILOT** and **COPILOT AIR** knobs – As required.
2. **DEFROST AIR** knob – As required.
3. **CABIN AIR** – Pull out in small increments. Allow 3–5 minutes after each adjustment for system to stabilize.

(2) If the cockpit is too hot:

1. **CABIN AIR** knob – As required.

2. **PILOT** and **COPILOT AIR** knobs – In as required.

3. **DEFROST AIR** knob – In as required.

b. Cooling Mode.

(1) If the cockpit is too cold:

1. **PILOT** and **COPILOT AIR** knob – In as required.

2. **DEFROST AIR** knob – In as required.

3. Overheat cockpit outlets – As required.

(2) If the cockpit is too hot:

1. **PILOT** and **COPILOT AIR** knobs – Out as required.

2. **CABIN AIR** knob – Close in small increments. Allow 3–5 minutes after each adjustment for system to stabilize. If **CABIN AIR** knob is completely closed before obtaining satisfactory cockpit comfort, it may be necessary to place the **AFT VENT BLOWER** switch in the **ON** position to activate the aft evaporator to re-circulate cabin air.

c. Automatic Mode Control. When the **AUTO** mode is selected on the cabin temp mode selector switch, the heating and air conditioning systems are automatically controlled. When the temperature of the cabin has reached the selected setting, the automatic temperature control allows heated air to bypass the air-to-air exchangers in the wing center section. The warm bleed air is mixed with the cooled air. The rear evaporator picks up re-circulated cabin air only.

(1) When the automatic control drives the environmental system from a heat mode to a cooling mode, the bypass valves close. When the left bypass valve reaches a fully closed position, the refrigeration system will begin cooling, provided the right engine N_1 speed is above 65% RPM. When the bypass valve is opened to a position approximately 30° from full open, the refrigeration system will turn off.

(2) The **CABIN TEMP INCR** control provides regulation of the temperature level in the automatic mode. A temperature sensing unit in the cabin, in conjunction with the control setting, initiates a heat or cool command to the temperature controller for desired cockpit and cabin environment.

d. Manual Mode Control. With the cabin temperature mode selector in the **MAN HEAT** or **MAN COOL** position, regulation of the cabin temperature is accomplished manually with the **MANUAL TEMP** switch.

(1) In the **MAN HEAT** mode, the automatic system is overridden and the system is controlled by opening or closing the two bypass valves with the **MANUAL TEMP / INCREASE / DECREASE** switch. To increase cabin temperature, hold the switch at the **INCREASE** position, to decrease cabin temperature, hold the switch in the **DECREASE** position. Allow approximately 30 seconds per valve to drive the bypass valves to the fully open or fully closed position. Only one valve moves at a time.

(2) With the cabin temperature selector switch in the **MAN COOL** position, the automatic temperature control system is bypassed. In the manual cooling mode, the refrigeration system is on, providing the right engine N_1 speed is above 65% RPM, however, the bypass valves may be manually positioned for the desired temperature. Hold the **MANUAL TEMP** switch in the **DECREASE** position approximately one minute to fully close air-to-air heat exchanger bypass valves.

e. Bleed Air and Vent Control.

(1) Bleed air entering the cabin is controlled by bleed air valve switches, placarded **BLEED AIR VALVE / OPEN / ENVIRO OFF / PNEU & ENVIRO OFF** **C D T1** and **ENVIRO & PNEU BLEED AIR / PNEU ONLY / ON / BOTH** **T2** . When the switch is in the **OPEN / ON** position, the environmental flow control unit and the pneumatic valve are open. When the switch is in the **ENVIRO OFF** or **PNEU ONLY** position, the environmental flow control unit is closed and the pneumatic bleed air valve is open; in the **PNEU & ENVIRO OFF** position, both are closed. For maximum cooling on the ground, turn the bleed air valve switches to the **ENVIRO OFF** or **PNEU ONLY** position.

(2) The forward vent blower is controlled by a switch, placarded **VENT BLOWER AUTO / LOW / HI** **C D T1** and **VENT BLOWER AUTO / LOW / HIGH** **T2**. The **HI / HIGH** and **LOW** positions regulate the blower to two speeds of operation. In the **AUTO** position, the fan will run at low speed except when the **CABIN TEMP** mode selector switch is placed in the

OFF position. In the **OFF** position, the blower will not operate.

(3) The aft vent blower is controlled by a switch, placarded **AFT VENT BLOWER / OFF / AUTO / ON**. The single speed blower operates automatically through the **CABIN TEMP** mode selector when the **AFT VENT BLOWER** switch is placed in the **AUTO** position with the landing gear extended. The blower will automatically shut off when the landing gear is retracted. The blower operates continuously when the switch is placed in the **ON** position and there is a cool command. In the **OFF** position, the blower will not operate.

Section IX. ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEM

2-81. DESCRIPTION C D1 .

The aircraft employ both direct current (dc) and alternating current (ac) electrical power. The dc electrical supply forms the basic power system energizing most aircraft circuits. Electrical power is used to start the engines, to power the landing gear and flap motors, and to operate the standby fuel pump, ventilation blower, lights and electronic equipment. Two inverters operating from dc power produce the required single-phase ac power. The three sources of dc power consist of one 20-cell 34-ampere hour battery and two 250-ampere starter-generators. DC power may be applied to the aircraft through an external power receptacle on the right nacelle. The starter generators are controlled by generator control units. The output of each generator passes through a cable to the respective generator bus. Refer to Figures 2-27 and Table 2-7. Other buses distribute power to aircraft dc loads, and derive power from the generator buses. The generators are paralleled to balance the dc loads between the two units. When one of the generating systems is not on-line, and no fault exists, aircraft dc power requirements continue to be supplied, from the other generating source. Most dc distribution buses are connected to both generator buses but have isolation diodes to prevent power crossfeed between the generating systems, when connection between the generator buses is lost. Thus, when either generator is lost because of a ground fault, the operating generator will supply power for all aircraft dc loads except those receiving power from the inoperative generator's bus that cannot be crossed. When a generator is not operating, reverse current and over-voltage protection is automatically provided.

2-82. DESCRIPTION D2 T .

The aircraft employ both dc and ac electrical power. The dc electrical supply forms the basic power system, energizing most aircraft circuits. Electrical power is used to start the engines; power the landing gear pump motor; power the flap motors; operate the standby fuel pump; power the ventilation blower, lights and electronic equipment. Two 750-VA inverters operating from dc power produce the required single-phase ac power. The three sources of dc power consist of one 20 cell 34-ampere hour battery and two 250-ampere starter-generators. DC power may be applied to the aircraft through an external power receptacle on the right nacelle. The starter generators are controlled by generator control units. The output of each generator passes through a cable to the respective generator bus. Refer to Figure 2-28, Sheets 1 and 2, and Tables 2-8, 2-9, and 2-10. Other buses distribute power to aircraft dc loads, and derive power from the generator buses. The generators are paralleled to balance the dc loads between the two units. When one of the generating systems is not on-line, and no fault exists, aircraft dc power requirements continue to be supplied, from the other generating source. Most dc distribution buses are connected to both generator buses but have isolation diodes to prevent power crossfeed between the generating systems, when connection between the generator buses is lost. Thus, when either generator is lost because of a ground fault, the operating generator will supply power for all aircraft dc loads except those receiving power from the inoperative generator's bus that cannot be crossfed. When a generator is not operating, reverse current and over-voltage protection is automatically provided.

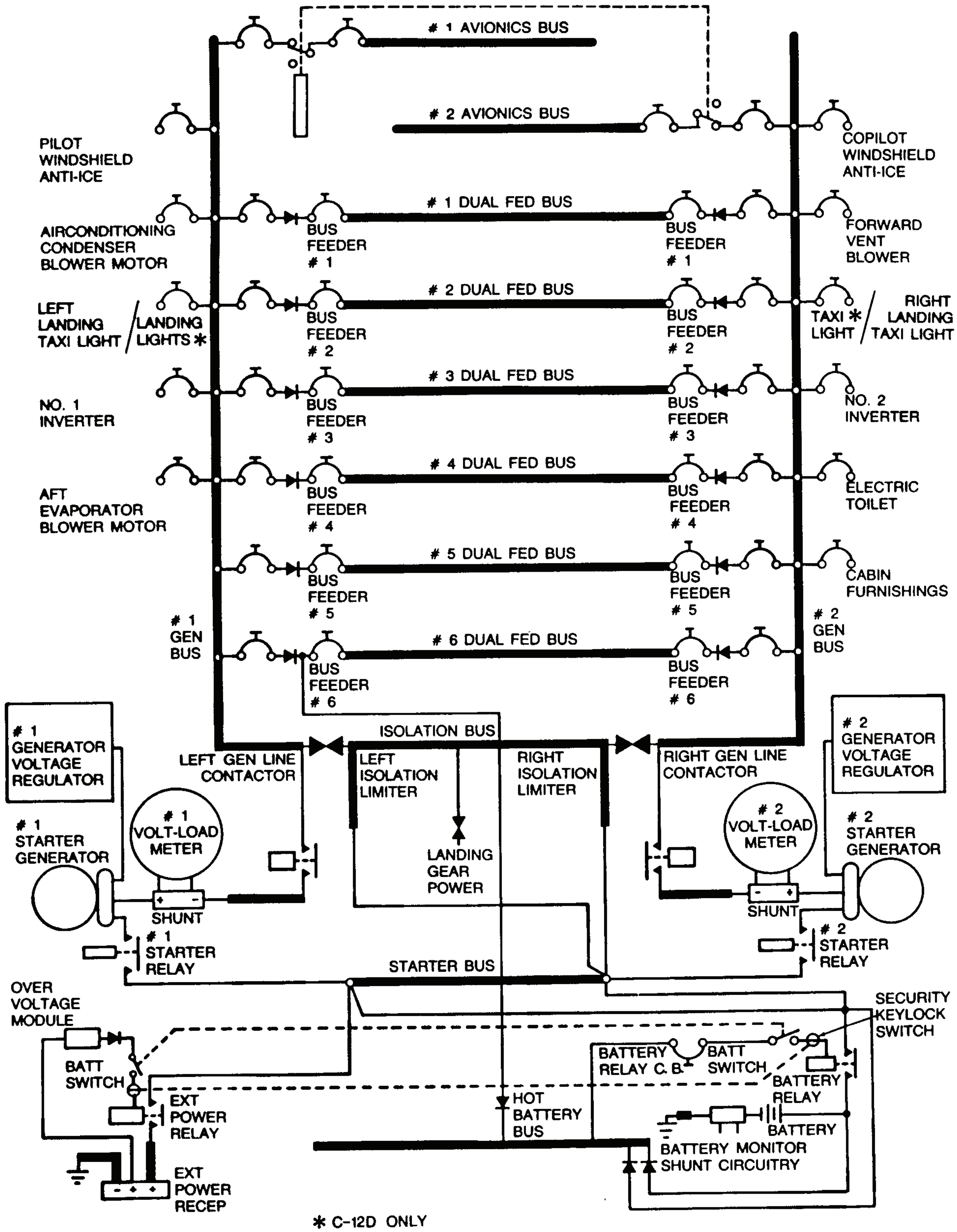


Figure 2-27. DC Electrical System Schematic C D1

Table 2-7. DC Electrical System C D1

#1 AVIONICS BUS		
HF RCVR	PILOT AUDIO	INTPH
#1 VHF	DME	AP PWR
#1 VOR	TRANSPONDER	PILOTS ALT ENCD
#1 ADF	UHF	VOICE ADVSR
#1 RMI	AFCS DIRECT	RADIO ALTM
#2 AVIONICS BUS		
#2 VHF	COPILOT AUDIO	SERVO DC
#2 VOR	PAGING	RADIO RELAY
#2 ADF	RADAR	COPILOT ALT
#2 RMI		
#1 DUAL FED BUS		
WARNING		
ANN IND	STALL WARN	LEFT BLEED AIR WARN
#1 CHIP DETR	LANDING GEAR IND	
FUEL		
#1 QTY IND	#1 STANDBY PUMP	#1 AUXILIARY TRANSFER [1]
#1 QTY WARN		
ENGINE		
#1 OIL TEMP	#1 OIL PRESS	
#2 DUAL FED BUS		
WARNING		
ANN PWR	FIRE DETR	RIGHT BLEED AIR WARN
#2 CHIP DETR	LANDING GEAR WARN	
FUEL		
#2 QTY IND	#2 STANDBY PUMP	#2 AUXILIARY TRANSFER [1]
#2 QTY WARN		
ENGINE		
#2 OIL TEMP	#2 OIL PRESS	
ELECTRICAL		
BATT CHARGE		
#3 DUAL FED BUS		
WEATHER		
WSHLD WIPER	LEFT PROP ANTI-ICE	PROP ANTI-ICE AUTO
SURF DEICE	LEFT FUEL VENT HEAT	LEFT FUEL CONTR HEAT
LEFT PITOT HEAT		
FUEL		
CROSSFEED	#1 FIREWALL VALVE	#1 PRESS WARN

Table 2-7. DC Electrical System C D1 (Continued)

ENGINE		
#1 START CONTR	#1 ICE VANE CONTR	#1 IGNITOR CONTR
PROP SYNC [2,3]		
#4 DUAL FED BUS		
WEATHER		
STALL WARN	RIGHT PROP ANTI-ICE	PROP ANTI-ICE CONTR
BRAKE DEICE	RIGHT FUEL VENT HEAT	RIGHT FUEL CONTR HEAT
RIGHT PITOT HEAT		
FUEL		
SCAVENGER PUMP	#2 FIREWALL VALVE	#2 PRESS WARN
ENGINE		
#2 START COUNTR	#2 ICE VANE CONTR	#2 IGNITOR CONTR
AUTOFEATHER [2,3]	PROP GOV	
AVIONICS		
HF POWER		
#5 DUAL FED BUS		
FLIGHT		
ELEC TRIM	FLAP MOTOR	PILOT TURN & SLIP
LANDING GEAR RELAY		
LIGHTS		
ICE	BCN	SUBPANEL & CONSOLE LIGHTS
INST INDIRECT	LEFT LANDING LIGHTS	RECOG [4]
ENVIRONMENTAL	TAXI LIGHT [3]	
TEMP CONTR	LEFT BLEED AIR CONTR	
ELECTRICAL		
#1 GEN RESET		
#6 DUAL FED BUS		
FLIGHT		
RUDDER BOOST	FLAP CONTR	COPILOT TURN & SLIP
LIGHTS		
EMERG LIGHTS	FLT INST	NAV
OVHD LIGHTS	RIGHT LANDING LIGHTS	FASTEN SEATBELT/NO SMOKE
ENVIRONMENTAL	(3) TAXI LIGHT	
PRESS CONTR	RIGHT BLEED AIR CONTR	
ELECTRICAL		
#2 GEN RESET		
FURNISHING		
CIGAR LIGHTER	(5) CABIN FURN [5]	
AVIONICS		
AVIONICS MASTER CONTR		

Table 2-7. DC Electrical System C D1 (Continued)

HOT BATTERY BUS		
#1 FIREWALL SHUTOFF VALVE	AFT BAGGAGE LIGHTS	#2 ENGINE FIRE EXTINGUISHER
#1 ENGINE FIRE EXTINGUISHER	SPAR & THRESHOLD LIGHTS	#2 STANDBY FUEL PUMP
#1 STANDBY FUEL PUMP	SHADIN ETMS	DOOR STEP & OBSERVATION LIGHTS
TRANSPONDER [4]	#2 FIREWALL SHUTOFF VALVE	ELT [4]

[1] AIRCRAFT WITH AUXILIARY FUEL TANKS ONLY

[2] C AIRCRAFT ONLY

[3] D AIRCRAFT ONLY

[4] IF INSTALLED

[5] AIRCRAFT WITH OPTIONAL INTERIOR ONLY

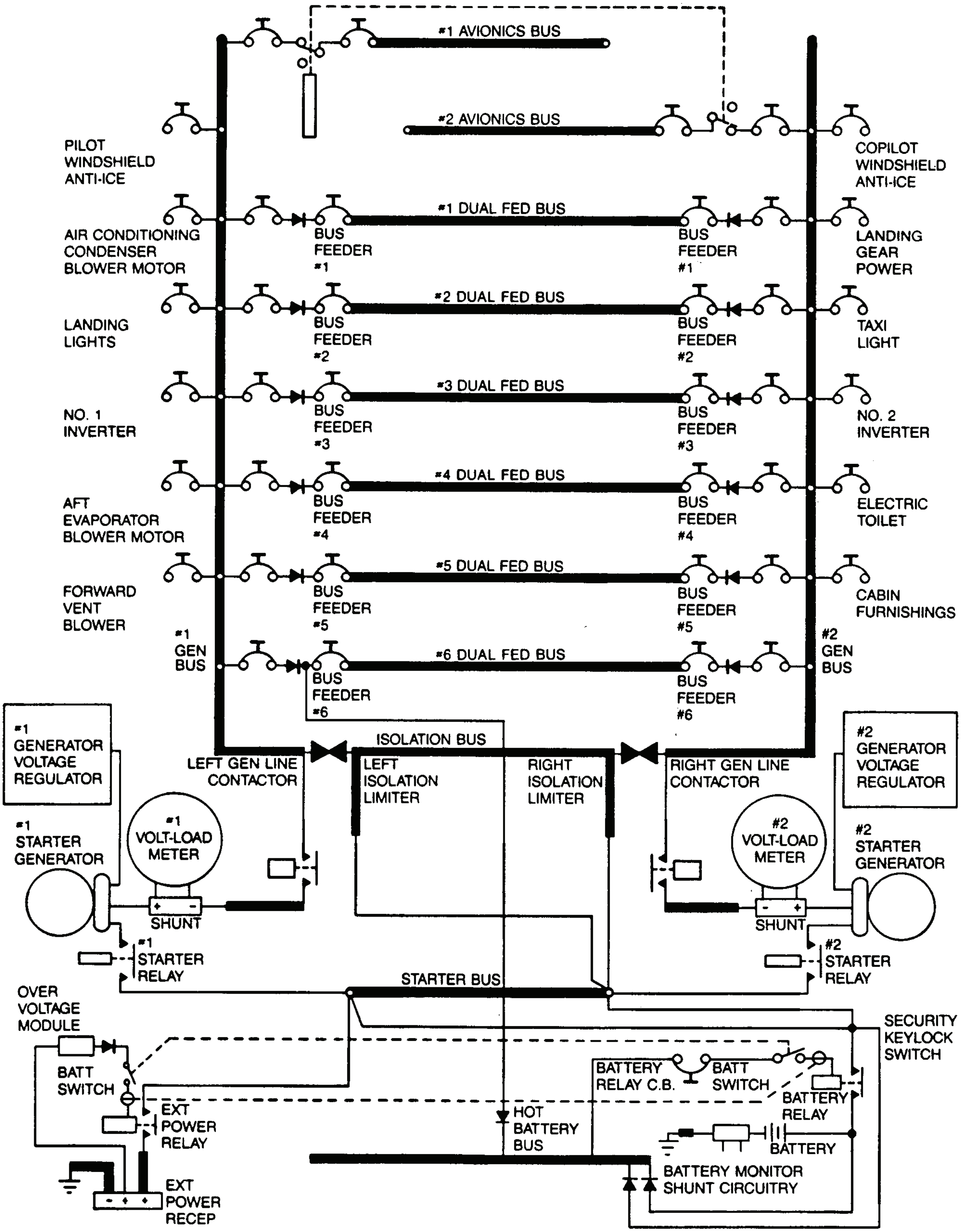


Figure 2-28. DC Electrical System Schematic **D2 T1** *(Sheet 1 of 2)*

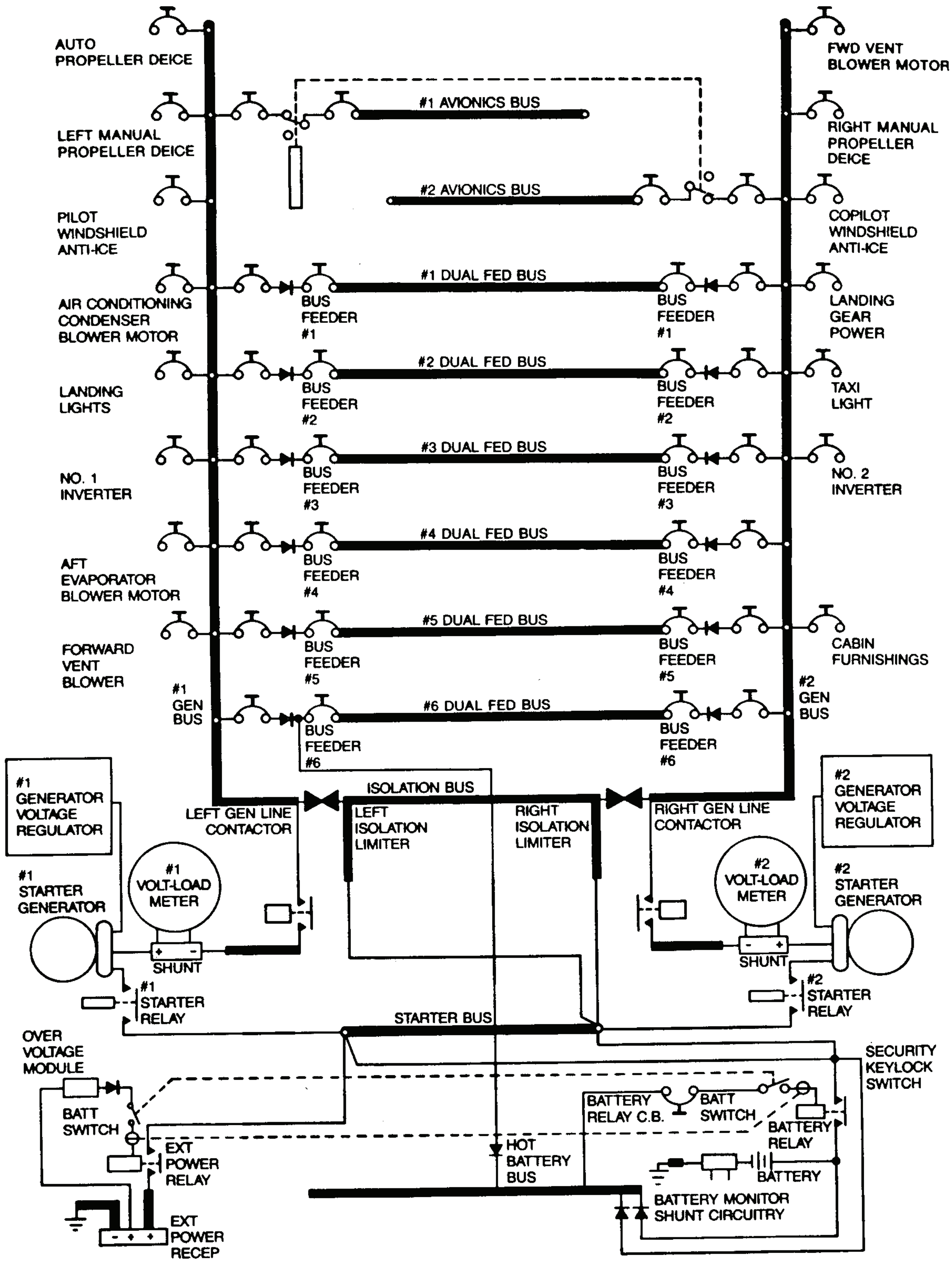


Figure 2-28. DC Electrical System Schematic T2 (Sheet 2 of 2)

Table 2-8. DC Electrical System D2

#1 AVIONICS BUS		
HF RCVR	PILOT AUDIO	#1 AFCS
#1 VHF	AIR DATA ENCODER	AP PWR
#1 NAV	TRANSPONDER	TACAN
#1 ADF	UHF	
#2 RMI	PAGING	
#2 AVIONICS BUS		
#2 VHF	COPILOT AUDIO	GRAPHIC DISPLAY
#2 NAV	RADIO ALTIMETER	COPILOT ALT
#2 ADF	RADAR	INTPH
#1 RMI	#2 AFCS	GPAAS POWER
#1 DUEL FED BUS		
WARNING		
ANN IND	STALL WARN	LEFT BLEED AIR WARN
#1 CHIP DETR	LANDING GEAR	
FUEL		
#1 QTY IND	#1 STANDBY PUMP	#1 AUXILIARY TRANSFER
#1 QTY WARN		
ENGINE		
#1 OIL TEMP	#1 OIL PRESS	
FURNISHING		
CIGAR LIGHTER		
#2 DUAL FED BUS		
WARNING		
ANN PWR	FIRE DETR	RIGHT BLEED AIR WARN
#2 CHIP DETR	LANDING GEAR WARN	
FUEL		
#2 QTY IND	#2 STANDBY PUMP	#2 AUXILIARY TRANSFER
#2 QTY WARN		
ENGINE		
#2 OIL TEMP	#2 OIL PRESS	
ELECTRICAL		
BATTERY CHARGE		
#3 DUAL FED BUS		
WEATHER		
WSHLD WIPER	LEFT PROP ANTI-ICE	PROP ANTI-ICE AUTO
SURF DEICE	LEFT FUEL VENT HEAT	LEFT FUEL CONTR HEAT
FUEL		
CROSSFEED	#1 FIREWALL VALVE	#1 PRESS WARN

Table 2-8. DC Electrical System D2 (Continued)

ENGINE		
#1 START CONTR	#1 ICE VANE CONTR	#1 IGNITOR CONTR
PROP SYNC		
#4 DUAL FED BUS		
WEATHER		
STALL WARN	RIGHT PROP ANTI-ICE	PROP ANTI-ICE CONTR
BRAKE DEICE	RIGHT FUEL VENT HEAT	RIGHT FUEL CONTR HEAT
RIGHT PITOT HEAT		
FUEL		
SCAVENGER PUMP C-12	#2 FIREWALL VALVE	#2 PRESS WARN
ENGINE		
#2 START CONTR	#2 ICE VANE CONTR	#2 IGNITOR CONTR
AUTOFEATHER	PROP GOV	
#5 DUAL FED BUS		
FLIGHT		
ELEC TRIM	FLAP MOTOR	PILOT TURN & SLIP
LIGHTS		
ICE	BCN	SUBPANEL & CONSOLE LIGHTS
INST INDIRECT	RECOG	LANDING LIGHTS
ENVIRONMENTAL		
TEMP CONTR	LEFT BLEED AIR CONTR	AIR COND CONTR
ELECTRICAL		
#1 GEN RESET	TAS PROBE HEAT POWER	
#6 DUAL FED BUS		
FLIGHT		
RUDDER BOOST	FLAP CONTR	
LIGHTS		
EMERG LIGHTS	FLT INST	NAV
OVHD LIGHTS	TAXI LIGHT	CABIN LTS & SIGNS
READING	#2 GEN RESET	
AVIONICS		
AVIONICS MASTER CONTR	COMPASS SWITCHING	TRANSPONDER EMERG MODE
AVIONICS ANNUNCIATOR		
HOT BATTERY BUS		
#1 FIREWALL SHUTOFF VALVE	#2 FIREWALL SHUTOFF VALVE	AFT BAGGAGE LIGHTS
#1 ENGINE FIRE EXTINGUISHER	#2 ENGINE FIRE EXTINGUISHER	SPAR & THRESHOLD LIGHTS
#1 STANDBY FUEL PUMP	#2 STANDBY FUEL PUMP	
DOOR STEP & OBSERVATION LIGHTS		

Table 2-9. DC Electrical System **T1**

#1 AVIONICS BUS		
FMS #1		
HF RCVR	AIR DATA ENCODER	#1 AFCS
#1 VHF	TRANSPONDER	AP PWR
#1 NAV	UHF	TACAN
#1 ADF	PAGING	PILOT HSI MFD
#2 RMI	TCAS PROCESSOR	CONTROL DISPLAY UNIT
PILOT DCU	PILOT MFD CONTROL PANEL	MODE S ALTIMETER ENCODER
PILOT AUDIO	DATA LOADER	PILOT ADI MFD
#2 AVIONICS BUS		
#2 VHF	COPILOT AUDIO	GRAPHIC DISPLAY
#2 NAV	RADIO ALTIMETER	COPILOT ALT
#2 ADF	RADAR	INPTH
#1 RMI	#2 AFCS	GPAAS POWER
COPILOT DCU	ARC-210	FMS #2
		STORMSCOPE
#1 DUAL FED BUS		
WARNING		
ANN IND	STALL WARN	LEFT BLEED AIR WARN
#1 CHIP DETR	LANDING GEAR	
FUEL		
#1 QTY IND	#1 STANDBY PUMP	#1 AUXILIARY TRANSFER
#1 QTY WARN	COPILOT HSI MFD	
ENGINE		
#1 OIL TEMP	#1 OIL PRESS	
FURNISHING		
CIGAR LIGHTER		
#2 DUAL FED BUS		
WARNING		
ANN PWR	FIRE DETR	RIGHT BLEED AIR WARN
#2 CHIP DETR	LANDING GEAR WARN	
FUEL		
#2 QTY IND	#2 STANDBY PUMP	#2 AUXILIARY TRANSFER
#2 QTY WARN	COPILOT ADI MFD	
ENGINE		
#2 OIL TEMP	#2 OIL PRESS	COPILOT MFD CONTROL PANEL
ELECTRICAL		
BATTERY CHARGE		
#3 DUAL FED BUS		

Table 2-9. DC Electrical System T1 (Continued)

WEATHER		
WSHLD WIPER	LEFT PROP ANTI-ICE	PROP ANTI-ICE AUTO
SURF DEICE	LEFT FUEL VENT HEAT	LEFT FUEL CONTR HEAT
FUEL		
CROSSFEED	#1 FIREWALL VALVE	#1 PRESS WARN
ENGINE		
#1 START CONTR	#1 ICE VANE CONTR	#1 IGNITOR CONTR
PROP SYNC		
#4 DUAL FED BUS		
WEATHER		
STALL WARN	RIGHT PROP ANTI-ICE	PROP ANTI-ICE CONTR
BRAKE DEICE	RIGHT FUEL VENT HEAT	RIGHT FUEL CONTR HEAT
RIGHT PITOT HEAT		
FUEL		
#2 FIREWALL VALVE	#2 PRESS WARN	
ENGINE		
#2 START CONTR	#2 ICE VANE CONTR	#2 IGNITOR CONTR
AUTOFEATHER	PROP GOV	
#5 DUAL FED BUS		
FLIGHT		
ELEC TRIM	FLAP MOTOR	PILOT TURN & SLIP
LIGHTS		
ICE	BCN	SUBPANEL & CONSOLE LIGHTS
INST INDIRECT	RECOG	LANDING LIGHTS
ENVIRONMENTAL		
TEMP CONTR	LEFT BLEED AIR CONTR	AIR COND CONTR
ELECTRICAL		
#1 GEN RESET	TAS PROBE HEAT POWER	
#6 DUAL FED BUS		
FLIGHT		
RUDDER BOOST	FLAP CONTR	
LIGHTS		
EMERG LIGHTS	FLT INST	NAV
OVHD LIGHTS	TAXI LIGHT	CABIN LTS & SIGNS
READING		
ENVIRONMENTAL		
PRESS CONTR	RIGHT BLEED AIR CONTR	AUTOMATIC OXYGEN CONTROL
RADIANT HEAT CARGO DOOR	TCAS VERT SPEED IND	
ELECTRICAL		
#2 GEN RESET		

Table 2-9. DC Electrical System T1 (Continued)

AVIONICS		
AVIONICS MASTER CONTR	COMPASS SWITCHING	TRANSPONDER EMERG MODE
AVIONICS ANNUNCIATOR		
HOT BATTERY BUS		
#1 FIREWALL SHUTOFF VALVE	#2 FIREWALL SHUTOFF VALVE	AFT BAGGAGE LIGHTS
#1 ENGINE FIRE EXTINGUISHER	#2 ENGINE FIRE EXTINGUISHER	SPAR & THRESHOLD LIGHTS
#1 STANDBY FUEL PUMP	#2 STANDBY FUEL PUMP	
DOOR STEP & OBSERVATION LIGHTS		

Table 2-10. DC Electrical System T2 (Continued)

#1 AVIONICS BUS		
HF RCVR	AIR DATA ENCODER	AUTOPILOT
#1 VHF	TRANSPONDER	TACAN
#1 NAV	PAGING	GPS
#1 ADF	TCAS	ALTITUDE ALERT
#2 RMI	#1 DCU	FMS #1
#1 MODE S	#1 AFCS	TCAS RMT
PILOT AUDIO		
#2 AVIONICS BUS		
#2 VHF	RADAR & MFD	INPTH
#2 NAV	#2 AFCS	MLS
#2 ADF	#2 DCU	GPAAS. POWER
#1 RMI	GPAAS	FMS #2
COPILOT AUDIO	COPILOT ALT	UHF
RADIO ALTIMETER	STORMSCOPE	
#1 DUAL FED BUS		
WARNING		
ANN IND	STALL WARN	LEFT BLEED AIR WARN
#1 CHIP DETR	LANDING GEAR IND	
FUEL		
#1 QTY IND	#1 STANDBY PUMP	#1 AUXILIARY TRANSFER
#1 QTY WARN		
ENGINE		
#1 OIL TEMP	#1 OIL PRESS	#1 EADI
		#1 EHSI
FURNISHING		
CIGAR LIGHTER		#1 CONTROL PANEL

Table 2-10. DC Electrical System T2 (Continued)

#2 DUAL FED BUS		
WARNING		
ANN PWR	FIRE DETR	RIGHT BLEED AIR WARN
#2 CHIP DETR	LANDING GEAR WARN	
FUEL		
#2 QTY IND	#2 STANDBY PUMP	#2 AUXILIARY TRANSFER
#2 QTY WARN		#2 EADI
ENGINE		
#2 OIL TEMP	#2 OIL PRESS	#2 EHSI
ELECTRICAL		
BATT CHARGE	#2 CONTROL PANEL	
#3 DUAL FED BUS		
WEATHER		
WSHLD WIPER	AUTO PROP DEICE CONTROL	LEFT FUEL CONTR HEAT
SURF DEICE	LEFT FUEL VENT HEAT	
LEFT PITOT HEAT		
FUEL		
CROSSFEED	#1 FIREWALL VALVE	#1 PRESS WARN
ENGINE		
#1 START CONTR	#1 ICE VANE CONTR	#1 IGNITOR CONTR
PROP SYNC		
#4 DUAL FED BUS		
WEATHER		
STALL WARN	MANUAL PROP DEICE CONTROL	RIGHT FUEL CONTR HEAT
BRAKE DEICE	RIGHT FUEL VENT HEAT	
RIGHT PITOT HEAT		
FUEL		
#2 FIREWALL VALVE	#2 PRESS WARN	
ENGINE		
#2 START CONTR	#2 ICE VANE CONTR	#2 IGNITOR CONTR
AUTOFEATHER	PROP GOV	
AVIONICS		
HF POWER		
#5 DUAL FED BUS		
FLIGHT		
ELEC TRIM	FLAP MOTOR	PILOT TURN & SLIP
LANDING GEAR		
LIGHTS		
ICE	BCN	SUBPANEL & CONSOLE LIGHTS

Table 2-10. DC Electrical System* T2 *(Continued)

INST INDIRECT	RECOG	LANDING LIGHTS
RADIO PANEL		
ENVIRONMENTAL		
TEMP CONTR	LEFT BLEED AIR CONTR	AIR COND CONTR
ELECTRICAL		
#1 GEN RESET		
#6 DUAL FED BUS		
FLIGHT		
RUDDER BOOST	FLAP CONTR	
LIGHTS		
EMERG LIGHTS	FLT INST	NAV
OVHD LIGHTS & EDGELIGHT	TAXI LIGHTS	CABIN LTS
PANEL LIGHTS	READING LIGHTS – SIGNS	
ENVIRONMENTAL		
PRESS CONTR	RIGHT BLEED AIR CONTR	AUTOMATIC OXYGEN CONTROL
RADIANT HEAT CARGO DOOR		
ELECTRICAL		
#2 GEN RESET		
AVIONICS		
AVIONICS MASTER CONTR	COMPASS SWITCHING	TRANSPONDER EMERG MODE
AVIONICS ANNUNCIATOR	TVSI	
HOT BATTERY BUS		
#1 FIREWALL SHUTOFF VALVE	#2 FIREWALL SHUTOFF VALVE	
#1 ENGINE FIRE EXTINGUISHER	#2 ENGINE FIRE EXTINGUISHER	
#1 STANDBY FUEL PUMP	#2 STANDBY FUEL PUMP	
CABIN LIGHT		
BATTERY RELAY		

2-83. DC POWER SUPPLY.

a. Description. One nickel-cadmium battery furnishes dc power when the engines are not operating. This 24-volt, 34-ampere hour battery, located in the right wing center section, is accessible through a panel on the top of the wing. DC power is produced by two engine-driven 28-volt, 250-ampere starter-generators. Controls and indicators associated with the dc supply system are located on the overhead control panel and consist of a single **BATT / ON / RESET** switch, two generator switches (**#I GEN** and **#2 GEN**), C D T1 and **BATTERY OFF / RESET** switch, two generator switches (**#1 / #2 GENERATOR**) T2, and two volt-loadmeters. Refer to Figure 2-15.

b. Battery Switch. A switch, placarded **BATT** C D T1 **BATTERY** T2, is located on the overhead control panel under the **MASTER SWITCH**. The **BATT** / **BATTERY** switch controls the dc power to the aircraft bus system through the battery relay, and must be **ON** to allow external power to enter aircraft circuits. When the **MASTER SWITCH** is placed aft, the **BATT / BATTERY** switch is forced **OFF**.

c. Generator Switches. Two switches, placarded **#1 GEN** / **#2 GEN** C D T1 and **#1 / #2**

GENERATOR T2 , are located on the overhead control panel under the **MASTER SWITCH**. The toggle switches control electrical power from the designated generator to paralleling circuits and the bus distribution system. Switch positions are **RESET** / **ON** / **OFF**. **RESET** is forward (spring-loaded back to **ON**), **ON** is center, and **OFF** is aft. When a generator is removed from the aircraft electrical system, due either to fault or from placing the **GEN / GENERATOR** switch in the **OFF** position, the affected unit cannot have its output restored to aircraft use until the **GEN / GENERATOR** switch is moved to **RESET**, then **ON**.

d. Master Switch. All electrical current may be shut off using the **MASTER SWITCH** bar that extends above the battery and generator switches. The **MASTER SWITCH** bar is moved forward when a battery or generator switch is turned on. When moved aft, the bar forces each switch to the **OFF** position.

e. Volt-Loadmeters C D T1**.** Two meters on the overhead control panel display voltage readings and show the rate of current usage from left and right generating systems. Each meter is equipped with a spring-loaded push-button switch which, when manually pressed, will cause the meter to indicate main bus voltage. Each meter normally shows output amperage reading from the respective generator, unless the push-button switch is pressed to obtain bus voltage reading. Current consumption is indicated as a percentage of total output amperage capacity for the generating system monitored.

f. DC Load and Voltmeters T2 **.** Four digital meters, located on the overhead panel, display voltage readings and show the rate of current usage from the left and right generating systems. The two load meters indicate output amperage as a percent of rated capacity from the respective generator. Current consumption is indicated as a percentage of total output amperage capacity for the generating system being monitored. The two voltmeters indicate bus voltage for the respective generating system.

g. Battery Monitor. Nickel-cadmium battery overheating will cause the battery charge current to increase if thermal runaway is imminent. The aircraft has a charge-current sensor, which will detect a charge current. The charge current system senses battery current through a shunt in the negative lead of the battery. Any time the battery charging current exceeds approximately 7-amperes for 6 seconds or longer, the yellow **BATTERY CHARGE** annunciator light and the master fault caution light will illuminate. Following a battery engine start, the caution light will illuminate approximately 6 seconds after the generator switch is placed in the **ON** position. The light will normally extinguish within 2 to 5 minutes, indicating that the battery is approaching a full charge. The time interval will increase if the battery has a low state of charge, the battery temperature is very low, or if the battery has previously been discharged at a very low rate (i.e., battery operation of radios or lights for prolonged periods). The caution light may also illuminate for short intervals after landing gear and/or flap operation. If the caution light should illuminate during normal steady-state cruise, it indicates that conditions exist that may cause a battery thermal runaway. If this occurs, the battery switch shall be turned **OFF** and may be turned back **ON** only for gear and flap extension and approach to landing. Battery may be usable after a 15 to 20 minute cooldown period.

h. Battery Temperature Monitoring System T2 **.** A battery temperature indicator system is provided to monitor the temperature of the nickel cadmium battery. The system consists of a battery temperature probe, a dc-powered (ANVIS) post lighted indicator, push-to-test switch and system circuit breaker. The battery temperature indicator and push-to-test switch, placarded **BAT TEMP TEST**, are both located on the pilot's subpanel. The systems circuit breaker, placarded **BATT TEMP**, is located in the **WARNING** section of the overhead circuit breaker panel. Dimming of the post lighted instrument is provided through the **SUBPANEL LIGHTS** rheostat.

The instrument indicating range is 100 °F (bottom of scale), to 190 °F (top of scale). A red, yellow and green band located alongside the indicator scale and two annunciators (lower) caution and (upper) warning located on the face of the indicator provide visual battery temperature information. When illuminated, the lower annunciator indicates the battery temperature exceeds 120 °F, the upper annunciator indicates the battery temperature exceeds 150 °F.

The push-to-test switch, placarded **BAT TEMP TEST**, when pressed and held, will normally move the indicator pointer to the top of the scale and illuminate both annunciators. The pointer rate of rise will vary, being somewhat slower with colder battery temperatures. If a probe is faulty or leaking, or a wire is broken, the pointer may not move at all or may stop down the scale. Allow approximately 45 seconds for the pointer to move to the top of the scale in normal temperatures; 60 seconds in colder temperatures.

i. Generator Out Warning Lights. Two caution/advisory annunciator panel lights inform the pilot when either generator is not delivering current to the aircraft dc bus system. These lights are placarded **#1 DC GEN** and **#2 DC GEN**. Two flashing **MASTER CAUTION** lights and illumination of either fault light indicates that either the identified generator has failed or voltage is insufficient to keep it connected to the power distribution system.

CAUTION

The Ground Power Unit (GPU) shall be adjusted to regulate at 28-volts maximum to prevent damage to the aircraft. Do not turn generators on when GPU is supplying power.

j. DC External Power Source. External dc power can be applied to the aircraft through an external power receptacle on the underside of the right wing leading edge just outboard of the engine nacelle. The receptacle is installed inside of the wing structure and is accessible through a hinged access panel. DC power is supplied through the dc external plug and applied directly to the battery bus after passing through the external power relay. Turn off external power while connecting the power cable to, or removing it from, the external power supply receptacle. The holding coil circuit of the relay is energized by the external power source when the keylock and **BATT / BATTERY** switches are in the **ON** position. The GPU shall be adjusted to regulate at 28-volts maximum to prevent damage to the aircraft battery and electronics.

k. Security Keylock Switch. The aircraft has a security keylock switch installed on the overhead control panel, placarded **OFF / ON**. The switch is connected into the battery relay and external power circuits, in series with the battery master power switch. The key cannot be removed from the lock when in the **ON** position. The key will not fit the keylocks on other Army aircraft.

l. Circuit Breakers. The overhead circuit breaker panel contains circuit breakers for most aircraft systems. The circuit breakers on the panel are grouped into areas, which are placarded as to the general function they protect. A dc power distribution panel is mounted beneath the floor forward of the main spar. This panel contains higher current rated circuit breakers and is not accessible to the flight crew under normal conditions. Refer to Figure 2-16, Sheet 1 for C configuration, Sheet 2 for D1, Sheet 3 for D2, and sheet 4 for T.

2-84. AC POWER SUPPLY.

a. Description C D1. AC power for the aircraft is supplied by inverter units, numbered #1 and #2, which obtain operating current from the dc power system. Refer to Figure 2-29. Both inverters are rated at 750 VA and provide single-phase output only. Each inverter provides 115-volt and 26-volt 400 Hz ac output. The inverters are protected by circuit breakers mounted on the dc power distribution panel mounted beneath the floor. Aircraft equipment operating from single-phase ac include the following: autopilot navigation receivers, the tuning portion of the ADF receiver, gyro magnetic compass, and engine instruments for fuel flow and torquemeters. Controls and indicators of the ac power system are located on the overhead control panel and on the caution/ advisory annunciator panel. The pilot selects ac sources using the two inverter select switches located on the overhead control panel.

NOTE T2

AC Power for ANVIS cathode tube lighting is provided by cathode power packs totally independent of the #1 and #2 aircraft inverters.

b. Description D2 T. AC power for the aircraft is supplied by inverter units, numbered #1 and #2, that obtain operating current from the dc power system. Refer to Figure 2-29, Sheets 2 and 3. Both inverters are rated at 750 VA and provide single-phase output only. Each inverter provides 115-volt and 26-volt 400 Hz ac output. The inverters are protected by circuit breakers mounted on the dc power distribution panel mounted beneath the floor. Aircraft equipment operating from single-phase ac include the following: autopilot/flight director, the tuning portion of the ADF receiver, gyro magnetic compass, RMI, pilot's altimeter, transponder IFF computer, and engine instruments for fuel flow and torquemeters. Controls and indicators of the ac power system are located on the overhead control panel and on the caution/ advisory annunciator panel. The pilot selects AC sources using the two inverter select switches located on the overhead control panel.

c. AC Power Warning Lights. Two flashing **MASTER CAUTION** lights and the illumination of an annunciator caution light **#1 INVERTER** or **#2 INVERTER**, indicate an inverter failure.

d. Inverter Control Switches. Two switches, placarded **INVERTER #1** or **#2** on the overhead control panel give the pilot a choice of inverters to provide single-phase ac power. Two inverters are involved in this selection.

e. Volt-Frequency Meters C D T1. Two volt-frequency meters are mounted in the overhead control panel to provide monitoring capability for both 115 Vac buses. Normal display on the meter is shown in frequency (Hz). To read voltage, press the button located in the lower left corner of the meter. Normal output of the inverters will be indicated by 115 Vac and 400 Hz on the meters.

f. Volt-Frequency Meters T2 . Two digital display volt-frequency meters are mounted in the overhead control panel to provide a monitoring capability for both 115 Vac buses. AC power load and frequency (Hz) are continuously displayed. Normal output of the inverters will be indicated by 115 Vac and 400 Hz on the meters.

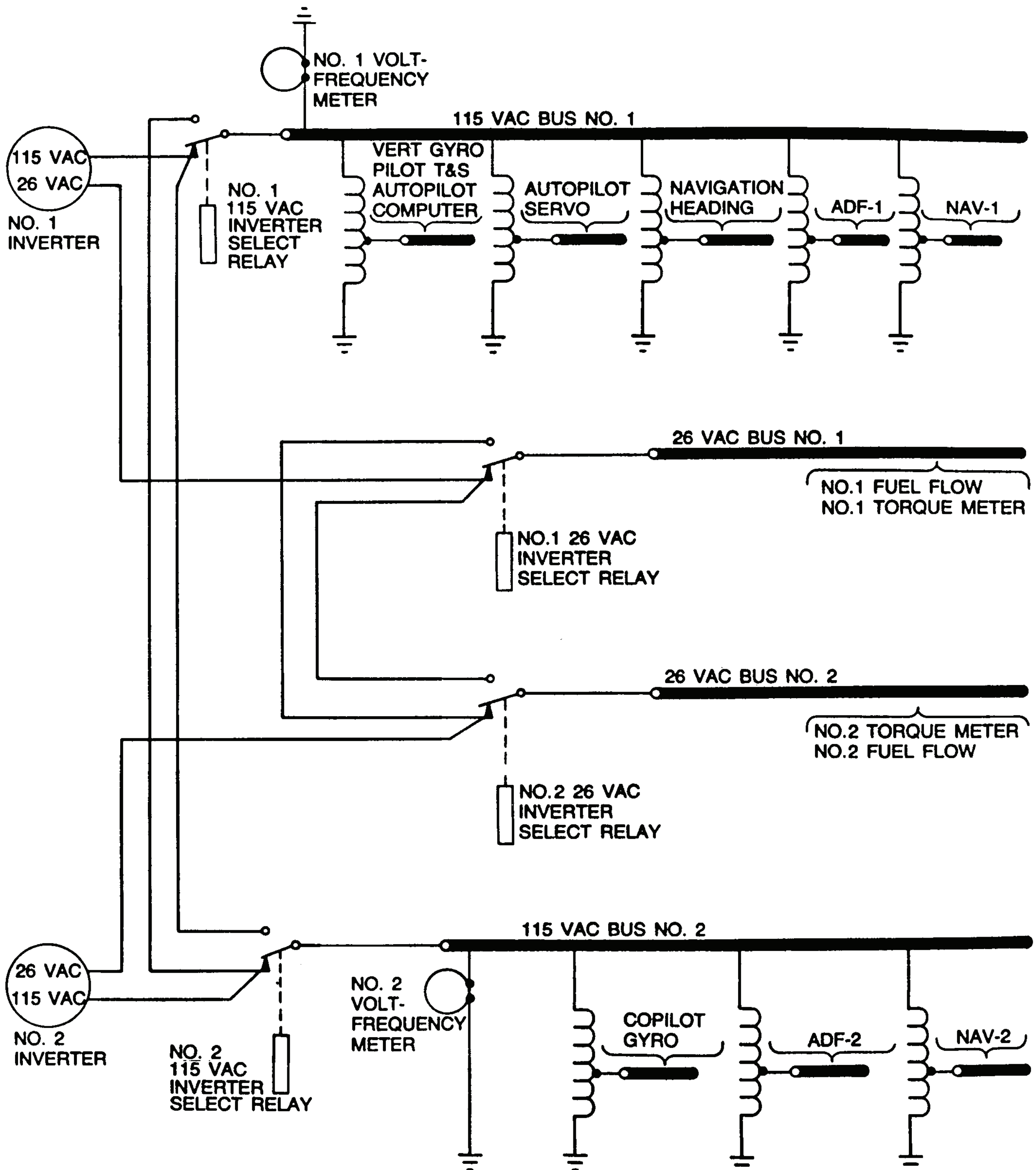


Figure 2-29. AC Electrical System Schematic Diagram **C D1** *(Sheet 1 of 3)*

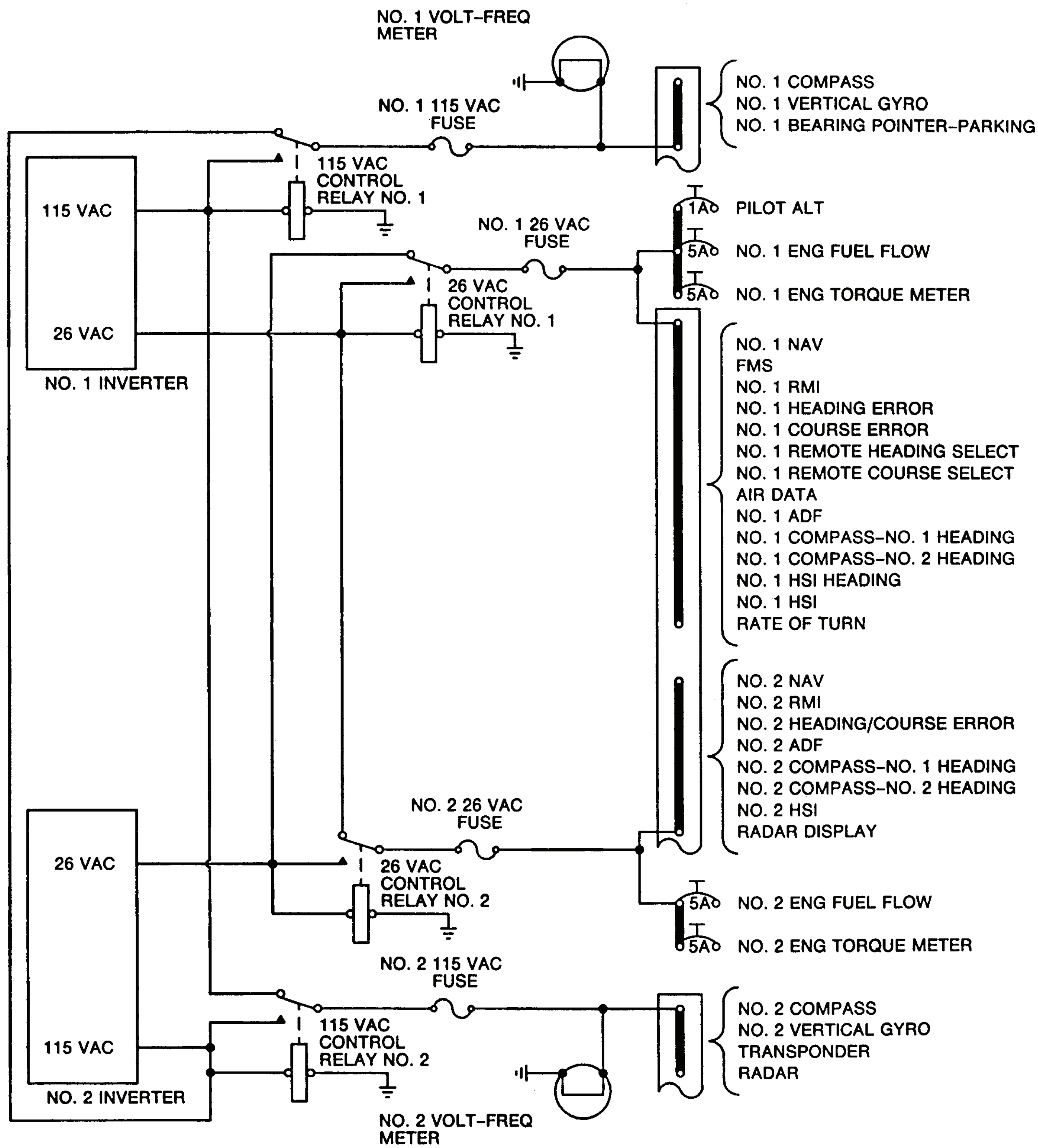


Figure 2-29. AC Electrical System Schematic Diagram **D2** *(Sheet 2 of 3)*

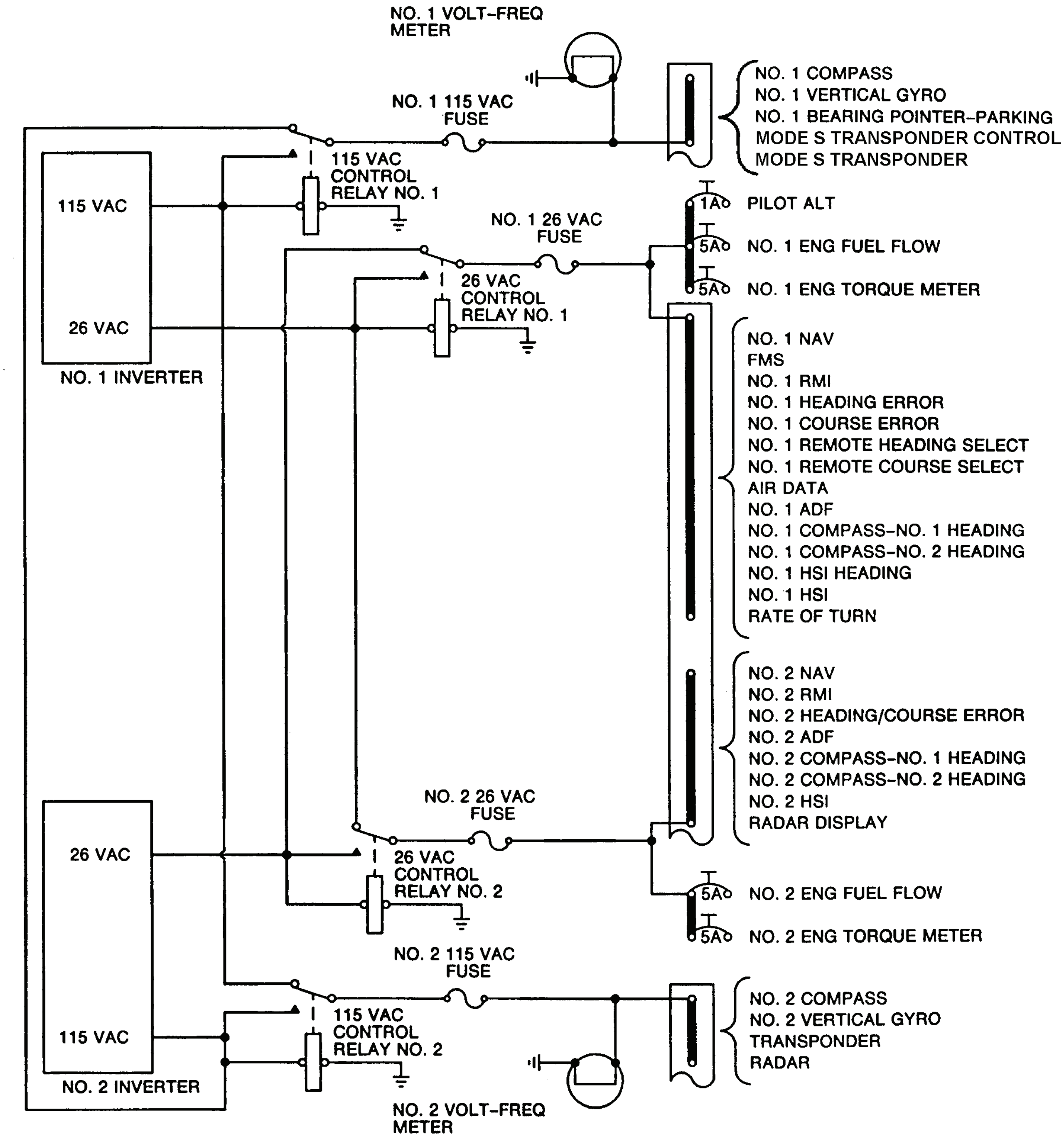


Figure 2-29. AC Electrical System Schematic Diagram **T** *(Sheet 3 of 3)*

Section X. LIGHTING

2-85. EXTERIOR LIGHTING.

a. Description. Exterior lighting consists of a navigation light on the aft top of the vertical stabilizer, one navigation light on each wing tip, two strobe beacons, one on top of the vertical stabilizer and one on the underside of the fuselage center section, one combination landing/taxi light recess mounted in each wing tip C , or dual landing lights and one taxi light mounted on the nose gear assembly D T , and two ice lights, one light flush mounted in each nacelle, positioned to illuminate along the leading edge of each outboard wing. In addition, some aircraft are equipped with a recognition light located in each wing tip. Refer to Figure 2-30.

b. Navigation Lights. The navigation lights are protected by a 5-ampere circuit breaker, placarded **NAV**, on the overhead circuit breaker panel. The lights are controlled by a switch, placarded **NAV ON**, on the overhead control panel.

c. Strobe Beacons. The strobe beacons are dual intensity units. They are protected by a 15-ampere circuit breaker placarded **BCN** on the overhead circuit breaker panel. Control of the lights is provided by a switch placarded **BEACON DAY NIGHT**. Placing the switch in the **DAY** position will activate the high intensity white section of the strobe lights for greater visibility during daytime operation. Placing the switch in the **NIGHT** position activates the lower intensity red section of the strobe lights.

d. Landing/Taxi Lights. Dual landing lights and a single taxi light are mounted on the nose gear assembly. The lights are controlled by switches placarded **LANDING** and **TAXI** located in the **LIGHTS** section of the pilot's subpanel. The control circuits are protected by two 5-ampere circuit breakers placarded **LANDING LIGHT TAXI LDG** on the overhead circuit breaker panel. The landing lights and taxi light power circuits are protected by 35-ampere and 15-ampere circuit breakers, respectively, located on the dc power distribution panel beneath the cockpit floor.

e. Ice Lights. The ice lights are protected by a 5-ampere circuit breaker, placarded **ICE**, on the overhead circuit breaker panel. The lights are controlled by a switch, placarded **ICE ON**, on the overhead control panel. Prolonged use during ground operation may generate enough heat to damage the lens.

f. Recognition Lights. A **RECOG** switch, located in the pilot's subpanel **LIGHTS** section, controls a white recognition light in each wing tip. This steady bright light is used for identification. The system is protected by a 7.5-ampere **RECOG** circuit breaker located on the overhead circuit breaker panel.

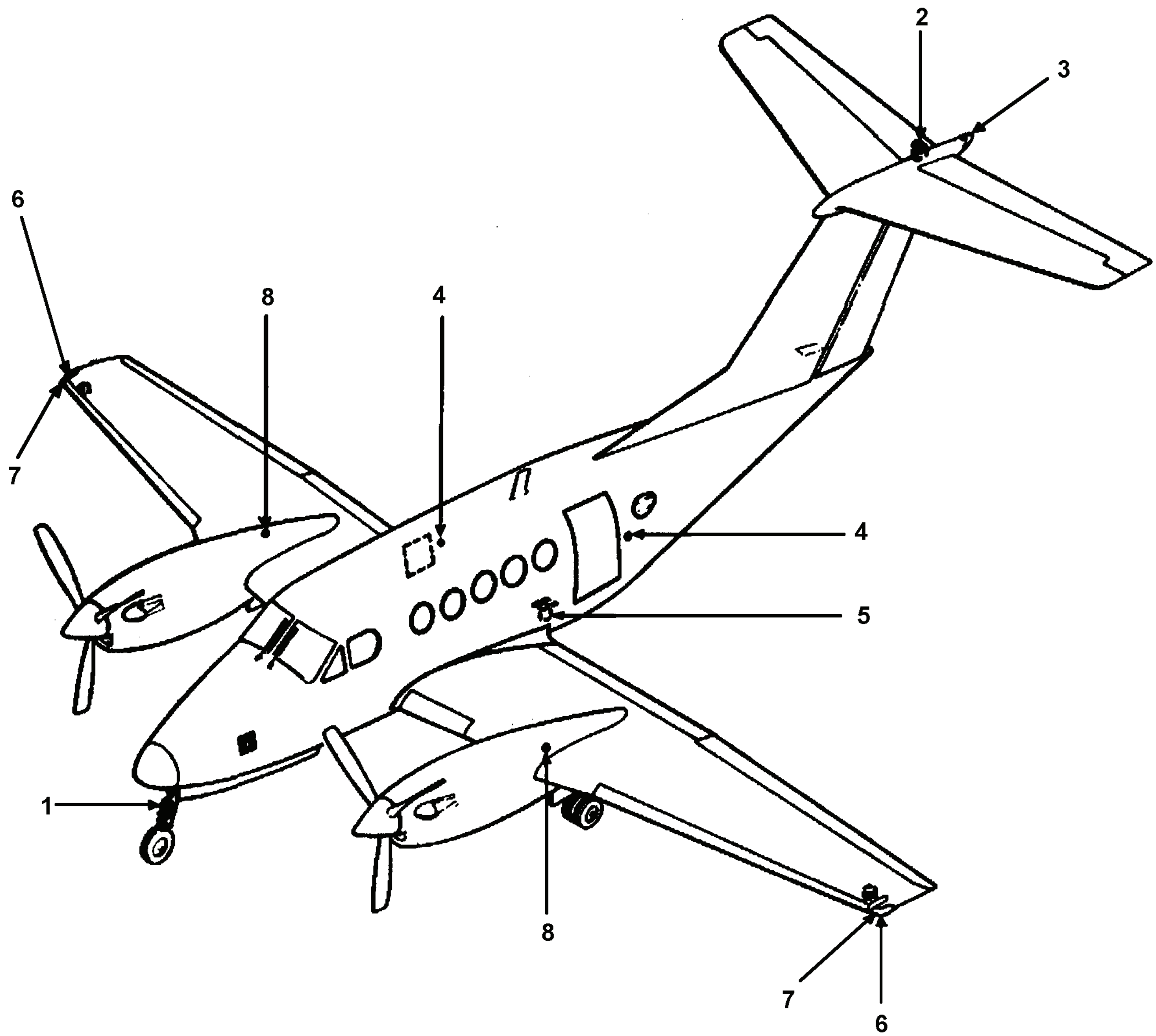
2-86. INTERIOR LIGHTS.

a. Description.

(1) Interior Lighting C D T1 . Lighting systems are installed for use by the pilot and copilot and by the passengers in the cabin area. The lighting systems in the cockpit are provided with intensity controls on the overhead control panel. A switch, placarded **MASTER PANEL LIGHTS**, on the overhead control panel, provides overall on-off control for all engine instrument lights, pilot and copilot instrument lights, overhead panel lights, console and subpanel.

(2) Interior Lighting T2 . Aviation Night Vision (ANVIS) compatible lighting is installed in the cockpit and cabin area. The cockpit lighting systems are provided with individually controlled, from **OFF** to **BRT** (bright) rheostats on the overhead control panel. Cabin lighting is controlled by two switches, placarded **CABIN LIGHT ON / BRIGHT** and **READING LIGHT ON** respectively.

A switch, placarded **MASTER PANEL LIGHTS**, on the overhead control panel provides an overall power on-off control for all engine instrument lights, pilot and copilot instrument and gyro instrument lights, instrument indirect lights, overhead flood lights, overhead panel lights and electroluminescent edgelights.



1. Landing/Taxi Lights
2. Upper Strobe Beacon
3. Tail Navigation Light
4. Emergency Exit Light
5. Lower Strobe Beacon
6. Wing Navigation Lights
7. Recognition Lights
8. Ice Lights

Figure 2-30. Exterior Lighting – Typical

b. Cockpit Lighting.

(1) Flight Instrument Lights. Each individual flight instrument contains internal lamps for illumination. The circuit is protected by a 7.5-ampere circuit breaker, placarded **FLT INST**, on the overhead circuit breaker panel. Control is provided by two rheostat switches, placarded **PILOT INST** or **COPILOT INSTR LIGHTS OFF / BRT**, on the overhead control panel. Turning the control clockwise from **OFF** turns the lights on and increases their brilliance.

(2) Instrument Indirect Lights. Lights are mounted in the glareshield overhang along the top edge of the instrument panel to provide instrument panel illumination. The circuit is protected by a 5-ampere circuit breaker, placarded **INST INDIRECT**, on the overhead circuit breaker panel. Control is provided by a rheostat switch, placarded **INST** or **INSTR INDIRECT LIGHTS OFF / BRT**, on the overhead control panel, Figure 2-15. Turning the control clockwise from **OFF** turns the lights on and increases their brilliance.

(3) Radio Panel Instrument Lights **D2 T** *.* Radio panel instrument lights provide direct adjustable lighting for individual radios and switches. A rheostat, placarded **RADIO PANEL LIGHTS**, located on the overhead control panel, is used to adjust light levels from **OFF** to **BRT** (bright). Turning the control clockwise from **OFF** turns the lights on and increases their brilliance. The circuit is protected through a 7.5-ampere circuit breaker, placarded **RADIO PANEL**, located on the overhead circuit breaker panel.

(4) Engine Instrument Lights. Each individual engine instrument contains internal lamps for illumination. The circuit is protected by a 7.5-ampere circuit breaker, placarded **FLT INST**, on the overhead circuit breaker panel. Control is provided by a rheostat switch, placarded **ENGINE INSTR LIGHTS**, on the overhead control panel. Turning the control clockwise from **OFF** turns the lights on and increases their brilliance.

(5) Flood Light. A single overhead flood light is installed in the oxygen control escutcheon aft of the overhead circuit breaker panel. It provides overall illumination of the entire cockpit area. The circuit is protected by a 5-ampere circuit breaker mounted beneath the battery and connected to the emergency battery bus. Control is provided by a rheostat switch, placarded **OVERHEAD FLOODLIGHT**, on the overhead control panel. Turning the control clockwise from **OFF** turns the light on and increases its brilliance.

(6) Overhead Panel Lights **C D T1** *.* Lamps on the overhead circuit breaker panel, control panel, and fuel management panel are protected by a 7.5-ampere circuit breaker, placarded **LIGHTS OVHD**, on the overhead circuit breaker panel. Control is provided by a rheostat switch, placarded **OVERHEAD PANEL LIGHTS OFF / BRT**, on the overhead control panel. Turning the control clockwise from **OFF** turns the lights on and increases their brilliance.

(7) Overhead Panel Lights **T2** *.* The rheostat, placarded **OVERHEAD PANEL LIGHTS**, controls lighting for the magnetic compass, #1 and #2 Vac frequency meters, #1 and #2 dc voltmeters, and fuel quantity gauges. Turning the control clockwise from **OFF** turns the lights on and increases their brilliance. Power and circuit protection is provided through a 7.5-ampere circuit breaker, placarded **LIGHTS OVHD**, located on the overhead control panel.

(8) Subpanel and Console Lights **C D** *.* Control is provided by two rheostat switches, placarded **SUBPANEL LIGHTS** and **CONSOLE INST LIGHTS OFF / BRT**, on the overhead control panel. Turning the control clockwise from **OFF** turns the lights on and increases their brilliance. Lamps on the pilot's and copilot's subpanels console edge lit panels and pedestal extension panels are protected by a 7.5-ampere circuit breaker, placarded **LIGHTS SUBPANEL & CONSOLE** **C D1** or **LIGHTS SUBPANEL & CONSOLE** **D2** on the overhead circuit breaker panel.

(9) Subpanel Lights **T2** *.* Post lighting of the gauges located on the pilot and copilot subpanels is controlled by a rheostat, placarded **SUBPANEL LIGHTS**, located on the overhead control panel. Turning the control clockwise from **OFF** turns the lights on and increases their brilliance. These lights receive electrical power through and are protected by a circuit breaker, placarded **SUBPNL & CONSOLE**, located in the overhead circuit breaker panel.

(10) Console Lights **T2** *.* Edge lighting of the pressurization controller panel located on extended pedestal is controlled by the rheostat, placarded **CONSOLE LIGHTS**. Turning the control clockwise from **OFF** turns the lights on and increases their brilliance. Power is through and circuit protection is provided by a circuit breaker, placarded **SUBPNL & CONSOLE**, located in the overhead circuit breaker panel.

(11) Free Air Temperature Lights **C D T1** *.* Two post lights are mounted adjacent to the free air temperature gauge on the left cockpit sidewall trim panel. The circuit is protected by a 7.5-ampere circuit

breaker, placarded **LIGHTS FLT INST**, on the overhead circuit breaker panel. Control is provided by a push-button switch adjacent to the gauge. No intensity control is provided.

(12) Free Air Temperature Light **T2**. A press to light switch located adjacent to the outside air temperature indicator controls the indicator **ON / OFF** power function. However, light intensity is controlled by the **COPILOT INSTR LIGHTS** rheostat. The light circuitry receives power through, and is protected by, the **LIGHTS FLT INST** circuit breaker located in the overhead circuit breaker panel.

c. Cabin Lighting.

(1) Interior Lights **C D T1** . Dual intensity fluorescent lights are installed on both sides of the overhead trim. The circuit is protected by a 10-ampere circuit breaker, placarded **FASTEN SEAT BELT / NO SMOKE** **C** and **CABIN LIGHTS & SIGN** **D T1** , on the overhead circuit breaker panel. Control is provided by a switch, placarded **INTR LIGHT OFF / DIM / BRT START**, on the overhead control panel. The switch must be placed in the **BRT START** position to illuminate the lights. Intensity can be reduced by placing the switch in **DIM** position.

(2) Interior Lights **T2** . Dual intensity cold cathode lights are installed on both sides of the overhead trim. The circuits are protected by a 10-ampere circuit breaker, placarded **CABIN LIGHTS**, located on the overhead circuit breaker panel. Control is provided by a switch, placarded **CABIN LIGHT ON BRIGHT**, located on the overhead control panel. Light intensity is increased by placing the switch in **BRIGHT** position. Cabin light intensity is also increased upon automatic deployment of the oxygen masks.

(3) No Smoking Fasten Seat Belt Lights. One light assembly is mounted in the overhead on each side of the cabin. The circuit is protected by a circuit breaker located on the overhead circuit breaker panel. Control is provided by a switch, placarded **CABIN SIGNS FASTEN SEAT BELT/ OFF /BOTH**, on the overhead control panel. Placing the switch in **SEAT BELT** position will illuminate both **FASTEN SEAT BELT** lights and sound the audible warning chime mounted behind the upholstery in the cabin. Placing the switch in **BOTH** position will illuminate both **FASTEN SEAT BELT** and both **NO SMOKING** lights and will sound the audible warning chime.

(4) Reading Lights. Reading lights are installed in the upholstery adjacent to each seat position. The circuit is protected by a 10-ampere circuit breaker, placarded **FASTEN SEAT BELT / NO SMOKE** **C** and a 5-ampere circuit breaker, placarded **READING LIGHTS** **T**, located on the overhead circuit breaker panel. Control is provided by a push-button switch adjacent to each light.

(5) Threshold and Spar Cover Lights. A threshold light is installed just above floor level on the left side of the cabin just inside the cabin door. A spar cover light is installed on the left side of the sunken aisle immediately aft of the main spar cover. Both circuits are protected by a 5-ampere circuit breaker mounted beneath the battery and connected to the emergency battery bus. Both lights are controlled by the switch mounted adjacent to the threshold light. If the lights are illuminated, closing the cabin door will automatically extinguish them.

(6) Dome Light. A dome light is installed in the baggage area in the overhead. The circuit is protected by a 5-ampere circuit breaker mounted beneath the battery and connected to the emergency battery bus. Control is provided by a switch mounted adjacent to the light.

2-87. EMERGENCY LIGHTING.

a. Description. An independent battery operated lighting system is installed. The system, which consists of five lights, is actuated automatically by shock such as a forced landing. It provides adequate lighting inside and outside the fuselage to permit crew and passengers to read instruction placards and locate exits. An inertia switch, when subjected to a 2 – 3 G shock, will illuminate interior lights in the cockpit, forward and aft cabin areas, exterior lights aft of the emergency exit, and aft of the cabin door. The battery power source is automatically recharged by the aircraft electrical system.

b. Operation. An emergency lights override switch located on the overhead control panel is provided to turn the system off if it is accidentally actuated. The switch is placarded **EMERG LIGHTS OVRD OFF / RESET** **C D T1** and **EMER LIGHTS OFF / RESET / AUTO /TEST** **T2** . Should the system accidentally actuate, placing the switch in the momentary **OFF/RESET** position will extinguish the lights. **T2** To test the system, place the switch in the momentary **TEST** position and the lights should illuminate. Moving the switch to the **OFF / RESET** position will turn the system off and reset it.

Section XI. FLIGHT INSTRUMENTS

2-88. PITOT AND STATIC SYSTEM.

NOTE

Instrument panels for each model aircraft are shown in Figure 2-17.

a. Description. The pitot and static system provides a source of impact air and static air for the operation of flight instruments. A heated pilot mast is located on each side on the lower portion of the nose. Tubing from each mast extends into the cabin to the instrument panel for the instruments. Refer to Figure 2-31.

b. Normal Static System. The normal static system provides two sources of static air to the flight instruments through two static air fittings on each side of the aft fuselage. Each static system utilizes one static button on each side of the fuselage.

c. Alternate Static System. An alternate static airline that terminates just aft of the rear pressure bulkhead, provides a source of static air for the pilot's instruments in the event of source failure from the pilot's static air line. A control on the pilot's subpanel, placarded **PILOT'S STATIC AIR SOURCE**, may be actuated to select either **NORMAL** or **ALTERNATE** air source by a two-position selector valve. A valve is secured in the **NORMAL** position by a spring clip. Altimeter and airspeed information graphs are provided in the Performance section for computation when operating on normal or alternate static air.

d. Static Line Drains. There are three drain petcocks for draining the static air lines located on the right lower sidewall. These are protected by an access cover, placarded **STATIC AIR LINE DRAIN**. These drain petcocks should be opened to release any trapped moisture at each 100-hour inspection, or more often if conditions warrant, and must be closed after draining.

2-89. TURN-AND-SLIP INDICATORS C D1 .

Turn and slip indicators are installed separately on the pilot and copilot sides of the instrument panel, Figure 2-17, Sheet 1. The pilot's indicator provides yaw damping information to the autopilot. These indicators are gyroscopically operated. They use dc power and are protected by 5-ampere circuit breakers, placarded **TURN & SLIP PILOT** or **COPILOT**, on the overhead circuit breaker panel.

2-90. TURN-AND-SLIP INDICATORS D2 .

Turn and slip indicators are installed separately on the pilot and copilot sides of the instrument panel, Figure 2-17, Sheet 2. These indicators are gyroscopically operated. The pilot's turn and slip indicator uses dc power, protected by a 5-ampere circuit breaker, placarded **TURN & SLIP PILOT**, located on the overhead circuit breaker panel. The copilot's turn and slip indicator does not require electrical power.

2-91. TURN-AND-SLIP INDICATOR T .

Only one turn and slip indicator is installed on the T1 and T2 aircraft. It is located on the pilot side of the instrument panel and uses dc power. It is protected by a 5-ampere circuit breaker, placarded **TURN & SLIP PILOT**, located on the overhead circuit breaker panel. Refer to Figure 2-16, Sheet 4.

2-92. AIRSPEED INDICATORS.

Airspeed indicators are installed separately on the pilot and copilot's sides of the instrument panel. These indicators require no electrical power for operation. The indicator dials are calibrated in knots from 40 to 300. A striped pointer automatically displays the maximum allowable airspeed (260 KIAS, 0.52 mach) at the aircraft's present altitude.

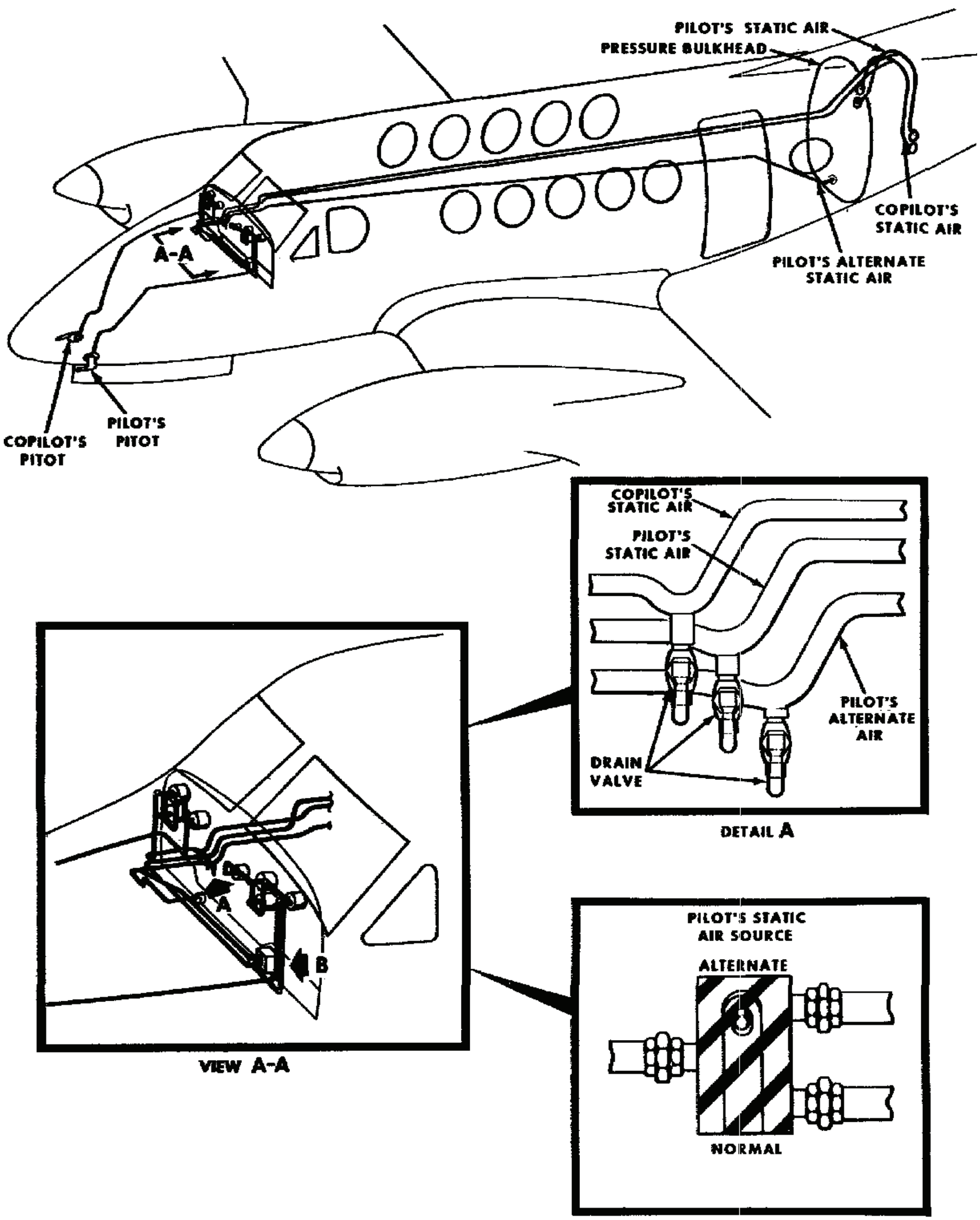


Figure 2-31. Pitot and Static System

2-93. PILOT'S ALTIMETER C D1 .

The altimeter is located on the upper left side of the instrument panel. The altimeter is a self-contained unit, which consists of a precision pressure altimeter combined with an altitude encoder. The display indicates, and the encoder transmits simultaneously, pressure altitude information to the transponder. Altitude is displayed on the altimeter by a 10,000-foot counter, a 1,000-foot counter, and a single needle pointer that indicates hundreds of feet on a circular scale in 20-foot increments. Below an altitude of 10,000 feet, a diagonal warning symbol will appear on the 10,000-foot counter. A barometric pressure setting knob is provided to insert the desired altimeter setting in inches Hg or millibars. A dc-powered vibrator operates inside the altimeter whenever aircraft power is on. If dc power to the altitude encoder is lost, a warning flag, placarded **CODE OFF**, will appear in the upper left portion of the instrument face. This indicates that the altitude encoder is inoperative and that the system is not reporting altitude to ground stations. Operating instructions are contained in Chapter 3.

2-94. PILOT'S ALTIMETER D2 T .

The pilot's altimeter provides a servoed counter drum/pointer display of barometrically corrected pressure altitude. The barometric pressure is set manually with the **BARO** knob, and displayed in units of inches of mercury and millibars on baro counters. Altitude is displayed on the altimeter by a 10,000-foot counter, a 1,000-foot counter, and a single needle pointer that indicates hundreds of feet on a circular scale in 20-foot increments. Below an altitude of 10,000 feet, a diagonal warning symbol will appear on the 10,000-foot counter. The altimeter is ac powered and is protected through a 1-ampere circuit breaker, placarded **PILOT ALTM (AC)**, located on the overhead circuit breaker panel, Figure 2-16, Sheets 1 and 2. Encoding capability is derived from the air data computer. The pilot's altimeter acts as an encoding repeater. For proper encoding operation, the 2-ampere circuit breaker, placarded **AIR DATA ENCDR**, located on the overhead circuit breaker panel must be in. Operating instructions are contained in Chapter 3.

2-95. COPILOT'S ALTIMETER.

The copilot's altimeter is located on the upper right side of the instrument panel. The altimeter is pneumatically operated and requires no electrical power for operation. The altimeter does not have altitude reporting capability. A dc-powered vibrator operates inside the altimeter whenever power is on. It is protected by a 1-ampere circuit breaker, placarded **COPILOT ALTM**, located on the overhead circuit breaker panel.

2-96. VERTICAL VELOCITY INDICATORS.

Vertical velocity indicators are installed separately on the pilot and copilot sides of the instrument panel, Figure 2-17. They indicate the speed at which the aircraft ascends or descends based on changes in atmospheric pressure. The indicator is a direct reading pressure instrument requiring no electrical power for operation. T The pilot's vertical velocity indicator is incorporated into the TVSI TCAS II indicator.

2-97. FREE AIR TEMPERATURE GAUGE.

The Free Air Temperature (FAT) gauge, mounted outboard of the pilot's seat indicates the outside air temperature in degrees Celsius.

2-98. STANDBY MAGNETIC COMPASS.

WARNING

Inaccurate indications on the standby magnetic compass will occur while wind-shield heat and/or air conditioning is being used.

The standby magnetic compass is located below the overhead fuel management panel to the right of the windshield divider, Figure 2-10. It may be used in the event of failure of the compass system or for instrument cross check. Readings should be taken only during level flight since errors may be introduced by turning or acceleration. A compass correction chart indicating deviation is located on the magnetic compass.

2-99. MISCELLANEOUS INSTRUMENTS.

a. Annunciator Panels C D1 . Two annunciator panels are installed. One is a warning panel with red fault identification lights, and the other is a caution/advisory panel with yellow and green identification lights. The warning panel is mounted near the center of the instrument panel below the glareshield, Figure 2-17, Sheet 1, and the caution/advisory panel is located on the center subpanel. Illumination of a red warning light signifies the existence of a hazardous condition requiring immediate corrective action. A yellow caution light signifies a condition other than hazardous requiring pilot attention. A green advisory light signifies other than hazardous requiring pilot attention. A green advisory light indicates a functional situation. Table 2-11 provides a list of causes for illumination of the individual warning annunciator lights. Table 2-12 provides a list of causes for illumination of the individual caution/advisory annunciator lights. In frontal view, both panels present rows of small opaque rectangular indicator lights. Word printing on each indicator identifies the monitored function situation or fault condition, but cannot be read until the light is illuminated. The bulbs of all annunciator panel lights are tested by activating the **ANNUNCIATOR TEST** switch, which is located on the right side of the caution/advisory panel. The system is protected by two 5-ampere circuit breakers, placarded **ANN PWR** and **ANN IND**, on the overhead circuit breaker panel, Figure 2-16. The annunciator system lights are dimmed when the **MASTER PANEL LIGHTS** switch is actuated and the pilot's flight instrument lights are on. The lights are automatically reset to maximum brightness if any of the following conditions exist.

(1) The main aircraft power (both dc generators) are off.

(2) The **INST INDIRECT LIGHTS** switch is on.

(3) The **MASTER PANEL LIGHTS** switch is off.

(4) The **MASTER PANEL LIGHTS** switch is **ON** and the **PILOT INST LIGHTS** switch is **OFF**.

b. Annunciator Panels D2 T .

NOTE T2

On C-12T2 aircraft equipped with the Aviation Night Vision Imaging System (ANVIS), the annunciator lighting is ANVIS green and ANVIS yellow. Both pilot and copilot sides have a master warning light (ANVIS yellow) and master caution light (ANVIS green) with a PRESS TO TEST switch located in the right inboard subpanel section. The warning annunciator panel is located in the glareshield immediately above the fire extinguisher system controls on the instrument panel. The caution/advisory panel is located on the subpanel. In other respects, the annunciator panels are as described in the following paragraph.

Table 2-11. C-12 Warning Annunciator Panels

NOMENCLATURE	COLOR	CAUSE FOR ILLUMINATION	AIRCRAFT EFFECTIVITY
		C D1	
#1 FUEL PRESS	Red	Fuel pressure failure on left side.	All
#2 FUEL PRESS	Red	Fuel pressure failure on right side.	All
L BL AIR FAIL	Red	Left bleed air warning line has melted or failed indicating possible loss of #1 engine bleed air.	All
R BL AIR FAIL	Red	Right bleed air warning line has melted or failed, indicating possible loss of #2 engine bleed air.	All
ALT WARN	Red	Cabin altitude exceeds 12,500 feet.	All
INST AC	Red	No AC power to engine instruments.	All
AP TRIM FAIL	Red	Trim won’t run or running opposite direction commanded.	All
#1 CHIP DETR	Red	Contamination of #1 engine oil detected.	All
#2 CHIP DETR	Red	Contamination of #2 engine oil detected.	All
		D2 T1	
ALT WARN	Red	Cabin altitude exceeds 12,500 feet.	All
INSTR AC	Red	No AC power to engine instruments.	All
#1 FUEL PRESS	Red	Fuel pressure failure on left side.	All
A/P TRIM FAIL	Red	Trim won’t run or running opposite direction commanded.	All
A/P DISC	Red	Autopilot is disconnected.	All
#2 FUEL PRESS	Red	Fuel pressure failure on right side.	All

Table 2-11. C-12 Warning Annunciator Panels (Continued)

NOMENCLATURE	COLOR	CAUSE FOR ILLUMINATION	AIRCRAFT EFFECTIVITY
L BL AIR FAIL	Red	Left bleed air warning line has melted or failed, indicating possible loss of #2 engine bleed air.	All
R BL AIR FAIL	Red	Right bleed air warning line has melted or failed, indicating possible loss of #2 engine bleed air.	All
#1 CHIP DETR	Red	Contamination of #1 engine oil detected.	All
#2 CHIP DETR	Red	Contamination of #2 engine oil detected.	All
T2			
#1 FUEL PRESS	ANVIS Yellow	Fuel pressure failure on left side.	All
L BL AIR FAIL	ANVIS Yellow	Left bleed air warning line has melted or failed, indicating possible loss of #2 engine bleed air.	All
ALT WARN	ANVIS Yellow	Cabin altitude exceeds 12,500 feet.	All
INSTR AC	ANVIS Yellow	No AC power to engine instruments.	All
R BL AIR FAIL	ANVIS Yellow	Right bleed air warning line has melted or failed, indicating possible loss of #2 engine bleed air.	All
#2 FUEL PRESS	ANVIS Yellow	Fuel pressure failure on right side.	All
#1 CHIP DETR	ANVIS Yellow	Contamination of #1 engine oil detected.	All
A/P TRIM FAIL	ANVIS Yellow	Trim won’t run or running opposite direction commanded.	All
A/P DISC	ANVIS Yellow	Autopilot is disconnected.	All
#2 CHIP DETR	ANVIS Yellow	Contamination of #2 engine oil detected.	All

Table 2-12. C-12 Caution/Advisory Annunciator Panels

NOMENCLATURE	COLOR	CAUSE FOR ILLUMINATION	AIRCRAFT EFFECTIVITY
C D T1			
#1 DC Gen	Yellow	#1 engine generator off line.	All
#1 INVERTER	Yellow	#1 inverter inoperative.	All
#1 NO FUEL XFR	Yellow	Auxiliary fuel tank on side of #1 engine not transferring fuel into nacelle tank.	All
#2 NO FUEL XFR	Yellow	Auxiliary fuel tank on side of #2 engine not transferring fuel into nacelle tank.	All
#2 INVERTER	Yellow	#2 inverter inoperative.	All
#2 DC GEN	Yellow	#2 engine generator off line.	All
#1 EXTGH DISCH	Yellow	#1 engine fire extinguisher discharged.	All

Table 2-12. C-12 Caution/Advisory Annunciator Panels (Continued)

NOMENCLATURE	COLOR	CAUSE FOR ILLUMINATION	AIRCRAFT EFFECTIVITY
#1 NAC LOW	Yellow	#1 engine has 20 minutes C or 30 minutes D T1 fuel remaining at sea level, normal cruise power consumption rate.	All
CABIN DOOR	Yellow	Cabin/cargo door open or not secure.	All
REV NOT READY	Yellow	Propeller levers are not in the high RPM (low pitch position) with the landing gear extended.	All
#2 NAC LOW	Yellow	#2 engine has 20 minutes C or 30 minutes D T1 fuel remaining at sea level, normal cruise power consumption rate.	All
#2 EXTGH DISCH	Yellow	#2 engine fire extinguisher discharged.	All
#1 VANE FAIL	Yellow	#1 engine ice vane malfunction. Ice vane has not attained proper position.	All
DUCT OVERTEMP	Yellow	Excessive bleed air temperature in environmental heat ducts.	All
IFF	Yellow	Transponder fails to reply to a valid mode 4 interrogation.	All
BATTERY CHARGE	Yellow	Excessive charge rate on battery.	All
PROP SYNC ON	Yellow	Synchrophaser turned on with landing gear extended.	C D
#2 VANE FAIL	Yellow	#2 engine ice vane malfunction. Ice vane has not attained proper position.	All
HYD FLUID LOW	Yellow	Hydraulic fluid level in reservoir is low.	D2 T1
PASS OXY ON	Green	Passenger oxygen system is on.	D
#1 VANE EXT	Green	#1 ice vane extended.	All
#1 IGN ON	Green	#1 engine ignition/start switch on or #1 engine auto ignition switch armed and engine torque below 20%.	All
L BL AIR OFF	Green	Left environmental bleed air valve closed.	All
R BL AIR OFF	Green	Right environmental bleed air valve closed.	All
#2 IGN ON	Green	#2 engine ignition/start switch on or #2 engine auto ignition switch armed and engine torque below 20%.	All
#2 VANE EXT	Green	#2 ice vane extended.	All
#1 AUTO-FEATHER	Green	#1 engine autofeather armed with power levels advanced above 90% N_1.	C D
AIR COND N_1 LOW	Green	#2 engine RPM too low for air conditioning load.	All
EXTERNAL POWER	Green	External power connector plugged in.	All
FUEL CROSS-FEED	Green	Cross-feed valve open.	All
BRAKE DEICE ON	Green	Brake deice system activated.	All
#2 AUTO-FEATHER	Green	#2 engine autofeather armed with power levers advanced above 90% N_1.	C D

Table 2-12. C-12 Caution/Advisory Annunciator Panels (Continued)

NOMENCLATURE	COLOR	CAUSE FOR ILLUMINATION	AIRCRAFT EFFECTIVITY
		T2	
#1 DC GEN	ANVIS Green	#1 engine generator off the line.	All
#1 INVERTER	ANVIS Green	#1 inverter inoperative.	All
#1 NO FUEL XFR	ANVIS Green	Auxiliary fuel tank on side of #1 engine not transferring fuel into nacelle tank.	All
#2 NO FUEL XFR	ANVIS Green	Auxiliary fuel tank on side of #2 engine not transferring fuel into nacelle tank.	All
#2 INVERTER	ANVIS Green	#2 inverter inoperative.	All
#2 DC GEN	ANVIS Green	#2 engine generator off the line.	All
#1 EXTGH DISCH	ANVIS Green	#1 fire extinguisher discharged.	All
#1 NAC LOW	ANVIS Green	#1 engine has 30 minutes fuel remaining at sea level, normal cruise power consumption rate.	All
CABIN DOOR	ANVIS Green	Cabin/cargo door open or not secure.	All
REV NOT READY	ANVIS Green	Propeller levers are not in the high RPM (low pitch position) with the landing gear extended.	All
#2 NAC LOW	ANVIS Green	#2 engine has 30 minutes fuel remaining at sea level normal cruise power consumption rate.	All
#2 EXTGH DISCH	ANVIS Green	#2 engine fire extinguisher discharged.	All
#1 VANE FAIL	ANVIS Green	#1 engine ice van malfunction. Ice vane has not attained proper position.	All
DUCT OVERTEMP	ANVIS Green	Excessive bleed air temperature in environmental heat ducts.	All
IFF	ANVIS Green	Transponder fails to reply to a valid mode 4 interrogation.	All
BATTERY CHARGE	ANVIS Green	Excessive charge rate on battery.	All
PROP SYNC ON	ANVIS Green	Synchrophaser turned on with landing gear extended.	All
#2 VANE FAIL	ANVIS Green	#2 engine ice vane malfunction. Ice vane has not attained proper position.	All
HYD FLUID LOW	ANVIS Green	Hydraulic fluid level in reservoir is low.	All
ELEC TRIM OFF	ANVIS Green	Electric trim is disconnected.	All
PASS OXY ON	ANVIS Green	Passenger oxygen system is on.	All
#1 VANE EXT	ANVIS Green	#1 ice vane extended.	All

Table 2-12. C-12 Caution/Advisory Annunciator Panels (Continued)

NOMENCLATURE	COLOR	CAUSE FOR ILLUMINATION	AIRCRAFT EFFECTIVITY
#1 IGN ON	ANVIS Green	#1 engine ignition/start switch on or #1 engine auto ignition switch armed and engine torque below 20%.	All
L BL AIR OFF	ANVIS Green	Left environmental bleed air valve closed.	All
R BL AIR OFF	ANVIS Green	Right environmental bleed air valve closed.	All
#2 IGN ON	ANVIS Green	#2 engine ignition/start switch on or #2 engine auto ignition switch armed and engine torque below 20%.	All
#2 VANE EXT	ANVIS Green	#2 ice vane extended.	All
#1 AUTOFEATHER	ANVIS Green	#1 engine autofeather armed with power levers advanced above 90% N_1.	All
AIR COND N_1 LOW	ANVIS Green	#2 engine RPM too low for air conditioning load.	All
EXTERNAL POWER	ANVIS Green	External power connector plugged in.	All
FUEL CROSS-FEED	ANVIS Green	Cross-feed valve open.	All
BRAKE DEICE ON	ANVIS Green	Brake deice system activated.	All
#2 AUTOFEATHER	ANVIS Green	#2 engine autofeather armed with power levers advanced above 90% N_1.	All

Two annunciator panels are installed. One is a warning panel with red fault identification lights, and the other is a caution/advisory panel with yellow and green identification lights. The warning panel is mounted in the center of the glareshield, Figure 2-17. The caution/advisory panel is located on the center subpanel, just forward of the control quadrant. Illumination of a red warning light signifies the existence of a hazardous condition requiring immediate corrective action. A yellow caution light signifies a condition other than hazardous requiring pilot attention. A green advisory light indicates a functional situation. Refer to Tables 2-11 and 2-12 for a list of causes for illumination of the individual annunciator lights. In frontal view, both panels present rows of small opaque rectangular indicator lights. Word printing on each indicator identifies the monitored function, situation, or fault condition; but cannot be read until the light is illuminated. The bulbs of all annunciator panel lights are tested by activating the annunciator **PRESS TO TEST** switch located on the right side of the warning panel, or the annunciator test switch located on the right subpanel. The system is protected by two 5-ampere circuit breakers, placarded **ANN PWR** and **ANN IND**, on the overhead circuit breaker panel, Figure 2-16. The annunciator system lights are dimmed when the **MASTER PANEL LIGHTS** switch is actuated and the pilot's flight instrument lights are on. The lights are automatically reset to maximum brightness if any of the following conditions exist.

(1) Main aircraft power (both dc generators) is off.

(2) The **INST INDIRECT LIGHTS** switch is on.

(3) The **MASTER PANEL LIGHTS** switch is off.

(4) The **MASTER PANEL LIGHTS** switch is **ON** and the **PILOT INST LIGHTS** switch is **OFF**.

c. Master Warning Light C D1 . A **MASTER WARNING** light (red) is provided for the copilot, located on the right side of the glareshield, Figure 2-17. Any time a warning light illuminates, the **MASTER WARNING** light will illuminate and will stay illuminated until the condition is corrected and/ or the **MASTER WARNING** light is pressed to reset the circuit. If a new condition occurs, the light will be reactivated and the applicable annunciator panel light will illuminate.

d. Master Warning Light D2 T . **MASTER WARNING** lights (red) are provided for both the pilot and copilot. They are located on the left and right side of the glareshield adjacent to the **MASTER CAUTION** lights, Figure 2-17. Any time a warning light illuminates, the **MASTER WARNING** light will illuminate and will stay illuminated until the condition is corrected and/or the **MASTER WARNING** light is pressed to reset the circuit. If a new condition occurs, the light will be reactivated and the applicable annunciator panel light will illuminate.

e. Master Caution Light C D1 . A **MASTER CAUTION** light (yellow) is provided for both the pilot and copilot. One is located adjacent to the **MASTER WARNING** light and the other is located on the left side of the glareshield, Figure 2-17. Whenever a caution light illuminates, the **MASTER CAUTION** will illuminate and will stay illuminated until the condition is corrected and/or the **MASTER CAUTION** light is pressed to reset the circuit. If a new condition occurs, the light will be reactivated and the appropriate annunciator panel lights will illuminate.

f. Master Caution Light D2 T . **MASTER CAUTION** lights (yellow) are provided for both the pilot and copilot. They are located on the left and right side of the glareshield adjacent to the **MASTER WARNING** lights, Figure 2-17. Whenever a caution light illuminates, the **MASTER CAUTION** will illuminate and will stay illuminated until the condition is corrected and/or the **MASTER CAUTION** light is pressed to reset the circuits. If a new condition occurs, the light will be reactivated and the appropriate annunciator panel lights will illuminate.

g. Clocks C D . One manual wind eight-day clock is mounted in the center of each control wheel, Figure 2-22.

h. Clocks T1 . One manual wind eight-day clock is mounted in the center of the pilot's control wheel, whereas a digital clock/timer is mounted in the copilot's wheel, Figure 2-22.

i. Clocks T2 . Two digital clock/timers are mounted in the center of the control wheels, Figure 2-22. The clocks operate independently of each other, receiving dc electrical power through the 5-ampere **CABIN LIGHTS** circuit breaker located in the overhead circuit breaker panel and a 1.5-ampere fuse located in the instrument lights fuse panel assembly under the aisle forward of the main spar.

Section XII. SERVICING, PARKING, AND MOORING

2-100. GENERAL.

The following paragraphs include the procedures necessary to service the aircraft, except lubrication. The lubrication requirements of the aircraft are covered in the aircraft maintenance manual. Refer to Table 2-3 for fuel quantity data. The servicing instructions provide procedures and precautions necessary to service the aircraft. Service the fuel tanks after each flight to keep moisture out of the tanks and to keep the bladder type cells from drying out.

2-101. FUEL HANDLING PRECAUTIONS.

WARNING

During warm weather, open fuel caps slowly to prevent being sprayed with fuel.

When aviation gasoline is used in a turbine engine, extreme caution should be used when around the combustion chamber and exhaust area to avoid cuts or abrasions. The exhaust deposits contain lead oxide, which will cause lead poisoning.

CAUTION

Proper procedures for handling jet fuels cannot be overstressed. Clean, fresh fuel shall be used and the entrance of water into the fuel storage or aircraft fuel system must be kept to a minimum.

When conditions permit, the aircraft shall be positioned so that the wind will carry the fuel vapors away from all possible sources of ignition. The fuel vehicle shall be positioned to maintain a minimum distance of 10 feet from any part of the aircraft, while maintaining a minimum distance of 20 feet between the fueling vehicle and the fuel filler point.

1. Shut off unnecessary electrical equipment on the aircraft, including radar and radar equipment. The master switch may be left on to monitor fuel quantity gauges; but shall not be moved during the fueling operation. Do not allow operation of any electrical tools, such as drills or buffers, in or near the aircraft during fueling.

2. Keep fuel servicing nozzles free of snow, water, and mud at all times.

3. 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 the servicing operation is completed.

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

5. Drain water from fuel tanks, filter cases, and pumps prior to first flight of the day. Preheat, when required, to ensure free fuel drainage.

6. Avoid dragging the fueling hose where it can damage the soft flexible surface of the deicer boots.

7. Observe **NO SMOKING** precautions.

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

9. Wash off spilled fuel immediately.

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

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

12. Wear only non-sparking shoes near aircraft or fueling equipment, as shoes with nailed soles or metal heel plates can be a source of sparks, functions as a biocide to commercial fuel.

2-102. FILLING FUEL TANKS.

Prior to removing the fuel tank filler cap, the hose nozzle static ground wire shall be attached to the grounding lugs that are located adjacent to filler opening.

CAUTION

Do not fill the auxiliary fuel tanks unless outboard main tanks are full.

Do not fill the ferry fuel tanks unless the aircraft's main and auxiliary tanks are full.

1. Attach bonding cables to aircraft.

2. Attach bonding cable from hose nozzle to ground socket adjacent to fuel tank being filled.

CAUTION

Do not insert fuel nozzle completely into fuel cell due to possible damage to bottom of fuel cell.

3. Remove fuel tank filler cap and fill main tanks before filling the corresponding auxiliary tank.

4. Secure applicable fuel tank filler cap. Make sure latch tab on cap is pointed aft.

5. Disconnect bonding cables from aircraft.

2-103. DRAINING MOISTURE FROM FUEL SYSTEM.

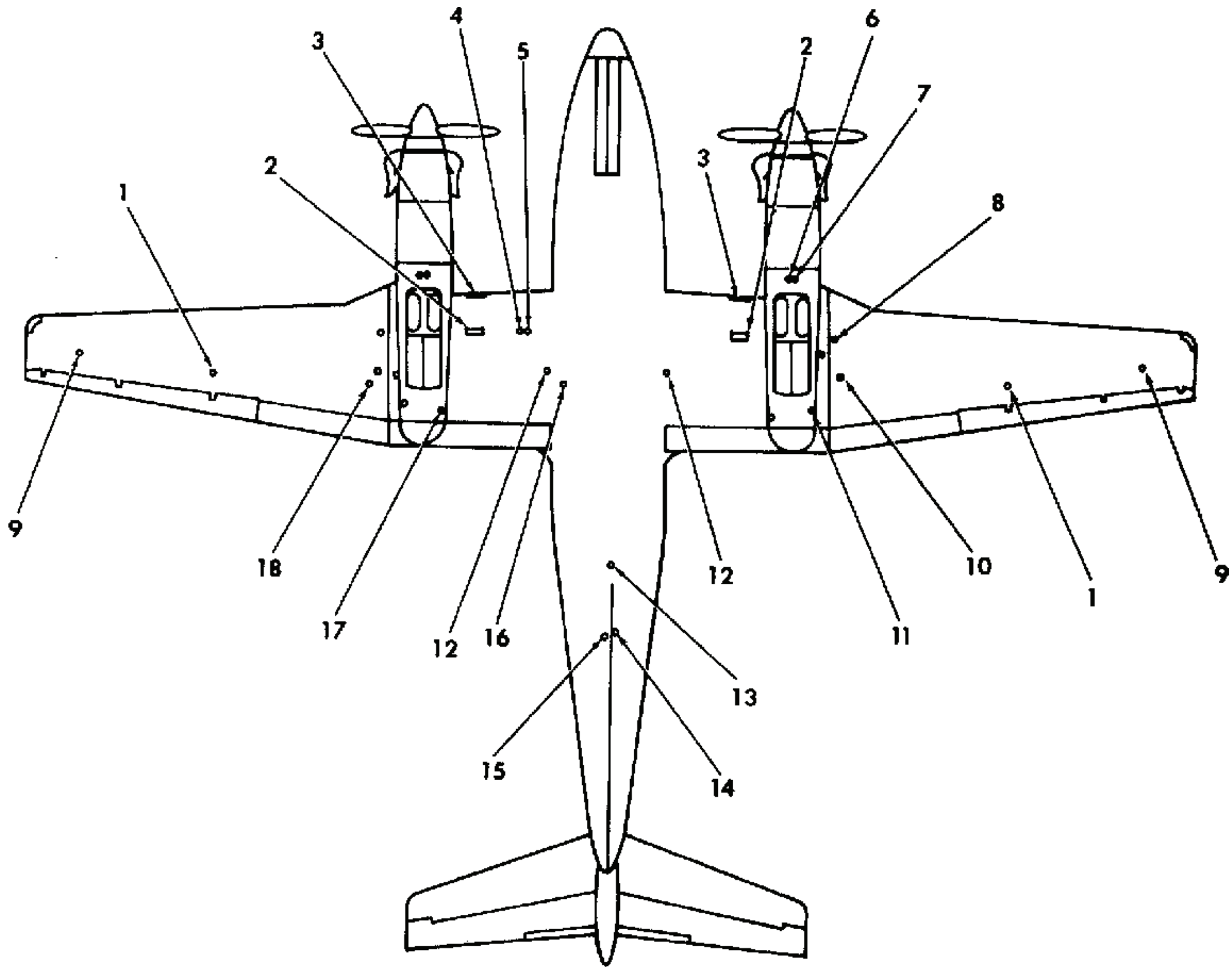
To remove moisture and sediment from the fuel system, 12 fuel drains are installed, plus 1 for the ferry system, when installed. Two drain lines are included with the fuel ferry tanks to drain off moisture from the tanks. Refer to Figure 2-32.

2-104. APPROVED FUEL TYPES.

a. Army Standard Fuels. In accordance with accepted commercial procedures. Army standard fuel is JP-8.

b. Alternate Fuels. Army fuel is JP-5.

c. Emergency Fuel. Avgas is emergency fuel and subject to 150-hour time limit. Refer to Tables 2-13, 2-14, and 2-15 for identification of, and information on, fuels used to service the aircraft.



1. Outboard Fuel Sump Drain
2. Bleed Air Heat Exchanger Exhaust
3. Bleed Air Heat Exchanger Intake
4. Battery Ram Air Vent
5. Battery Drain
6. Boost Pump Drain (Both Sides)
7. Fuel System Drain (Both Sides)
8. Leading Edge Tank Drain (Both Sides)
9. Fuel Vent
10. Ram Scoop Vent (Both Sides)
11. Engine Oil Vent (Both Sides)
12. Transfer Pump Filter Drain
13. Refreshment Bar Drain (If Installed)
14. Oxygen Regulator Vent
15. Relief Tube Drain
16. Surface Deice Ejector Exhaust
17. Fuel Sump Drain (Both Sides)
18. Heated Fuel Vent (Both Sides)

Figure 2-32. Vent / Drain Locations

Table 2-13. Approved Fuels

SOURCE	PRIMARY OR STANDARD FUEL	ALTERNATE FUEL	
US Military Fuel	JP-8 (MIL-T-5624)	JP-5 (MIL-T-5624)	
NATO Code No.	F-40 (Wide Cut Type)	F-44 (High Flash Type)	
COMMERCIAL FUEL (ASTM-D-1655)	**JET B**	**JET A**	**JET A-1** **NATO F-34**
American Oil Co.	American JP-8	American Type A	
Atlantic Richfield	Arcojet B	Arcojet A	Arcojet A-1
Richfield Div.		Richfield A	Richfield A-1
B. P. Trading	B.P.A.T.G.		B.P.A.T.K.
Caltex Petroleum Corp.	Caltex Jet B		Caltex Jet A-1
Cities Service Co.		CITGO A	
Continental Oil Co.	Conoco JP-8	Conoco Jet-50	Conoco Jet-60
Gulf Oil	Gulf Jet B	Gulf Jet A	Gulf Jet A-1
EXXON Co., USA	EXXON Turbo Fuel B	EXXON A	EXXON A-1
Mobil Oil	Mobil Jet B	Mobil Jet A	Mobil Jet A-1
Phillips Petroleum	Philjet JP-8	Philjet A-50	
Shell Oil	Aeroshell JP-8	Aeroshell 640	Aeroshell 650
Sinclair		Superjet A	Superjet A-1
Standard Oil Co.		Jet A Kerosene	Jet A-1 Kerosene
Chevron	Chevron B	Chevron A-50	Chevron A-1
Texaco	Texaco Avjet B	Avjet A	Avjet A-1
Union Oil	Union JP-8	76 Turbine Fuel	
FOREIGN FUEL	**NATO F-40**	**NATO F-44**	
Belgium	BA-PF-2B		
Canada	3GP-22F	3-6P-24e	
Denmark	JP-8 MIL-T-5624		
France	Air 3407A		
Germany (West)	VTL-9130-006	UTL-9130-007/UTL 9130-010	
Greece	JP-8 MIL-T-5624		
Italy	AA-M-C-1421	AMC-143	
Netherlands	JP-8 MIL-T-5624	D. Eng RD 2493	
Norway	JP-8 MIL-T-5624		
Portugal	JP-8 MIL-T-5624		
Turkey	JP-8 MIL-T-5624		
United Kingdom (Britain)	D. Eng RD 2454	D. Eng RD 2498	

NOTE

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel – The fuel system icing inhibitor shall conform to MIL-I-27686. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in aircraft fuel systems. Icing inhibitor conforming to MIL-I-27686 (PRIST) shall be added to commercial fuel, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Refueling operations shall be accomplished in accordance with accepted commercial procedures.

Table 2-14. Approved Military Fuels, Oil, Fluids, and Unit Capacities

SYSTEM	SPECIFICATION	CAPACITY
Fuel	MIL-T-5624 (JP-5 and JP-8)	544 U.S. Gallons usable
Engine Oil	MIL-L-23699	14 U.S. Quarts per engine
Hydraulic brake reservoir	MIL-H-5606	1 U.S. Pint
Hydraulic landing gear reservoir*	MIL-H-5606	8 U.S. Quarts
Oxygen	MIL-O-27210	49 Cubic feet
Toilet Chemical	Monogram DG-19	3 Ounces
D2 T		

NOTE

MIL-L-23699 oil, used in engine oil system, is authorized and directed for use. Do not mix different brands or types of oil when adding oil between changes. Different brands or types of oil may be incompatible due to the differences in chemical structure.

Table 2-15. Standard, Alternate, and Emergency Fuels

ENGINE	ARMY STANDARD FUEL	ALTERNATE FUEL	EMERGENCY FUEL	
			TYPE	*MAX. HOURS
PT6A	MIL-T-5624	MIL-T-5624	MIL-G-5572	150
	Grade JP-8	Grade JP-5	Any AV Gas	
* Maximum operating hours with indicated fuel between engine overhauls (TBO).				

2-105. USE OF FUELS.

a. Fuel Use Limitations. There is no special limitation on the use of Army standard fuel, but certain limitations are imposed when alternate or emergency fuels are used. For the purpose of recording, fuel mixtures shall be identified as to the major component of the mixture, except when the mixture contains leaded gasoline. The use of any fuels other than standard will be entered in the **FAULTS/REMARKS** column of DA Form 2408-13-1, Aircraft Maintenance and Inspection Record, noting the type of fuel, additives, and duration of operation.

b. Use Of Kerosene Fuels. The use of kerosene fuels (JP-5 type) in turbine engines dictates the need for observance of special precautions. Both ground starts and air restarts at low temperature may be more difficult due to low vapor pressure. Kerosene fuels have a freezing point of minus 40 °C (-40 °F) and limit the maximum altitude of a mission to 28,000 feet under standard day conditions.

c. Mixing Of Fuels In Aircraft Tanks. When changing from one type of authorized fuel to another, for example JP-8 to JP-5, it is not necessary to drain the aircraft fuel system before adding the new fuel.

d. Fuel Specifications. 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 where aircraft using NATO F-44 (JP-5) are refueled with NATO F-40 (JP-8) or Commercial ASTM Type B fuels. Whenever this condition occurs, the engine operating characteristics may change in that lower operating temperature, slower acceleration, lower engine speed, easier starting, and shorter range may be experienced. The reverse is true when changing from F-40 (JP-8) fuel to F-44 (JP-5) or Commercial ASTM Type A-1 fuels. Most commercial turbine engines will operate satisfactorily on either kerosene or JP-8 type fuel. The difference in specific gravity may possibly require fuel control adjustments; if so, the recommendations of the manufacturers of the engine and airframe are to be followed.

2-106. SERVICING OIL SYSTEM.

An integral oil tank occupies the cavity formed between the accessory gearbox housing and the compressor inlet case on the engine. The tanks have a calibrated oil dipstick and an oil drain plug. Avoid spilling oil. Any oil spilled must be removed immediately. Use a cloth moistened in solvent to remove oil. Overfilling may cause a discharge of oil through the accessory gearbox breather until a satisfactory level is reached. Refer to Figure 2-33 for aircraft servicing locations.

1. Open the access door on the upper rear cowling to gain access to the oil filler cap and dipstick.

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

2. If oil level is over 2 quarts low, motor or run engine as required, and service as necessary.

3. Remove oil filler cap.

4. Insert a clean funnel with a screen incorporated into the filler neck.

5. Replenish with oil to within 1 quart below **MAX** mark or the **MAX COLD** on dipstick (cold engine). Fill to **MAX** or **MAX HOT** (hot engine).

6. Check oil filler cap for damaged preformed packing, general condition, and locking.

CAUTION

Ensure that oil filler cap is correctly installed and securely locked to prevent loss of oil and possible engine failure.

7. Install and secure oil filler cap.

8. Check for any oil leaks.

2-107. SERVICING THE HYDRAULIC SYSTEM.

a. Servicing Hydraulic Brake System Reservoir.

1. Gain access to brake hydraulic system reservoir.

2. Remove brake reservoir cap and fill reservoir to washer on dipstick with hydraulic fluid.

3. Install brake reservoir cap.

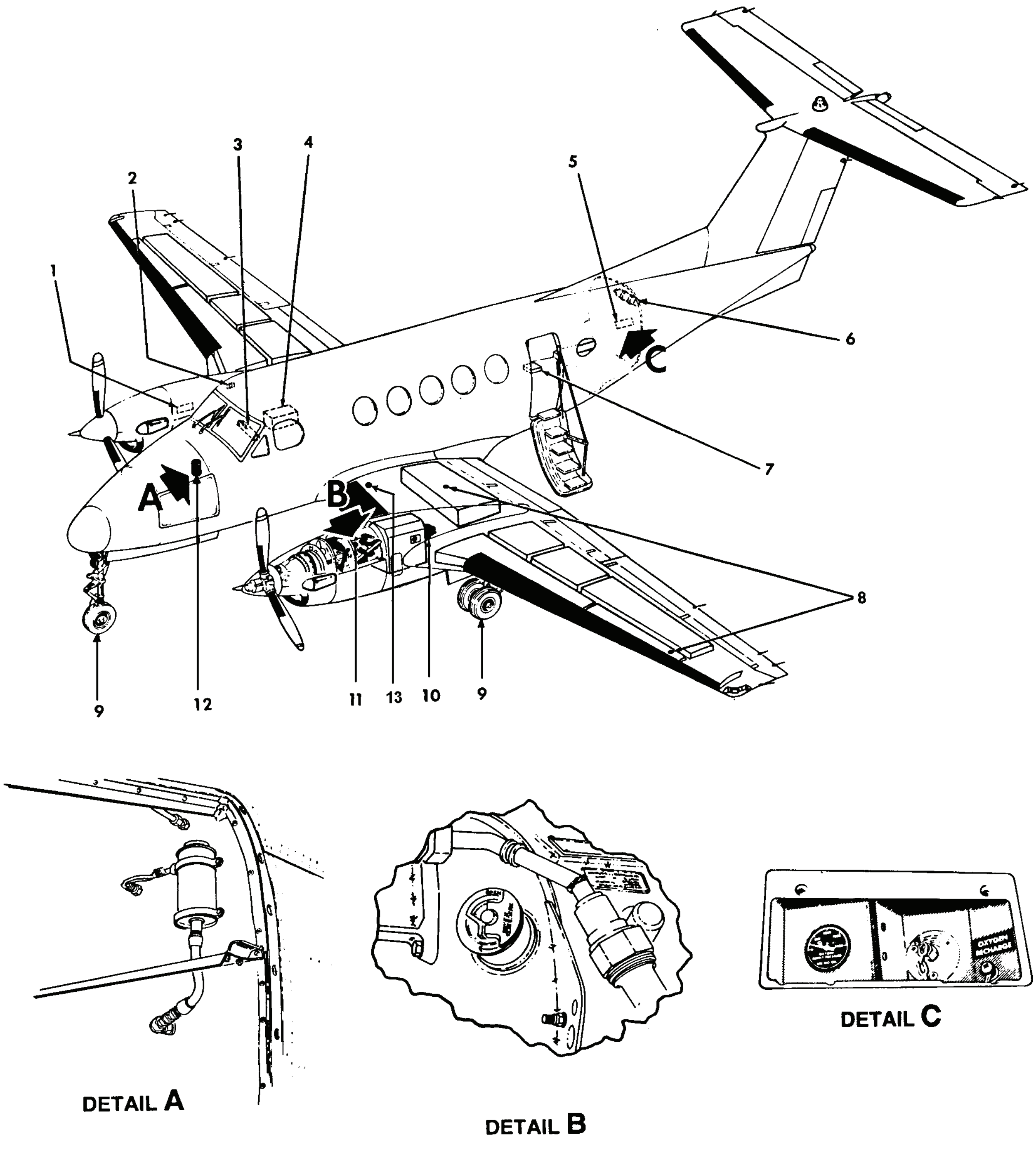
b. Servicing Hydraulic Landing Gear System D2 T. Servicing the hydraulic landing gear system consists of maintaining the correct fluid level and maintaining the correct accumulator precharge. The accumulator is located in the reservoir access area and is charged to 800 ± 50 psi using bottled nitrogen. A charging gauge is mounted on the accumulator. A reservoir, located just inboard of the LH nacelle and forward of the main spar, has a lid with a dipstick attached marked **FLUID TEMP 0 °F**, **50 °F**, **100 °F**. Add MIL-H-5606 hydraulic fluid (consumable materials list) as required to fill the system corrected for temperature.

(1) Shock Struts. Servicing the shock struts is part of each 100-hour inspection procedure. If it becomes necessary to service the shock struts due to the leakage of either the hydraulic oil or the air, the following procedures should be followed.

(2) Nose Gear Strut.

1. Release all of the air from the strut by pressing the core of the air valve on top of the strut.

2. Remove the air valve and wipe clean. With the strut fully compressed, the end of the filler neck on the air valve should touch the oil. If the oil is below this level, add approved hydraulic fluid. Reinstall and safety the air-valve.



1. Air Conditioning Compressor
2. External Power Receptacle
3. Hand Fire Extinguisher
4. Battery, 24 Vdc
5. Oxygen System Filler Port
6. Oxygen Cylinder, 49 Cu Ft
7. Electric Toilet
8. Fuel Filler Caps (Typical Left and Right)
9. Landing Gear Tires
10. Engine Fire Extinguisher
11. Engine Oil Filler Cap (Typical Left and Right)
12. Wheel Brake Fluid Reservoir
13. Hydraulic Reservoir

Figure 2-33. Servicing Locations

3. With the aircraft empty except for full fuel and oil, inflate the nose gear until the inner cylinder is extended 3 to 3.5 inches.

(3) Main Gear Strut.

1. Release all the air from the strut through the air valve and remove the core from the valve.

2. Fully compress the strut and attach a small hose over the air valve and immerse the other end of the hose in approved hydraulic fluid. Slowly extending the strut will vacuum the oil into the cylinder. Cycling the strut slightly as it is extended will expel any trapped air. Return the strut slowly to the fully compressed position; this will force the excess oil back into the container and the strut will be properly filled with oil.

3. With the aircraft empty except for full fuel and oil, inflate the strut until the inner cylinder is extended 5.56 to 5.93 inches.

2-108. INFLATING TIRES.

1. Inflate nose wheel tire to a pressure between 55 and 60 psi.

2. C Inflate main wheel tires to a pressure between 92 and 96 psi.

3. DT Inflate main wheel tires to a pressure between 60 and 64 psi.

2-109. SERVICING THE ELECTRIC TOILET C D (C-12 AIRCRAFT PRIOR TO C-12F SERIAL 86-60084).

The toilet should be serviced during routine ground maintenance of the aircraft following any usage. It is more efficient and convenient to remove, clean, and recharge the toilet tank on a regular basis than to wait until the tank is filled to capacity. Instructions for servicing are provided on a decal applied to the front side of the removable tank.

a. Tank Removal.

1. Open front access to the toilet as applicable, to remove the toilet tank.

2. Press the lock ring of the flush hose quick disconnect coupling located on the right side at the front of the tank top.

3. Drain any residue of flush fluid in the hose by partially disengaging the plug from the quick disconnect and manipulating the hose to assist drainage.

4. Remove the flush hose from the quick disconnect and place hose in the retaining clip located on the underside of the toilet mounting plate.

5. Install the cap attached to the quick disconnect to seal the coupling.

6. Close the knife valve at the bottom of the toilet bowl by pushing the actuator handle until the valve is fully closed.

7. Press the two fasteners on each side of the knife valve actuator to unlock the tank.

8. Remove the tank by pulling the recessed carrying handle on the tank tip.

b. Tank Cleaning.

1. Dispose of tank contents by holding the tank upside-down over a sewer or toilet and pulling the knife valve actuator handle, opening the valve and allowing the tank to drain.

2. Rinse the tank by filling one-half full with water. Close the knife valve and shake vigorously. Drain tank as in previous step.

NOTE

Commercial detergents and disinfectants can be included in the rinse water if desired. However, do not include these materials in the tank precharge.

3. Rinse and drain the tank several times to ensure that the tank is thoroughly clean.

4. Wipe the exterior surfaces of the tank using a cloth moistened with clear water and disinfectant.

c. Tank Precharge.

CAUTION

During freezing temperature, toilet shall be serviced with antifreeze solution to prevent damage.

Charge the tank with a mixture of 2 quarts of water and 3 ounces of Monogram DG-19 chemical.

NOTE

To assure toilet recirculation system operation during freezing weather, an ethylene glycol base anti-freeze containing antifoam agent may be added to the flush fluid.

d. Tank Installation.

1. Reinstall the tank by inserting the slides, located on each side of the knife valve, into the slide plate assembly on the bottom of the toilet and slide tank into place.

2. Press the two fasteners to the first detent to secure the tank.

3. Remove the cap in the flush hose quick disconnect and connect the hose coupling to the quick disconnect. Lock the disconnect lock ring.

4. Pull the knife valve actuator to fully open the valve.

5. Lift the toilet seat and shroud assembly from the top of the toilet and wipe with cloth moistened with clear water and disinfectant. Wipe the bowl and surrounding area.

6. Check flushing operation of the toilet and check for leaks.

7. Close access to the toilet.

2-110. SERVICING THE CHEMICAL TOILET T AIRCRAFT SERIAL 86-60084-86-0089.

The toilet is of the standard dry chemical type. The toilet should be removed and emptied after each flight, if used. An approved dry chemical, such as Commode Magic, may be used in accordance with the manufacturer's instructions. A stiff (nonmetallic) bristle brush and a water and detergent solution should be used to clean the bowl. Install a clean waste bag in the bowl before adding chemical.

2-111. ANTI-ICING, DEICING AND DEFROSTING PROTECTION.

The aircraft is protected in subfreezing weather by spraying the surfaces (to be covered with protective covers) with defrosting fluid. Spraying defrosting fluid on aircraft surfaces before installing protective covers will permit protective covers to be removed with a minimum of sticking. To prevent freezing rain and snow from blowing under protective covers and diluting the fluid, ensure that protective covers are fitted tightly. As a deicing measure, keep exposed aircraft surface wet with fluid for protection against frost.

NOTE

Do not apply anti-icing, deicing and defrosting fluid to exposed aircraft surfaces if snow is expected. Melting snow will dilute the defrosting fluid and form a slush mixture, which will freeze in place and become difficult to remove.

2-112. ANTI-ICING, DEICING, AND DEFROSTING TREATMENT.

Use undiluted anti-icing, deicing and defrosting fluid (MIL-A-8243 or MIL-F-5566) to treat aircraft surfaces for protection against freezing rain and frost. Spray aircraft surface sufficiently to wet area, but without excessive drainage. A fine spray is recommended to prevent waste. Use diluted, hot fluid to remove ice accumulations.

1. Remove frost or ice accumulations from aircraft surfaces by spraying with diluted anti-icing, deicing, and defrosting fluid mixed in accordance with Table 2-16.

2. Spray diluted, hot fluid in a solid stream (not over 15 gallons per minute). Thoroughly saturate aircraft surface and remove loose ice. Keep a sufficient quantity of diluted, hot fluid on aircraft surface coated with ice to prevent liquid layer from freezing. Diluted, hot fluid should be sprayed at a high pressure, but not exceeding 300 psi.

3. When facilities for heating are not available and it is deemed necessary to remove ice accumulations from aircraft surfaces, undiluted defrosting fluid may be used. Spray undiluted defrosting fluid at 15-minute intervals to assure complete coverage. Removal of ice accumulations using undiluted defrosting fluid is expensive and slow.

Table 2-16. Recommended Fluid Dilution Chart

AMBIENT TEMPERATURE (°F)	PERCENT DEFROSTING FLUID BY VOLUME	PERCENT WATER BY VOLUME	FREEZING POINT OF MIXTURE (°F) (APPROXIMATE)
+30° and above	20	80	+10°
+20°	30	70	0°
+10°	40	60	-15°
0°	45	55	-25°
-10°	50	50	-35°
-20°	55	45	-45°
-30°	60	40	-55°

NOTES:
1. Use anti-icing and deicing fluid (MIL-A-8243 or MIL-F-5566).
2. Heat mixture to a temperature of 82° to 93°C (180° to 200°F).

4. If tires are frozen to ground, use undiluted defrosting fluid to melt ice around tire. Move aircraft as soon as tires are free.

2-113. APPLICATION OF EXTERNAL POWER.

CAUTION

Before connecting the power cables from the external power source to the aircraft, ensure that the GPU is not touching the aircraft at any point. Due to the voltage drop in the cables, the two ground systems will be of different potentials. Should they come in contact while the GPU is operating, arcing could occur. Turn off all external power while connecting the power cable to, or removing it from the external power supply receptacle. Be certain that the polarity of the external power source is the same as that of the aircraft before it is connected.

Do not charge battery with GPU.

An external source is often needed to supply the electric current required to properly ground service the aircraft electrical equipment and to facilitate starting the aircraft's engines. An external dc power receptacle is installed on the outboard side of the right engine nacelle.

2-114. SERVICING OXYGEN SYSTEM.

The oxygen system furnishes breathing oxygen to the pilot, copilot, and passengers. Figure 2-33 shows the location of oxygen cylinder.

a. Oxygen System Safety Precautions.

WARNING

Keep fire and heat away 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, gasoline, and all other readily combustible substances. The utmost care shall be exercised in servicing, handling, and inspecting the oxygen system.

2. Do not allow foreign matter to enter oxygen lines.

3. Never allow electrical equipment to come in contact with the oxygen cylinder.

4. Never use oxygen from a cylinder without first reducing its pressure through a regulator.

b. Replenishing Oxygen System.

1. Remove oxygen access door on outside of aircraft.

2. Remove protective cap on oxygen system filler valve.

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

WARNING

If the oxygen system pressure is below 200 psi, do not attempt to service system. Make an entry on DA Form 2408-13-1.

4. Ensure that supply cylinder shutoff valves on the aircraft are open.

5. Slowly adjust the valve position so that pressure increases at a rate not to exceed 200 psi per minute.

6. Close pressure regulating valve on oxygen servicing unit when pressure gauge on oxygen system indicates the pressure obtained using the Oxygen System Servicing Pressure Chart, Figure 2-24.

NOTE

To compensate for loss of aircraft cylinder pressure as the oxygen cools to ambient temperature after recharging, the cylinder should be charged initially to approximately 10% over prescribed pressure. Experience will determine what initial pressure should be used to compensate for the subsequent pressure loss upon cooling. A small top-off will create little heat. A complete recharge will create substantial heating.

The final stabilized cylinder pressure should be adjusted for ambient temperature, Figure 2-24.

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

8. Install protective cap on oxygen filler valve.

9. Install oxygen access door.

2-115. GROUND HANDLING.

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

1. Do not attempt towing or taxiing of the aircraft with control surfaces in the **LOCKED** position.

2. Do not operate engines while towing equipment is attached to the aircraft, or while the aircraft is tied down.

3. When moving the aircraft, do not push on propeller deicing boots. Damage to the heating elements may result.

4. When the aircraft is being towed, a qualified person shall be in the pilot's seat to maintain control by use of the brakes.

5. When towing, do not exceed nose gear turn limits. Avoid short radius turns, and always keep the inside or pivot wheel turning during the operation.

6. When being moved backwards, do not apply the brakes abruptly.

7. Tow the aircraft slowly, avoiding sudden stops, especially over snowy, icy, rough, soggy or muddy terrain.

8. Do not tow aircraft with deflated shock struts.

2-116. GROUND HANDLING UNDER EXTREME WEATHER CONDITIONS.

Extreme weather conditions necessitate particular care in ground handling of the aircraft. In hot, dry, sandy, desert conditions, special attention shall be devoted to finding a firmly packed parking and towing area. If such areas are not available, steel mats or an equivalent solid base shall be provided for these purposes. In wet, swampy areas, care shall be taken to avoid bogging down the aircraft. Under cold, icy, arctic conditions, additional mooring is required, and added precautions shall be taken to avoid skidding during towing operations. The particular problems to be encountered under adverse weather conditions and the special methods designed to avoid damage to the aircraft are covered by the various phases of the ground handling procedures included in this section of general ground handling instructions. (Refer to TM 1-1500-204-23).

2-117. PARKING.

Parking is defined as the normal condition under which the aircraft will be secured while on the ground. This condition may vary from the temporary expedient setting of the parking brake and choking the wheels to the more elaborate mooring procedures described in Paragraph 2-119. The proper steps for securing the aircraft shall 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 mooring and/or evacuation.

1. When practical, head the aircraft into the wind, especially if strong winds are forecast or if it will be necessary to leave the aircraft overnight.

2. Set the parking brake, chock the wheels securely, and release the parking brake. Do not set parking brakes when the brakes are hot during freezing ambient temperatures. Allow brakes to cool before setting parking brakes.

3. Following engine shutdown, position and engage the control locks.

4. Cowlings and loose equipment will be suitably secured at all times when left in an unattended condition.

2-118. INSTALLATION OF PROTECTIVE COVERS.

The crew will ensure that the aircraft protective covers are installed.

2-119. MOORING.

The aircraft is moored to ensure its immovability, protection, and security under various weather conditions. The following paragraphs give, in detail, the instructions for proper mooring of the aircraft.

a. Mooring Provisions. Mooring points, Figure 2-34, are provided beneath the wings and tail. Additional mooring cables may be attached to each landing gear. General mooring equipment and procedures necessary to moor the aircraft, in addition to the following, are given in TM 1-1500-204-23.

1. Use mooring cables of 1/4-inch diameter aircraft cable and clamp (clip-wire rope), chain or rope 3/8-inch diameter or larger. Length of the cable or rope will be dependent upon existing circumstances. Allow sufficient slack in ropes, chains, or cable to compensate for tightening action due to moisture absorption of rope or thermal contraction of cable or chain. Do not use slip knots. Use bowline knots to secure aircraft to mooring stakes.

2. Chock the wheels.

b. Mooring Procedures for High Winds. 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. Refer to Figure 2-34.

1. After aircraft is properly located, place nose wheel in centered position. Head aircraft into the wind, or as nearly so as is possible within limits determined by locations of fixed mooring 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 mooring point approximately 3 to 5 feet downwind from ground mooring anchors.

2. Deflate nose wheel 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 nose wheel. 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 moored on steel mats. Set parking brake as applicable.

5. Accomplish aircraft tiedown by using mooring points shown in Figure 2-34.

6. Make tiedown with 1/4-inch aircraft cable, using two wire rope clips, or bolts, and a chain tested for a 3000-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 anti-slip knots, such as bowline knot, rather than slip knots. In the event tiedown rings are not available on hard surfaced areas, move aircraft to an area where portable tiedowns can be used. When anchor kits are not available, use metal stakes or dead-man type

anchors, providing they can successfully sustain a minimum pull of 3000 pounds.

7. In event nose position tiedown is considered to be of doubtful security due to existing soil condition, drive additional anchor rods at nose tiedown position. Place padded work stand or other suitable support under the aft fuselage tiedown position and secure.

8. Place control surfaces in locked position and trim tab controls in neutral position. Place wing flaps in up position.

9. 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 of the transient aircraft.

10. Secure propellers to prevent wind-milling.

11. Disconnect battery.

12. 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. The storm appears to pass two times, each time with a different wind direction. This will necessitate turning the aircraft after the first passing.

13. 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.

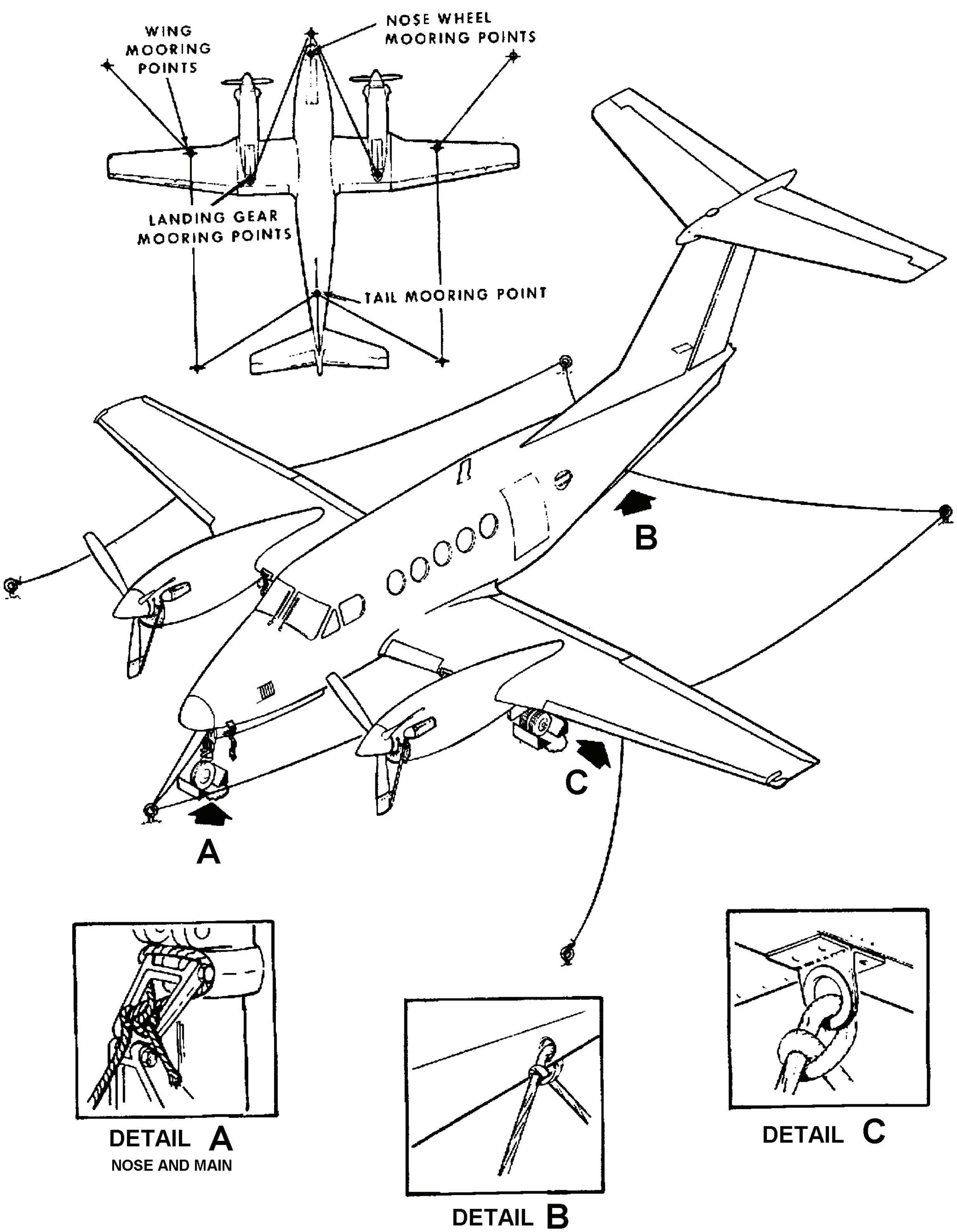


Figure 2-34. Mooring

CHAPTER 3
AVIONICS (COMMON) C D T1 T2

Section I. GENERAL

3-1. GENERAL DESCRIPTION.

This chapter covers the avionics equipment installed common to the C–12C, C-12D1, C-12D2, C-12T1, and C-12T2 aircraft. It includes a brief description of the avionics equipment, its technical characteristics, capabilities, and locations. Avionics installed in the C-12C and D1 aircraft are covered in Chapter 3A. Avionics installed in the C-12D2 aircraft are covered in Chapter 3B. Avionics installed in C-12T1 and T2 aircraft are covered in Chapter 3C.

3-2. AVIONICS EQUIPMENT CONFIGURATION.

The avionics configuration of the aircraft is comprised of three groups of electronic equipment. The communication equipment group consists of the interphone, UHF command C D , V/UHF command T , and HF command systems. The navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach on instruments under Instrument Meteorological Conditions (IMC). The navigation group includes equipment for determining altitude, attitude, position, destination, range and bearing, heading reference, groundspeed, and drift angle. The transponder and radar group includes an identification capability, a position and emergency tracking system, and a radar system to locate potentially dangerous weather areas. A Ground Proximity Altitude Advisory System (GPAAS) is also installed.

3-3. POWER SOURCE.

a. DC Power. DC power for the avionics equipment is provided by four sources: the aircraft battery, left and right generators, and external power. Power is routed through a 50-ampere circuit breaker to the avionics power relay that is controlled by the **AVIONICS MASTER POWER** switch on the overhead control panel, Figure 2-15. Individual system circuit breakers and the associated avionics buses are shown in Figures 2-27 and 2-28 and Tables 2-6, 2-7, 2-8, and 2-9. With the switch in the **ON** position, the avionics power relay is de–energized and power is applied through both the **AVIONICS MASTER POWER #1** and **#2** circuit breakers to the individual avionics circuit breakers on the overhead circuit breaker panel, Figure 2-16. In the off (aft) position, the relay is energized and power is removed from avionics equipment. When external power is applied to the aircraft, the avionics power relay is normally energized, removing power from the avionics equipment. To apply external power to the avionics equipment, move the **AVIONICS MASTER POWER** switch to the **EXT PWR** position. This de–energizes the avionics power relay and allows power to be applied to avionics equipment.

b. AC Power. Two inverters provide ac power for the avionics equipment. The inverters supply 115-volt and 26-volt single-phase ac power when operated by the **INVERTER #1** or **#2** switches. Either inverter is capable of powering all avionics equipment requiring ac power. 115 Vac power from the inverters is routed through fuses and transformers in the nose avionics compartment. The transformers provide the required 26 Vac needed by avionics equipment.

Section II. COMMUNICATIONS

3-4. COMMUNICATIONS DESCRIPTION.

The common avionics in the communications equipment group consists of the microphone switches, microphone jacks, and headset jacks.

3-5. MICROPHONE SWITCHES, MICROPHONE JACKS, AND HEADSET JACKS.

a. Microphone Switches. A bi-level microphone switch, placarded **INTPH XMIT / MIC**, is located on the pilot's and copilot's control wheels, Figure 2-22, and copilot's floor.

(1) ***MIC INTPH / XMIT*** *Switch.* Keys selected facility.

(a) ***INTPH.*** When pressed to first detent, keys interphone facility regardless of position of transmitter selector switch.

(b) ***XMIT.*** When pressed fully, keys facility indicated on transmitter selector switch.

b. Microphone Jacks. The pilot and copilot are each provided a microphone jack, placarded **MIC**, located on the extreme left and right sides of the instrument panel, Figure 2-17, for use with the hand held microphone or headset microphone. There is a microphone jack for the oxygen mask microphone, located next to the oxygen outlets.

(1) ***MIC HEADSET*** *Jack*. This jack provides a means of connecting microphone headset assembly to audio system.

(2) ***MIC*** *Jack*. This jack provides a means of connecting hand–held microphone with push–to–talk capability to the audio system.

c. Microphone Jack Selector Switches. The pilot and copilot are each provided with a switch, placarded **MIC HEADSET / OXYGEN MASK**, located on the extreme left and right sides of the instrument panel.

(1) ***MIC HEADSET / OXYGEN MASK*** *Switch*. Selects which microphone will be connected to audio system.

(2) ***MIC HEADSET***. Utilizes either hand-held microphone or headset–microphone assembly with audio system.

(3) ***OXYGEN MASK***. Utilizes microphone in oxygen mask assembly with audio system.

d. External Headset-Microphone Jack. A jack on the nose gear strut, placarded **MIC JACK**, is available for use by ground personnel. The jack connects headphones and microphone to the aircraft's interphone system.

e. Cockpit Floor Foot Microphone Switch. A floor–mounted foot microphone switch is installed on the floor on the copilot's side. The switch allows the copilot to key the system selected by the transmitter selector switch on the audio control panel while performing other operations.

Section III. NAVIGATION

3-6. NAVIGATION DESCRIPTION.

The overall navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach on instruments under Instrument Meteorological Conditions (IMC). The navigation configuration includes equipment for determining attitude, position, destination range and bearing, heading reference and groundspeed. The common avionics in the navigation equipment group consists of the gyromagnetic compass systems.

3-7. GLOBAL POSITIONING SYSTEM (KLN 90B).

a. Description. The Global Positioning System (GPS) is a satellite-based radio navigation system that utilizes precise range measurements from GPS satellites to determine precise position anywhere in the world. The KLN 90B provides en route navigation information and non-precision (except localizer, LDA, and SDF) instrument approach navigation.

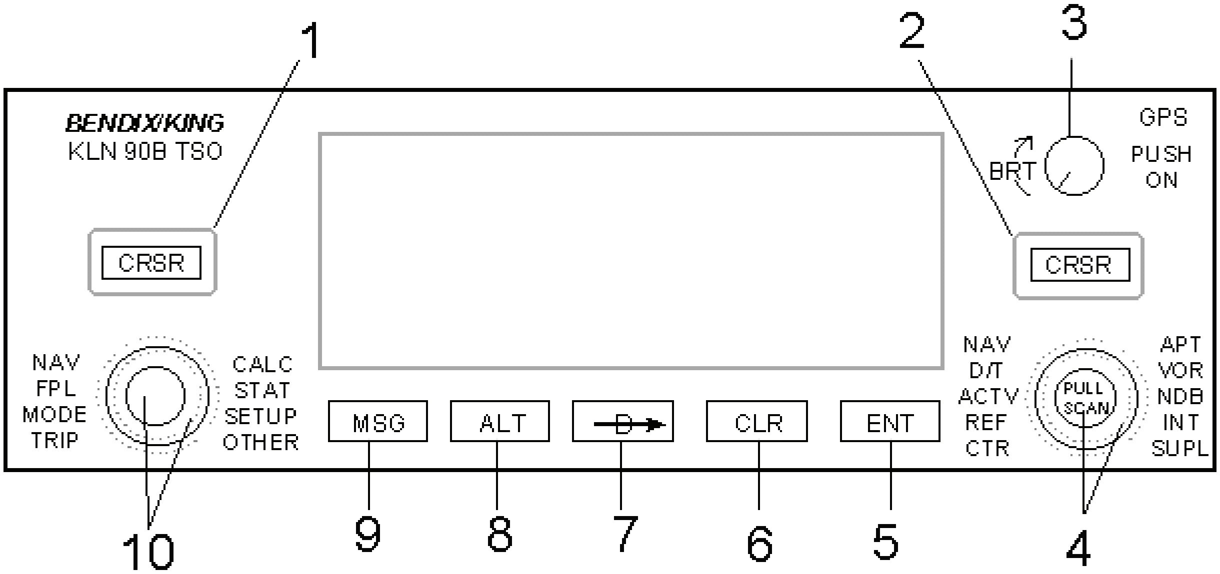
b. Components.

(1) KLN 90B Panel. Located above the weather radar on the instrument panel are the GPS sensor, the navigational computer, a CRT display, and all controls required to operate the unit, Figure 3-1. It also houses the database cartridge that plugs directly into the back of the unit. Refer to Figure 3–1.

(2) External Annunciators/Switches. A panel located just to the right of the fire handles **D2 T** or above the KLN 90B control panel **C D1** on the instrument panel contains switches to select **OBS** or **LEG** during en route navigation and a switch to arm the unit during approach. It also has annunciators to indicate when a message is active, when waypoint sequencing is about to occur, and when altitude alerting is occurring. The annunciator panel also contains a jack to load the database from a laptop computer. Refer to Figure 3-2.

(3) Antenna. A GPS antenna is located on the top of the fuselage at approximately STA 220.

c. Power. Vdc to the KLN 90B is provided through a dc circuit breaker panel through a 5-ampere circuit breaker labeled **KLN 90B** **C D** or **FMS #2** **T1** .



1. Left Cursor
2. Right Cursor
3. Power/Brightness Knob
4. Right Inner and Outer Concentric Knobs
5. ENT Button
6. CLR Button
7. —D▶ Button
8. Altitude Button
9. MSG Button
10. Left Inner and Outer Concentric Knobs

Figure 3-1. KLN 90B Controls

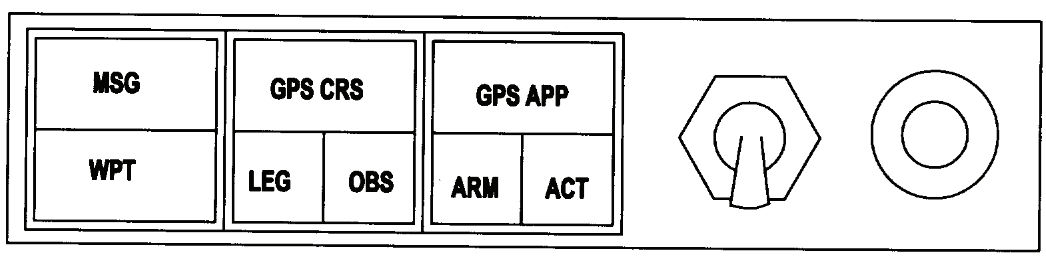


Figure 3-2. KLN 90B External Switches, Annunciators, and Data Loader C D (Sheet 1 of 3)

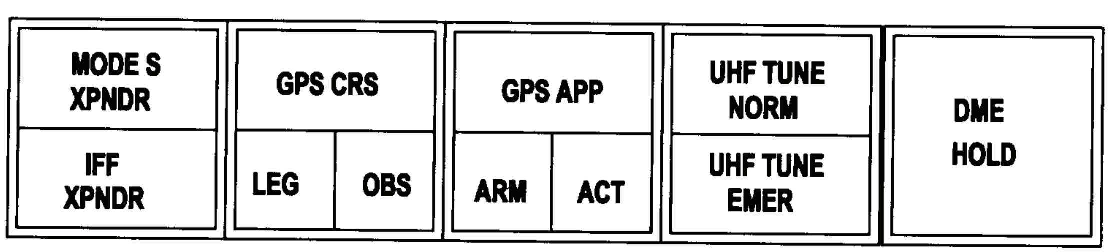


Figure 3-2. KLN 90B External Switches and Annunciators T1 (Sheet 2 of 3)

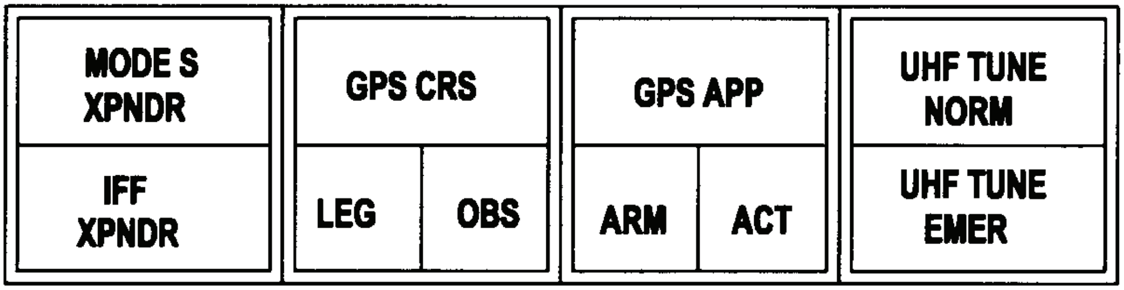


Figure 3-2. KLN 90B External Switches and Annunciators **T2** *(Sheet 3 of 3)*

d. Database. The databases for the KLN 90B have a primary and a secondary coverage area. All databases contain complete information for all worldwide VOR's, NDB's, and Minimum Safe Altitudes (MSA's). For its primary area, the database contains public use and military airports that have any runway at least 1000 feet in length. For its secondary area, the database also contains airports having a hard surface runway at least 3000 feet in length. Airport communication frequencies and runway information are provided only for airports in the primary area. Intersections, air route traffic control center data, flight service station frequencies, and special use airspace are also provided only for the primary area. Refer to Figure 3-3.

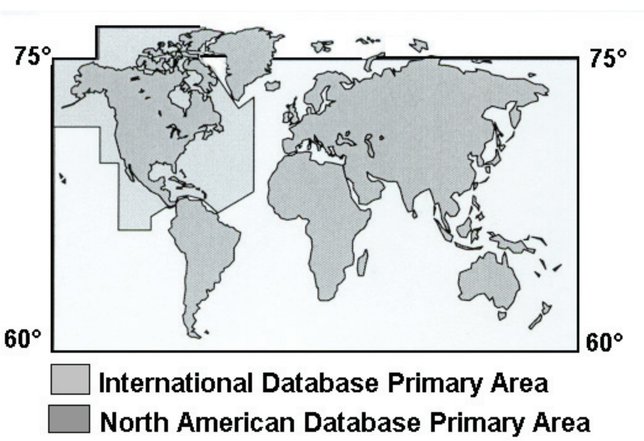


Figure 3-3. Database Area

The following is a list of the KLN 90B database contents.

NOTE

Items indicated with an asterisk are included in the primary database coverage area, but not in the secondary coverage area. The exception is that airports in the primary coverage area include those public and military bases having a runway at least 1000 feet in length. Airports in the secondary coverage area are those having a hard surface runway at least 3000 feet in length.

*(1) Airports**

(a) Identifier.

(b) Name.

(c) City, State, or Country.

(d) Type (public or military).

(e) Latitude and Longitude.

(f) Elevation.

(g) Approach indicator for precision, non-precision, or no instrument approach at the airport.

(h) Radar approach/departure environment indicator.

(i) Whether airport underlies CL B, TRSA, CL C, CTA, or TMA.

(j) Time relative to UTC (Zulu).

(k) Communication frequencies.

1 ATIS.

2 Clearance delivery.

3 Tower.

4 Ground control.

5 Unicom.

6 Multicom.

7 Approach (IFR).

8 Departure (IFR).

9 Class B, Class C, TRSA, CTA, TMA (VFR).

10 Center (when used for approach).

11 Arrival.

12 Radar.

13 Director.

14 Radio.

15 Automatic Weather Observing Station (AWOS).

16 Aeronautical Advisory Service (AAS).

17 Aerodrome Traffic Frequency (ATF).

18 Common Traffic Advisory Frequency (CTAF).

19 Mandatory Frequency.

20 Ramp control.

21 Pilot Controlled Lights.

(l) Runway data (designation, length, surface, lighting, traffic pattern direction).

(m) Airport services (fuel, oxygen, customs, indicator for presence of a landing fee).

(n) Airport comments (user may manually enter remarks of up to 33 characters at any 100 airports in the database).

(2) VOR's.

(a) Identifier.

(b) Name.

(c) Frequency.

(d) DME indicator.

(e) Class (high altitude, low altitude, terminal, undefined).

(f) Latitude and Longitude.

(g) Magnetic variation.

(3) NDB's.

(a) Identifier.

(b) Name.

(c) Frequency.

(d) Latitude and Longitude.

NOTE

Outer compass locators are stored as intersections.

*(4) Intersections.** (low altitude, high altitude, SID/STAR, approach, and outer markers).

(a) Identifier.

(b) Latitude and Longitude.

*(5) SID/STAR/Approach Procedures.**

(a) All compatible pilot nav SID/STAR procedures.

(b) Non–precision approaches (except Localizer Directional Aid and Simplified Directional Facility (SDF)) approved for overlay use. Includes all public GPS only approaches.

(6) Miscellaneous.

(a) Air Route Traffic Control Center (ARTCC's and FIR's) boundaries and frequencies (VHF and HF).

(b) Flight Service Stations (Location of points of communication and associated frequencies – VHF and HF).

(c) Minimum safe altitudes.

(d) Special Use Airspace boundaries (Prohibited, Restricted, Warning, Alert, MOA, Class B, TRSA, Class C, CTA, TMA).

(7) 250 User-Defined Waypoints.

(a) Identifier.

(b) Latitude and Longitude.

(c) Additional data depending on how user defines waypoint:

1 User airports (elevation and surface of longest runway).

2 User VOR (frequency and magnetic variation).

3 User NDB (frequency).

Waypoints are stored in the KLN 90B database almost exclusively by their ICAO identifiers.

NOTE

There are several exceptions in Alaska. In many cases, airports with three letter identifiers receive the prefix "P", but there are many that don't. The most reliable method of determining an Alaska airport identifier is to look it up from the airport name or city.

Not all airports receive the prefix letter. Airport identifiers that are combinations of letters and numbers do not receive the prefix letter.

(8) Database Update. There are two ways to update the database.

(a) Cartridge Exchange. The new update may be installed any time prior to the effective date and the KLN 90B will use the previous data up to the effective date and automatically begin using the new data on the effective date.

1. Insert the KLN 90B insertion/ removal tool in the small hole located on the right side of the unit. A standard 3/32-inch Allen wrench may also be used.
2. Turn tool counterclockwise until the locking mechanism becomes loose and then continue turning counter-clockwise until it just barely begins to become snug. Do not turn so far counterclockwise that the mechanism starts to bind and can no longer be turned.
3. Pull the unit out of the rack by pulling on the sides of the panel. DO NOT PULL ON THE KNOBS.
4. Remove the old cartridge by pulling it straight out of the back.
5. Insert new cartridge into the back of the KLN 90B as indicated by the label on the cartridge. When the cartridge is properly inserted, the "Insert To Here" marking on the label can just be seen protruding from the rear of the unit.
6. Make sure the front lug of the locking mechanism is in the UP position and insert unit into the rack as far as it can go.
7. Re-insert tool and turn clockwise until snug. Pull gently on front panel to verify unit is locked into the rack.

(b) Laptop computer using 3.5-inch diskettes.

1. Plug 9-pin female connector end of interface cable into a COM serial port of computer.
2. Plug the other end of the interface cable into the data loader jack on the annunciator panel.
3. Turn on computer, insert Disk 1 and the program will automatically load and the screen will indicate ready.
4. Turn on the KLN 90B. Press **ENT** as required to approve the Self-Test and Database pages. Use the left outer knob to select the Setup (SET) type pages and the left inner knob to select the SET 0 page.

NOTE

In steps 5, 6, and 7 repeated presses of CLR terminate the process and bring the display back to the original SET 0 page.

5. Press the left **CRSR** button. UPDATE PUBLISHED DB will now be displayed.

6. Press **ENT**. The database region and expiration date of the database presently loaded will be displayed. If the database is out of date, the word EXPIRES changes to EXPIRED.

7. Press **ENT** to acknowledge the information on this page and to continue the update procedure. The estimated load time in minutes is displayed.

8. Press **ENT** to acknowledge the estimated load time and begin erasing the existing database. The unit will display ERASING DATABASE. After the database has been erased, loading of the new database will begin automatically. As the new data is loaded, the percentage of transfer will be displayed.

9. When disk 1 is complete, the screen will display, "Insert Disk 2." Press any key to continue. Remove disk 1 and insert disk 2 and press any key on the computer. The load operation will continue. If the database has three disks, the computer will prompt when to insert disk 3.

10. The KLN 90B will indicate when the database update is complete and display the expiration date. You may turn the unit off at this time or press **ENT** to restart the KLN 90B.

CAUTION

Update of the database must be conducted on the ground. The KLN 90B will not perform navigation functions during updates. An update of database requires 10 minutes.

The accuracy of the database information is only assured if it is used before the end of the effective period.

The KLN 90B contains an internal lithium battery that is used to retain the user-defined database as well as the flight plans.

The KLN 90B was designed to provide worldwide navigation coverage from North 74° latitude to South 60° latitude. Outside this area, magnetic variation must be manually entered.

e. Turn-On and Self-Test.

(1) Turn on the KLN 90B by pressing the power/brightness knob to the IN position. It takes a few seconds for the screen to warm up.

(2) The Turn-On page will be displayed for a few seconds. During this time, the KLN 90B performs an extensive internal test. When the internal test is complete, the Self-Test page will automatically replace the Turn-On page, Figure 3-4.

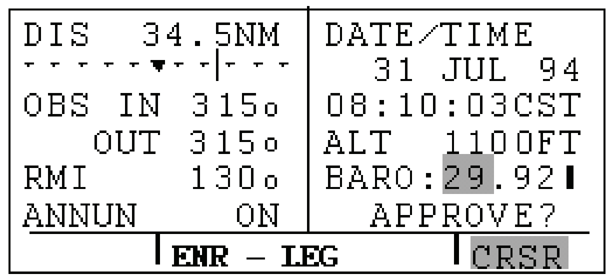


Figure 3-4. Self-Test Page

(3) Adjust the display brightness to the desired level by rotating the power/brightness knob.

(4) Verify the data displayed on the left side of the Self-Test page is the same as is being displayed on the HSI's. The distance field always displays 34.5 nm. The deviation bar on the HSI should be indicating a half scale right deviation. The TO/FROM indicator should be showing FROM. The OBS out field always displays 315°. If the HSI is capable of being driven by the KLN 90B, the course pointer on the HSI should be driven to 315° and both the OBS IN and OBS OUT fields should be displaying 315°. The RMI field always displays 130°. The copilot's RMI should indicate a bearing to the station of 130°.

(5) If the KLN 90B has passed the internal Self-Test, the bottom left side of the self–test page will display ANNUN ON to indicate that the external annunciators should all be illuminated. If a flashing TEST FAIL is displayed, recycle power to the KLN 90B. If the Self-Test page still displays TEST FAIL, the KLN 90B requires repair and should not be used for navigation.

(6) Correct Time, Date, Position.

(a) The KLN 90B needs to have the correct time, date, and position to be able to determine which satellites should be in view. This information is stored in the battery-backed memory of the KLN 90B so it is not normally necessary to update it. If the KLN 90B has the correct date, time, and position, the time to NAV ready will usually be 2 minutes or less. If this information is not correct, the KLN 90B will start to look for satellites to determine the position of the aircraft. This process can take as long as 12 minutes but will normally be around 6 minutes. It is possible to update this information manually, which will allow the KLN 90B to reach a NAV ready status much faster. If the date and time are correct, or acquisition time is not important, proceed to step (8).

(b) If the date is incorrect, rotate the right outer knob counterclockwise until the cursor is over the date field. Rotate the right inner knob until the correct day of the month is displayed. Then, rotate the right outer knob one step clockwise to place the flashing part of the cursor over the month field. Rotate the right inner knob to display the correct month. Rotate the right outer knob one step clockwise again and use the right inner knob to select the first digit of the correct year. Next, rotate the right outer knob one more step clockwise and then use the right inner knob to select the second digit of the year. When the date is correct, press **ENT**.

(c) If it is necessary to reset the time, use the right outer knob to position the cursor over the time zone field. Use the right inner knob to select one of 19 time zones. UTC - Coordinated Universal Time (Zulu) is always a safe choice. Then turn the right outer knob one step counterclockwise to position the cursor over the time field. Use the right inner knob to select the correct hour. Twenty-four hour time is used. Now turn the right outer knob one step clockwise to position the flashing part of the cursor over the first minutes position. Turn the right inner knob to select the desired value. Turning the right outer knob one more step clockwise positions the flashing cursor over the second minutes position and the right inner knob is not used to finalize the time selection. When the correct time has been entered, press **ENT** to start the clock running. The KLN 90B system time will automatically be corrected very precisely once a satellite is received.

(7) Altimeter Setting.

(a) With the Army Engine Trend Monitoring (AETM) system installed and interfaced with the appropriate altimeter, the correct barometric altimeter setting is input via the pilot's altimeter. It will not be possible to access the BARO field on the Self-Test page or the Altitude page. If there is no colon after the BARO field, it cannot be accessed by the pilot with the controls on the KLN 90B.

(b) Turn the right outer knob clockwise to position the cursor over the first two digits of the barometric altimeter setting if the cursor is not already there. If the correct altimeter setting is displayed, skip to step (d).

(c) To enter the correct altimeter setting, rotate the right inner knob to select the first two digits. Rotate the right outer knob one step clockwise to move the flashing cursor over the third position. Use the right inner knob to select the correct number. Use the right outer knob and inner knobs to complete the altimeter setting and press **ENT**.

(d) With the correct altimeter setting entered, the altitude displayed on line 4 should be correct within 100 feet.

(8) Turn the right outer knob clockwise to position the cursor over APPROVE? if it is not there already. Press **ENT** to approve the Self-Test page. Five beeps should be heard when the Self-Test page is approved to confirm altitude alert audio. If the **GPS CRS** switch is in the OBS position, then the OBS warning page will be displayed and **GPS CRS** switch should be pushed so that the LEG mode is selected.

(9) The database page will now be displayed with the cursor over ACKNOWLEDGE?. Line 1 indicates the coverage area. Line 3 will show the date the database expires. The KLN 90B will still function with an out of data database.

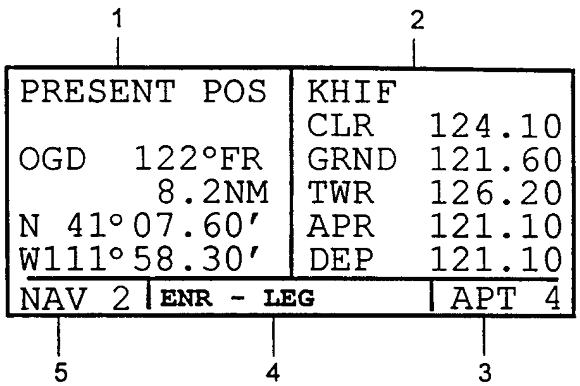
CAUTION

The accuracy of the database information is assured only if the database is current.

Press **ENT** to acknowledge the information on the database page.

The NAV 2 Present Position page is now automatically displayed on the left side of the screen and the Waypoint page which was active when the KLN 90B was last turned off will be displayed on the right side. Refer to Figure 3-5. If the last active waypoint was an airport, the APT 4 page (airport communications) will be displayed.

When the NAV 2 page first appears, it is possible that the present position will be dashed. It can take the KLN 90B several minutes to acquire the GPS satellites and to make its initial calculation of its position. When it reaches a NAV ready status and is able to navigate, the NAV 2 page will display the present position in two ways. The bottom of the page will display the aircraft's latitude and longitude. Above the latitude/longitude position is the present position expressed as the distance and radial from a nearby VOR. The VOR displayed on the NAV 2 page is the nearest low or high altitude class VOR. Terminal class VOR's are not used because many charts do not depict a compass rose around them and verifying the displayed radial would be difficult. Verify that the present position shown on the NAV 2 page is correct.



1. Left Information/Data Page
2. Right Information/Data Page
3. Right Page Identifier
4. Center Segment
5. Left Page Identifier

Figure 3-5. Present Position Page

NOTE

The aircraft must be located such that the GPS antenna has an unobstructed view of the sky so that required satellite signals are not being blocked. If necessary, position the aircraft away from hangars or other obstructions.

f. Display Format. The KLN 90B uses a Cathode Ray Tube (CRT) display. The display screen is divided into segments. These segments are formed by horizontal and vertical lines on the screen. Most of the time there are five segments. Aeronautical information/data is presented on the screen in the form of pages. A page is a presentation of specific data in an organized format. Various page types are used to display related kinds of data. One page type is NAV for navigational data and another is APT for airport information.

When the screen is divided in five segments, the KLN 90B displays two pages at one time. These pages are presented in the upper left and upper right segments of the screen. The lower left segment indicates what specific page is being displayed on the left side. The lower right segment indicates what specific page is being displayed on the right side. The page identification includes a number appended to the page type when there is more than one page for a page type. There is no number displayed in the page identifier if there is only one page for a particular page type. Whenever a + sign is part of a page identifier, there will be two or more pages, all having the same page number, used to present all of the information. That is, all of the information associated with a particular page number doesn't fit on the page being viewed.

The lower center segment of the display is used to present four different kinds of information. The first seven spaces of the segment indicate the mode in which the KLN 90B is operating. The last three spaces are usually blank but may contain the characters MSG or ENT. The characters MSG indicate that there is a message to be viewed on the Message page. The characters ENT will flash in these spaces when it is necessary to press the **ENT** button. This segment is also used for displaying short operational messages called status line messages. A complete listing of status line messages is contained in Paragraph 3-7aaj.

g. Basic Operation of Controls. The KLN 90B has five knobs and seven buttons which are used to perform all operations. In general, the two concentric knobs and the **CRSR** button located on the left side of the unit are used to select pages and enter data on the left side of the screen. Likewise, the two concentric knobs and the **CRSR** button on the right side of the unit are used to select pages and enter data on the right side of the screen.

The cursor is an area of inverse video on the screen. On many pages, data can be added, deleted, or changed by first pressing the appropriate **CRSR** button to turn the cursor function on and bring the cursor on the screen. The appropriate knobs are then used to enter the data. When a cursor is on the screen, the page name normally shown in the left and right lower segments is replaced with a CRSR annunciation in inverse video.

(1) Page Selection. The left outer knob is rotated to select one of eight page types for the left side of the screen. Refer to Table 3-1.

NOTE
The cursor function must be off.

Rotating the left outer knob one detent clockwise or counterclockwise selects the page type marked on the knob in that direction. Once the page type has been selected with the left outer knob, the page number is selected by rotating the left inner knob.

The right side operates in a similar manner. The navigation pages are available on both sides. The remainder of the page types are different. Refer to Table 3-2.

Only the right inner knob has both an in and an out position. With the knob pushed in, it works exactly as the left inner knob. In the out position, it performs a waypoint scan function. The usual position for the right inner knob is the in position.

(2) Waypoint Data Entry.

1. Press cursor to turn on the cursor function.
2. Rotate the outer knob to position the cursor in the desired location. The location will vary. Waypoint identifiers will be in different places on the page depending on the type page selected.
3. Rotate the inner knob to select the first character of the waypoint identifier.
4. Move the outer knob one step clockwise to move the cursor to the second character position.
5. Rotate the inner knob to select the second character.
6. Use the outer and inner knobs in this manner until the complete waypoint identifier is displayed.

Table 3-1. Left Side Types

PAGE IDENTIFIER	KNOB MARKING	PAGE NAME	PAGE NUMBERS
TRI	**TRIP**	Trip Planning	0–6
MOD	**MODE**	Mode	1–2
FPL	**FPL**	Flight Plan	0–25
NAV	**NAV**	Navigation	1–5
CAL	**CALC**	Calculator	1–7
STA	**STAT**	Status	1–5
SET	**SETUP**	Setup	0–9
OTH	**OTHER**	Other	1–4*
*Up to 10 with fuel management system and air data interfaces.			

Table 3-2. Right Side Types

PAGE IDENTIFIER	KNOB MARKING	PAGE NAME	PAGE NUMBERS
CTR	**CTR**	Center WPT	1–2
REF	**REF**	Reference WPT	None
ACT	**ACTV**	Active WPT	*
D/T	**D/T**	Distance/Time	1–4
NAV	**NAV**	Navigation	1–5
APT	**APT**	Airport WPT	1–8
VOR	**VOR**	VOR WPT	None
NDB	**NDB**	NDB WPT	None
INT	**INT**	Intersection WPT	None
SUP	**SUPL**	Supplemental WPT	None
*Varies with the type of waypoints in the active flight plan.			

7. If the waypoint is being entered on a page on the left screen when ENT is flashing in the lower middle segment of the display, press the **ENT** button. This will display a waypoint page on the right side of the screen for the identifier just entered.

8. Verify the waypoint information displayed, press the **ENT** button again to approve the waypoint entry. The right side will return to the page previously displayed.

(3) Alternate Waypoint Data Entry. This method applies when there is a page on the left side of the screen with the cursor over a field where a waypoint can be entered. Fill the waypoint on the left side by first selecting the desired waypoint page on the right side. When the **ENT** button is pressed, the waypoint field on the left will contain the flashing identifier of the waypoint that is displayed on the right side. To finalize the selection, press the **ENT** button again.

(4) The Duplicate Waypoint Page. There are some waypoints in the database with the same identifier. When a waypoint identifier has been entered that is not unique to a single waypoint, a duplicate waypoint page displays on the left side. The duplicate waypoint page is used to select which of the waypoints having the same identifier is actually desired. The waypoint identifier is displayed on the top left of the page. Refer to Figure 3-6.

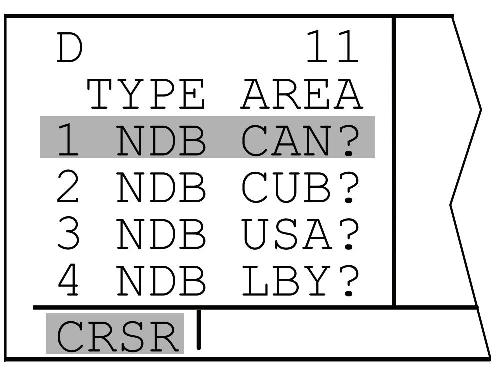


Figure 3-6. Duplicate Waypoint Page

To the right of the identifier is the number of waypoints in the database having the identifier. Below the identifier is a list of the waypoint types and the associated countries that use the identifier. If there are more than four waypoints having the same identifier, only the first four are initially shown. The cursor will be over the first waypoint listed. They are listed with the waypoint closest to the aircraft's present position displayed first and the waypoint farthest from the aircraft displayed last. To view the rest, rotate the left outer knob clockwise. Doing so will move the cursor over waypoints two, three, and four and then will cause the waypoint list to scroll so that the other waypoints in the list may be seen. To select the desired waypoint:

1. Move the cursor over the appropriate choice.

2. Press the **ENT** button to view the waypoint page for the selected waypoint.

3. Press the **ENT** button again to approve the entry of the waypoint.

h. Message Page. The MSG prompt flashing in inverse video at the bottom of the display indicates a situation that requires attention. View the message at the earliest opportunity. To view the message, press the **MSG** button. The Message page, which takes up the whole width of the display, will appear and show the new message. It is possible that several messages are displayed at one time on the message page. The newest message appears first and the rest in reverse chronological order.

After reading the message, press the **MSG** button again to return to the pages that were previously in view. If all the messages cannot be displayed on one page, repeated presses of the **MSG** button will show the other messages before returning to the pages which were previously in view. Whenever a message condition exists which requires a specific action, the message prompt will remain on but not flashing.

i. Initialization. Since the KLN 90B stores its position and other required parameters in memory when power to the unit is removed, it is seldom necessary to aid the unit in reaching a NAV ready status. In order for the unit to reach a NAV ready condition, it is necessary to meet the following conditions:

(1) The KLN 90B's almanac data must be current. Almanac data is crude orbital information for all the satellites and is used for initial acquisition when the unit is first turned on. This data is stored in the KLN 90B's non-volatile memory and is considered current up to 6 months. Each satellite sends almanac data for all satellites. Since the KLN 90B routinely updates the almanac data during normal operation, the almanac data will become out of date only if the KLN

90B hasn't been used for the previous 6 months or longer. Collecting new almanac data takes place automatically if the data is more than 6 months old. This will usually take about 6 minutes but no more than 12 minutes.

(2) The aircraft must be located so the GPS antenna has an unobstructed view of the sky.

(3) It is very helpful for the KLN 90B to have the correct date, time, and position. This information is stored in the battery-backed memory of the KLN 90B so it is not normally required to update it. If acquisition time is not important, then it is not necessary to update the date, time, and position. Refer to Paragraph 3-7e(6) for setting the date and time, if necessary. To update the position:

1. Select the Setup 1 page by first turning the left outer knob to **SETUP** displaying a SET page annunciated in the lower left segment of the display. Turn the left inner knob until the SET 1 page is selected.

2. Press the left **CRSR** button to bring the cursor on the page over the **WPT** field.

3. Use the left inner knob to enter characters and the left outer knob to move the cursor until the identifier for the location is entered.

4. Press the **ENT** button to view the waypoint page on the right side.

5. Press the **ENT** button again to approve the entry.

NOTE

As an alternative, the latitude and longitude of the present position can be entered directly instead of entering a waypoint identifier.

6. Use the left outer knob to position the cursor over CONFIRM?

7. Press the **ENT** button.

NOTE

The groundspeed and heading fields are not used for initialization in the aircraft. If the KLN 90B is in the take-home mode, entering a groundspeed will allow the KLN 90B to fly along the active flight plan (or direct to a waypoint) starting from the initialization waypoint. A heading may be entered in the initial heading field while in the take-home mode if the one offered is not desired. If the take-home mode is used, the KLN 90B must be initialized to the aircraft's location when it is re-installed.

8. Use the left knobs to select the NAV 2 page. When the KLN 90B reaches the NAV ready status and is able to navigate, the NAV 2 page will display the present position. Verify the latitude and longitude or the VOR radial and distance displays are correct.

j. Selecting Waypoints. There are five types of waypoints: airports, VOR's, NDB's, intersections, and supplemental. Waypoints in the published database fall into one of the first four types. Up to 250 user defined waypoints may be created and defined as any of the five types. There are three methods to select a specific waypoint for viewing: enter the waypoint's identifier directly, scan through the waypoint identifiers in alphabetical order, or enter the waypoint's name. If the waypoint is an airport, it may also be selected by entering the city where the airport is located.

(1) Selecting Waypoints By Identifier. The most direct way of selecting a specific waypoint is to simply enter the identifier directly on the appropriate waypoint page.

1. Rotate the right outer knob to select the appropriate waypoint type page. For the airport type waypoints, rotate the right inner knob to select the APT 1 page if it is not already in view. The airport identifier can be entered on any of the eight airport pages but the APT 1 page displays the airport name.

2. Press the right **CRSR** button to bring the cursor on the screen over the first character of the identifier. Check the right inner knob in the in position.

3. Turn the right inner knob to select the first character of the identifier.

Airports that have four-letter identifiers require all four letters. Turn the knob either clockwise or counterclockwise. The letters and numbers wrap around with a blank character separating the 9 and the A. Turn the knob clockwise to scan through the characters in alphabetical order or counterclockwise to scan in reverse alphabetical order. Numbers are considered lower than letters.

4. Rotate the right outer knob one step clockwise to position the cursor over the second character of the identifier.

5. Use the right inner knob to select the second character of the identifier.

6. Use the right outer and right inner knobs in the same manner as above to select the remainder of the identifier.

7. Press the right **CRSR** button to remove the cursor from the right page.

8. If the waypoint is an airport, the APT 2 through APT 8 pages may be viewed by rotating the right inner knob. Many times not all of the characters of a waypoint identifier need to be entered. Every time a character is entered, the KLN 90B searches its database to offer the first waypoint in the database that begins with the characters that have been entered so far.

(2) *Selecting Waypoints By Scanning.*

1. Select the desired waypoint type on the right side by using the right outer knob.

2. Pull the right inner knob to the "out" position.

3. Turn the right inner knob clockwise to scan through the waypoints in alphabetical order or counterclockwise to scan in reverse alphabetical order. Numbers are considered lower than letters. The faster the knob is turned, the larger the step through the waypoints. This variable rate scanning allows quick movement through the list. When the knob is turned slowly, the waypoints are scanned one at a time.

A list of the nine waypoints nearest to the present location is located at the beginning of the complete lists for airports, VOR's, and NDB's. It is necessary to scan backwards by turning the knob counterclockwise through the complete list to reach the nearest list. The top right portion of the page will flash the relative position of the waypoint to the present position, Figure 3-7. NR 1 indicates the nearest while NR 9 indicates the ninth nearest. Waypoint pages displayed in the nearest list do not contain latitude or longitude positions as they do in the complete list. Instead, the bearing and distance to the waypoint are displayed. In addition, nearest airport pages display the length, surface, and lighting of the longest runway. Once the nearest airport is displayed, the other airport pages for the airport are available for display by making sure the right inner knob is pressed in and then turning it to select the desired airport page.

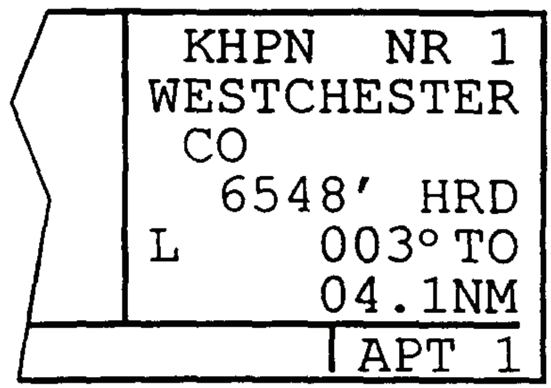


Figure 3-7. Nearest Airport Page

NOTE

The capability to display nearest airports exists only when the KLN 90B is actually operating in the primary database coverage area. For example, if the KLN 90B contains a North American database, it will not display the nearest airports while operating in South America.

In the event of an emergency, a special procedure exists to very quickly get to the beginning of the nearest airport list.

1. **MSG** button - Press.

2. **ENT** button - Press.

The waypoint page for the nearest airport is now displayed on the right side. The right inner knob may now be used in the normal manner to scan the other nearest airports, knob in the “out” position, or to view all eight airport pages for a specific airport, knob in the “in” position.

When the nearest airport page is initially displayed, NR 1 is displayed in the upper right hand corner of the page to designate this airport as the nearest airport. However, if flight is continued along the flight plan with this page selected, the same airport will be displayed and its position in the nearest airports list will change from NR 1 to NR 2, NR 3 … NR 9 until it finally won't be on the nearest airport list. The reason for this is that in the event of an actual emergency, once an airport has been selected, the list won't update while maneuvering or looking up data on other airport pages. To have the NR 1 continuously change to reflect the nearest airport, perform the following steps.

1. Display the nearest airport page by pressing the **MSG** button followed by pressing the **ENT** button.

2. Press the right **CRSR** button.

3. Rotate the right outer knob clockwise to position the cursor over NR 1. As long as the cursor is left in this position, this page will update so that the nearest airport is always shown as the flight progresses.

(3) Selecting Waypoints by Name or City. For VOR's and NDB's, the navaid name may be used. For airports, the airport name on the APT 1 page or the city name on the APT 2 page may be used.

1. Turn the right outer knob to display the VOR, NDB, or airport type waypoint. For the airport type waypoint, use the right inner knob to select APT 1, for airport name, or APT 2, for airport location, as appropriate.

2. Press the right **CRSR** button. Make sure the right inner button is pushed to the "in" position.

3. Rotate the right outer knob clockwise until the cursor is over the first character in the VOR name, NDB name, airport name, or airport city name.

4. Turn the right inner knob to display the first character.

5. Turn the right outer knob one step clockwise and then use the right inner knob to enter the second character.

6. Use the right outer and inner knob as before to select the remaining characters.

7. Press the right **CRSR** button to turn off the cursor function.

(a) Instead of an entire name, a few characters may be entered and the waypoints that begin with those characters may then be scanned:

1. Turn the right outer knob to display the VOR, NDB, or airport type waypoint. For the airport type waypoint, use the right inner knob to select APT 1 or APT 2 as appropriate.

2. Press the right **CRSR** button. Make sure the right inner button is pushed to the "in" position.

3. Rotate the right outer knob clockwise until the cursor is over the first character in the VOR name, NDB name, airport name, or airport city name.

4. Turn the right inner knob to display the first character.

5. Turn the right outer knob one step clockwise and then use the right inner knob to enter the second character.

6. Use the right outer and inner knobs in the same manner to select as many characters as desired.

(b) Now all names that begin with the selected characters can be scanned.

1. Pull the right inner knob to the "out" position.

2. Turn the right inner knob (in the "out" position) to scan all names beginning with the selected characters.

3. If desired, the right inner knob may be pushed back in and more characters added to the name.

4. When complete, push the right inner knob in and press the **CRSR** button to turn off the cursor function.

(c) There are a few changes made to names in order to accommodate the KLN 90B display. Names that are too long to fit on the display are abbreviated. The first six characters are usually exactly correct, with some exceptions. Refer to Table 3-3 for a list of exceptions.

Table 3-3. Abbreviations

North, Northern, East, Eastern, etc.	N, E
Southeast, Northwest, etc.	SE, NW
Point	PT
Port	PT
Fort	FT
Saint	ST
International	INTL, INT, IN
Regional	REGL, REG
General	GEN

1. Person's name – Uses initials for other than last name unless very well known (Will Rogers).

2. Delete "City of" (City of Colorado Springs).

3. Delete "Greater" (Greater Buffalo).

4. Delete "The."

(d) Unless the first word is greater than eight characters, it is usually not abbreviated.

(e) Delete most punctuation such as period and apostrophes.

(f) Abbreviations for International are INTL, INT, and IN.

(g) Abbreviations for Regional are REGL and REG.

k. DIRECT TO Operation. The —D▶ button is used to initiate navigation from the present position direct to a waypoint. When the —D▶ button is pressed, the Direct To page, Figure 3-8, will be displayed on the left side with a flashing cursor over a waypoint identifier. The waypoint identifier that appears on the Direct To page is chosen by the KLN 90B according to the following rules.

(1) If the flight plan 0 page is displayed on the left side and the cursor is over one of the waypoint identifiers in flight plan 0 when the —D▶ button is pressed, then that waypoint identifier will appear on the direct to page.

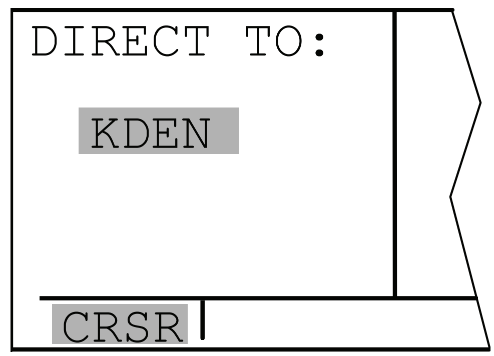


Figure 3-8. Direct To Page

(2) If the KLN 90B is displaying the super NAV 5 page and the right inner knob is in the "out" position, then the waypoint highlighted in the lower right hand corner of the super NAV 5 display will be the default waypoint.

If condition number 1 or 2 isn't occurring:

(3) If there is any waypoint page (APT 1-8, VOR, NDB, INT, SUP, or ACT page) in view on the right side when the —D▶ button is pressed, then the Direct To page will contain the identifier of the waypoint being viewed on the right side.

If none of conditions number 1, number 2, or number 3 above are occurring, then:

(4) When the —D▶ button is pressed, the waypoint identifier for the current active waypoint will be displayed. However, if the active waypoint is the missed approach point and the aircraft is passed the missed approach point, then the KLN 90B will display the first waypoint of the missed approach procedure on the Direct To page.

(5) If there is no active waypoint when the —D▶ button is pressed, then the Direct To page displays blanks. In order for there not to be an active

waypoint, there is no direct to waypoint and there are no waypoints in flight plan 0.

l. Direct to – Procedure 1.

1. Press the –D► button. The Direct To page is displayed on the left side. The cursor will already be on the left page. A waypoint identifier may or may not be displayed.

2. Rotate the left inner knob to select the first character of the desired waypoint's identifier.

3. Rotate the left outer knob one step clockwise to move the flashing portion of the cursor over the second character position.

4. Rotate the left inner knob to select the second character of the identifier.

5. Use the left outer and inner knobs as in the previous steps until the desired identifier is completely displayed.

6. Press the **ENT** button to display the waypoint page on the right side for the selected waypoint. If an incorrect identifier has been entered, immediately start using the left inner knob to re-enter the correct identifier.

7. Press the **ENT** button again to approve the displayed waypoint page. The right side will display the NAV 1 page, Figure 3–9, and the left side will return to the page that was displayed prior to pressing the –D► button. If the direct to was started while the NAV 1 page was shown on the left side, then the left and right pages will revert to the pages that were shown before the direct to was started. The selected waypoint is now the active direct to waypoint.

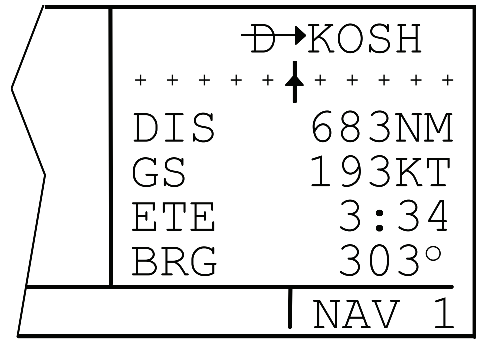


Figure 3-9. NAV 1 Page (Direct To Operation)

NOTE

In some cases during approach operations, the KLN 90B presents a page asking how a waypoint is used when the waypoint identifier is entered character by character. When this page is presented, simply choose the desired use of the waypoint (e.g., FAF or MAHP) by moving the cursor with the left outer knob and pressing ENT. Choosing correct use of the waypoint is required to ensure proper waypoint sequencing once the aircraft reaches the waypoint.

m. Direct To – Procedure 2.

1. Select the desired waypoint page on the right side.

2. Press the –D► button. The Direct To page is displayed on the left side and it contains the desired waypoint identifier.

3. Press the **ENT** button to approve the waypoint page displayed on the right side. The right side will now display the NAV 1 page, and the left side will return to the page that was displayed prior to pressing the –D► button. If the direct to was started while the NAV 1 page was shown on the left side, then the left and right pages will revert to the pages that were shown before the direct to was started. The selected waypoint is now the active DIRECT TO waypoint.

n. Recentering The Deviation Bar.

1. Select a non-waypoint page (NAV, D/T, REF, or CTR) or the Active Waypoint page on the right side.

2. Press the —D▶ button. The Direct To page is displayed on the left, containing the active waypoint identifier.

3. Press the **ENT** button.

NOTE

If the KLN 90B is in the approach mode and this method is used to center the deviation bar when the missed approach point is the active waypoint, then the approach mode will be canceled and the unit will revert to the approach arm mode. A missed approach will have to be executed.

o. Proceeding Direct To Another Waypoint. Proceed direct to another waypoint other than the active waypoint, by using Direct To procedure 1 or 2 at any time.

p. Canceling Direct To Operation. The primary reason for wanting to cancel direct to operation is to return to flight plan operation. To cancel direct to operation:

1. Press the —D▶ button.

2. Press the **CLR** button.

3. Press the **ENT** button.

q. Waypoint Alerting For Direct To Operation. Approximately 36 seconds prior to reaching a direct to waypoint, the arrow preceding the waypoint identifier on the waypoint page for the active waypoint will begin flashing. This arrow will also be flashing on any navigation page or any distance/time page displaying the active waypoint identifier. On the super NAV 5 page, the entire waypoint identifier will start to flash. This is called waypoint alerting. The external waypoint annunciator will begin flashing at the same time.

r. Navigation Pages. The KLN 90B has five navigation pages. Unlike any other pages, these pages may be selected and viewed on both the left and right sides of the screen.

(1) NAV 1 Page. The NAV 1 page, Figure 3-10, displays the following information.

(a) The Active Navigation Leg. For direct to operation, this consists of the direct to symbol, —D▶, followed by the active DIRECT TO waypoint identifier. For the leg of a flight plan, this consists of the FROM waypoint identifier and the active TO waypoint identifier. An arrow (→) precedes the active waypoint identifier.

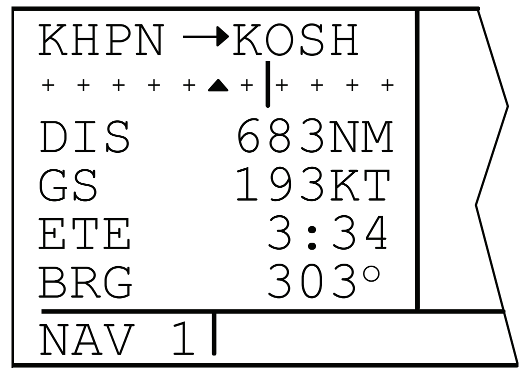


Figure 3-10. NAV 1 Page (Flight Plan Operation)

(b) A Course Deviation Indicator (CDI) that displays left and right deviation from the desired track. A vertical bar operates like a navigation needle on a conventional CDI or HSI. Each dot represents one nautical mile deviation from the desired track, 5 nm full scale deflection. The center triangle also serves as the CDI's TO / FROM indicator. The word FLAG is displayed over the CDI when the KLN 90B is not usable for navigation.

NOTE

It is possible to change the CDI scale factor to be 0.2 NM per dot, 1 nautical mile full-scale deflection, or 0.06 nm per dot, 0.3 nm full scale defection.

(c) The Super NAV 1 Page. When the NAV 1 page is selected on both the left and right sides at the same time, the Super NAV 1 page is displayed. The Super NAV 1 page contains exactly the same information as the standard NAV 1 page but spreads the data across the entire screen making it easier to view.

(2) NAV 2 Page. The NAV 2 page displays the aircraft's present position in two formats. The first format is in terms of the distance and radial from a nearby VOR. The second format is in latitude and longitude.

(3) NAV 3 Page. Refer to Figure 3-11.

(a) Desired Track (DTK). The great circle course between two waypoints. Any CDI or HSI driven by the KLN 90B, including the CDI displayed on the NAV 1 page, is referenced to this desired track.

NOTE

If the KLN 90B is in the OBS mode, the selected course (OBS) is displayed instead of the Desired Track (DTK).

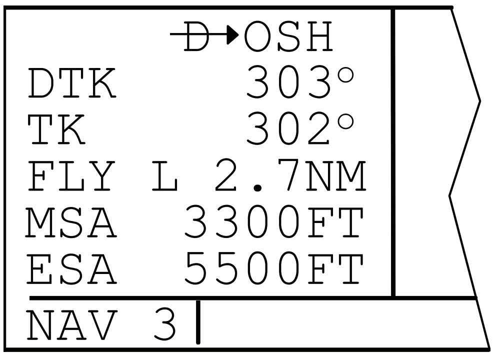


Figure 3-11. NAV 3 Page

(b) Actual Track (TK). The aircraft's present track over the ground.

(c) Cross Track Error Correction. This is a text means of indicating how far and which direction to get back on course. It is consistent with the vertical deviation bar displayed on the NAV 1 page.

(d) Minimum Safe Altitude (MSA). The MSA displayed is the altitude defined by Jeppesen as Grid Minimum Off-Route Altitude (Grid MORA). This altitude is derived by Jeppesen for sectors that are 1° of latitude by 1° of longitude in size. One degree of latitude is 60 nm. One degree of longitude is 60 nm at the equator and progressively less than 60 nm as one travels away from the equator. One degree of longitude is approximately 50 nm at the southern most parts of the U.S. and is approximately 40 nm at the northern most parts of the U.S. The MSA altitude information is contained in the database and is updated when the database cartridge is updated.

The MSA provides reference point clearance within these 1° latitude by 1° longitude sectors. A reference point is defined as a natural (peak, knoll, hill, etc.) or man-made (tower, stack, tank, building, etc.) object. Grid MORA values clear all reference points by 1000 feet in areas where the highest reference points are 5000 feet MSL or lower. MORA values clear all reference points by 2000 feet in areas where the highest reference points are above 5000 feet MSL. The KLN 90B displays dashes for areas outside the database coverage area or for areas where the Grid MORA is not defined.

WARNING

The MSA and ESA altitudes are advisory in nature only. They should not be relied upon as the sole source of obstacle and terrain clearance. Refer to current aeronautical charts for appropriate minimum clearance altitudes.

(e) Minimum En Route Safe Altitude (ESA). When the KLN 90B is in the leg mode, the ESA is the highest MSA from the present position to the active waypoint, then to the destination waypoint via the active flight plan. Refer to Figure 3-12. When the KLN 90B is in the OBS mode, the ESA is the highest MSA from the present position to the active waypoint.

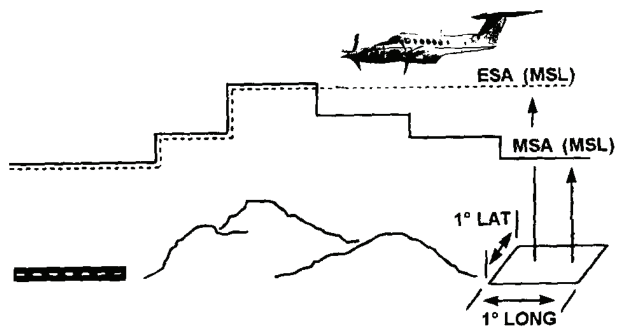


Figure 3-12. Minimum En route Safe Altitude

(4) NAV 4 Page. The NAV 4 page is used for altitude alerting and for advisory vertical navigation. Refer to Figure 3-13.

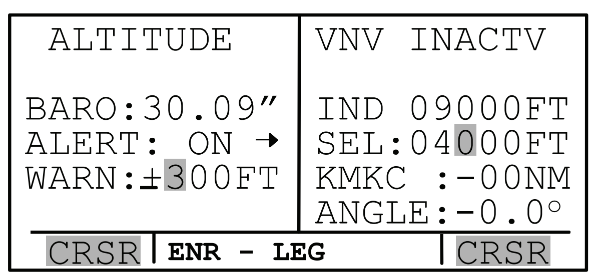


Figure 3-13. Altitude Page and NAV 4 Page

(a) Altitude alerting allows the selection of a target altitude and then provides a visual alarm 1000 feet prior to reaching the selected altitude, another upon reaching the altitude and another for deviation from the selected altitude.

1. Press the altitude button. The altitude page will be displayed on the left with the cursor over the first two digits of the barometric altimeter setting. The NAV 4 page will be displayed on the right with the cursor over the first digit of the selected altitude field.

2. Use the left knobs to update the altimeter setting, if required. There are three cursor positions. Use the left outer knob to move the cursor and the left inner knob to change the digits. With the proper altimeter setting, the indicated altitude on the right should be the same as the aircraft's actual altimeter.

NOTE

There may be some difference (less than 100 feet) between the indicated altitude and the aircraft's actual altitude if the altitude input to the KLN 90B is from an altitude encoder because these encoders only provide altitude in 100-foot increments.

3. Turn the left outer knob one step clockwise to position the cursor over the ALERT field. If OFF is displayed, turn the left inner knob to select **ON**. When alerting is enabled, an arrow to the right of ON points to the selected altitude on then right side of the screen.

4. Select an amount of warning by using the left outer knob to position the cursor over the WARN field and using the left inner knob to select the amount of warning. It is selectable in 100-foot increments from 200 feet to 900 feet.

5. Enter the selected altitude one digit at a time in the SEL field of the NAV 4 page by using the right outer knob to position the cursor over the desired digit and the right inner knob to change the digits.

6. Press altitude to return to the pages previously displayed.

CAUTION

The altitude–alerting feature will only be accurate if the barometric altimeter setting is kept updated.

NOTE

Due to the resolution of the altitude input, it may be necessary to descend slightly below or climb slightly above the selected altitude before the two tones are activated indicating that the selected altitude has been reached. This selected altitude alert must be activated to arm the system for providing the altitude deviation alert.

7. The altitude alert annunciator will flash three times at 1,000 feet prior to reaching the selected altitude, flash twice upon reaching the selected altitude, and flash four times when deviating above or below the selected altitude by more than the warning selected. Additionally, the altitude-alerting feature is interfaced with the GPAAS in aircraft that do not have an altitude pre-selector. The GPAAS will announce "Altitude, Altitude" in the above three situations. In those aircraft with an altitude pre-selector, altitude alerting is incorporated with that system.

(b) The KLN 90B has a Vertical Navigation (VNAV) feature that allows an ascent or descent path to be programmed and then provides advisory altitudes to fly to arrive at a waypoint at a specified altitude. The NAV 4 page is used to program vertical navigation.

1. Select the NAV 4 page on either side of the screen. The NAV 4 page can be selected either by using the outer and inner knobs or by pressing the altitude button to bring up the NAV 4 page on the right and the Altitude page on the left.

The identifier for the active waypoint is automatically displayed on the NAV 4 page. Prior to programming a VNAV operation, the top of the page displays VNV INACTV.

2. Press the appropriate **CRSR** button to turn on the cursor function if it is not already on.

3. Enter the desired altitude in the SEL field.

4. Use the outer knob to move the cursor to the offset field adjacent to the active waypoint identifier. Entering an offset allows reaching the desired altitude a specified distance before reaching the waypoint.

Notice that the bottom of the NAV 4 page now displays an angle. To start the descent now using the displayed descent angle, use the outer knob to position the cursor over the ANGLE field. VNAV operation is initiated by bringing the cursor over the ANGLE field. By leaving the cursor off of the ANGLE field, the angle will increase as flight is continued toward the waypoint. When the desired angle is reached, position the cursor over the ANGLE field and VNAV will commence. When VNAV begins, the top of the page displays an advisory altitude.

5. A desired angle may be programmed. The CAL 4 page may be used to calculate a descent angle. To program a descent angle:

   a. Using the outer knob, move the cursor to the ANGLE field and enter the desired descent angle. If the time to begin the descent is greater than 10 minutes, VNV ARMED will now be displayed on the top line of the NAV 4 page. If the time is less than 10 minutes, the top line displays a countdown to the time to begin descent.

   b. Return to any desired page for now. If the NAV 4 page was selected by pressing the altitude button, press the altitude button once again to return to the pages previously in view. If the NAV 4 page was selected by using the outer and inner knobs, insure the cursor function is off and use the outer and inner knobs to select the desired page. Approximately 90 seconds before the time to begin the descent, the message prompt will flash. The message page will display VNAV ALERT. This is notification to view the NAV 4 page because it is getting close to the time to begin the descent.

   c. When the countdown reaches 0:00, the time will be replaced with an altitude advisory. Begin the descent so that the altitude displayed on the altimeter matches the altitude advisory.

VNAV on a flight plan is virtually identical. The NAV 4 page will initially contain the identifier for the active waypoint. VNAV may be programmed referencing this waypoint or any waypoint in the active flight plan that is still in front of the aircraft's position. When another valid waypoint in the flight plan is entered on the NAV 4 page, the aircraft's lateral flight path is not altered.

(5) NAV 5 Page. The NAV 5 page provides a navigation graphics presentation. Refer to Figure 3-14.

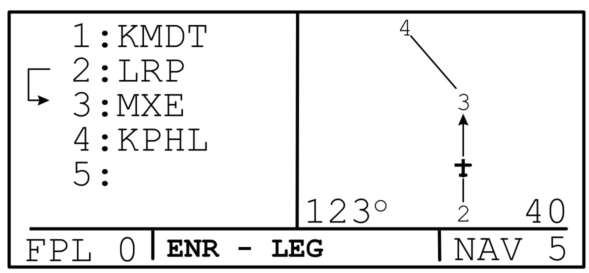


Figure 3-14. NAV 5 Page

In all KLN 90B installations there are three common map orientations that may be selected on the NAV 5 page: a true north up display, a desired track up display, or an actual track up display. In addition, if the KLN 90B is interfaced with the engine trend monitoring system, a heading up presentation may also be selected.

CAUTION

When using the actual track up format, it is typical for there to be a slight delay from the time a heading change is made until the correct map orientation is displayed. Do not confuse the desired track up display or the actual track up display with the heading up display.

When navigating using flight plan operation, the active flight plan (FPL 0) waypoints are displayed using the number associated with the waypoint as it appears on the FPL 0 page. An arrow points to the active waypoint and shows the current flight plan leg. When operating direct to a waypoint that is not in the active flight plan, the direct to waypoint is indicated with an asterisk. Refer to Figure 3-15.

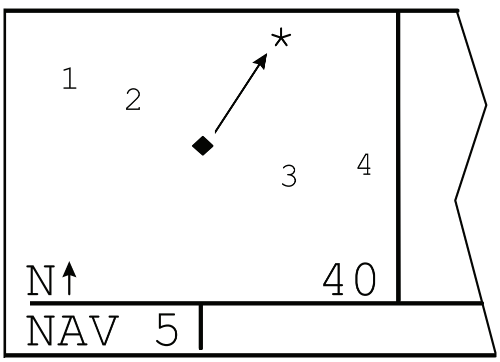


Figure 3-15. NAV 5 Page (Flight Plan Operation)

To select the desired NAV 5 orientation, press the appropriate **CRSR** button. The cursor will be over the map range scale. Turn the appropriate outer knob one step counterclockwise to position the cursor over the map orientation field. Rotate the appropriate inner knob to display N↑ for North up, DTK↑ for desired track up, TK↑ for actual track up, or HDG↑ for heading up. If the cursor is moved to the map range scale using the outer knob or if the cursor is turned off with the **CRSR** button, the DTK↑, TK↑, or HDG↑ annunciation is replaced with the actual value. In the North up format and the desired track up format, the aircraft's position is depicted by a diamond. In the actual track up and heading up format, the aircraft's position is depicted by an aircraft symbol.

The range scale is displayed in the right corner of the NAV 5 page. The range scale indicates the distance from the aircraft's position to the top of the screen. Range scale selections from 1 nm to 1000 nm may be made by pressing the appropriate **CRSR** button and turning the appropriate inner knob.

When the NAV 5 page is displayed on the left side of the screen and any selected waypoint page is displayed on the right side, the location of the selected waypoint is indicated by a "+" on the NAV 5 page. The display scale must be chosen which allows the selected waypoint to be displayed.

(6) Super NAV 5 Page. The Super NAV 5 page provides a moving map display of the present position and route of flight in relation to nearby navaids and airports. This page is displayed by selecting the NAV 5 page on both sides of the screen at the same time. The Super NAV 5 page has a unique format. There are no page display indicators in the lower left and right segments of the display. The mode annunciation is located on the far-left side. The message prompt will appear in the lower left corner of the graphics display. Refer to Figure 3-16.

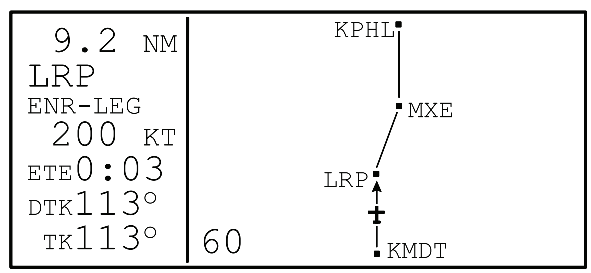


Figure 3-16. Super NAV 5 Page

The left side of the Super NAV 5 page shows the following information:

1. Distance to the active waypoint
2. The active waypoint identifier
3. Mode of operation
4. Groundspeed
5. Estimated time en route, cross-track error, or VNAV status as selected by the pilot
6. Desired track, bearing to the active waypoint, or radial from the active waypoint as selected by the pilot
7. Actual track, bearing to the active waypoint, or radial from the active waypoint as selected by the pilot

Make the selection in 4, 5, and 6 above by pressing the left **CRSR** button and rotating the left outer knob counterclockwise until it is over the desired line. Then turn the left inner knob to choose between the items for a given line. When all selections are complete, turn off the cursor by pressing the left **CRSR** button.

The map scale is also changed by using the left **CRSR** button. To change the map scale, press the left **CRSR** button to place the cursor over the map scale at the bottom left corner of the map display. The map scale choices are the same as for the NAV 5 page, except there is an additional choice, AUTO, that is located between the 1 and 1000 nm scale factors. The AUTO scale factor will automatically choose the smallest map scale that will display the active waypoint and, if there is one, the waypoint after the active waypoint. While taxiing on the airport or flying the traffic pattern, select the 1-nm or 2-nm scale to display the airport diagram. All runway designations are shown on the 1-nm scale. Only the longest runway designation is shown on the 2-nm scale.

NOTE

The track up graphics presentation can only be displayed if the aircraft is moving at least 2 knots. The heading up or North up display may be necessary if there is little or no movement.

Like the NAV 5 page, the Super NAV 5 page shows a graphic depiction of the direct to waypoint or the waypoints making up the active flight plan. The Super NAV 5 page, however, shows waypoint identifiers. Nearby VOR's, NDB's, and airports may be added to the graphics display. Refer to Figure 3-17. To do so, press the right **CRSR** button to display a pop up menu on the right side of the screen. Notice from the menu that a circle with a dot in the center represents a VOR, a smaller circle represents an NDB, and a small diamond represents an airport. The VOR's, NDB's, and airports displayed are those from the nearest waypoint lists.

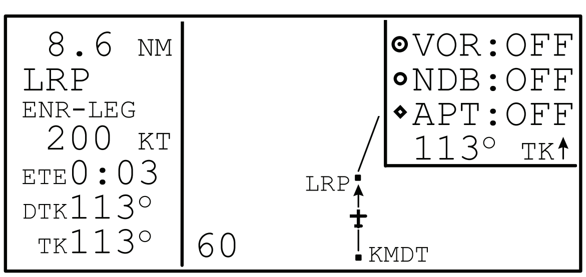


Figure 3-17. Super NAV 5 Page (Waypoint Identifiers)

NOTE

In some parts of the world, VOR's are not classified into one of the three standard classes, so TLH must be selected to display these undefined class VOR's.

When the menu is first displayed, the cursor will be on the VOR selection field. Rotate the right inner knob to display TLH, LH, H, or OFF. With TLH selected, terminal, low altitude, and high altitude VOR's are selected. In addition, VOR's of undefined class will be displayed.

If LH is selected, only low altitude and high altitude VOR's will be displayed. With H selected, only high altitude VOR's will be displayed. With OFF selected, no VOR's are displayed.

NDB's and/or airports may be selected by first using the right outer knob over the NDB or APT selection field and then using the right inner knob to select **ON** or **OFF**.

The map orientation can be changed by moving the cursor to the bottom line of the pop up menu and rotating the right inner knob. The map orientation choices are the same as for the NAV 5 page.

When the desired selections have been made, press the right **CRSR** button to remove the menu.

It is easy to clutter the display. Select a range scale that allows an uncluttered presentation. Or, select a less cluttered combination of VOR's, NDB's, and airports. Press the **CLR** button to de-clutter the graphics display.

CAUTION

The NAV 5 and super NAV 5 pages do not display weather, terrain, special use airspace, or other data.

It is possible to change the active waypoint to any of the flight plan waypoints on this page. Pull the right inner knob to the "out" position. This will create a window at the bottom right corner of the display that will initially contain the identifier of the active waypoint, Refer to Figure 3-18. The waypoint contained in this window will be the default waypoint when the direct to button is pressed. By turning the right inner knob, it is possible to scan through the waypoints of the active flight plan. Turning the knob clockwise will scan through the waypoints in sequence until the end of the flight plan is reached. Turning the knob counterclockwise will scan through the active flight plan in reverse order until the beginning of the flight plan is reached. Pushing the right inner knob in will remove the window from the display.

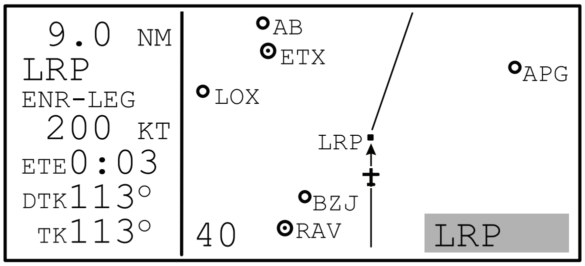


Figure 3-18. Super NAV 5 Page (Active Waypoint Identifiers)

The Super NAV 5 page can be configured to display the VNAV status. This means the VNAV status and advisory altitude for VNAV can be displayed on the Super NAV 5 page. The VNAV problem still needs to be set up on the NAV 4 page.

CAUTION

Advisory VNAV operation will only be accurate if the barometric altimeter setting is kept updated.

(7) Setting Up The VNAV Situation From The NAV 4 Page.

1. Turn to the Super NAV 5 page by selecting NAV 5 on both sides of the display.

2. Turn on the left cursor and rotate the left outer knob counterclockwise until the cursor is over the third line from the bottom of the display.

3. Rotate the left inner knob until VNAV is displayed. Turn the left cursor off.

4. The Super NAV 5 page will now display the VNAV status. If the VNAV problem has not been defined yet, then V OFF will be displayed. If the time to start VNAV operation is greater than 10 minutes, V ARM is displayed. When the time to VNAV operation is less than 10 minutes, the time until VNAV operation will start will be displayed, e.g., V 4:53. If the VNAV operation has started, a suggested altitude will be displayed, e.g., V 4300.

CAUTION

Failure to keep the barometric altimeter setting updated will result in inaccurate special use airspace alerting.

The KLN 90B's special use airspace alert is only a tool to assist the pilot and should never be relied upon as the sole means of avoiding these areas.

NOTE

Special use airspace alerting is disabled when in the approach arm or approach active modes.

s. Special Use Airspace Alert. The KLN 90B contains the location of areas of special use airspace. A message prompt is used to alert proximity to special use airspace. When the message page is viewed, it will display AIRSPACE ALERT and the name and type of the special use airspace. If the special use airspace is a Class B, Class C, CTA, or TMA, the message page will include instructions to see the APT 4 page for the primary airport for the correct communications frequency.

The special use airspace alert feature is three-dimensional. The areas are stored in the database with regard to altitude when the actual altitude limitations are charted in terms of Mean Sea Level (MSL). Therefore, for flight above or below an area of special use airspace there will be no alert. If the actual lower limit is charted in terms of an altitude Above Ground Level (AGL), it is stored in the KLN 90B as all altitudes below the upper limit. If the actual upper limit is charted in terms of AGL, it is stored in the KLN 90B as unlimited.

The types of areas stored in the database and the abbreviations used to denote these areas are listed in Table 3-4.

Only the outer lateral boundaries are stored for Class B, Class C, CTA, and TMA airspace. These special use airspace areas are stored as cylinders of airspace so all altitudes below the upper limit of these areas are considered to be in the area.

Table 3-4. Special Use Airspace

DISPLAY	EXPLANATION
ALRT	Alert Area
CAUT	Caution Area
CL B	Class B

Table 3-4. Special Use Airspace (Continued)

DISPLAY	EXPLANATION
CL C	Class C
CTA	Control Area (outside the USA)
DNGR	Danger Area
MOA	Military Operations Area
PROH	Prohibited Area
REST	Restricted Area
TMA	Terminal Area (outside the USA)
TRNG	Training Area
WARN	Warning Area

The message prompt for a special use airspace alert will occur when the aircraft is approximately 10 minutes from penetrating the outer boundary. It will also occur if the aircraft is within approximately 2 nm of one of these areas even if the aircraft won't actually penetrate the area. The pilot selects the amount of vertical buffer. If one of the areas is penetrated, another message will state, INSIDE SPC USE AIRSPACE.

t. Airport Pages. There are eight airport pages for every airport in the published database.

The database primary area contains public use and military airports that have a runway at least 1000 feet in length. The airport pages contain:

(1) Airport 1 Page. Refer to Figure 3-19.

NOTE

The APT 1 page has a different format when it is displayed as one of the nine nearest airports.

(a) Airport Identifier. An arrow precedes the identifier if the airport is the active waypoint.

(b) Airport Name.

(c) If the airport underlies the outer boundary of Class B or C airspace, CTA, or TMA, the letters CL B, CL C, CTA, or TMA will display. Additionally, if the airport is military, the letters MILTRY will display.

(d) The latitude and longitude of the airport reference point.

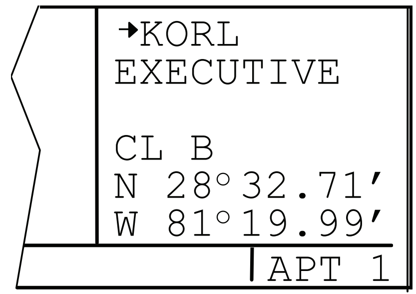


Figure 3-19. APT 1 Page

(2) Airport 2 Page. Refer to Figure 3-20.

(a) Airport Identifier. An arrow precedes the identifier if it is the active waypoint.

(b) The city where the airport is located.

(c) The state, if the airport is located in the United States, the province if in Canada, or the country outside of the United States and Canada.

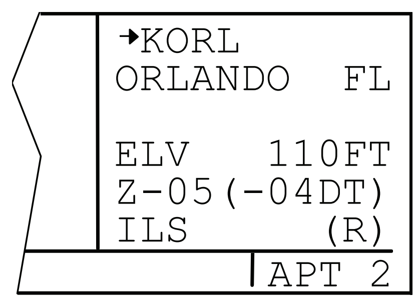


Figure 3-20. APT 2 Page

(d) Airport Elevation. The elevation is rounded to the nearest 10 feet.

(e) Time in relationship to UTC (Zulu). Z-05, for example, indicates local standard time is five hours behind UTC time. If the airport is located in an area which observes daylight savings time, the information in parentheses shows the daylight savings time in relation to UTC.

(f) Instrument Approach Information. Refer to Table 3-5 for the various displays and their explanations.

Table 3-5. Instrument Approach Information

DISPLAY	EXPLANATION
ILS	Airport has an ILS approach.
ILS/MLS	Airport has ILS and MLS approaches.
MLS	Airport has an MLS approach.
NO APR	Airport does not have an instrument approach.
NP APR	Airport has a non-precision approach and no ILS or MLS.

(g) The symbol (R) designates that the airport is serviced by an Approach/Departure control facility having radar capability.

(3) Airport 3 Page. Refer to Figure 3-21. The function of the APT 3 page is to display runway information for the selected airport. For many airports the first APT 3 page depicts a North up runway diagram.

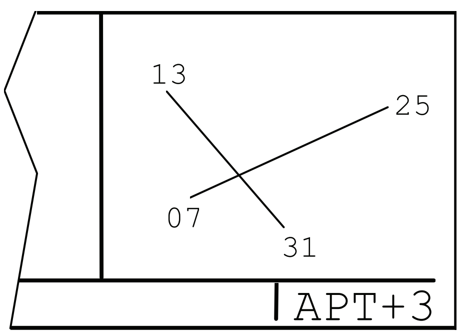


Figure 3-21. APT 3 Page

The primary APT 3 page follows the runway diagram. Runway designation, lighting, and types of surface for up to five runways are displayed in order of length, beginning with the longest. Many times all of the data does not fit on one page. A "+" inserted between the page type and the number indicates more than one of that page. Refer to Figure 3-22.

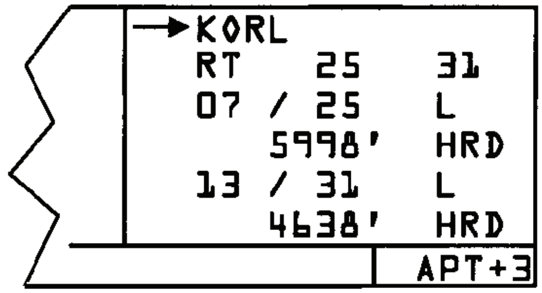


Figure 3-22. Primary APT 3 Page

(a) The letters RT, followed by a runway designation, indicate that the runway normally has a right-hand traffic pattern.

(b) Runway designation for both ends of the runway.

(c) Runway Lighting Availability. Refer to Table 3-6 for displays and explanations.

Table 3-6. Runway Lighting

DISPLAY	EXPLANATION
L	Runway lighting sunset to sunrise.
LPC	Runway lighting is pilot controlled.
LPT	Runway lighting is part-time or on request.
Blank	Blank indicates no lighting.

(d) Runway length in feet.

(e) Runway Surface. Refer to Table 3-7 for runway displays and explanations.

In the event that there is no runway information for an airport, RUNWAY DATA NOT AVAILABLE is displayed on the APT 3 page.

Table 3-7. Runway Surface

DISPLAY	EXPLANATION
Blank	Blank indicates runway surface unknown.
CLY	Clay
DRT	Dirt
GRV	Gravel

Table 3-7. Runway Surface (Continued)

DISPLAY	EXPLANATION
HRD	Hard surface (includes asphalt, concrete, pavement, sealed, tarmac, brick, and bitumen)
ICE	Ice
MAT	Steel matting
SHL	Shale
SND	Sand
SNW	Snow
TRF	Turf

(4) Airport 4 Page. The APT 4 page is used to display communication frequencies. Refer to Figure 3-23.

(a) Airport Identifier. An arrow precedes the identifier if it is the active waypoint.

(b) Frequencies. Refer to Table 3-8 for frequency abbreviations and their explanations.

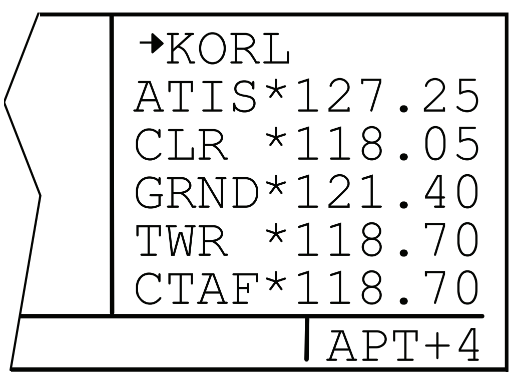


Figure 3-23. APT 4 Page

Table 3-8. Frequency Abbreviations

DISPLAY	EXPLANATION
AAS	Aeronautical advisory service
AFIS	Aerodrome flight information service
APR	Approach control
ARVL	Arrival
ATF	Aerodrome traffic frequency

Table 3-8. Frequency Abbreviations (Continued)

DISPLAY	EXPLANATION
ATIS	Automatic terminal information service
AWOS	Automatic weather observing station
CL B	Class B (VFR frequency)
CL C	Class C (VFR frequency)
CLR	Clearance delivery
CTA	Control area (VFR frequency)
CTAF	Common traffic advisory frequency
CTR	Center (when center is used for approach/departure control)
DEP	Departure control
DIR	Director (approach control/radar)
GRND	Ground control
MF	Mandatory frequency
MCOM	Multicom
PCL	Pilot controlled lighting
PTAX	Pre-taxi clearance
RAMP	Ramp/taxi control
RDO	Radio
RDR	Radar only frequency
TMA	Terminal area (VFR frequency)
TRSA	Terminal radar service area (VFR frequency)
TWR	Tower
UNIC	Unicom

In addition to the standard VHF frequencies, HF frequencies are shown at airports that utilize HF communications in the 2000 kHz to 30,000 kHz frequency band. Airports that have numerous communication frequencies will have multiple APT 4 pages indicated by APT+4. Refer to Figure 3-24. Part-time operation is indicated with an asterisk to the left of the frequency.

Frequencies associated with CL B, CL C, TRSA, CTA, or TMA are VFR frequencies. Airports that have one of these categories of frequencies also have APR and DEP which are IFR frequencies. Where required, APR, DEP, CL B, CL C, TRSA, CTA, and TMA frequencies are sectorized. The format for showing the sectorization is to show the frequency first, followed by the identifier of the associated reference point, followed next by the applicable radials, and, finally, the associated altitude restrictions.

NOTE

When an altitude restriction is shown on the APT 4 page, the abbreviation BEL means at and below the specified altitude. The abbreviation ABV means at and above the specified altitude.

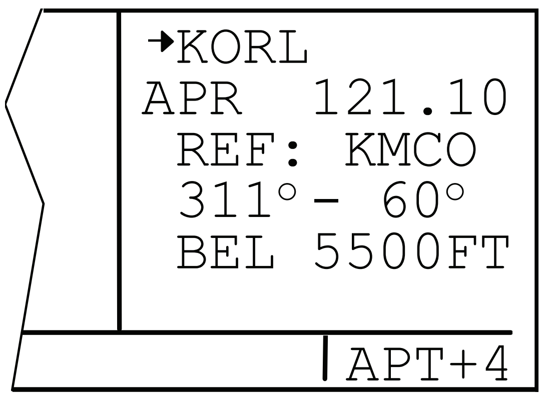


Figure 3-24. APT 4 Page (BEL)

In a few cases, APR, DEP, CL B, CL C, TRSA, CTA, and TMA frequencies are sectorized such that the restriction cannot be displayed on a single page. When this occurs, TEXT OF FREQUENCY USAGE NOT DISPLAYED is displayed on the APT 4 page. There are some airports in the database for which no communications information is available. In this case, COMM FREQ DATA NOT AVAIL is displayed.

(5) Airport 5 Page. The APT 5 page is used to store and display user-entered remarks. These remarks might include information on lodging, dining, airport services, etc. Up to 100 airports may contain these remarks. A remark may contain up to 3 lines of 11 characters each. Letters, numbers, hyphens, and spaces may be used in the remark.

1. Select the APT 5 page for the desired airport.
2. Press the right **CRSR** button.
3. Rotate the right outer knob until the cursor fills the entire third line of the screen.
4. Use the right inner knob to select the first character of the remark.
5. Turn the right outer knob one step clockwise to move the flashing portion of the cursor to the second cursor position, then use the right inner knob to select the second character.
6. Use the right outer and inner knobs to select the rest of the first line of the remark.
7. Press the **ENT** button to approve the first line. The cursor will move to the second line.
8. Use the above procedure to select the characters of the second and third lines of the remark. Press the **ENT** button to individually approve each line of the remark.
9. Press the right **CRSR** button to turn the right cursor function off.

(6) Airport 6 Page. The APT 6 page shows aeronautical services available for the selected airport. These services include customs, fuel, and oxygen availability as well as an indicator of a landing fee.

(a) Customs Information. Refer to Table 3-9 for customs displays and their explanations.

Table 3-9. Customs Information

DISPLAY	EXPLANATION
Blank	Blank line indicates that customs information is not available in the database.
CUSTMS–ADCS	Customs are available for private aircraft arriving to the U.S. from Canada or Mexico. Advance notice of arrival to customs officers is to be included in the flight plan transmitted to a FAA facility. This code is used when this is the only type customs facility available.
CUSTMS–PR	Customs facilities are available, but require prior request or permission for use.
CUSTMS–REST	Customs facilities are available on a restricted basis. Check with airport before planning to use.

Table 3-9. Customs Information (Continued)

DISPLAY	EXPLANATION
CUSTMS–FULL	Customs facilities are available without restriction.
NO CUSTMS	No customs facilities are avail–able.

(b) Fuel Types. Refer to Table 3-10 for fuel types displays and their explanations.

Table 3-10. Fuel Types

DISPLAY	EXPLANATION
MOGAS	Automotive Fuel
JET	Jet Fuel (Any Type Qualifies)
NO FUEL	No Fuel Available
80	80 Octane
100	100 Octane
100LL	100 Octane, Low–Lead

(c) Oxygen Services. If there are no oxygen services available at the selected airport, the fifth line will display, NO OXYGEN. If any type of oxygen is available, the fifth line will read, OX and the rest of the line will display the specific oxygen service. Refer to Table 3-11.

Table 3-11. Oxygen Services

DISPLAY	EXPLANATION
ALL	All Oxygen Services Are Available
H	High Pressure
HB	High Pressure Bottled
L	Low Pressure
LB	Low Pressure Bottled

(d) Landing Fees. The sixth line of the APT 6 page denotes a landing fee. Refer to Table 3-12 for landing fee explanations.

Table 3-12. Landing Fee Information

DISPLAY	EXPLANATION
LANDING FEE	The airport has a landing fee.
NO FEE INFO	No information on whether or not there is a landing fee for this airport.
NO LDG FEE	The airport does not have a landing fee.

(7) Airport 7 Page. The APT 7 page shows the SID and STAR procedures that are available for the selected airport. If both SID and STAR procedures are available, there will be two APT 7 pages indicated by APT+7. If there are no SID or STAR procedures in the database, then this page will display NO SID / STAR FOR THIS AIRPORT IN DATABASE. Use of SID's and STARS will be addressed after flight plans are presented.

(8) Airport 8 Page. The APT 8 Page shows the non–precision approaches that are available for the selected airport. If there are no approaches for this airport in the database, this page will display, NO APPROACH FOR THIS AIRPORT IN DATABASE. Use of approaches will be addressed after flight plans are presented.

u. VOR Page. Refer to Figure 3-25.

(1) VOR Identifier. An arrow precedes the identifier if it is the active waypoint.

(2) The letter D appears following the VOR identifier if the VOR has DME capability.

(3) The name of the VOR.

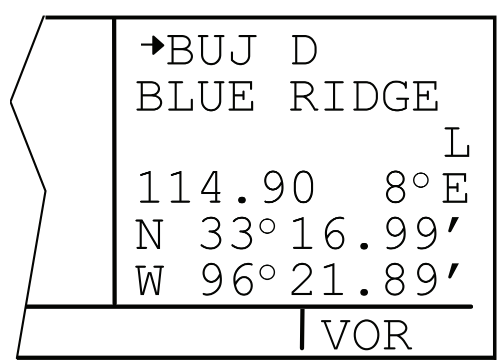


Figure 3-25. VOR Page

(4) The class of the VOR. Refer to Table 3-13 for VOR classifications.

Table 3-13. VOR Classification

DISPLAY	EXPLANATION
H	High altitude
L	Low altitude
T	Terminal
U	Undefined

(5) The VOR frequency.

(6) The published magnetic variation of the VOR.

(7) The latitude and longitude of the VOR.

The nine VOR's nearest to the aircraft's present position may be displayed. When a VOR page is displayed as part of the nearest VOR list, the latitude and longitude are replaced with the bearing and distance to the VOR.

NOTE

NDB's which are combined with outer markers (compass locators) are usually not stored with NDB's. However, they are always stored with intersections and are found on the INT page by using the outer compass locator name, not the NDB identifier. There is also a nearest NDB list. When an NDB page is displayed as one of the nearest NDB's, the latitude and longitude are replaced with the bearing and distance to the NDB.

v. NDB Page. Refer to Figure 3-26.

(1) The NDB Identifier. An arrow precedes the identifier if it is the active waypoint.

(2) The name of the NDB.

(3) The NDB frequency.

(4) The latitude and longitude.

w. Intersection Page. The intersection pages contain the named low altitude, high altitude, approach, and SID/STAR intersections as well as outer makers and outer compass locators. Refer to Figure 3-27.

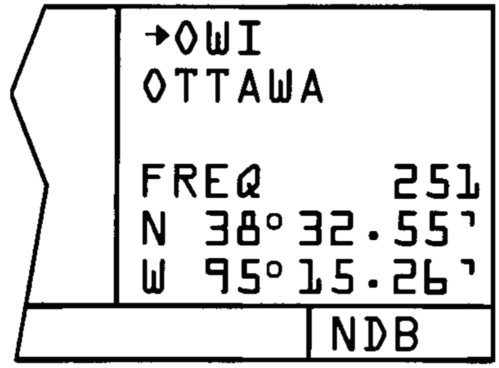


Figure 3-26. NDB Page

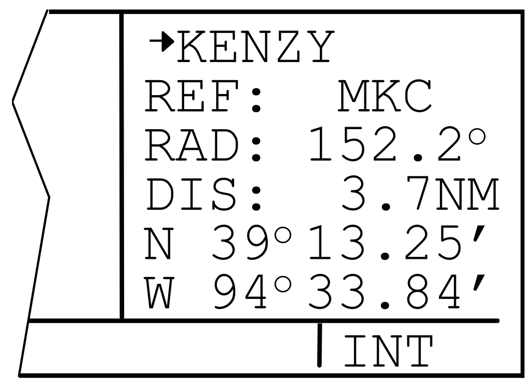


Figure 3-27. Intersection Page

(1) The intersection, outer marker, or outer compass locator name.

(2) The location of the intersection, outer marker, or outer compass locator expressed in terms of a radial and distance from a nearby VOR. The KLN 90B chooses the closest VOR. It takes a few seconds for the VOR ident, radial, and distance to be calculated and displayed.

(3) The latitude and longitude of the intersection, outer marker, or outer compass locator. The identifier of another VOR may be entered in the REF field, and the page will compute and display the radial and distance from that VOR to the intersection. This information is not stored with the INT page and is lost when leaving the page.

1. Display the desired intersection page.

2. Press the right **CRSR** button to turn on the cursor function.

3. Rotate the right outer knob until the cursor is positioned over the identifier adjacent to REF.

4. Use the right inner and outer knobs to select the desired identifier.

5. Press the **ENT** button to display the waypoint page for the identifier just entered.

6. Press the **ENT** button again to approve the waypoint page. The intersection page is displayed with the computed radial and distance.

7. Press the right **CRSR** button to turn off the right cursor function.

x. Supplemental Waypoint Page. Supplemental waypoints are user-defined waypoints that have not been defined specifically as an airport, VOR, NDB, or Intersection. Supplemental waypoints also include ARTCC center waypoints and reference waypoints discussed later. The following information is displayed on the supplemental waypoint page.

(1) The name of the identifier of the supplemental waypoint.

(2) The position of the supplemental waypoint expressed in terms of a radial and distance from a nearby VOR.

(3) The latitude and longitude of the supplemental waypoint.

The identifier of another nearby waypoint may be entered in the REF field and the page will compute and display the radial and distance from the nearby waypoint to the supplemental waypoint. This radial and distance is not stored with the supplemental waypoint page and is lost when leaving the page.

y. Creating User-Defined Waypoints. Up to 250 user-defined waypoints may be created. These waypoints may be defined as a user defined airport, VOR, NDB, or intersection. If the waypoint doesn't fit into one of these categories, it may be defined as a supplemental waypoint.

(1) Creating A User-Defined Airport Waypoint. A user-defined airport waypoint must contain an identifier, latitude, and longitude. In addition, any combination of airport elevation, one runway length, and associated runway surface (hard or soft), and remarks can also be stored. Communication frequencies cannot be stored on the APT 4 page, airport services cannot be stored on the APT 6 page, SID's and STAR's cannot be stored on the APT 7 page, and approach procedures cannot be stored on the APT 8 page.

1. Use the right outer knob to select the airport waypoint pages.

2. Rotate the right inner knob to select the APT 1 page.

3. Press the right **CRSR** button to turn on the right cursor function. The cursor will appear over the first character of the identifier.

4. Use the right inner and outer knobs to select the identifier of the user waypoint. The identifier can be up to four characters in length. Refer to Figure 3-28.

5. To create a waypoint at the present position, turn the right outer knob clockwise to position the cursor over PRES POS? and press the **ENT** button. The APT 1 page will now be displayed with the latitude and longitude of the waypoint at the bottom of the page.

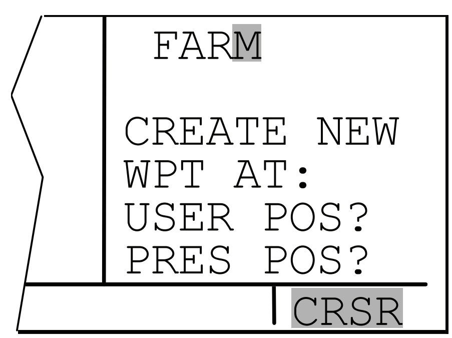


Figure 3-28. User-Defined Waypoint Page

6. To create a waypoint at a specified position, place the cursor over USER POS? and press the **ENT** button. A page with the identifier at the top and dashes at the bottom will not be displayed. Refer to Figure 3-29.

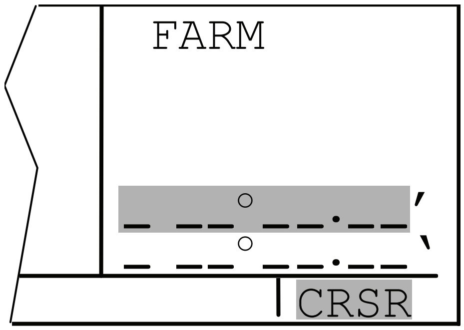


Figure 3-29. User-Defined Airport Waypoint Page

The cursor will be over the dashed latitude field. The latitude and longitude of the waypoint must be entered. Turn the right inner knob to display an N or an S and select the latitude in degrees, minutes, and hundredths of a minute by using the right inner and outer knobs. When the complete latitude has been selected, press the **ENT** button. The cursor will move down to the longitude field. Turn the right inner knob to select E or W. Use the right inner and outer knobs to select the longitude. Press the **ENT** button to approve the waypoint position.

7. Turn the right inner knob one step clockwise to display the APT 2 page as illustrated in Figure 3-30. To enter an airport elevation, press the right **CRSR** button and rotate the right outer knob to position the cursor over the dashes to the right of ELV. Use the right inner and outer knobs to enter the elevation. Press the **ENT** button to store the elevation. Press the right **CRSR** button to turn off the cursor.

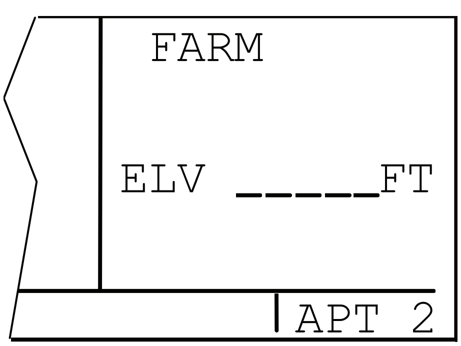


Figure 3-30. APT 2, User-Defined Airport Waypoint Page

8. Turn the right inner knob one step clockwise to display the APT 3 page. Refer to Figure 3-31. To enter a runway length, press the right **CRSR** button and rotate the right outer knob to position the cursor over the five dashes directly beneath RWY LEN. Use the right inner knob to select each individual digit and the right outer knob to position the cursor until the entire runway length is selected. Press the **ENT** button to approve the runway length. The cursor will move to the surface position. Turn the right inner knob to select either HRD or SFT. Press **ENT** to approve the runway surface. Press the right **CRSR** button to turn off the cursor function.

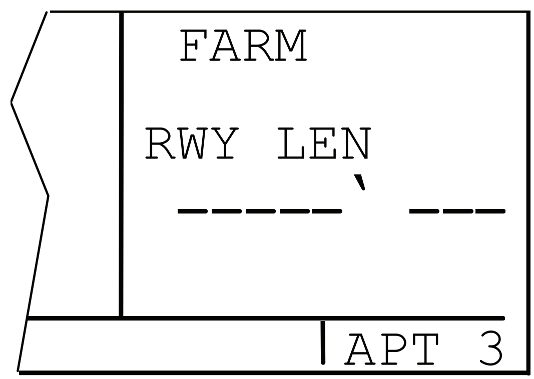


Figure 3-31. APT 3, User Defined Airport Waypoint Page

Airport remarks may be stored on the APT 5 page.

(2) Creating a User-Defined VOR Waypoint. A user-defined VOR waypoint must contain an identifier, magnetic variation, latitude, and longitude. The magnetic variation may be manually entered or, if one is not entered, one will automatically be calculated and stored. A VOR frequency may be stored. The procedure for creating a user-defined VOR waypoint is similar to that just described for creating a user-defined airport waypoint. Begin by selecting the VOR waypoint pages. The VOR identifier can be one to three characters in length. A user-defined VOR waypoint page contains the user identifier at the top of the page and three lines of dashes. The top line of dashes may be filled in with frequency and magnetic variation. The second line is for latitude and the third

line is for longitude. A user-defined VOR is stored as an Undefined (U) class. Refer to Figure 3-32.

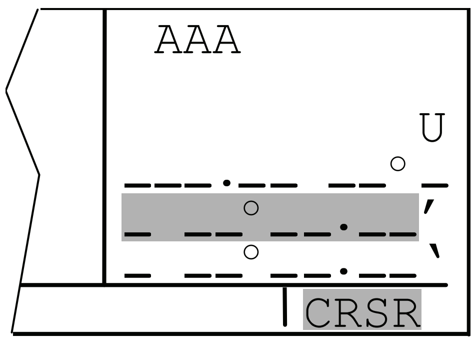


Figure 3-32. User Defined VOR Waypoint Page

(3) Creating A User-Defined NDB Waypoint. A user-defined NDB waypoint must contain an identifier, latitude and longitude. An NDB frequency may be stored. The procedure for creating an NDB user waypoint is similar to that described for creating an airport user waypoint. Begin by selecting the NDB waypoint type pages. The NDB identifier can be one to three characters in length. An NDB user waypoint page contains the user identifier at the top of the page and three lines of dashes. The top line of dashes may be filled in with the NDB frequency. The second line is for latitude and the third line is for longitude. Refer to Figure 3-33.

(4) Creating User-Defined Intersection or Supplemental Waypoints. A user-defined intersection or supplemental waypoint must contain an identifier, latitude, and longitude. The identifier for either can be one to five characters in length. There are two procedures which may be used to define these waypoints. Both procedures begin by selecting the INT or SUP type waypoints, as appropriate.

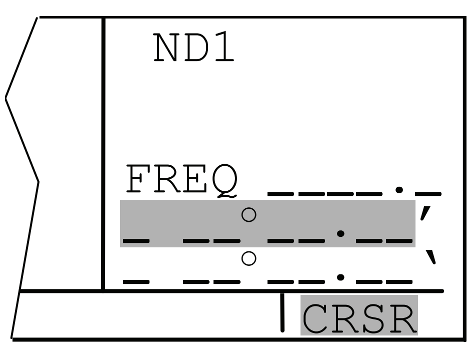


Figure 3-33. User-Defined NDB Waypoint Page

The first method is similar to that described for creating an airport, VOR, or NDB user waypoint. The second method is to define the waypoint's position in terms of a radial and the distance from any other published or previously defined user waypoint.

NOTE

Entering the reference waypoint, radial, and distance is done only to define the waypoint's latitude and longitude position. The reference waypoint, radial, and distance are not stored as part of the user waypoint. As soon as another page is viewed on the right side, these parameters are lost. If a waypoint page for a user-defined intersection or supplemental waypoint is viewed later on, it will display the radial and distance from the VOR nearest the user-defined waypoint. The original reference point may be reentered at any time.

1. Use the right outer knob to select INT or SUP type waypoints, as appropriate.

2. Use the right **CRSR** button and the right inner and outer knobs to select a waypoint identifier.

3. Rotate the right outer knob to position the cursor over USER POS? and press the **ENT** button.

4. Turn the right outer knob counterclockwise to position the cursor over the dashes to the right of REF. Refer to Figure 3-34.

5. Use the right inner and outer knobs to enter the identifier for the reference waypoint.

6. Press the **ENT** button to see the waypoint page for the reference waypoint just entered.

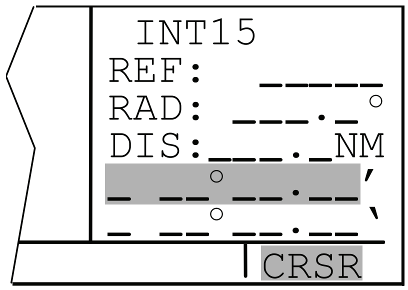


Figure 3-34. Intersection or Supplemental Waypoint Page

7. Press the **ENT** button again to approve this waypoint page. The waypoint page being created will return with the cursor over the dashes to the right of RAD.

8. Use the right inner and outer knobs to select the radial from the reference waypoint. The radial may be selected to the nearest tenth of a degree.

9. Press the **ENT** button. The cursor will move to the dashes to the right of DIS.

10. Use the right inner and outer knobs to select the distance. The distance may be selected to the nearest tenth of a nautical mile.

11. Press the **ENT** button. The latitude and longitude are calculated and displayed as illustrated in Figure 3-34.

z. Flight Plans.

(1) The KLN 90B is capable of storing in its memory 25-flight plans plus an active flight plan.

(2) Each of the flight plans may contain up to 30 waypoints. These waypoints may consist of any combination of published waypoints from the database or user created waypoints.

(3) The flight plans are numbered 0 thru 25.

(4) The active flight plan is always FPL 0. The standard procedure is to create a flight plan in one of the flight plans numbered as 1 through 25. When one of these numbered flight plans is activated, it becomes FPL 0, the active flight plan. If desired, a flight plan may be created directly in the active flight plan. This avoids creating the flight plan in a numbered flight plan and then having to activate it. The disadvantage is, the flight plan is not stored and retained for future use. It can, however, be stored.

(5) Modifications may be made to FPL 0 without affecting the way it is stored as a numbered flight plan.

(6) Unless direct to operation is being used, the active flight plan must contain at least two points.

aa. Creating Flight Plans.

1. Rotate the left outer knob to select the flight plan type pages. Refer to Figure 3-35.

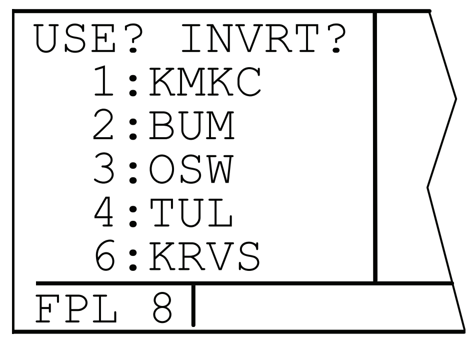


Figure 3-35. Flight Plan Page

2. Turn the left inner knob to select a flight plan page, preferably other than FPL 0, which does not contain a flight plan as depicted in Figure 3-36.

3. Press the left **CRSR** button to turn on the cursor function for the left page.

4. Use the left inner knob to select the first character of the departure waypoint.

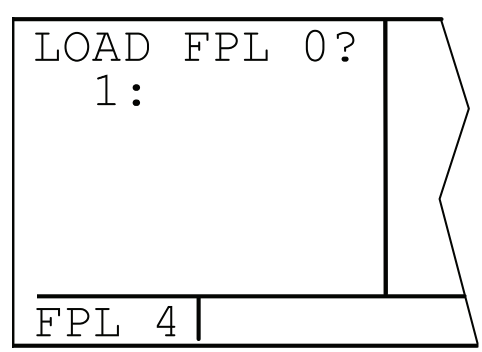


Figure 3-36. Flight Plan Page

NOTE

The KLN 90B flight plan operation is designed so that the first waypoint in the flight plan should always be the departure point. A four-character identifier, if available, must be used.

5. Use the left inner and outer knobs to enter the entire identifier.

6. Press the **ENT** button. A waypoint page for the identifier just entered will be displayed on the right side. Refer to Figure 3-37. If a mistake was made and the wrong identifier was entered, press the clear button and begin again. If the waypoint identifier just entered isn't in the database, a page allowing the creation of a user-defined waypoint will appear on the right.

```
USE? INVRT?  | KNEW
  1:KNEW     |LAKEFRONT
  2:         |
             | CL C
             |N 30°02.53'
             |W 90°01.69'
 CRSR |ENR - LEG  ENT |APT 1
```

Figure 3-37. Flight Plan and Waypoint Page

(1) Press the **ENT** button again to approve the waypoint page being displayed. The cursor will move to the second waypoint position. Refer to Figure 3-38.

NOTE

A small number of waypoints are stored in the database as waypoints that the governing agency has decided it is important to fly directly over instead of using turn anticipation. These waypoints are associated with SID/STAR procedures. In these cases, the KLN 90B will present a waypoint type identification page. Simply select the way in which the waypoint is intended to be used with the left outer knob and press the enter button. If the SID / STAR choice is selected, the KLN 90B will disable turn anticipation for that waypoint, if previously enabled. The KLN 90B will enable turn anticipation after the waypoint has been passed, if turn anticipation was previously enabled. If en route is selected, then normal turn anticipation occurs.

```
SWR          | SWR D
  TYPE WPT   |SQUAW
             |VALLEY    L
1 EN ROUTE?  |113.20 16°E
2 SID?STAR?  |N 39°10.82'
             |W120°16.18'
 CRSR |ENR - LEG  ENT |VOR
```

Figure 3-38. Waypoint Type Identification Page

(2) Use the same procedure to enter the rest of the waypoints in the flight plan. If the flight plan consists of five or more waypoints, the waypoints will automatically scroll as necessary to allow entry of the next waypoint.

(3) When all of the waypoints have been entered in the flight plan, the left outer knob may be rotated to move the cursor up and down and manually scroll through the waypoints making up the flight plan. If the flight plan consists of six or more waypoints, not all of the waypoints can be displayed at one time. When the left outer knob is rotated to the full counterclockwise position, the cursor will be positioned over USE?. If there are more than five waypoints in the flight plan, the first four will be displayed followed by the last waypoint in the flight plan. Rotate the left outer knob to move the cursor and manually scroll through the intermediate waypoints.

(4) Press the left **CRSR** button to turn off the cursor function. Additional flight plans may now be created in the same manner.

ab. Activating A Numbered Flight Plan. To activate a previously created numbered flight plan:

1. Use the left outer knob to select the flight plan type pages.

2. Rotate the left inner knob to select the desired flight plan.

3. Press the left **CRSR** button to enable the left cursor function. The cursor will appear over USE?. If the flight plan has just been created, rotate the left outer knob all the way counterclockwise to position the cursor over USE?.

4. Press the **ENT** button to activate the flight plan in the order shown. To activate the flight plan in inverse order, first waypoint becomes the last and last waypoint becomes the first, rotate the left outer knob one step clockwise to position the cursor over USE? INVRT? before pressing the **ENT** button.

5. The selected flight plan is now displayed as FPL 0, the active flight plan. Any changes made to FPL 0 will not affect how this flight plan is stored as the numbered flight plan.

ac. Adding A Waypoint To A Flight Plan. A waypoint may be added to any flight plan containing fewer than 30 waypoints.

1. Press the left **CRSR** button to enable the cursor function.

2. Rotate the left outer knob as necessary to position the cursor over the location in the flight plan where the new waypoint is to be added.

3. Use the left inner and outer knobs in the normal manner to enter the waypoint identifier being inserted. The existing waypoint in this position automatically jumps down to the next position.

4. Press the **ENT** button to display the waypoint page on the right side for the identifier just entered.

5. Press the **ENT** button again to approve the waypoint page.

6. Press the left **CRSR** button to turn off the left cursor function.

ad. Deleting A Waypoint From A Flight Plan.

1. Press the left **CRSR** button to enable the left cursor function.

2. Rotate the left outer knob to position the cursor over the waypoint to be deleted.

3. Press the **CLR** button. The letters DEL will appear to the left of the identifier and a question mark will appear to the right of the identifier. If a mistake was made, press the **CLR** button again. Refer to Figure 3-39.

4. Press the **ENT** button and the waypoint will be deleted from the flight plan. The other waypoints in the flight plan will be repositioned.

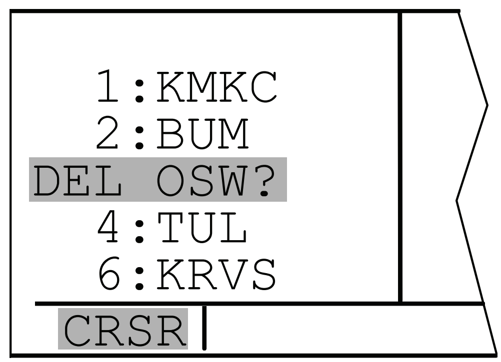


Figure 3-39. Deleting a Waypoint

ae. Deleting Flight Plans.

1. Display the flight plan that is to be deleted.

2. Make sure the left cursor function is off.

3. Press the **CLR** button. The words DELETE FPL? will appear at the top of the page, refer to Figure 3-40. If a mistake was made, press the **CLR** button.

4. Press the **ENT** button to clear the flight plan.

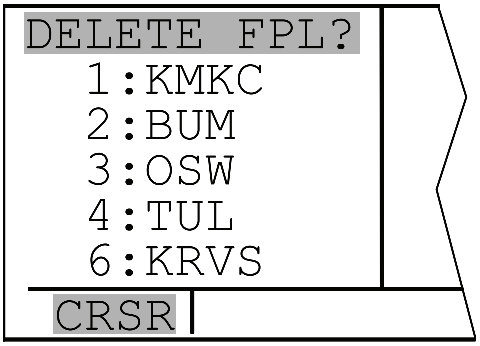


Figure 3-40. Deleting a Flight Plan

af. Storing FPL 0 As A Numbered Flight Plan. The active flight plan may be loaded into a numbered flight plan so that it can be recalled for later use.

1. Select a numbered flight plan page that does not contain any waypoints. If none exist, use the procedure for deleting flight plans to clear a flight plan that is no longer required.

2. Press the left **CRSR** button to turn on the left cursor function. The cursor will come on over the first blank waypoint position.

3. Rotate the left outer knob one step counterclockwise to position the cursor over LOAD FPL 0. Refer to Figure 3-41.

4. Press the **ENT** button to load the active flight plan into this numbered flight plan.

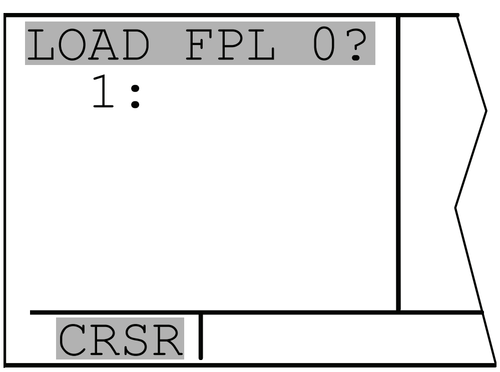


Figure 3-41. Storing 0 As A Numbered Flight Plan

ag. Operating From The Active Flight Plan. The following rules and considerations apply for flight plan operation while the KLN 90B is in the Leg mode.

(1) Although any of the pages may be utilized while operating along a flight plan, common selections are the FPL 0 page on the left side while simultaneously displaying one of the three Distance/Time pages or the NAV 5 page on the right side. The Super NAV 5 page is especially useful for flight plan operation. It provides a visual orientation of the aircraft position in the active flight plan. The other four NAV pages may also be used extensively.

(2) Always verify that the FPL 0 page is in view.

(3) The active leg of the flight plan is designated with a ↳ symbol. Refer to Figure 3-42. A leg is defined as the course line between a pair of points. The head of the arrow is positioned to the left of, and points to, the active TO waypoint. The tail of the symbol points to the FROM waypoint. The symbol is not displayed unless the KLN 90B is receiving signals suitable for navigation. Also, the symbol will not be displayed if DIRECT TO navigation is occurring. The top of the NAV 1 page will also indicate if point to point navigation or DIRECT TO navigation is occurring. To cancel the DIRECT TO operation and operate from the active flight plan; press the -D▶ button, then the **CLR** button and the **ENT** button.

(4) As the flight plan waypoints are reached, the active leg symbol automatically orients itself on the next leg.

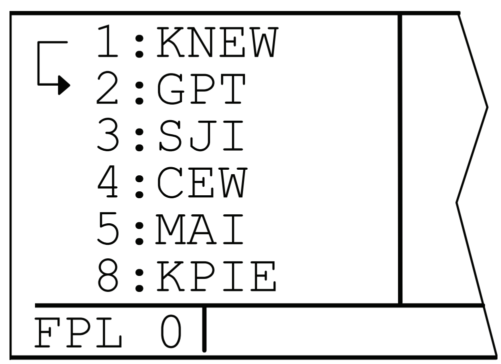


Figure 3-42. Storing a Flight Plan

(5) If the flight plan contains more waypoints than can be displayed on the screen at one time, the page will automatically scroll as progress is made along the flight plan so that the active leg is always displayed.

(6) The last waypoint in the flight plan is always displayed at the bottom of the FPL 0 page, even if all of the waypoints in the flight plan can't be

displayed on the page at one time. To view intermediate waypoints, turn the left cursor function on and use the left outer knob to manually scroll through all the waypoints. If scrolling is performed all the way to the end of the flight plan, a blank waypoint position will exist so that a waypoint may be added to the end of the flight plan.

ah. Turn Anticipation And Waypoint Alerting. Prior to reaching a waypoint in the active flight plan, the KLN 90B will provide navigation along a curved path segment to ensure a smooth transition between two adjacent legs in the flight plan. Refer to Figure 3-43. This feature is called turn anticipation. The transition course is based upon the aircraft's actual groundspeed and the amount of course angle change between the two legs. The KLN 90B automatically sequences to the next leg after passing the midpoint in the transition segment.

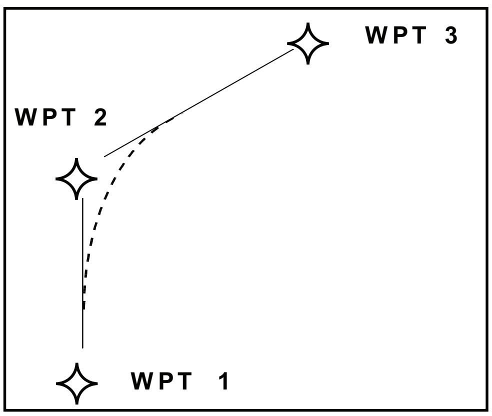


Figure 3-43. Turn Anticipation

Approximately 20 seconds prior to the beginning of turn anticipation, the arrow preceding the active waypoint identifier will begin flashing on the FPL 0 page and on any Navigation page, Distance/Time page, or Waypoint page displaying the active waypoint identifier. On the Super NAV 5 page, the entire waypoint identifier will start to flash. The external waypoint alert annunciator will begin flashing at the same time. This is called waypoint alerting.

To utilize the turn anticipation feature, start the turn transitioning to the next leg in the flight plan at the very beginning of turn anticipation. This occurs when the external waypoint alert annunciator or the active waypoint identifier on the Super NAV 5 page stops flashing and goes on steady. At this time, the KLN 90B will generate a message on the message page for the new desired track to select on the HSI: ADJ NAV IND CRS TO 123°. A message will not be given if the change in desired track is less than 5° or the KLN 90B is interfaced with an HSI having a course pointer that is automatically slewed to the correct desired track.

The desired track displayed on the NAV 3 page also changes to the value of the next leg at the beginning of turn anticipation. Turn anticipation becomes inactive when transition to the next leg has been made.

The KLN 90B can read the selected course set on the external HSI. The KLN 90B will flash the value of the desired track on both the NAV 3 and the Super NAV 5 pages when the desired track and the selected course differ by more than 10°. Set the selected course to match the desired track. This will ensure that the orientation is always pictorially correct.

If desired, turn anticipation may be disabled, or enabled, on the SET 6 page.

ai. Viewing The Waypoint Pages For The Active Flight Plan Waypoints. The waypoint pages for each of the waypoints in the active flight plan may be displayed by selecting the Active Waypoint page with the right outer knob. Refer to Figure 3-44. When the ACT page is first selected, the waypoint page for the active waypoint will be displayed. The sequence number of the waypoint in the flight plan is annunciated with a number to the left of the identifier. An arrow to the left of the waypoint number designates the active waypoint. The letter to the far right of the identifier designates the type of waypoint: A – airport, V – VOR, N – NDB, I – intersection, S – supplemental, or T – terminal. For VOR's having DME capability, the letter D is displayed between the VOR identifier and the V.

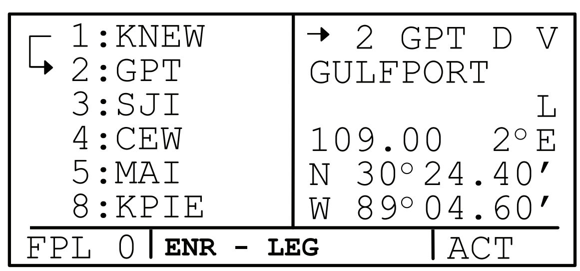


Figure 3-44. The Active Waypoint Page

To view the other waypoints in the flight plan, pull the right inner knob to the “out” position and turn it to view each of the waypoints in the order they are in the active flight plan. For airport waypoints, the right inner knob may be pushed back to the “in” position and rotated to display any of the eight airport pages.

Pulling the knob back out will allow further scanning of the waypoint pages in the active flight plan.

aj. Direct To Operation On The Active Flight Plan. When DIRECT TO operation to a waypoint on the active flight plan is selected, the system will provide navigation to the waypoint and then automatically resume navigation along the flight plan when the DIRECT TO waypoint is reached. Waypoints that exist prior to the DIRECT TO waypoint in the active flight plan are bypassed. Navigation on the active flight plan will not be resumed if the DIRECT TO operation is to a waypoint that is not in the active flight plan.

Any of the methods previously described for initiating DIRECT TO operation may be used. The following procedure is the easiest for this application.

1. Select the FPL 0 page on the left side.
2. Press the left **CRSR** button and then use the left outer knob to position the cursor over the desired waypoint. Refer to Figure 3-45.
3. Press the -D► button. The waypoint page for the selected waypoint will be displayed on the right side. Refer to Figure 3-46.
4. Press the **ENT** button to approve the waypoint page. The DIRECT TO waypoint identifier in the active flight plan will now be preceded by an arrow, Figure 3-47. The ↳ symbol is not displayed since there is no FROM waypoint.

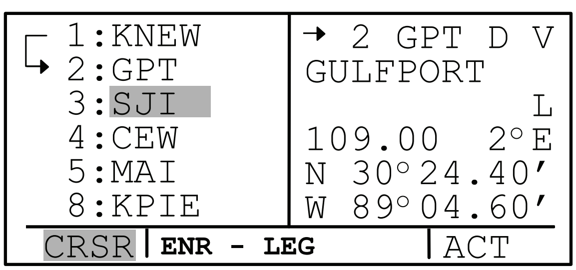


Figure 3-45. Select the DIRECT–TO Waypoint

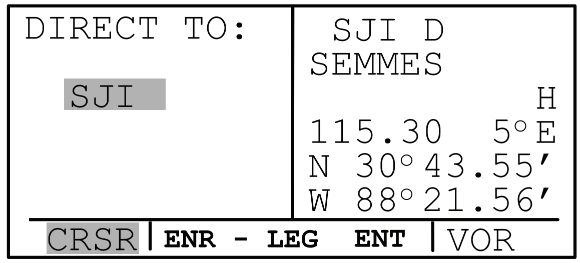


Figure 3-46. DIRECT–TO Waypoint

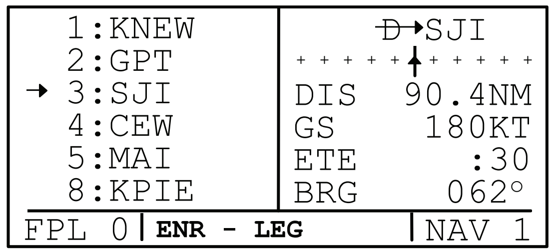


Figure 3-47. DIRECT–TO Navigation

An alternative method is to use the Super NAV 5 page to select the direct to waypoint. Pull out on the right inner knob. With the inner knob out, it is possible to scan through the waypoints of the active flight plan. When the desired waypoint is highlighted, press the -D► button and then the **ENT** button.

To cancel DIRECT TO operation prior to reaching the DIRECT TO waypoint in order to proceed along the flight plan leg, press the -D► button, then press the **CLR** button and then press the **ENT** button.

ak. Distance/Time Pages. The distance/time pages are designed to be used with the active flight plan.

(1) Distance/Time 1 Page. When the FPL 0 page is displayed on the left side and the D/T 1 page is displayed on the right side, the distance and estimated time en route are displayed for each of the active flight plan waypoints. The distance displayed is the cumulative distance from the aircraft's present position to each waypoint along the flight plan route. The ETE is displayed in hours and minutes. Refer to Figure 3-48. If DIRECT TO operation is occurring to a waypoint that is not in the active flight plan, the D/T 1 page is blank when the FPL 0 page is displayed on the left.

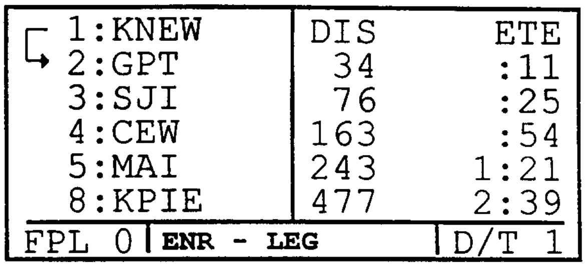


Figure 3-48. Distance/Time 1 Page

If a numbered flight plan page is displayed on the left side, the distances displayed are from the first waypoint in the flight plan and have nothing to do with the aircraft's position. No ETE's are shown.

If a non-flight plan page is displayed on the left side, the format of the D/T 1 page changes to display just the distance and ETE for the active waypoint and for the last waypoint in the flight plan. Refer to Figure 3-49.

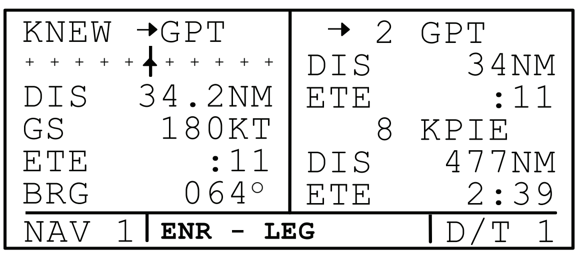


Figure 3-49. Non–Flight Plan, Distance/Time 1 Page

(2) Distance/Time 2 Page. When FPL 0 is displayed on the left side and the D/T 2 page is displayed on the right side, the distance and estimated time of arrival are displayed for each of the active flight plan waypoints. Refer to Figure 3-50. The distances are as described for the D/T 1 page. The time zone may be changed by enabling the right cursor function to bring the cursor over the time zone, and then turning the right inner knob to select the desired time zone. Changing the time zone on the D/T 2 page changes the time zone on other pages where time is displayed.

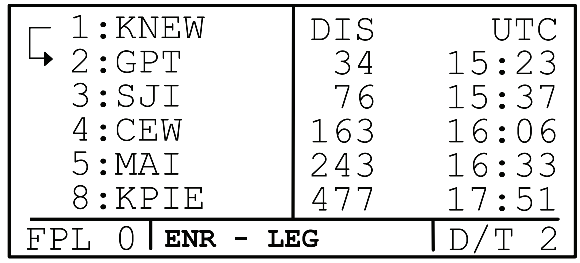


Figure 3-50. Distance/Time 2 Page

If a numbered flight plan page other than FPL 0 is displayed on the left side, no estimated times of arrival are displayed.

If a non-flight plan page is displayed on the left side, the format of the D/T 2 page changes to display just the distance and the estimated time of arrival for the active waypoint and for the last waypoint in the flight plan.

(3) Distance/Time 3 Page. When any flight plan page is displayed on the left side and the D/T 3 page is displayed on the right side, the distance and desired track are displayed. The distances are as described for the D/T 1 page. The desired track is the great circle course between two waypoints. Refer to Figure 3-51.

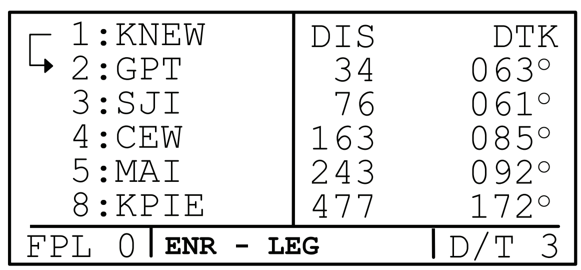


Figure 3-51. Distance/Time 3 Page

If a non-flight plan page is displayed on the left side, the format of the D/T 3 page changes to display just the distance and desired track for the active waypoint and for the next waypoint in the flight plan. Note that this is different from the D/T 1 and D/T 2 pages.

(4) Distance/Time 4 Page. The format for the D/T 4 page does not change. Refer to Figure 3-52. It displays on a single page the pertinent times for the flight regardless of what is displayed on the left side and regardless of whether flight plan or direct to operation is occurring. The following information is displayed on the D/T 4 page.

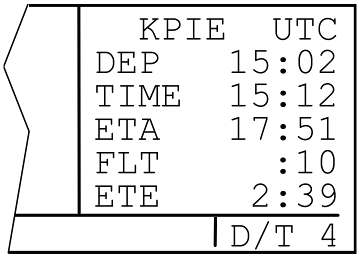


Figure 3-52. Distance/Time 4 Page

(a) Destination waypoint.

(b) Selected Time Zone. The time zone may be changed by pressing the right **CRSR** button and using the right inner knob to select the desired time zone.

(c) Departure Time. There are two definitions of departure time depending on what has been selected on the SET 4 page. If the SET 4 page displays, RUN WHEN GS > 30 knots, the departure time is that time when the groundspeed first reached 30 knots. If instead, the SET 4 page displays, RUN WHEN POWER IS ON, the departure time is the time when power was applied to the KLN 90B.

(d) The present time.

(e) The estimated time of arrival at the destination waypoint.

(f) Flight Time. If RUN WHEN GS > 30 knots is selected on the SET 4 page, flight time is the amount of time that the aircraft's groundspeed has been above 30 knots. Normally, this will be the time since takeoff. However, time spent at groundspeeds less than 30 knots, such as intermediate stops without shutting down power, is not counted as flight time. If RUN WHEN POWER IS ON is selected on the SET 4 page, flight time is the time since power on.

(g) Estimated time en route to the destination.

al. Modes Of Operation. The course to the active waypoint is defined by selecting between two course modes, LEG and OBS. The LEG mode means the course to the active waypoint is selected by the KLN 90B. It is the default mode when power is applied to the KLN 90B. The OBS course mode is the mode that allows the pilot to define the course to the active waypoint.

The KLN 90B also has three modes that are associated with approach operation: En Route, Approach Arm, and Approach Active.

The status of the course modes and the approach modes are annunciated in the lower center segment of the screen. The exceptions to this are on the turn on page where the mode is not annunciated and on the Super NAV 5 page where the mode is annunciated on the left side of the screen. The abbreviations used for mode annunciation are detailed in Table 3-14.

Table 3-14. Course Modes

DISPLAY	EXPLANATION
APR – LEG	Approach Active – Leg
ARM – LEG	Approach Arm – LEG
ARM : 259	Approach Arm – OBS
ENR – LEG	En route – Leg
ENR: 274	En route – OBS

The approach active – OBS mode is not a valid mode and cannot be selected. For the OBS modes, the number included in the annunciation is the magnetic course selected by the pilot.

(1) Selecting The Mode. The mode cannot be selected with the MOD pages because the external course mode selector/annunciator is used.

(a) Locate the external course mode selector/annunciator.

(b) Press the switch and it will change the modes and annunciate the mode selected.

(2) Leg Mode. The characteristics of the leg mode are as follows.

(a) The default Course Deviation Indicator (CDI) sensitivity is ± 5 nm, full scale. This applies to the CDI on the NAV 1 page as well as the external HSI. If the HSI has five dots left and right of the center position, each dot represents one nautical mile of deviation.

NOTE

In some installations where the KLN 90B is interfaced to certain models of EFIS equipment, the scale factor will be plus or minus 7.5 nm, full scale.

(b) Navigation is provided along the great circle path between two waypoints. Great circle navigation is the shortest distance between two points located on the earth's surface. In case of DIRECT TO operation, the FROM waypoint is not displayed but it is the point where DIRECT TO operation was initiated.

The course to fly while in this mode is referred to as the DTK. The desired track is displayed on the NAV 3 and D/T 3 pages. The Super NAV 5 page can also be configured to display the desired track. To fly a great circle course between two points, the desired course may be constantly changing.

(c) Automatic waypoint sequencing is provided during flight plan operation. As a waypoint is reached, the next leg of the flight plan automatically becomes active.

(d) Turn anticipation may be utilized in flight plan operation.

(e) The minimum En route Safe Altitude (ESA) displayed on the NAV 3 page is the highest MSA sector altitude from the present position to the destination waypoint along the active flight plan or direct to route, whichever is in use.

(3) OBS Mode.

(a) The default CDI sensitivity is ± 5 nm, full scale. This applies to the CDI on the NAV 1 page as well as the external HSI. If the HSI has five dots left and right of the center position, each dot represents one nautical mile of deviation.

NOTE

In some installations where the KLN 90B is interfaced to certain models of EFIS equipment, the scale factor will be ± 7.5 nm, full scale.

(b) The course is defined by the active waypoint and the selected magnetic course. A course to or from the waypoint may be selected.

(c) The course selection is normally made by changing the selected course displayed on an external indicator such as an HSI or EFIS. When this is done, the pilot must verify that the proper course has been selected by confirming the digital selected course readout displayed on the KLN 90B. In the OBS mode, the selected course is always displayed as part of the mode annunciation at the bottom center of the screen on all pages except the Super NAV 5 page. Refer to Figure 3-53. On the Super NAV 5 page, the mode/annunciation is displayed on the left side of the screen. Two or more navigation sources can be selected as the primary navigation source displayed on the HSI or EFIS. The primary navaid selector switch on the pilot's side of the instrument panel is used to determine the navigation source displayed. For the KLN 90B to properly read the external indicator, the KLN 90B must be the displayed navigation source on the external indicator.

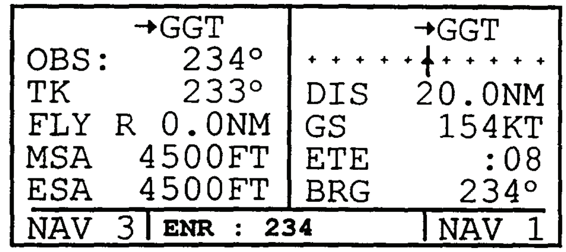


Figure 3-53. OBS Mode Indications

When the KLN 90B is not the displayed navigation source on the external indicator or if the KLN 90B is interfaced with an EFIS system, it is possible to change the selected course from several pages on the KLN 90B. This can be done from the NAV 3 page, the MOD 2 page, and the Super NAV 5 page if it is configured to display the track on the left-hand side.

NOTE

To tell if it is possible to enter the OBS value, note the OBS field. If a colon follows the letters OBS, it is possible to enter a value. If the colon is missing, the course must be changed from the external indicator.

If the KLN 90B is interfaced to EFIS or an electrically driven mechanical indicator, the external indicator will be slewed to agree with what was entered on the KLN 90B.

1. Select the NAV 3, MOD 2, or Super NAV 5 page.
2. Press the appropriate **CRSR** button to turn on the cursor function. If the course is being changed from the Super NAV 5 page, use the left outer knob to rotate the cursor over the OBS field.
3. Turn the appropriate inner knob to select the course.
4. Press the **CRSR** button to turn off the cursor function.

(d) There is no automatic leg sequencing or turn anticipation.

(e) The minimum ESA displayed on the NAV 3 page is the highest MSA sector altitude from the present position to the active waypoint. Other

waypoints in the active flight plan do not affect the ESA.

(f) When the active waypoint is a VOR or approach waypoint, the published magnetic variation for the VOR or approach waypoint is utilized rather than the calculated magnetic variation.

(4) Switching From The LEG Mode To The OBS Mode. The following mode transition occurs if the KLN 90B is in the LEG mode and the mode is changed to OBS.

(a) The waypoint that was active in LEG mode prior to the mode change remains the active waypoint in OBS mode.

(b) The selected course is defined by two different methods depending on the installation and status of the unit.

1 If the KLN 90B is the displayed navigation source when the change is made to the OBS mode, the selected course becomes whatever was set on the external indicator prior to changing to the OBS mode. This value should normally be the desired track to the active waypoint that was already set on the external indicator if it was set pictorially correct.

2 If the KLN 90B is interfaced with a compatible EFIS, electrically driven mechanical HSI, or is not displayed on the external indicator, the selected course is chosen by the KLN 90B such that the deviation from the selected course remains the same.

(c) If the OBS value chosen by default is unacceptable, the pilot may choose the OBS value as described in Paragraph 3-7al(3).

(5) Switching From The OBS Mode To The LEG Mode. The following mode transition occurs if the KLN 90B is in the OBS mode and is switched to the LEG mode.

(a) The active waypoint, while in the OBS mode, remains the active waypoint when the LEG mode is activated. The system does not attempt to orient itself on a leg of the active flight plan unless the TO / FROM indicator is indicating FROM. In this case, the KLN 90B will reorient on the active flight plan.

(b) The active selected course in the OBS mode prior to switching to a LEG mode becomes the desired track in the LEG mode, unless the switch was made on the FROM side, in which case the KLN 90B will calculate the correct desired track for the new leg.

(c) With the exception of (b) above, the characteristics of normal DIRECT TO operation apply.

(6) Going Direct To A Waypoint While In The OBS Mode. The DIRECT TO function will select the OBS value that will take the aircraft from the present position direct to the active waypoint when the KLN 90B is interfaced to a compatible EFIS, an electrically driven mechanical HSI, or when the KLN 90B is not the displayed navigation source on the external indicator.

If the KLN 90B is the displayed navigation source on a non-driven HSI, it is not possible for the KLN 90B to change the OBS value. In these situations, the KLN 90B will provide a scratchpad message that will announce the OBS value that should be selected to go direct to the active waypoint. Refer to Figure 3-54.

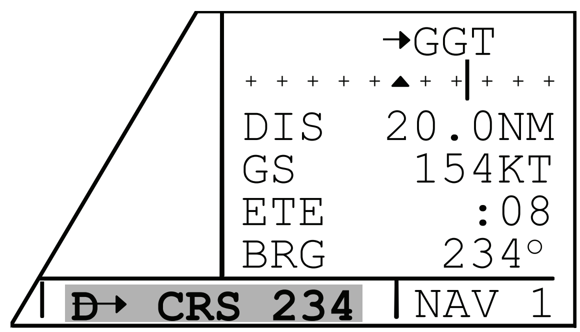


Figure 3-54. OBS DIRECT TO Course

(7) Activating A Waypoint While In The OBS Mode. While in the OBS mode, a waypoint may be activated by using the normal DIRECT TO method or by a second method. This second method activates another waypoint without changing the selected course. When the new waypoint is activated, the deviation bar is not centered.

1. Press the D→ button. The rules for the priority of waypoint selected for direct to operation apply.

2. Press the D→ button a second time. The annunciation DIRECT TO changes to ACTIVATE. The right side still displays the appropriate waypoint page. Repeated presses of the D→ button alternate between DIRECT TO and ACTIVATE. Ensure ACTIVATE is displayed. Refer to Figure 3-55.

3. Press the **ENT** button to approve the waypoint page and activate the waypoint. The selected course does not change; therefore, this method does not re-center the deviation bar like a DIRECT TO operation.

```
ACTIVATE:   |  FINAL
            | REF:  BTV
  FINAL     | RAD: 292.8°
            | DIS: 11.7NM
            | N 44°25.40'
            | W 73°27.20'
CRSR | ENR : 090  ENT | INT
```

Figure 3-55. Activating a Waypoint

(8) Changing The CDI Scale Factor. The CDI scale factor can be changed by using either the MOD 1 or MOD 2 pages. In normal operation, it is possible to select a CDI scale factor which is ± 5 nm, 1 nm, or 0.3 nm full-scale defection.

NOTE

The KLN 90B will automatically select a scale factor while in one of the approach modes. When the KLN 90B selects a CDI scale factor, it is not possible to select a scale factor that is less sensitive.

1. Select either the MOD 1 or MOD 2 page.

2. Press the left **CRSR** button. If necessary, use the left outer knob to move the cursor over the value of the CDI scale.

3. Rotate the left inner knob to select the desired scale factor.

4. Turn the left cursor function off.

am. Non-Precision Approach Operations. The message/waypoint annunciator is the primary navaid selector to select which navigation source is displayed on the pilot's HSI, the course mode selector/annunciator, to select the LEG or OBS modes, and the approach mode selector/annunciator, to arm and annunciate the approach modes, must be operational.

CAUTION

The KLN 90B obtains approach information from the database. It is extremely important that the database is current. The KLN 90B is approved for IFR non-precision approaches only when the database is current. If an approach is selected when the database is out of date, a status line message, OUTDATED DATABASE, will display in the bottom center of the screen.

The Super NAV 5 page has been specifically designed to provide most of the functions needed for non–precision approaches. This page provides an interface that presents pertinent navigation information, a way to access the flight plan, and a graphic presentation of the present position relative to the flight plan waypoints.

NOTE

There are some approach procedures that are not suited for the operational characteristics of the KLN 90B. These procedures are not included in the database. Ensure that the KLN 90B contains anticipated procedures for the flight.

In addition to the LEG and OBS course modes, there are also two approach modes. These are approach arm and approach active. The status of the approach mode is indicated both on the external switch/annunciator and on the status line of the KLN 90B. The external annunciator will indicate ARM for the approach arm mode and approach active will be annunciated by ACTV. The main difference between these modes from the normal en route mode is that the integrity monitoring is set to a tighter level. Another difference between these modes and the en route modes is that the CDI scale factor will usually change to ± 1.0 nm for ARM and will always change to ± 0.3 nm when in the APR ACTV mode.

The ARM mode can be selected in two ways. The normal way is that this mode will be selected automatically by the KLN 90B when the aircraft is within 30 nm of the destination airport and an approach for that airport has been loaded in the flight plan. It is possible to arm the approach mode at a distance greater than 30 nm from the airport by pressing the **GPS APR** switch, but the KLN 90B will not change the CDI scale factor until the aircraft reaches the 30-nm point. If the **GPS APR** external switch is pressed while the approach mode is armed, the KLN 90B will disarm the approach and change back to en route mode. The CDI scale factor will also change back to ± 5.0 nm. The approach can be rearmed by simply pressing the **GPS APR** switch again.

The APR ACTV mode can only be engaged automatically by the KLN 90B. To cancel the APR ACTV mode, press the external **GPS APR** switch. This 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.

an. General Procedures For Non-Precision Approaches. Non-precision approaches will all have the same general flow. Refer to Figure 3-56.

(1) Select And Load The Approach Into The Flight Plan. This can be done at almost any time, but must be completed before reaching the final approach fix and should be done as soon as possible (position A). If the aircraft is greater than 30 nm from the airport, the CDI scale factor will remain at the default ± 5.0 nm full scale deflection.

(2) Transition To The Approach Arm Mode. This will occur automatically when the aircraft is within 30 nm of the airport and there is an approach loaded into the flight plan (position B). The CDI scale factor will change to ± 1.0 nm over the next 30 seconds and the external annunciator will indicate ARM.

(3) Getting Established On The Final Approach Course.

1. No PT arrival route.

2. Radar vectors (requires OBS mode).

3. Procedure turn or holding pattern (requires OBS mode).

4. DME arc.

(4) Transition To The Approach Active Mode. This mode change is automatic and occurs at position C when:

1. The aircraft is 2 nm from the FAF and the approach mode is armed.

2. The LEG mode is selected.

3. The aircraft is heading towards the FAF.

4. The FAF or a co-located IAF/FAF is the active waypoint.

5. The KLN 90B confirms that adequate integrity monitoring is available to complete the approach.

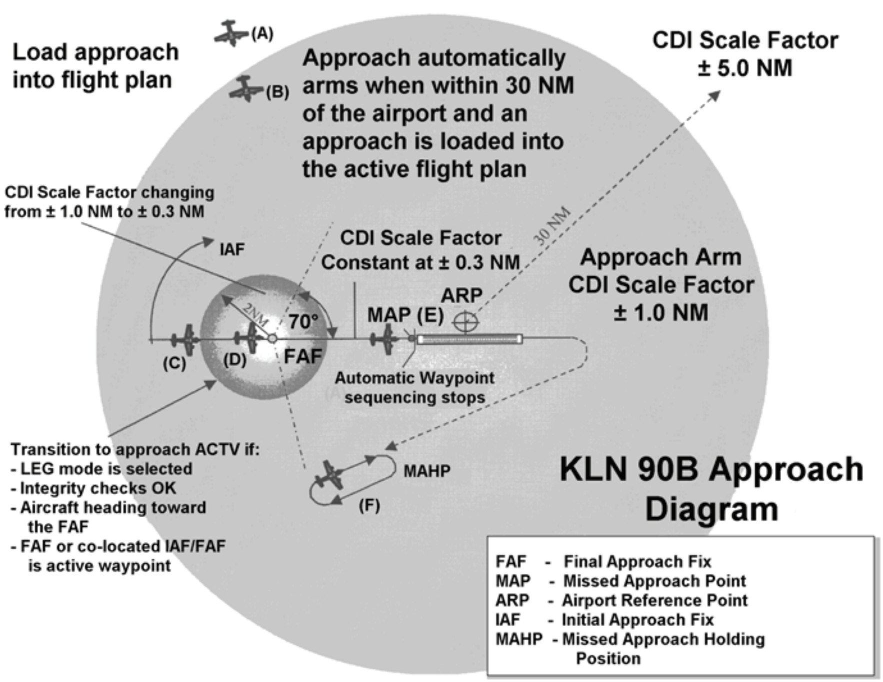


Figure 3-56. Approach Sequence

If any of these conditions are not met, the KLN 90B will not transition to the approach active mode and a missed approach will be required if the conditions do not change before reaching the FAF. If all of these conditions are met, the CDI scale factor will start to change to ± 0.3 nm and the external annunciator will indicate ACTV.

(5) At the FAF (position D), the CDI scale factor will be at ± 0.3 nm and will remain at this scale factor until the approach mode is canceled by pressing the external **GPS APR** button to change to the ARM mode, by initiating a direct to operation, or by changing to the OBS mode.

WARNING

It is not approved to conduct the final portion of the approach unless the KLN 90B is in the approach active mode.

(6) Fly to the missed approach point (position E). The KLN 90B will not automatically sequence to the next waypoint, it must be manually selected. By default, the KLN 90B will nominate the first waypoint of the published missed approach procedure when the **D→** button is pressed and the active waypoint is the MAP.

(7) If necessary, conduct the missed approach procedure. Always refer to the approach chart when conducting a missed approach. The KLN 90B does not include headings and altitude restrictions common to missed approach procedures. The OBS mode is usually needed at some point during a missed approach and is always required to fly a holding pattern (position F).

ao. Selecting An Approach. Approaches are selected from the APT 8 or ACT 8 page for the destination airport.

NOTE

Approaches can only be entered in FPL 0, the active flight plan. If the KLN 90B is turned off for more than 5 minutes, the approach is deleted when power is turned back on.

1. Turn to the APT or ACT pages and select the destination airport using the right cursor inner and outer knobs.
2. Use the right inner knob to turn to the APT or ACT 8 page. The APT 8 page can be reached by turning the right inner knob one step counterclockwise from the APT 1 page.
3. Turn the right cursor on. The right cursor comes up on the first approach in the list of approaches. Use the right outer knob to move the cursor to the different approaches. Refer to Figure 3-57. If there are more than five approaches to an airport, move the cursor down to scroll the other procedures into view by rotating the right inner knob clockwise.

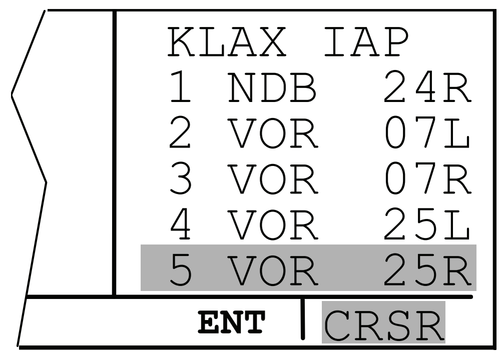


Figure 3-57. Selecting the Approach

4. With the cursor over the desired approach, press the **ENT** button.
5. The KLN 90B will present a list of Initial Approach Fixes (IAF) corresponding to this approach. Select the appropriate IAF by placing the cursor over the IAF and pressing the **ENT** button. Refer to Figure 3–58.

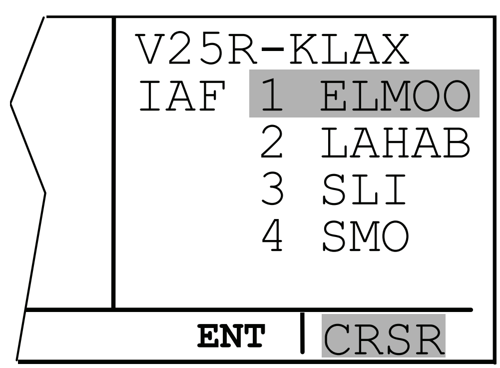


Figure 3-58. Selecting the Initial Approach Fix

6. The KLN 90B next presents a list of waypoints that make up the approach. Refer to Figure 3-59. Review the

waypoints to ensure the correct IAF has been selected. If there are more than four waypoints in the approach, move the cursor up with the right outer knob to scroll the other waypoints into view.

NOTE

If there is only one IAF for a procedure, the KLN 90B will skip this screen.

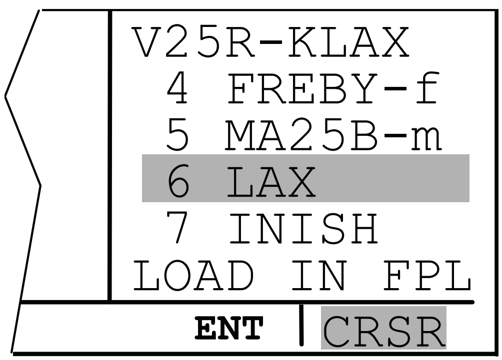


Figure 3-59. Approach Waypoints

7. If the cursor is over LOAD IN FPL and the **ENT** button is pressed, the KLN 90B checks to see if this airport is in the active flight plan. Refer to Figure 3-60. If it is not, the KLN 90B will ask if the approach and airport are to be added to the active flight plan.

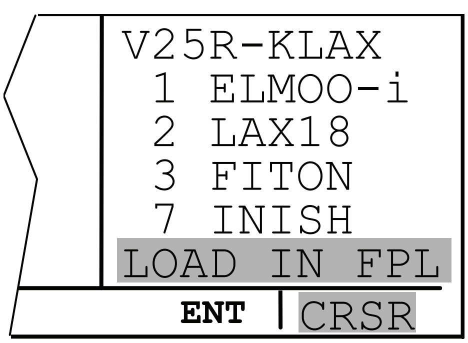


Figure 3-60. Loading the Approach

8. The KLN 90B will then bring up the FPL 0 page and put the sequence of approach waypoints in front of the airport reference point.

NOTE

At any time during the process of selecting an approach, return to the previous step by pressing the CLR button.

At the top of the list of approach waypoints is a header that describes the approach that follows. The form of this header is ABBBB-CCCC. A is the first letter of the type of approach (e.g., V for VOR). BBBB will be filled in with the runway that the approach is to. Finally, CCCC corresponds to the identifier of the airport that the approach is to. For example, V25R-KLAX means the VOR 25R approach to KLAX.

After the approach has been entered into the flight plan, the KLN 90B checks to make sure that the resulting flight plan makes sense. If the KLN 90B detects any waypoints that are in both the en route portion of the flight plan and the portion that makes up the approach, the message, REDUNDANT WPTS IN FPL - EDIT EN ROUTE WPTS AS NECESSARY, is displayed.

Check the flight plan and delete those en route waypoints that are not necessary.

ap. Naming Conventions Of Terminal Waypoints. Note waypoint five in the VOR 25R to KLAX. Refer to Figure 3-61. This is the missed approach point for runway 25. This approach applies to both left and right runways, so the letter B is used to mean both. Refer to Table 3-15 for naming conventions.

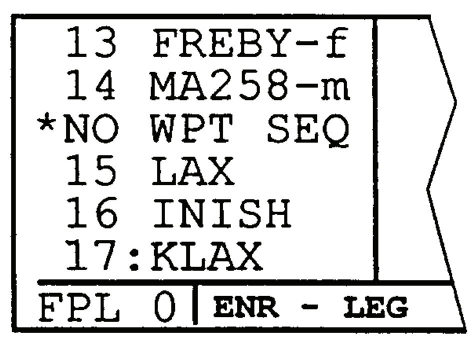


Figure 3-61. No WPT Sequencing

Table 3-15. Approach Waypoint Naming Conventions

DISPLAY	EXPLANATION
Cxyyy	C stands for course fix
Daaab	D stands for DME arc waypoint. Aaa is the radial that the fix is on from the reference VOR. B will be a letter corresponding to the distance from the reference VOR. For example, G is the seventh letter of the alphabet so D234G would be a point on the 234° radial 7 nm from the reference VOR. DME arcs greater than 26 nm will have waypoints where the first two characters are the first two letters of the DME identifier. The next three characters will be the radial that the arc waypoint is on.
Fxyyy	F stands for final approach fix
Ixyyy	I stands for intermediate approach fix
Mxyyy	M stands for missed approach fix
RWzzz	RW stands for runway fix. This is usually the MAP for the approach. Zzz will be a runway number, possibly including L for left, R for right, C for center, or B for both.

In the rules above, x and yyy are defined as follows: for runways with only one approach, x will be replaced with an A or an F; and for runways that have multiple approaches, x will be replaced with V for VOR, N for NDB, or R for RNAV. The letters yyy will be replaced with either the runway identifier (e.g. FF25L) or, for circling approaches, the inbound course to the missed approach point (e.g. MA259).

Waypoints along a given radial will be named such that the first three letters are the reference VOR/DME and the next two are the DME distance. If the distance is greater than 100 nm, the order is reversed. For example, LAX18 is 18 nm from LAX while 26FLW is 126 nm from FLW.

Some waypoints have a dash and a small letter at the end of the waypoint name. The small letter is an aid to help recognize important points in an approach. These suffixes are displayed on the FPL 0 page, the Super NAV 5 page, and the Super NAV 1 page. The suffixes are shown in Table 3-16.

Table 3-16. Approach Waypoint Suffixes

SUFFIX	EXPLANATION
f	final approach fix
i	initial approach fix
m	missed approach point
h	missed approach holding point

Every approach will have an FAF and a MAP. Almost all will have an IAF and a missed approach holding point.

Another item in the flight plan is the line *NO WPT SEQ. This is what is referred to as a fence and is an alert that the KLN 90B will not automatically sequence past the waypoint that precedes the fence. The waypoint before the fence is always the missed approach point. The reason that waypoint sequencing is not allowed is that many missed approach procedures require specific action before going to the missed approach holding point, e.g., climbing on a fixed heading until reaching an altitude.

aq. Changing Or Deleting An Approach Once Loaded Into The Flight Plan. The sequence of waypoints retrieved from the database of the KLN 90B defines the approach procedures as they are charted. To ensure that the proper path over the ground is followed, it is not possible to either delete or add waypoints to the approach section of the flight plan. To help see which waypoints are en route waypoints and which are approach waypoints, the KLN 90B does not display a colon next to the waypoint number on the FPL 0 page if the waypoint is an approach waypoint.

It is only possible to replace the existing approach with another one, or delete the entire approach from the flight plan.

1. With the left page displaying the active flight plan (FPL 0), turn the left cursor on. Refer to Figure 3-62.

2. Move the cursor so that it covers the approach header at the top of the approach procedure. Refer to Figure 3-63. Once the cursor comes over the approach header, it will change to read CHANGE APR?. If the **ENT** button is pressed, the APT 8 page will automatically come up on the right side. Now it is possible to select different approach procedures, different LAS's, or both.

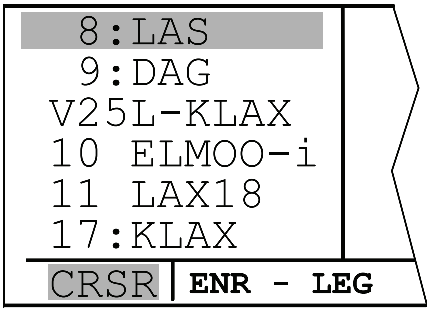


Figure 3-62. FPL 0 with Approach

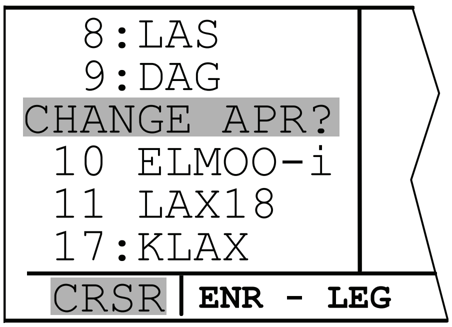


Figure 3-63. Change the Approach

3. If the **CLR** button is pressed while the cursor is over the approach header, it will change to read DELETE APR?. Refer to Figure 3-64. If **ENT** is pressed now, the KLN 90B will remove the entire approach procedure from the active flight plan. If the KLN 90B was in the approach arm or the approach active modes, deleting the approach will cause the KLN 90B to change back to the en route mode. This means the CDI scale factor will change back to the default ± 5.0-nm scale.

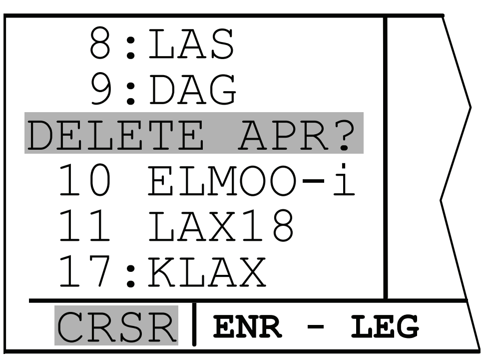


Figure 3-64. Delete the Approach

ar. No Procedure Turn Approach. This example will show how the KLN 90B sequences through an approach that does not require a procedure turn. It will remain in the LEG mode throughout the approach.

(1) Load the approach into the flight plan.

(2) At 30 nm the KLN 90B will automatically arm the approach mode and provide the message, PRESS ALT TO SET BARO. Press the **ALT** button to bring up the ALT page and verify that the altimeter setting is correct. At this time, the KLN 90B will change the GDI scale factor to ± 1.0 nm. The external approach mode annunciator will indicate that the approach is in the ARM mode.

(3) As the initial approach fix is approached, the KLN 90B will provide waypoint alerting on the external waypoint annunciator, as well as on the screen of the KLN 90B. Once the IAF is passed, the KLN 90B will sequence to the next waypoint on the approach.

(4) Use of the Super NAV 5 page is recommended because of its graphic presentation of the aircraft location and the approach course. Refer to Figure 3-65.

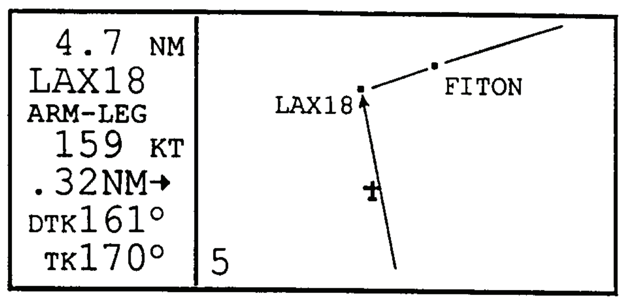


Figure 3-65. Super NAV 5 Page

(5) As the aircraft approaches the next waypoint, the KLN 90B will again provide waypoint alerting. Each time the aircraft passes a waypoint and sequences to the next waypoint, the KLN 90B will provide a message annunciating the new value to set on the HSI. If DTK is shown on the screen, this value will flash when the external selected course does not match the DTK within 10°.

NOTE

If the KLN 90B is interfaced with EFIS or an electrically driven mechanical indicator (HSI), the external indicator will be driven to the correct value when leg sequencing occurs.

(6) As the aircraft approaches the final approach fix, verify that the LEG mode is selected and that GPS is selected as the primary navigation source.

(7) Two nautical miles from the final approach fix, the KLN 90B will make a prediction to see if integrity will be available at the FAF and MAP. If the prediction indicates that integrity monitoring will be available, and RAIM is currently available, the KLN 90B will change the GPS APR annunciator to read ACTV and the status line will indicate APR. Refer to Figure 3-66. At this time, the KLN 90B will also start to change the CDI scale factor. By the time the aircraft reaches the FAF, the GDI scale factor will be down to ± 0.3 nm full-scale deflection.

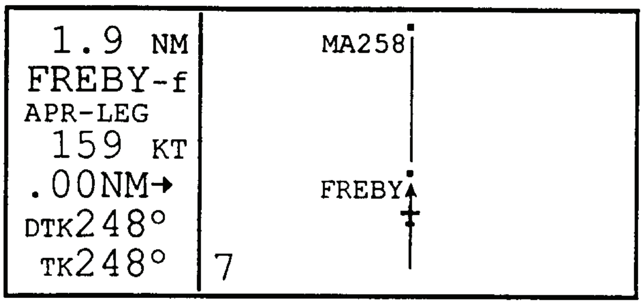


Figure 3-66. GPS Approach Mode Active

NOTE

Some approach procedures require adding up several along track distances to be able to identify a step down fix.

(8) A step down fix may not be included in the list if waypoints are provided in the database. Identify this point by using the along track distances given in the profile view of the approach plate. Remember, in the leg mode, the distance given by the KLN 90B is the distance to the next point (in this case, the MAP), not the distance from the last point (the FAF).

(9) The KLN 90B will again provide waypoint alerting as the missed approach point is approached. This is shown on the Super NAV 5 page as a flashing active waypoint identifier, as well as the external flashing waypoint annunciator. If the auto scale factor was chosen for the Super NAV 5 page, the airport diagram will be visible when the aircraft is within 5 nm of the airport. More detail is shown as the aircraft gets to within 1 nm of the airport.

NOTE

If ATC instructions for the missed approach are different from the published procedure, it is always possible to select a different DIRECT TO waypoint than the default DIRECT TO waypoint.

(10) If a missed approach is required, the KLN 90B will not automatically sequence past the missed approach point. To perform the published missed approach procedure, press the –D→ button to bring up the Direct To page. The default waypoint will be the first waypoint of the published missed approach procedure. Confirm this waypoint as the DIRECT TO waypoint and press the **ENT** button.

(11) Upon reaching the first point, the KLN 90B will sequence to the next waypoint in the missed approach procedure.

as. Off Airport Navaid Approach.

1. Load the approach into the flight plan. If there is only one IAF, the KLN 90B does not give the option to choose an IAF. If there is no active flight plan (i.e., direct to navigation is being used without an active flight plan), the KLN 90B will ask to add the airport and the approach to FPL 0. Refer to Figure 3-67.

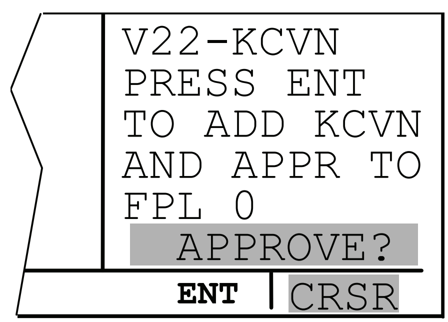


Figure 3-67. Load the Approach

2. If ATC then clears the aircraft to the IAF, with the Super NAV 5 page displayed, pull out the right inner knob and scan through the active flight plan. Once the IAF is displayed in the scanning window, press the –D→ button and then the **ENT** button to initiate a direct to operation to the IAP.

3. At a distance of 4 nm to the IAF, the KLN 90B will give the message, IF REQUIRED SELECT OBS.

This message provides a reminder that to fly a course reversal, the OBS mode needs to be selected. If the aircraft is approaching the IAF from an area where there is no need to perform a course reversal, ignore the message. A NoPT arrival sector is not stored in the database, so it is not possible for the KLN 90B to know that the course reversal is not required. Therefore, the KLN 90B will always give the message whenever a waypoint could be used for a course reversal. If the aircraft is approaching from a NoPT arrival sector, remain in the LEG mode. The KLN 90B will properly sequence to the FAF to MAP leg and transition to the approach mode when 2 nm from the IAF/FAF.

If approaching from a direction that requires a course reversal, the OBS mode will need to be selected. If the OBS mode is not selected before reaching the IAF/FAF, the KLN 90B will automatically sequence to the missed approach point. This is not desirable if a course reversal is to be done.

NOTE

The KLN 90B will only provide the reminder to select OBS if the IAF is the active waypoint.

4. If a course reversal is required, perform the appropriate procedure and set the inbound course on the HSI upon reaching the IAF. At this point, the KLN 90B works very similar to a conventional VOR/DME.

5. Once established on the inbound course, switch back to the LEG mode. When LEG mode is selected, the FAF is automatically made the active waypoint when the IAF and the FAF are the same waypoint.

NOTE

It is mandatory that the unit be in the LEG mode with the FAF as the active waypoint before crossing the FAF to activate the approach active mode and change to ± 0.3 nm scale factor. The CDI scale factor changes from ± 1.0 nm to ± 0.3 nm over the 2 miles to the FAF. 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 KLN 90B to change to the approach active mode.

(1) When the aircraft is 2 nm from the FAF, the KLN 90B will verify that proper integrity is available. If integrity monitoring is available for the approach, the KLN 90B will change to the approach active mode. This will be annunciated on the external approach status annunciator as well as on the KLN 90B. The CDI scale factor will also start to change from ± 1.0 nm to ± 0.3 nm.

(2) Upon reaching the FAF, the KLN 90B will automatically sequence to the MAP.

(3) A step down fix may not be included in the list if waypoints are provided in the database. Identify this point by using the along track distances given in the profile view of the approach plate. In the leg mode, the distance given by the KLN 90B is the distance to the next point (in this case, the MAP), not the distance from the last point (the FAF).

(4) The KLN 90B will provide waypoint alerting as the missed approach point is approached. This is shown on the Super NAV 5 page as a flashing active waypoint identifier, as well as the external flashing waypoint annunciator. If the auto scale factor was chosen for the Super NAV 5 page, the airport diagram will be visible when the aircraft is within 5 nm of the airport. More detail is shown as the aircraft gets to within 1 nm of the airport.

(5) If a missed approach is required, the KLN 90B will not automatically sequence past the missed approach point. To perform the published missed approach procedure, press the —D▸ button to bring up the Direct To page. The default waypoint will be the first waypoint of the published missed approach procedure. Confirm this waypoint as the DIRECT TO waypoint and press the **ENT** button.

NOTE

If ATC instructions for the missed approach are different from the published procedure, it is always possible to select a different direct to waypoint than the default DIRECT TO waypoint.

(6) Prior to reaching the first point, if holding is required, select the OBS mode to stop waypoint sequencing and define the inbound course for the holding pattern by setting the proper course on the HSI. If the OBS mode is not selected before the aircraft is within 4 nm of the holding point, the KLN 90B presents a message as a reminder to select the OBS mode.

NOTE

If another attempt at the approach is desired after holding, it is necessary to manually change the active waypoint. When the FAF and the missed approach holding point are the same, the KLN 90B will change the active waypoint to the FAF when the change from OBS to LEG is made. Make sure to make this change as soon as possible to ensure the approach active mode becomes the active mode.

at. Radar Vectors.

1. Select the approach and enter it into the flight plan.

2. When ATC initiates radar vectors, change the active waypoint to the FAF and select OBS. The order of these steps is not important. It is just as effective to change to OBS mode and then change the active waypoint.

3. Change the selected course on the HSI to the final approach course. It is possible to maintain the aircraft orientation on the Super NAV 5 page. Refer to Figure 3-68.

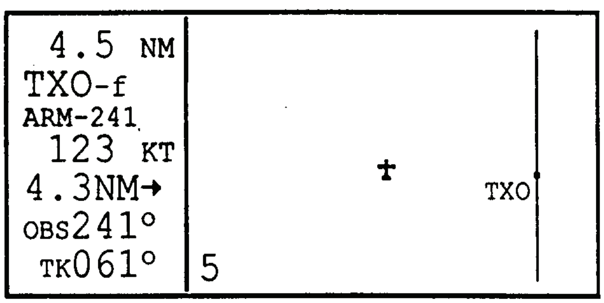


Figure 3-68. Radar Vectors

4. Once established on the inbound course, change back to the LEG mode to allow for proper approach operation and automatic leg sequencing. For best performance, the change back to LEG mode should be made before the aircraft is 2 nm from the FAF.

NOTE

It is mandatory that the unit be in the LEG mode with the FAF as the active waypoint before crossing the FAF to activate the approach active mode and change to ± 0.3 nm scale factor. The CDI scale factor changes from ± 1.0 nm to ± 0.3 nm over the 2 miles to the FAF. 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 KLN 90B to change to the approach active mode.

5. The rest of the approach will be flown using the same steps presented previously.

au. On Airport Navaid Approach.

1. Select the approach and enter it into the flight plan.

2. When the distance from the present position to the destination airport reaches 30 nm, the KLN 90B will arm the approach mode. The CDI scale factor will transition to ± 1.0 nm and the KLN 90B will provide more sensitive integrity monitoring. Press the altitude button to update the altimeter setting.

3. When the aircraft is 4 nm from the IAF, the KLN 90B will provide a reminder to select the OBS mode. The OBS mode is required for the procedure turn. After passing the IAF, select the outbound course on the HSI.

4. The aircraft is now headed outbound for the procedure turn. As soon as practical, change the active waypoint to the FAF.

   Pull out the right inner knob with the Super NAV 5 page displayed. Scan the waypoints until the FAF, FFxx–f, is displayed in the window and press the –D► button. Refer to Figure 3–69. Since the course to the FAF is already defined (in the OBS mode with the HSI set to the outbound course), press the –D► button a second time to activate this waypoint instead of going directly to it.

5. With the OBS mode selected and the FAF as the active waypoint, it is possible to fly the procedure turn. Allow enough

distance past the FAF to complete the procedure turn and still be 2 nm away from reaching the FAF. After completing the heading portion of the procedure turn, change the selected course to the inbound course on the HSI.

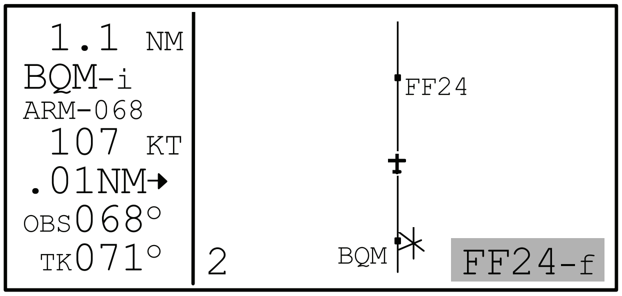


Figure 3-69. Activate the FAF

6. Once established on the inbound course, the LEG mode will again need to be selected so that proper approach operation and waypoint sequencing will occur.

NOTE

It is mandatory that the unit be in the LEG mode with the FAF as the active waypoint before crossing the FAF to activate the approach active mode and change to ± 0.3 nm scale factor. The CDI scale factor changes from ± 1.0 nm to ± 0.3 nm over the 2 miles to the FAF. 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 KLN 90B to change to the approach active mode.

7. When the aircraft is 2 nm from the FAF, the KLN 90B will verify the proper GPS integrity is available. If integrity monitoring is available for the approach, the KLN 90B will change to the approach active mode. This will be annunciated on the external approach status annunciator as well as on the KLN 90B. The CDI scale factor will also start to change from ± 1.0 nm to ± 0.3 nm.

8. Normal waypoint alerting will occur as the aircraft passes the final approach fix. The leg from the final approach fix to the missed approach point will become active and the CDI scale factor will remain at ± 0.3 nm. If the auto scale factor was selected on the Super NAV 5 page, the scale factor will zoom in on the airport as the aircraft gets closer and closer to the missed approach point. Eventually the map scale changes to 1 nm and the runway diagram becomes visible on the map.

9. The missed approach instructions may call for a climbing turn to a heading to intercept a course to the missed approach holding point. To fly this with the KLN 90B, it will be necessary to put the KLN 90B into the OBS mode. Make the missed approach holding point the active waypoint. Change the selected course on the external HSI to the published course to the missed approach holding point. Fly the heading until intercepting the course, then turn and track the course.

NOTE

The KLN 90B must be in the OBS mode for holding.

10. Once the aircraft reaches the missed approach holding point, perform the appropriate holding pattern entry. Set the selected course on the HSI to the inbound holding course.

av. DME Arc Approach. DME arc procedures with the KLN 90B are different from traditional VOR and DME equipment. The KLN 90B provides left/right guidance around the arc.

(1) ATC assigns the approach. Turn to the APT 8 page for the destination to select the approach. When the approach is selected, the KLN 90B presents the IAF selection page.

(2) Two of the IAF's may be in the form DxxxY. These two waypoints are the database identifiers for the ends of the arc. D040L means DME arc point, 040 is the radial on which the waypoint lies, and L indicates the distance of the arc. L is the twelfth letter of the alphabet, so L indicates that this is the 12 NM DME arc.

CAUTION

The KLN 90B does not take into account the geometry of the active flight plan 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 approaches that contain DME arcs until the aircraft is closer to the destination.

NOTE

If the present radial from the reference VOR is outside of the defined arc, the KLN 90B will default to the beginning of the arc.

(3) The KLN 90B recognizes if this point is associated with a DME arc. Once the arc waypoint is chosen, the KLN 90B determines on what radial of the reference VOR is presently located. A waypoint is created that is located at the intersection of the present radial and the DME arc. This waypoint is the first waypoint in the list of waypoints presented on the APT 8 page before loading the approach into the flight plan. This waypoint is named in the same convention as above.

(4) With the cursor over LOAD IN FPL, press the **ENT** button. The approach will be loaded into the active flight plan.

(5) After the approach is loaded into the flight plan, the KLN 90B may give the message, "REDUNDANT WPTS IN FPL - EDIT EN ROUTE WPTS AS NECESSARY."

Examine the flight plan and, if practical, observe the Super NAV 5 page to make sure that the sequence of waypoints does not have any unnecessary legs in it.

(6) The KLN 90B will now provide guidance to the arc intercept point. The Super NAV 5 page displays the entire arc on the screen. Refer to Figure 3-70. The portion between the beginning of the arc and the arc intercept is drawn with a dashed line. The part that is between the arc intercept point and the end of the arc is drawn with the normal solid line.

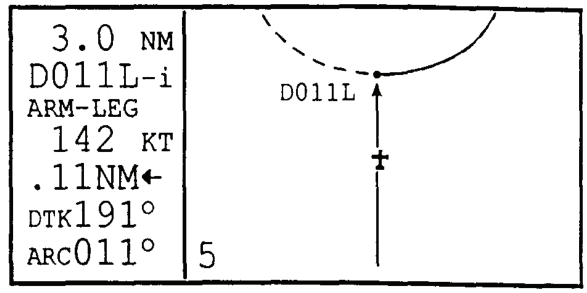


Figure 3-70. DME ARC

(7) In some cases, ATC may provide radar vectors to the arc. The KLN 90B provides a means to define a new intercept point based on the current track of the aircraft over the ground. This can be done from either the Super NAV 5 page or from the FPL 0 page. The dashed line on the Super NAV 5 page will help in determining if the ATC vectors are correct.

1. From the Super NAV 5 page, pull out the right inner knob to bring up the waypoint-scanning window.

2. Turn the right inner knob until the first waypoint of the arc is displayed. For approaches, this will have an "i" appended to the waypoint name. If the recalculation is to be done from the FPL 0 page, turn on the left cursor and move if over the first waypoint of the arc.

3. From either page press the clear button. This will change the waypoint to read MOVE?. Refer to Figure 3-71. If it is desired to re-compute the arc intercept point, press the **ENT** button. If a new arc intercept point is not desired, press the clear button again.

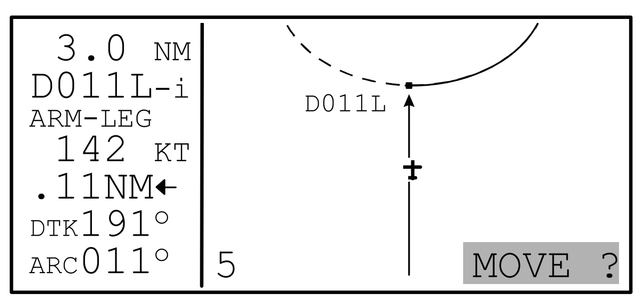


Figure 3-71. DME ARC MOVE?

4. If the **ENT** button was pressed, the KLN 90B will calculate an arc intercept point based on the present track of the aircraft over the ground.

NOTE

If the present track does not intercept the arc, the KLN 90B will display NO INTRCPT in the scratchpad area of the screen.

(8) When the aircraft approaches the arc, the KLN 90B will provide waypoint alerting and turn anticipation to join the arc.

(9) Once established on the arc, the KLN 90B provides left/right guidance relative to the curved arc. Distance to the active waypoint is the distance from the present position to the active waypoint, not the distance along the arc.

(10) During the arc, the desired track will be constantly changing. To help keep the orientation correct, the Super NAV 5 page will automatically display DTK on the sixth line. It is not possible to change this while on the arc. The value displayed for the desired track will flash when the difference between the CDI or HSI and the current desired track is greater than 10°.

(11) Some DME arcs have defined radials that serve as step down fixes. These points are not stored in the database. To help determine the position relative to these step down points along the arc, the KLN 90B will display a new value on the bottom line of the display on the Super NAV 5 page. This designation is the letters ARC followed by three numbers. The three numbers represent the current radial the aircraft is on relative to the reference VOR/DME. It is not possible to select any other information to display on this line. The arc radial is forced into this position when the aircraft is 30 nm from the arc.

NOTE

Autopilot performance may not be satisfactory if coupled in the NAV mode while flying the arc. Many autopilot systems were never designed to fly curved paths. If autopilot performance is unsatisfactory while flying DME arcs, select the heading mode and keep changing the heading bug to keep the deviation bar centered.

(12) As the aircraft approaches the end of the arc, the KLN 90B will provide waypoint alerting and turn anticipation to the next leg.

(13) When the aircraft is 2 nm from the FAF, the KLN 90B will attempt to transition to the approach active mode. Since the DME arc procedure is flown entirely in the LEG mode, the only possible problem would be if the integrity monitoring were not available.

(14) If a missed approach is needed, perform the following.

1. If the missed approach calls for a climb and then a turn, the KLN 90B will provide correct guidance for the climb.

2. Once the correct altitude has been reached, press the –D→ button. The first point in the published missed approach will be the default DIRECT TO waypoint. Press the **ENT** button to confirm the DIRECT TO waypoint.

NOTE

If ATC instructions for the missed approach are different from the published missed approach procedure, it is always possible to select a different DIRECT TO waypoint.

If another attempt at the approach is desired after holding, it is necessary to manually change the active waypoint. When the FAF and the missed approach holding point are the same, the KLN 90B will automatically change the active waypoint to the FAF when the change from OBS to LEG is made. This change needs to be made as soon as possible to ensure the approach active mode becomes the active mode.

3. The OBS mode will need to be selected to either fly a specific course or radial to the waypoint or to hold at the missed approach holding point. If this is not done before the aircraft gets to 4 nm from the missed approach holding point, the KLN 90B will provide a reminder message to select OBS.

aw. Approach Problems. Very rarely, there will be a problem with the integrity of the GPS system while conducting non-precision approaches. In some cases, the KLN 90B will determine that there will not be sufficient integrity monitoring for the leg between the FAF and the MAP, or RAIM is not currently available. In these cases, the KLN 90B will not go into the approach active mode and will present the message, RAIM NOT AVAILABLE, APR MODE INHIBITED, PREDICT RAIM ON STA 5.

(1) The approach must be discontinued. The STA 5 page provides a means to predict when RAIM will be available.

(2) To perform a RAIM prediction on the STA 5 page, two pieces of information are needed: the location that the prediction will be for and the time for the prediction.

(3) The destination waypoint will, by default, be the missed approach point of an approach loaded in the flight plan. If there is no approach in the flight plan, the default waypoint is the last waypoint in the active flight plan. It is possible for the pilot to enter any desired waypoint in this field.

(4) The time used for the RAIM prediction will be the current ETA to the destination airport or the MAP. This time is automatically updated by the KLN 90B, so there is no need to enter a value. If a RAIM prediction is desired for planning purposes, it is possible to enter a time in this field. The time used for the RAIM prediction is always in the future and is limited to 24 hours from the present time.

(5) To perform a RAIM prediction, perform the following steps.

1. Use the left outer and inner knobs to select the STA 5 page.
2. Press the left **CRSR** button. The cursor will be over the DEST field.
3. If necessary, enter the desired waypoint identifier by using the left inner and outer knobs.
4. Once the desired waypoint identifier is entered, press the **ENT** button. Press the **ENT** button again if the information is correct.
5. The cursor will now be over the ETA field. If necessary, use the left inner and outer knobs to enter the desired time and time zone. When the desired time is entered, press the **ENT** button. The RAIM calculations will start. The calculation will usually take a few seconds.
6. Once the RAIM calculation is complete, the STA 5 page will indicate the results of the test. Refer to Figure 3-72. This is done graphically in a bar graph. The center of the bar graph represents the ETA. Each bar represents 5 minutes of time. The RAIM calculation is good for ± 15 minutes of the ETA. Bars that are above the line indicate RAIM is available and bars below the line indicate when RAIM is not available.

Even more rare will be the case when the KLN 90B cannot provide sufficient integrity monitoring or if there is an actual satellite failure while the aircraft is on the leg from the FAF to the MAP. In these cases, the KLN 90B will flag the navigation solution and a missed approach will have to be flown. The KLN 90B will provide the following message, PRESS GPS APR FOR NAV.

7. Press the external **GPS APR** button. This will change the unit to the approach arm mode and navigation information will be restored.

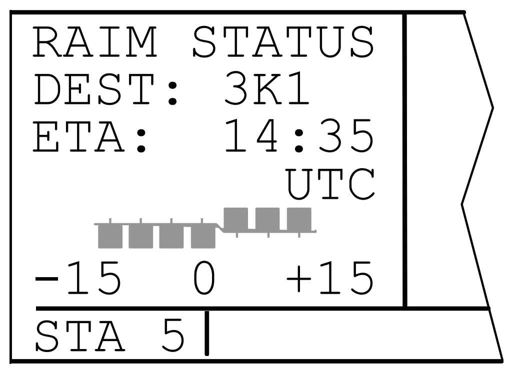


Figure 3-72. RAIM Status

ax. SID/STAR Procedures. The database contains the pilot NAV SID's and STAR's for the primary database coverage area. SID/STAR procedures stored in the database can only be considered accurate as long as the database is current. Even though the database contains SID/STAR procedures, there is a lot of information that is not included in the database. Therefore, the paper chart is still the primary source of information. Many procedures require the aircraft to fly at a certain altitude, along a heading until intercepting a course, and many other procedures that the KLN 90B cannot automatically accomplish. Many procedures require pilot action to ensure that the proper path is flown over the ground. The main purpose of loading a SID or a STAR into the active flight plan is to provide a quick way of loading a potentially large number of waypoints.

NOTE

There are some SID / STAR procedures that are not suited for the operational characteristics of the KLN 90B. These procedures are not included in the database.

(1) SID and STAR procedures are stored with the airport for which they apply. SID and STAR procedures are accessed through the APT 7 page. If there are both SID's and STAR's for a given airport, then there will be two APT 7 pages, one to select a SID and the other to select a STAR. This is indicated by APT+7.

(2) SID and STAR procedures are defined in three parts: the name, the transition, and the runway component. The APT 7 page leads the pilot through the selection process.

ay. Selecting a SID.

1. Select the departure airport APT 7 or ACT 7 page.

2. Turn the right cursor on by pressing the right **CRSR** button. Rotate the right outer knob until the cursor is over the desired SID. Press the **ENT** button.

3. The KLN 90B will now ask for the runway in use. Position the cursor over the appropriate runway and press the **ENT** button.

4. The transitions are presented for selection. Move the cursor over the desired transition and press the **ENT** button.

5. The KLN 90B now presents a list of waypoints that make up the SID. Review the waypoints. Press the **ENT** button with the cursor over LOAD IN FPL to load the SID into the active flight plan.

6. The KLN 90B will add the SID procedure after the airport reference point in the active flight plan. If the airport reference point is not included in the active flight plan, the KLN 90B will ask to add this waypoint to the active flight plan.

az. Selecting a STAR. The steps required to select a STAR are very similar to those required to select a SID. The only difference is the order of the steps to define the STAR and where the STAR is loaded into the flight plan.

1. Select the APT 7 or the ACT 7 page for the destination airport. Ensure the words, "SELECT STAR" are displayed near the top of the screen.

2. Turn the right cursor on by pressing the right **CRSR** button and, if necessary, rotate the right outer knob until the flashing cursor is over the desired STAR. Press the **ENT** button.

3. The KLN 90B will now ask which transition to use.

4. In some cases, the STAR procedure requires the selection of a specific runway. To select a specific runway, move the cursor over the desired runway and press the **ENT** button.

5. The KLN 90B now presents a list of waypoints that make up the STAR. Review these waypoints. With the cursor over LOAD IN FPL, press the **ENT** button to load the STAR into the active flight plan.

The KLN 90B will then add the STAR procedure before the airport reference point in the active flight plan. If the airport reference point is not included in the active flight plan, then the KLN 90B will ask to add this waypoint to the active flight plan.

NOTE

It is not possible to load a SID or a STAR into a flight plan other then FPL 0. SID and STAR procedures are deleted from FPL 0 after the power is off for more than 5 minutes.

ba. Editing A SID Or A STAR. SID and STAR procedures have procedure headers. It is possible to use these headers to delete and change the entire procedure, as is done with approach procedures. Refer to Figure 3-73. Unlike approaches, it is possible to add and delete waypoints in SID and STAR procedures.

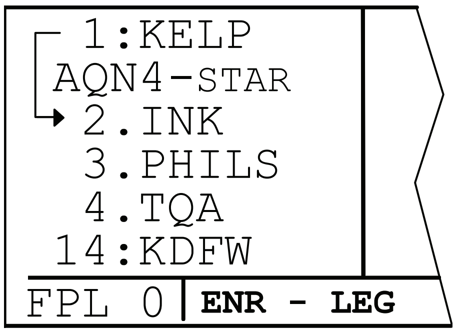


Figure 3-73. SID/STAR Procedure

To help differentiate between approaches (no adding or deleting waypoints) and SID and STAR procedures (adding and deleting waypoints allowed), the waypoint number has a period (.) next to it instead of a blank space. The period also differentiates a SID or STAR waypoint from a regular waypoint, which is followed by a colon (:).

(1) Adding An Individual Waypoint In The SID Or STAR Procedure.

1. Use the left knobs to select the FPL 0 page on the left side of the screen.

2. Turn the left cursor on by pressing the left **CRSR** button. Rotate the left outer knob as necessary to position the cursor over the waypoint identifier which will follow the waypoint being added.

3. Use the left inner and outer knobs to enter the new waypoint identifier.

4. Press the **ENT** button to display the waypoint page for this identifier. If the waypoint is correct, then press the **ENT** button a second time to confirm the waypoint page. The new waypoint is added to the waypoints that make up the SID or the STAR procedure.

(2) Deleting An Individual Waypoint In A SID Or A STAR Procedure.

1. Use the left knobs to select the FPL 0 page on the left side of the screen.

2. Rotate the left outer knob to place the cursor over the waypoint to be deleted.

3. Press the **CLR** button. The letters DEL will appear to the left of the identifier and a question mark will appear to the right of the identifier.

4. If this is the desired waypoint to delete, then press the **ENT** button. If it is not the desired waypoint, press the **CLR** button.

NOTE

Adding waypoints to or deleting waypoints from SID or STAR procedures does not change the way that they are stored in the published database.

(3) Changing Or Deleting An Entire SID Or STAR Procedure From The Active Flight Plan.

NOTE

Any waypoints manually added to a SID or STAR will be deleted if the SID or STAR is changed or deleted using the following procedure.

1. Use the left knobs to select the FPL 0 page on the left side of the screen.

2. Turn the left cursor on by pressing the left **CRSR** button. Move the cursor over the SID or STAR procedure header by using the left outer knob.

3. With the cursor over the procedure header, press the **ENT** button to change the SID or STAR procedure or press the **CLR** button and then the **ENT** button to delete the entire procedure.

bb. The Other Pages.

(1) Frequencies for Nearest Flight Service Stations (Other 1). The KLN 90B stores in its database the locations of Flight Service Stations (FSS) and their remote communications sites. In addition, the KLN 90B determines which two of these FSS points of communication are closest to the aircraft position.

NOTE

In some areas of the world, the KLN 90B provides the location of the nearest point of communication with a facility providing information (INF) or radio (RDO) services.

(a) Select the OTH 1 page on the left side to view two of the nearest points of communication with FSS. There will normally be two

OTH 1 pages, one for each of the two points of contact. The name of the FSS is at the top of the page. There can be from one to four frequencies. Where it is possible to communicate with FSS by transmitting on VHF and receiving on the VOR, the OTH 1 page displays the frequencies to use for transmit and receive and also the name of the VOR being used.

(b) In some parts of the world, HF communications are used for these services. These frequencies are displayed where appropriate.

NOTE

Frequencies for Area Control Centers are displayed on the OTH 2 page for some areas of the world.

(2) Frequencies for Air Route Traffic Control Centers (Other 2). The KLN 90B also stores in its database the low altitude boundaries of each of the ARTCC Centers. The KLN 90B determines the proper Center to contact and the appropriate frequencies to use for the aircraft's present position. The OTH 2 page is used to display this information.

(3) Deleting User-Defined Waypoints (Other 3). A listing of all user-defined waypoints is contained on the OTH 3 page. The user-defined waypoints are listed by category; airports (A) are first, VOR's (V) are second, NDB's (N) are third, intersections (I) are fourth, and supplemental (S) waypoints are last. Within each category, the waypoints are alphabetized by identifier. To the right of the identifier is the type waypoint (A, V, N, I, or S). If the waypoint is used in a flight plan, the flight plan number is shown to the right of the waypoint type. Refer to Figure 3-74. If more than five user waypoints exist, it is necessary to press the left **CRSR** button and then use the left outer knob to scroll through the complete list.

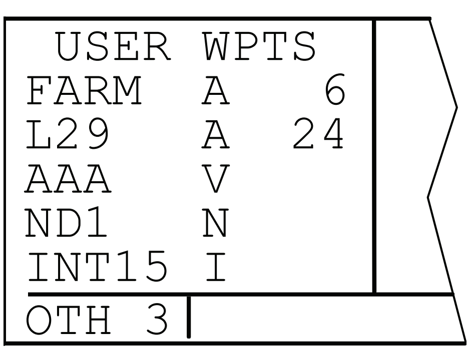


Figure 3-74. OTH 3 Page

(a) Deleting A User Waypoint.

1. Select the OTH 3 page.

2. Press the left **CRSR** button and use the left outer knob to move the cursor over the waypoint to be deleted. If more than five user-defined waypoints exist, it is necessary to use the left outer knob to scroll through the list. A waypoint contained in a flight plan cannot be deleted without first either deleting the waypoint from the flight plan or deleting the entire flight plan.

3. Press the **CLR** button. The waypoint page for the waypoint to be deleted appears on the right side.

4. Press the **ENT** button.

5. Press the left **CRSR** button to turn off the left cursor function.

(4) Deleting Airport Remarks (Other 4). The OTH 4 page includes a listing of all airports whose APT 5 pages contain remarks. To delete a previously entered remark, select the OTH 4 page, position the cursor over the desired airport identifier, press the clear button, and then press the **ENT** button. If there are more than five airports with remarks, use the left outer knob to scroll the cursor down the list to find the desired airport identifier.

(5) Fuel Management (Other 5 through 8). The installation of the Army Engine Trend Monitoring System (AETM) allows the KLN 90B to interface with real time fuel management data so that the system can continuously compute the amount of fuel required to reach the destination and the amount of fuel that will be on board upon reaching the destination. The AETM continuously sends the rate of fuel flow to the KLN 90B. The KLN 90B continuously calculates the aircraft's distance, groundspeed, and estimated time en route to the destination waypoint. The fuel required to reach the destination waypoint is the ETE multiplied by the current rate of fuel flow. The amount of fuel remaining at the destination is the amount of fuel presently remaining minus the fuel required to reach the destination.

CAUTION

The KLN 90B fuel calculations are based on the present rate of fuel flow, the present groundspeed, the present distance to the destination airport along the programmed route, and the amount of fuel onboard entered at departure. Before takeoff, the unit must be properly initialized with the amount of fuel on board. Since many factors influence the required amount of fuel to reach the destination, check the fuel pages often for significant changes. Some factors affecting the amount of fuel required are power changes, altitude changes, headwind/tailwind component changes, and routing changes.

(a) OTH 5 Page. The OTH 5 page displays the following information. Refer to Figure 3-75.

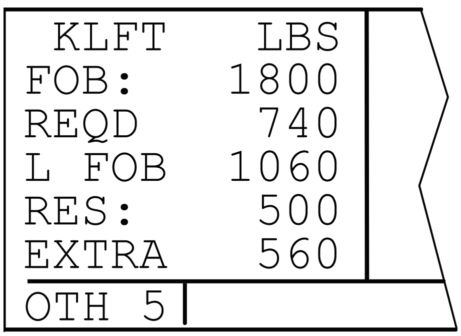


Figure 3-75. OTH 5 Page

1. The destination waypoint. An arrow is displayed to the left of the identifier if the waypoint is the active waypoint.

2. The fuel units as received from the AETM.

3. The fuel presently on board (FOB). To change the present fuel on board:

   a. Turn to the OTH 5 page.

   b. Press the left **CRSR** button to turn on the cursor function.

   c. Enter the current fuel on board using the left inner and outer knobs.

   d. Turn the cursor function off.

4. The fuel required to reach the destination waypoint at the current rate of fuel flow and the present groundspeed (REQD).

5. The landing fuel on board (L FOB) is the original fuel on board minus the total fuel required to reach the destination.

6. The desired fuel reserve (RES) is the amount of reserve fuel the pilot has entered. The fuel must be entered in the same units displayed on the first line. To enter the reserve, press the left **CRSR** button, rotate the left outer knob to move the cursor over the RES field. Use the left inner and outer knobs to enter the desired fuel quantity. Press the left **CRSR** button to turn off the left cursor function.

7. The calculated extra fuel (EXTRA) is the landing fuel on board (L FOB) minus the fuel reserve (RES).

(b) OTH 6 Page. The OTH 6 page displays the following information. Refer to Figure 3-76.

1. The endurance (ENDUR) in hours and minutes. The endurance is calculated based on the amount of fuel remaining after subtracting out the reserve (RES) entered on the OTH 5 page or the OTH 6 page from the present fuel on board.

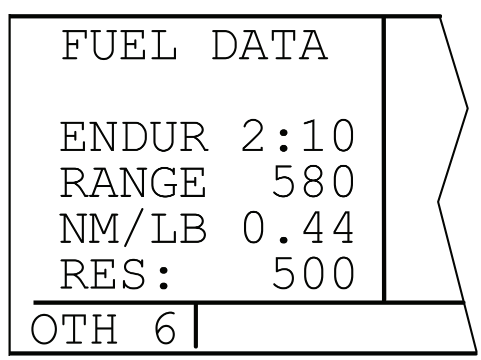


Figure 3-76. OTH 6 Page

2. The range (RANGE), which is the distance in nautical miles that could be flown based on the endurance calculated above and the present groundspeed.

3. The fuel efficiency, which is the groundspeed divided by the present fuel flow.

4. The desired fuel reserve (RES). Same as displayed on the OTH 5 page. Changing the reserve on one of the two pages also changes it on the other page.

(c) OTH 7 Page. The OTH 7 page displays rate of fuel flow as depicted in Figure 3-77.

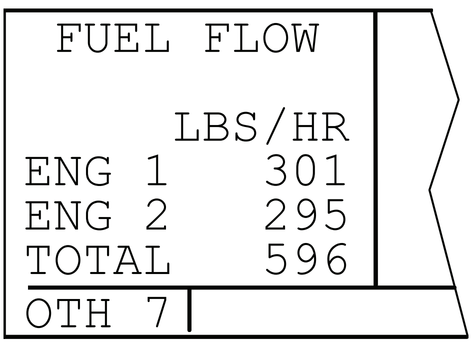


Figure 3-77. OTH 7 Page

(d) OTH 8 Page. The OTH 8 page displays the amount of fuel used as depicted in Figure 3-78.

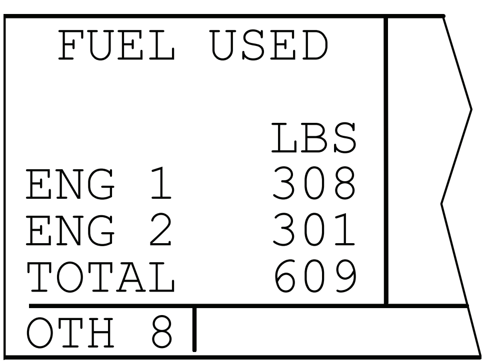


Figure 3-78. OTH 8 Page

(6) The Air Data Pages. When interfaced with the AETM, the KLN 90B will display real time air data parameters such as True Airspeed (TAS), Static Air Temperature (SAT), Total Air Temperature (TAT), Mach number, density altitude, and pressure altitude. The KLN 90B will also calculate and display real time wing data (magnitude and direction). The OTH 9 and OTH 10 pages are used to display air data information. Figure 3-79 depicts the OTH 9 page display.

NOTE

These air data pages receive inputs from air data sensors and display real time air data information. They are independent of the calculator pages that rely on manual pilot inputs to calculate air data information.

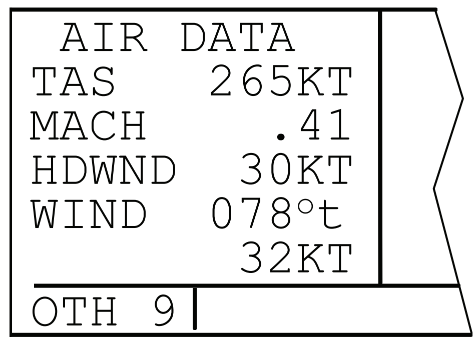


Figure 3-79. OTH 9 Page

(a) The TAS of the aircraft through the surrounding air mass.

(b) MACH - the ratio of the true airspeed to the speed of sound at a particular flight condition.

(c) The Tailwind (TLWND) component of the wind, if applicable.

(d) The Headwind (HDWND) component of the wind, if applicable.

(e) The Wind (WIND) direction relative to true North and the wind speed.

(f) OTH 10 Page. The OTH 10 page displays the following information.

1. SAT - the actual temperature of the surrounding air.

2. TAT - the air temperature including heat rise due to compressibility. This is the temperature measured directly by the OAT probe.

3. Pressure altitude (PRS) to the nearest 100 feet.

4. Density altitude (DEN) to the nearest 100 feet.

bc. The Setup Pages.

(1) The Setup 0 Page. The SET 0 page is used for computer updating of the database. Update information is sent on 3.5 inch disks. A computer is used via the data loader jack installed in the instrument panel. This is normally a maintenance function.

CAUTION

The KLN 90B does not perform any navigation functions while the database is being uploaded.

NOTE

The disks can only be used to update one KLN 90B, although they can be used to update a specific unit numerous times. The first time the disks are used in an update operation, a unique identification code from the KLN 90B being used is uploaded to the disks. These disks may be used in this specific KLN 90B an unlimited number of times that could be required if switching between the North American and International databases occurs during one update cycle. These disks, however, may not be used to update other KLN 90B's. This update protection ensures that Jeppesen Sanderson is properly compensated for their NavData™.

(2) The Setup 1 Page. The Setup 1 page is used to manually update the position of the KLN 90B and enter a groundspeed for use of the KLN 90B in the take home mode. Refer to Figure 3-80. Since the KLN 90B stores its position and other required parameters in memory when power to the unit is removed, it is seldom necessary to aid the unit in reaching a NAV ready status. In order for the unit to reach a NAV ready condition, it is necessary to meet the same conditions outlined in the Initialization, Paragraph 3-7i.

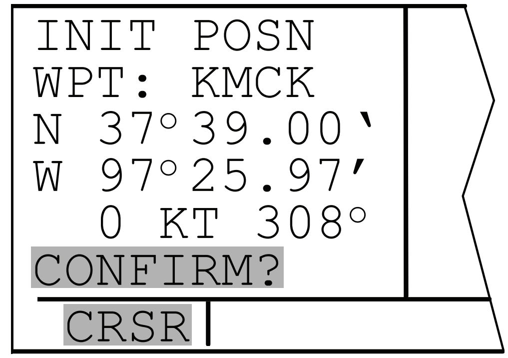


Figure 3-80. Setup 1 Page

(a) The KLN 90B's almanac data must be current. Almanac data is crude orbital information for all the satellites and is used for initial acquisition when the unit is first turned on. This data is stored in the KLN 90B's nonvolatile memory and is considered current up to 6 months. Each satellite sends almanac data for all satellites. Since the KLN 90B routinely updates the almanac data during normal operation, the almanac data will become out of date only if the KLN 90B hasn't been used for the previous 6 months or longer. Collecting new almanac data takes place automatically if the data is more than 6 months old. This will usually take about 6 minutes, but no more than 12 minutes.

(b) The aircraft must be located so the GPS antenna has an unobstructed view of the sky.

(c) It is very helpful for the KLN 90B to have the correct date, time, and position. This information is stored in the battery-backed memory of the KLN 90B, so it is not normally required to update it. If acquisition time is not important, it is not necessary to update the date, time, and position.

1. Select the Setup 1 page by turning the left outer knob to **SETUP,** displaying a SET page annunciated in the lower left segment of the display. Next, turn the left inner knob until the SET 1 page is selected.

2. Press the left **CRSR** button to bring the cursor on the page over the **WPT** field.

NOTE

As an alternative, the latitude and longitude of the present position can be entered directly instead of entering a waypoint identifier.

3. Use the left inner knob to enter characters and the left outer knob to move the cursor until the identifier for the location is entered.

4. Press the **ENT** button to view the waypoint page on the right side.

5. Press the **ENT** button again to approve the entry.

6. Use the left outer knob to position the cursor over CONFIRM?.

7. Press the **ENT** button.

NOTE

The groundspeed and heading fields are not used for initialization in the aircraft. If the KLN 90B is in the take-home mode, entering a groundspeed will allow the KLN 90B to fly along the active flight plan (or direct to a waypoint) starting from the initialization waypoint. A heading may be entered in the initial heading field while in the take-home mode if the one offered is not desired. If the take-home mode is used, the KLN 90B must be initialized to the aircraft's location when it is reinstalled.

8. Use the left knobs to select the NAV 2 page. When the KLN 90B reaches the NAV ready status and is able to navigate, the NAV 2 page will display the present position. Verify the latitude, longitude, and distance display of the VOR radial are correct.

(3) The Setup 2 Page. Refer to Figure 3-81 for a sample page. The KLN 90B system time and date should seldom require updating because they are automatically updated when at least one satellite is received. In addition, the KLN 90B contains an internal battery powered calendar clock to keep system time and date when the unit is not being used. The correct time and date are normally confirmed on the Self-Test page. The Setup 2 page can also be used.

NOTE

The time and date cannot be changed if the KLN 90B is receiving time and date from a satellite.

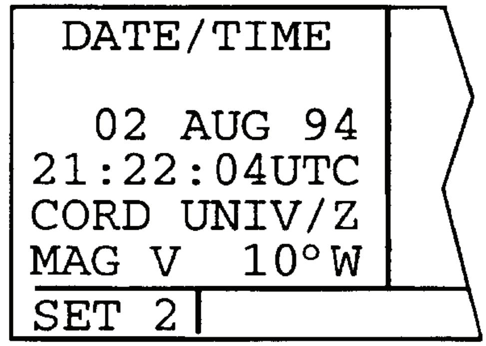


Figure 3-81. SET 2 Page – Set Date

(a) Date.

1. Select the SET 2 page on the left side.

2. Press the left **CRSR** button to turn on the left cursor function. The cursor will be over the entire date.

3. Rotate the left inner knob to select the correct day.

4. Turn the left outer knob one step clockwise to position the flashing part of the cursor over the month.

5. Rotate the left inner knob to select the correct month.

6. Turn the left outer knob one step clockwise to position the cursor over the tens digit of the year.

7. Use the left inner knob to select the correct tens digit of the year.

8. Turn the left outer knob one step clockwise to position the cursor over the remaining position of the year.

9. Use the left inner knob to complete the year.

10. Press the **ENT** button to start the KLN 90B using the new date.

(b) Time.

1. Select the SET 2 page on the left side. Refer to Figure 3-82.

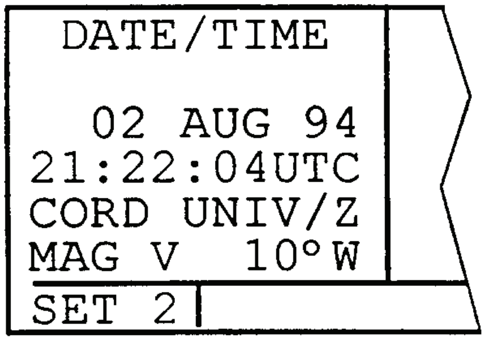


Figure 3-82. SET 2 Page – Set Time

2. Press the left **CRSR** button to turn on the left cursor function. The cursor will be over the entire date.

3. Use the left outer knob to position the cursor over the time zone.

4. Use the left inner knob to select the desired time zone.

5. Turn the left outer knob one step counterclockwise to position the cursor over the time.

6. Rotate the left inner knob to select the correct hour (24-hour time).

7. Turn the left outer knob one step clockwise to position the flashing part of the cursor over the tens position of the minute, and then use the left inner knob to select the correct value.

8. Turn the left outer knob one step clockwise to position the cursor over the remaining minutes position, and then use the left inner knob to complete the time selection.

9. Press the **ENT** button to start the clock running.

10. Press the left **CRSR** button to turn off the left cursor function.

The KLN 90B's primary coverage area is from N74° to S60° latitude. All navigation data presented outside this area is automatically reference to true North unless a manual input of magnetic variation is made on the SET 2 page. The same is true any time the KLN 90B is in the OBS mode and the active waypoint is outside the primary coverage area. Under both of these conditions, the message, MAGNETIC VAR INVALID – ALL DATA REFERENCED TO TRUE NORTH, is displayed on the message page.

When navigation is within the primary coverage area, the SET 2 page does not display magnetic variation. However, under the above conditions, a user-entered magnetic variation may be made on line 6 of the SET 2 page using the left **CRSR** button and the left inner and outer knobs.

(4) The Setup 3 Page. The nine airports in the nearest list are the nine airports that meet the criteria selected on the SET 3 page. Refer to Figure 3-83.

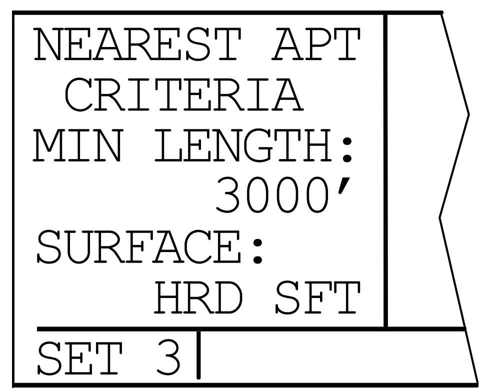


Figure 3-83. SET 3 Page

1. Select the SET 3 page on the left side.

2. Press the left **CRSR** button to turn on the left cursor function. The cursor will appear over the minimum runway length.

3. Use the left inner knob to select the minimum length runway desired for the airport to qualify for the nearest airport list. Values between 1000 feet and 5000 feet in 100-foot increments may be used.

4. Rotate the left outer knob one step clockwise to position the cursor over the runway surface criteria.

5. Turn the left inner knob to select either HRD SFT or HRD. If HRD SFT is chosen, both hard and soft surface runways meeting the required runway length will be included in the nearest

airport list. If HRD is chosen, only hard surface runways will be included. Hard surface runways include concrete, asphalt, pavement, tarmac, brick, bitumen, and sealed. Soft surface runways include turf, gravel, clay, sand, dirt, ice, steel matting, shale, and snow.

(5) The Setup 4 Page. The SET 4 page is used to define the departure time. Refer to Figure 3-84.

1. Select the SET 4 page.

2. Turn on the left cursor function.

3. Use the left inner knob to select between RUN WHEN GS > 30KT or RUN WHEN POWER IS ON.

4. Turn off the left cursor function.

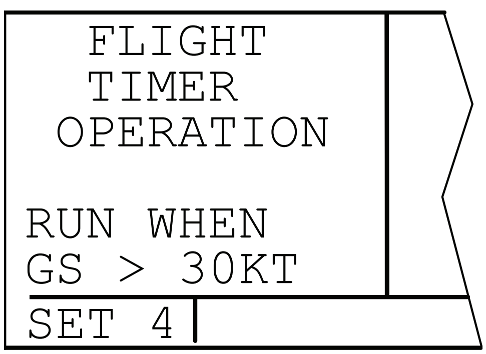


Figure 3-84. SET 4 Page

(6) The Setup 5 Page. The height above airport feature provides an alert annunciator when the aircraft has reached a selected altitude above the airport. This feature is enabled/disabled on the SET 5 page. Refer to Figure 3-85. The altitude is also selected on the SET 5 page.

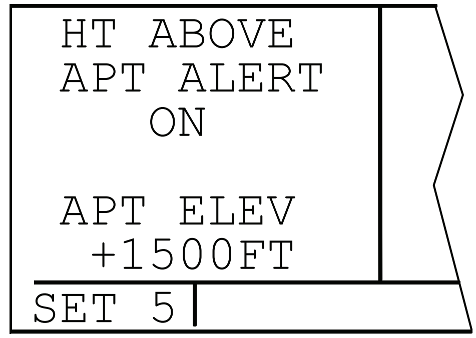


Figure 3-85. SET 5 Page

The height above airport alert feature does not serve the same function as a radar altimeter. It does not provide any warning about the aircraft's actual height above the airport's surrounding terrain.

CAUTION

The height above airport alert feature will only be accurate if the barometric altimeter setting is correct. If the height above airport function is enabled, ensure the barometric altimeter setting is correct on the ALT page.

When the height above airport is enabled, the KLN 90B creates a 5-nm radius cylinder of airspace centered on an airport. This airport is any airport that is a direct to waypoint or is the to waypoint in the active flight plan. The height of the cylinder above the airport is the height selected on the SET 5 page. The KLN 90B adds the selected altitude to the elevation stored in the database for the airport. The KLN 90B provides an altitude alert light when the aircraft first penetrates the cylinder.

To enable or disable the height above the airport alert, press the left **CRSR** button. Use the left outer knob to position the cursor over the enable/disable field. Turn the left inner knob to select on or off. To select the height, use the left outer knob to position the cursor over the altitude field. Turn the left inner knob to select an offset between 800 and 2000 feet. Press the left **CRSR** button to turn off the cursor function.

(7) The Setup 6 Page. Turn anticipation may be enabled or disabled on the SET 6 page. Refer to Figure 3-86. Turn on the left cursor function and use the left inner knob to select between ENABLE or DISABLE. If turn anticipation is disabled, navigation is provided all the way to the waypoint and waypoint

alerting occurs approximately 36 seconds prior to actually reaching the waypoint.

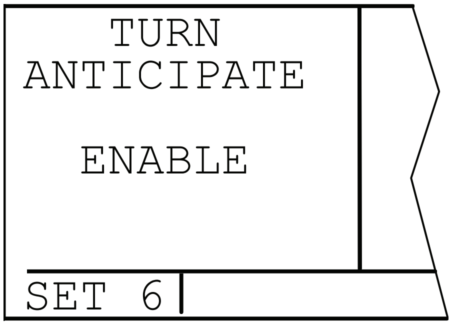


Figure 3-86. SET 6 Page

(8) The Setup 7 Page. The SET 7 page is used to select whether the altimeter setting used in the KLN 90B is made in inches of Mercury or millibars. Refer to Figure 3-87. To change the altimeter setting between inches of Mercury and millibars, select the SET 7 page, press the left **CRSR** button, and rotate the left inner knob to make the selection. When finished, press the left **CRSR** button to turn off the cursor function.

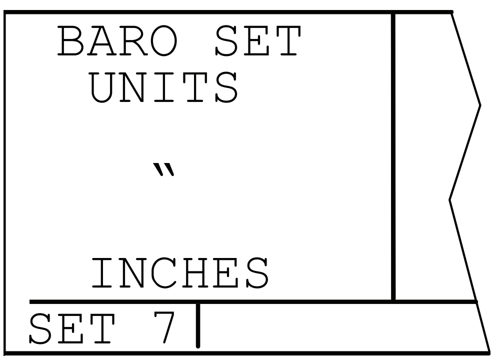


Figure 3-87. SET 7 Page

(9) The Setup 8 Page. The Special Use Airspace (SUA) alert feature may be enabled or disabled on the SET 8 page. Refer to Figure 3-88. After displaying the SET 8 page on the left side, press the left **CRSR** button to turn on the left cursor function. The left inner knob is used to display AIRSPACE ALERT ENABLE or AIRSPACE ALERT DISABLE. If the SUA feature has been enabled, the KLN 90B allows the selection of a vertical buffer in order to provide a vertical warning of SUA. To select a vertical buffer, ensure the SUA feature has been enabled. Press the left **CRSR** button to turn on the left cursor and then use the left outer knob to move the cursor over the first position of the vertical buffer. Use the left inner knob to select each number and the left outer knob to position the cursor. The buffer may be selected in 100-foot increments. After the desired selection has been made, press the left **CRSR** button to turn off the cursor function.

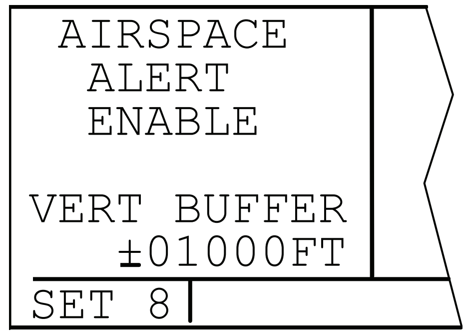


Figure 3-88. SET 8 Page

(10) The Setup 9 Page. There are no aural alarms associated with the KLN 90B; therefore, this page displays FEATURE DISABLED.

bd. The Trip Planning Pages. There are seven trip-planning pages (TRI) that can be displayed on the left side of the screen. The TRI 1 and 2 pages team together to provide trip planning from the present position to a selected waypoint. The TRI 3 and 4 pages provide trip planning between any two selected waypoints. The TRI 5 and 6 pages provide an analysis of any of the 26 flight plans in the flight plan pages.

Data entered on any of the trip planning pages have no effect on the navigation data provided on any navigation or flight plan page.

NOTE

The trip planning pages rely on pilot-entered inputs for true airspeed, groundspeed, and fuel flow. These pages do not utilize inputs from the fuel flow or air data sensors, if installed.

Areas of special use airspace are displayed on the trip planning pages without regard to altitude.

(1) The Trip Planning 0 Page. The anticipated true airspeed and winds aloft are entered on the TRI 0 page so this information may be used on the other trip planning pages. Refer to Figure 3-89.

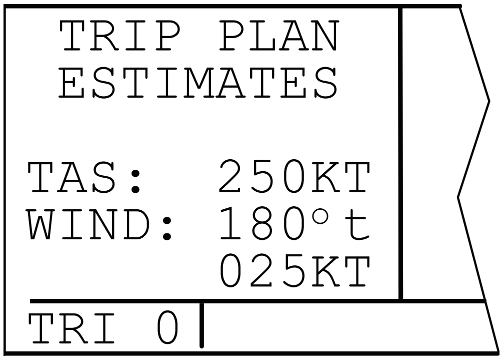


Figure 3-89. TRI 0 Page

(a) *Entering Data.*

1. Select the TRI 0 page on the left side.
2. Press the left **CRSR** button to turn on the cursor function.
3. Enter the TAS by using the left outer knob to move the cursor over the TAS field and the left inner knob to select each digit.
4. Rotate the left outer knob clockwise to position the cursor over the first two digits of the wind direction.
5. Turn the left inner knob to select the first two digits of the wind direction.
6. Rotate the left outer knob one step clockwise to position the cursor over the last digit of the wind direction. Use the left inner knob to complete the wind direction entry.
7. Enter the wind speed by using the left outer knob to move the cursor and the left inner knob to select each digit.
8. Press the left **CRSR** button to turn off the cursor function.

(2) *The Trip Planning 1 And 2 Pages*. The TRI 1 and 2 pages allow trip planning from the aircraft's present position to any selected waypoint. Unlike the other trip planning pages, in order to use the TRI 1 and 2 pages, the KLN 90B must either be receiving GPS signals sufficient to be in the NAV ready status or be in the take home mode.

The TRI 1 page provides estimates of distance, estimated time in route, bearing, and fuel requirements. Refer to Figure 3-90. The TRI 2 page displays the minimum En route Safe Altitude (ESA) and any areas of special use airspace that are between the present position and the selected waypoint. Refer to Figure 3-91.

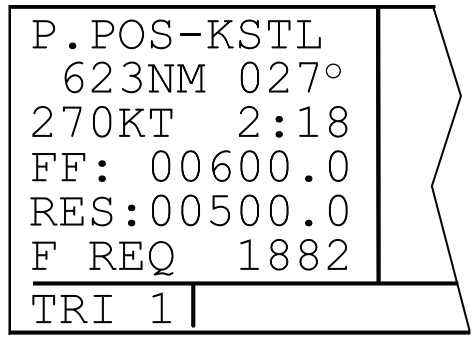


Figure 3-90. TRI 1 Page

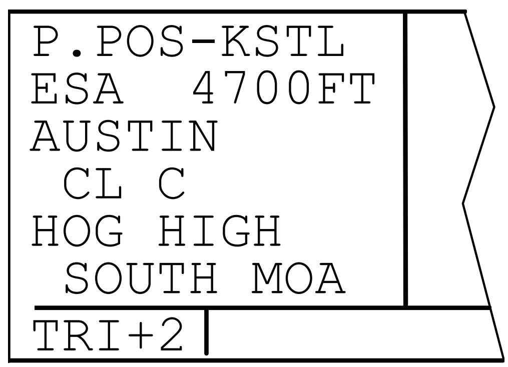


Figure 3-91. TRI 2 Page

NOTE

Prior to using the TRI 1 and 2 pages while the KLN 90B is in the take home mode, use the SET 1 page to enter the present position.

(a) *Trip Planning On The TRI 1 And 2 Pages.*

1. Use the left outer knob to select the TRI type pages.

2. Rotate the left inner knob to select the TRI 1 page.

3. Press the left **CRSR** button to turn on the left cursor function. The cursor will be over the waypoint identifier at the top of the page.

4. Use the left inner and outer knobs to enter the identifier of the selected waypoint.

5. Press the **ENT** button to view the waypoint page for the selected waypoint on the right side.

6. Press the **ENT** button again to acknowledge the waypoint page. The distance, bearing, and estimated time en route are now displayed.

If true airspeed and wind information were entered on the TRI 0 page, the groundspeed displayed is a result of those inputs applied to the direction of flight specified on the TRI 1 page. A different groundspeed may be entered using the left outer knob to position the cursor over each digit of the groundspeed and using the left inner knob to select each individual digit.

7. Calculate an estimate of the fuel required to the selected waypoint. Turn the left outer knob to position the cursor over the appropriate first digit adjacent to the Fuel Flow (FF).

8. Use the left inner and outer knobs as before to enter the aircraft's rate of fuel flow. The unit (gallons, pounds, etc.) is not important as long as all entries are in the same unit.

9. Use the left inner and outer knobs to enter the amount of reserve fuel (RES) desired upon arrival at the destination waypoint. The estimated amount of fuel required (F REQ) to fly to the selected waypoint with the specified reserve is now displayed. Entering the fuel flow and reserve fuel on the TRI 1 page also inputs this same information on the TRI 3 and 5 pages.

10. Press the left **CRSR** button to turn off the left cursor function.

11. Select the TRI 2 page. The minimum En route Safe Altitude (ESA) and a listing of areas of special use airspace along the route are displayed. If all the areas of special use airspace won't fit on one page, there will be multiple TRI 2 pages indicated by TRI+2, as illustrated in Figure 3-91.

(3) The Trip Planning 3 And 4 Pages. The TRI 3 and 4 pages allow trip planning between any two waypoints. The KLN 90B does not have to be receiving GPS signals to use these pages.

1. Select the TRI 3 page on the left side.

2. Press the left **CRSR** button to turn on the left cursor function. The cursor will be located over the FROM waypoint.

3. Use the left inner and outer knobs to enter the identifier of the FROM waypoint.

4. Press the **ENT** button to view the waypoint page on the right side for the waypoint just entered.

5. Press the **ENT** button again to approve the waypoint page. The cursor will position over the to waypoint identifier.

6. Use the left inner and outer knobs to enter the identifier of the the to waypoint.

7. Press the **ENT** button to view the waypoint page on the right side for the waypoint just entered.

8. Press the **ENT** button to approve the waypoint page. The distance, bearing, and estimated time en route are now displayed, as shown in Figure 3-92.

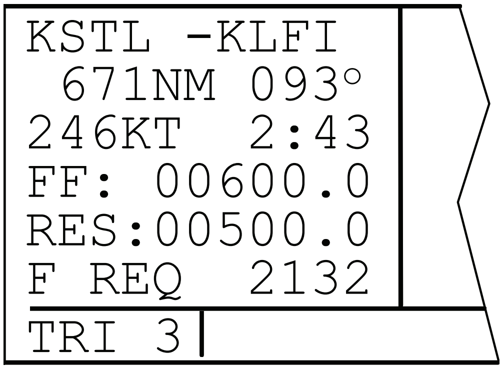


Figure 3-92. TRI 3 Page

If true airspeed and wind information were entered on the TRI 0 page, the groundspeed displayed is a result of those inputs applied to the direction of flight specified on the TRI 3 page. A different groundspeed may be entered using the left outer knob to position the cursor over each digit of the groundspeed and using the left inner knob to select each individual digit.

If data is entered for FF and RES, as described for the TRI 1 page, the fuel required for the trip is now displayed. Fuel flow and reserve fuel entries made on the TRI 3 page also input this same data on the TRI 1 and the TRI 5 pages.

9. Turn off the cursor function and then select the TRI 4 page. The minimum ESA and a listing of areas of special use airspace along the route are displayed. Refer to Figure 3-93. If all the areas of SUA won't fit on one page, there will be multiple TRI 4 pages indicated by TRI+4.

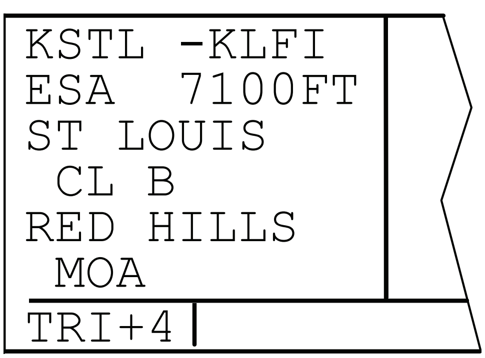


Figure 3-93. TRI 4 Page

(4) The Trip Planning 5 And 6 Pages. The TRI 5 and 6 pages are used to do trip planning for any one of the previously entered flight plans. The KLN 90B does not have to be receiving GPS signals in order to use these pages.

1. Select the TRI 5 page on the left side, Figure 3-94.

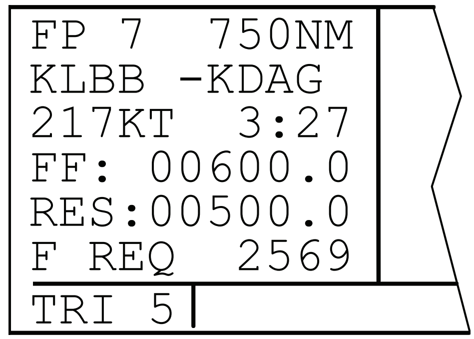


Figure 3-94. TRI 5 Page

2. Press the left **CRSR** button to turn on the left cursor function.

3. Rotate the left inner knob to select the desired flight plan. The first and last waypoints in the selected flight plan are displayed on the second line. The distance and the estimated time en route are also displayed. There is no bearing displayed since a flight plan can have up to 30 waypoints that create 29 flight plan legs.

If true airspeed and wind information were entered on the TRI 0 page, the groundspeed displayed is the average groundspeed for the flight plan. It is the result of those inputs applied to each leg of the flight plan. A different groundspeed may be entered using the left outer knob to position the cursor over each digit of the groundspeed and using the left inner knob to select each individual digit.

If data is entered for FF and RES, as described for the TRI 1 page, the fuel required for the trip is now displayed. Fuel flow and reserve fuel entries made on the TRI 5 page also input this same data on the TRI 1 and the TRI 3 pages.

4. Turn off the cursor function and then select the TRI 6 page. The minimum ESA and a listing of areas of special use airspace won't fit on one page; there will be multiple TRI 6 pages indicated by TRI+6. Refer to Figure 3-95.

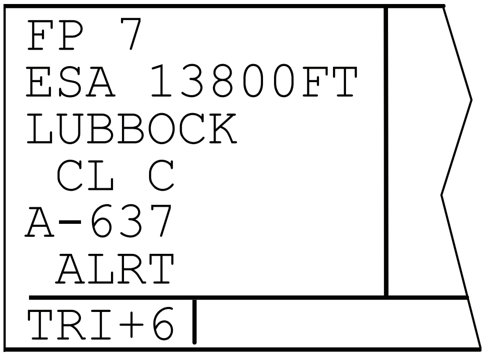


Figure 3-95. TRI 6 Page

be. The Calculator Pages. There are seven calculator pages that may be used to calculate a variety of information such as pressure altitude and density altitude, true airspeed, winds aloft, VNAV angle, and time zone conversions. The calculator pages rely on manual inputs of air data parameters even if the KLN 90B is interfaced with air data sensors.

(1) The Calculator 1 Page. The CAL 1 page is used to determine pressure altitude and density altitude.

NOTE

If the AETMS is installed and interfaced to the KLN 90B, the OTH 10 page displays pressure altitude and density altitude for the present conditions.

1. Display the CAL 1 page on the left side.

2. Press the left **CRSR** button to turn on the left cursor function.

3. Enter the altitude indicated on the aircraft altimeter (IND) to the nearest hundred feet by using the left outer knob to move the cursor to the desired position and the left inner knob to select each digit.

4. Use the left outer knob to move the cursor to the first BARO position, and then enter the current altimeter setting by using the left inner and outer knobs. The pressure altitude (PRS) is now displayed.

5. Use the left outer knob to move the cursor to the first TEMP position, and then enter the outside air temperature (in °C) by using the left inner and outer knobs. The first digit of the temperature is either zero if the temperature is above zero or a minus (–) if the temperature is below zero. For maximum accuracy, the static air temperature should be entered. Static air temperature is the temperature without the effect of heating due to movement through the air. The density altitude (DEN) is now displayed as illustrated in Figure 3-96.

6. Press the left **CRSR** button to turn off the left cursor function.

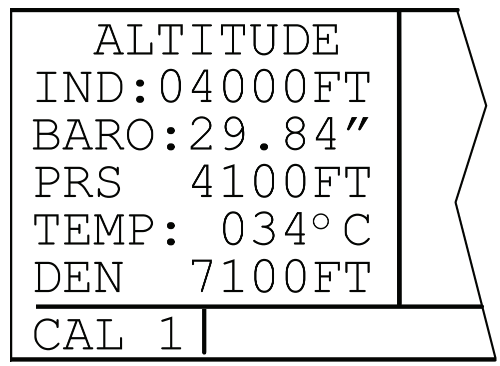


Figure 3-96. CAL 1 Page

(2) The Calculator 2 Page. The CAL 2 page is used to determine TAS.

NOTE

If the AETMS is installed and interfaced to the KLN 90B, the OTH 9 page displays the TAS for the present conditions.

1. Select the CAL 2 page on the left side.

2. Press the left **CRSR** button to turn on the cursor function.

3. Enter the aircraft's calibrated airspeed by using the left inner and outer knobs. If calibrated airspeed isn't known, use the indicated airspeed.

4. Use the left outer knob to move the cursor to the first ALT position, and then enter the indicated altitude using the left inner and outer knobs. If the indicated altitude was previously entered on the CAL 1 page, it will already be displayed.

5. Turn the left outer knob to move the cursor to the first BARO position and then enter the current altimeter setting using the left inner and outer knobs. If the altimeter setting was made on the CAL 1 page, it will already be displayed.

6. Rotate the left outer knob to move the cursor to the first TEMP position, and then enter the outside air temperature (in °C) by using the left inner and outer knobs. The first digit of the temperature is either zero (0) if the temperature is above zero or a minus (–) if the temperature is below zero. For maximum accuracy, the total air temperature should be entered. This is the temperature of the air including the effect of heating due to movement through the air. Because of the two types of temperature, a temperature entry made on the CAL 1 page is not transferred to the CAL 2 page. The TAS is now displayed as illustrated in Figure 3-97.

7. Press the left **CRSR** button to turn off the left cursor function.

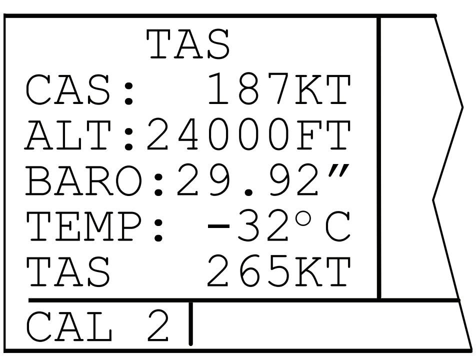


Figure 3-97. CAL 2 Page

(3) The Calculator 3 Page. The CAL 3 page is used to calculate the wind direction and speed. In addition, the headwind or tailwind component of the wind is displayed. Refer to Figure 3-98.

NOTE

Wind calculations are only correct when an accurate heading and true airspeed have been entered.

NOTE

If the KLN 90B is interfaced with the AETMS, line three of the CAL 3 page is blank. Heading is automatically input and used in the wind calculation.

If the KLN 90B is interfaced with the AETMS, the OTH 9 page displays present wind information directly.

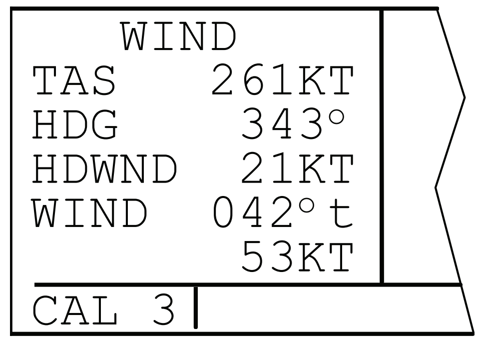


Figure 3-98. CAL 3 Page

1. Select the CAL 3 page on the left side.

2. Press the left **CRSR** button to turn on the cursor function.

3. Enter the TAS by using the left inner and outer knobs. If the CAL 2 page was previously used to calculate the TAS, it will already be displayed.

4. Use the left outer knob to move the cursor to the first HDG position, and then enter the aircraft's heading using the left inner and outer knobs. The headwind (HDWND) or tailwind (TLWND) and the wind direction and speed are now displayed. The wind direction is relative to true North.

5. Press the left **CRSR** button to turn off the cursor function.

(4) The Calculator 4 Page. The CAL 4 page is used to determine vertical navigation descent/ascent angles to use on the Nav 4 page. Refer to Figure 3-99.

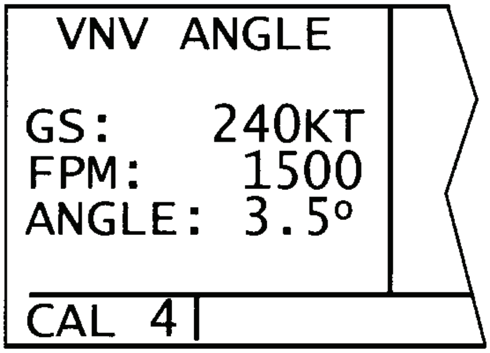


Figure 3-99. CAL 4 Page

1. Select the CAL 4 page on the left side.

2. Press the left **CRSR** button to turn on the cursor function.

3. Use the left inner and outer knobs to enter what the aircraft's groundspeed will be during the descent or ascent.

4. Turn the left outer knob to move the cursor to the first FPM position, and then enter the desired rate of descent or ascent (in feet per minute) using the left inner and outer knobs. The descent/ascent angle is now displayed. In addition, an angle may be entered and the angle will be determined.

5. Press the left **CRSR** button to turn off the cursor function.

(5) The Calculator 5 Page. The CAL 5 page is used to perform two types of conversions: between °C and °F and between knots and miles per hour. Refer to Figure 3-100.

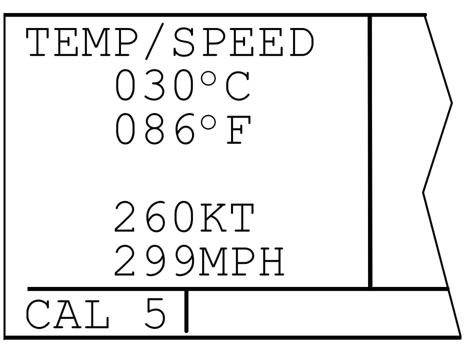


Figure 3-100. CAL 5 Page

1. Display the CAL 5 page on the left side.

2. Press the left **CRSR** button to turn on the left cursor function.

3. To convert °C to °F, use the left outer knob to position the cursor over the appropriate Celsius digits and use the left inner knob to select the desired values. When the desired temperature in °C is selected, the corresponding temperature in °F is displayed.

4. To convert °F to °C, use the left outer knob to position the cursor over the appropriate Fahrenheit digits and use the left inner knob to select the desired values. When the desired temperature in °F is selected, the corresponding temperature in °C is displayed.

5. To convert knots to miles per hour, use the left outer knob to position the cursor over the appropriate knot digits and use the left inner knob to select the desired values of speed. When the desired speed in knots is selected, the corresponding speed in miles per hour is displayed.

6. To convert miles per hour to knots, use the left outer knob to position the cursor over the appropriate miles per hour digits and use the left inner knob to select the desired values of speed. When the desired speed in miles per hour is selected, the corresponding speed in knots is displayed.

7. Press the left **CRSR** button to turn off the left cursor function.

(6) The Calculator 6 Page. The CAL 6 page is used to convert any time in one time zone to the corresponding time in another time zone. Refer to Figure 3-101.

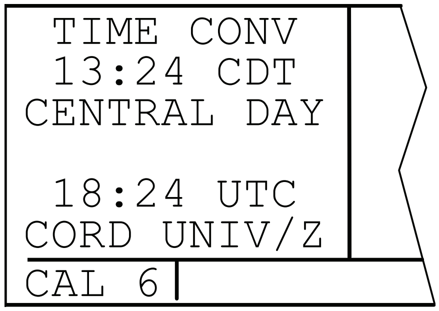


Figure 3-101. CAL 6 Page

NOTE

You may enter a time different than the actual time in either the top or bottom time display. When either the top or bottom time is changed, the other one also changes to show the correct corresponding time.

1. Select the CAL 6 page on the left side. The first time the CAL 6 page is viewed after the KLN 90B has been turned on, the top time showing will be the current system. It will be the same time displayed on the SET 2 page. The bottom time will be the current time referenced to the Coordinated Universal Time (UTC) time zone.

2. Press the left **CRSR** button to turn on the left cursor function.

3. Rotate the left outer knob to position the cursor over the top time zone abbreviation.

4. Turn the left inner knob to select the desired time zone.

5. Rotate the left outer knob to position the cursor over the bottom time zone abbreviation, and then use the left inner knob to select the desired time zone. The corresponding time is now displayed.

6. Press the left **CRSR** button to turn off the cursor function.

(7) The Calculator 7 Page. The CAL 7 page is used to display the times of sunrise and sunset for any waypoint in the published or user database. Refer to Figure 3-102. It can do this for any date up to 31 December 2087.

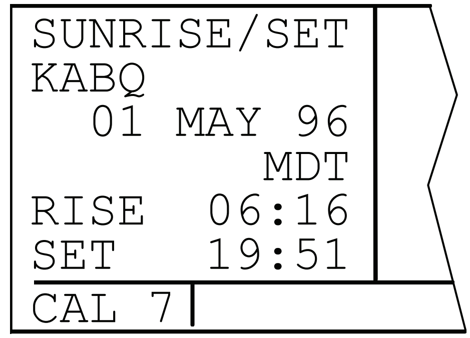


Figure 3-102. CAL 7 Page

1. Select the CAL 7 page on the left side. The first time the CAL 7 page is selected after the KLN 90B is turned on, the waypoint identifier defaults to the current destination, the date defaults to the current date, and the time zone defaults to the system time zone. Each of these three items may, however, be changed. The sunrise and sunset are displayed at the bottom of the page.

NOTE

The time zone initially displayed is the system time zone. This is the same as the one displayed on the SET 2 page. Note that the time zone displayed may not be appropriate for the waypoint shown.

2. Press the left **CRSR** button to turn on the cursor function.

3. If desired, select another waypoint identifier using the left inner and outer knobs. Press the **ENT** button to view the waypoint page for the waypoint entered. Press the **ENT** button again to approve the waypoint page.

4. If desired, select another date using the left inner and outer knobs. Press the **ENT** button to enter the date.

5. If desired, select another time zone. The sunrise and sunset times for the selected waypoint, date, and time zone are now displayed.

6. Press the left **CRSR** button to turn off the cursor function.

bf. Reference Waypoints. Creating a reference waypoint is a method of adding a waypoint to any flight plan. The reference waypoint lies on the great circle route between two other waypoints in the flight plan. The point where the reference waypoint lies on the great circle route is the point where the route passes closest to a pilot-designated point. Refer to Figure 3-103.

NOTE

The waypoint that is used to create the reference waypoint may be in the published or user database. This waypoint must be located relative to the flight plan such that it is possible to draw a perpendicular line from this waypoint to a segment of the flight plan.

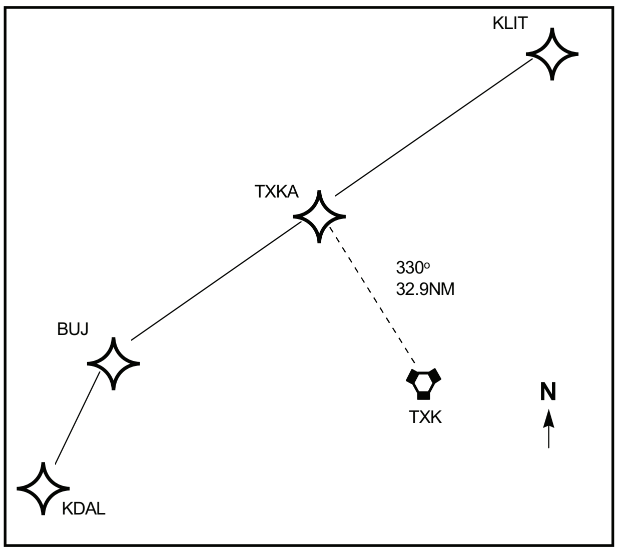


Figure 3-103. Pilot Designated Point

1. Select the reference waypoint page (REF) on the right side, Figure 3-104. If a flight plan page is not displayed on the left side, the REF page displays, "DISPLAY DESIRED - FPL ON - LEFT PAGE."

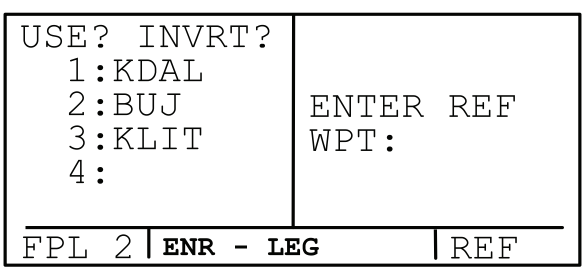


Figure 3-104. Reference Waypoint

2. Display the desired flight plan on the left side. The reference feature may be used on the active flight plan or on any of the 25 numbered flight plans that contain at least two waypoints.

3. Press the right **CRSR** button to turn on the right cursor function.

4. Use the RIGHT INNER and outer knobs to enter the identifier of the desired waypoint, Figure 3-105.

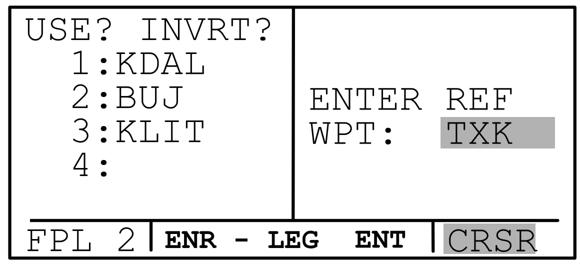


Figure 3-105. Desired Waypoint

5. Press the **ENT** button to display the waypoint page for the waypoint just entered.

6. Press the **ENT** button again to display the waypoint page for the newly created reference waypoint. The waypoint that was used to create the reference waypoint is automatically inserted into the REF field. The radial and distance as well as the latitude and longitude are also displayed. The left side of the screen shows where the reference waypoint will be inserted in the flight plan.

The KLN 90B automatically names the reference waypoint by appending the first available alphabetic character to the identifier of the waypoint used to define the reference waypoint. TXK becomes TXKA, etc. Refer to Figure 3-106. If TXK is used again to create a second reference waypoint in another flight plan, this second reference waypoint would be named TXKB. If a reference waypoint is created using a waypoint with a five-character identifier, the fifth character will be dropped, e.g., DUSTT becomes DUSTA.

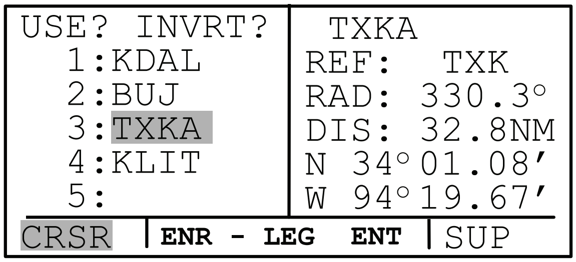


Figure 3-106. Reference Waypoint Name

7. Press the **ENT** button once again to approve the waypoint page for the reference waypoint and insert it into the flight plan.

8. Press the right **CRSR** button to turn off the right cursor function.

A reference waypoint is stored as a supplemental waypoint and counts as one of the 250 possible user-defined waypoints. Reference waypoints that are part of a flight plan show up on the listing of user–defined waypoints displayed on the OTH 3 page. However, reference waypoints that are not part of a flight plan are deleted from the list of user-defined waypoints when the KLN 90B is turned off.

bg. Center Waypoints. Like reference waypoints, creating Center waypoints is a method of adding waypoints to a flight plan. Center waypoints are waypoints at locations where a flight plan intersects the Center or FIR boundary. Placing waypoints on the boundary results in the minimum number of waypoints required for criteria of having one waypoint in each Center's airspace. The Center boundaries are stored in the database.

(1) Creating Center Waypoints.

1. Select the Center Waypoint 1 (CTR 1) page on the right side. If a flight plan page is not being displayed on the left side, the CTR 1 page will display: DISPLAY DESIRED - FPL ON - LEFT PAGE.

2. Select the desired flight plan page on the left side. It may be the active flight plan or one of the other 25 numbered flight plans.

3. Press the **ENT** button to compute the Center waypoints, Figure 3-107. A Center waypoint will be created at each intersection of the flight plan with a center boundary. When computation is complete, the CTR 1 page will display how many Center waypoints have been computed. Refer to Figure 3-108.

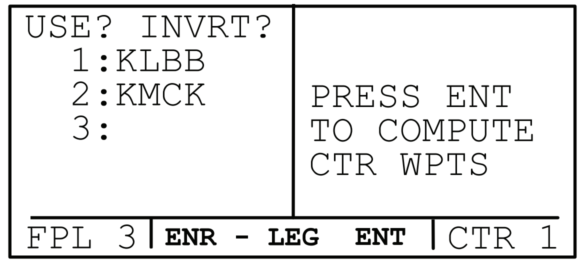


Figure 3-107. CTR 1 Page - Computing Waypoints

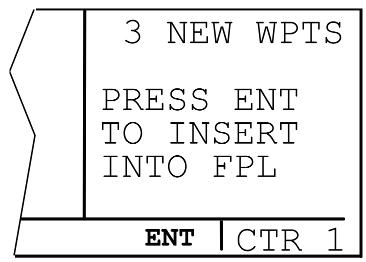


Figure 3-108. CTR 1 Page - Center Waypoints

4. To view the Center waypoints before inserting them into the flight plan, turn the RIGHT INNER knob to the CTR 2 page. Multiple Center 2 pages will be annunciated as CTR+2.

The top line contains the identifier of the Center waypoint. The KLN 90B automatically creates the identifier by appending the first available two–digit number to the identifier of the nearest VOR to the waypoint. Therefore, if Plainview (PVW) is the nearest VOR to the first Center waypoint location, the 00 is appended to PVW to create PVW00. If PVW were later used in the creation of another Center waypoint, the second waypoint's identifier would be PVW01.

The second line of the CTR 2 page shows from Center followed by the to Center. In this example, PVW00 lies on the boundary between Ft. Worth (FW) and Albuquerque (ABQ) Centers.

The third and fourth lines of the CTR 2 page display the Center waypoint location in terms of the identifier of the nearest VOR to the Center waypoint and the distance and radial from this VOR to the Center waypoint. Lines five and six display the Center waypoint location in terms of latitude and longitude. Refer to Figure 3-109.

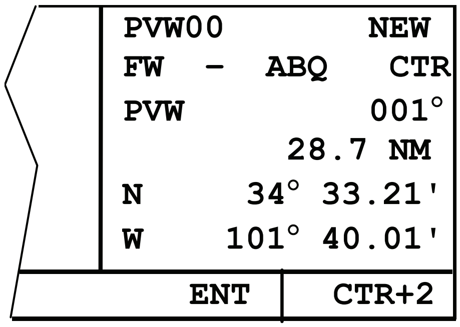


Figure 3-109. CTR 2 Page

(2) Inserting Center Waypoints Into Flight Plan. Insert the Center waypoints into the desired flight plan by returning to the CTR 1 page on the right side and pressing the **ENT** button. The Center waypoints are inserted into the flight plan in the correct order. Refer to Figure 3-110.

If inserting the waypoints would cause the number of waypoints to exceed 30, then no Center waypoints are displayed and the CTR 1 page will display, NOT ENOUGH ROOM IN FPL.

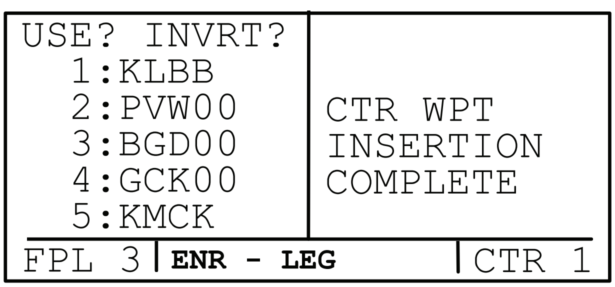


Figure 3-110. Insert Center Waypoints

After the Center waypoints have been inserted into a flight plan, they may be viewed by returning to the CTR 2 page. As long as the same flight plan is displayed on the left side of the screen, the Center waypoints may be viewed by displaying the CTR 2 page(s). The CTR 1 and 2 pages return to their original format any time the specific flight plan is no longer displayed on the left side. To view the Center waypoints again, return to the specific flight plan, select the CTR 2 page, and press the **ENT** button.

Center waypoints are stored as part of the 250 user-defined waypoints and are considered supplemental waypoints. When Center waypoints are viewed on the SUP page or on the active waypoint (ACT) page, they appear in the normal supplemental waypoint format. Center waypoints that are part of a flight plan show up on the OTH 3 page. Center waypoints that are not part of a flight plan are deleted from the list of user-defined waypoints when the KLN 90B is turned off.

Once Center waypoints have been inserted into a flight plan, they are treated like any other waypoints in the flight plan. If a flight plan containing Center waypoints is modified in any way, new Center waypoints may be computed. The original Center waypoints are now part of the flight plan and new Center waypoints are computed by treating the original Center waypoints the same as any other waypoints in the flight plan. If the interior of a flight plan containing Center waypoints is modified, it may be desirable to manually delete obsolete Center waypoints from the flight plan before computing new ones.

bh. The Status Pages. There are four status pages. The STA 1 and STA 2 pages display information pertaining specifically to the GPS receiver, while the STA 3 and STA 4 pages display supplementary information pertaining to the KLN 90B.

The STA 1 and STA 2 pages may be viewed at any time to determine the status of the GPS receiver and the GPS satellites being received. This includes which satellites are being tracked, the satellites' health, the signal to noise ratio for each of the satellites, the elevation of each satellite above the horizon, and the estimated position error.

The GPS receiver in the KLN 90B is capable of using signals from up to eight satellites to determine position. A valid position may be determined using as few as four satellites alone or three satellites with an altitude input. However, four satellites alone or three satellites with an altitude input do not necessarily ensure that navigation can take place. The satellites must be positioned relative to the aircraft such that sufficient geometry exists to determine an accurate position. The satellite constellation geometry is continually changing as each satellite rises, travels across the sky, and eventually sets relative to the aircraft's position. The GPS satellites are not in geosynchronous orbits positioned over the same spot on the earth at all times. Rather, the GPS satellites are in orbits that allow them to circle the earth about two times each day.

(1) STA 1 Page. There will be two STA 1 pages if more than four satellites are being received. The GPS state is indicated on line 1. Refer to Table 3-17 for GPS status codes and their meanings.

Table 3-17. GPS Status Codes

DISPLAY	EXPLANATION
ACQ	Acquisition
DEGRD	Navigation with position degradation
FAILR	Receiver failure
INIT	Initialization
NAV	Navigation
NAV A	Navigation with altitude aiding
NAV D	Navigation with data collection
TRAN	Transition

In the initialization stage, the GPS receiver is in the process of initializing and collecting information such as the date, time, and last position. Next the receiver collects data from its own memory to determine which satellites should be visible. After completing the initialization process, the receiver begins the acquisition process. During this time, the visible satellites are being acquired and data from them is being obtained.

The transition stage indicates an adequate number of satellites for navigation has been acquired and is being tracked, but no position data can yet be produced.

Normal navigation is indicated by a NAV, NAV A, or a NAV D GPS state. NAV A indicates that the altitude input is being used in the position solution. NAV D indicates that besides calculating position, the receiver is collecting and storing in its memory ephemera and almanac data information.

The specific GPS satellites or Space Vehicles (SV), being received are displayed in the left column. Each satellite has its own identification number. An asterisk (*) to the left of the satellite indicates this particular satellite is not presently being used in the navigation solution.

The satellite's health, transmitted by satellite, is indicated to the right of the satellite number. Health designators are defined in Table 3-18.

The Signal to Noise Ratio (SNR) for each satellite being received is displayed in the middle column and indicates the signal strength for each satellite. The higher the SNR value, the stronger the signal. Values usable for navigation will be in the mid 30's to 50's. Typical values are in the middle of this range.

Table 3-18. Satellite Health

DISPLAY	EXPLANATION
B	Bad
W	Weak
–	Unknown
Blank	Good

The elevation (ELE) above the horizon for each satellite is provided in the right column and will range from 5 ° to 90°. Refer to Figure 3-111.

(2) STA 2 Page. The STA 2 page displays the systems estimate of the position error expressed in nautical miles. Refer to Figure 3-112. The KLN 90B's position error depends on such factors as the number of satellites being received, the strength of the GPS signals, and the geometry of the satellites presently being used for navigation.

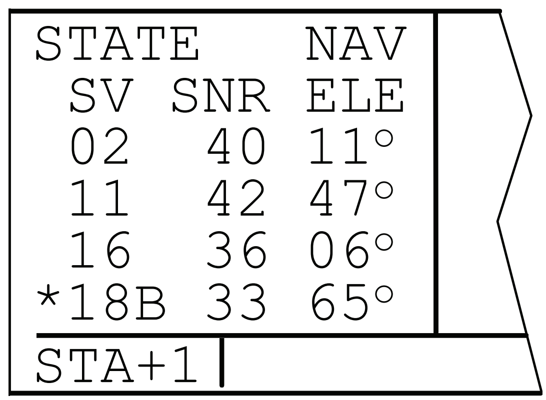


Figure 3-111. STA 1 Page

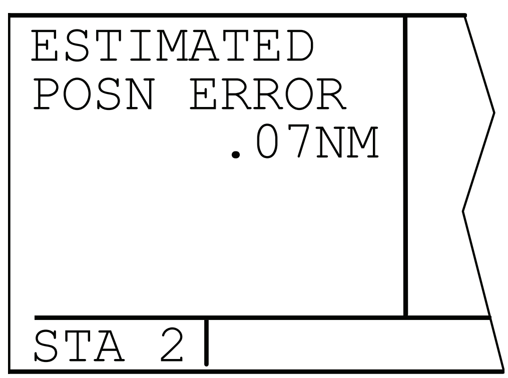


Figure 3-112. STA 2 Page

(3) STA 3 Page. The STA 3 page displays the software revision status of the KLN 90B host computer and of the GPS receiver. A field called OBS CAL is also included on this page. The value indicates the calibration of the internal resolver circuitry of the KLN 90B.

(4) STA 4 Page. The STA 4 page displays the KLN 90B's total operating time and also the number of times the unit has been turned on. These values are set to zero if the KLN 90B's nonvolatile memory is cleared.

bi. Messages. The following is a list of messages that can appear on the message page.

(1) ACTV ANNUNCIATOR FAIL - This message appears when there is a failure of the KLN 90B ACTV annunciator drive circuitry. To determine if the approach mode is active, look at the status line of the KLN 90B.

(2) ADJ NAV IND CRS TO 123° - The pilot should select the suggested course on the HSI. This message occurs at the beginning of turn anticipation.

(3) ADJ NAV IND CRS - This may appear in installations where the KLN 90B is interfaced with EFIS or with a mechanical HSI through the KA 90 adapter. Appears when the difference between the HSI's selected course and the KLN 90B's selected course is greater than 0.5°.

(4) AIRSPACE ALERT - Displays when the estimated time to enter special use airspace is approximately 10 minutes or the distance is less than 2 nm.

(5) ALTITUDE FAIL - Displays when altitude input fails. Altitude related features will be disabled.

(6) APT ELEVATION UNKNOWN - Displays when airport elevation for height above airport alert is unknown.

(7) ARINC 429 AIR DATA FAIL - This message indicates that the air data systems with ARINC 429 outputs are not being received correctly by the KLN 90B.

(8) ARINC 429 OUTPUT FAIL - This message indicates that the KLN 90B ARINC 429 output fails test. This affects EHI 40/50 electronic HSI and some navigation graphics displays.

(9) ARM ANNUNCIATOR FAIL - This message displays when there is a failure of the KLN 90B ARM annunciator drive circuitry. To determine if the approach mode is armed, look at the status line of the KLN 90B.

(10) ARM GPS APPROACH - If the approach arm mode has been disarmed, the KLN 90B will prompt arming the approach mode when the aircraft is 3 nm from the FAF.

(11) BAD SATELLITE GEOMETRY AND RAIM NOT AVAILABLE - Appears only if in the approach active mode, RAIM is not available, and the satellite geometry has further degraded to cause more uncertainty of the aircraft position.

(12) BAD SATELLITE GEOMETRY SEE EPE ON STA 2 PAGE - RAIM is not available. Possible position error is greater than allowed for IFR flight. Crosscheck the position of the aircraft with other means of navigation.

(13) BATTERY LOW: SERVICE REQUIRED TO PREVENT LOSS OF USER DATA - Internal battery is low and needs replacement.

(14) CHECK ACTV ANNUNCIATOR - A failure between the KLN 90B and the annunciator. To determine if the approach mode is active, look at the status line of the KLN 90B.

(15) CHECK ARM ANNUNCIATOR - A failure between the KLN 90B and the annunciator. To determine if the approach mode is armed, look at the status line of the KLN 90B.

(16) CHECK MSG ANNUNCIATOR - A failure between the KLN 90B and the annunciator. To determine if message alerting is being given, check the display of the KLN 90B.

(17) CHECK WPT ANNUNCIATOR - A failure between the KLN 90B and the annunciator. To determine if waypoint alerting is being given, check the display of the KLN 90B.

(18) DATABASE CHECKSUM ERR - Database fails internal test. Most likely cause is a failed database cartridge.

(19) DATABASE OUT OF DATE ALL DATA MUST BE CONFIRMED BEFORE USE - Database is out of date.

(20) EEPROM FAILURE: 1C___EXTERNAL D-BAR INVALID - The blanks contain the designator of a specific failed component. Record the data. Do not use it and external HSI. The rest of the KLN 90B is still usable, including the internal CDI. The page displays may not be centered on the screen.

(21) IF REQUIRED SELECT OBS - The aircraft is 4 nm from a waypoint which could be used as the basis of either a procedure turn or a holding pattern.

(22) INSIDE SPC USE AIRSPACE - Aircraft's present position is inside an area of special use airspace.

(23) MAGNETIC VAR INVALID ALL DATA REFERENCED TO TRUE NORTH - Magnetic variation is invalid due to operation outside of the database magnetic variation area without having a pilot entered magnetic variation.

(24) MSG ANNUNCIATOR FAIL - This message appears when there is a failure of the KLN 90B MSG annunciator drive circuitry. To determine if message alerting is being given, check the display of the KLN 90B.

(25) NAV SUPER FLAG FAILURE - This message appears when an internal test fails for a specific NAV flag output. The KLN 90B is still usable. HSI and autopilot should be used with caution.

(26) NO RCVR DATA - The GPS receiver fails a specific internal test. The unit will not provide any navigation capability.

(27) NO RS-232 DATA - Appears when no input is received on the RS-232 input, such as a fuel management or air data system.

(28) OBS WPT > 200 NM - The KLN 90B is in the OBS mode and the distance to the active waypoint is more than 200 nm. The system will perform normally, however, at this distance the deviation bar will be extremely sensitive to changes in selected course.

(29) OTHER WAYPOINTS DELETED - Appears when the message WAYPOINT___ DELETED would be effective for more than 10 waypoints.

(30) POSITION DIFFERS FROM LAST POSITION BY > 2NM - Appears when the GPS sensor first reaches the NAV mode if the new position differs from the position when the power was turned off by more than 2 nm.

(31) POSITION OF WPT HAS CHANGED - Either the latitude or the longitude of a waypoint used in a flight plan or the active waypoint has changed by more than 0.33 minutes as a result of updating the database.

(32) POSITIONS OF OTHER WAYPOINTS HAVE CHANGED - Appears when the above message POSITION OF WPT HAS CHANGED would be effective for more than 10 waypoints.

(33) PRESS ALT TO SET BARO - Appears when the approach mode is armed.

(34) PRESS GPS APR FOR NAV - Appears after the NAV flag has displayed due to a RAIM problem while the unit is in the approach mode. By pressing the **GPS APR** button, the unit will be able to restore navigation information so that a missed approach may be conducted based on navigation information provided by the KLN 90B.

(35) RAIM NOT AVAILABLE APR MODE INHIBITED PREDICT RAIM ON STA 5 - Appears when integrity monitoring (RAIM) is predicted to not be available at either the FAF or the MAP. The KLN 90B will not allow the unit to go into the approach active mode. Turn to STA 5 page to perform a RAIM prediction.

(36) RAIM POSITION ERROR CROSS CHECK POSITION - The unit has detected a problem with one of the satellites and the position cannot be assured to be within IFR limits. Cross check the position of the aircraft with other means of navigation every 15 minutes to verify the position.

(37) RCVR HARDWARE ERROR_____ - Appears when the unit fails a specific internal test. Record the numerical value.

(38) RECYCLE POWER TO USE CORRECT DATABASE DATA - The date entered on the self test page is before the database effective date and the date entered on the SET 2 page is after the database effective date, or vice versa. Turn the unit off and back on.

(39) REDUNDANT WPTS IN FPL EDIT EN ROUTE WPTS AS NECESSARY - Appears after the pilot inserts an approach or SID/STAR procedure in the flight plan. Remove those waypoints that occur both in the en route and the SID/STAR sections.

(40) RS-232 DATA ERROR - An error is detected in the received RS-232 data such as from a fuel management or air data system.

(41) RS-232 OUTPUT ERROR – RS-232 output fails internal test. Do not use moving map displays.

(42) SATELLITE COVERAGE INADEQUATE FOR NAV - Received GPS signals are not adequate

for navigation. Insufficient number of satellites or inadequate satellite geometry to accurately determine the position within 3.8 nm.

(43) SET FUEL ON BOARD ON OTH 5 IF NECESSARY - Appears when the KLN 90B is interfaced with a fuel flow computer that allows the fuel on board to be set.

(44) SYSTEM TIME UPDATED TO GPS TIME - Appears when the KLN 90B system time is automatically updated to GPS time by more than 10 minutes.

(45) USER DATA LOST - Appears when the unit determines that the internal memory backup battery is dead or that some other internal failure has occurred which has caused all user entered data to be lost.

(46) VNV ALERT - Appears when a VNAV operation has been programmed on the NAV 4 page and the estimated time to start the climb or descent is approximately 90 seconds.

(47) WAYPOINT ___ DELETED - Appears when a waypoint used in a flight plan, or the active waypoint, no longer exists as a result of updating the database. The waypoint is deleted from flight plans in which it was used.

(48) WPT ANNUNCIATOR FAIL - This message displays when there is a failure of the KLN 90B WPT annunciator drive circuitry. To determine if waypoint alerting is being given, check the display of the KLN 90B.

bj. Status Line Messages. These are short, operational messages that are displayed in the lower center segment of the screen.

(1) ACTIVE WPT - Appears if an attempt is made to delete a waypoint on the OTH 3 page and the waypoint is the active waypoint.

(2) D CRS XXX° - Appears when the KLN 90B is in the OBS mode and is interfaced with an external indicator which the KLN 90B cannot change the selected course and the pilot performs a direct to operation. Since the KLN 90B cannot change the selected course, the pilot is given a message for the OBS value to set the indicator to.

(3) DUP IDENT - More than one waypoint of that type has the same identifier.

(4) ENT LAT/LON - A reminder to enter the location of a user-defined waypoint.

(5) FPL FULL - An attempt has been made to add a waypoint to a flight plan that already contains 30 waypoints.

(6) IN ACT LIST - Appears when a user-defined VOR is the active waypoint and attempt is made to change the stored magnetic variation of this VOR. The magnetic variation cannot be changed while the VOR is the active waypoint.

(7) INVALID ADD - Appears when an attempt is made to add a waypoint to an approach.

(8) INVALID DEL - Appears when an attempt is made to delete a waypoint from an approach.

(9) INVALID ENT - Appears when an attempt is made to enter invalid data, e.g., 30 FEB 96.

(10) INVALID REF - Appears with an attempt to create an invalid reference waypoint.

(11) INVALID VNV - Appears when a waypoint identifier has been entered on the NAV 4 page if the waypoint is not valid for VNAV operation.

(12) NO ACTV WPT - Appears with an attempt to activate the OBS mode if there is no active waypoint.

(13) NO APPROACH - Appears with an attempt to arm the GPS approach mode when there is no approach loaded into the active flight plan.

(14) NO APT WPTS - Appears when the APT type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined airport waypoints.

(15) NO INT WPTS - Appears when the INT type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined intersection waypoints.

(16) NO INTRCEPT - Appears when an attempt is made to recalculate the intercept point on a DME arc and the actual track doesn't intercept the arc.

(17) NO NDB WPTS - Appears when the NDB type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined NDB waypoints.

(18) NO SUCH WPT - Appears when there is no waypoint in the database corresponding to the identifier entered on the reference waypoint page.

(19) NO SUP WAPTS - Appears when the SUP type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined supplemental waypoints.

(20) NO VOR WPTS - Appears when the VOR type pages have been selected if the KLN 90B doesn't contain a database cartridge and there are no user-defined VOR waypoints.

(21) OUTDATED DB - Appears whenever the pilot attempts to select an approach from an outdated database.

(22) RMKS FULL - Appears when an attempt is made to create a user-entered airport remark on the APT 5 page if 100 user-entered airport remarks already exist.

(23) RWY MISSING - Appears when the APT 3 page runway diagram shows some, but not all, of the runways at the selected airport.

(24) USED IN FPL - Appears when an attempt is made to delete a user-defined waypoint on the OTH 3 page if the waypoint is used in a flight plan.

(25) USR DB FULL - Appears with an attempt to create a user-defined waypoint if the user database already contains 250 waypoints.

bk. Abbreviations. For a complete list of abbreviations, see Allied Signals Pilot's Guide for the KLN 90B Navigation System.

Section IV. RADAR AND TRANSPONDER

3-8. GENERAL.

The radar and transponder group provides identification, position, emergency tracking system, and a radar system to locate weather areas. The common radar and transponder equipment consists of the stormscope (WX-1000E) and the transponder set (AN/APX-100).

3-9. STORMSCOPE (WX-1000E).

a. Description. The Stormscope system consists of three components that detect, locate, and map areas of vertical electrical discharge activity contained within thunderstorms. The antenna mounts externally to the aircraft and detects electrical discharges associated with thunderstorms over a 125,000 square mile area around the aircraft. The processor analyzes this information to aid in identification of valid electrical discharges from lightning and to determine range and azimuth for display in the cockpit. The analysis is completed in milliseconds. The location of a vertical electrical discharge associated with thunderstorms is plotted on the CRT display on the instrument panel as an individual discharge point (**+**).

b. Controls and Functions.

(1) Power/Brightness Control. Rotate to turn on the system and adjust the brightness of the display.

(2) Selector Buttons. The specific function of each button is displayed adjacent to the button in each operating mode.

c. Normal Operation.

(1) Self-Test. Each time the system is turned on, it will automatically cycle through a series of self–tests which ensure that all major functions are operating properly. These tests, which take approximately 15 seconds to complete, check antenna reception, processor circuitry calibration, memory and microprocessor function, and proper operation of the options. After proper operation has been verified by the self–test program, a confirmation message, ALL TESTS ARE OK, will display in reverse video. This message will remain on the display for approximately 3 seconds and then will be replaced automatically with MAIN MENU.

If the system fails any of the internal tests, an error message will appear indicating which test failed and which functions may be inoperative. In most cases, all other systems will continue to operate. If continued operation is possible, the message, PRESS ANY KEY TO CONTINUE, displays.

When initially turned on, the system may complete its self-test program before the CRT comes on. In that case it is possible that the first message that will be seen is the main menu. This is normal operation.

If the weather screen is selected immediately, it is possible the advisory message FLAG will display where heading information is normally displayed. This usually means the gyro system has not yet come up to speed. FLAG should be replaced with heading information momentarily.

(2) Main Menu. The main menu provides access to the two weather mode views and additional system functions, including checklists, time/date information, options, and navaid display. To select a specific menu item, press **NEXT** button on the display until the desired item is highlighted and press the **GO** button to view the selected menu item.

(3) Weather Modes. Two weather mode views are available from the main menu by pressing either the 360° or the 120° button. Refer to Figures 3-113 and 3-114, respectively. The symbol ➔ means to "go to." When the weather mode is initially selected, it will always be in the 200 nm range. Pressing the button beside the range setting will cycle through the additional range selections from 200 nm to 100 nm to 50 nm to 25 nm and back to 200 nm. The 25 nm range is indicated by a solid ring to advise of close proximity to potential thunderstorms. Either view can be selected from the main menu or the opposite view. When changing from one view to another, the range remains constant.

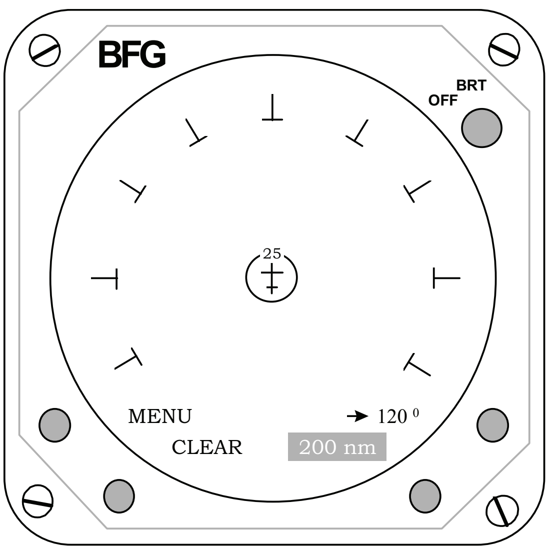


Figure 3-113. 360º Weather Mode

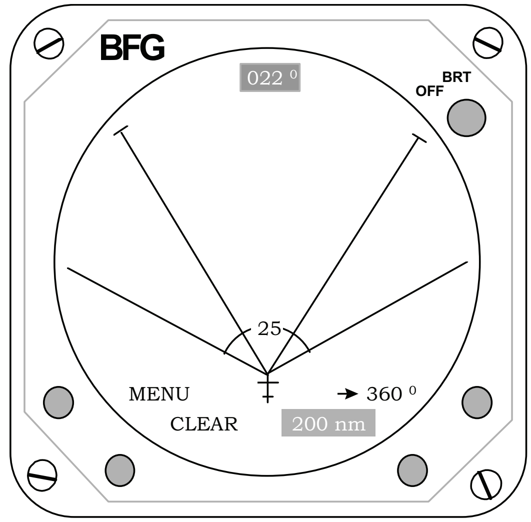


Figure 3-114. 120° Weather Mode

Press the **CLEAR** button to erase all weather data from the display and system memory. The intensity of a thunderstorm can be identified by the speed with which the discharge points appear. The system continually receives and processes new electrical discharge information. Monitor this by pressing the clear button often. The more intense the storm, the faster the discharge points reappear.

Multiple discharges, which appear as clusters, are indicative of thunderstorm activity. A large number of discharge points indicate a faster rate of occurrence and, therefore, a more severe thunderstorm. Fewer discharge points indicate a smaller, but not necessarily weaker, cell. Thunderstorm conditions change rapidly and monitoring their activity over a period of time by use of the **CLEAR** function is recommended. Any grouping of discharge points within the 25-nm range is cause for immediate avoidance.

WARNING

The Stormscope system should never be used to attempt thunderstorm penetration. The FAA and AIM recommend avoiding, by at least 20 miles, any thunderstorm identified as severe or giving an intense radar echo.

CAUTION

Persistent clusters of two or more discharge points indicate thunderstorms. There are several atmospheric phenomena that can cause isolated discharge points. Clusters of two or more discharge points indicate thunderstorm activity when they reappear persistently after clearing the screen.

Additionally, should the heading stabilization fail, it is necessary to press the **CLEAR** button for properly oriented data following an aircraft heading change.

Press the **MENU** button to return to the main menu.

NOTE
The date is set before the time.

(4) Time/Date Mode. The TIME/DATE mode can be selected only from the main menu. The time/date mode menu displays four items: stopwatch, elapsed time, time of day, and day, month, and year. Refer to Figure 3-115. When first selecting the time/date mode, the stopwatch digits will be highlighted. To use the stopwatch function, press the **START** button to start or stop. Pressing the **RESET** button will immediately reset the timer. To use the elapsed time feature, press the **NEXT** button to highlight the elapsed time digits and press the **START** button to start or stop the counter. Pressing the **RESET** button will reset the elapsed timer.

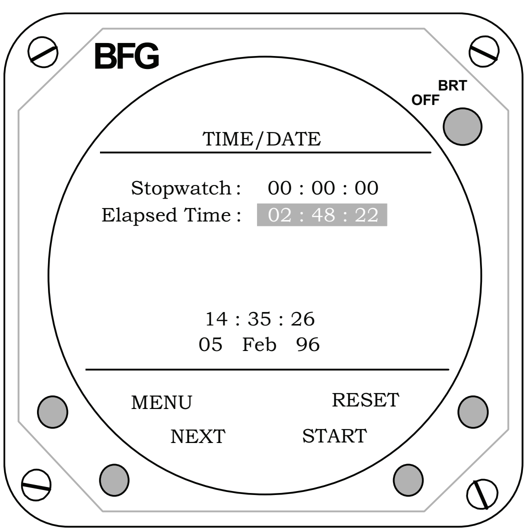


Figure 3-115. Time/Date Mode

To set the current date or the correct time, press the **NEXT** button to highlight the digits to be changed. Press the **UP** or **DOWN** button to step the digits to the proper value. When either the time or date are highlighted, the **RESET** and **START** button legends are replaced with **UP** and **DOWN**.

(5) Options Mode. The options mode can only be selected from the main menu. The system continuously self-tests many functions. Refer to Figure 3-116. Results are indicated by CONTINUOUS TEST: OK or FAULT. CONTINUOUS TEST: OK indicates that all internal self–test items have been operating properly. The continuous self-test is intended to advise only of major component failures. The pilot initiated self-test is more extensive than the continuous self-test and is recommended as a check on system operation whenever thunderstorm activity is noted on the display. Press the **TEST** button when in the options mode to manually initiate the test.

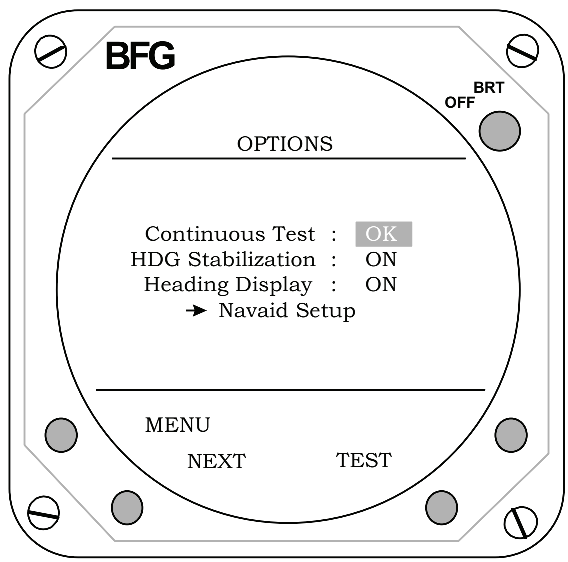


Figure 3-116. Options Test Mode

The system will initially power up with the heading stabilization feature on. Should the aircraft heading gyro fail, the heading stabilization feature can be turned off. To turn the heading display on or off, press the **NEXT** button to highlight heading display and press **ON/OFF** as appropriate. Refer to Figure 3-117. When on, the heading of the aircraft will appear as a digital indication at the top of the display when in either weather mode.

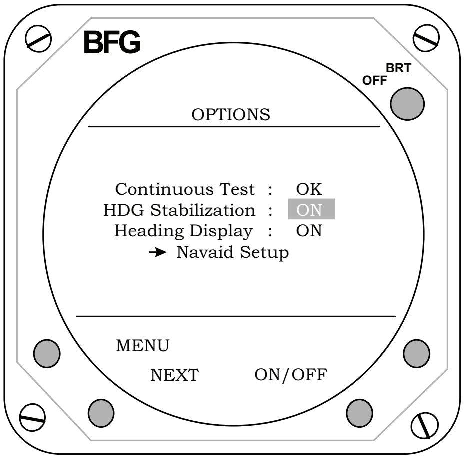


Figure 3-117. Heading Options

(6) Navaid Option. This option creates a weather avoidance and navigational view. Refer to Figure 3-118. Using data from the KLN 90B, this option provides simultaneous display of both thunderstorm and flight information on the system screen. The course line, selected waypoints, and a course deviation indicator are graphically displayed. Up to 10 waypoints may be displayed with the selected nautical mile range. The CDI is calibrated to indicate the course deviation up to 5 nm on either side of the course line. Up to six user-selectable data items can be displayed. The navaid option is selected from the main menu. Display range, ground speed, estimated time en route, bearing, crosstrack error, and estimated time of arrival are automatically displayed. The data or its position can be changed through the Navaid Setup function on the Options menu.

The Navaid Setup grid lists 14 data items and includes a blank space. Refer to Table 3-19 for data items definitions. Up to six items can be displayed on the weather-mapping screen. To select an item from the grid, move the highlight by pressing the **NEXT** button. Refer to Figure 3-119. The data items available for selection are dependent upon the specific information provided by the KLN 90B receiver. If an item on the grid is not available from the receiver, that grid space will include an asterisk.

Table 3-19. Navigation Data Items

ABBR	USER SELECTIONS
Brg	Bearing to Active Waypoint
ETA	Estimated Time of Arrival
ETE	Estimated Time En Route
GS	Ground Speed
Lat	Latitude
Long	Longitude
MESA	Minimum En Route Safe Altitude
MSA	Minimum Safe Altitude
Mvar	Magnetic Variation at Present Position
Rng	Range to Active Waypoint
Time	Stormscope System Stopwatch
Trk	Track
WPT	Waypoint Identifier
XTK	Crosstrack Error

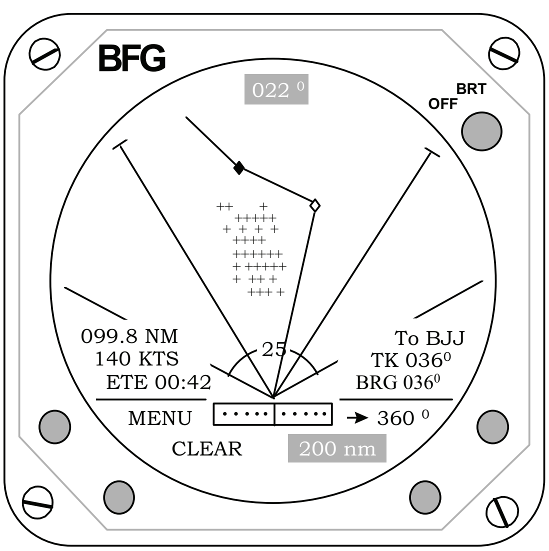


Figure 3-118. Navaid Option

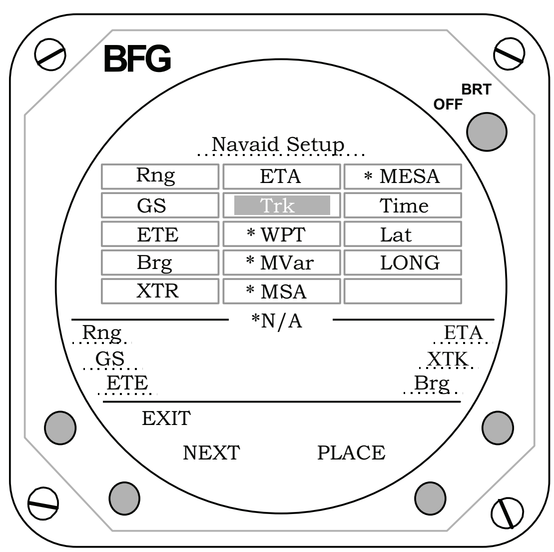


Figure 3-119. Navaid Setup – Select

To place the item into one of the six positions on the screen, press the **PLACE** button. This places the data item in the upper left position in the legend area. To move the item to another position, press the **MOVE** button. Each additional press of the **MOVE** button advances the item counterclockwise. Refer to Figure 3-120.

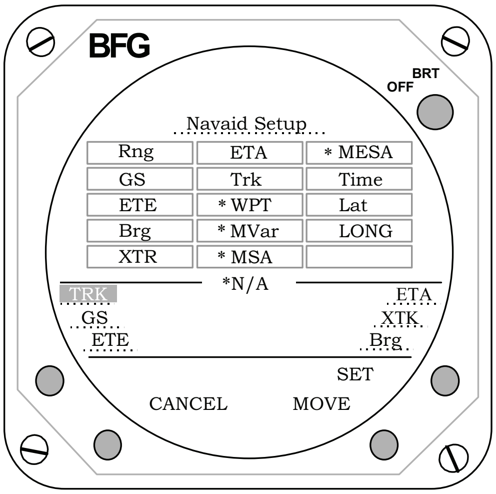


Figure 3-120. Navaid Setup – Move

To set the display position of a highlighted item, press the **SET** button. This establishes the position of the data item display on the weather screens. After pressing the **SET** button, the highlight will return to the next data item on the grid. To return the data item to the grid without setting, press the **CANCEL** button. This will return the data item highlight to the grid. Since the data item was not set to the legend area, any data item previously occupying the position will remain there. To select additional data items, repeat the sequence of **NEXT** to highlight the item, **PLACE** it from the grid to the legend area, **MOVE** it to the desired position on the legend area, and **SET** it. To replace a data item previously set in position, follow the same sequence. Pressing the **SET** button when a highlighted data item is in an occupied legend position causes the new item to replace the previous item.

To erase an item from the legend area, press **NEXT** to highlight the blank space on the grid, **PLACE** it to the legend area, **MOVE** it in the legend area to the position to be erased, and **SET** it.

Press the **EXIT** button to return to the Options Menu. Press **MENU** to return the Main Menu including the weather options.

(7) Error Messages. Most common errors and malfunctions are indicated on the display screen. These messages enable service personnel to diagnose and correct the problem. If continued operation is possible, a message to press any key to continue operation will be displayed. When the LORAN or GPS receiver fails to acquire a consistent signal and is not certain of its position, the message NAV FLAG will appear in place of the CDI. Navigational data will not be displayed if the receiver indicates a flag condition. In conditions where the LORAN or GPS receiver determines its position error to be greater than 1.7 nm, a W (warning) will appear next to the affected data items.

3-10. TRANSPONDER SET (AN/APX-100).

a. Description. The transponder system receives, decodes, and responds to interrogations from ATC radar to allow aircraft identification, altitude reporting, position tracking, and emergency tracking. The system receives a radar frequency of 1030 MHz and transmits preset coded reply pulses on a radar frequency of 1090 MHz at a minimum peak power of 200 watts. The range of the system is limited to line-of-sight.

The transponder system consists of a combined receiver/transmitter control panel, Figure 3-121, located on the pedestal extension; a pair of remote switches, one on each control wheel; and two antennas located on the underside and top of the fuselage. The system is protected by a 3-ampere circuit breaker, placarded **XPONDER** **D2** or **TRANSPONDER** **C D1** , or **XPONDER #2 IFF** **T** located on the right side of the circuit breaker panel, Figure 2-16.

b. Controls/Indicators and Functions. Refer to Figure 3-121.

(1) ***TEST / GO*** *Indicator* – Illumination indicates successful completion of built-in-test (BIT).

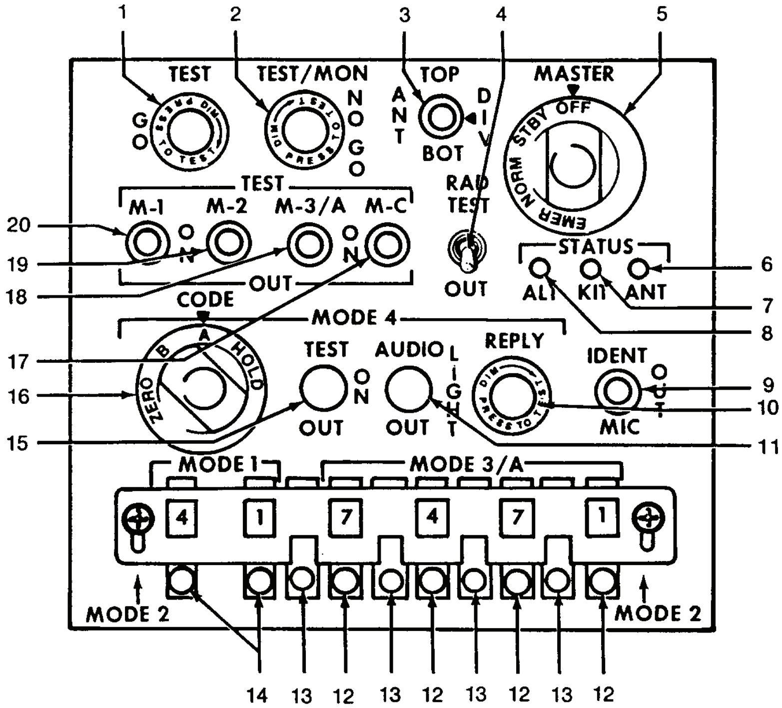
(2) ***TEST / MON*** *Indicator* – Illumination indicates unit has malfunctioned, or interrogation by a ground station (MON).

(3) ***ANT*** *Switch.* Selects desired antenna for signal output.

WARNING

Place the TOP / BOT / DIV switch in the DIV position during flight operations. Do not use the TOP or BOT position. This does not preclude using the TOP or BOT switch position for ground–based system checks.

(a) ***TOP*** – Selects use of top antenna.



1. **TEST / GO Indicator**
2. **TEST/MON NO GO Indicator**
3. **ANT Switch**
4. **RAD TEST / OUT Switch**
5. **MASTER Control**
6. **STATUS ANT Indicator**
7. **STATUS KIT Indicator**
8. **STATUS ALT Indicator**
9. **IDENT / OUT / MIC Switch**
10. **MODE 4 REPLY Indicator**
11. **MODE 4 AUDIO / LIGHT–OUT Switch**
12. **MODE 3/A Code Selectors**
13. **MODE 2 Code Selectors**
14. **MODE 1 Code Selectors**
15. **MODE 4 TEST / ON / OUT Switch**
16. **MODE 4 CODE Control**
17. **M–C TEST Switch**
18. **M–3/A TEST Switch**
19. **M–2 TEST Switch**
20. **M–1 TEST Switch**

Figure 3-121. Transponder Control Panel (AN/APX-100)

(b) ***DIV*** – Selects diversity operation using both antennas.

(c) ***BOT*** – Selects use of bottom antenna.

(4) ***RAD TEST OUT*** *Switch*. Enables an appropriately equipped transponder to reply test mode interrogations from an AN/UPM-92 or similar test set.

(5) ***MASTER*** *Control.* Selects system operating mode.

(a) ***OFF*** – Turns set off.

(b) ***STBY*** – Places set in warmup (standby) condition. Red NO-GO light is **ON** in standby position.

(c) ***NORM*** – Operates set at normal sensitivity.

(d) ***EMER*** – Transmits emergency reply code.

(6) ***STATUS ANT*** *Indicator* – Illumination indicates the BIT or MON failure is due to high VSWR in antenna.

(7) ***STATUS KIT*** *Indicator* – Illumination indicates the BIT or MON failure is due to external computer.

(8) ***STATUS ALT*** *Indicator* – Illumination indicates the BIT or MON failure is due to Altitude Digitizer.

(9) ***IDENT / OUT / MIC*** *Switch.* Selects source of aircraft identification signal.

(a) ***IDENT*** – Activates transmission of identification (IP) pulse.

(b) ***OUT*** – Disables **IDENT MIC**.

(c) ***MIC*** – Enables the **POS IDENT** button located only on the pilot's side **CONTROL** wheel to activate transmission of **IDENT** signal from transponder.

(10) ***MODE 4 REPLY*** *Indicator* – Illumination indicates that a reply has been made to a valid Mode 4 interrogation or will flash when in standby position and interrogated for Mode 4.

(11) ***MODE 4 AUDIO / LIGHT / OUT*** *Switch*.

WARNING

If the MODE 4 computer is installed in the aircraft, place the AUDIO / LIGHT / OUT switch in the AUDIO or LIGHT position during flight operations. Do not use the OUT position.

(a) ***AUDIO*** – Permits aural and **REPLY** light monitoring of valid Mode 4 interrogations and replies.

(b) ***LIGHT*** – Permits **REPLY** indicator only monitoring.

(c) ***OUT*** – Disables monitoring capability.

(12) ***MODE 3/A CODE*** *Selectors* – Selects the desired reply codes for mode 3/A operations.

NOTE

The cover over the MODE select switches must be slid forward to display the selected MODE 2 code.

(13) ***MODE 2 CODE*** *Selectors* – Selects the desired reply code for mode 2 operations.

(14) ***MODE 1 CODE*** *Selectors* – Selects the desired reply code for mode 1 operations.

(15) ***MODE 4 TEST / ON / OUT*** *Switch*.

(a) ***TEST*** – Initiates BIT of Mode 4 operation.

(b) ***ON*** – Enables Mode 4 operation.

(c) ***OUT*** – Disables MODE 4 operation.

(16) ***MODE 4 CODE*** *Control*. Selects dialed in Mode 4 **CODE** of the day.

(17) ***M–C TEST*** *Switch*.

(a) ***TEST*** – Permits self-test in the selected mode.

(b) ***ON*** – Permits set to reply in the selected mode.

(c) ***OUT*** – Disables replies.

(18) ***M–3/A TEST*** *Switch*.

(a) ***TEST*** – Permits self-test in the selected mode.

(b) ***ON*** – Permits set to reply in the selected mode.

(c) ***OUT*** – Disables replies.

(19) ***M-2 TEST*** *Switch*.

(a) ***TEST*** – Permits self–test in the selected mode.

(b) ***ON*** – Permits set to reply in the selected mode.

(c) ***OUT*** – Disables replies.

(20) ***M-1 TEST*** *Switch*.

(a) ***TEST*** – Permits self–test in the selected mode.

(b) ***ON*** – Permits set to reply in the selected mode.

(c) ***OUT*** – Disables replies.

NOTE

There is a POS IDENT button, located on the pilot's and copilot's control wheels, which, when pressed, activates transponder identification.

c. Normal Operation.

(1) *Turn-on Procedure*. Set **MASTER** switch to **STBY**. Depending on the type of receiver installed,

the **TEST/MON NO GO** indicator may illuminate. Disregard this signal.

(2) Test Procedure.

NOTE

Make no checks with the master switch in EMER, or with M-3/A codes 7600 or 7700, without first obtaining authorization from the interrogating station(s).

1. Allow set 2 minutes to warm up.
2. Select codes assigned for use in modes 1 and 3/A by pressing and releasing the push button for each switch until the desired number appears in the proper window.
3. Lamp Indicators. Operate press-to-test feature.
4. **M-1** Switch – Hold in **TEST**. Observe that no indicator lights illuminate.
5. **M-1** Switch – Return to **ON**.
6. Repeat steps 4 and 5 for the **M-2**, **M-3/A**, and **M-C** mode switches.
7. **MASTER** Control – **NORM**.
8. **MODE 4** Code Control – **A**. Set a code in the external computer.
9. **MODE 4 AUDIO OUT** Switch – **OUT**.

(3) Modes 1, 2, 3/A, and/or 4 Operating Procedure.

NOTE

If the external security computer is not installed, a NO GO light will illuminate any time the MODE 4 switch is moved out of the OFF position.

1. **MASTER** Control – **NORM**.
2. **M-1**, **M-2**, **M-3/A**, and/or **MODE 4 ON/OUT** switches – **ON**. Actuate only those switches corresponding to the required codes. The remaining switches should be left in the **OUT** position.
3. **MODE 1** Code Selectors – Set, if applicable.
4. **MODE 3/A** Code Selectors – Set, if applicable.
5. **MODE 4** Code Control – Set, if required.
6. **MODE 4 REPLY** Indicator – Monitor to determine when transponder set is replying to an SIF interrogation.
7. **MODE 4 AUDIO OUT** Switch – Set as required to monitor Mode 4 interrogations and replies.
8. **MODE 4** Audio and/or Indicator – Listen and/or observe for Mode 4 interrogations and replies.
9. **IDENT/MIC/OUT** Switch – Press to **IDENT** momentarily.
10. **MODE 4 TEST / ON / OUT** Switch – **TEST**.
11. Observe that the **TEST GO** indicator light illuminates.
12. **MODE 4 TEST / ON / OUT** Switch. **ON**.
13. **ANT** Switch – **BOT**.
14. Repeat steps 4, 5, and 6. Observe that the **TEST GO** indicator illuminates.
15. **TOP / DIV / BOT / ANT** Switch – **TOP**.
16. Repeat steps 4, 5, and 6. Observe that the **TEST GO** indicator illuminates.
17. **TOP / DIV / BOT / ANT** Switch – **DIV**.
18. Repeat steps 4, 5, and 6. Observe that the **TEST GO** indicator illuminates.
19. When possible, obtain the cooperation of an interrogating station to exercise the **TEST** mode.
    a. **RAD TEST / OUT** Switch – **TEST**.
    b. Obtain verification from interrogating station that a TEST MODE reply was received.

c. **RAD TEST / OUT** Switch – **OUT**.

(4) Transponder Set Identification Position Operating Procedure. The transponder set can make identification-position replies while operating in code modes 1, 2, and/or 3/A, in response to ground station interrogations.

1. **MODES 1**, **2**, and/or **3/A** – **ON**, as required.

NOTE

Holding circuits within the transponder receiver/transmitter will transmit identification/position signals for 15 to 30 seconds. This is normally sufficient time for ground control to identify the aircraft's position. During this time, it is normal procedure to acknowledge via the aircraft communications set that identification/ position signals are being generated.

Set any of the M1, M2, M3/A, M-C, or MODE 4 switches to OUT to inhibit transmission of replies in undesired modes.

With the IDENT / OUT / MIC switch set to the MIC position, the POS IDENT button must be pressed to transmit identification pulses.

2. **IDENT / OUT / MIC** Switch – Press momentarily to **IDENT**, when directed.

(5) Shutdown Procedure.

1. To retain mode 4 code in external computer during a temporary shutdown, perform the following procedure.

    a. **MODE 4 CODE** Switch – Rotate to **HOLD** and wait 15 seconds.

    b. **MASTER** Control – **OFF**.

2. To zeroize the mode 4 code in the external computer, turn **MODE 4 CODE** switch to **ZERO**.

3. **MASTER** Control – **OFF**. This will automatically zeroize the external computer unless codes have been retained (Step 1 above).

CHAPTER 3A
AVIONICS C D1

Section I. GENERAL

3A-1. DESCRIPTION.

This chapter covers the avionics equipment configuration installed in C-12C and C-12D1 aircraft. It includes a brief description of the avionics equipment and its technical characteristics, capabilities, and locations.

3A-2. AVIONICS EQUIPMENT CONFIGURATION.

The avionics configuration of the aircraft is comprised of three groups of electronic equipment. The communication equipment group consists of the interphone, UHF command, VHF command, and HF command systems. The navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach on instruments under Instrument Meteorological Conditions (IMC). The navigation group includes equipment for determining altitude, attitude, position, destination, range and bearing, heading reference, groundspeed, and drift angle. The transponder and radar group includes an identification, position and emergency tracking system, and a radar system to locate potentially dangerous weather areas. A Ground Proximity Altitude Advisory System (GPAAS) is also installed.

3A-3. POWER SOURCE.

a. DC Power. DC power for the avionics equipment is provided by four sources: the aircraft battery, left and right generators, and external power. Power is routed through two 50-ampere circuit breakers to the avionics power relay that is controlled by the **AVIONICS MASTER** switch on the overhead control panel, Figure 2-15. Individual system circuit breakers and the associated avionics buses are shown in Figure 2-27 and Table 2-6. With the switch in the **ON** position, the avionics power relay is de-energized and power is applied through both 50-ampere avionics **MASTER PWR #1** and **#2** circuit breakers to the individual avionics circuit breakers on the overhead circuit breaker panel. Refer to Figure 2-16, Sheets 1 and 2. In the off (aft) position, the relay is energized and power is removed from avionics equipment. When external power is applied to the aircraft, the avionics power relay is normally energized, removing power from the avionics equipment. To apply external power to the avionics equipment, move the **AVIONICS MASTER** switch to the **EXT PWR** position. This will de-energize the avionics power relay and allow power to be applied to avionics equipment.

b. AC Power. AC power for the avionics equipment is provided by two inverters. The inverters supply 115-volt and 25-volt single-phase ac power when operated by the **INVERTER #1** or **#2** switches. Either inverter will provide power for all avionics equipment requiring ac power. 115 Vac power from the inverters is routed through fuses and transformers in the nose avionics compartment. The transformers provide the required 26 Vac needed by avionics equipment.

Section II. Communications

3A-4. DESCRIPTION.

The communications equipment group consists of the interphone, UHF command, VHF command, and HF command systems.

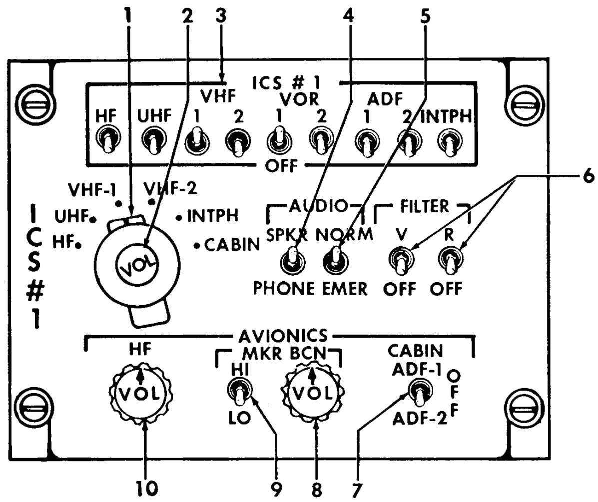
3A-5. MICROPHONE SWITCHES, MICROPHONE JACKS, AND HEADSET JACKS.

For information on microphone switches, microphone jacks, and headset jacks, refer to Chapter 3, Paragraph 3-5.

3A-6. INTERPHONE SYSTEM.

a. Description. Individual audio control panels are provided for the pilot and copilot. The controls and switches on each provide for reception and volume control of interphone, communication, and navigational audio signals and a choice of transmission on UHF, VHF, or HF transmitters. The audio control panels are protected by two 2-ampere circuit breakers, placarded **AUDIO PILOT** and **AUDIO COPILOT**, located on the overhead circuit breaker panel.

b. Controls and Functions, Pilot's Audio Control Panel. Refer to Figure 3A-1.



1. **Transmitter Selector Switch**
2. **VOL Control**
3. **ICS # 1 / OFF Switches**
4. **AUDIO SPKR / PHONE Switch**
5. **AUDIO NORM / EMER Switch**
6. **FILTER Switches**
7. **CABIN ADF-1 / OFF / ADF-2 Switch**
8. **MKR BCN VOL Switch**
9. **MKR BCN HI / LO Switch**
10. **HF VOL Control**

Figure 3A-1. Pilot's Audio Control Panel

(1) Transmitter Selector Switch. Controls operation of selected system.

(a) ***HF***. Permits reception of audio from the HF transceiver and routes key and microphone signals to the HF transceiver.

(b) ***UHF***. Permits reception of audio from the UHF transceiver and routes key and microphone signals to the UHF transceiver.

(c) ***VHF-1***. Routes key and mic signals to the #1 VHF transceiver.

(d) ***VHF-2***. Routes key and mic signals to the #2 VHF transceiver.

(e) ***INTPH****.* Permits transmission and reception of interphone signals.

(f) ***CABIN****.* Removes ADF audio from cabin speakers and allows the pilot to talk to cabin occupants.

(2) ***VOL*** *Control.* Controls audio volume.

(3) ***ICS # 1 / OFF*** *Switches.* Permits monitoring by pilot of selected audio regardless of position of transmitter selector switch.

(a) ***HF***. Permits monitoring of HF audio.

(b) ***UHF***. Permits monitoring of UHF audio.

(c) ***VHF 1***. Permits monitoring of VHF-1 audio.

(d) ***VHF 2***. Permits monitoring of VHF-2 audio.

(e) ***VOR 1***. Permits monitoring of VOR-1 audio.

(f) ***VOR 2***. Permits monitoring of VOR-2 audio.

(g) ***ADF 1***. Permits monitoring of ADF-1 audio.

(h) ***ADF 2***. Permits monitoring of ADF-2 audio.

(i) ***INTPH****.* Permits monitoring of interphone audio.

(4) ***AUDIO SPKR / PHONE*** *Switch.* Determines where selected audio will be heard.

(a) ***SPKR***. Allows selected audio to be heard via the speaker.

(b) ***PHONE***. Allows selected audio to be heard via the phone.

(5) ***AUDIO NORM / EMER*** *Switch.* Controls routing of received audio signals.

(a) ***NORM***. Routes audio signal through amplifier to speaker or headphone.

(b) ***EMER***. Audio signal bypasses amplifier. Applies audio signal to headphone only.

NOTE

Either the ADF or VOR switch must be in the OFF position for the other switch to function.

(6) ***FILTER*** *Switches.*

(a) ***FILTER V / OFF***. Filters out voice on ADF and VOR audio.

(b) ***FILTER R / OFF***. Filters out identification code on ADF-2 and VOR audio.

(7) ***CABIN ADF-1 / OFF / ADF-2*** *Switch.* Selects desired ADF audio for use with cabin speakers.

(a) ***ADF-1***. Selects ADF-1 audio for use.

(b) ***OFF***. Removes ADF audio from cabin speakers.

(c) ***ADF-2***. Selects ADF-2 audio for use.

(8) ***MKR BCN VOL*** *Switch.* Adjusts the volume of marker beacon audio.

(9) ***MKR BCN HI / LO*** *Switch.* Selects either high or low marker beacon sensitivity.

(10) ***HF VOL*** *Control*. Adjusts volume of marker beacon audio.

c. Controls and Functions, Copilot's Audio Control Panel. Refer to Figure 3A-2.

(1) Transmitter Selector Switch. Controls operation of selected system.

(a) ***HF***. Permits reception of audio from the HF transceiver and routes key and microphone signals to the HF transceiver.

(b) ***UHF*****.** Permits reception of audio from the UHF transceiver and routes key and microphone signals to the UHF transceiver.

(c) ***VHF-1***. Routes key and mic signals to the #1 VHF transceiver.

(d) ***VHF-2***. Routes key and mic signals to the #2 VHF transceiver.

(e) ***INTPH****.* Permits transmission and reception of interphone signals.

(f) ***CABIN****.* Removes ADF audio from cabin speakers and allows the copilot to talk to cabin occupants.

(2) ***VOL*** *Control.* Controls audio volume.

(3) ***ICS # 2 OFF*** *Switches.* Permits monitoring by copilot of selected audio regardless of position of transmitter selector switch.

(a) ***HF***. Permits monitoring of HF audio.

(b) ***UHF***. Permits monitoring of UHF audio.

(c) ***VHF 1***. Permits monitoring of VHF-1 audio.

(d) ***VHF 2***. Permits monitoring of VHF-2 audio.

(e) ***VOR 1***. Permits monitoring of VOR-1 audio.

(f) ***VOR 2***. Permits monitoring of VOR-2 audio.

(g) ***ADF 1***. Permits monitoring of ADF-1 audio.

(h) ***ADF 2***. Permits monitoring of ADF-2 audio.

(i) ***INTPH****.* Permits monitoring of interphone audio.

(4) ***FILTER*** *Switches.*

NOTE

Either the ADF or VOR switch must be in the OFF position for the other switch to function.

(a) ***FILTER V / OFF***. Filters out voice on ADF and VOR audio.

(b) ***FILTER R / OFF***. Filters out identification code on ADF-2 and VOR audio.

(5) ***AUDIO NORM / EMER*** *Switch.* Controls routing of received audio signals.

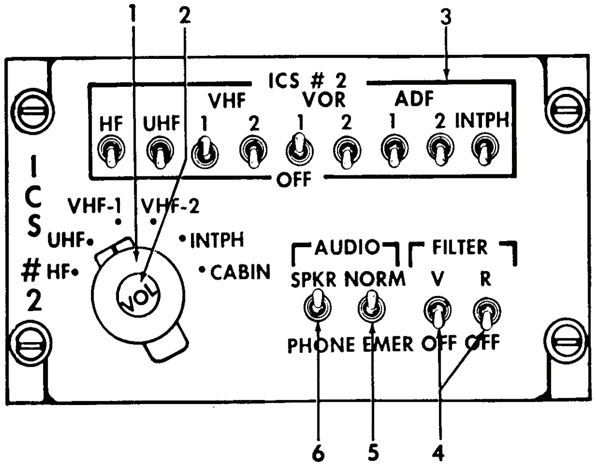
(a) ***NORM***. Routes audio signal through amplifier to speaker or headphone.

(b) ***EMER***. Audio signal bypasses amplifier. Applies audio signal to headphone only.

(6) ***AUDIO SPKR / PHONE*** *Switch.* Determines where selected audio will be heard.

(a) ***SPKR***. Allows selected audio to be heard via the speaker.

(b) ***PHONE***. Allows selected audio to be heard via the phone.



1. **Transmitter Selector Switch**
2. **VOL Control**
3. **ICS # 2 OFF Switches**
4. **FILTER Switches**
5. **AUDIO NORM / EMER Switch**
6. **AUDIO SPKR / PHONE Switch**

Figure 3A-2. Copilot's Audio Control Panel

d. Operation.

(1) Turn-On Procedure. The audio control panel is on whenever electrical power is applied to the aircraft and the **AVIONICS MASTER** switch is **ON**.

(2) Interphone Operating Procedure.

1. Transmitter selector switch – **INTPH**.
2. Microphone switch – Press, listen for sidetone.
3. **VOL** control – Adjust sidetone and interphone audio level in headphone.

(3) Navigational Aid And Receiver Monitoring Procedure.

1. **ICS # 1** or **ICS # 2** switch – As required.
2. **VOL** control – Adjust volume control of system being monitored.

(4) Transmitting Procedure.

1. Transmitter Selector Switch – As required.
2. Microphone Switch – Press, listen for sidetone.
3. Applicable transceiver volume control – Adjust for comfortable audio level.

e. Audio Control Panel Emergency Operation. An audio fail-safe system is provided for use in the event of an audio amplifier failure. If an audio amplifier fails, receiver audio bypasses the amplifier and is applied directly to the headsets and no audio will be available to the overhead speakers.

3A-7. UHF COMMAND SET (AN/ARC-164).

a. Description. The UHF command set provides two-way Amplitude Modulated (AM) voice communication within the frequency range of 225.000 to 399.975 MHz for a distance range of approximately 50 miles line-of-sight. Channel selection is spaced at 0.025 MHz intervals. Additionally, a separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz). The audio output of the UHF set is applied to the audio control panel where it is made available to the headsets and speakers. The UHF command set is protected by the 5-ampere **UHF** circuit breaker on the overhead circuit breaker panel. Refer to Figure 2-16, Sheets 1 and 2. Figure 3A-3 illustrates the UHF command set. The associated blade type antenna is shown in Figure 2-1.

b. Controls and Functions.

(1) Manual Frequency Selector Switch (Hundreds). Selects hundreds digit of frequency (either 2 or 3) in MHz.

(2) Manual Frequency Selector Switch (Tens). Selects tenths digit of frequency (0 through 9) in MHz.

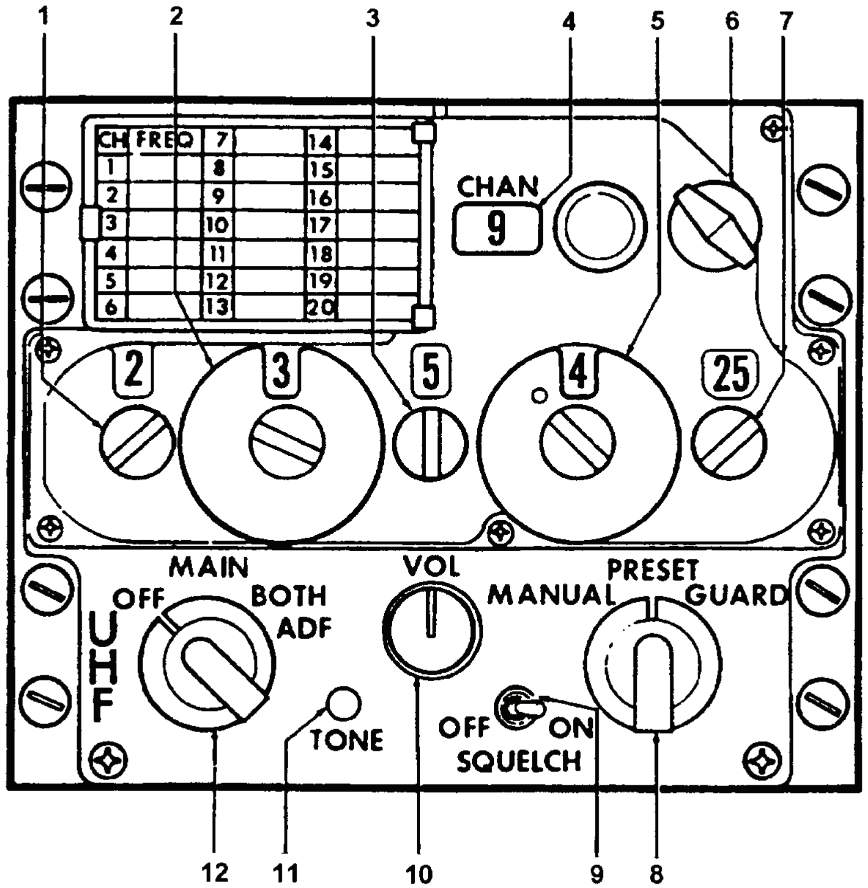
(3) Manual Frequency Selector Switch (Units). Selects unit digit of frequency (0 through 9) in MHz.

(4) ***CHAN*** *Indicator.* Displays preset channels.

(5) Manual Frequency Selector Switch (Tenths). Selects tenths digit of frequency (0 through 9) in MHz.

(6) Preset Channel Selector Switch. Selects one of 20 preset channels.

(7) Manual Frequency Selector Switch (Hundreds and Thousands). Selects hundredths and thousandths digits of frequency (00, 25, 50, or 75) in MHz.



1. Manual Frequency (100 MHz) Selector-Indicator
2. Manual Frequency (10 MHz) Selector-Indicator
3. Manual Frequency (1 MHz) Selector
4. CHAN Indicator
5. Manual Frequency (100 kHz) Selector
6. Present Channel Selector
7. Manual Frequency (10 and 1 kHz) Selector-Indicator
8. MANUAL / PRESET / GUARD Mode Selector
9. SQUELCH OFF / ON Switch
10. VOL Control
11. TONE Push-Button Switch
12. Function Switch

Figure 3A-3. UHF Command Set (AN/ARC-164)

(8) ***MANUAL / PRESET / GUARD*** *Mode Selector Switch.* Selects method of frequency selection.

(a) ***MANUAL***. Any one of 7,000 frequencies is manually selected using the five frequency selector switches.

(b) ***PRESET***. Frequency is selected using the preset channel selector switch for selecting any one of 20 preset channels.

(c) ***GUARD***. The main receiver and transmitter are automatically tuned to the guard frequency and the guard receiver is disabled.

(9) ***SQUELCH OFF / ON*** *Switch.* Turns squelch circuit of main receiver on or off.

(10) ***VOL*** *Control*. Adjusts volume.

(11) ***TONE*** *Push-Button Switch*. Selects transmission of a 1,020 Hz tone on the selected frequency.

(12) Function Switch. Selects operating function.

(a) ***OFF***. Shuts down equipment.

(b) ***MAIN***. Selects main receiver and transmitter.

(c) ***BOTH***. Selects main receiver, transmitter, and guard receiver.

(d) ***ADF***. Selects ADF or homing system, if installed, and main receiver.

c. Normal Operation.

(1) Turn On Procedure.

1. Function selector switch, UHF control panel – **BOTH**.

(2) Receiver Operating Procedure.

NOTE

The PRESET channel selector and manual frequency selectors are inoperative when the MANUAL / PRESET / GUARD switch is set to GUARD.

1. Function selector switch – As required.

2. Frequency – Select required frequency using either preset channel control or manual frequency selector controls.

3. Volume – Adjust.

4. **SQUELCH** – As required.

(3) Transmitter Operating Procedure.

1. Transmitter selector switch – **UHF** position.

2. Microphone switch – Press.

(4) Shutdown Procedure.

1. Function selector switch – **OFF**.

d. Emergency Operation.

NOTE

Transmission on emergency frequencies (guard channel) shall be restricted to emergencies only. An emergency frequency of 121.500 MHz is also available on the VHF command radio set.

1. Transmitter selector switch – **UHF** position.

2. Mode selector switch – **GUARD**.

3. Microphone switch – Press.

3A-8. UHF COMMAND SET (AN/ARC-164 HAVE QUICK).

a. Description. The UHF command set is a line-of-sight radio transceiver that provides transmission and reception of AM signals in the ultra high frequency range of 225.000 to 399.975 MHz for a distance range of approximately 50 miles. Channel selection is spaced at 0.025 MHz. A separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz). UHF audio output is applied to the audio panel where it is routed to the headsets.

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 the emergency frequency only.

Existing capabilities of the HAVE QUICK modified radio are preserved to the maximum extent possible when it is operated in the normal (non-hopping) mode. No new procedures are required for normal radio operation.

To operate in the AM mode, the radio must first be initialized. This initialization requires the setting of two control entries into the radio, Word of Day (WOD) and Time of Day (TOD). The WOD defines the choice of frequency hopping pattern for the day. The WOD choice is a managerial function and the same WOD may be used for one or more days. The TOD must be loaded into the clock contained within the radio.

The transmitter and receiver sections of the UHF unit operate independently, but share the same power supply and frequency control circuit. Separate cables route transmit and receive signals to their respective receiver/transmitter.

The UHF command set is protected by a 5-ampere **UHF** circuit breaker in the overhead circuit breaker panel. Refer to Figure 2-16, Sheets 1 and 2. The associated blade type antenna is shown in Figure 2-1.

b. Controls and Functions. Refer to Figure 3A-3.

(1) Manual Frequency Selector Switch (Hundredths). Selects hundredths digit of frequency (2, 3, A or T) in MHz.

(2) Manual Frequency Selector Switch (Tenths). Selects tenths digit of frequency (0 through 9) in MHz.

(3) Manual Frequency Selector Switch (Units). Selects unit digit of frequency (0 and 9) in MHz.

(4) ***CHAN*** *Indicator.* Displays preset channels.

(5) Manual Frequency Selector Switch (Tenths). Selects tenths digit of frequency (0 through 9) in MHz.

(6) Preset Channel Selector Switch. Selects one of 20 preset channel frequencies.

(7) Manual Frequency Selector Switch (Hundredths and Thousandths). Selects hundredths and thousandths digits of frequency (00, 25, 50, or 75) in MHz.

(8) ***MANUAL / PRESET / GUARD*** *Mode Selector Switch.* Selects method of frequency selection.

(a) ***MANUAL***. Enables the manual selection of any one of 7,000 frequencies is manually selected using the five frequency selector switches.

(b) ***PRESET***. Frequency is selected using the preset Channel selector switch for selecting any one of 20 preset channels.

(c) ***GUARD***. The main receiver and transmitter automatically tuned to the guard frequency and the guard receiver is disabled.

(9) ***SQUELCH OFF / ON*** *Switch*. Turns main receiver squelch circuit of main receiver on or off.

(10) ***VOL*** *Control.* Adjusts volume.

(11) ***TONE*** *Push Button.* When pressed, transmits a 1,020 Hz tone on the selected frequency.

(12) Function Switch. Selects operating function.

(a) ***OFF***. Shuts down equipment.

(b) ***MAIN***. Selects normal transmission with reception on main receiver.

(c) ***BOTH***. Selects main receiver, transmitter and guard receiver.

(d) ***ADF***. Not used.

c. Normal Operation.

(1) Turn On Procedure.

NOTE

It is presumed aircraft power is on and normally used avionic circuit breakers remain depressed.

1. **AVIONICS MASTER POWER** switch – **ON**.
2. Function switch – **MAIN** or **BOTH**, as required.

NOTE

If function selector is at MAIN setting, only the normal UHF communications will be received. If selector is at BOTH position, emergency communications on the guard channel and normal UHF communications will both be received.

(2) Receiver Operating Procedure.

1. Transmitter selector switch – No. 3 position.
2. UHF audio monitor switch – ON, No. 3 position.
3. **VOL** control – Mid position.

(3) To Use Preset Frequency.

1. Mode selector switch – **PRESET**.
2. Preset channel selector switch – As desired.

(4) To Use Non-Preset Frequency.

NOTE

The PRESET channel selector and manual frequency selectors are inoperative when the mode selector switch is set to the GUARD position.

1. Mode selector switch – **MANUAL**.
2. Five manual frequency selectors – Rotate each knob to set desired frequency digits.

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. Volume – Adjust.

4. **SQUELCH** – As desired.

(5) Transmitter Operating Procedure.

1. Transmitter selector – No. 3 position.

2. UHF control panel – Set required frequency using either **PRESET** or **MANUAL** frequency select controls.

3. Microphone jack selector switch – As desired.

4. Microphone switch – Press to transmit.

(6) Shutdown Procedure. Function selector switch – **OFF**.

3A-9. VHF COMMAND SET (VHF-20B).

a. Description. The VHF command set is a line-of-sight radio transceiver which provides transmission and reception of amplitude modulated signals in the very high frequency range of 116.000 to 151.975 MHz for a distance range of approximately 50 miles. Two VHF radio sets are installed placarded **COMM 1** and **COMM 2**. Audio signals are applied through the pilot and copilot transmitter selector switches and through the pilot and copilot VHF-1 audio switches to their respective headsets. The VHF radio sets are protected by a 10-ampere **VHF # 1** and **VHF # 2** circuit breakers located on the overhead circuit breaker panel, Figure 2-16, Sheets 1 and 2. Figure 3A-4 illustrates the VHF command set control panel. The associated antenna is shown in Figure 2-1.

b. Controls and Functions.

(1) Frequency Indicator. Indicates operating frequency of set.

*(2) **CONTROL** Indicator.* Indicates which control head is in operation.

*(3) **COMM TEST** Switch.* Overrides automatic squelch circuit.

(4) Frequency Selectors. Selects desired operating frequency of set.

*(5) **TRANS** Switch.* Selects which of two control heads determines operating frequency of set.

*(6) **VOL OFF** Control.* Adjusts volume of received audio and turns set on or off.

c. Normal Operation.

(1) Turn On Procedure.

1. **VOL** control – Turn clockwise.

(2) Receiver Operating Procedure.

1. Frequency selector – Select desire frequency.

2. **VOL** control – As required.

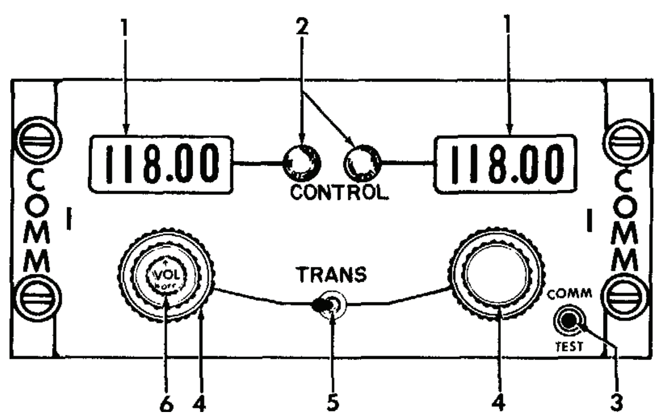
(3) Transmitter Operating Procedure.

1. Transmitter selector switch – **VHF 1** or **VHF 2**.

2. Microphone Switch – Press.

(4) Shutdown Procedure.

1. **VOL** control – Counterclockwise, **OFF**.



1. **Frequency Indicator**
2. **CONTROL Indicators**
3. **COMM TEST Switch**
4. **Frequency Selector**
5. **TRANS Switch**
6. **VOL OFF Control**

Figure 3A-4. VHF Control Panel

d. **Emergency Operation.**

NOTE

Transmission on emergency frequency, 121.500 MHz, will be restricted to emergencies only. An emergency frequency of 243.000 MHz, guard channel, is also available on the UHF command radio set.

1. Transmitter selector switch – **VHF 1** or **VHF 2**.

2. Frequency selector, VHF control panel – 121.500 MHz, emergency frequency.

3. Microphone switch – Press.

3A-10. VHF COMMUNICATIONS TRANSCEIVERS (VHF-22D).

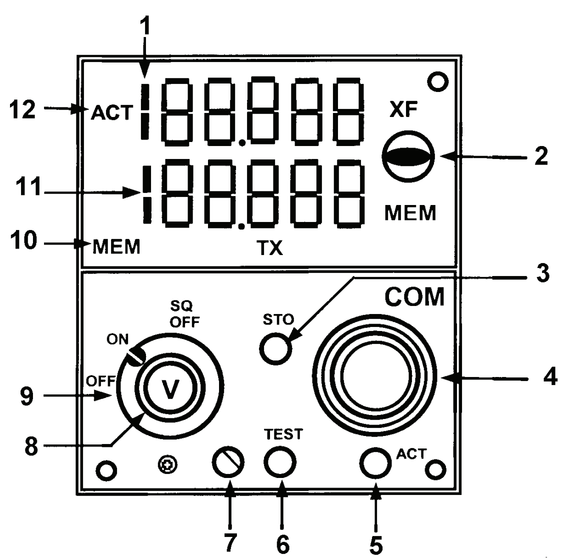
a. Introduction. The VHF communications transceivers are an 8.33 kHz channel spacing cable system. The operation between the 25 kHz and 8.33 kHz modes is seamless. Within the space occupied by each 25 kHz frequency exist three 8.33 kHz channels. The 8.33 kHz "frequency" is referred to as a "channel," not the actual frequency tuned. The channel scheme avoids possible confusion associated with shared 25 kHz and 8.33 kHz frequencies. This method ensures that the equipment will always be operating in the proper spacing mode and occurs automatically as the user tunes the controller. Provides airborne VHF communications from 118.000 through 151.975 MHz and is operated by two CTL-22C transceiver control units. Refer to Figure 3A-5.

The solid-state transceiver includes capture-effect automatic squelch to help prevent missed radio calls, plus audio leveling and response shaping to ensure audio quality. Transmitter sidetone comes from detected transmitter signal, and is therefore a reliable check of transmission quality. Each VHF transceiver is powered through its respective circuit breaker, placarded **VHF # 1** or **VHF # 2**, located on the circuit breaker panel.

b. Operating Controls. All operating controls for the transceivers are located on the CTL-22C transceiver control units. Refer to Figure 3A-5.

(1) Active Frequency Display. Displays the active frequency (frequency to which the transceiver is tuned) and diagnostic messages.

(2) Transfer / Memory Switch. This switch is a three-position spring-loaded toggle switch placarded **XF / MEM**, which, when held to the **XF** position, causes the preset frequency to be transferred up to the active display and the transceiver to be returned. The previously active frequency will become the new preset frequency and will be displayed in the lower window. When this switch is held to the **MEM** position, one of the six stacked memory frequencies will be loaded into the preset display. Successive pushes will cycle the six memory frequencies through the display (...2, 3, 4, 5, 6, 1, 2, 3...).



1. Active Frequency Display
2. Transfer/Memory Switch
3. Store Button
4. Frequency Select Knobs
5. Active Button
6. Test Button
7. Light Sensor
8. Volume Control
9. Power and Mode Switch
10. MEM TX Annunciators
11. Preset Frequency Display
12. Compare Annunciator

Figure 3A-5. VHF Communications Transceiver Control Unit – CTL-22C

(3) Store Button. This button, placarded **STO**, allows up to six preset frequencies to be selected and entered into the control unit's memory. After presetting the frequency to be stored, push the **STO** button. The upper window displays the channel number of available memory (CHAN 1 through CHAN 6) while the lower window continues to display the frequency to be stored. For approximately 5 seconds, the **MEM** switch may be used to advance through the channel numbers without changing the preset display. Push the **STO** button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

(4) Frequency Select Knobs. Two concentric tuning knobs control the preset or active frequency displays. The larger knob changes the three digits to the left of the decimal point in 1-MHz steps. The smaller knob changes the three digits to the right of the decimal point. The faster the kHz knob is turned, the more channels will be skipped. A single click of the kHz knob will either increase or decrease the channel by a single channel.

(5) Active Button. The active button, placarded **ACT**, enables the tuning knobs to directly tune the VHF transceiver, when depressed and held for 2 seconds. The bottom window will display dashes and the upper window will continue to display the active frequency. Pushing the **ACT** button a second time will return the control unit to the normal two-display mode.

(6) Test Button. This button, placarded **TEST**, initiates the transceiver self-test diagnostic routine. Self-test is active only when the **TEST** button is pressed.

(7) Light Sensor. This built-in light sensor automatically controls display brightness.

(8) Volume Control. The volume control is concentric with the power and mode switch.

(9) Power and Mode Switch. The power and mode switch contains three detented positions. The **ON** and **OFF** positions switch system power. The **SQ OFF** position disables the receiver squelch circuits.

*(10) **MEM TX** Annunciators*. The transceiver control unit contains a memory (**MEM**) and a transmit (**TX**) annunciator. The **MEM** annunciator illuminates whenever a preset frequency is being displayed in the lower window. The **TX** annunciator illuminates whenever the transceiver is transmitting.

(11) Preset Frequency Display. Displays the pre-set (inactive) frequency and diagnostic messages in the lower window.

(12) Compare Annunciator. An annunciator, placarded **ACT**, momentarily illuminates when frequencies are being changed. The **ACT** annunciator flashes if the actual radio frequency to which the transceiver is tuned is not identical to the frequency shown in the active frequency display.

NOTE

If two communications transceivers in the same aircraft are tuned to stations carrying the same voice message, attempting to listen to the received signals from both simultaneously could result in a great reduction in the actual audio volume.

c. Operating Procedures. The 8.33 kHz capable CTL-22C shows the VHF COM frequency as a channel frequency using all six digits of the display. There are no 8.33 kHz channels above 136.992 MHz. The last “channel name” is 136.990, which is an actual frequency of 136.9917 MHz. Table 3A-1 shows the channel/frequency scheme for the 180.000 to 136.992 MHz range. While the CTL is in the frequency range of 137.000 to 151.975 MHz, the unit behaves the same as a 25 kHz only unit.

NOTE

It is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by continually assessing the reasonableness of operation as displayed on the associated transceiver control unit and by the quality of received signals and transmissions.

(1) Equipment Startup. The transceiver and the control unit are turned on by rotating the power and mode switch on the transceiver control unit to the **ON** position. When the transceiver is first turned on, it sounds a brief tone while the microprocessor checks its own memory. If there is a memory defect the tone continues, indicating that the transceiver can neither receive nor transmit. After the memory check, the transceiver control unit will display the same active and preset frequencies that were present when the equipment was last turned off.

If two short 800-Hz tones are heard, the transceiver has detected an internal fault. Push the **TEST** button on the transceiver control unit to initiate self-test and display the fault code.

Table 3A-1. VHF Communications Transceiver Control UnitChannel/Frequency Scheme (118.000 To 136.992 MHz Range)

FREQUENCY	SPACING (kHz)	CHANNEL NAME (DISPLAYED)	FREQUENCY	SPACING (kHz)	CHANNEL NAME (DISPLAYED)
118.0000	25.00	118.000	118.0750	25.00	118.075
118.0000	8.33	118.005	118.0750	8.33	118.080
118.0083	8.33	118.010	118.0833	8.33	118.085
118.0167	8.33	118.015	118.0917	8.33	118.090
118.0250	25.00	118.025	118.1000	25.00	118.100
118.0250	8.33	118.030	•	•	•
118.0333	8.33	118.035	•	•	•
118.0417	8.33	118.040	•	•	•
118.0500	25.00	118.050	136.9750	25.00	136.975
118.0500	8.33	118.055	136.9750	8.33	136.980
118.0583	8.33	118.060	136.9833	8.33	136.985
118.0667	8.33	118.065	136.9917	8.33	136.990

Adjust the volume and perform a quick squelch test by setting the power and mode switch on the transceiver control unit to **SQ OFF** and adjusting the volume level with background noise. After a comfortable listening level has been established, return the power and mode switch to the **ON** position. All background noise should disappear unless a station or aircraft is transmitting on the active frequency.

(2) Frequency Selection. Frequency selection is made using either the frequency select knobs, or the **XF / MEM** switch.

NOTE

There is usually an installer supplied 8.33/25 kHz select switch in the cockpit. This switch provides a convenience to the pilots by not having to "ratchet pass" the 8.33 kHz channels when not operating in 8.33 airspace. The selected position of the (8.33 or 25) may or may not be annunciated, depending on installation.

After the desired frequency is set into the preset frequency display, it can be transferred to the active frequency display by momentarily setting the **XF / MEM** switch to **XF**. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. A short audio tone is applied to the audio system to indicate that the active frequency has been changed, and the **ACT** annunciator on the control will flash while the transceiver is tuning to the new frequency.

NOTE

The active annunciator's continuing to flash indicates that the transceiver is not tuned to the frequency displayed in the active display.

The transceiver control unit's memory permits storing up to six preset frequencies. Once stored, these frequencies can be recalled to the preset display by positioning the **XF / MEM** switch to the **MEM** position. The storage location (CHAN 1 through CHAN 6) for the recalled frequency is displayed in the active frequency display while the **XF / MEM** switch is held in the **MEM** position. All six stored frequencies can be displayed one at a time in the preset display by repeatedly positioning the **XF / MEM** switch to the **MEM** position. After the desired stored frequency has been recalled to the preset display, it can be transferred to the active display by momentarily positioning the **XF / MEM** switch to the **XF** position.

During normal operation, all frequency selections and revisions are done in the preset frequency display. However, the active frequency can be selected directly as described in the following paragraph.

(3) Direct Active Frequency Selection. The active frequency can be selected directly with the frequency select knobs by pushing the **ACT** button for about 2 seconds. The active frequency selection mode is indicated by dashes appearing in the preset display. Also, the **ACT** annunciator will flash as the frequency select knobs are turned to indicate that the transceiver is being returned.

NOTE

The ACT annunciator's continuing to flash after the frequency has been selected indicates that the transceiver is not tuned to the frequency displayed in the active display.

To return to the preset frequency selection mode, push the **ACT** button again for about 2 seconds. As a safety feature, the transceiver control unit switches to the active frequency selection mode when a frequency select knob is operated while the **STO** and **TEST** buttons or **XF / MEM** switch are actuated.

(4) Frequency Storage. To program the memory, select the frequency in the preset frequency display using the frequency select knobs and push the **STO** button once. One of the channel numbers (CHAN 1 through CHAN 6) will appear in the active display for approximately 5 seconds. During this time the channel number can be changed without changing the preset frequency by momentarily positioning the **XF / MEM** switch to the **MEM** position. After the desired channel number has been selected, push the **STO** button again to store the frequency.

NOTE

When storing a frequency, the second actuation of the STO button must be done within 5 seconds after selecting the channel number or the first actuation of the STO button. If more than 5 seconds elapse, the control will revert to the normal modes of operation and the second store command will be interpreted as the first store command.

After a frequency has been stored in memory, it will remain there until changed by using the **STO** button. Memory is retained even when the unit is turned off for an extended period of time.

(5) Stuck Microphone Switch. Each time the push-to-talk switch is pressed, the microprocessor in the transceiver starts a 2-minute timer. The **TX** annunciator on the transceiver control unit will be illuminated whenever the transmitter is transmitting. If the transmitter is still transmitting at the end of 2 minutes, the microprocessor turns it off. Most intentional transmissions last much less than 1 minute; a 2-minute transmission is most likely the result of a stuck microphone switch. This timing feature protects the ACT channel from long-term interference.

When it turns off the transmitter, the microprocessor switches the transceiver to receive operation. A stuck microphone switch will prevent you from hearing received signals, or the two warning beeps. The microprocessor then waits until the push-to-talk switch opens to sound the two beeps.

To transmit for more than 2 minutes, release the microphone switch briefly and then press it again. The 2-minute timer resets and starts a new count each time the microphone switch is pressed.

(6) Overtemperature Protection. The microprocessor regularly monitors the temperature of the transmitter. If the transmitter gets too hot during a transmission, the microprocessor will stop the transmission, and the sidetone will cease. When the microphone switch is released, you will hear two beeps. Press the **TEST** switch on the transceiver control unit to observe the fault code. As long as the temperature remains above the limit, the microprocessor will not respond to a normal push of the microphone switch. If you must transmit, however, you can override the protection by rapidly keying the microphone switch twice, holding it on the second push. The shutdown temperature is 160 °C (320 °F).

(7) Self-test. An extensive self-test diagnostic routine can be initiated in the transceiver by pushing the **TEST** button on the transceiver control unit. The control unit will modulate the active and preset display intensity from minimum to maximum to annunciate that self-test is in progress. Several audio tones will be heard from the audio system while the self-test routine is being executed. At the completion of the self-test program, the transceiver control unit will usually display dashes in the active display, and 00 in the preset display. This indicates normal operation. If any out-of-limit condition is found, transceiver control unit will display DIAG in the active display and a 2-digit fault code in the preset display. Record any fault codes displayed to help the service technician locate the problem. Refer to Table 3A-2 for a description of the self-test fault codes that can be displayed on the transceiver control unit. The **TEST** button must be pushed before any fault code can be displayed.

Table 3A-2. Self-test Codes

FAULT	CODE DESCRIPTION	FAULT	CODE DESCRIPTION
00	No fault found	15	Frequency out of range
01	5 Vdc below limit	16	Forward power below limit
02	5 Vdc above limit	17	Transmitter temperature excessive
03	12 Vdc below limit	21	Tuning voltage out of limit at highest receive frequency
04	12 Vdc above limit	22	Tuning voltage out of limit at 118 MHz
05	Synthesizer not locked	23	Local oscillator output below limit
07	Noise squelch open without signal	24	No-signal AGC voltage too high
08	Noise squelch open without signal	25	Inadequate AGC voltage increase with rf signal
12	BCD frequency code invalid	26	Reflected rf power above limit
13	2/5 frequency code invalid	27	Transmitter timed out
14	Serial message invalid		

3A-11. HF COMMAND SET (718U-5).

a. Description. The HF command set provides long-range voice communications within the frequency range of 2.000 to 29.999 MHz. The HF command set employs standard Amplitude Modulation (AM), Lower Sideband (LSB) modulation, or Upper Sideband (USB) modulation. The distance range of the HF command set is approximately 2,500 miles, and varies with atmospheric conditions. The HF command set is protected by the 3-ampere HF RCVR and the 25-ampere **HF PWR** circuit breakers located on the overhead circuit breaker panel, Figure 2-16, Sheets 1 and 2. The associated antenna is shown in Figure 2-1.

NOTE

Keying the HF radio set while operating the ADF No. 2 set causes unreliable ADF signals.

b. Controls and Functions, HF Command Set Control Panel. Refer to Figure 3A-6.

(1) Frequency Selectors. Operating frequency is selected by turning the frequency selector controls until the desired operating frequency is indicated. The controls may be operated in any order.

(2) ***MHz*** *Indicators.* Indicates operating frequency of set.

(3) ***SQL*** *Control.* The squelch control is adjusted to mute, undesired, background noise. Setting the control too far counterclockwise can result in blocking out weak signals. There are two different types of squelch control depending on the configuration installed in the aircraft. One configuration is the voice-operated squelch control that functions to mute the receiver output in the absence of a receive signal. The other type combines with RF gain control. Adjustment method of the squelch control is different for the two configurations.

(4) ***RF TEST*** *Indicator.* Four conditions of the **RF TEST** lamp indicate the operational status of the system. The mode selector must be in the **RF TEST** mode position. Lamp illuminated or flashing with system unkeyed provides a lamp test of the **RF TEST** lamp. Lamp not illuminated, flashing, or illuminated with the system keyed indicates the operational status of the rest of the system.

(a) Illuminated. Indicates fault in receiver-exciter portion.

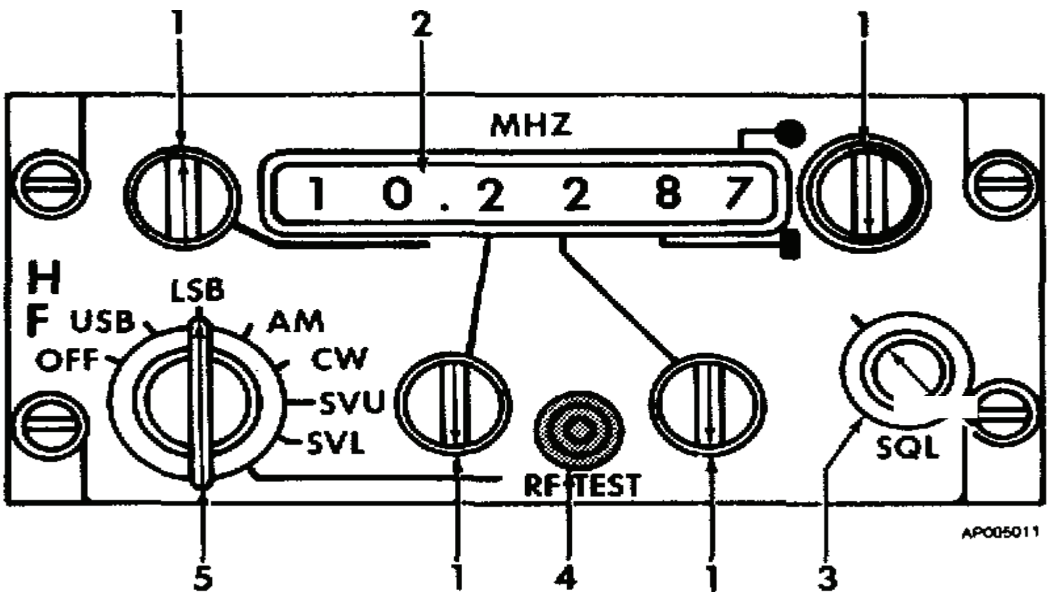
(b) Blinking. Indicates fault in power amplifier-coupler.

(c) Extinguished. System is operational.

(5) Mode Selector. Turns set off and determines operating mode.

(a) ***OFF****.* Turns set off.

(b) ***USB****.* Places set in Upper Sideband mode.



1. Frequency Selector
2. MHz Indicator
3. SQL Control
4. RF TEST Indicator
5. Mode Selector

Figure 3A-6. HF Control Panel

(c) ***LSB***. Places set in Lower Sideband mode.

(d) ***AM***. Places set in Amplitude Modulation mode.

(e) ***CW***. Not used in this installation.

(f) ***SVU***. Not used in this installation.

(g) ***SVL***. Not used in this installation.

(h) ***RF TEST***. Places set in test mode.

c. Operation.

CAUTION

Operation of the system is limited to 1 minute transmission (keyed) with a 3 minute (unkeyed) for SSB voice; 1 minute transmission (keyed) with a 7 minute (unkeyed) for AM, voice modulation up to 55 °F (131 °F) ambient temperature.

NOTE

No warmup is required before operation.

The system may be operated in the receive mode continuously.

1. Mode selector – As required.
2. Frequency selector – Select.
3. Squelch control – Set, turn completely clockwise.
4. Tune the system by momentarily pressing the microphone switch. A constant tone will be heard while the system is tuning, average tuning time is 3 to 5 seconds. After tuning, the tone stops and receiver noise will be heard.

NOTE

If a fault occurs during the tuning process, an interrupted tone (beeping) will be heard in the headset. To clear a fault, change any frequency selector knob at least one step and then return to the desired setting. Another tune cycle may now be attempted by pressing the microphone switch.

5. Microphone switch – Press to transmit.

NOTE

The presence of sidetone during transmission is an indication of proper operation. The lack of sidetone is an indication of failure.

6. If squelch operation is desired, rotate squelch control fully clockwise. With no signal present, rotate squelch control counterclockwise until the background noise is reduced to a comfortably audible level or until the control is fully counterclockwise. After a short delay, the receiver will mute.

NOTE

If background noise was reduced to a comfortable level before the audio was muted, the radio is equipped with a combination RF gain/squelch feature and control should be left at setting desired in the above step. If control was rotated to the full counterclockwise position with no reduction in background noise, your system incorporates the standard squelch version and you must perform the following step.

7. Rotate squelch knob clockwise one step at a time until background noise is heard, and squelch is broken. Set squelch control one position counterclockwise. After a short delay, the receiver will mute.

8. If a new frequency is desired, repeat steps 2 through 7.

d. Operator Maintenance.

WARNING

Do not touch antenna or antenna feedline when radio is transmitting. Painful RF burns and possibly death may result from high RF voltages.

(1) Fault Clearing. After the tune cycle has been completed, the normal tune tone should disappear. Should it fail to disappear, an interrupted tone, beeping, will occur approximately 8 seconds after the tune cycle was initiated. This beeping indicates a fault condition. To clear the fault, initiate a new tune cycle by either turning the mode selector to **OFF** and back to the operating mode, or turning any frequency selector away from and back to the operating frequency. The tune tone should be present for approximately 3 to 6 seconds, and then disappear. If the beeping recurs, try the clearing procedure a second time. If a fault is still indicated, a unit failure is probable.

(2) RF Test. To isolate a malfunction to a faulty unit or cable, perform the following procedure.

1. Set squelch control fully clockwise and tune to WWV. Check receive operation. Select **USB**, 20.701.0 MHz, and check for a 1-kHz tone. Select **LSB**, 20.699.0 MHz, and check for a 1-kHz tone. Select **CW**, 20.698.0 MHz, and check for a 1-kHz tone in receiver.

2. **RF TEST** Lamp – Check, system not keyed. Set the mode switch to the **RF TEST** position.

   a. If the **RF TEST** lamp does not illuminate, the lamp is defective or the receiver-exciter is faulty.

   b. If the **RF TEST** lamp blinks for more than 1 minute, the receiver-exciter is faulty.

   c. If the **RF TEST** lamp illuminates immediately or after an initial period of blinking, the **RF TEST** lamp and fault circuits are operational.

3. Set the mode switch to the **RF TEST** position. Change frequency selection to any frequency and key the system momentarily. Observe the **RF TEST** lamp during the tune cycle while the tune tone is audible. Normal tune time is 3 to 8 seconds.

4. System Does Not Complete Tune Cycle. If no tune tone is heard after initial keying, the fault is in the receiver-exciter, the **PTT** key to the receiver-exciter is faulty, or the exciter tune line between the receiver-exciter and pa-coupler is faulty.

NOTE

Nominal tune time of the pa-coupler is approximately 5 seconds; therefore, the RF TEST lamp indications below are only valid for approximately 5 seconds after initial keying.

5. If the **RF TEST** lamp stays illuminated continuously, the receiver-exciter is faulty. If the **RF TEST** lamp blinks on and off, the pa-coupler is faulty.

6. Tune Cycle Complete. If the **RF TEST** lamp is not illuminated, the tune tone drops, and a beeping tone is heard at the end of the time, the pa-coupler and coupler mount failed to tune the antenna.

7. If **RF TEST** lamp is not illuminated, switch to the USB mode and supply audio input while holding the system keyed. If sidetone is not audible, check audio interphone or microphone system before replacing the receiver-exciter. Presence of a sidetone indicates that the system is working properly.

3A-12. EMERGENCY LOCATOR TRANSMITTER (ELT).

a. Description. An Emergency Locator Transmitter (ELT) is provided to assist in locating an aircraft and crew in the event an emergency landing is necessitated. The output frequency is 121.5 and 243 MHz simultaneously. Range is approximately line-of-sight. The aircraft may be equipped with one of three different ELT's: the TR70-13, the TR70-17, or the ELT-10. All three have a **RESET** switch and **ON / OFF / ARM** switch located on the transmitter. The TR70-13 and ELT-10 are equipped with a switch, accessible through an access opening in the right side of the aft fuselage. In the event the impact switch has been inadvertently actuated, the beacon can be reset by actuating the remote mounted switch to the **RE ARM** (aft) position (TR70-13) or by firmly pressing the **RESET** switch on the front of the case. Access to the ELT is through the door on the bottom of the aft right fuselage.

b. Controls and Functions.

(1) TR70-17.

(a) ***ON / OFF / ARM*** *Switch.* Controls operation of the set.

1 ***ON****.* Turns set on for test purposes.

2 ***OFF****.* Turns set off.

3 ***ARM****.* Arms set so that it will turn on automatically in an impact.

NOTE

The TR70-17 has no remote switch.

(2) TR70-13, Remote Switch.

(a) ***RE ARM / ARM / XMIT*** *Switch.* Resets, arms, or activates transmitter.

1 ***RE ARM.*** Resets transmitter if it has been activated.

2 ***ARM.*** Arms transmitter to activate automatically on impact. Switch on front of transmitter must be set to **ARM**.

3 ***XMIT.*** Activates transmitter for test purposes. Switch on front of transmitter may be set to **OFF** or **ARM**.

(3) ELT-10, Remote Switch.

(a) ***ARM / XMIT*** *Switch.* Arms or activates transmitter.

1 ***ARM.*** Arms transmitter when switch on front of transmitter is set to ARM.

2 ***XMIT.*** Activates transmitter for test purposes.

Section III. NAVIGATION

3A-13. DESCRIPTION.

The overall navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach on instruments under Instrument Meteorological Conditions (IMC). The navigation configuration includes equipment for determining attitude, position, destination range and bearing, heading reference and groundspeed.

3A-14. RADIO MAGNETIC INDICATORS (RMI).

a. Description. The Radio Magnetic Indicators (RMI) are navigational aids that provide aircraft magnetic or directional gyro heading and VOR or ADF bearing information. Refer to Figure 3A-7. Two RMI indicators are installed. The pilot's RMI is identical in operation with the copilot's except that the copilot's **COMPASS # 1 / # 2** switch is used to select information for display on the compass card of the indicator. The pilot's RMI is protected by a 1-ampere **RMI #1** circuit breaker and the copilot's RMI is protected by the 1-ampere **RMI #2** circuit breaker. Both circuit breakers are located on the overhead circuit breaker panel, Figure 2-16, Sheets 1 and 2.

b. Associated Controls and Functions. Refer to Figure 2-17, Sheet 1.

*(1) Pilot's **COMPASS** Switch.* Selects desired source for magnetic heading information for display on pilot's RMI compass card.

*(a) **# 1**.* Selects compass system No. 1 for display.

*(b) **# 2**.* Selects compass system No. 2 for display.

*(2) Copilot's **COMPASS** Switch.* Selects desired source for magnetic heading information for display on copilot's RMI compass card.

*(a) **# 1**.* Selects compass system No. 1 for display.

*(b) **# 2**.* Selects compass system No. 2 for display.

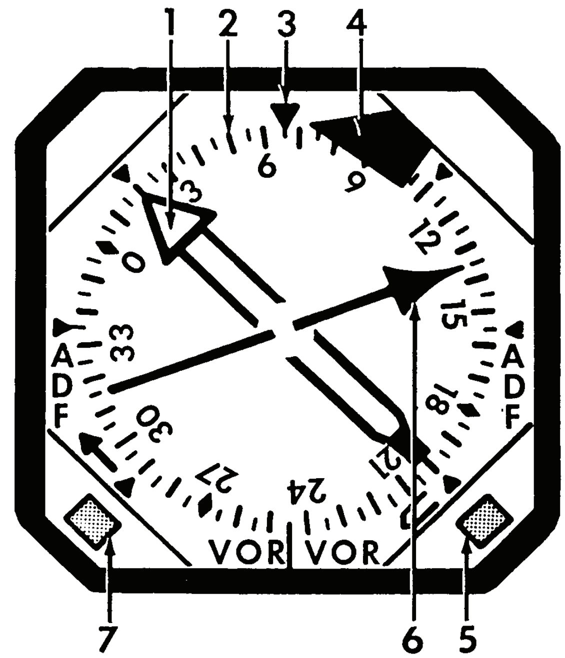
c. Controls and Functions. Refer to Figure 3A-7.

(1) Double Needle Pointer. Indicates bearing selected by double needle switch.

(2) Compass Card. Indicates aircraft heading at top of dial.

(3) Heading Index. Reference point for aircraft heading.

(4) Warning Flag. Indicates loss of heading signal or that bearing information is unreliable.



1. **Double Needle Pointer**
2. **Compass Card**
3. **Heading Index**
4. **Warning Flag**
5. **Double Needle Switch**
6. **Single Needle Pointer**
7. **Single Needle Switch**

Figure 3A-7. Radio Magnetic Indicator (RMI)

(5) Double Needle Switch. Selects desired signal to be displayed on the No. 2 double needle pointer.

*(a) **ADF** Position.* Selects ADF No. 2 bearing information.

*(b) **VOR** Position.* Selects VOR No. 2 bearing information.

(6) Single Needle Pointer. Indicates bearing selected by the No. 1 single needle switch.

*(a) **ADF** Position.* Selects ADF No. 1 bearing information.

*(b) **VOR**/GPS Position.* Selects VOR No. 1 or GPS bearing information.

(7) Single Needle Switch. Selects desired signal to be displayed on the No. 1 signal needle pointer.

3A-15. PILOT'S HORIZONTAL SITUATION INDICATOR.

a. Description. The pilot's Horizontal Situation Indicator (HSI) provides heading, course deviation, and glideslope deviation information. Information from this instrument is also fed to the flight control system.

b. Associated Controls/Indicators and Function. Refer to Figure 2-17, Sheet 1.

*(1) Pilot's **VOR 1 / VOR 2** Switch.* Controls course select and display circuits of the HSI.

*(a) **VOR 1**.* Circuits are connected to VOR No. 1 receiver.

*(b) **VOR 2**.* Circuits are connected to VOR No. 2 receiver.

*(2) Pilot's **VOR / GPS** Switch.* Selects information for pilot's HSI display and, when pressed, illuminates the HSI display.

*(3) Pilot's **COMPASS # 1 / # 2** Switch.* Selects desired source for magnetic heading information for display on compass card of indicator.

*(a) **# 1**.* Selects compass system No. 1 for display.

*(b) **# 2**.* Selects compass system No. 2 for display.

c. Controls/Indicators and Functions. Refer to Figure 3A-8.

(1) Compass Card. Indicates aircraft magnetic heading supplied by system selected on pilot's **COMPASS # 1 / # 2** switch.

(2) Heading Marker. Positioned by **HDG** knob to selected heading.

(3) Lubber Line. Indicates heading of aircraft.

(4) Course Arrow. Positioned by **COURSE** knob to selected VOR radial.

*(5) **HEADING** Flag.* Indicates loss of reliable heading information.

*(6) **COURSE** Indicator.* Presents a digital readout of course selected by the **COURSE** knob.

*(7) **NAV** Flag.* VOR 1 or VOR 2 selected indicates loss of or unreliable navigation signal VLF selected. The CMA-734 drives the normal VOR/LOC warning flag when VLF information is displayed on the pilot's HSI. The warning flag will be in view any time the VLF information is invalid or suspected, or when any of the system status annunciators (**SYS**, **SYN**, **AMB**, or **DR**) are illuminated. If the flag is in view with the Ambiguity (**AMB**) annunciator illuminated, the flag may be cancelled by pressing the **BK** key on the CDU.

*(8) **COURSE** Control Knob.* Used to select desired VOR course.

(9) Course Deviation Bar. Indicates lateral course deviation selected by the pilot's **VOR # 1 / # 2,** or **VLF** switch, if installed.

(10) To-From Arrow. Indicates direction toward the VOR station or VLF waypoint (if installed and if VLF is selected) along the course selected by the **COURSE** knob. The arrow is not visible when a localizer frequency is selected.

*(11) **HDG** Control Knob.* Used to select desired heading.

*(12) **GS** Flag.* Covers glideslope pointer when not receiving glideslope information.

(13) Glideslope Pointer. Displays deviation from correct glideslope during ILS approach.

3A-16. COPILOT'S HORIZONTAL SITUATION INDICATOR.

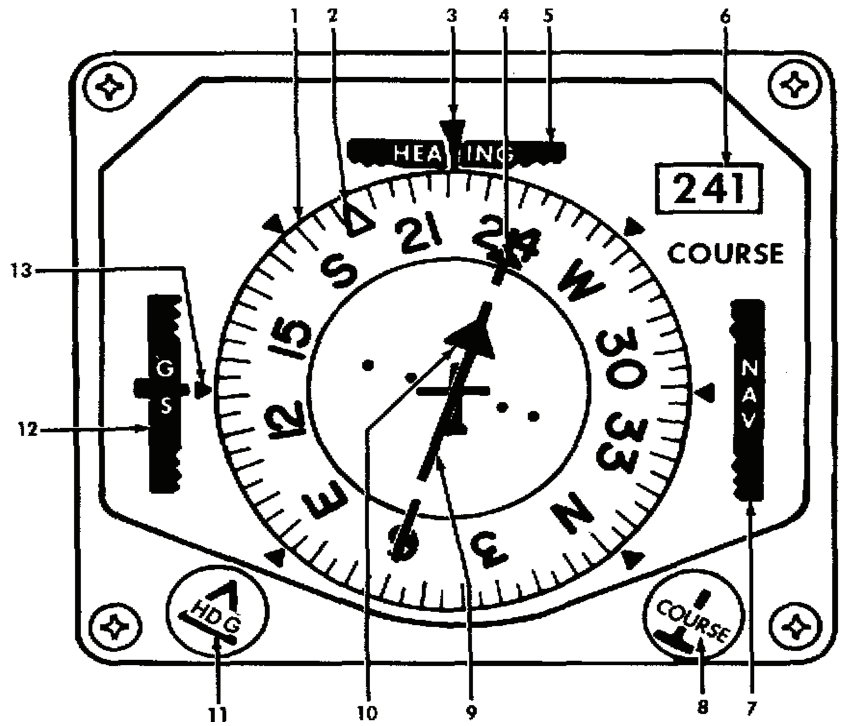
a. Description. The copilot's HSI provides heading, course deviation, and glideslope deviation information. It also switches to back localizer sensing whenever a localizer frequency is tuned, and the selected course and aircraft heading differ by more than 105°.

b. Associated Controls and Functions. Refer to Figure 2-17, Sheet 1.

NOTE

If the pilot's and copilot's VOR 1 / 2 switches are in the same position, the pilot has control of the course select circuits of the selected receiver and the copilot can only monitor deviation information from the selected receiver. A PILOT SELECT indicator will illuminate to notify the copilot that he has selected the same receiver as the pilot.

When the pilot has GPS selected, the copilot has the option of selecting VOR 1 or VOR 2 on the copilot's HSI.



1. Compass Card
2. Heading Marker
3. Lubber Line
4. Course Arrow
5. HEADING Flag
6. COURSE Indicator
7. NAV Flag
8. COURSE Control
9. Course Deviation Bar
10. To-From Arrow
11. HDG Control
12. GS Flag
13. Glideslope Pointer

Figure 3A-8. Pilot's Horizontal Situation Indicator

*(1) Copilot's **VOR 1 / 2** Switch.* Controls course select and display circuits of the HSI.

*(a) **VOR 1**.* Circuits are connected to VOR No. 1 receiver.

*(b) **VOR 2**.* Circuits are connected to VOR No. 2 receiver.

*(2) Copilot's **COMPASS # 1** / # **2** Switch.* Selects desired source for magnetic heading information for display on compass card of indicator.

c. Copilot's Horizontal Situation Indicator. Refer to Figure 3A-9.

(1) Heading Marker. Positioned by **HDG** knob to selected heading.

*(2) **COMPASS** Flag.* Indicates loss of reliable heading information.

(3) Lubber Line. Indicates heading of aircraft.

(4) Course Arrow. Positioned by **COURSE** knob to selected VOR radial.

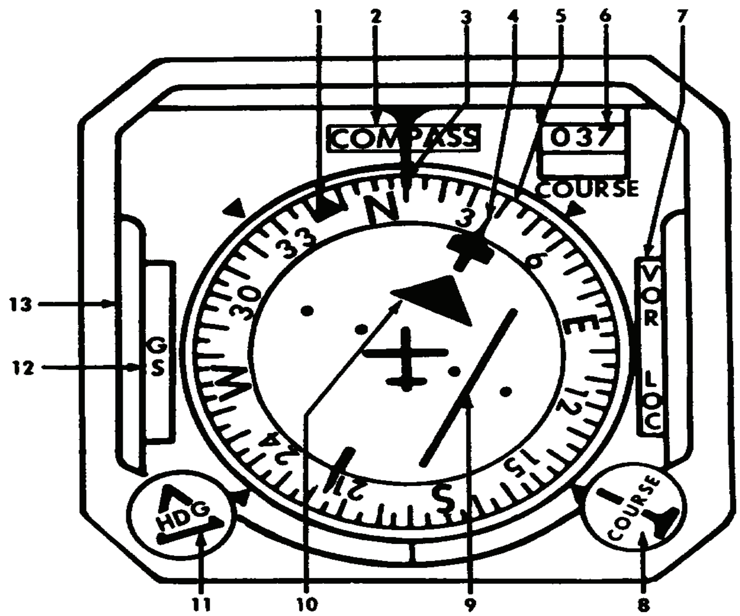
(5) Compass Card. Indicates aircraft magnetic heading supplied by system selected on copilot's **COMPASS # 1** / **# 2** switch.

*(6) **COURSE** Indicator.* Presents a digital readout of course selected by the **COURSE** knob.

*(7) **VOR LOC** Flag.* Indicates loss of or unreliable navigation signal.

*(8) **COURSE** Control Knob.* Used to select desired VOR course.

(9) Course Deviation Bar. Indicates lateral course deviation selected by the copilot's **VOR 1 / 2** switch.



1. Heading Marker
2. COMPASS Flag
3. Lubber Line
4. Course Arrow
5. Compass Card
6. COURSE Indicator
7. VOR LOC Flag
8. COURSE Control
9. Course Deviation Bar
10. To-From Arrow
11. HDG Control
12. GS Flag
13. Glideslope Pointer

Figure 3A-9. Copilot's Horizontal Situation Indicator

(10) To-From Arrow. Indicates direction toward the VOR station along the course selected by the **COURSE** knob.

*(11) **HDG** Knob.* Used to select desired heading.

*(12) **GS** Flag.* Covers glideslope pointer when not receiving glideslope information.

(13) Glideslope Pointer. Displays deviation from correct glideslope during ILS approach.

3A-17. PILOT'S HORIZON REFERENCE INDICATOR.

a. Description. The horizon reference indicator is the pilot's basic attitude horizon indicator and the attitude direction instrument for the flight director system. Refer to Figure 3A-10.

b. Controls and Functions.

(1) Crossed Needles. Displays computed steering commands.

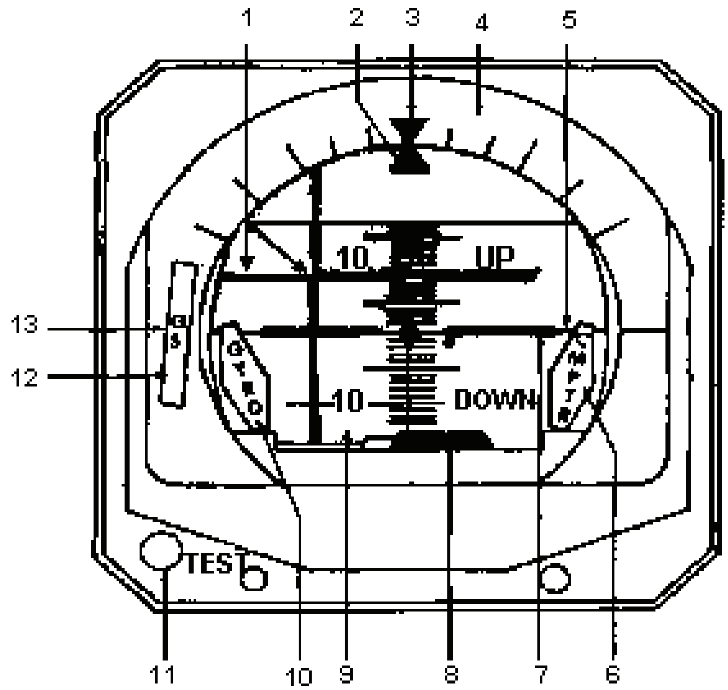
(2) Bank Angle Pointer. Indicates aircraft bank angle.

(3) Bank Angle Index. Reference indicating zero-degree bank.

(4) Bank Angle Scale. Allows measurement of aircraft bank angle from 0 to 60°.

(5) Horizon Line. Affixed to sphere, remains parallel to the earth's horizon at all times.

*(6) **CMPTR** Flag.* Presence indicates a malfunction within the autopilot computer.



1. **Crossed Needles**
2. **Bank Angle Pointer**
3. **Bank Angle Index**
4. **Bank Angle Scale**
5. **Horizon Line**
6. **CMPTR Flag**
7. **Miniature Aircraft**
8. **Lateral Deviation Indicator**
9. **Sphere**
10. **GYRO Flag**
11. **TEST Push Button**
12. **GS Flag**
13. **Vertical Deviation Indicator**

Figure 3A-10. Pilot's Horizon Reference Indicator

NOTE

When flying coupled to the GPS system, the CMPTR flag will be in view any time the steering information is invalid or a malfunction exists in the autopilot computer.

(7) Miniature Aircraft. Indicates attitude of aircraft with respect to the earth's horizon.

(8) Lateral Deviation Indicator. Displays localizer deviation information from VOR #1 receiver.

(9) Sphere. Remains oriented with the earth's axis at all times.

(10) ***GYRO*** *Flag.* Presence indicates loss of power to, or low rotational speed of, vertical gyro.

(11) ***TEST*** *Push Button.* When pressed, display indicates an additional 10° nose up and 20° right roll and the **GYRO** flag is visible.

(12) ***GS*** *Flag.* Presence indicates glideslope information is not being presented on indicator.

(13) Vertical Deviation Indicator. Displays glideslope deviation information from VOR No. 1 receiver.

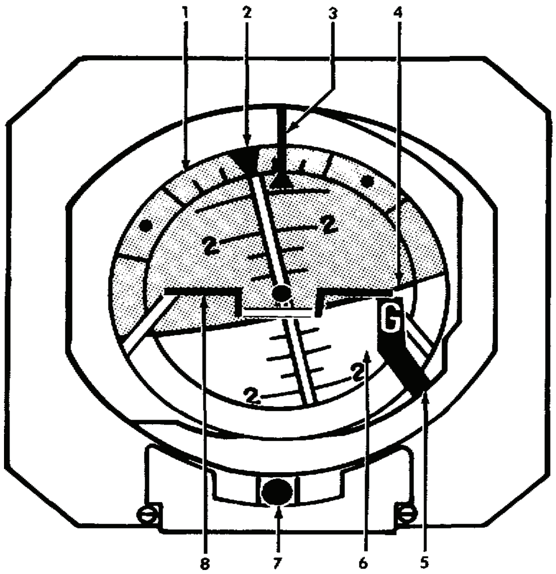
3A-18. COPILOT'S ATTITUDE INDICATOR.

a. Description. The copilot's attitude indicator is a flight instrument that indicates the aircraft's attitude. The indicator is designed to operate through all attitudes. There are no front panel fuses or circuit breakers provided for the copilot's attitude indicator. Refer to Figure 3A-11.

b. Controls/Indicators and Functions.

(1) Bank Angle Scale. Allows measurement of aircraft bank angle from zero to 90° with marks at 10, 20, 30, 45, 60, and 90°.

(2) Bank Angle Index. Reference indicating zero-degree bank.



1. Bank Angle Scale
2. Bank Angle Index
3. Bank Angle Pointer
4. Horizon Line
5. G Flag
6. Sphere
7. Inclinometer
8. Miniature Aircraft

Figure 3A-11. Copilot's Attitude Indicator

(3) Bank Angle Pointer. Indicates aircraft bank angle.

(4) Horizon Line. Affixed to sphere, remains parallel to the earth's horizon at all times.

*(5) **G** Flag.* Presence indicates loss of power.

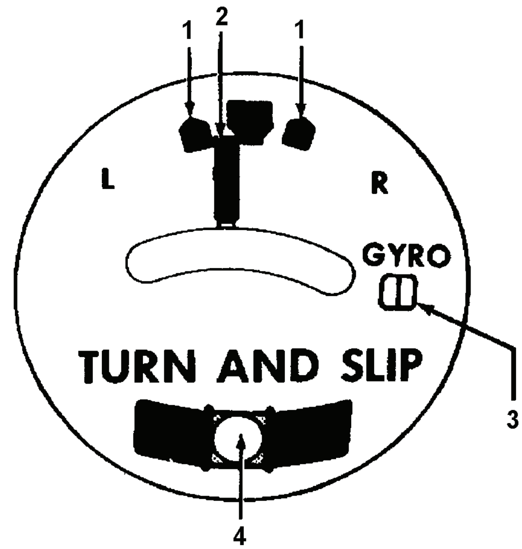
(6) Sphere. Remains oriented with the earth's axis at all times.

(7) Inclinometer. Assists the copilot in making coordinated turns.

(8) Miniature Aircraft. Indicates attitude of aircraft with respect to the earth's horizon.

3A-19. PILOT'S TURN AND SLIP INDICATOR.

a. Description. The pilot's turn and slip indicator is used to provide automatic yaw damping information to the autopilot in addition to performing the functions of a turn and slip indicator. Refer to Figure 3A-12. It is protected by the 5-ampere **PILOT TURN & SLIP** circuit breaker located on the overhead circuit breaker panel.



1. 2-Minute Turn Marks
2. Turn Rate Indicator
3. Gyro Warning Flag
4. Inclinometer

Figure 3A-12. Pilot's Turn and Slip Indicator

b. Controls and Function.

(1) Turn Rate Indicator. Deflects to indicate rate of turn.

(2) 2-Minute Turn Marks. Fixed markers indicate 2-minute turn rate when covered by turn rate indicator.

*(3) **GYRO** Warning Flag.* Indicates when power is not applied to turn gyro.

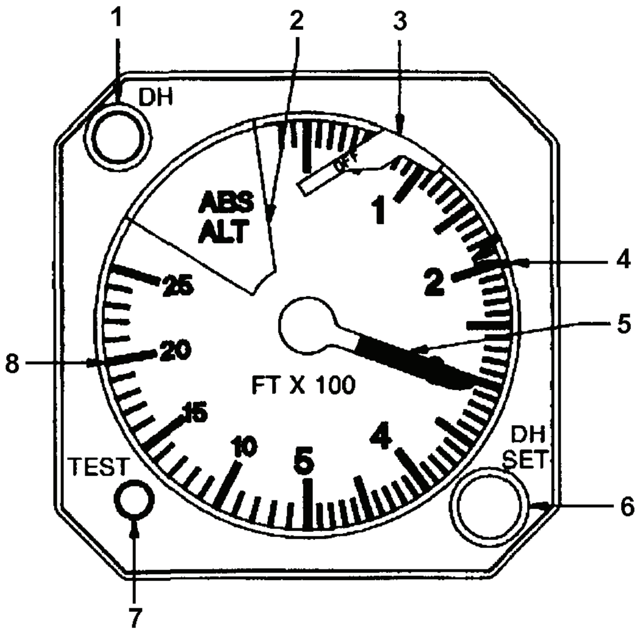
(4) Inclinometer. Indicates lateral acceleration, side slip, of aircraft.

3A-20. RADIO ALTIMETER (RA-315).

a. Description. The radio altimeter provides the pilot with the actual altitude of the aircraft above ground or surface level. Refer to Figure 3A-13. The indicator displays radio altitude information from 2500 feet to touchdown, with an expanded linear scale below 500 feet.

b. Controls and Functions.

(1) Decision Height Annunciator. An annunciator, placarded **DH**, located on the upper left corner of the radio altimeter indicator, will illuminate when the aircraft is at or below the selected decision height.



1. **Decision Height Annunciator**
2. **Pointer Mask**
3. **Failure Warning Flag**
4. **Decision Height Marker**
5. **Altitude Pointer**
6. **Decision Height Set Knob**
7. **Test Switch**
8. **Altitude Scale**

Figure 3A-13. Radio Altimeter (RA-315)

(2) Pointer Mask. The pointer mask, placarded **ABS ALT**, covers the pointer for altitudes above 2500 feet.

(3) Failure Warning Flag. A flag, placarded **OFF,** will be in view whenever the radio altimeter system information is unreliable.

(4) Decision Height Marker. The decision height marker is set to the desired decision height by the **DH SET** knob.

(5) Altitude Pointer. The altitude pointer indicates altitude above ground or surface level.

(6) Decision Height Set Knob. A knob, placarded **DH SET**, located on the lower right corner of the radar altimeter indicator, is used to set the orange decision height marker to the desired DH.

(7) Test Switch. A momentary push-button switch, placarded **TEST**, located on the lower left corner of the radio altimeter indicator, is used to activate the unit's self test function. When the switch is pressed, the **OFF** warning flag will come into view and the altitude pointer will indicate approximately 100 +20 feet. Releasing the switch will cause the altitude pointer to return to existing altitude, and **OFF** warning flag to retract from view.

(8) Altitude Scale. Indicates altitude of aircraft.

3A-21. GYROMAGNETIC COMPASS SYSTEMS.

a. Description. Dual identical compass systems provide accurate directional information for the aircraft at all latitudes of the earth. As a heading reference, two modes of operation are used, directional gyro (FREE) mode or slaved (SLAVE) mode. In Polar Regions of the earth where magnetic heading references are not reliable, the system is operated in the FREE mode. In this mode, the system furnishes an inertial heading reference, with latitude corrections introduced manually. In areas where magnetic heading references are reliable, the system is operated in the SLAVE mode. In this mode, the directional gyro is slaved to the magnetic azimuth detector, which supplies long-term magnetic reference for correction of the apparent drift of the gyro. Magnetic heading information from both systems is applied to various aircraft systems through pilot and copilot's **COMPASS** switches. There are no front panel fuses or circuit breakers for the gyromagnetic compass systems.

b. Controls and Functions. Refer to Figure 2-17, Sheet 1.

(1) Pilot's ***COMPASS # 1 / # 2*** *Switch.* Selects desired source for magnetic heading information for display on pilot's HSI copilot's RMI.

(a) ***# 1****.* Selects compass system No. 1 for display.

(b) ***# 2.*** Selects compass system No. 2 for display.

(2) Copilot's ***COMPASS # 1 / # 2*** *Switch.* Selects desired source for magnetic heading information for display on copilot's HSI and pilots RMI.

(a) ***# 1****.* Selects compass system No. 1 for display.

(b) ***# 2****.* Selects compass system No. 2 for display.

(3) ***COMPASS SLAVE*** *Annunciator.* Presents a visual indication of system synchronization operation.

(4) ***GYRO SLAVE / FREE*** *Switch*. Controls system mode of operation.

(a) ***SLAVE****.* Places system in SLAVE mode.

(b) ***FREE****.* Places system in FREE mode.

(5) ***INCREASE / DECREASE*** *Switch.* Provides manual fast synchronization for the system.

(a) ***INCREASE****.* Causes gyro heading output to increase.

(b) ***DECREASE.*** Causes gyro heading output to decrease.

3A-22. VOR RECEIVERS (VIR-30).

a. Description. Two VOR receivers are provided. VOR No. 2 is identical in operation to VOR No. 1 except that no marker beacon section is provided in VOR No. 2. The unit is an airborne navigation-communications radio whose function is to receive and interpret VOR and localizer (LOC) signals in the frequency range of 108.00 to 117.95 MHz, glideslope signals in the frequency range of 329.15 to 335.00 MHz, and marker beacon signals to 75 MHz. Signal reception is limited to line-of-sight and by the power of the transmitter with a maximum range of 120 miles. The VOR receivers are protected by two 2-ampere circuit breakers, placarded **VOR # 1** and **VOR # 2**, located on the overhead circuit breaker panel.

b. Associated Controls and Functions. Refer to Figure 2-17, Sheet 1.

(1) Pilot's ***VOR 1 / VOR 2*** *Switch.* Controls course select and display circuits of the pilot's HSI.

(a) ***VOR 1****.* Circuits are connected to VOR No. 1 receiver.

(b) ***VOR 2****.* Circuits are connected to VOR No. 2 receiver.

(2) Copilot's ***VOR 1 / VOR 2*** *Switch.* Controls course select and display circuits of the copilot's HSI.

(a) ***VOR 1****.* Circuits are connected to VOR No. 1 receiver.

(b) ***VOR 2****.* Circuits are connected to VOR No. 2 receiver.

NOTE

If the pilot's and copilot's VOR 1 / VOR 2 switches are in the same position, the pilot has control of the course select circuits of the selected receiver and the copilot can only monitor deviation information from the selected receiver. A PILOT SELECT indicator will illuminate to notify the copilot that he has selected the same receiver as the pilot.

(3) ***A*** *Indicator.* Illuminates when passing over airways marker station.

(4) ***O*** *Indicator.* Illuminates when passing over outer marker station.

(5) ***M*** *Indicator.* Illuminates when passing over middle marker station.

NOTE

Refer to Figure 3A-1 for items (6), (7), and (8).

(6) ***AUDIO VOR*** *Switch.* Applies VOR audio to respective headsets.

(7) ***MKR BCN HI-LO*** *Switch.* Controls sensitivity of marker beacon receiver.

(8) ***MKR BCN VOL*** *Control.* Adjusts volume of received signal.

c. Controls and Functions. Refer to Figure 3A-14.

(1) Frequency Indicator. Indicates operating frequency of set.

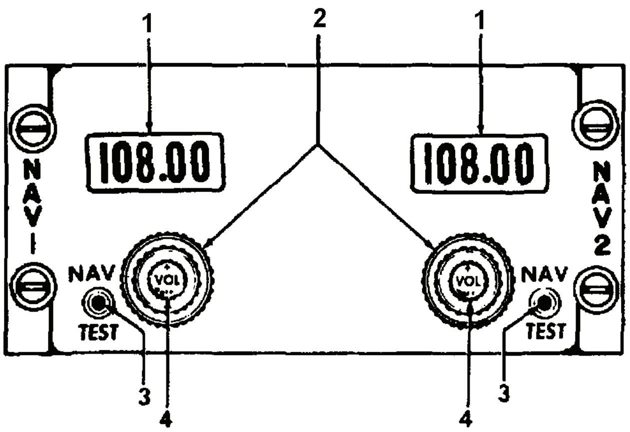
(2) Frequency Control. Selects desired operating frequency.

(3) ***NAV TEST*** *Push Button.* When pressed, the following indications are presented:

(a) RMI Single needle indicates 5°.

(b) HSI Lateral deviation to the right. Glideslope deviation down.

(4) ***VOL / OFF*** *Control.* Turns set on and adjusts volume.



1. **Frequency Indicator**
2. **Frequency Control**
3. **NAV TEST Push Button**
4. **VOL OFF Control**

Figure 3A-14. VOR Control Panel

d. Operation.

(1) Turn-On Procedure.

1. **VOL / OFF** control – Turn clockwise.

(2) Operating Procedure.

1. Frequency selectors – Set desired frequency.

2. **VOL** control – As required.

3. Determine course to station on horizontal situation indicator. Refer to Figure 3A-8 or 3A-9.

   a. **VOR 1 / VOR 2** switch – As required.

   b. **Course** knob – Rotate knob until course deviation bar is centered and to-from arrow indicates TO**.**

   c. **Course** readout – Read bearing to station.

4. Determine course to station on RMI. Refer to Figure 3A-7.

   a. Single or double needle pointer switches – As required, depending upon whether VOR 1 or VOR 2 is in use.

   b. Single or double needle on RMI – Read course to station.

(3) Localizer Receiver Operating Procedure.

1. Frequency selectors – Set required frequency.

2. **VOR 1 / VOR 2** switch – As required.

3. Course deviation indicator – Steer aircraft as required to center course deviation bar.

(4) Marker Beacon Operating Procedure.

1. Marker beacon indicator lights (Figure 2-17) – Observe for beacon indication.

2. **MKR BCN HI / LO** sensitivity switch (Figure 3A-1) – As required.

3. **MKR BCN VOL** control (Figure 3A-1) – As required.

(5) Glideslope Operating Procedure.

1. Frequency selectors – Set desired localizer frequency.

2. **VOR 1 / VOR 2** switch (Figure 2-17) – As required.

3. Glideslope pointer (Figure 3A-9) – Steer aircraft as required to center pointer.

(6) VHF Communications Receiver Operating Procedure.

1. Frequency selectors – Set desired frequency.

2. **VOL** control – As required.

(7) Shutdown Procedure.

1. **VOL / OFF** control – Turn counterclockwise.

3A-23. ADF RADIO SETS (DF-203).

a. Description. Two ADF radio sets are installed. The units are airborne low frequency radio direction finders that receive signals from transmitters in the 190 to 1750 kHz range to provide a visual and aural indication of the aircraft's bearing in relation to the transmitter. The set can also be used for homing and position fixing. The set also has a Beat Frequency Oscillator (BFO) function, used to more accurately tune weak signals. Reception distance of reliable signals depends on the power output of the transmitting station and the atmospheric conditions. Bearing indications are displayed visually on the RMI's and aural signals are applied to the audio control panels. The ADF radio sets are protected by a 1-ampere circuit breaker, placarded **ADF**, located on the overhead circuit breaker panel, Figure 2-16, Sheets 1 and 2.

NOTE

Keying the HF radio set while operating the ADF No. 2 set will cause a momentarily unreliable ADF signal.

b. Associated Controls and Functions. Refer to Figure 3A-1.

(1) ***ICS # 1 ADF 1 / 2*** *Switch.* Applies ADF audio to respective headsets.

(2) ***FILTER V / OFF*** *Switch.* Selects whether or not voice filter will be used with ADF audio.

(3) ***FILTER R / OFF*** *Switch.* Selects whether or not range filter will be used with ADF audio.

(4) ***CABIN ADF-1 / OFF / ADF-2*** *Switch*. Selects desired ADF audio for use with cabin speakers.

c. Controls and Functions. Refer to Figure 3A-15.

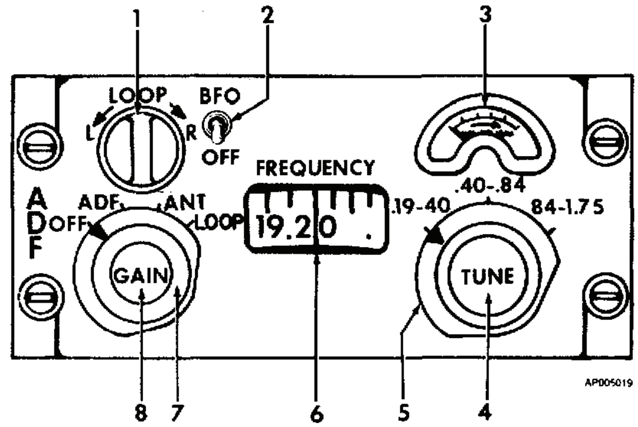
(1) ***LOOP*** *Control.* Operative only when the mode selector switch is in the **LOOP** or **ADF** position. Center position removes rotation signals from the loop antenna and the ADF pointer on the RMI's. First position left (**L**) or right (**R**) of center applies slow speed rotation signals to loop antenna and ADF pointer on RMI's for 360° rotation left or right. Second position left (**L**) or right (**R**) of center applies fast-speed rotation signals to loop antenna and ADF pointer on RMI's for 360° rotation left or right.

(2) ***BFO / OFF*** *Switch.* Turns BFO on or off.

(3) *Tuning Meter.* Indicates relative strength of received signals.

(4) ***TUNE*** *Control.* Tunes receiver.

(5) *Range Switch.* Selects operating frequency band.



1. **LOOP Control**
2. **BFO/OFF Switch**
3. **Tuning Meter**
4. **TUNE Control**
5. **Range Switch**
6. **FREQUENCY Indicator**
7. **Mode Selector**
8. **GAIN Control**

Figure 3A-15. ADF Control Panel

(6) ***FREQUENCY*** *Indicator.* Indicates the operating frequency.

(7) *Mode Selector.* Determines operating mode.

(a) ***OFF****.* Turns set off.

(b) ***ADF****.* Allows homing or automatic direction finding operation.

(c) ***ANT****.* Allows reception using sense antenna.

(d) ***LOOP****.* Allows aural-null homing and manual direction-finding operations.

(8) ***GAIN*** *Control.* Adjusts volume of received signals.

d. Operation.

(1) *Automatic Direction Finder.*

1. Mode selector – **ADF**.
2. **BFO / OFF** switch – **BFO**.
3. Range switch – Select.

4. **TUNE** control – Rotate for maximum reading on tuning meter and zero BFO beat.

5. **GAIN** control – As required.

6. **BFO / OFF** switch – **OFF**.

7. Single or double needle switches, RMI – As required.

8. Single or double needle on RMI – Read course to station.

(2) Sense Antenna Direction Finding.

1. Mode selector – **ANT**.

2. Range switch – Select.

3. **TUNE** control – Rotate for maximum reading on tuning meter.

4. **GAIN** control – As required.

(3) Aural-Null Direction Finding.

1. Mode selector – **ANT**.

2. **BFO / OFF** switch – **BFO**.

3. Range switch – Select.

4. **TUNE** control – Tune desired station.

5. **GAIN** control – Adjust for minimum audio output.

6. Single or double needle switches RMI – As required.

7. **BFO / OFF** switch – **OFF**.

8. Mode selector – **LOOP**.

9. **LOOP** switch – **L** or **R**. Turn left or right until a null is reached, minimum sound in headsets.

NOTE

The true null and direction to the radio station may be indicated by either end of the single needle. This ambiguity must be solved to determine proper direction to the station.

10. Single or double needle on RMI – Read course to station.

(4) Shutdown Procedure.

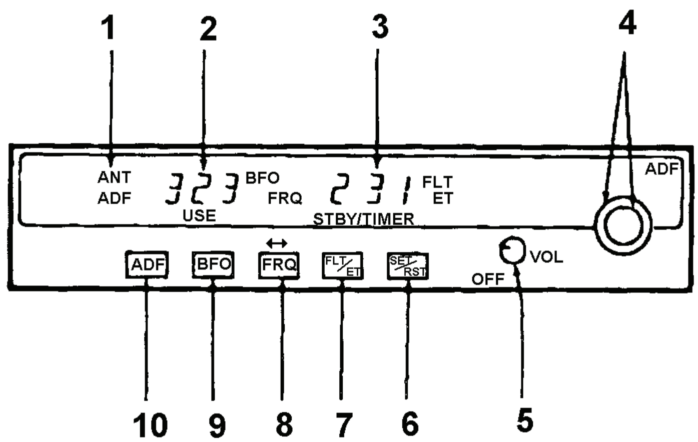
1. Mode selector – **OFF**.

3A-24. ADF RADIO (KR 87).

a. Description. The KR 87 automatic directional finder is a digitally tuned solid-state receiver which provides bearing information to stations in the 200 kHz to 1799 kHz frequency band, along with audio reception. Refer to Figure 3A-16. The unit displays the active frequency in the left, display window. The right window will display either the standby frequency (which can be transferred to the active window), or a flight timer, or programmable elapsed timer. The flight timer will keep track of the total flight lime, while the independent programmable elapsed timer can be reset to count up from zero or be preset to a value and count down to zero. The system is protected by a 1-ampere circuit breaker, placarded **ADF**, located on the right subpanel. The antenna located on the lower side of the aircraft contains loop and sense antennas, preamplifiers, and modulators, which combine the antenna signals into a single RF signal that is output to the receiver via a triaxial cable. Refer to Figure 2-1.

b. Operating Modes. The ADF has two operational modes. In the antenna (ANT) mode, the loop antenna is disabled and the unit acts as a receiver, allowing audio reception through the speaker or headphones. The indicator needle as selected on the RMI's will park at a 90° relative position and the ANT message on the left side of the display window will display. This mode will provide a slightly clearer audio reception and is used for station identification. In various parts of the world, some L/LM stations use an interrupted carrier for identification purposes. A Beat Frequency Oscillator (BFO) function is provided to permit these stations to be more easily identified. Pushing the **BFO** button will cause a 1000 Hz tone to be heard whenever there is a radio carrier signal present at the selected frequency. It will also light the BFO message in the center of the display.

With the **ADF** button pressed, the unit is placed into the ADF mode and the loop antenna is enabled. The ADF message on the left side of the window display will display and the indicator needle as selected on the RMI's will point to the relative bearing of the selected station. In order to tell if there is a sufficient signal for navigational purposes, place the unit back in the ANT mode, parking the indicator needle as selected on the RMI's at 90°. When the unit is then switched to the ADF mode, the needle should slew to the station bearing in a positive manner, without excessive sluggishness, wavering, or reversals.



1. **Mode Display**
2. **USE Frequency Display**
3. **STBY/TIMER Display**
4. **Frequency Select Knobs**
5. **OFF/VOL Control Switch**
6. **SET/RST Button**
7. **FLT/ET Button**
8. **FRQ Button**
9. **BFO Button**
10. **ADF Button**

Figure 3A-16. ADF Radio (KR 87)

c. Controls and Functions.

(1) Mode Display. Displays operating mode the unit is in.

*(2) **USE** Display.* Displays frequency to which the system is tuned.

*(3) **STBY/TIMER** Display.* Displays standby frequency, flight time, or elapsed time. The standby frequency is placed in memory when either Flight Time (FLT) or Elapsed Time (ET) mode is selected.

(4) Frequency Select Knobs. Selects active/standby frequencies.

(a) Active Frequency. The active frequency is displayed in the left portion of the window display. This frequency may be changed with the concentric knobs when either time mode (FLT or ET) is being displayed. To set the 10's digit, push the small knob in and rotate it. Clockwise rotation will increment the digit. The digit will roll over at 9 to 0 and roll under (when turning the knob counterclockwise) at 0 to 9. With the small knob pulled out, the 1's digit may be set. Its operation is the same as for the 10's digit.

Turning the large knob changes the l00's digit and the 1000's digit. The 100's digit carries to the 1000's digit from 9 to 10 and borrows from 10 to 9. The two digits roll over from 17 to 02 and under from 02 to 17, limiting the frequencies to the range or 200 kHz to 1799 kHz.

(b) Standby Frequency. The standby frequency is displayed in the right portion of the display window when the FRQ message is displayed. In this case, the standby frequency may be changed with the frequency control knobs as desired. If the standby frequency is not being displayed, it may be called to the window by pressing the **FRQ** button. Pressing this button when the standby frequency is displayed causes the current standby and active frequencies to be exchanged.

*(5) **OFF / VOL** Control Switch.* Rotating this control switch clockwise out of detent turns the unit on. Further rotation of the control switch increases volume.

*(6) **SET / RST** Button.* This button controls the elapsed time. Time is reset back to zero each time the button is pressed. The elapsed times have a countdown mode, which is set by pressing the **SET / RST** button for 2 seconds or until the ET display begins to flash. With the ET flashing, the selector knob will set any time up to 59 minutes, 59 seconds. To start the elapsed time count down, press the **SET / RST** button and the timer will start counting down. At zero, the timer will begin to flash for 15 seconds and then go to a solid display. While the FLT or ET is displayed, the in use frequency may be changed with the frequency control knobs.

(7) ***FLT/ET*** *Button.* If ET is currently displayed, pressing the **FLT / ET** button will cause the FT to be displayed. Pressing this button again will exchange the two timers in the display. If the standby frequency is displayed, pressing the **FLT / ET** button will cause the timer that was last displayed to reappear in the window.

NOTE

When power is first applied the flight timer is displayed.

(a) Flight Timer. The flight timer is displayed in the right portion of the display window when the FLT message is displayed. The timer receives power through the landing gear squat switch. The counter will count up to 59 hours, 59 seconds. It begins counting upon liftoff and will quit counting upon landing. The elapsed timer may be reset back to 0 by pressing the **SET / RST** button or turning the unit off.

(b) Elapsed Timer. This coupler has two modes: count up and count down. When power is applied, it is in the count up mode starting at 0. The timer will count up to 59 hours, 59 seconds displaying minutes and seconds until 1 hour has elapsed, then displaying hours and minutes. When in the count up mode, the timer may be reset to 0 by pressing the **SET / RST** button.

NOTE

Pressing the reset button will reset the elapsed timer regardless of what is currently being displayed.

To enter the count down mode, press the **SET / RST** button for approximately 2 seconds until the ET message begins to flash. While the ET message is flashing, the timer is in the ET set mode. In this mode a number up to 59 minutes, 59 seconds may be preset into the elapsed timer with the frequency select knobs. With the smaller knob pressed in, the 10's of seconds digit may be changed; it will roll over from 5 to 0 and under 0 to 5. With the knob pulled out, the 1's of seconds digit may be changed. It rolls over for 9 to 0 and under from 0 to 9. The larger knob modifies the minutes. It rolls over from 59 to 0 and under from 0 to 59. The timer will remain in the ET set mode (ET message flashing) for 15 seconds after a number is set in or until the **SET / RST**, **FLT / ET**, or **FRQ** button is pressed. The preset number will remain unchanged until the **SET / RST** button is pressed. When the **SET / RST** button is pressed after a number has been preset, the elapsed timer will start counting down. When the elapsed timer is counting down, pressing the **SET / RST** button again will have no effect unless it is held for approximately 2 seconds. This will cause the timer to stop and enter the set mode (ET message flashing). When the timer reaches 0, it changes to the count up mode and continues up from 0. The elapsed time will flash for 15 seconds, then annunciate a steady display,

(8) ***FRQ*** *Button.* The selected frequency is put into the active window by pressing the **FRQ** button. The standby and active frequencies will be exchanged.

(9) ***BFO*** *Button.* When the **BFO** button is pressed, the BFO mode is activated and BFO will display in the display window. In various parts of the world, some L/LM stations use an interrupted carrier for identification purposes. When in the BFO mode, these stations are more easily identified. Pressing the **BFO** button will cause a 1000 Hz tone to be heard whenever there is a radio carrier signal present at the selected frequency.

(10) ***ADF*** *Button.* When the **ADF** button is pressed, the unit is placed into the ADF mode with the loop antenna enabled. An ADF message on the left portion of the window will display. Indicator needles, as selected on the RMI's, will point to the relative bearing of the selected station.

d. Operating Procedure.

1. **AVIONICS MASTER** Switch – On.

2. **OFF / VOL** Control Switch – Turn clockwise out of detent. Adjust volume as required.

NOTE

An audio muting feature causes the audio output to be muted unless the receiver is locked onto a valid station. This reduces interstation noise and aids in identifying navigable stations.

3. ADF Test – Select ANT mode. Verify bearing pointers park in the 90-degree position.

4. Operating Mode – Select as desired.

5. Frequencies – Select. Ensure desired active frequency is displayed.

6. **FLT / ET** Switch – Operate as required.

e. Shutdown Procedures.

1. **OFF / VOL** Switch – Turn counterclockwise to off (detent).

2. **AVIONICS MASTER** Switch – **OFF**.

3A-25. DISTANCE MEASURING EQUIPMENT SYSTEM (DME-40).

a. Description. The DME system measures the slant range, line-of-sight, distance from the aircraft to a ground station and displays a continuous distance readout in nautical miles. The system also displays aircraft groundspeed in knots or time-to-station in minutes. The groundspeed and time-to-station are accurate only if the aircraft is flying directly toward the ground station at a sufficient distance that the slant range and ground range are nearly equal. The DME system is protected by a 2-ampere circuit breaker, placarded **DME**, on the overhead circuit breaker panel.

b. Controls and Functions, DME Control Panel. Refer to Figure 3A-17.

(1) ***DME SEL*** *Switch.* Controls operation of the system.

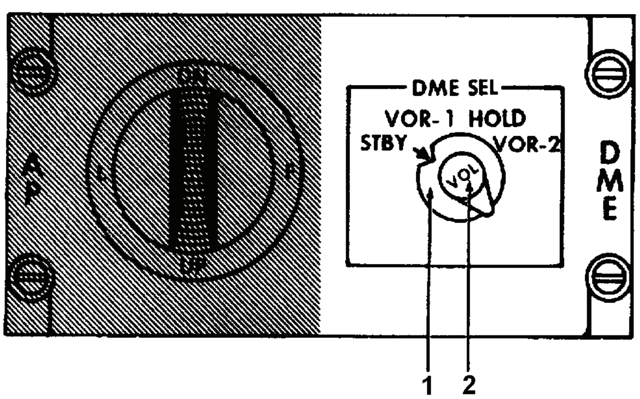
(a) ***STBY****.* Places system in standby.

(b) ***VOR-1****.* Allows channel selection using frequency controls for VOR-1.

(c) ***HOLD****.* System will remain tuned to previous channel if the VOR is tuned to a new frequency.

(d) ***VOR-2****.* Allows channel selection using frequency controls for VOR-2.

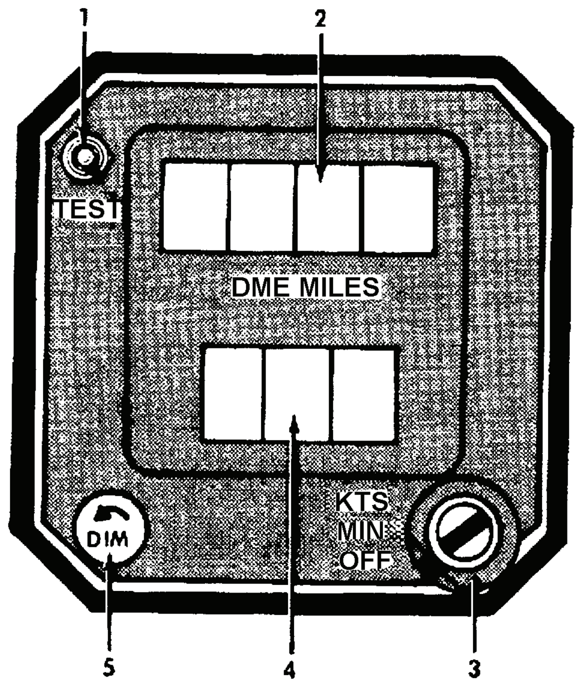
(2) ***VOL*** *Control.* Controls volume.



1. **DME SEL Switch**
2. **VOL Control**

Figure 3A-17. DME Control Panel

c. Controls/Indicators and Functions, DME Indicator. Refer to Figure 3A-18.



1. **TEST Push Button**
2. **DME MILES Indicator**
3. **Control Switch**
4. **Knots / Minutes Display**
5. **DIM Control**

Figure 3A-18. DME Indicator

(1) ***TEST*** *Push Button.* Initiates self-test of DME system. When pressed, upper display indicates 0.0 or 0.1 and lower display indicates dashes if control switch is in **MIN** position or 888 when in the **KTS** position.

(2) ***DME MILES*** *Indicator.* Digital display of slant-range distance from aircraft to ground station in nautical miles.

(3) Control Switch. Controls operation of the DME system.

(a) ***OFF****.* Turns system off.

(b) ***MIN****.* Selects time-to-station in minutes for display on bottom readout.

(c) ***KTS****.* Selects aircraft groundspeed in knots for display on bottom readout.

(4) Knots/Minutes Display. Digital display of time-to-station in minutes or groundspeed of aircraft in knots. This information is accurate only if the aircraft is flying directly toward the ground station.

*(5) **DIM** Control.* Controls intensity of digital readouts.

d. Normal Operation.

(1) Determining Slant Range Distance to Station.

1. VOR control panel – Tune required station.
2. **DME SEL** switch – **VOR-1** or **VOR-2**.
3. **DME MILES** indicator – Read distance in nautical miles.

(2) Determining Groundspeed And Time-To-Station.

1. VOR control panel – Tune required station.
2. **DME SEL** switch – **VOR-1** or **VOR-2**.
3. DME indicator control switch **– KTS.**
4. DME knots/minutes display – Read aircraft's groundspeed in knots and time-to-station in minutes.

3A-26. GLOBAL POSITIONING SYSTEM (KLN 90B).

For information on the Global Positioning System, refer to Chapter 3, Paragraph 3-7.

3A-27. AUTOPILOT SYSTEM (AP-106).

a. Description. The autopilot system is an integral part of the flight control system. The autopilot and flight director have a common computer system. When the autopilot is engaged, the flight control system controls the aircraft and the pilot monitors the flight path by observing the information displayed on the pilot's horizon reference indicator, the pilot's horizontal situation indicator, and the flight director system indicators. The autopilot system can maintain a pre-selected attitude, maintain a barometric altitude, maintain an indicated airspeed, capture and maintain a desired heading, capture and maintain a pre-selected radio course, and capture and maintain an ILS approach to published minimums. The autopilot/flight director commands are selected by the autopilot mode selector panel located on the pedestal extension. Roll rate and pitch commands can be given to the system through the autopilot pitch-turn panel, located on the pedestal extension. The operating status of the autopilot is indicated on the autopilot/flight director annunciator, located on the instrument panel directly above the pilot's horizon reference indicator. Two autopilot control switches are also provided on each control wheel. One is placarded **PITCH SYNC** & **CWS**, pitch synchronize and control wheel steering, and the other is placarded **DISC TRIM/AP YD**, disconnect trim/autopilot yaw damp. The autopilot system is protected by the 10-ampere **AP PWR** circuit breaker located on the overhead circuit breaker panel.

b. Autopilot Mode Selector. The autopilot/ flight director commands are selected by the autopilot mode selector. Selection is accomplished by pressing the face of the appropriate push-on/push-off switch. The lateral modes are **HDG**, **NAV**, **APPR**, and **B/C**. When not in a lateral mode the flight director command bars are biased out of view. The vertical modes are **ALT**, **IAS** and pitch, and are all hold modes. If a vertical mode is not selected, the pitch hold mode is automatically operational. Selection of a mode causes the legend of that push-button switch to illuminate. The self-test switch on the lower right of the autopilot control panel acts as a lamp test when pressed. For operation at night, overall illumination of the autopilot mode selector and switches is adjusted by the console light control.

c. Controls and Functions, Mode Selector. Refer to Figure 3A-19.

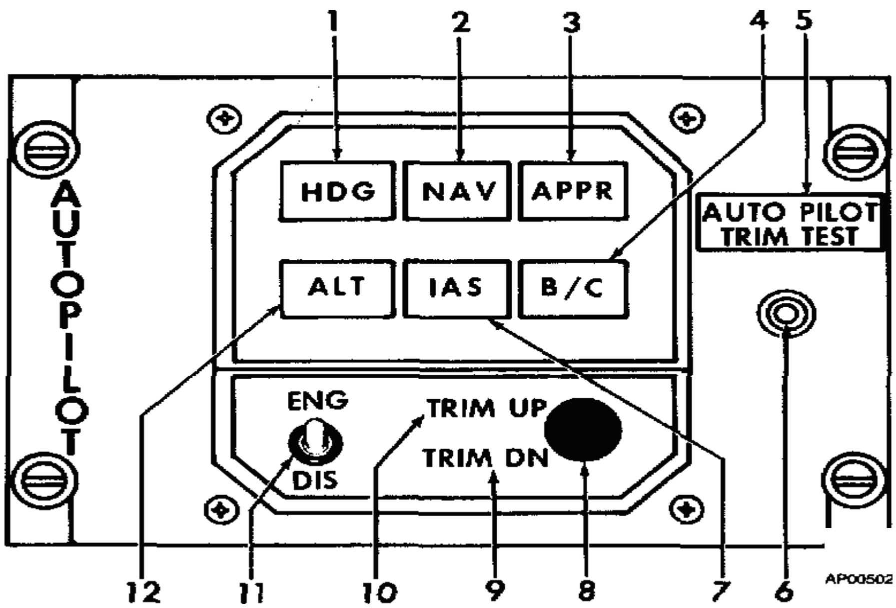
*(1) **HDG** Switch/Indicator.* Engages heading mode. Commands aircraft to acquire the heading indicated by heading marker on pilot's HSI.

*(2) **NAV** Switch/Indicator.* Engages navigation mode. VOR-1 or VOR-2 selected commands intercept and track VOR radial selected on pilot's HSI.

*(3) **APPR** Switch/Indicator.* Engages approach mode. Commands aircraft to intercept and track ILS inbound course.

*(4) **B C** Switch/Indicator.* Engages backcourse mode. Commands aircraft to intercept backcourse ILS.

*(5) **AUTO PILOT TRIM TEST** Indicator.* Illuminates when in test position.



1. HDG Switch / Indicator
2. NAV Switch / Indicator
3. APPR Switch / Indicator
4. B / C Switch / Indicator
5. AUTO PILOT TRIM TEST Indicator
6. AUTO PILOT TRIM TEST Switch
7. IAS Switch / Indicator
8. Self-Test Switch
9. TRIM DN Indicator
10. TRIM UP Indicator
11. ENG / DIS Switch
12. ALT Switch / Indicator

Figure 3A-19. Autopilot Mode Selector Panel

(6) ***AUTO PILOT TRIM TEST*** *Switch.* Used to simulate a no-trim condition to test trim monitor system.

(7) ***IAS*** *Switch/Indicator.* Engages airspeed hold mode. Commands aircraft to maintain airspeed.

(8) Self-Test Switch. Tests display and selector indicator circuits when pressed.

(9) ***TRIM DN*** *Indicator.* Illuminates when autopilot is driving trim servo in down direction or, (on some aircraft) if autopilot is disengaged, when manual down trim is required.

(10) ***TRIM UP*** *Indicator*. Illuminates when autopilot is driving trim servo in up direction or, (on some aircraft) if autopilot is disengaged, when manual up trim is required.

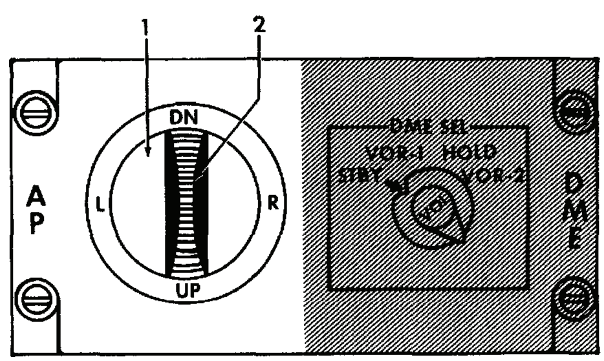
(11) ***ENG / DIS*** *Switch*. Controls coupling of the automatic pilot.

(a) ***ENG****.* Engages autopilot and illuminates engaged indicator.

(b) ***DIS****.* Disengages autopilot and illuminates disengaged indicator.

(12) ***ALT*** *Switch / Indicator*. Engages altitude hold mode. Commands aircraft to maintain pressure altitude.

d. Controls and Functions, Autopilot Pitch Turn Panel. Refer to Figure 3A-20.



1. Turn Control Knob
2. Pitch Control Thumbwheel

Figure 3A-20. Autopilot Pitch-Turn Panel

(1) Turn Control Knob. Supplies roll rate commands to autopilot. Spring loaded to center detent.

(2) Pitch Control Thumbwheel. Supplies pitch rate commands to autopilot. Spring loaded to center detent.

e. Controls and Functions, Control Wheel Switch.

*(1) **DISC-TRIM / AP YD** Push Button.* When pressed to first detent, autopilot system and yaw damp are disconnected. When pressed to second detent, electric trim is disconnected.

*(2) **PITCH SYNC & CWS** Push Button.* This button on the control wheels may be used instead of the pitch/turn control to establish the aircraft in a desired attitude. Pressing the button causes the autopilot servos to disengage from the control surfaces, enabling the pilot to manually fly the aircraft to the desired attitude until button is released.

f. Controls and Functions, GO-AROUND Switch.

*(1) **GO AROUND** Switch.* Located on the outboard side of left power lever. When pressed, activates the go-around mode of flight director. **GA** light illuminates on autopilot/flight director annunciator panel, the autopilot is disengaged, and the pilot's horizon reference indicator gives command for wings level and 70 nose up climb attitude.

g. Autopilot/Flight Director Annunciator Panel Indicators and Functions. Refer to Figure 3A-21. The autopilot/flight director incorporates its own annunciator panel located just above the flight director display on the instrument panel. The modes and indications given on the annunciator panel are placarded on the face of the lenses and illuminate when the respective conditions are indicated. Dimming of the annunciator panel lights is provided by a switch adjacent to the panel placarded **DIM** / **BRT**.

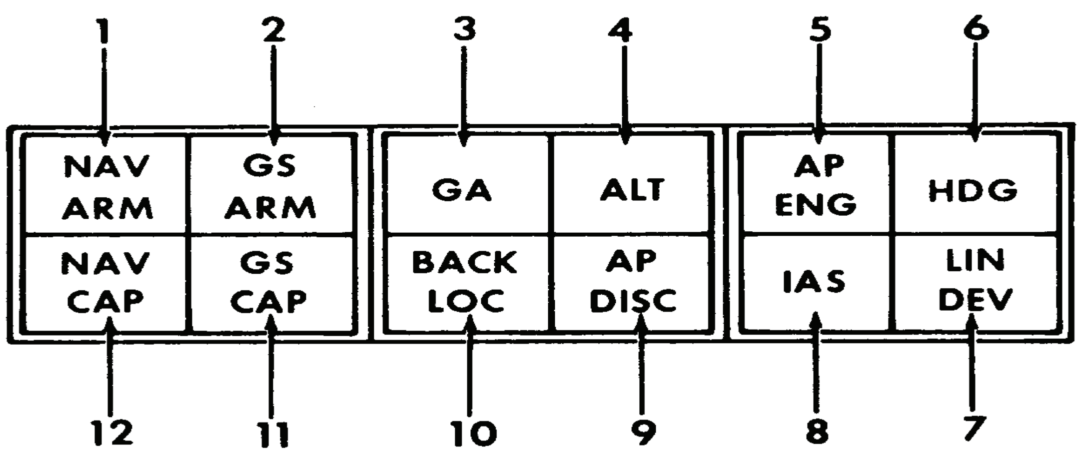
*(1) **NAV ARM** Indicator.* Illuminates when computer is armed to accept navigation signals.

*(2) **GS ARM** Indicator.* Illuminates when approach mode is selected prior to glideslope capture. Extinguishes after glideslope capture.

*(3) **GA** Indicator*. Illuminates when go-around mode is selected.

*(4) **ALT** Indicator.* Illuminates when altitude hold mode is selected.

*(5) **AP ENG** Indicator.* Illuminates when autopilot is disengaged.



1. **NAV ARM Indicator**
2. **GS ARM Indicator**
3. **GA Indicator**
4. **ALT Indicator**
5. **AP ENG Indicator**
6. **HDG Indicator**
7. **LIN DEV Indicator**
8. **IAS Indicator**
9. **AP DISC Indicator**
10. **BACK LOC Indicator**
11. **GS CAP Indicator**
12. **NAV CAP Indicator**

Figure 3A-21. Autopilot / Flight Director Annunciator Panel

*(6) **HDG** Indicator*. Illuminates when heading mode is selected.

*(7) **LIN DEV** Indicator.* Illuminates when distance and bearing data is received from VORTAC and DME is valid.

*(8) **IAS** Indicator*. Illuminates when airspeed hold mode is selected.

*(9) **AP DISC** Indicator.* Illuminates when autopilot is disengaged.

*(10) **BACK LOC** Indicator*. Illuminates when back-course mode is selected.

*(11) **GS CAP** Indicator*. Illuminates when glideslope is captured.

*(12) **NAV CAP** Indicator*. VOR-I or VOR-2 selected illuminates when selected radial is captured. VLF selected illuminates when VLF is coupled to the flight director.

h. Autopilot Modes of Operation.

(1) Attitude Mode. The autopilot is in the attitude mode when the **ENG / DIS** switch, autopilot mode selector panel, is in the **ENG** position and no mode selector switches (**HDG**, **NAV**, etc.), have been selected. Refer to Figure 3A-19. The autopilot will fly the aircraft and accept pitch and roll rate commands from the autopilot pitch-turn panel, Figure 3A-20.

(2) Guidance Mode. When the autopilot is in the attitude mode and a mode selector switch, **HDG**, **NAV**, etc., is pressed, the autopilot is coupled to the flight director and accepts steering commands from the computer. Depending on which mode selector switch on the autopilot mode selector control panel is pressed, autopilot operation can be described by the following sub-guidance modes.

(a) Heading Mode. When the HDG mode is selected on the autopilot mode selector panel with the autopilot engaged, the autopilot will fly the aircraft to the heading, and then maintain the heading under the heading marker on the pilot's horizontal situation indicator.

(b) Navigation Mode. When the NAV mode is selected on the autopilot mode selector panel, the system initially switches to the NAV ARM heading-hold submode, as shown by illumination of the **NAV ARM** and **HDG** indicators on the autopilot/ flight director annunciator panel. The autopilot will then command the aircraft to follow the heading under the heading marker on the pilot's horizontal situation indicator, with the heading marker set to produce the desired VOR or localizer intercept angle. The flight computer will compute a capture point based on deviation from desired radio beam, the rate at which the aircraft is approaching this beam, and the course intercept angle. When beam capture occurs, the **HDG** and **NAV ARM** indicator lamps on the autopilot/flight director annunciator panel will extinguish and the **NAV CAP** lamp will illuminate. The autopilot will then track the selected radio course with automatic crosswind correction.

(c) Navigation Mode (With Linear Deviation). The system features linearized VOR deviation when a VORTAC is being used. A **LIN DEV** light on the autopilot annunciator will illuminate to indicate operation. The lateral deviation bar indicates the distance in nautical miles from the selected radial regardless of how close the aircraft is to the ground station. Linear deviation measures the aircraft's displacement in nautical miles from the selected course rather than degrees of displacement associated with normal VOR navigation. Linear deviation permits flying parallel to any selected course by maintaining the appropriate needle deflection on the horizontal situation indicator. When the **LIN DEV** light is on, the flight director system is obtaining distance data from the DME and bearing from the VOR-1 receiver. Linear deviation operates only when DME is on NAV 1 receiver and is displayed on pilot's indicator only. For en route operation in the NAV mode, full-scale deflection of the lateral deviation bar equals 10 miles from the selected radial. For VOR approach operation, the APPR mode should be selected. This provides linear deviation with the sensitivity limits of the computer increased so that full-scale deflection of the lateral deviation bar equals 1 mile from the selected radial. APPR mode should be selected when within 10 miles of the final approach fix. Capture is the same as in the NAV mode.

NOTE

Failure to select APPR for VORTAC or VOR/DME instrument approaches when using linear deviation may result in not meeting obstruction clearance criteria.

(d) Backcourse Mode. When BACK LOC mode is selected on the autopilot mode selector panel, localizer capture is the same as in a front-course approach in NAV or APPR mode. Glideslope is inhibited during a backcourse approach. The HSI must be set to the front-course heading so that lateral deviation will be directional.

(e) Approach Mode. When APPR mode is selected on the autopilot mode selector panel, localizer capture is the same as in the NAV mode but glideslope arm and capture functions are also provided. When the APPR mode is selected, the **NAV ARM** annunciator lamp will illuminate, indicating that the system is armed for localizer capture. As the aircraft approaches the localizer beam, the **NAV CAP** annunciator lamp will illuminate. Once the localizer is being tracked, the **GS ARM** annunciator lamp will

illuminate. Glideslope capture is dependent on localizer capture and must occur after localizer capture. The localizer is always captured from a selected heading, but the glideslope may be captured with autopilot operating in any vertical mode (pitch hold, altitude hold, or indicated airspeed hold), and from above (not recommended) or below the glideslope. At the point of glideslope intercept, the **GS CAP** annunciator lamp will illuminate and all pre-selected vertical modes will be cleared.

NOTE

During coupled approaches, if the VOR/localizer signal is lost, or frequency changes, the flight director command bars will remain in view displaying unreliable indications.

(f) Go-Around Mode. Pressing the **GO AROUND** button on the outboard side of the left power lever selects the go-around mode. Go-around mode may be selected from any lateral mode, HDG, NAV, APPR, or BACK LOC. When go-around mode is selected, the autopilot will disengage, the **GA** annunciator lamp will illuminate, and a command presentation for wings level and 7° nose up pitch attitude will appear on the pilot's horizon reference indicator.

NOTE

The heading marker may be preset to the go around heading after the localizer is captured. After go-around airspeed and power settings are established, select the HDG mode to clear the go-around mode. Pitch attitude will remain at that used for go-around until changed with the PITCH SYNC & CWS button or the selection of a vertical mode.

(g) Pitch Hold Mode. The pitch hold mode is selected by selecting one of the vertical mode selector switches or actuating the pitch synchronize and control wheel steering switch, **PITCH SYNC & CWS**, located on each control wheel.

(h) Control Wheel Steering Mode. Pressing one of the **PITCH SYNC & CWS** switches located on each control wheel disconnects the autopilot servos from the control surfaces, allows the pilot to fly the aircraft to a new pitch attitude, and synchronizes the vertical command bar on the pilot's horizon reference indicator to aircraft attitude. The ALT or IAS mode will disengage, if selected, when the **PITCH SYNC** & **CWS** button is pressed. When the autopilot is coupled to the HDG, NAV, APPR, or BACK LOC modes, releasing the **PITCH SYNC** & **CWS** switch will cause the autopilot to couple to the previously selected mode.

(i) Altitude Hold Mode. Pressing the **ALT** selector switch on the autopilot mode selector panel when desired altitude has been reached, with autopilot engaged, will cause the autopilot to fly the aircraft to maintain the barometric altitude at which the aircraft was flying when **ALT** switch was pressed, illuminate the **ALT** annunciator lamp on the autopilot/flight director annunciator panel, and display the altitude hold commands on the vertical command bar of the pilot's horizon reference indicator with the flight director engaged.

(j) Indicated Airspeed Hold Mode. Pressing the **IAS** selector switch on the autopilot mode selector panel when desired airspeed has been reached, with autopilot engaged, will cause the autopilot to fly the aircraft to maintain the indicated airspeed at which the aircraft was flying when **IAS** switch was pressed, illuminate the **IAS** annunciator lamp on autopilot/flight director annunciator panel, and display the **IAS** hold commands on the vertical command bar of the pilot's horizon reference indicator.

i. Takeoff and Climbout.

(1) Before Takeoff.

1. Heading marker, pilot's horizontal situation indicator – Set to runway heading.

2. **HDG** selector switch, autopilot mode selector panel – Press, do not engage autopilot.

(2) Takeoff. Pressing the **PITCH SYNC & CWS** switch on control wheel will provide pitch sync and the crosspointers on the pilot's horizon reference indicator will command flight to the pitch attitude that existed at the time the **PITCH SYNC & CWS** switch was pressed.

(3) Climbout.

1. Climb profile – Establish.

2. **ENG / DIS** switch – **ENG**, when above 200 feet above ground level.

3. **IAS** selector switch – Press if desired.

4. **HDG** knob – Move heading marker as required to make heading changes.

(4) Cruise Altitude.

1. Vertical speed – Reduce to approximately 500 feet per minute just before reaching cruise altitude.

2. **ALT** button – Press when cruise altitude is reached.

j. VOR Operation.

(1) Establishing Aircraft On A Desired VOR Radial.

1. VOR receiver – Tune appropriate frequency.

2. **COURSE** knob, pilot's horizontal situation indicator – Set desired course to or from station in **COURSE** window.

3. **HDG** knob, pilot's horizontal situation indicator – Set desired beam intercept angle under heading marker. The intercept angle with respect to the radio beam may be any angle of 900 or less.

4. **NAV** selector switch – Press. Observe that **NAV ARM** annunciator lamp illuminates.

5. **NAV CAP** annunciator lamp – Monitor. At point of capture, **NAV CAP** annunciator lamp will illuminate.

(2) Changing Course Over A VOR Station While Operating In NAV Mode If Course Change Is Less Than 30°.

1. **COURSE** knob – Set desired heading in **COURSE** window.

(3) Changing Course Over A VOR Station While Operating In NAV Mode If Course Change Is Greater Than 30°.

1. **HDG** knob – Set desired intercept heading under heading marker.

2. **HDG** selector switch – Press. Observe that **HDG** annunciator lamp illuminates autopilot/flight director annunciator panel.

3. **COURSE** knob – Set new course in **COURSE** window.

4. **NAV** selector switch – Press. Observe that **NAV ARM** annunciator lamp illuminates.

5. **NAV CAP** annunciator lamp – Monitor. Illumination indicates capture of new radial.

k. Front-Course Approach.

1. **VOR** receiver – Tune appropriate frequency.

2. **COURSE** knob – Set inbound runway heading in **COURSE** window.

3. **HDG** knob – Set heading marker to desired intercept angle.

4. **HDG** selector switch – Press. Observe that **HDG** annunciator lamp illuminates autopilot/flight director annunciator panel.

5. Vertical mode – Select IAS, ALT, or pitch.

6. **APPR** selector switch – Press. Observe that **NAV ARM** annunciator lamp illuminates autopilot/flight director annunciator panel.

7. **NAV CAP** annunciator lamp will illuminate when system has captured localizer course.

8. **GS ARM** annunciator lamp will illuminate to verify that system is armed for glideslope capture.

9. **GS CAP** annunciator lamp will illuminate and all vertical modes will be cleared, indicating autopilot is tracking glideslope.

l. Go-Around. If visual runway contact is not made at missed approach point, execute a missed approach by performing the following.

1. **GO AROUND** switch, outboard side of left power lever – Press while increasing power to climb power setting and observe the following.

   a. **GA** annunciator lamp on autopilot/flight director annunciator panel illuminates.

   b. Autopilot is disengaged.

   c. Command presentation is given on pilot's horizon reference indicator for wings level and 7° nose up climb attitude.

NOTE

Go-around mode can be selected any time after selecting APPR mode.

2. **HDG** selector switch – Press, after aircraft cleanup, go-around power settings, and airspeed are established.

m. Back-Course Approach.

1. **VOR** receiver – Tune appropriate frequency.

2. **COURSE** knob – Set front course inbound runway heading in **COURSE** window.

3. **HDG** knob – Set heading marker to desired intercept angle.

4. **HDG** selector switch – Press. Observe that **HDG** lamp illuminates autopilot/flight director annunciator panel.

5. **B/C** selector switch – Press. Observe that **BACK LOC** and **NAV ARM** annunciator lamps illuminate autopilot/flight director annunciator panel, indicating that system is armed for back localizer capture. Any previously selected vertical mode will cancel.

6. **NAV CAP** annunciator lamp will illuminate when system has captured back localizer course.

7. **PITCH** control – Use to establish and maintain desired rate of descent.

n. Yaw Damper Operation.

(1) The rudder channel of the autopilot may be selected separately for yaw damping by pressing the **YAW DAMP** switch on the pedestal. The switch face will illuminate when the yaw damper is engaged.

(2) To disengage the yaw damper, press the disconnect button on the pilot's or copilot's control wheel to the first detent or press the **YAW DAMP** switch on the pedestal.

(3) Refer to Emergency Procedures for other means of disconnecting the yaw damper.

o. Disconnecting Autopilot. The autopilot may be disconnected by any of the following actions.

1. Pressing **DISC TRIM/AP YD** switch located on the outboard horn of either control wheel to the first detent.

2. Placing the **ENG / DIS** switch on the autopilot mode selector panel to the **DIS** position.

Section IV. RADAR AND TRANSPONDER

3A-28. DESCRIPTION.

The radar and transponder group provides identification, position, emergency tracking system, and radar system to locate weather areas.

3A-29. DIGITAL WEATHER RADAR (RDR 2000) SYSTEM.

a. Description. The RDR 2000 color weather radar not only displays in-flight weather, but also permits incorporation of the KGR-358 radar graphics unit. The color weather radar is used to detect significant enroute weather formations to preclude undesirable penetration of heavy weather and its usually associated turbulence. The weather radar system provides a 320 nm display, with a 240 nm weather avoidance range plus weather penetration advantages. With the radar graphics unit in the NAV mode, navigation information is integrated with the weather display. The phased array antenna (flat plate), located in the nose of the aircraft, is fully stabilized to compensate for aircraft pitch and roll. The antenna provides a full 90° scan angle, ±15° tilt, and a 4-microsecond pulse width in both weather and ground mapping modes.

Extended Sensitivity Time Control (STC) increases the displayed intensity of storms outside the normal STC range. Extended STC relates the storm intensity to its distance and assigns a corresponding color. As a result, the display presents a more accurate picture of storm intensity.

Weather systems are displayed as 5 colors, including black, depicting rainfall intensity overlaid with range rings. Bearing marks at dead ahead and 20° on either side, aids the pilot in judging the bearing of storms and necessary heading changes.

With radar graphics interfaced, activate a circle mode by pressing the page button located on the radar graphics control panel. Functional operation in this mode is the same as in the standard display mode and is available in both weather and SBY modes. The range information is displayed in the upper right corner and represents the outer ring. The inside ring represents half the displayed distance. The off screen pointer is replaced by an RMI BUG placed on the outer ring in the direction of the active waypoint and color coded to each navigation system. Position of the aircraft is indicated by the green airplane symbol in the center of the screen.

Indicator brightness is adjustable to accommodate varying ambient light conditions while automatically maintaining equal brightness between the four display colors. The system is protected through a 5-ampere circuit breaker, placarded **RADAR**, located on the overhead circuit breaker panel.

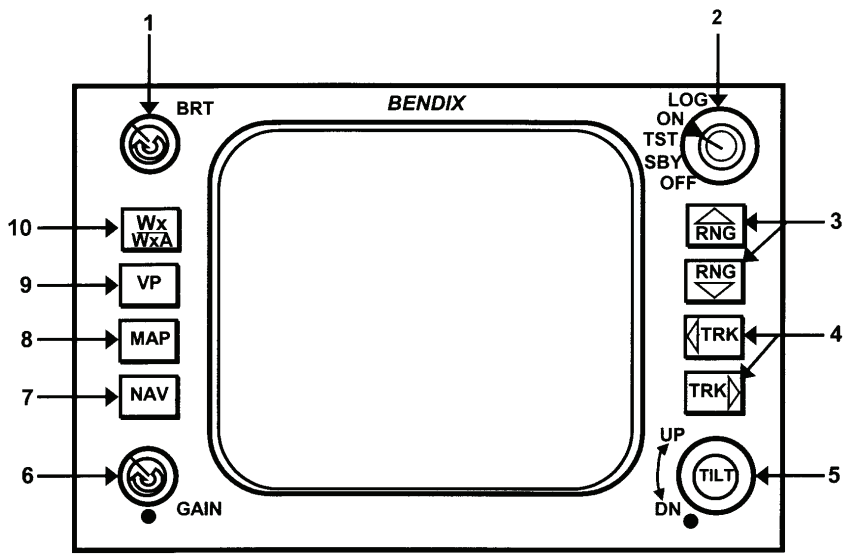
b. Controls and Functions. Refer to Figure 3A-22.

*(1) Brightness (**BRT**) Control Knob*. Controls brightness of the indicator display, CW rotation for max brightness.

(2) Function Switch Knob. The function switch knob is utilized to turn the system on/off and select **LOG**, **TST**, and **SBY** positions.

*(a) **LOG**.* Selected VOR frequencies along with bearings and distances are displayed. The radar transmits in the LOG mode.

*(b) **ON**.* Selects the normal condition of operation for weather detection and/or other modes of operation. The system will transmit after a 60-second warm-up time is completed. The radar system initializes to the Wx mode, 80 nm.



1. **Brightness Control Knob**
2. **Function Switch**
3. **Range Buttons**
4. **Track Buttons**
5. **Tilt Knob**
6. **Gain Knob**
7. **Navigation Button**
8. **Ground Mapping Button**
9. **Vertical Profile Button**
10. **Weather / Weather Alert Button**

Figure 3A-22. Digital Weather Radar (RDR 2000)

NOTE

The 60-second warmup period can be monitored upon power up of the system. When the knob is switched directly from OFF to ON mode, the display will blank. As the radar sweeps the blue/white will grow outward. Just before the warm-up period is complete, the screen will turn black for a few seconds, then the radar will begin transmitting and the screen will display radar returns. No radar transmissions occur until the warmup period is complete.

*(c) Test (**TST**).* The multicolored arc display test pattern is displayed in this mode of operation. The test pattern is initialized and sized to fit the 80 nm range and can also be scaled with the range select buttons. No radar transmissions occur while **TST** is selected. **TEST** will appear in the lower left of the display. STAB OFF is always displayed in top left.

*(d) **SBY**.* Fully energizes the system circuitry but no radar transmissions occur in the SBY mode of operation. The antenna is parked at 0° azimuth and 30° tilt down with the antenna drive motors locked.

*(e) **OFF***. Removes primary power from the radar indicator, but the radar still has power applied. The radar will remain active with no radar transmissions occurring, for up to a maximum time of 30 seconds. This time delay allows time to park the antenna at 0° azimuth and 30° tilt down.

*(3) Range (**RNG**) Buttons.* Clears the display and advances the indicator to the next range. The upper button increases range; the lower button decreases it. The RDR 2000 display range is: 10, 20, 40, 80, 160, 240 nm. The selected range is displayed in the upper right corner of the display with the range ring distance displayed along the right edge.

*(4) Track (**TRK**) Buttons.* Provides a yellow track centerline for vertical profile. With the radar on and a track button pushed, the track-line position moves left or right in 1° increments at a rate of about 15° per second. When Vertical Profile mode is selected, the antenna scans the slice at the track line azimuth position. While in Vertical Profile mode, the **TRK** buttons move the slice left and right. The azimuth position of the antenna is displayed on the upper left corner of the indicator.

*(5) **TILT** Knob.* Permits manual adjustment of antenna tilt 15° up or down for best indicator presentation. The tilt angle is displayed in the right corner of the display.

*(6) **GAIN** Knob.* The gain knob adjusts the radar gain from 0 to –20 dB (CCW rotation reduces gain). The gain knob will only function when in the MAP mode.

*(7) Navigation (**NAV**) Button.* Places indicator in navigation mode so that preprogrammed waypoints may be displayed. If other modes are also selected, the NAV display will be superimposed on them. The radar will display weather when **NAV** is selected if the radar selector is in the **ON** position.

*(8) Ground Mapping (**MAP**) Button.* Places the radar system in ground mapping mode. Gain control capability is configurable at installation to be enabled or disabled in ground map mode. Ground map colors are green for weak returns, yellow for moderate returns, and magenta for intense returns. “MAP” will appear on the lower left of the display.

*(9) Vertical Profile (**VP**) Button.* Selects and deselects the Vertical Profile mode of operation. When **VP** is selected on the indicator the radar will provide a vertical scan of ± 30° at the location of the horizontal track line. Selecting the VP mode of operation will not change the selected mode of operation: TST, Wx, WxA, or GND MAP. Once in VP, these modes may be changed as desired. VP will engage from the NAV MAP mode, but NAV data will not be displayed during operation.

*(10) Weather / Weather Alert (**Wx/WxA**) Button.* Alternately selects between the Weather (Wx) and Weather Alert (WxA) modes of operation. Wx or WxA will appear in the lower left of the display. When the WxA mode is selected, magenta areas of storms flash between magenta and black at a 1 Hz rate.

c. Fault Annunciations.

If a fault occurs, the fault annunciation will be presented on the display unit. The two general categories of faults are hard failures and soft failure/annunciations.

Hard failures are those which occur when a major function of the system is lost. Hard failures are typically a total loss of transmitter power, receiver gain, or no antenna scan. TURN OFF SYSTEM. Refer to Table 3A-3 for hard failure annunciations.

CAUTION

Should the system be left on, further damage to other system components could occur.

NOTE

A TX FLT is indicated if the Strut switch is configured to be active and the aircraft is on the ground.

Table 3A-3. Hard Failure Annunciations

ANNUNCIATION	FAILURE
TX FLT	Transmitter failure
429FLT	Loss of 429 bus data
ANT FLT	Loss of antenna position
IN FLT 6	Loss of communication between display and ART

Soft failures are those that can cause limited system operation. Radar data will still be displayed, but the flight crew should be aware that the display does not necessarily represent the true weather. Soft failures are typically configuration problems, stabilization problems, or some similar problem. Refer to Table 3A-4 for soft failure annunciations.

Table 3A-4. Soft Failure Annunciations

ANNUNCIATION	FAILURE
TX FLT	Configuration module not being read
STAB LMT	Stab is exceeding ±30°
STAB OFF	Alert that the scan is not being stabilized

d. Weather Radar System Operation.

WARNING

Never operate the weather radar in the Wx, WxA, LOG or GND MAP modes on the ground when personnel are forward of the aircraft wing and within 5 feet of the aircraft nose. Failure to observe this warning may result in permanent damage to the eyes and other body organs of those persons.

Never turn the radar on within 5 feet of containers of flammable or explosive material. Never operate radar during fueling operations.

NOTE

These procedures should be accomplished prior to flight.

(1) Accomplish the following procedure completely and exactly.

1. Function switch – **TST**.

2. **TILT** – **UP** 7.0, as shown on the indicator display, upper right corner.

The test pattern will appear. See that the test pattern conforms to the illustration. Refer to Figure 3A-23. The test pattern is sized to fit the 80 nm range and can be scaled with the range buttons, and observe the "update" action as a small ripple moves across the display along the outer edge.

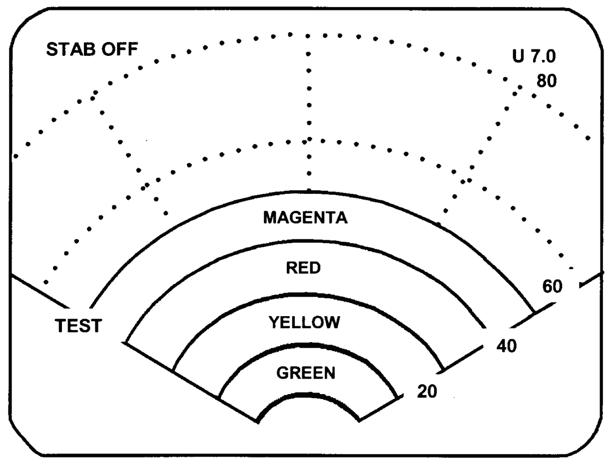


Figure 3A-23. Test Pattern

With the function switch in **TST** or **SBY**, taxi to a clear area where there are no people, aircraft, vehicles, or metallic buildings within approximately 100 yards.

3. Function switch – **ON**.

The indicator will automatically display in the Wx mode and 80-nm range. Any targets, weather or ground, will be displayed in green, yellow, red, or magenta.

NOTE

A 60-second warm-up time period is required before the system will transmit.

4. **RNG** ⬩ button – Press to display 40 nm as the maximum range.

5. **WxA** button – Press and observe the magenta areas (if any) flash.

6. Vary the **TILT** control manually between 0 and up 15° and observe that close in "ground clutter" appears at lower settings and that any local rain appears at higher settings.

7. Repeat the manual tilt adjustment, this time between the 0 and down 15° positions.

8. Function switch – Return to **TST** or **SBY** before taxiing.

9. Function switch, before or after takeoff – **ON** and operate as required.

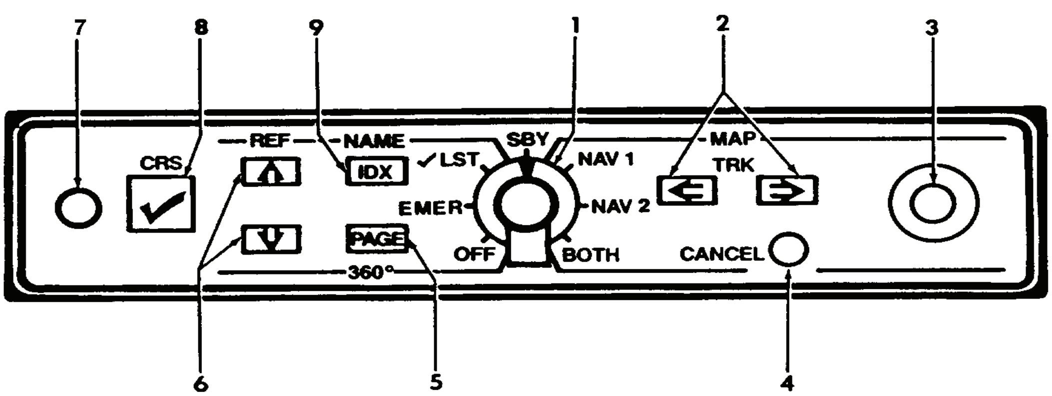
3A-30. RADAR GRAPHICS.

a. Description. The KGR-358 radar graphics unit interfaces with the weather radar system (RDR 2000), and receives navigation data from the flight management system, KLN 90B. Refer to Figure 3A-24. The unit can display NAV 1 or NAV 2 or both in a weather overlay, or as navigation information only display. In addition, NAV information can be viewed in a 360° (circle) display with weather in the top 90° sector. Two checklist modes are also provided for complete checklist capability when utilizing the pocket terminal.

With the KGR-358 in any of the NAV modes, the radar screen will display a normal weather picture plus the location of the waypoints listed in the active flight plan. Data referenced to NAV 1 is displayed in the lower left portion of the radar display. Data referenced to NAV 2 will display in the lower right portion of the display. Included in the data are the active waypoint name, the selected course bearing, and the aircraft position (radial to, and distance) from the active navigation fix. Aircraft magnetic heading is displayed in the upper left section of the radar display.

A line representing the course selected by the flight management system is drawn through the corresponding active waypoint. Selected course bearing for each NAV system is displayed with NAV data on each side of the screen. A waypoint line will also be displayed connecting the waypoints in numerical sequence. An R on the left side of the screen indicates all visible NAV aids selected by the flight management system will be displayed. The level of NAV aids displayed is indicated by one, two, or three dots on the left side of the R.

A joystick control is provided to move a waypoint to any position on the screen. The coordinates for this new waypoint will appear in the lower left or right corner depending upon which NAV is selected replacing the active waypoint data. If both NAV systems are selected, the new coordinates will be displayed corresponding to NAV 1, and may be switched to NAV 2. Pressing the check button will cause the data to transfer to the flight management system and be fixed as a position on the earth. Once the data is transferred to the flight management system, the pilot may enter it, as he desires.



1. **Mode Selector Knob**
2. **Left / Right Cursor Buttons**
3. **Joystick**
4. **CANCEL Button**
5. **PAGE Button**
6. **Up / Down Cursor Button**
7. **Input Jack**
8. **Checklist Button**
9. **Index Button**

Figure 3A-24. Radar Graphics

A track line enables a quick determination of how many degrees deviation left or right of a present heading is needed to provide for a clear path through weather or to a new fix. The number of degrees and a L or R is shown in the upper left corner replacing the magnetic heading when track mode is in operation.

Power is provided for the unit through a 2-ampere circuit breaker, placarded **GRPH-DSPL**, located on the overhead circuit breaker panel.

b. Controls and Functions.

(1) Mode Selector Knob. Allows the operator to turn the unit on, and select desired mode.

(a) ***OFF***. Power is removed from the unit when mode selector knob is in the **OFF** position.

(b) ***EMER***. Checklists of emergency procedures for the aircraft are displayed in the emergency (EMER) mode. The emergency index contains the titles of the emergency checklists. The selected checklist item is shown in yellow, while the others are shown in magenta.

(c) ***✓LST***. Selects the preprogrammed checklist for display.

(d) ***SBY***. Selects the standby mode. Nothing is displayed on the screen when in the SBY mode.

(e) ***NAV 1***. Selects NAV 1 information to be displayed. Data referenced to NAV 1 will be displayed in cyan, in the lower left portion of the radar display. If NAV data is invalid, the data will be replaced with dashes.

(f) ***NAV 2***. Selects NAV 2 information to be displayed. Data referenced to NAV 2 will be displayed in yellow, in the lower right portion of the radar display. If NAV data is invalid, the data will be replaced with dashes.

(g) ***BOTH***. Selects both NAV 1 and NAV 2 information to be displayed.

(2) Left / Right (⇐ Or ⇒) Button. When ⇐ or ⇒ is pressed, a track line will appear and move in the direction indicated by the button pressed. The track line will disappear 10 seconds after the button has been released.

(3) Joystick. The joystick is used to move a waypoint to any position on the radar screen.

(4) ***CANCEL*** *Button.* When pressed, the **CANCEL** button will remove displays from the radar screen.

(5) ***PAGE*** *Button.* The **PAGE** button is used to view consecutive pages within a checklist. It is also used, along with the ⇓ or ⇑ buttons, to bypass items without checking them off, or return to items previously bypassed.

(6) Up and Down (⇓ And ⇑) Button. The buttons are used along with the **PAGE** button to bypass items in the checklist without checking them off or return to items previously bypassed.

(7) Input Jack. Provides a means of connecting the pocket terminal to the unit.

(8) ✓ Button. Pressing the ✓ check button causes the selected checklist to be displayed. With the checklist displayed, the ✓ check button is used to check off items. When the last item in a list is checked off, the display automatically returns to any items previously bypassed. When all items have been checked off, the display returns to the index with the next checklist selected. An **END OF LIST** statement follows the last title in an index and the last item in a checklist. The pilot may return to the index prior to checking off all items by pressing the **IDX** button.

*(9) Index (**IDX**) Button.* Allows the pilot to return to index.

c. Operating Procedures. The following statement is displayed in all modes except standby (SBY) when the unit is first turned on. The statement will automatically disappear after 20 seconds or can be made to disappear sooner by pressing the **CANCEL** button.

THE NAVIGATION DATA PRESENTED ON THIS SCREEN IS NOT TO BE USED FOR PRIMARY NAVIGATION. CONTENTS OF THE CHECKLISTS ARE THE RESPONSIBILITY OF THE USER/ INSTALLER.

1. Mode selector switch – As required.

3A-31. POCKET TERMINAL.

a. Description. The KA-68 pocket terminal is used to program normal and emergency checklist information into the radar graphics control panel. The pocket terminal plugs into a jack on the front of the radar graphics unit. Refer to Figure 3A-25.

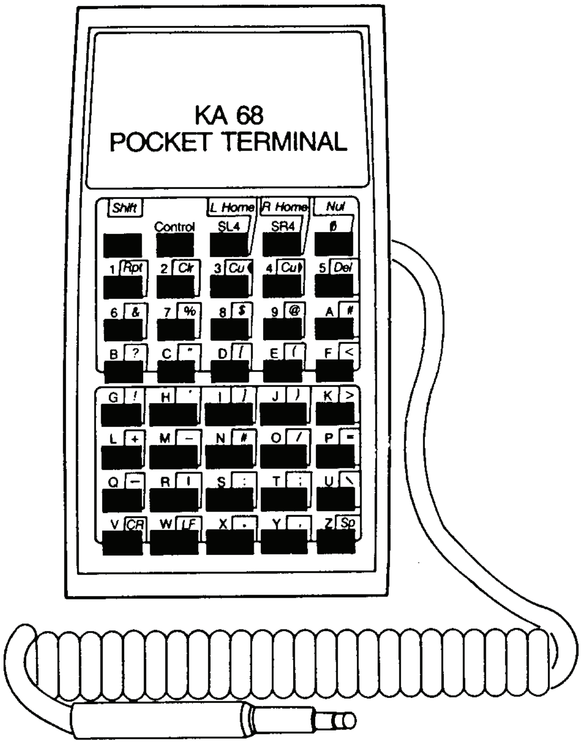


Figure 3A-25. Pocket Terminal

b. Operating Procedures.

(1) Programming Checklist Index. The title of a checklist is programmed into the appropriate index by selecting the desired mode on the KGR-358 (**EMER** or ✓ **LST**) and pressing the **IDX** button, if necessary, to enter the index. If the index already contains some titles, the ⇓ and ⇑ buttons are used to determine the location of the title to be added. If the number of index titles exceeds one page, the following pages may be selected by using the page button rather than cycling through the index with the ⇓ or ⇑ buttons. The last page of each index is indicated by an **END OF LIST** statement.

NOTE

The @, [ ], /, characters cannot be written into the KGR-358 even though they are shown on the pocket terminal keyboard.

The title is entered by pressing the appropriate keys on the pocket terminal. The title may consist of any combination of alphanumeric characters, spaces or punctuation up to a length of 27 characters (1 line). Any of the shaded functions are obtained by pressing the shift key prior to pressing the key with the desired function. For example, to obtain a space, press and release the shift key and then press the key placarded **SP**. As the title is entered, a white CSR BLK appears to the right of the last entered character indicating the location where the next character will be inserted. When the title is complete, it must be terminated by a carriage return (**Shift** – **CR**) to make the cursor disappear.

(2) Programming Checklist Items. Enter the checklist item by pressing the appropriate keys on the pocket terminal. A checklist item may consist of any combination of alphanumeric characters, spaces, or punctuation up to a length of 15 lines (450 characters). If the item is longer than one line long, do not use the carriage return to move from one line to the next. Use spaces (**Shift** – **Sp**) as necessary to move the cursor to the end of the line and to the beginning of the following line. The carriage return should be used only at the end of the entire item to make the cursor disappear.

(3) Error Correction. Error correction is accomplished with the delete function, **Shift** – **Del**, on the pocket terminal. While in insert mode (cursor on the screen), pressing **Shift** – **Del** will delete individual characters. Once an item has been terminated with a carriage return (no cursor on the screen), **Shift** – **Del** will delete the entire selected item (shown in yellow).

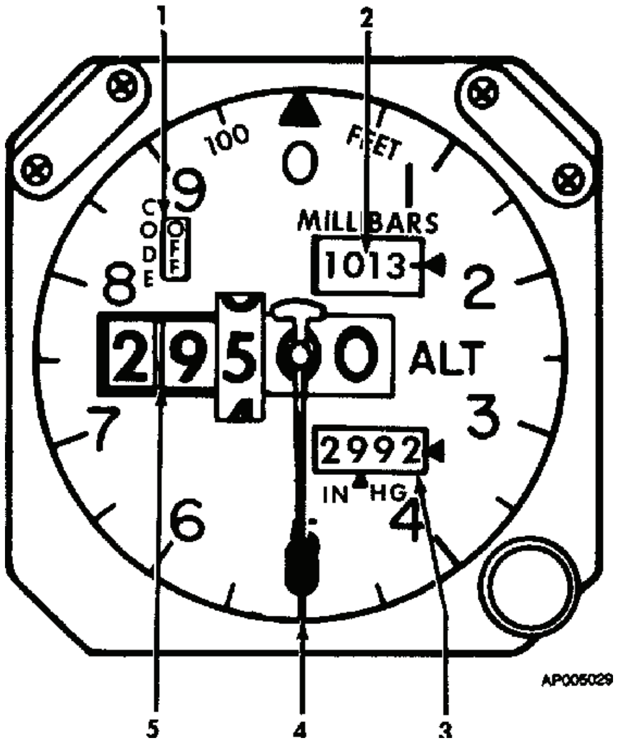
c. Special Functions. Certain special functions can be obtained on the pocket terminal by pressing the **Control** key prior to pressing **X**, **C**, or **I**. **Control** – **X** erases everything (all checklists) stored in nonvolatile memory in the KGR-358. After pressing **Control** – **X**, the message, "ERASE ENTIRE MEMORY YES/NO" appears on the radar screen. If **Y**–**E**–**S** is entered, the radar graphics unit will carry out the command. If **N**–**O** or any other key is pressed, the erase command is aborted. **Control** – **C** on the pocket terminal duplicates the function of the **PAGE** button on the radar graphics control panel. **Control** – **I** on the pocket terminal duplicates the function of the **IDX** button on the radar graphics control panel.

3A-32. PILOT'S ENCODING ALTIMETER.

a. Description. The encoding altimeter provides the pilot with an indication of his altitude above sea level in addition to providing the transponder with altitude information for use in Mode C. Refer to Figure 3A-26. The encoding altimeter is protected by a 5-ampere circuit breaker, placarded **PILOTS ALT ENCD**, located on the overhead circuit breaker panel.

b. Controls/Indicators and Functions.

*(1) **CODE OFF** Flag, Pilot Only.* Presence indicates loss of power to instrument.



1. CODE OFF Flag
2. MILLIBARS Display
3. IN HG Display
4. Needle Pointer
5. Drum Display

Figure 3A-26. Pilot's Encoding Altimeter

(2) ***MILLIBARS.*** Indicates local barometric pressure in millibars. Adjusted by use of set knob.

(3) ***IN HG.*** Indicates local barometric pressure in inches of mercury. Adjusted by use of set knob.

(4) Needle Indicator. Indicates aircraft altitude in hundreds of feet with subdivisions at fifty-foot intervals.

(5) Drum Display. Indicates aircraft altitude in ten thousands, thousands, and hundreds of feet above sea level.

c. Encoding Altimeter Operation.

NOTE

If the altimeter does not read within 70 feet of field elevation when the correct local barometric setting is used, the altimeter needs calibration or internal failure has occurred. An error of greater than 70 feet also nullifies use of the altimeter for IFR Flight.

(1) Turn-On Procedure. Encoding altimeter will operate when transponder is operating with **M-C** switch set to center position.

1. Barometric set knob – Set desired altimeter setting in **IN HG** window.

2. **CODE OFF** flag – Check not visible. Needle indicator – Check operation.

d. Encoding Altimeter Emergency Operation.

1. Altimeter circuit breaker – Pull, if encoder fault occurs.

3A-33. GROUND PROXIMITY ALTITUDE ADVISORY SYSTEM.

The ground proximity altitude advisory system will provide little, if any, warning for flight into precipitous terrain approaching a sheer wall if there is little gradually rising terrain before reaching the steep terrain.

a. Description*.* The Ground Proximity Altitude Advisory System (GPAAS) is provided to aid the flight crew in terrain avoidance. Refer to Figure 3A-27.

The GPAAS is a completely automatic system, requiring no input from the crew, which continuously monitors the aircraft's flight path at altitudes of between 100 and 2000 feet AGL.

The GPAAS computer processes the data and, when conditions warrant, selects the appropriate digitized voice advisory/warning message from its memory. This message is then announced over the pilot's and copilot's audio system. If the condition is not corrected, the GPAAS will rearm, and will again announce and repeat the warning if the condition recurs. The GPAAS computer remains ready to announce a different message during the intervals between repetitions. All messages are disabled below 100 feet AGL.

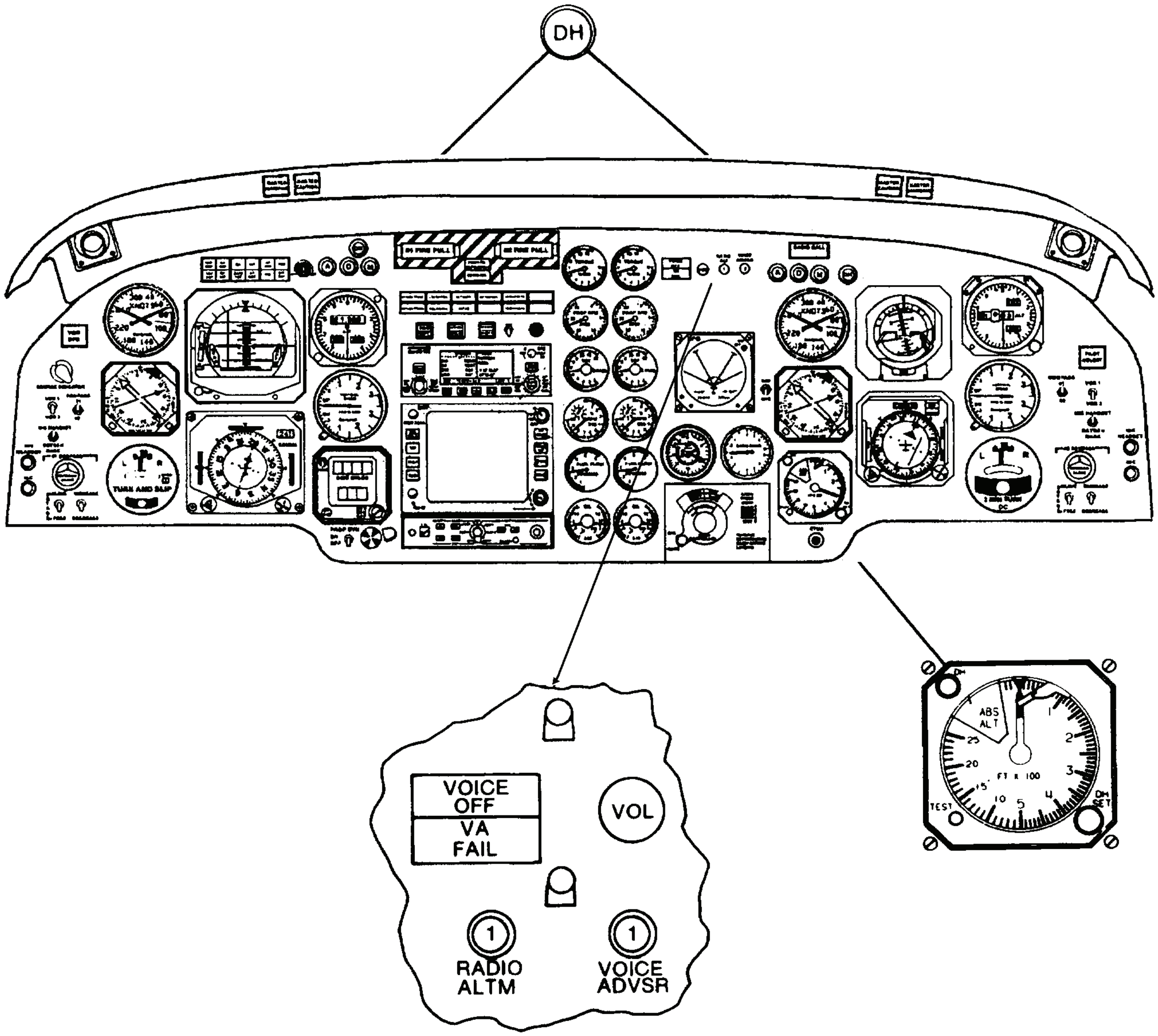


Figure 3A-27. Ground Proximity Altitude Advisory System Controls and Indicator

The GPAAS system receives 28 Vdc power through a 1-ampere circuit breaker, placarded **VOICE ADVSR**, located on the instrument panel.

(1) GPAAS Switch-Indicator Lights. A switch-indicator is located on the instrument panel. The upper half of the switch-indicator (yellow) is placarded **VOICE OFF**. The lower half is an indicator (red) only and is placarded **VA FAIL**.

Pressing the upper (**VOICE OFF**) switch indicator disables the GPAAS voice advisory, and illuminates the **VOICE OFF** indicator light.

The **VA FAIL** annunciator light (red) will illuminate when the GPAAS fails.

(2) GPAAS Volume Control. A GPAAS volume control placarded **VOL**, located on the instrument panel, controls the audio volume of the GPAAS advisory/warning messages down to a certain minimum level.

(3) GPAAS Aural Warning Indications. The following is a list of aural indications. Due to the possibility of activating more than one condition at a time, a warning priority has been established. The highest priority message will be announced first. If a higher priority item is received after a message is

started, voice annunciation of the higher priority message shall be announced after a lower priority message in progress at the end of the message segment. It will not stop in the middle of a word. On messages that are repeated three times at 4-second intervals, the priority list will be scanned for higher priority messages and will insert them in the interval between the messages. The messages provided by the system are listed in descending order of priority as follows.

1. "Two thousand" at 2000 feet AGL.
2. "One thousand" at 1000 feet AGL.
3. "Nine hundred" at 900 feet AGL.
4. "Eight hundred" at 800 feet AGL.
5. "Seven hundred" at 700 feet AGL.
6. "Six hundred" at 600 feet AGL.
7. "Five hundred" at 500 feet AGL.
8. "Check gear" will be announced immediately after 500-foot announcement if gear is not down.
9. "Four hundred" at 400 feet AGL.
10. "Check gear" will be announced immediately after 400-foot announcement if gear is not down.
11. "Three hundred" at 300 feet AGL.
12. "Check gear" will be announced immediately after 300-foot announcement if gear is not down.
13. "Two hundred" at 200 feet AGL.
14. "Check gear" will be announced immediately after 200-foot announcement if gear is not down.
15. "One hundred" at 100 feet AGL.
16. “Check gear" will be announced immediately after 100-foot announcement if gear is not down.
17. "Minimum, minimum" at decision height.
18. "Localizer" at 1.3 to 1.5 dots either side of center of beam. Will be repeated three times at 4-second intervals.
19. "Glideslope" at 1.3 to 1.5 dots above or below center of beam. Will be repeated three times at 4-second intervals.
20. "Altitude, altitude" at excessive deviation from altitude selected on the altitude alerter.
21. "Check trim" when trim failure has occurred. Will be repeated three times at 4-second intervals.
22. "Autopilot" when autopilot has disconnected.

The highest priority message will be announced first. If a higher priority item is received after a message has been started, voice annunciation of the higher priority message shall immediately override the lower priority message in progress at the end of the message segment. It will not stop in the middle of a word. On messages that are repeated three times at 4-second intervals, the priority list will be scanned for higher priority messages. If found, they will be inserted into the interval between the messages.

b. Normal Operation.

(1) Turn-On Procedure. The GPAAS is operable when the following conditions have been met.

1. Battery switch – **ON**.
2. **AVIONICS MASTER** switch – **ON**.
3. **VOICE ADVSR** circuit breaker – SET.
4. **RADIO ALTM** circuit breaker – SET.
5. **VA FAIL** annunciator light – Extinguished.

(2) GPAAS Ground Check.

1. GPAAS voice advisory **VOL** control – Full clockwise.
2. **VOICE OFF** switch-indicator – Extinguished.
3. Audio control panel – Set listening audio level.

4. **VA FAIL** annunciator light – Extinguished.

5. Radio altimeter **DH SET** control – Set to 200 feet.

6. Radio altimeter **TEST** switch – Press and hold. "Minimum, minimum" will be annunciated once followed by the illumination of the **VA FAIL** light.

7. Radio Altimeter **TEST** switch – Release.

c. GPAAS Modes of Operation. The GPAAS operates in the following modes of operation.

(1) Aural "Two Thousand" Advisory, Mode 1. The aural advisory "Two Thousand" indicates that the aircraft is at a radio altitude of 2000 feet AGL. This advisory is canceled when valid information from the radio altimeter is lost, during climb, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(2) Hundred Foot Increment Aural Altitude Advisories, Mode 2. The aural advisories "One Thousand, Nine Hundred, Eight Hundred, Seven Hundred, Six Hundred, Five Hundred, Four Hundred, Three Hundred, Two Hundred, One Hundred" indicate that the aircraft is at the associated radio altitude in feet above ground level. This advisory is canceled when valid information from the radio altimeter is lost, during climb, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(3) Aural "Localizer" Advisory, Mode 3. The aural advisory "Localizer" indicates that the aircraft has deviated from the center of the localizer beam in excess of 1.3 to 1.5 dots. The localizer advisory is armed when a valid localizer signal is detected and the aircraft is below 1000 feet AGL. It will be repeated no more than three times at 4-second intervals unless the aircraft is returned to less than 1.3 to 1.5 dots from the center of the localizer course. The localizer advisory is disabled when a valid localizer signal has been lost, during climb, below the decision height set on the radio altimeter, or if the navigation receiver is not tuned to a localizer frequency.

(4) Aural "Check Gear" Advisory, Mode 4. The aural "Check Gear" advisory indicates that the aircraft has descended to 500 feet AGL and the landing gear is not down. This advisory is repeated once at 100-foot intervals down to 100 feet AGL.

(5) Aural "Glideslope" Advisory, Mode 5. The aural advisory "Glideslope" indicates that the aircraft has exceeded 1.3 to 1.5 dots above or below the center of the glideslope beam. The glideslope advisory is armed when a valid glideslope signal is detected and the aircraft is below 1000 feet AGL. It will be repeated no more than three times at 4-second intervals unless the aircraft is returned to less than 1.3 to 1.5 dots from the center of the beam. The glideslope advisory is disabled upon loss of a valid glideslope signal, during climb, on a localizer back course, below the decision height set on the radio altimeter or, if the navigation receiver is not tuned to a localizer frequency. This advisory is inhibited by the weight on wheels strut switch.

(6) Aural Advisory "Minimum, Minimum" Mode 6. The aural advisory "Minimum, Minimum" indicates that the aircraft is at the radio altitude selected by the crew with the radio altimeter indicator decision height knob. This advisory is canceled when valid information from the radio altimeter is lost, during climb, whenever the aircraft is above 1000 feet AGL, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(7) Aural "Altitude, Altitude" Advisory, Mode 7. The aural advisory "Altitude, Altitude" indicates the approach to a pre-selected altitude as the aircraft reaches a point 1000 feet from the selected altitude or, after reaching the selected altitude, when the aircraft deviates more than 250 feet from the selected altitude.

(8) Aural "Check Trim, Check Trim, Check Trim" Advisory. The aural advisory "Check Trim, Check Trim, Check Trim" indicates that the autopilot has had a trim failure.

(9) Aural "Autopilot" Advisory. The aural advisory "Autopilot" indicates that the autopilot has disengaged.

d. Emergency Procedures. If an emergency or malfunction makes it necessary to disable the GPAAS, pull the **VOICE ADVSR** circuit breaker located on the instrument panel. Turn off the GPAAS audio by pressing the **VOICE OFF** switch.

3A-34. STORMSCOPE.

For information on the Stormscope, refer to Chapter 3, Paragraph 3-9.

3A-35. TRANSPONDER SET (APX-100).

For information on the transponder set, refer to Chapter 3, Paragraph 3-10.

CHAPTER 3B
AVIONICS D2

Section I. GENERAL

3B-1. GENERAL DESCRIPTION.

This chapter covers the avionics equipment configuration installed in C-12D2 aircraft. It includes a brief description of the avionics equipment, its technical characteristics, capabilities, and locations.

3B-2. AVIONICS EQUIPMENT CONFIGURATION.

The avionics configuration of the aircraft is comprised of three groups of electronic equipment. The communication equipment group consists of the interphone, UHF command, VHF command, and HF command systems. The navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach on instruments under Instrument Meteorological Conditions (IMC). The navigation group includes equipment for determining altitude, attitude, position, destination, range and bearing, heading reference, groundspeed, and drift angle. The transponder and radar group includes identification, position, and emergency tracking system and a radar system to locate potentially dangerous weather areas. A Ground Proximity Altitude Advisory System (GPAAS) is also installed.

3B-3. POWER SOURCE.

a. DC Power. DC power for the avionics equipment is provided by four sources: the aircraft battery, the left and right generators, and external power. Power is routed through two 50-ampere circuit breakers to the avionics power relay that is controlled by the **AVIONICS MASTER POWER SWITCH** on the overhead control panel. Refer to Figure 2-15, Sheet 1. Individual system circuit breakers and the associated avionics buses are shown in Figure 2-28 and Table 2-7. With the switch in the **ON** position, the avionics power relay is de-energized and power is applied through both 50-ampere **AVIONICS MASTER POWER #1** and **#2** circuit breakers to the individual avionics circuit breakers on the overhead circuit breaker panel. Refer to Figure 2-16, Sheet 3.

NOTE

Should the AVIONICS MASTER POWER switch fail to operate, power to the individual avionics circuit breakers can be provided by pulling the 5-ampere circuit breaker, placarded AVIONICS MASTER CONTROL, located on the overhead circuit breaker panel.

In the off (aft) position, the relay is energized and power is removed from avionics equipment. When external power is applied to the aircraft, the avionics power relay is normally energized, removing power from the avionics equipment. To apply external power to the avionics equipment, move the **AVIONICS MASTER POWER** switch to the **EXT PWR** position. This will de-energize the avionics power relay and allow power to be applied to avionics equipment.

b. AC Power. Two 750-volt ampere inverters provide ac power for the avionics equipment. The inverters supply 115-volt and 25-volt single-phase ac power when operated by the **INVERTER #1** or **#2** switches. Normally both switches will be **ON** for operation. However, either inverter will provide power for all avionics equipment requiring ac power, should one inverter fail. 115 Vac power from the inverters is routed through fuses and transformers in the nose avionics compartment. The transformers provide the required 26 Vac needed by avionics equipment.

Section II. COMMUNICATIONS

3B-4. DESCRIPTION.

The communications equipment group consists of the interphone, UHF command, VHF command, and HF command systems.

3B-5. MICROPHONE SWITCHES, MICROPHONE JACKS, AND HEADSET JACKS.

For information on microphone switches, microphone jacks, and headset jacks, refer to Chapter 3, Paragraph 3-5.

3B-6. AUDIO CONTROL PANELS.

a. Description. Individual audio control panels, part of the radio panel, are provided for the pilot and copilot. The controls and switches provide for selection of transmission on VHF, UHF, or HF transmitters and volume control of communication, navigation and interphone audio signals. Figure 3B-1 illustrates the pilot's and copilot's audio control panels.

b. Controls and Functions.

(1) ***PILOT*** *and* ***COPILOT AUDIO OFF*** *Switches.* Permits monitoring of selected audio regardless of position of transmitter selector switch.

(a) ***VHF 1****.* Permits monitoring of #1 VHF audio.

(b) ***VHF 2****.* Permits monitoring of #2 VHF audio.

(c) ***HF***. Permits monitoring of HF audio.

(d) ***UHF***. Permits monitoring of UHF audio.

(e) ***NAV 1***. Permits monitoring of #1 NAV audio.

(f) ***NAV 2***. Permits monitoring of #2 NAV audio.

(g) ***MKR BCN 1****,* ***2***. Permits monitoring of #1 and #2 marker beacon audio.

(h) ***DME/TACAN****.* Permits monitoring of DME/TACAN audio.

(i) ***ADF 1****.* Permits monitoring of #1 ADF audio.

(j) ***ADF 2****.* Permits monitoring of #2 ADF audio.

(2) Pilot's/Copilot's Transmitter Select Switches. Controls operation of selected system.

(a) ***VHF 1****.* Routes key and mic signals to the #1 VHF transceiver.

(b) ***VHF 2****.* Routes key and mic signals to the #2 VHF transceiver.

(c) ***HF****.* Permits reception of audio from the HF transceiver and routes key and microphone signals to the HF transceiver.

(d) ***UHF****.* Permits reception of audio from the UHF transceiver and routes key and microphone signals to the UHF transceiver.

(e) ***PA****.* Permits cabin paging.

(3) ***AUDIO / SPKR / OFF*** *Switch.* Determines where selected audio will be heard.

(4) ***VOLUME*** *Control. Controls audio volume.*

(a) ***SPKR***. Adjusts volume of cockpit speakers.

(b) ***PH****.* Adjusts volume of headset.

(c) ***PA****.* Adjusts volume of cabin speakers.

(d) ***DME/TAC****.* Adjusts volume of DME/TAC audio. Located on pilot's audio panel only.

(5) ***VOICE / BOTH / RANGE*** *Switch.* Controls both voice and range tone.

(a) ***VOICE***. Kills range and allows voice (ADF and VOR).

(b) ***BOTH****.* Allows both voice and range (ADF and VOR).

(c) ***RANGE****.* Kills voice and allows 1020 Hz range tone (ADF and VOR).

(6) ***MKR BCN 1 & 2 HI / LO / TEST*** *Switch and* ***VOL*** *Control.* Selects either sensitivity or **TEST** function.

(a) ***HI****.* Selects high sensitivity.

(b) ***LO****.* Selects low sensitivity.

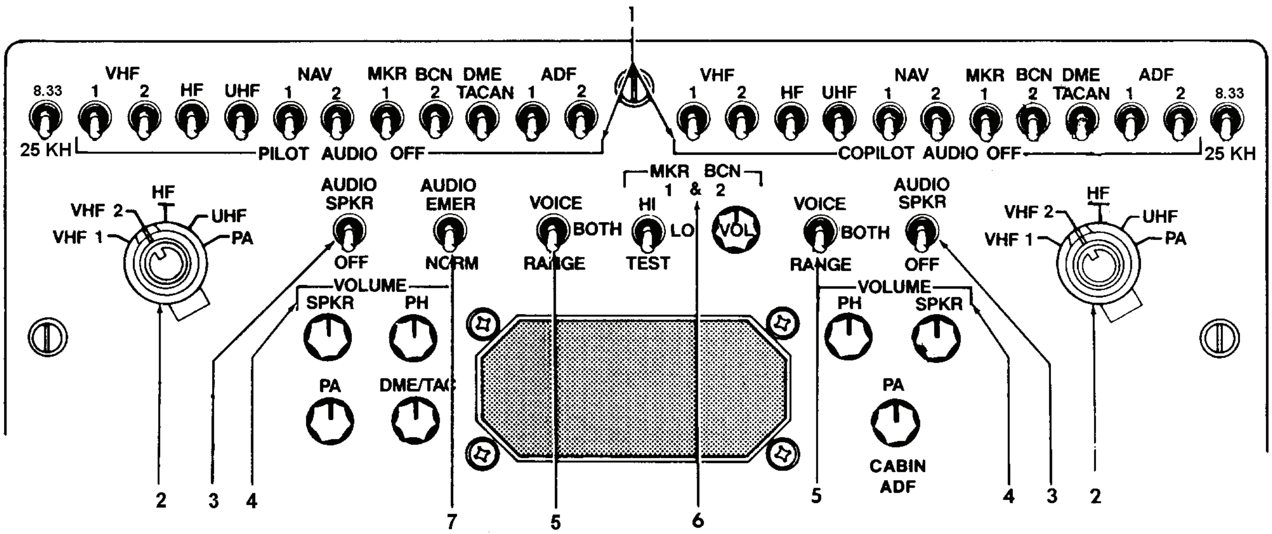
(c) ***TEST****.* Permits testing of marker beacon's annunciators.

(d) ***VOL*** *control.* Adjusts volume of marker beacon audio.

(7) ***AUDIO EMER / NORM*** *Switch.* Controls routing of received audio signals. Located on pilot's audio panel only.

(a) ***EMER****.* Audio signal bypasses amplifier. Applies audio signal to headphone only.

(b) ***NORM****.* Routes audio signal through amplifier to speaker or headphone.



1. PILOT/COPILOT AUDIO OFF Switches
2. Pilot's/Copilot's Transmitter Select Switch
3. Pilot's/Copilot's AUDIO SPKR / OFF Switch
4. Pilot's/Copilot's Audio VOLUME Controls
5. Pilot's/Copilot's VOICE / BOTH / RANGE Switch
6. MKR BCN 1 & 2 HI / LO / TEST Switch and VOL Control
7. AUDIO EMER / NORM Switch

Figure 3B-1. Audio Control Panel

c. Normal Operation.

(1) Turn-on Procedure. The audio control panel is on whenever electrical power is applied to the aircraft and the **AVIONICS MASTER POWER** switch is **ON**.

(2) Interphone Operating Procedure.

1. Transmitter selector switch – **PA**.
2. Microphone switch – Press, listen for sidetone.
3. **VOLUME** control – Adjust sidetone and interphone audio level in headphone.

(3) Navigational Aid and Receiver Monitoring Procedure.

1. Inter-communication switches – As required.
2. **VOLUME** control – Adjust volume control of system being monitored.

(4) Transmitting Procedure.

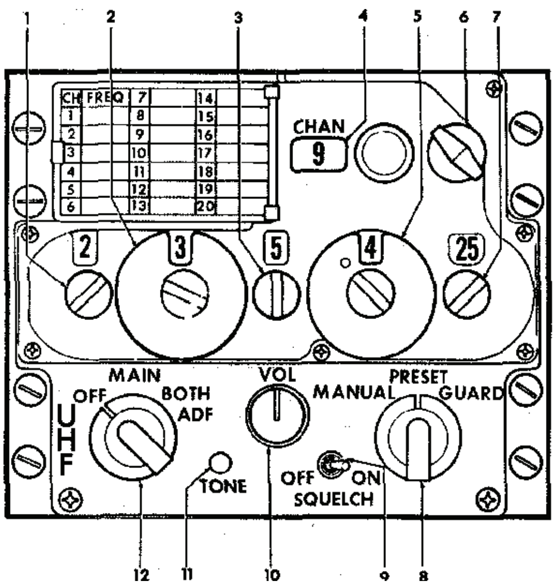
1. Transmitter selector switch – As required.
2. Microphone switch – Press, listen for sidetone.
3. Applicable transceiver volume control – Adjust for comfortable audio level.

d. Emergency Operation. An audio fail-safe system is provided for use in the event of an audio amplifier failure. If an audio amplifier fails, receiver audio bypasses the amplifier and is applied directly to the headsets. No audio will be available to the overhead speakers.

3B-7. UHF COMMAND SET (AN/ARC-164).

a. Description. The UHF command set provides two-way Amplitude Modulated (AM) voice communication within the frequency range of 225.000 to 399.975 MHz for a distance range of approximately 50 miles line-of-sight. Channel selection is spaced at 0.025 MHz intervals. Additionally, a separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz). The audio output of the UHF set is applied to the audio control panel where it is made available to the headsets and speakers. The UHF command set is protected by a

7 1/2-ampere circuit breaker placarded **UHF**, located on the overhead circuit breaker panel, Figure 2-16, Sheet 3. Figure 3B-2 illustrates the UHF command set. The associated blade type antenna is shown in Figure 2-1.



1. **Manual Frequency (100 MHz) Selector-Indicator**
2. **Manual Frequency (10 MHz) Selector-Indicator**
3. **Manual Frequency (1 MHz) Selector Indicator**
4. **Preset Channel Indicator**
5. **Manual Frequency (kHz) Selector-Indicator**
6. **Preset Channel Selector**
7. **Manual Frequency (10 and 1 kHz) Selector-Indicator**
8. **Mode Selector**
9. **SQUELCH Switch**
10. **VOL Control**
11. **TONE Push Button**
12. **Function Switch**

Figure 3B-2. UHF Command Set (AN/ARC-164)

b. Controls and Functions.

(1) Manual Frequency Selector Switch (Hundreds). Selects hundreds digit of frequency (either 2 or 3) in MHz.

(2) Manual Frequency Selector Switch (Tens). Selects tens digit of frequency (0 through 9) in MHz.

(3) Manual Frequency Selector Switch (Units). Selects unit digit of frequency (0 through 9) in MHz.

(4) Preset Channel Indicator. Displays preset channel selected.

(5) Manual Frequency Selector Switch (Tens). Selects tens digit of frequency (0 through 9) in MHz.

(6) Preset Channel Selector. Selects one of 20 preset channels.

(7) Manual Frequency Selector Switch (Hundreds And Thousands). Selects hundreds and thousands digits of frequency (00, 25, 50, or 75) in MHz.

(8) Mode Selector. Selects method of frequency selection.

(a) ***MANUAL****.* Any one of 7,000 frequencies is manually selected using the five frequency selector switches.

(b) ***PRESET****.* Frequency is selected using the preset channel selector switch for selecting any one of 20 preset channels.

(c) ***GUARD****.* The main receiver and transmitter are automatically tuned to the guard frequency and the guard receiver is disabled.

(9) ***SQUELCH*** *Switch.* Turns on or off squelch circuit of main receiver.

(10) ***VOL*** *Control.* Adjusts volume.

(11) ***TONE*** *Push Button.* When pushed, selects transmission of a 1,020 Hz tone on the selected frequency.

(12) Function Switch. Selects operating function.

(a) **OFF**. Turns set off.

(b) ***MAIN****.* Selects main receiver and transmitter.

(c) ***BOTH****.* Selects main receiver, transmitter, and guard receiver.

(d) ***ADF****.* Selects ADF or homing system (if installed) and main receiver.

c. Normal Operation.

(1) Turn On Procedure. Function switch (UHF control panel) – **BOTH**.

(2) Receiver Operating Procedure.

1. Function switch – As required.
2. Frequency – Select required frequency using either preset channel selector or manual frequency selector controls.

NOTE

The PRESET channel selector and manual frequency selectors are inoperative when the Mode Selector switch is set to GUARD.

3. **VOL** – Adjust.
4. **SQUELCH –** As required.

(3) Transmitter Operating Procedure.

1. Transmitter select switch located on the audio control panel, Figure 3B-1 – **UHF** position.
2. Microphone switch – Press.

(4) Shutdown Procedure. Function switch – **OFF**.

d. Emergency Operation.

NOTE

Transmission on emergency frequencies (guard channel) shall be restricted to emergencies only. An emergency frequency of 121.500 MHz is also available on the VHF command radio set.

1. Transmitter select switch located on the audio control panel, Figure 3B-1 – **UHF** position.
2. Mode selector switch – **GUARD**.
3. Microphone switch – Press.

3B-8. VHF COMMUNICATIONS TRANSCEIVERS (VHF-22D).

a. Introduction. The VHF communications transceivers are an 8.33 kHz channel spacing cable system. The operation between the 25 kHz and 8.33 kHz modes is seamless. Within the space occupied by each 25 kHz frequency exist three 8.33 kHz channels. The 8.33 kHz "frequency" is referred to as a "channel" not the actual frequency tuned. The channel scheme avoids possible confusion associated with shared 25 kHz and 8.33 kHz frequencies. This method ensures that the equipment will always be operating in the proper spacing mode and occurs automatically as the user tunes the controller. Provides airborne VHF communications from 118.000 through 151.975 MHz and is operated by two CTL-22C transceiver control units. Refer to Figure 3B-3.

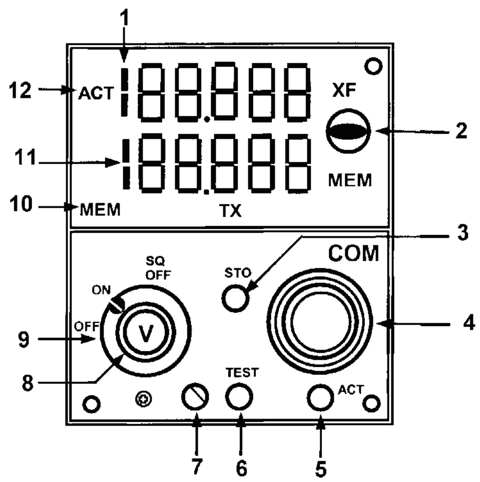
The solid-state transceiver includes capture-effect automatic squelch to help prevent missed radio calls, plus audio leveling and response shaping to ensure audio quality. Transmitter sidetone comes from detected transmitter signal, and is therefore a reliable check of transmission quality. Each VHF transceiver is powered through its respective circuit breaker, placarded **VHF 1** or **VHF 2**, located on the circuit breaker panel.

b. VHF Transceiver Operating Controls (VHF-22C). All operating controls for the transceivers are located on the CTL-22 transceiver control units. Refer to Figure 3B-3.

(1) Active Frequency Display. Displays the active frequency (frequency to which the transceiver is tuned) and diagnostic messages.

(2) Transfer/Memory Switch. This switch is a three-position, spring-loaded toggle switch placarded **XF/MEM**, which, when held to the **XF** position, causes the preset frequency to be transferred up to the active display and the transceiver to be returned. The previously active frequency will become the new preset frequency and will be displayed in the lower window. When this switch is held to the **MEM** position, one of the six stacked memory frequencies will be loaded into the preset display. Successive pushes will cycle the six memory frequencies through the display (...2, 3, 4, 5, 6, 1, 2, 3...).

(3) Store Button. This button, placarded **STO**, allows up to six preset frequencies to be selected and entered into the control unit's memory. After presetting the frequency to be stored, push the **STO** button. The upper window displays the channel number of available memory (CHAN 1 through CHAN 6) while the lower window continues to display the frequency to be stored. For approximately 5 seconds, the **MEM** switch may be used to advance through the channel numbers without changing the preset display. Push the **STO** button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.



1. Active Frequency Display
2. Transfer/Memory Switch
3. Store Button
4. Frequency Select Knobs
5. Active Button
6. Test Button
7. Light Sensor
8. Volume Control
9. Power and Mode Switch
10. Annunciators (MEM TX)
11. Preset Frequency Display
12. Compare Annunciator

Figure 3B-3. VHF Communications Transceiver Control Unit

(4) Frequency Select Knobs. Two concentric tuning knobs control the preset or active frequency displays. The larger knob changes the three digits to the left of the decimal point in 1-MHz steps. The smaller knob changes the three digits to the right of the decimal point. The faster the kHz knob is turned, the more channels will be skipped. A single click of the kHz knob will either increase or decrease the channel by a single channel.

(5) Active Button. The active button, placarded **ACT**, enables the tuning knobs to directly tune the VHF transceiver, when pressed and held for 2 seconds. The bottom window will display dashes and the upper window will continue to display the active frequency. Pushing the **ACT** button a second time will return the control unit to the normal two-display mode.

*(6) **TEST** Button.* This button, placarded **TEST**, initiates the transceiver self-test diagnostic routine. Self-test is active only when the **TEST** button is pressed.

(7) Light Sensor. This built-in light sensor automatically controls display brightness.

(8) Volume Control. The volume control is concentric with the power and mode switch.

(9) Power and Mode Switch. The power and mode switch contains three detented positions. The **ON** and **OFF** positions switch system power. The **SQ OFF** position disables the receiver squelch circuits.

(10) Annunciators. The transceiver control unit contains a **MEM** (memory) and a **TX** (transmit) annunciator. The **MEM** annunciator illuminates whenever a preset frequency is being displayed in the lower window. The **TX** annunciator illuminates whenever the transceiver is transmitting.

(11) Preset Frequency Display. Displays the pre-set (inactive) frequency and diagnostic messages in the lower window.

(12) Compare Annunciator. An annunciator, placarded **ACT**, momentarily illuminates when frequencies are being changed. The **ACT** annunciator flashes if the actual radio frequency to which the transceiver is tuned is not identical to the frequency shown in the active frequency display.

NOTE

If two communications transceivers in the same aircraft are tuned to stations carrying the same voice message, attempting to listen to the received signals from both simultaneously could result in a great reduction in the actual audio volume.

c. Operating Procedures. The 8.33 kHz capable CTL-22C shows the VHF COM frequency as a channel frequency using all six digits of the display. There are no 8.33 kHz channels above 136.992 MHz. The last “channel name” is 136.990, which is an actual frequency of 136.9917 MHz. Table 3B-1 shows the channel/frequency scheme for the 180.000 to 136.992 MHz range. While the CTL is in the frequency range of 137.000 to 151.975 MHz, the unit behaves the same as a 25 kHz only unit.

NOTE

It is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by continually assessing the reasonableness of operation as displayed on the associated transceiver control unit and by the quality of received signals and transmissions.

Table 3B-1. VHF Communications Transceiver Control UnitChannel/Frequency Scheme (118.000 To 136.992 MHz Range)

FREQUENCY	SPACING (kHz)	CHANNEL NAME (DISPLAYED)	FREQUENCY	SPACING (kHz)	CHANNEL NAME (DISPLAYED)
118.0000	**25.00**	118.000	118.0750	**25.00**	118.075
118.0000	**8.33**	118.005	118.0750	**8.33**	118.080
118.0083	**8.33**	118.010	118.0833	**8.33**	118.085
118.0167	**8.33**	118.015	118.0917	**8.33**	118.090
118.0250	**25.00**	118.025	118.1000	**25.00**	118.100
118.0250	**8.33**	118.030	•	•	•
118.0333	**8.33**	118.035	•	•	•
118.0417	**8.33**	118.040	•	•	•
118.0500	**25.00**	118.050	136.9750	**25.00**	136.975
118.0500	**8.33**	118.055	136.9750	**8.33**	136.980
118.0583	**8.33**	118.060	136.9833	**8.33**	136.985
118.0667	**8.33**	118.065	136.9917	**8.33**	136.990

(1) Equipment Startup. Turn on the transceiver and the control unit by rotating the power and mode switch to the **ON** position. When the transceiver is first turned on, it sounds a brief tone while the microprocessor checks its own memory. If there is a memory defect the tone continues, indicating that the transceiver can neither receive nor transmit. After the memory check, the transceiver control unit will display the same active and preset frequencies that were present when the equipment was last turned off.

NOTE

If two short 800-Hz tones are heard, the transceiver has detected an internal fault. Push the TEST button on the transceiver control unit to initiate self-test and display the fault code.

Adjust the volume and perform a quick squelch test by setting the power and mode switch to **SQ OFF** and adjusting the volume level with background noise. After a comfortable listening level has been established, return the power and mode switch to the **ON** position. All background noise should disappear unless a station or aircraft is transmitting on the active frequency.

(2) Frequency Selection. Frequency selection is made using either the frequency select knobs, or the **XF / MEM** switch.

NOTE

There is usually an installer supplied 8.33/25 kHz select switch in the cockpit. This switch provides a convenience to the pilots by not having to "ratchet pass" the 8.33 kHz channels when not operating in 8.33 airspace. The selected position of the (8.33 or 25) switch may or may not be annunciated, depending on installation.

After the desired frequency is set into the preset frequency display, it can be transferred to the active frequency display by momentarily setting the **XF / MEM** switch to **XF**. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. A short audio tone is applied to the audio system to indicate that the active frequency has been changed, and the **ACT** annunciator will flash while the transceiver is tuning to the new frequency.

NOTE

The ACT annunciator continuing to flash indicates that the transceiver is not tuned to the frequency displayed in the active display.

The transceiver control unit's memory permits storing up to six preset frequencies. Once stored, these frequencies can be recalled to the preset display by positioning the **XF / MEM** switch to the **MEM** position. The storage location (CHAN 1 through CHAN 6) for the recalled frequency is displayed in the active frequency display while the **XF / MEM** switch is held in the **MEM** position. All six stored frequencies can be displayed one at a time in the preset display by repeatedly positioning the **XF / MEM** switch to the **MEM** position. After the desired stored frequency has been recalled to the preset display, it can be transferred to the active display by momentarily positioning the **XF / MEM** switch to the **XF** position.

During normal operation, all frequency selections and revisions are done in the preset frequency display. However, the active frequency can be selected directly as described in the following paragraph.

(3) Direct Active Frequency Selection. The active frequency can be selected directly with the frequency select knobs by pushing the **ACT** button for about 2 seconds. The active frequency selection mode is indicated by dashes appearing in the preset display. Also, the **ACT** annunciator will flash as the frequency select knobs are turned to indicate that the transceiver is being returned.

NOTE

The ACT annunciator continuing to flash after the frequency has been selected indicates that the transceiver is not tuned to the frequency displayed in the active display.

To return to the preset frequency selection mode, push the **ACT** button again for about 2 seconds. As a safety feature, the transceiver control unit switches to the active frequency selection mode when a frequency select knob is operated while the **STO** and **TEST** buttons, or **XF / MEM** switch are actuated.

(4) Frequency Storage. To program the memory, select the frequency in the preset frequency display using the frequency select knobs and push the **STO** button once. One of the channel numbers (CHAN 1 through CHAN 6) will appear in the active display for approximately 5 seconds. During this time the channel number can be changed without changing the preset frequency by momentarily positioning the **XF/MEM** switch to the **MEM** position. After the desired channel number has been selected, push the **STO** button again to store the frequency.

NOTE

When storing a frequency, the second actuation of the STO button must be done within 5 seconds after selecting the channel number or the first actuation of the STO button. If more than 5 seconds elapse, the control will revert to the normal modes of operation and the second store command will be interpreted as the first store command.

After a frequency has been stored in memory, it will remain there until changed by using the **STO** button. Memory is retained even when the unit is turned off for an extended period of time.

(5) Stuck Microphone Switch. Each time the push-to-talk switch is pressed, the microprocessor in the transceiver starts a 2-minute timer. The **TX** annunciator on the transceiver control unit will be illuminated whenever the transmitter is transmitting. If the transmitter is still transmitting at the end of 2 minutes, the microprocessor turns it off. Most intentional transmissions last much less than 1 minute; a 2-minute transmission is most likely the result of a stuck microphone switch. This timing feature protects the ATC channel from long-term interference.

When it turns off the transmitter, the microprocessor switches the transceiver to receive operation. A stuck microphone switch will prevent you from hearing received signals, or the two warning beeps. The microprocessor then waits until the push-to-talk switch opens to sound the two beeps.

To transmit for more than 2 minutes, release the microphone switch briefly and then press it again. The 2-minute timer resets and starts a new count each time the microphone switch is pressed.

(6) Overtemperature Protection. The microprocessor regularly monitors the temperature of the transmitter. If the transmitter gets too hot during a transmission, the microprocessor will stop the transmission, and the sidetone will cease. When the microphone switch is released, you will hear two beeps. Press the **TEST** button to observe the fault code. As long as the temperature remains above the limit, the microprocessor will not respond to a normal push of the microphone switch. If you must transmit, however, you can override the protection by rapidly keying the microphone switch twice, holding it on the second push. The shutdown temperature is 160 °C (320 °F).

(7) Self Test. An extensive self-test diagnostic routine can be initiated in the transceiver by pushing the **TEST** button. The control unit will

modulate the active and preset display intensity from minimum to maximum to annunciate that self-test is in progress. Several audio tones will be heard from the audio system while the self-test routine is being executed. At the completion of the self-test program, the transceiver control unit will usually display dashes in the active display, and 00 in the preset display. This indicates normal operation. If any out-of-limit condition is found, transceiver control unit will display diagnostic (DIAG) in the active display and a 2-digit fault code in the preset display. Record any fault codes displayed to help the service technician locate the problem. Refer to Table 3B-2 for a description of the self-test fault codes that can be displayed on the transceiver control unit. The **TEST** button must be pushed before any fault code can be displayed.

3B-9. HF COMMUNICATION SET (KHF-950).

a. Description. The KHF-950 HF system consists of three units; the pedestal mounted KCU-951 control panel, the remote KAC-952 power amplifier/antenna coupler, and the KTR-953 receiver/exciter. The system will operate on any 0.1 kHz frequency between 2,000 and 29,999.9 kHz.

With the capability to preset and store 99 frequencies for selection during flight, the system also allows for selection of other frequencies manually (direct tuning) or reprogramming of any preset frequency. The system will automatically match the antenna by keying the microphone. Power to the system is routed through a 25-ampere circuit breaker, placarded **HF PWR**. The receiving portion of the system is protected by a 5-ampere circuit breaker, placarded **HF RECVR**. Both circuit breakers are located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

The HF system has two methods of frequency selection. The first method is called direct tuning (frequency agile). The second is a channelized operation in which desired operating frequencies are preset, stored and referenced to a channel number.

b. Controls and Functions. Refer to Figure 3B-4.

*(1) **FREQ** Display.* Displays frequency selected.

(2) Mode Display. Displays selected LSB, AM, or USB mode.

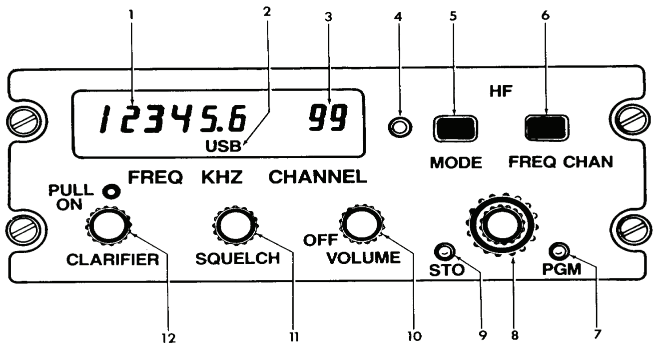
*(3) **CHANNEL** Display.* Displays channel selected.

(4) Light Sensor. The light sensor is a photocell which adjusts brightness of the display.

*(5) **MODE** Button.* The mode switch is a momentary push button switch that selects LSB, AM or USB.

Table 3B-2. Self-Test Codes

FAULT/ CODE	DESCRIPTION	FAULT/ CODE	DESCRIPTION
00	No fault found	15	Frequency out of range
01	5 Vdc below limit	16	Forward power below limit
02	5 Vdc above limit	17	Transmitter temperature excessive
03	12 Vdc below limit	21	Tuning voltage out of limit at highest receive frequency
04	12 Vdc above limit	22	Tuning voltage out of limit at 118 MHz
05	Synthesizer not locked	23	Local oscillator output below limit
07	Noise squelch open without signal	24	No-signal AGC voltage too high
08	Noise squelch open without signal	25	Inadequate AGC voltage increase with rf signal
12	BCD frequency code invalid	26	Reflected rf power above limit
13	2/5 frequency code invalid	27	Transmitter timed out
14	Serial message invalid		



1. **FREQ Display**
2. **Mode Display**
3. **CHANNEL Display**
4. **Light Sensor**
5. **MODE Button**
6. **FREQ / CHAN Button**
7. **PGM (Program) Button**
8. **Frequency/Channel Selector**
9. **STO (Store) Button**
10. **OFF / VOLUME Control**
11. **SQUELCH Control**
12. **CLARIFIER Control**

Figure 3B-4. HF Control Panel

(6) ***FREQ / CHAN*** *Button.* Transfers the HF system from a direct frequency operation to a channelized form of operation.

(7) ***PGM*** *Program Button.* Enables channelized data to be modified. The PGM message will be displayed whenever this switch is pressed.

(a) Program. The program mode must be used for setting or changing any of the 99 preset frequencies. Each of the 99 channels may be preset to receive and transmit on separate frequencies (semi-duplex), receive only, or transmit and receive on the same frequency (simplex). The operating mode (LSB, USB or AM) must be the same for both receive and transmit and can also be preset.

(8) Frequency/Channel Selector. This selector consists of two concentric knobs that control the channel and frequency digits, plus the lateral position of the cursor.

(a) Frequency Control. The outer knob becomes a cursor (flashing digit) control with the **FREQ / CHAN** switch in the **FREQ** position. The flashing digit is then increased/decreased with the inner knob.

(b) Channel Control. The outer knob is not functional when the **FREQ / CHAN** switch is in the **CHAN** position. The inner knob will provide channel control from 1 through 99, displayed at the right end of the display window.

(9) ***STO*** *Button.* Stores displayed data when programming preset channels.

(10) ***OFF / VOLUME*** *Switch.* Applies power to the unit and controls the audio output level.

(11) ***SQUELCH***. Provides variable squelch threshold control.

(12) ***CLARIFIER***. Provides 250 Hz of local oscillator adjustment.

c. Operating Procedures.

NOTE

The mode for each channel (LSB, USB, or AM) is stored along with the frequency. If the mode is changed, the system will receive and transmit in the mode selected for transmit.

(1) ***OFF / VOLUME*** *Switch.* Turn clockwise out of **OFF** position. Adjust volume as desired.

(2) Frequency Operation (Simplex Only). Each digit of the frequency may be selected instead of dialing up or down to a frequency. The larger concentric knob is used to select the digit to be changed. This digit will flash when selected. Rotation of the knob moves the flashing cursor in the direction of rotation. After the digit to be changed is flashing, the smaller concentric knob is used to select the numeral desired. This process is repeated until the new frequency has been selected. The flashing cursor may then be stowed by moving it to the extreme left or right of the display and then one more click. This stows the cursor behind the display until needed again. The cursor may be recalled by turning the concentric knob one click left or right.

(a) Direct Frequency Tuning (Simplex Only).

1. **FREQ / CHAN** switch – **FREQ**.
2. Mode – Select desired mode, USB, LSB, or AM.
3. Select digit to be changed (outer knob), digit (cursor) will flash.
4. Select numerical value of digit, inner knob.
5. Stow cursor, or repeat procedure for additional changes.
6. Tune antenna coupler, press microphone button.

(3) Channel Programming. There are three ways to set up a channel: Receive only, simplex, and semi-duplex. To gain access to channelized operation, press **FREQ / CHAN** button to the **CHAN** position. To utilize the existing programmed channels (i.e. no programming required), use the inner control knob to select the desired channel number. Then, momentarily key the microphone to tune the antenna coupler. If channel programming is required, it is necessary to activate the program mode as follows. With the **FREQ / CHAN** button in, use a pencil or other pointed object to push the **PGM** button in. The button is an alternate action switch, push-on, push-off. The letters PGM will appear in the lower part of the display window and the system will remain in the program mode until the **PGM** button is pressed again.

(a) Receive Only.

1. Stow the cursor if a frequency digit is flashing.
2. Select the channel to be preset.
3. Set the desired operating mode, LSB, USB or AM.
4. Set the desired frequency. Refer to frequency tuning.
5. Push and release **STO** button once.

NOTE

T will flash in the display window, however, a receive-only frequency is being set. The flashing T should be ignored.

If another channel is to be set, the cursor must be stowed before a new channel can be selected. Use the smaller concentric knob to select the channel and repeat the steps for selecting a new frequency.

6. To return to an operating mode, push the **PGM** button.

(b) Simplex. Setting a channel up for simplex operation (receive and transmit on the same frequency).

1. **FREQ / CHAN** – **CHAN**, cursor stowed.
2. **PGM** button – In.
3. Channel – Select.
4. Mode – Set LSB, USB, or AM.
5. Frequency – Set desired frequency. Refer to frequency tuning.
6. **STO** button – Push and release twice.

The first press of the **STO** button stores the frequency in the receive position and the second press stores the same frequency in the transmit position. The second push also stores the cursor. If another channel is to be reset, use the smaller concentric knob to select the channel and repeat the steps for selecting a new frequency. The cursor was automatically stowed. To return to one of the operating modes, push the **PGM** button again.

(c) Semi-Duplex. Setting a channel for semi-duplex. Transmit on one frequency and receive on another.

1. Channel – Select channel to be preset.
2. Frequency – Set desired frequency. Refer to frequency selection.
3. Mode – Set LSB, USB, or AM.
4. **STO** button – Push once.
5. Transmit frequency – Set.
6. **STO** button – Push again.

If another channel is to be reset, use the smaller concentric knob to select the channel and repeat the steps.

7. To return to an operating mode, push the **PGM** button.

3B-10. EMERGENCY LOCATOR TRANSMITTER.

a. Description. An automatic or manually activated Emergency Locator Transmitter (ELT) is located in the right side of the fuselage at approximately FS 340.00. The associated antenna is mounted on top of the aft fuselage at the same location, Figure 2-1, Sheet 2. An access hole with a spring-loaded cover is located in the right fuselage skin adjacent to the transmitter, enabling a downed pilot to manually initiate, terminate, or reset the ELT to an armed mode. Self-contained batteries provide operation for a minimum of 48 hours.

The transmitter contains an impact G switch that automatically activates the transmitter following a 3 to 7 G impact along the flight axis of the aircraft. When activated, it will simultaneously radiate omni-directional RF signals on the international distress frequencies of 121.5 and 243.0 MHz. The radiated signal is modulated with an audio swept tone.

b. Controls and Functions.

*(1) **ON / ARM / OFF** Switch.*

*(a) **ON**.* Turns set on, initiating emergency signal transmissions.

*(b) **ARM**.* Establishes a readiness state to start automatic emergency signal transmissions when the force of impact exceeds a preset threshold.

*(c) **OFF**.* Turns set off.

Section III. NAVIGATION

3B-11. DESCRIPTION.

The overall navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach on instruments under Instrument Meteorological Conditions (IMC). The navigation configuration includes equipment for determining attitude, position, destination range and bearing, heading reference, and groundspeed.

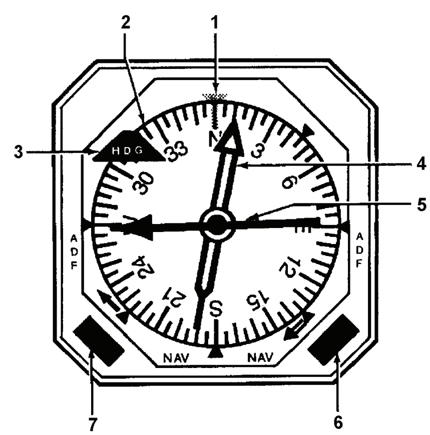
3B-12. RADIO MAGNETIC INDICATORS (RMI).

a. Description. Two identical KNI-582 RMI indicators are installed. Refer to Figure 3B-5. Each RMI provides aircraft heading and radio bearing information to/from a VOR, TACAN or ADF facility. A selector switch on the RMI allows the operator to select either #1 ADF and #1 VOR or #1 ADF and TACAN for single needle display. The double needle always points to the #2 ADF or #2 VOR bearing as selected by the double needle switch. The pilot's RMI is protected by a 1-ampere circuit breaker, placarded **#1 RMI**. The copilot's RMI is protected by a 1-ampere circuit breaker, placarded **#2 RMI**. Both circuit breakers are located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

b. Controls and Functions.

(1) Warning Flag. Indicates loss of heading signal, or that bearing information is unreliable.

(2) Compass Card. Gyro stabilized to indicate aircraft heading and bearing information.



1. **Warning Flag**
2. **Compass Card**
3. **Heading Index**
4. **Double Needle Pointer**
5. **Single Needle Pointer**
6. **Double Needle Switch**
7. **Single Needle Switch**

Figure 3B-5. Radio Magnetic Indicator (RMI)

(3) Heading Index. Reference point for aircraft heading.

(4) Double Needle Pointer. Indicates #2 ADF or #2 VOR bearing as selected by double needle switch.

(5) Single Needle Pointer. Indicates #1 ADF or VOR/TACAN bearing as selected by single needle switch.

(6) Double Needle Switch. Selects desired signal to be displayed on double needle pointer.

(a) ADF Position. Selects #2 ADF bearing information.

(b) VOR Position. Selects #2 VOR bearing information.

(7) Single Needle Switch.

(a) ADF Position. Selects #1 ADF bearing information.

(b) VOR Position. Selects #1 VOR/waypoint bearing information.

3B-13. PILOT'S HORIZONTAL SITUATION INDICATOR.

a. Description. The pilot's Horizontal Situation Indicator (HSI) combines numerous displays to provide a presentation of the aircraft position. Refer to Figure 3B-6. The indicator displays aircraft displacement relative to VOR, localizer, *glideslope* beam, GPS, TACAN, and selected heading, with respect to magnetic north. Any warning flag in view indicates that portion of the HSI display is unreliable. Display brightness is controlled by a dimming knob that is concentric with the **DH SET** knob and located on the pilot's ADI.

b. Associated Controls/Indicators and Function. Refer to Figure 2-9 Sheet 1.

*(1) **COURSE** Knob.* Positions the course pointer.

*(2) **HEADING** Knob.* Positions the heading bug to a pre-selected heading.

c. Controls/Indicators and Function.

*(1) Distance Display (**DIST**).* Provides digital displays of DME/TACAN, waypoint or GPS distance. DME/TACAN and waypoint distance is displayed in 1/10-mile increments. GPS distance is displayed in whole mile increments. The display will show dashes when the distance input data is invalid or absent.

(2) Rotating Heading (Azimuth) Dial. Displays gyro stabilized magnetic compass information on a dial that rotates with the aircraft throughout 360°. The azimuth ring is graduated in 5° increments.

(3) Lubber Line. Fixed heading marks located at the fore (upper) and aft (lower) position.

(4) Heading Bug. The notched orange heading bug is positioned on the rotating heading dial by the heading knob, to select and display a preselected compass heading. Once set to the desired heading, the heading bug maintains its position on the heading dial. The difference between the bug and the fore (upper) lubber line index is the amount of heading select error applied to the flight director computer. In the heading mode the ADI will display the proper bank commands to turn to and maintain this selected heading.

(5) **COURSE** Display. *Provides a digital readout of selected magnetic course*.

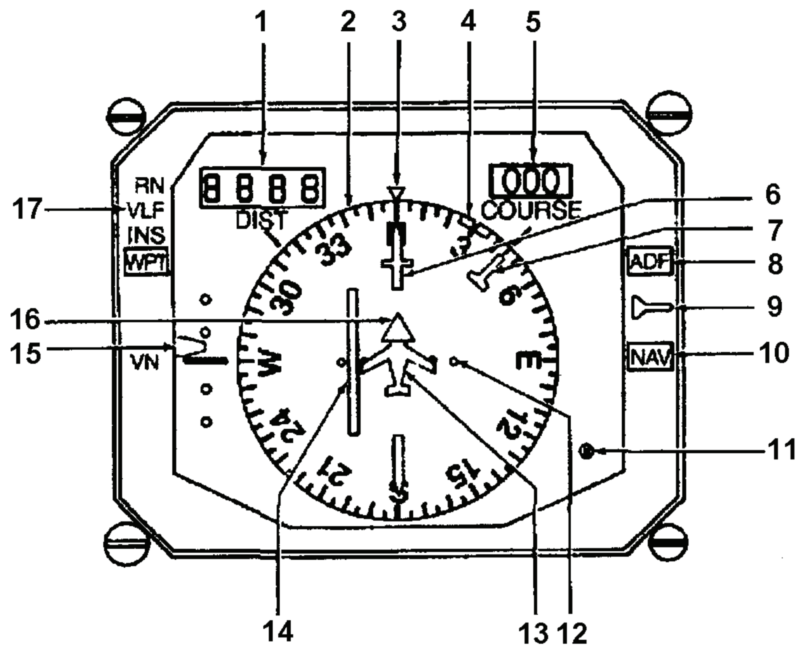
(6) Course Pointer. The yellow course pointer is positioned on the heading dial by the remote course knob, to a magnetic bearing that coincides with the selected course being flown. The course pointer is also positioned by the RNAV or VLF modes of operation. The course pointer rotates with the heading dial to provide a continuous readout of course error to the computer.

(7) Bearing Pointer. Indicates ADF or NAV relative bearing as selected by the bearing pointer source switch.

*(8) **ADF** Annunciator.* When illuminated, indicates ADF bearing information is being displayed.

(9) Bearing Pointer Source Switch. The bearing pointer source switch, located on the pilot's HSI, provides for selecting between ADF and NAV bearing information as presented by the bearing pointer. Each push of the select switch alternates selection of ADF or NAV. Upon power-up or following long-term power interruption, NAV is displayed.

*(10) **NAV** Annunciator*. When illuminated, indicates NAV bearing information is being displayed.



1. **Distance Display**
2. **Rotating Heading Dial**
3. **Lubber Line**
4. **Heading Bug**
5. **COURSE Display**
6. **Course Pointer**
7. **Bearing Pointer**
8. **ADF Annunciator**
9. **Bearing Pointer Source Switch**
10. **NAV Annunciator**
11. **Compass Synchronization Annunciator**
12. **Course Deviation Dots**
13. **Aircraft Symbol**
14. **Course Deviation Bar**
15. **Glideslope Pointer/Scale**
16. **To/From Pointer**
17. **Navigation Source Annunciators**

Figure 3B-6. Pilot's Horizontal Situation Indicator (HSI)

(11) Compass Synchronization Annunciator. The compass synchronization annunciator consists of a dot and X symbol display. When the compass system is in the slaved mode, the display will oscillate between the dot and X symbol, indicating the heading dial is synchronized with a gyro stabilized magnetic heading.

(12) Course Deviation Dots. In VOR operation, each dot represents 5° deviation from the centerline (+ 10°). In ILS operation, each dot represents 1° deviation from the centerline.

(13) Miniature Aircraft Symbol. The fixed miniature aircraft symbol corresponds to the longitudinal axis of the aircraft and lubber line markings. The symbol shows aircraft position and heading with respect to a radial course and the rotating heading (azimuth) dial.

(14) Course Deviation Bar. The course deviation bar represents the centerline of the selected VOR or localizer course. The miniature aircraft symbol pictorially shows actual aircraft position in relation to this selected course.

(15) Glideslope Pointer/Scale. The glideslope pointer displays glideslope deviation. The pointer is in view only when tuned to a localizer frequency. If the aircraft is below glideslope path, the pointer is displayed upward on the scale. Each dot on the scale represents approximately 0.4° displacement.

(16) To-From Pointer. The to-from pointers, aligned on the course pointer, are located 180° apart. One always points in the direction of the station, along the selected VOR radial.

(17) Navigation Source Annunciators. Two different annunciators display navigation data sources, RN for area navigation and GPS.

The pilot’s HSI also has a HDG flag which indicates a loss of heading information, a NAV flag which indicates a loss of NAV 1 or unreliable GPS navigational signal and a VERT flag which covers the glideslope pointer when not receiving glideslope information.

3B-14. COPILOT'S HORIZONTAL SITUATION INDICATOR.

a. Description. The copilot's Horizontal Situation Indicator (HSI) combines numerous displays to provide a presentation of the aircraft position. The indicator displays aircraft displacement relative to VOR, localizer, glideslope beam, and heading with respect to magnetic north. Any warning flag in view indicates that portion of the HSI display is unreliable. Display brightness is adjusted with a rheostat, placarded **HSI**, located on the copilot's instrument panel.

b. Controls/Indicators and Function. Refer to Figure 3B-7.

*(1) Digital Distance Display (**DIST**).* Provides digital display of station distance.

(2) Rotating Heading (Azimuth) Dial. Displays gyro stabilized magnetic compass information on a dial that rotates with the aircraft throughout 360°. The azimuth ring is graduated in 5° increments.

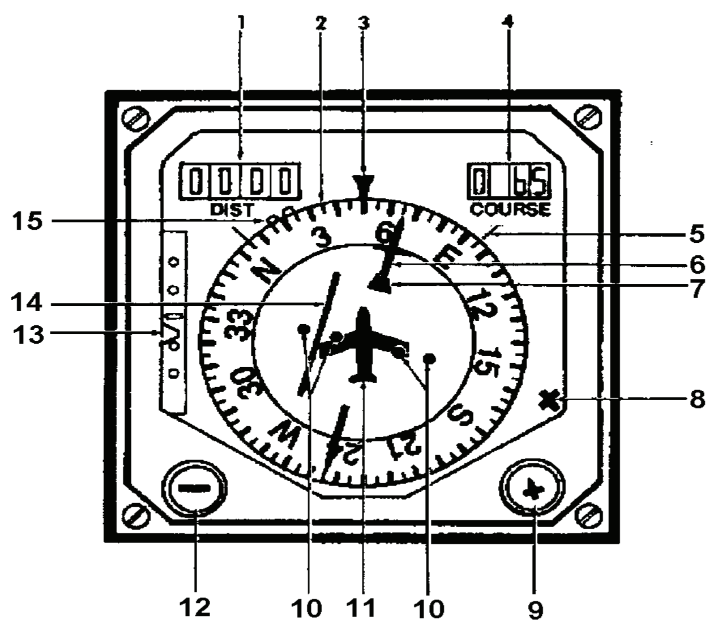
(3) Lubber Line. Fixed heading marks located at the fore (upper) and aft (lower) position.

*(4) **COURSE** Display.* Provides a digital readout of selected magnetic course.

(5) Azimuth Marks.

(6) Course Pointer. The yellow course pointer is positioned on the heading dial by the course knob to select a magnetic bearing that coincides with the desired VOR radial or localizer course. The course pointer rotates with the heading dial to provide a continuous readout of course error to the computer. When either one of the radio modes is selected, the vertical command bar on the Attitude Flight Director will display bank commands to intercept and maintain the selected radio course.

(7) To-From Pointer. The to-from pointers, aligned on the course pointer, are located 180° apart. One always points in the direction of the station, along the selected VOR radial.



1. **Digital DIST Display**
2. **Rotating Heading Dial**
3. **Lubber Line Mark**
4. **Digital COURSE Display**
5. **Azimuth Marks**
6. **Course Pointer**
7. **To-From Pointer**
8. **Compass Synchronization Annunciator**
9. **Course Knob**
10. **Course Deviation Dots**
11. **Aircraft Symbol**
12. **Heading Knob**
13. **Glideslope Pointer and Scale**
14. **Course Deviation Bar**
15. **Heading Bug**

Figure 3B-7. Copilot's Horizontal Situation Indicator (HSI)

(8) Compass Synchronization Annunciator. The compass synchronization annunciator consists of a □ and X symbol display. When the compass system is in the slaved mode, the display will oscillate between the □ and X symbol, indicating the heading dial is synchronized with a gyro-stabilized magnetic heading.

(9) Course Knob. Positions the course indicator.

(10) Course Deviation Dots. In VOR operation, each dot represents 5° deviation from the centerline (+ 10°). In ILS operation, each dot represents 1° deviation from the centerline.

(11) Aircraft Symbol. The fixed miniature aircraft symbol corresponds to the longitudinal axis of the aircraft and lubber line markings. The symbol shows aircraft position and heading with respect to a radio course and the rotating heading dial.

(12) Heading Knob. Positions the heading bug to a preselected compass heading.

(13) Glideslope Pointer/Scale. The glide-slope pointer displays glideslope deviation. The pointer is in view only when tuned to a localizer frequency. If the aircraft is below glideslope path, the pointer is displayed upward on the scale. Each dot on the scale represents approximately 0.4° displacement.

(14) Course Deviation Bar. The course deviation bar represents the centerline of the selected VOR or localizer course. The miniature aircraft symbol pictorially shows actual aircraft position in relation to this selected course.

(15) Heading Bug. The notched orange heading bug is positioned on the rotating heading dial by the heading knob, and displays preselected compass heading. The bug rotates with the heading dial. The difference between the bug and the fore (upper) lubber line index is the amount of heading error applied to the flight director computer. In the heading mode, the ADI will display the proper bank commands to turn to and maintain this selected heading.

The copilot's HSI also has an HDG flag which indicates loss of heading information, a VERT flag which covers the glideslope pointer when not receiving glideslope information, and a NAV flag which indicates a loss of NAV 2.

3B-15. PILOT'S ATTITUDE DIRECTOR INDICATOR.

a. Description. The pilot's Attitude Director Indicator (ADI) combines the attitude sphere display with computed steering information to provide the commands required to intercept and maintain a desired flight path. It also contains an eyelid display, expanded localizer, glideslope, radio altitude display, rate-of-turn indicator, mode annunciators, go-around and decision height annunciators, and inclinometer. Any warning flag in view indicates that portion of information is unreliable.

b. Controls/Indicators and Functions. Refer to Figure 3B-8.

(1) Attitude Sphere. Moves with respect to the symbolic aircraft reference to display actual pitch and roll attitude. Pitch attitude marks are in 5° increments on a blue and brown sphere.

(2) Roll Attitude Index. Displays actual roll attitude through a movable index and fixed scale reference marks at 0, 10, 20, 30, 45, 60 and 90°.

*(3) Go Around (**GA**) Annunciator.* Illuminates when go-around mode has been selected.

*(4) **SPD** Annunciator.* Illuminates when airspeed is being held by the flight director in the IAS mode.

*(5) **ALT** Annunciator.* Illuminates when altitude is being held by the flight director.

*(6) **HDG** Annunciator.* Illuminates when heading is being held by the flight director in the NAV ARM or BC ARM mode.

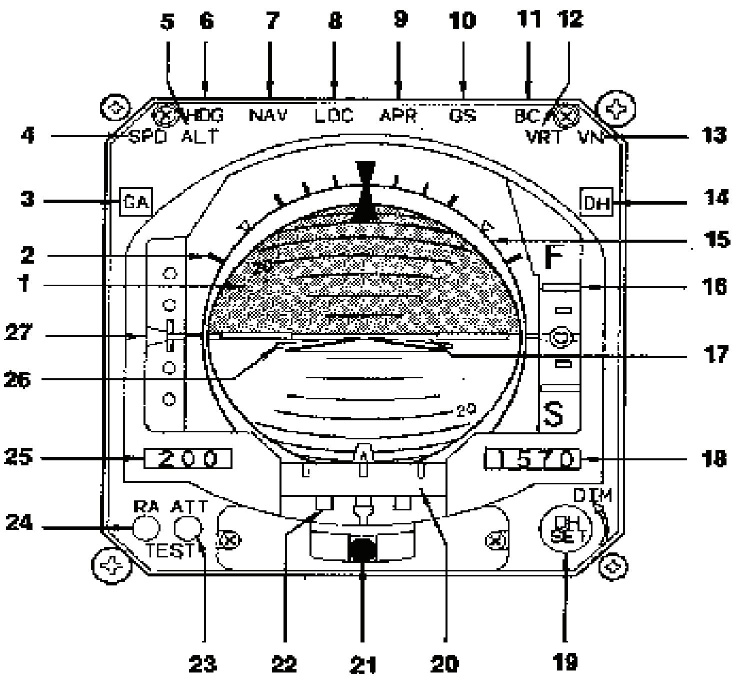
*(7) **NAV** Annunciator.* Illuminates when navigation is being controlled by the flight director, in the NAV CAP, VOR APR mode.

*(8) **LOC** Annunciator.* Illuminates whenever the flight director is controlling a localizer approach, in the NAV CAP mode.

*(9) **APR** Annunciator.* Illuminates whenever the flight director is controlling an approach, in the NAV CAP, VOR APR mode.

*(10) **GS** Annunciator*. Illuminates whenever the flight director is in GS CAP mode, and glideslope has been captured.

*(11) **BC** Annunciator*. Illuminates whenever the flight director is in BC CAP mode, and has captured the back course approach heading.



1. Attitude Sphere
2. Roll Attitude Index
3. GA Annunciator
4. SPD Annunciator
5. ALT Annunciator
6. HDG Annunciator
7. NAV Annunciator
8. LOC Annunciator
9. APR Annunciator
10. GS Annunciator
11. BC Annunciator
12. VRT Annunciator
13. VN Annunciator
14. DH Annunciator
15. Eyelid Display
16. Speed Command Display
17. Flight Director Command Cue
18. Radio Altitude Display
19. DH SET Knob
20. Expand Localizer
21. Inclinometer
22. Rate of Turn
23. ATT TEST Switch
24. RA TEST Switch
25. Decision Height Display
26. Symbolic Miniature Aircraft
27. Glideslope Scale/Pointer

Figure 3B-8. Pilot's Attitude Director Indicator

*(12) **VRT** Annunciator*. Illuminates when vertical speed is being held by the flight director, in the VS mode.

*(13) **VN** Annunciator*. When in an active vertical navigation mode, **VN** illuminates when the aircraft arrives at the designated climb or descent point.

*(14) **DH** Annunciator*. Illuminates when aircraft descends below selected decision height as set on the radio altimeter indicator.

(15) Eyelid Display. Surrounds the attitude sphere and provides positive attitude identification by means of a blue eyelid which always shows the relative position of the sky, and a brown eyelid which always shows the relative position of the ground. The eyelids maintain the proper ground-sky relationship, regardless of sphere position.

(16) Speed Command Display. The pointer indicates relative airspeed provided by the angle-of attack/speed command system.

(17) Flight Director Command Cue. Displays computed commands to capture and maintain a desired flight path. Always fly the symbolic miniature aircraft to the flight director cue. The cue will bias from view should a failure occur in either the pitch or roll channel.

(18) Radio Altitude Display. Radio altitude is digital displayed. The range capability of the display is from -20 to 2500 feet AGL. The display resolution between 200 and 2500 feet is in 10-foot increments. The display resolution below 200 feet is 5 feet. The display will be blank at altitudes over 2500 feet AGL. Dashes are displayed whenever invalid radio altitude is being received.

(19) ***DH SET*** *Knob*. Sets decision height from 0 to 990 feet. Decision height displays in the DH window on lower left corner of ADI. The brightness of the digital radio altitude and decision height display is controlled by the dimming knob that is concentric with the **DH SET** knob. The dimming knob also dims the distance and course display on the pilot's HSI, and the altitude alert display.

(20) Expanded Localizer. Raw localizer displacement data from the navigation receiver (HSI display) is amplified approximately 7 1/2 times to permit the expanded localizer pointer to be used as a sensitive reference indicator of the aircraft's position, with respect to the center of the localizer. It is normally used for assessment only, since the pointer is very sensitive and difficult to fly throughout the entire approach. During final approach, the pointer serves as an indicator of the Category II window. Full-scale deflection of the expanded localizer pointer is equal to 1/4° of beam signal. The expanded localizer is displayed by the localizer pointer only when a valid localizer signal is available.

(21) Inclinometer. Gives the pilot a conventional display of aircraft slip or skid, and is used as an aid to coordinated maneuvers.

(22) Rate Of Turn. Rate of turn is displayed by the pointer at the bottom of the ADI. The marks at the extreme left and right sides of the scale represent a standard rate turn.

(23) ***ATT TEST*** *Switch*. When pressed, the sphere will show an approximate attitude change of 20° of right bank at 10° pitch-up. The ATT warning flag will appear. In addition, all mode annunciator lights except **DH** will illuminate.

(24) ***RA TEST*** *Switch*. Pressing the **RA TEST** button causes the following displays on the radio altitude readout: all digits display 8's then dashes, and then the preprogrammed test altitude as set in the radio altimeter R/T unit, until the **TEST** button is released at which time the actual altitude is displayed. The DH display during the test displays all 8's with the altitude display and then displays the current set altitude for the remainder of the test. **RA TEST** is inhibited as a function of APR CAP.

(25) Decision Height Display. The digital decision height (DH) display displays decision height range from 0 to 990 feet in 10-foot increments. The decision height is set by the **DH SET** knob in the lower right corner of the ADI.

(26) Symbolic Miniature Aircraft. Serves as a stationary symbol of the aircraft. Aircraft pitch and roll attitudes are displayed by the relationship between the fixed miniature aircraft and the moveable sphere. The symbolic aircraft is flown to align the command cue to the aircraft symbol in order to satisfy the commands of the selected flight director mode.

(27) Glideslope Scale/Pointer. Displays aircraft deviation from glideslope beam center only when tuned to an ILS frequency and a valid glideslope is present. The aircraft is below glide path if pointer is displaced upward. The glideslope dot represents approximately 0.4° deviation from the beam centerline.

3B-16. COPILOT'S ATTITUDE DIRECTOR INDICATOR.

a. Description. The copilot's Attitude Director Indicator (ADI) combines the attitude sphere display with computed steering information to provide the commands required to intercept and maintain a desired flight path. It also contains an eyelid display, expanded localizer, glideslope, rising radio altitude bar and inclinometer. The indicator has go-around and decision height annunciators. Any warning flag in view indicates that portion of information is unreliable.

b. Controls/Indicators and Functions. Refer to Figure 3B-9.

(1) Attitude Sphere. Moves with respect to the symbolic aircraft reference to display actual pitch and roll attitude. Pitch attitude marks are in 5° increments on a blue and brown sphere.

(2) Roll Attitude Index. Displays actual roll attitude through a movable index and fixed reference marks at 0, 10, 20, 30, 45, 60, and 90°.

(3) Eyelid Displays. Surrounds the attitude sphere and provides positive attitude identification by means of a blue eyelid which always shows the relative position of the sky, and a brown eyelid which always shows the relative position of the ground. The eyelids maintain the proper ground-sky relationship, regardless of sphere position.

(4) Flight Director Command Cue. The three-dimensional command cue displays the computed steering commands to intercept and maintain a desired flight path. The cue moves up or

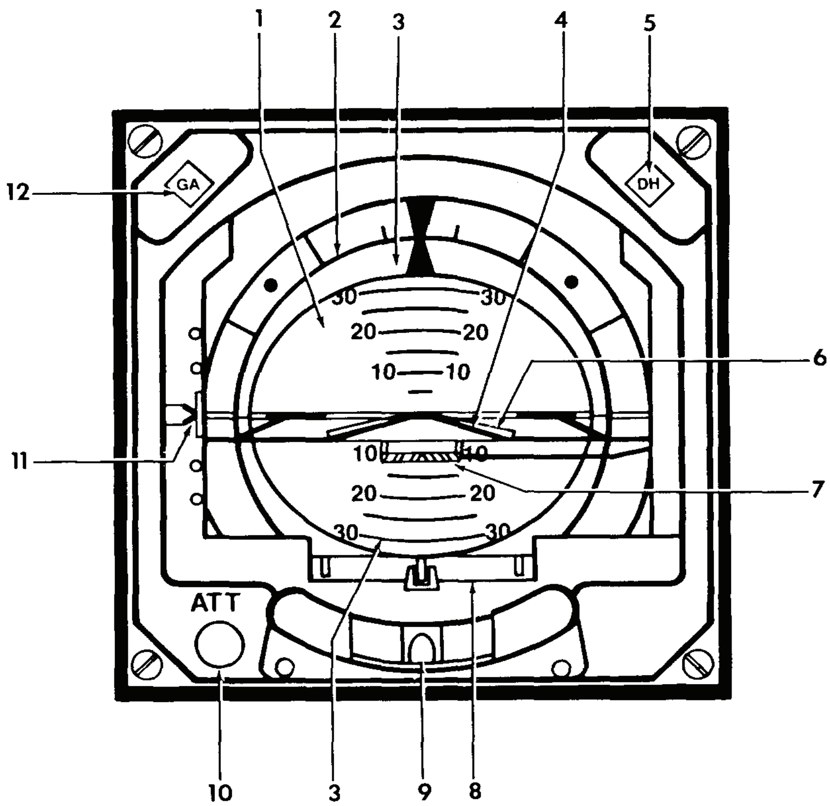
down to present pitch commands and rotates clockwise or counterclockwise for roll commands.

(5) ***DH*** *Annunciator.* Illuminates when the aircraft descends below a selected decision height as set on the radio altimeter indicator.

(6) *Symbolic Miniature Aircraft.* Serves as a stationary symbol of the aircraft. Aircraft pitch and roll attitudes are displayed by the relationship between the fixed miniature aircraft and the movable sphere. The symbolic aircraft is flown to, and aligned with, the command cue to satisfy the commands of the flight director mode selected.

(7) *Radio Altitude Bar.* For added backup during the critical approach phase of flight, absolute altitude above the terrain is displayed below 200 feet by a barber-pole radio altitude bar. The bar appears at 200 feet and moves toward the miniature aircraft as the aircraft descends toward the runway, contacting the bottom of the symbolic aircraft at touchdown.

(8) *Expanded Localizer.* Raw localizer displacement data from the navigation receiver (HSI display) is amplified approximately 7 1/2 times to permit the expanded localizer pointer to be used as a sensitive reference indicator of the aircraft's position, with respect to the center of the localizer. It is normally used for assessment only, since the pointer is very sensitive and difficult to fly throughout the entire approach. During final approach, the pointer serves as an indicator of the Category II window. Full-scale deflection of the expanded localizer pointer is equal to 1/4° of beam signal. The expanded localizer is displayed by the localizer pointer only when a valid localizer signal is available.



1. **Attitude Sphere**
2. **Roll Attitude Index**
3. **Eyelid Displays**
4. **Flight Director Command Cue**
5. **DH Annunciator**
6. **Symbolic Miniature Aircraft**
7. **Radio Altitude Bar**
8. **Expanded Localizer**
9. **Inclinometer**
10. **ATT Test Switch**
11. **Glideslope Scale and Pointer**
12. **GA Annunciator**

Figure 3B-9. Copilot's Attitude Director Indicator Change

(9) Inclinometer. Gives the pilot a conventional display of aircraft slip or skid, and is used as an aid to coordinated maneuvers.

*(10) Attitude (**ATT**) Test Switch*. Operates the attitude self-test. When pressed, the sphere will show approximately a 20° right bank and a 10° pitch-up attitude, and the ATT warning flag will appear.

(11) Glideslope Scale and Pointer. Displays aircraft deviation from glideslope beam center only when tuned to an ILS frequency and a valid glideslope signal is present. The aircraft is below glide path if pointer is displaced upward. The glideslope dot represents approximately 0.4° deviation from the beam centerline.

*(12) **GA** Annunciator*. Illuminates when go-around mode has been selected.

3B-17. TURN AND SLIP INDICATORS.

For information on turn and slip indicators, refer to Chapter 2, Paragraph 2-90.

3B-18. RADIO ALTIMETER INDICATOR.

a. Description. The AA-300 Radio Altimeter Indicator provides the pilot with actual altitude of the aircraft. The indicator displays radio altitude information from 2500 feet to touchdown, with an expanded scale under 500 feet.

b. Controls and Functions. Refer to Figure 3B-10.

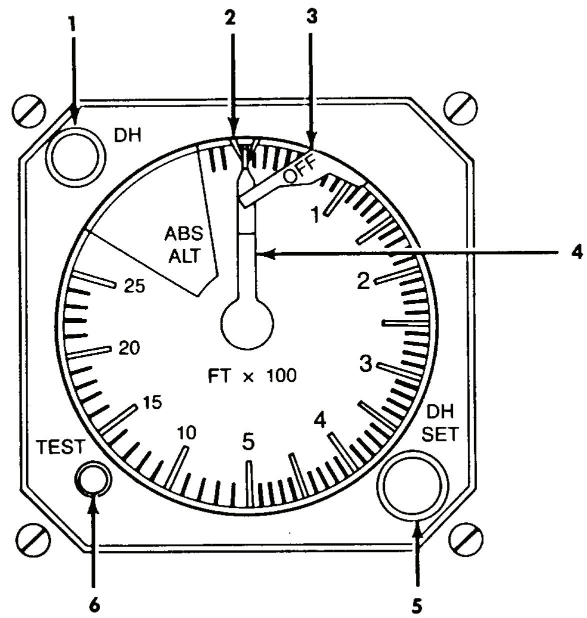
*(1) Decision Height **(DH)** Annunciator.* The **DH** annunciator will illuminate when the aircraft is at or below the selected decision height.

(2) Decision Height Bug. The decision height bug is set to the desired decision height, by the **DH SET** knob.

(3) Failure Warning Flag. The **OFF** warning flag will be in view whenever the system information is unreliable.

(4) Altitude Pointer. The altitude pointer will point to the existing altitude.

*(5) **DH SET** Knob.* The **DH SET** knob is used to set the decision height bug to the desired DH.



1. DH Annunciator
2. Decision Height Bug
3. Failure Warning Flag
4. Altitude Pointer
5. DH SET Knob
6. TEST Push Button

Figure 3B-10. Radio Altimeter Indicator

*(6) **TEST** Push Button.* When pressed, the **OFF** warning flag will come in to view and the altitude pointer will indicate approximately 100 feet. Release of the button will cause the altitude pointer to return to existing altitude, and **OFF** warning flag to retract.

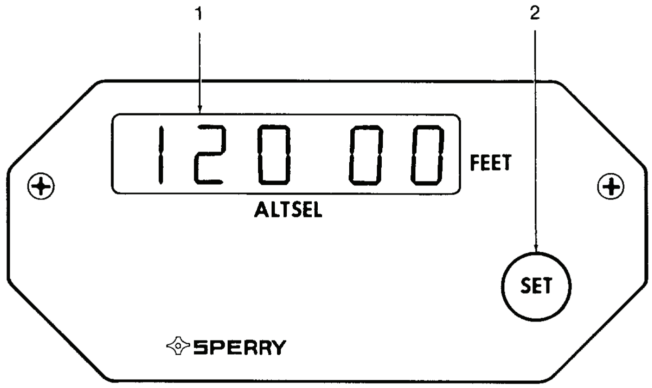
3B-19. ALTITUDE SELECT CONTROLLER.

a. Description. The altitude select controller provides a means for setting the desired altitude reference for the altitude alerting and altitude preselect system. It is protected through a 1-ampere circuit breaker, placarded **ALT ALERT**, located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

b. Controls and Functions. Refer to Figure 3B-11.

(1) Altitude Display. Displays the selected altitude.

*(2) Selector **SET** Knob.* The selector **SET** knob is used to set the desired altitude.



1. **Selected Altitude Display**
2. **Altitude Selector SET Knob**

Figure 3B-11. Altitude Select Controller

3B-20. GYROMAGNETIC COMPASS SYSTEM.

a. Description. Two identical compass systems provide accurate directional information for the aircraft at all latitudes of the earth. For heading reference, two modes of operation are used: directional gyro (FREE) mode, or slaved (SLAVE) mode. In areas where magnetic references are reliable, the system is operated in the SLAVE mode. In this mode, the directional gyro is slaved to the magnetic flux valve that supplies magnetic reference for correction of the apparent drift of the gyro. In FREE mode, the system is operated as a free gyro. In this mode, latitude corrections are manually introduced using the **INCREASE / DECREASE** switches, Figure 17, Sheet 2. The slave/free mode is selected, as desired, using the **SLAVE / FREE** switch, Figure 2-17, Sheet 2.

b. Controls and Functions.

*(1) **COMPASS #1** Switch.* Selects desired source of magnetic heading information for pilot's flight director/autopilot, HSI, flight management system and copilot's RMI. Refer to Figure 2-17, Sheet 2.

*(2) **COMPASS # 2** Switch.* Selects desired source of magnetic heading information for copilot's flight director/ autopilot, HSI, and pilot's RMI.

*(3) **ALL SYSTEMS ON COMPASS 1 / NORM / ALL SYSTEMS ON COMPASS 2** Switch.* This switch, located adjacent to the pilot's compass switch, allows the pilot to select all systems to operate off compass 1 or compass 2. When the switch is in the **NORM** position, magnetic heading information is provided to the pilot's flight director/autopilot, HSI, flight management system, and copilot's RMI.

*(4) **GYRO SLAVE / FREE** Switch.* Controls system mode of operation.

*(a) **SLAVE**.* Places system in SLAVE mode.

*(b) **FREE**.* Places system in FREE mode.

*(5) **INCREASE / DECREASE** Switch.* Provides manual fast synchronization for the system.

*(a) **INCREASE**.* Causes gyro heading output to increase.

*(b) **DECREASE**.* Causes gyro heading output to decrease.

(6) Compass Synchronization Annunciator. Two compass slave annunciators, located on both the pilot's and copilot's HSI's, provide a visual indication of system synchronization.

3B-21. NAV RECEIVERS (KFS-579A, KNR-634).

a. Description. Two NAV (KFS-579A/ KNR-634 and KFS-564A/KNR-634) airborne navigation receivers are provided which allow selection and storing of navigation frequencies. Refer to Figures 3B-12 and Figure 3B-13.

The NAV receivers receive and interpret VHF omnidirectional radio range (VOR) and localizer (LOC) signals in the frequency range of 108.00 to 117.95 MHz, glideslope signals in the frequency range of 329.15 to 335.00 MHz, and marker beacon signals to 75 MHz.

In addition, the KFS-579A #1 NAV/TAC control tunes the KTU-709 DME/TACAN system to 252 TACAN channels. Fifty-two TACAN channels are paired with frequencies in the COMM band. These are channels 1 through 16, and 60 through 69, which correspond to VHF frequencies 134.40 MHz through 135.95 MHz respectively.

Marker beacon receivers are utilized with the NAV receivers, to provide accurate fixes informing the pilot of his passage over beacon stations. Three types of beacons are used. They are the outer (blue annunciator) marker, middle (amber annunciator) marker, and inner (white annunciator) marker. The three markers are used in conjunction with radio instrument landing systems. The markers are all transmitted at a frequency of 75 MHz using three different frequencies of AM modulation.

Signal reception is limited to line-of-sight and power of the transmitting station with a maximum range of 120 miles. The NAV receivers are protected by 2-ampere circuit breakers placarded **NAV #1**; **NAV #2**, located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

b. Controls and Functions.

(1) ***OFF / VOL*** *Control.* Turns the system on/off, and adjusts audio volume.

(2) ***SBY*** *Frequency Display.* Provides a digital readout of selected standby frequencies.

(3) Active Frequency Display. Provides a digital readout of selected active frequencies.

(4) Light Sensor. Automatically adjusts indicator display brightness.

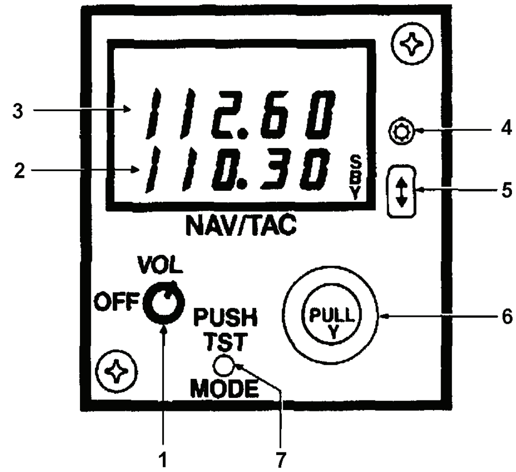
(5) Frequency Transfer Switch. Allows transferring of active or standby frequencies.

(6) Frequency Selector Knobs. Allows for selection of desired frequency. Normally, frequencies are selected while in the **SBY** display; however, to bypass the frequency transfer mode of operation and directly tune the set, pull out on the unit's small inner concentric tuning knob until the standby display shows dashes and select the desired frequency. To re-engage the frequency transfer mode, push the small tuning knob back in.

(7) ***PUSH TST / MODE*** *Knob (#1 NAV/TAC).* Refer to Figure 3B-12. A self-test is provided to verify range and bearing computation. When the NAV/TAC control unit is tuned to a TACAN station, and the **PUSH TST / MODE** knob is pressed, range data of 0 to 0.1 and bearing data of 180 ±2° will appear on the DME slave indicator and both HSI's.

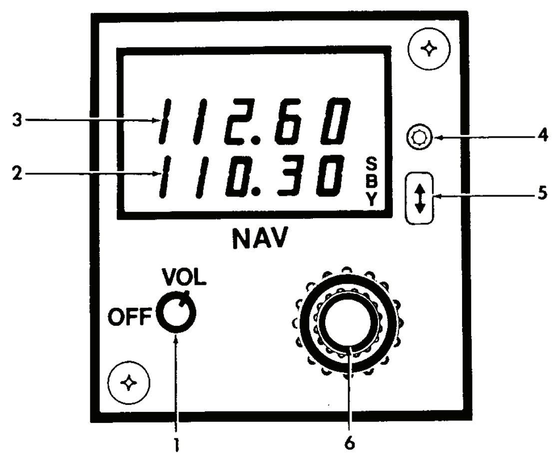
c. NAV Receiver Operation.

(1) Turn On Procedure. **OFF / VOL** switch – Turn clockwise.



1. **OFF/VOL Control Switch**
2. **SBY Frequency Display**
3. **Active Frequency Display**
4. **Light Sensor**
5. **Frequency Transfer Switch**
6. **Frequency Selector Knobs**
7. **PUSH TST Mode Knob**

Figure 3B-12. #1 NAV/TAC Control Unit



1. **OFF / VOL Control Switch**
2. **SBY Frequency Display**
3. **Active Frequency Display**
4. **Light Sensor**
5. **Frequency Transfer Switch**
6. **Frequency Selector Knobs**

Figure 3B-13. #2 NAV Control Unit

(2) Receiver Operating Procedure.

1. Frequency selector – Select desired frequency and press the frequency transfer switch.

2. **NAV 1** or **2** switch (Figure 3B-1) – As required.

3. **VOL** control – As required.

(3) Shutdown Procedure. **OFF / VOL** control – **OFF**.

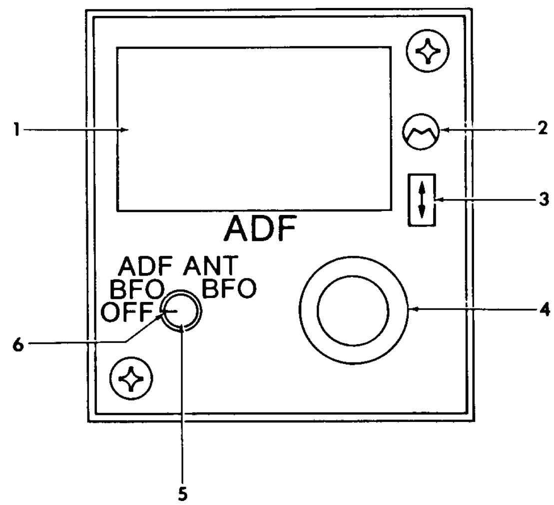
3B-22. ADF RADIO SETS (KDF-806).

a. Description. Two ADF radio sets are installed. Refer to Figure 3B-14. The units are airborne low frequency radio direction finders that receive signals from transmitters in the 190 to 1750 kHz range to provide a visual and aural indication of the aircraft's bearing in relation to the transmitter. The set can also be used for homing and position fixing. The KDF-806 has a Beat Frequency Oscillator (BFO) function, used to more accurately tune weak signals. Reception distance of reliable signals depends on the power output of the transmitting station and the atmospheric conditions. Bearing indications are displayed visually on the RMI's and aural signals are applied to the audio control panels. The system is protected by two 2-ampere circuit breakers, placarded **ADF 1** and **ADF 2**, located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

The KDF-806 incorporates a KFS-586A control unit. The control unit contains a digital display that presents both the active and standby frequencies. A photocell automatically adjusts the display brightness according to changes in ambient light conditions. The KFS-586A switches/controls provide power to the receiver, control the audio output level, control the OFF BFO ADF, and ANT BFO modes of the receiver, maintain the active and standby frequencies, and tune the receiver to the active frequency. The KFS-586A will retain the active and standby frequencies through a power off condition.

b. Controls and Functions.

(1) Control Display. Provides a display of selected frequencies and bearing validity. The display contains two frequencies and an X character. The upper frequency is the active frequency, or the frequency to which the receiver is tuned. The lower frequency is the standby frequency. The standby frequency is changed by the frequency select knobs in the lower right corner of the control unit. An X to the right of the active frequency informs the pilot that the bearing indicator (RMI) directional information is not valid.



1. Control Display
2. Light Sensor
3. Frequency Transfer Switch
4. Frequency Select Knobs
5. Volume Control Knob
6. OFF / ADF BFO / ANT BFO Function Control Knob

Figure 3B-14. ADF Control Unit

(2) Light Sensor. A photocell automatically adjusts the display brightness according to changes in ambient light conditions.

(3) Frequency Transfer Switch. Provides a means of interchanging the active/standby displayed frequencies. The transfer switch, when momentarily pressed, causes the active and standby frequencies to interchange. When the transfer switch is pressed and held, the two frequencies interchange on the display and approximately 2 seconds later the standby frequency will blank out. Pressing the transfer switch momentarily again will cause the standby frequency to reappear.

(4) Frequency Select Knobs. Provides a means of selecting frequencies. The normal method of selecting a frequency is with both the active and standby frequencies showing. The frequency select knobs will then tune the standby frequency; however, the active frequency may be changed by pressing and holding the frequency transfer switch for approximately 2 seconds. The standby frequency display will blank out. The active frequency display may then be directly tuned by rotating the frequency select knobs.

The outer control knob selects from 100 to 1700 kHz in increments of 100 kHz, then rolls over to 2182 kHz. The smaller inner knob selects from 100 to 1799 kHz in increments of 10 kHz with the small knob pushed in, and 1 kHz with the small knob pulled out. Between 2180 and 2189 kHz the small inner knob selects the 1 kHz whether pushed in or pulled out.

(5) Volume Control Knob. Adjusts volume of audio.

(6) ***OFF / ADF BFO / ANT BFO*** *Function Control Switch.* Controls operational functions of the unit.

(a) ***OFF***. Removes power from the unit.

(b) ***ADF BFO***. Allows for audio identification of stations with unmodulated signals and selects normal operation. The needle will point to the station.

(c) ***ANT BFO***. Allows for audio identification of stations with unmodulated signals and operates as aural receiver only. Bearing needle will park in a horizontal position.

c. Operating Procedure.

1. Control switch – Turn clockwise, out of **OFF** position.
2. **ADF 1** or **2** audio switch (Figure 3B-1) – **ON**.
3. **ADF BFO** switch – As required.
4. **ANT BFO** switch – As required.
5. Volume control – Adjust as required.

3B-23. TACAN/DME.

a. Description. The KTU-709 TACAN system consists of the following components: KFS-579A NAV/TAC control unit and KDI-573B DME slave indicator.

The KTU-709 Tactical Air Navigation (TACAN) system is a polar coordinate UHF navigation system that provides relative bearing and slant-range distance information with respect to a selected TACAN or VORTAC ground station. The effective range of the TACAN is limited to the line-of-sight. Actual operating range depends on the altitude of the aircraft, weather, type of terrain, location and altitude of the ground transmitter and transmitter power. Usually line-of-sight limitations will prevent an aircraft on the ground from receiving and locking on to a TACAN or VORTAC ground station.

The range measurement portion of the KTU-709 TACAN system electronically converts elapsed time-to-station by measuring the length of time between the transmission of a radio signal to a preselected TACAN, or VORTAC station, and reception of the reply signal. The distance is then indicated in nautical miles on the range/ groundspeed/time-to-station indicator. The distance is measured on a slant from the aircraft to the ground and is commonly referred to as slant-range distance. Slant-range distance should not be confused with actual ground distance. The difference between slant-range distance and ground distance is smallest at a low altitude and long range. However, if the range is three times the altitude or greater, the error is negligible. To obtain accurate groundspeed and time-to-station, the aircraft must be on a direct course to or from a TACAN or VORTAC ground station.

The KTU-709 TACAN system provides an audio capability allowing the pilot to identify the TACAN or VORTAC ground station by listening to the identification tones transmitted by the ground station at 30-second intervals. It also features an in-flight self-test mode for both bearing and range. The system is protected by a 2-ampere circuit breaker, placarded **TACAN**, located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

The KFS-579A NAV/TAC tunes the KTU-709 to 252 TACAN channels. Refer to Figure 3B-12. Fifty-two TACAN channels are paired with frequencies in the COMM band. These are channels 1 through 16 and 60 through 69, which correspond to VHF frequencies 134.40 MHz through 135.95 MHz respectively. Distance and bearing information is displayed on the pilot's #1 HSI. Associating the #1 NAV with the pilot's #1 HSI will be helpful in maintaining a sequence of operation.

The KDI-573B DME slave indicator displays range to the nearest tenth of a nautical mile from 0 to 99.9 nautical miles and to the nearest nautical mile from 100 to 389 nautical miles. Groundspeed is displayed to the nearest knot from 0 to 999 knots. Time-to-station is displayed to the nearest minute from 0 to 99 minutes. The display will indicate 99 minutes for any computed time-to-station greater than 99 minutes. The indicator will display RNAV when the displayed range, groundspeed and time-to-station are derived from an area navigation system. The indicator will display dashes while in search when power is first turned on or momentarily interrupted while in the frequency hold mode indicating loss of the DME holding frequency. A photocell automatically adjusts display brightness to compensate for changes in the ambient light level.

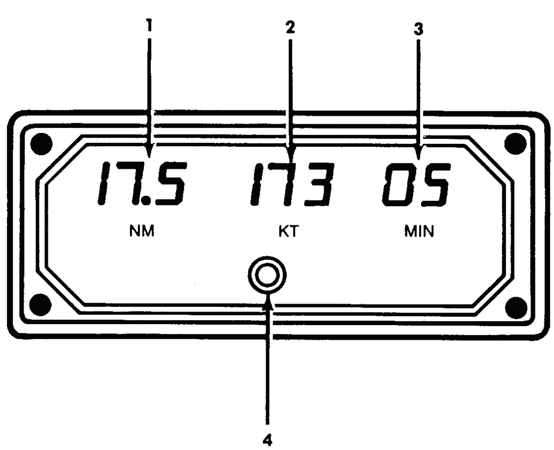
Pilot selection of #2 NAV to tune the TACAN will remove the TACAN derived steering information from the #1 HSI display. This action allows only the steering information obtained from the #1 NAV/TAC control to be displayed on the #1 HSI display. Pilot selection of #1 NAV/TAC **DME HOLD** will also remove the steering information from the #1 HSI display.

A **DME HOLD** push switch located on the pilot's instrument panel is utilized to select DME-HOLD mode of operation. A **DME/TAC** source selector switch, located on the pilot's audio control panel, permits selection of DME or TACAN mode of operation. With the switch in the TACAN mode, bearing information is derived from the TACAN signal of the TACAN station. The KTU-709 system is now serving as a navigation receiver as well as a DME. Distance and bearing information will be displayed on the pilot's HSI along with a display of range/ groundspeed/time-to-station data on the DME slave indicator.

CAUTION

Since the TACAN ground system does not provide guidance during Instrument Landing System (ILS) approaches, any ILS approach must be flown in the VOR/ILS mode, using the TACAN for DME only.

b. DME Slave Indicator. Allows display of nautical miles, groundspeed, and time-to-station. Refer to Figure 3B-15.



1. **NM (Nautical Miles)**
2. **KT (Knot)**
3. **MIN (Minutes)**
4. **Photocell**

Figure 3B-15. DME Slave Indicator

(1) ***NM****.* Displays nautical miles to the station.

(2) ***KT****.* Displays aircraft groundspeed.

(3) ***MIN****.* Displays time-to-station.

(4) Photocell. Allows for automatic brightness control of the display.

c. Operation.

CAUTION

Power to the KTU-709 TACAN system should be turned on only after engine start-up. This procedure will increase the reliability of the solid state circuitry.

(1) Operating Procedure.

1. **OFF/VOL** control – Turn clockwise.
2. **DME/TAC** source selector switch – As required.
3. Frequency selector – Select desired frequency, and press the mode button as required.

NOTE

Prior to station lock-on, dashes will appear in the window of the KDI-773 DME slave control indicator, as the system searches for the station. Search time is usually about one second. Once the system has locked on, the distance read-out will appear, followed quickly by groundspeed and time-to-station computations.

4. **DME/TACAN** audio switch – On. Verify station.
5. **VOL** control – As required.
6. **DME HOLD** switch – As required.

(2) Shutdown Procedure. **OFF/VOL** switch – **OFF**.

3B-24. GLOBAL POSITIONING SYSTEM (KLN 90B).

For information on the Global Positioning System, refer to Chapter 3, Paragraph 3-7.

3B-25. AUTOMATIC FLIGHT CONTROL SYSTEM.

a. Description. The Automatic Flight Control System is a completely integrated autopilot/flight director/air data system that has a full complement of horizontal and vertical flight guidance modes. These include all radio guidance modes and air data oriented vertical modes.

When engaged and coupled to the Flight Director (FD) commands, the system will control the aircraft using the same commands displayed on the attitude director indicator. When engaged and uncoupled from the flight director commands, manual pitch and roll commands may be inserted using the Touch Control Steering (**TCS**) or the pitch wheel and turn knob.

When the autopilot is coupled, the flight director instruments act as a means to monitor the performance of the autopilot. When the autopilot is not engaged, the same modes of operation are available for flight director only. The pilot maneuvers the aircraft to satisfy the flight director commands, as does the autopilot when it is engaged.

b. Air Data Computer. A digital air data computer, located in the forward avionics compartment, provides the altitude information for the pilot's encoding altimeter, altitude alerter, flight data recorder, and transponder. The computer also provides altitude and airspeed hold function data to the flight control computers. The air data computer receives 28 Vdc power through, and is protected by, a 2-ampere circuit breaker, placarded **AIR DATA – ENCDR**, located in the **AVIONICS** section of the overhead circuit breaker panel, Figure 2-16, Sheet 3. All air data computer functions are automatic in nature and require no flight crew action.

c. Autopilot Flight Director Transfer Switch. An alternate action autopilot and flight director transfer switch, placarded **AP FD 1** and **AP FD 2**, is located on the pilot's instrument panel directly below the glare shield. Refer to Figure 2-17, Sheet 2. This switch is used to select which autopilot flight director computer controls the aircraft flight servos. If **AP FD 2** is selected, the annunciator, placarded **AP FLT DIR NO. 2**, located on the copilot's instrument panel directly below the glare shield, will illuminate to alert the pilot that the No. 2 autopilot flight director computer is controlling the aircraft.

NOTE

The autopilot will disengage when transferring between the pilot and copilot flight directors.

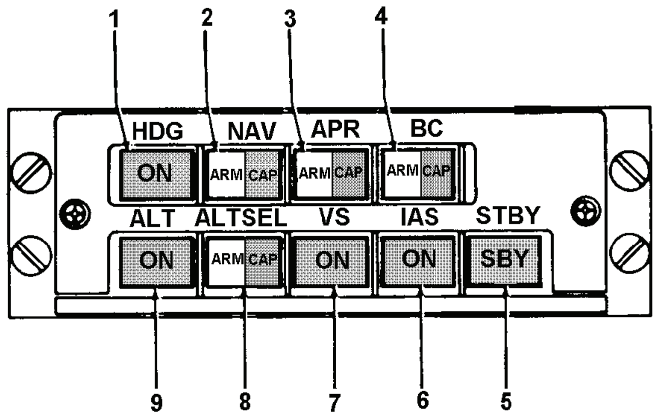
d. Flight Director/Mode Selector. The flight director/mode selector located on the pedestal, Figure 2-9, Sheet 1, provides for selection of all modes, except go-around that is initiated by remote switches located on the left power lever and on the copilot's control wheel, for the flight director. The top row of split light annunciated push buttons contains the lateral modes and the bottom row contains the vertical modes. The mode buttons will illuminate when manually selected or automatically selected through other modes. Refer to Figure 3B-16.

The split light push button annunciators illuminate amber for armed conditions and green for captured. When more than one lateral or vertical mode is selected, the flight director system automatically arms and captures the submode. Mode annunciation is also presented on remote annunciator blocks, located above both (pilot and copilot) Attitude Director Indicators (ADI's), and on the pilot's ADI.

e. Autopilot Modes of Operation.

*(1) Heading Mode Selector (**HDG**).* The heading select mode is selected by pressing the **HDG** button on the mode selector. In the HDG mode, the flight director computer provides inputs to the command cue to command a turn to the heading indicated by the heading bug on the HSI. The heading select signal is gain programmed as a function of airspeed. When **HDG** is selected, it overrides the NAV, BC APR and VOR APR modes. In the event of a loss of valid signal from the VG or compass, the command cue on the ADI is biased out of view.

*(2) Navigation Mode Selector (**NAV**).* The navigation mode represents a family of modes for various navigation systems including VOR, localizer, TACAN and VLF.



1. **Heading Mode Selector**
2. **Navigation Mode Selector**
3. **Approach Mode Selector**
4. **Backcourse Mode Selector**
5. **Standby Mode Selector**
6. **Indicated Airspeed Mode Selector**
7. **Vertical Speed Mode Selector**
8. **Altitude Preselect Mode Selector**
9. **Altitude Hold Mode Selector**

Figure 3B-16. Flight Director/Mode Selector

(a) VOR Mode. The VOR mode is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a VOR frequency and DME greater than 20 miles from the station. Prior to VOR capture, the command cue receives a heading select command as described above and the **HDG** mode switch is illuminated along with the **NAV ARM** annunciators. Upon VOR capture, the system automatically: switches to the VOR mode; **HDG** and **NAV ARM** annunciators extinguish; NAV capture (**NAV CAP**) annunciators will illuminate. At capture, a command is generated to capture and track the VOR beam. VOR deviation is gain programmed as a function of distance from the station. This programming corrects for beam convergence thus optimizing the gain through the useful VOR range. To utilize this feature, the DME must be tuned to the same VOR station as the NAV receiver that is feeding the flight director. The course error signal is gain programmed as a function of airspeed. Crosswind washout is included, which maintains the aircraft on beam center in the presence of crosswind. The intercept angle and DME distance are used in determining the capture point to ensure smooth and comfortable performance during bracketing.

When passing over the station, an overstation sensor detects station passage removing the VOR deviation signal from the command until it is no longer erratic. While over the station, course changes may be made by selecting a new course on the HSI.

If the NAV receiver is not valid prior to the capture point, the lateral beam sensor will not trip and the system will remain in the HDG mode. After capture, if the NAV receiver, compass data or vertical gyro go invalid, the ADI command cue will bias out of view. Also, the **NAV CAP** annunciators will extinguish if the NAV receiver becomes invalid.

(b) VOR Approach Mode. The VOR approach mode is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a VOR frequency and less than 20 DME miles from the station. The mode operates identically to the VOR mode with the gains optimized for a VOR approach.

(c) Localizer Mode. The localizer mode is selected by pressing the **NAV** button on the mode selector with the navigation receiver tuned to a LOC frequency. Mode selection and annunciation in the LOC mode is similar to the VOR mode. The localizer deviation signal is gain programmed as a function of radio altitude, time and airspeed. If the radio altimeter is invalid, gain programming is a function of glide slope capture, time and airspeed. Other valid logic is the same as the VOR mode.

*(3) Localizer Approach Mode (**APR**).* The approach mode is used to make an ILS approach. Pressing the **APR** button with an ILS frequency tuned, arms both the NAV and APR modes to capture the localizer and glideslope respectively. No alternate NAV source can be selected. Operating LOC mode is the same as described above except, if the radio altimeter is invalid in APR mode, gain programming is a function of glideslope capture, time, and airspeed.

With the APR mode armed, the pitch axis can be in any one of the other pitch modes except go-around. When reaching the vertical beam sensor trip point, the system automatically switches to the glideslope mode. The pitch mode and **APR ARM** annunciators extinguish and **APR CAP** annunciator illuminates on the controller. At capture, a command is generated to asymptotically approach the glideslope beam. Capture can be made from above or below the beam. The glideslope gain is programmed as a function of radio altitude, time and airspeed. The **APR CAP** annunciator on the mode selector will extinguish if the GS receiver becomes invalid after capture.

Glideslope capture is interlocked so that the localizer must be captured prior to glideslope capture. If the glideslope receiver is not valid prior to capture, the vertical beam sensor will not trip and the system will remain in the pitch mode. After capture, if the NAV receiver, GS receiver, compass data or vertical gyro becomes invalid, ADI command cue will bias out of view. If the radio altimeter is not valid, the glideslope gain programming will be a function of GS capture, time and airspeed.

While in the localizer approach mode, the pilot is able to use a Flight Management System (FMS) preprogrammed runway/outer marker waypoint for reference, by pressing the **OMEGA DIST/BGR** switch, located on the pilot's instrument panel, Figure 2-17, Sheet 2. Pressing the switch while in the APR (NAV) mode with the **NAV CTL** mode selector switch also pressed, will cause the waypoint distance and bearing to display on the pilot's HSI. This function will be disabled if the **FMS** switch and/or the TACAN mode of operation are selected.

(a) Pitch Hold Mode. Whenever a roll mode is selected without a pitch mode, the ADI command cue will display a pitch attitude hold command. The pitch attitude can be changed by pressing the **TCS** button on the control wheel and maneuvering the aircraft. The command cue will be synchronized to zero while the button is pressed. Upon release of the button, the pitch command will be such as to maintain the new pitch attitude. In the pitch hold mode, the ADI command cue will be biased out of view if the VG is not valid.

(b) TACAN Mode. The TACAN mode is selected by pressing the **DME/TAC** alternate source selector switch located on the pilot's radio control panel. Annunciators, placarded **TACAN/ADF 1,** and located on the instrument panel (both pilot and copilot side) will illuminate. TACAN navigation information will display on the pilot's HSI, and on the DME slave indicator.

NOTE

The NAV/TAC receiver must be tuned to a valid TACAN frequency.

TACAN functions are identical to VOR using TACAN information rather than VOR signals. The ARM/CAP annunciation is the same as in VOR mode.

*(4) Back Course Mode (**BC**).* The back course mode is selected by pressing the **BC** button on the mode selector. Back course operates the same as the LOC mode with the deviation and course signals reversed to make a back course approach on the localizer. When BC is selected, and outside the lateral beam sensor trip point, **BC ARM** and **HDG** annunciators will illuminate. At the capture point, **BC CAP** will be annunciated with **BC ARM** and **HDG** annunciators extinguished. When BC is selected, the glideslope circuits are locked out.

*(5) Standby Mode (**SBY**).* The standby mode is selected by pressing the **SBY** button on the mode selector. This resets all the other flight director modes and biases the ADI command cue from view. While pressed, SBY acts as a lamp test causing all mode annunciators to illuminate and the flight director warning flag on the ADI to come in view. When the button is released, the mode annunciator lights extinguish and the flight director warning flag retracts from view.

*(6) Indicated Airspeed Hold Mode (**IAS**).* The indicated airspeed hold mode is selected by pressing the **IAS** button on the mode selector. When IAS is selected, it overrides the APR CAP, GA, ALT, VS, and ALTSEL CAP modes. In the IAS mode the pitch command is proportional to airspeed error provided by the air data computer. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new airspeed hold reference without disengaging the mode. Once engaged in the IAS mode, the mode will be reset if the air data computer is not valid. The ADI command cue will bias out of view if the VG is not valid.

*(7) Vertical Speed Hold Mode (**VS**).* The vertical speed hold mode is selected by pressing the **VS** button on the mode selector. When VS is selected, it overrides the APR CAP, GA, ALT, ALTSEL CAP, and IAS modes. In the VS mode, the pitch command is proportional to VS error provided by the air data computer. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new vertical speed hold reference without disengaging the mode. Once engaged in the VS mode, the mode will be reset if the air data computer is not valid. The ADI command cue will bias out of view if the VG is not valid.

*(8) Altitude Preselect Mode (**ALTSEL**).* The altitude preselect mode is selected by pressing the **ALTSEL** button on the mode selector. The desired altitude is selected on the altitude preselect controller. Pitch hold, VS or IAS may be selected as a mode to fly to the selected altitude. When outside the altitude bracket trip point, the **ALTSEL ARM** annunciator, along with the selected pitch mode, are illuminated on the mode selector. When reaching the bracket altitude, the system automatically switches to the ALTSEL CAP mode and the previously selected pitch mode is cancelled. When the altitude is reached, the ALTSEL CAP mode is automatically cancelled and the flight director switches to the ALT hold mode. If the air data computer is not valid, the altitude preselect mode cannot be selected. The ADI command cue will bias out of view if the VG is not valid.

*(9) Altitude Hold Mode (**ALT**).* The altitude-hold mode is selected by pressing the **ALT** button on the mode selector. When ALT mode is selected, it overrides the APR CAP, GA, IAS, VS, and ALTSEL CAP modes. In the ALT mode the pitch command is proportional to the altitude error provided by the air data computer. The altitude error signal is gain programmed as a function of airspeed. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new altitude hold reference without disengaging the mode. Once engaged in the altitude hold mode, the mode will be reset if the air data computer is not valid and the ADI command cue will bias out of view if the VG is not valid.

NOTE

If the baro setting on the altimeter is changed, a command is generated to fly the aircraft back to the original altitude reference.

(10) Go-Around Mode. The go-around mode is selected by pressing the remote go-around switch. When selected, all other modes are reset, and the remote Go-Around (**GA**) and Yaw Damp (YD ENG) annunciators will be illuminated. The ADI command cue receives a wings level command (zero command when roll is zero). The command cue also receives the go-around command, which is a 7° visual pitch up attitude command. Selecting GA disconnects the autopilot, but the yaw damper remains on.

Once go-around is selected, any roll mode can be selected. The wings level roll command will cancel. The go-around mode is cancelled by selecting another pitch mode, or TCS.

f. Autopilot Controller. The autopilot controller engages the autopilot and yaw damper, as well as manually controlling the autopilot through the turn knob and pitch wheel. The autopilot system limits are listed in Table 3B-3.

Table 3B-3. Autopilot System Limits

MODE	CONTROL OF SENSOR	PARAMETER	VALUE
Yaw Damper	Yaw Control	Engage Limit	Unlimited
Basic A/P	Touch Control	Roll Control Limit	Up to ± 45° Roll
	Steering TCS	Pitch Control Limit	Up to ± 20° Pitch
	Turn Knob	Roll Angle Limit	± 30°
		Roll Rate Limit	± 15°/sec
	Pitch Wheel	Pitch Angle Limit	± 15° Pitch
	Heading Hold	Roll Angle Limit	Less than 6° and no roll mode selected
Heading Select	HSI Heading	Roll Angle Limit	± 25°
	Select Knob	Roll Rate Limit	± 3.5°/sec
		CAPTURE	
VOR	Course Knob, NAV Receiver and	Beam Angle Intercept (HDG SEL)	Up to ± 90°
	DME Receiver	Roll Angle Limit	± 25°
		Course Cut Limit at Capture	± 45° Course

Table 3B-3. Autopilot System Limits (Continued)

MODE	CONTROL OF SENSOR	PARAMETER	VALUE
		Capture Point	Function of beam, beam rate, course error, and DME distance.
		ON COURSE	
		Roll Angle Limit	± 13° Roll
		Crosswind	Up to ± 45°
		Correction	Course Error
		OVER STATION	
		Course Change	Up to ± 90°
		Roll Angle Limit	± 17°
		LOC CAPTURE	
LOC or APR or BC	COURSE Knob and NAV Receiver	Beam Intercept	Up to ± 90°
		Roll Angle Limit	± 25°
		Roll Rate Limit	± 5°/sec
		Capture Point	Function of Beam, Beam Rate and Course Error.
		NAV ON-COURSE	
		Roll Angle Limit	± 17° Roll
		Crosswind	± 30° of course
		Correction Limit	Error
		Gain Programming	Function of Time and (TAS) starts at 1200-ft radio altitude.
		GLIDESLOPE CAPTURE	
	GS Receiver and Air Data Computer	Beam Capture	Function of beam and beam rate.
		Pitch Command Limit	± 10°
		Glideslope Damping	Vertical Velocity
		Pitch Rate Limit	Function of (TAS)
		Gain Programming	Function of Time and (TS) Starts at 1200 ft radio altitude.
			Function of (Radio Alt) Starts at 250 ft.
GA	Control Switch on Power Lever	Fixed Pitch-Up Command, Wings Level	7° Pitch Up

Table 3B-3. Autopilot System Limits (Continued)

MODE	CONTROL OF SENSOR	PARAMETER	VALUE
Pitch Sync	TCS Switch on Control Wheel	Pitch Altitude Command	± 20° max
ALT Hold	Air Data Computer	ALT Hold Engage Range	0 to 50,000 ft
		ALT Hold Engage Error	± 20 ft
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
VA Hold	Air Data Computer	VERT Speed Engage Range	0 to ± 6000 ft/min
		ALT Speed Hold Engage Error	± 30 ft
		Pitch Rate	± 20°
		Pitch Rate Limit	Function of (TAS)
ALT Preselect	Air Data Computer	Preselect Capture Range	0 to 50,000 ft
		Maximum Vertical Speed for Capture	± 4000 ft/min
		Maximum Gravitational Force During Capture Maneuver	± .2g
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)

g. Controls and Functions. Refer to Figure 3B-17.

(1) Pitch Wheel. Rotation of the pitch wheel results in a change of pitch attitude proportional to the rotation of the pitch wheel and in the direction of wheel movement. Movement of the pitch wheel cancels any other previously selected vertical mode. However, movement of the pitch wheel has no effect with the autopilot coupled to the glideslope.

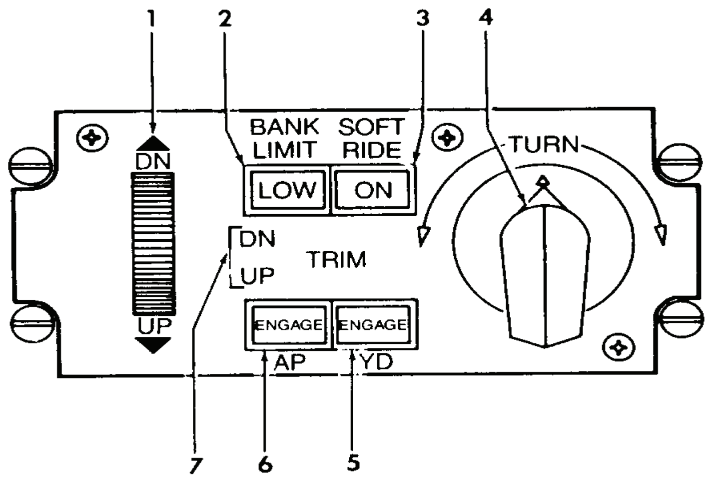
*(2) **BANK LIMIT** Push Button.* Selection of the bank limit mode on the autopilot controller provides a lower maximum bank angle while in the Heading Select mode. **LOW** will illuminate on the **BANK LIMIT** switch. The lower bank limit is inhibited and **LOW** is extinguished during NAV mode captures. If heading select is again engaged, **BANK LIMIT** will again be illuminated. Pressing **BANK LIMIT** when illuminated will return autopilot to normal bank limits.

*(3) **SOFT RIDE** Push Button.* Soft ride reduces autopilot gains while still maintaining stability in rough air. This mode may be used with any flight director mode selected.

*(4) **TURN** Knob.* Rotation of the **TURN** knob out of detent results in a roll command. The roll angle is proportional to and in the direction of the **TURN** knob rotation. The **TURN** knob must be in detent, center position, before the autopilot can be engaged. Rotation of the **TURN** knob cancels any other previously selected lateral mode.

*(5) **YD ENGAGE** Push Button.* When the autopilot is not engaged, the yaw damper may be utilized by pressing the **YD ENGAGE** push button.

*(6) **AP ENGAGE** Push Button.* The **AP ENGAGE** push button is used to engage the autopilot. Engaging the autopilot automatically engages the yaw damper. The autopilot may be engaged with the airplane in any reasonable attitude.



1. **Pitch Wheel**
2. **BANK LIMIT Push Button**
3. **SOFT RIDE Push Button**
4. **TURN Knob**
5. **YD ENGAGE Push Button**
6. **AP ENGAGE Push Button**
7. **Elevator TRIM Annunciators**

Figure 3B-17. Autopilot Controller

(a) Autopilot Disengage. The autopilot is normally disengaged by momentarily pressing the control wheel **AP DISC** switch. The autopilot may, however, be disengaged by any of the following.

1. Actuation of the control wheel **AP DISC** button. Disengagement is confirmed by five flashes of the **AP ENG** annunciator.
2. Pressing the respective vertical gyro **FAST ERECT** button.
3. Actuation of respective compass **INCREASE / DECREASE** switch.
4. Selection of go-around mode. Disengagement is confirmed by the **AP ENG** annunciator flashing five times and illumination of the **GA** and **YD ENG** annunciators.
5. Pulling the autopilot **AP POWER** circuit breaker.
6. Pressing the autopilot **AP ENGAGE** push button.
7. When transferring between pilot and copilot flight directors.
8. Actuation of either pilot's or copilot's electric elevator trim switches while pressing only one switch or pressing pairs of switch elements.

Any of the following malfunctions will cause the autopilot to automatically disengage.

1. Vertical gyro failure.
2. Directional gyro failure.
3. Autopilot power or circuit failure.
4. Torque limiter failure.

Disengaging under any of the previous four conditions will illuminate the **AP DISC** annunciator and the flashing **MASTER WARNING** light. Pressing the control wheel **AP DISC** switch will extinguish the **AP DISC** annunciator.

*(7) Elevator **TRIM** Annunciators.* The elevator trim annunciator indicates **UP** or **DN** when a sustained signal is being applied to the elevator servo. The annunciator should not be illuminated when engaging the autopilot.

h. Touch Control Steering (TCS). The **TCS** push button, located on the control wheel, allows the pilot to manually change aircraft attitude, altitude, vertical speed and/or airspeed without disengaging the autopilot. After completing the manual maneuver, the **TCS** push button is released, and the autopilot will automatically resynchronize to the vertical mode. Example: with IAS mode selected, the pilot may press the **TCS** push button and manually change airspeed. Once trimmed at the new airspeed, the **TCS** push button is released and the autopilot will hold this airspeed. If a large pitch attitude change is made, the pilot should trim the aircraft normally before releasing the **TCS** button.

NOTE

Either pilot's TCS button will permit changing of the autopilot regardless of which pilot has control of the autopilot. However, use of the TCS will cancel the other pilot's flight director GA mode.

The OBS/LEG, SNS, and MOD keys will cause the control display to immediately reflect the operational status change. However, the system will not actually activate the new operational status for a period of 1 second. Repeated presses of these keys during this 1-second period will reset the delay back to 1 second.

Automatic navaid selection does not occur when operating the system in AUTO/ LEG, VOR or TACAN, RNV APR. The pilot must specify a reference navaid for each waypoint in the reference name field of each waypoint page. This reference navaid is the particular navaid which the VOR navigation receiver and DME will be turned to when this waypoint is activated.

i. Shutdown Procedure. **ON/OFF** rocker switch – Press lower half.

3B-26. FLIGHT MANAGEMENT SYSTEM (KNS-660)

a. Description. The Flight Management System (FMS) is an integrated, long range, multi-sensor flight management system. It may be used to manage the entire range of navigational functions including trip planning, long-range great circle navigation, instrument approaches, and frequencies. The FMS serves as a computer processor/display for inputs from a choice of sensors such as VOR/DME, GPS, or TACAN. Navigation sensors may be selected separately or blended within the computer. It provides for manual operation to selected waypoints or automatic operation, providing uninterrupted navigation throughout a complete flight plan. The FMS consists of a cockpit-mounted Control Display Unit (CDU), a remote mounted navigation computer, and an "H" field antenna. Refer to Figure 3B-18 for an illustration of the CDU. The FMS calculates its present position in terms of latitude and longitude coordinates. The flight's destination must be inserted into the FMS in a latitude and longitude format or in a format that the FMS can convert to latitude and longitude, such as ICAO identifiers of navaids, airports, or intersections.

The FMS can use navigation inputs from VOR, DME, TACAN, and GPS navaids. In addition the system uses aircraft heading and altitude inputs.

The FMS system is protected through a 5-ampere circuit, breaker placarded **FMS**, located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

b. Data Base. The FMS incorporates a self-contained data base. This data base consists of an extensive library of navigation data that is loaded into the system at the time of manufacture. This data is updated by means of a 3 ½-inch diskette using the data loader in the pedestal extension every 28 days. The diskette contains updated worldwide navigation data that is broken down into the following 10 geographic regions:

USA	Mid East
Canada	Africa
Latin America	Eastern Europe
Europe	Pacific
South America	South Pacific

(1) The diskette contains the following navigational elements for each of these 10 regions:

(a) Navaids (VORTAC's, VOR/DME's, VOR's, ILS/DME's, DME's, and TACAN's).

(b) Airports having a hard surface runway that is at least 4,000 feet in length.

(c) Airports having a hard surface runway that is at least 3,000 feet in length.

(d) Runway thresholds.

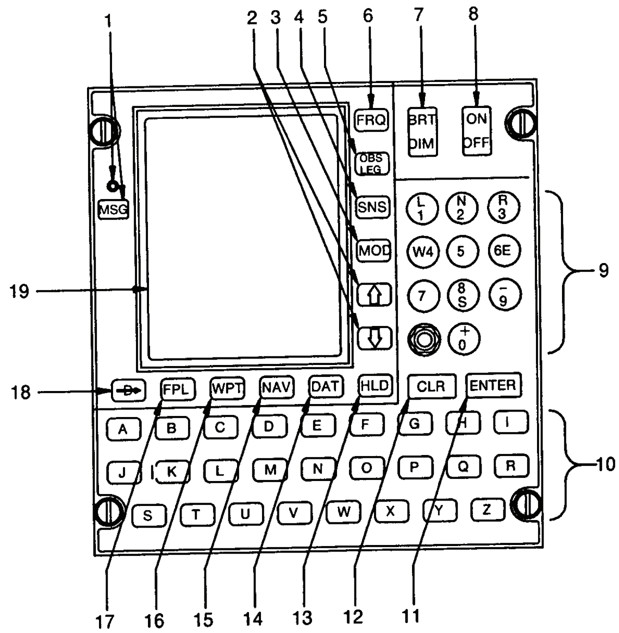
(e) Outer markers.

(f) High altitude waypoints.

(g) Low altitude waypoints.

(h) DP/STAR waypoints.

(i) Approach intersections.



1. **Message Key and Annunciator**
2. **Cursor Key**
3. **Mode Key**
4. **Sensor Key**
5. **OBS/LEG Key**
6. **Frequency Key**
7. **Brightness Control Switch**
8. **Power Switch**
9. **Numeric Entry Keys**
10. **Alphabetic Entry Keys**
11. **ENTER Key**
12. **Clear Key**
13. **Hold Key**
14. **Data Key**
15. **Navigation Key**
16. **Waypoint Key**
17. **Flight Plan Key**
18. **Direct Key**
19. **Display Screen**

Figure 3B-18. FMS Control Display Unit (KR 87)

(j) Multiple waypoints (waypoints that serve as members of any combination of high and low altitude waypoints, DR/STAR's, or approach intersections).

c. Configuring the Data Base. Not all the worldwide navigation data contained on the diskette will fit into the FMS system's internal data base (memory) at one time. It is necessary to choose which geographical regions and which navigational elements within those geographical regions are desired to be loaded at one time. The diskette may be used as often as necessary during the 28-day valid period.

d. Supplemental Data Base. In addition to the published navigation data base the FMS has an additional nonvolatile memory capacity that may be utilized for storing waypoints, flight plans, and other user defined data. This additional memory can store 100 flight plans, 800 waypoints, and 175 user-defined navaids and airports.

e. Data Base Revision Cycle. Every 28 days, several days prior to the effective date of the next revision, a diskette is sent to each data base subscriber that includes a complete new set of worldwide data. The update should be accomplished before the effective date of the revision. If the FMS is not in operation at 0000 GMT on the effective date, the system automatically switches to the revised data. If the FMS is in operation at 0000 GMT on the effective date, the system automatically switches to the revised data the next time it is turned on. If the FMS does not get updated with the latest revision data prior to the effective date, the system will continue to function but will provide a message stating: D/BASE OUT DATED.

f. Data Base Battery. A small battery located internally in the FMS computer keeps the data base alive when power is removed from the system. Typical battery life is 6 years. When about one week of battery life remains, the system will display a message stating: D/BASE BATT LOW. Maintenance technicians should replace the battery at this time.

g. ICAO Identifiers. In order to access data from the data base it is necessary to use International Civil Aviation Organization (ICAO) identifiers. In most cases the proper ICAO identifiers may be taken directly from navigation publication such as high altitude charts, low altitude charts, area charts, approach plates, DR's, STAR’s, and other references.

(1) Airport ICAO Identifiers. Airport reference points are stored by the airport ICAO identifier. The majority of airport identifiers have four letters beginning with a prefix letter that corresponds to the geographic area in which it is located (for example, KJFK). The prefix letter for the continental United States is "K". The prefix letter for Hawaii and Alaska is "P". Some airport identifiers are a combination of three or four letters and numbers such as 3LA, 7TX6, or M33. Most published airport identifiers in the continental United States are in the official ICAO format. The exception is an airport identifier that consists of only three letters and no numbers, such as

Chanute, Kansas (CNU). It is necessary in this case to add the "K" prefix to make the letter KCNU.

(2) Navaid ICAO Identifiers. Most navaid identifiers are made up of three letters, but combinations of two or three letters and number also exist.

(3) Waypoint ICAO Identifiers. Most waypoint identifiers (high altitude, low altitude, multiple, and approach intersections) consist of five letters, however, some waypoint identifiers consist of combinations of three to five letters and numbers such as GOONI, D3N, and L121.

(4) Runway Thresholds and Outer Markers. Runway thresholds and outer markers are not stored in the data base by ICAO identifiers. Access is from the appropriate airport waypoint page.

(5) On-airway NDB ICAO Identifiers. NDB's that are located on an airway are contained in the data base whenever any type of waypoint (high altitude, low altitude, DP/STAR, or approach intersection) has been loaded into the data base. On airway NDB's are accessed by the two or three character identifier plus an NB suffix, such as GNINB.

h. Dedicated Special Function Keys. Dedicated special function keys are physically and visually separated from the alpha/numeric keys used in the generation and storage of flight plans and waypoints.

i. FMS Interface with the MFD Radar Graphics Unit. The FMS interfaces with the MFD radar graphics unit, providing a radar graphics presentation on the weather radar display. This includes such items as flight plan waypoints, selected course, and reference ground stations.

j. Bulk Loading and Saving Using Data Loader. In addition to updating the data base, the data loader may be used to load and save flight plans, waypoints, and the user generated supplemental data base.

k. FMS Control-Display Unit Controls and Functions.

(1) Message Key and Annunicator. An alternate-action key placarded **MSG**, when pressed causes the message page to be displayed. Pressing the key once selects the message page, pressing the key again deselects the message page. The message annunciator is located above the message key. Illumination of the message light indicates that a message will be displayed on the FMS control-displayed unit when the message key is pressed. The message key is used to acknowledge a message annunciator. The message annunciator will be extinguished only after the message has been satisfactorily acknowledged.

(2) Cursor Keys. Two cursor keys are provided, ↑ and ↓, to position the cursor (a bright inverse video rectangle) over information in a line or portion of a line on the control display unit, in order to approve or change that information. If the cursor is out of view it can be brought onto the screen at the top or bottom by using the up or down cursor key.

(3) Mode Key. This key, placarded **MODE**, allows selection of NAV, RNV ENR (RNAV en route), or RNV APR (RNAV approach) modes of operation. When NAV is selected, normal angular HSI deviation bar sensitivity occurs (+ 10° full scale). When RNV ENR s selected the deviation bar indicates + 5 nautical mile full scale and when in RNV APR the deviation indicates ± 1.25 nautical mile full scale. When an ILS frequency is selected the sensor annunciated is ILS. OBS will be displayed as the method of operation and ILS will be displayed and the mode of operation. When the OMEGA or BLEND sensor is selected, RNV ENR is automatically selected as the only mode of operation.

(4) Sensor Key. The sensor key, placarded **SNS**, selects the active sensor to be used for navigation. Alternate key strokes will select VOR, OMEGA, TACAN, GPS, or BLEND. When the VOR sensor is selected, navigation is based upon available VOR/DME signals. When an ILS frequency has been selected as the active waypoint the sensor annunciation indicates ILS. When the OMEGA sensor is selected, navigation is based upon available omega and VLF signals. When the GPS sensor is selected, the NAVSTAR satellite global positioning system GPS) is used for navigation information. When the BLEND sensor is selected, navigation is based on a computer blend of position inputs from all active sensors.

*(5) **OBS/LEG** Key.* The **OBS/LEG** key selects method of operation. Each key push selects the next method of operation in the sequence of OBS, AUTO/LEG, then back to OBS.

(6) Frequency Key. The frequency key, placarded **FREQ**, selects the two frequency pages that allow frequency management of the VHF transceivers, NAV/TACAN, NAV 2, and the ADF receivers.

(7) Brightness Control Switch. The brightness control switch, placarded **BRT DIM**, is a rocker type switch which, when pressed at the top, increases the picture brightness and message light

intensity in incremental steps to the maximum level. When pushed at the bottom, the brightness is decreased in incremental steps to the minimum level. When the unit is turned on, the brightness is preset to 80% of the maximum level.

(8) Power Switch. The power switch, placarded **ON / OFF**, is a rocker type switch which, when pressed at the top, turns the system on and initiates the self test process. When pushed at the bottom and held for approximately 2 seconds, the unit will turn off. Prior to turning off, a caution message is presented on the screen.

(9) Numeric Entry Keys. The CDU has 10 numeric entry keys that are used to enter numerals 0 to 10. Eight of the 10 numeric keys are also used to enter North, South, East, West, left, right, minus (-), and plus (+).

(10) Alpha Entry Keys. The CDU has 26 keys that are dedicated to entering the characters A through Z.

(11) Enter Key. This key, placarded **ENTER**, is used to insert the data displayed under the cursor or a complete page of information into the computer memory. It is also used to select various menu items and to approve specific cursor statements.

(12) Clear Key. The clear key, placarded **CLR**, may be used to clear a single character in a data field, a complete data field, or an entire page depending upon the procedure used. It is also used on non-enterable fields preceded by a right caret (>) to cycle between two or more related selections.

(13) Hold Key. Pressing the hold key, placarded **HLD**, allows the CDU to display the two hold pages (HOLD 1 and HOLD 2). The HOLD 1 page is displayed the first time the HLD key is pressed and the HOLD 2 page is displayed when the HLD key is pressed again (alternate action). The HOLD functions are used for updating the FMS present position and for creating a waypoint at the aircraft's present position.

(14) Data Key. The data key, placarded **DAT**, is used for viewing the two data menu pages (DATA 1 and DATA 2). It is also used for returning from lower level data pages to higher level data pages.

(15) Navigation Key. Pressing the alternate-action navigation key, placarded **NAV**, allows viewing of the two NAV pages (NAV 1 and NAV 2). The NAV 1 page is displayed by pressing the NAV key once the NAV 2 page is displayed by pressing the NAV key again.

(16) Waypoint Key. The waypoint key, placarded **WPT**, has two functions: to cycle through the waypoint pages associated with the active flight plan (FPL 0), and to display the waypoint pages of other waypoints in the system.

(17) Flight Plan Key. The flight plan key, placarded **FPL**, is used to select viewing of the active flight plan page (FPL 0) or the flight plan menu pages (FPLS). Pressing the key repeatedly will cycle through the FPL 0 page and all FPLS pages and then back to the FPL 0 page. If the CDU is displaying a page other than the FPL 0 page or a FPLS page, pressing the FPL key once will display the FPL 0 page.

(18) Direct to key. The direct to key, placarded —D►, allows selection of Direct To operation. It may be used anytime after system initialization

(19) Display Screen. Presents display pages.

I. Page Display Definitions. The CDU presents information to the pilot arranged like pages in a book. Individual displays on the CDU are therefore referred to as pages. With the exception of the self-test page and the system failed page, each page has a header at the top consisting of:

(1) Page Name – located in the upper left portion of the header.

(2) Selected Sensor – located in the lower left portion of the header.

(3) Method of Operation – located in the upper right portion of the header.

(4) Mode of Operation – located in the lower right portion of the header.

The following is a list of page names that will appear (as selected) in the page name field:

NAV 1	FREQ 2
NAV 2	INIT
WPT	HOLD 1
DUPL	HOLD 2
FPLS	DATA
FPL	MSG
FPL 0	DATA 1
FREQ 1	DATA 2

The method of operation field (selected with the OBS/LEG key) displays the selected method of operation. This field normally displays either OBS or AUTO/LEG.

The selected sensor field displays the sensor chosen to provide navigation inputs to the system. The sensor key is used to make the sensor selection. The following is a list of possible sensor annunciations:

Blend – System uses position inputs from all available sensors.

VOR – VOR and DME.

TACAN – Tactical air navigation.

ILS – Instrument landing system (displayed when a localizer frequency is active).

GPS – Global Positioning System. The mode of operation displays in the mode of operation field. Possible modes of operation displayed are:

RNAV ENR – RNAV en route (± 5 NM full scale HSI deviation bar sensitivity).

RNAV APR – RNAV approach (± 1.25 NM full scale HSI deviation bar sensitivity).

NAV – Navigation (± 10° full scale HSI deviation bar sensitivity).

(5) Self-Test Page. The self-test page is the first page of information presented when the unit is turned on. Following an automatic self-test the status of the system is displayed as well as a list of navigation data for the pilot to verify on actual aircraft instruments and displays.

SYSTEM OK – Indicates that the unit has passed the self test.

RMI 130° – The aircraft's RMI needle should be pointing to 130°.

DIS 34.3 – The aircraft's DME display should be indicating 34.3 NM.

SEL CRS 315° – The course arrow on the HSI should be indicating 315°.

HORZ DEV RT 3 – The deviation bar on the HSI 3 or CDI should be 3 dots to the right of center (or an indication of 3 NM to the right of center).

VNAV DEV UP 3 – The VNAV indicator should be displaying an up 3-dot deflection (or an indication of 300 feet below the desired vertical flight path).

CHECK – RMI-DIS

CHECK – CDI-CRS

CHECK – ANN LTS. The annunciator lights illuminate to remind the pilot to check the applicable data values displayed on the control display unit with the actual aircraft instruments.

ORS – Operation revision status. A control number that indicates what level of operational capabilities are applicable to the system.

TEST OK? – Cursor position used to approve the self-test page.

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(6) Initialization Page. The initialization page will be displayed after the self-test page is approved.

DATE: – Greenwich date in the order of day-month-year. The first three letters of each month are used for month abbreviations.

GMT: – Greenwich mean time in hours and minutes. The correct date and GMT are retained, even when aircraft power is removed.

REF NAVAID ID – The NAVAID (within 50 NM miles) closest to the systems last computed position before power was removed.

WPT ID: – A data entry field where the waypoint identifier of the aircraft's present position may be entered.

POS: – The last known computer generated present position.

EST GS: – Estimated groundspeed manually entered. Should be

0 if the aircraft is on the ground, or a close estimate if in flight.

APPROVE? – Used to approve the data on the page and enter the data into the computer memory. Other pages are not accessible until this step is completed.

(7) Omega Restart Initialization Page. Not used.

(8) Message Page. The message (MSG) annunciators illuminate whenever there is a situation that requires the pilot's attention. The MSG annunciators will flash continuously until acknowledged by pressing the MSG key, which displays the message page. The message page lists the various messages that are applicable to the unit's operation at that time.

After viewing the message, the operator may either select a new page by pressing another page key or by pressing the MSG key that will return to the previous page. In either case, the message light will be extinguished unless there is a situation that requires operator action. In this case the message light will remain on solid until the pilot's action is taken. Whenever new messages are displayed the operator has never seen, they are separated from the previously viewed messages by a blank line.

(9) Flight Plan Pages. The flight plan menu pages (FPLS) display a listing of the flight plans contained in the systems memory. The flight plans are listed in increasing order of flight plan number. When initialization is complete, the first flight plan menu page appears. A maximum of 100 flight plans may be listed by the flight plan numbers 0 to 99. If more than nine flight plans are stored, successively pressing the FPL key will display additional FPLS pages containing the remaining stored flight plans.

SEL FPL: – The desired flight plan number is entered into this field. The flight plan number selected does not have to be displayed on this page.

0 – The 0 indicates the first flight plan number. Flight plan 0 is the active flight plan and is displayed on each flight plan menu page.

> – The > notes that another operation can be performed by pressing the CLR key while the cursor is over this field. When indexed to the left of a flight plan, it provides the option to store that flight plan in any unused flight plan position.

Asterisk (*) – The * indicates that this is a protected flight plan.

FPLS AVAIL – Indicates the number of empty flight plans available for use.

(10) Flight Plan # Page. Each flight plan page is called up via the flight plan menu page. A flight plan is limited to a maximum of 25 waypoints. An * after FPL would indicate that this is a protected flight plan.

ACTIVATE? – This flight plan can be made active by placing the cursor over ACTIVATE? and pressing **ENTER**.

INVERT – The option of activating this flight plan in inverted order is available (first waypoint becomes the last and last waypoint becomes the first) by placing the cursor over INVERT? and pressing **ENTER**.

NEXT PAGE? – When more than nine waypoints are used in a flight plan, the next page (or pages) can be displayed by placing the cursor over NEXT PAGE? and pressing **ENTER**. From the last page of the flight plan this procedure is used to return to the first page of the flight plan.

DIS – Distance is displayed from the initial waypoint.

REF WPT – A data entry field where a reference navaid or airport identifier may be entered to create an on course waypoint.

(11) Flight Plan 0 Page. The flight plan 0 page is a display of the active flight plan and its associated data.

DIR: – This line is present only when direct to operation is being used. The direct to waypoint name and distance to this waypoint are displayed. Estimated Time of Arrival (ETA) and Estimated Time En Route (ETE) to the direct waypoint may also be displayed.

>DIS – A cyclic field that changes from distance (>DIS) to >ETA to >ETE. As with all cyclic fields, the field is changed by positioning the cursor over the field and pressing the **CLR** key.

The distance displayed under the >DIS column beside each waypoint are the cumulative distances from the aircraft's present position to each waypoint along the flight plan route

>ETA – This column displays the estimated time of arrival in GMT and is based on the current ground speed and distance to each waypoint from the aircraft's present position.

>ETE – This column displays the estimated time en route to each waypoint based on the current ground speed and distance to each waypoint from the aircraft's present position.

>ALT – This column displays the selected altitudes associated with GMT that the system first calculated a ground speed greater than 50 knots. DEP is displayed only when ETA has been selected.

DEP – The departure time is the GMT that the system first calculated a ground speed greater than 50 knots. DEP is displayed only when ETA has been selected.

FLT – The total elapsed time in flight. The elapsed time begins when the system first calculates a groundspeed of 50 knots. FLT is displayed only when ETE is selected.

1 FIRST – The first waypoint is displayed at the top of the list of waypoints regardless of the number of waypoints in FPL 0. This line can become a non-enterable cursor field and will display WPT? when used for manual scrolling of the waypoints.

* 7: – A single * designates the direct to waypoint if it is part of FPL 0. A single * also designates the active waypoint when in OBS method of operation.

* 6: * 7: – When the system is in AUTO/ LEG operation and the Direct To feature is not being utilized, a pair of * designates the active FROM waypoint (top *) and TO waypoint (bottom *). Thus, the * *define the active flight plan leg. The *'s change automatically as the aircraft moves along the flight plan

The last waypoint in FPL 0 and its associated distance, estimated time of arrival, or estimated time en route are displayed at the bottom of the list of waypoints. This line can become a non-enterable cursor field and display WPT? when used for manual scrolling of the waypoints.

REF WP: – A data entry field where a reference navaid or airport identifier may be entered to create an on course waypoint.

(12) Waypoint Page. The waypoint page is used to display, verify, and create waypoints for use in the operation of the system.

WPT* – If the displayed waypoint has a protected status, an * will appear next to the WPT page field.

DSP: – Indicates the displayed waypoint number from the active flight plan. A –D– would indicate that the waypoint being displayed is a direct to waypoint that is not part of the active flight plan. If the displayed waypoint is not part of the active flight plan and is not a direct to waypoint, dashes will be displayed.

The field may be used to display a waypoint from flight plan 0 by entering the desired waypoint number into this data entry field.

ACT – Indicates the active waypoint number from the active flight plan. If the direct to feature is being used and the direct to waypoint is not contained in the active flight plan, then a "D" will be displayed.

USE? – Queries the operator if he wants to make the displayed waypoint the active waypoint. To do so, position the cursor is over this field and press **ENTER**.

WPT NAME: – The identifier or name of the displayed waypoint. From one to five alphanumeric characters are used to identify a waypoint.

REF NAME: – Reference facility identifier. The pilot may enter a navaid, airport, or any other waypoint stored in memory within 200 NM of the waypoint being defined. However, to utilize the VOR sensor (VOR or BLEND sensor selected) while operating in OBS method of operation the REF NAME entry must be a navaid identifier. In OBS operation the reference navaid is the only station tuned by the VOR navigation receiver and the DME (or TACAN).

FREQ – Frequency of the reference navaid. If the reference facility input is a navaid, its frequency is automatically entered. When the reference facility identifier entered is not a navaid, blanks are displayed.

A caret (>) will be displayed between FREQ and the frequency field when using the TACAN sensor. With the cursor over the frequency field the **CLEAR** key is used to select either frequencies or TACAN channels. The system will remain in the FREQ or CHNL select mode until changed by the pilot.

RAD DIS: – Radial and distance from the reference facility to the waypoint.

LAT: LON: – Position of the waypoint presented as latitude and longitude coordinates using degrees, minutes and tenths of minutes.

RUNWAY/OM? – This cursor field allows selection of runway thresholds and outer markers. It appears whenever the data base is loaded with runway thresholds and/or outer markers and when the identifier displayed in the WPT NAME field is an airport.

44 WPTS AVAIL – When the waypoint page is initially displayed, after having been previously approved, the number of memory locations available for waypoint storage is displayed.

APPROVE? – Following the first data entry on the waypoint page the WPTS AVAIL will be removed. The APPROVE? field will then appear.

When clearing a waypoint page, the interrogative field DELETE? will appear in place of APPROVE?.

(13) Waypoint Used-In Page. The waypoint used-in page is used for deleting a waypoint. The page displays the identifier of the waypoint to be deleted.

DELETE? – With the cursor over the field to be deleted, the field is deleted by pressing the **ENTER** key.

(14) Waypoint Runway/Outer Marker Page. When the selected waypoint is an airport and the data base contains runway and/or outer marker information the message RUNWAY/OM? will appear at the bottom of the waypoint page. The runway/outer marker page can then be selected. A runway or outer marker may be selected from the listing on this page.

SEL RW/OM: – The menu number to the left of the desired runway threshold or outer marker may be entered in this field.

NEXT PAGE – If all the runway thresholds and outer markers aren't contained on one page, this field is used to view the remainder that are contained on another page.

(15) Waypoint Duplication Page. When an identifier is entered in a waypoint identifier field and multiple definitions for this identifier exist in the system data base, the waypoint duplication page will be displayed.

SEL COUNTRY – The number associated with: the desired country may be entered in this field.

IDENTIFIER TOP – The identifier having multiple definitions stored in the data base. A listing of the countries containing the same waypoint identifier will display under IDENTIFIER TOP. If an identifier for an intersection has been entered, a "T" or an "E" will be delayed next to the country name to indicate that the intersection is terminal or en route.

(16) NAV Pages. There are two NAV pages (NAV 1 and NAV 2) alternately selected by pressing the **NAV** key.

NAV 1 PAGE – The NAV 1 page format varies somewhat depending on whether the method of operation is OBS or AUTO/LEG.

(a) OBS Method of Operation Display.

USE – The number displayed is the active waypoint number. When using the direct to feature (DIR) is displayed.

ID – The identifier code of the active waypoint.

DIS – Distance to the active waypoint in nautical miles.

ETE – Estimated time en route to the active waypoint in hours and minutes. This value is based on the present calculated groundspeed, assuming that the actual track is equal to the bearing to the waypoint.

GS – Groundspeed in knots.

TAS: – The colon (:), when displayed, indicates this is an enterable data field, only when there is no true airspeed source available. A true airspeed may be manually entered so that the system can make a wind calculation.

WIND – The computed wind using the TAS. Displayed in degrees true and knots. This field will display dashes if the computed wind is less than 10 knots.

BRG – The bearing from the aircraft's present position to the active waypoint.

HDG – The current aircraft heading.

>POS RAD MKC DIS – The aircraft's present position displayed in terms of a navaid, and the radial and distance from it. Another navaid identifier may be manually inputted. The present position will be referenced to that facility. If the navaid is manually changed, the system will resume automatic navaid selection forth is field in approximately 1 minute.

POS – The aircraft's present position coordinates in latitude and longitude. The pilot may change the present position back and forth as desired between the navaid identifier, radial, and distance format and the latitude/ longitude format by placing the cursor over the >POS field and pressing the CLEAR key. When an ILS frequency is active the POS block displays the ILS frequency and the radial and distance display dashes.

(b) Auto/Leg Method of Operation Display.

LEG – Active leg of flight plan.

When operating direct to a waypoint, (DIR) and the waypoint identifier are displayed.

DIS – Distance to the active waypoint in nautical miles.

ETE – Estimated time en route to the active waypoint in hours and minutes. This value is based on the present calculated groundspeed, assuming that the actual track is equal to the bearing to the waypoint.

GS – Groundspeed in knots.

TAS: – The colon (:), when displayed, indicates this is an enterable data field, only when there is no true airspeed source available. A true airspeed may be manually entered so that the system can make a wind calculation.

WIND – The computed wind using the TAS. Displayed in degrees true and knots. This field will display dashes if the computed wind is less than 10 knots.

DTK – Desired track. The great circle course in degrees along the active leg of the flight plan.

TK – Actual track. The track the aircraft is flying over the ground.

BRG – The bearing from the aircraft's present position to the active waypoint.

DA – The drift angle left or right in degrees. If the aircraft's actual track over the ground is to the right of the aircraft's heading a right (R) drift angle is indicated. If the track is to the left of the aircraft's heading a left (L) drift angle is indicated.

POS – The aircraft's present position displayed in terms of a navaid, and the radial from it. Another navaid identifier may be manually inputted and the present position will be referenced to that facility. If the navaid is manually changed, the system will resume automatic navaid selection for this field in approximately 1 minute.

(17) *Nav 2 Page.*

LEG – Varies somewhat depending on whether the method of operation is OBS or AUTO/LEG.

ACT – This column header indicates that data in this column is pilot selectable.

L XTK: R – The data to the left side of XTK: is the actual cross track error, which is the lateral displacement of the aircraft in nautical miles left or right of the desired track. If parallel track operation is desired, the selected cross track may be entered to the right of the XTK: field. The selected cross track distance provides steering to a left or right offset course parallel to the desired track.

REF MAG – The data to the left of REF is the actual magnetic variation in degrees computed for the present position of the aircraft. The data to the right of REF is the system compass mode. BGR, DTKM HDG, and TK are referenced with respect to the displayed system compass mode.

VNAV – The VNAV field and the associated VNAV lines below it are displayed only when the system is configured for manual VNAV operation. When present, the pilot can initiate a manual VNAV system configuration by entering data into the appropriate data fields.

ALT: – The data to the left of ALT: is the actual present aircraft altitude. The pilot may enter a selected altitude in the data field to the right of ALT:.

ANG: – The data to the left of ANG: is the actual vertical angle between the present aircraft position and the active vertical waypoint or vertical offset point if selected, between 0 and 9.9 degrees. If manual VNAV operation is utilized the pilot may select a vertical angle in the data entry field to the right of ANG:. If manual VNAV operation is not engaged this field displays the actual vertical angle.

OFST: – The data to the left of OFST: is the distance to the vertical waypoint or vertical offset point if selected. The pilot may enter an along track offset (nautical mile) in the data field to the right of OFST:. A positive number puts the vertical offset point past the waypoint and a negative number puts the vertical offset point between the aircraft and the waypoint.

(18) Hold 1 Page. The HOLD 1 page is used to check position accuracy, to update the KNS-660 position or create a waypoint at the aircraft's present position.

POS – The present position calculated by the system that was frozen in this display when the **HOLD** key was pressed.

IDENT: – The waypoint identifier of the fix contained in the systems memory, that was over flown to check or update position. If the identifier entered here is not contained in memory this becomes the identifier of a waypoint with the coordinates displayed adjacent to POS.

FIX: – The actual coordinates of the position overflown.

DIF – The difference in position between the systems calculated position and the **FIX** position in degrees, minutes and tenths o minutes.

UPDATE? – A cursor field used to update the systems position when the **ENTER** key is pressed.

(19) Hold 2 Page. The HOLD 2 page is used to update the system position. It is also used to make manual altitude, heading, or groundspeed entries when required by the system.

IDENT: – The waypoint identifier of a point to be overflown for position updating.

FIX: – The actual coordinates of the point to be overflown for position updating.

MAN HDG:°t – This field will be present on the HOLD 2 page only if all of the system's heading source inputs fail. The pilot may manually enter the aircraft's heading referenced to true north in this data field.

MAN ALT: FT – This field will be present only if all of the system's altitude inputs fail. The aircraft's altitude may then be manually entered in this data field.

EST GS: – This field will be present if the omega receiver requires dead reckoning in puts to gain navigational status. The estimated groundspeed may then be manually entered in this data field.

UPDATE WHEN OVER POSITION FIX – A non-cursor field, to remind the pilot that updating the item using the HOLD 2 page is done the position fix.

UPDATE? – A cursor field used to update the system position when the **ENTER** key is pressed. This field does not effect operation of the MAN HDG:, MAN ALT:, or EST GS fields.

(20) Frequency 1 Page. The FREQ 1 page is used for frequency management.

[ ] – Transponder code or frequency entered in the scratch pad area of display displays here.

SEL OPTION – The appropriate menu number choice may be entered in this field.

STBY – Menu numbers chosen from this column will result in the scratch pad frequency being loaded into the standby window of the appropriate control head.

ACT – Menu numbers chosen from this column will result in the scratch pad frequency or transponder code being loaded into the appropriate control head's active window.

(21) Frequency 2 Page.

[ ] – Frequency or transponder code entered in the scratch pad area of display, displays here.

FREQ SUMMARY – A non-cursor field that indicates that the listed below is all control heads connected for frequency management capability and their respective active frequency/codes.

Each of the ADF control heads tied to the frequency management is listed along with its respective active frequency/code. The frequency/code fields are manually enterable.

When the number one VOR NAV receiver is being used as a sensor for the KNS-660, a dot is displayed to indicate that data cannot be entered in this field. If the NAV CTL function is activated thereby removing the number one VOR NAV receiver as a sensor, the active NAV 1 frequency will be displayed and this will be an enterable data field.

m. Data 1 Menu Page. The DATA 1 menu page lists the actual data pages that can be selected from this page. Specific data pages are selected by entering the corresponding menu number into the SEL MENU ITEM: data field and pressing the **ENTER** key. They may also be selected by placing the cursor over the menu item and pressing the **ENTER** key.

(1) Nearest Airports Page. The nearest airport page may be called up at any time to provide three airports from the data base closest to the aircraft's present position (within 200 nautical miles).

NEAREST AIRPORTS AS OF GMT – The last Greenwich mean time the data base was queried for the three nearest airports. The data base is queried approximately every 2 minutes.

IDENT BGR DIS – The ICAO identifiers for the DIS three nearest airports are displayed along with the respective bearing and distance to these airports from the aircraft's present position. The bearing and distance displayed are real time data.

4: – This field provides a means to determine the bearing and distance to any airport entered that is listed in the data base, or any user defined airport.

(2) Trip Planning Menu Page. The trip planning menu page is a secondary menu that allows the pilot to choose from three different types of trip planning.

SEL MENU ITEM: – The menu number of the desired kind of trip planning can be entered in this data field.

(a) WPT REL TO PRESENT POS Trip planning from the aircraft's present position to another waypoint.

(b) WPT TO WPT ANALYSIS Trip planning between any two waypoints.

(c) FPL ANALYSIS Trip planning of one of the flight plans stored in the FPLS pages.

(3) Waypoint Relative To Present Position Trip Planning Page.

WPT NAME: – Desired waypoint identifier.

LAT: – The waypoint location presented in latitude coordinate.

LON: – The waypoint location presented in longitude coordinate.

DIS NM – The distance in nautical miles from the aircraft's present position to the selected waypoint. Not updated as the present position changes.

BRG TO – The bearing in degrees from the aircraft's present position to the selected waypoint. Not updated as the present position changes.

ENTER GS: – The aircraft's estimated groundspeed for the trip can be entered in this data field.

ETE H: M – The estimated time en route for the trip based on groundspeed.

(4) Fuel Planning Page.

REM – The total fuel remaining in pounds. Must be manually inputted. Automatically counts down as a function of time and the manually entered fuel flow.

FLOW: – The total fuel flow in lb/hr. Must be manually input.

RESERVE: – The desired fuel reserve in pounds. Must be manually input.

LAST UPDATE – Time in minutes since the pilot has updated any of the fuel planning data. After 15 minutes the HRS, RANGE, and NM/100 LB fields blank and an UPDATE INPUTS message flashes at the bottom of the page.

HRS – The endurance in hours and minutes based upon the manually inputted fuel remaining, fuel flow and fuel reserve data.

RANGE (NM) – The range in nautical miles based upon endurance and the aircraft's present groundspeed as calculated by the system.

NM/100LB – The aircraft's fuel economy in nautical miles per 100 lb of fuel based upon the present groundspeed and manually input fuel flow.

UPDATED INPUTS – This flashing message appears only if data has not been updated for 15 minutes.

(5) Position Summary Page. The position summary page displays the aircraft's position in latitude and longitude coordinates as determined by each of the sensors.

POS – The aircraft's present position coordinates based on inputs from the pilot selected sensor. When BLEND sensor has been selected this position is a computer optimized position that blends the position information from all the sensors.

VOR – The aircraft's present position coordinates based on inputs from the VOR and/or DME sensors.

TACAN – The aircraft's present position coordinates based on inputs from the TACAN sensor.

NEXT PAGE? – The NEXT PAGE field displays, indicating that the remaining sensors (GPS) are displayed on the next page. The next page is displayed by placing the cursor over this field and pressing the **ENTER** key.

(6) VOR/DME/Status Page. The VOR/ DME status page may be used to monitor the VOR and/or DME stations being used by the system.

VOR 1 REC – Indicates that the NAV sensor has tuned a programmed VOR station frequency. REC indicates that a valid (not flagged) signal is being received, and the station radial on which the aircraft is located.

DME 1 REC – -Indicates that the DME sensor is tuned to a programmed paired VOR frequency. REC indicates a valid (not flagged) signal is being received, and distance from the station to the aircraft.

DME 2 NM – Indicates that valid DME distance is not being received from a second station. The system is therefore providing rho-theta (angle provided by the VOR and distance from the DME) navigation data.

DME 2 REC – When valid DME data is received from a second DME station, this area displays REC, the identifier and frequency of the station utilized, and the aircraft's distance from the station. Under these conditions, the system is providing rho-rho navigation data.

When the system is providing rho-rho navigation it is not unusual for the VOR station identifier to be different from either of the DME station identifiers. It is also possible under valid rho-rho conditions for the VOR data to be blanked or flagged. It is normal during rho-rho operation for the DME stations to temporarily flag due to recalculation of optimum station pair.

(7) TACAN Status Page. The TACAN status page may be monitored to view the status of the TACAN stations being used by the system.

TACAN REC – Indicates valid (not flagged) TACAN bearing information is being received. The TACAN channel and radial the aircraft is on will display.

DME 1 REC – Indicates valid (not flagged) DME distance information is being received. Frequency and DME distance will display.

DME 2 NM – Indicates that valid DME distance is not being received from a second station. The system is therefore providing rho-theta navigation data.

DME 2 REC – When valid DME data is received from a second DME station this area displays REC, the identifier and paired VHF frequency of the station utilized, and the aircraft's distance from the station. Under these conditions, the system is providing rho-rho navigation data. When the system is providing rho-rho navigation the TACAN bearing data is dashed out.

(8) GPS Status Page. The GPS STATUS page is used to monitor the status of the GPS sensor.

(a) State Line. The STATE line indicates the status of the GPS sensor. The GPS sensor may be in any one of the following states:

INIT – In the process of initialization.

STS – In the process of searching the sky.

ACQ – In the process of acquiring satellites.

TRN – Transitioning between acquisition (ACQ) and navigation (NAV) modes.

NAV – In the navigation mode.

NAV DAT – In the process of data collection.

WARN – Degraded position information is being supplied.

FAIL CPU – CPU or 429 receiver has failed (catastrophic).

FAIL MEM – Memory has failed (catastrophic).

FAIL REC – Receiver hardware has failed (catastrophic).

EPE – The estimated position error for the GPS sensor is displayed on this line. It is in units of feet rather than nautical miles due to the higher accuracy available from the GPS system.

RESTART? – This field will appear if the GPS sensor is in an INIT, STA, ACQ, TRN, FAIL CPU, FAIL MEM, or FAIL REC state. Moving the cursor over this field when it appears and pressing the **ENTER** key will cause the GPS RESTART page to be displayed.

SAT SNR ELE HLT – This area of the GPS status page provides information on up to eight of the NAVSTAR GPS satellites visible to the

GPS sensor. Below the column labeled SAT appear the numerical designations of various satellites visible to the GPs sensor. An asterisk to the far left of the identifier indicates that the GPS sensor is not using the specific satellite in its position solution. The SNR (signal to noise ratio) column provides signal strength information for individual satellites. Typical SNR values will be in the 30 to 55 range. The elevation above the horizon is provided by the ELE column. Elevation is displayed in degrees and will typically be in the range of 5" to 90°. The last column, HLT, indicates the health state of each satellite. Three states are possible: GD (signal is good), WK (signal is weak), and BD (signal is bad).

(9) GPS Restart Page. This page is used to re-initialize (restart) the GPS sensor.

(a) Date Line (DATE). This line displays the Greenwich date in the order of day-month-year.

(b) Time Line (GMT). This line displays Greenwich Mean Time in hours and minutes.

(c) Waypoint Identifier Line (WPT ID). The space after WPT ID: is a data entry field where the present position waypoint identifier may be entered.

(d) Latitude and Longitude Lines (POS.). The latitude and longitude of the aircraft's resent position, which has been derived from either their position sensors or the waypoint identifier (WPT ID) will be displayed here or may be manually entered here.

(e) Mode Line. The mode field (MODES) allows one of three restart modes: NORMAL, COLD, or SEARCH SKY to be selected.

(f) Estimated Groundspeed Line (EST GS). Estimated groundspeed is manually entered here.

n. Data 2 Menu Page. The data 2 menu page lists the actual data pages that can be selected from its menu. Specific data pages are selected by entering the corresponding menu number into the SEL MENU ITEM: data field and pressing the **ENTER** key. They may also be selected by placing the cursor over the menu item and pressing the **ENTER** key.

(1) Navaid Page. This page is used to display the frequency, type, class, elevation, magnetic variation, latitude and longitude of a selected navaid. If the selected navaid is contained in the data base, the above information will be displayed when the navaid identifier is inputted into the station identifier field. A user-defined navaid is created by entering the above data into their respective fields and approving the page.

STA IDENT – Navaid identifier.

FREQ: – Navaid frequency or TACAN channel depending on which format is selected on the waypoint page. When TACAN channel is selected, FREQ: will be replaced with CHNL:.

TYPE> VORTAC – Displays the type of navaid. Also used when a user navaid is being defined, as a cyclic field in conjunction with the **CLEAR** key to choose the type of navaid from among the following choices: DME, VOR/DME, VORTAC, TACAN, ILS/DME or VOR.

CLASS> HIGH – Displays the class of navaid. Also used when a user navaid is being defined. It is a cyclic field and is modified with the **CLEAR** key to choose the class of navaid from the following choices: LOW, HIGH, TERMINAL, and UNDEFINED.

ELEV: FT: – The elevation (to the nearest 10 feet) of the navaid being displayed or defined.

MAG VAR: – The published magnetic variation in degrees of the navaid being displayed or defined.

LAT: LON: – The position of the navaid in latitude and longitude.

APPROVE? – A cursor field used to approve a user defined navaid.

(2) Airport Page. The airport page is used to display the elevation and the position of the Airport Reference Point (ARP) of a selected airport. If the selected airport is contained in the data base, the above information will be displayed when the airport ICAO identifier is inputted. User-defined airports can be created by inputting the above data into their respective fields and approving the page.

ICAO AIRPORT IDENTIFIER:	–	Airport ICAO identifier or other user-defined airport identifier.
ELEV: FT.	–	Airport elevation to the nearest 10 feet referenced to sea level.
LAT: LON:	–	Position in latitude and longitude of the ARP.
APPROVE?	–	A cursor field used to approve a user defined airport.

(3) Data/Time Page. The data displayed on the data/time page is for reference only and can not be changed from this page.

DATE	–	The current Greenwich date in the sequence day-month-year.
GMT	–	The current Greenwich mean time.
DEP TIME	–	The departure time that is defined as the time (GMT) the system first calculated a groundspeed that exceeded 50 knots.
FLT TIME	–	The flight time in hours and minutes, which is defined as the elapsed time since the system first calculated a groundspeed that exceeded 50 knots.

(4) Update Data Base Page. This page serves as a master menu for initiating three types of data base operations: reviewing the present configuration of what is currently loaded in the data base, modifying the configuration of what is to be loaded into the data base, and loading the data base with the data loader.

SEL MENU ITEM:	–	The number associated with the desired menu item is entered in this field.
REVIEW D/BASE	–	This menu item is selected to display additional data base review pages that are used to review what is presently loaded in the data base. The pages accessed via this menu item are the review data base page and the review elements page.
SELECT D/BASE	–	This menu item is selected to display additional data base modification pages that are used to configure the data base prior to being loaded with the data loader.
NEXT UPDATE	–	A non-enterable cursor field that displays the Greenwich date indicating when the next 28-day data base revision update is due.
LOAD D/BASE?	–	A flashing cursor field used to initiate a loading of the data base with the data loader.
*ON GROUND SELECT ONLY	–	*AFTER D/BASE COMPLETE

(5) Review Data Base Page. This page is used to review those regions of the world having data presently loaded in the data base. The world is divided into 10 regions, all of which are displayed on this page. The data base cannot be modified, from this page.

SEL MENU ITEM	–	The number associated with the desired geographic region can be entered in this field to display the region's review elements page.

Directly below the SEL MENU ITEM:, the 10 regions display. The * denotes that data is presently loaded in the data base for that region. No * indicates that data for those regions have not been loaded in the data base.

(6) Review Elements Page. This page is used to review the navigational elements loaded in the data base for a particular region of the world. The data base cannot be modified from this page.

NAVAID*	–	Navaids include VORTAC's, VOR/DME's, VOR's TACAN's DME's and ILS DME's. The * denotes that navaids for that region are presently loaded in

the data base.

APT‡4000 FT* – Airports having a hard surface runway at least 4000 feet in length. The * denotes that these airports are presently loaded in the data base.

APT‡3000 FT* – Airports having a hard surface runway at least 3000 feet in length. Only one of the two airport elements may be selected. No * denotes the element is not presently contained in the data base.

RW THRESHOLD * – Runway thresholds for which there exists verified latitude and longitude coordinates. No * denotes the element is not presently contained in the data base.

OUTER MKR – Outer markers.

HI ALT WPT – High altitude waypoints are named intersections that appear on high altitude en route charts.

LO ALT WPT – Low altitude waypoints are named intersections that appear on low altitude en route charts.

DP's/STAR – Departure Procedures (DP) and Standard Terminal Arrival Route (STAR) waypoints and intersections.

APR INTRSC – Approach intersections are named intersections that appear on instrument approach charts. They do not include outer markers since outer markers are a separate category.

MULT WPT – Waypoints that are used for multiple functions. For example, if a waypoint serves as both a low altitude waypoint and as an approach intersection, it is considered a multiple waypoint. Also, multiple waypoints include on-airway NDB's. If any type of waypoint (HI ALT, LO ALT, DP/STAR, or APR INTRSC) is loaded in the data base the multiple waypoints are automatically included.

(7) Modify Data Base Page. This page is used to select regions of the world from which data will be loaded in the data base. It is one of two pages used to configure the data base to the aircraft's specific requirements prior to using the data loader to actually load the data into the data base.

SEL MENU ITEM – The number associated with the desired menu item can be entered in this field.

The regions of the world are the same as those on the review data base page. The meaning of the *, however, is different. On this page the * denotes those regions of the world that will be loaded by the data loader. The * on the review data base page denotes those regions of the world that are currently loaded in the data base.

(8) Modify Elements Page. This page is used to select the navigation elements for a particular region of the world that will be loaded into the data base with the data loader.

BLKS AVAIL – The number of blocks of data base memory remaining (for entire data base, not just region being displayed). The number decreases each time an element below is selected.

NAVAID * – The data base elements listed are the same ones described on the review elements page. The number to the right of the element is the number of blocks required to store the element in the data base memory for the region of the world displayed. No numbers appear next to RW THRSHLD or OUTER MKR until one of the two APT (airport) elements has been selected. Whenever any or all of the waypoint elements (HI ALT WPT, LO ALT WPT, DP/STAR, or APR INTRSEC) are selected, the MULT WPT is automatically included. MULT WPT cannot be selected unless at least one of the four waypoint elements is selected.

The * denotes those elements which are being selected to be loaded into the data base with the data loader. An element without an * has not been selected.

(9) Unused Waypoints Page. These pages display in alphabetical order the identifiers of user created waypoints that are not currently being used in any existing flight plan and are not in a protected status. If the system is put into system protect mode this page will also show protected waypoints that are not being used in any flight plan.

This page can be used to delete unused waypoints from the system by placing the cursor over the waypoint identifier and pressing the **CLEAR** key and then the **ENTER** key.

PREVIOUS PAGE? – A cursor field used to display the previous page of unused waypoints when there is more than one page of these waypoints.

NEXT PAGE? – A cursor field used to display the next page of unused waypoints when there is more than one page of these waypoints.

(10) User-Defined Navaids Page. These pages are used to view the identifiers of the navaids contained in the supplement data base memory that have been defined by the user. The identifiers are listed in alphabetical order. These pages are also used to delete these user navaids from the supplemental data base.

PREVIOUS PAGE? – A cursor field used to display the previous page of user defined navaids when there is more than one page of these navaids.

(11) User-Defined Airports Page. These pages are used to view the identifiers of airports contained in the supplemental data base memory that have been defined by the user. The identifiers are listed in alphabetical order. These pages are also used to delete user defined airports from the supplemental data base.

PREVIOUS PAGE? – A cursor field used to display the previous page of user defined airports when there is more than one page of these airports.

NEXT PAGE? A cursor field used to display the next page of user defined airports when there is more than one page of these airports.

o. Navigation Displays.

(1) Pilot's HSI.

FMS – With FMS selected the KNS660 provides automatic course needle drive while using the AUTO/LEG method of operation. However, it will not provide course needle drive while using the OBS method of operation. In this case, the pilot must set the selected course manually either via the HSI course knob, located on the pedestal, or through the KNS-660 control unit. The course needle provides left/right steering information from the KNS-660. The DME display provides distance to the waypoint in nautical miles. Also, the DME slave indicator will display distance, groundspeed in knots, and time to the station. The bearing pointer provides bearing information derived from either the ADF or the KNS-660 depending on whether ADF or NAV is selected by the RMI selector.

(2) Copilot's HSI.

FMS – The copilot's HSI operates the same as the pilot's HSI with FMS selected except, it does not provide automatic course needle drive when in AUTO LEG mode and does not provide distance or bearing information.

NAV – With NAV selected the pilot must set the selected course manually via the HSI course knob, located on the pedestal. VOR/LOC/GS tuning is through the NAV 1 frequency control unit. Both VOR and

LOC signals provide left/right steering information. The DME display provides distance to the station in nautical miles. Also, the DME slave indicator will display distance, groundspeed in knots, and time to station. The bearing pointer provides bearing information derived from either the ADF 1 or the NAV 1 receiver depending on whether ADF or NAV is selected by the RMI selector.

(3) Pilot's and Copilot's RMI.

FMS – With FMS selected, the single bar needle provides bearing information derived from either the ADF or the KNS-660 depending on whether ADF or NAV is selected on the RMI.

NAV – With NAV selected, the single bar needle provides bearing information derived from either the ADF or the NAV 1 receiver depending on whether ADF or NAV is selected on the RMI.

p. FMS Operating Procedures.

NOTE

Operation must be in conformity with the KNS-660 Pilot's Guide, P/N 0068394-00, dated November 15, 1984 or later.

(1) Turn On Procedures.

1. **ON / OFF** rocker switch – Press top half. Allow 8 to 10 seconds for initial warmup.

2. **BRT / DIM** rocker switch – Adjust screen brightness as desired.

(2) Self Test.

1. Self-test page – Check that SYSTEM OK is being displayed.

NOTE

If SYSTEM FAIL is displayed, turn the system off and then back on using the ON/OFF rocker switch. If SYSTEM FAIL continues to display, the system requires service and must not be utilized.

2. Navigation instruments – Check as prompted by self-test page.

   a. RMI pointer on 130°.

   b. DME display reads 34.3 NM.

   c. Course selector slewed to 315°.

   d. Course deviation indicator displaying 3 dots right.

   e. VNAV deviation indicating 3° up.

3. Remote annunciators – Check **ON**.

4. **ENTER** key Press to verify satisfactory completion of self test page items.

(3) Initialization Page.

CAUTION

Position accuracy in initialization is very important, since it is possible that the amount of initialization error will be carried by the system throughout the flight.

Either one of the following initialization procedures may be used.

(a) Procedure A.

1. DATE: Check. If incorrect, enter the correct Greenwich date in sequence (day-month-year).

2. GMT: Check. If incorrect, enter the correct Greenwich time.

3. POS: Check the last known system generated position. If incorrect, procedure as follows:

   a. Cursor ↑ or ↓ key – Press so that the cursor field appears over the WPT ID: data field.

   b. Known ICAO airport identifier or waypoint identifier – Input.

c. **ENTER** key – Press to enter the identifier. The waypoint page will automatically display.

(1) If the waypoint identifier is contained in system memory, (waypoint latitude and longitude are listed on waypoint page).

d. Cursor ↑ or ↓ key – Press, if necessary, to place cursor field over APPROVE?.

e. **ENTER** key – Press. The initialization page will again appear with the cursor over APPROVE?. Continue with step 4.

(1) If the waypoint identifier is not contained in memory (no latitude or longitude entry and the cursor over REF NAME: field).)

f. REF NAME: – Input the identifier of a navaid or location contained in system memory from which the new waypoint can be referenced.

g. **ENTER** key – Press to enter the identifier.

h. RAD: – Input the radial in degrees and tenths of a degree from the navaid or location in the REF NAME field to the waypoint being defined.

i. **ENTER** key – Press to enter the radial into memory.

j. DIS: – Input the distance to the nearest tenth of a nautical mile from the navaid or location in the REF NAME data field to the waypoint being defined.

k. **ENTER** key – Press to enter the distance into memory.

l. **ENTER** key – Press twice to advance the cursor to the APPROVE? field.

NOTE

Steps a through g may be skipped and the latitude and longitude input directly, if known.

m. **ENTER** key – Press to approve the waypoint page. The initialization page will appear with the cursor over APPROVE?.

4. EST GS:

a. If on the ground, verify that 0 is displayed.

b. If in flight, Press ↑ to position cursor over EST GS: data field, input estimated groundspeed, and press **ENTER**.

5. APPROVE? – Press **ENTER** to approve all of the data on the initialization page and enter the data into memory. The first of the flight plan menu pages (FPLS) will now appear.

(b) Procedure B.

1. DATE: – Check. If incorrect, enter the correct Greenwich date in sequence day month-year.

2. GMT: – Check. If incorrect, enter the correct Greenwich mean time.

3. POS: – Check the last known system-generated position. If incorrect, proceed as follows.

a. Cursor ↑ or ↓ key – Press so that the cursor appears over the latitude position.

b. Latitude – Input. Use North or South key first, followed by the known latitude in degrees, minutes and tenths of a minute.

c. **ENTER** key – Press to enter the latitude into memory.

d. Longitude – Input. Use East or West key first, followed by the known longitude in degrees, minutes and tenths of minute.

e. **ENTER** key – Press to enter the longitude into memory.

4. EST GS:.

a. If on the ground, verify that 0 is displayed and press **ENTER**.

b. If in flight, Input estimated groundspeed, then press **ENTER**.

5. APPROVE? – Press **ENTER** to approve all of the data on the initialization page and enter the data in memory. The first page of the flight plan menu (FPLS) will now appear.

NOTE

The configuration of the main data base can be reviewed at any time after initialization. Since so many of the system capabilities depend upon the data base it is important to review which geographic region and which navigational elements within these regions are actually loaded in the data base.

(4) Reviewing the Data Base.

CAUTION

The data base should be reviewed prior to takeoff, since the system cannot provide a navigation function while the data base is being loaded.

1. **DAT** key – Press as required to display the DATA 2 menu page.

2. Menu item UPDATE D/BASE – Select using the menu selection procedure. The UPDATE D/BASE page will display.

3. Menu item REVIEW D/BASE – Select. The REVIEW D/BASE page will display. Only the geographic regions followed by an * are presently contained in the main data base.

4. Desired geographic region – Select. The review elements page for the selected region will display. Only the geographic regions followed by an * are presently contained in the main data base.

5. **DAT** key – Press to return to the review data base page. Navigational elements stored for each of the other geographic regions with an * can be viewed by repeating steps 4 and 5 as many times as necessary.

(5) Configuring the Data Base.

CAUTION

If the VOR and DME (TACAN) sensors are to be utilized, navaids for the geographic regions in which flight is to occur must be loaded in the data base.

NOTE

Since not all the worldwide data on the revision diskette can be contained at one time in the main data base, it is necessary to select which geographic regions and which navigational elements within these regions will be loaded into the data base. The data base does not need to be reconfigured if there are no configuration changes from the previous loading.

The system must be turned on and initialization must be complete before configuring the data base.

1. Data loader cover – Open.

2. Update diskette – Insert into data loader. The diskette will not lock into place if it is positioned incorrectly.

3. **DAT** key – Press twice or as required to display the DATA 2 menu page.

4. Menu item 5 – Select as follows:

a. Cursor ↑ or ↓ key – Press to position cursor over item 5.

b. **ENTER** key – Press. The update data base page will display.

5. Menu item 2 – Select as follows:

a. Cursor ↑ or ↓ key – Press to position cursor over item 2.

b. **ENTER** key – Press. The modify data base page will display.

6. Geographic regions no longer required – Delete as follows:

   a. Cursor 4 key – Press to position over region.

   b. **CLR** key – Press to delete the *.

7. Data base for desired region – Update.

   a. Menu item (region) desired – Select as follows:

      (1) Cursor ↑ or ↓ key – Press to position cursor over menu item (region) desired.

      (2) **ENTER** key – Press. The modify elements page for that region will display. The number proceeding BLKS AVAIL, indicates blocks of data base memory remaining (for entire data base, not just for region selected).

NOTE

There are a total of 10,000 blocks of data base memory. These blocks can be filled with any combinations of geographic regions and navigational elements within those regions as long as the total blocks chosen do not exceed 10,000.

8. Cursor ↑ or ↓ key – Press, if necessary, to position over navaid to be updated.

9. **ENTER** key – Press.

10. Repeat steps 8 and 9, as necessary, to update other navaids.

11. **DAT** key – Press once to return to the modify data base page. Asterisks will now display to the right of regions updated.

12. Repeat steps 1 through 11, as necessary, to update other desired geographic regions.

13. **DAT** key – Press as required to display the DATA 2 menu page.

14. Menu item 5 – Select as follows:

    a. Cursor ↑ or ↓ key – Press to position over menu item 5.

    b. **ENTER** key – Press. The update data base page will now display.

15. Cursor ↑ or ↓ key – Press to position cursor over LOAD D/BASE?.

16. **ENTER** key – Press to initiate data base loading.

17. Diskette reject button – Push to unlock diskette. Remove diskette from data loader and close clear protective cover.

CAUTION

Leaving an update diskette inserted in the data loader for extended periods of time will cause excessive wear to occur to data loader. Also, failing to keep the clear protective cover closed could allow a foreign substance to enter, damaging the mechanism or electronics.

(6) Establishing Operational Status. Refer to Table 3B-4 for Methods of Operation.

1. **OBS/LEG** key – Press as required to select method of operation.

2. **SNS** key – Press as required to select desired sensor.

3. **MOD** key – Press as required to select desired mode of operation.

NOTE

The OBS/LEG, SNS, and MOD keys will cause the control display to immediately reflect the operational status change. However, the system will not actually activate the new operational status for a period of 1 second. Repeated presses of these keys during this 1-second period will reset the delay back to 1 second.

Table 3B-4. Methods of Operation

OBS METHOD OF OPERATION				
SENSOR	**BLEND**	**VOR**	**TACAN**	**OMEGA**
MODE	**RNV ENR**	**RNV ENR**	**RNV ENR**	**RNV ENR**
		RNV APR	**RNV APR**	
		NAV	**NAV**	
AUTO/LEG METHOD OF OPERATION				
SENSOR	**BLEND**	**VOR**	**TACAN**	**OMEGA**
MODE	**RNV ENR**	**RNV ENR**	**RNV ENR**	**RNV ENR**
		RNV APR*	**RNV APR***	

* Automatic navaid selection does not occur when operating the system in AUTO/LEG, VOR or TACAN, RNV APR. The pilot must specify a reference navaid for each waypoint in the reference name field of each waypoint page. This reference navaid is the particular navaid which the VOR navigation receiver and DME will be turned to when this waypoint is activated.

q. Shutdown Procedure.

1. **ON / OFF** rocker switch – Press lower half.

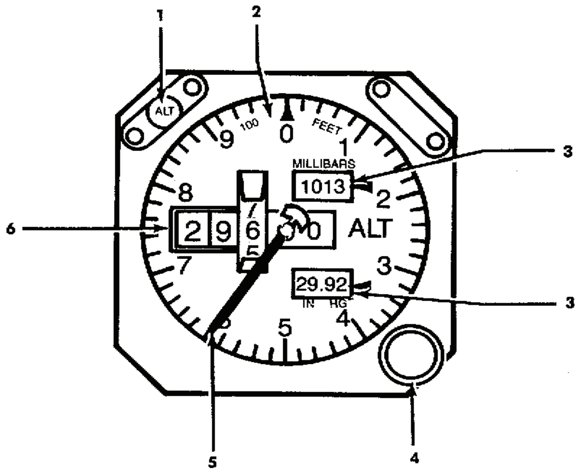
r. Emergency Procedures. If the KNS-660 system information is intermittent or lost, secure the system and utilize the remaining operational navigation equipment as required.

1. FMS/NAV CTL switch – Press. Verify NAV CTL illuminated.
2. CDU **ON / OFF** switch – Off.
3. FMS circuit breaker – Pull.

Section IV. RADAR AND TRANSPONDER

3B-27. PILOT'S ALTIMETER.

a. Description. The altimeter provides a servoed counter drum/pointer display of barometrically corrected pressure altitude derived from the air data system. Refer to Figure 3B-19. The barometric pressure is set manually with the baro knob and displayed in units of inches mercury and millibars on baro counters. The altimeter is ac powered and is protected through a 1-ampere circuit breaker, placarded **PILOT ALTM (AC)** located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.



1. **Altitude Alert (ALT) Annunciator**
2. **Pointer Display**
3. **Barometric Pressure and MILLIBARS Counter**
4. **Baro Knob**
5. **Altitude Pointer**
6. **Counter Drum Display**

Figure 3B-19. Pilot's Altimeter

b. Controls and Functions.

*(1) Altitude Alert (**ALT**) Annunciator.* The altitude alert annunciator illuminates to provide a visual indication when the aircraft is within 1000 feet of the preselected altitude during the capture maneuver and extinguishes when the aircraft is within 250 feet of the preselected altitude. After capture, the annunciator will illuminate if the aircraft departs more than 250 feet from the selected altitude, and extinguish when the aircraft has departed more than 1000 feet from the selected altitude.

(2) Pointer Display. Displays altitude between 1000-foot levels with 20-foot graduations.

WARNING

In the event of a total ac and dc electrical power loss, the warning flag will be in view, the altimeter will be inoperative, and the indicated altitude will remain as existed at the time of failure.

*(3) Barometric Pressure and **MILLIBARS** Counter.* The barometric pressure and **MILLIBARS** counter, set with the baro knob, displays barometric pressure in inches of mercury and millibars.

(4) Baro Knob. The baro knob is used to set the barometric pressure and **MILLIBARS** counter.

(5) Altitude Pointer. The altitude pointer points to the altitude on the pointer display between 1000-foot levels, in 20-foot increments.

(6) Counter Drum Display. The counter drum displays altitude and is marked in 20-foot increments. Altitudes below 10,000 feet are annunciated by a black and white crosshatch on the left-hand digit position of the counter display.

NOTE

A failure warning flag in view indicates the altitude information is unreliable; however, the Mode C information may be valid.

c. Operating Procedure.

1. Barometric set knob – Set desired altimeter setting in **IN HG** window.
2. Warning flag – Check not visible.
3. Needle indicator – Check operation.

NOTE

If the altimeter does not read within 70 feet of field elevation when the correct local barometric setting is used, the altimeter needs calibration or internal failure has occurred. An error of greater than 70 feet also nullifies use of the altimeter for IFR flight.

3B-28. WEATHER RADAR (KWX-58) SYSTEM.

a. Description. The KWX-58 color weather radar not only displays in-flight weather, but also permits incorporation of the KGR-358 radar graphics unit. The color weather radar is used to detect significant enroute weather formations to preclude undesirable penetration of heavy weather and its usually associated turbulence. The weather radar system provides a 320 nm display, with a 250 nm weather avoidance range plus weather penetration advantages. With the radar graphics unit in the NAV mode, navigation information is integrated with the weather display. The phased array antenna (flat plate), located in the nose of the aircraft, is fully stabilized to compensate for aircraft pitch and roll. The antenna provides a full 90° scan angle, + 12° tilt, and a 3.75 microsecond pulse width in both weather and ground mapping modes.

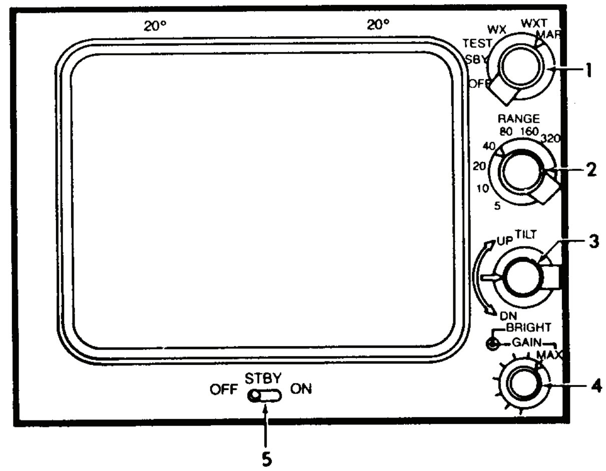
Extended Sensitivity Time Control (STC) increases the displayed intensity of storms outside the normal STC range. Extended STC relates the storm intensity to its distance and assigns a corresponding color. As a result, the display presents a more accurate picture of storm intensity.

Weather systems are displayed as four colors, depicting rainfall intensity overlaid with range rings. Bearing marks at dead ahead and 20° on either side aid the pilot in judging the bearing of storms and necessary heading changes.

With radar graphics interfaced, activate a circle mode by pressing the page button located on the radar graphics control panel. Functional operation in this mode is the same as in the standard display mode and is available in both weather and SBY modes. The range information is displayed in the upper right corner and represents the outer ring. The inside ring represents half the displayed distance. The off screen pointer is replaced by an RMI BUG placed on the outer ring in the direction of the active waypoint and color coded to each navigation system. Position of the aircraft is indicated by the green airplane symbol in the center of the screen.

Indicator brightness is adjustable to accommodate varying ambient light conditions while automatically maintaining equal brightness between the four display colors. The system is protected through a 5-ampere circuit breaker, placarded **RADAR**, located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

b. Controls and Functions. Refer to Figure 3B-20.



1. **Mode Selector Control Knob**
2. **RANGE Selector Control Knob**
3. **TILT Control Knob**
4. **BRIGHT/GAIN/MAX Control Knob**
5. **STBY OFF/ON Switch**

Figure 3B-20. Weather Radar Control Indicator

(1) Mode Selector Control Knob. The mode selector knob turns the system on and off and selects **SBY**, **TEST**, **WX**, **WXT**, and **MAP** positions.

(a) ***OFF.*** Turns the system off.

(b) ***SBY.*** In SBY mode the display is blanked and transmitter circuits are disabled with the magnetron heater remaining on.

(c) ***TEST.*** When placed in the test mode all circuitry is activated, except the transmitter. All weather colors will display for verification in the test mode as well as the WX, WXT, and MAP modes.

(d) ***WX.*** The WX mode is the normal weather mode with green for light, yellow for moderate, red for heavy, and magenta for extremely heavy precipitation.

(e) ***WXT.*** The WXT mode is used to alert the pilot of weather that is beyond the displayed range. Only returns of significant intensity between 83 and 320 nm are displayed with a white arc at the approximate azimuth of the storm. A yellow T on a red background will appear in the upper left corner of the display, indicating that a storm target has been located.

(f) ***MAP***. The MAP mode is used for terrain mapping. Prominent ground features such as lakes, bays, rivers, cities, coastlines, and offshore drilling rigs can be clearly discerned and used as a

navigation cross-reference. The display colors are changed in the MAP mode as follows: green to cyan, yellow stays the same, red to magenta, magenta to blue. When using the MAP mode, the gain control is used to adjust the prominence of ground features.

*(2) **RANGE** Selector Control Knob.* The range selector knob selects for displays, range at **5**, **10**, **20**, **40**, **80**, **160**, and **320** nm. This enables the pilot to select the displayed distance for most weather conditions that exist. There are four range calibration rings on each range setting with numerical read-out of their range in nautical miles. In addition to the range rings, bearing markers are positioned dead ahead and 20° to either side of the aircraft heading for use in judging the storm bearing and necessary heading changes.

*(3) Weather Radar Control Indicator **TILT** Control Knob.* The **TILT** knob is used to adjust the radar antenna angle + 12°, relative to the horizon. Proper tilt adjustment is one of the most important factors in obtaining optimum use from the weather radar. Too high an angle will pass the majority of the radar beam above the storm cell, particularly when the storm is a great distance away. Too low an antenna tilt will clutter the indicator with ground returns. The maximum distance at which ground clutter can be obtained will depend greatly on the terrain and aircraft altitude. The tilt setting is displayed in the top right corner of the screen. When the **STBY** switch is in the **ON** position the designation is replaced by STAB.

*(4) **BRIGHT / GAIN / MAX** Control Knobs.* These knobs control display brightness and manual adjustment of gain. Brightness of the display screen is fully adjustable to compensate for a range of ambient light levels, while automatically maintaining equal brightness between the three colors displayed. Likewise, the gain control can be manually adjusted in both weather and ground mapping modes to provide maximum flexibility in target interpretation. Whenever the gain is varied from the preset maximum level, the screen will annunciate VAR to remind the pilot to reset the gain for standard intensity levels.

*(5) **STBY OFF / ON** Selector Switch.* The selector knob permits the pilot to select gyro-stabilized control of the weather radar system. In the **ON** position, the radar's antenna scan is kept parallel to the horizon and at the same relative tilt angle previously selected. The displayed view is kept straight and level, despite changes in aircraft pitch and roll, thus preventing ground clutter from wiping out potential weather targets.

c. Weather Radar System Operation.

WARNING

Never operate the weather radar in the WX, WXT, or MAP modes on the ground when personnel are forward of the aircraft wing and within 5 feet of the aircraft nose. Failure to observe this warning may result in permanent damage to the eyes and other body organs of those persons.

NOTE

To increase the solid state circuitry reliability, it is recommended that the aircraft engines be started before applying power to the weather radar system.

(1) Turn On Procedure. Mode selector switch – Turn clockwise past detent to **SBY** position.

NOTE

Warmup period is approximately 10 seconds.

(2) Operating Procedure.

1. Mode selector switch – **TEST**. Verify that all four colors are present.

NOTE

If TEST mode is bypassed and WX, WXT, or MAP mode is selected, the display will light up, and the warmup annunciator in the lower left corner will illuminate. The transmitter will become operational after 60 seconds.

2. Mode selector switch – **SBY** while taxiing and until clear of personnel, then as required.

(3) Shutdown Procedure.

1. Mode selector switch – **OFF**.

3B-29. RADAR GRAPHICS.

a. Description. The KGR-358 radar graphics unit interfaces with the weather radar system (KWX-58), and receives navigation data from the flight management system (KNS-660). The unit can display NAV 1 or NAV 2 or both in a weather overlay, or as navigation information only display. In addition, NAV information can be viewed in a 360° (circle) display with weather in the top 90° sector. Two checklist modes are also provided for complete checklist capability when utilizing the pocket terminal.

With the KGR-358 in any of the NAV modes, the radar screen will display a normal weather picture plus the location of the waypoints listed in the active flight plan. Data referenced to NAV 1 is displayed in the lower left portion of the radar display. Data referenced to NAV 2 will display in the lower right portion of the display. Included in the data are the active waypoint name, the selected course bearing, and the aircraft position (radial to, and distance) from the active navigation fix. Aircraft magnetic heading is displayed in the upper left section of the radar display.

A line representing the course selected by the flight management system is drawn through the corresponding active waypoint. Selected course bearing for each NAV system is displayed with NAV data on each side of the screen. A waypoint line will also be displayed connecting the waypoints in numerical sequence. An R on the left side of the screen indicates all visible NAV aids selected by the flight management system will be displayed. The level of NAV aids displayed is indicated by one, two, or three dots on the left side of the R.

A joystick control is provided to move a waypoint to any position on the screen. The coordinates for this new waypoint will appear in the lower left or right corner depending upon which NAV is selected replacing the active waypoint data. If both NAV systems are selected the new coordinates will be displayed corresponding to NAV 1, and may be switched to NAV 2. Pressing the check button will cause the data to transfer to the flight management system and be fixed as a position on the earth. Once the data is transferred to the flight management system, the pilot may enter it as he desires.

A track line enables a quick determination of how many degrees deviation left or right of a present heading is needed to provide for a clear path through weather or to a new fix. The number of degrees and an L or R is shown in the upper left corner replacing the magnetic heading when track mode is in operation.

Power is provided for the unit through a 2-ampere circuit breaker, placarded **GRPH-DSPL**, located on the overhead circuit breaker panel, Figure 2-16, Sheet 3.

b. Controls and Functions. Refer to Figure 3B-21.

(1) Mode Selector Knob. Allows the operator to turn the unit on, and select desired mode.

(a) ***OFF****.* Power is removed from the unit when mode selector knob is in the **OFF** position.

(b) ***EMER.*** Checklists of emergency procedures for the aircraft are displayed in the emergency (**EMER**) mode. The emergency index contains the titles of the emergency checklists. The selected checklist item is shown in yellow while the others are shown in magenta.

(c) ***✓ LST****.* Selects the preprogrammed checklist for display.

(d) ***SBY****.* Selects the standby mode. Nothing is displayed on the screen when in the SBY mode.

(e) ***NAV 1****.* Selects NAV 1 information to be displayed. Data referenced to NAV 1 will be displayed in cyan, in the lower left portion of the radar display. If NAV data is invalid, the data will be replaced with dashes.

(f) ***NAV 2****.* Selects NAV 2 information to be displayed. Data referenced to NAV 2 will be displayed in yellow, in the lower right portion of the radar display. If NAV data is invalid, the data will be replaced with dashes.

(g) ***BOTH****.* Selects both NAV 1 and NAV 2 information to be displayed.

(2) Left/Right ***(⇐ ⇒)*** *Cursor Buttons.* When ⇐ or ⇒ is pressed, a track line will appear, and move in the direction indicated by the button pressed. The track line will disappear 10 seconds after the button has been released.

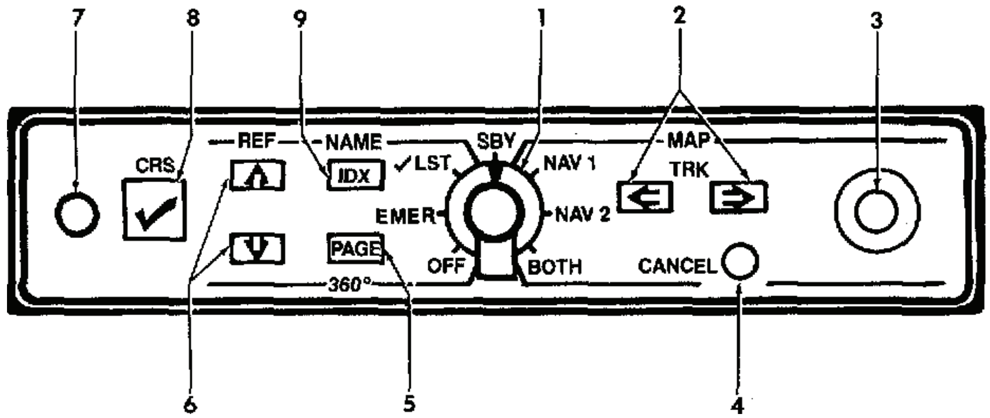
(3) Joystick. The joystick is used to move a waypoint to any position on the radar screen.

(4) ***CANCEL*** *Button.* When pressed, the **CANCEL** button will remove displays from the radar screen.

(5) ***PAGE*** *Button.* The **PAGE** button is used to view consecutive pages within a checklist. It is also used, along with the ⇑ or ⇓ buttons, to bypass items without checking them off, or return to items previously bypassed.

(6) Up/Down ***(⇑ ⇓)*** *Cursor Buttons.* The ⇑ and ⇓ buttons are used, along with the **PAGE** button, to bypass items in the checklist without checking them off, or return to items previously bypassed.

(7) Input Jack. Provides a means of connecting the pocket terminal to the unit



1. Mode Selector Knob
2. Left/Right Cursor Buttons
3. Joystick
4. CANCEL Button
5. PAGE Button
6. Up/Down Cursor Buttons
7. Input Jack
8. ✓ CRS Button
9. IDX Button

Figure 3B-21. Radar Graphics

*(8) ✓ **CRS** Button.* Pressing the ✓ **CRS** button causes the selected checklist to be displayed. With the checklist displayed, the ✓ **CRS** button is used to check off items. When the last item in a list is checked off, the display automatically returns to any items previously bypassed. When all items have been checked off, the display returns to the index with the next checklist selected. An **END OF LIST** statement follows the last title in an index and the last item in a checklist. The pilot may return to the index prior to checking off all items by pressing the **IDX** button.

*(9) **IDX** Button.* Allows the pilot to return to index.

c. Operating Procedures. The following statement is displayed in all modes except standby (**SBY**) when the unit is first turned on. The statement will automatically disappear after 20 seconds or can be made to disappear sooner by pressing the **CANCEL** button.

THE NAVIGATION DATA PRESENTED ON THIS SCREEN IS NOT TO BE USED FOR PRIMARY NAVIGATION. CONTENTS OF THE CHECKLISTS ARE THE RESPONSIBILITY OF THE USER /INSTALLER.

1. Mode selector - switch. As required.

3B-30. POCKET TERMINAL.

a. Description. The KA-68 pocket terminal is used to program normal and emergency checklist information into the radar graphics control panel. Refer to Figure 3B-22. The pocket terminal plugs into a jack on the front of the radar graphics unit.

b. Operating Procedures.

(1) Programming Checklist Index. The title of a checklist is programmed into the appropriate index by selecting the desired mode on the KGR-358 (**EMER**, or ✓**LST**) and pressing the **IDX** button, if necessary, to enter the index. Refer to Figure 3B-20. If the index already contains some titles, the ⇓ and ⇑ buttons are used to determine the location of the title to be added. If the number of index titles exceeds one page, the following pages may be selected by using the **PAGE** button rather than cycling through the index with the ⇓ or ⇑ buttons. The last page of each index is indicated by an **END OF LIST** statement.

NOTE

The @, [ ], /, characters cannot be written into the KGR-358 even though they are shown on the pocket terminal keyboard.

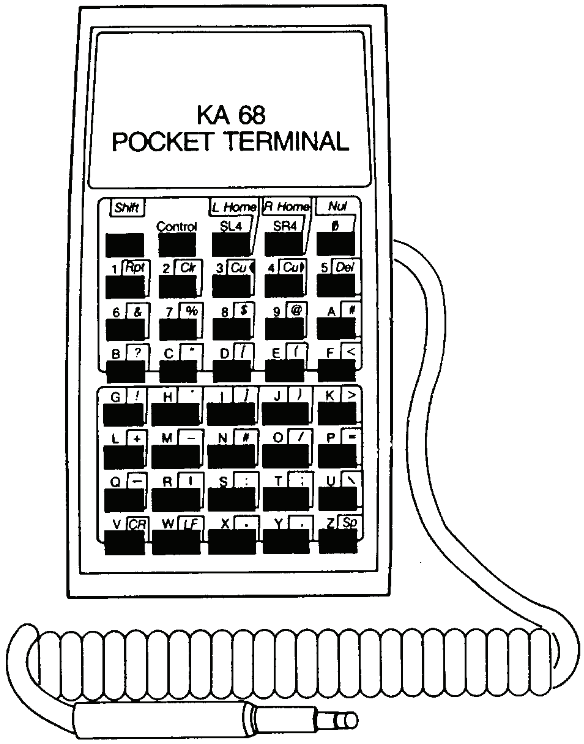


Figure 3B-22. Pocket Terminal

Enter the title by pressing the appropriate keys on the pocket terminal. The title may consist of any combination of alphanumeric characters, spaces or punctuation up to a length of 27 characters (1 line). Any of the shaded functions are obtained by pressing the **SHIFT** key prior to pressing the key with the desired function. For example, to obtain a space, press and release the **SHIFT** key and then press the key placarded **SP**. As the title is entered, a white CSR BLK appears to the right of the last entered character indicating the location where the next character will be inserted. When the title is complete, it must be terminated by a carriage return, **SHIFT** – **CR**, to make the cursor disappear.

(2) Programming Checklist Items. Enter the checklist item by pressing the appropriate keys on the pocket terminal. A checklist item may consist of any combination of alphanumeric characters, spaces, or punctuation up to a length of 15 lines (450 characters). If the item is longer than one line long, do not use the carriage return to move from one line to the next. Use spaces as necessary to move the cursor to the end of the line and to the beginning of the following line. The carriage return should be used only at the end of the entire item to make the cursor disappear.

(3) Error Correction. Error correction is accomplished with the delete function, **SHIFT – DEL**, on the pocket terminal. While in insert mode (cursor on the screen), pressing **SHIFT – DEL** will delete individual characters. Once an item has been terminated with a carriage return (no cursor on the screen), **SHIFT** – **DELETE** will delete the entire selected item (shown in yellow).

c. Special Functions. Certain special functions can be obtained on the pocket terminal by pressing the **CONTROL** key prior to pressing **X**, **C**, or **I**. **CONTROL – X** erases everything (all checklists) stored in nonvolatile memory in the KGR-358. After pressing **CONTROL – X**, the message ERASE ENTIRE MEMORY YES/NO appears on the radar screen. If **Y-E-S** is entered, the radar graphics unit will carry out the command. If **N-O** or any other key is pressed, the erase command is aborted. **CONTROL – C** on the pocket terminal duplicates the function of the **PAGE** button on the radar graphics control panel. **CONTROL – I** on the pocket terminal duplicates the function of the **IDX** button on the radar graphics control panel.

3B-31. GROUND PROXIMITY ALTITUDE ADVISORY SYSTEM.

WARNING

The ground proximity altitude advisory system will provide little, if any, warning for flight into precipitous terrain approaching a sheer wall if there is little gradually rising terrain before reaching the steep terrain.

a. Description. The Ground Proximity Altitude Advisory System (GPAAS) is provided to aid the flight crew in terrain avoidance. Refer to Figure 3B-23.

The GPAAS is a completely automatic system (requiring no input from the crew) which continuously monitors the aircraft's flight path at altitudes of between 100 and 2000 feet Above Ground Level (AGL).

The GPAAS computer processes the data and, when conditions warrant, selects the appropriate digitized voice advisory/warning message from its memory. This message is then announced over the pilot's and copilot's audio systems. If the condition is not corrected, the GPAAS will rearm, and will again announce and repeat the warning if the condition recurs. The GPAAS computer remains ready to announce a different message during the intervals between repetitions. All messages are disabled below 100 feet AGL.

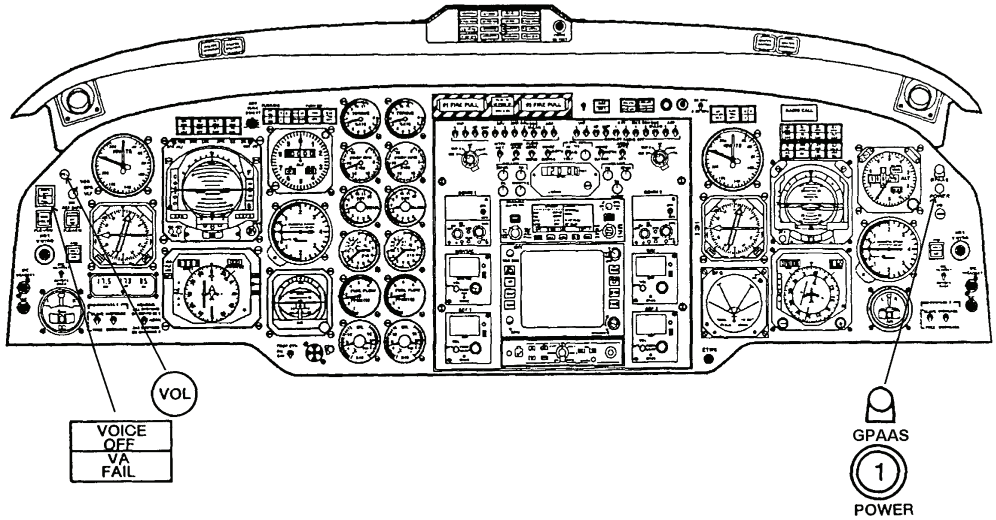


Figure 3B-23. Ground Proximity Altitude Advisory System Controls and Indicators

(1) GPAAS Circuit Breaker. The GPAAS system receives 28 Vdc power through a 1-ampere circuit breaker, placarded **GPAAS POWER**, located on the instrument panel.

(2) GPAAS Switch-Indicator Lights. A switch-indicator is located on the instrument panel. The upper half of the switch-indicator (yellow) is placarded **VOICE OFF**. The lower half is an indicator (red) only and is placarded **VA FAIL**.

Pressing the upper (**VOICE OFF**) switch-indicator disables the GPAAS voice advisory, and illuminates the **VOICE OFF** indicator light.

The **VA FAIL** annunciator light (red) will illuminate when the GPAAS fails.

(3) GPAAS Volume Control. GPAAS volume control, placarded **VOL**, located on the instrument panel, controls the audio volume of the GPAAS advisory/warning messages down to a certain minimum level.

(4) GPAAS Aural Warning Indications. The following is a list of aural indications. Due to the possibility of activating more than one condition at a time, a warning priority has been established. The highest priority message will be announced first.

If a higher priority item is received after a message is started, voice annunciation of the higher priority message shall be announced after a lower priority message in progress at the end of the message segment. It will not stop in the middle of a word. On messages that are repeated three times at 4-second intervals, the priority list will be scanned for higher priority messages and will insert them in the interval between the messages. The messages provided by the system are listed in descending order of priority as follows:

1. "Two thousand" at 2000 feet AGL.
2. "One thousand" at 1000 feet AGL.
3. "Nine hundred" at 900 feet AGL.
4. "Eight hundred" at 800 feet AGL.
5. "Seven hundred" at 700 feet AGL.
6. "Six hundred" at 600 feet AGL.
7. "Five hundred" at 500 feet AGL.
8. "Check gear" will be announced immediately after 500-foot announcement if gear is not down.
9. "Four hundred" at 400 feet AGL.
10. "Check gear" will be announced immediately after 400-foot announcement if gear is not down.
11. "Three hundred" at 300 feet AGL.

12. "Check gear" will be announced immediately after 300-foot announcement if gear is not down.

13. "Two hundred" at 200 feet AGL.

14. "Check gear" will be announced immediately after 200-foot announcement if gear is not down.

15. "One hundred" at 100 feet AGL.

16. "Check gear" will be announced immediately after 100-foot announcement if gear is not down.

17. "Minimum, minimum" at decision height.

18. "Localizer" at 1.3 to 1.5 dots either side of center of beam. Will be repeated three times at 4-second intervals.

19. "Glideslope" at 1.3 to 1.5 dots above or below center of beam. Will be repeated three times at 4-second intervals.

20. "Altitude, altitude" at excessive deviation from altitude selected on the altitude alerter.

21. "Check trim" when trim failure has occurred. Will be repeated three times at 4-second intervals.

22. "Autopilot" when autopilot has disconnected.

b. Normal Operation.

(1) Turn-on Procedure. The GPAAS is operable when the following conditions have been met.

1. Battery switch – **ON**.
2. Avionics master switch – On.
3. **GPAAS POWER** circuit breaker – Set.
4. **RADIO ALTM** circuit breaker – Set.
5. **VA FAIL** annunciator light – Extinguished.

(2) GPAAS Ground Check.

1. GPAAS voice advisory **VOL** control – Full clockwise.
2. **VOICE OFF** switch-indicator – Extinguished.
3. Audio control panel – Set audio level.
4. **VA FAIL** annunciator light – Extinguished.
5. Radio altimeter **DH SET** control – Set to 200 feet.
6. Radio altimeter **TEST** switch – Press and hold. "Minimum, minimum" will be annunciated once followed by the illumination of the **VA FAIL** light.
7. Radio altimeter **TEST** switch – Release.

c. GPAAS Modes of Operation. The GPAAS operates in the following modes of operation.

(1) Aural "Two Thousand" Advisory (Mode 1). The aural advisory "Two Thousand" indicates that the aircraft is at a radio altitude of 2000 feet AGL. This advisory is cancelled when valid information from the radio altimeter is lost, during climb, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(2) Hundred Foot Increment Aural Altitude Advisories (Mode 2). The aural advisories "One Thousand, Nine Hundred, Eight Hundred, Seven Hundred, Six Hundred, Five Hundred, Four Hundred, Three Hundred, Two Hundred, One Hundred" indicate that the aircraft is at the associated radio altitude in feet AGL. This advisory is cancelled when valid information from the radio altimeter is lost, during climb, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(3) Aural "Localizer" Advisory (Mode 3). The aural advisory "Localizer" indicates that the aircraft has deviated from the center of the localizer beam in excess of 1.3 to 1.5 dots. The localizer advisory is armed when a valid localizer signal is detected and the aircraft is below 1000 feet above ground level. It will be repeated no more that 3 times at 4-second intervals unless the aircraft is returned to less than 1.3 to 1.5 dots from the center of the localizer course. The localizer advisory is disabled when a valid localizer signal has been lost, during climb, below the decision height set on the radio altimeter, or if the navigation receiver is not tuned to a localizer frequency.

(4) Aural "Check Gear" Advisory (Mode 4). The aural "Check Gear" advisory indicates that the aircraft has descended to 500 feet AGL and the landing gear is not down. This advisory is repeated once at 100-foot intervals down to 100 feet AGL.

(5) Aural "Glideslope" Advisory (Mode 5). The aural advisory "Glideslope" indicates that the aircraft has exceeded 1.3 to 1.5 dots above or below the center of the glideslope beam. The glideslope advisory is armed when a valid glideslope signal is detected and the aircraft is below 1000 feet AGL. It will be repeated no more than three times at 4-second intervals unless the aircraft is returned to less than 1.3 to 1.5 dots from the center of the beam. The glideslope advisory is disabled upon loss of a valid glideslope signal, during climb, on a localizer back course, below the decision height set on the radio altimeter or if the navigation receiver is not tuned to a localizer frequency. This advisory is inhibited by the weight on wheels strut switch.

(6) Aural Advisory "Minimum, Minimum" (Mode 6). The aural advisory "Minimum, Minimum" indicates that the aircraft is at the radio altitude selected by the crew with the radio altimeter indicator's decision height knob. This advisory is cancelled when valid information from the radio altimeter is lost, during climb, whenever the aircraft is above 1000 feet AGL, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(7) Aural "Altitude, Altitude" Advisory (Mode 7). The aural advisory "Altitude, Altitude" indicates the approach to a preselected altitude as the aircraft reaches a point 1000 feet from the selected altitude or, after reaching the selected altitude, when the aircraft deviates more than 250 feet from the selected altitude.

(8) Aural "Check Trim, Check Trim, Check Trim" Advisory. The aural advisory "Check Trim, Check Trim, Check Trim" indicates that the autopilot has had a trim failure.

(9) Aural "Autopilot" Advisory. The aural advisory "Autopilot" indicates that the autopilot has disengaged.

d. Emergency Procedures. If an emergency or malfunction makes it necessary to disable the GPAAS, pull the **GPAAS POWER** circuit breaker located on the instrument panel (GPAAS audio may be turned off by pressing the **VOICE OFF** switch).

3B-32. TRANSPONDER SET (AN/APX-100).

For information on the transponder set, refer to Chapter 3, Paragraph 3-10.

CHAPTER 3C
AVIONICS T1 T2

Section I. GENERAL

3C-1. DESCRIPTION.

This chapter covers the avionics equipment configuration installed in C-12T1 and C-12T2 aircraft. It includes a brief description of the avionics equipment, its technical characteristics, capabilities, and locations. It covers systems and controls and provides the proper techniques and procedures to be employed when operating the equipment. For more detailed operational information, consult the vendor manuals that accompany the aircraft's loose tools.

3C-2. AVIONICS EQUIPMENT CONFIGURATION.

The avionics configuration of the aircraft consists of three groups of electronic equipment. The communication equipment group consists of the interphone and V/UHF, VHF, and HF communications transceivers and an Emergency Locator Transponder (ELT). The navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach on instruments in Instrument Meteorological Conditions (IMC). The navigation group includes equipment for determining altitude, attitude, position, destination, range, bearing, heading, groundspeed, and drift angle. The transponder and radar group includes an identification, position, a emergency tracking system, and a radar system to locate potentially dangerous weather areas. A Ground Proximity Altitude Advisory System (GPAAS), Traffic Alert and Avoidance System (TCAS-II), and Stormscope are also installed.

3C-3. POWER SOURCE.

a. DC Power. The avionics equipment is supplied with DC power from the aircraft battery, left and right generators, and external power. Power is routed through two 50-ampere circuit breakers to the avionics power relay, which is controlled by the avionics master power switch, located on the overhead control panel, Figure 2-15. Individual system circuit breakers and the associated avionics buses are shown in Figure 2-28. A three-position switch, placarded **AVIONICS MASTER POWER ON / EXT PWR**, located on the overhead control panel controls a relay which applies power to two 35-ampere circuit breakers, placarded **AVIONICS MASTER PWR #1 / #2**, located on the overhead circuit breaker panel, Figure 2-16. When the **AVIONICS MASTER POWER** switch is set to the **ON** (center) position, the avionics power relay is de-energized and power is applied through two 35-ampere circuit breakers, placarded **AVIONICS MASTER PWR #1 / #2**, located on the overhead circuit breaker panel.

NOTE

If the AVIONICS MASTER POWER switch fails to operate, power to the individual avionics circuit breakers can be provided by pulling the 5-ampere circuit breaker, placarded AVIONICS MASTER CONTR, located on the overhead circuit breaker panel.

In the off (aft) position, the relay is energized and power is removed from avionics equipment. When external power is applied to the aircraft, the avionics power relay is normally energized, automatically removing power from the avionics equipment. To apply external power to the avionics equipment, move the **AVIONICS MASTER POWER** switch to the **EXT PWR** position, which overrides the automatic avionics lockout system. This will de-energize the avionics power relay and allow power to be applied to the avionics equipment.

b. AC Power. AC power for the avionics equipment and ac engine instruments is provided by two 400 Hz 750 volt-ampere single-phase inverters. During normal operation, the number 1 inverter supplies 115 Vac and 26 Vac to the number 1 avionics and navigation system and the left engine ac instruments, while the number 2 inverter supplies 115 Vac and 26 Vac to the number 2 avionics and navigation system and the right ac engine instruments. If either inverter fails, the total ac load will be switched to the remaining inverter automatically, unless a ground fault exists. The inverters are controlled by two switches, placarded **INVERTER #1/ON** and **INVERTER #2/ON**, located on the overhead control panel.

Section II. COMMUNICATIONS

3C-4. DESCRIPTION.

The communications equipment group consists of an interphone system, V/UHF, VHF, and HF communications transceivers, and an ELT.

3C-5. MICROPHONE SWITCHES, MICROPHONE JACKS, AND HEADSET JACKS.

Refer to Chapter 3, Paragraph 3-5, for information on microphone switches, microphone jacks, and headset jacks.

3C-6. AUDIO CONTROL PANEL T .

a. Description. Individual audio control panels, part of the radio panel, are provided for the pilot and copilot. The controls and switches provide for a selection of transmission on V/UHF, VHF, or HF transmitters and volume control of communication, navigation, and interphone audio signals. Figure 3C-1 illustrates the pilots and copilot's audio control panel.

b. Controls and Functions.

(1) ***PILOT/COPILOT AUDIO OFF*** *Switches* – Permits monitoring of selected audio regardless of position of transmitter selector switch.

(a) ***VHF 1*** – Permits monitoring of #1 VHF audio.

(b) ***VHF 2*** – Permits monitoring of #2 audio.

(c) ***HF*** – Permits monitoring of HF audio.

(d) ***UHF*** – Permits monitoring of V/UHF audio.

(e) ***NAV 1*** – Permits monitoring of #1 NAV audio.

(f) ***NAV 2*** – Permits monitoring of #2 NAV audio.

(g) ***MKR BCN 1*** – Permits monitoring of 1 and 2 marker beacon audio.

(h) ***MKR BCN 2*** – Permits monitoring of 2 marker beacon audio.

(i) ***DME/TACAN*** – Permits monitoring of DME / TACAN audio.

(j) ***ADF 1*** – Permits monitoring of #1 ADF audio.

(k) ***ADF 2*** **–** Permits monitoring of #2 ADF audio.

(2) Copilot's Transmitter Selector Switch – Controls operation of selected system.

(a) ***VHF 1*** – Routes key and microphone signals to the #1 VHF transceiver.

(b) ***VHF 2*** – Routes key and microphone signals to the #2 VHF transceiver.

(c) ***HF*** – Permits reception of audio from the HF transceiver and routes key and microphone signals to the HF transceiver.

(d) ***UHF*** – Permits reception of audio from the UHF transceiver and routes key and microphone signals to the UHF transceiver.

(e) ***PA*** – Permits cabin paging.

(3) Copilot's ***AUDIO SPKR / OFF*** *Switch* – Determines where selected audio will be heard.

(4) Copilot's ***VOLUME*** *Control* – Controls audio volume.

(a) ***PH*** – Adjusts volume of headset.

(b) ***SPKR*** – Adjusts volume of cockpit speakers.

(c) ***PA / CABIN ADF*** – Adjusts volume of cabin speakers.

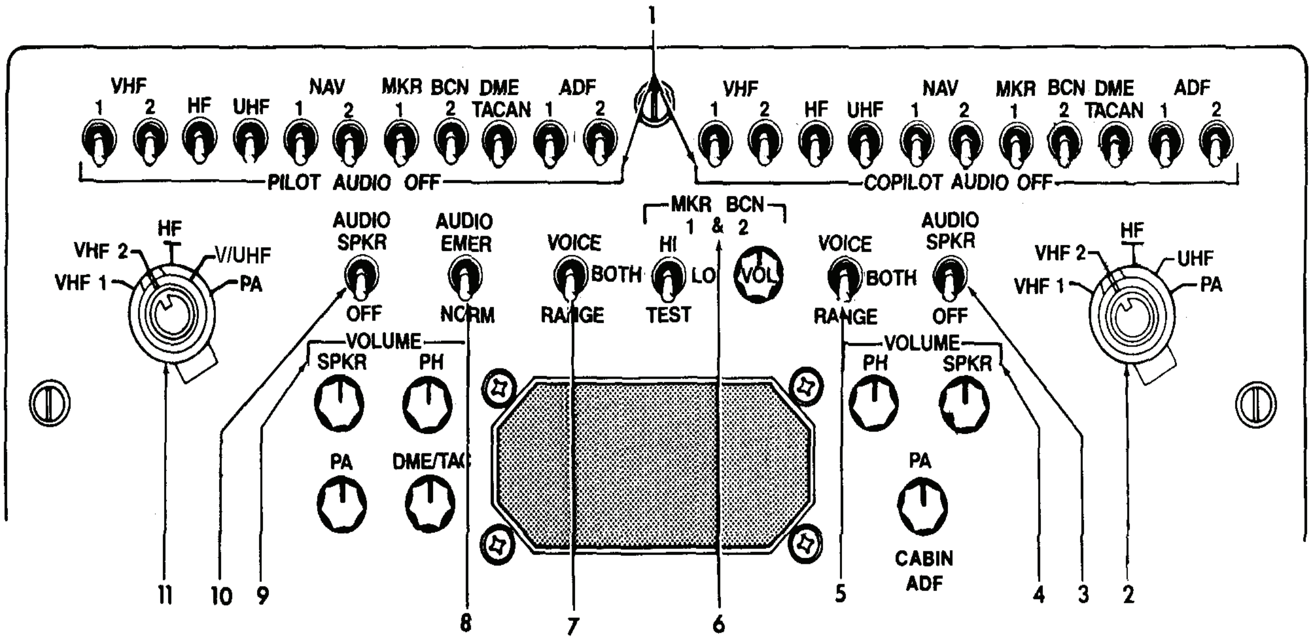
(5) Copilot's ***VOICE / BOTH / RANGE*** *Switch and* ***VOL*** *Control* – Controls both voice and range tone.

(a) ***VOICE*** – Kills range, allows voice (ADF and VOR).

(b) ***BOTH*** – Allows both voice and range (ADF and VOR).

(c) ***RANGE*** – Kills voice, allows 1020 Hz range tone (ADF and VOR).

(6) ***MKR BCN 1*** *and* ***2 HI / LO / TEST*** *and* ***VOL Control*** *Switch* – Selects either sensitivity or **TEST** function.



1. PILOT/COPILOT AUDIO OFF Switches
2. Copilot's Transmitter Select Switch
3. Copilot's AUDIO / SPKR / OFF Switch
4. Copilot's Audio VOLUME Controls
5. Copilot's VOICE / BOTH / RANGE Switch
6. MKR BCN HI / LO / TEST Switch & VOL Control
7. Pilot's VOICE / BOTH / RANGE Switch
8. AUDIO EMER / NORM Switch
9. Pilot's Audio VOLUME Controls
10. Pilot's AUDIO / SPKR / OFF Switch
11. Pilot's Transmitter Select Switch

Figure 3C-1. Audio Control Panel **T1**

(a) ***HI*** – Selects high sensitivity.

(b) ***LO*** – Selects low sensitivity.

(c) ***TEST*** – Permits testing of marked beacon annunciators.

(d) ***VOL*** *Control* – Adjusts volume of marker beacon audio.

(7) Pilot's ***VOICE / BOTH / RANGE*** *Switch* – Controls both voice and range tone.

(a) ***VOICE*** – Kills range, allows voice (ADF and VOR).

(b) ***BOTH*** **–** Allows both voice and range (ADF and VOR).

(c) ***RANGE*** – Kills voice, allows 1020 Hz range tone (ADF and VOR).

(8) ***AUDIO EMER / NORM*** *Switch* – Controls routing of received audio signals. Located on pilot's audio panel only.

(a) ***EMER*** – Audio signal bypasses amplifier. Applies audio signal to headphone only.

(b) ***NORM*** – Routes audio signal through amplifier to speaker or headphone.

(9) Pilot's ***VOLUME*** *Control* – Controls audio volume.

(a) ***SPKR*** – Adjusts volume of cockpit speakers.

(b) ***PH*** – Adjusts volume of headset.

(c) ***PA*** – Adjusts volume of cabin speakers.

(d) ***DME/TAC*** – Adjusts volume of DME/TAC audio. Located on the pilot's audio panel only.

(10) Pilot's ***AUDIO / SPKR / OFF*** *Switch* – Determines where selected audio will be heard.

(11) Pilot's Transmitter Selector Switch – Controls operation of selected system.

(a) ***VHF 1*** – Routes key and microphone signals to the #1 VHF transceiver.

(b) ***VHF 2*** – Routes key and microphone signals to the #2 VHF transceiver.

(c) ***HF*** – Permits reception of audio from the HF transceiver and routes key and microphone signals to the HF transceiver.

(d) ***V/UHF*** – Permits reception of audio from the V/UHF transceiver and routes key and microphone signals to the V/UHF transceiver.

(e) ***PA*** – Permits cabin paging.

c. Operation.

(1) Turn-on Procedure. The audio pilot and copilot control panel is on whenever electrical power is applied to the aircraft and the **AVIONICS MASTER POWER** switch is **ON**.

(2) Interphone Operating Procedure.

1. Transmitter Selector Switch – **PA**.
2. Microphone Switch – Press (listen for sidetone).
3. **VOLUME** Control – Adjust sidetone and interphone audio level in headphone.

(3) Navigational Aid and Receiver Monitoring Procedure.

1. Pilot and Copilot Switches – As required.
2. **VOLUME** Control – Adjust volume control of system being monitored.

(4) Transmitting Procedure.

1. Transmitter Selector Switch – As required.
2. Microphone Switch – Press (listen for sidetone).
3. Applicable Transceiver **VOLUME** Control – Adjust for comfortable audio level.

3C-7. AUDIO CONTROL PANEL T2 .

a. Description. The audio control panel, located on the instrument panel, Figure 2-17, contains controls and switches which provide the pilot and copilot with a means of selecting desired reception and transmission sources, and also a means of controlling the volume of audio signals received from interphone, communication, and navigation systems. Refer to Figure 3C-2. The user selects between the VHF, V/UHF, or HF transceivers. The audio control panel is fed through two 2-ampere circuit breakers, placarded **AUDIO PILOT** and **COPILOT**, located on the overhead circuit breaker panel, Figure 2-16.

b. Controls and Functions.

(1) Pilot and Copilot Receiver Audio Switches. The pilot and copilot are each provided with a set of the following list of receiver audio switches, which are located across the top of the audio control panel. These two position switches permit monitoring of the selected audio facility. These switches are listed in this paragraph using their placarded names. The switches are moved to the up position to select the desired audio facility and down to the off position, which is placarded either **PILOT AUDIO OFF** or **COPILOT AUDIO OFF**.

(a) ***VHF 1*** *Switch* – Permits monitoring of VHF 1 audio.

(b) ***VHF 2*** *Switch* – Permits monitoring of VHF 2 audio.

(c) ***HF*** – Permits monitoring of HF audio.

(d) ***V/UHF*** *Switch* – Permits monitoring of the ARC-210 audio.

(e) ***NAV 1*** *Switch* – Permits monitoring of the NAV 1 audio.

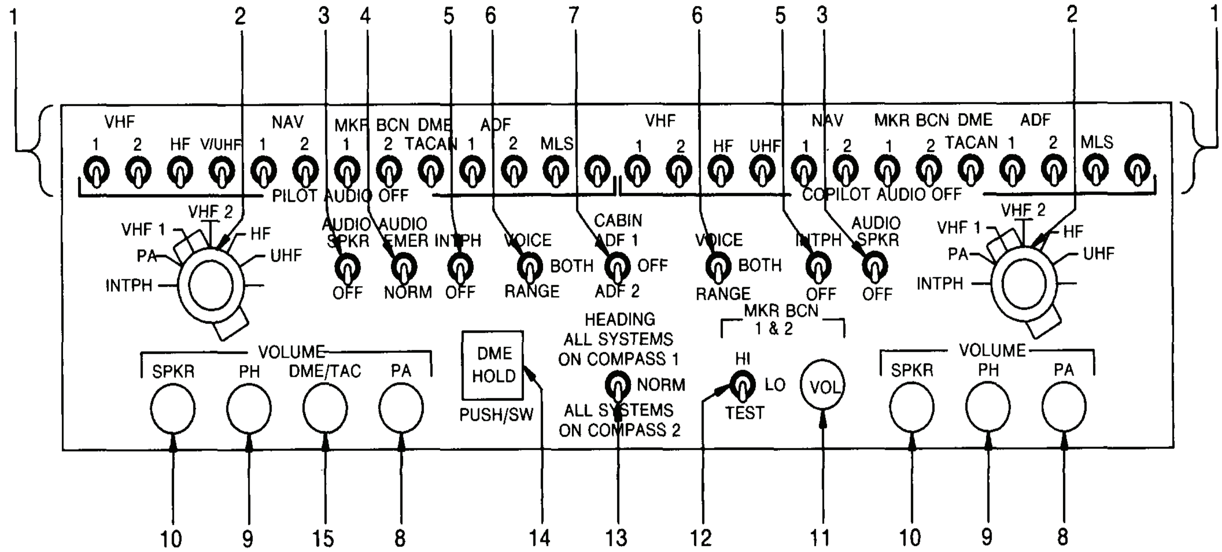
(f) ***NAV 2*** *Switch* – Permits monitoring of NAV 2 audio.

(g) ***MKR BCN 1*** *Switch* – Permits monitoring of marker beacon 1 or 2 audio.

(h) ***MKR BCN 2*** *Switch* – Permits monitoring of marker beacon 1 or 2 audio.

(i) ***DME/TACAN*** *Switch* – Permits monitoring of DME/TACAN audio.

(j) ***ADF 1*** *Switch* – Permits monitoring of ADF 1 audio.



1. **Receiver Audio Switches**
2. **Transmitter Selector Switch**
3. **AUDIO SPKR Switch**
4. **AUDIO EMER / NORM Switch**
5. **INTPH/OFF Switch**
6. **VOICE / RANGE / BOTH Switch**
7. **CABIN ADF Switch**
8. **Public Address Volume Control**
9. **Headphone Volume Control**
10. **Cockpit Speaker Volume Control**
11. **MKR BCN/VOL Control**
12. **MKR BCN HI / LO / TEST Switch**
13. **Compass System Selector Switch**
14. **DME HOLD Switch**
15. **DME/TAC Volume Control**

Figure 3C-2. Audio Control Panel **T2**

(k) ***ADF 2*** *Switch* – Permits monitoring of ADF 2 audio.

(l) ***MLS Switch*** – Non-functional.

(m) Unmarked Switch – Non-functional.

(2) Pilot and Copilot Transmitter-Selector Switches. The pilot and copilot are each provided with a transmitter-selector switch. These switches connect the user's microphone and headset to the selected radio transmitter, intercom, or paging system, regardless of the position of the respective receiver audio switch.

(a) ***INTPH.*** When the pilot's or copilot's transmitter selector switch is set to the **INTPH** position, the pilot at that station is able to talk to the other pilot by pressing his microphone switch and speaking into his microphone. He will not be able to receive the other pilot's intercom transmission unless the other pilot's transmitter/selector switch is also set to the **INTPH** position, or the **INTPH/OFF** switch is in the interphone position and the audio speaker switch is in the **OFF** position.

(b) ***PA*** – Setting the transmitter selector switch to the **PA** (public address) position allows the pilot at that station to speak through the four cabin speakers when his microphone is keyed. Talking through the PA speakers will override cabin ADF audio.

(c) ***VHF 1.*** Setting the transmitter selector switch to the **VHF 1** position routes key and microphone signals to the number 1 VHF transmitter.

(d) ***VHF 2.*** Setting the transmitter selector switch to the **VHF 2** position routes key and microphone signals to the number 2 VHF transmitter.

(e) ***HF.*** Setting the transmitter selector switch to the HF position routes key and microphone signals to the HF transmitter.

(f) ***UHF****.* Setting the transmitter selector switch to the **UHF** position routes key and microphone signals to the ARC-210 transmitter.

(3) Pilot and Copilot ***AUDIO SPKR*** *Switch.* The pilot and copilot are each provided with a switch placarded **AUDIO SPKR/OFF**, located on the pilot's and copilot's side of the audio control panel, which provide a means of controlling audio to the respective pilot's and copilot's speaker system. When either of these switches is set to the **SPKR** position, audio is applied to the respective speaker system. When set to the **OFF** position audio is removed from the respective

speaker system. Headphone audio is independent of the position of these switches.

*(4) **AUDIO EMER / NORM** Switch.* A two-position switch, placarded **AUDIO EMER / NORM**, located on the pilot's side of the audio control panel, provides a means of selecting a secondary audio source in the event of a failure disabling both audio amplifiers. When the switch is set to the **EMER** position, power is removed from both audio amplifiers and audio is routed directly from the receivers to the headphones. Speaker audio and cabin public address will be inoperative. When the switch is set to the **NORM** position, audio is routed normally through amplifier to speakers or headphones.

*(5) **INTPH/OFF** Switch.* The pilot and copilot are each provided with a two-position switch placarded **INTPH OFF**, located on their respective sides of the audio control panel, which controls the operation of their voice-actuated interphone systems. When the switch is set to the **INTPH** position, the headset microphone of the pilot at that station will be actuated whenever the microphone is spoken into, and will be heard by the other pilot. When both the pilot's and copilot's **INTPH** switches are ON (up), continuous voice-actuated intercom is available. When the switch is set to the **OFF** position, voice-actuated intercom operation is discontinued. The interphone switch is connected through the speaker **OFF** switch to disable the hot interphone when the speaker is ON.

*(6) **VOICE / BOTH / RANGE** Switch.* The pilot and copilot are each provided with a three-position switch placarded **VOICE / BOTH / RANGE**, located on their respective sides of the audio control panel, which controls selection of ADF voice or range filtering. When the switch is set to the **VOICE** position, the range tone is disabled, enhancing voice identification. When the switch is set to the **RANGE** position, the 1020 Hz range tone is enhanced, and voice is suppressed.

*(7) **CABIN ADF** Switch.* A two-position switch placarded **CABIN ADF 1 / OFF / ADF 2**, located in the center of the audio control panel, controls the selection of ADF audio which is routed to the four cabin speakers. When set to the **ADF 1** or **ADF 2** position, audio from the respective ADF 1 or ADF 2 receiver is channeled to the cabin speakers. When set to the **OFF** position, ADF audio is removed from the cabin speakers.

(8) Pilot and Copilot Public Address Volume Control. This knob, placarded **PA**, adjusts audio volume to the four cabin speakers.

(9) Pilot and Copilot Headphone Volume Control. This knob, placarded **PH**, adjusts audio volume to headphones.

(10) Pilot and Copilot Cockpit Speaker Volume Control. This knob, placarded **SPKR**, adjusts audio volume to cockpit speakers.

*(11) **MKR / BCN / VOL** Control.* The marker beacon volume control knob, placarded **MKR BCN 1 & 2, VOL**, is used to control the audio volume from the marker beacon receivers.

*(12) **MKR BCN HI / LO / TEST** Switch.* A three-position switch, placarded **MKR BCN 1 & 2**, **HI / LO / TEST**, located on the audio control panel, selects sensitivity of the marker beacon receivers and test function. When the switch is set to the **HI** position, the marker beacon receivers are set to high sensitivity. When the switch is set to the **LO** position, the marker beacon receivers are set to low sensitivity. When the switch is held in the spring-loaded **TEST** position, the marker beacon annunciator lights will be illuminated.

(13) Compass System Selector Switch. A three position **HEADING** switch placarded **ALL SYSTEM ON COMPASS 1 / NORM / ALL SYSTEMS ON COMPASS 2** is located in the center of the audio control panel. This switch allows the selection of heading data to be all systems on compass 1 or all systems on compass 2 or norm, pilot on compass 1 and copilot on compass 2.

*(14) **DME HOLD** Switch.* A push-on/push-off switch, placarded **DME HOLD PUSH/SW**, located on the audio control panel, controls selection of the DME hold function. When the **DME HOLD** switch is pushed to the on position, the DME/TACAN distance frequency in the DME/TACAN receiver-transmitter will be held constant regardless of the frequency selected on the NAV 1 control unit. The **DME HOLD** switch will illuminate when the DME hold function is selected, and will be extinguished when DME hold function is deselected. The **DME HOLD** switch is disabled in TACAN mode or if the FMS is controlling the DME.

*(15) **DME/TACAN** Volume Control.* This knob, placarded **DME/TAC**, located on the pilot's side of the audio control panel only, adjusts DME or TACAN audio volume.

c. Operation.

(1) Turn-on Procedure. Electrical power is applied to the audio control panel whenever electrical power is applied to the aircraft and the **AVIONICS MASTER POWER SWITCH** is set to the **ON** position.

(2) Interphone Operating Procedure (Voice-Actuated Continuous Microphone Availability).

1. Pilot's and copilot's interphone switches – Set to **INTPH**.

2. Pilot's and copilot's speaker switches – Set to **OFF**.

3. Begin speaking into headset microphone to actuate intercom operation.

4. **VOLUME** controls – Adjust audio level in headphones.

(3) Interphone Operating Procedure (Press-To-Talk Microphone Operation).

1. Microphone switch – Press to first level then speak into microphone.

OR

2. Pilot's and Copilot's Transmitter Selector Switches – **INTPH**.

3. Microphone Switch – Press second level then speak into microphone.

OR

4. Copilot – Press foot-switch then speak into microphone.

(4) Navigation Aid and Receiver Monitoring Procedure.

1. Receiver Audio Monitor Switches – Set switches of desired receivers to on "up" position.

2. **VOLUME** Control – Adjust individual receiver being monitored.

(5) Transmitting Procedure.

1. Transmitter Selector Switch – Set to desired transmitter.

2. Microphone Switch – Press.

3. Speak into microphone.

d. Emergency Operation.

1. **AUDIO EMER / NORM** Switch – Set to **EMER**.

2. Pilot/Copilot Audio Switches – **OFF**. Audio will bypass the amplifiers and will be applied directly to the headsets. Turn **OFF** unused receivers or turn down individual **VOLUME** controls to eliminate undesired audio.

3C-8. V/UHF COMMUNICATIONS TRANSCEIVER (AN/ARC-210(V)).

a. Description. The AN/ARC-210(V) Communication System provides multimode voice and data communications in either normal or jam-resistant modes via Line Of Sight (LOS). It operates in the 30-400 MHz frequency range (VHF/UHF) and on AM and FM single channel operation.

b. Table 3C-1 lists the frequency coverage and modulation available with the AN/ARC-210(V) Radio.

Table 3C-1. AN/ARC-210(V) Frequency Coverage and Modulation

FREQUENCY RANGE (MHz)	MODULATION
30-88	FM Clear/Secure Voice/Data
108-136	AM Clear/Secure Voice/Data (108-118 MHz receive only)
136-156	FM Clear/Secure Voice/DATA
156-174	FM – (Maritime)
225-400	AM/FM – Voice/Data HAVE QUICK and SATCOM
121.5 (Guard)	AM
243.0 (Guard)	AM of FM

c. Refer to Paragraph 3C-25, Automatic Flight Control, for operating procedures.

3C-9. VHF COMMUNICATIONS TRANSCEIVERS (VHF-22C).

a. Introduction. The VHF communications transceivers provide airborne VHF communications on 772 channels from 118.00 through 136.990 MHz, and is operated by two CTL-22 transceiver control units.

The solid-state transceiver includes capture-effect automatic squelch to help prevent missed radio calls, plus audio leveling and response shaping to insure audio quality. Transmitter sidetone comes from detected transmitter signal, and is therefore a reliable check of transmission quality. Each VHF transceiver is powered through its respective circuit breaker, placarded **VHF # 1** or **VHF # 2**, located on the circuit breaker panel.

b. VHF Transceiver Operating Controls (VHF-22C). All operating controls for the transceivers are located on the CTL-22 transceiver control units. Refer to Figure 3C-3.

(1) Active Frequency Display. Displays the active frequency (frequency to which the transceiver is tuned) and diagnostic messages.

(2) Transfer/Memory Switch. This switch is a three-position spring-loaded toggle switch placarded **XF / MEM**, which, when held to the **XF** position, causes the preset frequency to be transferred up to the active display and the transceiver to be returned. The previously active frequency will become the new preset frequency and will be displayed in the lower window. When this switch is held to the **MEM** position, one of the six stacked memory frequencies will be loaded into the preset display. Successive pushes will cycle the six memory frequencies through the display (...2, 3, 4, 5, 6, 1, 2, 3...).

(3) Store Button. This button, placarded **STO**, allows up to six preset frequencies to be selected and entered into the control unit's memory. After presetting the frequency to be stored, push the **STO** button. The upper window displays the channel number of available memory (CHAN 1 through CHAN 6) while the lower window continues to display the frequency to be stored. For approximately 5 seconds, the **MEM** switch may be used to advance through the channel numbers without changing the preset display. Push the **STO** button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

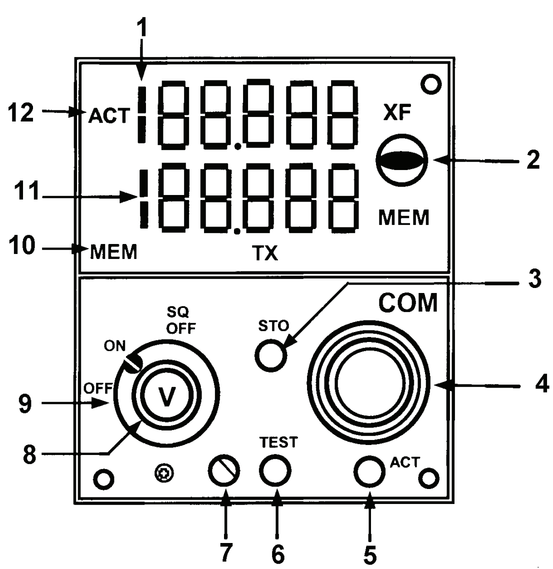
(4) Frequency Select Knobs. Two concentric tuning knobs control the preset or active frequency displays. The larger knob changes the three digits to the left of the decimal point in 1-MHz steps. The smaller knob changes the three digits to the right of the decimal point. The knob is “Rate Aided.” The faster the kHz knob is turned, the more channels will be skipped. A single click of the kHz knob will either increase or decrease the channel by a single channel.

(5) Active Button. The active button, placarded **ACT**, enables the tuning knobs to directly tune the VHF transceiver, when depressed and held for 2 seconds. The bottom window will display dashes and the upper window will continue to display the active frequency. Pushing the **ACT** button a second time will return the control unit to the normal two-display mode.

*(6) **TEST** Button*. This button, placarded **TEST**, initiates the transceiver self-test diagnostic routine. Self-test is active only when the **TEST** button is pressed.

(7) Light Sensor. This built-in light sensor automatically controls display brightness.

(8) Volume Control. The volume control, placarded **V**, is concentric with the power and mode switch.



1. Active Frequency Display
2. Transfer/Memory Switch
3. Store Button
4. Frequency Select Knobs
5. Active Button
6. TEST Button
7. Light Sensor
8. Volume Control
9. Power and Mode Switch
10. Annunciators (MEM TX)
11. Preset Frequency Display
12. Compare Annunciator

Figure 3C-3. VHF Transceiver Control Unit

(9) Power and Mode Switch. The power and mode switch contains three detented positions. The **ON** and **OFF** positions switch system power. The **SQ OFF** position disables the receiver squelch circuits.

(10) Annunciators. The transceiver control unit contains a **MEM** (memory) and a **TX** (transmit) annunciator. The **MEM** annunciator illuminates whenever a preset frequency is being displayed in the lower window. The **TX** annunciator illuminates whenever the transceiver is transmitting.

(11) Preset Frequency Display. Displays the pre-set (inactive) frequency and diagnostic messages in the lower window.

(12) Compare Annunciator. An annunciator, placarded **ACT**, momentarily illuminates when frequencies are being changed. The **ACT** annunciator flashes if the actual radio frequency to which the transceiver is tuned is not identical to the frequency shown in the active frequency display.

WARNING

If two communications transceivers in the same aircraft are tuned to stations carrying the same voice message, attempting to listen to the received signals from both simultaneously could result in a great reduction in the actual audio volume.

c. Operating Procedures. The 8.33 kHz capable CTL-22C shows the VHF COM frequency as a channel frequency using all six digits of the display. There are no 8.33 kHz channels above 136.992 MHz. The last "channel name" is 136.990, which is an actual frequency of 136.9917 MHz. Table 3C-2 shows the channel/frequency scheme for the 180.000 to 136.992 MHz range. While the CTL is in the frequency range of 137.000 to 151.975 MHz, the unit behaves the same as a 25 kHz only unit.

NOTE

It is possible that erroneous operation could occur without a fault indication. It is the responsibility of the pilot to detect such an occurrence by continually assessing the reasonableness of operation as displayed on the associated transceiver control unit and by the quality of received signals and transmissions.

(1) Equipment Startup. The transceiver and the control unit are turned on by rotating the power and mode switch on the transceiver control unit to the **ON** position. When the transceiver is first turned on, it sounds a brief tone while the microprocessor checks its own memory. If there is a memory defect the tone continues, indicating that the transceiver can neither receive nor transmit. After the memory check, the transceiver control unit will display the same active and preset frequencies that were present when the equipment was last turned off.

Table 3C-2. VHF Communications Transceiver Control Unit Channel/Frequency Scheme (118.000 To 136.992 MHz Range)

FREQUENCY	SPACING (kHz)	CHANNEL NAME (DISPLAYED)	FREQUENCY	SPACING (kHz)	CHANNEL NAME (DISPLAYED)
118.0000	25.00	118.000	118.0750	25.00	118.075
118.0000	8.33	118.005	118.0750	8.33	118.080
118.0083	8.33	118.010	118.0833	8.33	118.085
118.0167	8.33	118.015	118.0917	8.33	118.090
118.0250	25.00	118.025	118.1000	25.00	118.100
118.0250	8.33	118.030	•	•	•
118.0333	8.33	118.035	•	•	•
118.0417	8.33	118.040	•	•	•
118.0500	25.00	118.050	136.9750	25.00	136.975
118.0500	8.33	118.055	136.9750	8.33	136.980
118.0583	8.33	118.060	136.9833	8.33	136.985
118.0667	8.33	118.065	136.9917	8.33	136.990

NOTE

If two short 800-Hz tones are heard, the transceiver has detected an internal fault. Push the TEST button on the transceiver control unit to initiate self-test and display the fault code.

Adjust the volume and perform a quick squelch test by setting the power and mode switch on the transceiver control unit to **SQ OFF** and adjusting the volume level with background noise. After a comfortable listening level has been established, return the power and mode switch to the **ON** position. AU background noise should disappear unless a station or aircraft is transmitting on the active frequency the fault code.

(2) Frequency Selection. Frequency selection is made using either the frequency select knobs, or the **XF / MEM** recall switch.

NOTE

There is usually an installer supplied 8.33/25 kHz select switch in the cockpit. This switch provides a convenience to the pilots by not having to "ratchet pass" the 8.33 kHz channels when not operating in 8.33 airspace. The selected position of the (8.33 or 25) may or may not be annunciated, depending on installation.

After the desired frequency is set into the preset frequency display, it can be transferred to the active frequency display by momentarily setting the **XF / MEM** switch to **XF**. At the same time that the preset frequency is transferred to the active display, the previously active frequency is transferred to the preset display. A short audio tone is applied to the audio system to indicate that the active frequency has been changed, and the active (**ACT**) annunciator on the control will flash while the transceiver is tuning to the new frequency.

NOTE

The ACT annunciator continuing to flash indicates that the transceiver is not tuned to the frequency displayed in the active display.

The transceiver control unit's memory permits storing up to six preset frequencies. Once stored, these frequencies can be recalled to the preset display by positioning the **XF / MEM** switch to the **MEM** position. The storage location (CHAN 1 through CHAN 6) for the recalled frequency is displayed in the active frequency display while the **XF / MEM** switch is held in the **MEM** position. All six stored frequencies can be displayed one at a time in the preset display by repeatedly positioning the **XF / MEM** switch to the **MEM** position. After the desired stored frequency has been recalled to the preset display, it can be transferred to the active display by momentarily positioning the **XF / MEM** switch to the **XF** position.

During normal operation, all frequency selections and revisions are done in the preset frequency display. However, the active frequency can be selected directly as described in the following paragraph.

(3) Direct Active Frequency Selection. The active frequency can be selected directly with the frequency select knobs by pushing the **ACT** button for about 2 seconds. The active frequency selection mode is indicated by dashes appearing in the preset display. Also, the **ACT** annunciator will flash as the frequency select knobs are turned to indicate that the transceiver is being returned.

NOTE

The ACT annunciator continuing to flash after the frequency has been selected indicates that the transceiver is not tuned to the frequency displayed in the active display.

To return to the preset frequency selection mode, push the **ACT** button again for about 2 seconds. As a safety feature, the transceiver control unit switches to the active frequency selection mode when a frequency select knob is operated while the **STO** and **TEST** buttons, or **XF / MEM** switch are actuated.

(4) Frequency Storage. To program the memory, select the frequency in the preset frequency display using the frequency select knobs and push the **STO** button once. One of the channel numbers (CHAN 1 through CHAN 6) will appear in the active display for approximately 5 seconds. During this time the channel number can be changed without changing the preset frequency by momentarily positioning the **XF / MEM** switch to the **MEM** position. After the desired channel number has been selected, push the **STO** button again to store the frequency.

NOTE

When storing a frequency, the second actuation of the STO button must be done within 5 seconds after selecting the channel number or the first actuation of the STO button. If more than 5 seconds elapse, the control will revert to the normal modes of operation and the second store command will be interpreted as the first store command.

After a frequency has been stored in memory, it will remain there until changed by using the **STO** button. Memory is retained even when the unit is turned off for an extended period of time.

(5) Stuck Microphone Switch. Each time the push-to-talk switch is pressed, the microprocessor in the transceiver starts a 2-minute timer. The **TX** annunciator on the transceiver control unit will be illuminated whenever the transmitter is transmitting. If the transmitter is still transmitting at the end of 2 minutes, the microprocessor turns it off. Most intentional transmissions last much less than 1 minute; a 2-minute transmission is most likely the result of a stuck microphone switch. This timing feature protects the ATC channel from long-term interference.

When it turns off the transmitter, the microprocessor switches the transceiver to receive operation. A stuck microphone switch will prevent you from hearing received signals, or the two warning beeps. The microprocessor then waits until the push-to-talk switch opens to sound the two beeps.

To transmit for more than 2 minutes, release the microphone switch briefly and then press it again. The 2-minute timer resets and starts a new count each time the microphone switch is pressed.

(6) Overtemperature Protection. The microprocessor regularly monitors the temperature of the transmitter. If the transmitter gets too hot during a transmission, the microprocessor will stop the transmission, and the sidetone will cease. When the microphone switch is released, you will hear two beeps. Press the **TEST** switch on the transceiver control unit to observe the fault code. As long as the temperature remains above the limit, the micro-processor will not respond to a normal push of the microphone switch. If you must transmit, however, you can override the protection by rapidly keying the microphone switch twice, holding it on the second push. The shutdown temperature is 160 °C (320 °F).

(7) Self-test. An extensive self-test diagnostic routine can be initiated in the transceiver by pushing the **TEST** button on the transceiver control unit. The control unit will modulate the active and preset display intensity from minimum to maximum to annunciate that self-test is in progress. Several audio tones will be heard from the audio system while the self-test routine is being executed. At the completion of the self-test program, the transceiver control unit will usually display dashes in the active display, and 00 in the preset display. This indicates normal operation. If any out-of-limit condition is found, transceiver control unit will display DIAG (diagnostic) in the active display and a 2-digit fault code in the preset display. Record any fault codes displayed to help the service technician locate the problem. Refer to Table 3C-3 for a description of the self-test fault codes that can be displayed on the transceiver control unit. The **TEST** button must be pushed before any fault code can be displayed.

Table 3C-3. Self-test Codes

FAULT/CODE DESCRIPTION			
00	No fault found	15	Frequency out of range
01	5 Vdc below limit	16	Forward power below limit
02	5 Vdc above limit	17	Transmitter temperature excessive
03	12 Vdc below limit	21	Tuning voltage out of limit at highest receive frequency
04	12 Vdc above limit	22	Tuning voltage out of limit at 118 MHz
05	Synthesizer not locked	23	Local oscillator output below limit
07	Noise squelch open without signal	24	No-signal AGC voltage too high
08	Noise squelch open without signal	25	Inadequate AGC voltage increase with rf signal
12	BCD frequency code invalid	26	Reflected rf power above limit
13	2/5 frequency code invalid	27	Transmitter timed out
14	Serial message invalid		

3C-10. HF COMMUNICATIONS TRANSCEIVER (KHF 950).

a. Description. The HF communications transceiver provides long-range voice communications within the frequency range of 2.0000 to 29.9999 MHz (280,000 possible frequencies). The unit can employ either amplitude modulation (AM), upper sideband (USB) modulation, or lower sideband (LSB) modulation. The KHF-950 HF system consists of a KCU-951 control display unit located on the pedestal extension (Figure 2-9), a KTR-953 receiver/exciter, and KAC-952 power amplifier/antenna coupler (the latter two items are located aft of the rear pressure bulkhead). The system is powered through a 25-ampere circuit breaker placarded **HF PWR**, and a 5-ampere circuit breaker placarded **HF REC**. Both circuit breakers are located on the overhead circuit breaker panel (Figure 2-16).

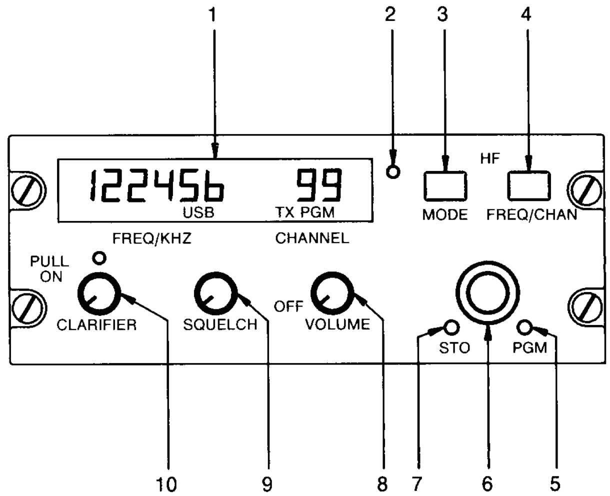
b. HF Transceiver Control/Display Unit Controls and Functions. Refer to Figure 3C-4.

(1) Digital Display. A digital display located on the upper left portion of the control display unit provides frequency, mode, and operational status information. The upper (larger) display shows 6-digit frequency information, and two-digit channel numbers. The lower (smaller) display shows signal emission mode (LSB, AM, and USB) transmitter operation (TX), and program mode (PGM). Display brightness is controlled by a dimming control, placarded **HF**, located left of the altitude alert indicator on the instrument panel.

(2) Photocell. A photocell, located to the right of the display, senses ambient light conditions and adjusts display brightness accordingly.

(3) Emission Mode Switch. A push-button switch placarded **MODE**, located on the HF control unit, selects transmission and reception mode. Momentary pressing of the **MODE** switch cycles the system from Upper Sideband (USB) mode, to Lower Sideband (LSB), to Amplitude Modulation (AM) modes. Mode selection is indicated on the display by the illumination of the respective USB, LSB, or AM annunciators.

(4) Frequency/Channel Switch. A two-position push-button switch, placarded **FREQ/CHAN**, located on the upper right portion of the HF control unit controls the method of frequency selection. When the switch is in the out position, the system is in the direct frequency tuning (simplex) mode. When the switch is in the pressed position, the system is in the preset channel mode.



1. **Digital Display**
2. **Photocell**
3. **Emission Mode Switch**
4. **Frequency/Channel Switch**
5. **Program Switch**
6. **Tuning Knobs**
7. **Store Switch**
8. **OFF/Volume Control**
9. **SQUELCH Control**
10. **CLARIFIER Control**

Figure 3C-4. HF Transceiver Control-Display Unit (KCU-951)

(5) Program Switch. A momentary push button switch, placarded **PGM**, located on the lower right side of the HF control unit, causes the system to enter the program mode when pressed. When the system is in the program mode, frequencies and the transceiver emission mode may be assigned to a preset channel number and stored in the memory for future use.

(6) Tuning Knobs. Two concentric tuning knobs on the HF control unit are provided to set frequencies and preset channel numbers. The outer knob becomes a cursor control (flashing light) with the frequency/channel switch in the **FREQ** (out) position. The cursor is moved over the digit which is to be changed by rotating the outer concentric tuning knob, causing the digit to flash. The flashing digit can then be changed by rotation of the inner concentric knob. When all digits have been changed, the cursor should be stowed by moving it to the right or left of the display, then turning the tuning knob one more click to position the cursor off the display. To recall the flashing cursor, twist the larger concentric tuning knob in either direction until the cursor reappears.

(7) Store Switch. A momentary push-button switch, placarded **STO**, is located on the HF control

panel to the left of the tuning knobs is used to store in memory the displayed data when programming preset channels.

*(8) **OFF / VOLUME** Control.* A knob, placarded **OFF / VOLUME**, located on the HF control panel turns the system off and on and controls volume. Clockwise rotation from the detent applies power to the system. Further clockwise rotation increases audio output level.

*(9) **SQUELCH** Control.* A knob placarded **SQUELCH** on the HF control unit provides a variable squelch threshold control.

*(10) **CLARIFIER** Control*. A knob placarded **CLARIFIER PULL ON** located on the lower left corner of the HF control unit is used to eliminate unnatural audio quality when operating in the Single Sideband (SSB) mode by slightly shifting the receiver generated frequency to match the frequency of the signal being received. To operate the clarifier, the knob is pulled out and rotated in either direction from the index mark (which is located directly above the clarifier knob) until the audio quality is optimized. When the voice quality is natural the clarifier knob should be pushed in. Turning the clarifier knob has no effect when it is pushed in.

c. Frequency Selection. The HF system has two methods of frequency selection, frequency mode and channel mode. In the frequency mode, frequencies are tuned directly on the display using the tuning knobs. In the channel mode, preset channels are programmed with an assigned channel number (1 through 99) and stored in memory.

(1) Frequency Mode. In the frequency mode, the desired frequency is set into the display using the tuning knobs. Only simplex operation is allowed while operating in the frequency mode.

(2) Channel Mode. When the HF control unit is in the channel mode, channels and their respective frequencies are changed using the tuning knobs. To place the unit into the channel mode, press the **FREQ/CHAN** switch. This allows access to existing programmed channels. Frequencies in the channel mode are stored with channel number, emission mode (USB, LSB, or AM), and transmit and receive frequency.

(3) Program Mode. When the HF control unit is in the program mode, channel numbers, emission mode (USB, LSB, or AM), and transmit and receive frequency are set up and stored in memory. The program mode is entered from the channel mode by pressing the **PGM** switch with a pencil or other pointed object. When in the program mode, channel number, emission mode, and transmit frequency are all displayed. Transmitter operation is inhibited. The transmit frequency may be examined by keying the microphone. Channels may be programmed for the following types of operation.

(a) Receive Only. The operator programs a frequency in the receive portion of transmit frequency. The transmitter is locked out when a channel has been programmed for receive only operation. The receive-only function is used for listening to weather, time, omega status, frequency standard, and geophysical alert broadcasts.

(b) Simplex Operation. The operator programs the same frequency in receive and transmit, and assigns an operating mode (USB, LSB, or AM). The simplex function is used by air traffic control, ARINC, and others.

(c) Semi-Duplex. In semi-duplex operation the operator programs two different frequencies, one for transmit and one for receive. The semi-duplex function is used by maritime radio/telephone network (public correspondence) stations.

d. HF Communications Transceiver Operation.

(1) Direct Frequency Tuning Operation (Simplex Only).

(a) Frequency/Channel Switch – **FREQ** (out position).

(b) Mode Selector Switch – Set emission mode (USB, LSB, or AM).

(c) Tuning Knobs – Set desired frequency, then stow cursor.

(d) Antenna Coupler – Tune, press microphone button.

(2) Programming Preset Channels.

(a) Receive Only.

1. Cursor – Stow if a frequency digit is flashing.

2. Tuning Knobs – Select channel to be preset and desired frequency.

3. Mode Selector Switch – Set emission mode (USB, LSB, or AM).

4. **STO** Switch – Press.

NOTE

A flashing TX will appear in the display window, but should be ignored since a receive only frequency is being set.

If another channel is to be set, the cursor must be stowed before a new channel can be selected. Use the smaller concentric knob to select the channel and repeat the steps for selecting a new frequency.

5. To return to an operating mode, push the **PGM** switch.

(b) Simplex.

1. Cursor – Stow if a flashing digit is present.

2. Frequency/Channel Switch – **CHAN** (in).

3. **PGM** Switch – Press, check that **PGM** annunciator in the display is illuminated.

4. Tuning Knobs – Select channel to be preset and desired frequency.

5. Mode Selector Switch – Select emission mode (LSB, USB, or AM).

6. **STO** Switch – Press and release twice. The first press of the **STO** button stores the frequency in the receive position and the second press stores the same frequency in the transmit position. The second push also stores the cursor.

7. If another channel is to be reset, use the smaller concentric knob to select the channel and repeat the steps for selecting a new frequency. The cursor will be automatically stowed. To return to an operating mode, push the **PGM** button again.

(c) Semi-Duplex.

1. Cursor – Stow if a flashing digit is present.

2. **FREQ/CHAN** Switch – **CHAN** (in).

3. Mode Selector Switch – Set emission mode (USB, LSB, or AM).

4. **PGM** Switch – Press, check that **PGM** annunciator in the display is illuminated.

5. Tuning Knobs – Select channel to be preset, operating mode (USB, LSB, or AM), and desired receive frequency.

6. **STO** Switch – Press and release once.

7. Transmit Frequency – Set.

8. **STO** Switch – Press again. If another channel is to be preset, use the smaller concentric knob to select the channel and repeat the steps.

9. To return to an operating mode, push the **PGM** button.

NOTE

The mode for each channel (LSB, USB, or AM) is stored along with the frequency. If the mode is changed, the system will receive and transmit in the mode selected for transmit.

3C-11. EMERGENCY LOCATOR TRANSMITTER (DM ELT8.1).

a. Description. An automatic or manually activated Emergency Locator Transmitter (ELT) is located on the right side of the aft fuselage. The associated antenna is mounted on top of the aft fuselage at the same location, Figure 2-1. An access hole with a spring-loaded cover is located in the right fuselage skin adjacent to the transmitter, enabling a downed pilot to manually initiate, terminate, or reset the ELT to an armed mode. Self-contained batteries provide operation for a minimum of 48 hours **T1** and 50 hours **T2** at 200 milliwatts. The transmitter contains an impact G switch that automatically activates the transmitter following a 3-7G impact along the flight axis of the airplane **T1** and a 10 G impact along any axis of the aircraft **T2**. When activated, it will simultaneously radiate omnidirectional RF signals on the international distress frequencies of 121.5 and 243.0 MHz. The radiated signal is modulated with an audio swept tone.

b. ELT Controls and Functions.

*(1) **ON / ARM / OFF** Switch (Located on ELT).*

(a) ***ON*** – Turns set on, initiating emergency signal transmission.

(b) ***ARM*** – Establishes a readiness state to start automatic emergency signal transmission when forces on the ELT exceed a preset threshold.

(c) ***OFF*** – Turns set off.

*(2) Remote **RESET / AUTO / XMIT** Switch.*

(a) ***AUTO*** – Arms the set to operate automatically upon impact.

(b) ***XMIT*** – Turns set on.

(c) ***RESET*** – In the event the ELT is accidentally triggered, pushing the switch to the reset position five times within 3 seconds will deactivate the transmitter and return the set to the armed (**AUTO**) condition.

Section III. NAVIGATION

3C-12. DESCRIPTION.

The navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position, and to make an approach on instruments in Instrument Meteorological Conditions (IMC). The navigation configuration includes equipment for determining attitude, position, destination, range, bearing, heading, and groundspeed.

3C-13. FLIGHT DISPLAY SYSTEM (FDS-255).

a. System Overview. The Flight Display System (FDS-255), is a replacement for existing electromechanical Attitude Direction Indicator (ADI) and Horizontal Situation Indicator (HSI) flight instruments.

The top and bottom displays are physically identical. The top display is configured as an Electronic Attitude Direction Indicator (EADI) and the bottom display is configured as an Electronic Horizontal Situation Indicator (EHSI).

The MFD provides all of the internal diagnostics, data processing, and hardware configuration to provide the following display modes.

(1) HSI. Full compass rose (360°) or HSI ARC which includes course needles, a bearing needle, heading bug, etc.

(2) MAP. A centered 360° MAP or an expanded compass rose segment (80°). Both of these modes include the current set of waypoints and course legs from the FMS selected as the Nav Source.

(3) ADI. Provides aircraft attitude pitch and roll, lateral deviation, and vertical deviation.

(4) Primary Flight Display (PFD). ADI and HSI combined on one display as a reversionary mode upon failure of a display.

(5) Diagnostics. Provides Multi Functional Display (MFD) status pages.

b. External Aircraft Controls*.*

*(1) Reversionary Switch (**ALT ADI**).* Reversionary switches are external push button switches allowing the operator to place the EADI information on the bottom display. The pilot's switch is located on the lower left portion of the dash panel under the Turn and Slip Indicator. The copilot's switch is located on the lower right portion of the dash panel under the Vertical Speed Indicator. The switch has two positions, normal and reversionary. In the normal position the top display is an EADI and the bottom display is an EHSI. In the reversionary position the top display blanks and the bottom display becomes a PFD.

*(2) **OBS / LEG** Switch*. The **OBS / LEG** switch places the FMS 2 KLN 90B in either LEG or OBS mode. The **OBS / LEG** switch is located on the top center portion of the dash panel to the right of the altitude select panel. While in LEG mode the KLN 90B continuously updates the desired course in order to fly a great circle route between the FROM and TO waypoints. If the leg selection is made and FMS 2 is selected as the primary navigation source, the digital course label displays **DTK**. While in OBS mode the pilot's MFD control panel updates the course and sends the manually selected course to the KLN 90B. If the OBS selection is made and FMS 2 KLN 90B is selected as the course source, the digital course label displays CRS and reflects the pilot's control panel course selection.

(3) ***EFIS #1*** *and* ***EFIS #2*** *Power Switch*. The **EFIS #1 / EFIS #2** power switch is a push-button switch located on the lower left side of the dash panel beneath the Turn and Slip Indicator. Power is applied to the pilot's display via **EFIS #1** switch and power is applied to the copilot's display via **EFIS #2** switch.

(4) ***DME HOLD*** *Switch.* The **DME HOLD** switch enables the DME hold feature of VHF Omnidirectional Radio (VOR) 1. The **DME HOLD** switch is located on the audio control panel **T2** and right of the FIRE PULL handles on the **T1**. The pilot's MFD monitors the **DME HOLD** switch and annunciates its position.

(5) ***COMPASS 1*** *and* ***COMPASS 2*** *Switches*. The **COMPASS 1** switch is located on the lower left side of the dash panel under the **EFIS #1 / EFIS #2** switch. The **COMPASS 2** switch is located on the lower right side of the dash panel under the Vertical Speed Indicator. The compass switches consist of a gyro **FREE / SLAVE** switch and an **INCREASE / DECREASE** (slew) switch. Selecting **FREE** on the **FREE / SLAVE** switch disengages the gyro and allows manual slewing of the compass card via the **INCREASE / DECREASE** switch. When **FREE** is selected, heading validity is ignored. The **COMPASS 1** switches control the pilot side compass card and the **COMPASS 2** switches control the copilot side compass card. The MFD does not interface with the slew switches and only annunciates the state of the **FREE / SLAVE** switch.

(6) Heading Switch. The Heading Switch is a three-position switch located on the lower left side of the dash panel to the right of the **COMPASS 1** Switches. This switch allows the selection of Heading data to be all systems on Compass 1, all systems on Compass 2, or Normal (pilot on **COMPASS 1** and copilot on **COMPASS 2**). The MFD provides an indication when both sides have the same compass selected.

c. MFD Display Control Panel*.* The MFD Control Panel provides integrated display management via the controls shown in Figure 3C-5. Unless otherwise noted the pilot's control panel drives the pilot's displays, and the copilot's control panel drives the copilot's displays. The pilot can select PFD on the display control panel when in the reversionary mode. This makes the top display a PFD without some of the functions.

WARNING

Whenever either display fails, it is probable that functions of that display will also fail.

d. Display Control Panel Controls and Functions. Listed below are the controls found on the Control Panel and their corresponding functions.

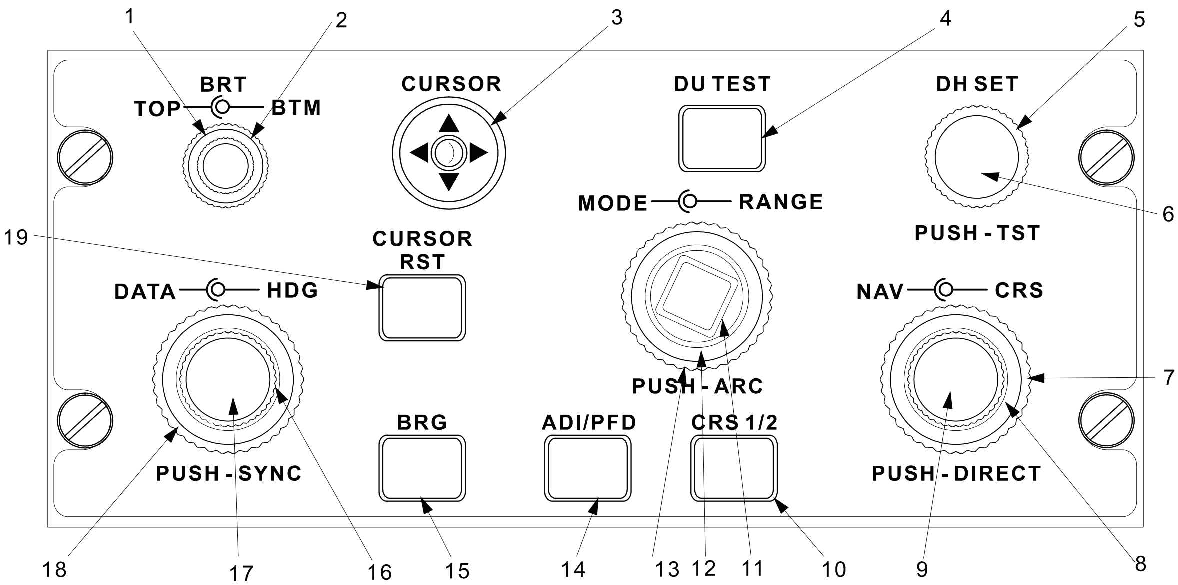
(1) EHSI Brightness Control. The brightness control consists of two concentric knobs. The inner knob controls the brightness of the EHSI (bottom MFD). Full counterclockwise rotation of the brightness knob provides the minimum brightness level and full clockwise rotation is interpreted as the maximum brightness setting.

(2) EADI Brightness Control. The brightness control consists of two concentric knobs. The outer knob controls the brightness of the EADI (top MFD). Full counterclockwise rotation of the brightness knob provides the minimum brightness level and full clockwise rotation is interpreted as the maximum brightness setting.

(3) ***CURSOR***. The **CURSOR** control operates on the Map and Map ARC displays. The **CURSOR** joystick moves a crosshair symbol in XY motion. The bearing and distance to the cursor symbol is displayed next to the aircraft symbol. The absolute bearing is in degrees. Any time the cursor is active, the MFD displays its absolute bearing (north referenced azimuth) and range in degrees/nm (for example – 273/22) next to the cursor. A dashed line connects the aircraft symbol and the cursor symbol. After 30 seconds of no cursor movement, the cursor bearing and distance information is removed from the display and the cursor location is reset to a bearing and distance of zero. The MFD will reset the cursor back to the aircraft symbol when crosshair time out occurs, 30 seconds, when the **CURSOR RST** button is pressed, or when a different page is selected. The bearing and distance of the cursor location is sent out of the pilot's bottom MFD to FMS 1. To activate the MARK function, align the cursor crosshairs over a desired location such as a waypoint and press the **MARK** button on the FMS-800 control.

(4) MFD Test Button. Pressing the MFD Test button, placarded **DU TEST**, places both onside MFD's into diagnostics mode when the current display page is not a diagnostic page and the aircraft is on the ground.

The diagnostics page consists of MFD status information shown as a result of a Built-In-Test (BIT). Normal pilots' tests are completed by pushing the **DU TEST** button once displaying the first test page. From that page it can be determined that the MFD display is at the correct position and mounted in the correct aircraft. Additional test pages are maintenance functions and can only be accomplished while the aircraft is on the ground.



1. **EHSI Brightness Control**
2. **EADI Brightness Control**
3. **CURSOR**
4. **MFD Test Button**
5. **DH Setting**
6. **Radio Altitude Test**
7. **Course Source Selector**
8. **Course Selector**
9. **Course Sync Button**
10. **CRS 1/2 Button**
11. **ARC Button**
12. **Range Button**
13. **Mode Selector**
14. **ADI / PFD Button**
15. **Bearing Source Selector**
16. **HDG Selector**
17. **HDG SYNC Button**
18. **Data Selector**
19. **Cursor Reset**

Figure 3C-5. Multi-Functional Display Control Panel

Perform the following procedure to select the MFD status page.

1. Press the MFD **DU TEST** button on the control panel.

2. Press the Course Sync button or the **ARC** button on the control panel to exit diagnostics.

(5) DH Setting. The **DH SET** knob rotates and has a center push button. The **DH SET** knob is used to set the decision height. Clockwise rotation increases the decision height. The decision height is displayed in green following the letters **DH** in the lower right corner of the ADI. When the radio altitude is at or below the DH setting, the yellow letters **DH** appear in the right center portion of the ADI or PFD display and a “Minimum” aural annunciation is sounded. Once the **DH** annunciation appears, it is removed from the display when the radio altitude climbs at least 25 feet above the decision height. If the radio altimeter system fails, the decision height annunciator is removed and the radio altitude flag appears.

(6) Radio Altitude Test. The center push button on the **DH SET** knob setting is a radio altitude test button. Pushing the test button causes the radio altimeter to go into test. While the radio altimeter is in test, the digital readout remains displayed, even when the radio altimeter validity is flagged.

(7) Course Source Selector. The blind course select knob placarded **CRS** is a dual concentric knob with a center push button. The outside knob selects the active course sources. The selections are FMS or VOR. The selector switch is a knob that when rotated, cycles between the sources. Used in conjunction with the **CRS 1/2** button, the Nav sources are switched between all navigation sources (i.e., FMS 1/FMS 2 or VOR/VOR 2).

(8) Course Selector. The inner knob on the Course Source Control selects the desired course for the active course source. When the knob is moved

slowly, a single click will result in a 1° course change. If the knob is rotated quickly, the course setting changes numerous degrees per click.

If the **OBS / LEG** switch is in the OBS mode, the pilot's course setting knob will control the course for the KLN 90B. The bottom MFD on the pilot's side provides the selected course to the KLN 90B when it is in the OBS mode.

(9) Course Sync Button. The center push button on the course source control is a **CRS** sync button. Pressing the **CRS** sync (Direct-To) button for a VOR (VHF Omni Range) course source sets the active source's course to the source's bearing.

*(10) **CRS 1/2** Button*. The **CRS 1/2** button toggles the selected navigation course (selected by the Course Source Control) between #1 and #2.

*(11) **ARC** Button*. The center push button on the mode selector is an **ARC** button. Pressing the **ARC** button toggles the EHSI display.

1. HSI Mode. Full 360° compass rose or HSI ARC 80° compass rose.

2. MAP Mode. Map 80° arc or Map full 360° compass.

(12) Range Selector. The inner knob on the mode selector selects the range for displays where range is applicable. Available ranges are 2.5, 5, 10, 20, 40, 80, 160, 320, and 640 nm. Range information is stored in the control panel and defaults to the last selected value at power up.

*(13) **MODE** Selector*. The **MODE** select knob is a dual concentric knob with a center push button. The outer knob allows you to select between HSI and map modes.

*(14) **ADI/PFD** Button*. The **ADI / PFD** button on the display control panel toggles the display between the basic EADI display and the Primary Flight display.

(15) Bearing Source Selector. The bearing (**BRG**) button selects the navigation source to be displayed on the EHSI bearing pointer. The aircraft bearing selections are **OFF**, **FMS 1**, **FMS 2**, **VOR 1, TCN 1**, **VOR 2**, **ADF 1**, and **ADF 2**. If a VOR frequency is tuned on the pilot's NAV receiver, the source becomes VOR 1.

*(16) Heading (**HDG**) Selector*. The inner knob of the data selector is used to position the heading bug. When the heading knob is moved slowly, a single click results in one degree heading changes. If the knob is rotated quickly, the heading setting changes numerous degrees per click.

*(17) **HDG SYNC** Button*. The center push button on the data selector is a HDG SYNC selection. Pressing the **PUSH SYNC** button will automatically slew the selected heading bug to the lubber line. When FMS 1 is the selected navigation source and the **PUSH** button is pressed, the FMS heading bug is displayed on the MFD and the navigation source label FMS changes to FHDG. The FMS heading bug then syncs to the selected heading.

*(18) **DATA** Selector*. The **DATA** select knob is a dual concentric blind selector with a center push button. The outer knob provides sequential selection of FMS data to include Groundspeed (GS), True Airspeed (TAS), Time To Go to next waypoint (TTG), Elapsed Time (ET) from WOW, and off-no data displayed.

(19) Cursor Reset. The cursor reset (**CURSOR RST**) button resets the cursor to the aircraft symbol.

3C-14. ELECTRONIC ATTITUDE DIRECTOR INDICATOR.

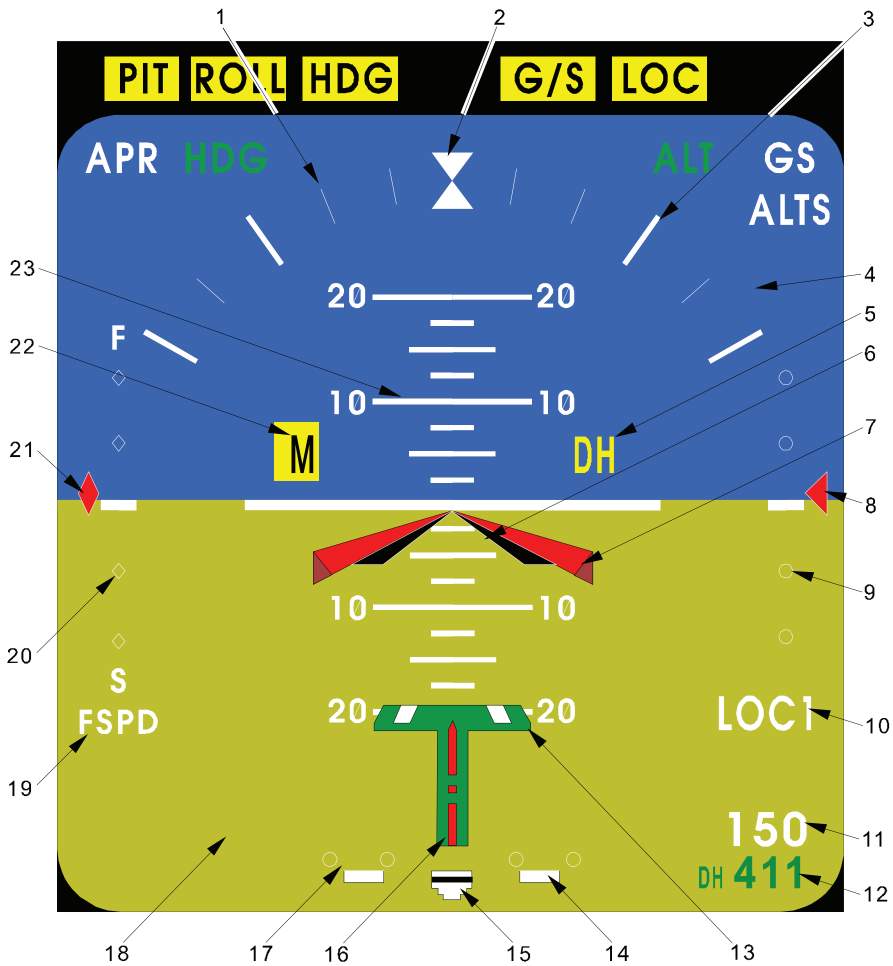
a. Description. The EADI, Figure 3C-6, is an instrument whose primary function is to display the aircraft's current attitude. It combines the functions of many electromechanical indicators into a single electronic display. This display consists of the Attitude Display Indicator (ADI) display page and the Primary Flight Display (PFD). The default display format on the EADI is the ADI format on powerup.

The ADI presents attitude, comparator warning annunciations, decision height setting, and rate of turn indicator. Other parameters that are displayed as a function of pilot selection are DH annunciation, Radio Altitude, Rising Runway, Vertical Deviation (GS or VNAV), Speed Deviation, Flight Director Command Bars (V Bars), Aircraft Symbol, Lateral Deviation, Marker Beacons, Flight Director Annunciations, and Course Source (Location (LOC), VOR, or FMS).

b. ADI Display Symbology.

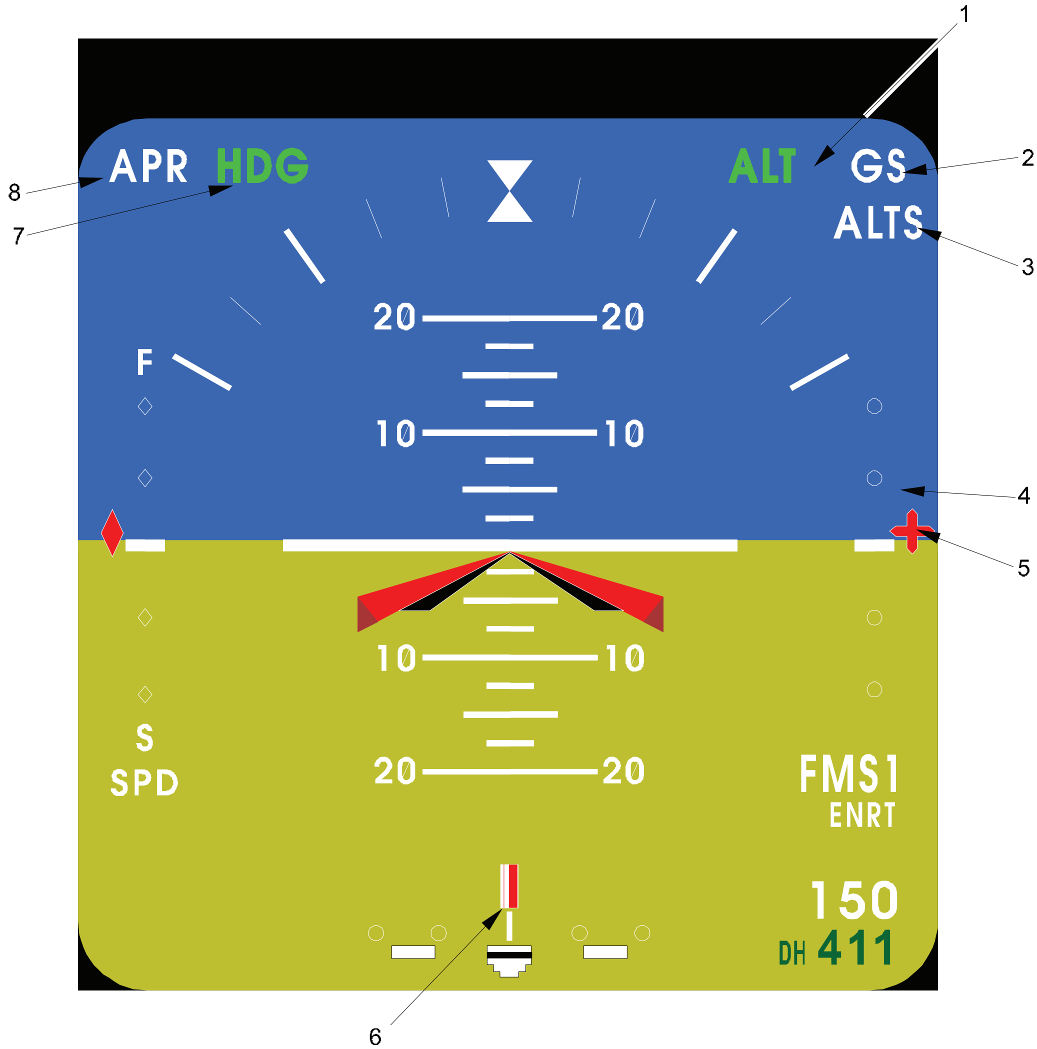
(1) Pitch and roll attitudes are indicated by the position of the blue sky and brown ground relationship. The aircraft symbol is outlined in white with a black interior. Precise pitch attitude is provided by the position of the pitch scale with reference to the nose of the aircraft symbol. Precise roll attitude is provided by the position of the moving roll pointer with reference to the roll scale. The pitch scale disappears

behind the roll pointer and the lateral deviation pointer to prevent interference between the symbols. Roll is a continuous 360° display and pitch is ± 90° display.



1. Roll Scale
2. Index Marks
3. 30º Bench Marks
4. Sky
5. DH Annunciation
6. Aircraft Symbol
7. Flight Director Command Bars (VBARS)
8. GS Pointer
9. Vertical Deviation Scale
10. NAV Source
11. Radio Altitude Readout
12. DH Setting
13. Rising Runway
14. Rate of Turn Scale
15. Rate of Turn Pointer
16. Lateral Deviation Approach Pointer
17. Lateral Deviation Scale
18. Ground
19. FMS Speed Label
20. Speed Deviation Scale
21. Speed Deviation Pointer
22. Marker Beacon Annunciation
23. Pitch Scale

Figure 3C-6. ADI Display Symbology (Sheet 1 of 2)



1. **Vertical Capture (ALT Hold)**
2. **Vertical Arm #1 (GS Armed)**
3. **Vertical Arm #2 (ALTSEL Armed)**
4. **Vertical Deviation Scale**
5. **VNAV Pointer**
6. **Lateral Deviation Non-Approach Pointer**
7. **Lateral Capture (HDG Mode Captured)**
8. **Lateral Arm (VOR APR Armed or LOC Source)**

Figure 3C-6. ADI Display Symbology (Sheet 2 of 2)

If an attitude sensor failure occurs, an attitude flag appears which consists of a red box with black letters **ATT**. An attitude flag removes the pitch scale, roll scale, roll pointer, sky/ground raster, flight director annunciations and command bars from the display.

(2) The pitch scale, Figure 3C-7, consists of 2.5° increments between 30° to 40° of pitch. Approximately 40° of the pitch scale is visible at any given time.

(3) The roll scale displays the current roll attitude of the aircraft. It rotates about the aircraft symbol such that the aircraft roll is graphically indicated on the roll scale. The roll scale contains the ± 10°, 20°, 30°, 45°, and 60° increments. The rest of the scale is white. If the roll input is invalid or unavailable, the roll scale and pointer are removed from the screen and the **ATT** flag appears.

(4) If the pitch attitudes exceed +30° or -20° or if the bank attitude exceeds ± 65° all information

except the aircraft symbol, attitude, and attitude sensor annunciation are removed from the ADI. Refer to Figure 3C-7. All ADI information is restored when at +25° or -15° of pitch or ± 60° of roll. If the PFD is displayed when an extreme attitude condition occurs, the excessive attitude ADI page automatically is displayed. Refer to Figure 3C-8. The PFD is not selectable until the extreme attitude condition is removed and then it must be reselected.

(5) Flight Director Command Bar Display. The command bars are in view when the flight director is being used. The command bars are removed from view by the flight director when it is turned off, in standby mode, commanded out of view, and FD Validity Failed.

The integrated command bars flank the triangular aircraft symbol with a zero command input. The command bars move a maximum of ± 15° pitch and ± 30° roll.

The command bars are removed from the display and the flight director annunciation appears when the commanded pitch or roll is invalid. The flight director annunciation consists of the label FD in black on a solid red box.

c. Flight Director Annunciations. The Flight Director (FD) annunciations are displayed in the Lateral Arm, Lateral Capture, Vertical Capture, Vertical Arm 1, and Vertical Arm 2 annunciator fields. The capture annunciations are green and the arm annunciations are white. To ensure that the flight crew does not miss a FD change, the FD annunciation flashes for 5 seconds when a new annunciation occurs. Refer to Table 3C-4 for FD output and their annunciations.

The MFD displays red-colored dashes in the FD fields and retains the FD command bars if the FD sets more than one annunciation for that field or if the Data Concentrator Unit fails. The annunciator fields will be blanked when the command bars are removed from the display, when the unit is turned off, placed in standby mode, commanded out of view, or FD validity flagged.

d. Vertical Guidance. The FDS-255 supports glideslope and VNAV Guidance. The glideslope scale and pointer are displayed when the navigation source is LOC, the localizer is valid, and the glideslope is valid. The VNAV scale and pointer will be displayed when the navigation course source is FMS, the FMS is valid, the VNAV is valid, and the VNAV is available from the FMS.

A scale and pointer located on the right side of the indicator displays deviation from the selected vertical path. The scale consists of a pair of white dots above and below a white center index. Maximum travel of the pointer is 2.5 dots.

The glideslope (GS) deviation pointer is a magenta trapezoid outlined in white. If a glideslope failure is detected, the letters **GS** appear boxed and in red. The GS pointer and scale will be removed from the display. The GS pointer moves a maximum of ± 2.5 dots.

The VNAV deviation pointer is a magenta star outlined in white. When a VNAV failure is detected the VNAV annunciation appears boxed and in red. The VNAV pointer and scale will be removed. The pointer moves a maximum of ± 2.5 dots.

e. Lateral Deviation. The pointer and scale are located on the bottom center of the ADI. The pointer moves a maximum of ± 2.5 dots. The scale consists of two white dots on either side of a white center index.

The lateral deviation pointer is a white rectangle with two magenta bars for VOR, or non-approach FMS navigation sources. The rising runway serves as the lateral deviation pointer for LOC, BC, and approach FMS course sources. Back course deviation is reversed on the ADI when the B/C is set via the flight director control panel.

If the navigation source is invalid or missing, the course source annunciation is boxed in red and the pointer, rising runway (LOC, BC, or FMS approach), and lateral deviation scale are removed from the display.

The FMS Navigation warning indicates that the information accuracy is in question but usable. The FMS navigation solution remains displayed but the color changes to amber.

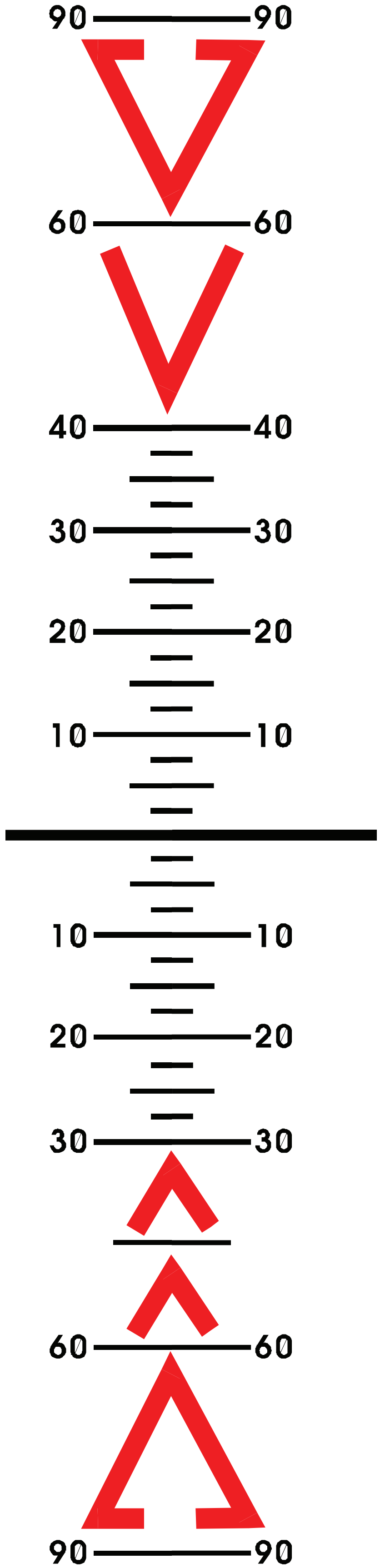


Figure 3C-7. ADI Pitch Scale

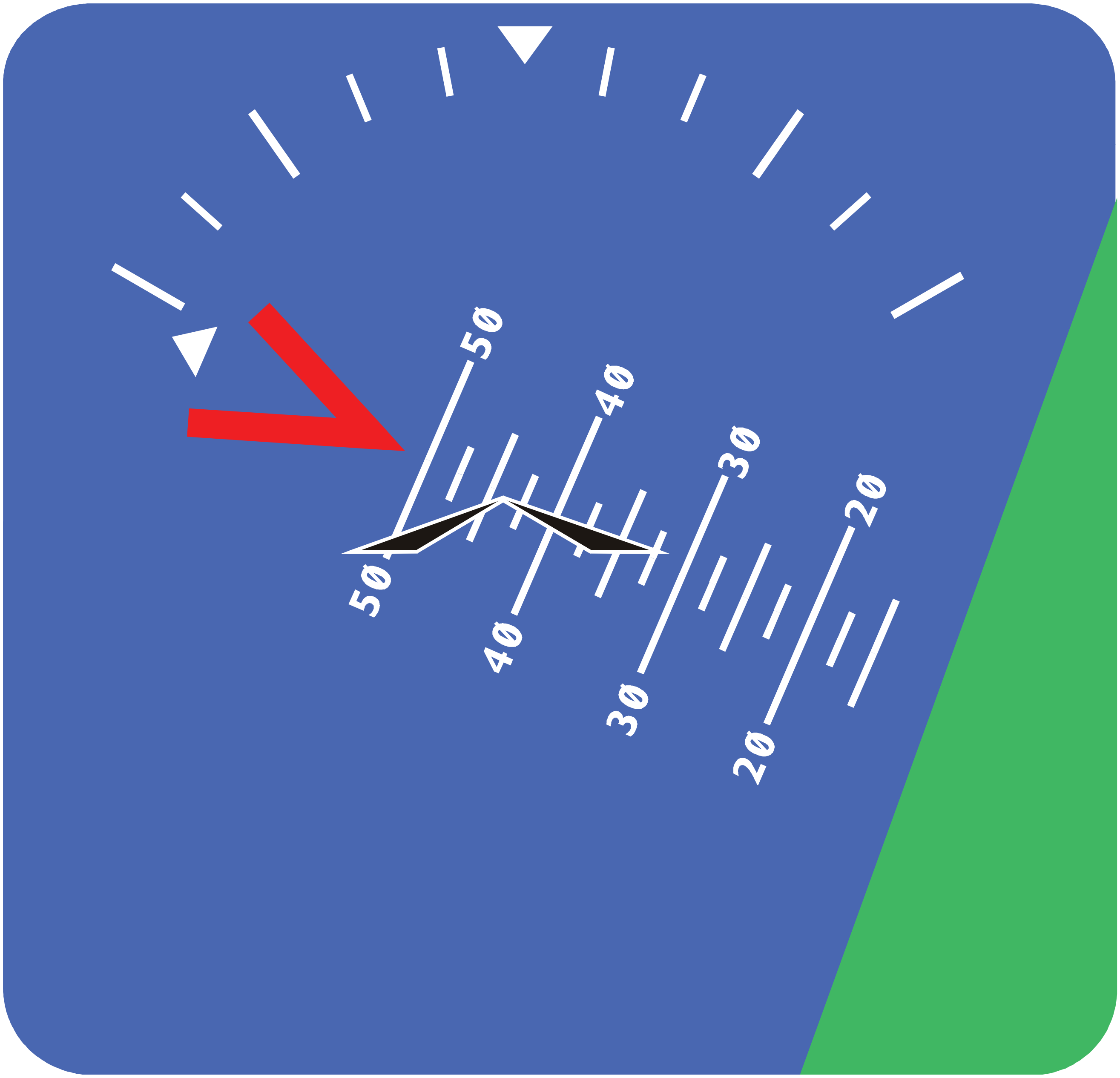


Figure 3C-8. ADI Excessive Attitude Display

Table 3C-4. Flight Director Annunciations

ANNUNCIATOR FIELD	FD ANNUNCIATOR INPUT	MFD ANNUNCIATION
Lateral Arm (Upper Left-White)	NAV Arm (while LOC is NOT the NAV source) NAV Arm (while LOC is the NAV source)	NAV APR
Lateral Arm (Upper Left-White)	BC Arm VOR APR Arm	APR
Lateral Capture (Upper Left-Green)	BC Capture VOR APR Capture	APR
	NAV Capture (while LOC is NOT the NAV source)	NAV

Table 3C-4. Flight Director Annunciations (Continued)

ANNUNCIATOR FIELD	FD ANNUNCIATOR INPUT	MFD ANNUNCIATION
	NAV Capture (while LOC is the NAV source)	APR
Lateral Capture (Upper Left-Green)	HDG	HDG
	GA	GA
	LNAV	NAV
Vertical Arm 1 (Upper Right-White)	APPR Arm	GS
Vertical Arm 2 (Upper Right-White)	ALTS Arm	ALTS
Vertical Capture (Upper Right-Green)	APPR CAPT ALT Hold	GS ALT
	ALTS Capture	ALTS
	IAS	IAS
	VS	VS
	GA	GA

f. Rate of Turn Indicator. The indicator displays turn rate information. It is located below the lateral deviation scale and consists of a three-bar scale with an indicator shown as a white bar outlined in black. The pointer will deflect either left or right indicating the turn rate in that direction. The pointer moves a maximum of ± 2 bars, twice the standard rate turn. Refer to Table 3C-5.

Heading data is used to calculate the rate of turn. If this source is flagged, the rate of turn goes invalid. The pointer and scale are removed when the rate of turn is invalid.

Table 3C-5. Rate of Turn Scale

DOT DEVIATION	DEGREES PER SECOND	UNITS
2 Needle Widths (1 bar)	3°/Sec	Standard Rate Turn
4 Pointer Widths	6°/Sec	Twice Standard Rate Turn

g. Rising Runway. The rising runway is shown in green, white, and magenta, outlined in black when the course source is a localizer, back course, or FMS approach mode. During localizer or FMS approach deviation, the pointer is a trapezoidal runway symbol. When the radio altitude reaches 200 feet while in LOC, BC, or FMS approach mode, the runway symbol starts to rise. The symbol achieves maximum height when the radio altitude is at a value of zero feet. The rising runway correlates to approximately the bottom of the aircraft symbol. If the localizer or FMS deviation is invalid or unavailable, the rising runway will be removed. If the radio altitude fails, the rising runway does not rise.

h. Radio Altitude Display. Radio altitude is displayed in white above the decision height readout area. The display appears automatically when within the radio altitude range (2500 feet) and changes to 50-foot increments between 2500 and 1000 feet, 10-foot increments between 999 and 100 feet, and 5-foot increments below 99 feet.

NOTE

Loss of radio altitude data will cause loss of the TCAS II due to the absence of required input data.

Radio altitude data is rate-limited to prevent nuisance radio altimeter changes as the result of fast changing data (uneven terrain). The digital readout will blank for valid radio altitude data less than 0 feet or over 2500 feet.

When a failure is detected, the radio altitude display is dashed red and the black letters **RA** in a solid red box are annunciated. DH set and the **DH** annunciator are also removed.

i. Decision Height Set Readout. Decision height set is displayed in the lower right corner and is green. If the radio altimeter system fails, the decision height readout is removed.

When the radio altitude is at or below the DH setting, the yellow letters **DH** appear in the right center portion of the ADI or PFD display. The **DH** annunciation flashes for 10 seconds after it appears. Once the **DH** annunciation appears, it will be removed when the radio altitude climbs at least 25 feet above the decision height setting or if the radio altitude is less than 10 feet. If the radio altimeter system fails, the decision height annunciator is removed and the radio altitude flag appears.

j. Fast/Slow Deviation and Pointer. Speed deviation indicates whether the aircraft is fast or slow relative to an established reference. The speed deviation scale consists of four white dots with the letters F and S to the left of the top and bottom dots. The scale is located on the left side of the ADI. The speed deviation pointer is a magenta diamond outlined in white. The scale is relative to FMS speed (FSPD) associated with FMS 1. Whenever FMS speed is available, the letters FSPD in white are positioned below the scale. When selected, fast/slow input is invalid and the source is drawn in black on a solid red box. The speed deviation pointer is displayed in amber when the cross-side FMS is the selected navigational source. The pointer and scale will be removed from the display.

k. Inclinometer Indicator. The inclinometer is a separate element mounted under each display. The inclinometer is a weighted ball in a liquid-filled curved glass tube to provide assistance in making coordinated maneuvers. Aircraft slip/skid movement is shown by the movement of the ball.

l. Marker Beacons. The inner, middle, or outer marker beacon annunciation is displayed on the center left of the display when set by the marker beacon receiver. The marker beacon annunciator will be removed from the display when the marker beacon signal is no longer available from the marker beacon receiver. The marker beacon annunciator consists of an **O** in amber for the outer marker, **M** in cyan for the middle marker, and **I** in white for the inner marker.

m. Free Format Line. The free format line is used to display system faults only.

n. Comparator Warning Annunciation. Each display compares pitch attitude, heading, glideslope deviation, localizer deviation, and radio altitude to the cross-side (X-side) display. If the comparison exceeds a threshold, the appropriate annunciation appears at the top of the EADI.

o. Primary Flight Display Format. For reversionary purposes. The Primary Flight Display mode consists of an ADI positioned on top of an HSI with a 360° compass rose. Refer to Figure 3C-9. The differences in the display are listed in the following paragraphs.

(1) The rising runway and lateral deviation pointer is removed from the ADI.

(2) Approximately 30° of the pitch scale is visible.

(3) The lubber line is a solid white triangle pointer and heading is not digitally displayed.

(4) Approximately 200° of the compass rose is displayed. The bottom half of the compass rose is clipped from view.

(5) No wind text label.

(6) No off the display heading readout or pointer for the heading bug.

In extreme pitch attitudes, the presentation reverts to the normal excessive attitude display that is a modified full ADI display.

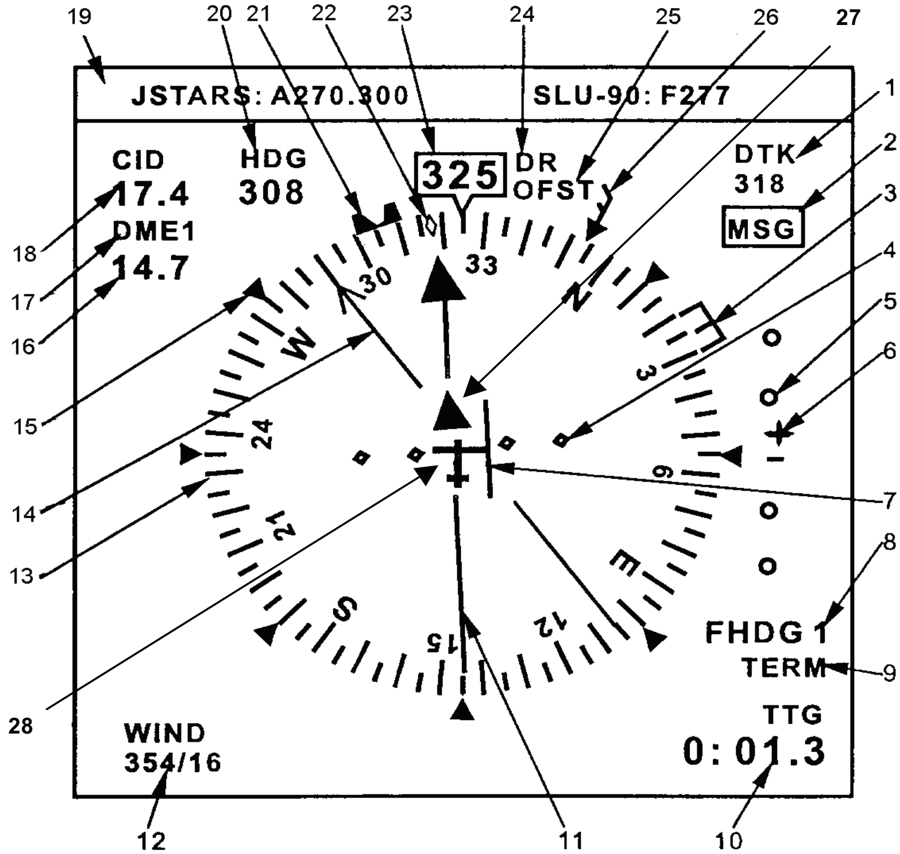
Figure 3C-9. Primary Flight Display Mode Display

3C-15. ELECTRONIC HORIZONTAL SITUATION INDICATOR.

a. Description. The EHSI is located on the instrument panel directly below each pilot's and copilot's EADI. It is physically identical to the EADI, except it is configured as an EHSI. Flight data information is electronically displayed on both EHSI's. Refer to Figure 3C-10.

b. Power. Twenty-eight Vdc power is provided to each EHSI through separate 7½-ampere circuit breakers, placarded **EADI 1** & **2** and **EHSI 1** & **2**, located on the overhead circuit breaker panel, Figure 2-16.

c. EHSI Modes. The EHSI allows for multiple display formats. See Table 3C-6 for the display formats that are selectable from the control panel.



1. Course Readout / Label
2. FMS Message Alert
3. FMS Heading Bug
4. Course Deviation Scale
5. Vertical Deviation Scale
6. Vertical Deviation Pointer
7. Lateral Deviation Bar
8. Course Source Annunciations
9. FMS Flight Modes
10. Data Selection Display
11. Course Pointer
12. Wind Direction
13. Compass Rose
14. Bearing Pointer
15. Compass Benchmarks
16. Distance of Bearing Source
17. Bearing Source
18. Course Source Distance Readout
19. Free Format Line (ARC-210 Freq)
20. Digital HDG Bug Readout
21. Heading Bug
22. Track Indicator
23. Digital Heading Readout
24. DR or RAIM Alert
25. FMS OFST
26. Wind Pointer
27. TO / FROM Indicator
28. Miniature Aircraft

Figure 3C-10. Electronic Horizontal Situation Indicator

Table 3C-6. EHSI Display Modes

MODE	FORMAT
HSI	HSI (360° compass) HSI ARC (Partial 80° compass)
MAP	Map ARC (Partial 80° compass) Map (360° reference)
Diagnostics	MFD Status

d. EHSI Outputs. The EHSI outputs the following to the flight director.

(1) HDG Datum.

(2) CRS Datum.

(3) LOC Tune if the course source is LOC.

(4) Lateral Deviation.

(5) Glideslope Deviation. Glideslope deviation is sent to the flight director when it is available.

(6) Roll Steering. The bottom MFD outputs roll steering to the flight director when the flight director is valid and the course source is FMS.

e. HSI Graphic Format*.* The following graphics are used on the EHSI during the HSI Mode. Refer to Figure 3C-10.

(1) Course Readout/Label. When a valid source is tuned, the course selected is displayed in white. Next to the course readout is the label **CRS** or **DTK** in white letters. The digital **CRS** or **DTK** readout is always associated with the course source.

(a) Radial Source (VOR). The course label is CRS and the digital course readout is independently controlled by each MFD control panel.

(b) FMS-800 Operation. The label is **CRS** when the primary source is not FMS. If the primary source is tuned to FMS, the **CRS** will be replaced with Desired Track (**DTK**) for all FMS modes except TO / FROM mode (TACAN Emulation). When FMS is the course source, the course is automatically set by FMS.

(c) KLN 90B Operation. Refer to **OBS / LEG** switch in Paragraph 3-7.al for a description of the course readout.

(2) FMS Message Alert. The message (MSG) alert appears whenever the FMS sends an alert to the MFD. The amber MSG alert indicates to the crew that they should look at FMS on the selected side of the cockpit [on-side/x (cross) side].

(3) FMS Heading Bug. The FMS heading bug is only available for display when the FMS-800 is the NAV source and the FMS is commanding the bug to be displayed. The FMS heading bug is white and travels about the aircraft symbol around the outer edge of the compass. The center of the FMS heading bug indicates the selected heading in 1° increments. When the FMS selected heading is set, the FMS **NAV** source label is replaced with **FHDG 1** in white letters. If the FMS selected heading is invalid, unavailable, or the primary course source is not FMS 1, the heading bug will not be displayed. The FMS-selected heading bug is displayed in amber when a cross-side source is selected.

(4) Course Deviation Scale. Four white lateral deviation scale dots indicate deviation from course. The course deviation scale rotates about the aircraft symbol such that the scale is always perpendicular to the selected primary course. The maximum deviation is ± 2.5 dots. When the selected course or source is invalid, the course deviation scale is removed from the display.

The EHSI outputs lateral deviation and lateral deviation validity to the flight director and/or autopilot. The lateral deviation validity signal corresponds with the selected course source's lateral deviation. The lateral deviation output flag is displayed when the lateral deviation for the selected primary navigation source is invalid or an MFD failure results in bad or failed lateral deviation output.

(5) Vertical Deviation Scale. The vertical deviation scale, four small circles located on the right side of the MFD, indicate the vertical deviation of the aircraft.

(6) Vertical Deviation Pointer. The vertical deviation pointer, represented by a white star, displays the deviation with respect to the selected source.

(7) Lateral Deviation Bar. The center of the course pointer moves laterally with respect to the aircraft symbol and the four white deviation scale dots to indicate lateral deviation. The course deviation scale rotates about the aircraft symbol so that the scale is always perpendicular to the selected primary course.

(8) Course Source Annunciations. The navigation sensor is annunciated in white at the right center of the display. The possible course source annunciations are as follows.

1. FMS 1 or FHDG 1

2. FMS 2

3. VOR 1, TCN 1, LOC 1, or BC 1

4. VOR 2, LOC 2, or BC 2

The NAV source label is displayed in amber when a cross-side source is selected. When both the on-side and cross-side displays have the same NAV source selected, the NAV source label is boxed in amber.

If a NAV sensor failure is detected while selected as the course source, the sensor annunciator becomes red and boxed.

If FMS 1 is selected and a FMS NAV Warn occurs, the FMS 1 course source annunciator turns amber.

If FMS 1 is selected as the primary source, the FMS mode is annunciated in white below the primary navigation source. The FMS 1 modes are **NONE**, **APPR**, **ENRT**, **OCNC**, or **TERM**. The FMS mode will flash for 10 seconds starting 1 mile prior to transitioning into APPR mode. When the mode is NONE or ENRT, the annunciation field will be blank.

If the FMS 2 course is selected as the primary source, the FMS mode is annunciated in white below the course source. The FMS 2 course modes are **ENRT**, **APPR**, or **TERM**. The FMS mode will flash for 10 seconds during the transition from **TERM** to **APPR**. When the mode is **ENRT**, the annunciation field will be blank.

(9) FMS Flight Modes. If FMS 1 is selected as the primary source, the FMS mode is annunciated in white below the primary navigation source. The FMS 1 modes are **NONE**, **APPR**, **ENRT**, **OCNC**, or **TERM**. The FMS mode will flash for 10 seconds starting 1 mile prior to transitioning into APPR mode. When the mode is NONE or ENRT, the annunciation field will be blank.

If the FMS 2 course is selected as the primary source, the FMS mode is annunciated in white below the course source. The FMS 2 course modes are **ENRT**, **APPR**, or **TERM**. The FMS mode will flash for 10 seconds during the transition from **TERM** to **APPR**. When the mode is ENRT, the annunciation field will be blank.

(10) Data Selection Display (Navigation Data). The **DATA** switch on the control panel provides sequential selection of OFF, GS, TAS, TTG, ET, or OFF (no navigation data displayed) from the onside FMS. The selected data is displayed in white in the lower right-hand corner of the display. When the data is invalid, the digital value is replaced with red dashes. If the data is unavailable, the data value is blanked.

(a) FMS-800 Operation. OFF, GS, AS, TTG, and ET are valid data displays for the FMS-800.

(b) KLN 90B Operation. OFF, GS, and TTG are valid data displays for the KLN 90B.

(11) Course Pointer. The selected course is shown by the relationship of the solid single bar arrow (pointer) with respect to the compass card and is repeated numerically in the upper right corner. The course pointer is white for all navigation sources. The digital course readout and course needle change by 1° increments and rotate such that the needle head points to the selected primary course on the compass.

(12) Wind Direction. The MFD displays wind velocity (knots) and direction (degrees) on the bottom of the MFD in green below the label **WIND.** If no wind data is available, the data will be blank. If the wind data is invalid, the data will be dashed red.

(13) Compass Rose (360°). The compass rose provides a graphical representation of the current heading of the aircraft. It is a full 360° rose approximately 3 inches in diameter with **N**, **E**, **S**, and **W** designating the cardinal points and numerics at the 30° points. Aircraft heading is read against the lubber line. Major division marks are every 10° and minor division marks are every 5° on the compass rose. The compass card, lubber line, and reference lines are white.

(14) Bearing Pointer. The bearing source is selected by the bearing switch on the control panel. The bearing arrow is a solid cyan line with an open arrow extending through the aircraft symbol to the minor tick marks on each side of the compass. The arrowhead points to the compass location corresponding to the bearing of the station.

(15) Compass Benchmark. A compass benchmark surrounds the compass rose. The benchmarks are white triangle marks located every 45° except at 360° along the outside of the compass rose.

(16) Distance of Bearing Source. When distance is available for the selected bearing source, the distance source and the distance in nautical miles to the NAV source are displayed in the upper left corner of the MFD. When the bearing source is FMS, the active waypoint is displayed as the distance source. If the bearing source is VOR, DME will be displayed as the distance source.

NOTE

If an offside FMS is selected for bearing data/distance and it is not activated as the primary NAV source on the off-side, the distance/bearing information will not be displayed. This is caused by the method of data importation into the EHSI displays. If the offside FMS data is required, the offside primary NAV source must be selected.

The distance readout displays tenths of a mile up to 99.9 nm, and above 99.9 nm it displays whole miles. If VOR is the selected course source and the VOR is in DME hold mode, a cyan **H** is annunciated to the right of the DME distance.

When the distance is invalid, the digital portion of the readout is replaced with red dashes. If the distance is unavailable, the digital portion of the readout blanks. When the bearing source is invalid or not available, the distance source is replaced with the bearing source annunciation drawn in black on a solid red box.

(17) Bearing Source. The bearing source is identified in cyan in the upper left corner of the EHSI below the course source/distance. When the bearing is unavailable, the needle is removed but the source annunciation remains. When the bearing source is invalid, the needle is removed from the display and the bearing source annunciation is replaced with the source abbreviation drawn in black on a solid red box.

(18) Course Source Distance Readout. When distance is available for the selected course source, the distance source and the distance in nautical miles to the NAV source is displayed in the upper left corner of the MFD. If the course source is FMS, the active waypoint is displayed as the distance source. If the course source is VOR, DME is displayed as the distance source. If TCN is the course source, TCN is displayed as the distance source.

The distance readout displays tenths of a mile up to 99.9 nm, and above 99.9 nm it displays whole miles. If VOR is the selected course source and the VOR is in DME hold mode, a white **H** is annunciated to the right of the DME distance.

When the distance is invalid, the digital portion of the readout is replaced with red dashes and the distance source is replaced with the course source annunciation. If the distance is unavailable, the distance identifier is replaced with the course source annunciation and digital portion of the readout blanks.

(19) Free Format Line. The free format line is a 32-character message line filled by the FMS-800. The FMS-800 controls the content of the message, color, and flashing of characters. The message line displays the active and last tuned ARC-210 frequencies. The left side of the message line consists of the active communication call sign and frequency in green. The right side of the message line consists of the last-tuned communication call sign and frequency in cyan.

*(20) Digital **HDG** Bug Readout.* Located to the right of the course source/distance. When the selected heading changes, the selected heading readout is displayed. If the selected heading does not change for 10 seconds, the selected heading readout is removed from the display. If the heading bug is off the screen, the readout will be constantly displayed.

(21) Heading Bug. The heading bug is magenta and travels around the aircraft symbol on the outside edge of the compass. It travels in 1° increments. The center of the heading bug indicates the selected heading in 1° increments. When the heading bug or heading source is invalid, the heading bug is not displayed.

(22) Track Indicator. The track indicator shows the actual course of the aircraft. It is drawn as a cyan diamond. It travels around the aircraft symbol on the inner edge of the compass rose, such that the bottom of the indicator points into the compass and is aligned with the track value on the compass. The track indicator is removed from the display if it becomes invalid or unavailable. The track indicator is displayed in amber when a cross-side source is selected. See Table 3C-7 for Heading Reference Indicator Values.

(23) Digital Heading Readout. The compass rose rotates about the aircraft symbol such that the current heading is graphically indicated below the lubber line. Within the white lubber line symbol is a white digital heading readout. The lubber line is located directly above the aircraft symbol along the outside of the compass rose.

When the heading is invalid, the bearing pointer and the HSI go into OBS backup modes.

When the heading is invalid, the heading readout is removed from the display and replaced with the heading annunciator. The heading is labeled HDG in black letters on a solid red box.

(24) Dead Reckoning and Receiver Autonomous Integrity Monitoring Alert. The display annunciates Dead Reckoning (**DR**) or Receiver Autonomous Integrity Monitoring (**RAIM**) in amber to the right of the digital heading readout. If DR and RAIM Alert are present at the same time, DR overrides the RAIM Alert.

The FMS goes into DR when it loses navigation sources. When FMS goes into DR, it calculates its present position based on inertial data. The display annunciates DR in amber to the right of the digital display.

(25) FMS Offset. The crew can select a parallel offset (OFST) source via the FMS. The lateral deviation scale is relative to the parallel offset course. **OFST** is annunciated to the right of the digital heading readout in white.

Table 3C-7. Heading Reference Indicator Values

HEADING SWITCH SELECTION	ACTIVE FREE / SLAVE SWITCH	FREE / SLAVE SELECTION	HEADING REFERENCE INDICATOR DISPLAYED
All on Compass 1	Pilot	Free	DG1 (amber)
		Slave	MAG1 (amber)
All on Compass 2	Copilot	Free	DG2 (amber)
		Slave	MAG2 (amber)
Normal	On-side	Free	DG (white)
		Slave	Blank

(26) Wind Pointer. The wind indicator consists of a green symbol located on the outside edge of the compass and graphically layered to not obscure the heading bug symbol, lubber line, or heading readout. The wind indicator rotates about the aircraft symbol such that the arrow is always pointing into the compass at the wind direction. The arrow displays zero to five green fins on its tail to represent wind speed. Long fins represent 10 knots and short fins represent 5 knots. If the wind velocity is 0 knots, the arrow is removed from the display. If the wind velocity is less than 2.5 knots, the arrow is displayed with no fins. The wind indicator indicates wind from .1 knots to 45.5 knots. If the wind exceeds 45.5 knots, the wind indicator changes to a maximum wind symbol (wind indicator with a filled triangle fin at the tail). When the wind speed or wind direction is invalid or unavailable, the wind indicator is removed from the display.

(27) To/From Indicator. A white triangle to or from indicator rotates around the aircraft symbol on the course needle. It indicates TO the station when the triangle points towards the head of the course needle and FROM the station when the triangle points towards the tail of the course needle. If FMS is the selected course and FMS outputs a waypoint alert, the TO **/** FROM flag flashes.

If the course source is not FMS, the indicator is set to TO when the angular difference between the relative bearing to the station and the primary course is less than 89°. When the angle is greater than 91° FROM is indicated. The indicator is OFF when the angle is between 89° and 91°. When FMS is the primary source then the FMS determines the TO **/** FROM indication. If the TO **/** FROM indication is invalid or unavailable, an active navaid has not been selected, or the indicator is OFF, the TO **/** FROM flag will be removed from the display.

(28) Miniature Aircraft. The white aircraft symbol is located in the center of the compass rose.

f. EHSI Operations

(1) OBS Backup Mode. When the heading is invalid, the compass rose rotates about the aircraft such that the selected course is always referenced at the top of the display. When the selected course is invalid, the compass freezes at the last known position.

(2) Course Source Flag. When the navigation information for the selected course is flagged invalid, the course source label is removed from the display and replaced with the course source annunciation drawn in black on a solid red box. The deviation bars and scale are removed from the display with a navigation flag. If the primary course goes invalid, the selected course readout is replaced with red dashes. If FMS-800 or the KLN 90 is selected and an FMS NAV Warn occurs (RAIM Alert), the **MS NAV** source annunciator turns amber and all the navigation information remains on the display.

(3) LOC/BC. If an LOC frequency has been tuned and backcourse is selected on the flight director, BC is displayed in place of the LOC source. Once BC has been set it will remain set as long as the BC discrete is set.

g. HSI ARC Format. The compass arc format, Figure 3C-11, is a graphic representation of the current heading of the aircraft. It is similar to the compass rose, except that only an 80° slice is shown. The arc format is an expanded compass with the compass segment at the top of the display and the aircraft symbol centered laterally at the bottom. The compass rotates about the center point of the aircraft such that the current heading is indicated directly below the lubber line.

The HSI format with the 360° compass rose display is the same as the HSI Arc display with the following exceptions.

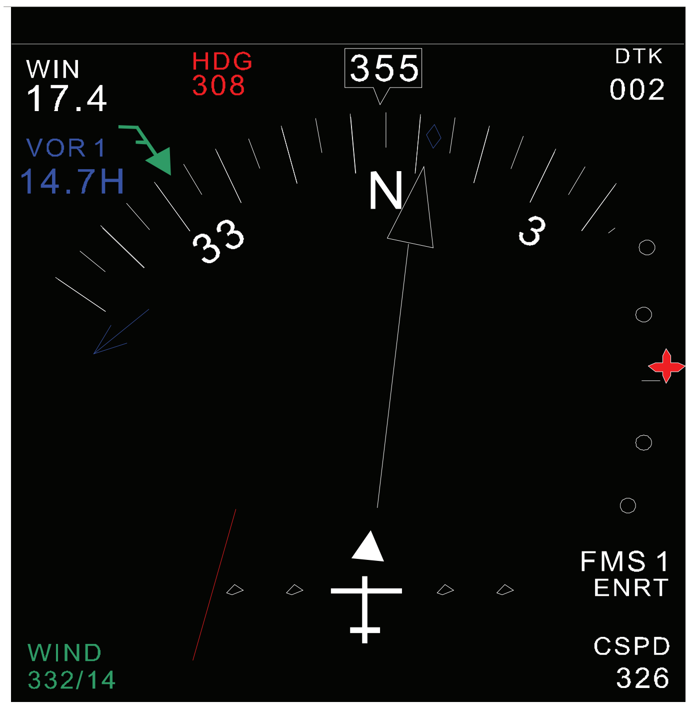


Figure 3C-11. HSI ARC Format (Off Display CRS, HDG, and Bearing)

(1) Selected HDG Readout. A digital readout of a selected heading is displayed in the upper left-hand corner of the display. When the heading bug is visible, it will appear when the selected heading is changed and is removed 10 seconds after the heading bug quits moving. If the heading bug is off the screen, the readout is constantly displayed.

(2) Course Needle. When the primary course moves out of view, the primary course needle and deviation bar size reduce so that the head or tail is always visible.

(3) Bearing Needle. When the bearing needle head and tail are outside of the displayable area, a cyan bearing needle appears on the inside of the compass within its major tick marks pointing to where the needle head would be.

h. Map ARC Format (Partial 80°). The Map ARC format (Heading Up Map, Figure 3C-12) is an expanded rose format with a compass segment at the top of the display and the aircraft symbol centered laterally at the bottom. The ARC Map provides a display of the active flight plan. Refer to Figure 3C-13 for a description of the map symbols.

The operation of the peripheral information, compass rose and annunciations, are the same as the HSI ARC mode with the following exceptions.

(1) Range Arc. The range knob, concentric with the mode switch, selects range on the map format. The static dashed range ring and label consist of one cyan arc and cyan text representing half the value of the range setting. The arc is half way between the aircraft symbol position and the point of the lubber line. Available full-scale ranges are 2.5, 5, 10, 20, 40, 80, 160, 320, and 640 nm.

(2) Selected HDG Readout. A digital readout of the selected heading is displayed in the upper left-hand corner of the display. When the heading bug is visible, it will appear when the selected heading is changed and is removed 10 seconds after the heading bug quits moving.

(3) FMS Waypoints Displayed. The MFD will display up to 15 FMS waypoints of a flight plan. One past and 14 future waypoints are located in their proper rho-theta position with respect to the selected range and aircraft symbol. The active waypoint is magenta and all other waypoints are drawn in white. Waypoints are identified by identifiers next to the waypoint symbol. An Arc pattern or a holding pattern associated with the active waypoint (TO) is drawn if the pattern is activated. If not, an ICON symbol representing the pattern type is drawn. Pattern ICON's are drawn next to all future waypoints that have an associated pattern. DME Arcs are drawn whenever they are present.

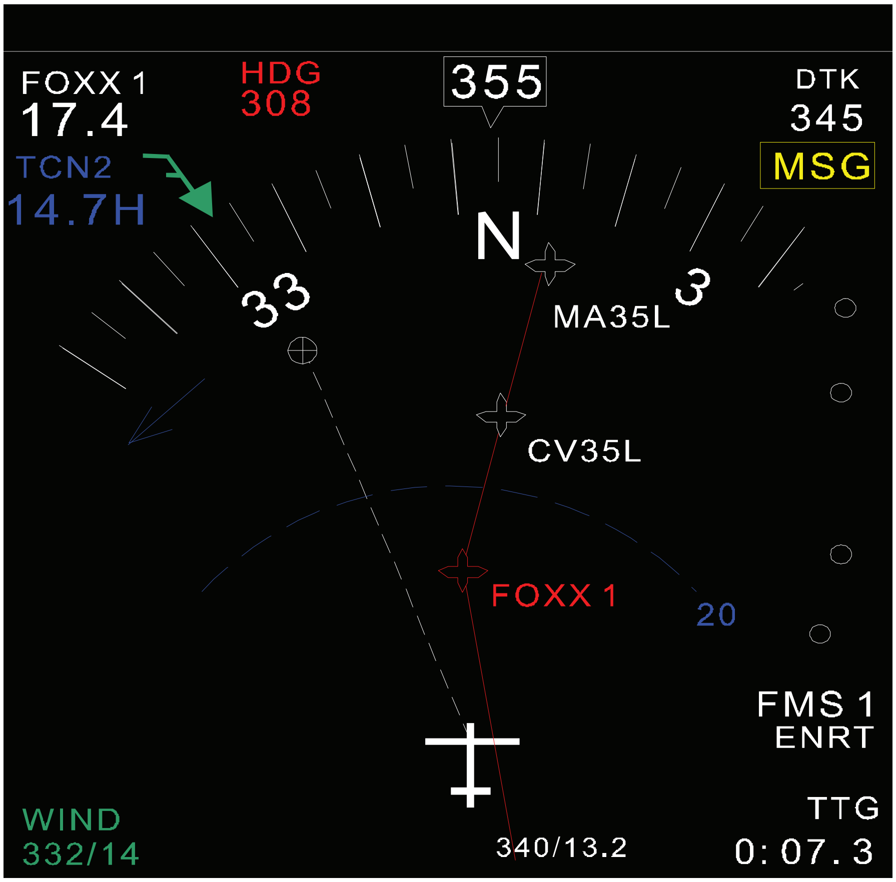


Figure 3C-12. Map ARC Format

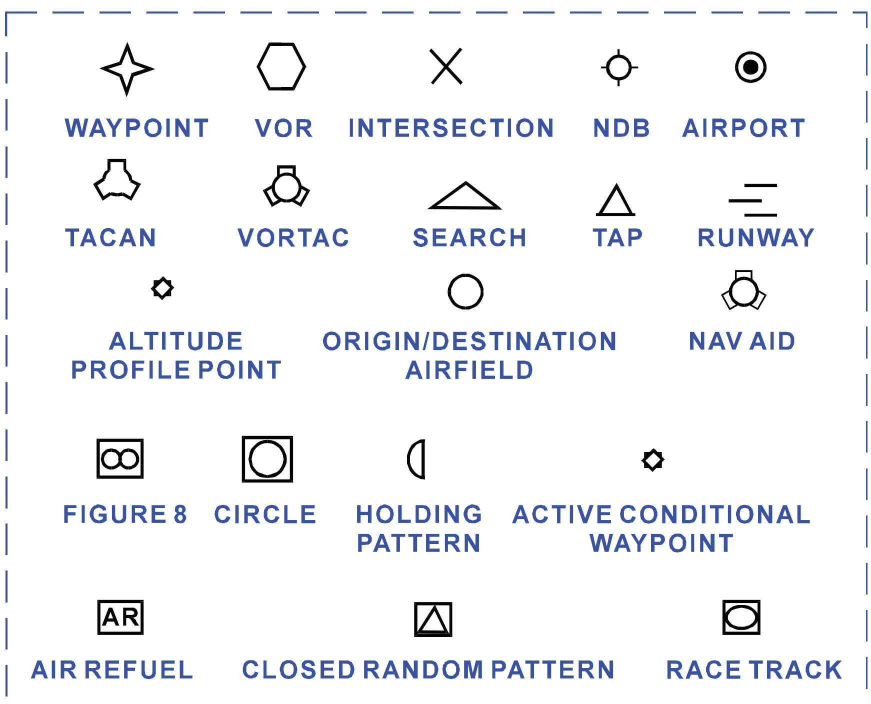


Figure 3C-13. Map Symbols

If an FMS is attached to the MFD, a waypoint alert occurs when the aircraft is about to reach the active waypoint. The active waypoint flashes to indicate a waypoint alert.

i. Active Flight Plan and Other Course Sources. If FMS is the selected course source, waypoint symbols are connected together by course lines of solid magenta ARC's, unless a gap in the course line connections is commanded by the FMS. The active waypoint and course line are drawn in magenta. Other symbols and lines are drawn in white. If the rho-theta location of a waypoint lies off the displayable map area, a course line is drawn to the edge of the display. All the waypoints that lie after that waypoint are not connected with course lines. If VOR is selected as the course source, bearing lines are drawn on the map instead of course lines.

j. Course Source Failure. When the selected course source sensor failure is detected, the sensor annunciator becomes red and boxed and all symbols and course lines are removed from the display. If the course source goes invalid, the selected course readout is replaced with red dashes. If a heading source fails, all NAV information is removed from the display.

k. FMS-800 Map Display Operation. Refer to Table 3C-8 for display options.

Table 3C-8. FMS-800 Map Display Operation

MAP MODE	PREVIOUS WAYPOINT DISPLAYED	COURSE LINE TO ACTIVE WAYPOINT
FMS To-To	Yes	Previous and Active waypoint are connected. The FMS flies a DTK.
FMS Direct-To	No	Desired Track line is drawn to the active waypoint from the computer Direct-To position
FMS To-From	Yes	Manually entered course line is drawn to the Active waypoint.
Manual Sequencing	Yes	A dashed line extends from the active waypoint.

If the accuracy of the FMS navigation falls below the 95% threshold, a NAV Warn occurs. All navigation information remains on the display during a NAV Warn. The NAV Warn is indicated by changing the FMS Primary NAV source annunciator to amber.

l. KLN 90B Map Display Options. Refer to Table 3C-9 for display options.

Table 3C-9. KLN 90B Map Display Options

MAP MODE	PREVIOUS WAYPOINT DISPLAYED	COURSE LINE TO ACTIVE WAYPOINT
Leg Mode	Yes	Previous and Active waypoint are connected. The FMS flies a DTK.
OBS Direct-To Mode	No	Desired Track line is drawn to the active waypoint from the aircraft's current position.
OBS Mode	Yes	Manually entered course line is drawn from the Active waypoint.
Manual Sequencing	Yes	A dashed line extends from the active waypoint.

m. VOR Map Display Operation. Refer to Table 3C-10 for the display option.

If the primary source is a VOR, a solid white bearing line is drawn from the aircraft to the VOR station. Since distance information is not available to the VOR station, the VOR station symbol is not drawn.

Table 3C-10. VOR/TCN Display Option

MAP MODE	PREVIOUS WAYPOINT DISPLAYED	BEARING LINE TO ACTIVE WAYPOINT
VOR	No	Bearing line extends from the aircraft symbol towards the station. The VOR symbol is not displayed.

The bearing line will always extend to the edge of the map. When the bearing is invalid or unavailable, the bearing line is removed from the display and the primary source abbreviation displayed in black letters on a solid red box.

n. Bearing Needle and Bearing Source. The bearing needle and bearing source display and operation are the same as on the HSI ARC display.

o. Map Format (Full 360 Degree Compass Map). The map display, Figure 3C-14, provides position awareness information to the crew. The operation of the peripheral labels and annunciations is the same as the ARC display mode. The map (full 360°) format is reached by toggling the **ARC** push button while in the Map mode. To return to the Map ARC mode (partial 80° compass) toggle the **ARC** push button.

p. Compass Display. The current heading is graphically indicated within the lubber line. A digital white current heading readout is provided within the white lubber line symbol. The point of the lubber line is located directly above the aircraft symbol along the outside of the selected range ring. Next to the heading readout is the heading reference indicator (**T** = True reference, Blanked reference = Magnetic reference).

When the heading is invalid, the heading readout is replaced with the heading annunciator. The heading annunciator displays **HDG** in black on a solid red box.

q. Range Ring. The range knob selects range on the MAP format. The range ring is displayed in cyan with the aircraft symbol located in the center of the ring. Two range rings are displayed. An outside range ring is labeled with the selected range and passes directly under the lubber line. The range ring is stationary and provides tick marks in 30° intervals. The inner range ring is half the selected range. It is a cyan dashed ring. Available full-scale ranges are 2.5, 5, 10, 20, 40, 80, 160, and 320 nm. A digital readout of the selected heading is displayed in the upper left-hand corner of the display. The bearing needle and bearing source display and operation are the same as on the 360° HSI.

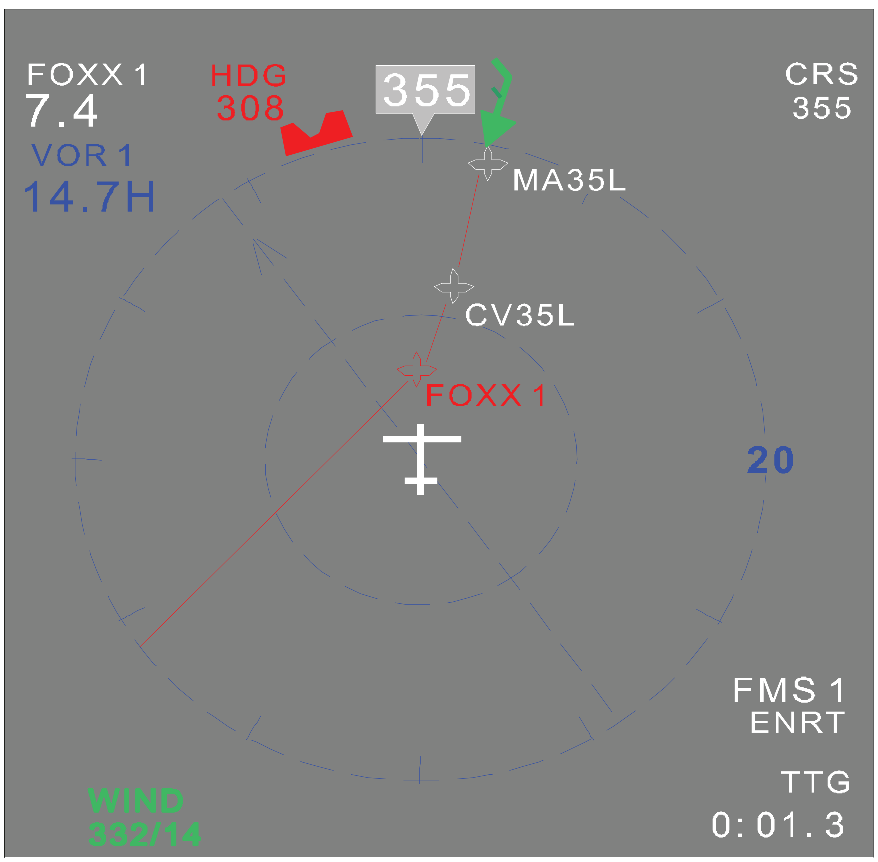
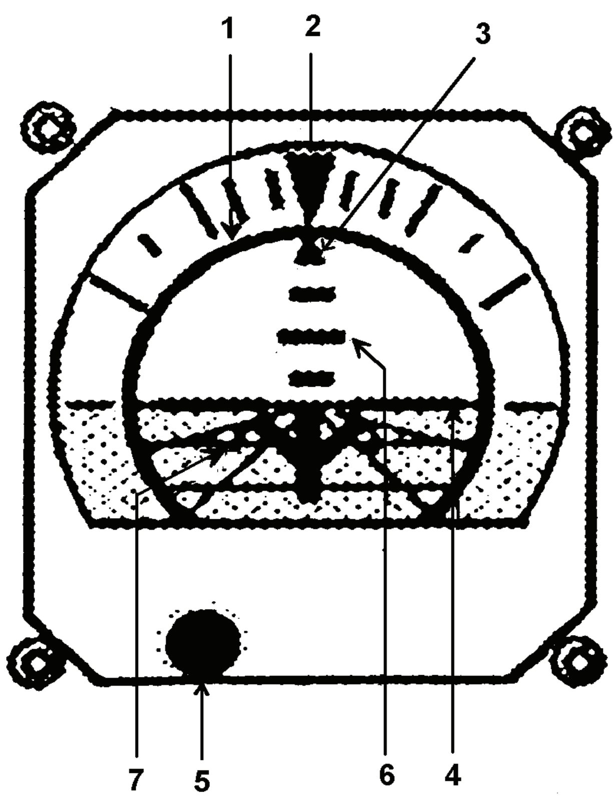


Figure 3C-14. 360 Degree Map

3C-16. STANDBY ATTITUDE REFERENCE SYSTEM

a. Description. The standby attitude indicator, located below the TCAS II display, Figure 3C-15, is powered by engine bleed air and provides a visual reference of the aircraft pitch and roll. The attitude indicator is comprised of a self-contained gyro to erect the sphere providing the pitch and roll reference, an indicating symbol representing the aircraft, and a horizontal line behind the indicating symbol that represents the horizon. The moveable indicating symbol may be adjusted vertically to correct for variations in level flight attitudes by a small knob located on the front base of the indicator.



1. **Attitude Sphere**
2. **Roll Index**
3. **Roll Pointer**
4. **Horizon Line**
5. **Pitch Knob**
6. **Pitch Scale**
7. **Symbolic Miniature Aircraft**

Figure 3C-15. Standby Attitude Indicator

b. Controls and Indexes.

(1) Attitude Sphere. Contains gyro and reference lines for pitch and roll degrees.

(2) Roll Index. Rotates with aircraft to provide measurement of angular displacement by the roll pointer.

(3) Roll Pointer. Indicates vertical in any roll attitude.

(4) Horizon Line. Indicates earth horizon relative to aircraft pitch attitude.

(5) Pitch Knob. Rotates to adjust the miniature aircraft.

(6) Pitch Scale. Measures pitch displacement of miniature aircraft.

(7) Symbolic Miniature Aircraft. Represents aircraft nose and wings. Indicates pitch and roll attitude relative to the horizon. Adjustable through pitch knob for varying pitch attitudes.

3C-17. TURN AND SLIP INDICATORS.

a. Description. One turn and slip indicator is installed on the pilot's side of the instrument panel. This indicator is gyroscopically controlled. The pilot's unit is operated by dc power. It is protected by a 5-ampere circuit breaker, placarded **PILOT TURN & SLIP**, on the overhead circuit breaker panel, Figure 2-16.

b. Control, Indicator, and Functions.

(1) Turn Rate Indicator. Indicates direction and rate of turn. A 2-minute turn rate is indicated when the turn rate indicator is deflected one needle width to the left of the index.

(2) Index. A reference mark for alignment of the turn rate indicator.

(3) GYRO Warning Flag (Pilot's Indicator). When in view, indicates loss of power to the gyro.

(4) Inclinometer. Indicates lateral acceleration (side-slip) of aircraft.

c. Each EADI and EHSI contains an inclinometer on the bottom of the bezel.

3C-18. RADIO ALTIMETER (RA-315).

a. Description. The radio altimeter provides the pilot with the actual altitude of the aircraft above ground or surface level. The altitude is displayed in the lower right-hand corner of the EADI when the aircraft is at or below 2500 feet Above Ground Level

(AGL). Radio altitude does not display when the aircraft is over 2500 feet AGL.

b. The Radio Altitude (RA) flag comes into view, replacing the RA readout, if the RA input is invalid.

c. Pressing the **PUSH TST** button on the EFIS control panel initiates a self-test of the radio altimeter.

d. Decision Height (DH) is the radio altitude where a decision needs to be made to land or go-around. The DH is set using the **DH/SET** knob on the display control panel. A **DH** annunciation comes on, flashing for 5 seconds, and an aural annunciation is activated when the aircraft descends to the DH. The **DH** annunciator then stays on steady until reset. It is reset by climbing to 25 feet above the DH or descending to 20 feet radio altitude.

The **DH** annunciation will not come into view and is removed if already being displayed when the radio altitude input is invalid.

The **DH** setting is removed if the DH or display control panel input is invalid, or when the aircraft is in an extreme attitude.

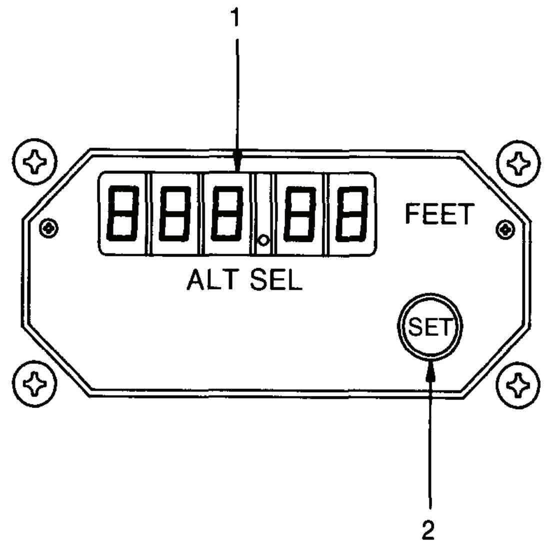
3C-19. ALTITUDE ALERTER / PRE-SELECTOR (AL800).

a. Description. The altitude alerter/pre-selector provides a means for setting the desired altitude reference for the altitude alerting and altitude pre-select system. The altitude alerter/pre-selector is powered through a 1-ampere circuit breaker, placarded **ALT ALERT**, located on the overhead circuit breaker panel, Figure 2-16.

b. Altitude Alerter/Pre-Selector Control, Indicator, and Functions. Refer to Figure 3C-16.

(1) Altitude Display. The altitude display indicates the selected altitude.

(2) Altitude Selector Knob. A knob, placarded **SET**, on the altitude select controller, is used to set the altitude in the display.



1. Altitude Display
2. Altitude Selector Knob

Figure 3C-16. Altitude Alerter/Pre-Selector (AL-800)

c. Altitude Alerter/Pre-Selector Operation.

(1) Altitude Pre-Selection.

1. Selector Knob – Set desired altitude in display window.
2. Altitude Selector Switch (flight director mode controller, Figure 2-17) – Push on.
3. Pilot must now initiate the altitude preselect maneuver by flying toward the preselected altitude.
4. Flight Director Mode Controller (pedestal extension, Figure 2-9) – Select pitch hold mode (pitch hold, IAS, or VS) if desired.
5. Autopilot controller (pedestal extension, Figure 2-9) – Engage if desired.
6. Upon capture of pre-selected altitude, the previously selected pitch mode will be reset.

(2) Altitude Alert.

(a) Altitude Selector Control Knob. Set desired altitude in altitude display window.

(b) When the aircraft reaches an altitude 1000 feet from selected altitude, the **ALT** annunciator on upper right corner of pilot's altimeter and the **ALT ALERT** annunciator in the annunciator block above the copilot's airspeed indicator will illuminate and a warning horn will sound for 1 second. The lights will remain illuminated until the aircraft reaches an altitude 250 feet from the selected altitude. If the aircraft now deviates from the selected altitude by more than 250 feet, the ALT lights will again be illuminated. The lights will remain illuminated until the aircraft is once again within 250 feet of the selected altitude.

3C-20. GYROMAGNETIC COMPASS SYSTEMS (C14A).

a. Description. Two identical compass systems are installed to provide accurate directional information for the aircraft. For heading reference, two modes of operation are used, directional gyro (FREE) mode or slaved compass (SLAVE) mode. In areas where magnetic references are reliable, the system is operated in the slaved compass mode. In this mode, the directional gyro is slaved to the magnetic flux valve that supplies a magnetic reference for correction of gyro precession. In the free gyro mode, the system is operated as a free gyro. In this mode, heading corrections are manually introduced using the pilot's or copilot's **INCREASE / DECREASE** switches. The slave/free mode is selected as desired, using the pilot's or copilot's **SLAVE / FREE** switches.

b. Gyromagnetic Compass System Controls, Indicators, and Functions.

(1) Compass System Selector Switch. A three-position switch, placarded **HEADING ALL SYSTEMS ON COMPASS 1 / NORM / ALL SYSTEMS COMPASS 2,** located left of the pilot's EHSI, controls the selection of compass system. When the switch is set to the **ALL SYSTEMS ON COMPASS 1** position, both EHSI's, both flight director computers, and the flight management system receive heading information from compass system number 1. When the switch is set to the **NORM** position, the flight director computer number 1, EHSI number 1, and flight management system receive heading information from compass system number 1, while the flight director computer number 2 and EHSI number 2 receive heading information from compass system number 2. When the switch is set to the **ALL SYSTEMS ON COMPASS 2** position, both EHSI's, both flight director computers, and the flight management system receive heading information from compass system number 2.

(2) Heading Comparator Warning Annunciator Compass. The EADI compares the heading inputs from system number 1 and system number 2 and displays a yellow flag placarded **HDG** on the top of the EADI to show a miscompare between the two heading inputs to the pilot's and copilot's EHSI.

(3) Gyro Slave / Free Switches. The pilot and copilot are each provided with a switch placarded **GYRO SLAVE / FREE**, located on the extreme left and right sides of the instrument panel. When the switch is in the **SLAVE** position, the pilot's flight instruments are receiving heading information based on magnetic north. When the switch is in the **FREE** position, the respective pilot's or copilot's EHSI and FMS are receiving heading information referenced to a free gyro.

(4) Gyro Increase / Decrease Switches. The pilot and copilot are each provided with a three-position switch spring-loaded to the center (off) position, placarded **GYRO INCREASE / DECREASE**, and located on the extreme left and right sides of the instrument panel. When the respective pilot's or copilot's gyro slave/free switch is in the **FREE** position, these switches may be used to increase or decrease the magnetic heading indication of the respective pilot's or copilot's EHSI.

(5) Heading Source. The heading source field annunciates the source for the aircraft heading input on the EHSI's. Magnetic north heading can be referenced with or without the directional gyro slaved to a magnetic flux detector. Table 3C-11 indicates the heading source annunciations.

Table 3C-11. Heading Reference Indicator Values

HEADING SWITCH SELECTION	ACTIVE FREE / SLAVE SWITCH	FREE / SLAVE SELECTION	HEADING REFERENCE INDICATOR DISPLAYED
All on Compass 1	Pilot	Free	DG1 (amber)
		Slave	MAG1 (amber)
All on Compass 2	Copilot	Free	DG2 (amber)
		Slave	MAG2 (amber)
Normal	On-side	Free	DG (white)
		Slave	Blank

3C-21. NAVIGATION RECEIVERS (KNR-634A).

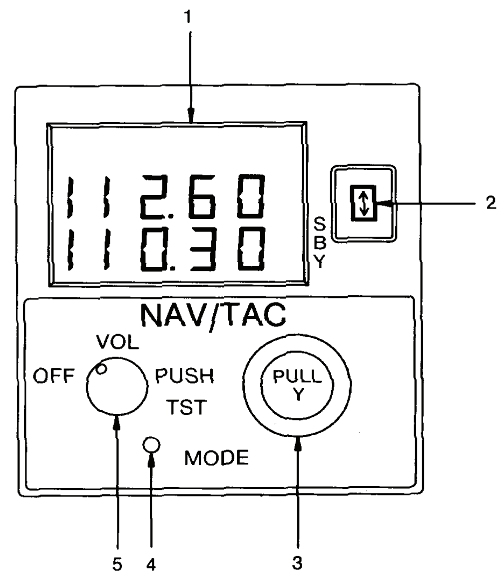
a. Description. Two VOR localizer / glideslope/ marker beacon navigation receivers (KNR634A T1, KNR-634 T2) and a TACAN/DME unit (KTU-709) are controlled by two control units (KFS-579A and KFS-564A) mounted in the instrument panel.

The NAV receivers receive and interpret VOR range and LOC signals in the frequency range of 108.00 to 117.95 MHz, glideslope signals in the frequency range of 329.15 to 335.00 MHz, and 75 Hz marker beacon signals. In addition, the KFS-579A #1 NAV/TAC control tunes the KTU-709 TACAN/DME system to all 252 TACAN channels. The NAV receivers are powered through two 2-ampere circuit breakers, placarded **NAV #1** and **#2**, located on the overhead circuit breaker panel, Figure 2-16.

b. NAV/TAC Control Unit (KFS-579A) Controls, Indicators, and Functions. Refer to Figure 3C-17.

(1) Frequency Display. Liquid crystal digital readouts provide a continuous display of both the active frequency, or TACAN channel, and standby frequency or TACAN channel (bottom line, placarded **SBY**) when the system is in the frequency mode. Display brightness is controlled by a switch, placarded **VHF / NAV / ADF**, located right of the altitude alert on the instrument panel.

(2) Frequency Transfer Switch. The frequency transfer switch is a momentary push-button switch, placarded with a two-headed vertical arrow, located to the right of the digital display.



1. **Frequency Display**
2. **Frequency Transfer Switch**
3. **Tuning Knobs**
4. **MODE Switch**
5. **OFF / VOL / PUSH TST Control**

Figure 3C-17. NAV/TAC Control Unit (KFS-579A)

(a) Standby Entry Mode. Pressing the frequency transfer switch with the unit in the standby entry mode causes the frequency or TACAN channel displayed in the active (upper) digital display to interchange with the frequency or TACAN channel shown in the lower (standby) digital display.

(b) Active Entry Mode. While the unit is in the standby entry mode, pressing the transfer switch for longer than 2 seconds will cause the unit to enter the active entry mode. While in the active entry mode, momentarily pressing the transfer switch will return the unit to the standby entry mode.

(3) Tuning Knobs. Two concentric tuning knobs, located on the right side of the NAV/TACAN control panel, are used to set the frequency or TACAN channel shown on the digital display, depending on the mode being used.

(a) Frequency or TACAN Channel Standby Entry Mode. When the unit is in the frequency or TACAN channel standby entry mode, the larger concentric knob is used to increase or decrease the first two digits to the left of the decimal point from 08 to 17 MHz (frequencies) or 01 to 29 (TACAN channels) of the standby digital display. When the larger concentric knob is turned to increase the digits above 17 (frequencies) or 29 (TACAN channels), the display will start over at 08 or 00 respectively. Conversely, when the knob is turned to decrease the digits below 08 (frequencies) or 00 (TACAN channels) the display will start over at 17 or 29 respectively. When in the frequency mode, the smaller concentric knob, placarded **PULL Y**, is used to set frequencies with 50 kHz spacing (i.e., .75, .80, .85, .90, etc.). When in the TACAN mode with the smaller concentric knob turned in the pulled-out position, the TACAN **X** designator will be changed to **Y**.

(b) Frequency/Active Entry Mode. When in the active entry mode, the tuning knobs operate the same as they do in the standby entry mode, but will change the upper digital display frequency or TACAN channel rather than the standby frequency.

*(4) **MODE** Switch.* A momentary push-button switch, placarded **MODE**, located on the lower portion of the NAV/TAC control unit, is used to put the unit into the TACAN mode. Momentarily pressing the **MODE** switch while in a frequency mode puts the unit into the TACAN mode.

*(5) **OFF /VOL / PUSH TST** Control.* A control knob on the front of the NAV/TACAN control unit, placarded **OFF** / **VOL** / **PUSH TST**, controls the operation of the unit. Turning the knob in the clockwise direction from the **OFF** position (detent) applies power to the unit and audio volume output is increased as the knob is turned further to the right. Pressing **PUSH TST** overrides the automatic squelch circuitry. Turning the knob clockwise past the automatic squelch threshold, while the automatic squelch circuitry is overridden, will allow background audio to be heard through the headphones or speaker and demonstrate whether the receiver is working or not, and allow setting of audio volume. To return the unit to automatic squelch control, press the **PUSH TST** control knob again.

c. Modes of Operation. The NAV/TACAN control unit may be operated in TACAN or frequency mode in either standby entry or active entry mode.

(1) Standby Entry Mode (Frequency or TACAN Channel). When the unit is operated in the standby entry mode, a new frequency or TACAN channel is set on the standby digital display, using the tuning knobs. When the operator is ready, the frequency or channel is transferred to the active display by pressing the transfer switch.

(2) Active Entry (Frequency or TACAN Channel). When the unit is operated in the active entry mode, a new frequency or TACAN channel is set on the active digital display using the tuning knobs. The active entry mode is entered from the standby entry mode by pressing the transfer switch for longer than 2 seconds. The standby digital display will be blank while the unit is in the active mode.

(3) TACAN Mode. Enter the TACAN mode by momentarily pressing the **MODE** switch. While in this mode, the tuning knobs change the TACAN channel numbers.

d. NAV/TACAN Control Unit (KFS-579A) Operation.

(1) Turn On Procedure.

1. Avionics Master Switch (overhead control panel, Figure 2-15) – **ON**.
2. **OFF / VOL / PUSH TST** Knob – Turn clockwise out of detent, then press to turn off automatic squelch circuit. Continue turning knob clockwise until background noise is heard in headphones or speaker, assuring that receiver is operating, then set audio volume to desired level. Press knob again to return unit to automatic squelch control.

(2) Receiver Operating Procedure.

1. **MODE** Push-Button Switch – As required.
2. Tuning Knobs – Set desired frequency or channel.
3. NAV I Receiver Audio Switch (audio control panel, Figure 3C-1) – ON (up).
4. **VOL** Control – Adjust as required.

(3) *Shutdown Procedure*.

1. **OFF / VOL / PUSH TST** Control – Turn counterclockwise to **OFF** position.

e. NAV Control Unit (KFS-564A) Controls and Functions. Refer to Figure 3C-18.

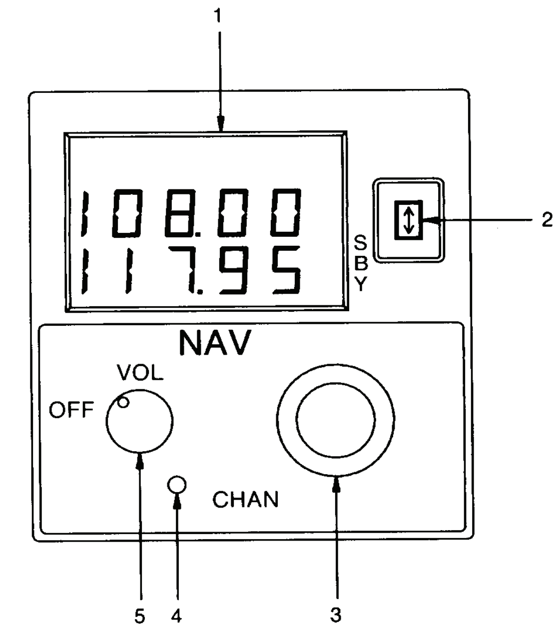
(1) Frequency Display. Liquid crystal digital readouts provide a continuous display of both the active frequency and standby frequency when the system is in the frequency mode. System mode is controlled by the **CHAN** push-button switch. When the system is in the channel mode, the upper digital display reads **CH** (channel) and a channel number (1 through 9), while the lower digital readout displays the frequency of the displayed channel number. When the system is in the program mode, the upper digital display will read **P** (program) and a channel number, while the lower digital display will read the frequency of the displayed channel. In all modes, a small **TX** will appear at the right end of the upper digital display when the system is transmitting.

(2) Frequency Transfer Switch. The frequency transfer switch is a momentary push-button switch, placarded with a two-headed vertical arrow, located to the right of the digital display.

(a) Standby Entry Mode. Pressing the frequency transfer switch with the unit in the standby entry mode causes the frequency displayed in the active digital display to interchange with the frequency shown in the standby digital display.

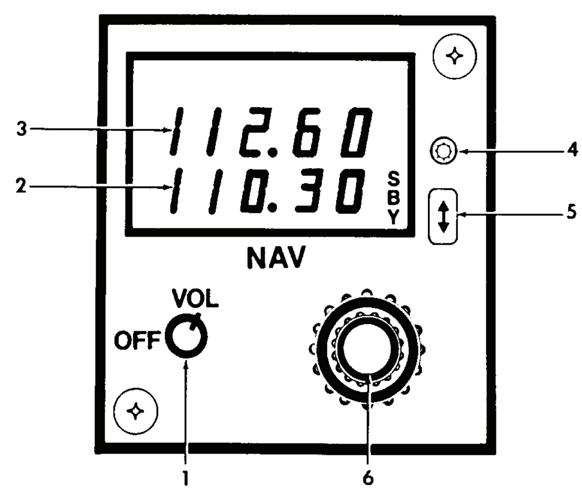
(b) Active Entry Mode. While the unit is in the standby entry mode or the channel mode, holding the transfer switch pressed for longer than 2 seconds will cause the unit to enter the active entry mode. While in the active entry mode, momentarily pressing the transfer switch will return the unit to the standby entry mode.

(c) Channel Mode. When the unit is in the channel mode, pressing the transfer switch will return the unit to the frequency standby mode. The channel frequency will become the new active frequency and the last active frequency will become the new standby frequency. If the unit was in the active entry mode prior to entering the channel mode, pressing the transfer switch will return the unit to the standby entry mode.



1. Frequency Display
2. Frequency Transfer Switch
3. Tuning Knobs
4. CHAN Switch
5. OFF / VOL Control

Figure 3C-18. Number 2 NAV Control Unit (KFS-564A) T2 (Sheet 1 of 2)



1. OFF / VOL control Switch
2. SBY Frequency Display
3. Active Frequency Display
4. Light Sensor
5. Frequency Transfer Switch
6. Frequency Selectors

Figure 3C-18. Number 2 NAV Control Unit (KFS-564A) T1 (Sheet 2 of 2)

(3) Tuning Knobs. Two concentric tuning knobs, located on the right side of the NAV receiver control panel, are used to set the frequency or channel shown on the digital display, depending upon the mode of operation being used.

(a) Frequency Standby Entry Mode. When the unit is in the frequency standby entry mode, the larger concentric knob is used to increase or decrease the first two digits to the left of the decimal point (08 to 17), of the standby digital display. When the larger concentric knob is turned to increase the digits above 17, the display will start over at 08. Conversely, when the knob is turned to decrease the digits below 08, the display will start over at 17. The smaller concentric knob is used to set frequencies with 50 kHz spacing (i.e., .75, .80, .85, .90, etc.).

(b) Frequency Active Entry Mode. When in the active entry mode, the tuning knobs operate the same as they do in the standby entry mode, but will change the active digital display frequency, rather than the standby frequency.

(c) Channel Mode. When the unit is in the channel mode, turning either tuning knob will change the channel number in the upper display and the corresponding frequency in the lower display.

(d) Program Mode. When the unit is in the program mode, the tuning knobs are used to select the channel number in the upper display (when flashing) or the channel frequency in the lower display (when flashing).

(4) ***CHAN*** *Switch.* A momentary push-button switch, placarded **CHAN**, located on the lower portion of the NAV control unit, is used to put the unit into the channel and program modes. Momentarily pressing the channel switch while in a frequency mode puts the unit into the channel mode. Holding the channel switch for longer than 2 seconds puts the unit into the program mode.

(5) ***OFF / VOL*** *Control.* A control knob on the front of the VHF control unit, placarded **OFF** / **VOL,** controls the operation of the unit. Turning the knob in the clockwise direction from the **OFF** position (detent) applies power to the unit, and audio volume output is increased as the knob is turned further to the right.

f. Modes of Operation. The NAV receiver control unit may be operated in the frequency mode (either standby entry or active entry), channel mode, or program mode.

(1) Frequency Modes. The NAV receiver control unit may be operated in standby entry and active entry.

(a) Standby Entry. When the unit is operated in the standby entry frequency mode, a new frequency is set on the standby digital display using the tuning knobs. When the operator is ready, the frequency is then transferred to the active display by pressing the frequency transfer switch.

(b) Active Entry. When the unit is operated in the active entry frequency mode, a new frequency is set on the active digital display using the tuning knobs. The active entry mode is entered from the standby entry mode by pressing the transfer switch for longer than 2 seconds. The standby digital display will be blank while the unit is in the active mode.

(2) Channel Mode. When the NAV receiver control unit is in the channel mode, the upper digital display will show a channel number (1 through 9) and the lower digital display will show the frequency assigned to the channel number in the upper digital display. The tuning knobs will change the channel number and corresponding frequency shown on the displays. The channel mode is entered by momentarily pressing the **CHAN** button located on the VHF transceiver control unit. If there are no valid frequencies programmed, the unit will display a **CH 1** in the upper display and dashes in the lower display. The unit can be changed from the channel mode to the frequency mode in three ways.

(a) Momentarily pressing the transfer switch will return the unit to the frequency mode, placing the channel frequency in the active display and the previous active frequency in the standby display.

(b) Momentarily pressing the **CHAN** switch will return the unit to the frequency mode, and will return the active and standby displays to what they displayed prior to entering the channel mode.

(c) The unit will return to the frequency mode if no knob activity takes place for 5 seconds after the unit was put into channel mode. When returned in this manner, the channel frequency will be put into the standby display with the active frequency remaining as it was before entering channel mode. If no frequencies were programmed, the frequencies will remain the same as they were before entering channel mode.

(3) Program Mode. The preset channels and frequencies are set using the program mode. Pressing and holding the **CHAN** switch for 2 seconds will place the unit into the program mode. A **P** and a

channel number will be shown in the active display and a frequency or dashes will be shown in the standby display. Immediately after entering the program mode, the channel number will begin to flash, indicating that rotating the tuning knobs will change the channel number. Momentarily pressing the transfer switch will cause the channel number to stop flashing and cause the frequency to begin flashing, indicating that rotating the tuning knobs will change the frequency. Momentarily pressing the **CHAN** switch will return the unit to the frequency mode. The standby frequency will return to what it was prior to entering the program mode. The unit will automatically return to the frequency mode if no front panel activity takes place for 20 seconds.

g. NAV/TACAN Control Unit (KFS-564A) Operation.

(1) Turn On Procedure.

1. Avionics Master Switch (overhead control panel, Figure 2-15) – **ON**.

2. **OFF/VOL** Knob – Turn clockwise out of detent, then press to turn off automatic squelch circuit. Continue turning knob clockwise until background noise is heard in headphones or speaker, assuring that receiver is operating, then set audio volume to desired level. Press knob again to return unit to automatic squelch control.

(2) Receiver Operating Procedure.

1. **MODE** Push-Button Switch – As required.

2. Tuning Knobs – Set desired frequency or channel.

3. NAV 1 Receiver Audio Switch (audio control panel, Figure 3C-1) – **ON**.

4. **VOL** Control – Adjust as required.

(3) Shutdown Procedure.

1. **OFF / VOL** Control – Turn counterclockwise to **OFF** position.

3C-22. TACAN/DME (KTU-709).

a. Description. The TACAN system is a polar coordinate UHF navigation system that provides relative bearing and slant range distance information with respect to a selected TACAN or VORTAC ground station. The effective range of the TACAN is limited to the line-of-sight. Actual operating range depends on the altitude of the aircraft, weather, type of terrain, location and altitude of the ground transmitter, and transmitter power.

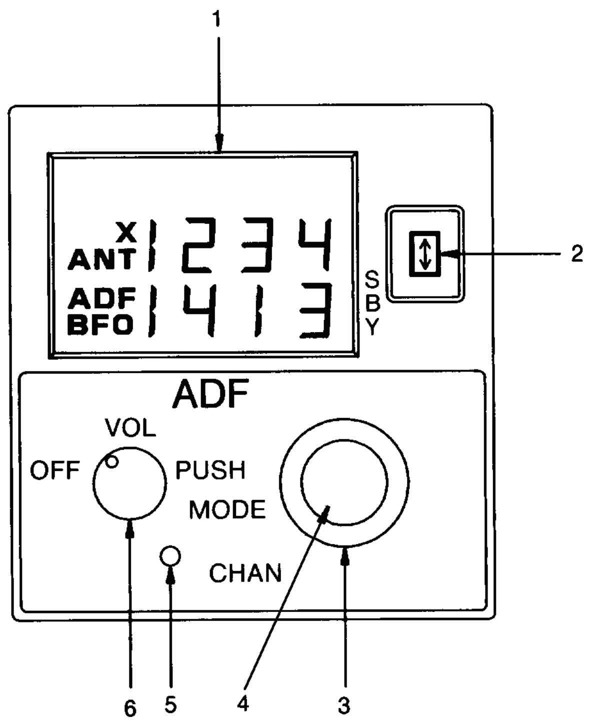
TACAN audio is applied to the audio control panel. The TACAN system also has a self-test mode for both bearing and distance functions. The NAV/TAC control unit, Figure 3C-17, tunes the KTU-709 to all 252 TACAN channels and all DME channels. TACAN course deviation information may be displayed on the pilot's or copilot's EHSI's. When NAV Source Selector is set to radio position, the TACAN radio is tuned to a TACAN station and the radio is supplying valid navigational data. TACAN or DME distance information is displayed on the pilot's and copilot’s EHSI’s in the upper right-hand corner of the displays. The system is protected by a 2-ampere circuit breaker, placarded **TACAN**, located on the overhead circuit breaker panel, Figure 2-16.

b. DME Hold Switch. A push-on/push-off switch, placarded **DME HOLD PUSH/SW**, located on the audio control panel **T2** and right of the radio call sign placard **T1** , controls selection of the DME hold function. When the **DME HOLD** switch is pushed to the on position, the DME/TACAN distance frequency in the DME/TACAN receiver/transmitter will be held constant regardless of the frequency selected on the NAV 1 control unit. The **DME HOLD** switch will illuminate when the DME hold function is selected and will be extinguished when the DME hold function is deselected. The **DME HOLD** switch is inoperative when the NAV/TAC is in the TAC mode or if the FMS is controlling the DME.

3C-23. ADF RECEIVER (KDF-806).

a. Description. Two ADF navigation receivers are installed to provide a visual indication of the relative bearing to a selected ground radio station. The units are airborne low frequency radio direction finders that receive signals from transmitters in the 190 to 1799 kHz range, and the international distress frequency of 2182 kHz. The ADF receiver can also be used for homing and position fixing. The ADF receiver is equipped with a Beat Frequency Oscillator (BFO) which is used to more accurately tune weak signals. Reception distance of reliable signals depends upon the power output of the transmitting station and the atmospheric conditions. Bearing information from the number 1 ADF receiver may be displayed visually by the single-needle pointer on the pilot's and copilot's EHSI. Bearing information from the number 2 ADF receiver may be displayed visually by the double-needle pointer on the pilot's and copilot's EHSI. ADF audio signals are applied to the audio control panel. The ADF receivers are powered through two 2-ampere circuit breakers, placarded **ADF #1** and **#2**, located on the overhead circuit breaker panel, Figure 2-16.

b. ADF Control Unit (KFS-586A) Controls, Indicators, and Functions. Refer to Figure 3C-19.



1. **Frequency Display**
2. **Frequency Transfer Switch**
3. **Tuning Knobs**
4. **MODE Switch**
5. **CHAN Switch**
6. **OFF /VOL / PUSH Control**

Figure 3C-19. ADF Receiver Control Unit (KFS-586A)

(1) Frequency Display. Liquid crystal digital readouts provide a continuous display of both the active frequency (top line) and standby frequency (bottom line, placarded **SBY**) when the system is in the frequency mode. System mode is controlled by the **CHAN** push-button switch. When the system is in the channel mode, the upper digital display reads **CH** (channel) and a channel number (1 through 9), while the lower digital readout displays the frequency of the displayed channel number. When the system is in the program mode, the upper digital display will read **P** (program) and a channel number, while the lower digital display will read the frequency of the displayed channel. The operating mode (**ANT**, **ADF**, and **BFO**) is also shown in the display. A small **X** located on the left of the active display informs the operator that the bearing information is invalid. Display brightness is controlled by a dimming control, placarded **VHF / NAV / ADF**, located right of the altitude alert indicator on the instrument panel.

(2) Frequency Transfer Switch. The frequency transfer switch is a momentary push-button switch placarded with a two-headed vertical arrow, located to the right of the digital display.

(a) Standby Entry Mode. Pressing the frequency transfer switch with the unit in the standby entry mode causes the frequency displayed in the active digital display to interchange with the frequency shown in the standby digital display.

(b) Active Entry Mode. While the unit is in the standby entry mode or the channel mode, holding the transfer switch pressed for longer than 2 seconds will cause the unit to enter the active entry mode. While in the active entry mode, momentarily pressing the transfer switch will return the unit to the standby entry mode.

(c) Channel Mode. When the unit is in the channel mode, pressing the transfer switch will return the unit to the frequency standby mode. The channel frequency will become the new active frequency and the last active frequency will become the new standby frequency. If the unit was in the active entry mode prior to entering the channel mode, pressing the transfer switch will return the unit to the standby entry mode.

(3) Tuning Knobs. Two concentric tuning knobs, located on the right side of the ADF receiver control panel, are used to set the frequency or channel shown on the digital display, depending upon the mode of operation being used.

(a) Frequency Standby Entry Mode. When the unit is in the frequency standby entry mode, the larger concentric knob is used to increase or decrease the hundreds kHz digits (1 to 17), of the standby digital display. When the larger concentric knob is turned so as to increase the digits above 17, the display will start over at 1. Conversely, when the knob is turned so as to decrease the digits below 1, the display will start over at 17. When the control unit is in the standby entry mode or in the program mode when the frequency is flashing and the larger tuning knob is turned so as to increase the hundred kHz digits above 17, the display will change to 2182 kHz. If the larger concentric knob is turned so as to increase the frequency above 2182 kHz, the hundred kHz digits will start over at 1. The smaller concentric knob is

used to set the 10 kHz digits when pushed in. When pulled out it is used to set the 1 kHz digits. When the display is changed to 2182 kHz the smaller knob will change the ones digits (from 2180 to 2189 kHz) whether pushed in or pulled out.

(b) Frequency Active Entry Mode. When in the active entry mode, the tuning knobs operate the same as they do in the standby entry mode, but will change the active digital display frequency rather than the standby frequency.

(c) Channel Mode. When the unit is in the channel mode, turning either tuning knob will change the channel number in the upper display and the corresponding frequency in the lower display.

(d) Program Mode. When the unit is in the program mode, the tuning knobs are used to select the channel number in the upper display (when flashing), or the channel frequency in the lower display (when flashing).

(4) Mode Switch. A momentary push-button switch, placarded **MODE**, is used to select the operating mode of the ADF receiver. Each press of the **MODE** switch cycles the system through the **ANT**, **ADF**, **ANT/BFO**, and **ADF/BFO** modes. The current mode is shown on the display.

(5) Channel Switch. A momentary push button switch, placarded **CHAN**, located on the lower portion of the ADF control unit, is used to put the unit into the channel and program modes. Momentarily pressing the **CHAN** switch while in a frequency mode puts the unit into the channel mode. Holding the channel switch pressed for longer than 2 seconds puts the unit into the program mode.

*(6) **OFF / VOL / PUSH** Control.* A control knob on the front of the ADF control unit placarded **OFF** / **VOL** / **PUSH** controls the operation of the unit. Turning the knob in the clockwise direction from the **OFF** position (detent) applies power to the unit, and audio volume output is increased as the knob is turned further to the right. Pressing **PUSH** overrides the automatic squelch circuitry. Turning the knob clockwise past the automatic squelch threshold, while the automatic squelch circuitry is overridden, will allow background audio to be heard through the headphones or speaker and demonstrate whether the receiver is working or not, and allow setting of audio volume. To return the transceiver to automatic squelch control, press the **PUSH** control knob again.

c. Frequency/Channel Selection Modes. The ADF receiver control unit may be operated in the frequency mode (either standby entry or active entry), channel mode, or program mode.

(1) Frequency Modes. The ADF receiver control unit may be operated in standby entry or active entry.

(a) Standby Entry. When the unit is operated in the standby entry frequency mode, a new frequency is set on the standby digital display, using the tuning knobs. When the operator is ready, the frequency is then transferred to the active display by pressing the frequency transfer switch.

(b) Active Entry. When the unit is operated in the active entry frequency mode, a new frequency is set on the active digital display using the tuning knobs. The active entry mode is entered from the standby entry mode by pressing the transfer switch for longer than 2 seconds. The standby digital display will be blank while the unit is in the active mode.

(2) Channel Mode. When the ADF receiver control unit is in the channel mode, the upper digital display will show a channel number (1 through 9), and the lower digital display will show the frequency assigned to the channel number in the upper digital display. The tuning knobs will change the channel number and corresponding frequency shown on the displays. The channel mode is entered by momentarily pressing the **CHAN** button located on the ADF receiver control unit. If there are no valid frequencies programmed, the unit will display a CH 1 in the upper display and dashes in the lower display. The unit can be changed from the channel mode to the frequency mode in three ways.

(a) Momentarily pressing the transfer switch will return the unit to the frequency mode, placing the channel frequency in the active display and the previous active frequency in the standby display.

(b) Momentarily pressing the **CHAN** switch will return the unit to the frequency mode, and will return the active and standby displays to what they displayed prior to entering the channel mode.

(c) The unit will return to the frequency mode if no knob activity takes place for 5 seconds after the unit was put into channel mode. When returned in this manner, the channel frequency will be put into the standby display with the active frequency remaining as it was before entering channel mode. If no frequencies were programmed, the frequencies will remain the same as they were before entering channel mode.

(3) Program Mode. The preset channels and frequencies are set using the program mode. Pressing and holding the **CHAN** switch for 2 seconds will place the unit into the program mode. **A** – **P-** and a channel number will be shown in the active display, and a frequency or dashes will be shown in the standby display. Immediately after entering the program mode the channel number will begin to flash, indicating that rotating the tuning knobs will change the channel number. Momentarily pressing the transfer switch will cause the channel number to stop flashing and cause the frequency to begin flashing, indicating that rotating the tuning knobs will change the frequency. Momentarily pressing the **CHAN** switch will return the unit to the frequency mode. The standby frequency will return to what it was prior to entering the program mode. The unit will automatically return to the frequency mode if no front panel activity takes place for 20 seconds.

d. Modes of Operation. The ADF receiver mode of operation is selected by a momentary push button switch placarded **MODE**. The operating mode changes from **ADF** to **ANT** to **ADF/BFO** to **ANT/BFO** with each press of the mode switch.

(1) Antenna Mode (ANT). When the ADF receiver is in the ANT mode, audio will be present in the speaker or headphone (if the respective number 1 or 2 ADF receiver audio switch is on), and the RMI indicator needle that is being used will be parked at the 90° relative position.

(2) Automatic Direction Finder (ADF) Mode. When the ADF receiver is in the ADF mode of operation, the RMI needle or HSI bearing pointer that is being used will indicate the relative bearing to the station.

(3) Beat Frequency Oscillator (BFO) Mode. The BFO is used to hear audio when the tuned station is a keyed continuous wave (CW) station. The BFO may be used either in the ANT or ADF mode.

e. ADF Receiver Control Unit (KFS-564A) Operation.

(1) Turn On Procedure.

1. Avionics Master Switch (overhead control panel, Figure 2-15) – **ON**.

2. **OFF / VOL / PUSH** Knob – Turn clockwise out of detent, then press to turn off automatic squelch circuit. Continue turning knob clockwise until background noise is heard in headphones or speaker, ensuring that the receiver is operating, then set audio volume to desired level. Press knob again to return unit to automatic squelch control.

(2) ADF Operating Procedure.

1. Number 1 or Number 2 ADF Receiver Audio Monitor Switch (audio control panel, Figure 3C-1) – **ON**.

2. Mode Switch – Set operating mode as required.

3. Tuning Knobs – Set desired frequency or channel.

4. **VOL** Control – As required.

5. **RMI** Switch – As required.

3C-24. AUTOMATIC FLIGHT CONTROL SYSTEM (SPZ-4000).

a. Description. The automatic flight control system is an integrated autopilot/flight director/air data system.

When the autopilot is engaged and coupled to the commands of the flight director, the flight control system will control the aircraft using the same commands which are displayed on the attitude director indicator by the flight director command cue. When the autopilot is engaged and uncoupled from the flight director commands, manual pitch and roll commands may be inserted using the Touch Control Steering (TCS) on the control wheels or the pitch wheel and turn knob on the autopilot control panel.

When the autopilot is coupled, the flight director command cue indications on the attitude director indicator provide a means of monitoring the performance of the autopilot. When the autopilot is not engaged, the same modes of operation are available for flight director only. The pilot maneuvers the aircraft to satisfy the flight director commands, as does the autopilot when it is engaged.

b. Air Data Computer. A digital air data computer located in the forward avionics compartment provides the altitude information for the pilot's altimeter, altitude alerter, and transponder. The computer also provides altitude and airspeed hold function data to the flight control computers. The air data computer is powered through a 2-ampere circuit breaker, placarded **AIR DATA ENCODER**, on the overhead circuit breaker panel, Figure 2-16. All air data computer functions are automatic in nature and require no flight crew action.

c. Pilot's Autopilot/Flight Director Switch/ Indicator. An alternate action autopilot/flight director switch/indicator, placarded **AP FD 1** and **AP FD 2**, is located on the pilot's instrument panel, directly below the glare shield, Figure 2-17. This switch is used to select which autopilot/flight director computer will control the aircraft flight servos.

d. Copilot's Autopilot/Flight Director Number 2 Annunciator. If the pilot selects AP FD 2, an annunciator placarded **AP FLT DIR NO**. **2**, located on the copilot's instrument panel directly below the glare shield, will illuminate to alert the copilot that the No. 2 autopilot flight director computer is controlling the aircraft.

NOTE

The autopilot will disengage when transferring between the pilot and copilot flight directors.

e. Flight Director Mode Selector (MS-400). The flight director/mode selector located on the pedestal extension, Figure 2-9, provides for selection of all flight director modes except go-around (which is initiated by remote switches located on the left power lever and on the copilot's control wheel). The top row of split-light, annunciated push buttons contains the lateral modes and the bottom row contains the vertical modes. The mode buttons will illuminate when manually selected, or automatically selected through other modes. The split-light, push-button annunciators illuminate amber for armed conditions and green for captured. When more than one lateral or vertical mode is selected, the flight director system automatically arms and captures the submode. Mode annunciations are also presented on remote annunciator blocks, located above both the pilot's and copilot's EADI,'s and on the pilot's EADI.

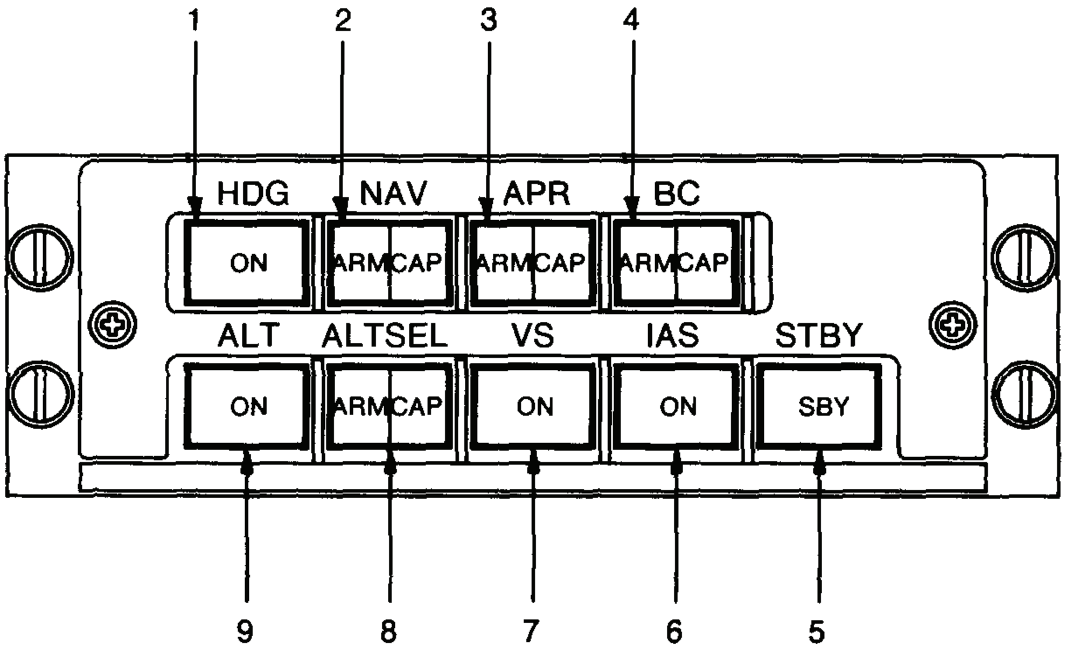
f. Autopilot Modes of Operation. Refer to Figure 3C-20.

(1) Heading Select Mode (HDG). The heading select mode is selected by pressing the **HDG** button on the mode selector. In the HDG mode the flight director computer provides inputs to the command cue to command a turn to the heading indicated by the heading bug on the EHSI. The heading select signal is gain programmed as a function of airspeed. When **HDG** is selected, it overrides the NAV, BC APR, and VOR APR modes. In the event of a loss of valid signal from the vertical gyro or compass, the command bar on the EADI is biased out of view.

*(2) Navigation Mode (**NAV**).* The navigation mode represents a family of modes for various navigation systems including VOR, localizer, TACAN, and FMS 1 or FMS 2.

(a) VOR Mode. The VOR mode is selected by selecting the radio position with the NAV Source Selector on the EFIS control panel and either VOR 1 or VOR 2, as selected by the **CRS 1/2** switch tuned to a VOR frequency and DME greater than 20 miles from the station. Prior to VOR capture, the command cue receives a heading select command as described above and the **HDG** mode switch is illuminated along with the **NAV ARM** annunciators. Upon VOR capture the system automatically switches to the VOR mode, **HDG** and **NAV ARM** annunciators extinguish, and NAV capture (**NAV CAP**) annunciators will illuminate. At capture, a command is generated to capture and track the VOR beam. VOR deviation is gain programmed as a function of distance from the station. This programming corrects for beam convergence, thus optimizing the gain through the useful VOR range. To use this feature, the DME must be tuned to the same VOR station as the NAV receiver that is feeding the flight director and DME hold must not be selected. The course error signal is gain programmed as a function of airspeed. Crosswind washout is included, which maintains the aircraft on beam center in the presence of crosswind. The intercept angle and DME distance are used in determining the capture point to insure smooth and comfortable performance during bracketing.

When passing over the station, an overstation sensor detects station passage removing the VOR deviation signal from the command until it is no longer erratic. While over the station, course changes may be made by selecting a new course on the EHSI. If the NAV receiver is not valid prior to the capture point, the lateral beam sensor will not trip and the system will remain in the HDG mode. After capture, if the NAV receiver, compass data or vertical gyro go invalid, the ADI command cue will bias out of view. Also, the **NAV CAP** annunciators will extinguish if the NAV receiver becomes invalid.



1. Heading Mode Selector
2. Navigation Mode Selector
3. Approach Mode Selector
4. Back Course Mode Selector
5. Standby Mode Selector
6. Indicated Airspeed Mode Selector
7. Vertical Speed Mode Selector
8. Altitude Preselect Mode Selector
9. Altitude Hold Mode Selector

Figure 3C-20. Flight Director Mode Selector

(b) VOR/FMS Approach Mode. The VOR/FMS approach mode is selected by pressing the **NAV** button on the mode selector with the FMS as the Nav Source; or VOR with a navigation receiver tuned to a VOR frequency and less than 20 DME miles from the station. The mode operates identically to the VOR mode with the gains optimized for a VOR approach.

(c) Localizer Mode. The localizer mode is selected by selecting radio position with the NAV Source Selector on the EFIS control panel and VOR 1 or VOR 2 as selected by the CRS 1/2 switch tuned to a localizer frequency. Mode selection and annunciation in the LOC mode is similar to the VOR mode. The localizer deviation signal is gain programmed as a function of radio altitude, time, and airspeed. If the radio altimeter is invalid, gain programming is a function of glideslope capture, time, and airspeed. If the radio altimeter is invalid, gain programming is a function of glideslope capture, time, and airspeed. Other valid logic is the same as the VOR mode.

(3) Localizer Approach Mode (APR). The approach mode is used to make an ILS approach only. Pressing the **APR** button with an ILS frequency tuned arms both the NAV and APR modes to capture the localizer and glideslope respectively. No alternate NAV source can be selected. Operating LOC mode is the same as described above except, if the radio altimeter is invalid in APR mode, gain programming is a function of glideslope capture, time, and airspeed.

With the APR mode armed, the pitch axis can be in any one of the other pitch modes except go-around. When reaching the vertical beam sensor trip point, the system automatically switches to the glideslope mode. The pitch mode and **APR ARM** annunciators extinguish and **APR CAP** annunciator illuminates on the controller. At capture, a command is generated to asymptotically approach the glideslope beam. Capture can be made from above or below the beam. The glideslope gain is programmed as a function of radio altitude, time, and airspeed. The **APR CAP** annunciator on the mode selector will extinguish if the GS receiver becomes invalid after capture.

Glideslope capture is interlocked so that the localizer must be captured prior to glideslope capture. If the glideslope signal is not valid prior to capture, the vertical beam sensor will not trip and the system will remain in the pitch mode. After capture, if the NAV receiver, GS receiver, compass data, or vertical gyro becomes invalid, ADI command bars will bias out of view. If the radio altimeter is not valid, the glideslope gain programming will be a function of GS capture, time, and airspeed.

(4) Back Course Mode (BC). The back course mode is selected by pressing the **BC** button on the mode selector. Back course operates the same as the LOC mode with the deviation and course signals reversed to make a back course approach on the localizer. When **BC** is selected, and outside the lateral beam sensor trip point, **BC ARM** and **HDG** annunciators will illuminate. At the capture point, **BC CAP** will be annunciated with **BC ARM** and **HDG** annunciators extinguished. When BC is selected, the glideslope circuits are locked out.

(5) Standby Mode (SBY). The standby mode is selected by pressing the **SBY** button on the mode selector. This resets all the other flight director modes and biases the EADI command bars from view. While pressed, SBY acts as a lamp test causing all mode annunciators to illuminate and the FD warning flag on the EADI to come in view. When the button is released, the mode annunciator lights extinguish and the flight director warning flag retracts from view.

(6) Indicated Airspeed Hold Mode (IAS). The indicated airspeed hold mode is selected by pressing the **IAS** button on the mode selector. When IAS is selected, it overrides the APR CAP, GA, ALT, VS, and ALTSEL CAP modes. In the IAS mode, the pitch command is proportional to airspeed error provided by the air data computer. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new airspeed hold reference without disengaging the mode. Once engaged in the IAS mode, the mode will be reset if the air data computer is not valid. The EADI command cue will bias out of view if the vertical gyro is not valid.

(7) Vertical Speed Hold Mode (VS). The vertical speed hold mode is selected by pressing the **VS** button on the mode selector. When VS is selected, it overrides the APR CAP, GA, ALT, ALTSEL CAP, and IAS modes. In the VS mode, the pitch command is proportional to VS error provided by the air data computer. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new vertical speed hold reference without disengaging the mode. Once engaged in the VS mode, the mode will be reset if the air data computer is not valid. The ADI command cue will bias out of view if the vertical gyro is not valid.

(8) Altitude Preselect Mode (ALTSEL). The altitude preselect mode is selected by pressing the **ALTSEL** button on the mode selector. The desired altitude is selected on the altitude preselect controller. Pitch hold, VS, or IAS may be selected as a mode to fly to the selected altitude. When outside the altitude bracket trip point, the **ALTSEL ARM** annunciator along with the selected pitch mode is illuminated on the mode selector. When reaching the bracket altitude, the system automatically switches to the ALTSEL CAP mode and the previously selected pitch mode is cancelled. When the altitude is reached, the ALTSEL CAP mode is automatically cancelled and the flight director switches to the ALT hold mode. If the air data computer is not valid, the altitude preselect mode cannot be selected. The EADI command bars will bias out of view if the vertical gyro is not valid.

NOTE

If the baro setting on the altimeter is changed, a command is generated to fly the aircraft back to the original altitude reference.

(9) Altitude Hold Mode (ALT). The altitude hold mode is selected by pressing the **ALT** button on the mode selector. When ALT mode is selected, it overrides the APR CAP, GA, IAS, VS, and ALTSEL CAP modes. In the ALT mode the pitch command is proportional to the altitude error provided by the air data computer. The altitude error signal is gain programmed as a function of airspeed. Pressing and holding the **TCS** button allows the pilot to maneuver the aircraft to a new altitude hold reference without disengaging the mode. Once engaged in the altitude hold mode, the mode will be reset if the air data computer is not valid and the EADI command bars will bias out of view if the vertical gyro is not valid.

(10) Pitch Hold Mode. Whenever a roll mode is selected without a pitch mode, the EADI command cue will display a pitch attitude hold command. The pitch attitude can be changed by pressing the **TCS** button on the control wheel and maneuvering the aircraft. The command cue will be synchronized to zero while the button is pressed. Upon release of the button, the pitch command will be such as to maintain the new pitch attitude. In the pitch hold mode, the EADI command bars will be biased out of view if the vertical gyro is not valid.

(11) Go-around Mode. The go-around mode is selected by pressing one of the remote go-around switches. One go-around switch is located on the left power lever, Figure 2-9, and the other is located on the copilot's control wheel. When selected, all other modes are reset and the remote go-around (**GA**) and yaw damp (**YD ENG**) annunciators will be illuminated. The EADI command cue receives a wings level command (zero command when roll is zero). The command cue also receives the go-around command that is a 7° visual pitch up attitude command. Selecting GA disconnects the autopilot; however, the yaw damper remains on.

Once go-around is selected, any roll mode can be selected. The wings level roll command will cancel. The go-around mode is canceled by selecting another pitch mode or TCS.

(12) TACAN Mode. The TACAN mode is selected by selecting the radio position with the NAV source selector on the EFIS control panel and either VOR 1 or VOR 2 selected by the **CRS 1/2** switch to a valid TACAN frequency. TACAN distance information will be displayed on the EHSI.

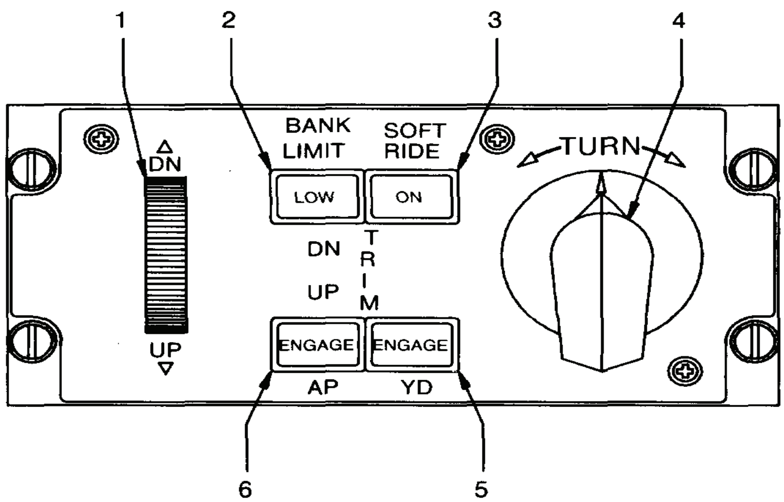
NOTE

The NAV/TAC receiver must be tuned to a valid TACAN frequency.

TACAN functions are identical to VOR using TACAN information rather than VOR signals. The **ARM / CAP** annunciation is the same as in VOR mode.

(13) TACAN Approach Mode. The TACAN approach mode is the same as a VOR approach mode, except that it uses a TACAN in place of a VOR station.

g. Autopilot Controller. The autopilot controller provides the means of engaging the autopilot and yaw damper, as well as manually controlling the autopilot through the turn knob and pitch wheel. Refer to Figure 3C-21. The autopilot system limits are listed in Table 3C-12.



1. **Pitch Thumbwheel**
2. **Bank Limit Switch**
3. **Soft Ride Switch**
4. **Turn Knob**
5. **YD Engage Switch**
6. **AP Engage Switch**

Figure 3C-21. Autopilot Controller

Table 3C-12. Operating Parameters

MODE	CONTROL OR SENSOR	PARAMETER	VALUE
Yaw Damper	Yaw Control	Engage Limit	Unlimited
A/P Engage		Engage Limit	Roll Up to ± 90° Pitch Up to ± 30°
Basic	Touch Control	Roll Control Limit	Up to ± 45° Roll
A/P	Steering TCS	Pitch Control Limit	Up to ± 20° Pitch
	Turn Knob	Roll Angle Limit	± 30°
		Roll Rate Limit	± 15°/sec
	Pitch Wheel Heading Hold	Pitch Angle Limit Roll Angle Limit	± 15° Pitch Less than 6° and no roll mode selected

Table 3C-12. Operating Parameters (Continued)

MODE	CONTROL OR SENSOR	PARAMETER	VALUE
Heading	HSI Heading	Roll Angle Limit	± 25°
Select	Select Knob	Roll Rate Limit	± 3.5°/sec
CAPTURE			
VOR	Course Knob, NAV Receiver and DME	Beam Angle Intercept (HDG SEL)	Up to ± 90°
		Roll Angle Limit	± 25°
		Course Cut Limit at Capture	± 45° Course
		Capture Point	Function of beam, beam rate, course error, and DME distance
		ON COURSE Roll Angle Limit	± 13° Roll
		Crosswind	Up to ± 45°
		Correction	Course Error
		OVER STATION Course Change	Up to ± 90°
		Roll Angle Limit	± 17°
		LOC CAPTURE	
LOC or APR or BC	Course Knob and NAV Receiver	Beam Intercept	Up to ± 90°
		Roll Angle Limit	± 25°
		Roll Rate Limit	± 5°/sec
		Capture Point	Function of Beam, Beam Rate and Course Error
		NAV ON-COURSE	
		Roll Angle Limit	± 17° Roll
		Crosswind	± 30° of course
		Correction Limit	error
		Gain Programming	Function of Time and (TAS) starts at 1200-ft radio altitude
GLIDESLOPE CAPTURE			
LOC or APR or BC	GS Receiver and Air Data Computer	Beam Capture	Function of beam and beam rate
		Pitch Command Limit	± 10°
		Glideslope Damping	Vertical Velocity
		Pitch Rate Limit	Function of (TAS)
		Gain Programming	Function of Time and (TAS) Starts at 1200-ft radio altitude
			Function of (Radio Alt) Starts at 250 ft

Table 3C-12. Operating Parameters (Continued)

MODE	CONTROL OR SENSOR	PARAMETER	VALUE
GA	Control Switch on Power Lever	Fixed Pitch-Up Command, Wings Level	7° Pitch Up
Pitch Sync	TCS Switch on Control Wheel	Pitch Attitude Command	± 20° max.
ALT Hold	Air Data Computer	ALT Hold Engage Range	0 to 50,000 ft
		ALT Hold Engage Error	± 20 ft
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
VS Hold	Air Data Computer	VERT Speed Engage Range	O to ± 6000 ft/min
		ALT Speed Hold	± 30 ft
		Engage Error Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
IAS Hold	Air Data Computer	IAS Engage Range	80 to 450 knots
		IAS Hold Engage Error	± 5 knots
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)
ALT Preselect	Air Data Computer	Preselect Capture Range	0 to 50,000 ft
		Maximum Vertical Speed for Capture	± 4000 ft/min
		Maximum Gravitational Force During Capture Maneuver	± 20g
		Pitch Limit	± 20°
		Pitch Rate Limit	Function of (TAS)

h. Autopilot Controller (PC-400) Controls and Functions.

(1) Pitch Thumbwheel. Rotation of the pitch thumbwheel with the autopilot engaged results in a change of pitch attitude proportional to the rotation of the pitch wheel and in the direction of wheel movement. Movement of the pitch thumbwheel will cancel any other previously selected vertical mode. However, for safety, movement of the pitch thumbwheel has no effect with the autopilot coupled to a glideslope signal.

*(2) **BANK LIMIT** Switch.* Selection of the bank limit mode on the autopilot controller provides a lower maximum bank angle while in the heading select mode. **LOW** will illuminate on the **BANK LIMIT** switch. The lower bank limit is inhibited and **LOW** is extinguished during NAV mode captures. If heading select is again engaged, bank limit will again be illuminated. Pressing **BANK LIMIT** when illuminated will return autopilot to normal bank limits.

*(3) **SOFT RIDE** Switch.* Soft ride reduces autopilot gains while still maintaining stability in rough air. This mode may be used with any flight director mode selected.

*(4) **TURN** Knob.* Rotation of the turn knob out of detent results in a roll command. The roll angle is proportional to and in the direction of the turn knob rotation. The **TURN** knob must be in detent (center position) before the autopilot can be engaged. Rotation of the **TURN** knob cancels any other previously selected lateral mode.

*(5) **YD ENGAGE** Switch.* When the autopilot is not engaged, the yaw damper may be used by pressing the **YD ENGAGE** switch.

*(6) **AP ENGAGE** Switch.* The **AP ENGAGE** switch is used to engage the autopilot. Engaging the autopilot automatically engages the yaw damper. The autopilot may be engaged with the airplane in any reasonable attitude.

i. Disengaging the Autopilot. The autopilot is normally disengaged by momentarily pressing the control wheel **AP DISC** switch. The autopilot may, however, be disengaged by any of the following:

1. Actuation of the control wheel **AP DISC** button. Disengagement is confirmed by five flashes of the **AP ENG** annunciator.
2. Pressing the respective vertical gyro **FAST ERECT** button.
3. Actuation of respective compass **INCREASE / DECREASE** switch.
4. Selection of go-around mode. Disengagement is confirmed by the **AP ENG** annunciator flashing five times and illumination of the **GA** and **YD ENG** annunciators.
5. Pulling the autopilot **AP POWER** circuit breaker.
6. Pressing the autopilot **AP ENGAGE** push button.
7. Transferring between pilot and copilot flight directors.

Any of the following malfunctions will cause the autopilot to *automatically* disengage.

8. Vertical gyro failure.
9. Directional gyro failure.
10. Autopilot power or circuit failure.
11. Torque limiter failure.

Disengaging under any of the last four conditions will illuminate the **AP DISC** annunciator and the flashing **MASTER WARNING** light. Pressing the control wheel **AP DISC** switch will extinguish the **AP DISC** annunciator.

j. Elevator TRIM Annunciators. The elevator trim annunciator indicates **UP** or **DN** when a sustained signal is being applied to the elevator servo. The annunciator should not be illuminated when engaging the autopilot.

NOTE

Only the TCS button on the side that has control of the autopilot will permit changing the autopilot without canceling the other pilot's GA mode.

k. Touch Control Steering (TCS). The **TCS** push button located on the control wheel allows the pilot to manually change aircraft attitude, altitude, vertical speed, and/or airspeed without disengaging the autopilot. After completing the manual maneuver, the **TCS** push button is released, and the autopilot will automatically resynchronize to the vertical mode. For example, with IAS mode selected, the pilot may press the **TCS** push button and manually change airspeed. Once trimmed at the new airspeed, the **TCS** push button is released and the autopilot will hold this airspeed. If a large pitch attitude change is made, the pilot should trim the aircraft normally before releasing the **TCS** button while in the ALT hold mode.

3C-25. FLIGHT MANAGEMENT SYSTEM NO. 1 (FMS-800).

a. Description.

(1) System Overview. The FMS-800 flight management system provides global autonomous guidance using GPS navigation. This FMS guidance may be used to fly published airways, direct routing, TACAN emulation procedures, and published non-precision or autonomous GPS approaches, as well as various mission patterns.

The FMS-800 permits pre-flight loading of 40 complete mission plans using a data cartridge. It also permits the crew to generate or modify mission plans on the aircraft, using a global International Civil Aviation Organization (ICAO) data base of waypoints and automatic flight plan calculations.

The FMS-800 also provides simplified crew control of the communication radios.

NOTE

The C-12 installation uses a single Control Display Unit (CDU). Any references to "designated pilot" in this manual refer to pilot only.

(2) System Architecture. Figure 3C-22 shows a simplified diagram of the FMS-800 system. The CDU provides access to all system functions for a single crewmember. It also provides user interface between the FMS-800 and MIL-STD-1553B and non-1553B aircraft systems.

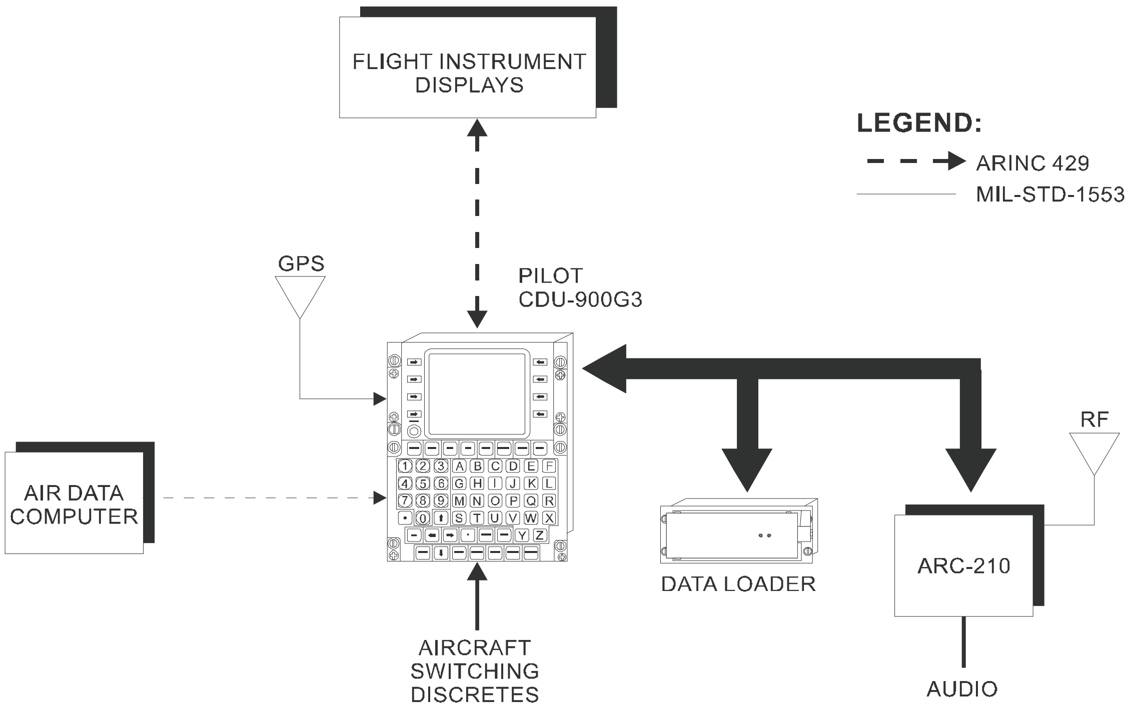


Figure 3C-22. FMS-800 Simplified Diagram

The data cartridge is used to load mission data and to act as an in-flight library of ICAO waypoints. It also loads the current worldwide magnetic variation tables automatically upon power-up and can be used to load or store GPS almanac data to reduce GPS cold start time following installation of a GPS receiver.

NOTE

A lithium battery is installed in the CDU to reduce the initialization time.

The MIL-STD-1553B multiplexed serial digital data bus is the primary means of control and data Transferal within the FMS-800. This bus has the following characteristics.

(a) Dual data paths (buses) between each remote terminal and the bus controller.

(b) No operator actions required for initialization or any other aspect of normal bus controller operation.

The CDU operates on the MIL-STD-1553B data bus as a Bus Controller (BC). The CDU that is functioning as bus controller performs all navigation and guidance computations, builds all page displays, communicates with all external equipment and performs all other computations required to support FMS-800 operation.

b. CDU Operations.

(1) General Operation Concepts. CDU data entry operations are performed with a full alphanumeric keypad, arrow keys, function keys, and eight line select keys, Figure 3C-23. The CDU display has 8 lines of 22 characters each. Lines 1, 3, 5, and 7 are data lines with a line select key on both the right and left of the field. Line 2 is reserved for page title and line 6 is reserved as an annunciation line. Line 4 is an unreserved data line and line 8 is the scratchpad for holding all keypad entries. See Table 3C-13 for the descriptions of the CDU's function and application keys.

NOTE

The character set displayed in Figure 3C-23 does not represent the actual view on the CDU screen.

1. **Line Select Keys**
2. **Function Keys**
3. **Function Keys**
4. **Clear Key**
5. **Scroll Keys**

Figure 3C-23. Control Display Unit Front Panel

Table 3C-13. FMS-800 CDU Function and Application Keys

FUNCTION KEYS			
KEY	**DESCRIPTION**	**KEY**	**DESCRIPTION**
COM	Accesses control pages for UHF/VHF radio.	**M3**	Function not used.
DATA	Enables display of expanded data for any selected waypoint.	**MARK**	Marks and stores present position plus any active cursor position transmitted from the Flight Display System (FDS).
DIR	Enables immediate selection of Direct-To waypoint.	**MSN**	Accesses a menu of additional mission functions.
EDIT	Accesses Flight Plan pages.	**NAV**	Accesses the Navigation information page.
FPLN	Accesses Flight Plan pages.	**PSN**	Accesses Pilot Position (present position and track) pages.
IDX	Accesses index of additional functions not available on top-level keys.	**STAT**	Accesses avionics LRU status pages.
IFF	Function not used.	**STR**	Accesses Pilot Steering pages.
INAV	Accesses comprehensive data pages for GPS navigation solutions.		
APPLICATION KEYS			
–	Deletes data from entry fields or causes data to revert to a default value.	↓	Scrolls vertically to related pages of data or scrolls down through lists of data on a page.
CLR	Clears the scratchpad of incorrect entries or annunciations.	→	Horizontally scrolls right to access additional pages of information.
/	Separates the waypoint identifier, bearing, and distance components.	←	Horizontally scrolls left to access additional pages of information.
↑	Scrolls vertically to related pages of data or scrolls up through lists of data on a page.		

(a) Scratchpad. The scratchpad is a buffer to hold all data for review prior to executing the input. As data is keyed into the CDU with the keypad, the entered values are displayed within the scratchpad field at the bottom of the display. Incorrect entries are cleared with the **CLR** key. A single press clears the last character on the right. Holding the **CLR** key down clears the entire scratchpad. The scratchpad is cleared automatically when the system accepts valid inputs.

(b) Function Keys. The labeled function keys are used to call up specific top-level pages of the CDU and to simultaneously dedicate the line select keys to the functions indicated on that page. Exceptions are the **MARK**, **DATA**, and **M3** keys that do not change the page but do initiate their respective functions. Some functions, which are less frequently used in flight, are accessed through the index (**IDX**) and flight plan edit (**EDIT**) function keys and then via line select keys on the respective menu page. The Index and Flight Plan Edit pages are shown in Figure 3C-24 and Table 3C-14.

(c) Line Select Keys. Line select keys can be used to access lower level pages, toggle modes of the function, enter data in the associated field, or copy data in the scratchpad. When undefined line select keys are pressed, no operation is performed and no annunciation is displayed.

When a label next to the line select displays an outward pointing arrow, selecting the line select will access the page identified by the line select label.

When a colon is displayed next to a line select label, selecting the line select will toggle the label value to a different state. When two labels are shown, the toggled value is the innermost label or value.

When brackets ([ ]) are displayed next to a line select, selection of the line select with valid data in the scratchpad will enter the data into the bracketed field and enable use of that data by the FMS. When the scratchpad is blank, selection of the line select next to the bracketed data will copy that data to the scratchpad.

When a label next to a line select displays an inward pointing arrow, selecting this line select will either select, enable, or disable the indicated function or item. For single step functions, an asterisk to identify the function as enabled will replace the arrow. When multiple selections are needed prior to activation of the function, a "fat" arrow to highlight the selection will replace the arrow. When all selections are made, an asterisk will replace the fat arrow when the function is enabled.

Symbolic aids are used to indicate what entries can be made, what functions are on or engaged, and what selections are possible. Refer to Figure 3C-25 for a summary of these symbols.

NOTE

The lateral and vertical scroll arrows are located next to the scratchpad on the display.

(d) Display Scrolling. Often more data is available than what fits on a single display page. In these cases display scrolling is used to access all the related information.

Two types of scrolling are page scrolling and line scrolling. Vertical scrolling with up (↑) and down (↓) arrows either accesses additional pages of the information shown or scrolls through lists of data. Horizontal scrolling with left (←) or right (→) arrows accesses additional pages of similar information.

Holding the arrow keys causes the scrolling to continue until the key is released. Special characters (horizontal double-headed arrow, vertical double-headed arrow, and multi-headed arrow) are displayed next to the scratchpad to indicate the type of scrolling.

(e) Confirmation Function. Functions that involve destruction of significant internal data require confirmation before execution. A message, CONFIRM XXX, will appear in the scratchpad, where XXX is a message unique to the item requiring confirmation. The scratchpad message is cleared by either reselecting the appropriate line select key to confirm the selection or by pressing the **CLR** key if the function is not desired.

(f) Copying and Transferring Data. Most data to be entered on the CDU can be copied into the scratchpad in its original form by pressing the adjacent line select key, except where other operations are performed which take precedence. Once copied into the scratchpad, this data may be transferred elsewhere in the FMS-800. For example, a waypoint may be transferred from the mark point list to the flight plan, or the flight plan waypoint sequence may be reordered without having to re-enter the waypoint data.

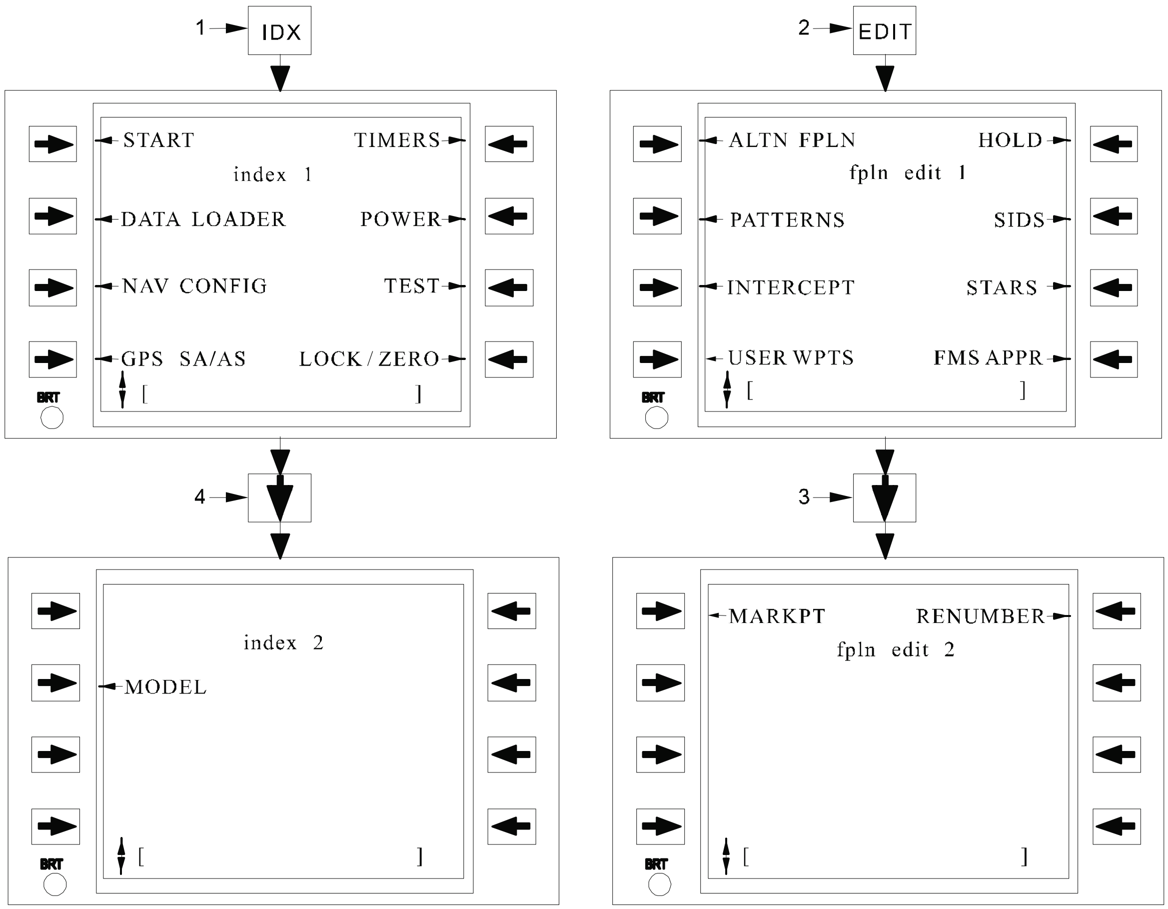
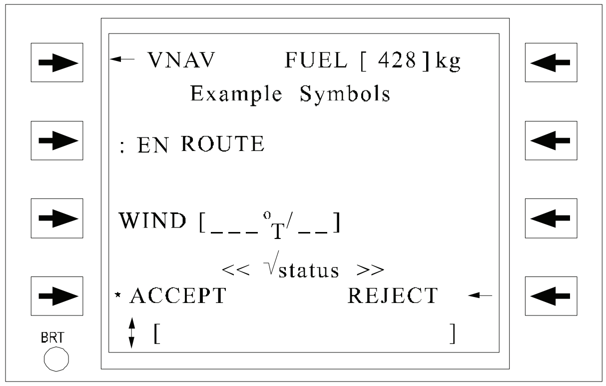


Figure 3C-24. Index and Flight Plan Edit Pages

Table 3C-14. Index and Flight Plan Edit Page Procedures

NO.	DESCRIPTION/FUNCTION
1	Press IDX function key to access Index Page.
2	Press EDIT function key to access Edit Page.
3	Scroll to access Edit 2 Page.
4	Scroll to access Index 2 Page.



←→	Pushing the line select key will access the page indicated by the label.	√	Check (as in check status for equipment failures).
→←	Pushing the line select key will select the item or enable the mode.	– – –	No computed data is available or meaningful, or power is off.
⇒⇐	Function is selected, but not enabled.	[ ]	Data entry is possible / required.
★	Function is on or enabled.	↕↑↓	Vertical page or line scrolling is possible (in direction of arrow).
:	Alternate selection among modes (toggle).	←→	Lateral page scrolling is possible (in direction of arrow).
°	Reference is degrees magnetic north.		Lateral and vertical page scrolling is possible.
°T	Reference is degrees true (indicated by "T" symbol).		

Figure 3C-25. CDU Standard Display Symbols

(2) Data Entry and Display Formats. The acceptable entry formats, valid data ranges, and display formats are discussed in the following paragraphs. They are applicable to all CDU pages unless stated otherwise. On many CDU pages, configuration settings and entered data are maintained through each power cycle to maintain continuity between aircraft sorties. Also, a lot of data is maintained in the event of a bus controller swap.

(a) Valid Data Ranges and Units for Entry and Display. Data entry valid ranges for a given field are generally limited by the display resolution with assumption of a fixed decimal point and positive entries (i.e., a four-digit numerical field with no decimal point will accept entries from 0 to 9999). Some entered data is limited by operational considerations, e.g., VNAV angle of 6.0° or 3500 fpm maximum. For values which cannot be computed due to insufficient data, the CDU will display dashes (– – – –); e.g., if gross weight cannot be computed by the FMS because total fuel has not been specified. Asterisks (****) are displayed if the value is too large for its respective display field.

(b) Entry and Display of Waypoints. Flight plan waypoints and other locations are entered in three basic formats.

1. Position Coordinates. Latitude-longitude waypoint pair.

2. Waypoint Identifier. Up to a five-character alphanumeric string. The appropriate data is extracted from an on-board ICAO waypoint data base or user-defined waypoint list of navigation aids, airports, intersections, etc.

3. Identifier / Bearing / Distance. Position defined at the specified bearing and distance from a data

base waypoint with the indicated identifier.

(c) Entry and Display of Latitude-Longitude Waypoints. Latitude-longitude waypoints are entered in the form of degrees and minutes followed by optional decimal minutes or seconds and decimal seconds. The required format is an N or S followed by four or six digits, with a decimal point and up to three additional optional digits and followed by E or W with five or seven digits, with a decimal point and up to three additional digits optional.

Latitude-longitude waypoints are displayed as whole minutes on all CDU pages except in the scratchpad when the value is copied and on the Position, Integrated Navigation, Start 1, or Data pages where thousandths of minutes are displayed.

(d) Entry and Display of Identifier Waypoints. Identifiers are entered as up to five alphanumeric. Identifier waypoints are displayed left justified, with alphabetic characters always written as capital letters. Crew-entered identifiers are limited to between two and five characters. Single character identifiers cannot be entered by the crew and are only accessed by inserting a SID, STAR, or approach that includes such a waypoint in the procedure.

(e) Entry and Display of Identifier / Bearing / Distance Waypoints. Identifier / bearing / distance waypoints are entered as an identifier followed by a /, followed by the bearing, followed by a /, followed by distance. Bearings are entered as three digits optionally followed by a decimal point and an additional digit. Bearing is displayed as three digits rounded to the nearest degree. An entry of 145.3° will be displayed as 145°. In the case of a number such as 145.5°, the CDU always rounds up to the nearest whole number. Distances are entered as up to four digits optionally followed by a decimal point and one additional digit.

When a bearing/distance is applied to a waypoint, the waypoint will appear as one of the following.

1. If the waypoint is an ICAO identifier and the distance is 999 nm or less, the waypoint will be displayed as identifier/bearing/ distance (e.g. EDW/350/45).

2. If the waypoint is not a waypoint identifier or the distance is greater than 999 nm, the waypoint will be displayed as latitude/longitude.

(f) Use of Magnetic Variation and Declination. Magnetic variation is used in converting most azimuth angles from true to magnetic reference. Courses into navaid waypoints and any offset waypoints described relative to these waypoints use stored station declination rather than magnetic variation in the computations, so that they match those on published Instrument Flight Rules (IFR) charts.

(g) Entry and Display of Time and Date. Time is entered with no delineators between hours, minutes, and seconds. Seconds are optional, so that three to six digits are acceptable. If no time or date is available for a given field, blanks are displayed. All times are entered and displayed as Coordinated Universal Time (UTC). Dates are entered and written using the military convention of day, month, year (six digits total). Example would be 16/12/97 (December 16, 1997).

The FMS-800 system has been designed to avoid date and time rollover problems. The operator will not see problems if a current date and time are entered into the CDU prior to initializing GPS modules.

(h) Deletion of Data. Most data entry fields may have the associated data deleted by entering a **–** in the scratchpad and pressing the line select adjacent to the desired field. In some cases, the dash entry causes the data to revert to a fixed default value (e.g., wind to 360º/0).

(3) System Annunciations and Scratchpad Messages. The CDU will alert the crew of avionics failures, degraded operations, system modes of operation, or operator entry errors via the CDU annunciation line and scratchpad.

(a) Annunciations on the annunciation line of the CDU.

(b) Scratchpad messages only displayed locally on the CDU causing the condition.

(c) Master CDU alert annunciation is provided as an external alert in the pilot's primary field of view.

Table 3C-15 provides a list of CDU annunciations and scratchpad messages.

Table 3C-15. CDU Annunciations and Scratchpad Messages

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
ACTIVE CHANNEL	Attempting to perform an ERF on a hopset that is the currently tuned preset on the V/UHF.	Clear key.	SP	A		
ADD ALTN BEFORE?	An alternate flight plan has been selected to be added to the flight plan.	Clear key or insertion of the alternate flight plan into the flight plan.	SP	N		
ALTN FPLN FULL	Attempt to insert more than 60 legs into the alternate flight plan.	Clear key.	SP	A		
ANTI JAM MISMATCH	Attempt to tune to an anti-jam preset that contains a Have Quick net when the V/UHF's preset contains a SINCGARS net, and vice versa.	Clear key.	SP	A		
APPROACH	Given for the following conditions: 1. For a GPS approach mode, 10 seconds after flashing **APPROACH** annunciation is activated and the HSI deviations and RAIM Integrity performance are set for approach mode. 2. Flight sequence mode transitions or manually selected to approach and the 10 second flashing APPROACH annunciation is not active.	HSI deviations change to terminal, en route, or oceanic mode.	A	N	X	

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
APPROACH (continued)	3. Following flashing approach annunciation or when Flight Mode transitions or manually selected to approach mode. HSI deviations and RAIM integrity performance are set for approach.	Ten seconds after initiation or HSI deviations change to terminal, en route, or oceanic mode.	A	B	X	
APPROACH DEFINED	Attempt to: 1. Enter a VNAV parameter at the MAP or visual runway extension waypoint. 2. Delete the V attribute at the MAP of an approach or the RWXND waypoint of a visual approach. 3. Attach a Hold to an Initial Approach Fix (IAF) (with a data base holding pattern), MAP, or Missed Approach Holding Point (MAHP) (with a data base holding pattern). 4. Attach a pattern to an IAF, (with a data base holding pattern), FAF/runway extension point, MAP, or MAHP (with a data base holding pattern). 5. Insert an offset when approach waypoint is the active waypoint 6. Enter a waypoint between the FAF/ runway extension point and MAP. 7. Perform a direct-to the MAP.	Clear key.	SP	A		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
	8. Enter an approach into the flight plan when an approach is already inserted.					
APPROACH IS ACTIVE	Attempt to: 1. Delete or remove the approach from the flight plan during execution (MAP is the active waypoint). 2. Modify the flight plan course, approach parameters, or (before the MAP is passed) the sequencing mode when a MAP is the active waypoint. 3. Insert a PPSN hold or insert a waypoint at the active waypoint when the MAP is the active waypoint.	Clear key.	SP	A		
ATTACH CIR AT?	A circle pattern without a defined fix has been selected for insertion into the FPLN or alternate flight plan.	Clear key or valid insert.	SP	N		
ATTACH CRP AT?	A closed random pattern without a defined fix has been selected for insertion into the FPLN or alternate flight plan.	Clear key or valid insert.	SP	N		
ATTACH FG8 AT?	A figure 8 pattern without a defined fix has been selected for insertion into the FPLN or alternate flight plan.	Clear key or valid insert.	SP	N		
ATTACH HOLD AT?	A hold has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
Attach RTK AT?	A racetrack pattern without a defined fix has been selected for insertion into the FPLN or alternate flight plan.	Clear key or valid insert.	SP	N		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
CARTRIDGE IN USE	Attempt to access the data cartridge while data is currently being up/down loaded.	Clear key.	SP	A		
√bank limit	Bank limit is less than 25° and a refuel pattern is activated, or a holding pattern fix is passed for the first time, or within 30 nm of the FAF/runway extension point or airport for the first time.	Clear key.	A	B		
√baroset	Within 30 nm of the FAF/runway extension point for the first time.	Clear key or entering a BARO set on the pilot or copilot vertical steer page.	A	B		
√gps	Loss of GPS use as an INAV source (five second filter while in approach sealing mode, 25 second filter while in oceanic, enroute or terminal scaling modes).	Clear key or re-obtaining GPS or selecting an INU only INAV solution.	A	B		
√IFF2	Attempt to set IFF #1 to normal power mode when IFF #2 is active.	Clear key.	SP	A		
√nav error	Downgrade in 95% probable error.	Clear key or upgrade in position index.	A	B		X
√POWER	Attempt to control modes of equipment when power is disabled on power page.	Clear key	SP	A		
√speed	During a TNAV, groundspeed (or IAS for pattern) deviates from the guidance solution's groundspeed (or IAS for pattern) by the designated amount entered on the Navigation Configuration page (3-second filter).	Correction in airspeed or clear key.	A	B		X

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
√status	Detected failure of an LRU or interface signal (3-second filter).	Clear key or selection of the STAT key.	A	B		X
√STATUS	A request for display or operation that cannot be provided due to failure or the LRU is under test.	Clear key.	SP	A		
√timer 1	Down-count to zero.	Clear key.	A	B		X
√timer 2	Down-count to zero.	Clear key.	A	B		X
√timer 3	Down-count to zero.	Clear key.	A	B		X
√version	CDU software versions incompatible.	Replace or power down unit with incorrect version.	A	B	X	X
cir active	Circle pattern is currently being executed.	Circle pattern canceled.	A	N	X	
CIR IS ACTIVE	Attempt to delete or modify the circle fix, delete Mission Flight Patterns (MFP) attribute, or modify the flight plan course or attempt to insert a PPOS hold or insert a waypoint at the active waypoint during pattern execution.	Clear key.	SP	A		
CONF LOADXXXXXXX X	Request to load the alternate flight plan XXXXXXXX into the CDU from the data cartridge.	Clear key, reselect entered ALTN.	SP	N		
CONFIRM ADD	Request to add a new user waypoint to the data base.	Clear key, or select Add.	SP	N		
CONFIRM ALTN RMV	Request to remove a Pattern from the alternate flight plan.	Clear key or reselect ALTN FPLN.	SP	N		
CONFIRM CHNG TO CIR	Request to change MFP type to circle.	Clear key or selection of PTRN CHNG.	SP	N		
CONFIRM CHNG TO FG8	Request to change MFP type to figure 8.	Clear key or selection of PTRN CHNG.	SP	N		
CONFIRM CHNG TO RTK	Request to change MFP type to racetrack.	Clear key or selection of PTRN CHNG.	SP	N		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
CONFIRM CLEAR COMM	Request to clear COMM presets.	Clear key or reselect COMM.	SP	N		
CONFIRM CLEAR FPLNS	Request to clear flight plan and alternate flight plans.	Clear key or reselect FPLN/ALTN.	SP	N		
CONFIRM CLEAR GPS	Request to clear GPS SA/AS keys.	Clear key or reselect GPS.	SP	N		
CONFIRM CLEAR PTS	Request to clear the markpoint and waypoint list.	Clear key MKPTS/WPTS.	SP	N		
CONFIRM ERASE DATA	Request to erase flight data. (Start 3 page).	Clear key or reselect ERASE FLT/DATA.	SP	N		
CONFIRM ERASE ALTN	Request to erase alternate flight plan. (Altn Fpln page)	Clear key or reselect ERASE ALTN.	SP	N		
CONFIRM ERASE FPLN	Request to erase flight plan. (Start 3 page)	Clear key or reselect ERASE FPLN.	SP	N		
CONFIRM FPLN RMV	Request to remove a Hold, FMS approach, SID, STAR, Pattern or Intercept from the flight plan.	Clear key or reselect FPLN RMV.	SP	N		
CONFIRM HOLD PPSN	Request to hold at present position.	Clear key reselect HOLD PPSN.	SP	N		
CONFIRM LOAD ALMNAC	Request to load the GPS almanac data.	Clear key or reselect LOAD ALMANAC.	SP	N		
CONFIRM LOAD ALTN	Request to load the alternate flight plan into the CDU from the data cartridge.	Clear key, reselect LOAD, or reselect entered altn.	SP	N		
CONFIRM LOAD COMM	Request to load COMM data into the CDU from the data cartridge.	Clear key or reselect LOAD COMM.	SP	N		
CONFIRM LOAD DATA	Request to load flight data. (Start 3 page).	Clear key or reselect LOAD FLT/DATA.	SP	N		
CONFIRM LOAD PTS	Request to load markpoint and waypoint lists into the CDU from the data cartridge.	Clear key or reselect LOAD MKPT/WPT.	SP	N		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
CONFIRM OVERWRITE	Request to replace existing information on the user waypoint data base.	Clear key or select Add.				
CONFIRM POWER OFF	Request to turn off power to all IFF and Nav/Com radios.	Clear key or reselect Radio Master.	SP	N		
CONFIRM RENUMB FPLN	Request to renumber the flight plan.	Clear key or reselect RENUMBER.	SP	N		
CONFIRM RPLACE FPLN	Request to replace the flight plan with the alternate. (Start 3 and Altn Fpln pages).	Clear key or reselect REPLACE FPLN.	SP	N		
CONFIRM RVRSE ALTN	Request to reverse the alternate flight plan.	Clear key or reselect RVRS ALTN.	SP	N		
CONFIRM SAVE ALMNAC	Request to save the selected GPS almanac data.	Clear key or reselect SAVE ALMANAC.	SP	N		
CONFIRM SAVE ALTN	Request to save the alternate flight plan to the data cartridge.	Clear key or reselect SAVE.	SP	N		
CONFIRM SAVE COMM	Request to save COMM data into the data cartridge from the CDU.	Clear key or reselect SAVE COMM.	SP	N		
CONFIRM SAVE PTS	Request to save markpoint and waypoint lists to the data cartridge.	Clear key or reselect SAVE MKPT/WPT.	SP	N		
CONFIRM SAVE STATUS	Request to save markpoint and waypoint lists to the data cartridge.	Clear key or reselect SAVE STAT.	SP	N		
CONFIRM SID RPLACE	Request to replace a SID in the flight plan.	Clear key or reselect the line select key.	SP	N		
CONFIRM STAR RPLACE	Request to replace a STAR in the flight plan.	Clear key or reselect the line select key.	SP	N		
CONFIRM SYSTEM TEST	Request to initiate test on all LRU's controlled by FMS-800.	Clear key or reselect SYSTEM.	SP	N		
CONFIRM UPDATE AJ	Attempting to update the CNMS antijam preset list with the V/UHF antijam preset list.	Clear key or reselect UPDATE AJ PRESETS.	SP	N		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
CONFIRM ZERO ALL	Request to zeroize the system.	Clear key or reselect ZERO ALL.	SP	N		
crp active	Closed random pattern is currently being executed.	Closed random pattern canceled.	A	N	X	
CRP IS ACTIVE	Attempt to delete or modify the closed random pattern fix or delete MFP attribute or modify the flight plan course or attempt to insert a PPOS hold or insert a waypoint at the active waypoint during pattern execution.	Clear key.	SP	A		
CRS CHANGE >90	Attempt to apply course edit greater than 90 degrees from the current inbound course while in automatic or flyover leg sequence mode.	Clear key.	SP	A		
crs reversal	Generated at 3 nm from a course reversal procedure execution.	Enabling the holding pattern at the TO or switched to capturing inbound leg of course reversal or sequencing by the FAF or IAF.	A	N	X	
CRS RVRSL IS ACTIVE	Attempt to delete the active waypoint, modify the flight plan course, or attempt to insert a PPSN hold or insert a waypoint at the active waypoint during course reversal execution.	Clear key.	SP	A		
data expired	Current date is greater than the data base effective period.	Clear key or new data base.	A	N		X
DATA FOR?	Prompt for access to Data page.	Clear key or valid waypoint selection.	SP	N		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
DIRECT TO CRP?	Access of CRP page from the Direct – To Flight Plan page.	Clear key or selection of CRP point for Direct-To Flight Plan page.	SP	N		
DISCONTINUITY	Attempt to enter a course to waypoint when a discontinuity is the active waypoint.	Clear key.	SP	A		
discontinuity	A discontinuity is the active waypoint.	Delete the discontinuity, delete the associated waypoint, insert a waypoint between the discontinuity and the associated waypoint, or direct-to any waypoint.	AL	N		
DUPLICATE USER WPT	Attempt to assign a user waypoint identifier with the **/** function when the same identifier already exists in the User Waypoint List.	Clear key.	SP	A		
ELEMENT OMITTED	Attempt to initiate Multiple Words of the Dat (MWOD) LOAD or Frequency Management Training (FMT) LOAD when the entered list is not complete.	Clear key.	SP	A		
EMER/GUARD ENGAGED	Attempt to change COMM modes when set to emergency configuration.	Clear key.	SP	A		
ENTER ANGLE OR RATE	Attempt to toggle between CLIMB and DESCNT when no vertical angle or rate has been entered.	Clear key.	SP	A		
ENTER DATE	Attempt to verify a date is in the V/UHF when there is no date entered on the CDU.	Clear key.	SP	A		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
ENTER FIX	Attempt to enter a magnetic track or toggle to a magnetic track when a target fix has not been entered on the Intercept A page.	Clear key.	SP	A		
ENTER PARA-METERS	Attempt to insert an intercept, MFP, or approach into the flight plan when defining parameters have not been entered.	Clear keys.	SP	A		
enter utc	On power up if time is not available and crew has not entered time or if bus control is switched with time not valid.	Clear key or entry of time or return of valid time.	A	N		
ENTER UTC/DATE	Attempt to start one of the times without a valid UTC and Date available in system.	Clear key.	SP	A		
ENTER WAYPOINT	Attempt to enter an alternate flight plan parameter prior to entering the waypoint or attempt to enter a flight plan course when no TO exists.	Clear key.	SP	A		
ERF IN PROCESS	Attempt to initiate another action on the V/UHF when an ERF is in process.	Clear key.	SP	A		
exiting hold	Active hold is canceled by deletion of the H attribute.	Hold fix is crossed.	AL	N		
fg8 active	Figure 8 pattern is currently being executed.	Figure 8 pattern canceled.	A	N	X	
FG8 IS ACTIVE	Attempt to delete or modify the figure 8 fix; delete MFP attribute, modify flight plan course, insert a PPSN hold, or insert a waypoint at the active waypoint during pattern execution.	Clear key.	SP	A		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
FINAL APPR CRS XXX°	Direct-To is made to the FAF of an approach.	Clear key or selecting CRS entry on the Flight Plan page.	SP	N		
FL005 FT MINIMUM	Attempt to enter VNAV or alternate flight plan altitude less than FL005.	Clear key.	SP	A		
FPLN FULL	Attempt to insert more than 60 waypoints into the flight plan.	Clear key.	SP	A		
GROUND ONLY	Attempt to perform a ground operation during flight.	Clear key.	SP	A		
hold active	Hold is currently being executed.	Hold canceled.	A	N	X	
HOLD DEFINED	Attempt to attach a pattern on a waypoint with a Hold attached or an attempt to insert an offset when a holding fix is the TO waypoint.	Clear key.	SP	A		
HOLD IS ACTIVE	Attempt to delete the holding fix or modify the flight plan course or insert a PPOS hold or insert a waypoint at the active waypoint during hold execution.	Clear key.	SP	A		
INSERT CIR BEFORE?	A circle pattern with a defined fix has been selected for insertion into the fpln or alternate flight plan.	Clear key or valid insert.	SP	N		
INSERT CRP BEFORE?	A closed random pattern with a defined fix has been selected for insertion into the fpln or alternate flight plan.	Clear key or valid insert.	SP	N		
INSERT FG8 BEFORE?	A figure 8 pattern with a defined fix has been selected for insertion into the fpln or alternate flight plan.	Clear key or valid insert.	SP	N		
INSERT INTR BEFORE?	An intercept has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
INSERT PRESET AT?	A preset has been selected for insertion into the scan list.	Clear key or valid insert.	SP	N		
INSERT RTK BEFORE?	A racetrack pattern with a defined fix has been selected for insertion into the fpln or alternate flight plan.	Clear key or valid insert.	SP	N		
INSERT SID BEFORE?	A SID has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSERT STAR BEFORE?	A STAR has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSERT G-APR BEFORE?	A GPS data base approach has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSRT T-APR BEFORE?	A Tactical approach has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INSRT V-APR BEFORE?	A Visual approach has been selected for insertion into the flight plan.	Clear key or valid insert.	SP	N		
INTERCEPT DEFINED	Attempt to enter VNAV parameters for or attach a Hold or pattern to a point defined as an intercept.	Clear key.	SP	A		
intr active	An intercept is currently the flight plan TO waypoint.	Deletion of intercept point via Direct-To.	A	N	X	
INTR IS ACTIVE	Attempt to delete the intercept from the flight plan during execution (current TO) or attempt to modify the flight plan course when an intercept is the TO waypoint.	Clear key.	SP	A		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
INVALID DELETION	Attempt to delete the intercept or approach attributes, history way-point (if only one exists), intercept, or MFP parameters when in the flight plan or alternate flight plan.	Clear key.	SP	A		
INVALID ENTRY	Attempt to insert scratchpad data that does not pass format or range tests, attempt to select a function when insufficient data has been entered, or attempt to select a non-waypoint entry to call up the Data page.	Clear key or selecting a line key for which the entry is allowed.	SP	A		
INVALID SINCGARS	Attempting to perform a SINCGARS time operations when a SINCGARS error condition is present.	Clear key.	SP	A		
key alert	GPS SA/AS keys will expire in 2 hours in the GPS receiver.	Clear key or entry of new keys passing time test.	A	B		
load fail	Failure passing data to/from the data cartridge.	Clear key or selecting another data loader load request.	A	N		
LOAD IN PROGRESS	Attempt to replace the active flight plan while the alternate flight plan is in the process of being loaded.	Clear key.	SP	N		
locked	Password has been entered locking the system.	Entry of correct password or zeroizing the system.	A	N	X	
MAX INTRS IN FPLN	Attempt to insert more than 10 intercepts into flight plan.	Clear key.	SP	A		
MAX PTRNS IN ALTN	Attempt to insert more than 20 patterns into the alternate flight plan.	Clear key.	SP	A		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
MAX PTRNS IN FPLN	Attempt to insert more than 20 patterns into the flight plan.	Clear key.	SP	A		
1000 FT MINIMUM	Attempt to enter VNAV or alternate flight plan altitude less than 1000 ft.	Clear key.	SP	A		
need key	Insufficient GPS SA/AS keys in selected GPS for mission duration.	Clear key or entry of keys sufficient for mission duration or shortening mission duration to fit keys available.	A	B		
NET NOT FOUND	Attempt to tune to have a SINCGARS or Have Quick net that is not stored in the CNMS preset list.	Clear key.	SP	A		
no appr RAIM	Active when the following conditions are true. 1. When a transition to GPS approach mode occurs (2 nm from FAF) and the approach Predicative RAIM Availability is not available or unable to be computed. 2. AIM Available indicates unavailable when the MAP becomes the active waypoint. 3. RAIM Available indicates unavailable after the 5 minute NO APPR RAIM annunciation suppression period expires.	Data-based GPS approach disabled or removed.	A	N		
No appr vnav	Insertion of a Minimum Descent Altitude (MDA) type approach into the flight plan.	Clear key or GPS approach removed from flight plan.	A	N		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
NO CARTRIDGE	Attempt to access Data Loader Data when no cartridge is installed.	Clear key.	SP	A		
no gps appr	Active when the following conditions are true. 1. Within 3 nm from the data base FAF or the data-based MAP is the TO. 2. Approach is enabled. 3. Navigation mode set to a non-GPS based solution.	Navigation mode switched to a solution with valid GPS data or data-based approach disabled or (MAP not the TO and Final Approach Fix (FAF) in history or deleted).	A	N		X
no keys zero	Failure to zeroize GPS SA/AS keys in all GPS receivers.	Clear key or subsequent successful clearing of keys.	A	B		
NO MAG VAR	Attempt to enter Magnetic referenced input (course, bearing, or track) without Magnetic Variation tables.	Clear key.	SP	A		
no raim	RAIM is lost in selected GPS receiver and the NO APPR RAIM annunciation is not active or has been removed (30 second filter applies).	RAIM function is returned, or NO APPR RAIM annunciation is generated, or clear key.	A	N		
NON-SINCGARS MODE	Attempt to perform SINCGARS operations while not tuned to a SINCGARS mode.	Clear key.	SP	A		
NOT Stored	Entry not found in data base.	Clear key.	SP	A		
ONLOAD DEFINED	Attempt to enter extra fuel or total fuel on the Fuel page when an on-load is defined in the alternate flight plan.	Clear key.	SP	A		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
PATTERN DEFINED	Attempt to attach a hold or pattern at a point defined to be a pattern, attempt to insert an offset when an MFP fix is the TO waypoint, or attempt to modify the pattern fix when the pattern has been inserted in the flight plan or alternate flight plan.	Clear key.	SP	A		
PATTERN NOT IN FPLN	Attempt to enable refuel pattern when pattern is not in active flight plan.	Clear key.	SP	N		
pca intercept	The intercept solution for the active waypoint is to the Point of Closest Approach.	Clear key or non-PCA intercept solution becomes available.	A	N		
RAIM CHECK ACTIVE	Attempt to enter RAIM prediction data when automatic approach RAIM point check is in progress.	Clear key or completion of point check.	SP	A		
RENUMBER FPLN	Attempt to insert a waypoint between non-inserted waypoint in the flight plan when the alphanumeric Z is already in use at the associated waypoint.	Clear key.	SP	A		
rfl active	Refuel pattern is currently being executed.	Refuel pattern canceled.	A	N	X	
RFL IS ACTIVE	Attempting to delete or modify the refuel fix or delete MFP attribute or modify the flight plan course or insert a PPOS hold or insert a waypoint at the active waypoint during pattern execution.	Clear key.	SP	A		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
RE-SELECT ARPT	Attempt the following immediately after data cartridge has been removed and reinserted or a data loader failure transient of more than 3 seconds occurs while the data cartridge is already inserted. 1. Select a SID or associated runway and no SID is currently in the working copy. 2. Select a STAR or associated runway and no STAR is currently in the working copy. 3. Select a data base GPS approach from the FMS Approach page and no data base GPS approach is currently in the working copy. 4. Select a visual approach from the FMS Approach page and no data base GPS approach is currently in the working copy. 5. Select an IAF or insert a GPS approach and no data base GPS approach is currently in the working copy. 6. Insert a visual approach and no visual approach is currently in the working copy.	CLR key or entry of four letter airport identifier on SID, STAR, or FMS Approach page.	SP	N		
rtk active	Racetrack pattern is currently being executed.	Racetrack pattern canceled.	A	N	X	

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
RTK IS ACTIVE	Attempting to delete or modify the racetrack fix or delete MFP attribute or modify the flight plan course or insert a PPOS hold or insert a waypoint at the active waypoint during pattern execution.	Clear key.	SP	A		
safe keys	GPS SA/AS keys on the GPS's.	Clear key.	A	N		
SELECT ALTN LOAD	Access the Alternate Flight Plan Catalog page from the Start 3 page.	Clear key or select alternate.	SP	N		
SELECT SID/RWY	Attempt to access SID Transitions page without both SID and RWY selected.	Clear key or selecting a SID or RWY.	SP	N		
SELECT STAR/RWY	Attempt to access STAR Transitions page without both STAR and RWY selected.	Clear key or selecting a STAR or RWY.	SP	N		
SET MASTER OFF	Attempt to set late net entry to ON when the ARC-210 has been designated net master.	Clear key.	SP	A		
sincgars cue	V/UHF R/T indicates to the FMS that another user is on the cue frequency.	Clear key.	A	B		
SINCGARS MODE	Attempting to send or receive time or toggle squelch while tuned to a SINCGARS channel.	Clear key.	SP	A		
TIME OP IN PROCESS	Comm time operation being performed.	Clear key.	SP	A		
UNUSED FUNCTION	Attempt to select IFF or M3 key.	Clear key.	SP	N		
update magvr	Current magnetic variation data is more than 6 months old.	Clear key or load new magnetic variation data.	A			
USER WPT LIST FULL	Attempt to add a user waypoint when the user waypoint data base is full.	Clear key.	SP	A		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
verify proc	In AUTO or FLYOVER sequencing mode when TTG is 1 minute before sequencing into a discontinuity or the TTG is less than one minute when the waypoint preceding a discontinuity becomes the TO waypoint.	Clear key or delete the discontinuity, delete the associated waypoint, insert a waypoint between the discontinuity and the associated waypoint, remove the related SID, STAR, or Approach or direct-to any waypoint or the discontinuity becomes the active waypoint.	A	N		X
VNAV IS ACTIVE	Attempt to toggle between CLIMB and DESCNT when a VNAV is active.	Clear key.	SP	A		
V/UHF BUSY	Attempt to request a V/UHF sequence while another sequence is in progress for the same radio.	Clear key.	SP	A		
WPT MAX EXCEEDED	Attempt to enter a SID or STAR with more than 30 waypoints.	Clear key.	SP	N		
wpt passed	Active waypoint passed and sequencing to the next waypoint is inhibited.	Clear key, or sequence waypoint.	A	N		
wrong key	Incorrect SA/AS key received.	Clear key on entry of correct key.	A	B		
xtk alert	Aircraft crosstrack deviation exceeds crew entered specified threshold (with 3-second filter).	Clear key or aircraft is maneuvered to bring the cross track deviation within the threshold or the deviation threshold is expanded.	A	B		

Table 3C-15. CDU Annunciations and Scratchpad Messages (Continued)

ANNUNCIATION / SP MESSAGE	INITIATING CONDITION	RESET MECHANISM	LOCATION	BLINKING	NOT CLEARABLE	CDU MSG ALERT
XXXX:XX	UTC DISPLAY enabled on the Start 1 page.	Disable UTC DISPLAY on Start 1 page.	A	N	X	
LEGEND	Location	SP	scratchpad message			
		A	annunciation line			
	Blinking	N	steady (non-blinking)			
		B	blinking			
		A	alternating (between SP message and entered SP data)			
	Not Clearable	X	annunciation is non-clearable			
	MSG Alert	X	activates external CDU alert annunciation			

The scratchpad messages are displayed in uppercase letters. Some of the messages alternate with the entered data that caused the message. If a scratchpad message is simultaneously displayed with data, the first **CLR** key activation will clear the scratchpad message and the next **CLR** will clear the scratchpad.

Annunciations are displayed in lowercase letters. The annunciation line displays only a single annunciation at a time; however, a + marker will appear to indicate when multiple annunciations are present. The priority of annunciations is shown in Table 3C-15. The + flashes whenever an unacknowledged and lower priority annunciation is generated. Annunciations are acknowledged by pressing the **CLR** key and cycling through the currently active annunciations.

Additionally, the chart indicates if the annunciation is non-clearable and if the CDU master alert annunciation is also set by the associated condition. For clearable annunciations, use the **CLR** key to clear. If data or scratchpad messages are in the scratchpad, the **CLR** key will first clear the scratchpad before clearing the annunciation line.

Table 3C-16 shows the priority of the CDU annunciations (highest priority at top of list).

In addition to the annunciations and scratchpad messages listed in Table 3C-16, the FMS-800 will provide the additional alerts listed in Table 3C-17 to inform the flight crew of various flight conditions. These alerts may appear either on electronic flight instrument displays or on annunciator light displays.

Table 3C-16. CDU Annunciation Line Priorities

ANNUNCIATIONS			
ident	no gps appr	sincgars cue	inux battery
m4 warn	no appr raim	√speed	wpt passed
m4 reply	no keys zero	√status	pca intercept
locked	safe keys	exiting hold	crs reversal
√version	xtk alert	hold active	√baroset
no appr vnav	√bank limit	intr active	approach
discontinuity	√nav source	crp active	need key
verify proc	√nav error	rfl active	wrong key
enter utc	√gps	fg8 active	load fail
√timer 1	compare gps	rtk active	data expired
√timer 2	no RAIM	cir active	update magvr
√timer 3	√inux	key alert	XXXX:XX [1]
XXXX:XX represents the UTC time (e.g., 0810:40)			

Table 3C-17. Additional Alerts

TYPE OF ALERT	INITIATING CONDITION
Waypoint	Within waypoint alert prior to waypoint sequence when in EN ROUTE and OCEANIC sensitivity modes. Ten seconds prior to waypoint sequence when in TERMINAL and APPROACH sensitivity modes.
Terminal	FMS in Terminal Mode.
Approach	FMS in Transition or Approach Mode.
RAIM Alert	GPS RAIM function detects error (RAIM Warn).
Parallel Track	Parallel offset has been applied to the active flight plan.
CDU MSG Alert Light	The MSG Alert column in this table lists which annunciations are accompanied by a message alert.
No INPUT (with a blank screen)	A bus terminal has taken control of the MIL-STD-1553 bus, but is not responding as a bus controller. Activate the bus-split switch to split operations and isolate the faulty device on the 1553 bus. Or CDU has experienced a catastrophic failure of the CDU chip or a flash memory fault and should not be used for navigation because navigation data may be corrupted and extremely unreliable. Switch to backup navigation means immediately.
	NOTE **Resetting the CDU power may restore full operation if the failure was caused by the CDU's misreading its terminal address during cyclic power fluctuations. If this occurs, cross-check all navigation data until you are ensured that the primary FMS-800 system is operating properly.**

c. **Power Control.**

(1) FMS-800 System Power. All FMS-800 units operate from + 28 Vdc aircraft essential bus power. Power is provided through a 5 amp CB placarded **FMS 1** on the right side circuit breaker panel.

(2) CDU Power Control of Associated Subsystems. Using the CDU, the crew can control the power on/off state of the avionic subsystems managed by the FMS-800. Whenever a unit is powered off, the CDU shows dashes for the data normally supplied by that unit. Attempts by the flight crew to control that subsystem is inhibited and results in a √POWER message in the scratchpad.

(3) CDU Power Control Procedures. On Index 1 page, pressing the **POWER** line select key displays the Master Power page. Refer to Figure 3C-26 and Table 3C-18. This page permits on/off control of individual communication or navigation radios. It also provides a **RADIO MASTER** selection which turns the controlled radio on or off.

d. **System Initialization.**

(1) Initialization Overview. The FMS-800 system preflight initialization includes confirming or entering the current position, time, and date for GPS initial acquisition. It also verifies the cartridge effectivity date of the data loader cartridge and the erasing or loading of flight plan and mission data.

(2) Initialization Procedures. A normal preflight startup procedure follows.

1. At power-up the CDU display will be on START page 1. Verify or enter position, time, date, and chart datum on the START page 1. Refer to Figure 3C-27 and Table 3C-19. Normally the GPS will provide the correct position, time, and date shortly after the GPS power is turned on.

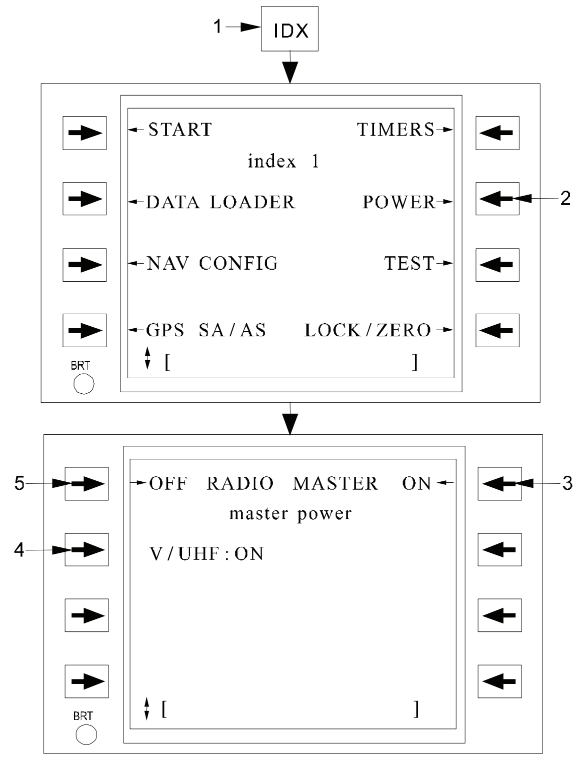


Figure 3C-26. Master Power Page

Table 3C-18. Master Power Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Select index 1 page.
2	Access Master Power page.
3	To set all communication radio power to **ON**.
4	Toggle individual unit power **ON** or **OFF**.
5	To set all communication radio power to **OFF** (requires confirmation).

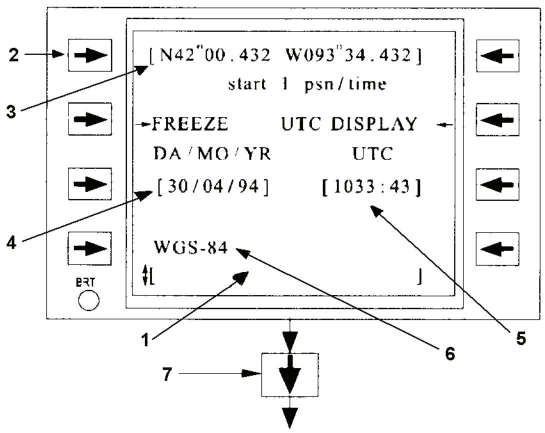


Figure 3C-27. Start 1 Position/Time Initialization

Table 3C-19. Start 1 Position/Time Initialization Procedures

NO.	DESCRIPTION/FUNCTION
1	Enter airport identifier in Scratchpad.
2	Press Left Line Key 1.
3	Verify the Lat and Long.
4	Verify UTC date, change as required.
5	Verify UTC time, change as required.
6	Verify current system datum.
7	Scroll to Start page 2.

2. If the initial date or time is incorrect, enter the correct values. and continue the initialization on the START page 2. Refer to Figure 3C-28 and Table 3C-20.

NOTE

IAW Army standardization programs and policy, the GPS will be initialized upon each power-up.

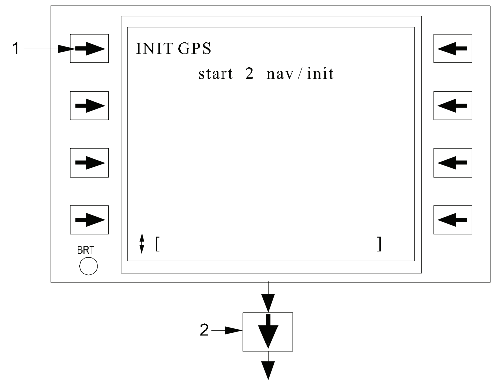


Figure 3C-28. Start 2 Navigation/Initialization

Table 3C-20. Start 2 Navigation/ Initialization Procedure

NO.	DESCRIPTION/FUNCTION
1	Command GPS initialization.
2	Scroll to Start 3 page.

3. Scroll to the START page 3 and verify the effectivity date of the ICAO data base is correct. Refer to Figure 3C-29 and Table 3C-21. If a new flight plan and mission data are to be entered manually, select **ERASE FPLN**. If a new plan is to be loaded from the cartridge, first enter the desired flight plan number or access the Alternate Flight Plan Catalog and select the desired flight plan (requires confirmation – select twice). After loading is complete, select **FPLN REPLACE**. This transfers the alternate flight plan data into the active flight plan so that both plans are identical at the beginning of the mission. The crew may select **FLT /DATA LOAD** to load all remaining preplanned mission data, including the radio presets, V/UHF HAVE QUICK II MWOD's, FMT's, SINCGARS net identifiers, and user waypoint and markpoint lists.

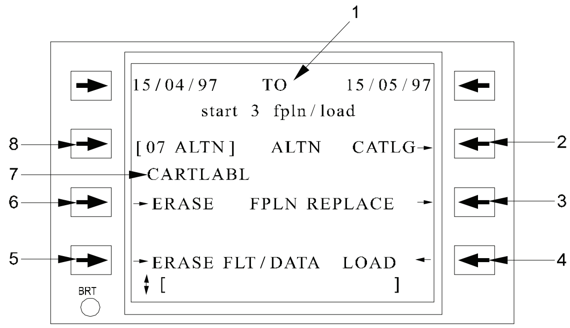


Figure 3C-29. Start 3 Flight Plan/Load Page

Table 3C-21. Start 3 Flight Plan/Load Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Effectivity dates for ICAO identifier data base.
2	If selecting a Flt Plan from the catalog, select ALTN CATLG for catalog of available alternate flight plans.
3	If using a flight plan from ALTN CATLG, replace the active flight plan with the alternate flight plan.
4	If applicable, load mission data from data cartridge.
5	Erase mission data.
6	Erase flight plan.
7	User-defined data cartridge label (defined at ground station).
8	Enter desired alternate flight plan number or name.

4. Access the Navigation/ Communication Radio Information pages to view the desired presets and channels for each radio.

5. Access the Status pages for all LRU's and confirm the current status conditions, including bus status, indicate **GO** for all LRU's.

6. To prepare the FMS for recording the fault history of the flight, access the data Loader pages and select the **STAT SAVE** line select key twice. This resets the date and time stamped to the current day and time and initializes the fault history record.

7. Configure the system for desired behavior and performance.

NOTE

Position, time, and date are periodically updated with GPS data when it is valid.

The Start 1 Page is initially displayed following FMS startup.

(3) *Navigational Chart Datums.* The normal global chart datum is WGS-84. The current system datum is indicated on the Start 1 page.

(4) *Initializing Configuration Functions*.

(a) *Time Annunciation*. On the Start 1 page, select the **UTC DISPLAY** line select to enable a continuous display of actual UTC time on the annunciation line. Time will be continuously displayed on the annunciation line when enabled. When higher priority annunciations "hide" the time, press **CLR** to acknowledge the annunciation and restore time as the foremost annunciation.

(b) *Freeze Position*. When **FREEZE** is selected on the Start 1 page, the position on the first line of the page will be frozen. Typically, the GPS position as displayed on this page will continuously change as the GPS solution updates, even when stationary on the ground. When frozen, the position can be copied to other pages as desired or used to begin initialization of the GPS receiver.

1 When a position is entered manually at line 1, left or right, the position is automatically frozen for use. To unfreeze, select the freeze line and select again.

2 The position frozen on the first line is used by the system as waypoint 00 when loading a flight plan for active use and as the starting position of the model aircraft function. If waypoint 00 is not at the desired starting position when initializing the system, enter the desired position on the Start 1 page and either load a new flight plan from the alternate flight plan or erase the flight plan. The start position will then be inserted as waypoint 00 in the flight plan.

(c) *Erasing System Data*. On the Start 3 page, two selections are available to erase the active flight plan and the user waypoint and markpoint lists. The erase function requires confirmation by the operator, and when confirmed will erase data from the CDU's memory. Erasure does not affect the flight plans, user waypoint and markpoint lists, or radio presets on the data cartridge.

(d) FMS Guidance Configuration. On the Navigation Configuration 1 page, the current mode of flight can be inspected by the pilot or overridden at pilot request. Refer to Figure 3C-30 and Table 3C-22. Under normal operation, the FMS will automatically configure the FMS for the current mode of flight, selecting either **TERMINAL**, **EN ROUTE**, or **APPROACH**. If a different flight mode is desired, including OCEANIC, select the **FLT MODE** line select to activate the desired mode. The flight mode not only affects the scaling of deviation pointers, but also sets the limits of the GPS RAIM function and navigation accuracy limits. The system bank limit can be entered on the Navigation Configuration 1 page. The bank limit applies to FMS guidance during execution of the flight plan.

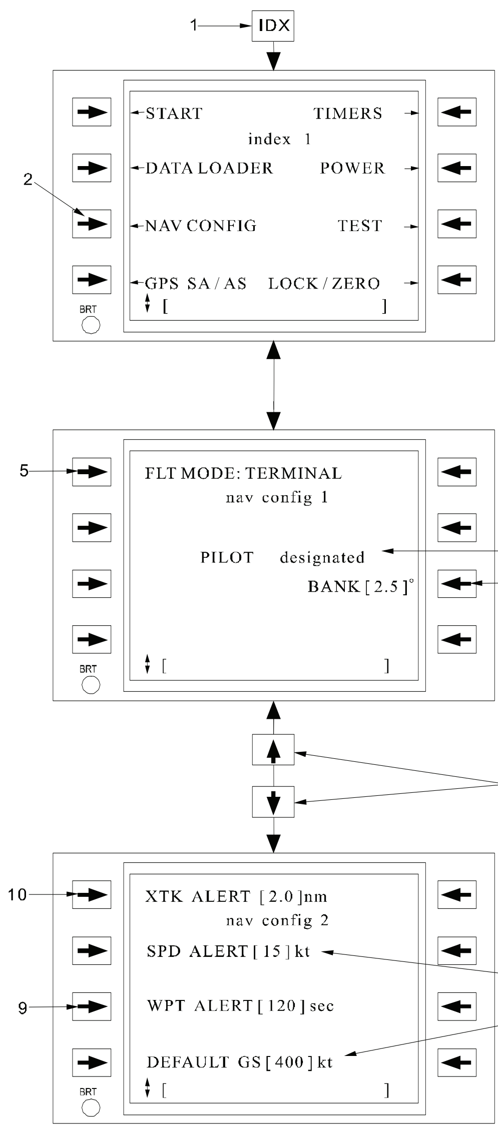


Figure 3C-30. Navigation Configuration Page Access and Functions

Table 3C-22. Navigation Configuration Page Access and Functions Procedure

NO.	DESCRIPTION/FUNCTION
1	Select index 1 page.
2	Access Nav Config 1 page.
3	Indication of pilot selection.
4	Flight Plan Guidance-Bank Limit.
5	Flight instrument scaling mode selection: OCEANIC, EN ROUTE, TERMINAL, or APPROACH.
6	Scroll vertically to access more configuration pages.
7	Entered Speed deviation alert threshold (knots).
8	Entered groundspeed default for calculations while on the ground.
9	Entered waypoint alert time in seconds prior to waypoint arrival or leg switch.
10	Entered cross track deviation alert threshold (nautical miles).

(e) External Alert Configuration. On the Navigation Configuration 2 page, alert thresholds can be entered to configure the FMS alerts to desired limits that the pilot wishes to maintain. When the FMS reaches the alert threshold, an appropriate annunciation or external alert is provided to advise the pilot. When crosstrack deviation is exceeded, an XTK ALERT annunciation is provided until the aircraft is maneuvered back into desired limits. When the speed of the aircraft exceeds the speed alert limits, a √SPEED annunciation is provided until the aircraft's speed is throttled back within limits.

When a waypoint alert time is entered, the FMS will provide an external waypoint alert advisory and then the FMS will sequence to the next waypoint with the alert threshold. This waypoint alert threshold only affects external advisories on capsule lights or flight instruments to give the pilot a heads-up of impending transitions while in OCEANIC or EN ROUTE flight modes. When in TERMINAL or APPROACH modes, the FMS and external advisories will always be generated 10 seconds prior to waypoint sequencing.

(f) Ground Calculation. When on the ground, the FMS provides the pilot the ability to review flight profiles and system calculations. On the Navigation Configuration 2 page while on the ground, a groundspeed entry is provided for the pilot to forecast anticipated performance in flight and provide expected flight times en route to each destination in the flight plan.

e. Active Flight Plan Waypoints and Courses.

(1) Flight Plan Overview. The active flight plan is a list of up to 60 waypoints, stored in the order they are to be flown. The flight plan is maintained through addition, modification, or deletion of waypoints. When a waypoint is passed, it is retained in the flight plan history list, where the last 39 passed waypoints are maintained in order. History waypoints are identified in the flight plan with a **#** symbol following the waypoint number and may be viewed by scrolling the Flight Plan page using the ↑ key. The crew may delete history waypoints, using a **–** entry, but may not enter waypoints into history.

The FMS-800 guidance function assists in execution of the flight plan by determining deviations from the desired flight plan and controlling the sequencing of waypoints. When automatic leg advance is selected via the Flight Plan page, waypoint switching is determined as a function of aircraft speed, wind, and magnitude of course change to provide turn anticipation. A waypoint alert is generated prior to reaching the waypoint switching point for the next leg.

(a) Flight Plan Loading. There are three ways to enter flight plan data.

1. Through the active flight plan.
2. The alternate flight plan.
3. The data cartridge catalog.

(b) Data Cartridge. The data cartridge is a storage device containing a catalog of Alternate Flight Plans (AFP). The cartridge can be modified at a Mission Planning Ground Station (MPGS) which can store thousands of unique flight plans. Up to 40 flight plans at one time can be transferred from the MPGS to the Alternate Flight Plan Catalog in the data cartridge. The pilot can then choose one of these AFP's from the catalog on the data cartridge to load into the AFP in the CDU. After loading the AFP, the pilot can make any changes or transfer the AFP directly to the active flight plan. If desired, the pilot can also modify an AFP and save it back to the catalog in the cartridge. Refer to Figure 3C-31 for a summary of the information flow.

(2) Flight Plan Active Waypoint. The waypoint that all flight instruments and CDU guidance display is referred to as the active waypoint. Pressing the **FPLN** key on the CDU accesses the Flight Plan page with the active waypoint displayed as the TO waypoint. This is signified by ↓↓ pointing to the active waypoint.

(a) Associated with the active waypoint are the following parameters, which are displayed on the Flight Plan page. Refer to Figure 3C-32 and Table 3C-23.

1. Current desired inbound course measured at the waypoint, not current desired track at aircraft position.

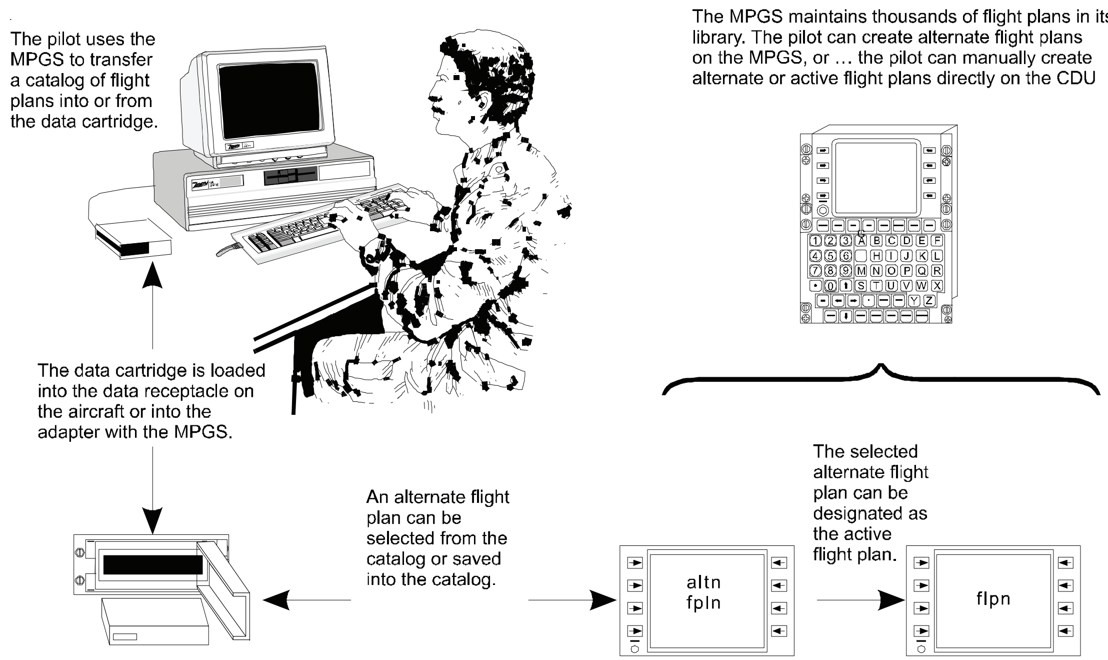


Figure 3C-31. Flight Plan Management

2. Source of inbound course. Computed (↓ ↓), manually entered (↓ man ↓), or direct-to (↓ dir ↓).

3. Waypoint number in flight plan sequence.

4. Flight Plan sequencing mode.

5. Waypoint attribute (hold, etc.).

6. FROM indication on right side of title indicating when on the From side of the active waypoint.

7. Outbound course and distance to the next waypoint after the active waypoint.

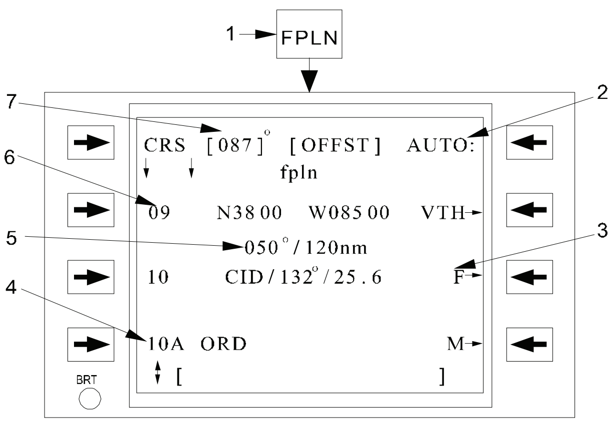


Figure 3C-32. Flight Plan Active Waypoint

Table 3C-23. Flight Plan Active Waypoint Procedure

NO.	DESCRIPTION/FUNCTION
1	Select FPLN.
2	Sequencing mode toggles between AUTO, FLYOVER, and MAN sequencing modes.
3	Waypoint attached attribute.
4	Waypoint sequence number.
5	Outbound course and distance to next waypoint.
6	Active waypoint.
7	Course at active waypoint.

(b) When a waypoint becomes a history waypoint, a **#** following the waypoint number indicates that the waypoint is no longer an active or future waypoint.

(3) Flight Plan Waypoints.

(a) Numbering of Waypoints. A maximum of 60 active waypoints and 39 history waypoints are allowed in the flight plan at a time. The flight plan waypoints are numbered sequentially in increments of one, from 01 to 99, with waypoint 00 as the initial history waypoint. If a waypoint is added past 99, the numbering starts at 01 and uses the first available waypoint number not used by a history or active waypoint. Non-SID, STAR, approach, or alternate flight plan waypoints that are inserted between existing waypoints receive an alphabetical suffix. If a SID, STAR, approach, or alternate flight plan is inserted into the flight plan, no alphabetical suffix is used. The SID, STAR, and approach waypoints are numbered in the normal method with subsequent waypoints automatically renumbered. These features prevent the duplication of a waypoint number within the flight plan.

(b) Inserting Waypoints in Sequence. When the flight plan has been erased, the Start 1 page starting position is inserted as the first history waypoint and the Flight Plan page indicates ***END** in lieu of the active waypoint. Refer to Figure 3C-33 and Table 3C-24.

When a waypoint is inserted before ***END**, when ***END** is on the last line, the Flight Plan page automatically scrolls as necessary to keep the ***END** indicator in view on the bottom line. This permits the pilot to enter a long sequence of points without having to manually scroll the page. The FPLN FULL message will appear in the scratchpad if there is an attempt to load a 61st waypoint.

(c) Inserting and Deleting Intermediate Waypoints. In most cases, the waypoints may be inserted or deleted between any two waypoints in the flight plan. When waypoints are inserted, succeeding waypoints are automatically moved down the list. Upon insertion, the new waypoint assumes the number of the immediately preceding waypoint and adds an alphabetical suffix (e.g., 03A, 03B, etc). An exception to this would be when a waypoint is inserted between waypoints that already have an alphabetical suffix. The next character in sequence would be used as the next suffix. If lettering goes as high as Z and there is an attempt to insert another waypoint, the RENUMBER FPLN scratchpad message will occur. When the waypoints are deleted, the flight plan automatically eliminates all holes by moving waypoints up the list as required. The waypoint numbers being out of the normal sequence can identify deleted waypoints. There are three exceptions to the above waypoint statements. Refer to Figure 3C-34 and Table 3C-25.

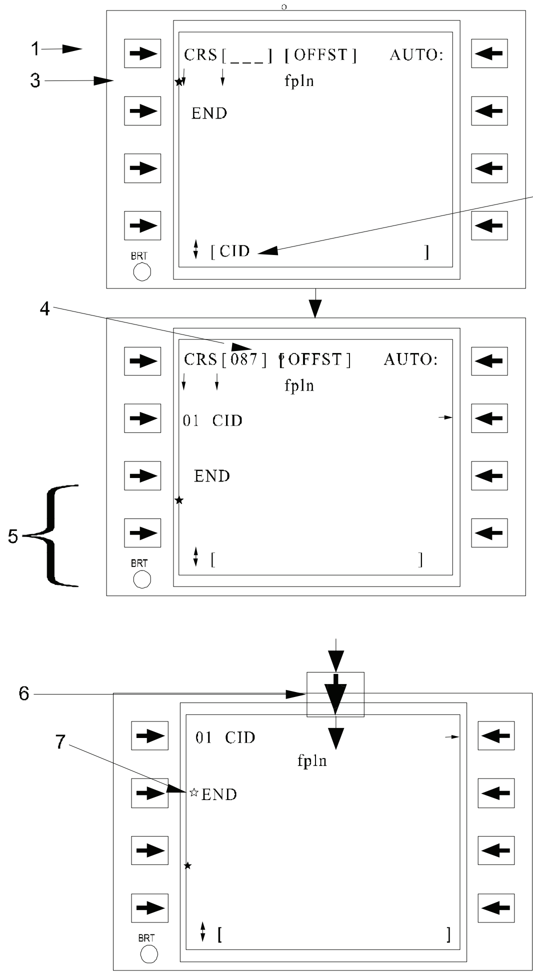


Figure 3C-33. Inserting Flight Plan Waypoints in Sequence

Table 3C-24. Inserting Flight Plan Waypoints in Sequence Procedure

NO.	DESCRIPTION/FUNCTION
1	Erase Flight Plan as described.
2	Enter first desired waypoint into the scratchpad.
3	Insert waypoint.
4	Horizontal course into the first waypoint is computed and displayed.
5	Successive waypoints may be inserted in sequence. Numbers are automatically assigned.
6	Scroll to insert additional waypoints, if more than three.
7	Indicates end of flight plan marker.

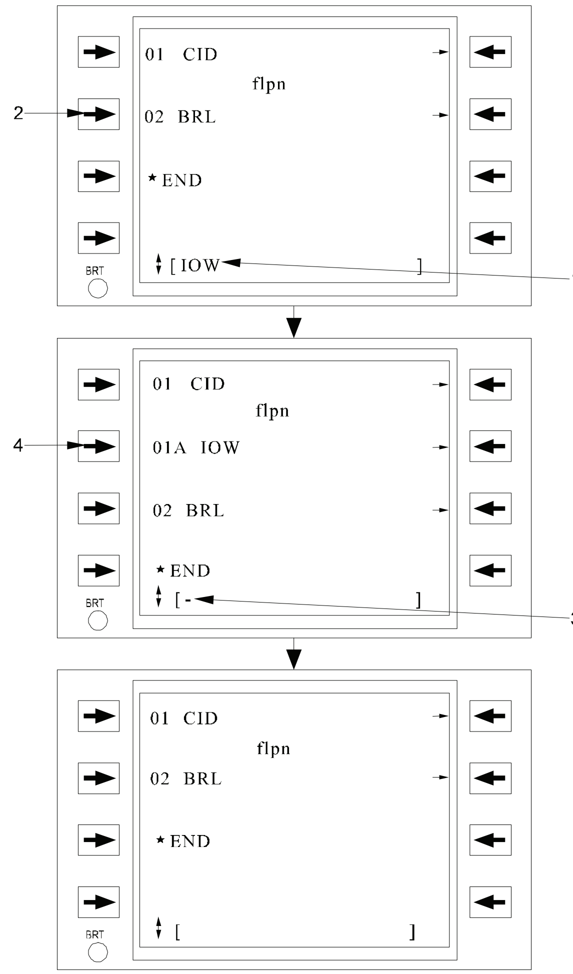


Figure 3C-34. Inserting and Deleting Intermediate Flight Plan Waypoints

Table 3C-25. Inserting and Deleting Intermediate Flight Plan Waypoint Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter next desired waypoint into the scratchpad.
2	Insert waypoint, moving BRL down in the flight.
3	Enter a **–** in scratchpad to delete waypoint.
4	Delete waypoint, closing up the hole created in the flight plan.

1 Inserting a new FROM waypoint. Instead of waypoints moving down the list when inserting a new FROM waypoint, the current FROM waypoint moves up the list. An alphabetical suffix is added based on the preceding waypoint, which was the former FROM waypoint.

2 No waypoints can be inserted between any two-history waypoints.

3 The last history waypoint (waypoint 00) cannot be deleted.

Sixty waypoints is the maximum number of waypoints allowed in the active flight plan. The FPLN FULL message will appear in the scratchpad if an insertion of a 61st waypoint is attempted.

(d) Renumbering Flight Plan Waypoints. After inserting or deleting waypoints, there becomes a requirement to renumber the flight plan to remove waypoints with alphabetical suffixes. Access the Flight Plan Edit 2 page and select the **RENUMBER** line select key (requires confirmation). This causes all future flight plan waypoints to be renumbered in sequence without alphabetic suffixes, starting at the active waypoint number. The active waypoint and the history waypoints are not renumbered.

(e) Modifying Waypoint Locations. If a bearing/distance (e.g., 050/23) is inserted at a waypoint identifier, that waypoint is offset by the bearing and distance, and displayed in the scratchpad with the bearing and distance offset applied. Refer to Figure 3C-35 and Table 3C-26. If the bearing and distance is applied at any other type of waypoint (e.g. latitude/longitude), the FMS-800 computes the offset latitude and longitude of the position and displays it in the scratchpad. Refer to Figure 3C-36 and Table 3C-27. In either of the two cases stated above, the new waypoint can now be inserted into the flight plan. If the original waypoint needs to be deleted, follow the procedure in Paragraph 3C-25.e.(3)(c).

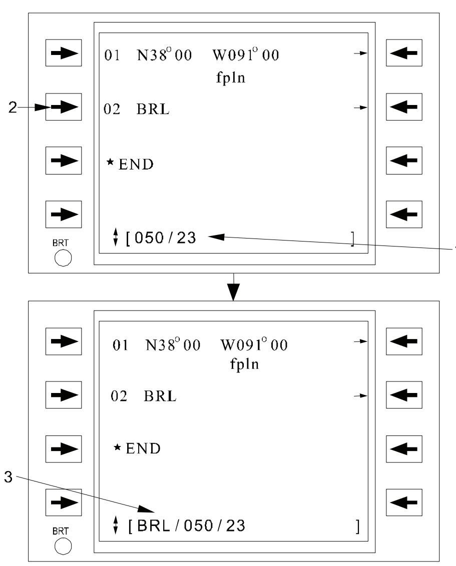


Figure 3C-35. Modifying Waypoint Locations

Table 3C-26. Modifying Waypoint Identifier Location Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter the bearing/distance offset into the scratchpad.
2	Apply the offset to BRL.
3	Ensure that there is a new waypoint offset to the desired bearing/distance displayed in the scratchpad. It may be inserted into the flight plan as desired.

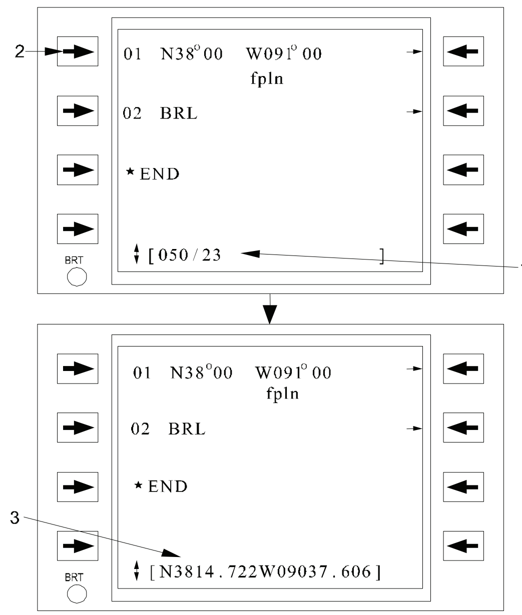


Figure 3C-36. Modifying Latitude / Longitude Locations

Table 3C-27. Modifying Latitude / Longitude Location Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter the bearing/distance offset in the scratchpad.
2	Apply the offset to a lat-long.
3	The computed lat-long is displayed in the scratchpad and available for insertion into the flight plan (original waypoint may be deleted manually if desired.)

The bearing is referenced to the Station declination, for a waypoint that is a VOR, VORTAC, VOR-DME, or TACAN, and for all other waypoints.

(f) Waypoints with Duplicate Identifiers. If a waypoint identifier is entered which is duplicated in another area of the world, the Select Waypoint page is automatically accessed and displays the data for up to 20 waypoints having that identifier. Refer to Figure 3C-37 and Table 3C-28. If more than two do exist, the pages can be scrolled for viewing. Up to 19 duplicate identifiers will be searched from the primary ICAO database on the cartridge. One duplicate identifier will be searched from the User Waypoint list. The identifiers are ordered from closest to present position to furthest from present position when the navigation solution is valid. Select the desired waypoint by pressing its adjacent line key and the CDU will immediately return to the original page with the waypoint inserted in the desired location. A frequency or station channel will only be displayed if the waypoint identifier is associated with a navigation radio beacon. Possible types of waypoints include VOR, V/T (for VORTAC), TCN (for TACAN), V/D (VOR-DME), NDB, N/D (for NDB-DME), FIX, APT (for Airport), and DME.

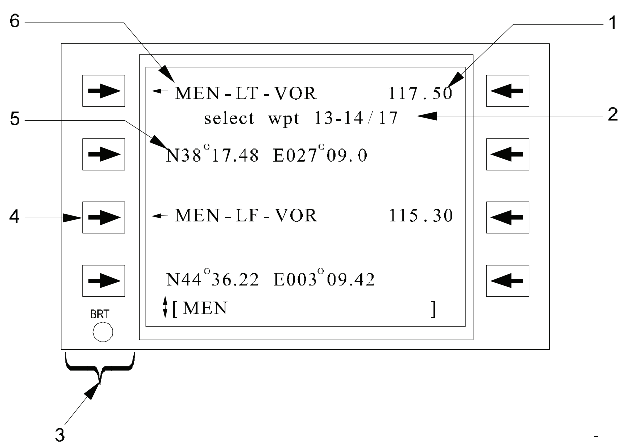


Figure 3C-37. Waypoints With Duplicate Identifiers

Table 3C-28. Waypoints With Duplicate Identifier Procedure

NO.	DESCRIPTION/FUNCTION
1	NAV aid Frequency or channel (if an NDB, VOR, DME, or TACAN).
2	Signifies that the displayed waypoints are numbers 13-14 of a total of 17.
3	Line Select Keys 1 and 3 enter the adjacent waypoint into the originating page.
4	Selects the waypoint and enters it on the originating page.

Table 3C-28. Waypoints With Duplicate Identifier Procedure (Continued)

NO.	DESCRIPTION/FUNCTION
5	Waypoint's latitude and longitude.
6	Waypoint ID, country code and type.

The title line displays the number range of the displayed duplicate identifiers (i.e., 1-2, 3-4, 5-6, etc.) and the total number of duplicate identifiers for the entered waypoint. The scratchpad retains the original waypoint identifier entry until a duplicate waypoint identifier has been selected.

The information line will display SEARCH IN PROGRESS when a search for duplicates is being conducted. If a search is interrupted, SEARCH FAILED will be displayed. An interruption of a search can be caused by removal of the cartridge, a data receptacle failure, or bus controller swap.

A listing of the country codes is provided in Table 3C-29. This list is not meant to be comprehensive or current, because the country identifiers change frequently. Refer to ICAO Document No. 7910, Location Indicators, for a current listing. The country code ** is used for user-defined waypoints.

(g) Flight Plan Waypoint Attribute Indicators. The right side of the FPLN page shows any special attributes that have been assigned to waypoints in the flight plan. These provide a quick reference for the pilot and are also indicated on the individual FPLN WPT pages where selection of the adjacent line key provides instant access to the respective pattern or other defined function. These attributes may be deleted by entering a **–** in the scratchpad and selecting the line key next to the attribute to be deleted. This feature enables the crew to delete maneuvers without leaving the FPLN page. If more than one attribute is displayed, the right-most attribute will be deleted first (e.g., if **VH** is displayed, the **H** will be deleted first). Table 3C-30 lists the attribute designators and their meanings.

Up to three attributes can be assigned to each waypoint. Attribute hierarchy and possible attribute combinations are shown in Table 3C-31. Attributes within each column of the table cannot be assigned to the same waypoint.

Table 3C-29. Country Codes

A1	ANTARCTICA
AB	AUSTRALIA
AD	AUSTRALIA
AG	SOLOMON ISLANDS
AM	AUSTRALIA
AN	NAURU
AP	AUSTRALIA
AS	AUSTRALIA
AY	PAPUA NEW GUINEA
BG	GREENLAND
BI	ICELAND
CF	CANADA
CU	CANADA
CW	CANADA
CY	CANADA
CZ	CANADA
DA	ALGERIA
DB	BENIN
DF	BURKINA FASO
DG	GHANA
DI	IVORY COAST
DN	NIGERIA
DR	NIGER
DT	TUNISIA
DX	TOGO
EB	BELGIUM
ED	GERMAN (W.)
EE	ESTONIA
EF	FINLAND
EG	UNITED KINGDOM
EH	NETHERLANDS
EI	IRELAND
EK	DENMARK
EL	LUXEMBOURG
EN	NORWAY
EP	POLAND
ES	SWEDEN
ET	GERMANY (E.)
EV	LATVIA
EY	LITHUANIA
FA	SOUTH AFRICA
FB	BOTSWANA
FC	CONGO
FD	SWAZILAND
FE	CENTRAL AFRICAN REPUBLIC
FG	EQUATORIAL GUINEA
FH	ASCENSION IS.

FI	MAURITIUS
FJ	BRIT INDIAN OCEAN TERR.
FK	CAMEROON
FL	ZAMBIA
FM	MADAGASCAR, COMORES, LA REUNION, MAYOTTE
FN	ANGOLA
FO	GABON
FP	SAO TOME AND PRINCIPE
FQ	MOZAMBIQUE
FS	SEYCHELLES
FT	CHAD
FV	ZIMBABWE
FW	MALAWI
FX	LESOTHO
FY	NAMIBIA
FZ	ZAIRE
GA	MALI
GB	FAMBIA
GC	CANARY ISLANDS
GE	MELIA
GF	SIERRA LEONE
GG	GUINEA BISSAU
GL	LIBERIA
GM	MOROCCO
GO	SENEGAL
GQ	MAURITANIA
GS	SAHARA OCCIDENTAL
GU	REP. De GUINEE
GV	CAPE VERDE
HA	ETHIOPIA
HB	BURUNDI
HC	SOMALIA
HE	EGYPT
HF	DJIBOUTI
HH	ERITREA
HK	KENYA
HL	LIBYA
HR	RWANDA
HS	SUDAN
HT	TANZANIA
HU	UGANDA
K*	USA
LA	ALBANIA
LB	BULGARIA
LC	CYPRUS
LD	CROATIA

LE	SPAIN
LF	FRANCE
LG	GREECE
LH	HUNGRY
LI	ITALY
LJ	SLOVENIA
LK	DZECH
LL	ISRAEL
LM	MALTA
LN	MONACO
LO	AUSTRIA
LP	PORTUGAL
LQ	BOSNIA AND HERZEGOVINA
LR	ROMANIA
LS	SWITZERLAND
LT	TURKEY
LU	REPUBLIC OF MOLDOVA
LW	MACEDONIA
LX	GIBRALTAR
LY	YUGOSLAVIA
LZ	SLOVAKIA
MB	TURKS AND CAICOS ISLANDS
MD	DOMINICAN REP
MG	GUATEMALA
MH	HONDURAS
MK	JAMAICA
MM	MEXICO
MN	NICARAGUA
MP	PANAMA
MR	COSTA RICA
MS	EL SALVADOR
MT	HAITI
MU	CUBA
MW	CAYMAN ISLANDS
MY	BAHAMAS
MZ	BELIZE
NC	COOK ISLANDS
NF	FIJI, TONGA
NG	KIRIBATI, TUVALU
NI	NIUE ISLAND
NL	WALLIS ISLAND
NS	SAMOA
NT	FRENCH POLYNESIA
NV	VANUATU
NW	NEW CALEDONIA
NZ	NEW ZEALAND
OA	AFGANISTAN

Table 3C-29. Country Codes (Continued)

OB	BAHRAIN
OE	SAUDI ARABIA
OI	IRAN
OJ	JORDAN
OK	KUWAIT
OL	LEBANON
OM	UNITED ARAB EMIRATES
OO	OMAN
OP	PAKISTAN
OQ	BOSNIA AND HERZEGOVINA
OR	IRAQ
OS	SYRIA
OT	QATAR
OY	YEMEN
PA	ALASKA
PB	BAKER ISLAND
PC	PHOENIX ISLAND
PF	ALASKA
PG	MARIANA ISLAND OR GUAM
PH	HAWAII
PJ	JOHNSTON ISLAND
PK	MARSHALL ISLANDS
PL	LINE ISLAND OR KIRIBATI
PM	MIDWAY ISLAND
PO	ALASKA
PP	ALASKA
PT	MICRONESIA
PW	WAKE ISLAND
RC	CHINA (TAIWAN)
RJ	JAPAN
RK	KOREA
RP	PHILIPPINES
S1	ANTARCTICA
SA	ARGENTINA
SB	BRAZIL
SC	CHILE
SE	ECUADOR
SF	FALKLAND ISLANDS
SG	PARAGUAY
SK	COLOMBIA

SL	BOLIVIA
SM	SURINAM
SN	BRAZIL
SO	URUGUAY
SV	VENEZUELA
SY	GUYANA
TA	ANTIGUA, BARBUDA
TB	BARBADOS
TD	DOMINICA
TF	FRENCH ANTILLES
TG	GRENADA
TI	VIRGIN IS (U.S.)
TJ	PUERTO RICO
TK	ST. KITTS-NEVIS
TL	ST. LUCIA
TN	NETHERLANDS ANTILLES, ARUBA
TQ	ANGUILLA ISLAND
TR	MONTSERRAT IS
TT	TRINIDAD AND TOBAGO
TU	VIRGIN IS (U.K.)
TV	ST. VINCENT, GRENADINES
TX	BERMUDA
U*	RUSSIA
UA	KAZAKHSTAN, KYRGYZSTAN
UB	AZERBAIJAN
UE	RUSSIA
UG	GEORGIA
UH	RUSSIA
UI	RUSSIA
UK	MOLDOVA, UKRAINE
UL	RUSSIA
UM	RUSSIA, BELARUS
UN	RUSSIA
UO	RUSSIA
UR	RUSSIA, KAZAKHSTAN
US	RUSSIA
UT	KAZAKHSTAN, TAJIKISTAN, TURKEMISTAN, UZBEKISTAN
UU	RUSSIA
UW	RUSSIA

VA	INDIA
VB	BYANMAR
VC	SRI LANKA
VD	CAMBODIA
VE	INDIA
VG	BANGLADESH
VH	HONG KONG
VI	INDIA
VL	LAOS
VM	MACAO
VN	NEPAL
VO	INDIA
VQ	BHUTAN
VR	MALDIVES
VT	THAILAND
VV	VIETNAM
VY	MYANMAR
WA	INDONESIA
WB	MALAYSIA, BRUNEI
WI	INDONESIA
WM	MALAYSIA
WP	INDONESIA
WR	INDONESIA
WS	SINGAPORE
Y*	AUSTRALIA
YB	AUSTRALIA
YM	AUSTRALIA
YP	AUSTRALIA
YS	AUSTRALIA
ZB	CHINA
ZG	CHINA
ZH	CHINA
ZK	KOREA
ZL	CHINA
ZM	MONGOLIA
ZP	CHINA
ZS	CHINA
ZT	CHINA
ZU	CHINA
ZW	CHINA
ZY	CHINA

Table 3C-30. Attribute Designators

ATTRIBUTE	DESCRIPTION
C	A course reversal is enabled at this waypoint.
D	A DME Arc will be flown to this waypoint. DME Arcs only exist in published GPS approaches.
F	The waypoint is designated as the Final Approach Fix (FAF) for database and tactical approaches.
H	A holding pattern has been attached to this waypoint. If the waypoint is an IAF or missed approach holding point with a data base holding pattern attached, this attribute is displayed on the holding Flight Plan page when the holding pattern is enabled.
I	The waypoint is a valid intercept solution for a moving target.
M	The waypoint is designated as the Missed Approach Point (MAP).
P	This waypoint is a fix for a pattern that will be executed upon arrival at the point.
R	This waypoint is part of a STAR.
S	This waypoint is part of a SID.
T	The waypoint has a desired time of arrival associated with it. This indicates that a Time Navigation (TNAV) function will be performed to obtain the Required Time of Arrival (RTA) on the Flight Plan Waypoint page.
V	The waypoint has an altitude specified that will cause vertical navigation to be performed.

Table 3C-31. Attribute Hierarchy

ATTRIBUTES			
M	T	V	H
D			C
F			P
I			
R			
S			

NOTE

The right-most column of attributes shown in this table is deleted first when used in combination with other listed attributes.

(4) Automatic Leg Advance. When waypoints beyond the active waypoint are in the flight plan and the flight plan advance mode is automatic (AUTO or FLYOVER mode), the FMS-800 computes great circle tracks between those waypoints. It also automatically transitions smoothly from one waypoint to the next.

To sequence past a waypoint, the aircraft track angle must be within 90° of the active leg course and the Track Angle Error (TKE) must be within 90°. Otherwise, sequencing will be inhibited and guidance will continue to reference the inbound course to the waypoint.

To prevent overshoot of the next leg, automatic leg switching in AUTO mode includes turn anticipation, up to 30 nm prior to the waypoint, for course changes ≤ 150°. Over 150°, the waypoint will be overflown and a teardrop turn is made to intercept the next leg. Refer to Figure 3C-38.

NOTE

When the change in the resulting course between flight plan legs is greater than 150°, the FMS will provide guidance to turn and intercept the next course, resulting in an S-turn maneuver into the course. The course to the next waypoint is based on geometry between waypoints, not waypoint course guidance, for smooth turns.

When the pilot has selected the FLYOVER mode, leg switching is also automatic, but each waypoint is overflown prior to turning to intercept the next leg.

Prior to the leg switch point, the waypoint alert light illuminates and the waypoint number on the Flight Plan page and the ↓ to ↓ indicator on the Lateral Steer page will flash for 10 seconds.

When the MAP becomes the active waypoint, sequencing is automatically inhibited as the sequence mode is switched to MAN. On the TO side of the MAP, pilot selection of AUTO sequencing is inhibited and AUTO can be selected on the FROM side of the MAP. A Direct-To any waypoint other than the MAP will switch sequencing back to AUTO.

The FMS will automatically revert from FLYOVER to AUTO sequencing for procedure execution when the first SID, STAR, or APPROACH waypoint becomes the active waypoint or the aircraft enters the TERMINAL area. If a SID, STAR, or APPROACH point is specifically identified as a flyover waypoint in the database procedure, the FMS will sequence the waypoint in flyover mode but remain in AUTO sequence mode on the Flight Plan page. The pilot may override the automatic sequence mode selections, except when the MAP is the active waypoint.

(5) Lateral To-To Course Transitions with Automatic Sequencing, Manual Sequencing, and Course Selection.

(a) Manual Sequence Mode. When manual sequencing is selected, the flight plan does not advance to the next leg automatically. The flight plan only sequences when the crew selects AUTO; selects FLYOVER sequence mode on the Flight Plan page; or performs a Direct-To any other waypoint. The course from the active waypoint is based on the computed course at the active waypoint or a crew-entered course on the Flight Plan page. Prior to passing over the active waypoint, a waypoint alert indication will occur at the time to go specified on the Navigation Configuration page. At 10 seconds prior to the waypoint, the waypoint number on the Flight Plan page and the ↓ to ↓ indicator on the Lateral Steer page will flash for 10 seconds. As the waypoint is passed, the **WPT PASSED** annunciation will be displayed on the annunciation line and a **FROM** indication will be displayed on the title line of the Flight Plan and Lateral Steer pages. The FMS will continue to provide guidance to the outbound FROM course from the active waypoint.

To fly on a desired outbound course, perform the following steps.

1. Select **MAN** sequence mode on the Flight Plan page.

2. Select (via a Direct-To) or enter the desired active waypoint data.

3. Enter the desired course.

By selecting **MAN**, the new active waypoint is prevented from sequencing when it is inserted into the flight plan or the new desired course is entered. A new inbound course may also be manually entered when the sequencing mode is AUTO or FLYOVER, but entry is limited to ± 90° of the computed inbound course. If the aircraft is on the TO side of the waypoint after completing these steps, the aircraft must fly to that waypoint before it can fly the outbound (FROM) course as selected. If the aircraft is on the FROM side of the waypoint, the FMS will immediately initiate guidance to the desired outbound course and the TO indication will change to a FROM indication. Refer to Figure 3C-39 for an example of execution of manual sequencing and course edits.

(b) TACAN Emulation. Since the FMS provides the capability to fly a selected course TO or FROM the active waypoint (TO-FROM navigation), it can be used to perform emulation of TACAN navigation. The crew can enter, display, and fly the courses printed on the Instrument Flight Rules (IFR). En Route Low and High Altitude aeronautical charts for published airways or courses associated with VOR's, VORTAC's, VOR-DME's, or TACAN's. Refer to Figure 3C-40 and Table 3C-32 for a description of configuring the FMS for TACAN emulation. The steps to configure for TACAN emulation are the same as for manual sequencing and course edits, except that the new active waypoint must be the ICAO identifier for a VOR, VORTAC, VOR-DME, or TACAN. The FMS will provide guidance to the flight instruments, as it appears published on the aeronautical charts. If a DME arc is to be flown, the CDU Lateral Steering page continues to show the bearing and distance to the station (waypoint) as the arc is flown. Distance on the Lateral Steer page is always direct distance to the waypoint, not a path distance.

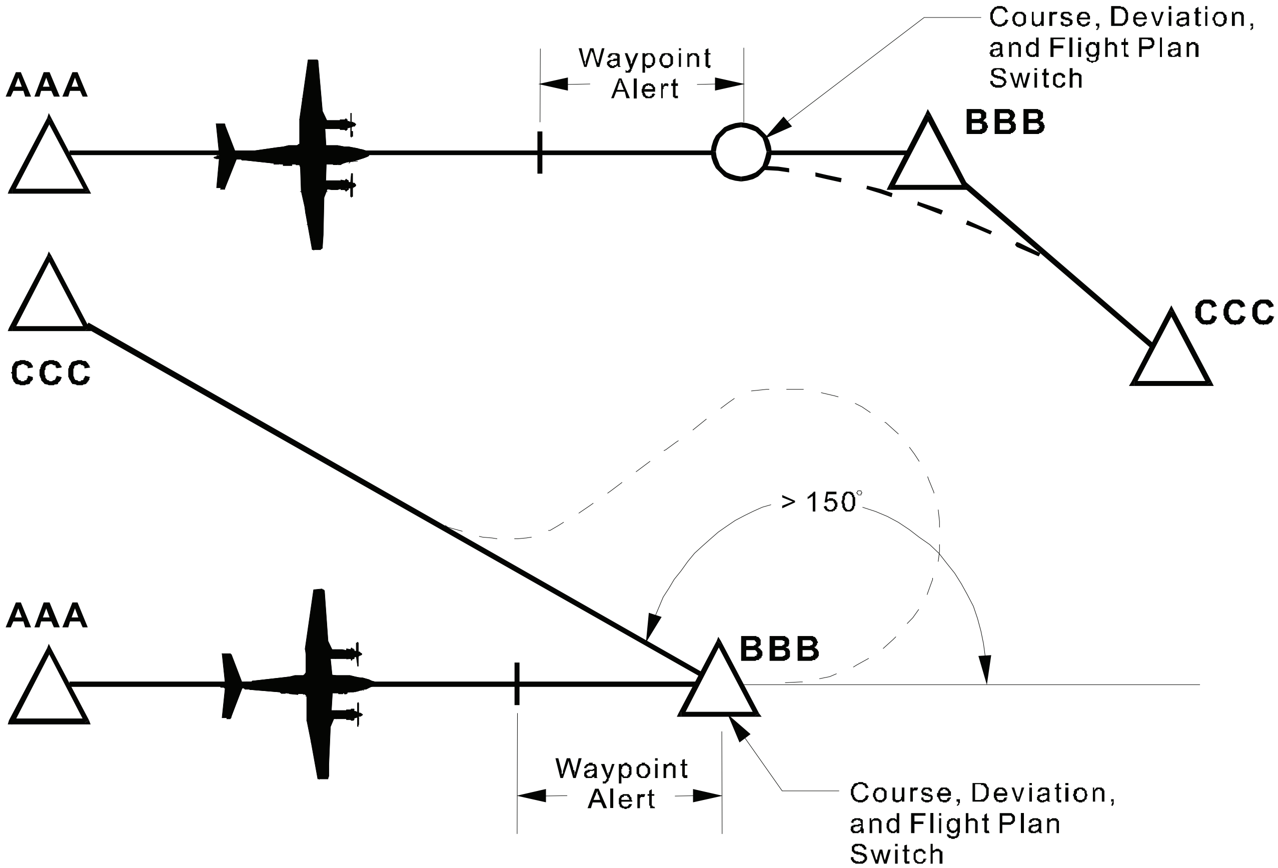


Figure 3C-38. Lateral To-To Course Transitions with Automatic Sequencing

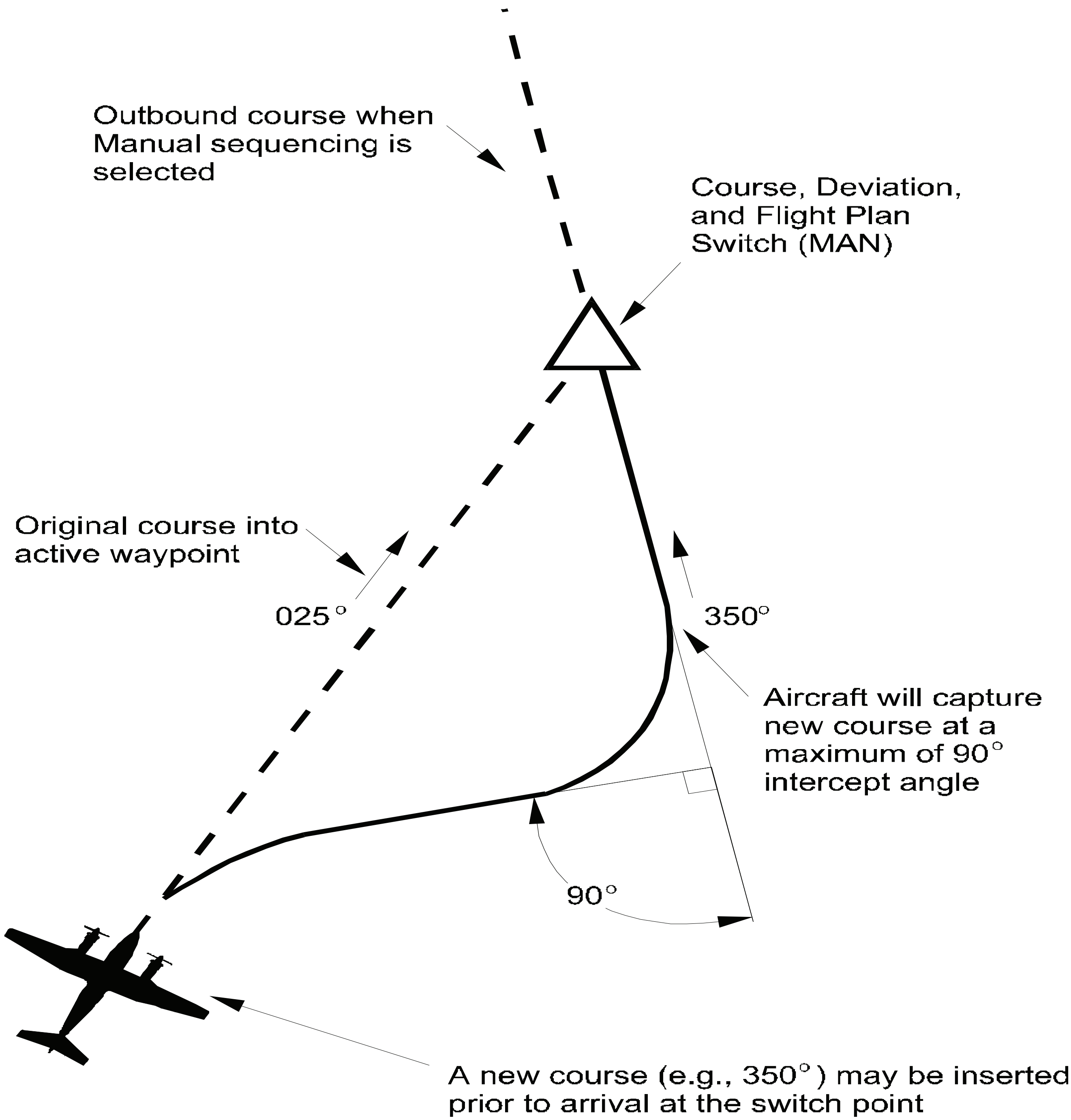


Figure 3C-39. Lateral Course Edit

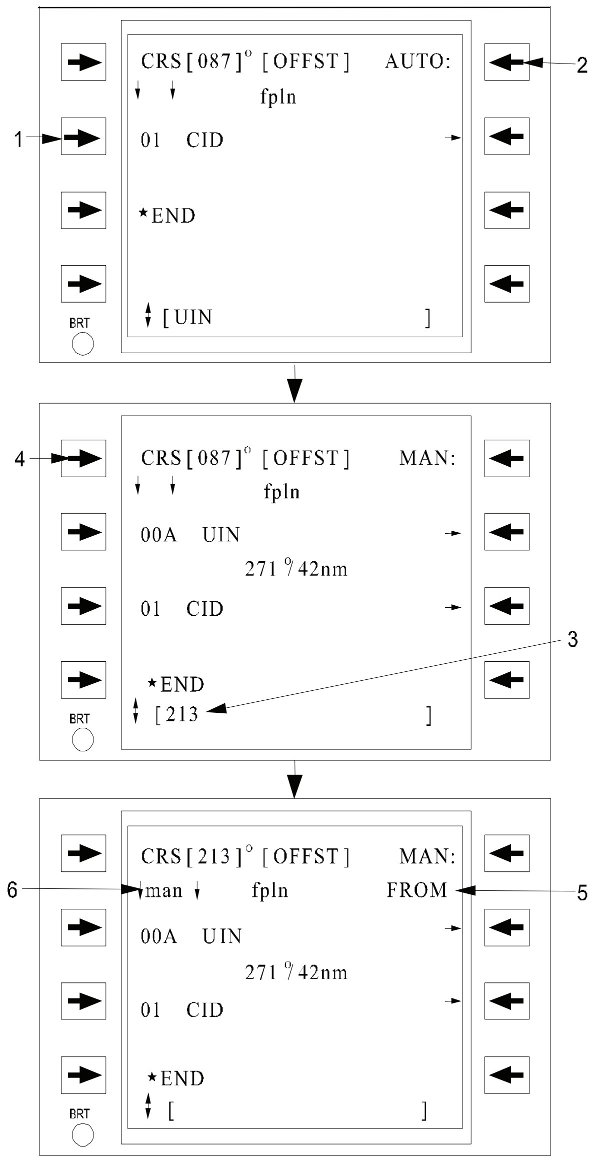


Figure 3C-40. Manual Sequencing and TACAN Emulation

Table 3C-32. Manual Sequencing and TACAN Emulation Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter TACAN identifier or waypoint.
2	Select **MAN** advance (if desired) to prevent waypoint passage into history.
3	Enter the desired/published course in the scratchpad.
4	Enter the course to/from the waypoint.
5	A FROM indicator is provided when the station is passed. The waypoint does not move into history.
6	Indicates type of course entry: Computed (blank), Manual (man), or Direct-To computed (dir).

(c) Modifying the FROM Waypoint. When scrolling back into the history waypoints, the waypoint immediately preceding the active waypoint is the current FROM waypoint. The FMS normally provides steering to intercept the course between the FROM and TO waypoints. By entering a new FROM waypoint, the FMS steers to intercept a new course between the newly entered FROM and original TO waypoints. Figure 3C-41 is an example of the effect of modifying the FROM waypoint on guidance to the active waypoint.

(6) Waypoint Steering Data. Once an active flight plan is entered, the FMS-800 computes the pilot's steering solution. The nomenclatures on the CDU refer to the steering data that is entered into the pilot's flight instruments.

(a) Display of Pilot's Steering Data. When the **STR** function key is pressed, the CDU displays the Pilot's Lateral Steer page. Refer to Figure 3C-42 and Table 3C-33. The pilot's steering uses GPS as its single navigational source.

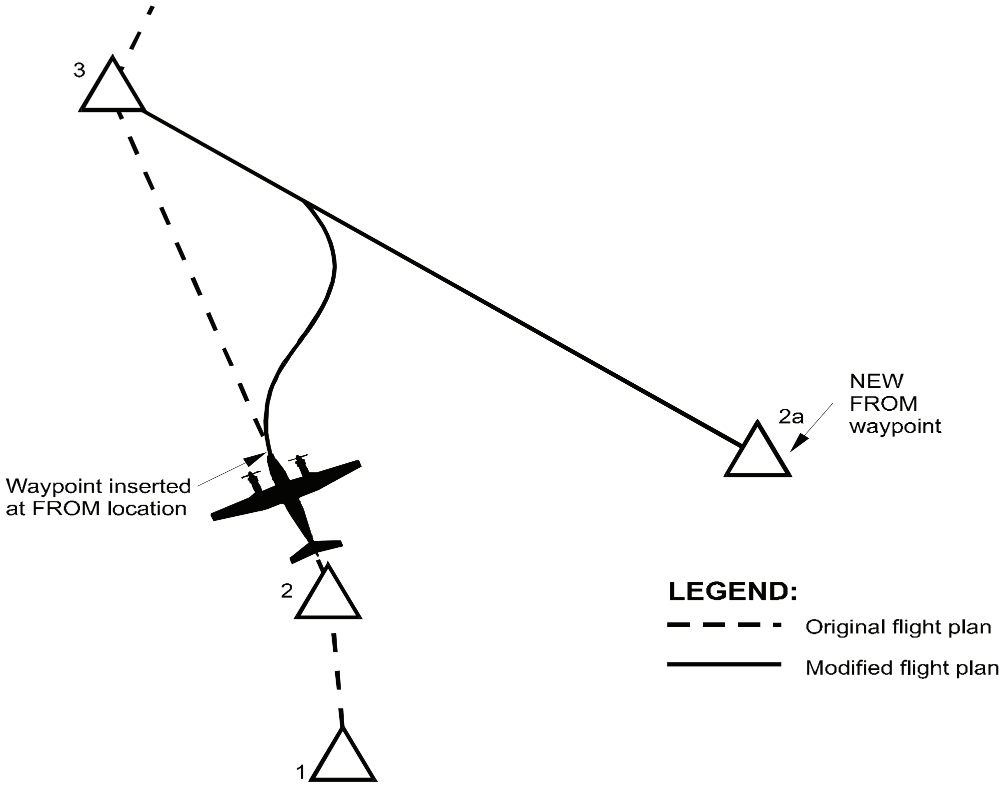


Figure 3C-41. Entry of a New FROM Waypoint

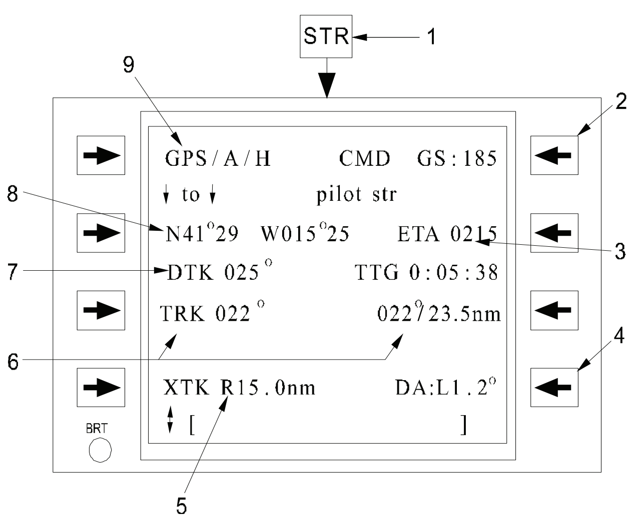


Figure 3C-42. Pilot's Lateral Steer Page

Table 3C-33. Pilot's Lateral Steer Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Select Steering (STR) page.
2	Toggle between commanded groundspeed (CMD GS), groundspeed error.
3	Estimated time of arrival and time to go to the active waypoint.
4	Toggle between Drift Angle (DA) and Track Angle Error (TKE) display.
5	Crosstrack deviation.
6	Current aircraft track and bearing/distance to go to the action deviation.
7	Desired track at present position to steer to active waypoint.
8	Active waypoint.
9	Source for pilot's steering solution.

(b) Speed Command for Required Time of Arrival (RTA).

NOTE

Current implementation of the RTA function is prohibited from use for Air Traffic Control (ATC) airspace operations.

A required RTA can be entered at one or more waypoints on the Flight Plan Waypoint Data page. If an alternate flight plan with RTA's at any waypoint is transferred to the active fight plan, the RTA's are maintained at the same waypoints and times. To delete an RTA enter a **–** in the scratchpad and select the RTA line select key on the Flight Plan Waypoint page.

To view the computed groundspeed required to achieve the RTA, select the Pilot Lateral Steer page. The speed command is for the first future flight plan waypoint that has an RTA assigned.

If the crew desires to be alerted when the actual speed differs from the commanded speed, enter the desired threshold on the Navigation Configuration page. Refer to Figure 3C-43 and Table 3C-34. When the actual speed differs from the commanded speed by an amount greater than the entered threshold, a √SPEED annunciation will be displayed and CDU alert annunciator will be activated.

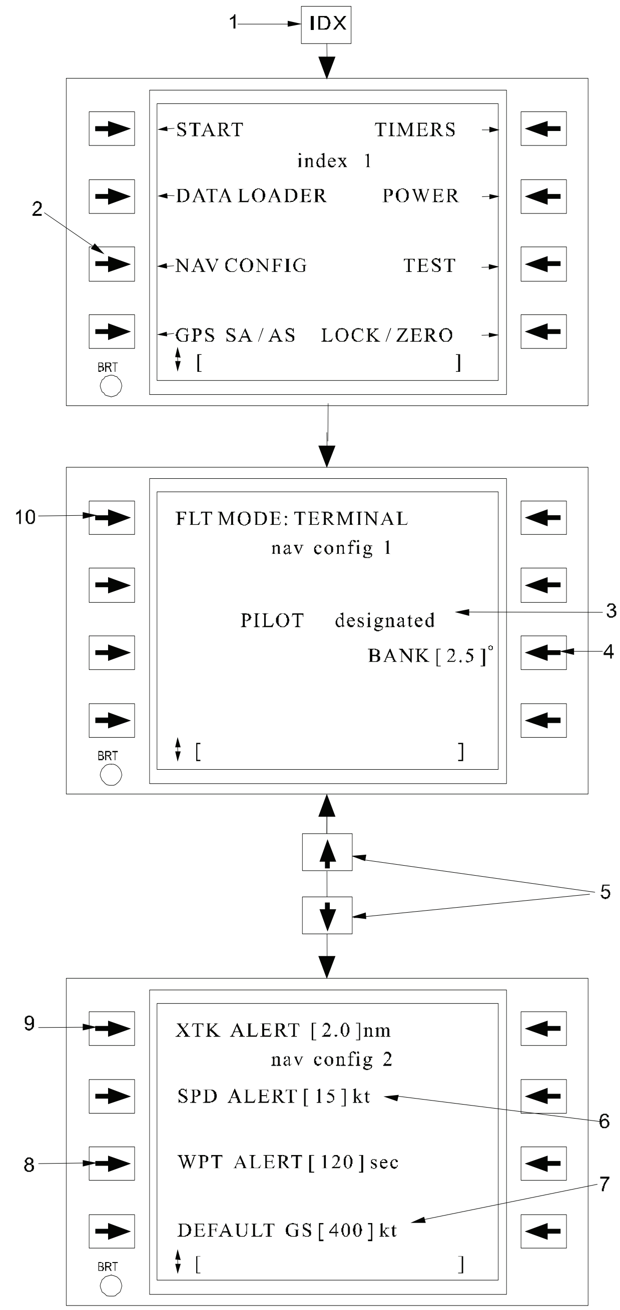


Figure 3C-43. Navigation Configuration Page

Table 3C-34. Navigation Configuration Page

NO.	DESCRIPTION/FUNCTION
1	Select Index page (**IDX**).
2	Select Navigation Configuration page.
3	Indication of designated pilot selection (always PILOT).
4	Entered Flight Plan Bank Limit.

Table 3C-34. Navigation Configuration Page (Continued)

NO.	DESCRIPTION/FUNCTION
5	Scroll vertically to access more configuration pages.
6	Entered Speed deviation alert threshold (knots).
7	Entered groundspeed default for calculations while on the ground.
8	Entered waypoint alert time in seconds prior to waypoint arrival or leg switch.
9	Entered cross track deviation alert threshold (nautical miles).
10	Flight instruments scaling mode selection: OCEANIC, EN ROUTE, TERMINAL, or APPROACH.

(c) Entry and Use of Waypoint Wind. On the Flight Plan Waypoint page, a predicted wind can be entered for each waypoint in the flight plan. Refer to Figure 3C-44 and Table 3C-35. Wind entries are used with current True Airspeed to provide improved prediction for waypoint ETA and ETE as shown on the Lateral Steer page, Figure 3C-42.

When wind is entered at a future waypoint, the wind entry will be fixed at the entry waypoint and propagate through the flight plan to all subsequent waypoints. When new waypoints are inserted into the flight plan, the default wind for the new waypoint will be based on the previous waypoint's wind entry. When no wind entry is provided, the FMS uses current wind for predicted arrivals at the waypoint. The active waypoint wind will show the current wind conditions and entry is not permitted. The wind for history waypoints is the actual wind measured at waypoint passage, and entry is not permitted. Wind direction is entered in the direction from which the wind is blowing.

When transferring a flight plan from the alternate to the active flight plan, the waypoint wind entered in the alternate flight plan will be retained in the active flight plan definition.

(d) Control and Display of Bank Command Limits and Crosstrack Deviation Alerting. The bank command limit for the FMS steering and flight plan leg switching is controlled by the crew entering a value on the Navigation Configuration page.

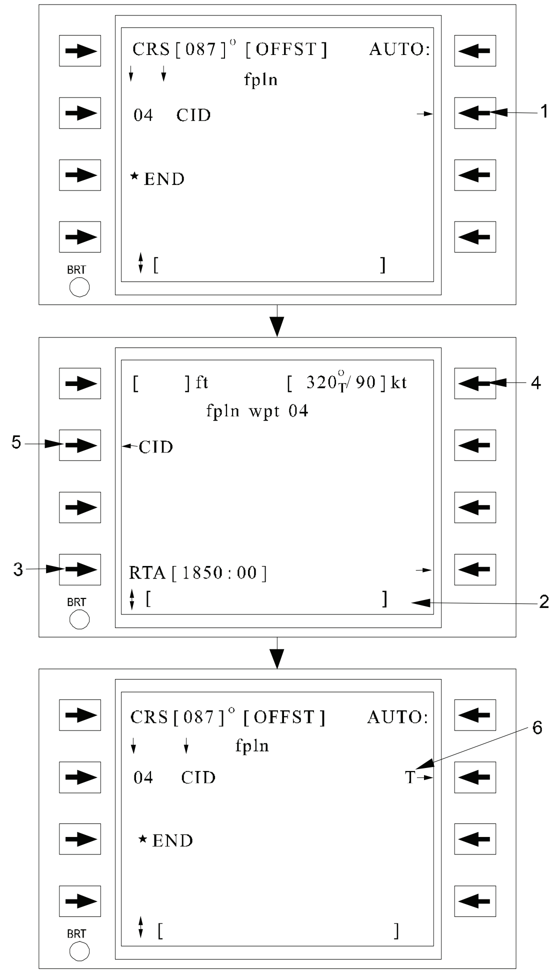


Figure 3C-44. Flight Plan Waypoint Page

Table 3C-35. Flight Plan Waypoint Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Access Flight Plan Waypoint page.
2	Enter RTA into the scratchpad.
3	Select RTA line select key to insert RTA.
4	Entered wind for future legs (defaults to computed wind for current leg).
5	Return to the Flight Plan page.
6	T indicates RTA assigned to the waypoint. Entering a **–** and pressing this line select key will delete the RTA at this waypoint.

The bank command limit is used by the FMS guidance function to limit FMS commanded banks to the entered threshold. Turn anticipation for waypoint sequencing along the flight plan is adjusted according to the limit specified to minimize overshoot conditions.

On the Navigation Configuration page, the crew may enter parameters for the waypoint alert and cross track deviation threshold. Entering the number of seconds for the waypoint alert will set an alert anticipation that activates external waypoint annunciations on capsule lights or flight instrument displays the specified time before a waypoint transitions.

For cross track alerts, entering a value (in nautical miles) for the cross track annunciation will trigger an XTK ALERT when the cross track deviation exceeds the entered threshold value. This alert is inhibited during turns from one leg to the next.

(e) Selection of Flight Mode. On the Navigation Configuration page, the current mode of flight can be selected. The mode selection affects the lateral steering scaling and integrity determination of the GPS and INU/GPS navigation solutions. When powered up, the FMS defaults to TERMINAL mode until the aircraft has left the 30 nm terminal area around the origin airport. When the aircraft comes within 30 nm of the destination airport, the FMS automatically transitions back to the TERMINAL mode. When the aircraft reaches the Final Approach Fix (FAF) of an approach, the FMS automatically transitions to the APPROACH mode. Each flight mode can be manually overridden on the Navigation Configuration page.

(7) Oceanic Reporting Function. The FMS-800 provides an oceanic flight position reporting and trip log function to simplify crew procedures for these tasks.

(a) Data Access and Display. To view the Oceanic Mission page, press the mission (MSN) function key on the CDU. Select the Oceanic line key to display the Oceanic Reporting page. Refer to Figure 3C-45 and Table 3C-36. This page shows the current flight plan waypoints in sequence with each waypoint's respective ETA (for future waypoints) or Actual Time of Arrival (ATA) (for history waypoints). These may be read and reported without additional paging. A typical position report includes the time passing the most recent reporting point and the ETA's of the next three reporting points in UTC. The calculation of the active waypoint's ETA is based on current true airspeed and wind. All subsequent waypoint ETA's are calculated using current airspeed and either the current default or pilot-entered leg wind for subsequent legs.

Each time a waypoint is passed into history, the ATA is recorded by the FMS. To view this trip log of waypoint passage times, scroll the list upward to view the history waypoints and their ATA's. If waypoints have been bypassed via a Direct-To operation, dashes are displayed for the ATA.

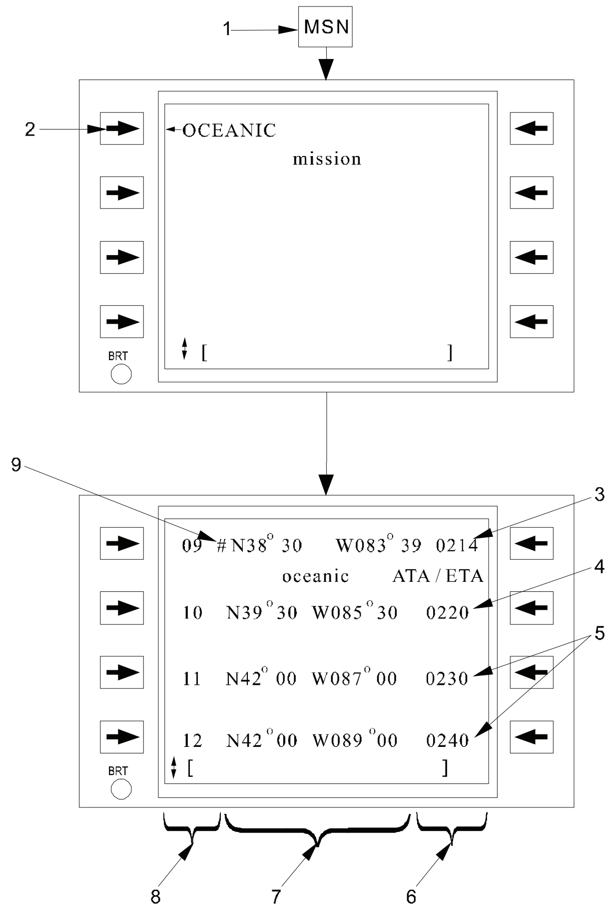


Figure 3C-45. Oceanic Mission Pages

Table 3C-36. Oceanic Mission Pages Procedure

NO.	DESCRIPTION/FUNCTION
1	Press Mission Function Key - **MSN**.
2	Select OCEANIC page.
3	FROM waypoint (ATA).
4	TO waypoint (ETA).
5	Subsequent waypoints (ETA).
6	Waypoint ATA's or ETA's.
7	Waypoint positions or ID's.
8	Waypoint numbers.
9	A # indicates the waypoint is a history waypoint.

f. Direct-To Operations.

(1) Direct-To Overview. Direct-To courses are used to either bypass existing waypoints in the flight plan or to insert an impromptu waypoint, interrupting the current leg. In each case a system generated turn point is used to calculate the course to the newly selected active waypoint. This system's generated turn point provides turn anticipation and prevents S turns during capture of the new course. The system's generated turn point is calculated internally and not displayed to the operator. The Direct-To function differs from simple active waypoint entry by the course being set from the aircraft position rather than from the last history waypoint. When used during Vertical Navigation (VNAV), the Direct-To function computes an immediate climb or descend path to a waypoint with an altitude crossing assigned.

When the **DIR TO** line select key is pressed, the Flight Plan page is accessed with DIR TO [ ] displayed on the top line. Refer to Figure 3C-46 and Table 3C-37.

After selecting a waypoint for the Direct-To operation, the normal Flight Plan page display will return.

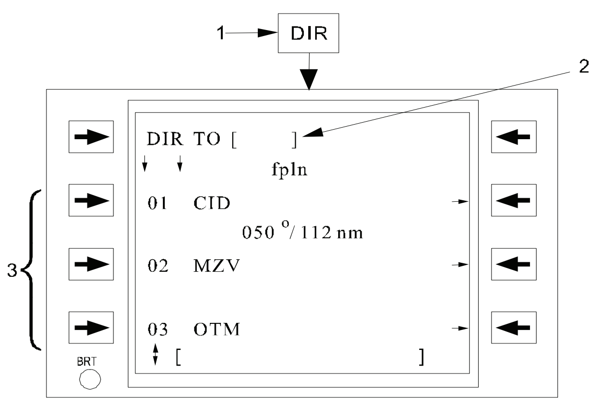


Figure 3C-46. Direct-To Line Select Key

Table 3C-37. Direct-To Line Select Key Procedure

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key - **DIR**.
2	DIR TO [ ] label remains on line 1 as waypoints are scrolled to indicate that only Direct-To operations are possible.
3	Flight plan edits (i.e., waypoint insertion and deletion, and labeling) are permitted.

(2) Direct-To Flight Plan Waypoints. A Direct-To course may be initiated to any existing flight plan waypoint including the history waypoints. DIR TO [ ] remains on the top line as the flight plan is scrolled to indicate that Direct-To selections may be made. Refer to Figure 3C-47 and Table 3C-38. If the waypoint selected for the Direct-To operation is a future waypoint, the intermediate waypoints are bypassed and moved into the flight plan history list (up to 39 waypoints). If the selected waypoint is a history waypoint, the history waypoints following the Direct-To waypoint are moved into the future flight play list and repeated in their original sequence. If any manual edits were made to the courses between flight plan points, they will be reset to the original courses once they become history points.

A Direct-To to the MAP of an approach procedure is prohibited. The FMS must sequence through the FAF waypoint for the MAP to become the active waypoint.

If the pilot has selected the FMS navigation source on the EHSI, the Direct-To course may also be activated to the current active waypoint by momentarily pressing the **CRS** select knob on the Flight Display System (FDS) control panel. This single action Direct-To capability is useful in situations where the pilot must deviate from a course and wishes to proceed directly to the waypoint. It is also useful in terminal area maneuvering in conjunction with GPS data-based approaches.

NOTE

The FMS-800 creates a Direct-To course between the turn anticipation point directly ahead of aircraft present position and the selected direct-to waypoint. When the change in the resulting course is greater than 150°, the FMS will provide guidance to turn and intercept this course, resulting in an S-turn maneuver to the course.

(3) Direct-To DME Arc Procedure. A Direct-To a future or history waypoint that is the endpoint of a DME arc will cause the FMS to intercept the arc along the DME arc leg. To fly directly to the waypoint without intercepting the arc, select Direct-To the DME Arc endpoint again while it is the active waypoint to override the DME Arc leg intercept.

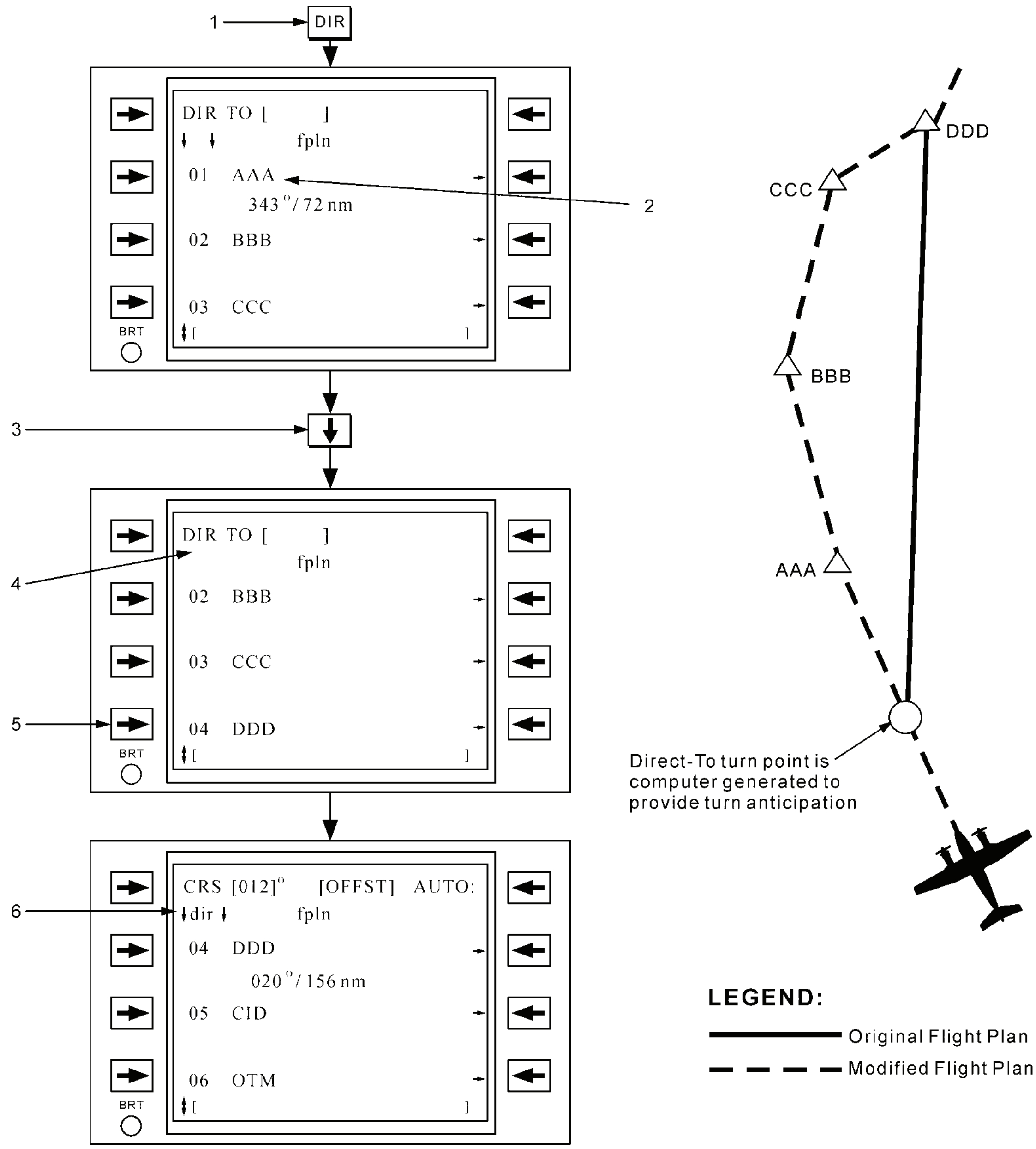


Figure 3C-47. Direct-To a Flight Plan Waypoint

Table 3C-38. Direct-To a Flight Plan Waypoint Procedure

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key – **DIR**
2	Indicates the active waypoint.
3	Scroll to the desired waypoint DDD.
4	The double arrows will disappear when scrolled away from the active waypoint.
5	Select the desired waypoint.
6	When the Dir-To becomes the active waypoint, the course indicator displays dir.

(4) Direct-To Impromptu Waypoints. Impromptu waypoints may be inserted into the flight plan interrupting execution of the current flight plan leg. The impromptu point may be any valid waypoint format. Refer to Figure 3C-48 and Table 3C-39 and Figure 3C-49 and Table 3C-40 for an illustration of the two methods of executing Direct-To operations to impromptu waypoints. When performing a Direct-To the scratchpad waypoint, the active waypoint will be pushed one waypoint into the future and the scratchpad waypoint becomes the new active waypoint. When the MAP is the active waypoint, executing a Direct-To the scratchpad waypoint will move the MAP into history (not future), allowing departure into a missed approach procedure. Waypoint insertion between the FAF and the MAP is prohibited, even when the FAF is in history.

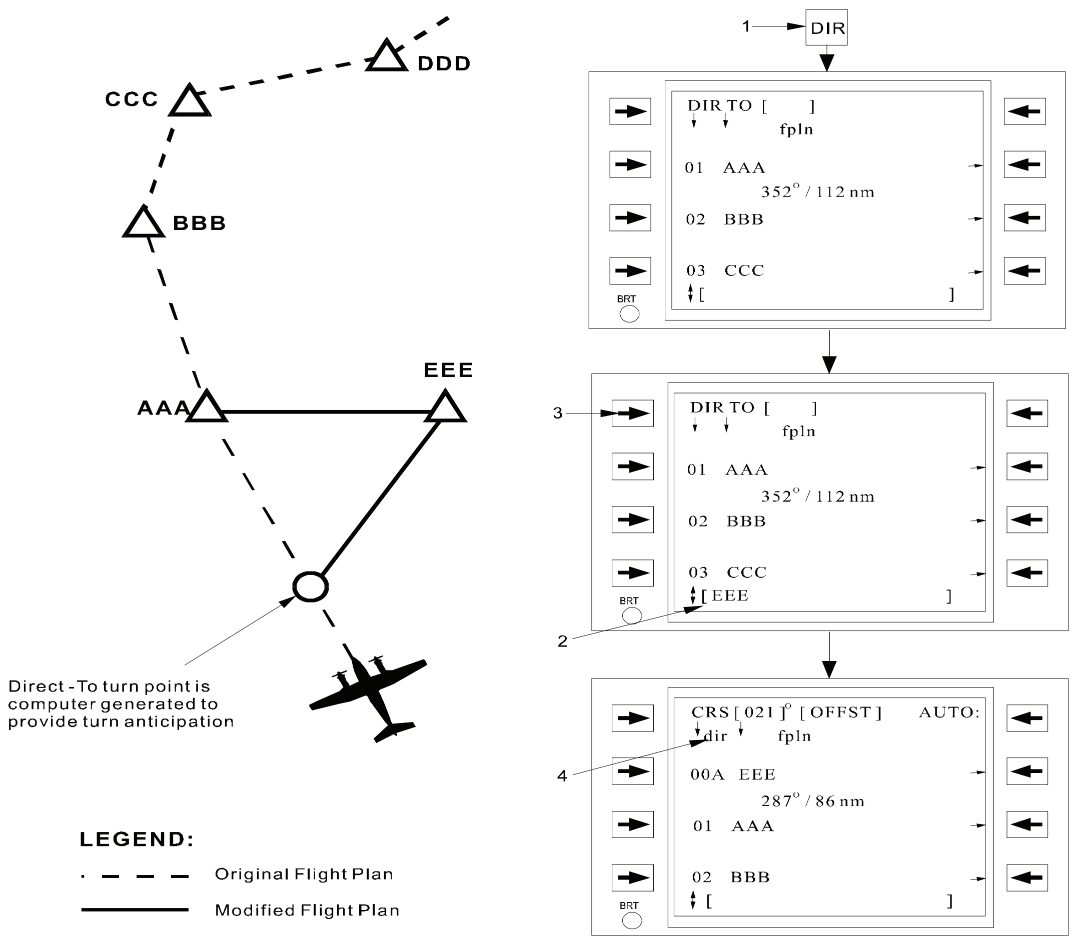


Figure 3C-48. Direct-To an Impromptu Waypoint

Table 3C-39. Direct-To an Impromptu Waypoint Procedure

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key - **DIR**.
2	Enter waypoint in scratchpad.
3	Insert impromptu waypoint.
4	When the Direct To becomes the active waypoint, the course indicator displays dir.

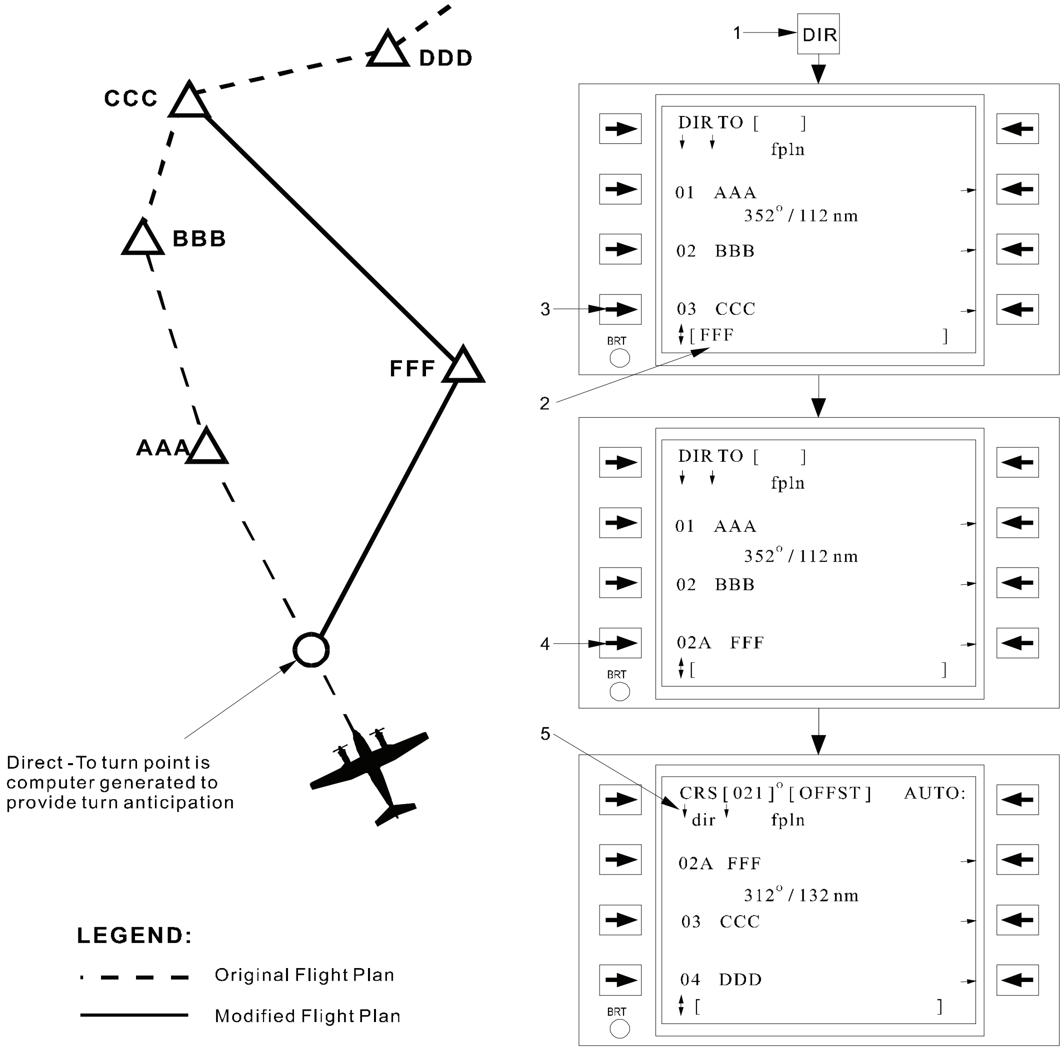


Figure 3C-49. Direct-To Impromptu Waypoint Inserted as a Future Flight Plan Waypoint

Table 3C-40. Direct-To Impromptu Waypoint Inserted as a Future Flight Plan Waypoint Procedure

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key - **DIR**.
2	Enter desired impromptu location in the scratchpad.
3	Insert impromptu location after intervening flight plan waypoints.
4	Press the line select key a second time to execute a Direct-To the same point.
5	When the Direct To becomes the active waypoint, the course indicator displays dir.

To execute a Direct To the non-flight plan waypoint that is stored within the FMS, like a Markpoint, copy the desired waypoint into the scratchpad, select **DIR**, and select line select 1L to activate the Direct-To the scratchpad waypoint.

(5) Direct-To Vector From Present Position. The impromptu point may also be defined as a vector from the present position of the aircraft. Vector waypoints are handled in exactly the same manner as a normal waypoint except that the FMS-800 computes the waypoint position from present position. Refer to Figure 3C-50 and Table 3C-41.

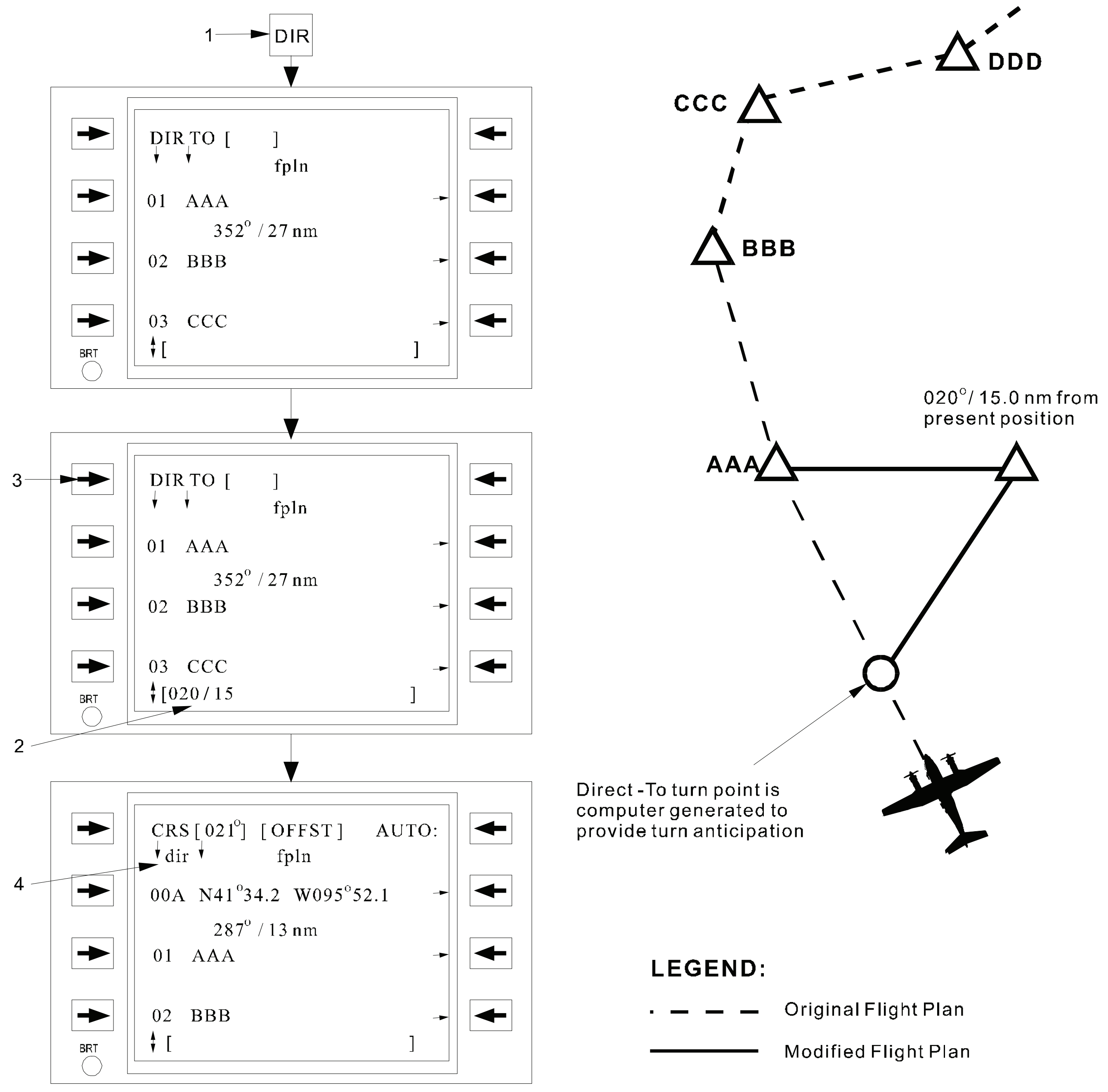


Figure 3C-50. Direct-To Vector From Present Position

Table 3C-41. Direct-To Vector From Present Position Procedure

NO.	DESCRIPTION/FUNCTION
1	Press Direct Function Key - **DIR**.
2	Indicates the desired vector location (Bearing/Distance from present position).
3	Press line select key **DIR TO [ ]**.
4	When the Dir-To becomes the active waypoint, the course indicator displays dir.

g. **Parallel Course Offsets.**

NOTE

Offsets may be defined to the left or right of the original course. Once applied they remain in effect for the remainder of the flight plan unless canceled.

(1) Parallel Course Offset Geometry. A parallel course offset may be applied to the flight plan for weather or traffic avoidance or when assigned by ATC. When an offset is applied, all displays keyed to the active waypoint (e.g., time and distance to go, TO / FROM flag) become referenced to the pseudo-waypoint at the intersection of the course change bisector and the offset course. The leg switch point and the associated 10-second alert are computed relative to the pseudo-waypoint. Crosstrack deviation is computed relative to the offset course. Figure 3C-51 shows the geometry associated with waypoint switching when a parallel offset is applied.

NOTE

Executing Direct-To a waypoint will cancel a parallel course offset if one has been applied.

(2) Parallel Offset Initiation, Termination, Or Change. Parallel course offsets may be applied, changed, or deleted any time the active waypoint is not identified as a pattern or an approach waypoint. Refer to Figure 3C-52 and Table 3C-42 for an illustration of application and deletion of parallel course offset. If the waypoint identified as a pattern or an approach waypoint fix becomes the active waypoint or FLYOVER sequencing is selected while an offset is defined, the offset is automatically canceled and the aircraft will capture the original flight plan course. If a pattern or approach is applied to an active waypoint with an offset applied, the offset is automatically canceled. Initiation of the Direct-To function automatically cancels the parallel offset. Refer to Figure 3C-53.

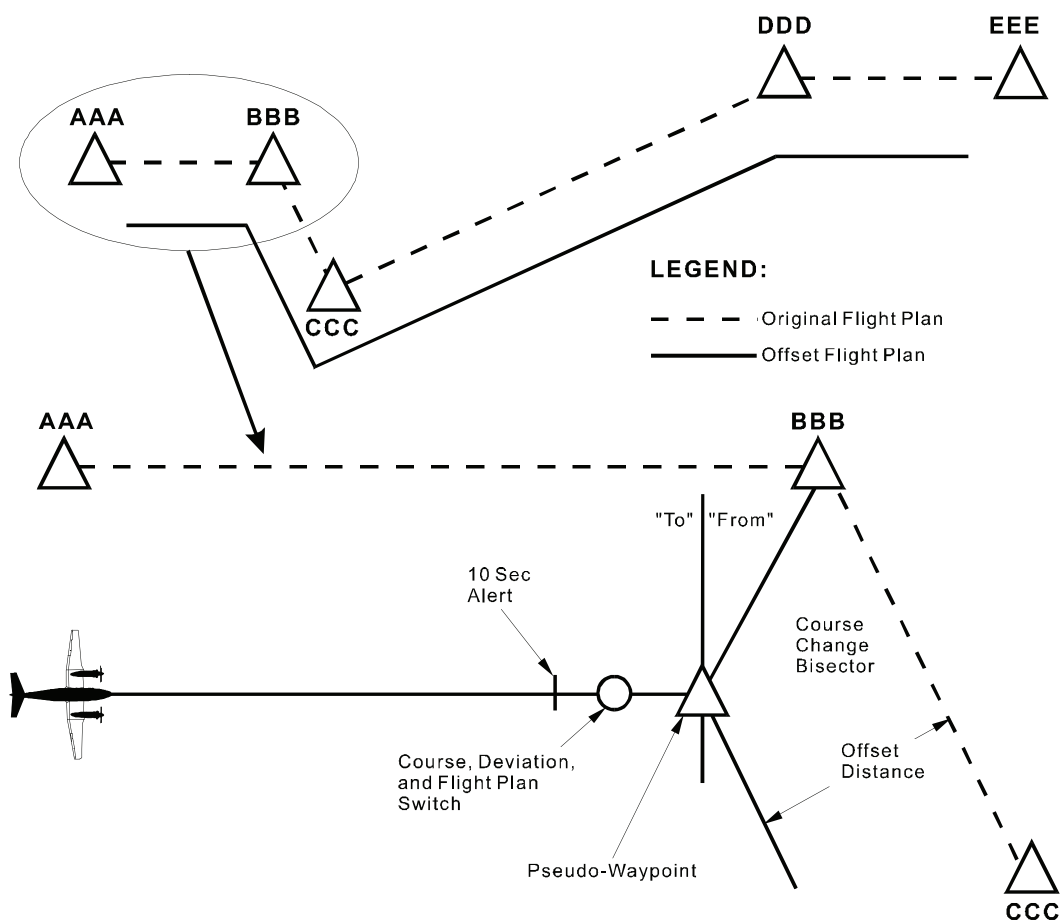


Figure 3C-51. Parallel Course Offset Geometry

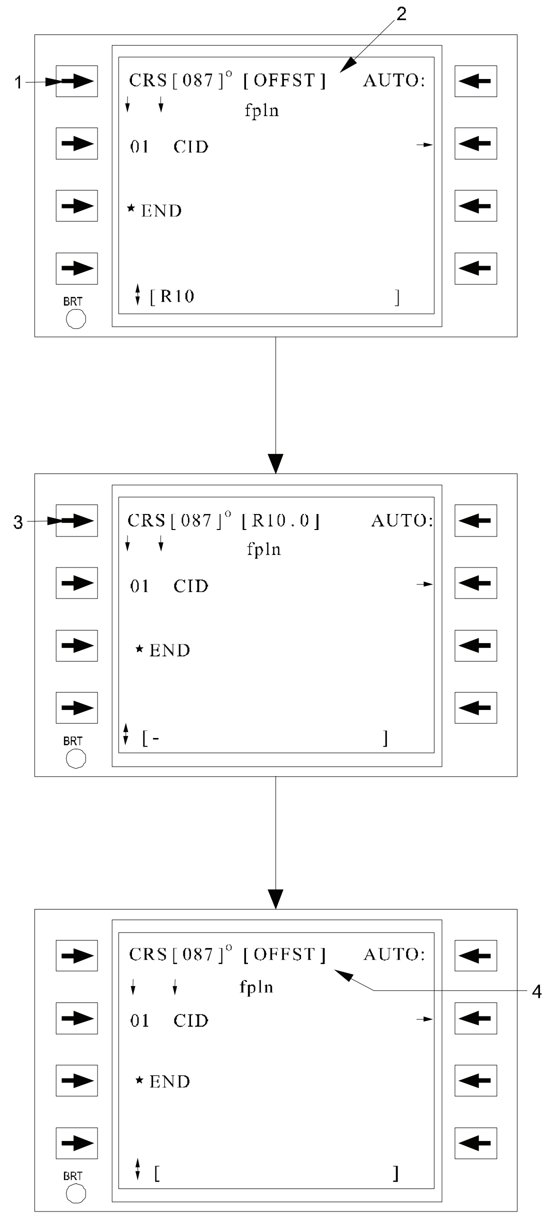


Figure 3C-52. Entering and Deleting Parallel Course Offsets

Table 3C-42. Entering and Deleting Parallel Course Offset Procedure

NO.	DESCRIPTION/FUNCTION
1	Insets a parallel course offset. Right or left must be specified as the first character (e.g. RO.4, R5, L7.0, L12.8).
2	The current value for parallel course offset, or OFFST if none is defined.
3	Deletes a parallel course offset if the scratchpad contains **–**, 0.0, 0., .0, or 0.
4	Display is returned to [OFFST].

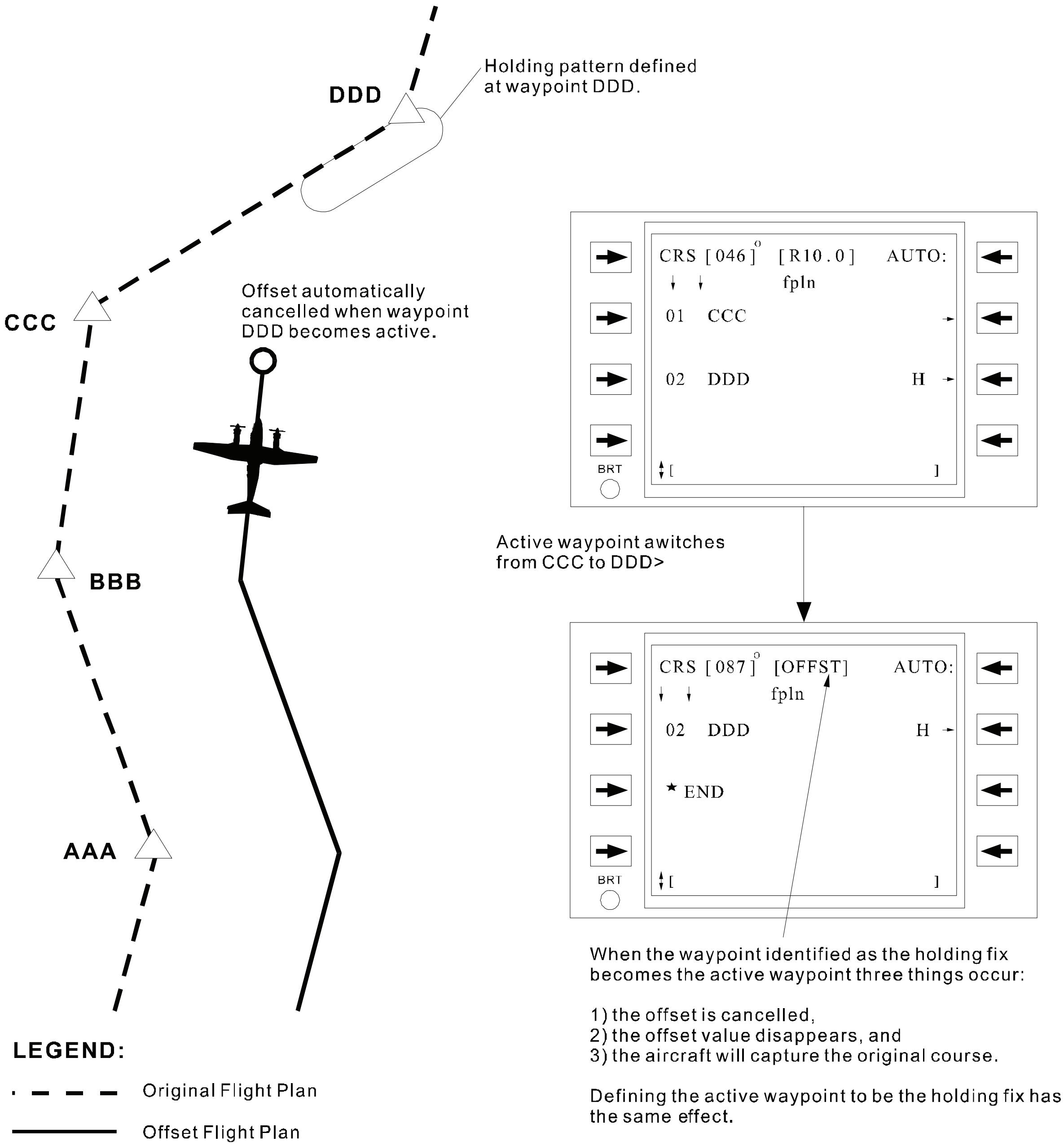


Figure 3C-53. Automatic Cancellation of Parallel Course Offsets

An OFST annunciation on the Horizontal Situation Indicator (HSI) or external OFFSET capsule light annunciation is activated whenever an offset is action.

(3) Waypoint Transition with Parallel Offsets. The parallel offset flight plan may result in severe geometry at waypoints with large course changes. To resolve this condition the offset pseudo-waypoint is never displaced along the inbound leg track by more than two times the width of the offset. Figure 3C-54 shows an offset definition where the along track shift of the pseudo - waypoint is less than two times the offset width, resulting in a continuous offset flight plan.

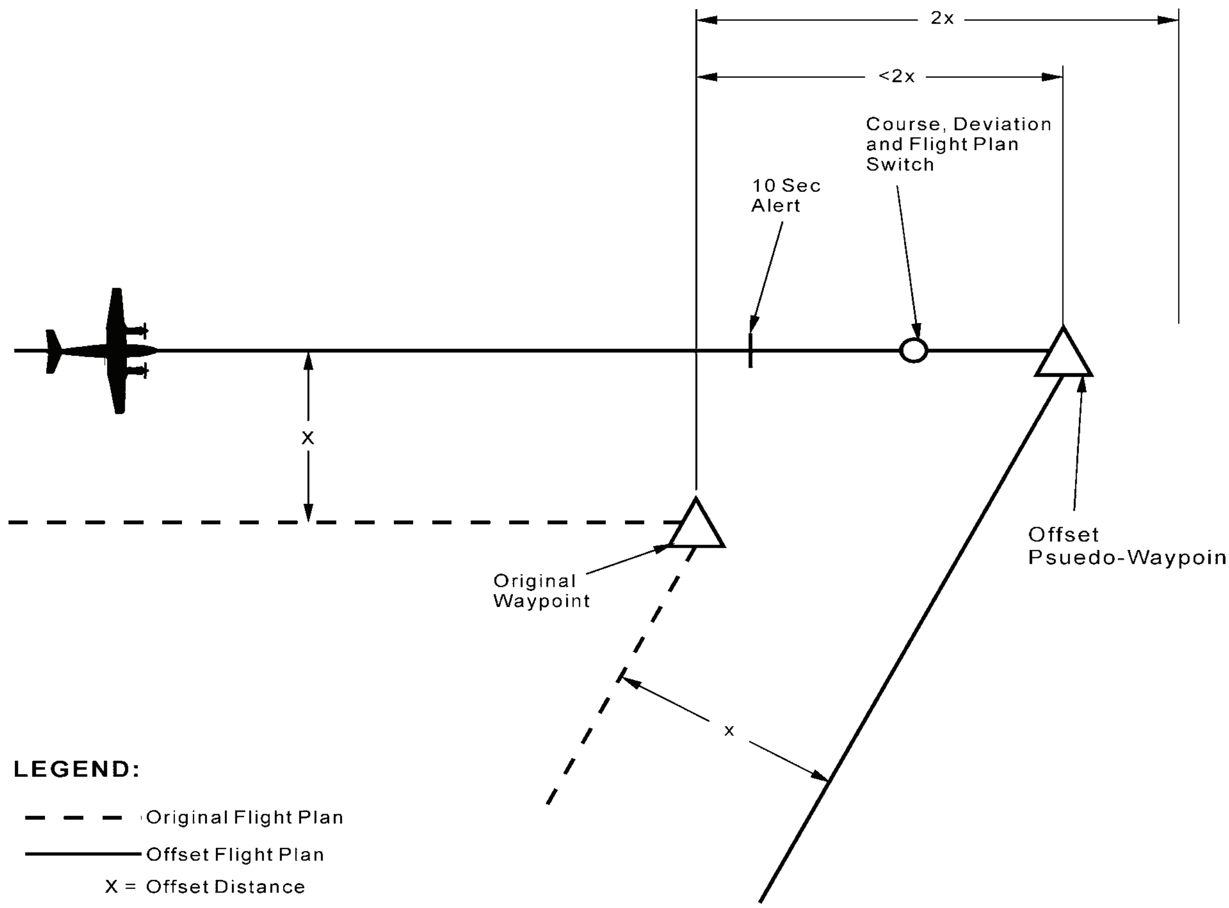


Figure 3C-54. Normal Parallel Offset Positions

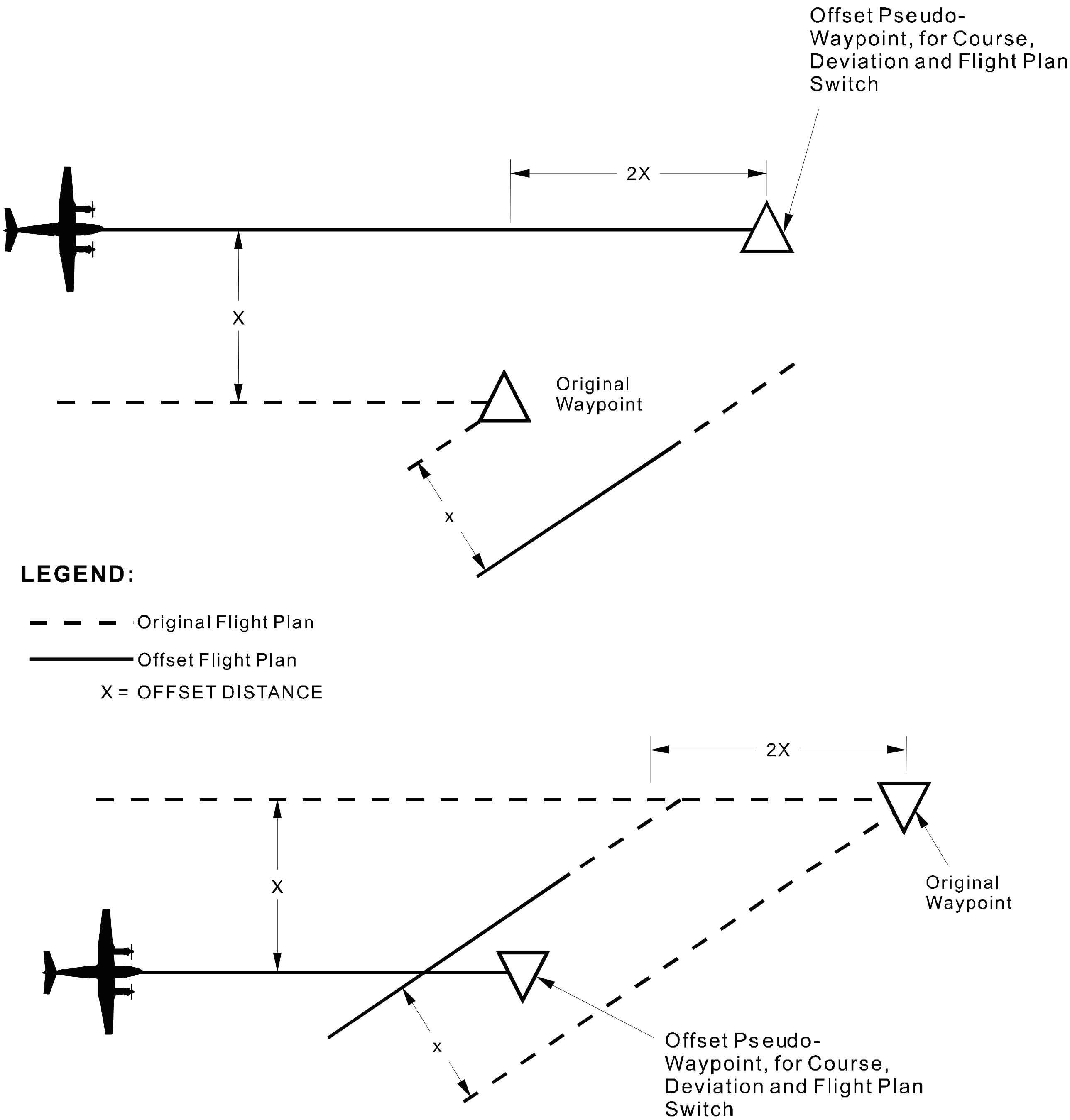
If a leg course change is greater than 127°, a course discontinuity is created. Upon reaching the switch point, the new offset course for the next leg becomes active. Figure 3C-55 shows examples with the offset on both the inside and outside of the required turn.

h. Vertical Navigation.

(1) Vertical Navigation (VNAV) Overview. The FMS-800 VNAV function provides guidance for a climb or descent to an assigned altitude at a waypoint or crossing fix in STAR or initial approach procedure. It also provides situational awareness for climb and descent planning and allows fuel-efficient descents with adjustments for actual wind.

Vertical guidance is not provided during holding pattern, DME arc, course reversal, intercept, or pattern execution. Also, it is not provided for vertical path segments that extend into the previous flight plan leg.

(2) Assigning an Altitude or Flight Level. VNAV guidance requires an altitude or Flight Level (FL) to be entered at a waypoint in the flight plan. If an active flight plan is transferred from the alternate flight plan, all altitudes assigned at waypoints are also transferred. When an altitude has been assigned to a waypoint, it is indicated by a **V** attribute on the right side of the Flight Plan page waypoint line. To delete this altitude assignment, enter a **–** and press the right adjacent line select key, or the upper left line select key if on the Flight Plan Waypoint page.



NOTE

Aircraft overflies pseudo-waypoint and turns to capture the next course (S-turns likely).

Figure 3C-55. Parallel Offset Transition with Large Course Change

To enter an altitude, select the Flight Plan Waypoint page for the waypoint where it is to be assigned. Refer to Figure 3C-56 and Table 3C-43. Altitudes are entered in feet and are automatically referenced by the FMS-800 to the local baroset. If a flight level is desired enter FL followed by the three-digit flight level. This indicates that the altitude is referenced in the FMS-800 to the flight level pressure datum (29.92 in. Hg) instead of the local barometric pressure. The FMS-800 automatically computes the guidance through the transition altitude (climbs) or transition flight level (descents) if the above procedure is followed, regardless of where the transition takes place, which may vary in different countries.

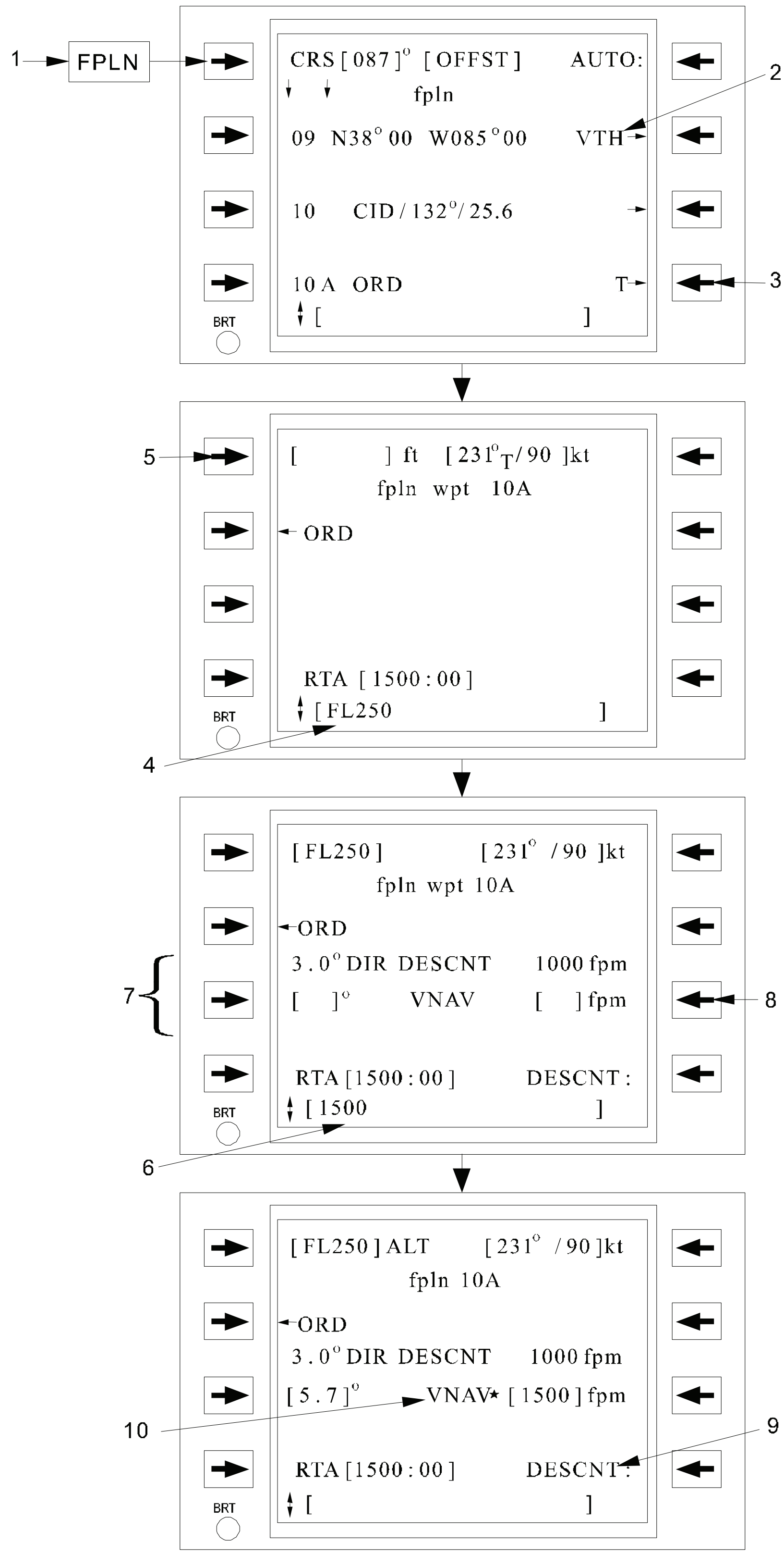


Figure 3C-56. Entry and Display of VNAV Parameters

Table 3C-43. Entry and Display of VNAV Parameter Procedure

NO.	DESCRIPTION/FUNCTION
1	Press Flight Plan Function Key - **FPLN**.
2	V indicates an altitude has been assigned at this waypoint.
3	Press right line select key to access Flight Plan Waypoint page for desired waypoint.
4	Enter flight level (or altitude) in the scratchpad.
5	Press altitude line select key to insert flight level (or altitude).
6	Enter vertical rate (or angle) in the scratchpad.
7	The VNAV information is displayed.
8	Press the insert rate (3R) or angle (3L).
9	Toggle between **CLIMB** and **DESCNT** selections.
10	Asterisk indicates rate is the fixed or entered quantity; after VNAV capture, the angle becomes fixed and vertical speed becomes variable with groundspeed.

If the waypoint is an FMS approach MAP, the altitude is displayed, but no entry is permitted. If an angle is associated with the MAP altitude, the **V** attribute will be displayed on the Flight Plan page. On MDA approaches, no descent angle is defined for the approach, so vertical guidance is disabled and the **V** attribute is not displayed.

(3) Entry and Display of Climb or Descent Path. If only an altitude/flight level is entered and no climb or descent path is specified, the climb/descent path is undefined and no vertical guidance is provided. To activate vertical guidance to the assigned altitude, either a climb/descent path rate or angle must be defined, or a Direct-To VNAV will be executed.

If two consecutive waypoints are assigned altitudes/flight levels, the default path is a straight-line climb or descent between them, the same as for a published profile descent.

To specify a climb/descent path other than the default, enter the desired angle (0.0 to 6.0°) or initial vertical rate (0 to 3500 fpm). Press the **VNAV** line select key for angle or rate entry. Refer to Figure 3C-57 and Table 3C-44. Select either **CLIMB** or **DESCNT** line select key on the Flight Plan Waypoint page.

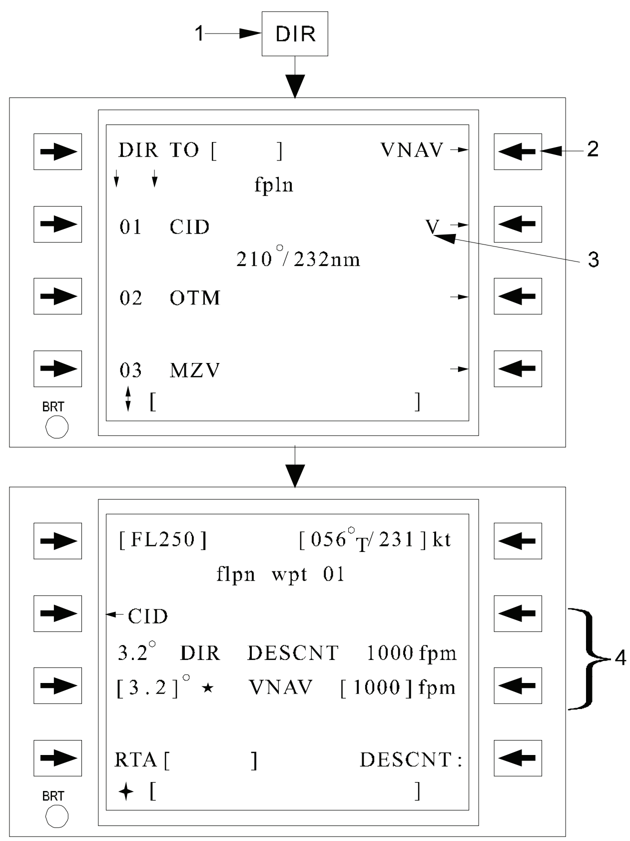


Figure 3C-57. VNAV Direct-To

Table 3C-44. VNAV Direct-To Procedure

NO.	DESCRIPTION/FUNCTION
1	Press the Direct function key - **DIR**.
2	Select VNAV Direct-To the active waypoint, if it has an altitude/flight level assigned (indicated by the V attribute). If the waypoint on line 3 does not have an altitude/flight level assigned, the VNAV label is blanked.
3	Indicates V attribute.
4	VNAV CLIMB/DESCNT path synchronizes to the Direct-To path.

If an angle is entered, the vertical rate will be dynamically updated based on the angle prior to and during capture and the subsequent vertical path. An * will appear next to the angle value to indicate that it is fixed. If a vertical rate is initially entered, the angle is updated based on the entered rate prior to the capture points plus an * appears next to the rate. At capture of the vertical path, the angle becomes fixed and the entered rate is now updated during the climb/descent. The * is now displayed next to the angle to indicate the fixed value.

(4) Direct Climb or Descent Path Display. The DIRECT CLIMB/DESCNT vertical rate or angle on the Flight Plan Waypoint page is computed based on the FMS-800 present position and altitude for any waypoint with an altitude assigned, not just for the active waypoint. Refer to Figure 3C-58 and Table 3C-45. This advisory enables the pilot to plan his climb or descent. He is apprised of the actual vertical maneuver required. For example, ATC delays his climb/descent clearance beyond the planned Bottom Of Climb (BOC) or Top Of Descent (TOD), or clears the aircraft Direct-To another waypoint using the specified waypoint altitude. This is also the value that will be inserted if the pilot were to select a VNAV Direct-To.

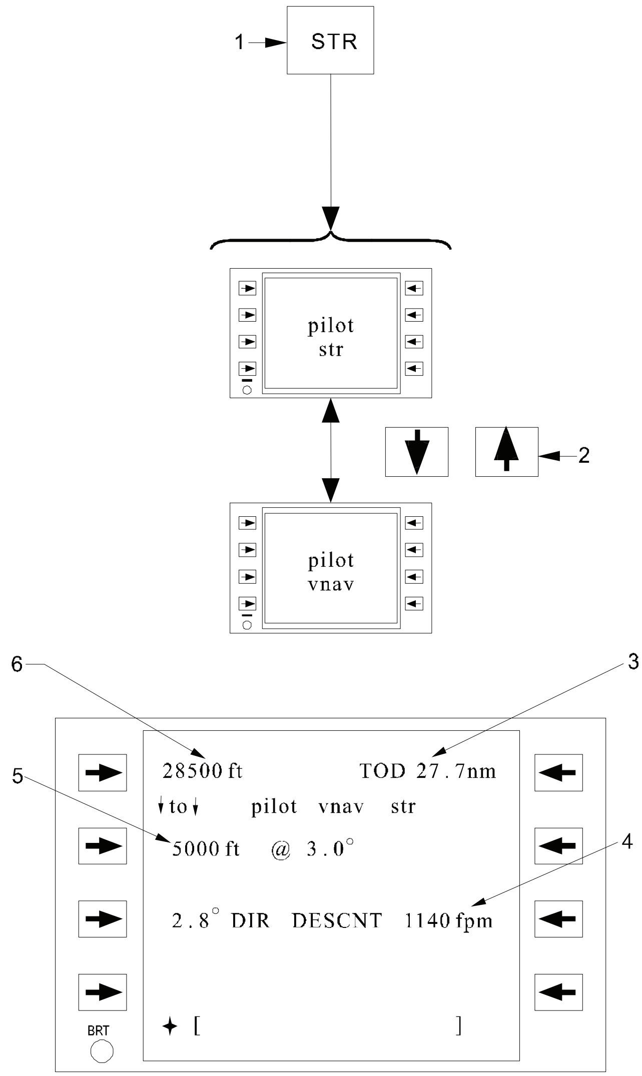


Figure 3C-58. VNAV Steering Pages

Table 3C-45. VNAV Steering Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing the Steering function key – **STR** will access the last viewed Steering page.
2	Scrolls vertically between the Steering pages.
3	Indicates the distance to BOC/TOD.
4	Indicates direct VNAV guidance.
5	Specified altitude/flight level and path angle to the active waypoint.
6	Current aircraft altitude.

(5) VNAV Direct-To. To perform a VNAV Direct-To climb or descent, follow the procedure specified in Figure 3C-59.

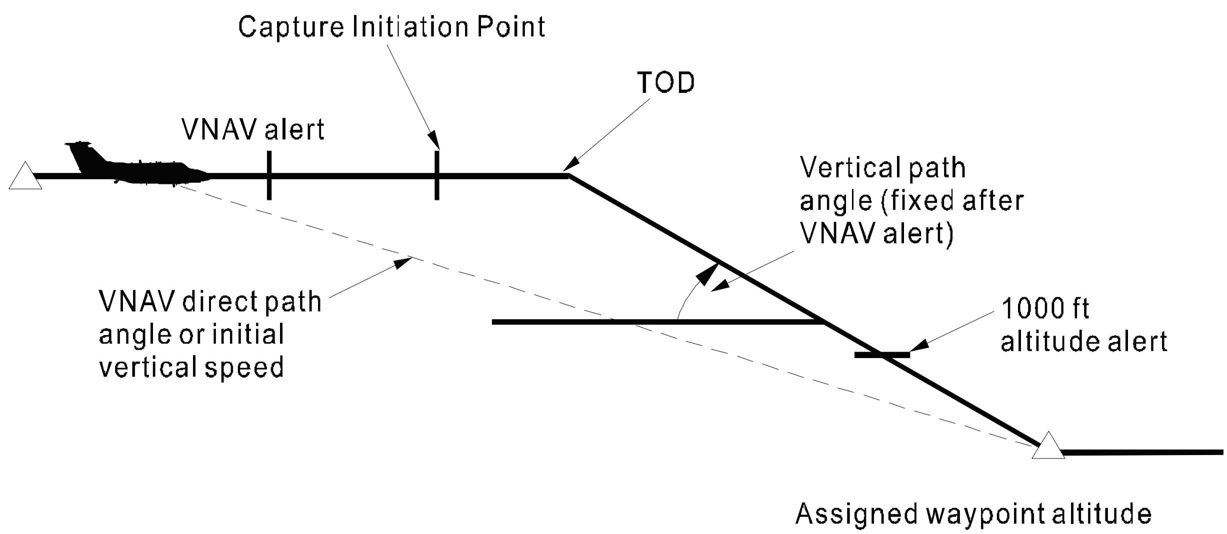


Figure 3C-59. VNAV Profile

(6) VNAV Guidance and Alerting. After a waypoint with an altitude becomes active, the FMS-800 provides vertical steering to fly the entered or default VNAV climb or descent path. On the Pilot VNAV Steering page, the specified VNAV path parameters are displayed on data line 2. The continuously updated altitude is on data line 1 and the vertical rate and angle for a direct vertical path to the waypoint are presented on data line 3.

Prior to VNAV capture, the distance to the BOC/TOD is displayed. This display is dashed after the VNAV path is captured.

Figure 3C-60 and Table 3C-46 show a typical VNAV profile along with the alerts associated with the VNAV capture and termination. Ten seconds prior to the VNAV path capture, the CDU page alerts flashes. At an altitude 1000 feet below/above the waypoint crossing altitude, a second alert is issued.

When the active waypoint for the VNAV guidance passes into history or is deleted, the VNAV steering parameters become invalid or are reset to their default values for the next vertical waypoint in the flight plan.

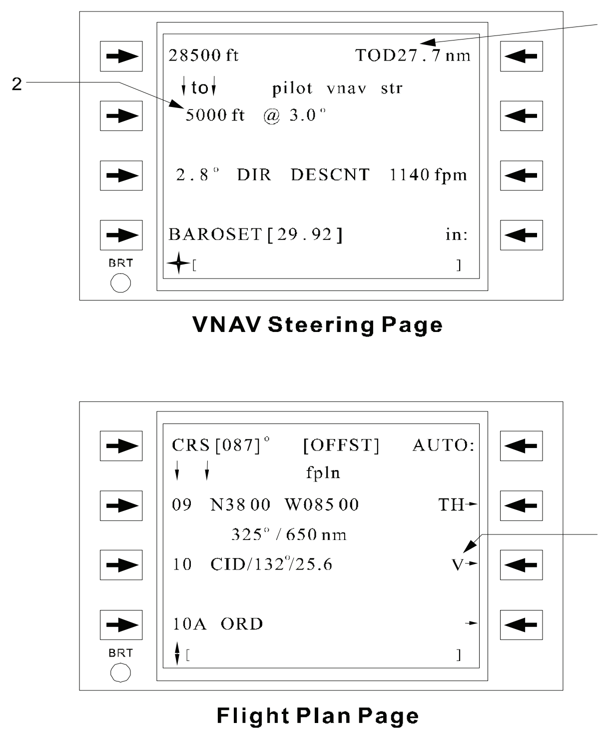


Figure 3C-60. VNAV Capture and Termination Alerts

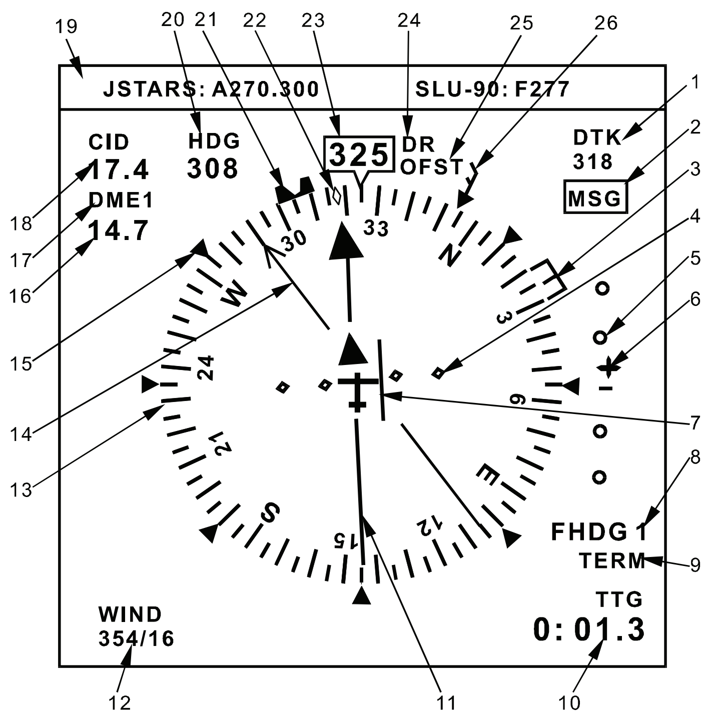
Table 3C-46. VNAV Capture and Termination Alert Procedure

NO.	DESCRIPTION/FUNCTION
1	TOP OF DESCENT label flashes 10 seconds prior to VNAV capture (same for BOC).
2	Altitude flashes at 1000 feet above/below waypoint crossing altitude.
3	V attribute flashes 10 seconds prior to VNAV capture and at 1000 feet above/below waypoint crossing altitude.

i. Flight Instrument and Autopilot/Flight Director Guidance.

(1) *Flight Instrument Displays*. The FMS-800 provides lateral and vertical navigational situation information to the pilot's flight displays. The pilot's displays are driven using the navigational solutions from the CDU Pilot Steering page, Paragraph 3C-25.e.(6)(a).

(2) *Horizontal Situation Displays (HSI).* In order to display horizontal situational data on the EHSI, the FMS source must be selected by the pilot. The EHSI data includes the HSI course arrow (desired track), TO / FROM pointer, and bearing pointer to the FMS-800 outputs. These outputs always relate to the flight plan active waypoint or pattern turn point. Refer to Figure 3C-61. If the EHSI distance interface is compatible and aircraft switching is installed, the distance readout will also show great circle distance to the active waypoint.



1. **Course Readout / Label**
2. **FMS Message Alert**
3. **FMS Heading Bug**
4. **Course Deviation Scale**
5. **Vertical Deviation Scale**
6. **Vertical Deviation Pointer**
7. **Lateral Deviation Bar**
8. **Course Source Annunciations**
9. **FMS Flight Modes**
10. **Data Selection Display**
11. **Course Pointer**
12. **Wind Direction**
13. **Compass Rose**
14. **Bearing Pointer**
15. **Compass Benchmarks**
16. **Distance of Bearing Source**
17. **Bearing Source**
18. **Course Source Distance Readout**
19. **Free Format Line (ARC-210 Freq)**
20. **Digital HDG Bug Readout**
21. **Heading Bug**
22. **Track Indicator**
23. **Digital Heading Readout**
24. **DR or RAIM Alert**
25. **FMS OFST**
26. **Wind Pointer**

Figure 3C-61. HSI Display

The course/desired track readout and pointer on the EHSI show the great circle desired track at current aircraft position along the active leg. This may differ from the CRS display on the CDU Flight Plan page when the distance to the waypoint is large, especially at high latitudes. The CRS display on the Flight Plan page always references the inbound track measured at the waypoint. Refer to Figure 3C-62.

When the inbound course to the active waypoint is manually entered on the Flight Plan page, the course display and course pointer on the HSI show the desired course at the waypoint.

The scaling of the lateral deviation display on the HSI is determined by the selected FMS flight guidance mode selected on the Navigation Configuration page, Paragraph 3C-25.e.(6)(d).

1. En route. ± 4.0 nm full scale (2 dots) linear deviation.

2. Oceanic. ± 4.0 nm full scale (2 dots) linear deviation.

3. Terminal. ± 1.0 nm full-scale linear deviation.

4. Approach. ± 0.3 nm full-scale linear deviation.

The scaling of the vertical deviation display on the HSI is also determined by the current flight mode.

5. Oceanic, En route, or Terminal. ± 1000 feet full-scale deflection.

6. Approach. ± 300 feet full-scale deflection.

If no flight plan active waypoint is present and the navigation solution is valid, the HSI display will be blank removing current guidance information. If the navigation solution is invalid, the navigation source indicator will be red. If the navigation solution is valid but performance is degraded, the navigation source indicator will be yellow.

(3) Flight Director and Autopilot Lateral (Bank) Steering. Using the Flight Director or autopilot, the FMS can steer the aircraft directly through all of the possible flight plan maneuvers including holding patterns, MFP's, SID's, STAR's, and FMS approaches. This interface also enables the FMS to limit the commanded bank angle to the value specified on the Navigation Configuration page.

The FMS provides a heading submode (FMS heading) that allows the crew to temporarily fly to selected headings while still using FMS waypoint navigation. For those aircraft equipped with Electronic Flight Instrument Systems (EFIS), select FMS heading mode by pressing the **HDG** knob and adjusting the knob to the desired heading. The FMS will provide commanded bank to the selected heading indefinitely or until the heading is adjusted in such a way as to re-intercept the previous course.

(a) Additional Displays on Electronic Flight Instrument Systems. For those aircraft which are equipped with an electronic flight display system (EFIS or FDS), additional displays may be provided as shown in Figure 3C-62.

1. Eight future flight plan waypoints (including the active) to give advance notice of impending leg changes and relative distances to future waypoints when the EHSI is in MAP mode, Figure 3C-63.

2. Identification of the type of waypoint (i.e., NAV aid, intercept, standard waypoint, airport, etc.) and label identifier.

3. Groundspeed.

4. True Airspeed.

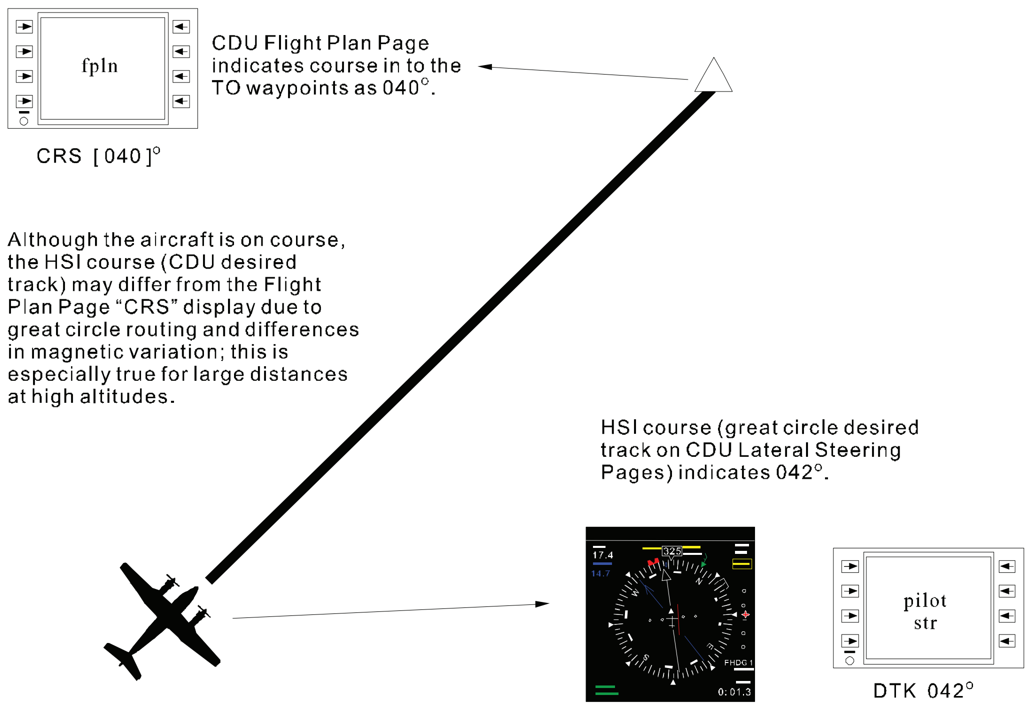
5. Wind direction and speed.

6. Time to go.

7. Bearing to Waypoint.

8. Elapsed Time.

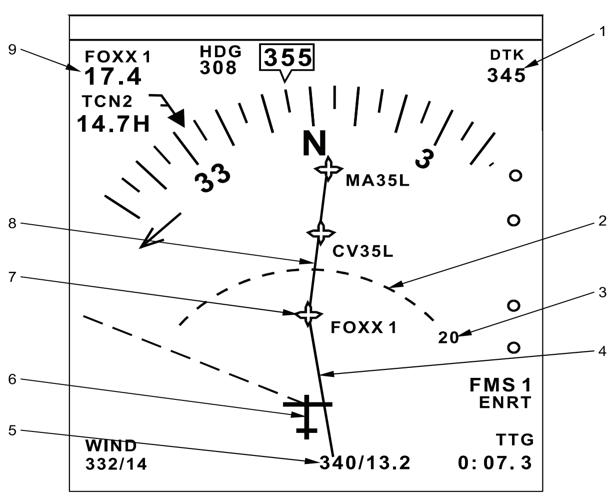
(4) FMS Heading Mode Overview. The FMS-800 provides heading guidance for radar vectoring to intercept a final approach course of a published GPS approach, without the pilot needing to deselect and reselect the flight control system NAV mode.



NOTE

Display values of course and desired track are shown for examples only.

Figure 3C-62. CDU Course Display and HSI Course (CDU Desired Track) Display



1. **Course Readout**
2. **Range Scale Arc**
3. **Distance**
4. **Active Flight Plan Leg**
5. **Course Bearing/Range Readout**
6. **Aircraft Symbol**
7. **Waypoint Symbol**
8. **Interconnecting Track Lines**
9. **Distance Display**

Figure 3C-63. EHSI Map Mode Display

(a) Activation of FMS Heading Mode. When commencing a published GPS approach, if ATC gives instructions to follow radar vectors to intercept the final approach course, select **DIRECT TO** the FAF. The message FINAL CRS XXX° will appear in the CDU scratchpad. Select line key L1 on the CDU to insert that final approach course extension as the currently displayed FMS course. Press the **HDG** knob on the FDS control panel to activate the FMS heading mode, and select the desired heading to intercept the final approach course. The FMS roll command will guide the aircraft to acquire and hold the displayed heading and any subsequent desired heading entered by the pilot on the FDS control panel. The FMS heading mode will continue to guide to the FDS selected heading as long as the heading is steering away from the flight plan course. When the selected heading is steering towards the flight plan course, the FMS heading mode will automatically cease when the course can be captured by normal FMS lateral guidance.

(b) Termination of FMS Heading Mode. With no further action on the part of the pilot, the FMS will automatically drop the FMS heading mode and recapture the final approach course when the final course is intercepted, without overshoot. To manually terminate the FMS heading mode, select **DIRECT / TO**

the FAF or any other waypoint. The FMS will immediately resume FMS course guidance.

j. Alternate Flight Plan Overview. The alternate flight plan is a complete plan for a mission or a mission segment that includes a route of up to 60 waypoints, with calculations of courses, distance, time, gross weight, and fuel requirements including reserve allocations. It includes standard flight planning data and provides an electronic hard copy of the flight plan in the FMS-800 that may be modified at any time.

Forty alternate flight plans may be stored on the data cartridge from either an MPGS or laptop facility, or by manual entry via the CDU on the aircraft. One alternate flight plan at a time may be selected and transferred into the CDU for viewing and the operations are described in this section. This alternate flight plan is separate from the active flight plan and does not sequence or change unless the crew modifies it. It can be transferred or added to the active flight plan, Paragraph 3C-25.e, and the alternate flight plan will remain intact.

The alternate flight plans stored on the data cartridge are not automatically updated with new waypoint data whenever a new primary ICAO database is loaded onto an FMS data cartridge. With each ICAO database update, each alternate flight plan should be updated at a ground station (outdated waypoints replaced with current ICAO definition), and the on-aircraft FMS purged of existing flight plans. The updated alternate flight plans can then be used for normal operations.

(1) Alternate Flight Plan Structure. The alternate flight plan operates as a spreadsheet calculator. The crew inputs the flight plan routing, wind, and aircraft performance. The FMS-800 calculates the individual leg data as well as the flight totals. Vertical scrolling on the CDU accesses the legs of the plan (1 through 60). Complete data for each leg is accessed by lateral scrolling among leg pages with suffixes A, B, and C. Refer to Figure 3C-64 and Table 3C-47.

The Alternate Flight Plan Waypoints page presents the alternate flight plan in a format similar to the active flight plan, Figure 3C-64. Modify the alternate flight plan on this page in the same manner as the active flight plan.

(2) Alternate Flight Plan Access and Transfer. On the Alternate Flight Plan page, various top-level access and transfer options are offered to the crew. Refer to Figure 3C-65 and Table 3C-48. When an alternate flight plan is transferred or added to the active flight plan, only the sequence of waypoints and the following waypoint attributes are transferred: All others are calculated by the FMS-800 using sensed data rather than the planned parameters of the alternate flight plan.

(a) Wind for each leg.

(b) Altitude for each waypoint (if assigned).

(c) The time associated with the last entered time of arrival.

(d) MFP for each waypoint (if assigned).

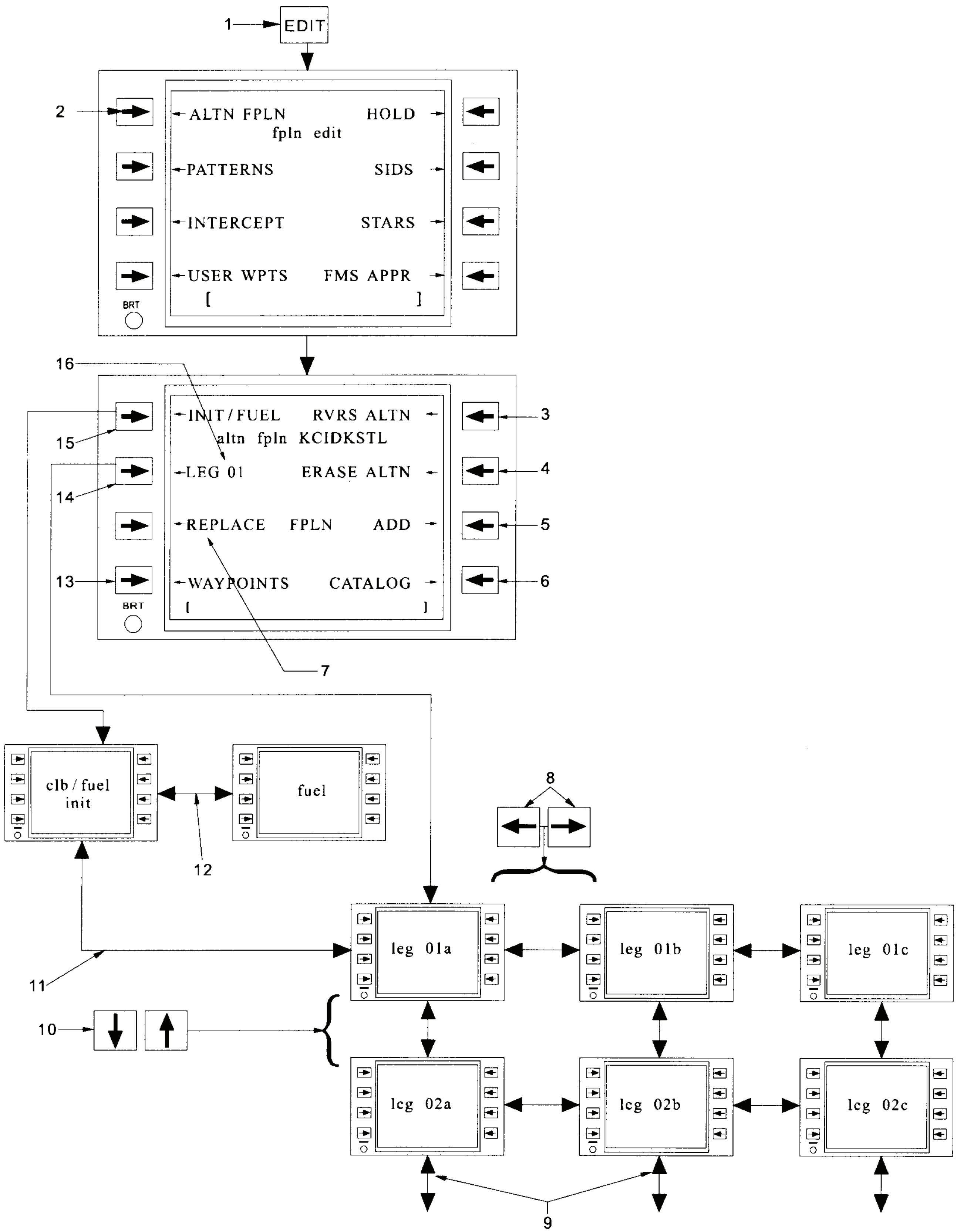


Figure 3C-64. Alternate Flight Plan Schedule

Table 3C-47. Alternate Flight Plan Structure

NO.	DESCRIPTION/FUNCTION	NO.	DESCRIPTION/FUNCTION
1	Pressing **EDIT** function key to access edit page.	9	For vertical strolling to additional Leg pages.
2	Selecting **ALTN FPLN** select key.	10	Scroll vertically among the Leg pages in sequence.
3	To reverse the alternate flight plan waypoint sequence.	11	Scroll vertically between the Leg 01A page and the Climb Init page.
4	To erase the alternate flight plan.	12	Scroll laterally between the Fuel Init page, Fuel summary page, and the Climb Init page.
5	To add alternate flight plan at desired location in active flight plan.	13	To select listing of alternate flight plan waypoints.
6	To select catalog of available alternate flight plans on data cartridges.	14	To access Leg pages.
7	To replace active flight plan with alternate flight plan.	15	To access Init page.
8	Scroll laterally among the Leg pages for each leg.	16	Leg number corresponds to the last viewed Leg page; pressing this line select key will re-access the Leg page.

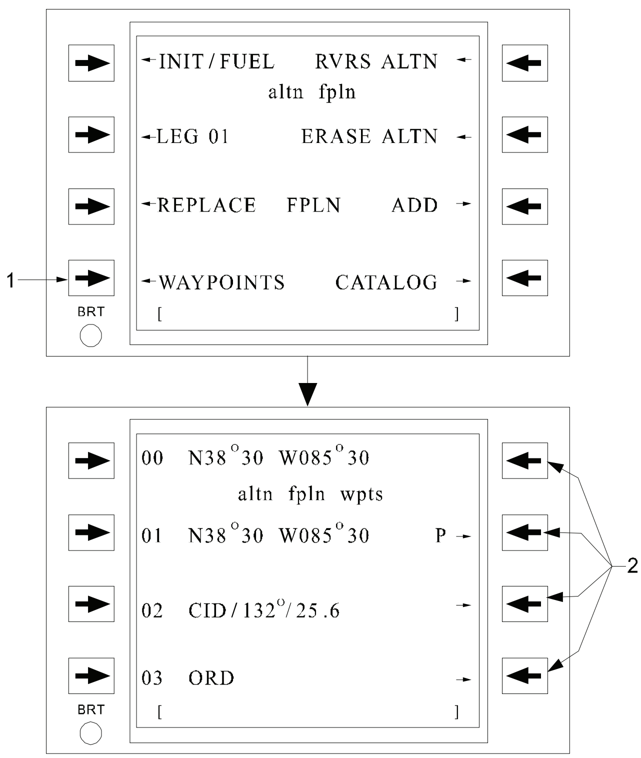


Figure 3C-65. Alternate Flight Plan Waypoints Page Access

Table 3C-48. Alternate Flight Plan Waypoints Page Access Procedure

NO.	DESCRIPTION/FUNCTION
1	Press to access the Alternate Flight Plan Waypoints page.
2	Waypoints reviewed and entered as on the Flight Plan page.

(3) Alternate Flight Plan Initial Time, Fuel, and Weight. The alternate flight plan initial time, fuel, and weight entries are optional. If the alternate flight plan is added to an existing flight plan, the crew cannot include climb parameters. Refer to Figure 3C-66 and Table 3C-49.

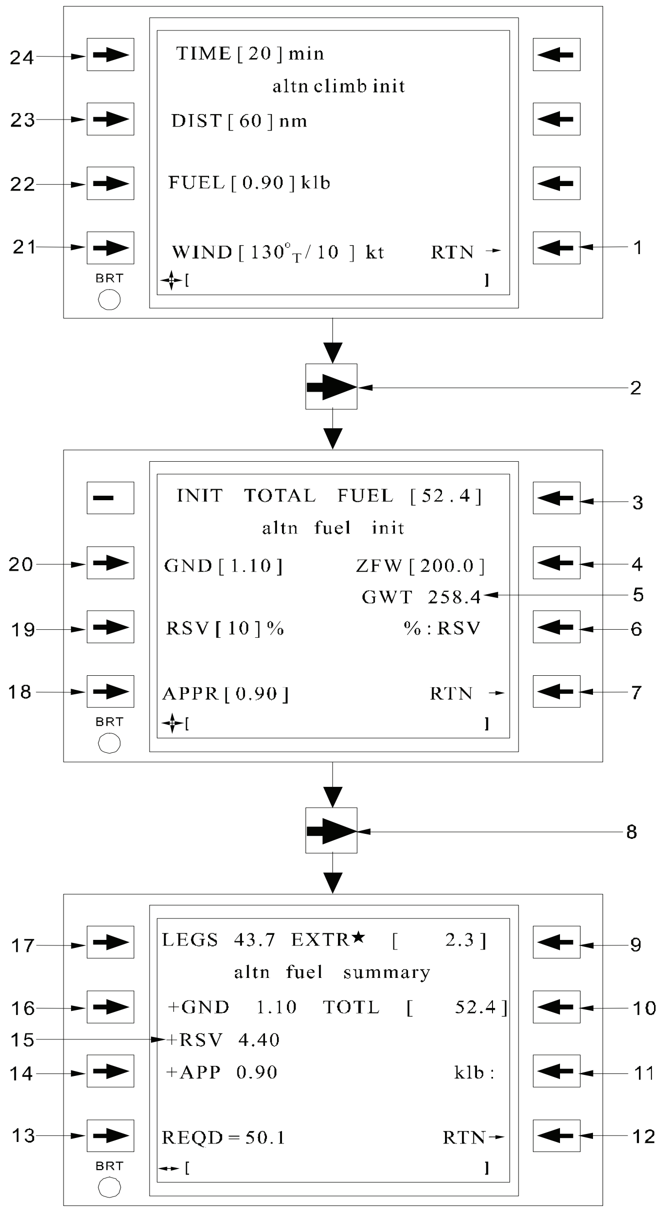


Figure 3C-66. Alternate Flight Plan Init and Fuel Pages

Table 3C-49. Alternate Flight Plan Init and Fuel Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Return to Alternate Flight Plan page.
2	Scroll laterally to access the Fuel Init page.
3	Insert initial fuel load.
4	Insert zero fuel weight.
5	Calculated gross weight.
6	Select desired reserve fuel calculation: klb, 0/0, or min.
7	Return to Alternate Flight Plan page.

Table 3C-49. Alternate Flight Plan Init and Fuel Page Procedure (Continued)

NO.	DESCRIPTION/FUNCTION
8	Scroll laterally to access the Fuel Summary page.
9	Insert/display extra fuel (an asterisk indicates that the value was entered).
10	Insert/display initial ramp fuel (an asterisk indicates that the value was entered.)
11	Select the summary display between hours (hrs) and weight in thousands of pounds (klb).
12	Return to alternate Flight Plan page.
13	Total mission fuel required.
14	Approach fuel (entered on Fuel Init page).
15	Reserve fuel (entered on Fuel Init page).
16	Ground fuel (entered on Fuel Init page).
17	Sum of all leg fuels.
18	Enter the approach fuel allowance.
19	Enter the reserve fuel with type of reserve selected at line select 3R.
20	Enter ground fuel allowance.
21	Insert average climb wind.
22	Insert climb fuel.
23	Insert zero wind climb distance.
24	Insert time to climb in minutes.

When the climb parameters are entered on the Alternate Climb Init page, the FMS calculates a Top Of Climb (TOC) leg segment that is used for fuel calculations. The TOC is displayed on the Alternate Flight Plan Leg A page for the leg that contains the TOC. Refer to Figure 3C-67 and Table 3C-50. All leg segments previous to the TOC use the climb leg calculations for fuel burn. Following the TOC, the fuel burn rates for each leg are used for fuel usage calculations.

The initial fuel entered on the Alternate Fuel Init page is used in the total fuel summary for the currently defined alternate flight plan. Initial total fuel is entered when the quantity of fuel loaded is currently known or planned. If desired, this value can remain blank and the FMS will calculate a total fuel summary that must be entered prior to departure on the Fuel Summary page.

Reserve fuel can be entered as either a percentage of mission fuel (%), specified weight (klb), or duration (min) using the fuel burn rate of the last leg of the alternate flight plan.

The ground and approach fuel allowances are calculated in the total fuel summary as indicated on the Fuel Summary page.

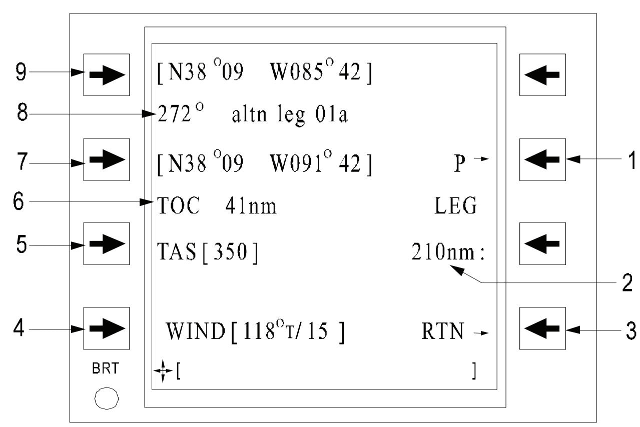


Figure 3C-67. Alternate Flight Plan Leg A Page

Table 3C-50. Alternate Flight Plan Leg A Page Procedure

NO.	DESCRIPTION/FUNCTION
1	The P indicates pattern attached; pressing this line select key will access the associated pattern Definition page.
2	Leg distance or distance to waypoint/ remaining.
3	Return to Alternate Flight Plan page.
4	Insert leg wind (– resets to blank; no defined wind).
5	Insert leg TAS (– resets to previous leg).
6	TOC location within current leg.
7	Insert leg TO waypoint.
8	Outbound bearing of FROM / TO waypoint.
9	Insert leg FROM waypoint (leg 01 only).

The zero fuel weight entry is used to calculate the gross weight of the aircraft on the ground with fuel loaded and the gross weight remaining after each leg is flown, as indicated on the Alternate Flight Plan B page. Refer to Figure 3C-68 and Table 3C-51.

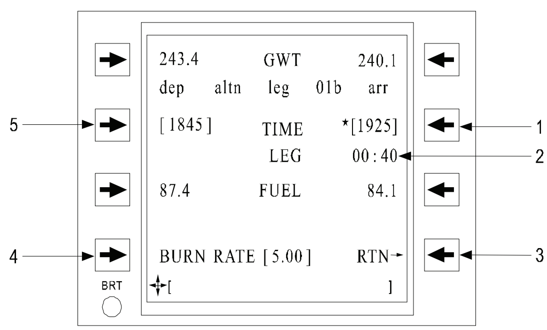


Figure 3C-68. Alternate Flight Plan Leg B Plan

Table 3C-51. Alternate Flight Plan Leg B Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Insert planned time of arrival (* indicates quantity has been inserted; all other times calculated from entered time).
2	Leg Estimated Time En Route (ETE).
3	Return to Alternate Flight Plan page.
4	Insert leg fuel burn rate.
5	Insert planned time of departure (first leg only).

(4) *Alternate Flight Plan Fuel Summary*. The Fuel page presents a summary of the fuel requirements for the alternate flight plan. Refer back to Figure 3C-66. If no approach (APPR) fuel is entered, no approach time is allocated. If an approach fuel is entered, a standard 15-minute time allotment is added to the total flight time, regardless of the amount of fuel entered. If an initial total fuel has been entered on the Fuel Init page, the EXTRA fuel is calculated by subtracting the required (REQ) from the TOTAL. If an EXTRA value is entered (in hours or kilo-pounds), the required initial total fuel is calculated and shown as the TOTAL. If an aerial refueling (ONLOAD) is entered at a waypoint in the alternate flight plan, an EXTRA entry is not permitted. With an ONLOAD fuel defined, the initial total fuel is not automatically computed (fixed entry) and EXTRA fuel is calculated from the initial total fuel, ONLOAD fuel, fuel required, and total fuel entered. The display of total and extra fuel summary can be selected between total fuel quantity (klb) and duration (hr).

(5) *Entry and Display of Alternate Flight Plan Legs*. Unless entered by the crew, the default starting point for the first leg is the current aircraft position from the Start 1 page at the time a new plan is created. Waypoints may be inserted and deleted on the Leg A pages or on the Alternate Flight Plan Waypoints page, in the same manner as for the active flight plan.

The bearing displayed on the Leg A page is the outbound bearing from the starting waypoint for that leg.

The TOC readout appears on the leg with the distance into that leg that the TOC is planned to occur, given the average climb wind and performance data entered on the Climb Initialization page.

Selecting line select 3R toggles between distance from the origin of the Alternate Flight Plan (AFP) to the current waypoint/distance from the current waypoint to the end of the AFP or total leg distance for the current displayed leg.

If time and/or fuel calculations are desired, enter the TAS and forecast wind at the cruising altitude on this page. A TAS or wind entry on this page will transmit from the current displayed waypoint to all succeeding waypoints when entered. Insertion of a new waypoint will use the previous leg's wind and TAS entries. A blank wind will default to no wind when in the alternate flight plan. Refer to Paragraph 3C-25.e.(6)(b) for a description of waypoint wind usage in flight planning.

MFP's may also be inserted or attached to waypoints in the alternate flight plan. When inserted or attached, a **P** is indicated on the right side of line 3 and this also allows direct access to that pattern's definition page for review or modification.

(6) Entry and Display of Alternate Flight Plan Leg Time, Fuel, and Weight. Scrolling laterally from the Leg A page to the Leg B page, the pilot may enter parameters to compute the time, fuel, and gross weights for each leg.

The waypoint departure and arrival times for each leg shows elapsed time from takeoff (i.e., assume a default takeoff time of 00:00). If a required departure or waypoint arrival time is entered, the times are fixed times with respect to the entered value. The alternate flight plan ETA's are calculated to each waypoint using the waypoint wind and TAS entries provided for each waypoint on the Leg A pages.

Only one required time may be entered in the alternate flight plan, either the first departure time or any waypoint arrival time. The * indicates an entered required time versus a computed departure or arrival time. If a loiter/hold/pattern on-station elapsed time is entered on the Leg C page, the arrival and departure times for a waypoint will differ by that planned loiter time. If a fuel onload or cargo offload is entered at a waypoint, the arrival and departure fuel and/or gross weight will differ by the entered amount. Refer to Figure 3C-69 and Table 3C-52.

(7) Entry and Display of Planned Altitude. On the Leg C page, optional entries of the planned cruise altitude/flight level and bank command limit for each leg may be made. Each altitude/flight level entry is transferred to the active flight plan when the alternate flight plan is transferred.

(8) Entry and Display of On-Station Loiter Time and Fuel Parameters. If the mission includes an aerial refueling pattern, holding pattern, MFP, or other loiter on-station at a waypoint, enter the planned loiter time and fuel burn rate on the Leg C page. This will cause the total mission time and fuel calculations to accommodate the planned loiter. If an intermediate landing without refueling is planned, enter the ground time with no fuel burn or use another alternate flight plan for the next segment.

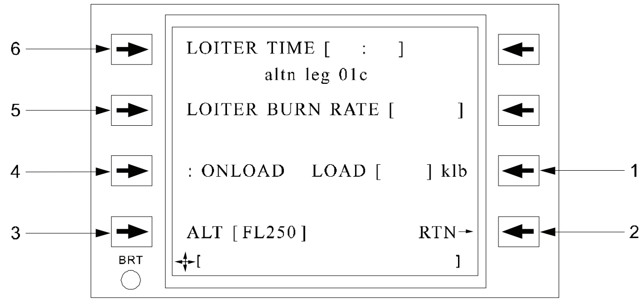


Figure 3C-69. Alternate Flight Plan Leg C Page

Table 3C-52. Alternate Flight Plan Leg C Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter the ONLOAD or OFFLOAD weight.
2	Return to Alternate Flight Plan page.
3	Insert planned cruise leg or waypoint crossing altitude/flight level.
4	Select planned aerial refueling ONLOAD or cargo/deliver OFFLOAD.
5	Insert planned loiter fuel burn rate.
6	Insert planned on-station loiter time.

(9) Entry and Display of Fuel/Weight ONLOAD/OFFLOAD. If an aerial refueling/cargo delivery is planned during the flight plan leg, perform the following procedure.

1. Select **ONLOAD** or **OFFLOAD** at line select 3L for the waypoint where the delivery is to occur.

2. Enter the **ONLOAD / OFFLOAD** quantity in the scratchpad.

3. Select and press the **LOAD** line select key.

If an ONLOAD is entered, the FMS-800 assumes that the loaded quantity is usable fuel and increments both the departure gross weight and fuel remaining at that waypoint. In this case, the REQD and TOTAL (mission) fuel on the Fuel Summary page will be greater than the initial ramp fuel loaded on the Init Fuel page.

If an offload is entered, the FMS-800 assumes that it is either an airdrop payload or a tanker aerial refueling offload (i.e., it will reduce the gross weight but not the usable fuel remaining at that waypoint).

(10) Alternate Flight Plan Loading To/From the Data Cartridge. The alternate flight plan may be transferred to or from one of 40 alternate flight plan files located on the data cartridge. Paragraph 3C-25.d. describes the initial preflight loading of an alternate flight plan on the Start 3 page via either entering the plan number or label, or accessing the Alternate Flight Plan Catalog page.

To save an alternate flight plan that has been created or modified on a CDU to the data cartridge, access the Alternate Flight Plan Catalog page from the Alternate Flight Plan page. The line select keys on the Alternate Flight Plan Catalog page do not operate as they do when this page is accessed from the Start 3 page. Selecting a line select key on the Alternate Flight Plan Catalog page when accessed from the Alternate Flight Plan page will access the Alternate Flight Plan Load/Save page. From this page, either load the alternate flight plan associated with the line select key pressed or enter a new label for the alternate flight plan and save it to the data cartridge. Refer to Figure 3C-70 and Table 3C-53 for the procedures/descriptions on how to use the Alternate Flight Plan Load/Save page.

When a save or load of an alternate flight plan is in progress, LOADNG ALTN or SAVING ALTN will display on the information line of the Alternate Flight Plan page, Alternate Flight Plan Catalog page, and the Alternate Flight Plan Load/Save page.

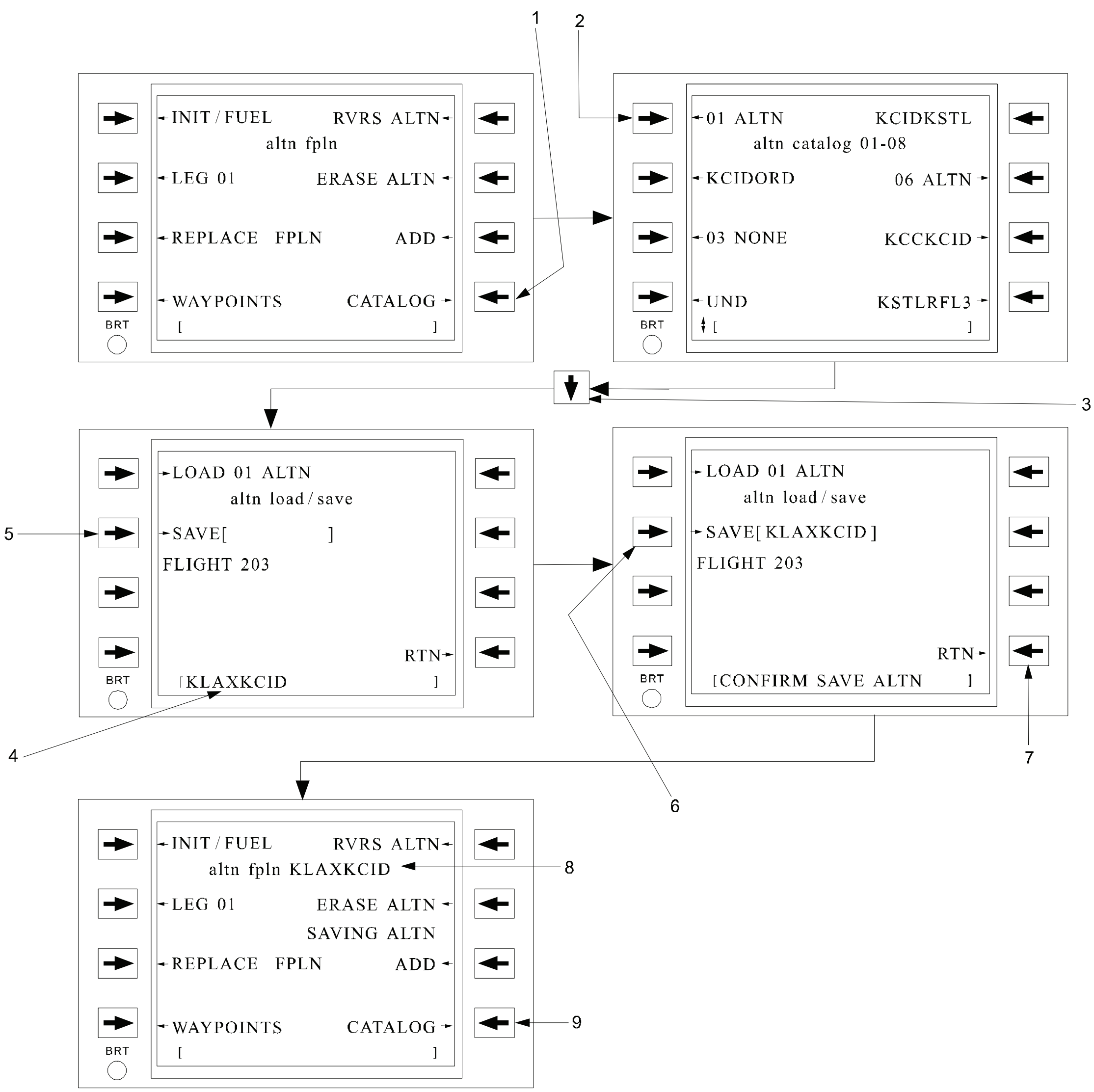


Figure 3C-70. Alternate Flight Plan Load/Save Page Access

Table 3C-53. Alternate Flight Plan Load/Save Page Access Procedure

NO.	DESCRIPTION/FUNCTION
1	Press the line select key to access Catalog page.
2	Alternate flight plan 01 has been modified in this example; to save it to the cartridge, press the **01 ALTN** line select key.
3	Vertical scrolling will access additional Catalog pages.
4	Enter the new name in the scratchpad.
5	Select **SAVE**.
6	Press the line select key to confirm the save.
7	Press the line select key to return to the Alternate Flight Plan page.
8	Indicates the current loaded alternate flight plan.
9	Indicates the save/load is in progress.

k. Holding Patterns.

(1) Holding Pattern Overview. The FMS-800 holding pattern conforms to the Federal Aviation Administration (FAA) definition of RNAV and conventional holding pattern guidance, with standard (right-hand) and non-standard (left-hand) holding patterns using approved entry flight procedures.

The FMS supports two types of holding pattern definitions.

1. User-defined holding patterns attached to fixed waypoints by the user.

2. Published holding patterns that are derived from published instrument approach charts.

A holding pattern may be associated with one fixed waypoint (the holding fix). When the aircraft crosses the holding fix, holding guidance is activated, suspending normal leg advance until the holding pattern is canceled. The parameters that define the holding pattern are inbound course, turn direction, and pattern length.

(2) Holding Pattern Entry Guidance. An advisory and steering guidance for the entry method is computed in accordance with standard FAA procedures. The geometry for a standard (clockwise) holding pattern is shown in Figure 3C-71. For left-hand turns, a mirror image of each entry procedure applies. This advisory is displayed on the Hold page. Refer to Figure 3C-71 and Table 3C-54.

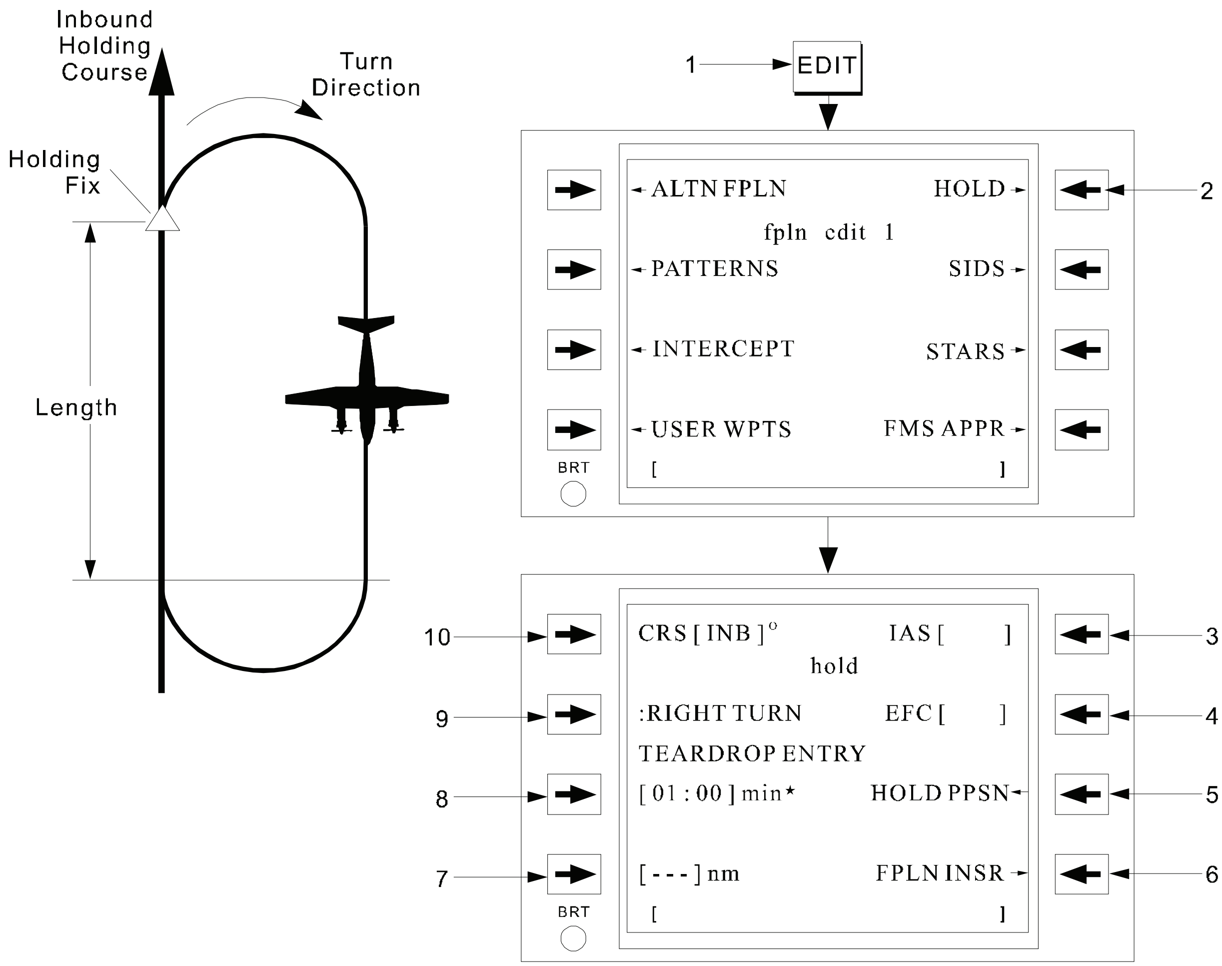


Figure 3C-71. User-Defined Holding Pattern Definition

Table 3C-54. User-Defined Holding Pattern Definition Procedure

NO.	DESCRIPTION/FUNCTION
1	Accesses the Edit page.
2	To select to the Hold page.
3	Enters the desired IAS, in knots, for the holding pattern.
4	Enters the Expect Further Clearance (EFC) time.
5	Executes the holding pattern at the present position.
6	Inserts the holding pattern into the flight plan or removes it.
7	Inserts the length of pattern's inbound leg. Defaults to 4 nm. If computed (not entered), it remains dashed until the hold pattern is active.
8	Enters the duration of the inbound leg (in minutes).
9	Selects between right and left turns in the pattern. Defaults to right turn.
10	Enters the course inbound to the holding fix (in degrees).

Prior to entering the holding pattern, the entry advisory will show the expected entry based on the inbound course to the holding fix. When the aircraft passes the holding fix, the advisory will be updated to show the actual entry in progress based upon the aircraft track at the holding fix. Refer to Figures 3C-72, 3C-73, 3C-74, and 3C-75 for possible entries into the holding pattern.

(3) Designation of the Holding Fix. After the user–defined holding pattern definition parameters have been entered, the active waypoint or a future fix waypoint may be designated as the holding fix. After pressing the **FPLN INS** line select key on the Hold page, the Flight Plan page is accessed with the message ATTACH HOLD AT? in the scratchpad. Scroll the flight plan to the desired location. Press the adjacent line select key to identify the associated waypoint as the holding fix. An **H** is displayed to the right of the designated waypoint as a reminder that it has been designated as the holding fix. Refer to Figure 3C-76 and Table 3C-55.

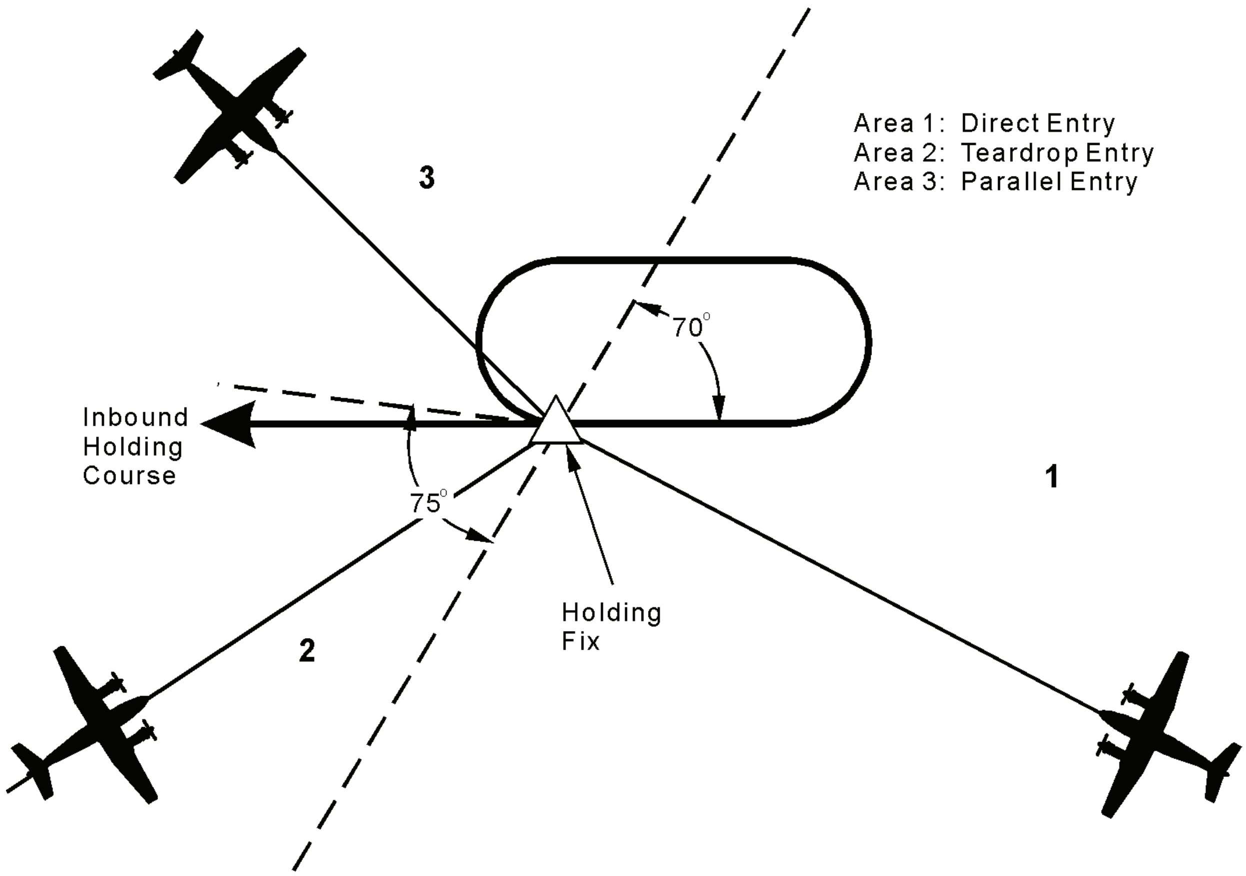


Figure 3C-72. Required Entry Methods

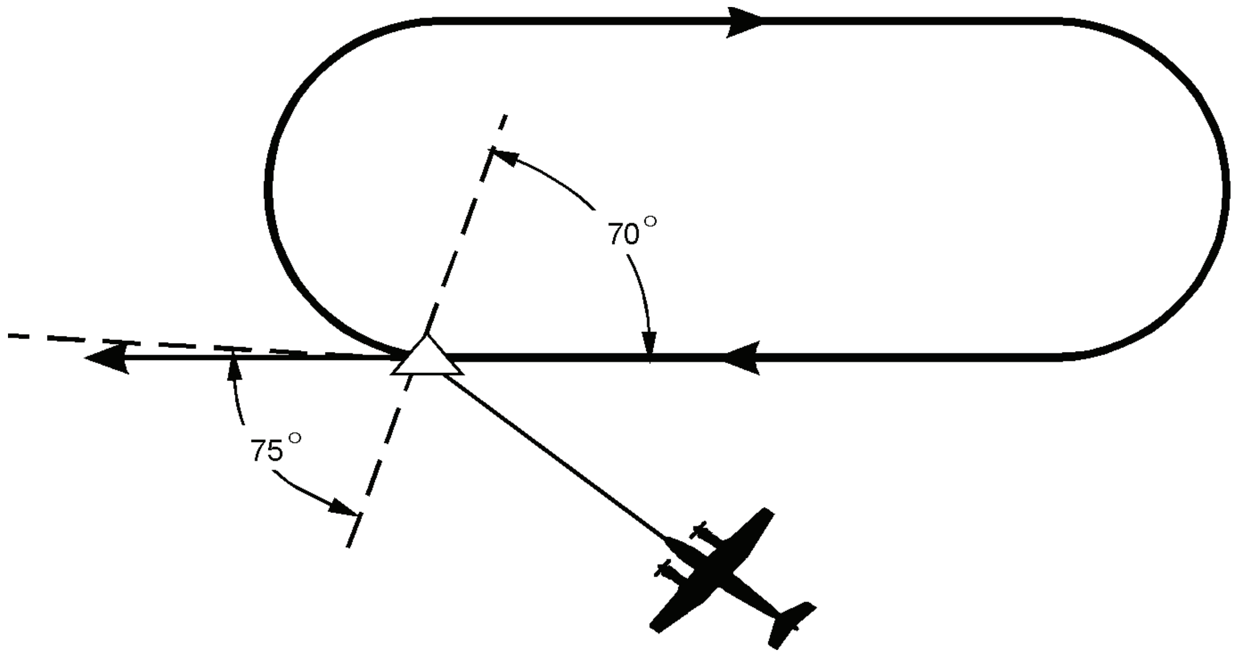


Figure 3C-73. Direct Entry Into a Holding Pattern

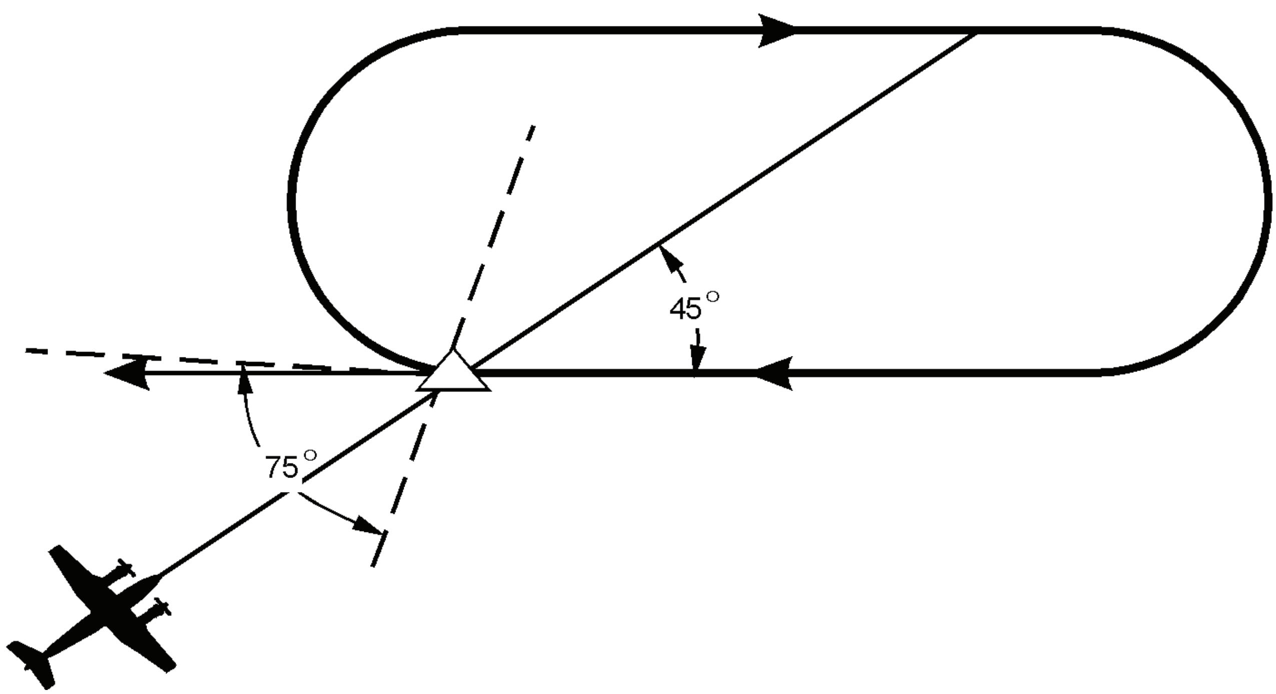


Figure 3C-74. Teardrop Entry Into a Holding Pattern

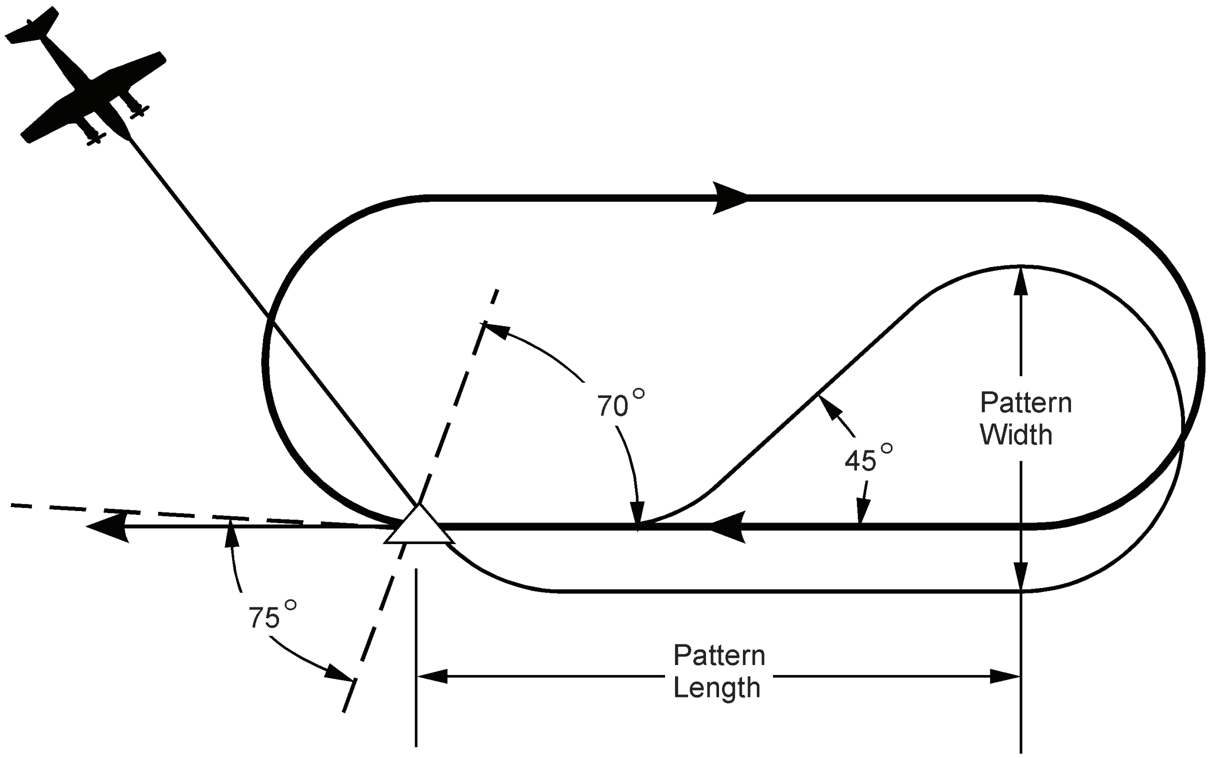


Figure 3C-75. Parallel Entry Into a Holding Pattern

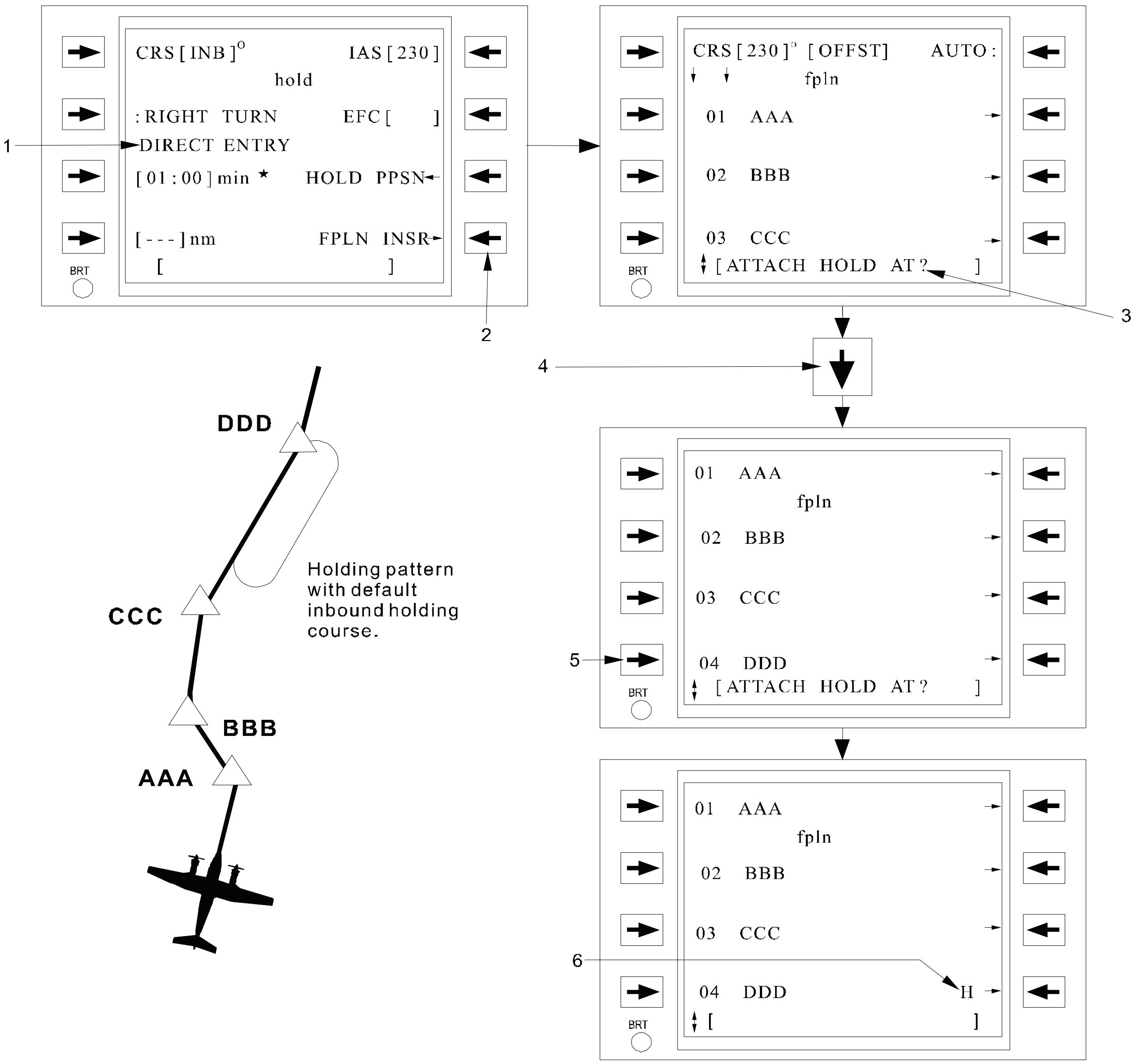


Figure 3C-76. Designation of Holding Fix

Table 3C-55. Designation of Holding Fix Procedure

NO.	DESCRIPTION/FUNCTION
1	Indicates pattern entry advisory on Hold page.
2	Press the **FPLN INSR** line select key to access Flight Plan page.
3	ATTACH HOLD AT? is in the scratchpad.
4	Scroll to the desired waypoint.
5	Pressing line select key will identify the associated waypoint as the holding fix.
6	**H** indicates which flight plan waypoint has been designated as the holding fix.

(4) Immediate Present Position Hold. If it becomes necessary to hold the present position, access the Hold page. Press the **HOLD PPSN** line select key and confirm the selection by pressing it again. Refer to Figure 3C–77 and Table 3C-56. The aircraft's present position is immediately inserted into the flight plan as the active waypoint, interrupting the current flight plan leg and activates a holding pattern at that fix with either the entered or default parameters on the Hold page. This pattern, and its holding fix, is treated the same as a preplanned hold at a flight plan waypoint. All parameters may be edited. Any user–defined holding patterns defined at future waypoints will be deleted when a present position hold is activated.

(5) Holding Course Edits. If no holding pattern inbound course has been inserted, the inbound course to the fix is used when holding guidance is activated. If an inbound course has been inserted, the inbound holding course is fixed but may be edited.

The holding course is entered by two different methods. Default to the current inbound course to the fix or enter the desired course by the crew via the scratchpad. In either method the course can be modified as needed.

To restore the inbound course to the fix waypoint as the holding course, enter a **–** and select the **CRS** line select key.

(6) Holding Pattern Length. The length of the holding pattern can be defined by either defining an inbound leg length or inbound leg duration. Before execution of the pattern, only the entered value will be displayed for the hold definition and will be identified with an *****. After the aircraft passes the holding fix, the FMS will calculate the length or duration that was not entered based upon the current groundspeed at the pattern fix. Default values for pattern length are 4.0 nm or 1 minute duration.

(7) Holding Pattern Activation and Execution. When the holding fix is passed for the first time, the holding guidance computations are activated. At this time, the following changes will take place in the flight plan operation and page displays.

(a) The automatic leg advance is suspended.

(b) Course edits on the Flight Plan page may no longer be made. Inbound holding course edits may be made on the Hold page.

(c) All displays reference the inbound course displayed on the Hold page.

(d) Holding fix cannot be edited.

To edit a user–defined holding pattern once it is in the flight plan, press the line select key on the Flight Plan Waypoint page adjacent to the **H** attribute or use the **EDIT** key and select **HOLD**.

If the inbound course is changed, the FMS–800 commands an immediate turn to the current inbound course and upon passing the holding fix, performs a holding pattern entry procedure. If the direction is changed, the action commanded is similar to a course change. The FMS–800 commands an immediate turn to the inbound leg and, upon passing the holding fix, turns onto the outbound leg in the new turn direction. If the leg length is changed, it will take effect immediately. The effect will depend on the position of the aircraft in the holding pattern at the time the length was changed. If the aircraft is outbound, the FMS–800 will command an immediate turn or maintain course depending on whether the new turning point is behind or in front of the aircraft. If the aircraft is in a turn, it will continue the turn and intercept the leg based on the old length. Upon completion of the turn, the new length will be active. The length and width of the holding pattern is recomputed, using the inbound groundspeed, each time the aircraft passes the holding fix.

When the holding guidance has been activated, all course and lateral deviation displays will reference the inbound holding course. The inbound holding course is referenced whether the aircraft is on the inbound or outbound leg of the holding pattern. The 10-second turn alert will be computed on the outbound leg to alert the crew of the upcoming turn to the inbound leg.

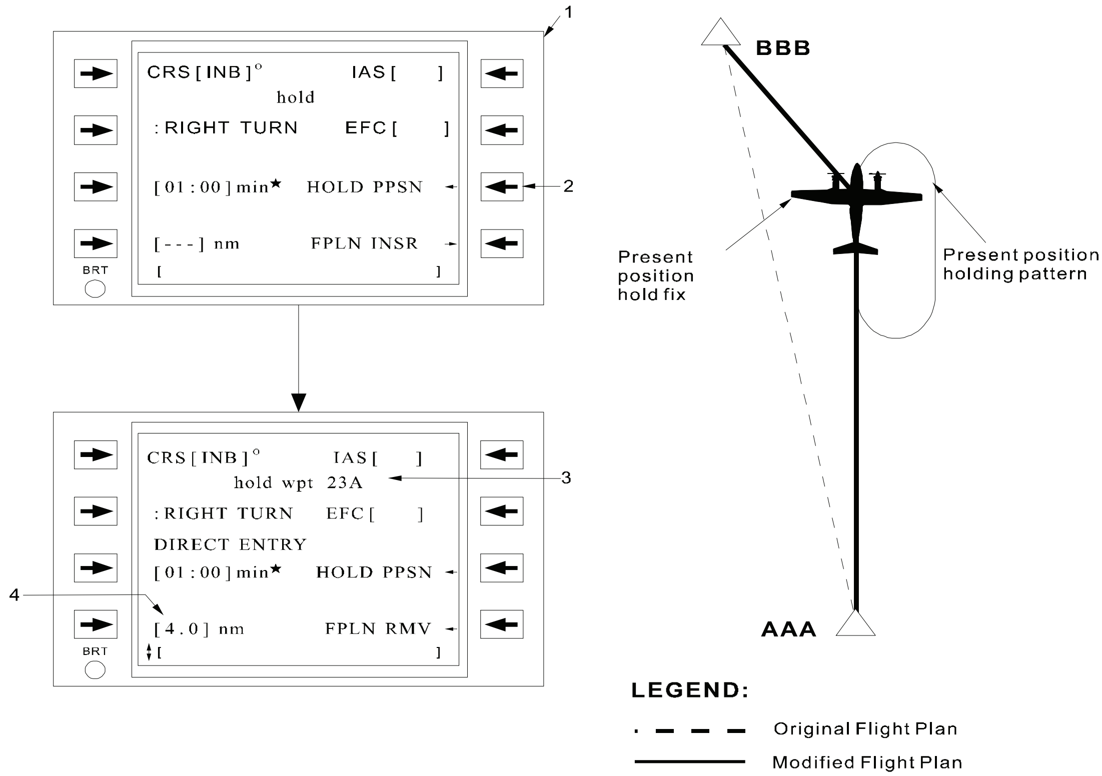


Figure 3C-77. Holding Present Position

Table 3C-56. Holding Present Position Procedure

NO.	DESCRIPTION/FUNCTION
1	Access the Hold page.
2	Press the **HOLD PPSN** line select key to perform a hold at present position and press twice to confirm selection.
3	Present position hold fix is inserted in flight plan (example: as waypoint 23A); inbound course is set to flight plan course to the fix.
4	When the hold becomes active, the computed value will appear.

(8) Holding Speed and Expected Further Clearance Time. The commanded holding speed and Expected Further Clearance (EFC) time entries and displays assist the pilot in executing a holding pattern in accordance with FAA air traffic control procedures. This also permits future waypoint ETA's to be more realistically calculated.

(a) Entry and Display of Holding Speed. Enter a desired holding speed at the IAS line select. Refer to Figure 3C-78 and Table 3C-57. When the IAS defaults to blanks, the operator must enter a desired holding speed to enable the speed alert function during the holding patterns. Three minutes prior to arrival at the holding fix, the holding speed becomes the commanded speed reference on the Lateral Steering pages for the ADI fast/slow indicator (if available) and for the speed threshold alert function. Upon exiting the holding pattern, the speed command function reverts to its normal mode.

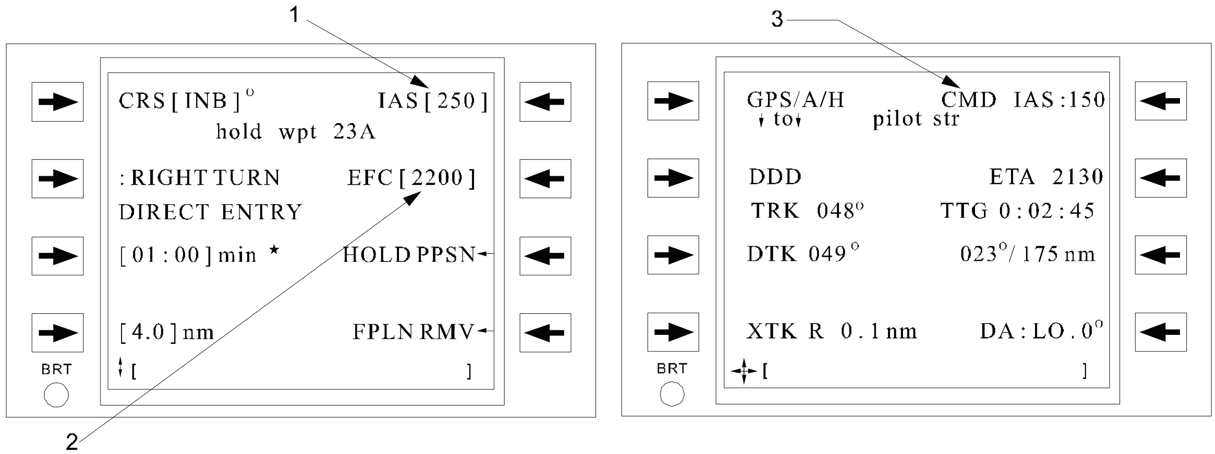


Figure 3C-78. Holding Airspeed and EFC Time Entry and Display

Table 3C-57. Holding Airspeed and EFC Time Entry and Display Procedure

NO.	DESCRIPTION/FUNCTION
1	The desired holding speed inserted.
2	EFC time inserted.
3	The CMD IAS holding speed appears on the Lateral Steering pages 3 minutes prior to arrival at holding fix.

(b) Entry and Display of Expected Further Clearance Time. The Hold page allows an optional entry of the ATC EFC or planned departure time from the holding fix. This permits more realistic future waypoint ETA. If an EFC is entered (in Coordinated Universal Time), all future waypoint ETA's are calculated from that holding fix departure reference. If no EFC is entered or it is deleted, all future ETA's are calculated as if no loiter time will be spent in the holding pattern.

(9) Exiting the Holding Pattern.

(a) Cancellation. To cancel a holding pattern, delete "**–**" the pattern attribute next to the waypoint on the Flight Plan page. A leg switch to the next flight plan waypoint will occur when the fix is crossed again, if automatic flight plan advancing is selected. The hold data is defaulted after sequencing and the hold attribute is removed from the waypoint.

(b) Direct–To Another Waypoint Other than the Holding Fix. This removes the holding pattern definition from the fix waypoint and resets the holding pattern parameters to default conditions.

(10) Published Holding Patterns. A published GPS approach in the flight plan may include several holding pattern definitions as part of the procedure. Published holding patterns are enabled on the Holding Pattern page for the holding fix waypoint. To review the holding pattern definition, select the right line select key adjacent to the IAF or Missed Approach Holding Point (MAHP) to access the Flight Plan Waypoint page for that waypoint. Then, select the right line select key for the pattern attribute to access the holding pattern definition. The IAF and MAHP holding pattern definitions are derived from published procedures.

When an approach procedure is inserted into the flight plan, the holding patterns associated with the IAF are disabled and the holding pattern associated with the MAHP is automatically enabled. To enable an IAF or FAF holding pattern, access the respective Holding Pattern page and select the **ENBL HLD** line. Refer to Figure 3C–79 and Table 3C-58. To disable a published holding pattern, enter a – on the Flight Plan page and delete the **H** attribute. Unlike the user–defined holding pattern, disabling the published holding pattern does not delete the holding pattern definition from the waypoint, but only disables execution of the pattern at the holding fix. When the attribute is deleted, the FMS will conclude the holding pattern and immediately turn inbound to the holding fix while annunciating, “Exiting Hold."

The course, turn direction, and size of the published holding pattern are defined by the procedure, but may be modified as described in previous paragraphs for user–defined holding patterns. Entry and execution of the published holding pattern is identical to what is used for the user–defined holding patterns.

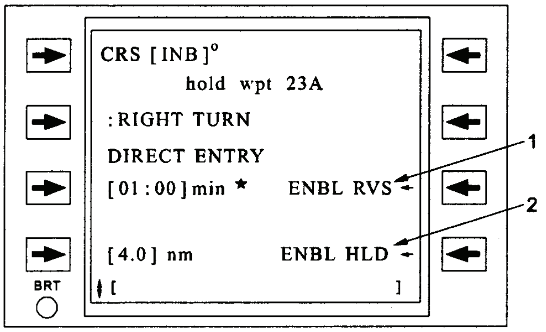


Figure 3C-79. Hold Page (Database Hold)

Table 3C-58. Hold Page (Database Hold) Procedure

NO.	DESCRIPTION/FUNCTION
1	Select to enable the Course Reversal Execution.
2	Select to enable the Holding Pattern execution.

I. SID's and STAR's.

(1) SID/STAR Overview. The FMS–800 enables the pilot to select, by name, a Standard Instrument Departure (SID) and/or a Standard Terminal Arrival Route (STAR) for insertion into the active flight plan only. When a SID or STAR is selected, the FMS–800 inserts all of the SID/STAR procedure waypoints in the correct sequence, along with any crossing altitude restrictions.

(2) SID/STAR Selection and Flight Plan Entry. To select a SID/STAR procedure for use in the active flight plan, press the **EDIT** key on the CDU and then select the **SID** or **STAR** line select to access the corresponding SID/STAR definition pages. Refer to Figure 3C–80 and Table 3C-59. To define a desired SID or STAR, enter the airport associated with the desired SID or STAR and select the **ORIG** or **DEST** line selects to access the possible procedures for the airport. Next, select the SID/STAR name and desired runway. Access the Transition Page and select a desired transition point (optional) and insert the procedure into the active flight plan. When a transition point is not selected, the FMS will insert into the flight plan only the common leg segments for the procedure.

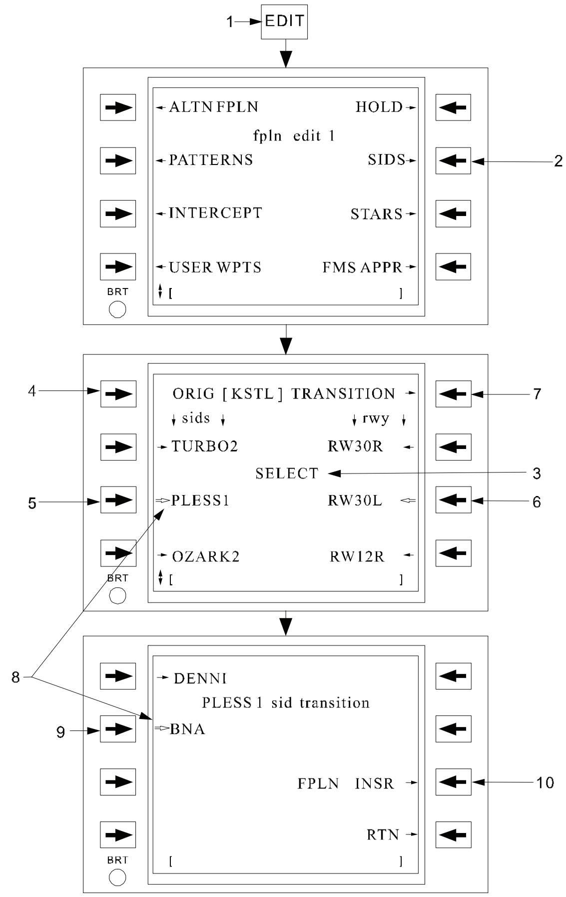


Figure 3C-80. Selecting SID/STAR

Table 3C-59. Selecting SID/STAR Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Select the SID or STAR definition.
3	Indicator shows no procedure currently in the active flight plan.
4	Enter the airport associated with the desired SID or STAR.
5	Select the desired SID or STAR.
6	Select the desired runway.
7	Press to access the Transition page.
8	Fat Arrows indicate current selection for insertion.
9	Select the desired transition point (optional).
10	Insert the procedure in the flight plan.

Two different SID/STAR's for an airport can be maintained by the FMS–800. One is inserted into the flight plan and the other is referred to as the working copy. The current SID/STAR's definition being displayed is indicated by the data on the information line of the SID/STAR page and by asterisks and larger arrows displayed adjacent to the selected SID/STAR runway and transition items. Large arrows indicate that the item has been selected for insertion into the flight plan (working copy). Asterisks indicate that the item is currently included in the active flight plan.

(3) The current definition of a SID or STAR procedure is accessed by selecting the SID **S** or STAR **R** attributes from the Flight Plan and Flight Plan Waypoint pages. Refer to Figure 3C–81 and Table 3C-60. The current definition can be removed or modified as needed.

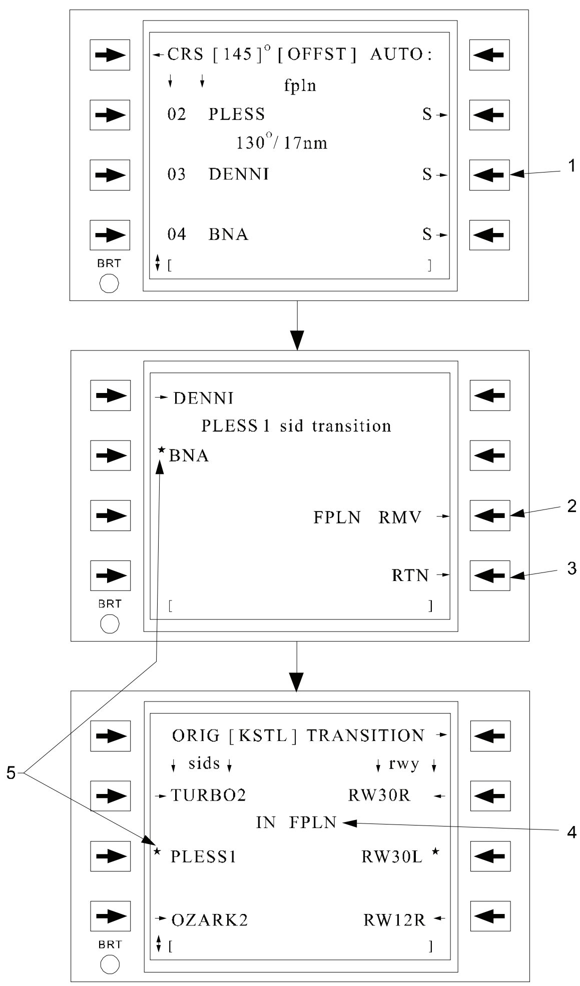


Figure 3C-81. Active Flight Plan SID/STAR Procedure

Table 3C-60. Active Flight Plan SID/STAR Procedure

NO.	DESCRIPTION/FUNCTION
1	Select the SID or STAR attribute on the Flight Plan page and Flight Plan Waypoint page to access the current procedure definition.
2	Select to remove the SID/STAR procedure from the active flight plan.
3	To Return to Flight Plan page.
4	Indicator shows that this definition is currently in the flight plan.
5	Asterisks indicate current definition in the active flight plan.

(4) When modified, the modified procedure becomes the working copy definition for the SID/STAR. Modification of the SID/STAR definition on the SID/STAR pages does not affect the active flight plan procedure until the operator chooses to modify the flight plan with the new procedure. The working copy definition of a SID or STAR is accessed from the EDIT menu. Refer to Figure 3C-82 and Table 3C-61. When the working copy is defined, it can be used to modify the active flight plan procedure with the new definition.

If a SID is in the flight plan, the information line of the SID page displays IN FPLN and asterisks are shown next to the selected SID items. The working copy is displayed if the information line displays either SELECT or MODIFY and there are large arrows displayed next to the selected SID items. If SELECT is displayed, no SID is in the flight plan and if MODIFY is displayed, a SID is inserted in the flight plan but can be replaced with the new working definition.

The selection, removal, and flight plan operation of STAR's is identical to that of SID's. The exception is that the STAR's are accessed using the STAR line key on FPLN EDIT 1 page and are displayed for the entered destination airport rather that the origin airport. The destination airport for a STAR and approach definitions are shared in the respective working copy definitions until either definition is entered into the active flight plan. SID's, STAR's, and approaches entered into the active flight plan may be selected for different airports. For example, a STAR may be flown for one destination airport and an FMS approach may be executed for another airport nearby. The STAR waypoints are indicated by an **R** attribute on the Flight Plan page instead of an **S** for a SID waypoint. As SID or STAR waypoints are passed into history, they lose their S or R attribute and become ordinary waypoints. To re–execute a SID/STAR procedure once it passes into history, the entire procedure must be replaced into the flight plan.

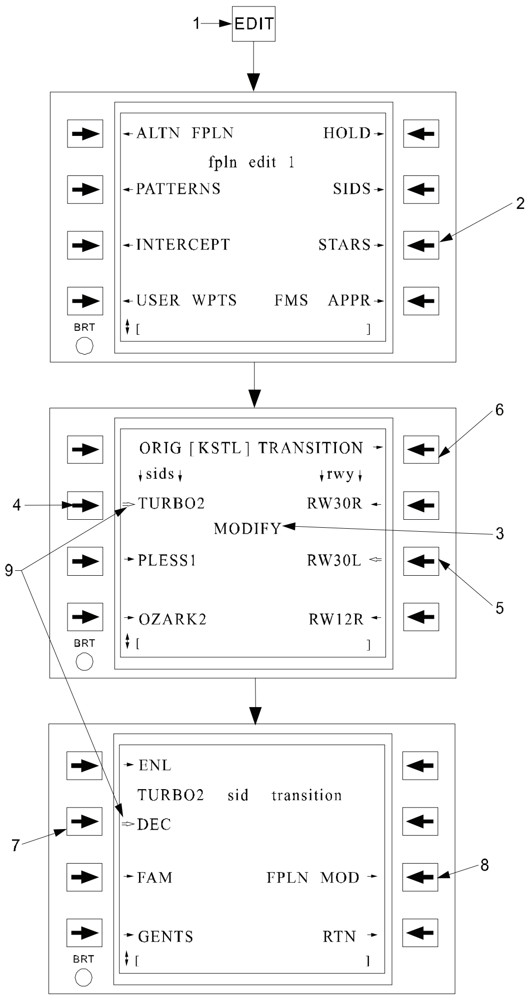


Figure 3C-82. Working Copy SID/STAR Procedure

Table 3C-61. Working Copy SID/STAR Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Select the Sid or STAR definition.
3	Indicator shows the definition is currently not in the flight plan, but the active flight plan SID/STAR procedure can be modified.
4	Select the desired SID or STAR.
5	Select the desired runway.
6	Press to access the Transition page.
7	Select the desired transition point (optional).
8	Select to modify the flight plan with the selected SID/STAR procedure. This selection will replace the current procedure in the active flight plan.
9	Fat arrows indicate current selection for insertion.

Table 3C-61. Working Copy SID/STAR Procedure (Continued)

(5) Flight Plan Discontinuities. A discontinuity in the flight plan may occur when using SID/STAR's. A discontinuity is associated with a waypoint and requires crew action to resolve in order to obtain proper flight plan sequencing. The waypoint associated with the discontinuity can be either the one preceding, following, or both. A discontinuity is inserted into the flight plan under the following three conditions.

1. Following a STAR or preceding a SID when it is inserted in the flight plan (DISCONTINUITY).

2. When a leg of a SID/STAR has a non–flyable leg (LEG DISCON).

3. When a flyable leg of a SID/STAR has a turn direction associated with it (LEG DISCON).

Refer to Figure 3C–83 and Table 3C-62 for an example of the Flight Plan page with a discontinuity. The **VERIFY PROC** annunciation and CDU MSG alert are displayed when there is 1 minute to go before sequencing into the discontinuity. If the discontinuity becomes the active waypoint, a **DISCONTINUITY** annunciation is displayed. The discontinuity is resolved by the following methods.

1. Delete the discontinuity.

2. Delete the waypoint the discontinuity is associated with.

3. Insert a waypoint between the discontinuity and the waypoint it is associated with.

4. Remove the SID/STAR from the flight plan (except if the discontinuity is the active waypoint).

5. Perform a direct–to while in the discontinuity.

When the discontinuity becomes active, guidance displays will be invalidated and the FMS will continue a wings–level flight until the pilot takes action to resolve the discontinuity.

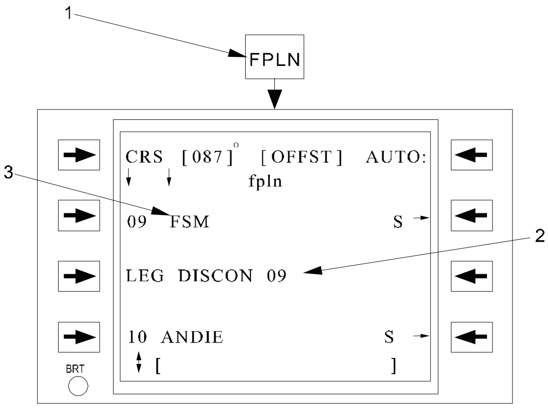


Figure 3C-83. Discontinuity in the Flight Plan

Table 3C-62. Discontinuity in the Flight Plan Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing **FPLN** function key for Flight Plan page.
2	The waypoint associated with the discontinuity.
3	The active waypoint.

m. FMS Approaches.

(1) FMS Approach Overview. The FMS approach function employs GPS navigation to fly the following types of approaches.

1. FAA published RNAV approaches.

2. FAA published RNAV, VOR, VOR/DME, VORTAC, and NDB approaches with GPS overlay approved procedures (GPS or INU/GPS only).

3. FAA published GPS approaches (GPS or INU/GPS only).

4. Military approved approach procedures for air bases in lieu of ILS or other approach guidance.

5. Visual runway approaches at night or in reduced visibility.

6. Military tactical approaches to forward air bases where the approach key points have been surveyed or marked using precise GPS.

(2) Selection of an FMS Approach. FMS approaches may be flown using the active flight plan guidance. They may not be inserted into an alternate flight plan.

(3) To select an FMS approach for use in the active flight plan, press the **EDIT** function key on the CDU and then select **FMS APPR** line key to access the FMS APPR selection page. Refer to Figure 3C-84 and Table 3C-63. The three types of FMS approaches that may be selected are GPS, Visual, or Tactical. To select either a published GPS or runway visual approach, enter the Destination (DEST) airport identifier at the top of the page (also entered on the working copy STAR definition). This calls up a listing of available GPS approaches and runways for that airport. To select a user defined tactical approach, no airport identifier is required, select the **TACTICAL** line key.

Two different FMS approaches can be selected and maintained by the FMS–800. One is inserted into the active flight plan and the other is referred to as the working copy. The current approach definition being displayed is indicated by the data on the information line of the FMS Approach page and by asterisks and larger arrows displayed adjacent to the selected approach. Large arrows indicate that the item has been selected for insertion (working copy). Asterisks indicate that the item is currently included in the active flight plan.

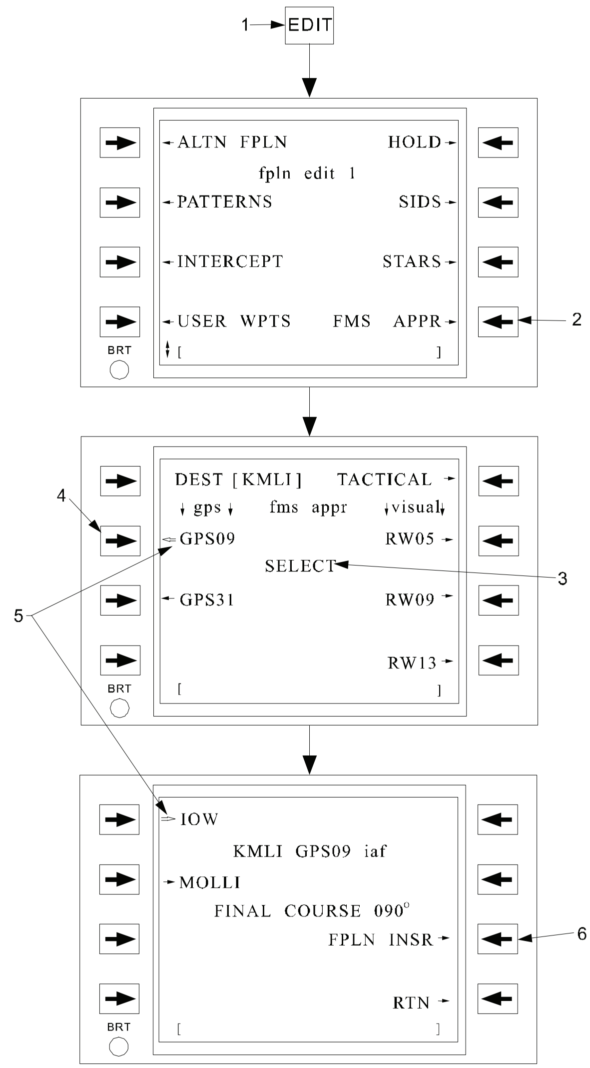


Figure 3C-84. Defining An Approach

Table 3C-63. Defining An Approach Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Press the line select key to access the FMS approach page.
3	Indicator shows NO definition is currently in the active flight plan.
4	Press the line select key to access GPS approach page.
5	Fat arrows indicate current selection for insertion.
6	To insert the approach into the flight plan press line select key.

(4) Selecting the approach MAP attribute from the Flight Plan and Flight Plan Waypoint pages, Figure 3C–85 and Table 3C-64, accesses the current definition of an approach procedure. The current definition can be removed or modified as needed. When modifying, the modified procedure becomes the working copy definition for the approach. Modification of the approach definition on the Approach pages do not affect the active flight plan approach until the operator chooses to modify the flight plan with a new procedure. The working copy definition of an approach is accessed from the Edit menu, Figure 3C-86 and Table 3C-65. When the working copy is defined, it can be used to modify the active flight plan approach procedure, replacing the existing procedure with the new definition.

Using the FMS approach function requires the system to insert a sequence of waypoints into the flight plan. All approaches will have a FAF or Runway Extension Point, and a MAP. GPS approaches may also have a MAHP and an IAF. These points are treated by the system as any other waypoint. The MSL altitudes may be entered for each point, with the exception of the MAP and visual approach's runway extension point. The altitudes and descent angles for a MAP are fixed definitions.

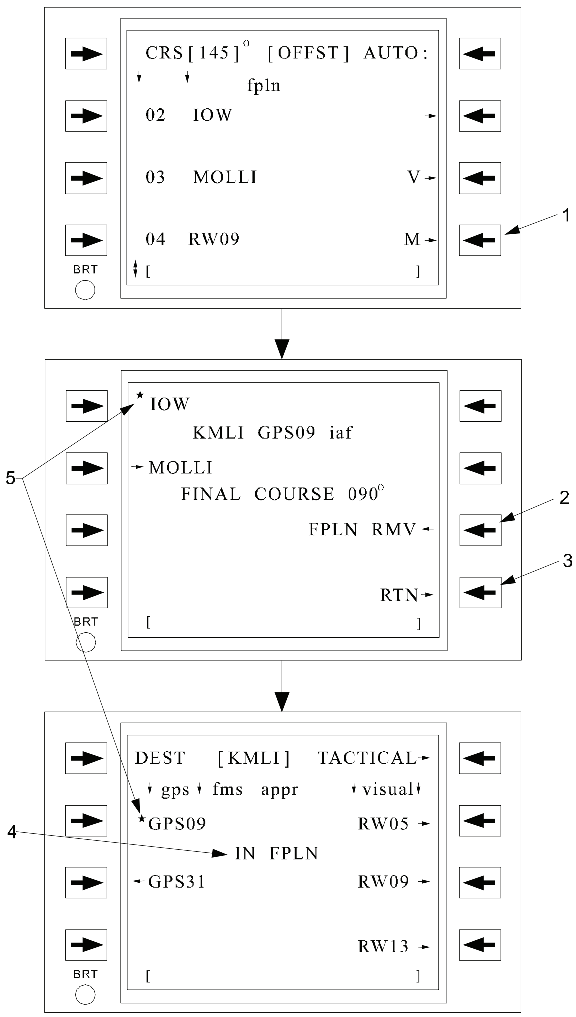


Figure 3C-85. Active Flight Plan Approach Definition

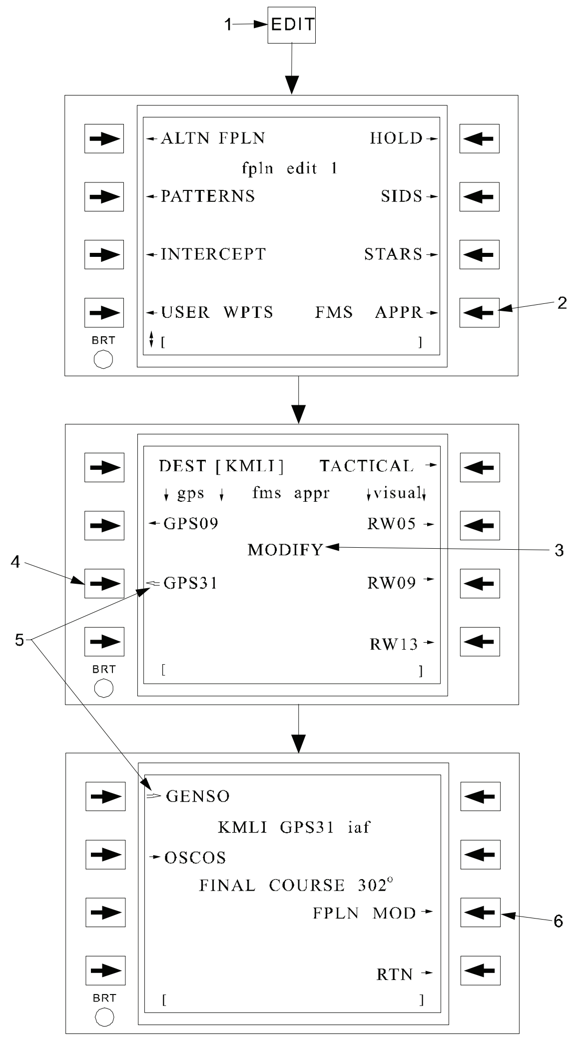


Figure 3C-86. Working Copy Approach Definition

Table 3C-64. Active Flight Plan Approach Definition Procedure

NO.	DESCRIPTION/FUNCTION
1	Select MAP attribute on the Flight Plan page and Flight Plan Waypoint page to access the current approach definition.
2	Press the line select key to remove the approach from the active flight plan.
3	Select line key to return to FMS approach page.
4	Indicator shows this definition is currently in the flight plan.
5	* indicates that the current definition is in the flight plan.

Table 3C-65. Working Copy Approach Definition Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Press the line select key to access the FMS approach page.
3	Indicator shows this definition is currently not in the flight plan, but is available to modify the active flight plan approach procedure.
4	To select GPS approach page.
5	Fat arrows indicate current selection for insertion.
6	Select line key to modify the flight plan with the selected approach procedure. This selection will replace the current procedure in the active flight plan.

(5) Refer to Figure 3C-87 for definition and execution of a typical FMS approach as described in the following paragraphs

(6) GPS Approaches. After entering the destination airport identifier, select a published GPS approach to access the IAF page. Refer to Figure 3C-88 and Table 3C-66. Select the desired IAF and press the **FPLN INSR** line key to call up the Flight Plan page. The INSRT G–APR BEFORE? scratchpad message will appear. Select the point at which the approach is to be inserted in the flight plan.

After the approach is inserted, the Flight Plan page will show the published IAF, intermediate points, the FAF, and the MAP. The missed approach procedure points and MAHP will also be shown. The MAP of a GPS approach is either at the runway threshold of the approach, or a MAP for a circling approach. Consult published procedures to determine correct operation for GPS approach into the MAP. If the missed approach point is not at the runway threshold (as in a circling approach), then the MAP altitude will be the Minimum Descent Altitude (MDA) published for that approach. For MDA approach altitudes, the descent angle into the MAP will be blanked on the Flight Plan Waypoint page for the MAP, and FMS vertical guidance will be disabled for the final approach into the MAP. The V attribute for vertical guidance definition will not be displayed on the Flight Plan page for MDA approaches. For MDA approach altitudes, select the MDA altitude on the autopilot altitude preselector to initiate guidance to the MDA approach. MAP's that do not terminate at the runway threshold are assigned identifiers other than the RWXX identifier.

There are no user–defined entries other than the airport identification, GPS runway selection, and the initial approach fix selection. On the IAF Select page, the approach can be inserted without selecting an IAF. The FMS will use the IAF at the top of the page as the default. Published GPS approaches that have been defined without identifiable IAF's have been filtered out of the FMS operation. The FMS does not recognize a GPS approach without an IAF.

The FMS supports three types of GPS approach procedures.

1. GPS approaches with basic T configuration and point–to–point guidance.

2. GPS overlay approach with DME arc.

3. GPS overlay approach with course reversals/procedure turns.

Each approach is described in greater detail under GPS approach execution.

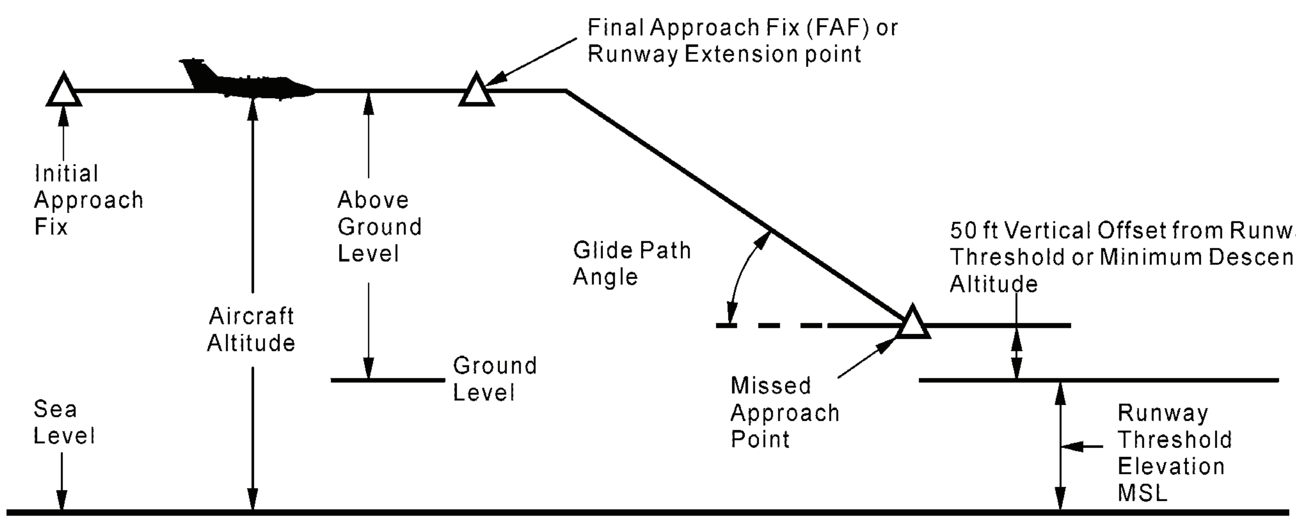


Figure 3C-87. Approach Execution

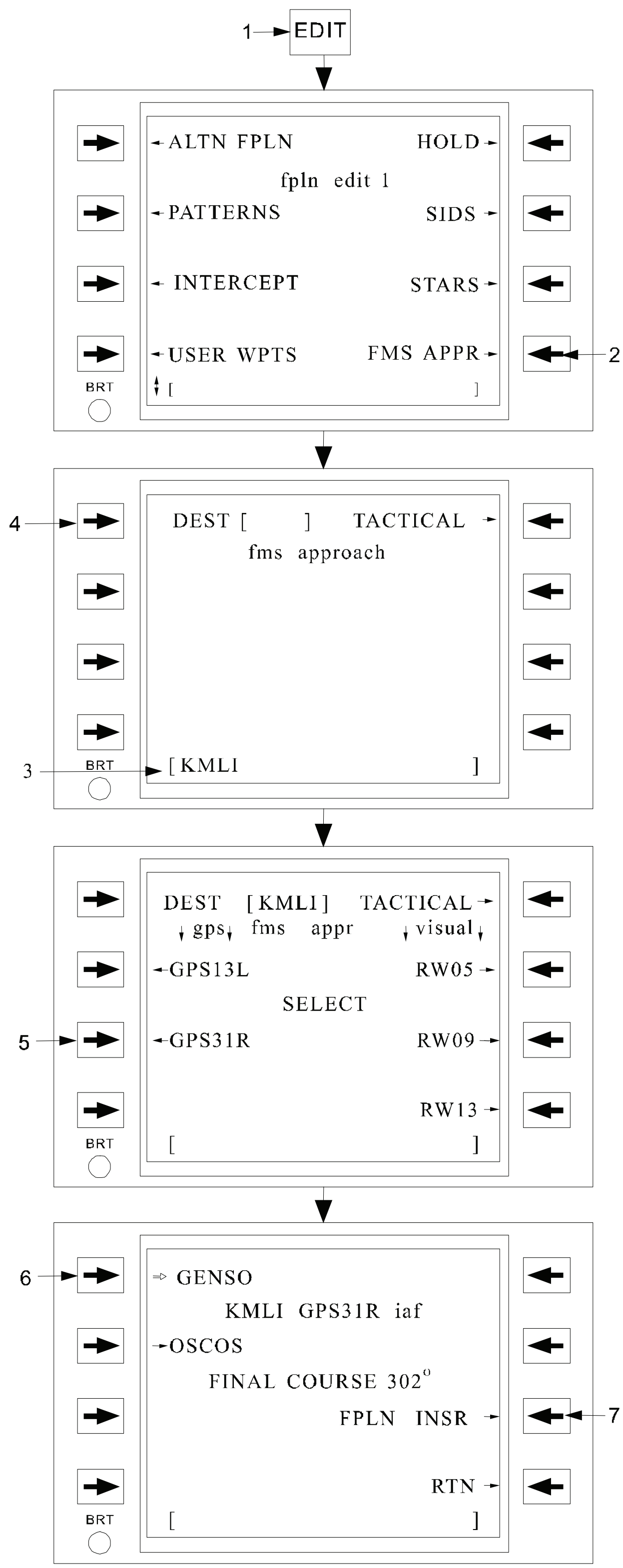


Figure 3C-88. Published GPS Approach Access

Table 3C-66. Published GPS Approach Access Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Press **FMS APPR** line select key for access to the FMS approach page
3	Enter the airport identifier into the scratchpad.
4	Insert destination airport identifier.
5	Select the desired GPS approach.
6	Select the Initial Approach Fix.
7	Insert the approach into the active flight plan.

(7) Visual Approaches. Selecting a runway on the right side of the FMS Approach page calls up the Visual Runway Approach page. Refer to Figure 3C-89 and Table 3C-67. The default visual approach parameters, which can be modified, are a 5.0 nm final segment and a 3.0° glideslope, with a crossing altitude for the runway extension point of 1500 feet AGL. Press the **FPLN INSR** line key to insert the approach into the active flight plan at the desired location in the same manner as for the published GPS approach. The Flight Plan page will be displayed and the message, INSRT V–APR BEFORE?, will appear in the scratchpad. Press the line select key next to the desired waypoint to insert the approach at that point. This action inserts a computed runway extension point (RXTND) and the selected runway threshold (RWY09) into the flight plan in sequence at the desired point.

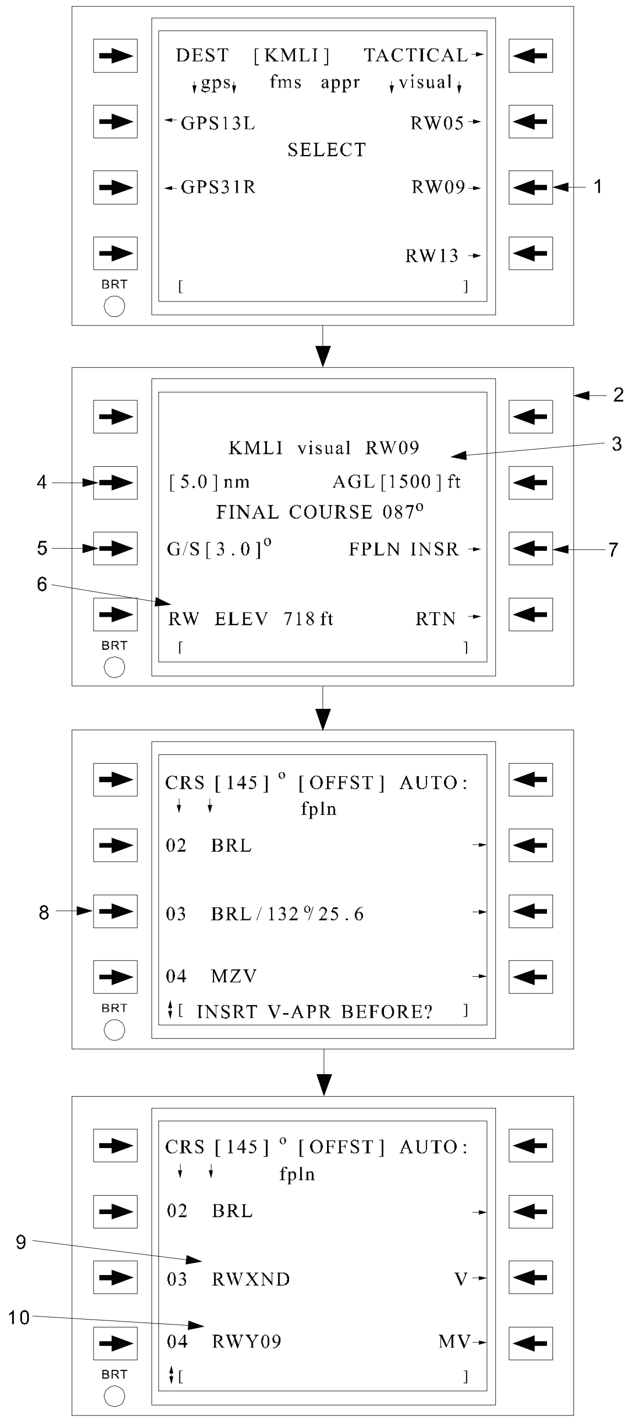


Figure 3C-89. Visual Approach Selection

Table 3C-67. Visual Approach Selection Procedure

NO.	DESCRIPTION/FUNCTION
1	Select visual approach data for desired runway.
2	Define the desired visual approach.

Table 3C-67. Visual Approach Selection Procedure (Continued)

NO.	DESCRIPTION/FUNCTION
3	Enter the distance above the runway elevation for the runway extension point.
4	Enter runway extension point distance from runway.
5	Enter desired glideslope to runway.
6	Indicates elevation of runway from database.
7	Insert the approach into the flight plan.
8	Press the line select key to insert the approach.
9	Runway extension point (FAF equivalent).
10	Missed Approach Point or Runway Threshold.

(8) Tactical Approaches. Pressing the **TACTICAL** line select key will access the Tactical Approach page as shown in Figure 3C–90 and Table 3C-68. If required, modify the default tactical approach parameters and press the **FPLN INSR** line select key to insert the approach into the active flight plan.

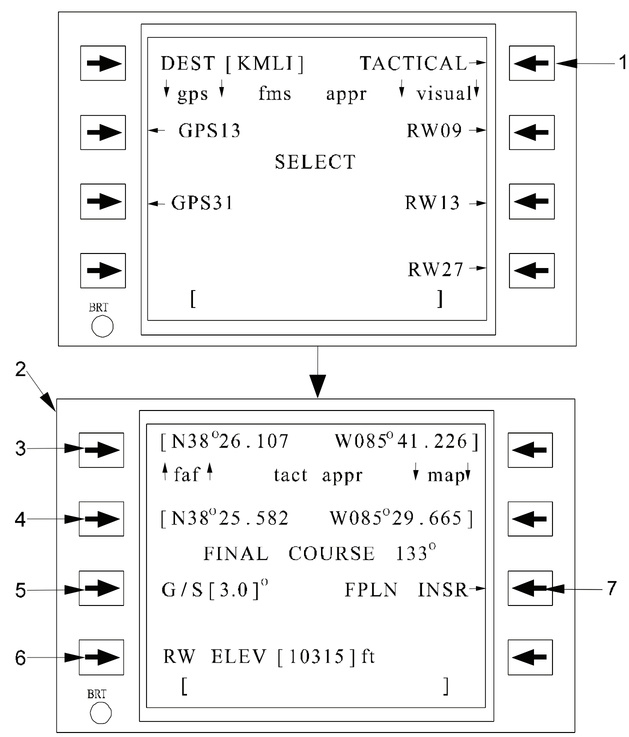


Figure 3C-90. Tactical Approach Selection

Table 3C-68. Tactical Approach Selection Procedure

NO.	DESCRIPTION/FUNCTION
1	Select the tactical approach page.
2	Define the approach as desired.
3	Enter a FAF.
4	Enter a MAP.
5	Enter the desired glideslope into the MAP.
6	Enter the Runway Elevation mean sea level for the MAP.
7	Insert the approach into the flight plan.

(a) To change the FAF displayed on line 1, type in a valid waypoint in the scratchpad and press line select key 1 or 5. To copy the waypoint displayed on line 1 into the scratchpad, press line select key 1 or 5 when the scratchpad is blank. To delete the waypoint indicated on line 1, enter a **–** in the scratchpad and press line select key 1 or 5.

(b) To change the MAP, type a valid waypoint in the scratchpad and press line select key 2 or 6. To copy the MAP into the scratchpad, press line select key 2 or 6 when the scratchpad is blank. To delete the MAP, enter an ***** in the scratchpad and press line select key 2 or 6.

(c) The default value defining the glideslope is 3.0° and is automatically displayed at line select key 3 when the Tactical Approach page is displayed. To change this value, enter the desired value (0 to 6.0°) into the scratchpad and press the line select key 3. To change the runway elevation, type a valid elevation in the scratchpad and press the line select key 2 or 6.

(d) To insert the tactical approach into the flight plan, select the **FPLN INSR** line select key. The Flight Plan page will be displayed and the message, INSRT V–APR BEFORE?, will appear in the scratchpad. Press the line select key next to the desired waypoint to insert the approach at that point.

(e) If one or more of the FAF, MAP, or runway elevation parameters are missing, an attempt to insert the approach will result as an ENTER PARAMETERS message in the scratchpad.

(9) Deleting or Changing the FMS Approach. Once an FMS Approach of any type is in the flight plan, it may be deleted or replaced with a different approach. Access the FMS Approach pages via the **EDIT** key to access a working copy definition of the approach or press the **A** or **F** attribute line select on the Flight Plan Waypoint page for the MAP or FAF waypoint to access the current flight plan definition.

Select the desired approach in the working copy approach definition and select **FPLN MOD**. When the working copy replaces the existing approach, the existing approach is discarded. To remove the current approach procedure from the flight plan, access the current approach definition and select **FPLN RMV**.

(10) Approach Guidance and Leg Advance (Tactical/Visual Approach). Once an approach is defined, the sequencing from EN ROUTE to APPROACH guidance is automatic. When the aircraft is within 30 nm of the FAF or runway extension point, the HSI lateral deviation display scaling switches to TERMINAL mode and a CDU annunciation, √BAROSET, reminds the pilot to enter the reported local barometric pressure setting for the airport of landing. For a tactical or visual approach, the HSI lateral deviation display scaling switches to APPROACH mode and the flight plan switches from automatic (AUTO) to manual (MAN) sequence mode upon arriving at the FAF or runway extension point. Refer to Figure 3C-91.

(11) Published GPS Approach Guidance and Leg Advance. If the approach is a published GPS approach, the approach sequence is somewhat different from the tactical or visual approach, as shown in Figure 3C–92.

In a GPS approach, the APPROACH annunciation on the CDU flashes when the distance is 2 miles from the FAF, to alert the pilot of the transition to approach. The APPROACH annunciation is then displayed steadily during the approach. At 2 miles from the FAF, the HSI deviation scaling transitions linearly from 1.0 nm full scale (TERMINAL) to 0.3 nm full scale (APPROACH) at the FAF and the GPS approach integrity performance is activated.

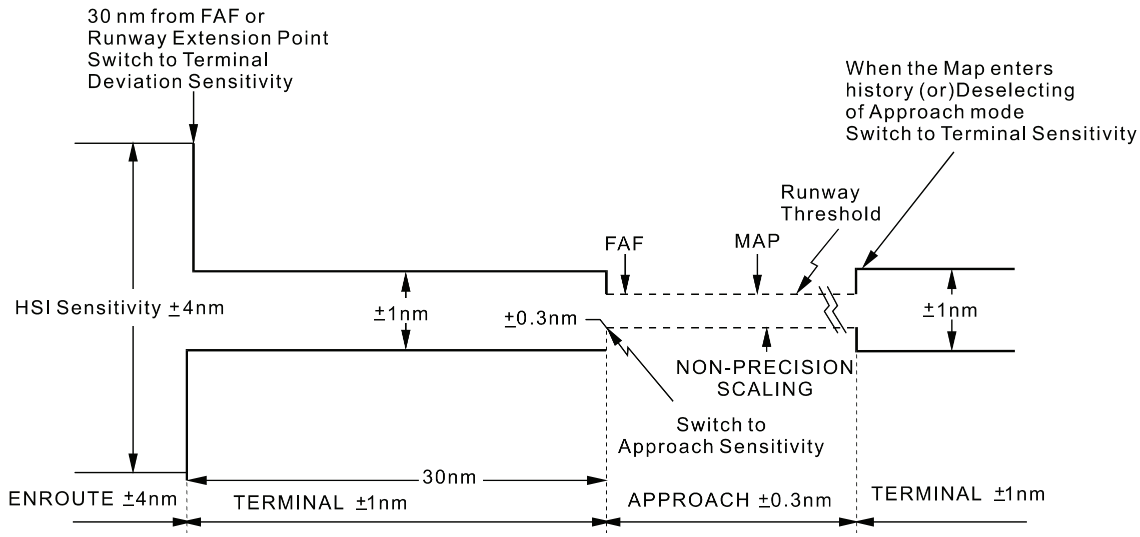


Figure 3C-91. Visual/Tactical Approach and Sequence

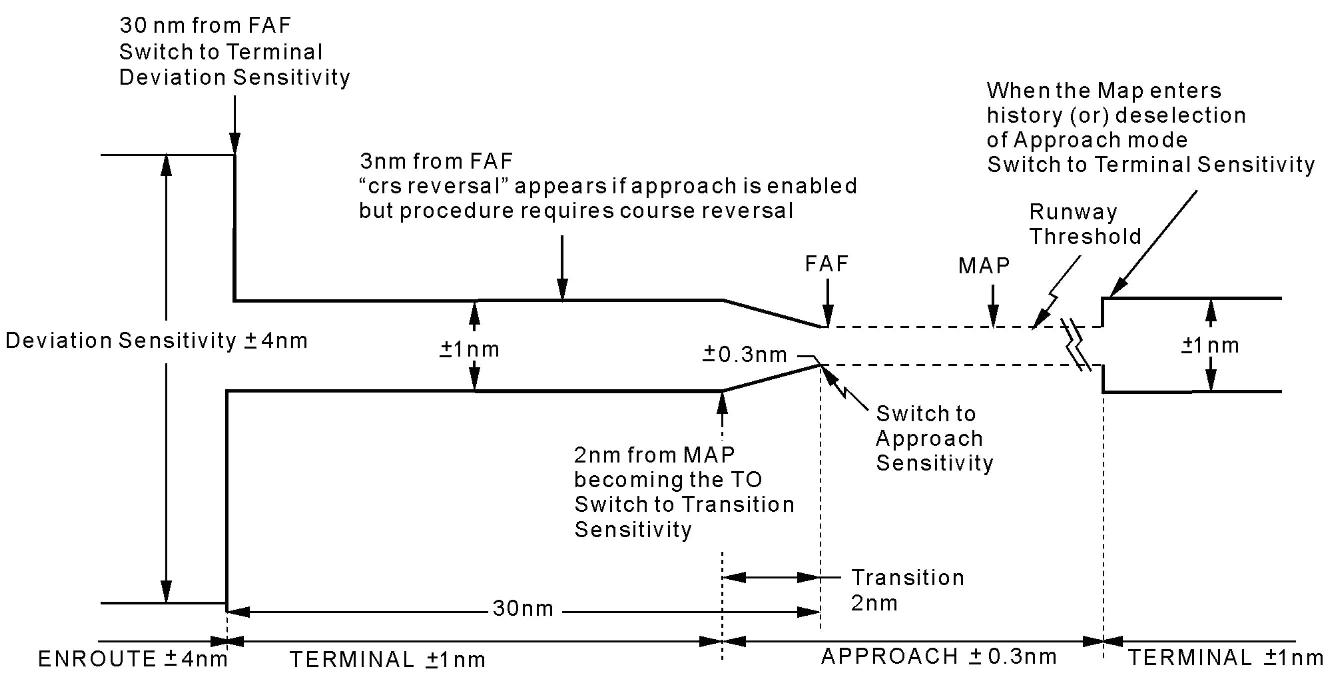


Figure 3C-92. Published GPS Approach Scaling and Sequencing

To sequence past the FAF into the GPS approach, the aircraft track must be within 90° of the final approach course and current leg course, and within 2 nm of the FAF waypoint. If not, the FMS will inhibit sequencing past the FAF waypoint and continue guidance for the inbound course to the FAF until the aircraft is maneuvered into the final approach configuration.

Once the aircraft sequences past the FAF waypoint, the sequencing mode of the FMS will switch to manual sequencing (MAN). Sequencing beyond the MAP is inhibited until the MAP is passed or a direct–to is executed to a missed approach waypoint.

(a) DME Arc Guidance. If a published GPS overlay approach contains a DME arc leg, it is indicated by a **D** attribute on the right side of the Flight Plan page for the waypoint at the termination of the DME arc leg. The HSI and flight director/autopilot guidance will follow the arc and the distance display on the HSI, while on that leg will be the direct distance from the arc to the waypoint. The flight plan leg switching is normal. Refer to Figure 3C–93.

A Direct–To the endpoint of a DME arc, when it is not the active waypoint, will cause the FMS to intercept the arc along the DME arc leg. To intercept a Direct–To course directly to the DME arc endpoint waypoint without intercepting the arc, select Direct–To the DME arc endpoint again which will override the DME arc leg intercept.

(b) Course Reversal Guidance. On selected GPS approaches, a published procedure turn may be defined for execution in the approach procedure. The FMS performs a course reversal procedure with standard holding pattern entry logic to execute the procedure turn. When the approach is inserted into the flight plan, the course reversal will be automatically enabled for execution. A **C** attribute will be identified next to the GPS approach IAF waypoint when the course reversal is enabled.

Execution of the course reversal will follow standard holding pattern entry logic. The definition of the course reversal procedure uses the holding pattern definition for the IAF waypoint. To review the course reversal definition, press the line select key adjacent to the **C** attribute on the Flight Plan and Flight Plan Waypoint pages to access the Holding Pattern page for the IAF waypoint.

The operator can modify the course reversal size, duration, and length, when in the Holding Pattern page, but the course reversal course and turn direction cannot be changed. Changes to the course or turn direction will automatically disable the course reversal procedure. When the course reversal is re-enabled, the published course and turn direction will be restored to the published definition.

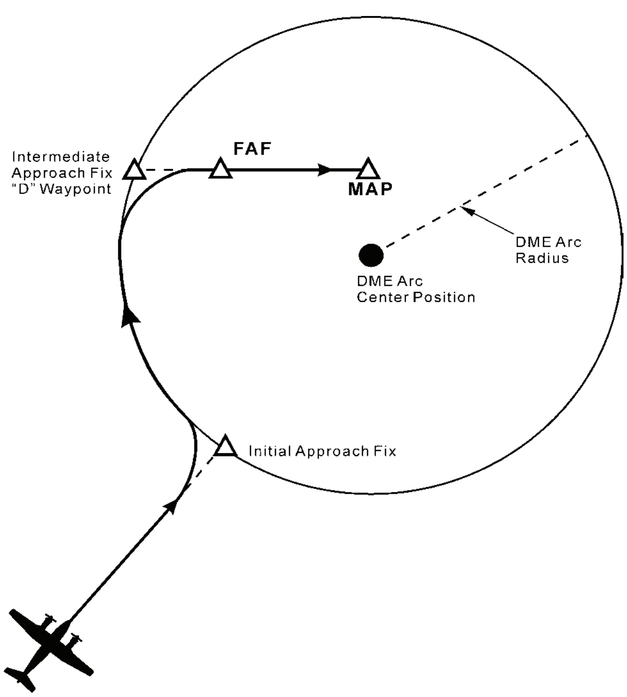


Figure 3C-93. DME Arc Flight Path

Course reversal and holding pattern procedures at the IAF waypoint are mutually exclusive. Only one procedure can be enabled on the Holding Pattern page. To enable the course reversal, select the **ENBL RVS** line select on the IAF Holding Pattern page. This will also automatically disable the hold. When the hold is enabled while the course reversal is enabled, the course reversal will automatically be disabled.

If the pilot elects, or ATC provides, direct clearance for a NO PT approach, either delete the **C** attribute at the IAF, delete the IAF, or perform a direct-to the FAF to avoid course reversal execution, as instructed by ATC. This action does not necessarily result in a straight in approach as when given radar vectors for final approach. To disable the course reversal, enter a **–** on the Flight Plan page and delete the **C** attribute at the IAF. If the course reversal is currently active, the aircraft will immediately turn inbound, as in holding pattern termination, and conclude the course reversal. Additionally, a direct-to any waypoint while the course reversal is active will terminate course reversal guidance.

There are three types of course reversals typically defined within a GPS approach procedure. Refer to Figures 3C-94, 3C-95, and 3C-96.

1. IAF course reversal.

2. Collocated IAF/FAF course reversal.

3. Extended FAF course reversal.

In the co-located IAF/FAF and extended FAF type course reversals, the course reversal execution is actually performed at the FAF waypoint, even though definition is provided with the IAF waypoint. In these two cases, the FAF holding pattern and IAF course reversal execution are mutually exclusive. If a holding pattern is enabled at the FAF, the course reversal will be disabled. Additionally, when the IAF holding pattern is disabled and an extended FAF course reversal is defined at the IAF, the course reversal to be executed into the FAF will automatically be re-enabled. This will ensure proper execution of the procedure turn at the FAF. However, if a holding pattern has been attached to the FAF and the **H** attribute is subsequently deleted to disable the FAF hold prior to the hold execution, the course reversal procedure at the FAF is NOT automatically re-enabled. The operator must access the course reversal definition at the IAF and re-enable the course reversal to execute the reversal at the FAF.

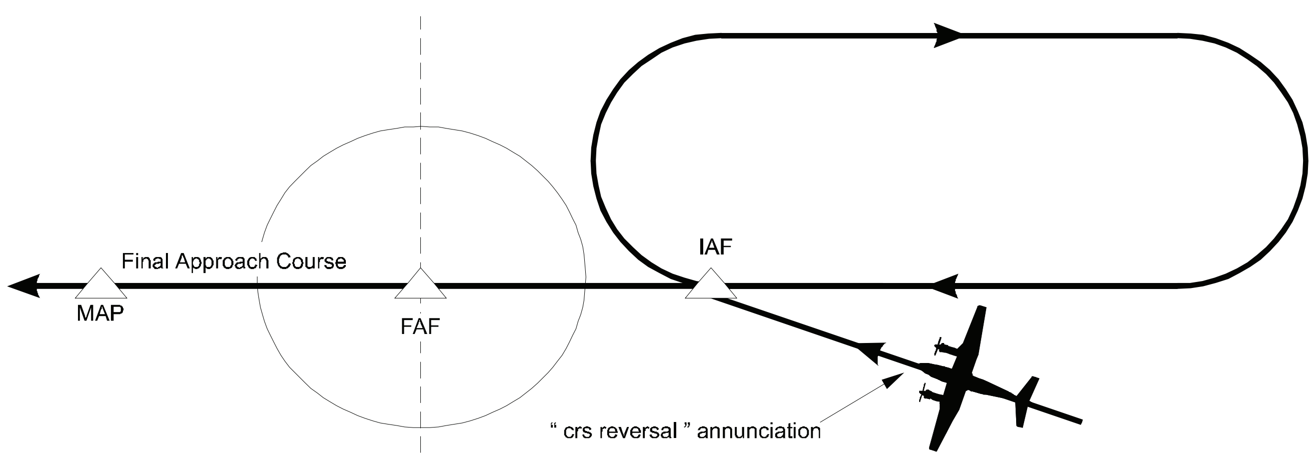


Figure 3C-94. Case I: IAF Course Reversal

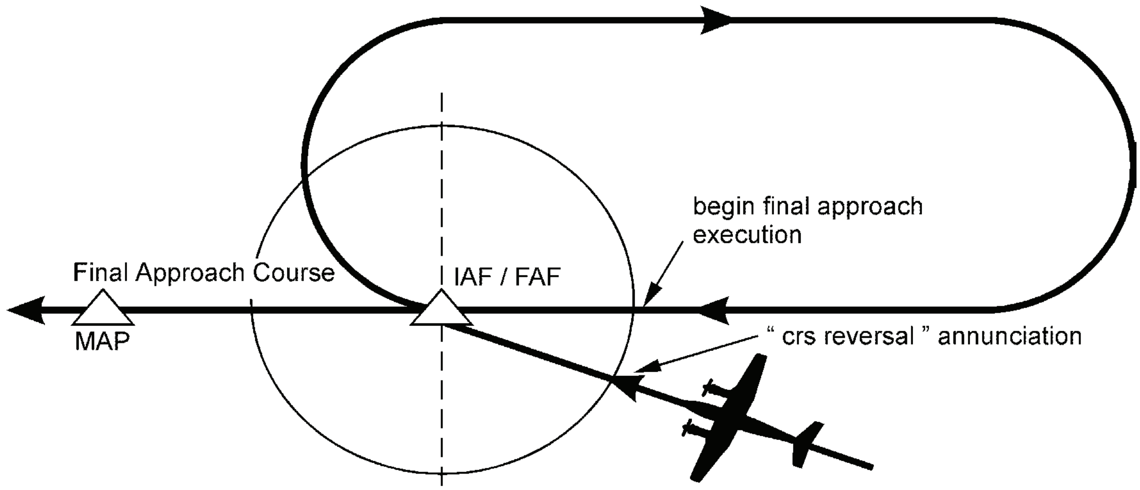


Figure 3C-95. Case II: Collocated IAF/FAF Course Reversal

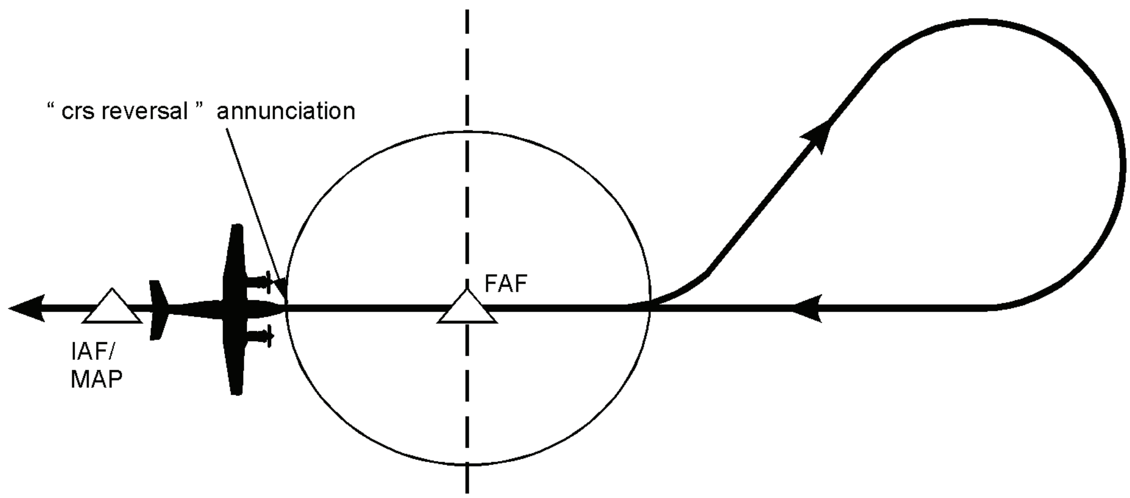


Figure 3C-96. Extended FAF Course Reversal

(12) Radar Vectoring to Final Approach. If ATC gives radar vectors to intercept the final approach course of an FMS approach, select direct–to the FAF (F attribute waypoint) on the Flight Plan page. The FMS–800 will display the message, FINAL COURSE XXX°, where XXX is the final approach course, as shown in Figure 3C–97, but will execute a course direct-to the FAF. To intercept the final approach course, select the CRS line select with the FINAL COURSE displayed in the scratchpad. The FMS will provide lateral guidance to guide the aircraft to intercept the final approach course into the waypoint.

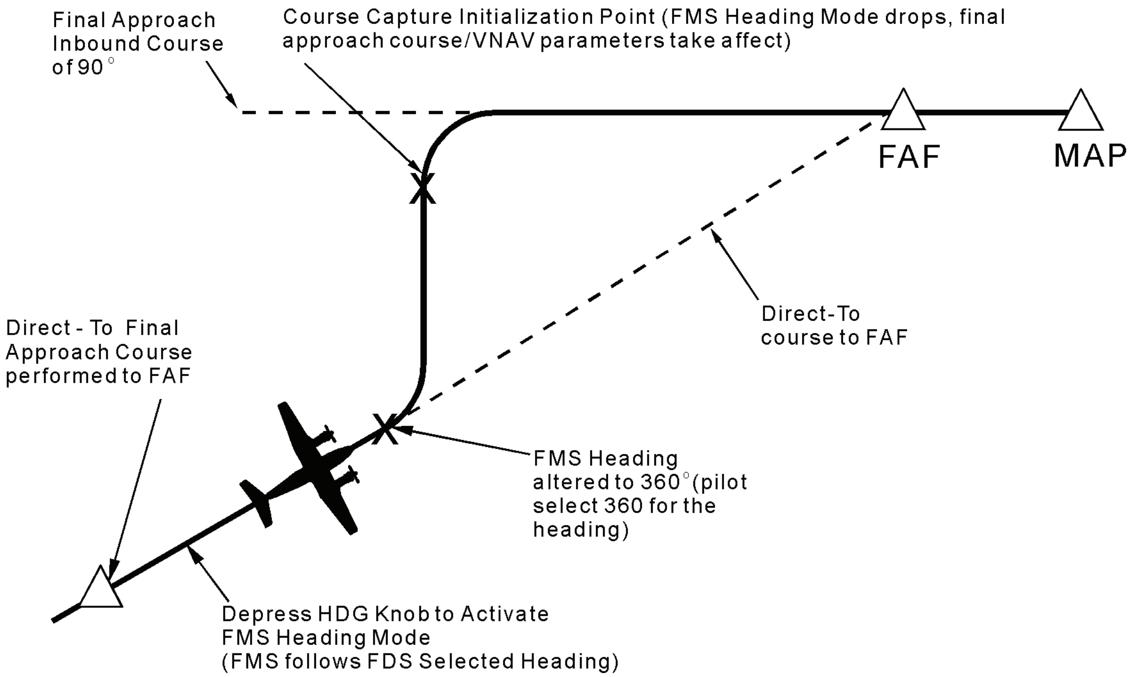


Figure 3C-97. Final Approach Vectoring

The final approach course will be displayed on the HSI and CDU. The FMS will provide lateral guidance to directly intercept the final approach course and vertical guidance to intercept the final approach glideslope into the FAF waypoint. To follow the radar vectors, activate the FMS heading mode by pressing the **HDG** knob on the flight instrument control panel. The FMS will then provide guidance to continually capture the selected heading from the flight instruments until the final approach course has been captured.

The FMS roll command will guide the aircraft to acquire and hold the displayed heading and any subsequent desired heading entered by the pilot on the FDS control panel. The FMS heading mode will continue to guide to the FDS selected heading as long as the heading is steering away from the flight plan course. When the selected heading is steering towards the flight plan course, the FMS heading mode will automatically cease when the course can be captured by normal FMS lateral guidance.

(13) When FAF or MAP waypoint is the active waypoint and approach mode is active, the pilot may disable the approach either by pressing the go–around switch on the aircraft control yoke or perform a direct–to another waypoint other than the MAP. When disabled by go–around, the FMS flight mode will switch to TERMINAL mode scaling, but lateral guidance will continue to be provided through the MAP waypoint. Vertical guidance advisories on the CDU will be terminated when the approach is disabled. To re-enable the approach, select direct–to the FAF or any other flight plan waypoint that would place the FAF as a future flight plan waypoint.

If the Navigation Flag on the flight instruments is displayed (red **FMS** annunciation), and the RAIM warning, NO GPS APPR, or annunciations are active, disable the GPS approach and go–around for another approach. The RAIM Warning annunciation on the flight instruments indicates that the GPS solution is possibly false due to satellite system failures. The NO GPS APPR annunciation indicates there is not a satisfactory GPS solution being provided to execute the GPS approach. The NO APPR RAIM annunciation indicates that the GPS receiver is unable to determine the suitability of the satellite constellation during the approach phase of the flight.

If a missed approach is executed, either perform a direct–to the missed approach holding fix and fly the published holding pattern or select Direct–To the IAF or FAF (in history) and be vectored for another approach. When the MAP is the active waypoint, pressing the **CRS** select knob on the EFIS display control panel will perform a direct–to the missed approach holding point rather than the MAP.

NOTE

If providing steering guidance through the flight director, the FMS will command the flight director to turn the shortest distance to the missed approach holding point. This direction of turn may conflict with published missed approach procedures.

When the MAP is the active waypoint, flight plan sequencing will be inhibited on the TO side of the MAP. On the FROM side of the MAP, AUTO sequencing may be selected by the operator to go to the next waypoint. To sequence to the missed approach holding point or other waypoints following the MAP in the flight plan, delete the discontinuity after the MAP (otherwise, the FMS sequences into the discontinuity) and select AUTO sequencing on the Flight Plan page. The next waypoint will become the active waypoint, with the inbound course into the new active waypoint established by the geometry between the MAP and the active waypoint. To change the inbound course to the new active waypoint, enter the desired CRS on the Flight Plan page. If a holding pattern is enabled at the active waypoint, the FMS will provide entry guidance into the holding pattern.

(14) Flight Plan Discontinuities. A discontinuity in the flight plan may occur when using approaches. A discontinuity is associated with a waypoint and requires crew action to resolve in order to obtain proper flight plan sequencing. The waypoint associated with the discontinuity can be either the one preceding, following, or both. A discontinuity is inserted into the flight plan under two conditions.

1. Following a MAP when inserted in the flight plan.
2. Following a MAP when a direct–to puts the history FAF and MAP waypoints as future waypoints.

The VERIFY PROC annunciation and CDU alert are displayed when one minute to go before sequencing into the discontinuity. If the discontinuity becomes the active waypoint, a DISCONTINUITY annunciation is displayed and guidance is provided for wings–level flight.

The discontinuity is resolved by the following methods.

1. Delete the discontinuity.
2. Delete the waypoint with which the discontinuity is associated.
3. Insert a waypoint between the discontinuity and the waypoint with which it is associated.
4. Remove the approach from the flight plan, except if the discontinuity is the active waypoint.
5. Perform a direct–to while in the discontinuity.

n. Mission Flight Patterns.

(1) Mission Flight Pattern Overview. The FMS–800 allows definition of special MFP's to meet specific operational requirements for military operations.

1. Racetrack
2. Figure Eight
3. Circle
4. Closed Random Pattern (CRP)

The FMS–800 provides guidance within each pattern type, including entry flight procedures similar to those used for holding patterns.

Any MFP may be associated with up to 20 fixed waypoints in the flight plan. When the aircraft crosses a pattern fix, the pattern guidance is activated, suspending normal leg advance until the MFP is exited.

(2) MFP Definition. Each pattern provides a definition on the MFP page. To create a new MFP, access the MFP pages from the Patterns page. Refer to Figure 3C–98 and Table 3C-69. There are four parameters that define the racetrack and figure eight patterns.

1. Inbound Course.
2. Turn Direction.
3. Pattern Length.
4. Pattern Width.

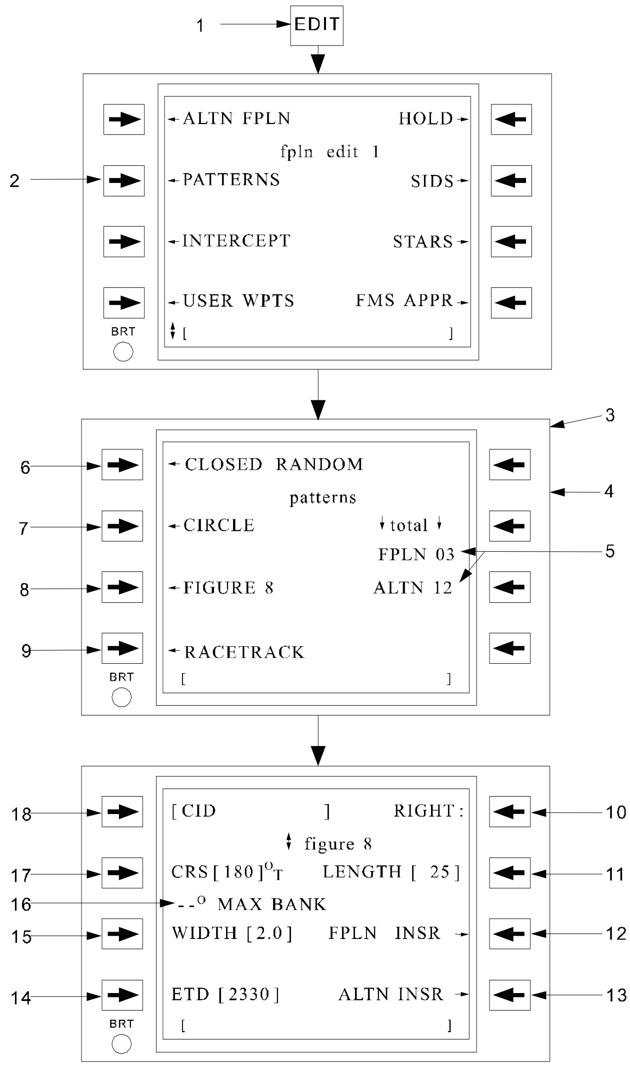


Figure 3C-98. MFP Page Access from the Patterns Page

Table 3C-69. MFP Page Access from the Patterns Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **EDIT** function key for Edit page.
2	Select the pattern page.
3	Select the desired pattern.
4	Enter pattern data and insert the pattern into the active or alternate flight plans.
5	Indicates the total number of MFP's currently in the flight plan and alternate flight plan.

Table 3C-69. MFP Page Access from the Patterns Page Procedure (Continued)

NO.	DESCRIPTION/FUNCTION
6	To access the Closed Random Pattern MFP page.
7	To access the Circle MFP page.
8	Access the Figure 8 MFP page (Figure 8 is used as an example).
9	To access the Racetrack MFP page.
10	Select LEFT or RIGHT turns.
11	Insert pattern length.
12	To access the Flight Plan page and insert the pattern.
13	To access the Alternate Flight Plan page and insert the pattern.
14	Insert estimated time of departure (optional).
15	Insert pattern width.
16	Computed maximum bank limit for pattern width.
17	Insert pattern inbound course (optional).
18	Insert pattern fix (optional).

(3) Circle patterns require all parameters defined above except for pattern length. MFP geometry definitions are shown in Figure 3C–99.

CRP's are special patterns made up of crew defined points connected together to form an enclosed flight path. A CRP may be flown in repeated forward or reverse sequence.

(4) MFP Entry Guidance. The FMS–800 provides entry guidance into MFP's similar to that for holding patterns.

(5) Designation of the Pattern Fix. The pattern fix can be specified either directly on the MFP pages or by attaching an MFP to a flight plan waypoint. To specify the pattern fix on the MFP page and insert it in the flight plan, press the **FPLN INSR** line select key on the MFP page. This accesses the Flight Plan page with INSERT XXX BEFORE? displayed in the scratchpad. Where XXX is FG8, RTK, CIR, or CRP depending on which type of MFP was defined. After the flight plan is scrolled to the desired location, press the line select key adjacent to the waypoint, which will follow the pattern fix.

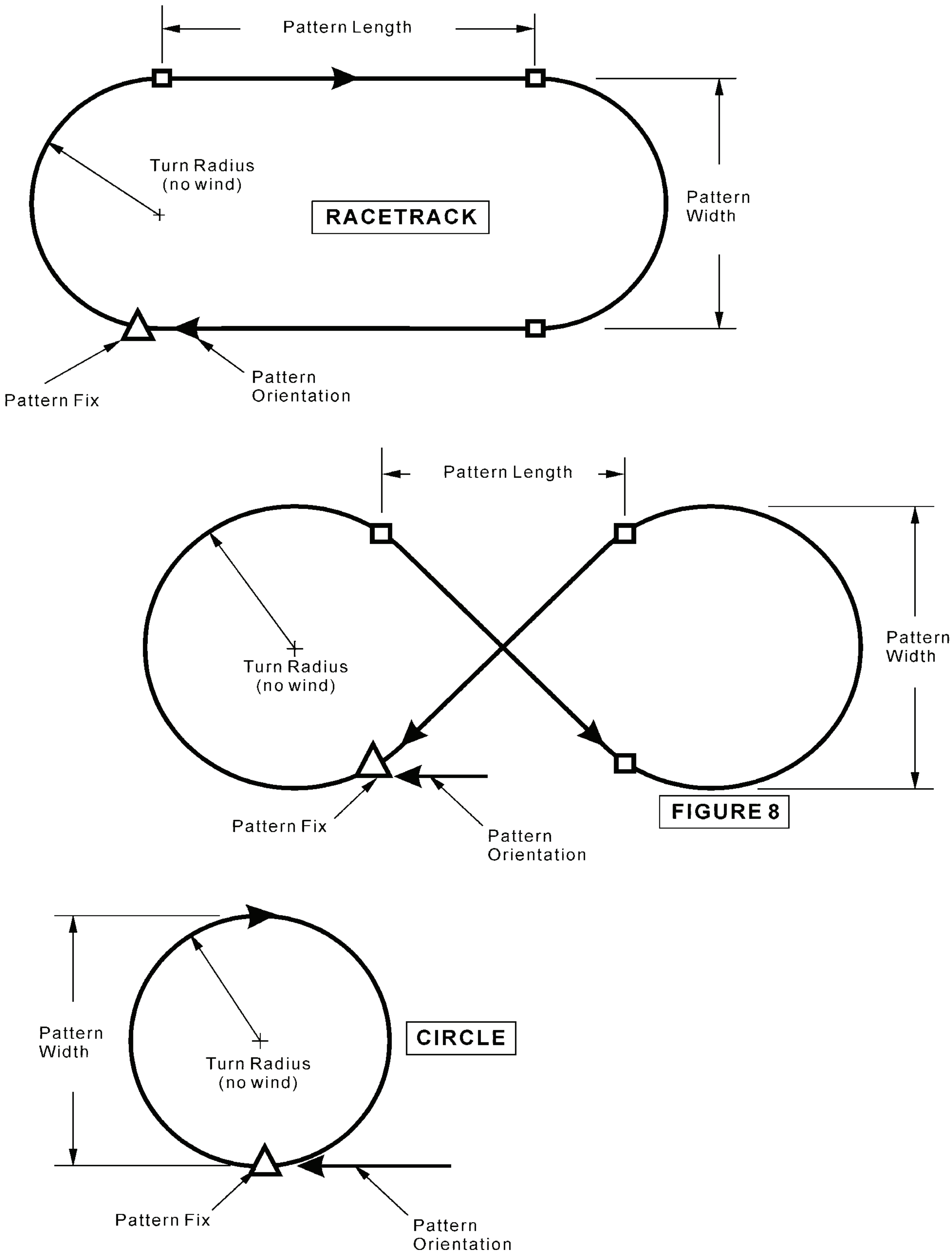


Figure 3C-99. MFP Geometry Definitions

To attach an MFP to an already existing flight plan waypoint, define the MFP but leave line 1 blank on the MFP page. Press line select key **FPLN INSR** to access the Flight Plan page with the message, ATTACH XXX AT?, displayed in the scratchpad. Where XXX is FG8, RTK, CIR, or CRP depending on which type of MFP was defined. After the flight plan is scrolled to the desired location, press the line select key adjacent to the pattern fix.

A **P** is displayed to the right of the designated waypoint as a reminder that it has been designated as the pattern fix.

Once an MFP has been inserted into the flight plan, the MFP parameters can be viewed and modified, with the exception of the pattern fix, by pressing the line select key adjacent to the associated **P** symbol on the Flight Plan page. Pressing this key once will access the associated Flight Plan Waypoint page and a second time will access the MFP Waypoint page.

(6) MFP Pattern Course Edits. The pattern course is entered by two different methods. In either case, the course can be modified.

1. Defaulting to the current inbound course to the fix.

2. The crew enters the desired course via the scratchpad.

(7) MFP Activation and Execution. When the pattern fix is passed for the first time, pattern guidance computations are activated. At this time, four changes occur in both the flight plan operation and page displays.

1. Automatic leg advance is suspended.

2. Course edits on the Flight Plan page may no longer be made. Inbound pattern course edits may be made on the MFP Waypoint page, which is accessed through the Flight Plan Waypoint page.

3. When on the inbound leg, all displays will reference the computed inbound course, not necessarily the inbound course displayed on the MFP page. Computed inbound course for figure eight patterns is significantly different than displayed inbound course.

4. When on the outbound leg, the displays will reference the computed outbound course.

If any MFP definition parameters are changed while in the pattern, the changes are applied after the aircraft passes the pattern fix (transition from TO to FROM), except for the pattern length and width, which take effect immediately if on the outbound leg.

When pattern guidance has been activated, all course and lateral deviation displays now reference the computed inbound or outbound course of the pattern. The 10-second turn alert will be computed on the outbound leg to alert the crew of the upcoming turn to the inbound leg.

(8) CRP Definition and Execution. CRP's are defined by entering points (i.e., identifiers, latitude–longitude positions, etc.) on the CRP MFP pages 1 through 3. Up to nine waypoints (in addition to the fix point, which is optional) may be specified. To specify the MFP fix on the CRP MFP pages, enter the position at the FIX line on CRP MFP page 1.

CRP's will only be executed upon arrival at the CRP fix if AUTO or FLYOVER sequence mode is selected. If MAN sequence mode is selected, the fix is overflown. To insert the pattern, toggle the sequence mode to **AUTO** or **FLYOVER**.

Once the CRP is being executed, guidance is provided to each point in the CRP as if they were flight plan waypoints. An * is displayed adjacent to the CRP waypoint number of the current TO waypoint, which is on the associated CRP MFP page.

To fly directly to any CRP pattern point, press **DIR**. Instead of selecting the line selects on the left-hand side of the Flight Plan page, select the **P** attribute of the CRP fix waypoint on the right-hand line select. This action will access the CRP Patterns page and allow selection of the CRP point for direct–to flight.

(9) Maximum Bank Angle. When an MFP is inserted in the flight plan, the FMS–800 computes and displays the maximum bank angle allowing for proper execution of the pattern based on pattern width and aircraft speed, if airborne. The maximum bank is displayed on line 4 of the MFP Waypoint page.

(10) Estimated Time of Departure. The Estimated Time of Departure (ETD) entry permits future waypoint ETA’s to be more realistically calculated. If an ETD is entered (in UTC), then all future waypoint ETA’s are calculated from that pattern fix departure reference. If no ETD is entered or it is

deleted, all future ETA's are calculated as if no loiter time will be spent in the MFP.

(11) Exiting the MFP. Performing a direct-to another waypoint, besides the pattern fix, is the only way to terminate MFP's. This places the pattern fix waypoint into history.

o. Intercept Operations.

(1) Intercept Calculations. Up to 10 moving targets may be simultaneously defined. Intercept solutions to these targets may be inserted as either the active waypoint for immediate (direct-to) execution or as a future waypoint to implement a future intercept of a moving target. Figure 3C-100 and Table 3C-70 illustrate how to define moving waypoint parameters for use in intercept solutions.

The intercept computations determine the true minimum time to intercept to the moving waypoint. This is not a homing type solution. If interception is not possible, the Point of Closest Approach (PCA) (i.e., the location where the target will be the closest) is computed and "PCA Intercept" will be annunciated when the intercept is the active waypoint.

Solutions are regularly computed for all intercepts whether inserted in the flight plan or not. If an intercept has not been inserted, the computations are performed as if it were a direct–to intercept from present position.

(a) Direct Intercept. When an intercept is the active waypoint, the intercept location is regularly updated based on the following information.

1. Current own aircraft position and speed

2. Moving target definition

The intercept point location is adjusted as required and the inbound course is edited to match the current Direct–To course into the waypoint. To perform a direct intercept, perform the following steps.

1. Enter the desired parameters on the Intercept A page.

2. Press the **FPLN INSR** line select key.

3. Press the line select key adjacent to the TO waypoint location. Refer to Figure 3C–101 and Table 3C-71.

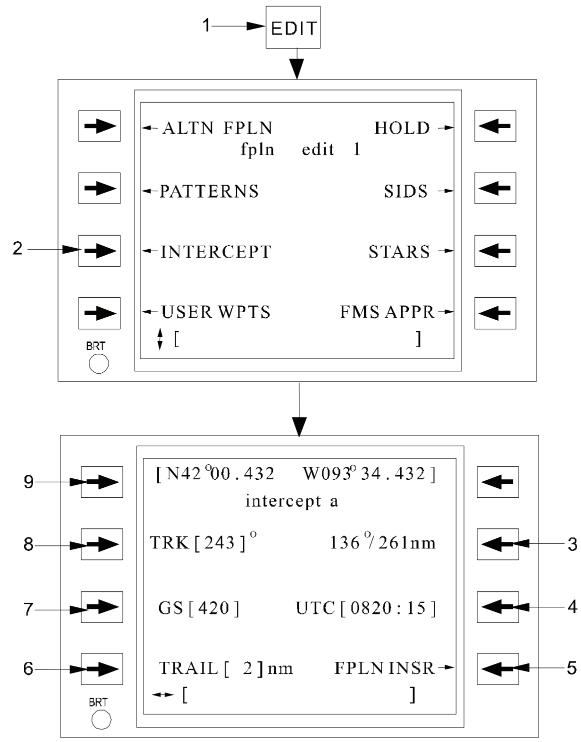


Figure 3C-100. Intercept Definition

Table 3C-70. Intercept Definition Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing **EDIT** function key will access the Edit page
2	Press to access the Intercept A page
3	Displays the current bearing/distance to target, NOT to intercept point.
4	Insert target fix time; defaults to the UTC in effect when the target fix was inserted.
5	Access Flight Plan page for insertion or removal of intercept from flight plan.
6	Insert the intercept in trail distance (defaults to zero).
7	Insert the reported target groundspeed.
8	Insert the reported target track.
9	Insert the reported target fix.

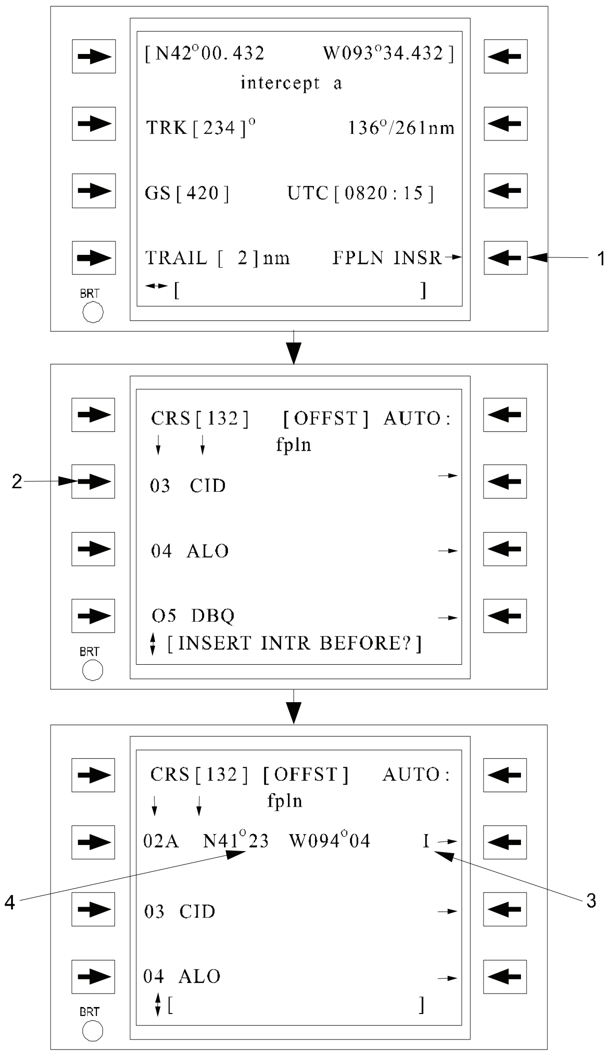


Figure 3C-101. Direct Intercept Insertion

Table 3C-71. Direct Intercept Insertion Procedure

NO.	DESCRIPTION/FUNCTION
1	When the intercept has been defined, pressing **FPLN INSR** line select key will access the flight plan.
2	Inserts the intercept before this point in the flight plan (in this case, a direct intercept is being performed).
3	An **I** indicates that an intercept has been attached to this waypoint.
4	Intercept position is displayed as a LAT–LONG and is updated every 22 seconds.

(b) Planned Intercepts. When the intercept is inserted as a future waypoint, the intercept location is regularly updated based on the following information.

1. Location of the flight plan waypoint immediately prior to the intercept.

2. Distance along the flight plan from aircraft position to the waypoint prior to the intercept.

3. Current own aircraft speed.

4. Moving target definition.

5. Current wind.

The estimated time of arrival at the waypoint immediately prior to the intercept is computed. The intercept point and its ETA are computed from that point in exactly the same manner as the direct case. The intercept is executed exactly as the direct intercept when it becomes active. Refer to Figures 3C-102 and 3C-103.

(2) Intercept Passage. When an intercept is passed into history, the latitude–longitude of the intercept at the time of waypoint passage is recorded as the flight plan history waypoint and the **I** is removed from the waypoint.

(3) Multiple Intercepts. Ten moving waypoint (intercept) definitions may be inserted in the flight plan. Each intercept solution is computed independently and flown in the flight plan sequence.

(4) A calculator function is provided to allow the crew to enter an alternate TAS and see the effect on the intercept. This calculator is available for an intercept not inserted into the flight plan and for the next intercept in the flight plan. Refer to Figure 3C-104 and Table 3C-72.

p. Markpoint and Waypoint List Storage.

(1) Markpoint and Waypoint List Overview. The FMS–800 maintains a markpoint list of up to 10 markpoints and a user waypoint list of up to 200 waypoints. The lists are stored in nonvolatile memory. Each list is maintained on separate pages and is accessed from the Flight Plan Edit page. Refer to Figure 3C–105 and Table 3C-73. To access the Markpoint List page, press the **MARKPT** line select key on the Flight Plan Edit page. To access the Waypoint List page, press the **USER WYPT** line select key.

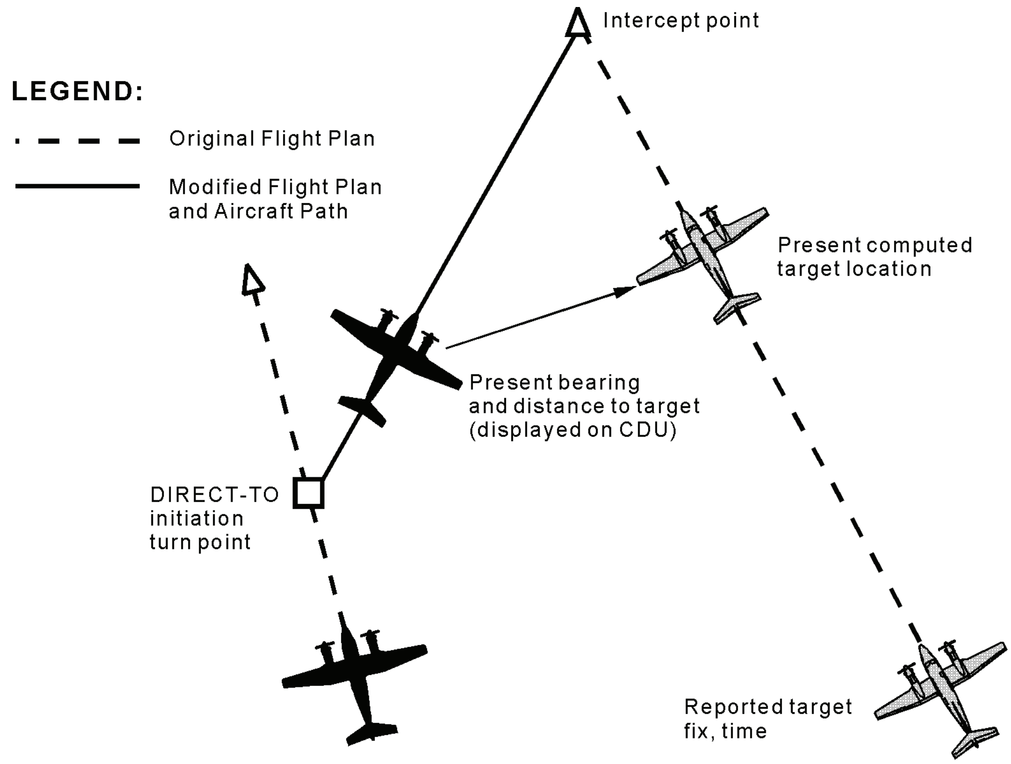


Figure 3C-102. Direct Intercept

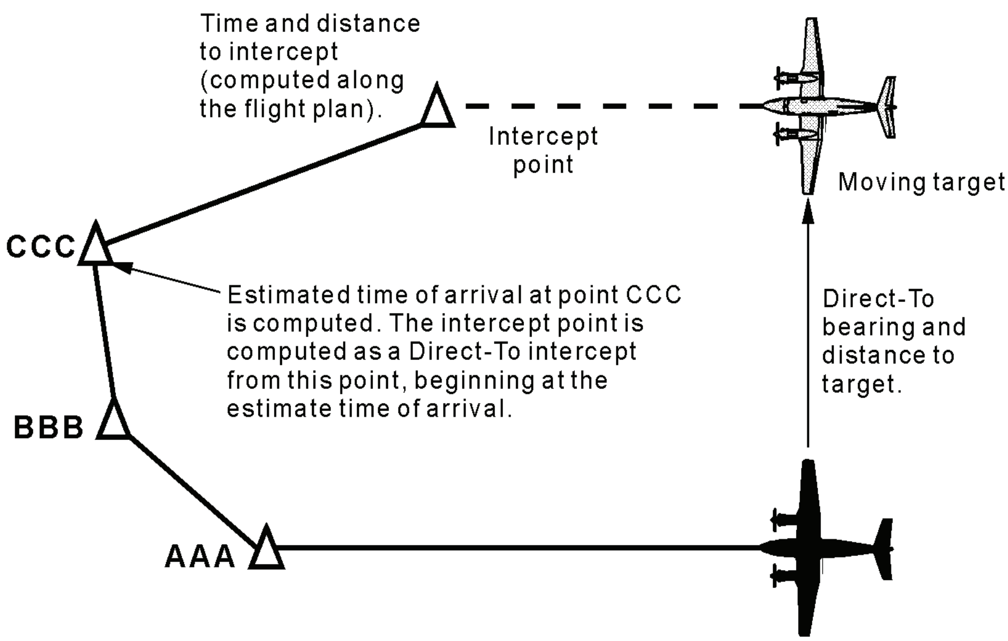


Figure 3C-103. Future Intercept Geometry Alternate Intercept Solution

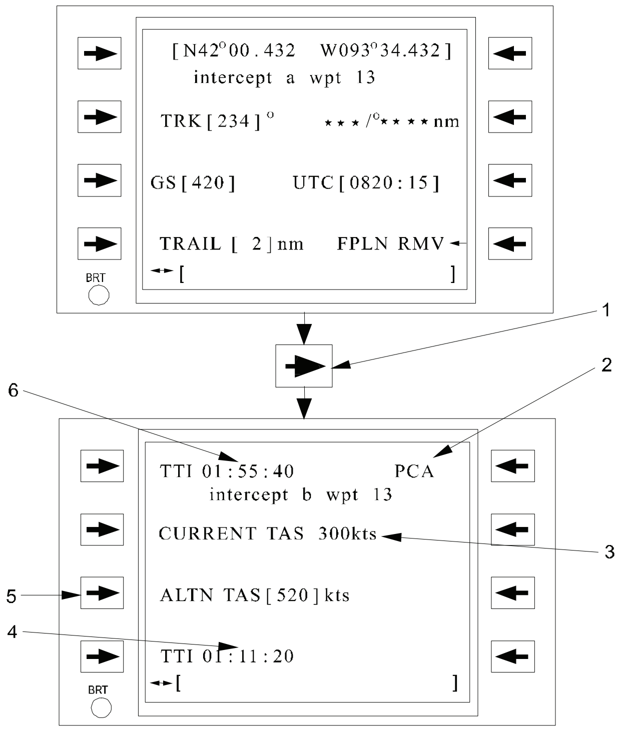


Figure 3C-104. Intercept Function Calculator

Table 3C-72. Intercept Function Calculator

NO.	DESCRIPTION/FUNCTION
1	Scroll laterally to the B page for intercept calculator solution.
2	The PCA indicates the intercept is not possible.
3	The aircraft current true airspeed.
4	Time to intercept based on alternate airspeed.
5	Insert alternate true airspeed for calculator solution.
6	Time to intercept or PCA (intercept not possible in this example).

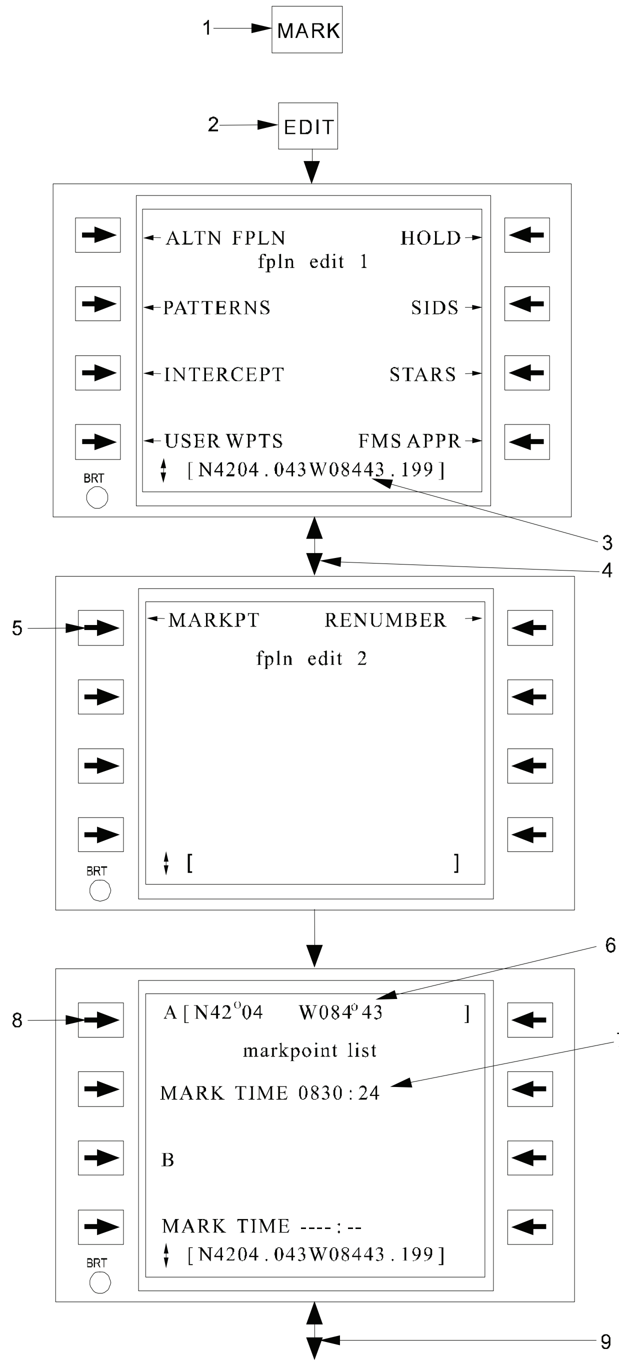


Figure 3C-105. Markpoint List and Waypoint List Page Access and Usage

Table 3C-73. Markpoint List and Waypoint List Page Access and Usage Procedure

NO.	DESCRIPTION/FUNCTION
1	Mark waypoints regardless of which CDU page is displayed.
2	Pressing **EDIT** function key will access the Edit page.
3	Mark position recorded in the scratchpad and in the markpoint list.
4	Scroll to the Flight Plan Edit 2 page.
5	To view markpoints, access the Markpoint List page.
6	Mark position recorded in the markpoint list.
7	Mark time is recorded automatically.
8	Possible entries at the A line select key: Press with a **–** in scratchpad to delete the point. Press with an empty scratchpad to copy the point to the scratchpad. Enter **I** with identifier name to name the markpoint location and add it to the user waypoint list.
9	Scroll vertically to view other markpoints.

(2) Markpoint List. To create a markpoint, press the **MARK** function key when the desired position is overflown. Pressing the **MARK** key will indicate in the scratchpad the pilot's present position solution offset by any active cursor position as displayed on the FDS and automatically adds the position to the markpoint list on the Markpoint List page. It assigns the markpoint a unique letter identifier (A through J), and records the mark time. The Markpoint List page does not need to be displayed to use this function.

Once the markpoint is on the Markpoint List page, it is treated like any other waypoint and can be copied, inserted elsewhere, or deleted. The marked position in the scratchpad can be inserted as a waypoint or position. It can be cleared with the **CLR** key.

If 10 markpoints exist on the Markpoint List page and another mark is performed, the new mark overwrites the first (oldest) mark in the list. A subsequent mark overwrites the second, and so on.

Manual position entries are not allowed on the Markpoint List page. To store entered waypoints manually, see the Waypoint List page.

(3) Waypoint List. The user waypoint list is a list of up to 200 user-defined waypoint identifiers that the user can predefine for use in the FMS. Once a user waypoint is created, it can be recalled, copied, and used like any identifier from the primary ICAO database stored on the data cartridge. The user waypoint list is maintained in non-volatile memory of the CDU, so user-defined waypoints are maintained through power cycles.

To create a user waypoint, access the User Waypoint List page as shown in Figure 3C–106 and Table 3C-74. Select the **NEW** line select key to access a blank waypoint definition. On the User Waypoint page, give the new waypoint a name and a location. The location can be a latitude/longitude, another waypoint identifier, or bearing/distance offset from an identifier. Select the waypoint type from the following selections: FIX, VOR, VORTAC, TACAN, VOR/DME, NDB, NDB/DME, DME, or AIRPORT. If a NAV aid type is selected, enter the associated NAV aid frequency and station declination. If desired, enter the elevation of the user waypoint. When all elements have been completed, RTN will switch to ADD and the new user waypoint can be inserted into the user waypoint list. If a user waypoint already exists with the same name, a prompt will appear to confirm overwriting the old waypoint definition. To prevent an overwrite, press **CLR** or confirm to overwrite.

To use the new user waypoint, recall the waypoint by name on the Flight Plan page, or any other FMS page that uses ICAO identifier waypoints, or copy the waypoint from the User Waypoint List page. The User Waypoint List page includes a search utility to help find a desired waypoint or to scroll through the list to view waypoints in alphabetical order.

To modify or review the definition of a user waypoint, access the User Waypoint List page and select the right line select adjacent to the waypoint to be modified. Modify the user waypoint definition on the User Waypoint page and reinsert the new waypoint when complete.

To delete a user waypoint, access the User Waypoint List page, enter a – in the scratchpad, and press the left line select key adjacent to the user waypoint to be deleted. When 200 user waypoints have been defined in the list, the FMS will prevent any more additional waypoint entries. To add more user waypoints, current user waypoints must first be deleted.

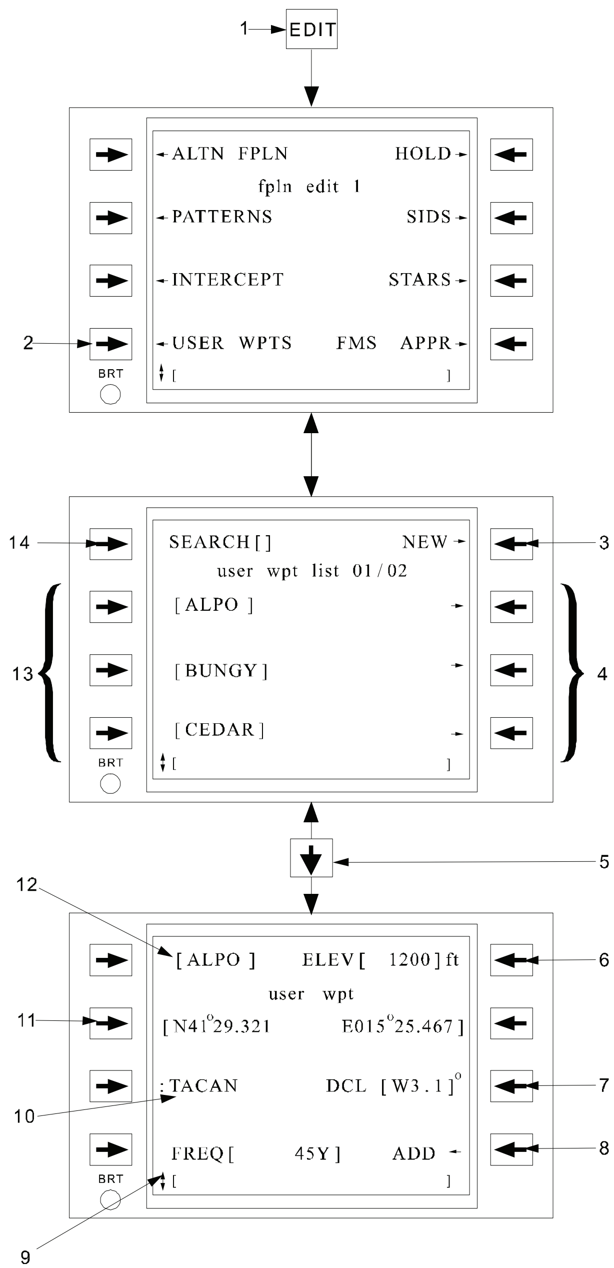


Figure 3C-106. User Waypoint List Access and Use

Table 3C-74. User Waypoint List Access and Use Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing **EDIT** function key will access the Edit page.
2	Press to access User Waypoint List.
3	Select to create a new user waypoint from scratch.
4	Select to review or edit a current waypoint definition.
5	Scroll vertically to view other user waypoints in alphabetical order.
6	Enter user waypoint ground elevation (optional).
7	Enter waypoint station declination, if needed.
8	Select to add to or modify waypoint list.
9	Enter waypoint station frequency, if needed.
10	Select waypoint type.
11	Enter location of user waypoint.
12	Enter name of user waypoint.
13	Copy or delete the current user waypoint.
14	Enter a user waypoint identifier to search for.

(4) User Waypoint Naming. Waypoints within the FMS can be given a user-defined identifier name by applying a **/** followed by the desired waypoint name. Refer to Figure 3C–107 and Table 3C-75. Valid waypoints that can be named by this function are latitude/longitude and ident/bearing/distance waypoints. ICAO identifier or existing user-defined waypoints can not be renamed with the user waypoint naming function.

To apply a user waypoint name to a waypoint, and insert that waypoint into the user waypoint list, enter a / followed by a waypoint name consisting of two to five characters. This name can be applied to waypoints on the Flight Plan, Alternate Flight Plan Waypoints, Alternate Flight Plan Leg A, MFP, Tactical Approach, Markpoint, RAIM Prediction, and Update pages. Once inserted into the user waypoint list, the newly named waypoint can be used like any other ICAO identifier waypoint.

To complete the definition of the named waypoint, access the User Waypoint List page for the named waypoint and change the desired parameters in the waypoint definition. The default definition is for a FIX waypoint with undefined elevation.

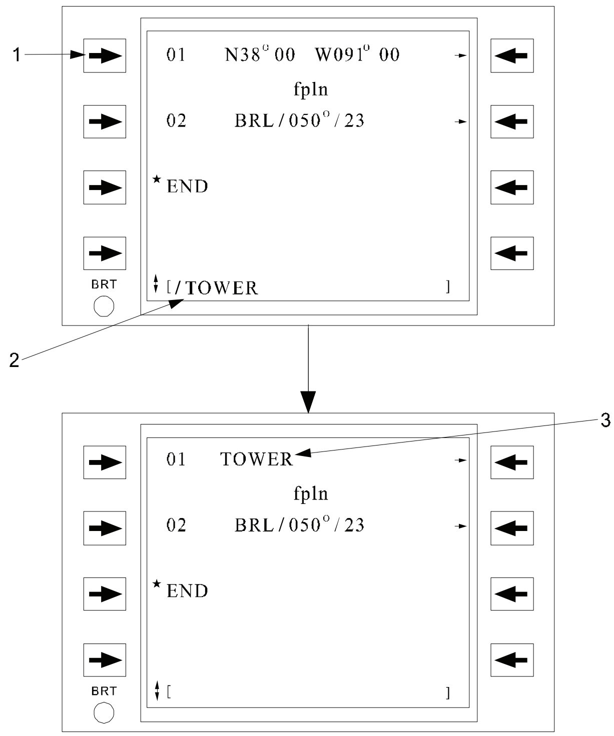


Figure 3C-107. Creating User Named Waypoints

NOTE

New name can be copied or entered like any other ICAO identifier waypoint. Access the User Waypoint page to modify the user waypoint definition.

Table 3C-75. Creating User Named Waypoints Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter name in the scratchpad, prefixed with a /.
2	Apply name to waypoint.
3	New name is now associated with this waypoint.

If the user waypoint list is full when the name is applied to a waypoint, a USER WPT LIST FULL message will be displayed. Access the User Waypoint List page and delete any unused or no longer needed waypoints to allow continued naming of waypoints. If the user waypoint name already exists in the user waypoint list, a DUPLICATE USER WPT message will be displayed. Use a different name or delete the repeated name from the user waypoint list. The FMS only allows one name to be used for each waypoint in the use waypoint list. User waypoint identifiers can be duplicates of identifiers in the ICAO database. When using the named waypoint with an ICAO duplicate, the Select Waypoint page will be accessed to allow selection of the desired waypoint. The user named waypoint is identified on the Select Waypoint page with ** as the country code.

q. From–To And Waypoint Data Pages.

(1) Data Page Overview. Independent of the active and alternate flight plans, the FMS–800 will compute, on demand, the bearing/distance, distance along the active flight plan, and ETE/ETA for a variety of FROM–TO waypoint pairs and direct options selected by the crew. Refer to Figure 3C–108.

1. FROM any active flight plan waypoint TO the next succeeding flight plan waypoint.

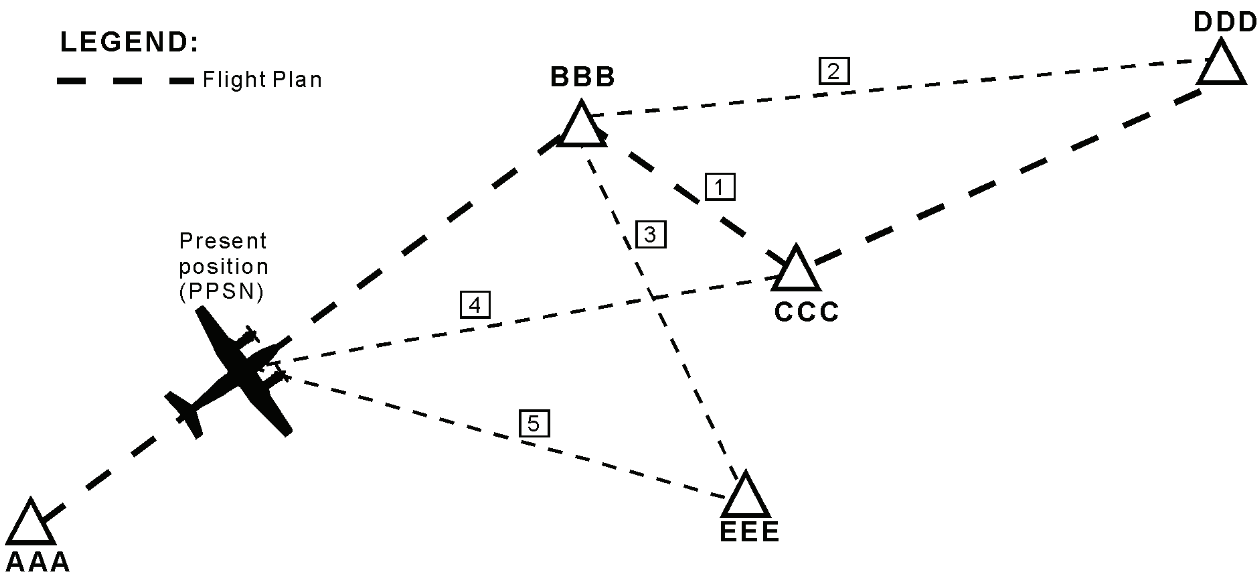
2. FROM any flight plan waypoint TO any other flight plan waypoint.

3. FROM any flight plan waypoint TO a non-flight plan waypoint.

4. FROM aircraft present position TO any flight plan waypoint.

5. FROM aircraft present position TO any non-flight plan waypoint.

(a) Data Page Access and Waypoint Entry. To access the Data page, press the **DATA** function key and press the line select key adjacent to any waypoint in the active flight plan, alternate flight plan, waypoint list, or markpoint list. Refer to Figure 3C–109 and Table 3C-76.



Option 1: BBB to CCC (flight plan waypoint to next flight plan waypoint)
Option 2: BBB to DDD (flight plan waypoint to other flight plan waypoint)
Option 3: BBB to EEE (flight plan waypoint to non-flight plan waypoint)
Option 4: PPSN to CCC (present position to flight plan waypoint)
Option 5: PPSN to EEE (present position to non-flight plan waypoint)

Figure 3C-108. FROM-TO Options for the Data Page (Examples Only)

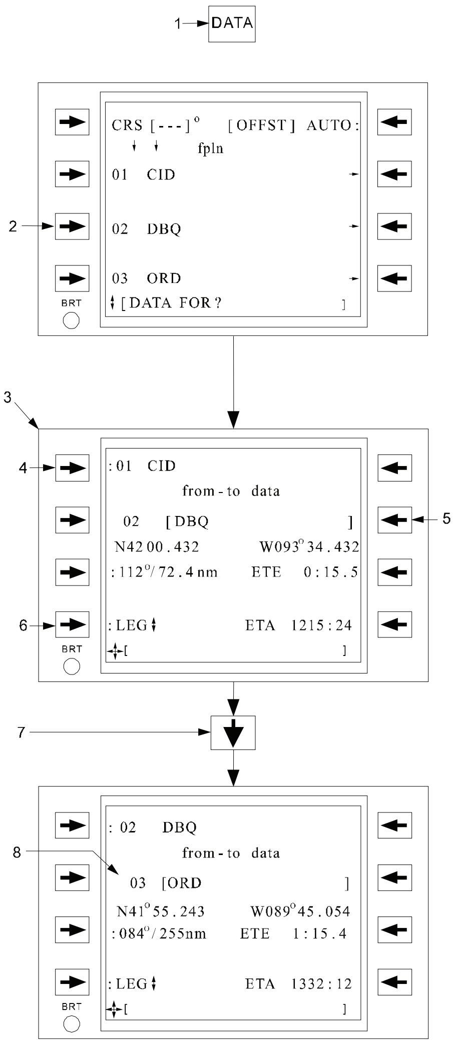


Figure 3C-109. Data Page Access and Leg or Waypoint Scrolling/Selection

Table 3C-76. Data Page Access and Leg or Waypoint Scrolling/Selection Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **DATA** function key to display DATA FOR? in the scratchpad.
2	Access Data page for waypoint DBQ.
3	The Data page displays data for the FROM–TO pair of CID and DBQ waypoints.
4	Select between flight play **FROM** waypoint, **PPSN DIRECT**, or **PPSN VIA FPLN**.
5	Insert a nonflight plan waypoint.
6	Select either waypoint **WPT** or **LEG** scrolling.

Table 3C-76. Data Page Access and Leg or Waypoint Scrolling/Selection Procedure (Continued)

NO.	DESCRIPTION/FUNCTION
7	Scroll through flight plan legs (if LEG selected) or waypoints (if WPT selected).
8	Scrolling down displays data for the next waypoint in the flight plan.

After the Data page has been accessed, other TO waypoints may be selected or entered. FROM–TO display options can also be selected also.

If the initially selected waypoint is a flight plan waypoint, press the vertical scroll key ⌉ or ⌋ to scroll leg by leg through the flight plan, Option 1, Figure 3C-110.

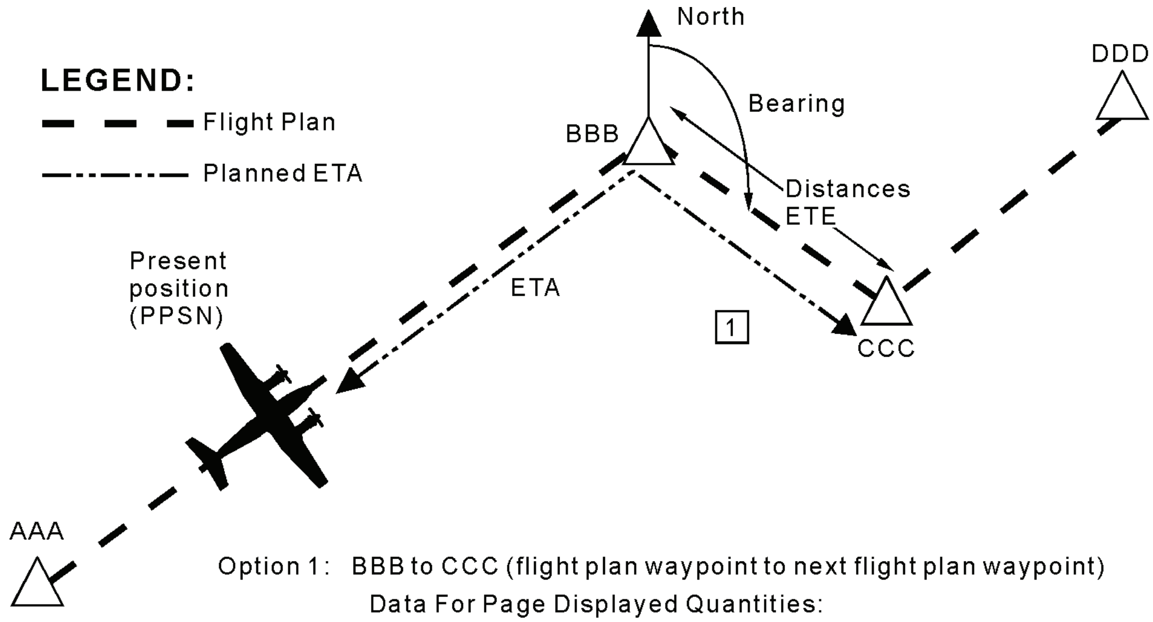
To freeze the FROM waypoint, press the line select key to select **WPT**. Then press the ↑ or ↓ arrow keys to scroll from waypoint to waypoint through the flight plan while retaining the same FROM waypoint, Option 2, Figure 3C–111.

To view a direct segment FROM a flight plan waypoint TO a nonflight plan waypoint, scroll the flight plan in the LEG mode until the desired FROM waypoint is at the top of the page. Then insert the desired TO waypoint on data line 2 in place of the existing TO waypoint, Option 3, Figure 3C–112.

To view data from present position to any flight plan waypoint, scroll the flight plan so that the desired TO waypoint is on data line 2. Then select either **PPSN DIRECT** or **PPSN VIA FPLN** at line select key 1L, Option 4, Figures 3C–113 and 3C-114.

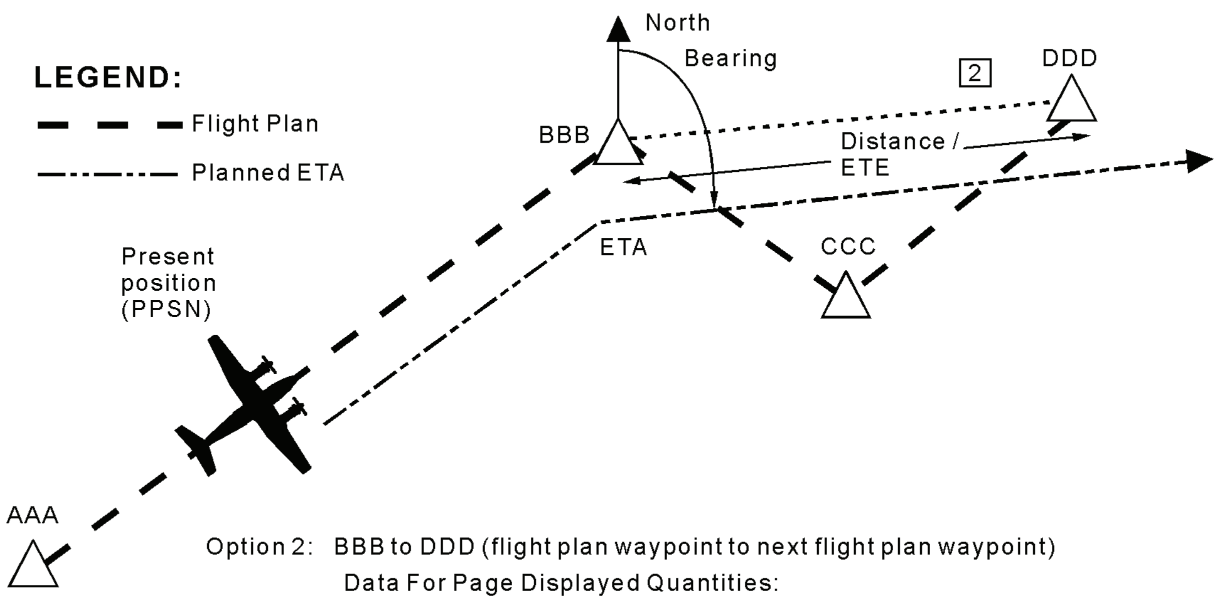
To view data from present position to a non–flight plan waypoint, select **PPSN DIRECT** and insert the desired waypoint in place of the TO waypoint on data line 2, Option 5, Figure 3C–115.

(b) Data Page Displayed Information. The Data page presents data related to the selected DATA FOR? Waypoint, which is called the TO waypoint of the FROM–TO waypoint pair. Refer to Figure 3C–116 and Table 3C-77, data line 2. It also shows data for the FROM–TO leg and the ETA for a hypothetical flight either via the active flight plan routing to the FROM waypoint and to the TO waypoint along the displayed leg or directly FROM aircraft present position TO the displayed waypoint (PPSN DIRECT), or from aircraft present position along the flight plan to a waypoint (PPSN VIA FPLN). The present position in this case is the position of the designated pilot's navigational solution.



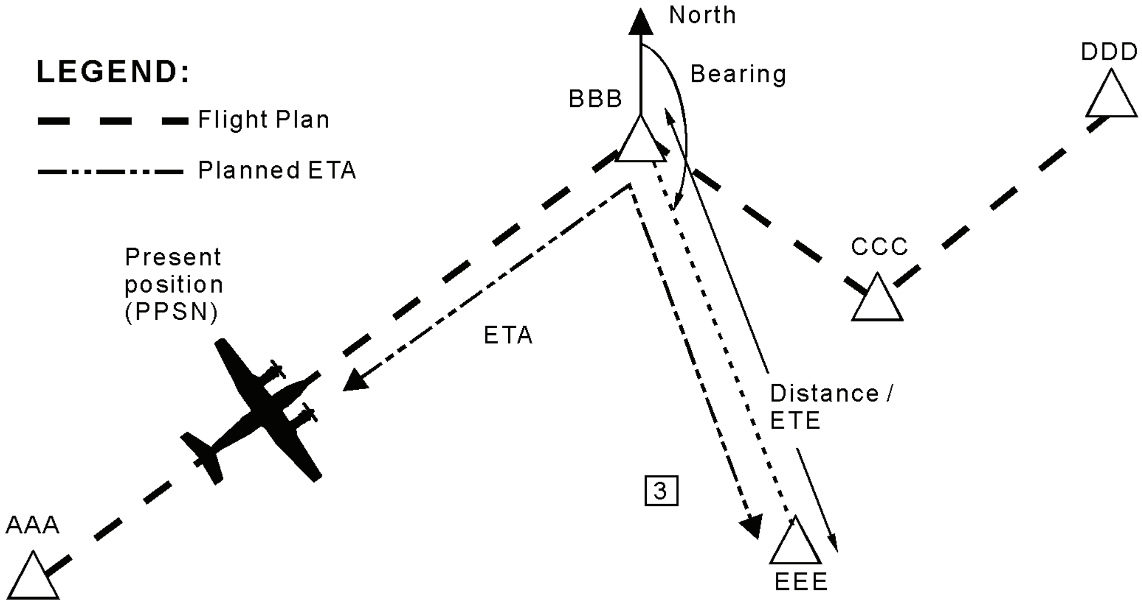
Option 1: BBB to CCC (flight plan waypoint to next flight plan waypoint)
Data For Page Displayed Quantities:
Bearing/ Distance are from BBB to CCC
ETE is Time Enroute Between BBB and CCC
ETA is Arrival Time from PPSN though Flight Plan to CCC

Figure 3C-110. Data For Option 1



Option 2: BBB to DDD (flight plan waypoint to next flight plan waypoint)
Data For Page Displayed Quantities:
Bearing/ Distance are from BBB to DDD Direct
ETE is Time Enroute Between BBB and DDD Direct
ETA is Arrival Time from PPSN though Flight Plan
to BBB then Direct to DDD

Figure 3C-111. Data For Option 2



Option 3: BBB to EEE (flight plan waypoint to non-flight plan waypoint)

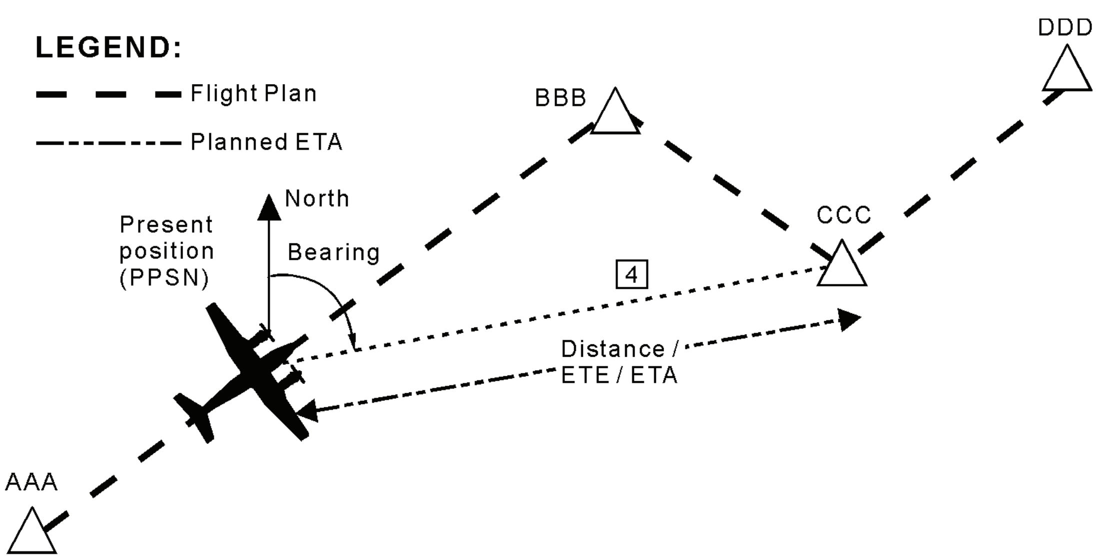
Data For Page Displayed Quantities:

Bearing/ Distance are from BBB to EEE Direct

ETE is Time Enroute Between BBB and EEE Direct

ETA is Arrival Time from PPSN though Flight Plan to BBB then Direct to EEE

Figure 3C-112. Data For Option 3



Option 4: PPSN DIRECT to CCC (present position direct to flight plan waypoint)

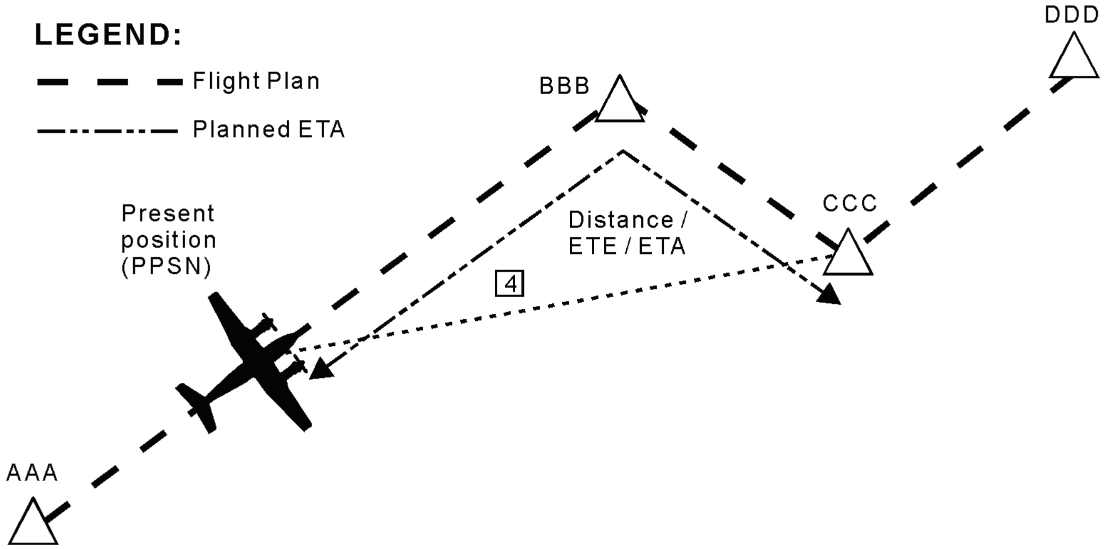
Data For Page Displayed Quantities:

Bearing/ Distance are from PPSN Direct to CCC

ETE is Time Enroute from PPSN Direct to CCC

ETA is Arrival Time from PPSN Direct to CCC

Figure 3C-113. Data For Option 4

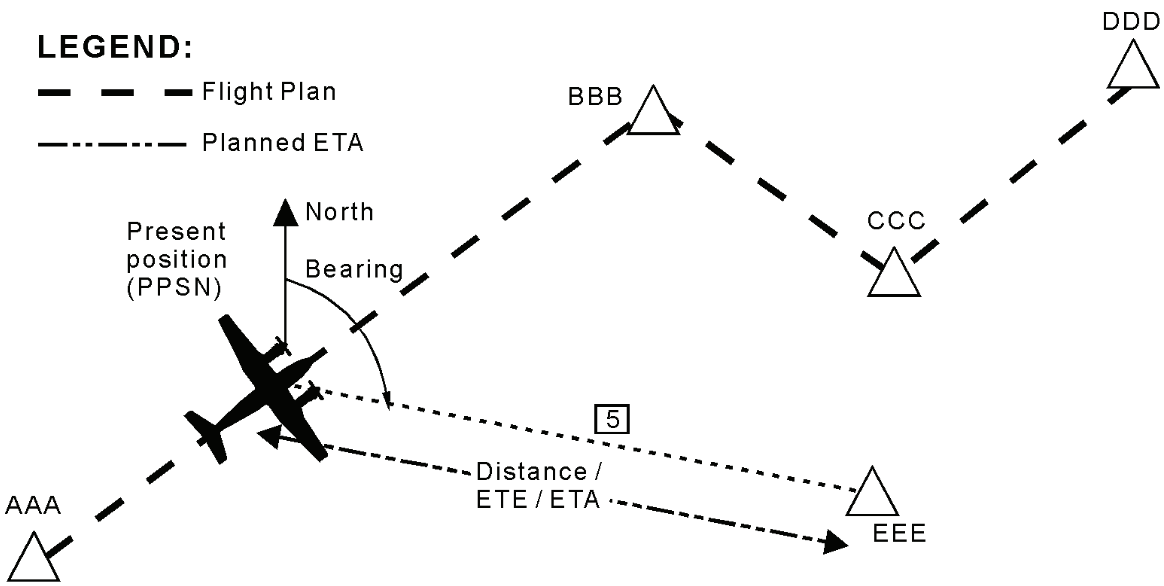


Option 4: PPSN VIA FPLN to CCC (present position through flight plan to flight plan waypoint)

Data For Page Displayed Quantities:

Distance is total distance from PPSN through Flight Plan to CCC
ETE is Time Enroute from PPSN through Flight Plan to CCC
ETA is Arrival Time from PPSN through Flight Plan To CCC

Figure 3C-114. Data For Option 4 (Via Flight Plan)



Option 5: PPSN DIRECT to EEE (present position to non-flight plan waypoint)

Data For Page Displayed Quantities:

Bearing/ Distance are from PPSN Direct to EEE
ETE is Time Enroute from PPSN Direct to EEE
ETA is Arrival Time from PPSN Direct to EEE

Figure 3C-115. Data For Option 5

If the FROM and/or TO waypoints are in the active flight plan, their corresponding flight plan waypoint numbers are displayed.

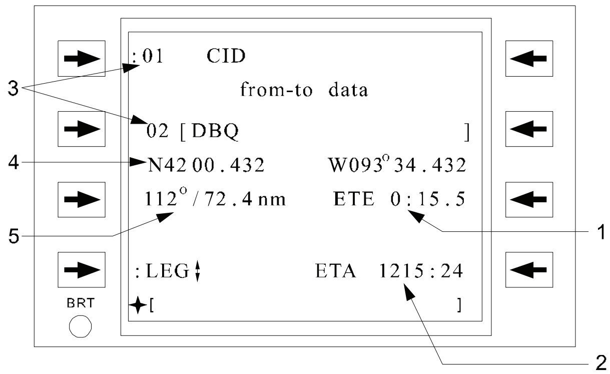


Figure 3C-116. Data Page Displayed Information

Table 3C-77. Data Page Displayed Information Procedure

NO.	DESCRIPTION/FUNCTION
1	ETE for displayed leg, direct segment, or along flight plan.
2	ETA using current TAS and wind or entered groundspeed.
3	Flight plan waypoint number.
4	Latitude–Longitude of TO waypoint.
5	FROM–TO bearing/distance or distance along flight plan.

If the FROM waypoint on the Data page is a flight plan waypoint and a holding pattern or MFP is in the flight plan at, or prior to that point, the ETA at the TO waypoint assumes the aircraft will depart the holding fix at the entered EFC time or depart the MFP pattern fix at the ETD, if entered. Otherwise, no holding or pattern "on–station" loiter time is included in the ETA calculation.

When the FROM waypoint or PPSN DIRECT is selected, then the bearing and great circle distance between the FROM and TO waypoints are indicated on data line 3. Refer to Figures 3C–110 through 3C-115. When the PPSN VIA FPLN is selected, the along flight plan distance to the TO waypoint is indicated, Figure 3C–114.

The ETE and ETA are indicated on data lines 3 and 4, respectively. When the **FROM** waypoint is selected, the ETA is calculated from aircraft present position to the FROM waypoint, and then direct to the TO waypoint; and, the ETE is calculated between the FROM and TO waypoints, Figures 3C-110, 3C-111, and 3C–112. When **PPSN DIRECT** is selected, the ETE and ETA are calculated for a flight path directly between aircraft present position and the TO waypoint, Figures 3C-113 and 3C–115. When **PPSN VIA FPLN** is selected, the ETA and ETE are calculated along the flight plan from present position, Figure 3C-114.

The ETA and ETE are calculated one of two ways, depending on the TO waypoint. If the TO waypoint is the active waypoint, direct to a future flight plan waypoint (PPSN DIRECT), or a nonflight plan waypoint, the current wind and TAS are used to calculate the ETA and ETE. If the TO waypoint is a future or history waypoint, the intervening leg winds are used to calculate the ETA and ETE. When the aircraft is not airborne, the groundspeed entered on the Navigation Configuration page is used for ETA and ETE calculations.

(2) Selection and Display of Waypoint Identifier Data. To view the ICAO database information for identifier–referenced waypoints, select or enter the waypoint identifier or leg pair on the Data page and press one of the ← or → arrow function keys to scroll to the corresponding Ident Data page for the TO waypoint. Refer to Figure 3C-117 and Table 3C-78.

If the TO waypoint on the Data page selected leg is an ICAO identifier–referenced waypoint (including identifier / bearing / distance waypoints), its corresponding database information is presented. The waypoint type, identifier, station frequency/ TACAN channel (if applicable), and elevation MSL are displayed. If the waypoint is a NAV aid with a station declination, it is displayed as DCL. If the waypoint is not a NAV aid with a station declination, the FMS–800 computes the magnetic variation for that location and displays MVAR.

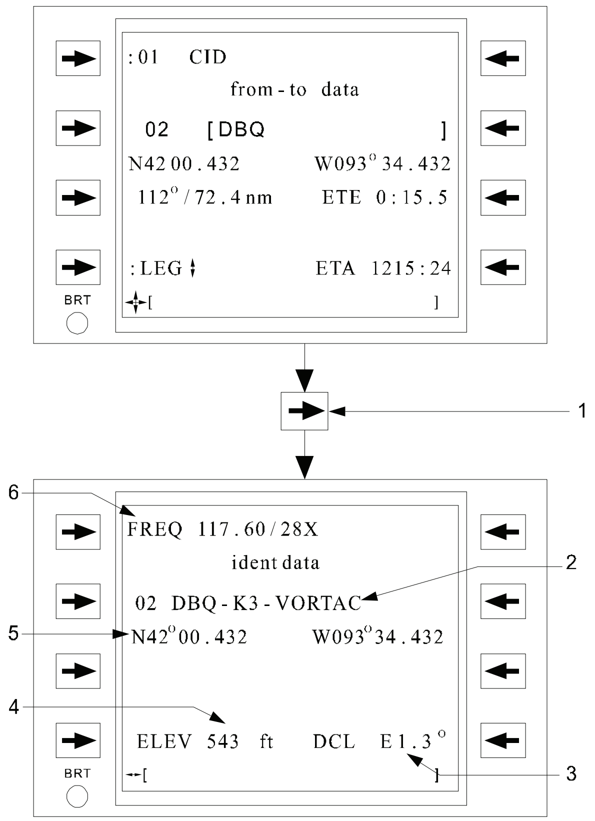


Figure 3C-117. Indent Data Page Access and Displayed Information

Table 3C-78. Ident Data Page Access and Displayed Information Procedure

NO.	DESCRIPTION/FUNCTION
1	Scroll horizontally with scroll function key.
2	ICAO identifier with country code, and waypoint type (if applicable).
3	Waypoint Station declination or magnetic variation.
4	Waypoint elevation MSL.
5	Waypoint latitude/longitude.
6	Station frequency and/or TACAN channel.

r. GPS Integrated Navigation.

(1) Navigational System Overview. The GPS navigational source used for the pilot's steering solution is displayed on the Pilot Lateral Steering page. Refer to Figure 3C-118 and Table 3C-79.

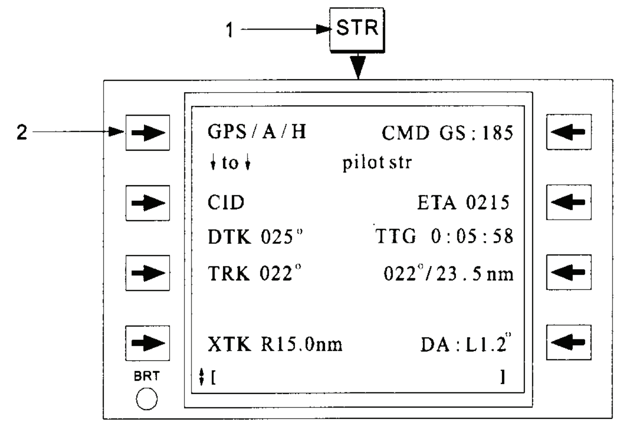


Figure 3C-118. Pilot Lateral Steering Page

Table 3C-79. Pilot Lateral Steering Page Procedure

NO.	FUNCTION/DESCRIPTION
1	Pressing the **STR** function key will access the last viewed steering page. Vertically scroll if necessary to access the pilot lateral steer page.
2	Navigation Source.

(2) Position, Track, and Air Data Displays. The navigation solution for the GPS navigation source is displayed on the pilot position page as shown in Figure 3C-119 and Table 3C-80. The true airspeed and SAT shown on this page comes from the Air Data Computer (ADC).

The wind vector is displayed as either a current wind vector, crosswind component, or head/tail wind component. For the headwind/ tailwind component, a ↑ will indicate a tail wind and a ↓ will indicate a headwind. For the crosswind component, a → will indicate a left crosswind with the magnitude to the right of the arrow, and a ← will indicate a right crosswind with the magnitude to the left of the arrow.

When the groundspeed and true airspeed are invalid, the numeric display for the wind will be dashed and the headwind/tailwind and crosswind data will be removed.

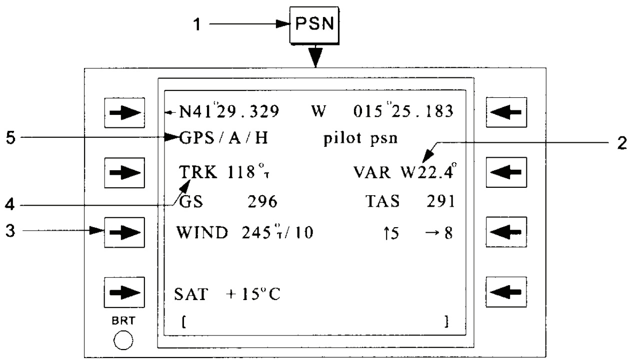


Figure 3C-119. Pilot Position Page

Table 3C-80. Pilot Position Page Procedure

NO.	FUNCTION/DESCRIPTION
1	Pressing **PSN** function key will access the pilot position page.
2	Computed magnetic variation at present position.
3	This line select key is non-operational if a computed wind speed is available or if the FMS is displaying an INU wind. Otherwise, the following three actions will occur. 1. Selection with a valid entry in the scratchpad will enter the wind. 2. Selection with an empty scratchpad will copy the wind entry into the scratchpad. 3. Selection with a **–** in the scratchpad will set the wind speed to 0 knots.
4	Track displays MAG track.
5	Navigation source selected on pilot/copilot lateral steer pages.

The status and validity of the navigational source is indicated on the title lines of the Pilot Position pages. Table 3C-81 lists the indications and their meanings. Any automatic downgrading of the navigation source is annunciated on the CDU.

A √NAV error annunciation and/or the HSI flag are provided when either the status of the selected navigation sensors has degraded or the 95% error exceeds a threshold determined by the current flight plan guidance mode; EN ROUTE, TERMINAL, or APPROACH. When these alerts are provided, examine the current state of the GPS navigation solution and compare the solution to the other on-board navigation systems. If necessary, select a different navigation sensor to provide continued guidance of the aircraft.

(a) GPS Display. The GPS INAV page shows the present position output from the GPS receiver. It also shows a 95% error figure of merit for the probable system accuracy, given the current GPS satellite navigational quality (satellite tracking state and geometry) as shown in Figure 3C-120 and Table 3C-82. If GPS/A/H is indicated on the title line, the FMS-800 is using airspeed and heading sensor inputs to smooth the GPS data. This is required to have a valid bank (roll) command output to the flight director and autopilot.

The MODE indicates the current GPS receiver tracking/aiding mode of INIT, TEST, or NAV/PVA.

The STATE indicates the lowest tracking state of the four primary satellite tracking channels: STATE 1 is acquisition, STATE 3 is code track only (in jamming), and STATE 5 is code and carrier lock (no jamming).

The number of satellites being tracked for primary navigational purposes is displayed. Normally four satellites are tracked to provide a fully determined position (a four dimensional position requires four satellites). Less than four may result in GPS's data being invalid.

Table 3C-81. Display of Navigation Mode on Position Pages

SELECTED NAV SOLUTION	DISPLAYED MODE	CONDITIONS FOR DISPLAY
GPS	GPS/A/H	GPS navigation data is smoothed with airspeed and heading
GPS	GPS/ - /H	GPS navigation data is being smoothed with GPS groundspeed and heading
GPS	GPS/ - / -	GPS is not being smoothed with airspeed and heading data
GPS	- - - /A/H	GPS is invalid; FMS is dead reckoning with airspeed and heading data
MODEL	MODEL	The model aircraft function is providing the navigation solution. This function is available only while on the ground.

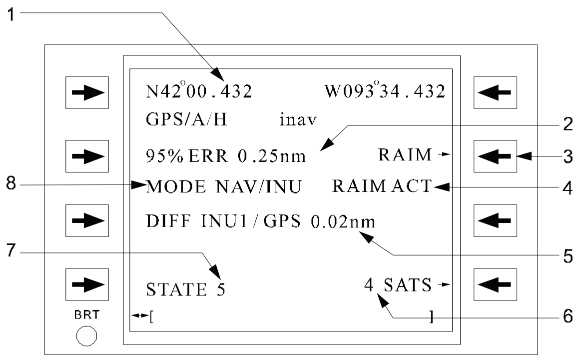


Figure 3C-120. GPS Integrated Navigation Page

Table 3C-82. GPS Integrated Navigation Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Indicates present GPS position.
2	95% probably position error.
3	Selects GPS RAIM page.
4	Indicates the current RAIM Status.
5	Difference from designated pilot's source.
6	Number of GPS satellites tracked.
7	The GPS receiver state.
8	The current GPS tracking/aiding mode.

(b) GPS Satellite Data. The FMS-800 provides the crew access to the page displaying the individual channel/satellite tracking status for the GPS receiver. Selecting the **SATS** line select key on the GPS INAV page will access this page. Refer to Figure 3C-121 and Table 3C-83.

NOTE

The possible state displays are listed below.

1, 2	S	Search
4, 6	T	Tracked
3	I	Interference
5	D	Tracked with data
7	R	Recovery

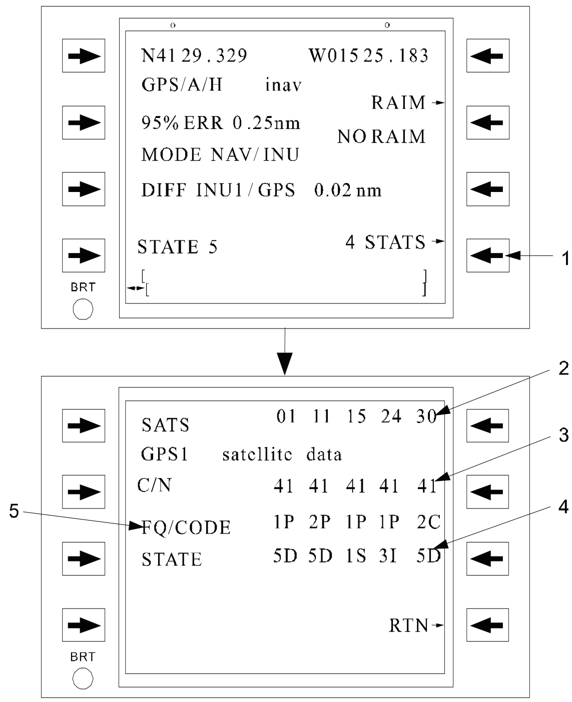


Figure 3C-121. GPS Satellite Data

Table 3C-83. GPS Satellite Data Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing line select key **SATS** will access the channel/satellite tracking status page.
2	Indicates satellite vehicles in track or search.
3	Indicates the carrier to noise ratio of satellite signal.
4	Indicates tracking state of satellite channel.
5	The frequency and code in track.

The GPS satellite data page provides information regarding the current tracking state of each GPS receiver channel. This page also provides information on which satellite is currently being tracked, current carrier to noise ratio for the incoming signal, frequency and code types being tracked, and the current state of receiver tracking.

(c) GPS Receiver Autonomous Integrity Monitoring (RAIM). The FMS-800 provides the crew access to a page providing the RAIM control/predictive RAIM for the active GPS receiver. Selecting the RAIM line key on the GPS INAV page accesses these pages. Refer to Figure 3C-122 and Table 3C-84

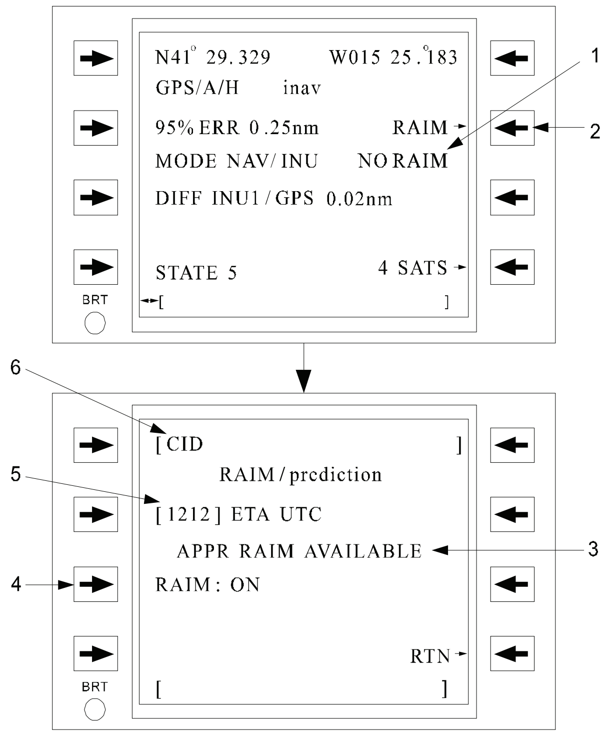


Figure 3C-122. GPS RAIM

Table 3C-84. GPS RAIM Procedure

NO.	DESCRIPTION/FUNCTION
1	Indicates the current state of active RAIM solution.
2	Pressing line select key **RAIM** will access the RAIM/prediction page.
3	Expected state of RAIM availability at destination.
4	Select to disable nuisance RAIM annunciations.
5	Indicates Estimated Time of Arrival at destination.
6	Destination of interest for RAIM

The FMS-800 provides an active RAIM solution at present position. By tracking GPS satellite state-of-health and orbital geometry, the FMS-800 is capable of determining when the GPS navigation solution is degraded or suspect due to satellite failures. If the GPS receiver is unable to provide a RAIM solution due to satellite tracking problems or problems with the satellite constellation geometry, a **NO RAIM** annunciation is shown to inform the crew of the absence of RAIM protection. During a NO RAIM period, the GPS navigation solution may be acceptable, but the integrity of that solution will be indeterminate. During normal GPS navigation with an active RAIM solution, if the GPS receiver determines that there is an inconsistency in the GPS navigation solution, a RAIM alert will be provided to inform the crew of a degraded GPS navigation solution. When an alert is indicated, the crew should compare the GPS-based navigation solution with other available sensors (INU, TACAN, and VOR/DME) to ensure the GPS navigational accuracy is acceptable. If unacceptable, select a non-GPS based navigation solution on the lateral steer page, Figure 3C-118, until the integrity of the GPS navigation solution is restored.

The current state of the GPS RAIM solution is provided on the Primary GPS INAV page as follows:

1. **NO RAIM** when RAIM processing is unavailable.

2. **RAIM ACT** when RAIM processing is actively performing integrity checks.

3. **RAIM WRN** when RAIM has detected an inconsistency.

The line select key next to RAIM on the RAIM/prediction page will enable or disable the RAIM annunciations. When **OFF** is selected, RAIM annunciations are inhibited and the pilot advisories regarding GPS integrity performance will be only available on the GPS INAV page. RAIM annunciations should only be disabled if a failure is suspected in the GPS receiver causing nuisance annunciations. Annunciations will be automatically re-enabled whenever the FMS is powered on or enters the terminal area.

To request the availability of approach RAIM at a destination airport, enter the identifier of the airport in the top line of the RAIM/Prediction page. Enter the ETA in UTC. After performing the predicted calculation, the FMS-800 will display the availability of approach RAIM on the page information line. This availability applies to a period from 15 minutes prior to the entered ETA until 15 minutes after the ETA. A predictive RAIM solution only provides an indication of the availability of RAIM protection that is expected at the destination based on the current orbital characteristics of the GPS constellation. It does not provide an actual integrity determination at the desired location.

(d) Selective Availability/Antispoofing Control Page. The FMS-800 provides access to a GPS Selective Availability/Antispoofing control page. From the IDX page, select **SA/AS** to access the SA/AS control. From this page, the current status of GPS receiver keying is displayed, with two selections for mission duration and SA/AS mode selection. GPS

mission duration is entered in days and defines the expected length of an aircraft mission requiring GPS keys. If more keys are loaded into the GPS receiver than are needed, the entry of duration will zeroize the excess keys. If duration exceeds the availability of keys, the FMS will annunciate the need to load additional keys. The duration displayed on the page is the current duration of the keys loaded into the GPS receiver.

NOTE

When the GPS receiver is configured for Y-Only mode and no keys are loaded into the GPS receiver to decrypt the satellite telemetry, RAIM processing is disabled and RAIM protection will be unavailable.

The SA/AS mode selection allows the operator to select between a mixed mode satellite constellation with both keyed and unkeyed satellite transmissions, or restrict the receiver to Y-only keyed satellites, excluding the use of satellites not currently keyed for P(Y) code encryption.

s. Navigation Radio Information.

(1) Navigation Radio Information Overview. The FMS-800 provides navigation radio information upon valid entry of an airport identifier. The crew may access the Navigation Radio Information page via the NAV function key on the CDU. Refer to Figure 3C-123 and Table 3C-85.

Selection of the airport identifier, with a valid airport ID in the scratchpad and loaded on the data cartridge, will load the airport navigation information of that airport from the data cartridge. The entered ID will also be entered on the Communications Radio page.

(2) Navigation Radio Information Page Functionality. Data lines 2 through 4 display the following data.

1. The name of the approach which includes the type of NAV aid and the runway. The possible types of NAV aids are ILS, LOC, Back Course (BC) and for an LOC, BC, Localizer type Directional Aid (LDA), or Simplified Directional Facility (SDF).

2. The frequency of the NAV aid.

3. The NDB frequency associated with the approach, if any. The NDB frequency is the frequency of a compass locator at the outer, middle, or inner marker beacons.

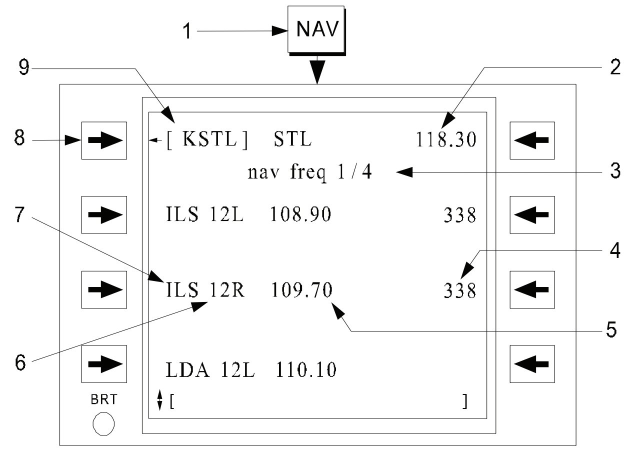


Figure 3C-123. Navigation Radio Information Page

Table 3C-85. Navigation Radio Information Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing the function key **NAV** will access the Navigation Radio Information page.
2	Indicates the frequency of the recommended airport navigation aid.
3	Indicates page 1 of 4.
4	The NDB frequency.
5	The frequency of the navigation aid.
6	The runway ID.
7	Type of navigation aid.
8	When a valid airport ID is in the scratchpad, LS1 retrieves the navigation information for that ID from the data cartridge.
9	The airport ID.

(3) Vertical Scrolling. Vertical scrolling has the following characteristics.

1. Will access additional approach frequency data for other runways and wrap around in both directions if more than one page of information exists.

2. Data line 1 will remain fixed during scrolling.

The frequencies will be displayed in groups of three per page. A maximum of 12 frequencies or 4 pages may be accessed.

t. Communication Radio Control.

(1) Communication Radio Control Overview. The FMS-800 provides control of the following functions from the CDU for the ARC-210 V/UHF radio.

1. V/UHF radio mode selection.

2. V/UHF radio squelch, bandwidth, tone, and modulation control.

3. V/UHF radio scanning operation.

4. HAVE QUICK I/II function control, including MWOD and FMT list selection, time synchronization, date entry, MWOD verification, and SINCGARS control functions.

In addition, the flight displays provide heads up control and display of the communication radios.

Communication radio frequency selection is available via the communication page by selecting the COM function key of the CDU. The V/UHF control pages provide the basic radio control features. Specialized pages, such as the V/UHF HAVE QUICK II setup pages and SINCGARS control pages, are also available.

If the FMS-800 cannot interface with a radio for any reason (i.e., LRU failure, data bus failure, etc.), a check mark (√) will be displayed to the left of the title line of all pages corresponding to that radio. A √ will also be displayed on the communication pages adjacent to the preset number of the LRU.

Power to the communication radio is controlled via the power pages.

The FMS-800 also has provisions for an external, crew-activated emergency mode switch for setting all communication radios to emergency frequencies, if installed on the aircraft.

(2) V/UHF Radio Control.

(a) V/UHF Frequency Selection. The crew may tune the V/UHF radios by frequency, callsign, maritime channel, or preset number. Frequency tuning is performed directly on the Communications page by entering the desired frequency in the scratchpad and pressing the channel selection line select key. Refer to Figure 3C-124 and Table 3C-86. A valid frequency is entered as two to three digits followed by up to four decimals, followed by A, AM, F, or FM to define the modulation type. An **M** is displayed as the preset number to indicate the frequency was entered manually. Possible ways of tuning the communication radio are with manual frequency selections (including frequencies, net identifiers, or maritime channel entries), preset callsign entry, preset number selection, or airport frequency selection.

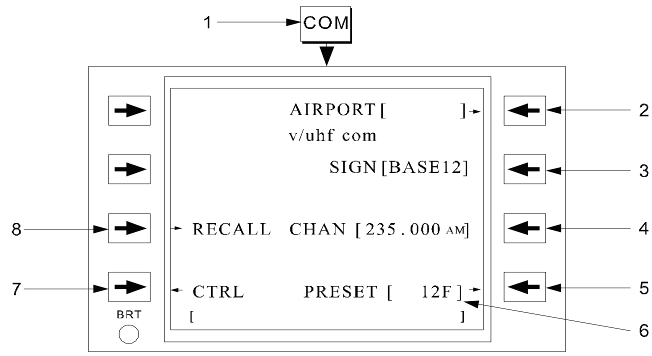


Figure 3C-124. Frequency Control Communication Page

Table 3C-86. Frequency Control Communication Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing the function key **COM** will access the communication page.
2	Enter airport identifier and access the V/UHF airport frequency page.
3	Enter preset callsign or display airport callsign.
4	Enter frequency or channel.
5	To access preset list.
6	Indicates preset number.
7	To access the V/UHF control page.
8	Recall frequency to last tuned.

The crew may also tune a V/UHF frequency using the scratchpad of any CDU page and the **QUICK TUNE** push button, located on the pilot's and copilot's control yoke. Enter any of the following into the CDU scratchpad and press the **QUICK TUNE** push button to tune the radio.

1. A valid V/UHF frequency, channel, or net identifier.

2. A valid callsign for a V/UHF frequency located in the preset list. This does NOT include airport frequency callsigns.

When the crew changes the radio frequency, the FMS-800 saves the previous frequency. To return to the previous frequency, press the **RECALL** line select key or press the **QUICK TUNE** push button with no CDU scratchpad entry.

(b) Preset Frequency Tuning. Preset frequencies can be entered manually on the V/UHF preset pages, which can be stored on or loaded from a data cartridge. The FMS-800 maintains one list of 52 presets for the V/UHF radio. To select a preset frequency, either enter the preset number and press line select key 4R on the Communications page, access the V/UHF presets pages and select one of the 52 available presets, or enter the preset callsign and press the appropriate line select key. Once the preset is selected, the preset number is displayed in the preset number field on the Communication page along with the associated callsign. Refer to Figure 3C-125 and Table 3C-87.

To tune the radio to a preset callsign, enter the callsign and press the appropriate line select key on the Communication page. The FMS-800 will search the preset list for that callsign and tune the radio to that frequency, if found. If the callsign is not found, SIGN NOT FOUND will be displayed.

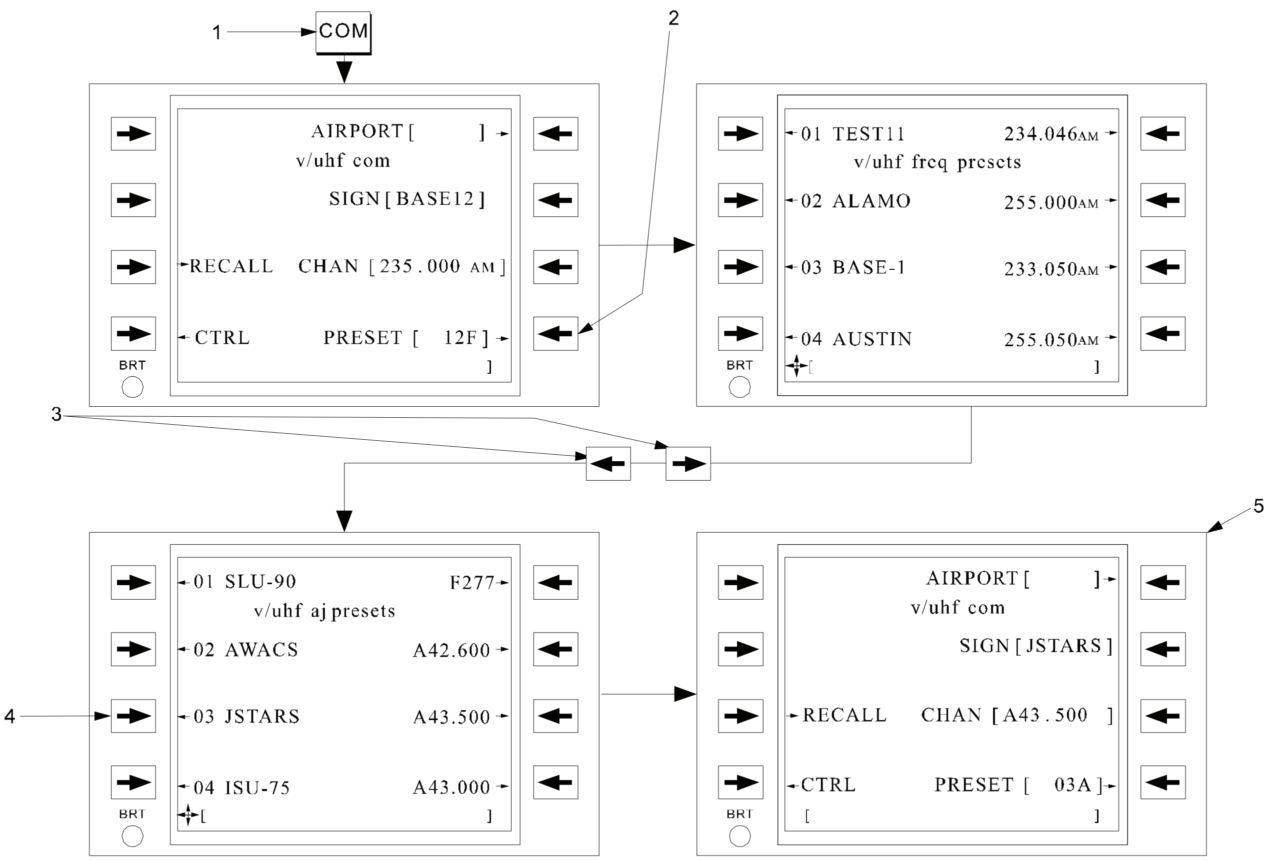


Figure 3C-125. Preset Page Access and Usage

Table 3C-87. Preset Page Access and Usage Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing **COM** function key will access the communication page.
2	Pressing line select key **PRESET** will access the V/UHF presets page.
3	Laterally scroll between the frequency presets and the V/UHF antijam presets pages.
4	To select a new preset number
5	The communication page returns with the selected preset displayed.

To enter the preset frequencies into the preset lists, access the Preset pages from the Communication page and laterally scroll to the Frequency Preset or Antijam Preset page. Refer to Figure 3C-126 and Table 3C-88. Access the Preset page by selecting the right line select key corresponding to the preset list item and assign a frequency and callsign to the preset list item.

On the last page of the Antijam presets, select **UPDT CDU AJ PRESETS** to reload ARC-210 Antijam presets into the CDU to align radio and CDU preset lists.

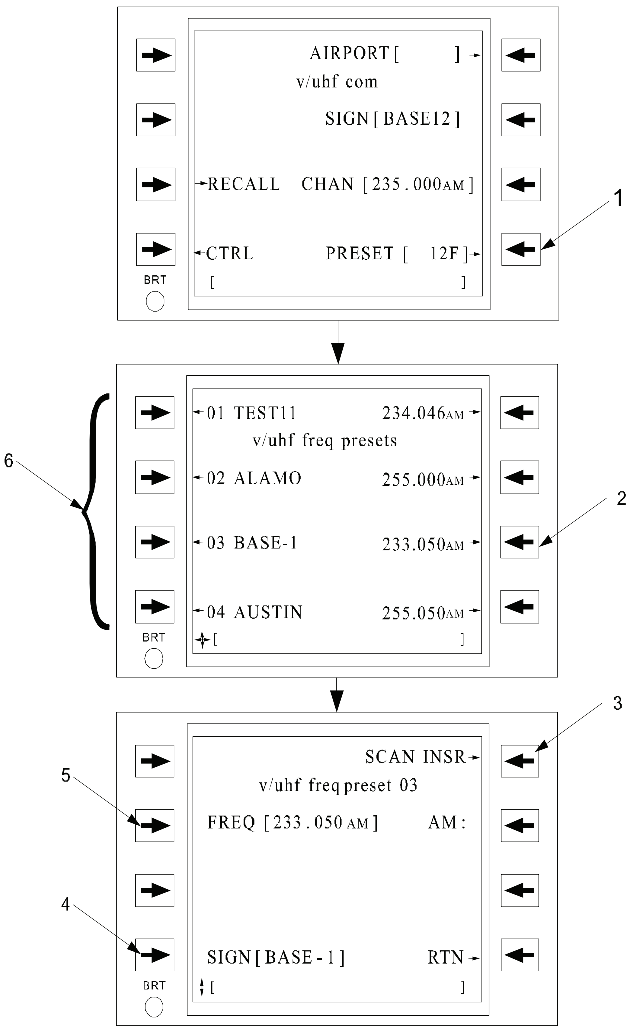


Figure 3C-126. Frequency and Antijam Preset Page Access and Usage

Table 3C-88. Frequency and Antijam Preset Page Access and Usage Procedure

NO.	DESCRIPTION/FUNCTION
1	To access the presets page(s) and laterally scroll to the desired preset list page.
2	To access frequency preset page to define preset.
3	Select to insert into scan list.
4	Select callsign for preset frequency.
5	Select frequency and modulation for preset.
6	Select to tune to preset and return to communication page.

(c) Maritime Channels. To use a maritime channel, enter **M** and the channel number. If the transmit frequency is to be the coast frequency associated with that channel, insert a **C** after the channel number. If **C** is not entered, the ship frequency will be used as the transmit frequency. To switch radio tuning between ship and coastal frequencies, enter an **S** (ship) or **C** (coast) into the CDU scratchpad and press the **CHAN** line select key.

(d) V/UHF Scan Function. The FMS-800/ARC-210 provides an ability to continuously scan up to four communications frequencies for incoming signals. To enable the ARC-210 scan function, access the V/UHF control page and toggle the SCAN mode to **ON**. **SCAN:** will replace the callsign field of the communication page and the frequency field will display the scan frequency. The radio will progressively scan through each of the four scan frequencies entered on the V/UHF scan list page. When the radio detects a signal on one of the scan frequencies, **RECV:** will be displayed as long as a signal is detected. The frequency on which the signal was detected will be displayed in the frequency field. To lock onto that frequency, press the **RECV** line select key to toggle the channel to LOCKX. Repeat pressing this line select key to recall former locked scan frequencies. Up to three scanning frequencies can be recalled as locked frequencies. When the oldest locked frequency is displayed, press the same line select key again to return the radio to scan mode.

To enter the frequencies into the scan list, access the preset pages from the Communication page and laterally scroll to the V/UHF Scan List page. Refer to Figure 3C-127 and Table 3C-89. The first scan frequency is the scan transmit frequency (i.e., the frequency on which the radio will transmit, if keyed while scanning). Access the Scan Preset page by selecting the right line select key corresponding to the scan list item and, like on the Frequency Preset page, assign a frequency and callsign to the scan list item. On the Frequency Presets pages, transfer presets from the V/UHF Presets pages to the scan list by accessing the V/UHF Preset xx page of the desired preset and press the **SCAN INSR** line select key. The V/UHF Scan List page will be displayed with INSERT PRESET AT? in the scratchpad. Press any of the four left line select keys to insert the frequency preset into the scan list.

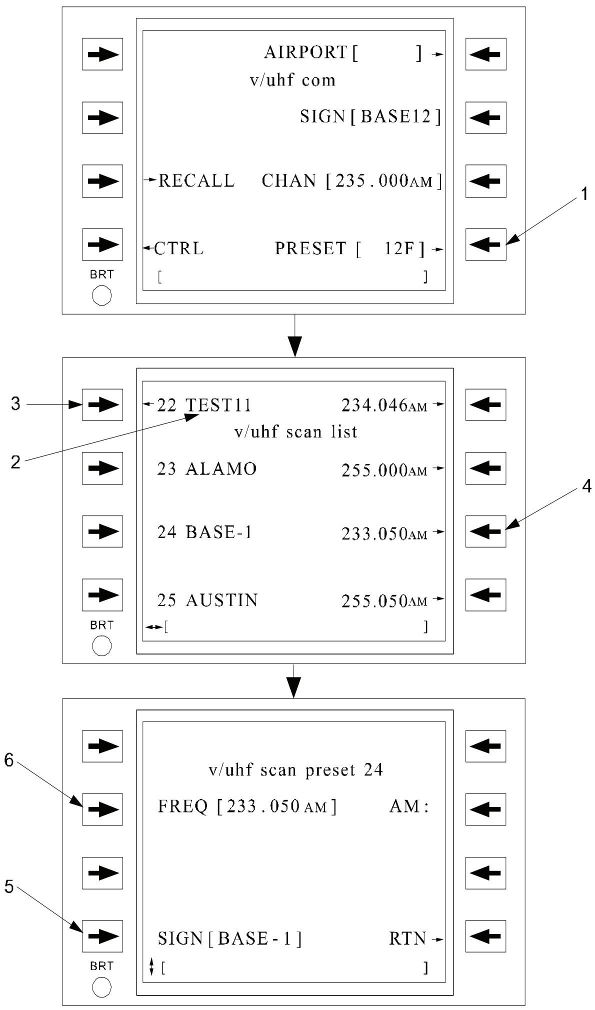


Figure 3C-127. Scan Preset Page Access and Usage

Table 3C-89. Scan Preset Page Access and Usage Procedure

NO.	DESCRIPTION/FUNCTION
1	Press the line select key to access the presets page(s) and laterally scroll to the scan list page.
2	Indicates first scan list item used when push-to-talk is pressed during scan.
3	To activate scan function and return to communication page.
4	Press the line select key to access scan preset page to define.
5	Select callsign for scan frequency.
6	Select frequency and modulation for scan.

(e) V/UHF Airport Frequency Selection. To tune the radio to airport frequencies stored on the data cartridge, access the V/UHF Airport Frequency page. The V/UHF Airport Frequency page may be accessed from the Communication page by entering a valid airport identifier and then pressing the line select key 1R. Refer to Figure 3C-128 and Table 3C-90. With a valid airport identifier displayed at line select key 1R, press this key to access the communication radio frequencies associated with that airport.

Line select keys 1L through 4L on the Airport Frequency page will select the corresponding airport frequency and tune the radio to the frequency or channel that was selected. The currently tuned frequency will be indicated with an * instead of an → adjacent to the line select key.

Vertical scrolling will access additional V/UHF Airport Frequency pages. The scrolling wraps around if more than one page exists.

Data lines 1 through 4 will display the following airport frequency information.

1. The V/UHF frequency.

2. The 3 or 4-character communication type (ATI, CPT, etc.).

3. The sectorization data, if any.

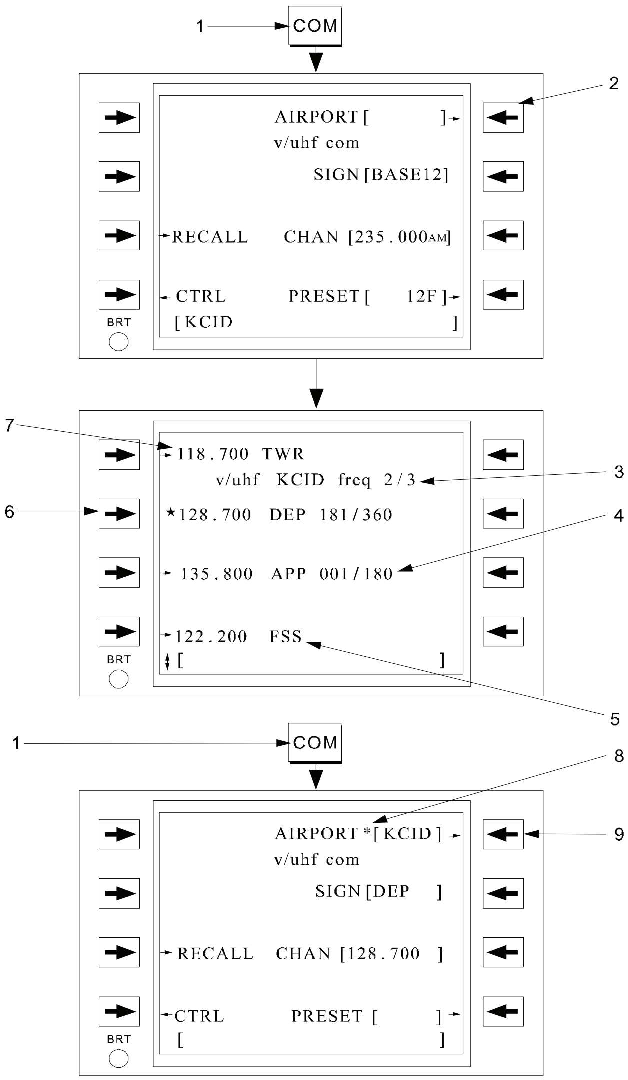


Figure 3C-128. Tuning to Airport Frequencies

Table 3C-90. Tuning to Airport Frequencies

NO.	DESCRIPTION/FUNCTION
1	Pressing function key **COM** will access the communication page.
2	Enter airport to access airport frequency.
3	Indicates page 2 of 3. Scroll vertically to access additional pages.
4	Sectorization.
5	Communication type.
6	Select desired airport frequency.
7	Airport frequencies.
8	An * indicates airport frequency is currently tuned.
9	Access airport frequencies for given airport.

(f) V/UHF Radio Mode Selection. To select the V/UHF radio mode, toggle the **MODE** line select key on the V/UHF control page. Refer to Figure 3C-129 and Table 3C-91. The possible selections are Transmit/Receive (TR), transmit/receive with the independent guard receiver activated (TR/G), UHF guard (GD243), and VHF guard (GD121). In UHF guard mode, the FMS-800 tunes the V/UHF transmitter/receiver to 243.000 MHz and deactivates the independent guard receiver. In VHF guard mode, the FMS-800 tunes the V/UHF transmitter/receiver to 121.500 MHz and deactivates the independent guard receiver. When in either of the guard modes, the Communication page displays the guard frequencies and GUARD for the callsign.

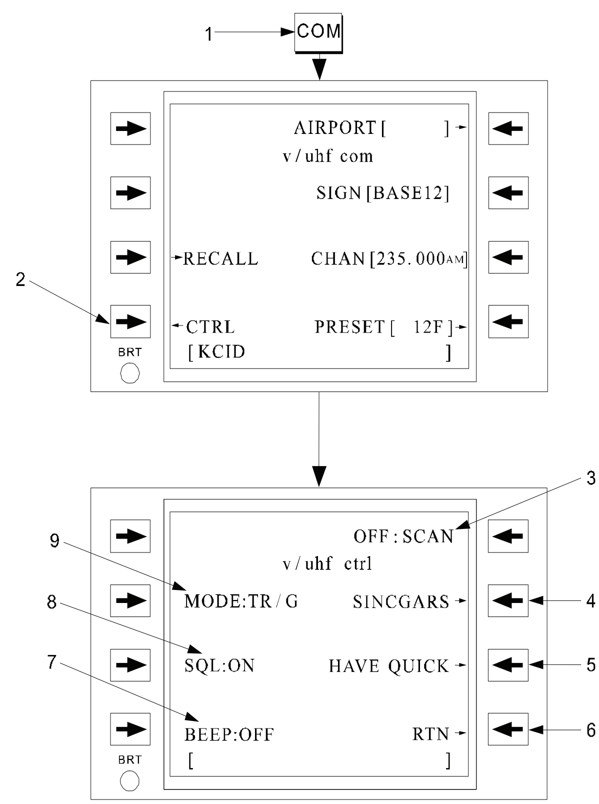


Figure 3C-129. V/UHF Control Functions

Table 3C-91. V/UHF Control Functions Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing the function key **COM** will access the communication page.
2	Press to access the V/UHF CTRL page.
3	Enable/disable frequency scanning.
4	Access SINCGARS control.
5	Access HAVE QUICK control.

Table 3C-91. V/UHF Control Functions Procedure (Continued)

NO.	DESCRIPTION/FUNCTION
6	Returns to the communication page.
7	Enable/disable audio beeps.
8	Enable/disable squelch.
9	Select radio modes: TR, TR/G, G243.0, or G121.5.

(g) V/UHF Radio Squelch, Bandwidth, Tone, and Modulation Control. Control of the V/UHF radio squelch and tone is performed on the V/UHF Control page. Toggle the squelch **ON** or **OFF** by pressing the **SQL** line select key. Select headset beeps on and off by pressing the **BEEP** line select key.

(h) V/UHF HAVE QUICK I/II Functionality. The FMS-800 order of operations for setting up the V/UHF radios for HAVE QUICK I/II functionality is listed below.

1. Load the Multiple Words of the Day *(*MWOD's) and/or FMT lists into the V/UHF.
2. Load the desired date into the V/UHF – ensure a Word of the Day (WOD) is loaded for the entered date.
3. Synchronize time with the V/UHF radio.
4. Enter the desired net identifier on the Communication page.

(i) Loading Multiple Words of the Day. An MWOD list can be created manually using the V/UHF MWOD Entry pages or loaded from a data cartridge. The FMS-800 maintains one MWOD list for V/UHF radios consisting of six WOD's. To load each WOD element into the MWOD list manually, access the MWOD Entry page as shown in Figure 3C-130 and Table 3C-92. To load the MWOD list into the V/UHF radio, press the **ENTER** line select key on the V/UHF MWOD Entry page. Entry of the MWOD list into the V/UHF radio will load the WOD's for the selected day into the V/UHF radio. Up to 6 days of MWOD lists may be transferred into the V/UHF radio. To enter additional daily MWOD's, enter the selected date for the MWOD and load WOD's as described above. When an MWOD is successfully loaded into the V/UHF radio, the radio will acknowledge the load with one short tone following each WOD loaded, and will end with two short headset beeps.

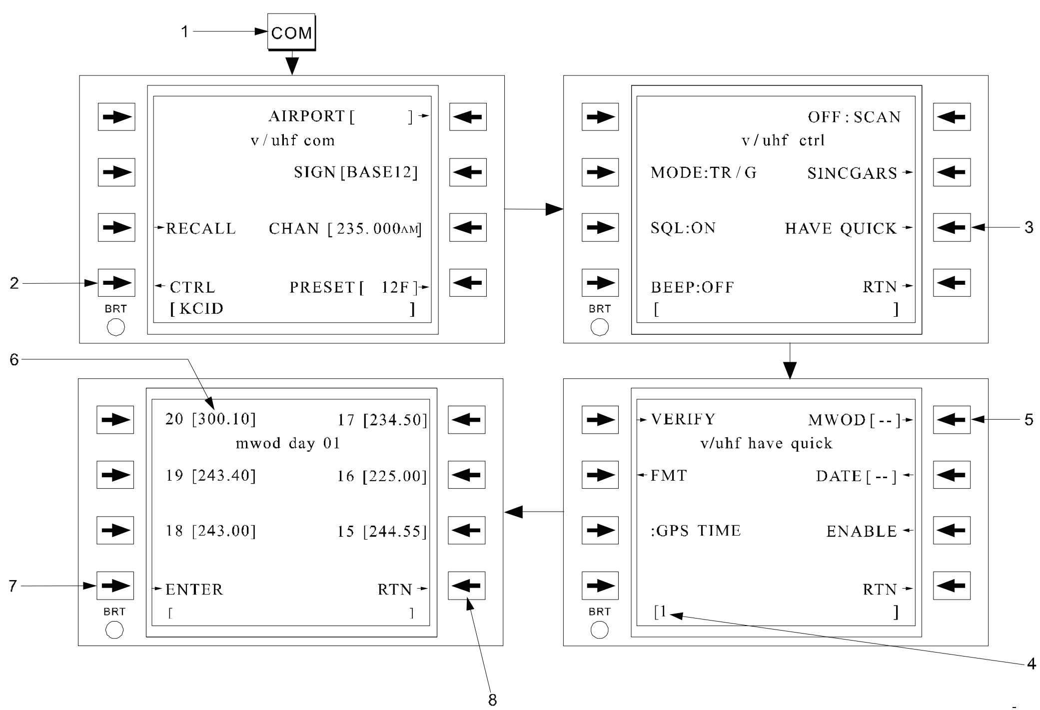


Figure 3C-130. UHF MWOD List Selection and Loading

Table 3C-92. UHF MWOD List Selection and Loading Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **COM** function key to access communication page.
2	Press **CTRL** line select key to access V/UHF CTRL page.
3	Access the V/UHF HAVE QUICK setup page via the V/UHF control page.
4	Enter the MWOD date.
5	Access the V/UHF MWOD entry page for the selected day and enter the WOD elements if necessary. The MWOD elements can be loaded from the data cartridge also.
6	Element 20 must be between 200.0xx and 299.9xx or 300.1xx and 399.9xx (xx can be any two digits) for a WOD.
7	Load the MWOD list into the corresponding V/UHF radio.
8	Return to the V/UHF HAVE QUICK setup page.

(j) Loading Frequency Management Training Lists. An FMT list can be created manually using the V/UHF FMT Load pages or loaded from the data cartridge. Refer to Figure 3C-131 and Table 3C-93. To load each FMT element into the FMT list manually, access the FMT Load pages as shown in Figure 3C-131. Finally, to load the FMT list into the V/UHF radio, press the **ENTER** line select key on any of the V/UHF FMT Load pages. When an FMT list is successfully loaded into the V/UHF radio, the radio will acknowledge each FMT element load with a short tone, ending with two headset beeps.

NOTE

FMT elements can be manually entered or loaded from the data cartridge.

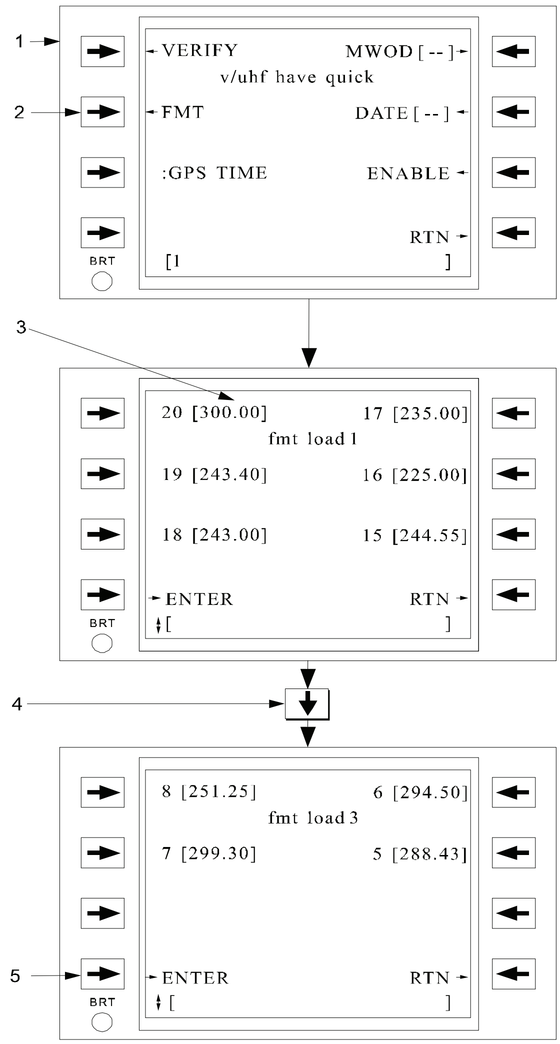


Figure 3C-131. V/UHF FMT List Selection and Loading

Table 3C-93. V/UHF FMT List Selection and Loading Procedure

NO.	DESCRIPTION/FUNCTION
1	Refer to Figure 3C-132 for details on how to access the V/UHF 1 HAVE QUICK setup page.
2	To access FMT load 1 page.
3	Element 20 must be set to 300.0xx (xx can be any two digits) for an FMT list.
4	Scroll to the V/UHF FMT load pages 2 and 3.
5	Load the FMT list into the corresponding V/UHF radio.

(k) Entering Active MWOD Date. To set the V/UHF radio to the desired date and enable the MWOD list for the given date, enter the date in the scratchpad (one or two digits representing the calendar day of the month) and press the **DATE** line select key on the V/UHF HAVE QUICK II Setup page. The V/UHF radio will acknowledge the load with one headset tone. Refer to Figure 3C-132 and Table 3C-94.

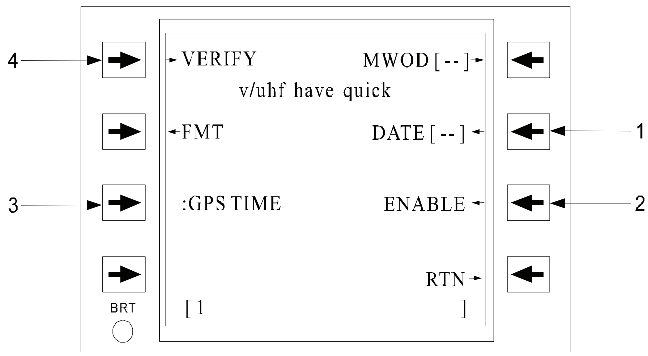


Figure 3C-132. HAVE QUICK Setup Page

Table 3C-94. HAVE QUICK Setup Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter active date for MWOD.
2	Enable time synchronization.
3	Select type of time synchronization: GPS, RECV, SEND, or internal clock RESET.
4	Verify MWOD loaded for given date or reset radio.

The **VERIFY** line select key on the V/UHF HAVE QUICK II Setup page performs two functions: it verifies WOD's have been entered for a given date and performs a reset function by taking the V/UHF radio's HAVE QUICK computer off-line momentarily. To verify WOD's are loaded for a given date, enter the date in the scratchpad and press the **VERIFY** line select key. To reset the HAVE QUICK computer, ensure the scratchpad is cleared and press the **VERIFY** line select key.

(l) HAVE QUICK Time Synchronization. To synchronize the V/UHF HAVE QUICK radios, access the V/UHF HAVE QUICK Setup page, and select the desired synchronization mode. Select **GPS TIME** to synchronize the radio to GPS UTC. Select **RECV TIME** or **SEND TIME** to receive or send a time synchronization from another radio. Select **RESET TIME** to reset the internal clock when no other time is available. Activate the time synchronization by pressing the **ENBLE** line select key.

When performing GPS time synchronization, first confirm that the GPS time figure of merit is reasonable by monitoring the 95% ERR display on the GPS INAV page. Although this is the position error, it is directly proportional to time error. If the 95% ERR value is less than 0.40 nm, the GPS time figure of merit should be adequate for time synchronization.

(m) Tuning HAVE QUICK Net Identifiers. HAVE QUICK I/II net identifiers are entered on the Communication page identically to normal communication frequencies except that an "A" must be entered in the hundreds digit (i.e., A01.125 is a valid net identifier entry). Table 3C-95 lists valid HAVE QUICK I/II net identifiers for combat and training nets.

Table 3C-95. HAVE QUICK I/II Net Identifiers

NET TYPE	VALID NET IDENTIFIER	FUNCTION
Combat MWOD	Axx.x00 *	A/B Nets
	Axx.x25	NATO Nets
	Axx.x50	Non – NATO Nets
Training MWOD	A00.x0	Training Net
	A0x.x25	FMT Net
* x = any integer		

(n) V/UHF SINCGARS Functionality. The FMS-800 controls the following SINCGARS functions of the V/UHF radio.

1. Electronic Remote Fills (ERF's)
2. Late net entries
3. Time requests
4. Cold start, Cue, and Net master selection

The V/UHF SINCGARS Control page may be accessed via the V/UHF Control page. Refer to Figure 3C-133 and Table 3C-96.

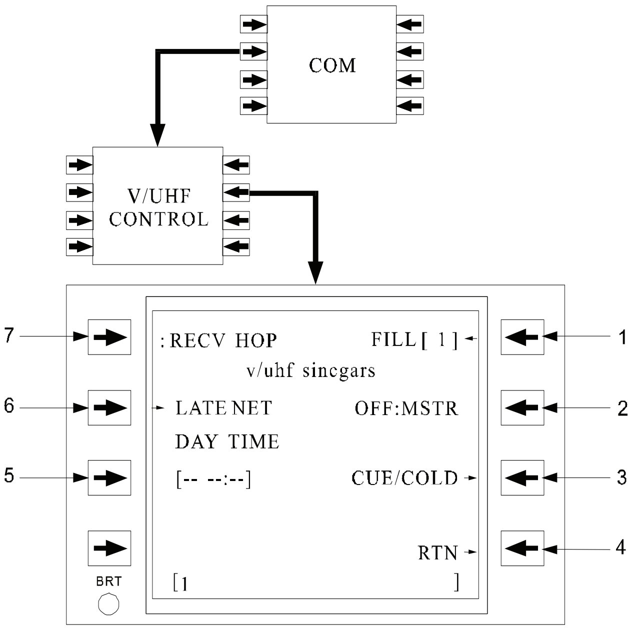


Figure 3C-133. SINCGARS Page Access

Table 3C-96. SINCGARS Page Access Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter hopset/lockout number or enable fill with a blank scratchpad.
2	Enable V/UHF as net control station master.
3	Access cue/cold preset page.
4	Access V/UHF control page.
5	Enter day/time for net synchronization.
6	Enable late net entry.
7	Select ERF fill type.

(o) Electronic Remote Fill (ERF). To activate an ERF of hopset or lockout frequencies for SINCGARS, select the type of ERF by toggling the line select key between the following keys.

1. RECV HOP (Receive Hopset)

2. RECV LOCK (Receive Lockout)

3. SEND HOP (Send Hopset)

4. SEND LOCK (Send Lockout)

Enter the hopset or lockout number at line select 1R and select line select 1R once more to activate the ERF. Valid hopsets will be 1 – 25 and valid lockouts will be 1 – 8.

(p) Late Net Entry. To access a SINCGARS net that has already been established, press line select key 2L. The hopset and lockout variables must already be established to allow entry into the net. Late net entries will be enabled or disabled as long as the radio is not the net master.

(q) Time Synchronization. To update the time synchronization of the SINCGARS net as a station master, enter a day/time for synchronization at the appropriate line select key. The correct entry format is DDHHMM, where DD is the date (range 0 – 99), HH is the hour (range 0 – 23), and MM is the minute (range 0-59). With a blank scratchpad, the CDU will request a current time synchronization from the V/UHF radio and display the synchronized time.

(r) Net Control Station Master Selection. If the V/UHF radio has been designated as the master control station radio, select **MSTR** to enable the master synchronization of all net radios from this radio. The designated radio must be operating in an antijam mode when selected.

(s) V/UHF Cue/Cold Page. The V/UHF Cue/Cold page may be accessed from the V/UHF SINCGARS Control page or the Communications page, if the V/UHF radio is tuned to the cue or cold preset. Refer to Figure 3C-134 and Table 3C-97.

(t) Cold Start Operation. To initially open a SINCGARS net, enter a cold start frequency and select that frequency. The cold start frequency will be enabled on the Communication page. To activate the net, use the ERF setup procedures as described above and synchronize the net radios.

(u) Cue Operation. To enter an active SINCGARS net, enter the cue frequency and select that frequency. The cue frequency will be enabled on the Communication page to allow entry into the SINCGARS net.

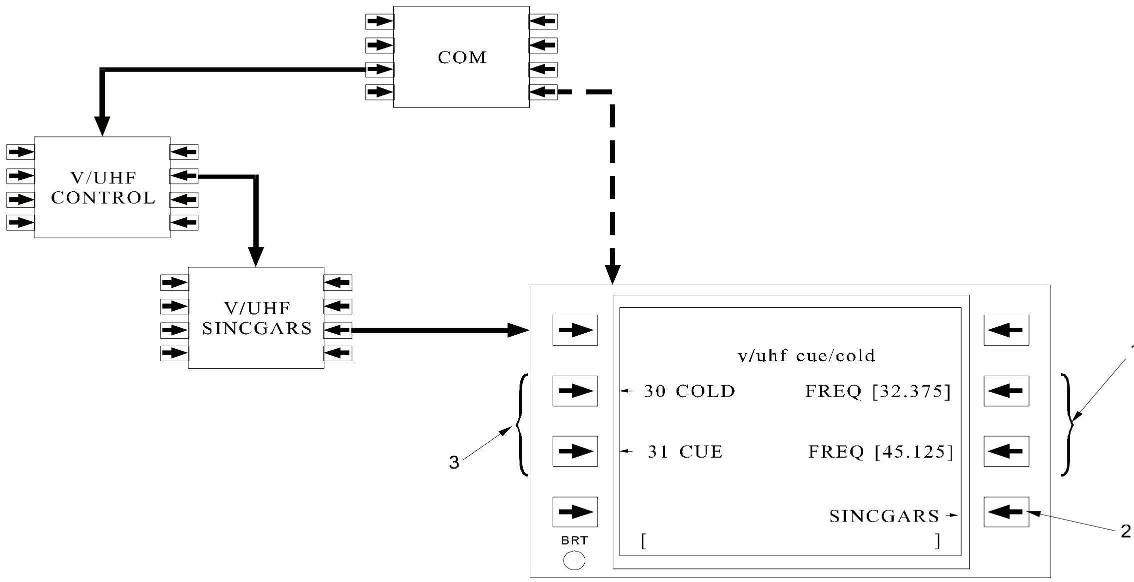


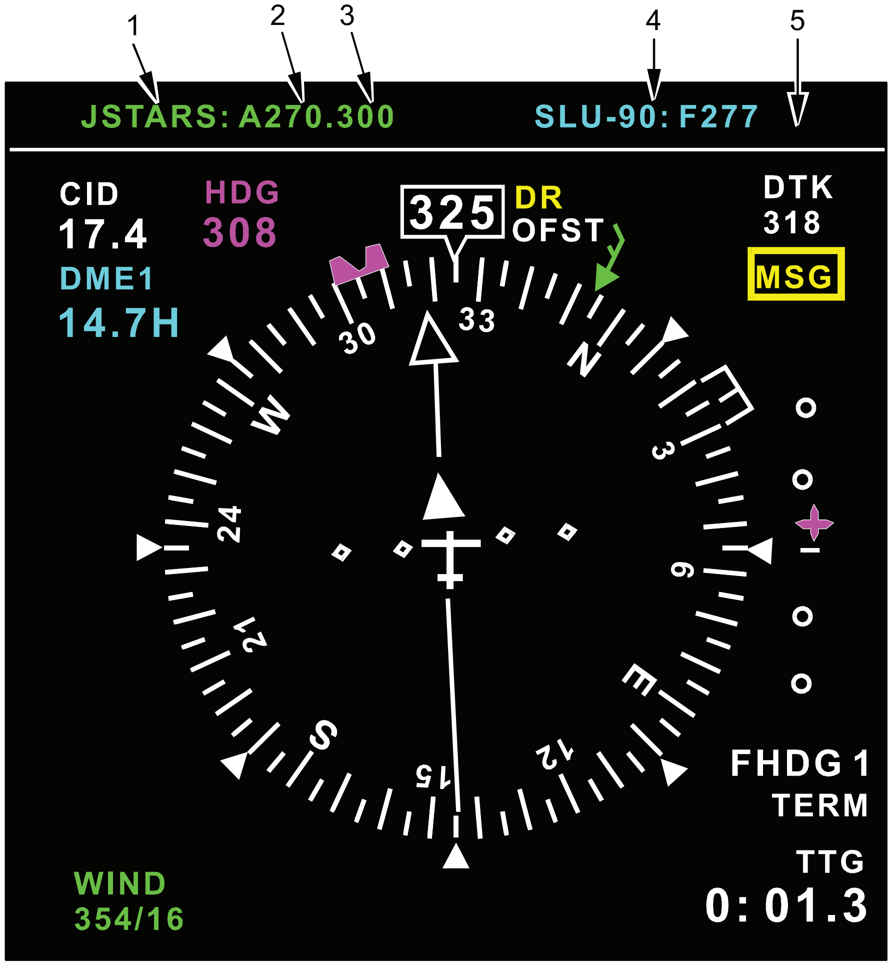
Figure 3C-134. Cue/Cold Page Access

Table 3C-97. Cue/Cold Page Access Procedure

NO.	DESCRIPTION/FUNCTION
1	Enter cold start and cue frequencies.
2	Return to SINCGARS page.
3	Select to activate cue and cold start settings of the V/UHF.

(3) Head Up Communication Radio Data. The FDS-255 provides the pilot with a heads up display of the V/UHF communication radio data on the Flight Display Free Format Line (FFL) as shown in Figure 3C-135. The current tuned callsign and frequency are displayed in green on the left side of the FFL. The previous tuned callsign and frequency are displayed in cyan on the right side of the FFL. An external **QUICK TUNE** push button, located on the pilot's and copilot's control yokes, is dedicated for remote communication radio frequency control.

The **QUICK TUNE** push button works in conjunction with the CDU scratchpad to allow the crew to tune the radio displayed on the EHSI. To tune the radio to the previously tuned frequency, press the **QUICK TUNE** push button without a valid entry in the CDU scratchpad. To tune the displayed radio to a different frequency, enter the frequency or callsign in the CDU scratchpad, regardless of what page is currently being displayed. Press the **QUICK TUNE** push button. The V/UHF will be tuned to the new frequency and the change is reflected on both the EHSI free format line and the Communication page. Refer to Figure 3C-136 and Table 3C-98 for an example of tuning a radio via the quicktune push button.



1. Callsign
2. Active Frequency (green)
3. Modulation
4. Recall Frequency (cyan)
5. Free Format Line

Figure 3C-135. Electronic Horizontal Situation Indicator Free Format Line

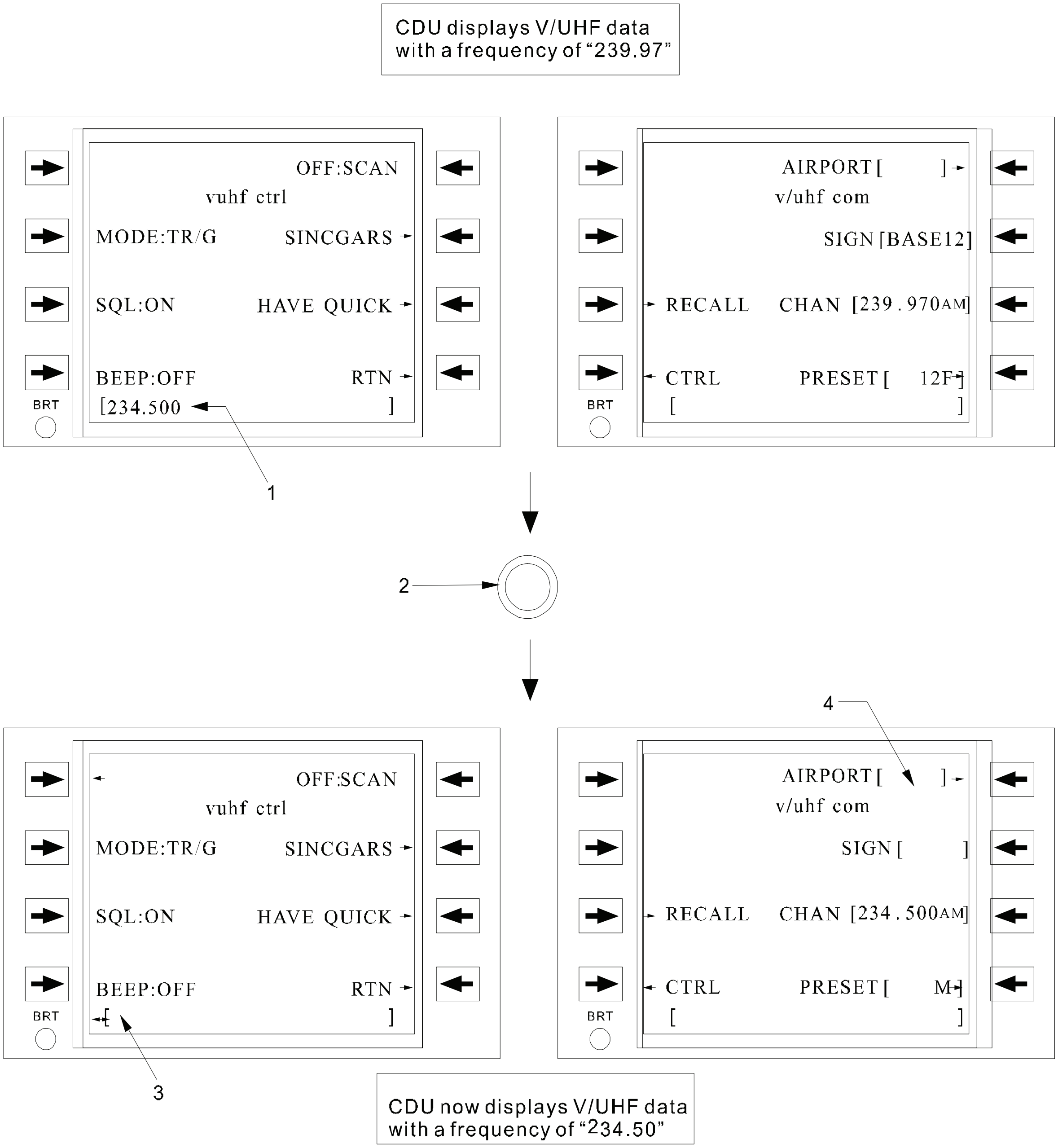


Figure 3C-136. QUICK TUNE Push Button Example

Table 3C-98. QUICK TUNE Push Button Example Procedure

NO.	DESCRIPTION/FUNCTION
1	Pilot enters a new V/UHF frequency in the scratchpad of the CDU.
2	Pilot presses the quicktune push button on the flight yoke.
3	The CDU scratchpad is cleared.
4	The FMS-800 updates the communication page V/UHF frequency display.

u. FMS1 Data Loader Operation.

(1) Data Loader Operation Overview. The FMS-800 data loader provides an interface to data cartridges for data storage and retrieval capability. The data loader and cartridge allows the crew to perform the following functions.

1. Load preplanned flight plans and preset information, as well as other flight data.
2. Save selected flight data, including system status information.
3. Access the ICAO identifier database.
4. Load a 200 waypoint user waypoint database.

The current magnetic variation tables can be loaded on the data cartridge and automatically transferred to the CDU nonvolatile memory upon installation of the cartridge into the data loader. If this file already exists in CDU memory, the FMS-800 will compare the new file to the existing file and determine which one is the most current. If the new file is the most current, the FMS-800 will overwrite the old files.

Access to data cartridge files is performed from the Data Loader pages or the start 3 page. Points from the ICAO identifier database can be requested from any page where waypoint entry is permitted. Refer to Figure 3C-137 and Table 3C-99.

(2) Loading Flight Data. The following data can be loaded from the data cartridge, if available.

1. Any one of 40 alternate flight plans with a maximum of 60 waypoints each.
2. Markpoint and User Waypoint lists.
3. GPS almanac data.
4. Fifty-two V/UHF Communication radio presets, HAVE QUICK II MWOD, and FMT lists.
5. Navigation radio information (12 ILS/LOC frequencies).
6. Airport communication frequencies.

Most of these files can be loaded individually on the Data Loader pages.

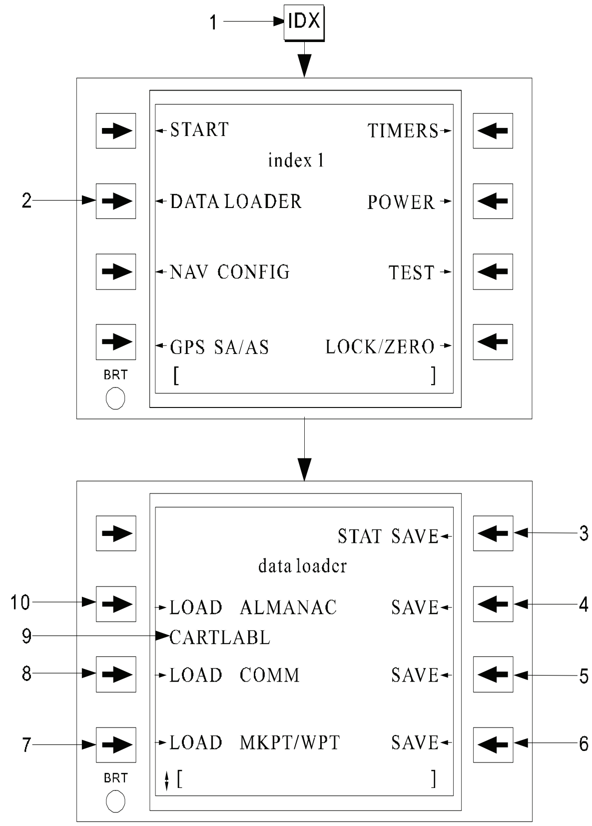


Figure 3C-137. Data Loader Page Access and Usage

Table 3C-99. Data Loader Page Access and Usage Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing function key **IDX** will access the index page.
2	Access the Data Loader pages.
3	Saves the fault history of all avionics LRU's to the cartridge.
4	Saves the current GPS almanac data to the cartridge.
5	Saves the communication radio preset data to the cartridge.
6	Saves the markpoint and waypoint lists to the cartridge.
7	Load markpoint and waypoint lists.
8	Load communication radio preset data from the cartridge.
9	The 10-character data cartridge label.
10	Load the GPS almanac data and transfer it to the GPS

(3) Saving Flight Data. The following data can be saved individually to the data cartridge.

1. Up to 40 alternate flight plans with a maximum of 60 waypoints each.
2. Markpoint and User Waypoint lists.
3. GPS almanac data.
4. Fifty-two V/UHF Communication radio presets, HAVE QUICK II MWOD, and FMT lists.
5. System fails history of all integrated avionics LRU's that provide fault status, including continuous BIT fail history, most recent initiate BIT results, and bus status fail history.

(4) Accessing the ICAO Identifier Database. ICAO identifiers stored in the data cartridge are accessed by entering the identifier into the scratchpad and pressing a waypoint entry line select key (i.e., a line select key on a CDU page allowing entry of waypoints, for example, the Flight Plan page). Once the line select key is pressed the FMS-800 searches for the entered identifier in the data cartridge and the user waypoint list. It searches first in the data cartridge and, if not found, in the user waypoint list. If the identifier is found, the corresponding information is transferred with the identifier to the CDU (i.e., waypoint type, latitude-longitude, elevation, station declination, etc.). If the identifier is not found in either database, the FMS-800 will annunciate, informing the crew that the identifier was not found in the database.

v. System Status.

(1) Status Monitoring Overview. The FMS-800 continuously monitors the status of each of the avionics system LRU's. When an LRU reports a failure with its internal Continuous Built-In Test (CBIT) routines, a √STATUS annunciation appears on the annunciation line and the CDU alert or Message (MSG) annunciation is activated.

The FMS provides continuous monitoring of CBIT results of the following LRU's:

1. CDU's.
2. Data Loader.
3. GPS Receivers.
4. ADC's.
5. V/UHF Radio.

Additionally, a detailed Status page is available for each LRU providing expanded results on both the LRU and the MIL-STD-1553B data bus for each LRU on the bus.

(2) Reporting CBIT Results. Results from CBIT routines are compiled and reported to the LRU level on the FMS Status and Navigation Status pages. A detailed status page is available for each LRU providing expanded results on the LRU itself and the MIL-STD-1553B data bus status for each LRU on the bus.

(3) System Status Page. The status pages display the status of all the LRU's in the system and provide access to the individual LRU detail status pages. Checkmarks designate which LRU caused the √STATUS annunciation when a failure is detected. The LRU checkmark is cleared when the detailed status page for the failed LRU is accessed. Refer to Figure 3C-138 and Table 3C-100.

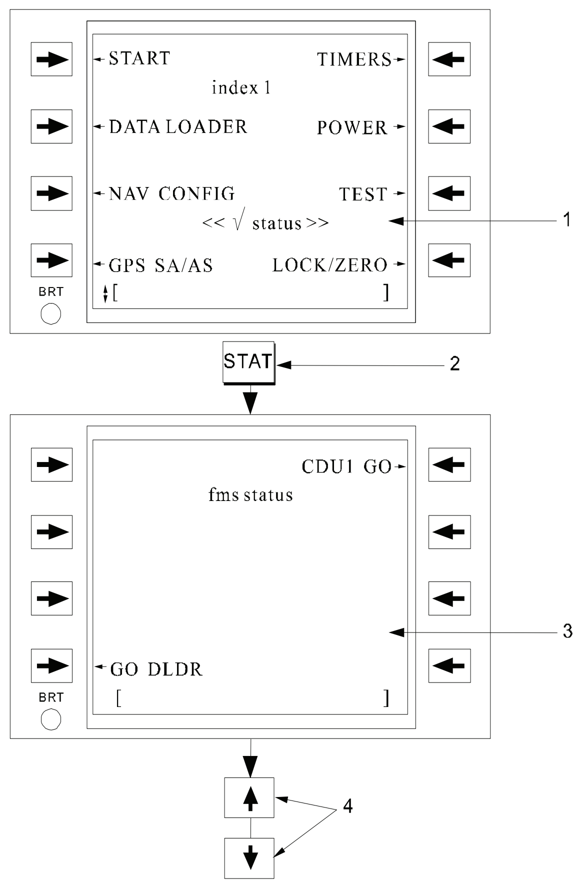


Figure 3C-138. Subsystem Status Page

Table 3C-100. Subsystem Status Page Procedure

NO.	DESCRIPTION/FUNCTION
1	The √status annunciation indicates that a failure has occurred.
2	Press to access the FMS status page.
3	The √status is cleared when FMS Status page is accessed. It can also be cleared with the **CLR** function key while on other pages.
4	Vertically scroll to access navigation sensor and navigation radio status pages.

(4) Individual LRU Detailed Status Pages. The results of CBIT's by each LRU is displayed on the respective detailed status pages which are accessed by pressing the line select key adjacent to the respective LRU display on the status page. Unknown status (i.e., bus controller is unable to communicate with a LRU) is indicated by dashes in the top-level status field. A failure counter is provided on all detailed status pages to indicate the total number of hardware and MIL-STD-1553B data bus failures. Status monitoring may be disabled for any LRU on its individual status pages (for example, if an intermittent failure is causing nuisance alerts). This prohibits the √STATUS annunciation from being displayed and the CDU alert or MSG annunciation from being activated for LRU failures. All status-monitoring results continue to be displayed on the detailed status page. The state of this selection is always reset to enable reporting on power up. Refer to Figure 3C-139 and Table 3C-101. The definition of each LRU status indication is provided in Table 3C-102. Bit definition is read from left (bit 1) to right (bit 16) on each status page. A 1 indicates a failure condition.

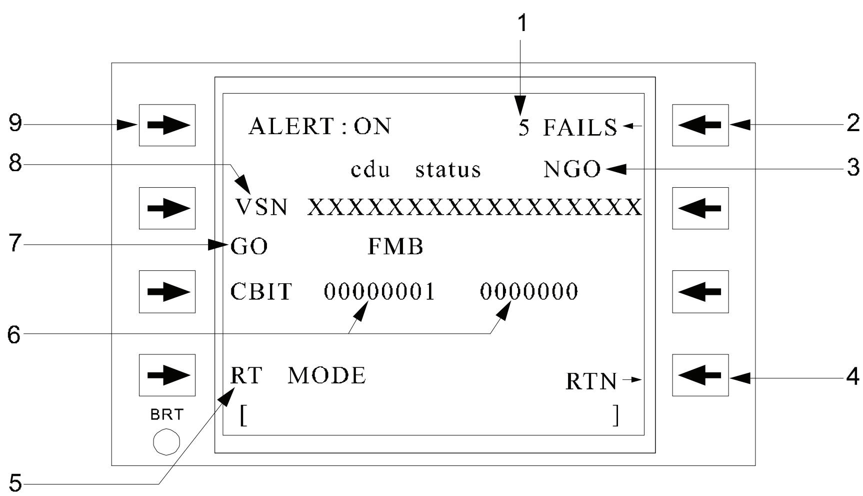


Figure 3C-139. Detailed CDU Status Page

Table 3C-101. Detailed CDU Status Page Procedure

NO.	DESCRIPTION/FUNCTION
1	Indicates the total number of failures since last reset of failure counter.
2	Resets failure counter to 0.
3	Indicates overall CDU status: GO, NGO, TST, or ---.
4	Returns to the FMS status page.
5	Indicates if CDU is either BC (bus controller) or RT (remote terminal).
6	CBIT word, detailing LRU failures, reads left-to-right and 1 indicates a failure.
7	FMB bus status: GO, NGO-A (bus A failed), NGO-B (bus B failed), NGO-T (terminal failure or both bus A and B failed)
8	OFP version.
9	Enables (ON) or disables (OFF) reporting of status monitoring annunciations.

Table 3C-102. System Failure Indications

SUBSYSTEM	FAILURE INDICATION	POSSIBLE EFFECTS
CDU Status		
Bit 1	CDU Subsystem Status	CDU may be inoperative or have impaired capability.
Bit 2	MIL-STD-1553 Terminal Status	CDU may be unable to communicate on the 1553 bus.
Bit 3 – 5	Expansion I/O Card Status	CDU may not be communicating on ARINC buses or discrete interfaces; CDU keypad entry may also be inoperative.
Bit 6	CDU Display Status	CDU display may be inoperative.
Bit 7	1553 CD Status	Not Used.
Bit 8	1553 AB Status	CDU may be unable to communicate on A and B (primary FMB) buses.
Bit 9	Serial I/O Status	CDU may not be communicating on ARINC buses.
Bit 10	Discrete I/O Status	CDU may be unresponsive to discrete inputs or incapable of generating discrete outputs.
Bit 11	Power Supply Status	CDU may be inoperative or have impaired capability.
Bit 12	Flash Memory Status	CDU program memory may be incorrect or unavailable; OFP will cease to function. Bus control relinquished.
Bit 13	NVM Status	CDU long-term memory (pilot entered data) may be incorrect or unavailable.
Bit 14	ROM Status	CDU memory may be incorrect or unavailable. Bus control relinquished.
Bit 15	RAM Status	CDU temporary memory may be incorrect or unavailable; Bus control relinquished
Bit 16	CPU Status	CDU CPU may cease to function or have impaired capability; Bus control relinquished.
BUS	MIL-STD-1553 Bus Status	NGO-A: CDU is not responding on the A bus. NGO-B: CDU is not responding on the B bus. NGO-T: CDU is not responding on either 1553 bus.
Data Loader Status		
Bit 1-3	Not Used	
Bit 4	Terminal Address Failure	Data Loader is unable to respond on the 1553 bus.
Bit 5	Fail – Safe Timer Fail	Data Loader processor has ceased to process 1553 data; 1553 data transmission terminated.
Bit 6	Memory Checksum Failure	Data Loader program memory may be incorrect or unavailable; OFP may cease to function.
Bit 7	Not Used	
Bit 8	RAM Memory Failure	Data Loader program memory may be incorrect or unavailable.
Bit 9	Not Used	
Bit 10	LSI Fault	Data Loader 1553 circuitry failed; 1553 data transmission terminate.
Bit 11	Transmit B Bus	Data Loader has failed to transmit data on the 1553 B bus.

Table 3C-102. System Failure Indications (Continued)

SUBSYSTEM	FAILURE INDICATION	POSSIBLE EFFECTS
Bit 12	Transmit A Bus	Data Loader has failed to transmit data on the 1553 A bus.
Bit 13	Fault B Bus	1553 B data is corrupted; 1553 data transmission terminated.
Bit 14	Fault A Bus	1553 A data is corrupted; 1553 data transmission terminated.
Bit 15	Data Loader Subsystem Status	Data Loader may be inoperative or have impaired capability.
Bit 16	MIL-STD-1553 Terminal Status	Data Loader may be unable to communicate on the 1553 bus.
BUS	MIL-STD-1553B Bus Status	NGO-A: Data Loader is not responding on the A bus. NGO-B: Data Loader is not responding on the B bus. NGO-T: Data Loader is not responding on either 1553 bus.
GPS Receiver Status		
RPU	GPS Receiver CPU Status	GPS CPU may cease to function or have impaired capability.
BATT	GPS Receiver Battery Status	GPS Battery Voltage is low. Almanac data could be lost on power-down.
ADC Status		
ADC	ADC Subsystem Status	ADC may be inoperative or have impaired capability.
V/UHF Status		
Bit 1	Power Supply Ready Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 2	High Power Amp (HPA) Low Voltage Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 3	HPA Temperature Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 4	HPA Voltage Standing Wave Radio Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 5	HPA Protection Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 6	Power Amp Low Power Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 7	Synthesizer Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 8	Antenna Converter Fault	V/UHF radio receive or transmit capability may be inoperative or have impaired capability.
Bit 9	Command/Compare Fault	V/UHF radio may not respond to control commands on the 1553 bus. Radio may be operative, but control may be unavailable.
Bit 10	Not Used	
Bit 11	Applique Fault	V/UHF radio may be inoperative or have impaired capability.

Table 3C-102. System Failure Indications (Continued)

SUBSYSTEM	FAILURE INDICATION	POSSIBLE EFFECTS
Bit 12	Antenna Fault	V/UHF radio receive or transmit capability may be inoperative or have impaired capability.
Bit 13	Radio Fault	V/UHF radio may be inoperative or have impaired capability.
Bit 14	Equipment Fault	V/UHF radio may be inoperative or have impaired capability. Verify other faults for functional degradation.
Bit 15	MIL-STD-1553 Terminal Status	V/UHF radio may be unable to communicate on the 1553 bus.
Bit 16	V/UHF Radio Subsystem Status	V/UHF radio may be inoperative or have impaired capability.
BUS	MIL-STD-1553B Bus Status	NGO-A: V/UHF radio is not responding on the A bus. NGO-B: V/UHF radio is not responding on the B bus. NGO-T: V/UHF radio is not responding on either 1553 bus.

w. Miscellaneous Functions.

(1) *Miscellaneous Functions*. The FMS-800 also provides the following functions that are not covered in the previous sections.

(a) *Timers*. Three independent stop-watch lap counters are available complete with time-out annunciations.

(b) *Model Aircraft*. The model aircraft inserts heading, altitude, wind, and true airspeed data into the navigation equations in order to provide a flight simulation capability.

(2) *Timer Function*. Access the timers by pressing the **TIMERS** line select key on the Index 1 page. The three timers can be used independently to display elapsed time (counting up to 23:59:59) or countdown to 00:00:00. They can be stopped at any time. Refer to Figure 3C-140 and Table 3C-103.

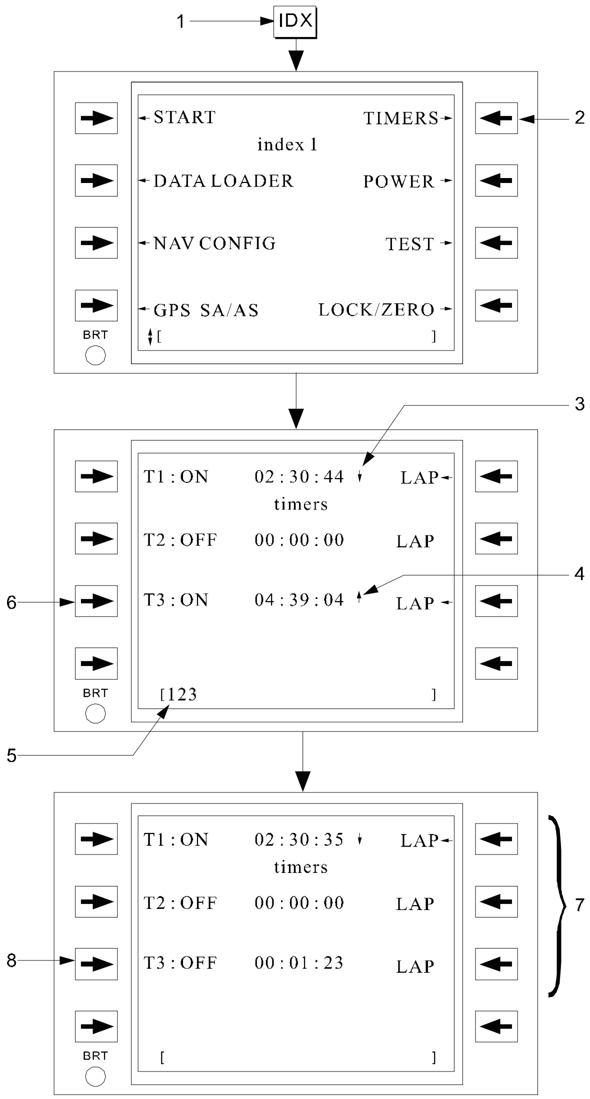


Figure 3C-140. Timer Page Access and Usage

Table 3C-103. Timer Page Access and Usage Procedure

NO.	DESCRIPTION/FUNCTION
1	Press **IDX** function key for access to index page.
2	Access timers page.
3	Timer 1 is counting down.
4	Timer 3 is counting up.
5	Enter a new countdown time in the scratchpad.
6	Set timer 3 to the new countdown time.

Table 3C-103. Timer Page Access and Usage Procedure (Continued)

NO.	DESCRIPTION/FUNCTION
7	Freeze the timer display by pressing the **LAP** line select keys. The timer keeps running and an asterisk replaces the arrow. Unfreeze the timer display by pressing the **LAP** line select key.
8	Press the line select key for timer 3 to automatically toggled to OFF and set to the new time. Press the line select key again to start the countdown.

(3) Model Aircraft Function. The model aircraft is a mission simulation capable of following all flight plan maneuvers to include holding patterns, vertical navigation, and intercepts. The model aircraft can only be operated when the weight on wheels discrete indicates the aircraft is on the ground. The ability of the model to correctly navigate is limited to the mid-latitude (< 70°) regions and airspeed above 10 knots. Higher latitudes and low airspeeds may produce unexpected results in system response due to instabilities in the model.

Prior to accessing the Model Aircraft page, enter the initial present position on the Start 1 page. Access the Model Aircraft page by pressing the **MODEL** line select key on the Index 2 page. Refer to Figure 3C-141 and Table 3C-104. Toggle the **MODE** line select key to **RUNNING** to run the model. All steering displays will reflect guidance information as though the aircraft were flying and executing the flight plan. Toggle the **MODE** line select key to **STOPPED** to stop the model.

The heading/track and speed values on the Model Aircraft page will correctly reflect the current aircraft model's state and can be re-entered to different values. The modes of heading available are steering (STR) mode and heading (HLD) hold mode. When STR mode is selected, the model's heading changes in response to steering commands calculated to follow the flight plan. When HLD mode is selected, the model maintains the entered heading. Toggle the **HDG** line select key on the model aircraft page to select the desired mode.

Altitude may be entered to any desired value. When the desired vertical path has been captured, the model tracks the vertical flight plan. When no altitude has been assigned, a level altitude will be maintained.

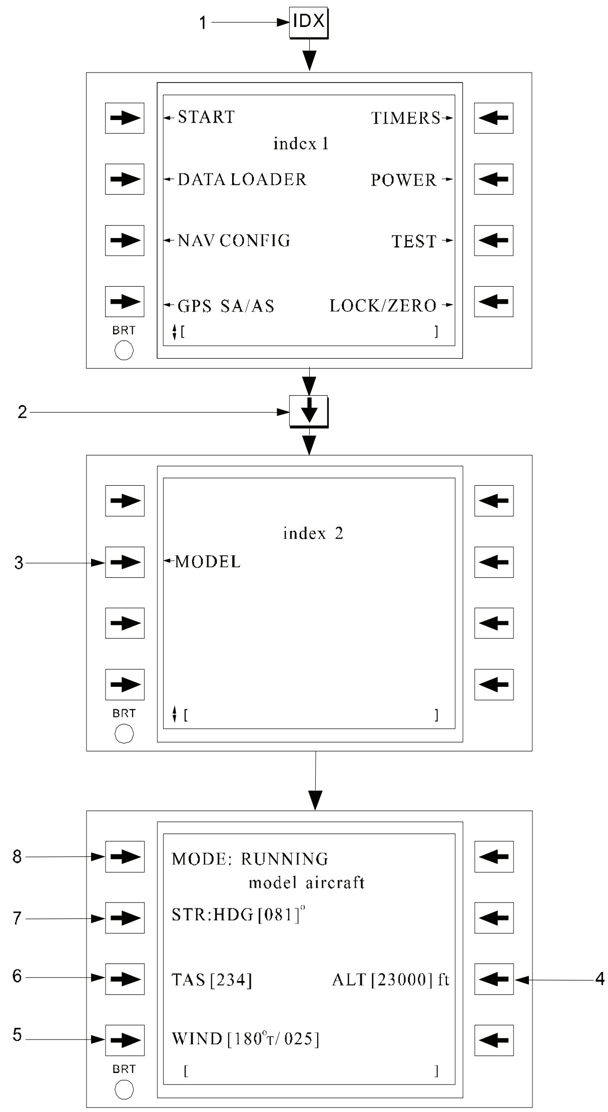


Figure 3C-141. Model Aircraft Page Access and Function

Table 3C-104. Model Aircraft Page Access and Usage Procedure

NO.	DESCRIPTION/FUNCTION
1	Pressing **IDX** function key will access the index page.
2	Scroll to index 2 page.
3	Accesses model aircraft page.
4	Inserts the model altitude.
5	Inserts the model wind.
6	Inserts the model true airspeed.
7	Inserts the heading; toggles heading mode between flight plan Steering (STR) and Heading Hold (HLD).
8	Toggle the line select key for either RUNNING or STOPPED modes.

x. Postflight Operations.

(1) Postflight Operations Overview. The FMS-800 postflight operations are as follows.

1. Saving and clearing GPS selective availability/anti-spoofing keys
2. Saving GPS almanac data
3. Saving system status data
4. Zeroizing system data
5. Locking the system

(2) Saving and Clearing GPS Selective Availability/Anti-Spoofing (SA/AS) Keys. The GPS SA/AS functions are controlled on the GPS SA/AS page, which is accessed from the Index 1 page. The GPS SA/AS page indicates whether or not the GPS contains keys and the current mission duration as reported by the GPS. To change the mission duration, enter the number of days in the scratchpad and press the **DAYS** line select key on the GPS SA/AS page. Entering a duration less than the current number of loaded daily keys will zeroize any keys exceeding the desired mission duration.

To zeroize the SA/AS keys, access the Lock/Zeroize page and press the **ZERO ALL** or **GPS** line select key twice. If after a zeroize attempt the GPS SA/AS keys were not zeroized, for any reason, a NO KEYS ZERO annunciation appears. If it was zeroized, a SAFE KEYS annunciation will be displayed.

(3) Saving GPS Almanac Data. Saving the GPS almanac data to the data cartridge can ensure almanac data is available to reduce acquisition time for following flights. To save the GPS almanac data, access the Data Loader page and press the **ALMANAC SAVE** line select key twice.

(4) Saving System Status Data. The FMS-800 maintains an in-flight fail history of all avionic LRU's including CBIT, IBIT, and bus status failures for later examination by maintenance personnel. To save this status data to the data cartridge, access the Data Loader pages and press the **STAT SAVE** line select key twice. The failed history file contains start and end dates of the record. A new fail history record will begin whenever the crew saves the status data to the cartridge.

(5) Zeroizing System Data. The Lock/Zeroize page permits selective blanking of data within CDU nonvolatile memory and the data loader cartridge. In addition to selective blanking, a single key commands a master zeroize of all data stored in the system, including V/UHF HAVE QUICK data, and the GPS selective availability/anti-spoofing keys. Figure 3C-142 and Table 3C-105 show the Lock/Zeroize page and its associated operation in blanking different portions of system memory.

A ZERO ALL command will erase all system data. Flight plan zeroization and erasure will delete the active waypoint. Following flight plan zeroization, guidance will be indeterminate and revert to a wings-level configuration.

(6) Locking the System. The FMS-800 provides a system lock function to prevent improper investigation or tampering of system data while the aircraft is on the ground. The system lock, when activated with a password entry, disables the CDU function keys with the exception of two line select keys. One unlocks the system with the entry of the same password and one that performs a zeroization of system data.

To lock the system, access the Lock/Zeroize page, enter a three-character password in the scratchpad, and press the **LOCK** line select key. Both CDU's will display the lock/zeroize page and display the LOCKED annunciation, indicating the system is locked. No function keys or line select keys (other than the LOCK and ZERO ALL) are operational at this point. Once the system is locked, it can only be unlocked and full functionality restored to the CDU's by either re-entering the same password in the scratchpad of the CDU and pressing the **LOCK** line select key or pressing the **ZERO ALL** line select key twice on the CDU to zeroize system data. Refer to Figure 3C-142 and Table 3C-105.

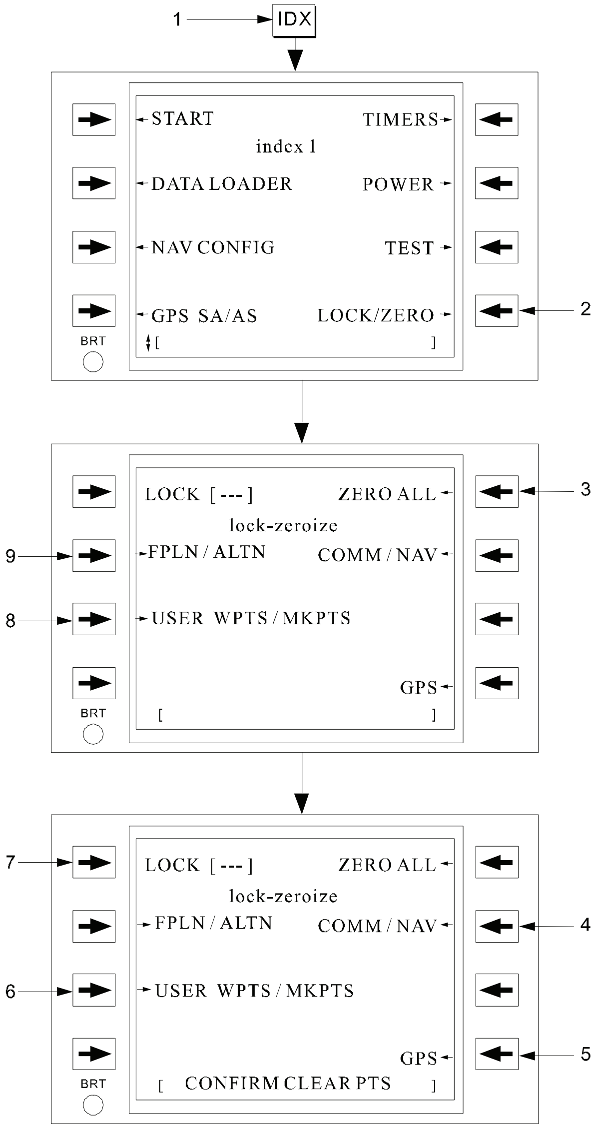


Figure 3C-142. Zeroizing or Locking Up System Data

NOTE

A zeroize command involving the CDU will erase any associated nonvolatile memory in the CDU.

All functions on this page will delete significant amounts of data stored in the CDU or other subsystem nonvolatile memory. They all require confirmation prior to execution by pressing the same key a second time to acknowledge the confirmation message.

Table 3C-105. Zeroizing or Locking Up System Data Procedure

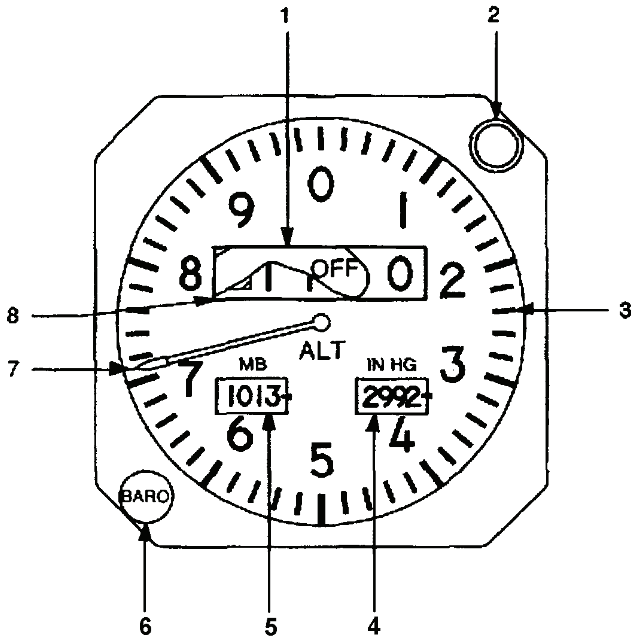
NO.	DESCRIPTION/FUNCTION
1	Pressing **IDX** function key will access the Index page.
2	To access the Lock/Zeroize page.
3	Request zeroization of all CDU data, V/UHF presets and keys, and GPS SA/AS keys.
4	Request zeroization of communication data, including presets and V/UHF HAVE QUICK data.
5	Request zeroization of GPS SA/AS keys.
6	Confirm desire to zeroize markpoint and user waypoint lists.
7	Password entry locks/unlocks the system.
8	Request zeroization of markpoint and user waypoint lists.
9	Request zeroization of flight plan and alternate flight plan.

3C-26. PILOT'S ALTIMETER (BA-141).

a. Description. The pilot's altimeter provides a servoed counter drum/pointer display of barometrically corrected pressure altitude. Refer to Figure 3C-143. In addition, it provides the transponder with altitude information for mode C operation. The barometric pressure (altimeter setting) is set manually with the **BARO** knob and displayed in units of inches mercury and millibars on counter-drum indicators. The altimeter is ac powered through a 1-ampere circuit breaker, placarded **PILOT ALTM**, located on the overhead circuit breaker panel, Figure 2-16.

b. Pilot's Altimeter Controls, Indicators, and Functions.

(1) Failure Warning Flag. A failure warning flag, placarded **OFF**, comes into view to indicate that the altitude information is unreliable, however, the mode C information may be valid.



1. **Failure Warning Flag**
2. **Altitude Alert Annunciator**
3. **Altitude Scale**
4. **Barometric Pressure Counter Drum Indicator Window (inches of Mercury)**
5. **Barometric Pressure Counter Drum Indicator Window (Millibars)**
6. **Manual Barometric Pressure Setting Knob**
7. **Altitude Indicator Needle**
8. **Counter Drum Altitude Display**

Figure 3C-143. Pilots Altimeter (BA-141)

WARNING

In the event of a total ac and dc electrical power loss, the warning flag will be in view, the altimeter will be inoperative, and the indicated altitude will remain as existed at the time of failure.

(2) Altitude Alert Annunciator. The altitude alert annunciator illuminates to provide a visual indication that the aircraft is within 1000 feet of the pre-selected altitude during the capture maneuver and extinguishes when the aircraft is within 250 feet of the pre-selected altitude. After capture, the **ALT** annunciator on upper right corner of pilot's altimeter and **ALT ALERT** annunciator in the annunciator block above the copilot's airspeed indicator will illuminate if the aircraft departs more than 250 feet from the selected altitude, and will extinguish when the aircraft has departed more than 1000 feet from the selected altitude.

(3) Altitude Scale. The face of the altimeter has a marked scale from 0 to 9 in 20-foot increments.

(4) Barometric Pressure Counter Drum Indicator Window (Inches of Mercury). This window indicates barometric pressure as set by manual barometric pressure setting knob.

(5) Barometric Pressure Counter-Drum Indicator Windows (Millibars). The barometric pressure and millibar counter-drum indicator windows, display barometric pressure in millibars.

(6) Manual Barometric Pressure Setting Knob. The manual barometric pressure setting knob, placarded **BARO**, is used to set the barometric pressure and millibar counter-drum indicators.

(7) Altitude Indicator Needle. The altitude indicator needle points to the altitude on the pointer display between 1000-foot levels in 20-foot increments.

(8) Counter-Drum Altitude Display. The counter drum displays altitude and is marked in 20-foot increments. Altitudes below 10,000 feet are annunciated by a black and white crosshatch on the left-hand digit position of the counter display.

c. Operating Procedure.

NOTE

If the altimeter does not read within 70 feet of field elevation when the correct local barometric setting is used, the altimeter needs calibration or internal failure has occurred. An error of greater than 70 feet also nullifies use of the altimeter for IFR Flight.

1. BARO knob – Set desired altimeter setting.

2. Warning flag – Check not visible.

3. Needle indicator – Check operation.

Section IV. RADAR AND TRANSPONDER

3C-27. WEATHER RADAR (KWX-58) SYSTEM T1.

a. Description. The KWX-58 color weather radar not only displays in-flight weather, but also permits incorporation of the KGR-358 radar graphics unit. The color weather radar is used to detect significant en route weather formations to preclude undesirable penetration of heavy weather and its usually associated turbulence. The weather radar system provides a 320 nm display, with a 250 nm weather avoidance range plus weather penetration advantages. With the radar graphics unit in the NAV mode, navigation information is integrated with the weather display. The phased array antenna (flat plate), located in the nose of the aircraft, is fully stabilized to compensate for aircraft pitch and roll. The antenna provides a full 90° scan angle, ± 12° tilt, and a 3.75 microsecond pulse width in both weather and ground mapping modes.

(1) Extended Sensitivity Time Control (STC) increases the displayed intensity of storms outside the normal STC range. Extended STC relates the storm intensity to its distance and assigns a corresponding color. As a result, the display presents a more accurate picture of storm intensity.

(2) Weather systems are displayed as four colors, depicting rainfall intensity overlaid with range rings. Bearing marks at dead ahead and 20° on either side aid the pilot in judging the bearing of storms and necessary heading changes.

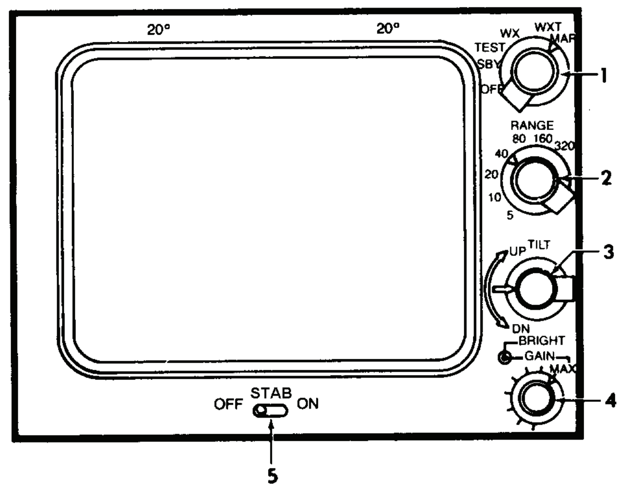
(3) With radar graphics interfaced, a circle mode may be activated by pressing the page button located on the radar graphics control panel. Functional operation in this mode is the same as in the standard display mode and is available in both weather and SBY modes. The range information is displayed in the upper right corner and represents the outer ring. The inside ring represents half the displayed distance. The off screen pointer is replaced by an RMI BUG annunciation placed on the outer ring in the direction of the active waypoint and color coded to each navigation system. Position of the aircraft is indicated by the green airplane symbol in the center of the screen.

(4) Indicator brightness is adjustable to accommodate varying ambient light conditions while automatically maintaining equal brightness between the four display colors. The system is protected through a 5-ampere circuit breaker, placarded **RADAR**, located on the overhead circuit breaker panel, Figure 2-16.

b. Controls and Functions. Refer to Figure 3C-144.

(1) Mode Selector Control Knob. The mode selector knob is used to turn the system on/off, and select **SBY**, **TEST**, **WX**, **WXT**, and **MAP** positions.

(a) ***SBY***. In SBY mode, the display is blanked and transmitter circuits are disabled with the magnetron heater remaining on.



1. **Mode Selector Control Knob**
2. **RANGE Selector Control Knob**
3. **TILT Control Knob**
4. **BRIGHT / GAIN / MAX Control Knob**
5. **OFF / STAB / ON Switch**

Figure 3C-144. Weather Radar Control Indicator T1

(b) ***TEST***. When placed in the TEST mode, all circuitry is activated, except the transmitter. All weather colors will display for verification in the TEST mode as well as the WX, WXT, and MAP modes.

(c) ***WX***. The WX mode is the normal weather mode with green for light, yellow for moderate, red for heavy, and magenta for extremely heavy precipitation.

(d) ***WXT***. The WXT mode is used to alert the pilot of weather that is beyond the displayed range. Only returns of significant intensity between 83 and 320 nm are displayed with a white arc at the approximate azimuth of the storm. A yellow **T** on a red background will appear in the upper left corner of the

display, indicating that a storm target has been located.

(e) ***MAP***. The MAP mode is used for terrain mapping. Prominent ground features such as lakes, bays, rivers, cities, coastlines, and offshore drilling rigs can be clearly discerned and used as a navigation cross-reference. The display colors are changed in the MAP mode as follows: green to cyan, yellow stays the same, red to magenta, and magenta to blue. When using the MAP mode, the gain control is used to adjust the prominence of ground features.

(2) ***RANGE*** *Selector Control Knob*. The RANGE selector knob selects for displays, range at 5, 10, 20, 40, 80, 160, and 320 nm. This enables the pilot to select the displayed distance for most weather conditions that exist. There are four range calibration rings on each range setting with numerical read-out of their range in nautical miles. In addition to the range rings, bearing markers are positioned dead ahead and 20° to either side of the aircraft heading for use in judging the storm bearing and necessary heading changes.

(3) ***TILT*** *Control Knob*. The TILT knob is used to adjust the radar antenna angle ± 12°, relative to the horizon. Proper tilt adjustment is one of the most important factors in obtaining optimum use from the weather radar. Too high an angle will pass the majority of the radar beam above the storm cell, particularly when the storm is a great distance away. Too low an antenna tilt will clutter the indicator with ground returns. The maximum distance at which ground clutter can be obtained will depend greatly on the terrain and aircraft altitude. The tilt setting is displayed in the top right corner of the screen. When the stab switch is in the **ON** position, the designation TILT is replaced by STAB.

(4) ***BRIGHT / GAIN / MAX*** *Control Knobs*. These knobs control display brightness and manual adjustment of gain. Brightness of the display screen is fully adjustable to compensate for a range of ambient light levels, while automatically maintaining equal brightness between the three colors displayed. Likewise, the gain control can be manually adjusted in both weather and ground mapping modes to provide maximum flexibility in target interpretation. Whenever the gain is varied from the preset maximum level, the screen will annunciate VAR to remind the pilot to reset the gain for standard intensity levels.

(5) ***OFF / STAB / ON*** *Selector Switch*. The selector knob permits the pilot to select gyro-stabilized control of the weather radar system. In the **ON** position, the radar's antenna scan is kept parallel to the horizon and at the same relative tilt angle previously selected. The display view is kept straight and level, despite changes in aircraft pitch and roll, thus preventing ground clutter from wiping out potential weather targets.

c. Weather Radar System Operation.

WARNING

Never operate the weather radar in the WX, WXT, or MAP modes on the ground when personnel are forward of the aircraft wing and within 5 feet of the aircraft nose. Failure to observe this warning may result in permanent damage to the eyes and other organs.

NOTE

To increase the solid circuitry reliability, it is recommended that the aircraft engines be started before applying power to the weather radar system.

(1) Turn On Procedure.

1. Mode Selector Switch – Turn clockwise past detent to **SBY** position.

NOTE

Warmup period is approximately 10 seconds.

(2) Operating Procedure.

1. Mode Selector Switch – **TEST**. Verify that all four colors are present.

NOTE

If TEST mode is bypassed and WX, WXT, or MAP mode is selected, the display will light up and the warmup annunciator in the lower corner will illuminate. The transmitter will become operational after 60 seconds.

2. Mode Selector Switch – **SBY** while taxing and until clear of personnel, then as required.

(3) Shutdown Procedure.

1. Mode Selector Switch – Turn counterclockwise to **OFF** position.

3C-28. RADAR GRAPHICS T1 .

a. Description. The KGR-358 radar graphics unit interfaces with the weather radar system (KWX-58) and receives navigation data from the flight management system. The unit can display NAV 1 or NAV 2 or both in a weather overlay, or as navigation information only display. In addition, NAV information can be viewed in a 360° (circle) display with weather in the top 90° sector. Two checklist modes are also provided for complete checklist capability when using the pocket terminal.

(1) With the KGR-358 in any of the NAV modes, the radar screen will display a normal weather picture, plus the location of the waypoints listed in the active flight plan. Data referenced to NAV 1 is displayed in the lower left portion of the radar display. Data referenced to NAV 2 will display in the lower right portion of the display. Included in the data are the active waypoint name, the selected course bearing, and the aircraft position (radial to and distance) from the active navigation fix. Aircraft magnetic heading is displayed in the upper left section of the radar display.

(2) A line representing the course selected by the flight management system is drawn through the corresponding active waypoint. Selected course bearing for each NAV system is displayed with NAV data on each side of the screen. A waypoint line will also be displayed connecting the waypoints in numerical sequence. An **R** on the left side of the screen indicates all visible NAV aids selected by the flight management system will be displayed. The level of NAV aids displayed is indicated by one, two, or three dots on the left side of the **R**.

(3) A joystick control is provided to move a waypoint to any position on the screen. The coordinates for this new waypoint will appear in the lower left or right corner, depending on which NAV is selected replacing the active waypoint data. If both NAV systems are selected, the new coordinates will be displayed corresponding to NAV 1 and may be switched to NAV 2. Pressing the check button will cause the data to transfer to the flight management system and be fixed as a position on the earth. Once the data is transferred to the flight management system, the pilot may enter it as he desires.

(4) A track line enables a quick determination of how many degrees deviation left or right of a present heading is needed to provide for a clear path through weather or to a new fix. The number of degrees and an **L** or **R** is shown in the upper left corner replacing the magnetic heading when track mode is in operation.

(5) Power is provided for the unit through a 2-ampere circuit breaker, placarded **GRPH DSPL**, located on the overhead circuit breaker panel.

b. Controls and Functions. Refer to Figure 3C-145.

(1) Mode Selector Knob. Allows the operator to turn the unit on and select desired mode.

(a) ***OFF*** – Removes power from the unit when mode selector knob is in the **OFF** position.

(b) ***EMER*** – Checklists of emergency procedures for the aircraft are displayed in the emergency (EMER) mode. The emergency index contains the titles of the emergency checklists. The selected checklist item is shown in yellow while the others are shown in magenta.

(c) ***✓LST*** – Selects the preprogrammed checklist for display.

(d) ***SBY*** – Selects the standby mode. Nothing is displayed on the screen when in the SBY mode.

(e) ***NAV 1*** – Selects NAV 1 information to be displayed. Data referenced to NAV 1 will be displayed in cyan in the lower left portion of the radar display. If NAV data is invalid, the data will be replaced with dashes.

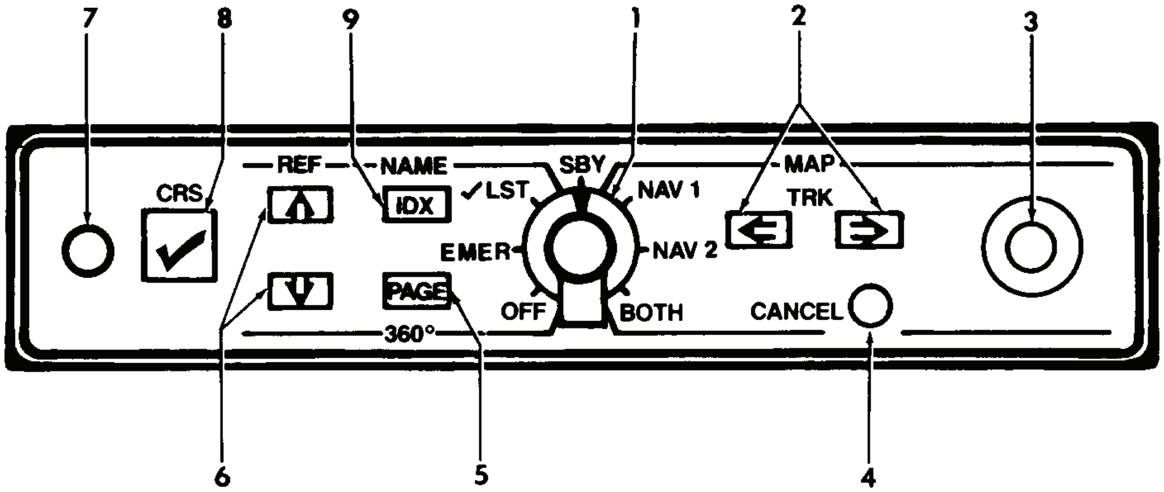
(f) ***NAV 2*** – Selects NAV 2 information to be displayed. Data referenced to NAV 2 will be displayed in yellow in the lower right portion of the radar display. If NAV data is invalid, the data will be replaced with dashes.

(g) ***BOTH*** – Selects both NAV 1 and NAV 2 information to be displayed.

(2) Left/Right Cursor Buttons. When ⇐ or ⇒ is pressed, a track line will appear and move in the direction indicated by the button pressed. The track line will disappear 6 to 10 seconds after the button has been released.

(3) Joystick. The joystick is used to move a waypoint to any position on the radar screen.

(4) ***CANCEL*** *Button*. When pressed, the **CANCEL** button will remove displays from the radar screen.



1. Mode Selector Knob
2. Left/Right Cursor Buttons
3. Joystick
4. CANCEL Button
5. PAGE Button
6. Up/Down Cursor Buttons
7. Input Jack
8. Checklist Button
9. IDX Button

Figure 3C-145. Radar Graphics **T1**

(5) ***PAGE** Button*. The **PAGE** button is used to view consecutive pages within a checklist. It is also used, along with the ⇑ or ⇓ buttons, to bypass items without checking them off or to return to items previously bypassed.

(6) *Up/Down Cursor Switches*. The ⇑ and ⇓ buttons are used along with the **PAGE** button to bypass items in the checklist without checking them off or to return to items previously bypassed.

(7) *Checklist Button.* Pressing the ✓CRS button causes the selected checklist to be displayed. With the checklist displayed, the ✓CRS button is used to check off items. When the last item in a list is checked off, the display automatically returns to any items previously bypassed. When all items have been checked off, the display returns to the index with the next checklist selected. An **END OF LIST** statement follows the last title in an index and the last item in a checklist. The pilot may return to the index prior to checking off all items by pressing the **IDX** button.

(8) *Input Jack.* Provides a means of connecting the pocket terminal to the unit.

(9) ***IDX** Button*. Allows the pilot to return to index.

c. Operating Procedures. The following statement is displayed in all modes except SBY when the unit is first turned on. The statement will automatically disappear after 20 seconds or can be cleared sooner by pressing the **CANCEL** button.

THE NAVIGATION DATA PRESENTED ON THIS SCREEN IS NOT TO BE USED FOR PRIMARY NAVIGATION. CONTENTS OF THE CHECKLISTS ARE THE RESPONSIBILITY OF THE USER/ INSTALLER.

1. Mode selector switch – As required.

3C-29. POCKET TERMINAL T1 .

a. Description. The KA-68 pocket terminal is used to program normal and emergency checklist information into the radar graphics control panel. Refer to Figure 3C-146. The pocket terminal plugs into a jack on the front of the radar graphics unit.

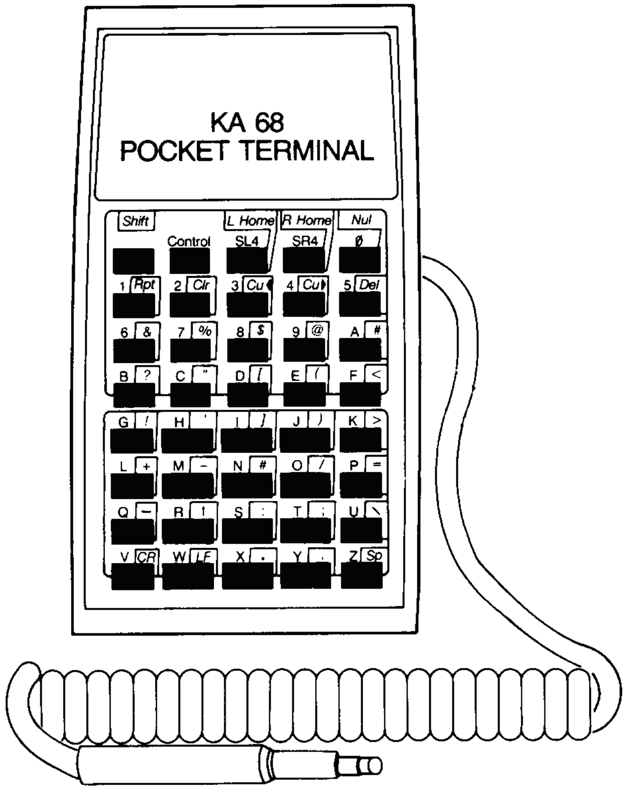


Figure 3C-146. Pocket Terminal T1

b. Operating Procedures.

(1) Programming Checklist Index. The title of a checklist is programmed into the appropriate index by selecting the desired mode on the KGR-358 (EMER or ✓LST) and pressing the **IDX** button, if necessary, to enter the index. If the index already contains some titles, the ⇑ and ⇓ buttons on the KGR-358 are used to determine the location of the title to be added. If the number of index titles exceeds one page, the following pages may be selected by using the page button rather than cycling through the index with the ⇑ or ⇓ buttons. The last page of each index is indicated by an END OF LIST statement.

NOTE

The @, [ ], and \ characters cannot be written into the KGR-358 even though they are shown on the pocket terminal keyboard.

Enter the title by pressing the appropriate keys on the pocket terminal. The title may consist of any combination of alphanumeric characters, spaces, or punctuation up to a length of 27 characters (1 line). Any of the shaded functions are obtained by pressing the shift key prior to pressing the key with the desired function. For example, to obtain a space, press and release the **SHIFT** key and then press the key placarded **SP**. As the title is entered, a white **CSR BLK** appears to the right of the last entered character indicating the location where the next character will be inserted. When the title is complete, it must be terminated by a carriage return (**SHIFT – CR**) to make the cursor disappear.

(2) Programming Checklist Items. Enter the checklist item by pressing the appropriate keys on the pocket terminal. A checklist item may consist of any combination of alphanumeric characters, spaces, or punctuation up to a length of 15 lines (450 characters). If the item is longer than one line long, do not use the carriage return to move from one line to the next. Use spaces (**SHIFT – SP**) as necessary to move the cursor to the end of the line and to the beginning of the following line. The **SHIFT – CR** should be used only at the end of the entire item to make the cursor disappear.

(3) Error Correction. Error correction is accomplished with the delete function (**SHIFT – DEL**) on the pocket terminal. While in insert mode (cursor on the screen), pressing **SHIFT – DEL** will delete individual characters. Once an item has been terminated with a carriage return (no cursor on the screen), **SHIFT – DEL** will delete the entire selected item (shown in yellow).

(4) Special Functions. Certain special functions can be obtained on the pocket terminal by pressing the **Control** key prior to pressing **X**, **C**, or **I**. **Control – X** erases everything (all checklists) stored in nonvolatile memory in the KGR-358. After pressing **Control – X**, the message ERASE ENTIRE MEMORY YES/NO appears on the radar screen. If **Y-E-S** is entered, the radar graphics unit will carry out the command. If **N-O**, or any other key is pressed, the erase command is aborted. **Control – C** on the pocket terminal duplicates the function of the **PAGE** button on the radar graphics control panel. **Control – I** on the pocket terminal duplicates the function of the **IDX** button on the radar graphics control panel.

3C-30. WEATHER RADAR AND MULTIFUNCTION DISPLAY (ED 600) T2 .

WARNING

The radar system is intended for weather detection or ground mapping only and is not intended, nor should it be used or relied upon, for proximity warning, anticollision, or terrain avoidance.

a. Description. The weather radar/ Multifunction Display (MFD) system provides long and short-range navigation maps, checklists, and weather radar. The system contains two controllers. The MFD controller provides for the selection and control of the MFD format, modes, and waypoint designators. The weather radar controller selects the radar modes and adjustable quantities that may then be displayed on the radar screen. The system consists of a Receiver/Transmitter Antenna (RTA) (located in the radome), a symbol generator (located on the bottom shelf of the nose avionics compartment), the MFD located in the center of the instrument panel, the MFD controller, and the radar controller located on the pedestal extension, Figure 2-6. The radar is operated in conjunction with the multifunction display to provide a composite display of weather and navigation information. In the weather detection mode, the system gives the pilot a color visual indication of storm intensity.

Table 3C-106 shows the relationship between the intensity levels displayed on the MFD and the National Weather Service VIP levels. In this mode, target returns are displayed at one of five video levels (0, 1, 2, 3 or 4), with level 0 represented by a black screen, because of weak or no returns. Levels 1, 2, 3, or 4 are represented by green, yellow, red, and magenta to show progressively stronger returns. In ground mapping mode, video levels of increasing reflectivity are displayed as black, cyan, yellow and magenta.

b. Radar Control Unit (WC-650). The radar control unit is located on the console and contains all controls necessary for operating the radar system. Refer to Figure 3C-147.

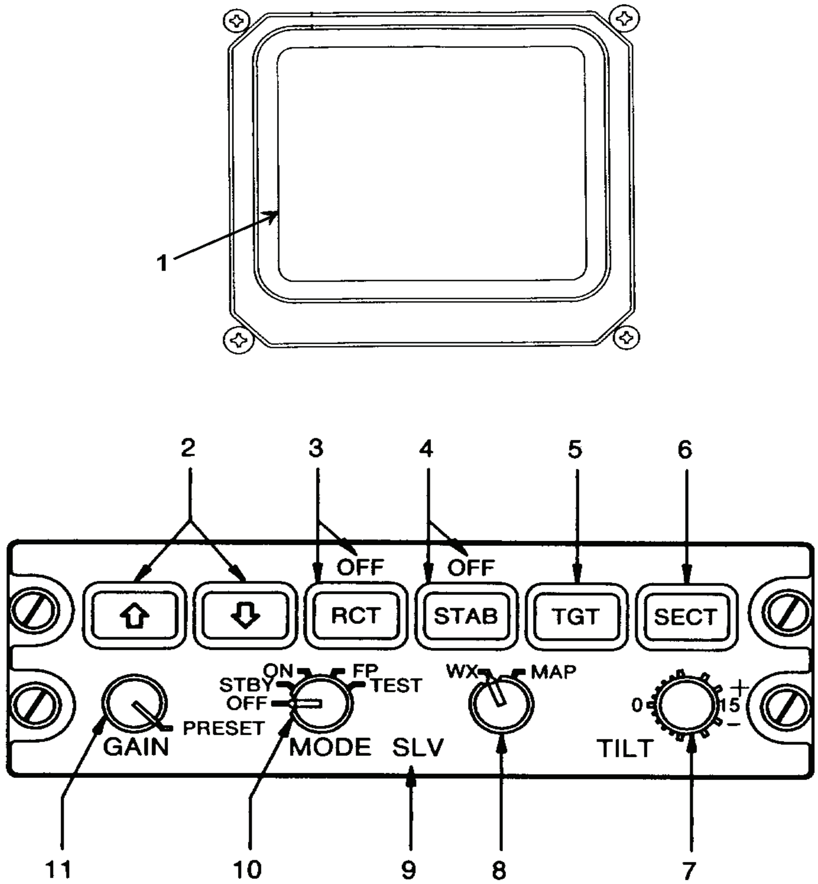
(1) Multifunction Display (ED-650). The multifunction display indicator is an instrument panel-mounted, full-color digital display system. Weather display, ground mapping, and text functions are provided. The inputs are displayed on the screen together with range, mode, and status alphanumerics to facilitate evaluation of the picture.

(2) Range Switches. The range switches are two alternate action push-button switches, one placarded ⬩ and the other placard ✦, which are used to select the radar operating range from 5 to 300 nm full scale in the ON mode or 5 to 1000 nm full scale in the flight plan mode. The ✦ push button selects increasing ranges and the ⬩ push button selects decreasing ranges.

(3) Rain Echo Attenuation Compensation Technique Switch and ***OFF*** *Annunciator*. This is a momentary alternate action push-button switch, placarded **RCT**, which activates the rain echo attenuation compensation technique circuitry. Selecting the RCT mode activates a cyan-colored background field that indicates ranges at which the radar receiver calibration has been exceeded. The rain echo attenuation compensation technique is active at all times in the WX mode to compensate for attenuation of the radar signal as it passes through a storm. This is accomplished by increasing the gain of the receiver as weather is detected. An **OFF** annunciator above the **RCT** switch indicates that the RCT circuitry has been disabled.

Table 3C-106. Radar Display Levels Related to National Weather Service VIP Levels

DISPLAY LEVEL	RAINFALL RATE (MN/HR)	RAINFALL RATE (INCHES/HR)	VIDEO INTEGRATED PROCESSOR (VIP) CATEGORIZATIONS			MAXIMUM CALIBRATED RANGE (NM) 12-INCH FLAT-PLATE
			STORM CATEGORY	VIP LEVEL	RAINFALL RATE (MN/HR) (INCHES/HR)	
4 MAGENTA	GREATER THAN 52	GREATER THAN 2.1	EXTREME	6	GREATER THAN 125	175
			INTENSE	5	50-125 (2-5)	
3 (RED)	GREATER THAN 12	GREATER THAN 0.5	VERY STRONG	4	25-50 (1-2)	175
	12-52	0.5-2.1	STRONG	3	12-25 (0.5-1)	
2 (YELLOW)	4-12	0.17-0.5	MODERATE	2	2.5-12 (0.1-0.5)	175
1 GREEN	1-4	0.04-0.17	WEAK	0.25-2.51	(0.01-0.1)	175
0 BLACK	LESS THAN 1	LESS THAN 0.04				---



1. **Multifunction Display**
2. **Range Switches**
3. **Rain Echo Attenuation Compensation Technique Switch and OFF Annunciator**
4. **Stabilization Switch and OFF Annunciator**
5. **Target (TGT) Alert Switch**
6. **Sector Selection Switch**
7. **TILT Control**
8. **Weather/Map Selector Switch**
9. **Slave Annunciator (Not Used)**
10. **Mode Selector Switch**
11. **GAIN Control**

Figure 3C-147. Radar Control Unit (WC-650) and Multifunction Display (ED-600)

*(4) Stabilization Switch and **OFF** Annunciator.* The stabilization switch is a momentary alternate-action, push-button switch, placarded **STAB**, which permits disabling of stabilization inputs. When disabled, the **OFF** condition is annunciated above the switch. In this case, pitch and roll inputs are assumed to be zero.

(5) Target Alert Switch. The target alert switch is a momentary alternate-action, push-button switch, placarded **TGT,** which selects the target alert function. TGT mode annunciates significant weather conditions within + 7.5° of dead ahead. Selecting **TGT** disables the variable gain rotary control.

(6) Sector Selection Switch. A momentary alternate-action, push-button switch, placarded **SECT**, selects either full azimuth scan (120°) or sector azimuth scan (60°).

*(7) **TILT** Control.* The **TILT** control is a rotary control, placarded **TILT**, which regulates antenna tilt between 15° up and 15° down. The range between +5° and -5° is expanded to allow more precise setting.

(8) Weather/Map Selector Switch. The weather/map selector switch is a two-position rotary switch, placarded **WX / MAP**, which selects weather or map display when the mode switch is in the **ON** position.

(9) Slave Annunciator. Not used.

(10) Mode Selector Switch. The mode selector switch is a five-position rotary switch,

placarded **MODE OFF / STBY / ON / FP / TEST**, which selects primary radar operating mode.

*(a) **OFF**.* Removes system power.

*(b) **STBY**.* Places system in non-operational status.

*(c) **ON**.* Selects the WX or MAP weather display.

*(d) **FP**.* Selects system flight plan (navigation) display mode.

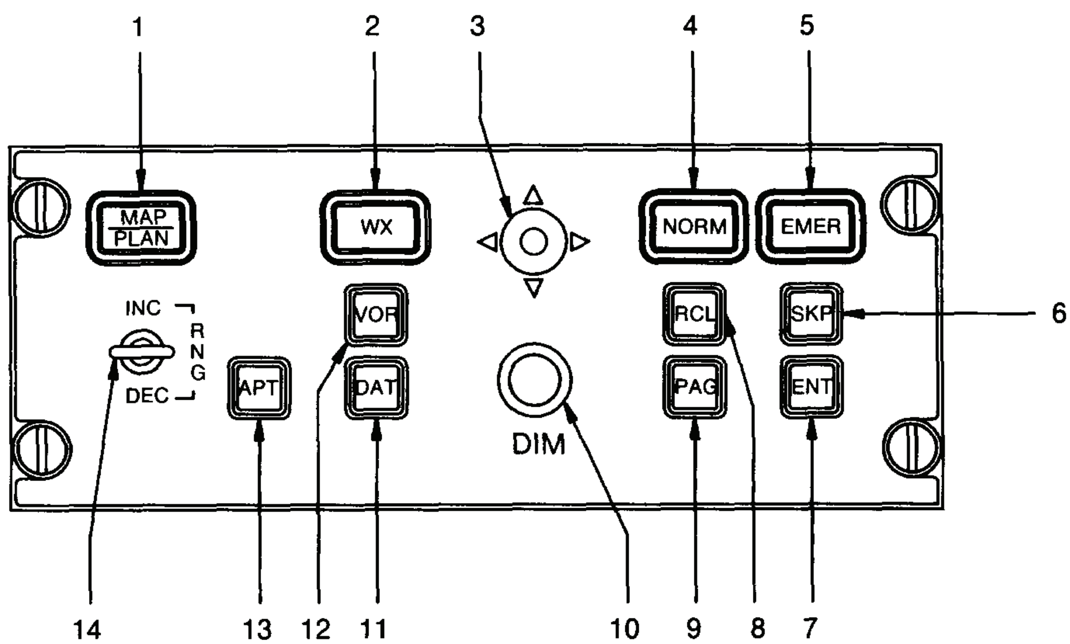
*(e) **TEST**.* Selects system self-test mode.

*(11) **GAIN** Control.* The **GAIN** control is a rotary control, which regulates receiver gain. A detented **PRESET** position is provided at the full clockwise end of rotation. Full counterclockwise rotation sets minimum receiver gain. Full clockwise rotation (not into the detent) commands minimum gain of approximately 6 to 8 decibels higher than preset gain.

c. Multifunction Display Radar Graphics Control Unit (MC-800). Refer to Figure 3C-148.

*(1) **MAP / PLAN** Key.* The **MAP / PLAN** key selects either the MAP or PLAN display mode. In MAP mode, radar Sensitivity Time Control (STC) circuitry is disabled for ground mapping operations. In PLAN mode, a NAV PLAN format is selected. This mode is a north up mode in which the aircraft symbol is positioned with respect to the NAV route and progresses along the displayed route. Weather information is not displayed while in PLAN mode.

(2) Weather Key. The weather key, placarded **WX**, adds weather information to the multifunction display.



1. **MAP/PLAN Key**
2. **Weather (WX) Key**
3. **Cursor Joystick**
4. **Normal (NORM) Checklist Key**
5. **Emergency (EMER) Checklist Key**
6. **Skip (SKP) Key**
7. **Enter (ENT) Key**
8. **Recall (RCL) Key**
9. **Page (PAG) Key**
10. **Multifunction Display Brightness Control**
11. **Data (DAT) Key**
12. **VOR Key**
13. **Airport (APT) Key**
14. **Range Control**

Figure 3C-148. Multifunction Display Graphics Control Unit (MC-800)

(3) Cursor Joystick. The cursor joystick positions the cursor on the multifunction display screen while in the MAP or PLAN mode. While the system is displaying the normal or emergency checklists, vertical

actuation of the stick changes the active line while horizontal actuation controls paging. Right actuation selects the next page and left actuation selects the previous page.

(4) Normal Checklist Key. The normal checklist key, placarded **NORM**, provides entry into the multifunction display's normal checklist mode.

(5) Emergency Checklist Key. The emergency checklist key, placarded **EMER**, provides entry into the multifunction display's emergency checklist mode.

(6) Skip Key. This key, placarded **SKP**, moves the cursor to the next displayed waypoint in the MAP or PLAN mode or skips the active line in a checklist or index and advances the active selection to a subsequent line when text is being displayed on the MFD.

(7) Enter Key. This key, placarded **ENT**, enters the displayed designator position (LAT/LON) as a waypoint in place of a TO waypoint in the MAP or PLAN mode. In a text mode (checklist or index), actuation of the switch checks off a line in a checklist or selects an index line item for display.

(8) Recall Key. This key, placarded **RCL**, recalls the cursor to its home position when in MAP or PLAN mode. In a text mode (NORM or EMER checklist), actuation of this switch recalls the lowest-numbered skipped line in a checklist.

(9) Page Key. This key, placarded **PAG**, advances the page and places the active line selection at the first line of the page.

(10) Multifunction Display Brightness Control. This control, placarded **DIM**, controls multifunction display brightness.

(11) Data Key. This key, placarded **DAT**, adds long range navigation information to the MFD MAP or PLAN displays.

*(12) **VOR** Key.* This key, placarded **VOR**, adds VOR/DME symbols to the MFD MAP or PLAN displays.

(13) Airport Key. This key, placarded **APT**, adds airport symbols to the MFD MAP or PLAN displays.

(14) Range Control. This control, placarded **RNG INC / DEC**, selects map range limits of 5, 10, 25, 50, 100, 200, 300, and 600 nm. Movement of switch toward **INC** increases the selected range, while movement toward **DEC** decreases selected range. This switch is active only when **WX** is not selected for display. When **WX** is selected, range is controlled by the radar controller.

d. MFD Weather Radar Normal Operation.

WARNING

If the radar system is operated in any other mode other than standby while the aircraft is on the ground, direct the nose of the aircraft so that the antenna scan sector is free of large metallic objects, such as hangars or other aircraft, for a distance of 100 feet (30 meters) and tilt the antenna fully upwards.

Do not operate radar during refueling of aircraft or during refueling operations that are within 100 feet (30 meters).

Do not operate radar if personnel are standing too close to the 270° forward sector of the aircraft.

Output power is radiated in TEST mode.

(1) Initial Control Settings.

1. Mode control – **OFF**.
2. **GAIN** control – **PRESET** position.
3. **TILT** control – +15°.

(2) Turn On Procedure.

1. Avionics Master Switch – **ON**.
2. Mode Control – **STBY**.

NOTE

When power is first applied, the radar will be in WAIT for 45 seconds to allow the magnetron to warmup.

(3) Weather Radar Operation.

1. Weather/map Switch – **WX**.
2. Range Switches – As required.

3C-31. GROUND PROXIMITY ALTITUDE ADVISORY SYSTEM (GPAAS).

WARNING

The GPAAS will provide little, if any, warning for flight into precipitous terrain approaching a sheer wall if there is little gradually rising terrain before reaching the steep terrain.

a. Description. The GPAAS is provided to aid the flight crew in terrain avoidance. Refer to Figure 3C-149.

The GPAAS is a completely automatic system (requiring no input from the crew) which continuously monitors the aircraft's flight path at altitudes of between 100 and 2000 feet AGL.

The GPAAS computer processes the data and, when conditions warrant, selects the appropriate digitized voice advisory/warning message from its memory. This message is then announced over the pilot's and copilot's audio systems. If the condition is not corrected, the GPAAS will rearm, and will again announce and repeat the warning if the condition recurs. The GPAAS computer remains ready to announce a different message during the intervals between repetitions. All messages are disabled below 100 feet AGL. The GPAAS system receives 28 Vdc power through a 1-ampere circuit breaker placarded **GPAAS**, located on the overhead circuit breaker panel.

(1) GPAAS Switch-Indicator Lights. A switch-indicator is located on the instrument panel. The upper half of the switch-indicator (yellow) is placarded **VOICE OFF**. The lower half is an indicator (red) only and is placarded **VA FAIL**. Pressing the **VOICE OFF** switch indicator disables the GPAAS voice advisory, and illuminates the **VOICE OFF** indicator light. The **VA FAIL** annunciator light (red) will illuminate when the GPAAS fails.

(2) GPAAS Volume Control. A GPAAS volume control placarded **VOL**, located on the instrument panel just to the right of the **GPAAS** switch indicator lights, controls the audio volume of the GPAAS advisory/warning messages down to a certain minimum level.

(3) GPAAS Aural Warning Indications. The following is a list of aural indications. Due to the possibility of activating more than one condition at a time, a warning priority has been established. The highest priority message will be announced first. If a higher priority item is received after a message is started, voice annunciation of the higher priority message shall be announced after a lower priority message in progress at the end of the message segment. It will not stop in the middle of a word. On messages that are repeated three times at 4-second intervals, the priority list will be scanned for higher priority messages and will insert them in the interval between the messages. The messages provided by the system are listed in descending order of priority.

1. "Two thousand" at 2000 feet AGL.

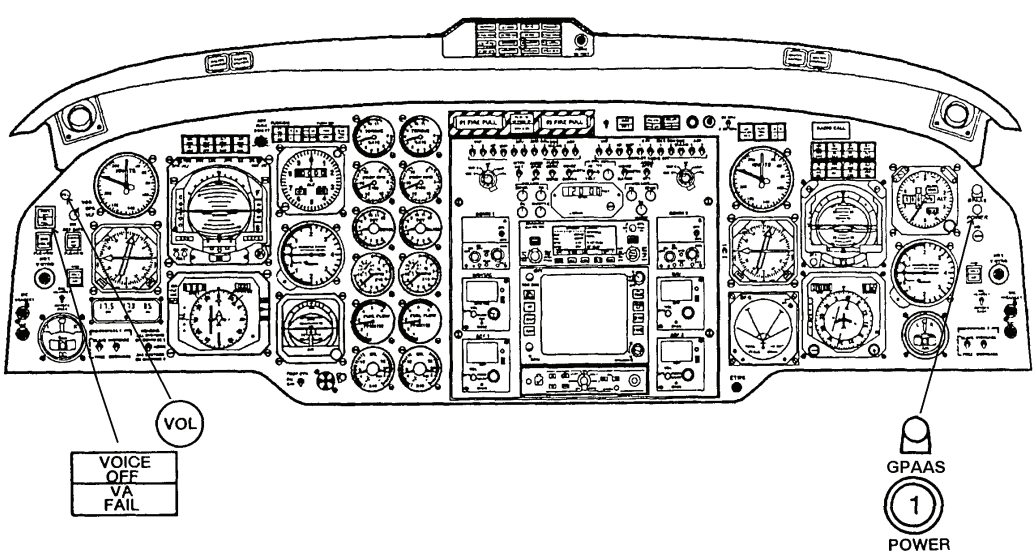


Figure 3C-149. Ground Proximity Altitude Advisory System Controls and Indicator

2. "One thousand" at 1000 feet AGL.

3. "Nine hundred" at 900 feet AGL.

4. "Eight hundred" at 800 feet AGL.

5. "Seven hundred" at 700 feet AGL.

6. "Six hundred" at 600 feet AGL.

7. "Five hundred" at 500 feet AGL.

8. "Check gear" will be announced immediately after the 500 feet announcement if gear is not down.

9. "Four hundred" at 400 feet AGL.

10. "Check gear" will be announced immediately after the 400 feet announcement if gear is not down.

11. "Three hundred" at 300 feet AGL.

12. "Check gear" will be announced immediately after the 300 feet announcement if gear is not down.

13. "Two hundred" at 200 feet AGL.

14. "Check gear" will be announced immediately after the 200 feet announcement if gear is not down.

15. "One hundred" at 100 feet AGL.

16. "Check gear" will be announced immediately after the 100 feet announcement if gear is not down.

17. "Minimum, minimum" will be announced at decision height.

18. "Localizer" will be announced at 1.3 to 1.5 dots either side of center of beam. Will be repeated three times at 4-second intervals.

19. "Glideslope" will be announced at 1.3 to 1.5 dots above or below center of beam. Will be repeated three times at 4-second intervals.

20. "Altitude, altitude" will be announced at excessive deviation from altitude selected on the altitude alerter.

21. "Check trim" will be announced when trim failure has occurred. Will be repeated three times at 4-second intervals.

22. "Autopilot" will be announced when autopilot has disconnected.

b. Normal Operation.

(1) Turn On Procedure. The GPAAS is operable when the following conditions have been met.

1. Battery switch – **ON**.

2. Avionics master switch – **ON**.

3. **GPAAS POWER** circuit breaker – Set.

4. **RADIO ALTM** circuit breaker – Set.

5. **VA FAIL** annunciator light – Extinguished.

(2) GPAAS Ground Check.

1. GPAAS voice advisory **VOL** control – Full clockwise.

2. **VOICE OFF** switch-indicator – Extinguished.

3. Audio control panel – Set listening audio level.

4. **VA FAIL** annunciator light – Extinguished.

5. Radio altimeter **DH SET** control – Set to 200 feet.

6. Radio altimeter **TEST** switch – Press and hold. "Minimum, minimum" will be annunciated once followed by the illumination of the **VA FAIL** light.

7. Radio altimeter **TEST** switch – Release.

c. GPAAS Modes of Operation. The GPAAS operates in the following modes of operation.

(1) Aural "Two Thousand" Advisory (Mode 1). The aural advisory "Two Thousand" indicates that the aircraft is at a radio altitude of 2000 feet AGL. This advisory is cancelled when valid information from the radio altimeter is lost, during

climb, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(2) Hundred Foot Increment Aural Altitude Advisories (Mode 2). The aural advisories "One Thousand, Nine Hundred, Eight Hundred, Seven Hundred, Six Hundred, Five Hundred, Four Hundred, Three Hundred, Two Hundred, One Hundred" indicate that the aircraft is at the associated radio altitude in feet AGL. This advisory is cancelled when valid information from the radio altimeter is lost, during climb, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(3) Aural "Localizer" Advisory (Mode 3). The aural advisory "Localizer" indicates that the aircraft has deviated from the center of the localizer beam in excess of 1.3 to 1.5 dots. The localizer advisory is armed when a valid localizer signal is detected and the aircraft is below 1000 feet AGL. It will be repeated no more that three times at 4-second intervals unless the aircraft is returned to less than 1.3 to 1.5 dots from the center of the localizer course. The localizer advisory is disabled when a valid localizer signal has been lost, during climb, below the decision height set on the radio altimeter, or if the navigation receiver is not tuned to a localizer frequency.

(4) Aural "Check Gear" Advisory (Mode 4). The aural "Check Gear" advisory indicates that the aircraft has descended to 500 feet AGL and the landing gear is not down. This advisory is repeated once at 100-foot intervals down to 100 feet AGL.

(5) Aural "Glideslope" Advisory (Mode 5). The aural advisory "Glideslope" indicates that the aircraft has exceeded 1.3 to 1.5 dots above or below the center of the glideslope beam. The glideslope advisory is armed when a valid glideslope signal is detected and the aircraft is below 1000 feet AGL. It will be repeated no more than three times at 4-second intervals unless the aircraft is returned to less than 1.3 to 1.5 dots from the center of the beam. The glideslope advisory is disabled upon loss of a valid glideslope signal, during climb, on a localizer back course, below the decision height set on the radio altimeter or, if the navigation receiver is not tuned to a localizer frequency. This advisory is inhibited by the weight on wheels strut switch.

(6) Aural Advisory "Minimum, Minimum" (Mode 6). The aural advisory "Minimum, Minimum" indicates that the aircraft is at the radio altitude selected by the crew using the radio altimeter indicator **DH** knob. This advisory is cancelled when valid information from the radio altimeter is lost, during climb, whenever the aircraft is above 1000 feet AGL, or whenever the aircraft is out of the operating altitude range of the radio altimeter.

(7) Aural "Altitude, Altitude" Advisory (Mode 7). The aural advisory "Altitude, Altitude" indicates the approach to a pre-selected altitude as the aircraft reaches a point 1000 feet from the selected altitude or, after reaching the selected altitude, when the aircraft deviates more than 250 feet from the selected altitude.

(8) Aural "Check Trim, Check Trim, Check Trim" Advisory. The aural advisory "Check Trim, Check Trim, Check Trim" indicates that the autopilot has had a trim failure.

(9) Aural "Autopilot" Advisory. The aural advisory "Autopilot" indicates that the autopilot has disengaged.

d. Emergency Procedures. If an emergency or malfunction makes it necessary to disable the GPAAS, pull the **GPAAS POWER** circuit breaker located on the instrument panel. GPAAS audio may be turned off by pressing the **VOICE OFF** switch.

3C-32. TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS II).

a. System Overview.

(1) The Traffic Alert and Collision Avoidance System is an airborne system that interrogates mode A/C and mode S transponders in nearby aircraft and uses the replies to identify and display potential and predicted collision threats to the flight crew. The system protects a volume of air space around your own aircraft. Aural and visual advisories are provided to the flight crew to assure adequate separation when a system analysis of the intruding aircraft closure rate, derived from transponder replies, predicts a penetration of the protected airspace. The TCAS II is controlled through the TTC-920 Transponder/TCAS control panel located on the pedestal.

(2) Traffic alerts and resolution advisories are indicated on the TVI-920 Transponder/TCAS Display. Traffic alerts provide the flight crew with the relative bearing and distance to intruding aircraft that are approximately 40 seconds from Closest Point of Approach (CPA). This alert provides aid in visually acquiring the intruding aircraft. No maneuvers are commanded. The resolution advisory provides threat resolution information in the form of a vertical maneuver (corrective) or restricted vertical speed range (preventive) that will increase aircraft separation when the threat aircraft is approximately 25 seconds from CPA.

(3) A traffic display and a resolution advisory display are provided to the flight crew. The traffic display consists of the relative position of mode A/C and mode S transponder-equipped aircraft around the TCAS equipped aircraft. The resolution advisory display indicates the appropriate vertical maneuver or restricted vertical speed range to avoid a threat.

(4) Only operating mode A/C or mode S transponders that provide altitude information will generate resolution advisories. Only traffic alerts will be generated by mode A/C or mode S transponders that provide no altitude information.

b. TCAS II Controls and Functions.

(1) Controls and functions of the TTC-920 are illustrated in Figure 3C-150 and detailed in Table 3C-107.

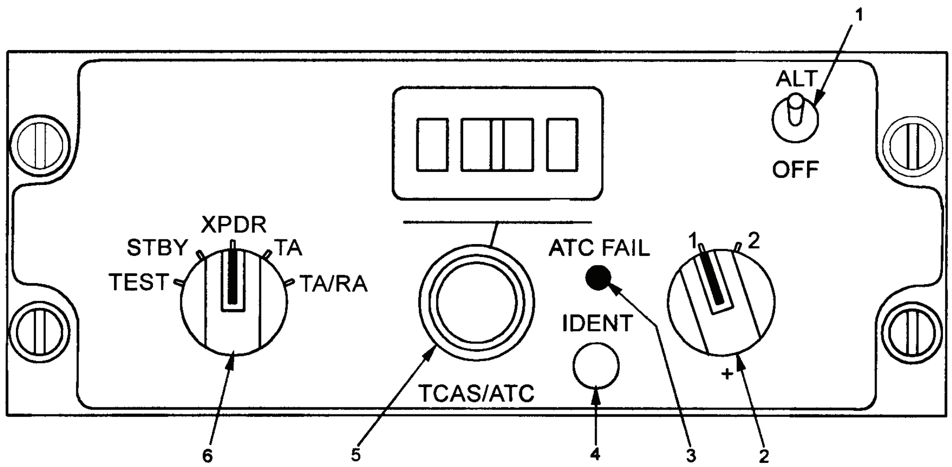


Figure 3C-150. TTC-920 Transponder/TCAS Control

Table 3C-107. TTC-920 Transponder/TCAS Control Switch Descriptions

SWITCH		LEGENDS	FUNCTIONS
1	Altitude Enable Switch	**ALT / OFF**	Enable altitude reporting on transponder.
2	Transponder Enable Switch	**1 / 2**	Enables #1 or #2 transponder.
3	Fail Indicator	**ATC FAIL**	Indicates failure in transponder, control panel, antennas, or air data system when lamp remains lit.
4	Identification Button	**IDENT**	Enables transponder **IDENT**.
5	**TCAS/ATC** Mode Select Switch	0000 through 7777, as selected	Selects transponder code displayed in window.
6	Function Select Switch	**TEST / STBY / XPDR/ TA / TA/RA**	Selects indicated functions. **TEST** and **STBY** apply to both TCAS and transponder. **XPDR** turns on transponder and leaves TCAS in standby. **TA** equals TA only. Other positions enable TCAS and transponder.

(2) Controls and functions of the TVI-920 Display are illustrated in Figure 3C-151 and detailed in Table 3C-108.

Figure 3C-151. TV1-920 Transponder/TCAS Display

Table 3C-108. TVI-920 Transponder/TCAS Display Switch Functions

SWITCH		LEGENDS	FUNCTION
1	Mode push-button switch	**A/B**	Selects above or below for display of traffic.
2	Range push-button switch	**R**	Allow selection of forward direction display range.

c. TVI-920 Transponder/TCAS Display Symbols. Symbols displayed on TCAS display are shown in Table 3C-109.

d. TCAS Mode/Warning Flags and Messages. TCAS mode/warning flags and messages are shown in Figure 3C-152 and Table 3C-110. They may appear in one of the seven indicated slots on the display face.

e. Aural Annunciator Messages. There are two types of aural annunciator messages: a traffic advisory annunciation and a resolution advisory annunciation. The annunciator messages are described in Table 3C-111.

Table 3C-109. TVI-920 Transponder/TCAS Display Symbols

SYMBOL	INTERPRETATION
VERTICAL SPEED DISPLAY	
Vertical Speed Scale (White)	100-ft index marks from 0 to ± 1000 fpm and 500-foot index marks from ± 1000 to ± 6000 fpm are always displayed.
Pointer (White)	Indicates present vertical speed. Pointer displayed when vertical speed is valid.
VERT SPEED X 1000 FPM (Cyan)	Legend displayed on indicator when operating in the transponder only mode and in some failure modes.
Red Arc(s)	Do not enter range if vertical speed is outside of arc (preventive resolution); exit range if vertical speed is within arc (corrective resolution).
Green Arc	Recommended vertical speed to resolve corrective resolution advisory.
TRAFFIC DISPLAY	
Aircraft (White)	"Own aircraft" symbol displayed continuously.
Range Ring (White)	Two-mile radius range about aircraft. If no bearing message is displayed only the forward half of ring will be displayed.
Solid Square (Red)	Threat-level intruder; RA generated; range and bearing relative to own aircraft.
Solid Circle (Yellow)	Potential threat-level intruder; TA generated; range and bearing relative to own aircraft.
Solid Diamond (Cyan)	Proximate traffic within ± 1200 ft and 6 nm of own aircraft.
Open Diamond (Cyan)	Other traffic; beyond 6 nm and/or greater than ± 1200 ft from own aircraft.
Traffic altitude tag (Same color as associated symbol)	Relative or absolute (flight level) altitude of intruder. If altitude is not available, data tag is not displayed.
Vert speed trend arrow (Same color as associated symbol)	Arrow indicating direction of vertical speed change (>500 fpm) of intruder.
Partial traffic symbol (Same color as fully displayed symbol)	Off scale or out of range RA or TA intruder; symbol at periphery of display at bearing to intruder.

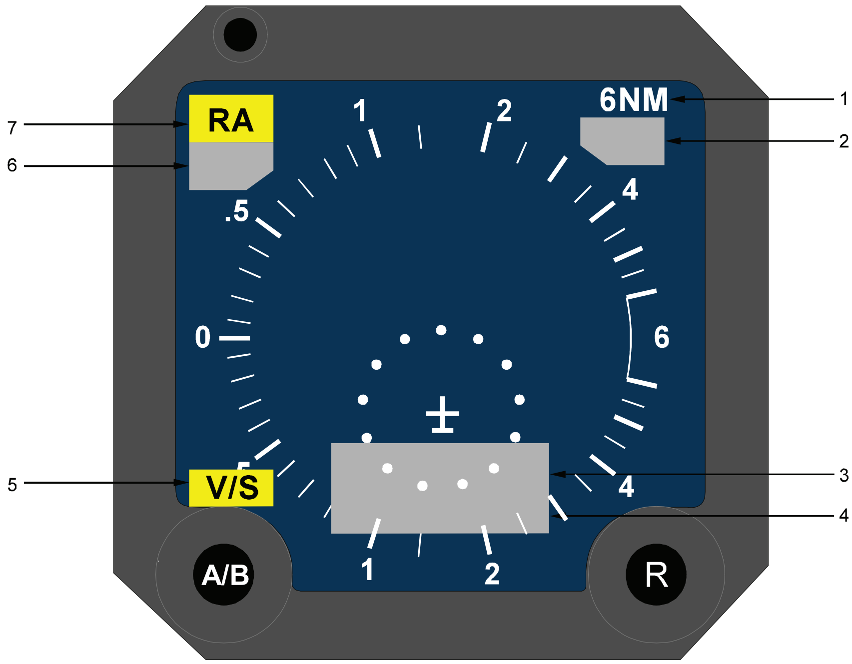


Figure 3C-152. TVI-920 Transponder/TCAS Mode/Warning Flags and Messages

Table 3C-110. TVI-920 Transponder/TCAS Mode/Warning Flags and Messages

SLOT NUMBER	SYMBOL	INTERPRETATION
1	6NM or 12NM	Selected forward range of traffic display.
1 & 2	TCAS OFF	TCAS set to standby, either manually or automatically.
3	TEST	TCAS set to test mode.
3 & 4	No bearing message (Red if RA; yellow if TA)	Range and altitude of Resolution Advisories (RA) or Traffic Advisories (TA) intruders for which no bearing information is available.
4	ABV	Traffic displayed in altitudes from + 9900 ft to – 2700 ft, relative to own aircraft. (If no message is displayed, traffic display is from + 2700 ft to – 2700 ft relative to own aircraft.)
4	BLW	Traffic displayed in altitudes from – 9900 ft to + 2700 ft, relative to own aircraft. (If no message is displayed, traffic display is from + 2700 ft to – 2700 ft relative to own aircraft.)
5	V/S	Vertical speed is unreliable, or system is in test mode.
6 & 7	ONLY T/A	TCAS set to or operating in TA only mode. If TA occurs, message and box border change to yellow.
7	R/A	Resolution advisory or vertical speed is unreliable (Red flag).
7	TCAS	TCAS functions have failed (Yellow flag).

Table 3C-111. Aural Annunciator Messages

MESSAGE	INTERPRETATION
Traffic Advisory Annunciation	
Traffic; Traffic	Traffic has entered 20 to 48-second envelope. Symbol has changed to solid yellow circle.
Resolution Advisory Annunciations (Maneuver should begin within 5 seconds)	
Climb; Climb; Climb	Climb at rate shown on vertical speed indicator.
Climb-Crossing Climb; Climb-Crossing Climb	Climb at rate shown on vertical speed indicator. Flight path will cross intruder's flight path.
Reduce Climb; Reduce Climb	Reduce rate of climb to that on vertical speed indicator.
Descend; Descend; Descend	Descend at rate shown on vertical speed indicator.
Descend, Crossing Descend; Descend, Crossing Descend	Descend at rate shown on vertical speed indicator. Flight path will cross through intruder's flight path.
Reduce Descent; Reduce Descent	Reduce rate of descent to that shown on vertical speed indicator.
Monitor Vertical Speed; Monitor Vertical Speed	Monitor present vertical speed to prevent entering restricted (red arc) vertical speed.
Increased Action Resolution Advisory Annunciations (Maneuver should begin within 2 1/2 seconds)	
Increase Climb; Increase Climb	Follows "Climb" advisory due to intruding aircraft's maneuvering. Rate of climb of own aircraft should be increased.
Increase Descent; Increase Descent	Follows "Descend" advisory due to intruding aircraft's maneuvering. Rate of descent of own aircraft should be increased.
Climb-Climb Now; Climb, Climb Now	Follows "Descend" advisory when reversal of vertical speed is required due to maneuvering of intruding aircraft.
Descend, Descend Now; Descent, Descend Now	Follows "Climb" advisory when reversal of vertical speed is required due to maneuvering of the intruding aircraft.
Threat Situation Resolved	
Clear of Conflict	Intruding aircraft is no longer a threat.

f. Traffic Display. Four types of symbols differentiated by shape and color are used to display intruders around your own aircraft. The different symbols represent Other Traffic, Proximate Traffic, TA, and RA.

(1) Off-Scale and No-Bearing Traffic. When an intruder is outside the indicator display range, the symbol associated with it will be a partial one shown at the outside edge of the display at the relative bearing to the target. As the aircraft moves into the display range, the symbol will become a full symbol as it moves into the display area. When the TCAS cannot compute bearing information on an RA or TA intruder, a text message will be displayed. For example, RA 1.4-10↑ IS A RESOLUTION ADVISORY DUE TO AN AIRCRAFT 1.4 MILES DISTANT, 1000 FEET BELOW YOUR AIRCRAFT AND CLIMBING. The text for an RA will be red and a TA will be yellow.

(2) Other Traffic. A cyan or white open diamond indicates an Other Traffic intruder. It represents an aircraft greater than 6 nm away and/or greater than ± 1200 feet altitude relative to your aircraft.

(3) Proximate Traffic. A Proximate Traffic intruder is displayed as a cyan or white solid diamond. It represents an aircraft within 6 nm and ± 1200 feet relative altitude. These aircraft are not considered a

threat, but are displayed to assist the flight crew in visually acquiring the intruders.

(4) Traffic Advisory Traffic. TA aircraft are displayed as yellow solid circles. At the time an intruder is upgraded to a TA, the aural alert, "Traffic, Traffic" is annunciated. A TA is an aircraft that is within the limits from the CPA shown in Table 3C-112. This gives the crew time to visually acquire the intruding aircraft. No maneuvers will be commanded by the TCAS during this time. TA traffic may be upgraded to RA traffic, depending upon the intruders flight path.

Table 3C-112. Traffic Advisory Chart

ALTITUDE (FEET)	SECONDS TO CPA
Up to 1000 AGL	20
1000 – 2350 AGL	25
2350 AGL – 5000 BARO	30
5000 – 10,000 BARO	40
10,000 – 20,000 BARO	45
20,000 – Above BARO	48

The upgraded traffic advisory is displayed as a solid, red, square. At this time, the intruder is upgraded to an RA and an aural alert, advising flight action, is initiated. The aural alert varies on the action required to achieve maximum vertical separation between your aircraft and the intruder. Refer to Table 3C-111 for aural alert messages. Intruders become a threat and an RA issued when the limits in Table 3C-113 are exceeded.

Table 3C-113. Resolution Advisory Chart

ALTITUDE (FEET)	SECONDS TO CPA
Below 900 AGL	RA not issued if descending
Below 1100 AGL	RA not issued if climbing
1000 – 2350 AGL	15
2350 AGL – 5000 BARO	20
5000 – 10,000 BARO	25
10,000 – 20,000 BARO	30
20,000 – Above BARO	35

(5) Resolution Advisory Display. RA maneuver guidance symbols are red and green arcs superimposed on the vertical speed scale of the vertical speed indicator.

Two types of RA's may be displayed, a preventive and a corrective. A preventive advisory indicates a vertical speed range or pitch that is to be avoided while maintaining the present flight path. A corrective advisory indicates a necessary change in flight path by displaying a vertical speed range or pitch to be flown to. Either advisory serves to ensure that the maximum separation between the aircraft and an intruder is maintained. Refer to Table 3C-114.

Table 3C-114. Resolution Advisory Inhibits

Radio Altitude	Resolution Advisory Status
Below 1450 FT AGL	INCREASE DESCENT RA inhibited
Below 1000 FT AGL descending; Below 1200 FT AGL climbing	DESCEND RA inhibited
Below 900 FT AGL descending; Below 1100 FT AGL climbing	All RA's inhibited (TA ONLY) and TA Aural Message inhibited.

(a) Preventive Advisory. The preventive advisory is an RA that occurs when the TCAS has determined that a threat exists, but that the current vertical speed or pitch will result in sufficient separation from the intruder. The general conditions for a preventive advisory occur when the intruder is within 300 to 800 feet (relative altitude), the range separation is decreasing, and there are approximately 25 seconds to the CPA. The RA display will show a red vertical-speed arc indicating speeds or pitches to avoid. No other action is advised.

(b) Corrective Advisory. This is an RA that occurs when the TCAS has determined that the flight crew should take action to change vertical speed or pitch to avoid an intruder.

1 This advisory occurs when the threat aircraft is within 300 feet (relative altitude), the range separation is decreasing, and there are approximately 25 seconds to the closest point of approach. The TCAS will provide the flight crew with a recommended vertical speed or pitch to provide maximum aircraft separation at the closest point of approach. The corrective advisory consists of one or two red arcs and a green arc. As with the preventive advisory, the red represents vertical speed or pitch ranges that are to be avoided.

2 The pilot should act on the corrective advisory command within approximately 5 seconds after it is issued. Strengthened (increased climb or increased descents) resolution advisories or

reversals represent more urgent situations and should be acted upon within not more than 2.5 seconds.

NOTE

The RA (either preventive or corrective) may downgrade to a TA when the intruder begins diverging from your aircraft. When the RA changes to a TA, the vertical speed maneuver guidance arcs are removed and the aural message, "Clear Of Conflict" is annunciated.

g. TA Only. In the TA-only mode the display will appear as shown in Figure 3C-153. The TA only mode can be manually selected on the transponder/ TCAS control panel or automatically in certain situations, such as when below 100 feet AGL. The display will show the **ONLY TA** flag in message slots 1 and 2 and also that the 6-nm range is selected.

NOTE

The TA ONLY mode does not identify RA intruders and will not generate corrective or preventive RA displays. If an RA threat level aircraft is present, the display will show it as a TA target when the TA ONLY mode is selected.

h. Corrective RA. Figure 3C-154 shows a corrective RA display advising immediate action to provide maximum aircraft separation at CPA. The indication shows the flight path correction's having been started. The aircraft is descending through 650 fpm to exit the vertical speeds indicated by the red arc. Desired vertical speed is indicated by the green arc, 1500 to 2000 fpm, down.

(1) The maneuver is being performed to avoid the threat traffic indicated by the solid, red, square. The traffic is at 1/2 mile and 12 o'clock, 200 feet above your altitude and level.

Figure 3C-153. TA ONLY Operational Situation

Figure 3C-154. Corrective RA Operational Situation

(2) At the same time this traffic was upgraded from a TA to an RA display, the aural alert "Descend, Descend, Descend" would have been annunciated.

(3) Proximate traffic is also shown on this display. The solid diamond at 11 o'clock and 3.5 miles is 300 feet above your own altitude and descending. It poses no present threat, but is within the 6-mile, ± 1200 feet relative altitude range. The other proximate traffic is at 2 o'clock and 4 miles, 500 feet below your altitude and climbing. It does not pose a present threat.

(4) Two corrective commands may be issued if the initial corrective command does not provide the desired aircraft separation. When the threat aircraft maneuvers in a direction that results in a conflict if your own aircraft continues with the previously recommended maneuver these will occur.

(5) An increase advisory, either climb or descend at 2500 fpm to 3000 fpm, will occur if the previous 1500 fpm to 2000 fpm rate of climb or descent is no longer adequate. This display will be accompanied by an aural annunciation of, "Increase Climb, Increase Climb" or "Increase Descent, Increase Descent," as appropriate for the advisory.

(6) A reversal advisory, a climb advisory after a descend advisory, or a descend advisory after a climb advisory will occur if the TCAS determines that the initial advisory should be reversed. An example of when this advisory would occur would be when the intruder causing the initial climb advisory was above you descending into your aircraft's flight path, then alerted its flight path to present a new conflict if your aircraft were to continue to climb.

(7) Reversal advisory displays will also initiate an aural annunciation of "Climb, Climb Now; Climb, Climb Now" or "Descend, Descend Now; Descend, Descend Now."

i. Preventive RA. Figure 3C-155 shows a preventive RA display. Your aircraft is descending at 1700 fpm. The red arc advises that you should not climb at any vertical speed to avoid the threat aircraft at 12 o'clock and 600 feet above you. When this traffic was upgraded from a TA to an RA display, an aural annunciation of "Monitor Vertical Speed, Monitor Vertical Speed" would have been heard.

(1) Proximate traffic is also shown in this display. The solid diamond at 11 o'clock and 3.5 miles is 700 feet above your own altitude and descending. The other proximate traffic at 2 o'clock and 4 miles is 100 feet below and climbing. Neither of these intruders poses a threat.

Figure 3C-155. Preventive RA Operational Situation

(2) If the threat aircraft maneuvers to cause a new conflict before the RA clears, a corrective RA may be issued, overriding the preventive RA.

j. No Bearing Messages. When an intruder is detected, but no bearing can be determined for the aircraft, a no-bearing message is displayed in slot 6 (and slot 7 if two or more aircraft produce this situation; highest priority will be displayed first). A No Bearing Message is displayed. Refer to Figure 3C-156. The yellow **TA** indicates that the intruder is causing a traffic alert. The 1.2 indicates a distance to the intruder of 1.2 miles. The 00 indicates that the intruder is level at your own altitude. An RA No Bearing Message, displayed in red, would be interpreted the same.

k. Clear of Conflict. When the range of an intruder responsible for causing an RA begins to increase, its conflict is considered to be resolved. If more than one intruder is involved in an RA, all conflicts must be resolved before the clear-of-conflict message will be issued. When this occurs, "Clear of Conflict" will be annunciated.

l. Failure Indications.

(1) Figure 3C-157 shows a TCAS flag, indicating failure of the TCAS and no range ring is displayed. Normal vertical speed operation is not affected. If the display is a result of a self-test being completed, the aural message, "TCAS System Test Fail" will be annunciated.

(2) Figure 3C-158 shows an **RA** and a **V/S** flag, indicating failure of the vertical speed indicator. If the vertical speed function of the indicator has failed, it can display no vertical speed commands, thus no RA maneuvers can be commanded. The **RA** flag is also displayed because of this.

Figure 3C-156. No-Bearing Message Operational Situation

Figure 3C-157. Failure Indication Display

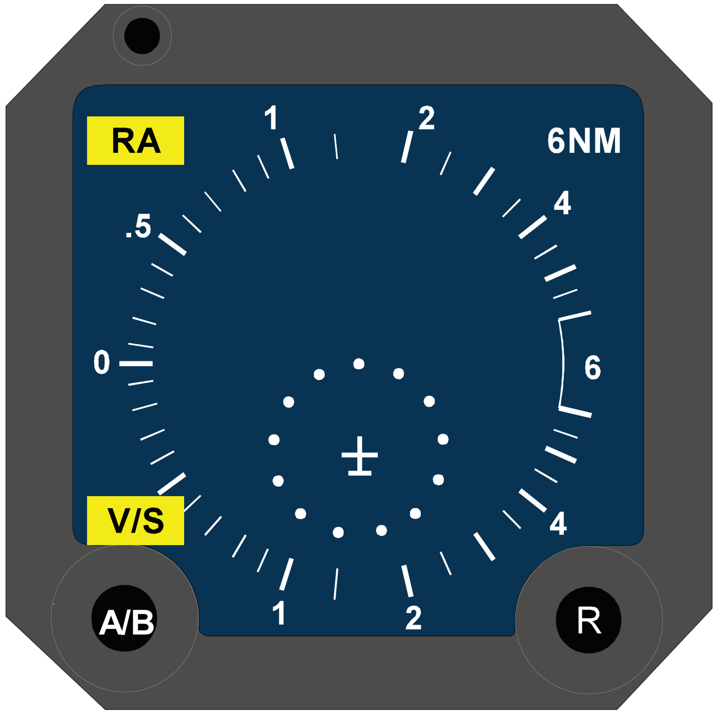


Figure 3C-158. Vertical Speed Indicator Failure

m. TCAS System Test. Self-test is initiated by selecting **TEST** on the transponder/TCAS control panel. While in the self-test mode, normal operation of the TCAS is suspended. On the self-test display in Figure 3C-159, this test pattern is displayed on the vertical speed/TCAS indicator for a few moments. When the self-test is activated, it will also cause transponder self-test indications on the control panel. The squawk code digits display all 8's and the **FAIL** indicator lights momentarily. If the TCAS system passes the internal self-test, the message "TCAS System Test Okay" is annunciated. If the TCAS system fails, the message "TCAS System Test Fail" will be annunciated and the TCAS flag will be in view.

n. Operating Procedures. There are no particular preflight procedures to be performed on the TCAS. The only warmup time required is about 10 seconds after application of primary power for the unit power supplies to come to full voltage and the computer circuits to be reset to initial operating conditions.

NOTE

The average RF output power of the TCAS is below the minimum allowable for human exposure. The system may be operated normally on the ground without danger to personnel in the vicinity.

(1) When executing takeoff and climbout, it is suggested the 6 nm, or shorter, range and ABOVE scan be used. This will eliminate the display of intruders more than 2700 feet below you and allow intruders at altitudes up to 9900 feet above you to be detected during climbout. This range will keep distant intruders from cluttering the display at the time your aircraft is in areas of high traffic density, such as airport traffic areas. Any available range and altitude selection may be used.

(2) The following steps may be performed any time before system operation is required.

1. Select **STBY** on transponder/TCAS control. Power is applied to the transponder and TCAS any time the related primary power circuit breaker is closed. There is no off position. Set assigned ATC squawk code for transponder on transponder/TCAS control.

2. Select **ALT** or altitude source.

3. Select transponder 1 or 2.

4. Select 5-nm range.

Figure 3C-159. TCAS System Test

(3) To initiate self-test, perform the following procedure.

1. Select **TEST** and then select **STBY** on transponder/TCAS control.

2. Vertical speed/TCAS indicator will remove operating TCAS display from indicator and show traffic test pattern and TEST on indicator.

3. At the end of test sequence an aural message "TCAS System Test Okay" or "TCAS System Test Fail" will be annunciated. If the **FAIL** light stays on, it denotes a failure in the transponder or units monitored by the transponder. **FAIL** illuminates for 1 second to verify operation of the light and test mode in the transponder. Transponder code digits will display 8888 for 1 second to verify that all digit segments will illuminate.

o. Normal/In-Flight Operation. By selecting TA/RA mode, the system automatically inhibits RA displays when the aircraft is below 900 feet AGL on approach or 1100 feet AGL on climbout. When flying in close proximity to other aircraft during takeoff and landing, this may be desirable.

(1) Takeoff.

1. Immediately before beginning takeoff, select **TA/RA**.

2. Select short range (5 nm) to reduce clutter.

(2) Cruise.

1. Select desired display range.

2. Select normal (neither Above nor Below).

(3) Descent.

1. Select 10-nm range display.

2. Select Below for descent into the terminal area.

(4) Post Flight. The recommended procedure is to place the TCAS in STBY mode as soon as practical after a landing is completed.

p. Alternate Operating Procedures. The following are suggested alternate operating procedures for use in event a TCAS flag is displayed on the vertical speed indicator or the **FAIL** indicator on the transponder/TCAS control panel is lit. RA's cannot be displayed so the RA flag will also be displayed.

(1) V/S and RA Flags Displayed.

1. Select **TA ONLY.**
2. Traffic display will provide information, including TA's relative to intruders in your area.

WARNING

Do not maneuver the aircraft solely with reference to information on the traffic display.

(2) RA Flag Displayed. Appearance of this flag on the vertical speed indicator indicates failure of the RA functions of the TCAS. Follow the same procedure as in (1) above.

(3) TCAS Flag Displayed. Appearance of this flag indicates failure of some part of the TCAS system. This includes the associated display systems, as well as the units, generating the major TCAS functions and signals.

1. Verify that **ATC FAIL** indicator is not lit. If lit, refer to **ATC FAIL** indicator procedures. If not, continue with the following procedures.
2. Select **TA ONLY**.

WARNING

Do not maneuver the aircraft solely with reference to information on the traffic display.

3. If **TCAS** flag is replaced by a **TA ONLY** message, continue TCAS operation in TA mode.
4. If **TCAS FAIL** flag remains, select **XPDR** or **STBY**, as TCAS is no longer available.

3C-33. STORMSCOPE (WX-1000E).

Refer to Chapter 3, Paragraph 3-9, for information on the Stormscope.

CHAPTER 4
MISSION EQUIPMENT

4-1. MISSION EQUIPMENT.

These aircraft are not equipped with mission equipment.

CHAPTER 5
OPERATING LIMITS AND RESTRICTIONS

Section I. GENERAL

5-1. PURPOSE.

This chapter identifies or refers to all important operating limits and restrictions that shall be observed during ground and flight operations.

5-2. GENERAL.

The operating limitations set forth in this chapter are the direct result 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 are also covered in this chapter.

5-3. EXCEEDING OPERATIONAL UNITS.

Anytime an operational limit is exceeded, an appropriate entry shall be made on DA Form 2408–13–1. Entry shall state the limit or limits that were exceeded, range, time beyond limits, and any additional data that would aid maintenance personnel in the maintenance action that may be required.

5-4. MINIMUM CREW REQUIREMENTS.

The minimum crew required for flight operation is two pilots. Additional crewmembers will be added, as required, at the discretion of the commander, in accordance with pertinent Department of the Army regulations.

Section II. SYSTEM LIMITS

5-5. INSTRUMENT MARKINGS.

Figure 5-1 illustrates instruments that display operation limitations. The operating limitations are color coded on the instrument faces. Color coding of each instrument is defined in the illustration.

5-6. INSTRUMENT MARKING COLOR CODES.

Operating limitations and ranges are illustrated by the colored markings that appear on the dial faces of engine, flight, and utility system instruments. Red markings indicated 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 that the range of the operation covered by the instrument requires special attention. Operation is permissible in the yellow range, but should be avoided. White arcs on the airspeed indicator indicate the flap operating range. The Blue marking on the airspeed indicator indicates best rate of climb with one engine inoperative, at maximum gross weight, forward gross loading, i.e., sea level standard day conditions.

5-7. INSTRUMENT GLASS ALIGNMENT MARKS

Limitation markings consist of strips of semi–transparent color tape which adhere to the glass outside of an indicator dial. Each tape strip shall align to increment marks on the dial face so correct operating limits are portrayed. The pilot should occasionally verify alignment of the glass to the dial face. For this purpose, some engine instruments that have limitation markings shall have short, vertical, white alignment marks extending from the bottom part of the dial glass onto the fixed base of the indicator. These slippage marks appear as a single vertical line when limitation markings on the glass properly align with reading increments on the dial face. However, the slippage marks appear as separate radial lines when a dial glass has rotated.

5-8. PROPELLER LIMITATIONS.

The maximum propeller overspeed limit is 2200 RPM. Propeller speeds above 2000 RPM indicate failure of the constant speed (primary) governor. Propeller speeds above 2120 RPM indicate failure of both primary and overspeed governors. Torque is limited to 81%, for sustained operation above 2000 RPM.

TORQUE

G — 20-100% NORMAL OPERATING RANGE

R — 100% MAXIMUM

TURBINE TACHOMETER (N1 SPEED)

R — 101.5% MAXIMUM

TURBINE GAS TEMPERATURE

G — 400-750°C NORMAL OPERATING RANGE

R — 750°C MAXIMUM CONTINUOUS
750°C MAXIMUM REVERSE (1 MINUTE)

R W — 1000°C MAXIMUM STARTING (5 SECONDS)

Figure 5-1. Instrument Markings and Operating Limits **C D** *(Sheet 1 of 7)*

OIL TEMPERATURE AND PRESSURE

OIL TEMPERATURE SCALE

G	10-99°C NORMAL OPERATING RANGE
R	99°C MAXIMUM

OIL PRESSURE SCALE

R	60 PSI MINIMUM 60 TO 85 PSI, 49% TORQUE MAXIMUM
G	85-135 PSI NORMAL OPERATING ABOVE 21,000 FEET
Y	85-105 PSI CAUTION RANGE BELOW 21,000 FEET
G	105-135 PSI NORMAL OPERATING BELOW 21,000 FEET
R	200 PSI MAXIMUM STARTING WITH COLD OIL

PROPELLER TACHOMETER

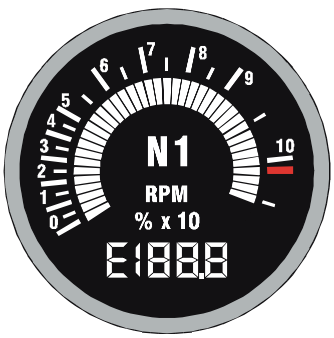
G	1600-2000 RPM NORMAL OPERATING RANGE
R	2000 RPM MAXIMUM

Figure 5-1. Instrument Markings and Operating Limits **C D** *(Sheet 2 of 7)*

TORQUE

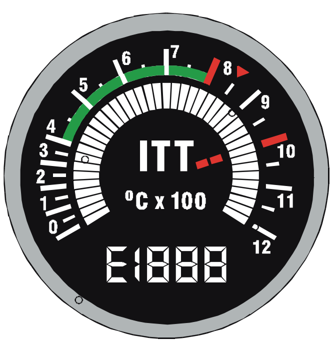
G — 20 TO 100% NORMAL OPERATING RANGE

R — 100% MAXIMUM



TURBINE TACHOMETER (N_1 SPEED)

R — 101.5% MAXIMUM



INTERSTAGE TURBINE TEMPERATURE INDICATOR

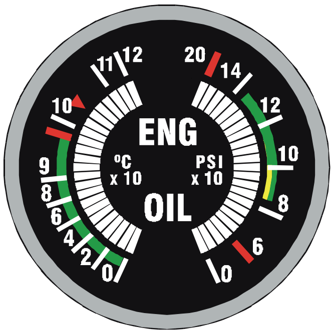
G — 400-800 °C NORMAL OPERATING RANGE

R — 800 °C MAXIMUM CONTINUOUS

R — 1000 °C MAXIMUM STARTING (5 SECONDS)

R ▲ — TRANSIENT ACCELERATION RANGE
850 °C MAXIMUM TRANSIENT

Figure 5-1. Instrument Markings and Operating Limits **T1 T2** *(Sheet 3 of 7)*



OIL TEMPERATURE AND PRESSURE INDICATOR

OIL TEMPERATURE SCALE

G — 0-99 °C NORMAL OPERATING RANGE

R — 99 °C MAXIMUM

R — 104 °C TRANSIENT (5 MINUTES)

OIL PRESSURE SCALE

R — 60 PSI MINIMUM
60 TO 85 PSI, 49% TORQUE MAXIMUM

G — 85-100 PSI NORMAL RANGE ABOVE 21,000 FEET
Y — 85-100 PSI CAUTION RANGE BELOW 21,000 FEET

G — 100-135 PSI NORMAL OPERATING BELOW 21,000 FEET

R — 200 PSI MAXIMUM STARTING WITH COLD OIL

PROPELLER TACHOMETER

G — 1600-2000 RPM NORMAL OPERATING RANGE

R — 2000 RPM MAXIMUM

Figure 5-1. Instrument Markings and Operating Limits **T1 T2** *(Sheet 4 of 7)*

PNEUMATIC PRESSURE

G	12-20 PSI NORMAL OPERATING RANGE
R	20 PSI MAXIMUM

PROPELLER DEICER AMMETER

G	14-18 AMPERES NORMAL OPERATION

Figure 5-1. Instrument Markings and Operating Limits (Sheet 5 of 7)

FUEL QUANTITY

Y — 0-265 LB NO TAKEOFF RANGE

CABIN ALTIMETER AND DIFFERENTIAL PRESSURE

G — 0-6.1 PSI NORMAL RANGE **C D T1**
0-6.5 PSI NORMAL RANGE **T2**

R — 6.1 PSI MAXIMUM **C D T1**
6.5 PSI MAXIMUM **T2**

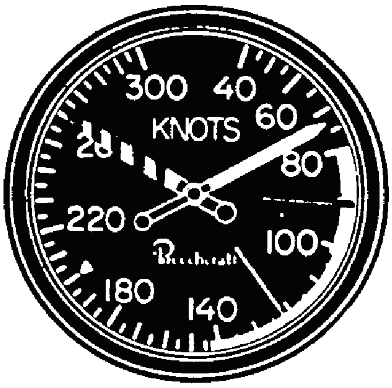
FLAP POSITION INDICATOR

W — 40% TAKEOFF AND APPROACH

Figure 5-1. Instrument Markings and Operating Limits (Sheet 6 of 7)

NOTE

The airspeed markings presented here are for reference only. The actual airspeed indicator in the aircraft may differ in the marking of the operating and limitation airspeeds (KCAS or KIAS). This is dependent on the original aircraft type certificate associated with the particular model and/or the installation of an approved replacement indicator.



AIRSPEED INDICATOR

W R 260 KCAS MAXIMUM (Vmo) (260 KIAS .52 MACH)

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

R 91 KCAS (86 KIAS) MINIMUM SINGLE-ENGINE CONTROL SPEED (Vmca)

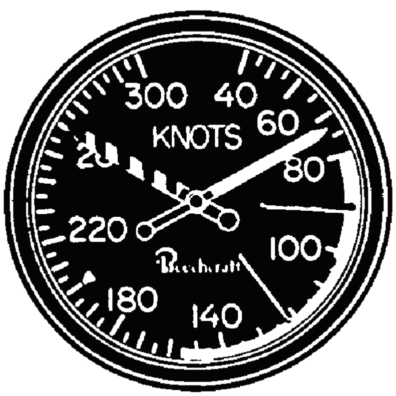
BL 122 KCAS (121 KIAS) ONE-ENGINE INOPERATIVE BEST RATE-OF-CLIMB (Vyse)

W 80-144 KCAS (75-143 KIAS) FULL FLAP OPERATING RANGE

BK W 200 KCAS (199 KIAS) MAXIMUM APPROACH FLAP EXTENSION SPEED

Figure 5-1. Instrument Markings and Operating Limits C *(Sheet 7 of 8)*

AIRSPEED INDICATOR



W R 260 KCAS MAXIMUM (Vmo) (260 KIAS .52 MACH)

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

R 91 KCAS (86 KIAS) MINIMUM SINGLE-ENGINE CONTROL SPEED (Vmca)

BL 122 KCAS (121 KIAS) ONE-ENGINE INOPERATIVE BEST RATE-OF-CLIMB (Vyse)

W 80-155 KCAS (75-154 KIAS) FULL FLAP OPERATING RANGE D
75-157 (KIAS) FULL FLAP OPERATING T1 T2

BK W 200 KCAS (199 KIAS) MAXIMUM APPROACH FLAP EXTENSION SPEED

Figure 5-1. Instrument Markings and Operating Limits D T *(Sheet 8 of 8)*

5-9. STARTER LIMITATIONS.

The starters in this aircraft are limited to an operating time of 40 seconds on, then 60 seconds off, for two starter operations. After two starter operations, the starter shall be operated for 40 seconds on, then 30 minutes off.

5-10. AUTOPILOT LIMITATIONS.

a. A pilot must be seated at the controls with the seat belt fastened when the autopilot is in operation.

b. Operation of the autopilot and yaw damper is prohibited during takeoff and landing and below 200 feet above terrain. Maximum speed for autopilot operation is 260 knots/0.52 Mach.

c. During coupled ILS approach, do not operate the propellers in the 1750 to 1850 RPM range.

5-11. FUEL SYSTEM LIMITS.

NOTE

Aviation gasoline (AVGAS) contains a form of lead that has an accumulative adverse effect on gas turbine engines. The lowest octane AVGAS available (less lead content) should be used. If any AVGAS is used, the total operating time shall be entered on DA Form 2408–13-1.

a. Operating Limits. Operation with **FUEL PRESS** light on is limited to 10 hours. Log **FUEL PRESS** light on time on DA Form 2408–13-1. One standby boost pump may be inoperative for takeoff. Crossfeed fuel will not be available from the side with the inoperative standby boost pump. Operation on aviation gasoline is time limited to 150 hours between engine overhaul and altitude limited to 20,000 feet with one standby boost pump inoperative. Crossfeed capability is required for climb when using aviation gasoline above 20,000 feet.

b. Fuel Management. Fuel shall not be added to auxiliary tanks unless the corresponding main tank is full. Maximum allowable fuel imbalance is 1000 pounds. Do not take off if fuel quantity gages indicate in yellow arc, less than 265 pounds of fuel in each main tank. Crossfeed only during single engine operation.

c. Fuel System Anti–Icing. Icing inhibitor conforming to MIL–1–27686 (PRIST) shall be added to commercial fuel not containing an icing inhibitor during fueling operations, regardless of ambient temperatures. The additive provides anti–icing protection and functions as a biocide to kill microbiological growth in aircraft fuel systems.

d. Limitations with Ferry Fuel Tanks Installed.

WARNING

Failure to comply with Paragraph 5–11d(1) could result in the collapse of the tanks. If the 1500 feet per minute rate of descent is exceeded, the air may not flow through the surge tank and tank vent lines fast enough to keep the tank air pressure and cabin air pressure equalized. If an extreme emergency dictates a greater rate of descent, loosening or removing the tank caps will allow the two air pressures to equalize but could allow fuel fumes to escape into the cabin.

(1) The cabin air pressure **RATE OF DESCENT MUST NOT EXCEED 1500 FEET PER MINUTE** when the extended range fuel tanks are installed in the cabin and the caps are on.

(2) Maximum takeoff weight must not exceed 14,500 pounds (130% of normal max weight), V_{NE} must not exceed 216 knots, V_{MO} must not exceed 0.43 Mach, and the aft CG must not exceed 196.4 inches.

(3) Maximum quantity of fuel carried in the ferry fuel tanks must not exceed 240 U.S. gallons total.

(4) The use of autopilot for flight operations greater than 12,500 pounds is prohibited.

(5) Weather conditions with moderate to severe turbulence should be avoided.

(6) When a landing over 12,500 pounds has been made or the aircraft has encountered moderate to severe turbulence while over 12,500 pounds, the aircraft must be inspected for damage. Inspections performed and the findings must be entered in the Airframe Log Book. The pilot in command is responsible, before the next flight, for determining that the aircraft is in an airworthy condition.

5-12. LANDING GEAR CYCLING AND BRAKE DEICE LIMITATIONS.

a. Hydraulic Landing Gear D2 T . While conducting training operations, the landing gear cyclic rate shall not exceed five complete (extension and retraction) cycles equally spaced in 20 minutes, without allowing a 10 to 15 minute interval between the

20 minute time groupings. It is suggested the cycle rate should not exceed 10 cycles equally spaced in 1 hour. This rate is to keep the power pack motor operations within an intermittent duty class.

b. Brake Deice Limitations. The following limitations apply to the brake deice system.

(1) The brake deice system shall not be operated, except to test, at ambient temperatures above 15 °C.

(2) The brake deice system shall not be operated longer than 10 minutes, one timer cycle, with the landing gear retracted. If operation does not automatically terminate approximately 10 minutes after gear retraction, turn **BRAKE DEICE** switch off.

(3) Maintain 85% N_1 or higher during simultaneous operation of the brake deice and surface deice systems. If adequate pneumatic pressure cannot be provided for simultaneous operation of the brake deice and surface deice systems, turn **BRAKE DEICE** switch off.

(4) **BRAKE DEICE** switch shall be turned off during single engine operation, in order to maintain an adequate supply of systems pneumatic bleed air.

5-13. PNEUMATIC SURFACE DEICE BOOTS LIMITATIONS.

The pneumatic surface deice system shall not be operated when ambient temperatures are below -40 °C. Permanent damage to the deice boots can occur.

Section III. POWER LIMITS

5-14. ENGINE LIMITATIONS.

Operation of the engines is monitored by instruments, with the operating limits marked on the face of each instrument.

CAUTION

Engine operation using only the engine–driven fuel pump without boost pump fuel pressure is limited to 10 cumulative hours. All time in this category shall be entered on DA Form 2408-13-1 for the attention of maintenance personnel.

Use of aviation gasoline is time limited to 150 hours of operation during any Time–Between–Overhaul (TBO) period. It may be used in any quantity with primary or alternate fuel.

NOTE

Aviation gasoline (AVGAS) contains a form of lead that has an accumulative adverse effect on gas turbine engines. The lowest octane AVGAS available (less lead content) should be used. If any AVGAS is used the total operating time must be entered on DA Form 2408-13-1.

5-15. OVERTEMPERATURE AND OVERSPEED LIMITATIONS.

a. Whenever limiting temperatures, listed in the Engine Operating Limitations, Table 5-1, are exceeded and cannot be controlled by retarding the power lever, shutdown the engine and land as soon as practicable.

b. During engine starting, the temperatures and time limits, listed in the Engine Operating Limitations, Table 5–1, must be observed. When these limits are exceeded, the incident will be entered as an engine discrepancy in the appropriate maintenance forms. It is particularly important to record the amount and duration of overtemperature.

c. Whenever the prescribed engine overspeed limit or engine RPM operating limit is exceeded, the incident must be reported as an engine discrepancy in the appropriate maintenance forms. It is particularly important to record the maximum percent of RPM registered by the tachometer, and the duration of overspeed.

d. Continued engine operation above 725 °C **C D** (770 °C **T**), TGT will reduce engine life.

NOTE

The following limitations shall be observed. Each column presents limitations. The limits presented do not necessarily occur simultaneously. Whenever operating limits are exceeded, the pilot shall record the value and duration of the condition encountered on DA Form 2408-13-1.

Table 5-1. Engine Operating Limitations

OPERATING CONDITION	TORQUE PERCENT (1)	MAXIMUM OBSERVED TGT °C	GAS GENERATOR RPM N_1 (2) %	PROP RPM N_2	OIL PRESS PSI (3)	OIL TEMP °C (4) (5)
STARTING	——	1000 (6)	——	——	——	–40
LOW IDLE	——	660 C D 750 T	52 C D 56 T	——	60 (min)	–40 to 99
TAKEOFF AND MAX CONTINUOUS (7)	100	750 C D 800 T	101.5	2000	105–135 C D 100–135 T	10 to 99 C D 0 to 99 T
NORMAL CLIMB AND CRUISE (8)	——	725 C D 770 T	——	——	——	——
MAX REVERSE (9)	——	750	——	1900	105–135 C D 100–135 T	0 to 99
TRANSIENT	123 (6)	850	102.6 (10)	2200 (6)	——	0 to 104 (5)

NOTES

(1) Torque limit applies within range of 1600 – 2000 propeller (N_2) RPM. Below 1600 RPM torque is limited to 49%. Above 2000 RPM, torque is limited to 81%.

(2) Turbine tachometer 100.1% maximum below –48 °C.

(3) Normal takeoff and max continuous oil pressures are 105 to 135 psig C D , 100 to 135 psig T, at gas generator speeds (N_1) greater than 27,000 RPM (72%) with oil temperature between 60 °C and 71 °C. Above 21,000 feet, the minimum oil pressure is 85 psig.

Oil pressure between 60 and 85 psig should be tolerated only for the completion of the flight; and then only with a power setting not exceeding 49% torque.

Oil pressure below 60 psig is unsafe and requires that either the engine be shut down or a landing be made as soon as possible, using minimum power required to sustain flight.

During extreme cold starts, oil pressure may reach 200 psig. Fluctuations of ±10 psig are acceptable.

(4) A minimum of 74 °C to 80 °C (165 °F to 176 °F) is recommended. A minimum oil temperature of 55 °C (130 °F) is recommended for fuel heater operation at takeoff.

(5) Oil temperature limits are –40 °C to 99 °C (–40 °F to 210 °F) C D –44 °C to 99 °C (–45 °F to 210 °F) T with limited times of 5 minutes at 104 °C (220 °F).

(6) These values are time limited to 5 seconds.

(7) The maximum power available from the engine for takeoff and for emergency use at the pilot's discretion.

(8) Continued operation above recommended TGT limits will reduce engine life.

(9) These values are time limited to 1 minute.

(10) These values are time limited to 10 seconds.

5-16. POWER DEFINITIONS FOR ENGINE OPERATIONS.

a. Takeoff and Maximum Continuous. The maximum power available from the engine for takeoff, and for emergency use at the pilot's discretion.

5-17. AMBIENT TEMPERATURE TAKEOFF LIMITATION.

A limitation based on pressure altitude and ambient temperature prohibits aircraft takeoff under certain high ambient temperature conditions.

5-18. GENERATOR LIMITS.

Maximum generator load is limited to 100% for flight and 85% during ground operations. Observe the limits shown in Tables 5–2 and 5-3 during ground operation.

***Table 5-2. Generator Limits* C D**

GENERATOR LOAD	MINIMUM GAS GENERATOR RPM N_1	
	WITHOUT AIR CONDITIONING	*WITH AIR CONDITIONING
0% to 70%	52%	61%
70% to 75%	55%	61%
75% to 80%	60%	61%
80% to 85%	65%	65%
*Right engine only, after stabilized.		

***Table 5-3. Generator Limits* T**

GENERATOR LOAD	MINIMUM GAS GENERATOR RPM N_1	
	WITHOUT AIR CONDITIONING	*WITH AIR CONDITIONING
0% to 75%	56%	62%
75% to 80%	60%	62%
80% to 85%	65%	65%
*Right engine only, after stabilized.		

Section IV. LOADING LIMITS

5-19. CENTER OF GRAVITY LIMITATIONS.

Center of gravity limits and instructions for computation of the center of gravity are contained in Chapter 6. The center of gravity range will remain within limits, providing the aircraft loading is accomplished according to instructions in Chapter 6.

5-20. WEIGHT LIMITATIONS.

a. Maximum Weights.

(1) Takeoff. Maximum Gross Takeoff Weight (GTOW) is 13,500 pounds C D 14,000 pounds D2 T .

(2) Landing. Maximum gross landing weight is 12,500 pounds.

(3) Maximum Ramp Weight. Maximum ramp weight is 13,590 pounds C D1 14,090 pounds D2 T.

(4) Maximum Zero Fuel Weight. Maximum zero fuel weight is 11,000 pounds for all operations.

(5) Altitude. When operating at or below 12,500 pounds GTOW, at least 75% of total missions shall be flown at altitudes greater than 5000 feet above ground level; and, at least 50% of total missions shall be flown at altitudes greater than 10,000 feet above ground level.

b. Operations Over 12,500 Pounds Gross Takeoff Weight C D1 .

(1) *Requirements*.

WARNING

Artificial stall warning systems may only provide a 1 to 5 knot stall warning.

CAUTION

Maximum Gross Takeoff Weight charts must be strictly followed during performance planning to ensure climb capability in the event of an engine failure during takeoff.

(a) Takeoffs. Takeoffs shall only be performed on a smooth paved runway. Takeoffs shall not be performed with a tailwind.

(b) Landing. Maximum landing weight is 12,500 pounds. Landings shall only be made on a smooth paved runway and the sink rate shall not exceed 500 feet per minute.

(c) Flight Altitude and Duration. All missions with over 12,500 pounds GTOW shall be planned and flown at or above 10,000 feet above ground level and be a minimum of 60 minutes in duration unless restricted by Air Traffic Control, turbulence, other weather conditions, or emergencies.

(d) Center of Gravity (CG) Limits. The CG limits shall be IAW with Figure 6-8.

1 The aft CG limit above 12,500 pounds is 196.4 ARM inches.

2 The forward CG limit at 13,500 pounds is 188.3 ARM inches. Intermediate values to 12,500 vary linearly to 185.0 ARM inches.

(e) Limited Applicability to Certain Aircraft. The following aircraft are authorized to be operated at weights greater than 12,500 pounds only if the wing spars have been replaced after 10,000 hours of service.

C–12C	73–22250
	73–22252 through 73–22264
	73–22267 through 73–22269

c. Operations Over 12,500 Pounds Gross Takeoff Weight D2 T.

(1) *Requirements*.

WARNING

Artificial stall warning systems may only provide a 1 to 5 knot stall warning.

CAUTION

Maximum Gross Takeoff Weight charts must be strictly followed during performance planning to ensure climb capability in the event of an engine failure during takeoff.

(a) Aircraft shall be equipped with Raisbeck Engineering dual aft body strakes and engine ram air recovery system with PT6A–42 engines.

(b) Landing. Maximum landing weight is 12,500 pounds, unless required by an emergency. If it is necessary to land with a weight over 12,500 pounds, the landing shall be made on a smooth, paved runway at a sink rate of 500 feet per minute or less, if possible.

(c) Flight Altitude and Duration. All missions with over 12,500 pounds GTOW shall be planned and flown at or above 10,000 feet above ground level and be a minimum of 60 minutes in duration unless restricted by Air Traffic Control, turbulence, other weather conditions, or emergencies.

(d) Takeoff. All missions with over 12,500 pounds GTOW shall be flown on a smooth, paved runway. Takeoffs shall not be performed with a tailwind.

Section V. AIRSPEED LIMITS, MAXIMUM AND MINIMUM

5-21. AIRSPEED LIMITATIONS.

Airspeed indicator readings contained in procedures, text, and illustrations throughout this Operator's Manual are given as indicated airspeed (IAS). Airspeed indicator markings Figure 5-1 and placarded airspeeds, located on the cockpit overhead control panel, Figure 2-15, are Calibrated Airspeeds (CAS) C D and Indicated Airspeeds (IAS) T . Airspeed Calibration Charts are in Chapter 7.

5-22. MAXIMUM ALLOWABLE AIRSPEED.

The maximum allowable airspeed is 260 KIAS/0.52 Mach.

5-23. LANDING GEAR EXTENSION/EXTENDED SPEED.

The airspeed limit for extending the landing gear and for flight with the landing gear extended is 181 KIAS.

5-24. LANDING GEAR RETRACTION SPEED.

The airspeed limit for retracting the landing gear is 163 KIAS.

5-25. WING FLAP EXTENSION SPEEDS.

The airspeed limit for **APPROACH** extension, 40% of the wing flaps is 199 KIAS. The airspeed limit for full **DOWN** extension, 100% of the wing flaps is 143 KIAS C 154 KIAS D 157 KIAS T. If wing flaps are extended above these speeds, the flaps or their operating mechanisms may be damaged.

5-26. MINIMUM SINGLE ENGINE CONTROL AIRSPEED (V_{mc}).

NOTE

Single engine stall speed may be higher than V_{mc}.

The minimum single engine control airspeed (V_{mc}) at sea level standard conditions is 86 KIAS.

5-27. MAXIMUM DESIGN MANEUVERING SPEED.

The maximum design maneuvering speed for flaps retracted is 181 KIAS and 111 KIAS for flaps fully extended at 12,500 pounds.

Section VI. MANEUVERING LIMITS

5-28. MANEUVERS.

a. The following maneuvers are prohibited.

(1) Spins.

(2) Aerobatics of any kind.

(3) Abrupt maneuvers above 181 KIAS at 12,500 pounds.

(4) Any maneuver which results in a positive load factor of 3.17 G's or a negative load factor of 1.27 G's with wing flaps up, or a positive load factor of 2.0 G's or a negative 1.27 G's with wing flaps down at 12,500 pounds.

b. Recommended turbulent air penetration airspeed is 170 KIAS.

5-29. BANK AND PITCH LIMITS.

a. Bank limits are 60° left or right.

b. Pitch limits are 30° above or below the horizon.

Section VII. ENVIRONMENTAL RESTRICTIONS

5-30. ALTITUDE LIMITATIONS.

The maximum altitude that the aircraft may be operated at is 31,000 feet C D T1 , 35,000 feet T2. When operating with inoperative yaw damp, the altitude limit is 17,000 feet if the aircraft is not equipped with dual aft body strakes.

5-31. TEMPERATURE LIMITS.

a. The aircraft shall not be operated when the ambient temperatures are warmer than International Standard Atmosphere (ISA) +37 °C at SL to 25,000 feet or ISA +31 °C above 25,000 feet.

b. Engine ice vanes shall be retracted at +15 °C and above for flight operations.

5-32. FLIGHT UNDER INSTRUMENT METEORO–LOGICAL CONDITIONS (IMC).

This aircraft is qualified for operation in instrument meteorological conditions.

5-33. ICING LIMITATIONS (TYPICAL).

WARNING

While in icing conditions, if there is an unexplained 30% increase of torque needed to maintain airspeed in level flight, a cumulative total of 2 or more inches of ice accumulation on the wing, an unexplained decrease of 15 knots IAS, or an unexplained deviation between pilot's and copilot's airspeed indicators, the icing environment should be exited as soon as practicable. Ice accumulation on the pitot tube assemblies could cause a complete loss of airspeed indication.

The following conditions indicate a possible accumulation of ice on the pitot tube assemblies and unprotected aircraft surfaces. If any of these conditions are observed, the icing environment should be exited as soon as practicable.

a. Total ice accumulation of 2 inches or more on the wing surfaces. Determination of ice thickness can be accomplished by summing the estimated ice thickness on the wing prior to each pneumatic boot deice cycle (e.g. four cycles of minimum recommended ½–inch accumulation).

b. A 30% increase in torque per engine required to maintain an desired airspeed in level flight (not to exceed 85% torque) when operating at recommended holding speed.

c. A decrease in indicated airspeed of 15 knots after entering the icing condition (not slower than 1.4 power off stall speed) if maintaining original power setting in level flight. This is determined by comparing pre–icing condition entry speed to the indicated speed after a surface and antenna deice cycle is completed.

d. Any variations from normal indicated airspeed between the pilot's and copilot's airspeed indicators.

5-34. ICING LIMITATIONS (SEVERE).

WARNING

Severe icing may result from environmental conditions outside of those for which the aircraft is certified. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in a buildup on protective surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of these protected surfaces. This ice may not shed using ice protection systems, and may seriously degrade the performance and controllability of the aircraft.

a. During flight, severe icing conditions that exceed those for which the aircraft is certified shall be determined by the following visual cues. If one or more of these visual cues exist, immediately request priority handling from air traffic control to facilitate a route or an altitude change to exit the icing conditions:

(1) Unusually extensive ice accreted on the airframe in areas not normally observed to collect ice.

(2) Accumulation of ice on the upper (or lower, as appropriate) surface of the wing aft of the protected area.

(3) Accumulation of ice on the propeller spinner farther aft than normally observed.

b. Since the autopilot may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the aircraft is in icing conditions.

5-35. OXYGEN REQUIREMENTS.

a. One oxygen mask must be provided for each passenger and crewmember. A minimum 10–minute supply of supplemental oxygen shall be available during flight at or above an altitude of 25,000 feet based on the highest total aircraft oxygen flow rates.

b. In addition, sufficient oxygen will be carried for each flight, assuming a decompression will occur at the altitude or point of flight that is most critical from the standpoint of oxygen need, and that after decompression the aircraft will descend, in accordance with the emergency procedures, to a flight altitude that will allow successful termination of the flight.

Following decompression, the cabin pressure altitude is considered to be the same as the flight altitude.

c. When flying at altitudes above 25,000 feet, one mask per occupant must be coupled to the oxygen outlet and immediately available C .

d. Oxygen system data/duration tables may be found in Chapter 2.

5-36. CABIN PRESSURE LIMITS.

Maximum cabin differential pressure is 6.1 psi C D T1 6.6. psi T2.

5-37. CRACKED CABIN WINDOW/WINDSHIELD.

If a crack occurs in a single ply of cabin exterior window, the aircraft is limited to unpressurized flight. If a crack occurs in both outer and inner plies of the cabin exterior window, the aircraft shall not be flown unless proper authorization is obtained for an unpressurized ferry flight. If a crack occurs in an outer ply windshield, no action is required in flight. If a crack occurs in an inner ply windshield or if a crack occurs in either/both plies of a cabin window, refer to emergency procedures in Chapter 9.

Section VIII. OTHER LIMITATIONS

5-38. PASSENGER SEATS.

The cabin passenger seats may be used in the forward or aft positions. The headrest and seat back, when occupied, must be in the fully upright position for takeoff and landing.

5-39. ILS LIMITS.

During an ILS approach, do not operate the propellers in the 1750 to 1850 RPM range.

5-40. INTENTIONAL ENGINE CUT SPEED.

In-flight engine cuts below the safe one-engine inoperative speed of V_{sse}, 104 KIAS are prohibited.

5-41. LANDING ON UNPREPARED RUNWAY.

CAUTION

Operation on unimproved, soft, or rough surfaces is recommended only for aircraft equipped with high floatation landing gear.

CAUTION

Except in an emergency, propellers should be moved out of reverse above 40 knots to minimize propeller blade erosion, and during crosswind, to minimize stress imposed on propeller, engine and airframe. Care shall be exercised when reversing on runways with loose sand or dust on the surface. Flying gravel will damage propeller blades and dust may impair the pilot's forward visibility at low airplane speeds. The aircraft has demonstrated landings on hard, smooth surfaces and dry sod runways. Hard braking, i.e., skidding tires while operating on other than smooth surfaces, can result in damage to the landing gear. When landing on other than dry surfaces, use discretionary propeller reverse to stop the airplane on the available runway.

5-42. MINIMUM OIL TEMPERATURE REQUIRED FOR FLIGHT.

CAUTION

Anti-icing additive must be properly blended with the fuel to avoid deterioration of the fuel cell. The additive concentration by volume shall be a minimum of .06% and maximum .15%. Approved procedure for adding anti-icing concentrate is contained Chapter 2, Section XII.

CAUTION

Some fuel suppliers blend anti-icing additive in their storage tanks. Prior to refueling, check with the fuel supplier to determine if fuel has been blended. To assure proper concentration by volume of fuel on board, blend only enough additive for the unblended fuel.

Engine oil is used to heat the fuel on entering the fuel control. Since no temperature measurement is available for the fuel at this point, it must be assumed to be the same as the OAT. The minimum oil fuel temperature graph, Figure 5-2, is a guide in preflight planning, based on known or forecast operating conditions, to allow the operator to become aware of operating temperatures where icing at the fuel control could occur. If the pilot should indicate that oil temperatures versus OAT are such that ice formation could occur during takeoff or in flight anti-icing additive per MIL-I-27686 should be mixed with the fuel at refueling to ensure safe operation. In the event that authorized fuels are not available, limitations on graph apply.

5-43. TIRE LIMITATIONS.

Maximum tire speeds are:

High Flotation Gear……..…139 Knots (160 MPH)

Standard Gear……………..155 Knots (180 MPH)

5-44. STRUCTURAL LIMITATIONS.

Maximum sink rate
at touchdown (12,500 pounds)…………600 FPM

Refer to Chapter 4 of the A200/A200CT/B200C Maintenance Manual for structural limitations.

5-45. FDS 255 REQUIREMENTS.

a. EFIS fans must be operational.

b. Both pilots flight displays must be in the traditional ADI and HSI mode for takeoffs and the final segment of instrument approaches. MAP modes are not authorized for takeoffs or the final segment of instrument approaches.

c. Full-scale ADI and HSI displays are required for normal operations. The Primary Flight Display (PFD) mode is for reversionary use.

d. The following placard must be installed above the right seat pilot's EADI: **"FMS2 OBS MODE MUST BE FLOWN FROM THE LEFT SEAT PILOT'S SEAT ONLY."**

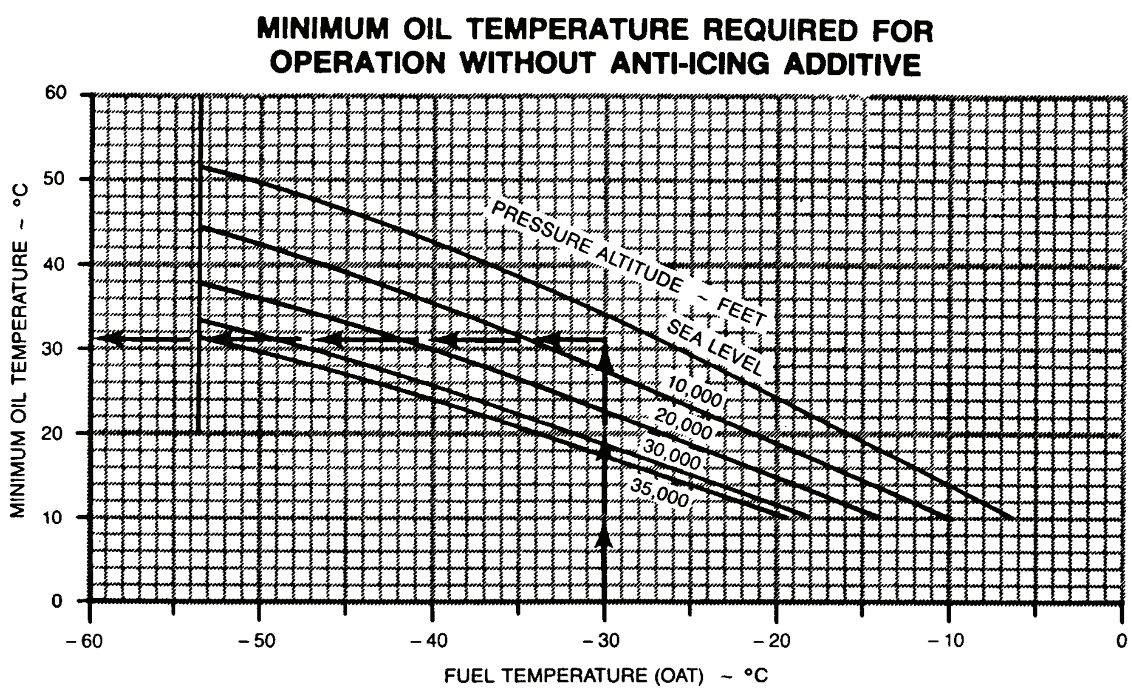


Figure 5-2. Oil/Fuel Temperature Graph

Section IX. REQUIRED EQUIPMENT FOR VARIOUS CONDITIONS OF FLIGHT

5-46. REQUIRED EQUIPMENT LISTING.

The Required Equipment List (REL) is approved by the Directorate of Evaluation and Standardization (DES) USAAVNC, Fort Rucker. It is fully coordinated with the Master Minimum Equipment List (MMEL) and AR 95-1. It is the governing document for flight with inoperative components and items of equipment. Changes or modification to the REL are not authorized unless approved by DES and distributed by the Fixed Wing Product Manager's Office (FWPMO).

CHAPTER 6
WEIGHT/BALANCE AND LOADING

Section I. GENERAL

6-1. EXTENT OF COVERAGE.

Sufficient data has been provided so that, knowing the basic weight and moment of the aircraft, any combination of weight and balance can be computed.

6-2. CLASS.

Army Model C-12 is in class 2. Additional directives governing weight and balance of class 2 aircraft forms and records are contained in AR 95-1, TM 55-1500-342-23 and DA PAM 738-751.

6-3. AIRCRAFT COMPARTMENTS AND STATIONS.

The aircraft is separated into two compartments associated with loading. These compartments are the cockpit and the cabin. Sheet 1 from Figure 6-1 illustrates the general description of aircraft compartments of C D T1 and Sheet 2 illustrates T2.

Section II. WEIGHT AND BALANCE

6-4. PURPOSE.

The data to be inserted on weight and balance charts and forms is applicable only to the individual aircraft whose serial number appears on the title page of the booklet, supplied by the aircraft manufacturer, entitled WEIGHT AND BALANCE DATA and on the various forms and charts which remain with the aircraft. The charts and forms referred to in this chapter may differ in nomenclature and arrangement from time to time but the principle on which they are based will not change.

6-5. CHARTS AND FORMS.

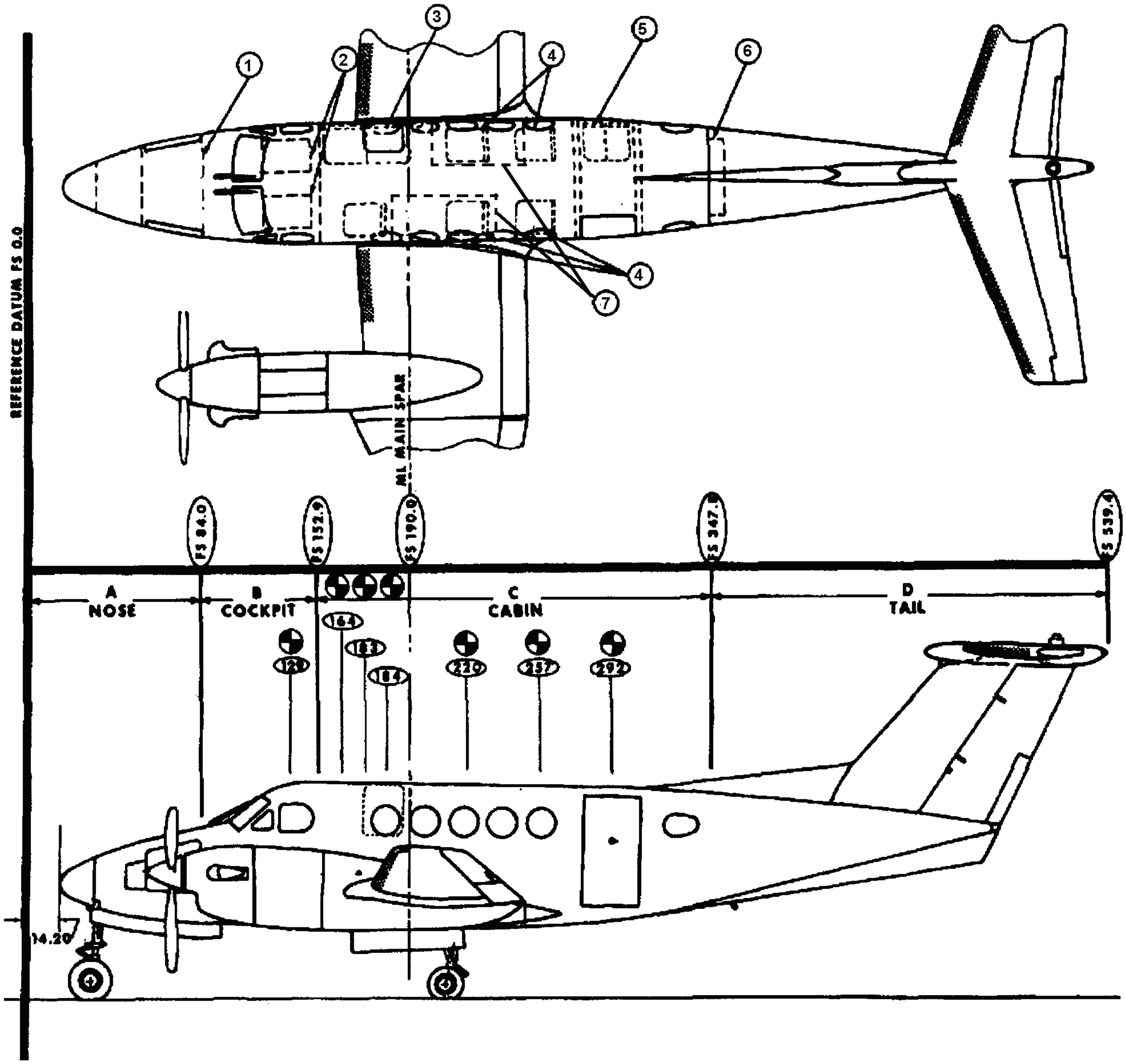
The standard system of weight and balance control requires the use of several different charts and forms. Within this chapter, the following are used:

a. Chart C – Basic Weight and Balance Record, DD Form 365-3.

b. Form F – Weight and Balance Clearance Form F, DD Form 365-4 (Transport).

6-6. RESPONSIBILITY.

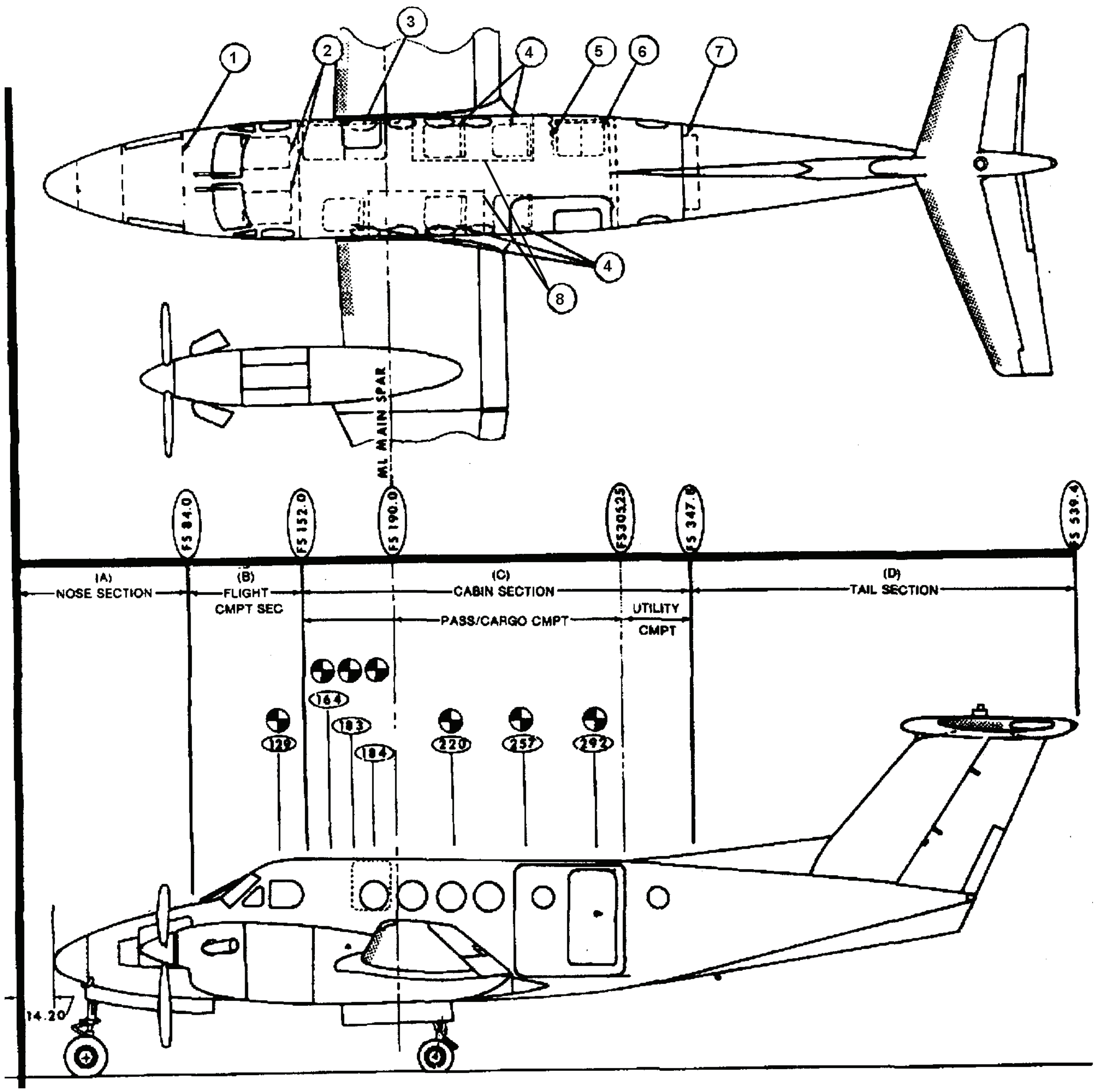
The aircraft manufacturer inserts all aircraft identifying data on the title page of the booklet entitled, "Weight And Balance Data," and on the various charts and forms. All charts, including one sample Weight and Balance Clearance Form F, if applicable, are completed at time of delivery. This record is the basic weight and balance data of the aircraft at delivery. All subsequent changes in weight and balance are compiled by the weight and balance technician.



1. Avionics Compartment
1. Pilot and Copilot Seats
2. Two Place Couch
3. Passenger Seats (5)
4. Lavatory
5. Avionics Shelf
6. 120-Gallon Ferry Tanks

⊕ Denotes Seating Centroids

Figure 6-1. Aircraft Compartments and Stations C D T1 *(Sheet 1 of 2)*



1. Avionics Compartment
2. Pilot and Copilot Seats
3. Two Place Couch
4. Passenger Seats (5)
5. Privacy Curtain
6. Lavatory
7. Avionics Shelves, Oxygen Bottle
8. 120-Gallon Ferry Tanks

⊕ Denotes Seating Centroids

Figure 6-1. Aircraft Compartments and Stations **T2** *(Sheet 2 of 2)*

6-7. CHART C – BASIC WEIGHT AND BALANCE RECORD.

Chart C is a continuous history of the basic weight and moment resulting from structural and equipment changes made in service. At all times, the last weight and moment/100 entry is considered the current weight and balance status of the basic aircraft.

6-8. WEIGHT AND BALANCE CLEARANCE FORM F, DD FORM 365-4.

a. General. Form F is a summary of the actual disposition of load in the aircraft. It records the balance status of the aircraft step by step. It serves as a worksheet on which the weight and balance technician records the calculations and any corrections that must be made to ensure the aircraft will be within weight and CG limits. It is necessary to complete Form F prior to flight whenever an aircraft is loaded in a manner for which no previous valid Form F is available.

The form is used to derive the gross weight and CG of any aircraft. The Form F furnishes a record of the aircraft weight and balance status at each step of loading process. It serves as a worksheet to record weight and balance calculations and corrections that must be made to ensure that the aircraft will be within weight and CG limits. Instructions for filling out a Form F are given in TM 55-1500-342-23.

Section III. FUEL/OIL

6-9. FUEL LOAD.

Fuel loading imposes a restriction on the amount of load that can be carried. The required fuel must first be determined, then that weight subtracted from the total weight of passengers, baggage and fuel. Weights up to and including the remaining allowable capacity can be subtracted directly from the weight of passengers, baggage and fuel. As the fuel load is increased, the loading capacity is reduced.

6-10. FUEL AND OIL DATA.

a. Fuel Moment Chart. This chart, Figure 6-2, shows usable fuel moment/1000 for US gallons or pounds of fuel at specific weights of 6.5 lb/gal (JP-4) and 6.8 lb/gal (JP-5/8). Fuel moments should be determined by entering the chart with fuel weight and using the line on Figure 6-2 that represents the specific weight closest to that of the fuel being used. For a given weight of fuel there is only a very small variation in fuel moment with change in fuel specific weight. Additional correction for fuel specific weight is not required.

The fuel tank usable fuel weight will vary depending upon specific weight. The fuel quantity indicator is calibrated for correct indication when using JP-5 or JP-8. When using other fuels, multiply the indicated fuel quantity in pounds by .99 for JP-4 or by .98 for Aviation Gasoline (100/130).

The following information is provided to show the general range of fuel specific weights to be expected. Specific weight of fuel will vary depending on fuel temperature. Specific weight will decrease as fuel temperature rises and increase as fuel temperature decreases at the rate of approximately 0.1 lb/gal for each 15 °C change. Specific weight may also vary between lots of the same fuel at the same temperature by as much as 0.5 lb/gal. The following approximate fuel specific weights at 15 °C may be used for most mission planning.

FUEL TYPE	SPECIFIC WEIGHT
JP-4	6.5 LB/GAL
JP-5	6.8 LB/GAL
JP-8	6.8 LB/GAL

b. Oil Data. Total oil weight is 62 pounds and is included in the basic weight of the aircraft. Servicing information is provided in Section XII of Chapter 2.

FUEL MOMENT CHART

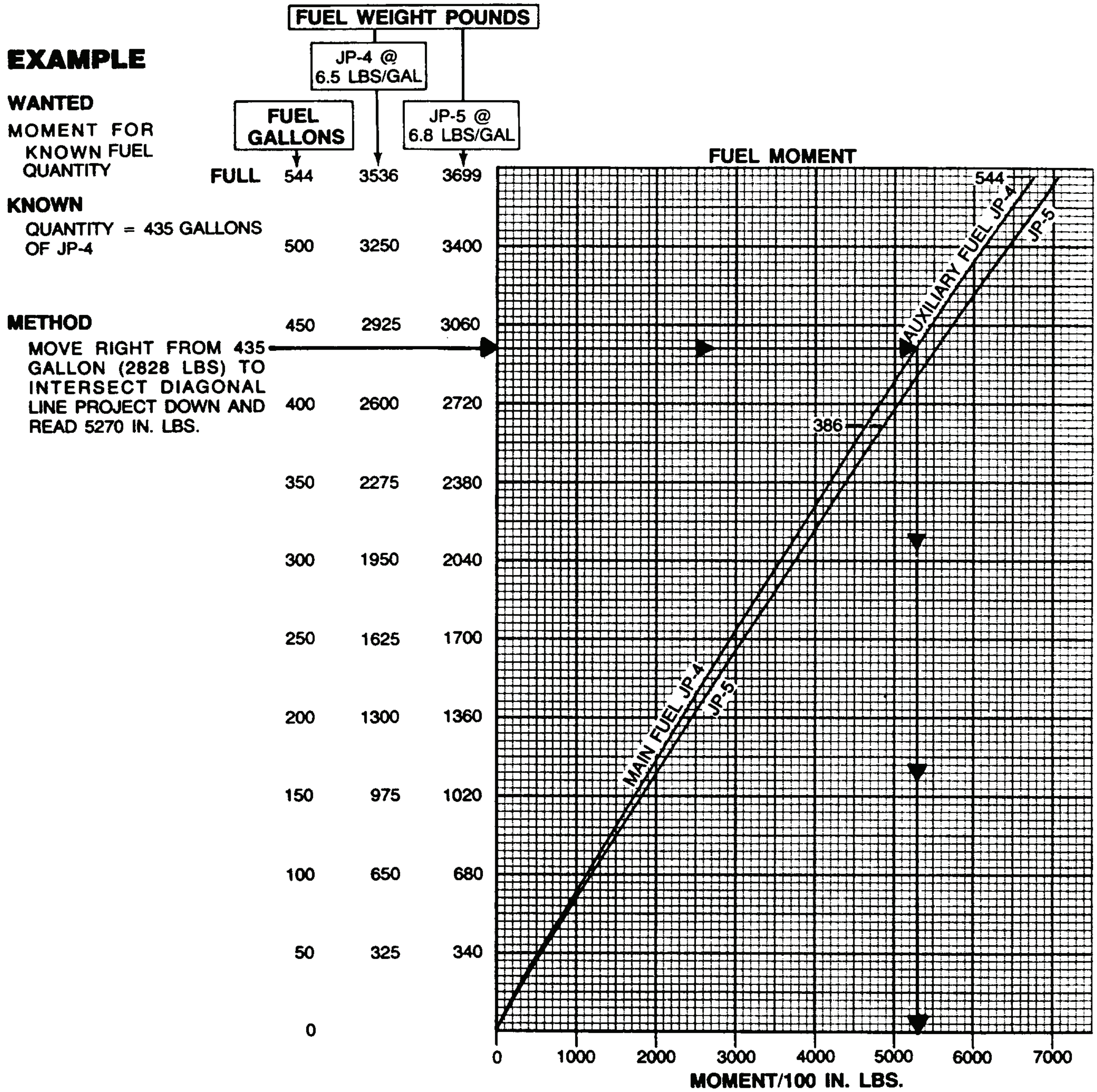


Figure 6-2. Fuel Moment Chart

Section IV. PERSONNEL

6-11. CABIN AREA.

a. Cabin. The cabin extends from the back of the cockpit partition to the aft cabin wall. This area provides 253.0 cubic feet of space. The cabin is 57.0 inches high and 54.0 inches wide. Access is gained through the entrance door that measures 51.5 inches high and 26.7 inches wide. The cabin section flooring will withstand a loading of 200 pounds per square foot for storage supported on the seat tracks. Floor areas where seat tracks are not present (walkways and aft baggage/utility area) will only support 100 pounds per square foot floor loads. Refer to Section V, to determine maximum cargo capacity and load position. Payload shall be limited in conjunction with fuel loading to stay within the design gross weight limitations.

b. Seating Arrangement. Seating is provided for eight passengers. These seats may be installed facing aft. A side-facing toilet is installed across from the cabin entrance door, separated from the passenger area by a partition. A seat belt is provided and seating of one passenger is allowed in the toilet area. A baggage storage area is provided in the farthest aft portion of the cabin. Refer to Figure 6-3 for baggage moments.

NOTE

The baggage/utility compartment area, containing 53.3 cubic feet of space, provides for storage of 550 pounds of baggage.

c. Ferry Fuel Configuration. The cabin area may be converted to accommodate ferry missions by removing the passenger seats and floor panels. The tank platforms and ferry tanks are secured with seat rail cargo rings on seat rails. The fuel tanks are connected to the provisions already installed in the fuel system.

6-12. PERSONNEL LOADING AND UNLOADING.

a. Seat Installation. The seats are mounted on full-length seat tracks to provide for quick removal and various seating arrangements. The armrests adjacent to the aisle may be lowered to allow ease of entry. The seats have reclining backs that may be adjusted for individual comfort. Seat back must be in the full upright position for takeoff and landing.

b. Seat Belts and Shoulder Harnesses. The pilot's and copilot's seats are equipped with shoulder harnesses. The belt for the shoulder harness is in a "Y" configuration with a single strap contained in an inertia reel attached to the seat back. One strap is worn over each shoulder and fastened by metal loops to the seat belt buckle. Spring loading of the inertia reel allows normal movement. A locking device will secure the harness in the event of sudden forward movement or impact action. Each passenger seat is equipped with a lap seat belt. An over the shoulder restraint belt, in addition to the lap belt, is installed on T2 models.

6-13. PERSONNEL LOAD COMPUTATION.

When aircraft are operated at critical gross weights, the exact weight of each individual occupant, plus equipment, should be used. Refer to Figure 6-4 for personnel moments chart. Crew and passengers with no equipment: compute weight according to each individual's estimate.

NOTE

Personnel loading configurations other than those shown in Figure 6-4 shall be computed using Cargo Moment Chart, Figure 6-5.

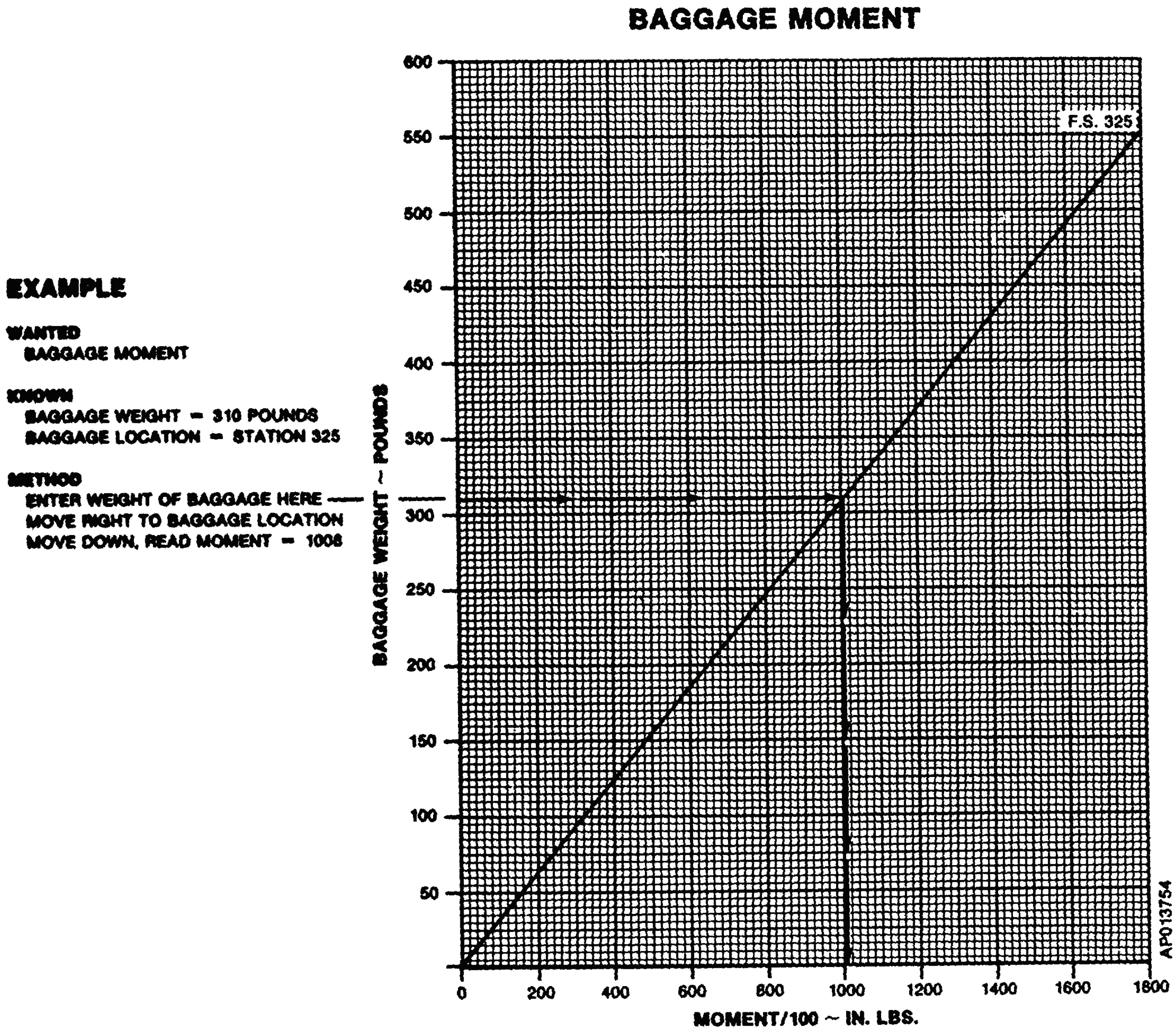


Figure 6-3. Baggage Moment

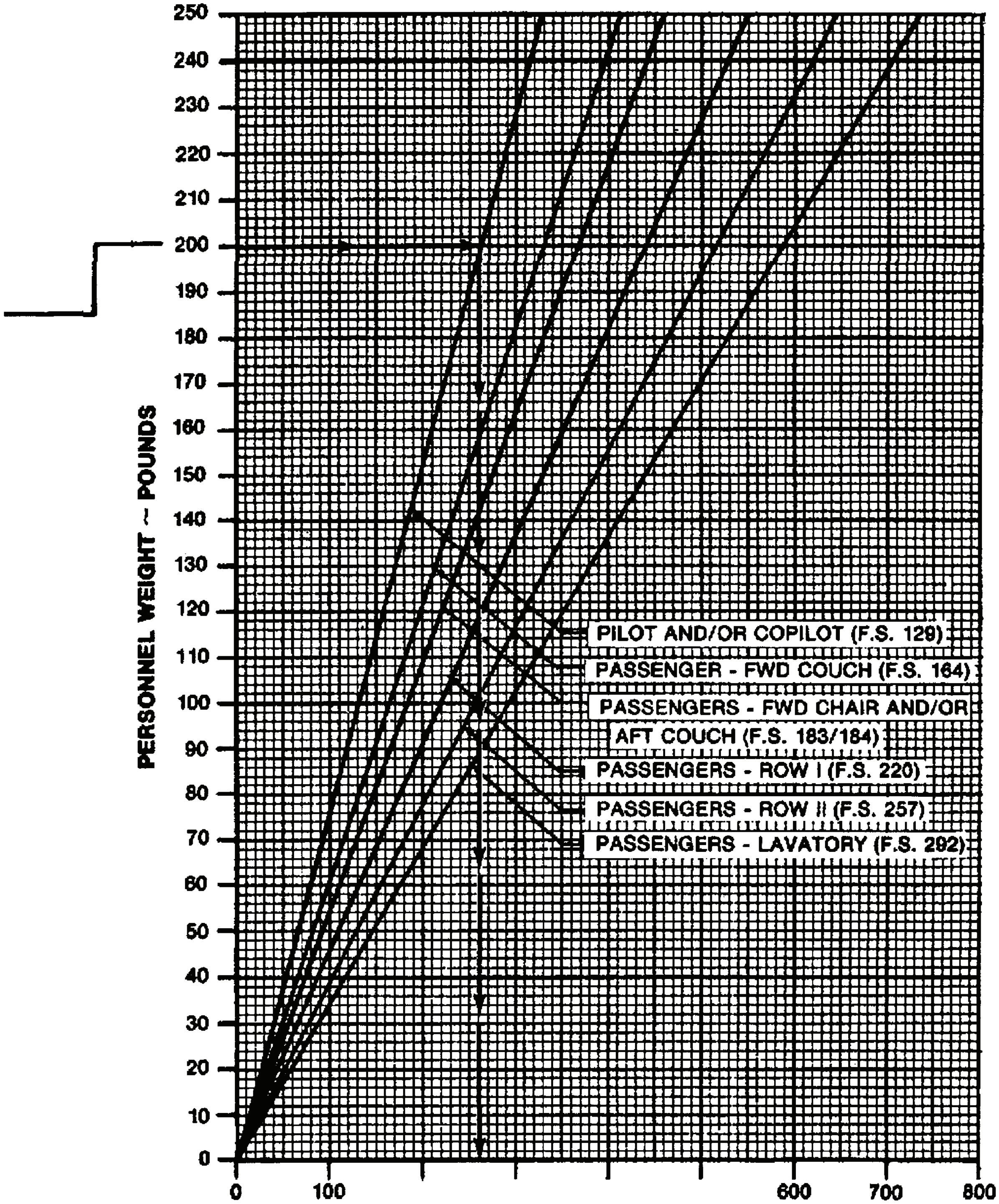


Figure 6-4. Personnel Moments

CARGO MOMENT

EXAMPLE

WANTED

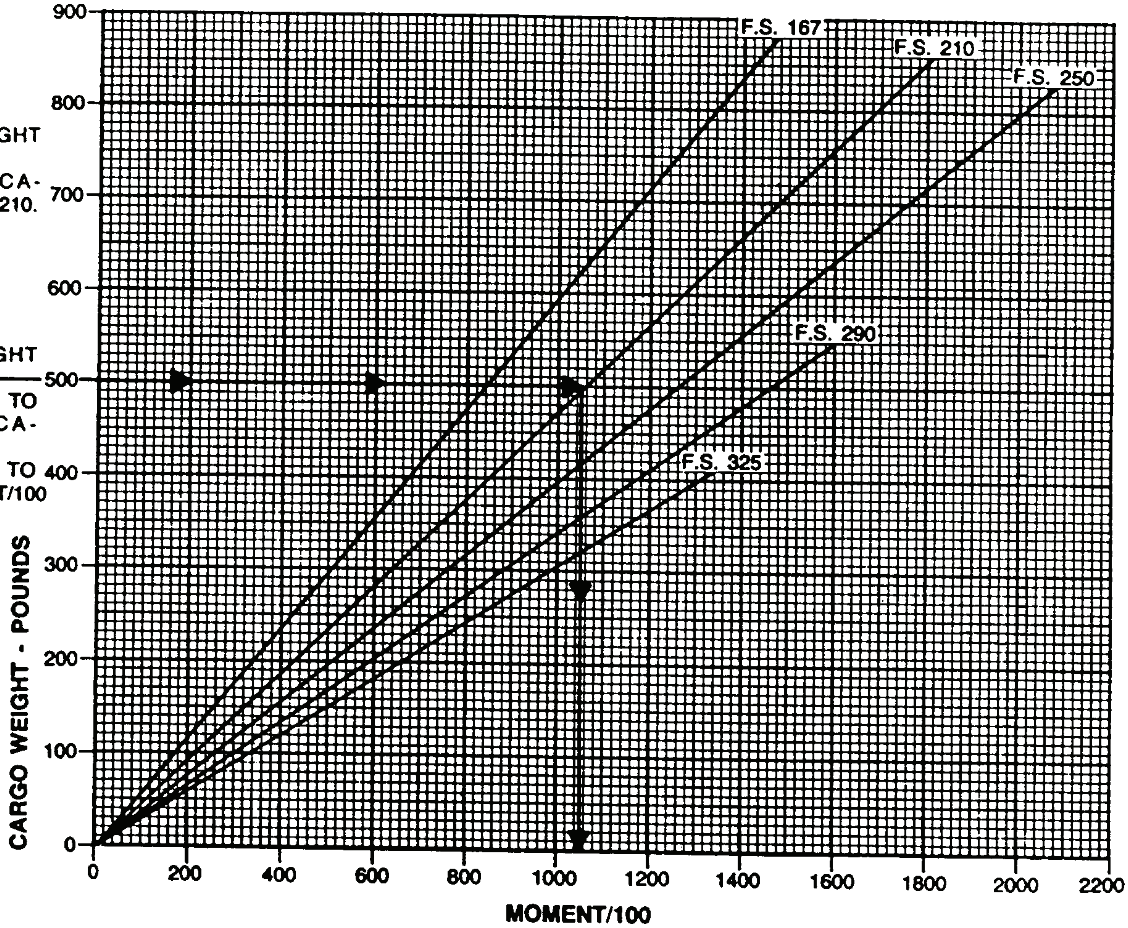
CARGO MOMENT.

KNOWN

CARGO WEIGHT = 500 LBS.
CARGO LOCATION = F.S. 210.

METHOD

ENTER WEIGHT OF CARGO———MOVE RIGHT TO CARGO LOCATION.
MOVE DOWN TO READ MOMENT/100 = 1050.



WARNING

OPERATION OF THIS AIRCRAFT (IN THE CARGO CONFIGURATION) WITH PILOT AND CO-PILOT ONLY MAY EXCEED THE FORWARD C.G. LIMIT. ADD BAGGAGE AND/OR REMOVABLE BALLAST IN AFT BAGGAGE COMPARTMENT AS REQUIRED UP TO ALLOWABLE MAXIMUM.

Figure 6-5. Cargo Moment C D1 T1 (1 of 2)

CARGO MOMENT

WARNING

OPERATION OF THIS AIRCRAFT (IN THE CARGO CONFIGURATION) WITH PILOT AND CO-PILOT ONLY MAY EXCEED THE FORWARD C.G. LIMIT. ADD BAGGAGE AND/OR REMOVABLE BALLAST IN AFT BAGGAGE COMPARTMENT AS REQUIRED UP TO ALLOWABLE MAXIMUM.

EXAMPLE

WANTED
CARGO MOMENT

KNOWN
CARGO WEIGHT = 500 LBS.
CARGO LOCATION = F.S. 218

METHOD
ENTER WEIGHT OF CARGO →
MOVE RIGHT TO CARGO LOCATION.
MOVE DOWN TO READ MOMENT/100 = 1090

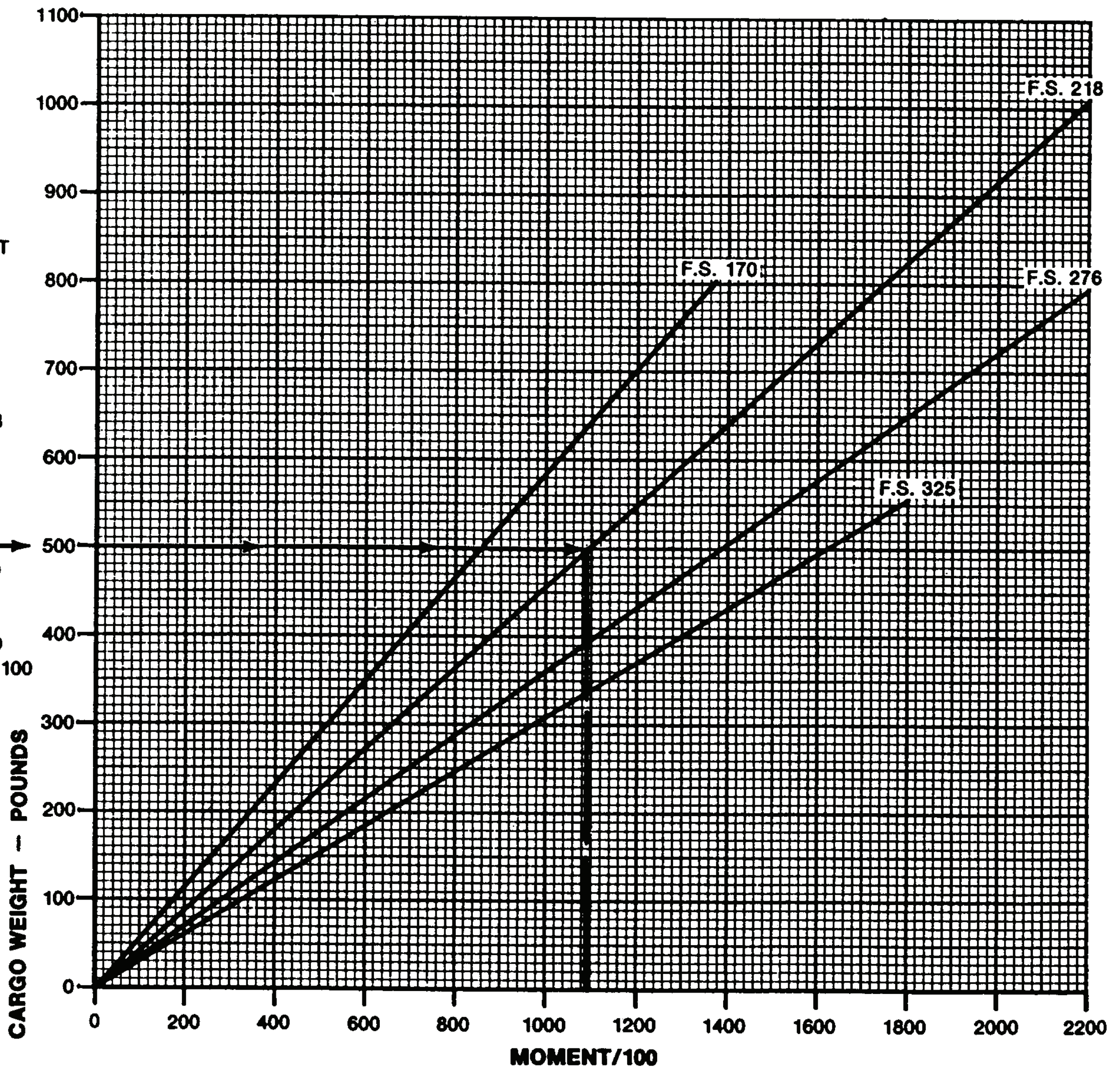


Figure 6-5. Cargo Moment **T2** *(2 of 2)*

Section V. MISSION EQUIPMENT

Not Applicable.

Section VI. CARGO LOADING

6-14. AIR CARGO FEATURES.

The 245 cubic foot cabin area is easily converted for mixed or all cargo use by removing passenger seats and a partial partition, Figure 6-6. A top-hinged cargo door with an opening 52 inches wide by 52 inches high, is provided on the left side of the fuselage to admit bulk cargo D1 T The floor is designed to support 200 pounds per square foot when supported by the seat tracks. The areas where seat track support is not possible will support 100 pounds per square foot floor loading. Seat tracks are to be used for securing cargo containers.

6-15. AERIAL DELIVERY SYSTEM.

WARNING

Procedures for aerial delivery of personnel and cargo have not been developed.

The cargo door is a structural panel and shall be closed for flight.

There are no provisions for static lines; however, free fall parachute operations may be accomplished. The cabin door may be removed for flight by installing Beech Aircraft Corporation Kit 100-4006. Flights with the door removed must be in accordance with the Federal Aviation Administration approved flight manual supplement, which accompanies this kit.

6-16. PREPARATION OF GENERAL CARGO.

Before loading cargo, loading personnel should determine such data as weight, dimensions, center of gravity, and contact areas of the individual cargo items for use in positioning the load.

6-17. CARGO CENTER OF GRAVITY PLANNING.

The cargo loading shall be planned so that the center of gravity of the loaded aircraft will fall within the operating limits shown on Center of Gravity Limitations graph, Figures 6-7 and 6-8. Cargo moment may be determined by using the Cargo Moment chart, Figure 6-5.

6-18. LOAD PLANNING.

The basic factors to be considered in any loading situation are as follows:

a. Cargo shall be arranged to permit access to all emergency equipment and exits during flight.

b. Floorboard and bulkhead structural capacity shall be considered in the loading of heavy or sharp edged containers and equipment. Shorings shall be used to distribute highly condensed weights evenly over the cargo areas.

c. All cargo shall be adequately secured to prevent damage to the aircraft, other cargo, or the item itself.

6-19. LOADING PROCEDURE.

a. Loading of cargo is accomplished through the cabin door C or cargo door D T.

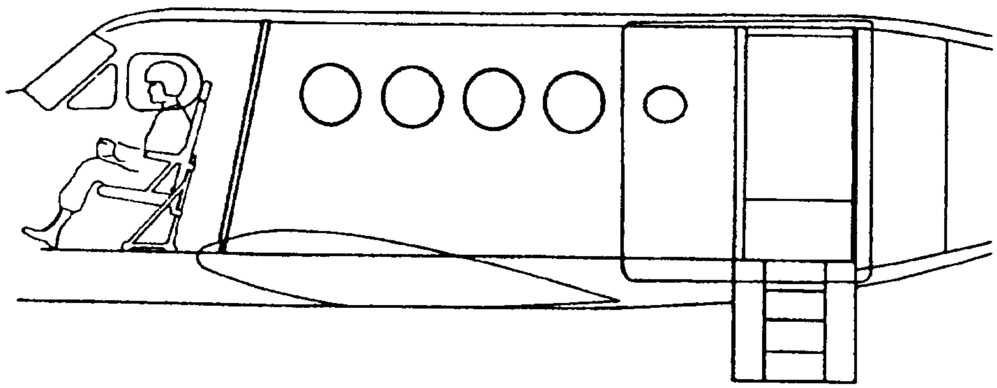
6-20. SECURING LOADS.

All cargo shall be secured with restraints strong enough to withstand the maximum force exerted in any direction. The maximum force can be determined by multiplying the weight of the cargo item by the applicable load factor. These established load factors (the ratio between the total force and the weight of the cargo item) are 1.5 to the side and rear, 3.0 up 3.0 down, and 9.0 forward.

6-21. RESTRAINT DEVICES.

The aircraft is equipped with full-length seat tracks, which are used to support the cargo and provide attachment points for the cargo tiedown devices, Figure 6-9. When cargo is properly secured by tiedown devices, it will be restrained from moving in any direction within the aircraft.

CARGO VERSION



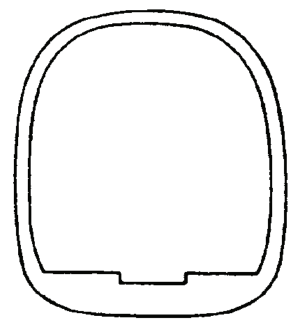
D T1

CARGO ENTRANCE DOOR OPENING

HEIGHT 52 IN.
WIDTH 52 IN.

MAIN ENTRANCE DOOR OPENING

HEIGHT 51.5 IN.
WIDTH 26.7 IN.



SECTION	MAXIMUM	CENTROID ARM
C1	880 LB	F.S. 167
C2	860 LB	F.S. 210
C3	830 LB	F.S. 250
C4	550 LB	F.S. 290
C5	550 LB	F.S. 325

CARGO TIEDOWN PROVISIONS ARE NOT PROVIDED. CARGO SHALL BE SUPPORTED UPON AND TIED DOWN TO THE SEAT TRACKS.

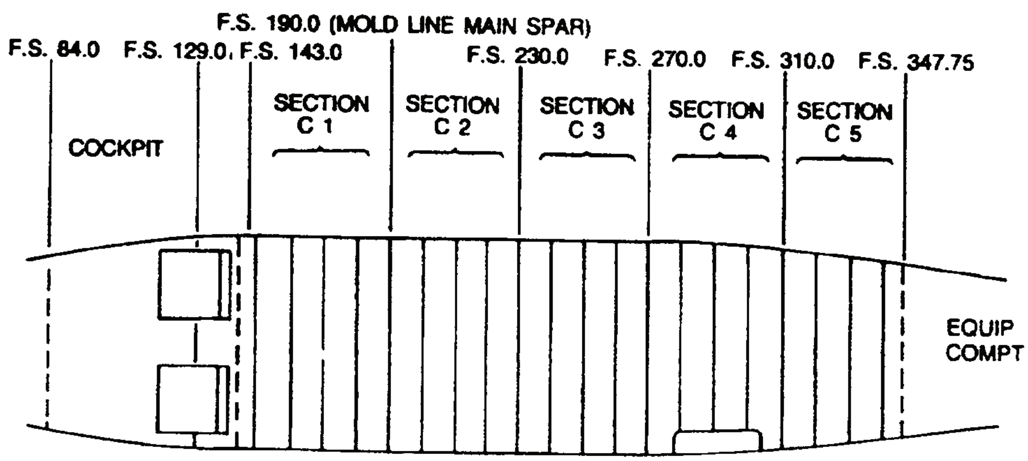
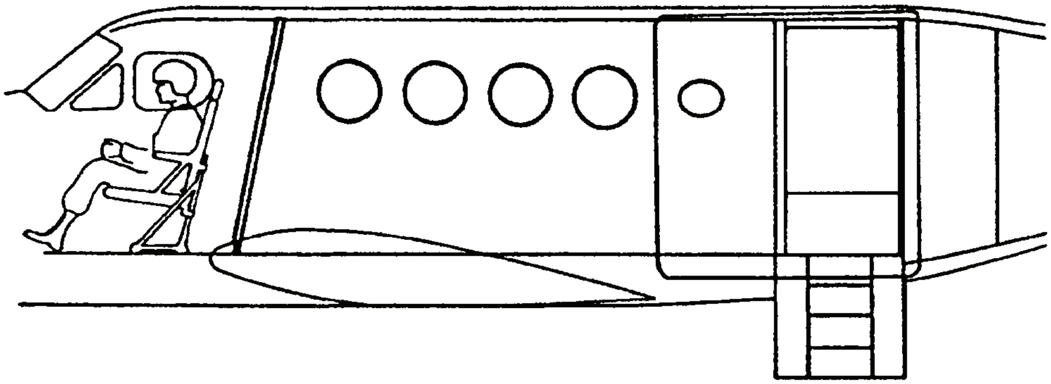


Figure 6-6. Cargo Loading C D T1 *(1 of 2)*

CARGO VERSION

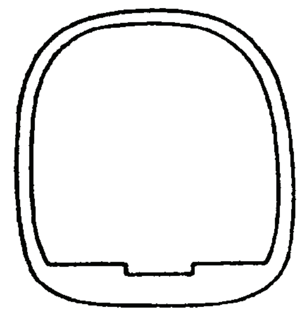


CARGO ENTRANCE DOOR OPENING

HEIGHT	52 IN.
WIDTH	52 IN.

MAIN ENTRANCE DOOR OPENING

HEIGHT	51.5 IN.
WIDTH	26.7 IN.



SECTION	MAXIMUM STRUCTURAL CAPACITY	CENTROID ARM
I	800 LBS	F.S. 170
II	1300 LBS	F.S. 218
III	1370 LBS	F.S. 276
IV	550 LBS	F.S. 325

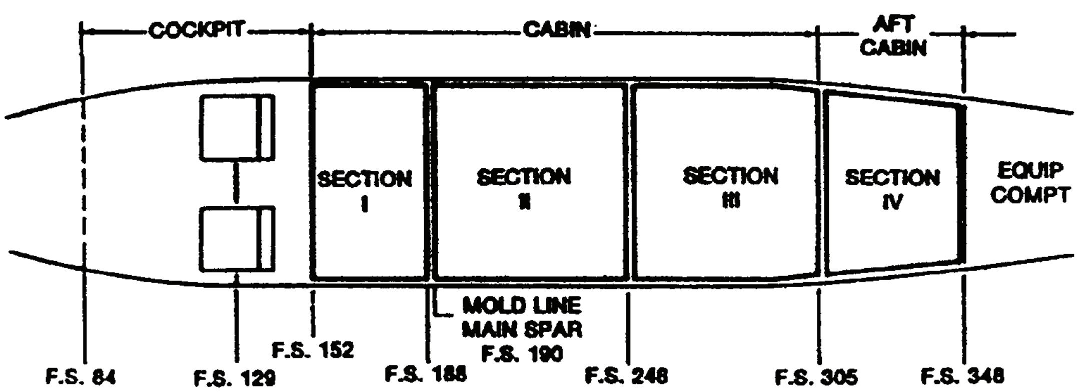


Figure 6-6. Cargo Loading T2 (2 of 2)

CENTER OF GRAVITY LIMITATIONS

EXAMPLE

WANTED

DETERMINE IF LOADING LIMITS ARE EXCEEDED AND DETERMINE CG POSITION

KNOWN

GW = 12070
MOMENT/100 = 22680

METHOD

ENTER GROSS WEIGHT HERE
MOVE RIGHT TO TOTAL MOMENT = 22,680
READ LOAD WITHIN LIMITS
MOVE DOWN
READ ARM = 187.9

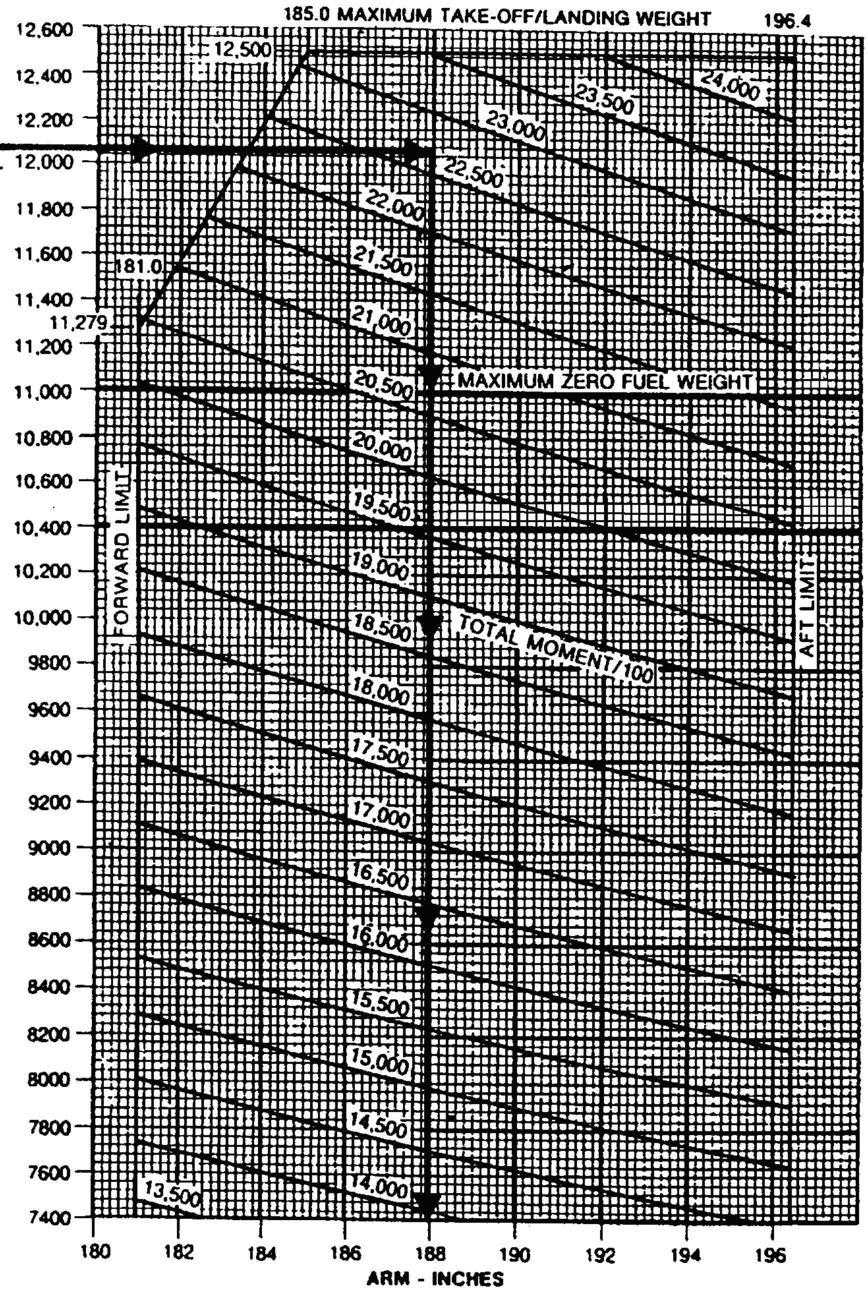


Figure 6-7. Center of Gravity Limitations

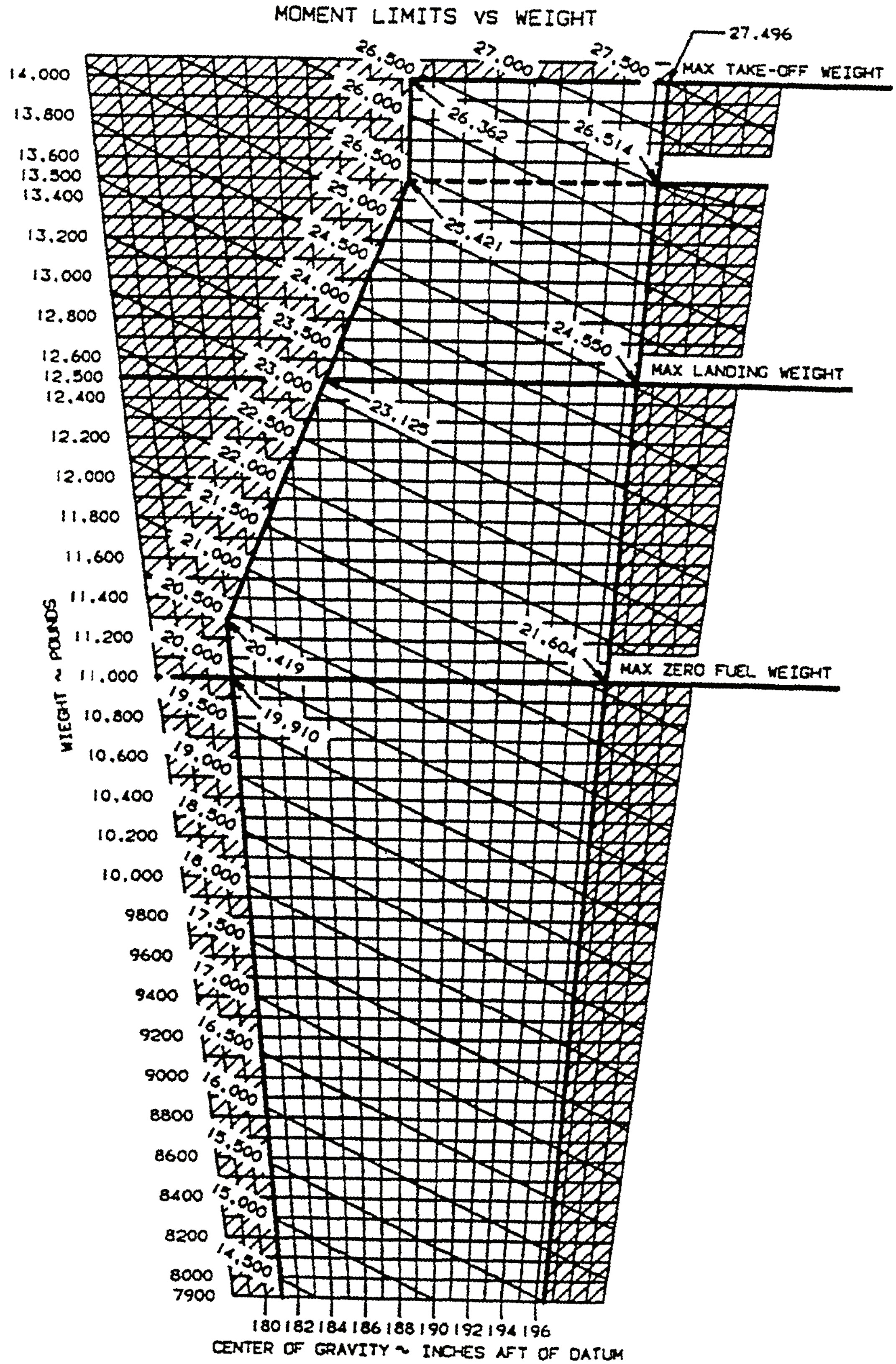


Figure 6-8. Center of Gravity Limitations Above 12,500

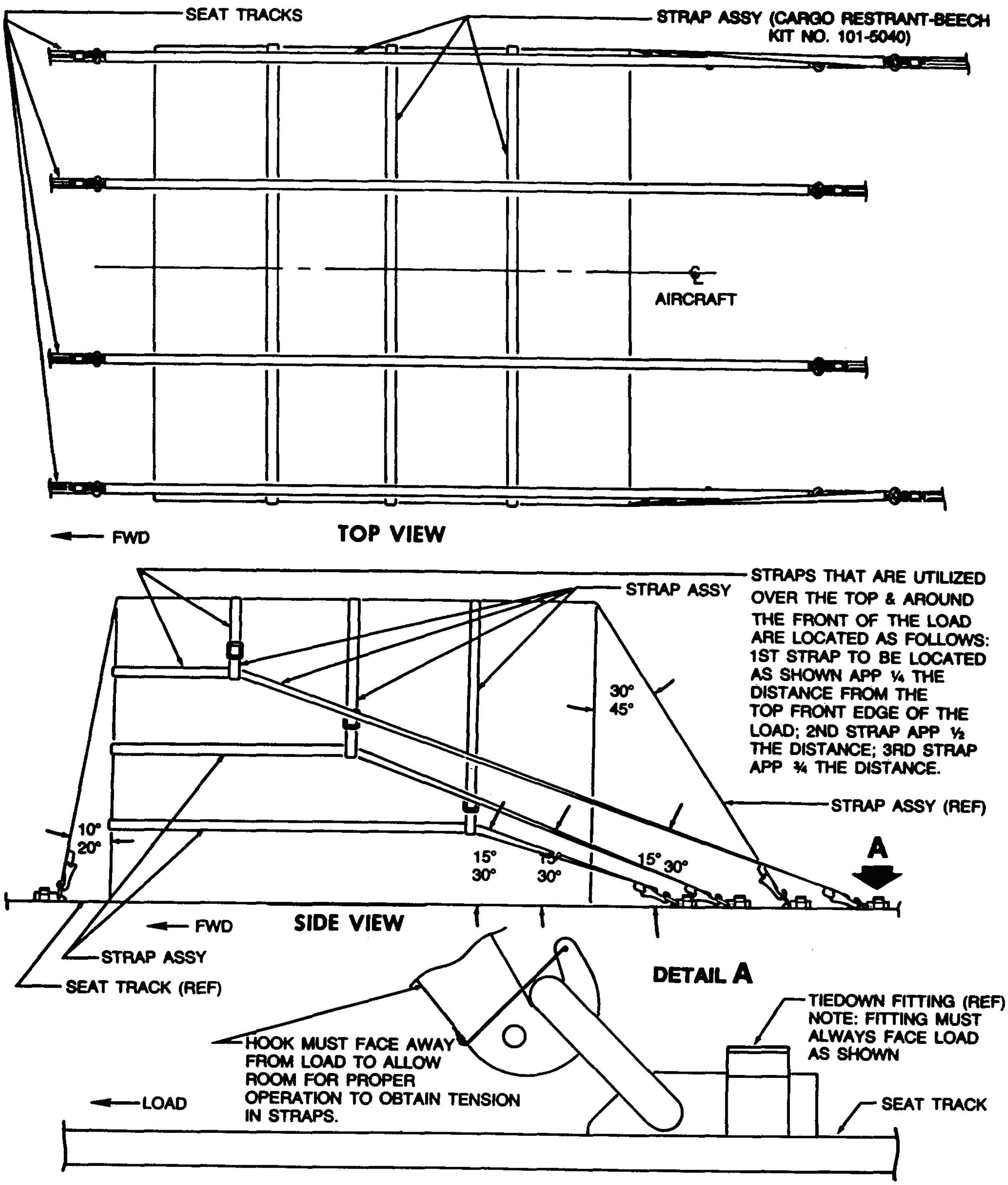


Figure 6-9. Cargo Restraint and Tiedown Method

6-22. CARGO RESTRAINING METHOD.

CAUTION

To avoid structural damage, all cargo shall be restrained in accordance with Beech Kit Drawing No. 101-5040, which provides the correct methods for restraint and approved hardware.

Cargo is restrained by passing tiedown devices over and around the cargo and attaching the ends of the tiedown device to the seat tracks as shown in Figure 6-9. The number of tiedown devices required to restrain a given weight of cargo may vary.

6-23. CARGO UNLOADING.

Unloading of cargo shall be accomplished through the cabin door C or cargo door D T.

Section VII. CENTER OF GRAVITY

6-24. CENTER OF GRAVITY LIMITATIONS.

Center of gravity limitations are expressed in ARM inches, which refers to a positive measurement from the aircraft's reference datum. The forward CG limit at 11,279 pounds or less is 181.0 ARM inches. At 12,500 pounds, the forward CG limit is 185.0 ARM inches and a straight-line variation is used between given points. At 12,500 pounds or less, the aft CG limit is 196.4 ARM inches. The Center of Gravity Limitations graph is designed to establish forward and aft CG limitations. Refer to Figures 6-7 and 6-8.

CHAPTER 7
PERFORMANCE DATA C D1

7-1. INTRODUCTION TO PERFORMANCE.

The graphs and tables in this chapter present performance information for takeoff, climb, landing, and flight planning at various parameters of weight, power, altitude, and temperature. Examples explaining appropriate use are provided for performance graphs.

7-2. HOW TO USE GRAPHS.

a. All airspeed and references to airspeeds in this chapter are indicated airspeeds unless otherwise noted.

b. A reference line indicates where to begin following the guidelines. Always project to the reference line first, then follow the guidelines to the next item by maintaining the same proportional distance between the guideline above and the guideline below the projected line. For instance, if the projected line intersects the reference line in the ratio of 30% down/70% up between the guidelines, then maintain this same 30%/70% relationship between the guidelines all the way to the next item.

c. The Airspeed Calibration - Normal System – Takeoff Ground Roll graph was used to obtain V_1 and V_r Indicated Airspeeds (IAS). All other indicated airspeeds were obtained by using the Airspeed Calibration - Normal System graph.

d. In addition to presenting the answer for a particular set of conditions, the example on a graph also presents the order in which the various scales on the graph should be used. For instance, if the first item in the example is Outside Air Temperature (OAT), then enter the graph at the known OAT. In some cases, performance planning may require entering the chart at one point in order to establish a baseline and then entering the chart at another point in order to obtain the answer. Follow the sequence of the example, or establish the necessary baseline and then follow the sequence of the example.

e. The associated conditions define the specific conditions from which performance parameters have been determined. They are not intended to be used as instructions; however, performance values determined from charts can be achieved only if the specified conditions exist.

f. Notes have been provided on various graphs and tables to approximate performance with ice vanes extended. The effect will vary, depending upon airspeed, temperature, altitude, and ambient conditions. At lower altitudes, where operation on the torque limit is possible, the effect of ice vane extension will be less, depending upon how much power can be recovered after the ice vanes have been extended.

7-3. EXAMPLES.

The following example presents the performance decision making process for correct flight planning and completion of the Takeoff and Landing Data (TOLD) card. Weather conditions for the departure and destination airports are given to illustrate the impact on performance planning and mission capabilities. The example mission is from Airport Alpha (AAA) to Airport Bravo (BBB). The en route distance is 700 nm. The planned cruise altitude is FL240.

a. Conditions. At Airport Alpha (AAA):

OAT . . . . 85°F (+30°C)

Field Elevation . . . . 3800 feet

Altimeter Setting. . . . . 29.72 in. Hg

Wind . . . . 330° at 10 knots

NOTE

Do not use headwinds for takeoff performance planning.

Runway 35 Length . . . . .6000 feet

Weather . . . . .400 feet overcast

Visibility . . . . .1 mile, rain/haze

b. Other Than Standard Takeoff Minimums and/or (Obstacle) Departure Procedures. At Airport Alpha:

Takeoff Minimums. . . . . Rwy 35, 500-2*

*Or standard with minimum climb of 250/NM to 5000′.

c. Mission. Transport the following load (personnel, baggage, and equipment) from Airport Alpha to Airport Bravo:

Personnel – 6

(1) 185 pounds	(1) 160 pounds
(1) 200 pounds	(1) 155 pounds
(1) 170 pounds	(1) 190 pounds

Subtotal pax……………………1060 pounds

Baggage and Equipment –

(6) baggage @ 40 pounds = 240 pounds

(1) 24″ x 24″ box = 25 pounds

Subtotal baggage and equip = 265 pounds

Total load………………………………1325 pounds

d. Performance Planning (Back of TOLD Card). Refer to Figure 7-1. The back side of the TOLD card is a takeoff weight worksheet. It is designed to assist the crew in the decision making process as to maximum allowable takeoff weight for the conditions and the takeoff configuration. The instructions herein are consistent with TC 1-218, Aircrew Training Manual (ATM). Complete the card as follows:

(1) Field Length Available is 6,000 feet.

NOTE

If the runway has an approved runway overrun, that distance may be added to the runway length for Accelerate/Stop calculations.

(2) Temperature (forecast for time of departure) is +30 °C.

Takeoff Weight Worksheet

FIELD LENGTH AVAILABLE: (1)

TEMP. °C: (2) **P.A.:** (3)

TAKEOFF CONFIGURATION: (4)

FLAPS	**UP**	**40%**
Max Wt to Achieve SE Climb	(5)	(6)
Max Wt For ACC/STOP	(7)	(8)
***Max Wt For Req. SE CLB GRAD** (Min 3.3%)	(9)	

Max Allow Takeoff Weight ________(10)________.

***SE Climb Conversion:**

$$\frac{\text{Ft. per nm}}{6{,}076'} \times 100 = \_\_\_\_\%$$

DA FORM 4888-R (Back) **C-12 TOLD**

Figure 7-1. TOLD Card (Back)

(3) Pressure Altitude (PA). To determine the PA, add 1000 feet to field elevation for each 1.00 in. Hg that the reported altimeter setting value is below 29.92 in. Hg, and subtract 1000 feet for each 1.00 in. Hg above 29.92 in. Hg. First, find the difference between 29.92 in. Hg and the reported altimeter setting. Then, multiply the answer by 1000 to find the difference in feet between field elevation and pressure altitude. PA is inversely proportional to barometric pressure, as the barometric pressure decreases the PA increases and as the barometric pressure increases, the PA decreases.

Pressure Altitude at AAA:

29.92 in. Hg - 29.72 in. Hg = 0.20

0.20 X 1000 feet = 200 feet

Because the barometric pressure is lower than ISA, the PA will be higher than field elevation. The pressure altitude at AAA is 200 feet above field elevation.

Pressure Altitude at AAA = Field Elevation 3800 feet + 200 feet = 4000 feet.

(4) Takeoff Configuration, Flaps 0% or 40%, will be determined by the crew after completing this side of the TOLD card.

(5) and *(6)* Maximum weight allowable to achieve a single engine climb, flaps 0% and 40%. Refer to Figures 7-14 and 7-15, Takeoff Gross Weight Limit (To Achieve 100 FPM One Engine Inoperative Rate-of-Climb at Liftoff), Flaps 0% and Flaps 40%.

Enter each of the graphs at the pressure altitude of 4000 ft., trace to the right until intersecting the correct temperature line, +30 °C, then trace down vertically and read the maximum allowable takeoff weight for these conditions. For Flaps 0% it is 12,400 pounds. For Flaps 40% it is 11,800 pounds. Enter those takeoff weight limitations in the appropriate blocks of the TOLD card.

(7) and *(8)* Maximum Weight to accomplish Accelerate and Stop distance, flaps 0% and 40%. Refer to Figures 7-19 and 7-22, Accelerate – Stop, Flaps 0% and Flaps 40%.

Enter each of the graphs on the right vertical scale, ACCELERATE-STOP FIELD LENGTH ~ FEET, at the field length available. In this example there is no runway overrun, therefore the field length available is the runway length of 6000 feet. Mark that line as a baseline, it becomes the limit for maximum allowable takeoff weight.

Enter the left side of the graph at the OUTSIDE AIR TEMPERATURE ~ °C at the forecast temperature of +30°. Trace up vertically until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace to the right until intersecting the first REFERENCE LINE. Because the point on the REFERENCE LINE for Flaps 0% is above the 6000 feet runway length, maintain the same relative distance between the guidelines and trace down until intersecting the 6000 feet field length line. From that point, trace down vertically to read the maximum allowable takeoff weight that will allow accomplishment of an acceleration to V_1 and stop. The maximum allowable takeoff weight is 12,800 pounds.

Using Figure 7-22, utilize the chart in the same manner. In this, case the point on the REFERENCE LINE for Flaps 40% is below the 6000 feet field length line, the accelerate-stop distance is 5,900 feet and accelerate – stop can be accomplished at 13,500 pounds.

For Flaps 0% the maximum takeoff weight to achieve Accel/Stop is 12,800 pounds. For Flaps 40% it is 13,500 pounds. Enter those takeoff weight limitations in the appropriate blocks of the TOLD card.

(9) Maximum Weight Allowable To Accomplish the Required Single Engine Climb Gradient. Refer to Figure 7-27 Climb – One Engine Inoperative.

A 3.3% single engine climb gradient is required for all IFR takeoffs. In the absence of any Departure Procedure (DP) or other requirement, the 3.3% climb gradient line is the baseline for determining the maximum allowable takeoff weight in order to achieve that single engine climb gradient.

In this example, the weather forecast for the time of departure is 400 feet overcast and 1 mile visibility with rain and haze. The non-standard takeoff minimums for Airport A are 500 foot ceiling and 2 miles visibility. However, the departure may be accomplished using standard AR 95-1 takeoff minimums if a single engine climb gradient of 250 feet per nm can be achieved. Therefore, the maximum allowable takeoff weight to achieve a single engine climb gradient of 250 feet per nm must be determined.

In Figure 7-27, to use the CLIMB GRADIENT ~ % scale, the required gradient of 250 feet per nautical mile must be converted to a percentage. The method is included in the Climb Conversion portion of the TOLD card. The feet per nautical mile are divided by 6076 (the number of feet in a nautical mile) and multiplied by 100, yielding the climb gradient in percent.

For this example divide 250 feet per nautical mile by 6076, then multiply by 100 in order to convert to a percentage.

$250 \div 6076 \times 100 = 4.1\%$

From the CLIMB GRADIENT ~ % scale trace horizontally from 4.1% to the left onto the graph in order to establish the baseline limit for maximum takeoff weight in order to achieve the required single engine climb gradient of 4.1%.

Now, enter the graph at the OUTSIDE AIR TEMPERATURE ~ °C scale at +30 °C. Trace up until intersecting the 4000 feet PA line, trace horizontally to the right until intersecting the REFERENCE LINE. Because the intersecting point on the reference line is below the 4.1% baseline, maintain the same relative distance between the guidelines and trace up until intersecting the 4.1% baseline. From that point, trace down to read the maximum allowable takeoff weight in order to achieve a single engine climb gradient of 4.1%.

The maximum allowable takeoff weight to achieve a 4.1% single engine climb gradient is 12,600 pounds. Enter that weight in the appropriate block on the TOLD card.

(10) Maximum Allowable Takeoff Weight. Enter the most restrictive weight from each column, including the **Max Wt For Req. SE CLB GRAD** block, in the appropriate space on the TOLD card. For Flaps 0% the weight is 12,400 pounds. For Flaps 40% the weight is 11,800 pounds.

e. Completed TOLD (Back) and Decision Making. Refer to Figure 7-2. The completed back side of the TOLD card is now used for determining the takeoff configuration (Flaps 0% or 40%) and the fuel load in order to maintain the aircraft at the maximum allowable weight for all of the conditions.

(1) For this example, the takeoff can be accomplished at an aircraft weight of 12,400 pounds with the flaps 0%, or 11,800 pounds with the Flaps at 40%. This takeoff is planned with Flaps 0% at 12,400 pounds.

For this example, the aircraft Operating Weight is 8,900 pounds and the Load for the mission is 1,325 pounds therefore, the Zero Fuel Weight (Operating Weight plus the Load) is 10,225 pounds. The takeoff weight of 12,400 pounds minus the zero fuel weight of 10,225 pounds allows for 2,175 pounds of fuel for the mission.

Takeoff Weight Worksheet		
FIELD LENGTH AVAILABLE: *6,000 ft*		
TEMP. °C: *+30 °C*	**P.A.:** *4,000 ft*	
TAKEOFF CONFIGURATION: (4) FLAPS	**UP**	**40%**
Max Wt to Achieve SE Climb	*12,400*	*11,800*
Max Wt For ACC/STOP	*12,800*	*13,500*
***Max Wt For Req. SE CLB GRAD** (Min 3.3%) *4.1%*	*12,600*	
Max Allow Takeoff Weight	*12,400*	*11,800*

***SE Climb Conversion:**

$$\frac{250 \text{ ft per nm}}{6{,}076 \text{ feet}} \times 100 = 4.11\%$$

DA FORM 4888-R **C-12 TOLD (Back)**

Figure 7-2. TOLD Card Back (Example Completed)

(2) Transpose the pertinent information to the front side of the TOLD card and complete it for the departure.

f. Performance Planning (Front of TOLD Card). Refer to Figure 7-3. The front side of the TOLD card is used to record the critical information for conduct of the takeoff and, in the event of an emergency during the takeoff, landing data for an immediate return to the departure airport. The instructions here are consistent with the ATM.

TAKEOFF and LANDING DATA (TOLD)	
TAKEOFF	
Station: (1)	**Field Lgth Avail:** (2)
Temp °C: (3)	**P.A.:** (4)
Takeoff Weight: (5)	
Min. Takeoff Power: ___(6)___.	
Configuration: Flaps 0%___ **Flaps 40%**___. (7)	
T.O. Fld. Lgth Req'd: ___(8)___.	
ACC/GO Distance: ___(9)___.	
V_1 / V_r (10). **V2 / V_{yse}** (11) **Vx** (11a).	
Clb. Grd. Alt. ___(12)___.	
LANDING	
Rwy Lgth Available: ___(13)___.	
Landing Weight: ___(14)___.	
V_{ref} ___(15)___. Flaps 100% (1.3 X V_{so} @ Ldg. Wt.) Flaps 40% to 99%+(1.3 X V_{s1} @ Ldg. Wt.)	**V_{app}** ___(16)___. Inst. App. = V_{ref} + 20 KIAS Stabilized = V_{ref} + 10 KIAS Visual App = V_{ref} + 10 KIAS
LANDING DISTANCE ___(17)___.	
DA FORM 4888-R	**C-12 Takeoff and Landing Data**

Figure 7-3. TOLD Card (Front)

(1) thru *(5)* were determined on the back side of the card and transposed to these blocks.

(6) Minimum Takeoff Power. Use Figure 7-16. Minimum Take-Off Power at 2000 RPM with Ice Vanes Retracted (65 Knots) or Figure 7-17. Minimum Take-Off Power at 2000 RPM with Ice Vanes Extended (65 Knots).

Enter the appropriate graph at the OUTSIDE AIR TEMPERATURE ~ °C. From +30 °C trace up until intersecting the correct PRESSURE ALTITUDE – FEET line, 4000 feet. Trace horizontally to the left until intersecting the ENGINE TORQUE AT 2000 RPM ~ PERCENT scale and read the Minimum Takeoff power.

In this example the minimum takeoff power is 87.5%. Enter the information on the TOLD card.

NOTE

Performance planning methodology and operational procedures for Minimum Takeoff Power takeoffs and Reduced Power takeoffs are contained in the ATM.

(7) Configuration. Mark (✓ or X) the appropriate configuration as determined on the back of the TOLD card. For this example, it was decided to takeoff with the Flaps 0%.

(8) Takeoff Field Length Required. Enter the field length that was used on the back of the TOLD card to determine the maximum weight to achieve an acceleration and stop maneuver. It will be the available runway length or the available runway length plus the length of any approved runway overrun.

For this example 6000 feet is the available field length.

(9) Accelerate – Go Distance. This distance is advisory only. Use Figure 7-20. Accelerate – Go, Flaps 0% or Figure 7-23. Accelerate – Go, Flaps 40%.

Enter the graph at the OUTSIDE AIR TEMPERATURE ~ °C, +30 °C. Trace up until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace horizontally to the right until intersecting the REFERENCE LINE. Maintain the same relative distance between the guidelines and trace up until intersecting the aircraft takeoff WEIGHT ~ POUNDS line. Trace horizontally to the right and read the accelerate – go distance.

In this example, the takeoff weight is planned at 12,400 pounds. The accelerate – go distance is 11,000 feet.

Enter the distance, 11,000 feet, in the appropriate block on the TOLD card.

As already stated, Accelerate-Go distance is advisory only. However, a point 35 feet above the end of the departure runway is normally the point from which climb gradients are calculated. Therefore, regardless of all other prudent performance planning, if an engine fails at V_1 on this example departure the aircraft will not be capable of clearing all obstacles. If weather conditions are at or near minimums, the crew should consider some other options to assure the capability to accomplish an acceleration and go maneuver such as:

Decreasing the load and/or fuel.

Reducing takeoff weight and using flaps 40%.

Delaying the departure for more favorable weather conditions.

(10) V_1 (Takeoff Decision Speed) / V_r (Rotation Speed). In the C-12 aircraft V_1 and V_r are always the same speed. Use the tabular data table at the top of Figure 7-18, Take-Off Distance, Flaps 0% or Figure 7-21, Take-Off Distance, Flaps 40%.

The takeoff configuration for this example is Flaps 0%. The V_1/V_r speed is 103 KIAS.

Enter the speed, 103 KIAS, in the appropriate block on the TOLD card.

(11) V_2 / V_{yse}. Use the tabular data table at the top of Figure 7-27. Climb – One Engine Inoperative. In accordance with the ATM, flaps are retracted just after liftoff at 105 KIAS for both a normal takeoff and in the event of an engine failure after V_1. The V_2/V_{yse} - KNOTS, Figure 7-27, is V_{yse} and is essentially the same speed as V_2 for a takeoff with flaps at 0%. Consequently, V_2 flaps 0% and V_{yse} are used as the V_2 speed for entry on the TOLD card. V_2 / V_{yse} for a 12,400 pound aircraft is 121 KIAS.

Enter the speed in the appropriate block on the TOLD card.

(11A) If conducting an obstacle clearance climb, use the "Vx" speed from the TAKEOFF DISTANCE – FLAPS APPROACH chart.

(12) Climb Gradient Altitude. This is the altitude to which the single engine climb gradient must be continued as specified in the applicable DP. The information is advisory and intended as a reminder to the crew of the altitude to which they must climb at V_2 / V_{yse} in order to clear obstacles.

For this example, the DP specified climbing to 5000 feet MSL.

Enter the altitude, 5000 feet, in the appropriate block on the TOLD card.

NOTE

Items 13 through 17 are initially calculated at takeoff weight as a contingency for a necessary return to the takeoff airport right after departure. The items must be re-calculated for the arrival at the destination.

(13) Runway Length Available. This is the runway length available for landing.

For this example, the runway length is 6000 feet and there is no displaced threshold or other information limiting the useful landing distance of the runway.

Enter the length, 6000 feet, in the appropriate block on the TOLD card.

(14) Landing Weight. For the takeoff TOLD card, landing and takeoff weights are the same. For arrival at the destination the TOLD card must be re-calculated to reflect actual aircraft weight and airport conditions.

For this example, takeoff and landing weight is 12,400 pounds.

Enter the weight, 12,400 pounds, in the appropriate block on the TOLD card.

(15) V_{ref} Speed. This speed is 1.3 times V_{so} at the intended landing weight if the landing will be accomplished using Flaps **DOWN** (100%). If the landing will be accomplished with the Flaps at 40%, or any setting greater than **APPROACH** but less than 100%, then V_{ref} is 1.3 times V_{s1} (the stall speed for FLAPS 40%). Use Figure 7-9, Stall Speeds – Power Idle to determine applicable stall speeds.

For this example, the landing weight (assuming an emergency return to the departure airport) is 12,400 pounds a landing with the Flaps **DOWN** (100%) is planned. The V_{so} for a 12,400 pound aircraft is 74.8 KIAS. Therefore, V_{ref} is 1.3 times 75 = 97.5 and is rounded up to 98 KIAS.

There is another method to determine V_{ref} when the landing will be accomplished with the Flaps **DOWN**. Subtract 5 KIAS from the APPROACH SPEED ~ KNOTS obtained from the tabular data table at the top of Figure 7-30, Landing Distance Without Propeller Reversing, Flaps 100%. For a 12,400 pound aircraft the given APPROACH SPEED is 103 KIAS – 5 KIAS = 98 KIAS.

As another example, if the landing was planned using the Flaps at **APPROACH** (40%), or any intermediate setting short of **DOWN** (100%), then the V_{ref} speed would be 1.3 times V_{s1} (the FLAPS APPROACH stall speed). FLAPS APPROACH stall speed for a 12,400 pound aircraft is 84.8 KIAS. Therefore, the V_{ref} speed is 1.3 times 85 = 110.5 and is rounded up to 111 KIAS.

For the landing with Flaps **DOWN** enter the V_{ref} speed, 98 KIAS at the appropriate place on the TOLD.

(16) V_{app} Speed. This is the intended final approach speed. It is V_{ref} plus 20 KIAS for a normal instrument approach; V_{ref} plus 10 KIAS for a stabilized approach; and, V_{ref} plus 10 KIAS for a visual approach as determined by the PC.

For this example, the landing is planned with the Flaps **DOWN** (100%) so the V_{ref} is 98 KIAS. The weather conditions are such that a normal instrument approach back into the departure airport is planned in the event of a takeoff emergency. Therefore, the V_{app} will be V_{ref} plus 20 KIAS.

V_{ref} is 98 KIAS + 20 KIAS = V_{app} 118 KIAS. Enter this speed in the appropriate block on the TOLD card.

(17) Landing Distance. The distance, measured from the landing touchdown, required to land the aircraft and stop. Use Figure 7-30, Landing Distance Without Propeller Reversing - Flaps 100%.

NOTE

Do not use a headwind or headwind component in calculating landing distance. But, if a downwind landing is required, then ensure the tailwind is factored.

Enter the chart at the OUTSIDE AIR TEMPERATURE ~ ºC, +30 ºC. Trace up until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace horizontally to the right until intersecting the first REFERENCE LINE. Maintain the same relative position between the guidelines and trace down until intersecting the aircraft weight line. From that point, trace horizontally to the DISTANCE ~ FEET scale to determine the landing distance.

For this example, the landing weight is 12,400 pounds. Assuming a takeoff emergency, the landing weight may exceed the landing weight limit of 12,500 pounds.

The landing distance is 2,120 feet.

Enter that number, 2,120 feet, in the appropriate block of the TOLD card. Remember, if the landing is planned for touchdown to be at the 1000-foot markers, then 3,120 feet will be required to accomplish this landing with full flaps. Refer to Figure 7-4 for an example of a completed TOLD Card front.

TAKEOFF and LANDING DATA (TOLD)	
TAKEOFF	
Station: *AAA*	**Field Lgth Avail:** *6000 ft*
Temp C°: *+30 ºC*	**P.A.:** *4000 ft*
Takeoff Weight: *12,400*	
Min. Takeoff Power: *87.5%* . (7)	
Configuration: Flaps 0% *X* **Flaps 40%** ___ .	
T.O. Fld. Lgth Req'd: *6000 ft* .	
ACC/GO Distance: *11,000 ft* .	
V1 / Vr *103* . **V2 / Vyse** *121* . **Vx** ___ .	
Clb. Grd. Alt. *5000 ft* .	
LANDING	
Rwy Lgth Available: *6000 ft* .	
Landing Weight: *12,400* .	
V_{ref} *98* . Flaps 100% (1.3 X V_{so} @ Ldg. Wt.) Flaps 40% to 99%+(1.3 X V_{s1} @ Ldg. Wt.)	**V_{app}** *118* . Inst. App. = V_{ref} + 20 KIAS; Stabilized = V_{ref} +10 KIAS; Visual App = V_{ref} + 10 KIAS
LANDING DISTANCE *2120 ft* .	
DA FORM 4888-R	**C-12 Takeoff and Landing Data**

Figure 7-4. TOLD Card (Example Completed)

g. Performance Planning, Cruise. Recommended Cruise Power, 1700 RPM charts beginning at Figure 7-38 are normally used for cruise performance planning. Use Figure 7-11, ISA Conversion, to determine the correct chart, relative to ISA, for cruise performance planning. For this example, the mission is planned to be flown at FL240.

(1) If a weather forecast provides the forecast temperature at the cruise altitude, enter Figure 7-11 at that temperature. Trace up until intersecting the planned PRESSURE ALTITUDE ~ FEET. At that point, determine the closest ISA +/- guideline and use the corresponding chart for planning.

If the forecast temperature for FL 240 is –10 ºC, enter the chart at that temperature. Trace up until intersecting the 24,000 feet reference line. Note which reference line is closest and use the corresponding chart for planning. If the point is exactly midway between two reference lines, use the reference line to the right of the point.

In this example, the point is between ISA + 20 and ISA + 30, and is closest to ISA + 20. Therefore, use Figure 7-43. Recommended Cruise Power, 1700 RPM - ISA +20 ºC for cruise performance planning.

Enter the chart at 24,000 feet pressure altitude and read across horizontally to determine cruise torque, fuel flow, and airspeeds.

(2) If a weather forecast does not include a temperature at the cruise altitude, then the temperature must be calculated using a standard lapse rate and the temperature at the departure airport.

In this example, the temperature at the departure airport is +30 ºC. The pressure altitude is 4000 feet and the ISA temperature at that pressure altitude would be +7 ºC.

Temperature decreases at 2 ºC per thousand feet; 4000 feet ÷ 1000 feet = 4; 4 x 2 ºC = 8 ºC decrease in temperature. Therefore, ISA at 4000 feet PA is +15 ºC (SL ISA) – 8 ºC = +7 ºC.

The actual surface temperature of +30 ºC at Airport A, PA 4000 feet, is 23º above ISA (+7 ºC). Therefore, it is ISA +23 at the airport. If it is ISA +23º at the departure surface and a standard lapse rate of 2º per thousand feet of increased altitude is used, then it will be ISA +23º at the planned cruise altitude.

On Figure 7-11, ISA +23º is closest to the ISA + 20 reference line; therefore, use Figure 7-43, Recommended Cruise Power, 1700 RPM, - ISA +20 ºC for cruise performance planning.

(3) The following planning data is derived from the Figure 7-43, Recommended Cruise Power, 1700 RPM - ISA +20 ºC cruise chart for this example:

Torque per engine – 67%

Fuel flow per engine – 275 pounds/hour

Total fuel flow – 550 pounds/hour

IAS (12,000 pounds) – 171 KIAS

TAS (12,000 pounds) – 259 KTAS

The above data is used for the corresponding entries on the DD Form 175 and for flight planning.

As a general rule, the total fuel flow from the Recommended Cruise charts will sufficiently match the results of a more detailed fuel planning process using: time, fuel, and distance to climb; cruise fuel; and, time, fuel, and distance to descend. Therefore, for mission planning purposes, the total fuel flow from the appropriate cruise chart will suffice. Therefore, for this example, the total fuel in hours and minutes for entry on the DD Form 175 is 3+59 or 4+00 hours.

Fuel for the mission 2175 pounds ÷ fuel flow per hour 550 pounds = 3.95 hours (4+00)

The minimum reserve fuel for the mission is 413 pounds.

Fuel flow per hour 550 pounds x 45 minutes, .75 = 412.5 (413 pounds)

Fuel available for the mission minus required reserve is 1762 pounds.

Total mission fuel 2175 pounds – reserve fuel 413 pounds = 1762 pounds

Mission endurance fuel, minus reserves, is 3 hours and 12 minutes (3.2 hours).

Mission fuel minus reserve 1762 pounds ÷ fuel flow per hour 550 = 3.2 hours

Model: C-12CD
DATE 11 JANUARY 1988
DATA BASIS ESTIMATE
(CONSULT APPROPRIATE CHARTS FOR
EXACT VALUES AND ASSOCIATED CONDITIONS)

FLAPS 0%
ZERO WIND
ICE VANES RETRACTED

ENGINE PT6A-41
PROPELLER T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

SEA LEVEL

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (15°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA +20°C TORQUE = 95.9%			ISA +30°C TORQUE = 87.3%			V KIAS
13.500	3400	4700	6700	3600	4900	7200	3800	5200	7700	4000	5400	8200	4200	5600	8800	4600	6000	9800	5200	6500	R	125
13,000	3200	4500	6100	3300	4700	6500	3500	4900	6900	3700	5100	7400	3900	5400	7900	4300	5700	8800	4800	6100	R	123
12,500	2900	4300	5500	3100	4500	5900	3300	4700	6300	3500	4900	6700	3700	5100	7100	3900	5400	7900	4400	5800	9500	120
12,000	2700	4100	5000	2900	4200	5400	3000	4400	5700	3200	4600	6100	3400	4800	6400	3700	5100	7100	4100	5500	8400	118
11,500	2500	3900	4600	2700	4000	4900	2800	4200	5200	3000	4400	5500	3100	4600	5800	3400	4800	6400	3800	5200	7500	117
11,000	2400	3700	4200	2500	6900	4400	2600	4000	4700	2800	4200	5000	2900	4400	5300	3100	4600	5800	3500	4900	6700	116
10,500	2200	3500	3800	2300	3700	4000	2400	3800	4300	2500	4000	4500	2700	4100	4800	2900	4400	5200	3200	4600	6000	114
10,000	2000	3400	3400	2100	3600	3600	2200	3700	3800	2300	3900	4000	2500	4000	4300	2700	4200	4700	3000	4500	5400	111
9,500	1800	3400	3100	1900	3500	3200	2000	3600	3400	2200	3800	3600	2300	3900	3800	2400	4100	4200	2700	4400	4700	110
9,000	1700	3300	2700	1800	3400	2900	1900	3600	3000	2000	3700	3200	2100	3800	3400	2200	4000	3700	2500	4300	4200	108

1000 PA

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (13°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA +20°C TORQUE = 95.0%			ISA +30°C TORQUE = 86.9%			
13.500	3500	4900	7000	3800	5100	7600	4000	5400	8100	4200	5600	8700	4400	5900	9300	4800	6200	R	5000	6700	R	125
13,000	3300	4600	6400	3500	4900	6800	3700	5100	7300	3900	5300	7800	4100	5600	8400	4500	5900	9500	5100	6400	R	123
12,500	3100	4400	5800	3200	4600	6200	3400	4800	6600	3600	5100	7100	3800	5300	7500	4200	5600	8500	4700	6000	R	120
12,000	2900	4200	5300	3000	4400	5600	3200	4600	6000	3400	4800	6400	3500	5000	6800	3900	5300	7600	4300	5700	9000	118
11,500	2600	4000	4800	2800	4200	5100	3000	4400	5400	3100	4600	5800	3300	4800	6100	3600	5000	6800	4000	5400	8000	117
11,000	2400	3800	4400	2600	4000	4600	2700	4200	4900	2900	4300	5200	3000	4500	5600	3300	4800	6200	3700	5100	7200	116
10,500	2300	3600	4000	2400	3800	4200	2500	4000	4500	2700	4100	4700	2800	4300	5000	3100	4500	5500	3400	4800	6400	114
10,000	2100	3500	3600	2200	3700	3800	2300	3900	4000	2400	4000	4200	2600	4200	4500	2800	4400	4900	3100	4700	5700	111
9,500	1900	3500	3200	2000	3600	3400	2100	3800	3600	2200	3900	3800	2400	4100	4000	2600	4300	4400	2900	4500	5000	110
19,000	1800	3400	2900	1900	3500	3000	2000	2700	3200	2100	3800	3400	2200	4000	3600	2300	4200	3900	2600	4400	4400	108

2000 PA

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (11°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA + 20°C TORQUE = 93.6%			ISA +30°C TORQUE = 86.0%			
13.500	3700	5000	7400	3900	5300	8000	4200	5600	8600	4400	5800	9200	4600	6100	9900	5100	6500	R	5800	7000	R	125
13,000	3400	4800	6700	3600	5000	7200	3900	5300	7700	4100	5500	8300	4300	5800	8900	4700	6200	R	5300	6700	R	123
12,500	3200	4600	6100	3400	4800	6500	3600	5000	7000	3800	5300	7400	4000	5500	8000	4400	5900	9100	4900	6300	R	120
12,000	3000	4300	5500	3100	4600	5900	3300	4800	6300	3500	5000	6700	3700	5200	7200	4100	5500	8100	4500	5900	9700	118
11,500	2800	4100	5000	2900	4300	5300	3100	4500	5700	3200	4700	6100	3400	4900	6500	3800	5300	7300	4200	5600	8600	117
11,000	2500	3900	4600	2700	4100	4900	29000	4300	5200	3000	4500	5500	3200	4700	5800	3500	5000	6600	3900	5300	7600	116
10,500	2400	3800	4100	2500	3900	4400	2600	4100	4700	2800	4300	5000	2900	4500	5300	3200	4700	5900	3500	5000	6800	114
10,000	2200	3700	3700	2300	3800	3900	2400	4000	4200	2600	4200	4400	2700	4300	4700	2900	4600	5200	3300	4900	6000	111
9,500	2000	3600	3300	2100	3700	3500	2200	3900	3700	2300	4000	4000	2500	4200	4200	2700	4400	4700	3000	4700	5300	110
9,000	1800	3500	3000	1900	3600	3200	2000	3800	3300	2100	3900	3500	2300	4100	3700	2500	4300	4100	2700	4600	4700	108

NOTES

Column 1 = Normal Take – Off Distance ~ FT
Column 2 = Accelerate – Stop Distance ~ FT
Column 3 = Accelerate – Go Distance ~ FT
R = Distance Exceeds 10,000 FT
BT00217A

Figure 7-5. Takeoff Performance Planning Tabulations – Flaps 0%

Model: C-12CD
DATE 11 JANUARY 1988
DATA BASIS
(CONSULT APPROPRIATE CHARSTS FOR
EXACT VALUES AND ASSOCIATED CONDITIONS)

FLAPS 40%
ZERO WIND
ICE VANES RETRACTED

ENGINE PT6A-41
PROPELLER T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

SEA LEVEL

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (+ 9°C) TORQUE = 100%			ISA + 10°C TORQUE = 98.6%			ISA +20°C TORQUE = 92.8%			ISA +30°C TORQUE = 95.2%			V_2 KIAS
13.500	3900	5200	7800	4100	5500	8400	4300	5800	9100	4600	6100	9800	4900	6400	R	5400	6800	R	6100	7400	R	125
13,000	3600	5000	7100	3800	5200	7600	4000	5500	8200	4300	5700	8800	4500	6000	9400	5000	6500	R	5600	6900	R	123
12,500	3300	4700	6400	3500	5000	6900	3700	5200	7300	4000	5500	7900	4200	5700	8400	4600	6100	R	5200	6600	R	120
12,000	3100	4500	5800	3300	4700	6200	3500	4900	6600	3700	5200	7100	3900	5400	7600	4300	5800	8900	4800	6200	R	118
11,500	2900	4300	5300	3000	4500	5600	3200	4700	6000	3400	4900	6400	3600	5100	6800	4000	5500	7800	4400	5900	9200	117
11,000	2700	4100	4800	2800	4300	5100	3000	4500	5400	3100	4700	5800	3300	4900	6200	3700	5200	7000	4100	5500	8200	116
10,500	2400	3900	4300	2600	4000	4600	2700	4200	4900	2900	4400	5200	3100	4600	5600	3400	4900	6300	3700	5200	7300	114
10,000	2300	3800	3900	2400	3900	4100	2500	4100	4400	2700	4300	4700	2800	4500	4900	3100	4800	5600	3400	5100	6400	111
9,500	2100	3700	3500	2200	3800	3700	2300	4000	3900	2400	4200	4100	2600	4400	4400	2800	4600	4900	3200	4900	5600	110
9,000	1900	3600	3100	2000	3800	3300	2100	3900	3500	2200	4100	3700	2400	4300	3900	2600	4500	4400	2900	4800	5000	108

4000 PA

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (+ 7°C) TORQUE = 100%			ISA + 10°C TORQUE = 97.3%			ISA +20°C TORQUE = 91.2%			ISA +30°C TORQUE = 84.2%			V_2 KIAS
13.500	4000	5400	8300	4300	5700	8900	4600	6000	9600	4800	6300	R	5200	6700	R	5800	7100	R	6500	7700	R	125
13,000	3700	5200	7500	4000	5400	8000	4200	5700	8600	4500	6000	9300	4800	6300	R	5300	6800	R	6000	7300	R	123
12,500	3500	4900	6700	3700	5200	7200	3900	5400	7800	4200	5700	8300	4500	6000	9100	4900	6400	R	5500	6900	R	120
12,000	3200	4700	6100	3400	4900	6500	3600	5100	7000	3800	5400	7500	4100	5700	8200	4500	6000	9500	5100	6500	R	118
11,500	3000	4400	5500	3200	4600	5900	3400	4900	6300	3600	5100	6700	3800	5400	7300	4200	5700	8400	4700	6100	9900	117
11,000	2800	4200	5000	3000	4400	5300	3100	4600	5700	3300	4800	6100	3500	5100	6600	3900	5400	7500	4300	5800	8800	116
10,500	2600	4000	4500	2700	4200	4800	2900	4400	5200	3000	4600	5500	3200	4800	5900	3600	5100	6700	3900	5500	7800	114
10,000	2400	3900	4100	2500	4100	4300	2600	4300	4600	2800	4500	4900	3000	4700	5300	3300	5000	5900	3600	5300	6800	111
9,500	2200	3800	3600	2300	4000	3900	2400	4200	4100	2600	4300	4400	2700	4500	4700	3000	4800	5300	3300	5100	6000	110
9,000	2000	3700	3200	2100	3900	3400	2200	4100	3700	2300	4200	3900	2500	4400	4200	2700	4700	4600	3000	5000	5300	108

5000 PA

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (+ 5°C) TORQUE = 98.2%			ISA + 10°C TORQUE = 95%			ISA + 20°C TORQUE = 89.7%			ISA +30°C TORQUE = 82.5%			V_2 KIAS
13.500	4200	5600	8700	4500	5900	9500	4800	6200	R	5100	6600	R	5500	7000	R	6100	7500	R	6900	8100	R	125
13,000	3900	5400	7900	4200	5600	8500	4400	5900	9200	4700	6200	9900	5100	6600	R	5600	7100	R	6300	7600	R	123
12,500	3600	5100	7100	3900	5300	7600	4100	5600	8200	4400	5900	8900	4700	6300	R	5200	6700	R	5800	7200	R	120
12,000	3400	4800	6400	3600	5100	6900	3800	5300	7400	4000	5600	7900	4400	5900	8900	4800	6300	R	5400	6800	R	118
11,500	3100	4600	5800	3300	4800	6200	3500	5100	6700	3700	5300	7100	4000	5600	7900	4400	6000	9100	4900	6400	R	117
11,000	2900	4400	5300	3100	4600	5600	3300	4800	6000	3500	5000	6400	3700	5300	7100	4100	5600	8100	4500	6000	9500	116
10,500	2700	4100	4800	2800	4300	5100	3000	4600	5400	3200	4800	5800	3400	5000	6400	3800	5300	7200	4200	5700	8400	114
10,000	2500	4000	4300	2600	4200	4500	2800	4400	4800	2900	4600	5200	3200	4900	5700	3500	5200	6400	3800	5500	7300	111
9,500	2300	3900	3800	2400	4100	4000	2500	4300	4300	2700	4500	4600	2900	4700	5000	3200	5000	5600	3500	4530	6400	110
9,000	2100	3800	3400	2200	4000	3600	2300	4200	3800	2500	4400	4100	2700	4600	4500	2900	4900	5000	3200	5200	5600	108

NOTES

1. Column 1 = Normal Take – Off Distance ~ FT
2. Column 2 = Accelerate – Stop Distance ~ FT
3. Column 3 = Accelerate – Go Distance ~ FT
4. R = Distance Exceeds 10,000 FT

BT00217A

Figure 7-6. Takeoff Performance Planning Tabulations – Flaps 0%

Model: C-12CD
DATE 11 JANUARY 1988
DATA BASIS
(CONSULT APPROPRIATE CHARSTS FOR
EXACT VALUES AND ASSOCIATED CONDITIONS)

FLAPS 40%
ZERO WIND
ICE VANES RETRACTED

ENGINE PT6A-41
PROPELLER T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (15°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA +20°C TORQUE = 95.9%			ISA +30°C TORQUE = 87.3%			V KIAS
SEA LEVEL	13.500	2500	4300	5300	2700	4500	5800	2800	4700	6200	3000	4900	6700	3100	5200	7200	3400	5400	8200	3800	5900	R	106
	13,000	2400	4000	4900	2500	4200	5200	2600	4400	5600	2800	4600	6000	3000	4800	6400	3200	5100	7300	3600	5400	9200	105
	12,500	2300	3900	4500	2400	4100	4800	2500	4300	5100	2700	4500	5400	2800	4600	5800	3000	4900	6500	3400	5200	8100	104
	12,000	2100	3800	4100	2200	4000	4300	2400	4200	4600	2500	4300	4900	2600	4500	5300	2800	4700	5900	3200	5100	7100	103
	11,500	2000	3700	3700	2100	3900	4000	2200	4000	4200	2300	4200	4500	2500	4400	4800	2700	4600	5300	3000	4900	6300	103
	11,000	1900	3600	3400	2000	3800	3600	2100	4000	3800	2200	4100	4100	2300	4300	4300	2500	4500	4800	2800	4800	5600	102
	10,500	1800	3600	3100	1900	3700	3300	2000	3900	3500	2100	4000	3700	2200	4200	3900	2400	4400	4300	2600	4700	5000	102
	10,000	1700	3500	2900	1800	3700	3000	1900	3800	3200	2000	4000	3400	2100	4100	3600	2200	4300	3900	2500	4600	4500	101
	9,500	1600	3400	2600	1700	3600	2800	1700	3700	2900	1800	3900	3100	1900	4000	3300	2100	4200	3600	2300	4500	4100	101
	9,000	1500	3400	2500	1600	3500	2600	1700	3600	2700	1700	3800	2900	1800	3900	3100	2000	4100	3300	2200	4400	3800	100
	WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (13°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA +20°C TORQUE = 95.0%			ISA +30°C TORQUE = 86.9%			
1000 PA	13.500	2600	4400	5600	2800	4700	6100	2900	4900	6600	3100	5100	7100	3300	5400	7600	3600	5700	9000	4000	6100	R	106
	13,000	2500	4200	5100	2600	4400	5500	2800	4600	5900	2900	4800	6400	3100	5000	6800	3400	5300	7900	3800	5600	R	105
	12,500	2300	4100	4700	2500	4200	5000	2600	4400	5400	2800	4600	5800	2900	4800	6200	3200	5100	7000	3600	5400	8800	104
	12,000	2200	3900	4300	2300	4100	4600	2500	4300	4900	2600	4500	5200	2800	4700	5600	3000	4900	6300	3400	5300	7700	103
	11,500	2100	3800	3900	2200	4000	4200	2300	4200	4400	2500	4300	4700	2600	4500	5000	2800	4800	5700	3100	5100	6800	103
	11,000	2000	3800	3600	2100	3900	3800	2200	4100	4000	2300	4300	4300	2400	4400	4500	2600	4700	5100	2900	5000	6000	102
	10,500	1900	3700	3300	2000	3800	3500	2100	4000	3700	2200	4200	3900	2300	4300	4100	2500	4600	4600	2800	4900	5400	102
	10,000	1700	3600	3000	1800	3800	3200	1900	3900	3300	2000	4100	3500	2100	4200	3800	2300	4500	4200	2600	4700	4800	101
	9,500	1600	3500	2700	1700	3700	2900	1800	3800	3100	1900	4000	3200	2000	4200	3400	2200	4400	3800	2400	4600	4300	101
	9,000	1600	3500	2600	1600	3600	2700	1700	3800	2900	1800	3900	3000	1900	4100	3200	2100	4300	3500	2300	4500	4000	100
	WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (11°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA + 20°C TORQUE = 93.6%			ISA +30°C TORQUE = 86.0%			
2000 PA	13.500	2700	4600	6000	2900	4800	6500	3100	5100	7000	3300	5200	7500	3400	5600	8200	3800	5900	9900	4300	6400	R	106
	13,000	2600	4300	5400	2700	4500	5800	2900	4700	6300	3100	4900	6700	3300	5200	7300	3600	5500	8600	4000	5900	R	105
	12,500	2400	4200	4900	2600	4400	5300	2700	4600	5700	2900	4800	6100	3000	5000	6500	3400	5300	7600	3800	5700	9500	104
	12,000	2300	4100	4500	2400	4200	4800	2600	4400	5100	2700	4600	5500	2900	4800	5900	3200	5100	6800	3500	5500	8800	103
	11,500	2200	3900	4100	2300	4100	4400	2400	4300	4700	2600	4500	5000	2700	4700	5300	3000	5000	6100	3300	5300	7300	103
	11,000	2000	3900	3700	2200	4000	4000	2300	4200	4200	2400	4400	4500	2500	4600	4800	2800	4900	5400	3100	5200	6400	102
	10,500	1900	3800	3400	2000	3900	3600	2100	4100	3800	2300	4300	4100	2400	4500	4300	2600	4700	4900	2900	5000	5700	102
	10,000	1800	3700	3100	1900	3900	3300	2000	4000	3500	2100	4200	3700	2200	4400	3900	2400	4600	4400	2700	4900	5100	101
	9,500	1700	3700	2900	1800	3800	3000	1900	4000	3200	2000	4100	3400	2100	4300	3900	2300	4500	4000	2500	4800	4600	101
	9,000	1600	3600	2700	1700	3700	2800	1800	3900	3000	1900	4000	3200	2000	4200	3400	2200	4400	3700	2400	4700	4200	100

NOTES

Column 1 = Normal Take – Off Distance ~ FT
Column 2 = Accelerate – Stop Distance ~ FT
Column 3 = Accelerate – Go Distance ~ FT
R = Distance Exceeds 10,000 FT
BT00217A

Figure 7-7. Takeoff Performance Planning Tabulations – Flaps 40%

Model: C-12CD
DATE 11 JANUARY 1988
DATA BASIS
(CONSULT APPROPRIATE CHARSTS FOR
EXACT VALUES AND ASSOCIATED CONDITIONS)

FLAPS 40%
ZERO WIND
ICE VANES RETRACTED

ENGINE PT6A-41
PROPELLER T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

3000 PA

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (9°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA +20°C TORQUE = 95.9%			ISA +30°C TORQUE = 87.3%			V KIAS
13.500	2900	4800	6300	3000	5000	6900	3200	5300	7400	3400	5500	8000	3600	5800	8800	4000	6200	R	4500	6600	R	106
13,000	2700	4500	5700	2900	4700	6200	3000	4900	6600	3200	5100	7200	3400	5400	7800	3800	5700	9400	4200	6100	R	105
12,500	2500	4300	5200	2700	4500	5600	2900	4700	6000	3000	5000	6500	3200	5200	7000	3600	5500	8300	4000	5900	9500	104
12,000	2400	4200	4700	2500	4400	5100	2700	4600	5400	2900	4800	5800	3000	5000	6300	3300	5300	7300	3700	5700	9000	103
11,500	2300	4100	4300	2400	4300	4600	2500	4500	4900	2700	4700	5200	2800	4900	5600	3100	5200	6500	3500	5500	7800	103
11,000	2100	4000	3900	2300	4200	4200	2400	4400	4400	2500	4600	4700	2700	4800	5100	2900	5100	5800	3300	5400	6900	102
10,500	2000	3900	3600	2100	4100	3800	2200	4300	4000	2400	4500	4300	2500	4700	4600	2800	4900	5200	3100	5200	6100	102
10,000	1900	3800	3300	2000	4000	3500	2100	4200	3700	2200	4400	3900	2400	4600	4200	2600	4800	4700	2900	5100	5400	101
9,500	1800	3800	3000	1900	3900	3200	2000	4100	3400	2100	4300	3600	2200	4500	3800	2400	4700	4300	2700	5000	4900	101
9,000	1700	3700	2800	1800	3800	3000	1900	4000	3100	2000	4200	3300	2100	4400	3500	2300	4600	3900	2500	4900	4500	100

4000 PA

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (7°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA +20°C TORQUE = 95.0%			ISA +30°C TORQUE = 86.9%			
13.500	3000	5000	6700	3200	5200	7300	3400	5500	7900	3600	5700	8600	3900	6100	9800	4300	6500	R	4800	7000	R	106
13,000	2800	4600	6000	3000	4900	6500	3200	5100	7100	3400	5300	7600	3600	5600	8500	4000	6000	R	4500	6400	R	105
12,500	2700	4500	5500	2800	4700	5900	3000	4900	6400	3200	5200	6900	3400	5400	7600	3800	5800	9100	4200	6200	R	104
12,000	2500	4300	5000	2700	4500	5300	2800	4800	5700	3000	5000	6200	3200	5300	6800	3500	5600	8000	3900	6000	9900	103
11,500	2400	4200	4500	2500	4400	4800	2700	4600	5200	2800	4800	5500	3000	5100	6100	3300	5400	7100	3700	5700	8500	103
11,000	2200	4100	4100	2400	4300	4400	2500	4500	4700	2600	4700	5000	2800	5000	5400	3100	5300	6300	3400	5600	7400	102
10,500	2100	4000	3700	2200	4200	4000	2300	4400	4200	2500	4600	4500	2700	4900	4900	2900	5100	5600	3200	5500	6600	102
10,000	2000	4000	3400	2100	4100	3600	2200	4300	3900	2300	4500	4100	2500	4700	4500	2700	5000	5000	3000	5300	5800	101
9,500	1800	3900	3100	2000	4100	3300	2100	4200	3500	2200	4400	3700	2300	4600	4100	2500	4900	4500	3800	5200	5200	101
9,000	1800	3800	2900	1900	4000	3100	2000	4100	3300	2100	4300	3500	2200	4500	3800	2400	4800	4200	2700	5100	4800	100

5000 PA

WEIGHT LBS	ISA -30°C TORQUE = 100%			ISA -20°C TORQUE = 100%			ISA -10°C TORQUE = 100%			ISA (5°C) TORQUE = 100%			ISA + 10°C TORQUE = 100%			ISA + 20°C TORQUE = 93.6%			ISA +30°C TORQUE = 86.0%			
13.500	3100	5100	7100	3300	5400	7800	3500	5700	8500	3800	6000	9300	4100	6300	R	4500	6800	R	5100	7300	R	106
13,000	3000	4800	6400	3100	5000	6900	3300	5300	7500	3600	5600	8200	3900	5900	9500	4200	6300	R	4700	6800	R	105
12,500	2800	4600	5800	3000	4900	6300	3200	5100	6800	3400	5400	7300	3600	5700	8400	4000	6000	R	4500	6500	R	104
12,000	2600	4500	5200	2800	4700	5600	3000	5000	6100	3200	5200	6600	3400	5500	7400	3800	5800	8700	4200	6200	R	103
11,500	2500	4400	4700	2600	4600	5100	2800	4800	5500	3000	5000	5900	3200	5300	6600	3500	5700	7700	3900	6000	9400	103
11,000	2300	4300	4300	2500	4500	4600	2600	4700	4900	2800	4900	5300	3000	5200	5900	3300	5500	6800	3700	5900	8100	102
10,500	2200	4200	3900	2300	4400	4200	2500	4600	4500	2600	4800	4800	2800	5100	5300	3100	5400	6000	3400	5700	7100	102
10,000	2000	4100	3600	2200	4300	3800	2300	4500	4100	2400	4700	4300	2600	4900	4800	2900	5200	5400	3200	5600	6300	101
9,500	1900	4000	3300	2000	4200	3500	2200	4400	3700	2300	4600	4000	2500	4800	4300	2700	5100	4900	3000	5400	5600	101
9,000	1800	3900	3000	1900	4100	3200	2000	4300	3400	2200	4500	3700	2300	4700	4000	2500	5000	4500	2800	5300	5100	100

NOTES

Column 1 = Normal Take – Off Distance ~ FT
Column 2 = Accelerate – Stop Distance ~ FT
Column 3 = Accelerate – Go Distance ~ FT
R = Distance Exceeds 10,000 FT
BT00217A

Figure 7-8. Takeoff Performance Planning Tabulations – Flaps 40%

NOTES:

STALL SPEEDS-POWER IDLE

1. MAXIMUM ALTITUDE LOSS DURING A NORMAL STALL RECOVERY IS APPROXIMATELY 1000 FEET.
2. MAXIMUM NOSE DOWN PITCH ATTITUDE AND ALTITUDE LOSS DURING RECOVERY FROM ONE ENGINE INOPERATIVE STALLS PER FAR 23.205 ARE APPROXIMATELY 20° AND 850 FEET RESPECTIVELY.
3. A NORMAL STALL RECOVERY TECHNIQUE MAY BE USED. THE BEST PROCEDURE IS A BRISK FORWARD WHEEL MOVEMENT TO A NOSE DOWN ATTITUDE. LEVEL THE AIRPLANE AFTER AIRSPEED HAS INCREASED APPROXIMATELY 25 KNOTS ABOVE STALL.

EXAMPLE:

WEIGHT	11,700 LBS
FLAPS	APPROACH
ANGLE OF BANK	30°
STALL SPEED	95 KTS CAS 90 KTS IAS

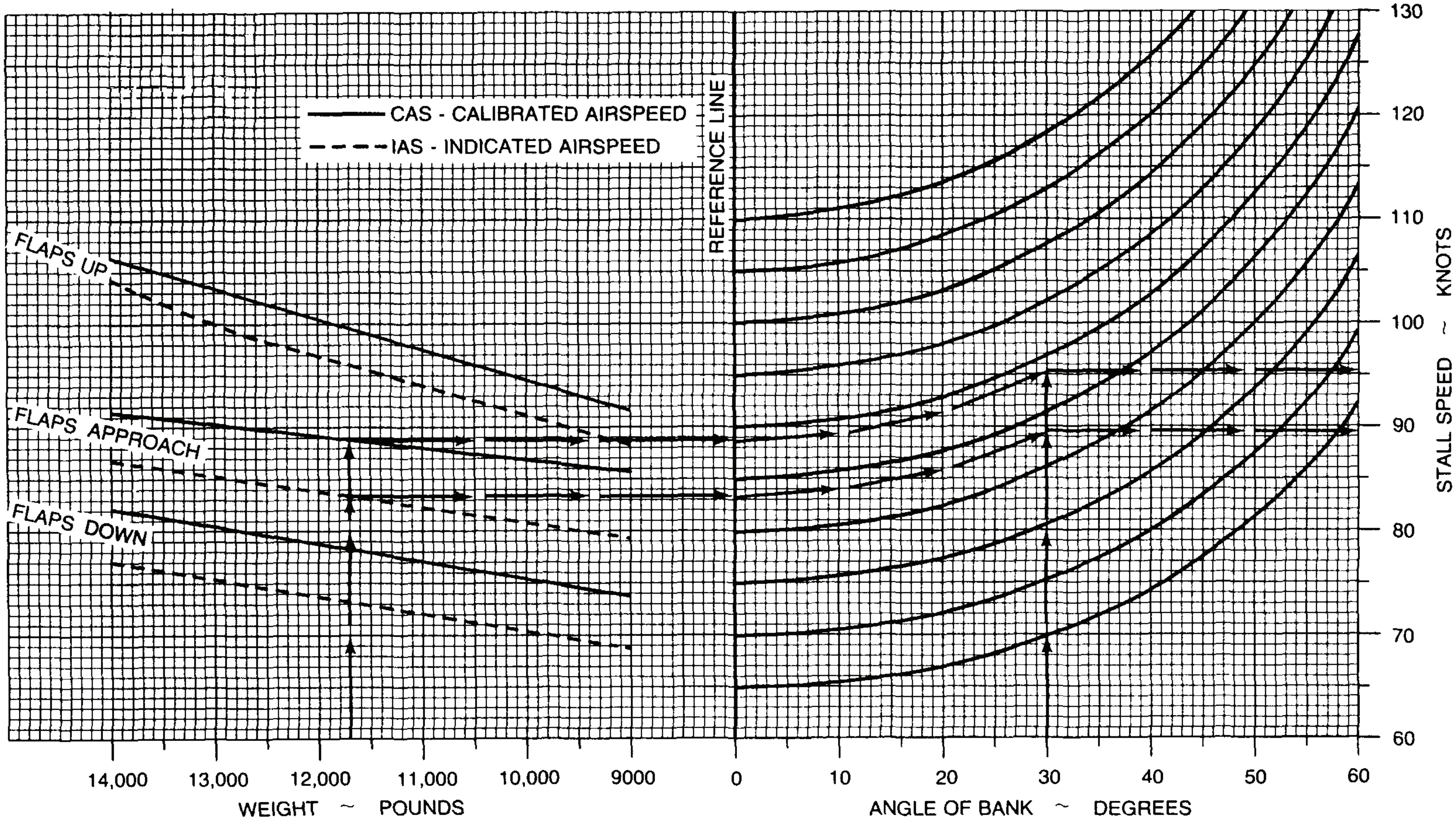


Figure 7-9. Stall Speeds – Power Idle

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: ESTIMATED

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

CONFIGURATION:

GEAR: .... UP
FLAPS: .... UP

EXAMPLE:

INDICATED AIR TEMPERATURE: .... -22 °C
TRUE AIRSPEED: .... 220 KNOTS
AMBIENT AIR TEMPERATURE: .... -27 °C

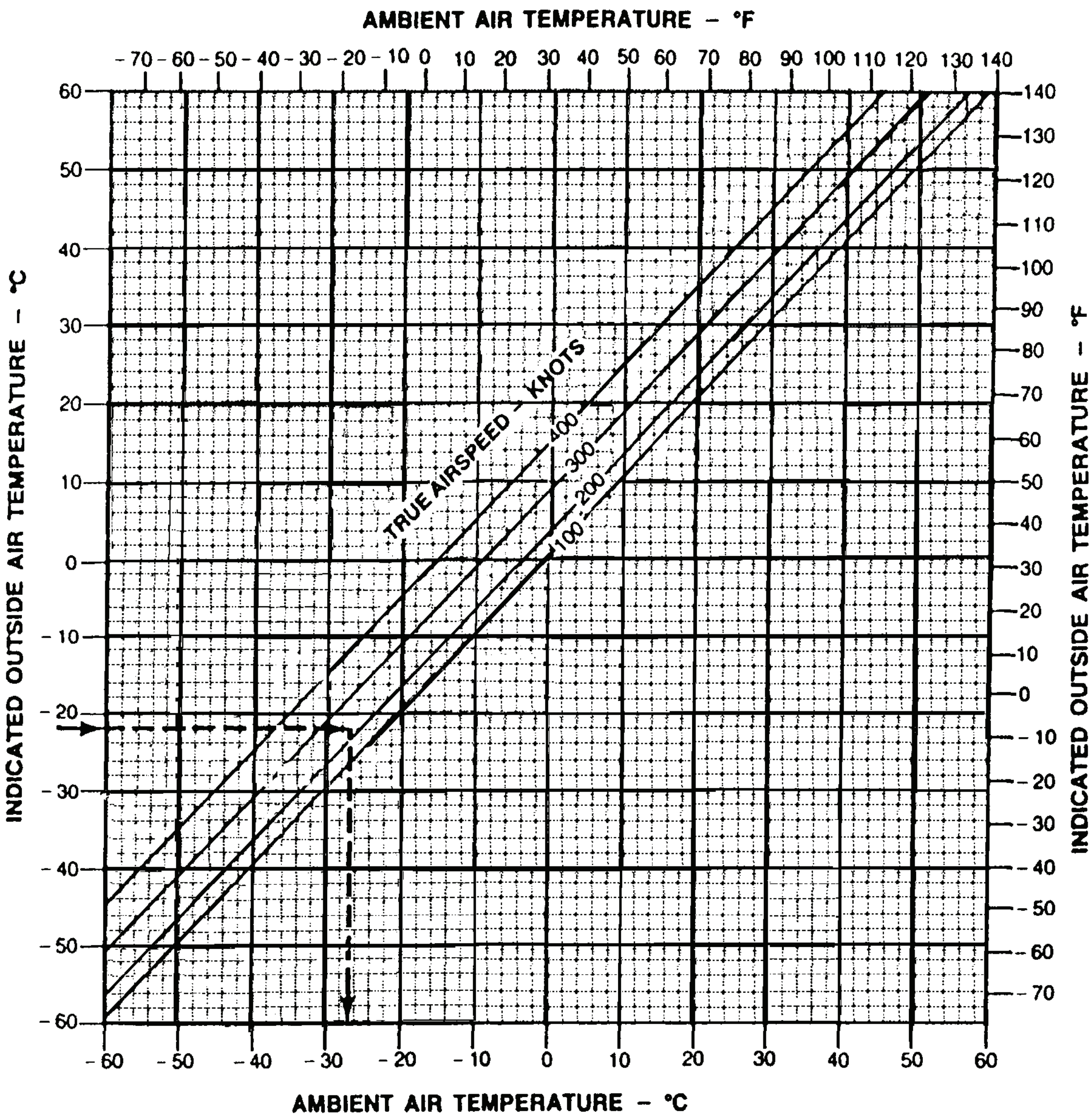


Figure 7-10. Temperature Conversion/Correction for Compressibility

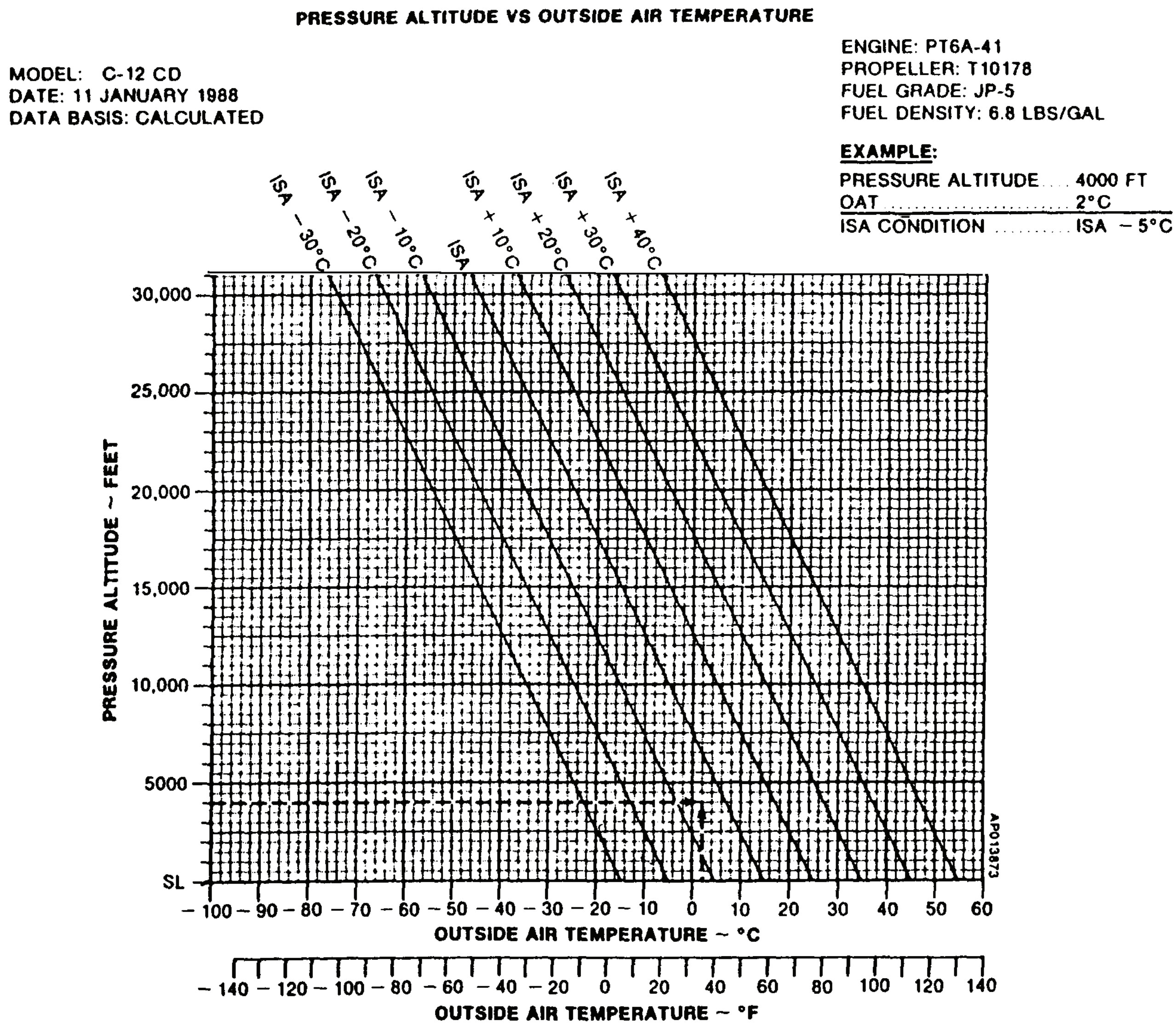


Figure 7-11. ISA Conversion

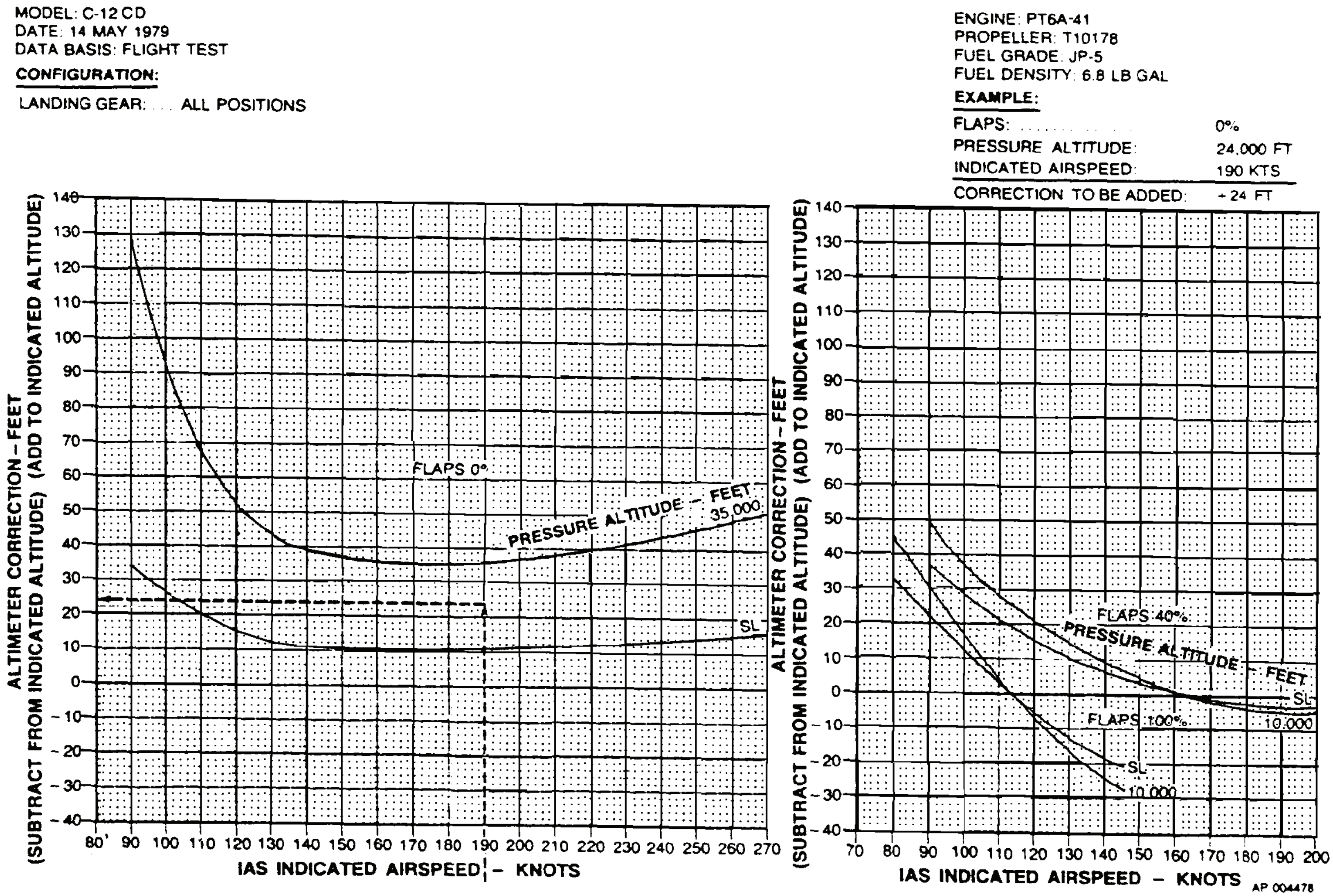


Figure 7-12. Altimeter Position Error Correction – Normal System

MODEL: C-12CD
DATE: 14 MAY 1979
DATA BASIS FLIGHT TEST

CONFIGURATION
FLAPS..........................0% OR 40%
GEAR........................... DOWN

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE JP-5
FUEL DENSITY: 6.8 LB/GAL

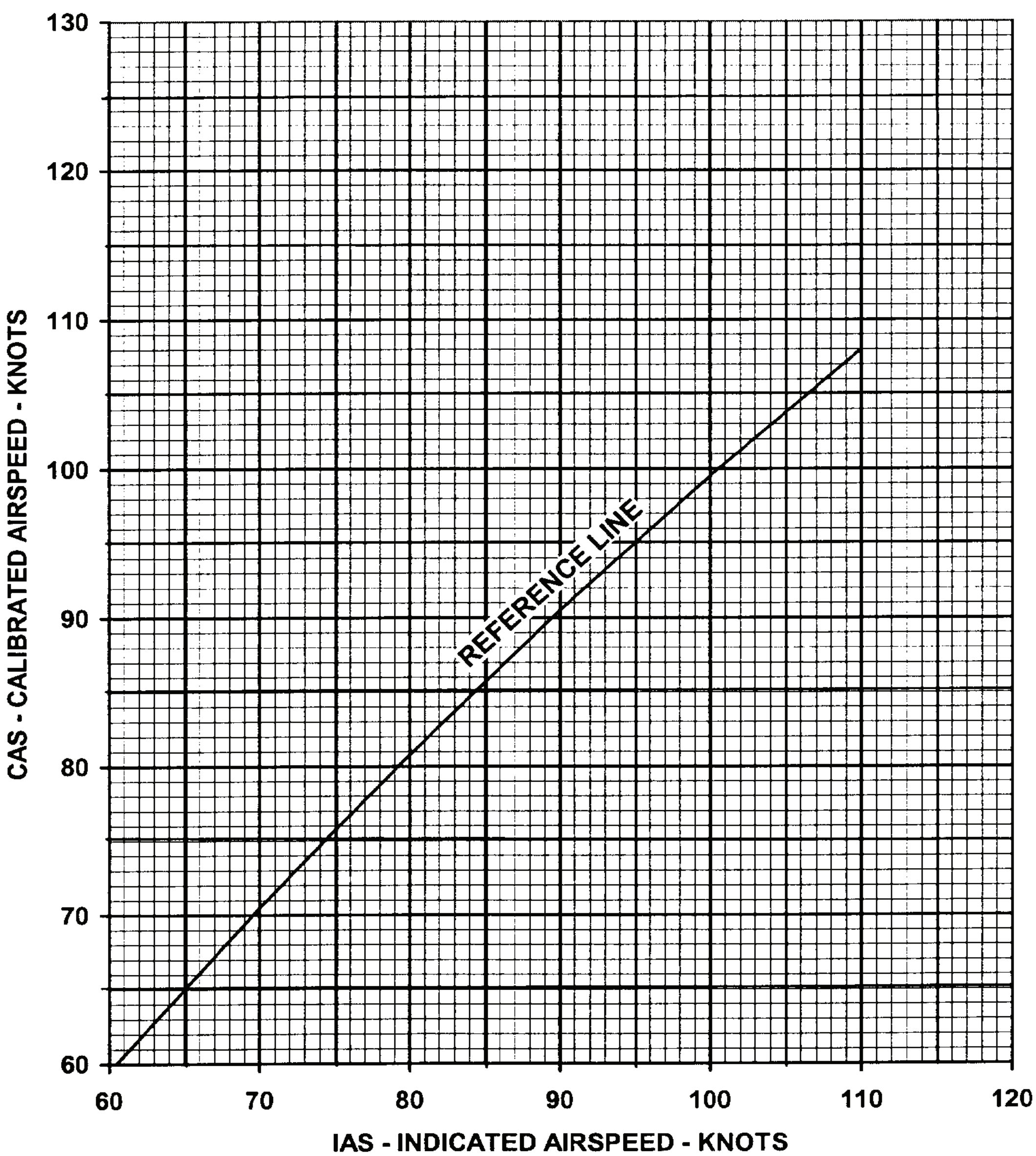


Figure 7-13. Airspeed Calibration – Normal System – Ground Roll

MODEL C-12 CD
DATE 14 MAY 1979
DATA BASIS FLIGHT TEST

ENGINE PT6A 41
PROPELLER T10178
FUEL GRADE JP-5
FUEL DENSITY 6.8 LB GAL

CONFIGURATION:

POWER	TAKEOFF
FLAPS	UP (0%)
LANDING GEAR	DOWN

NOTE

FOR OPERATION WITH ICE VANES EXTENDED, ADD 10°C TO THE ACTUAL OAT BEFORE ENTERING THE GRAPH

EXAMPLE:

PRESSURE ALTITUDE	4000 FT
OAT	+30°C
TAKEOFF WEIGHT	12,400 LBS

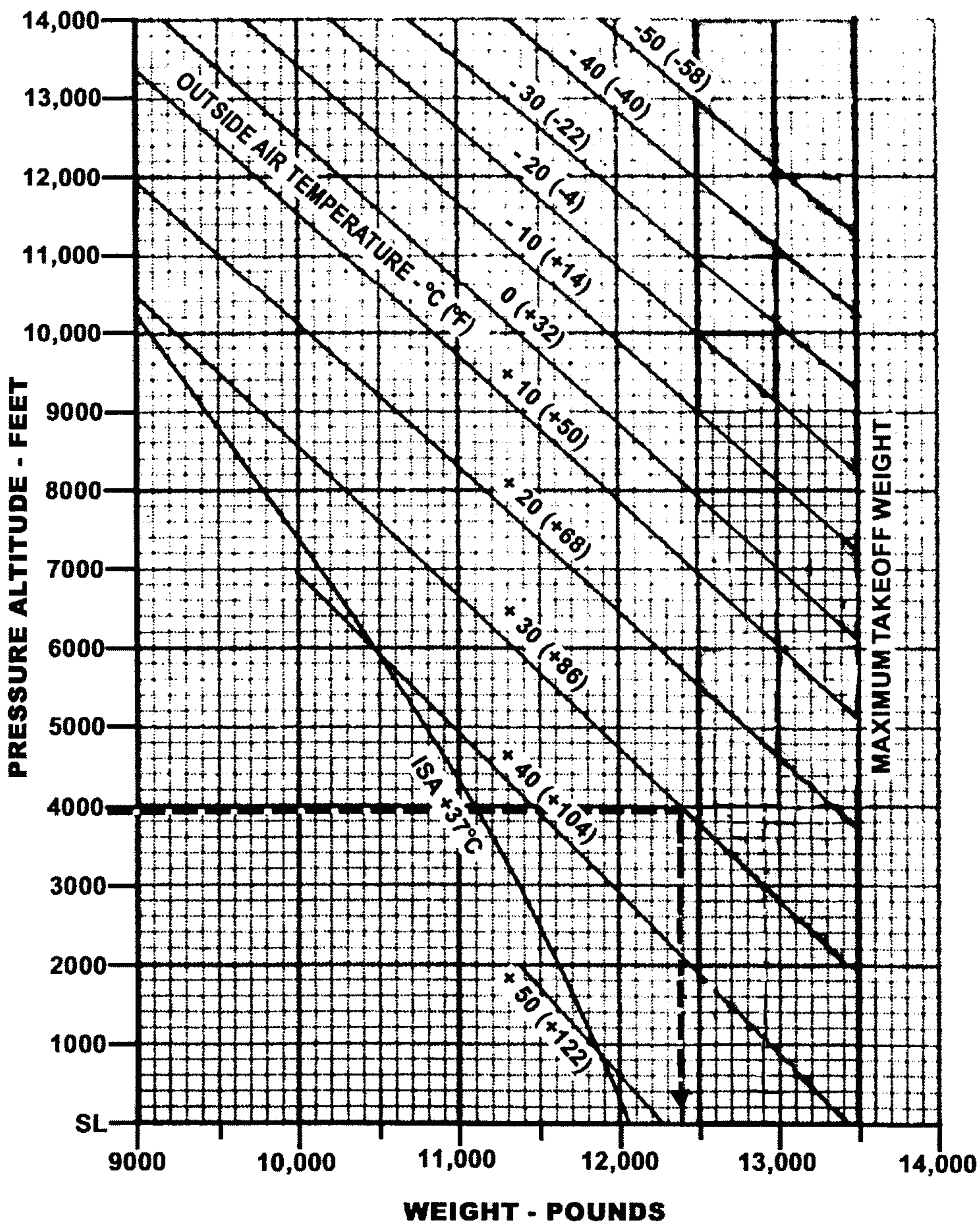


Figure 7-14. Takeoff Gross Weight Limit – Flaps 0% (To Achieve 100 FPM One Engine Inoperative Rate-of-Climb At Liftoff)

MODEL: C-12CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: .... TAKEOFF
FLAPS: 40%
LANDING GEAR: DOWN

NOTE

FOR OPERATION WITH ICE VANES EXTENDED. ADD 10°C TO THE ACTUAL OAT BEFORE ENTERING THE GRAPH

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB GAL

EXAMPLE:

PRESSURE ALTITUDE 4000 FT
OAT +30°C

TAKEOFF WEIGHT: 11,800 LBS

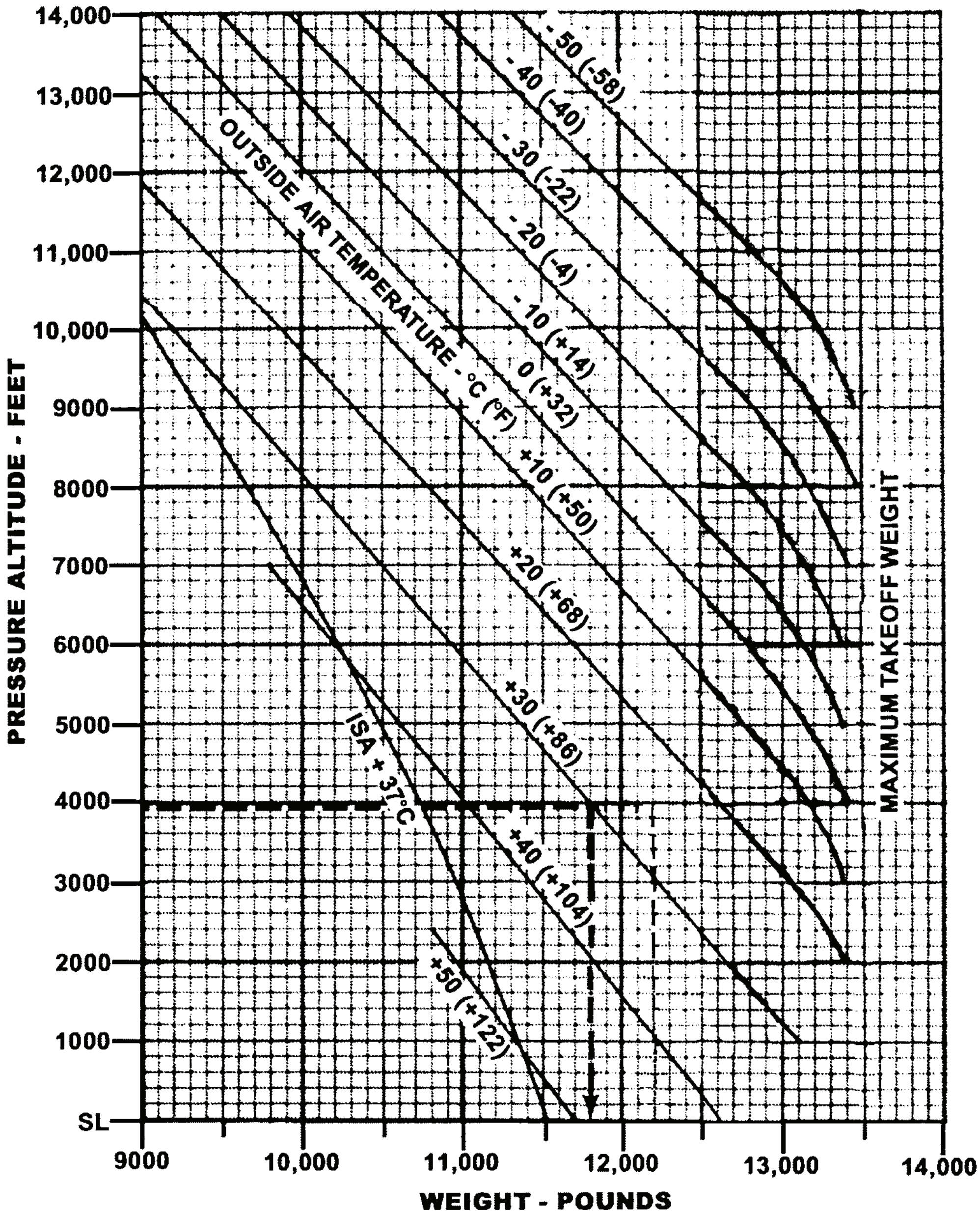


Figure 7-15. Takeoff Gross Weight Limit – Flaps 40% (To Achieve 100 FPM One Engine Inoperative Rate-of-Climb At Liftoff)

MINIMUM TAKE-OFF POWER AT 2000 RPM
(ICE VANES RETRACTED)
(65 KNOTS)

NOTE: 1. TORQUE INCREASE APPROXIMATELY 1% FROM 0 TO 65 KNOTS
2. THE PERCENT TORQUE INDICATED IN THIS FIGURE IS THE MINIMUM VALUE AT WHICH TAKE-OFF PERFORMANCE PRESENTED IN THIS SECTION CAN BE REALIZED . ANY EXCESS POWER WHICH MAY BE DEVELOPED WITHOUT EXCEEDING ENGINE LIMITATIONS MAY BE UTILIZED.

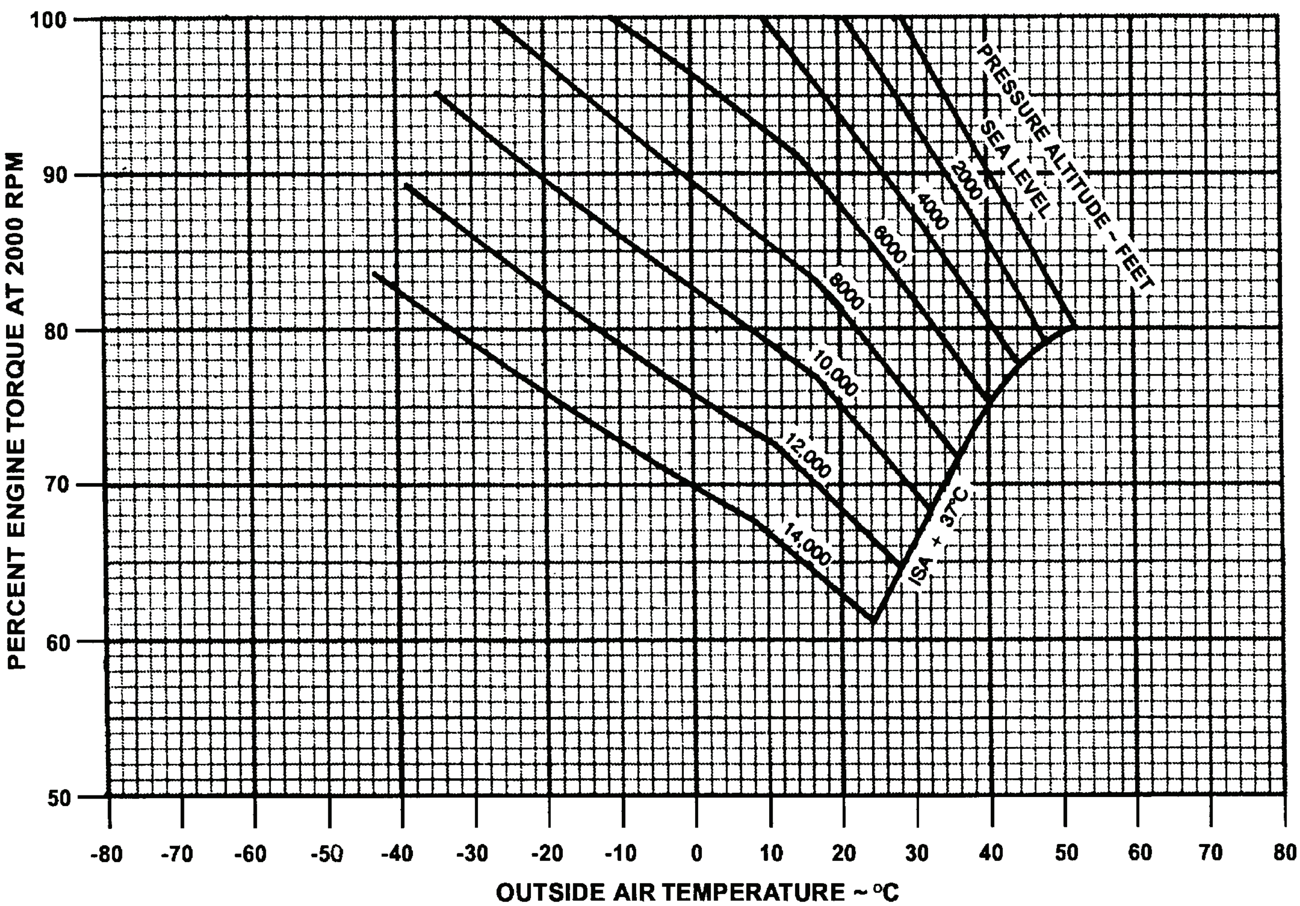


Figure 7-16. Minimum Take-Off Power at 2000 RPM (Ice Vanes Retracted), (65 Knots)

MINIMUM TAKE-OFF POWER AT 2000 RPM
(ICE VANES EXTENDED)
(65 KNOTS)

NOTE:
1. TORQUE INCREASE APPROXIMATELY 1% FROM 0 TO 65 KNOTS
2. THE PERCENT TORQUE INDICATED IN THIS FIGURE IS THE MINIMUM VALUE AT WHICH TAKE-OFF PERFORMANCE PRESENTED IN THIS SECTION CAN BE REALIZED WITH ICE VANES EXTENDED . ANY EXCESS POWER WHICH MAY BE DEVELOPED WITHOUT EXCEEDING ENGINE LIMITATIONS MAY BE UTILIZED.
3. DO NOT EXTEND ICE VANES WITHIN SHADED AREA.

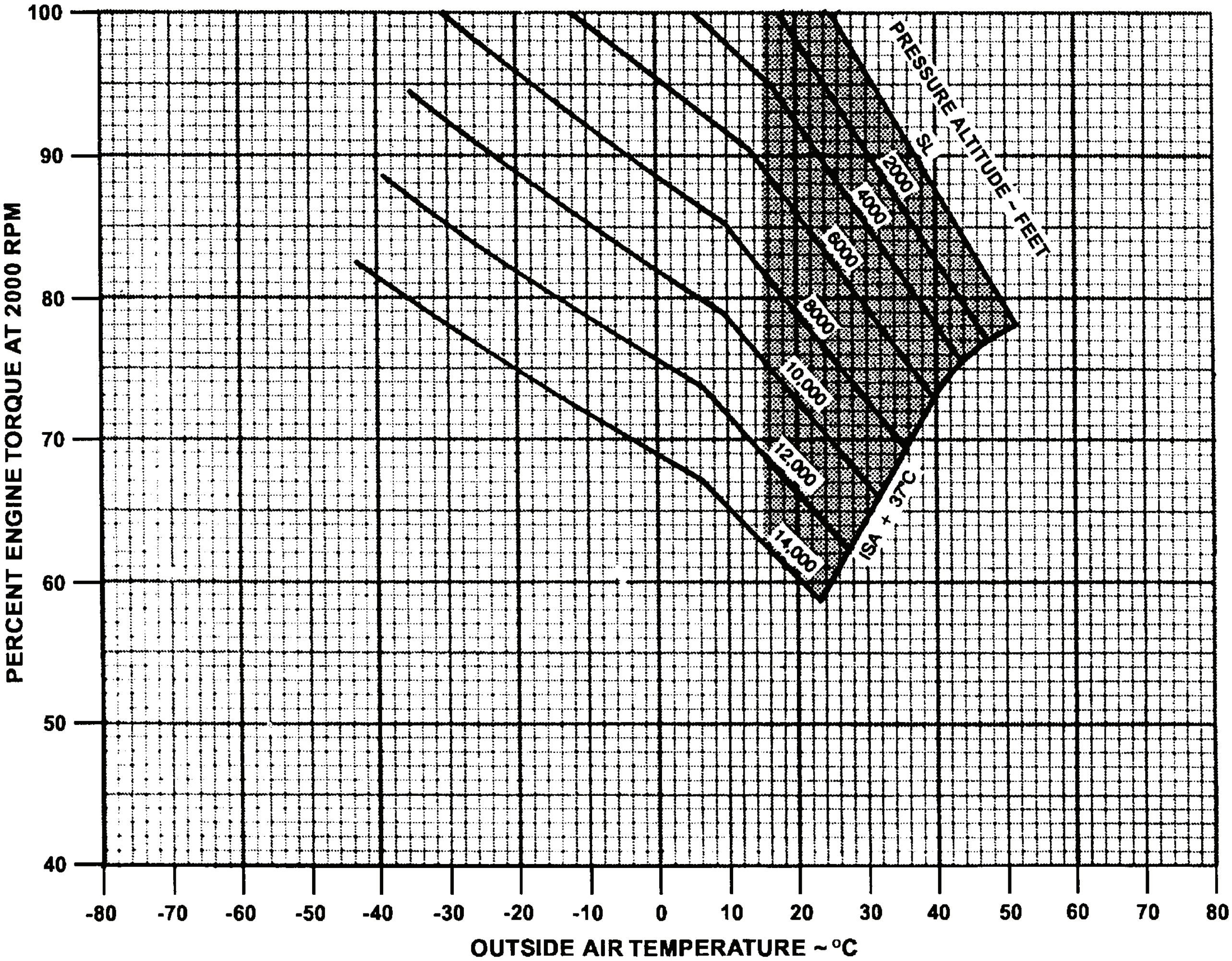


Figure 7-17. Minimum Take-Off Power at 2000 RPM (Ice Vanes Extended), (65 Knots)

MODEL: C-12CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: TAKEOFF POWER SET BEFORE BRAKE RELEASE
FLAPS: 0%
GEAR: RETRACT AFTER LIFT-OFF
RUNWAY: PAVED, LEVEL, DRY SURFACE

WEIGHT – POUNDS	TAKEOFF SPEED – KNOTS	
	V_1	V_2
13,500	106	125
12,500	103	120
12,000	102	118
11,000	98	116
10,000	96	111
9000	96	108

NOTE

FOR OPERATION WITH ICE VANES EXTENDED, ADD 10°C TO THE ACTUAL OAT BEFORE ENTERING CHART.

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT: 25°C
PRESSURE ALTITUDE: 3966 FT
TAKEOFF WEIGHT: 12,000 LBS
HEADWIND COMPONENT: 9.5 KNOTS

GROUND ROLL: 2750 FT
TOTAL DISTANCE OVER 50 FT OBSTACLE: 4200 FT
TAKEOFF SPEED
AT ROTATION: 102 KNOTS
AT 50 FT: 118 KNOTS

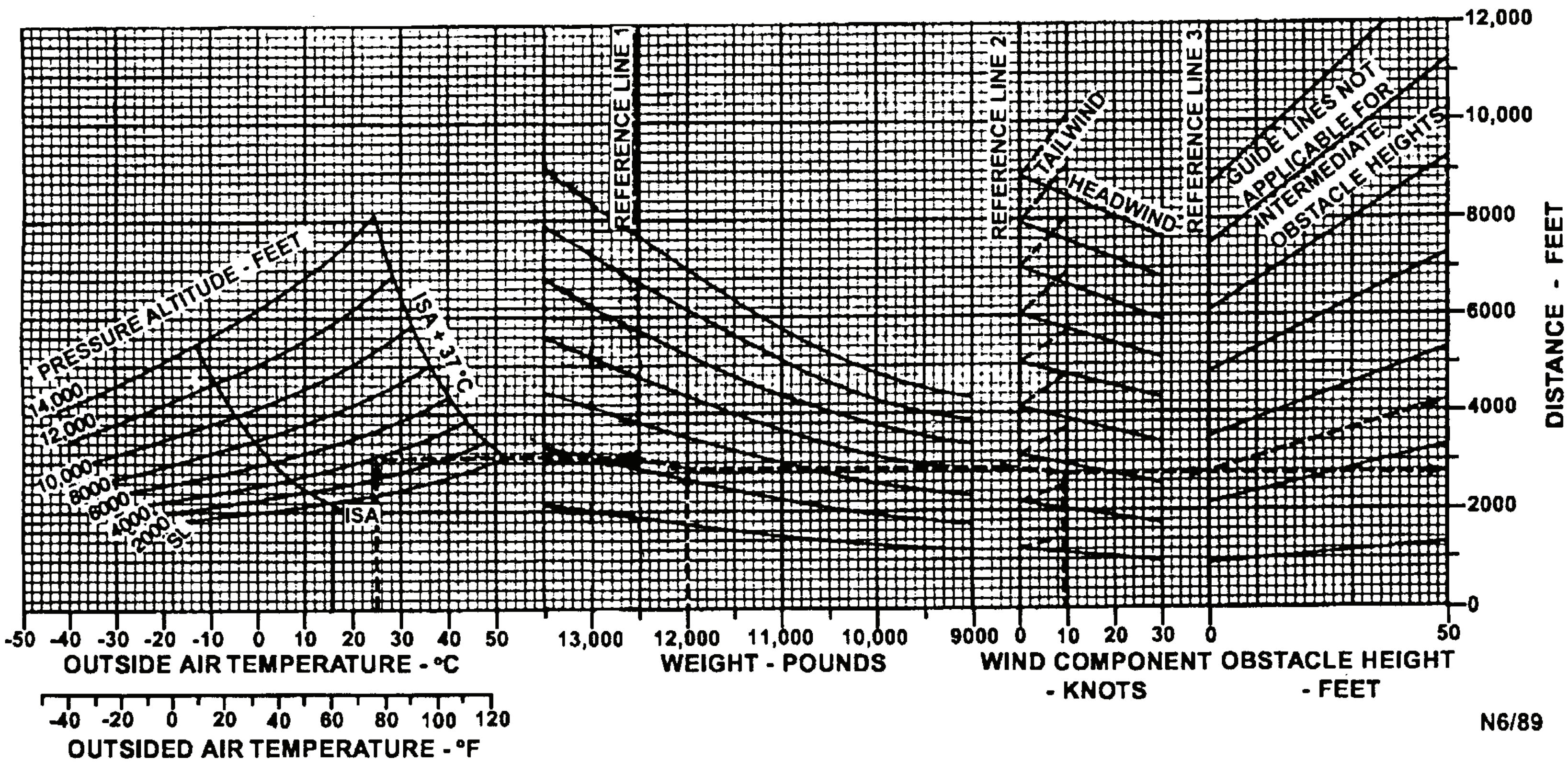


Figure 7-18. Takeoff Distance – Flaps 0%

MODEL: C-12CD
DATE: 11 JANUARY 1988
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER : 1. TAKEOFF POWER SET BEFORE BRAKE RELEASE
2. BOTH ENGINES IDLE AT V_1 SPEED AND REVERSE OPERATING ENGINE

FLAPS : 0%

BRAKING : MAXIMUM WITHOUT SLIDING TIRES

RUNWAY : PAVED, LEVEL, DRY SURFACE

WEIGHT ~ POUNDS	V_1 ~ KNOTS
13,500	106
12,500	103
12,000	102
11,000	98
10,000	96
9000	96

NOTE

. FOR OPERATION WITH ICE VANES EXTENDED. PERFORMANCE IS NOT AFFECTED.

ENGINE PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT:	+30°C
PRESSURE ALTITUDE:	4000 FT
FIELD LENGTH AVAILABLE	6000 FT
V_1 :	104 KTS
WEIGHT	12,800 LBS

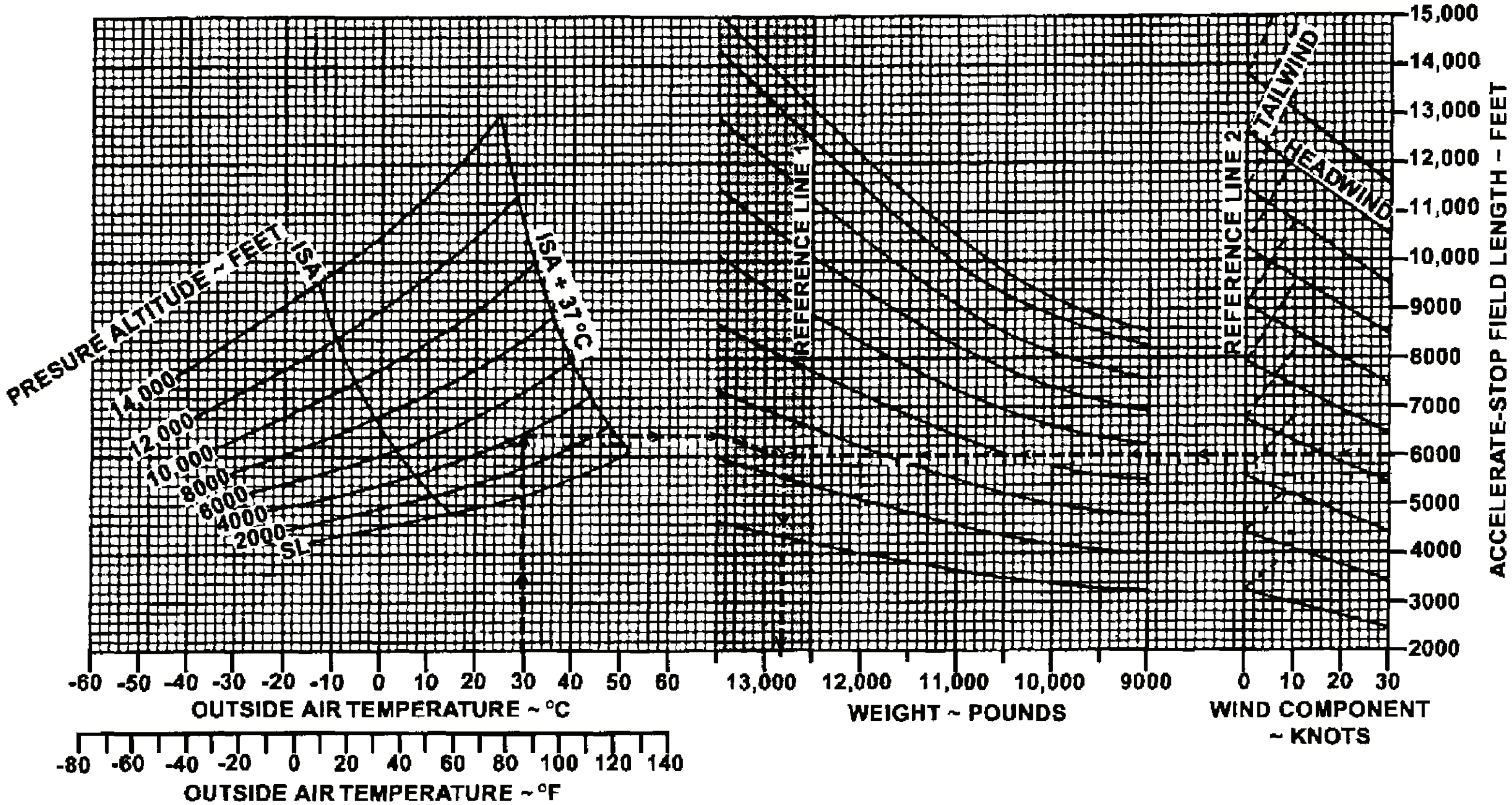


Figure 7-19. Accelerate Stop Distance – Flaps 0%

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: .... TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS: 0%
LANDING GEAR: ... RETRACT AFTER LIFT-OFF
RUNWAY: .... PAVED, LEVEL, DRY SURFACE
ENGINE: .... FAILED AT V_1

WEIGHT – POUNDS	SPEED – KNOTS V_1	V_2
13,500	106	125
12,500	103	120
12,000	102	118
11,000	98	116
10,000	96	111
9000	96	108

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT: .... 30°C
PRESSURE ALTITUDE: .... 4000 FT
TAKE-OFF WEIGHT: .... 12,400 LBS

SPEEDS: V_1 .... 103 KTS
V_2 .... 120 KTS

NOTES:

1. V_1 (ENGINE FAILURE SPEED) EQUALS V_R (ROTATION SPEED).
2. FOR OPERATION WITH ICE VANES EXTENDED, ADD 6°C TO THE ACTUAL OAT BEFORE ENTERING GRAPH.

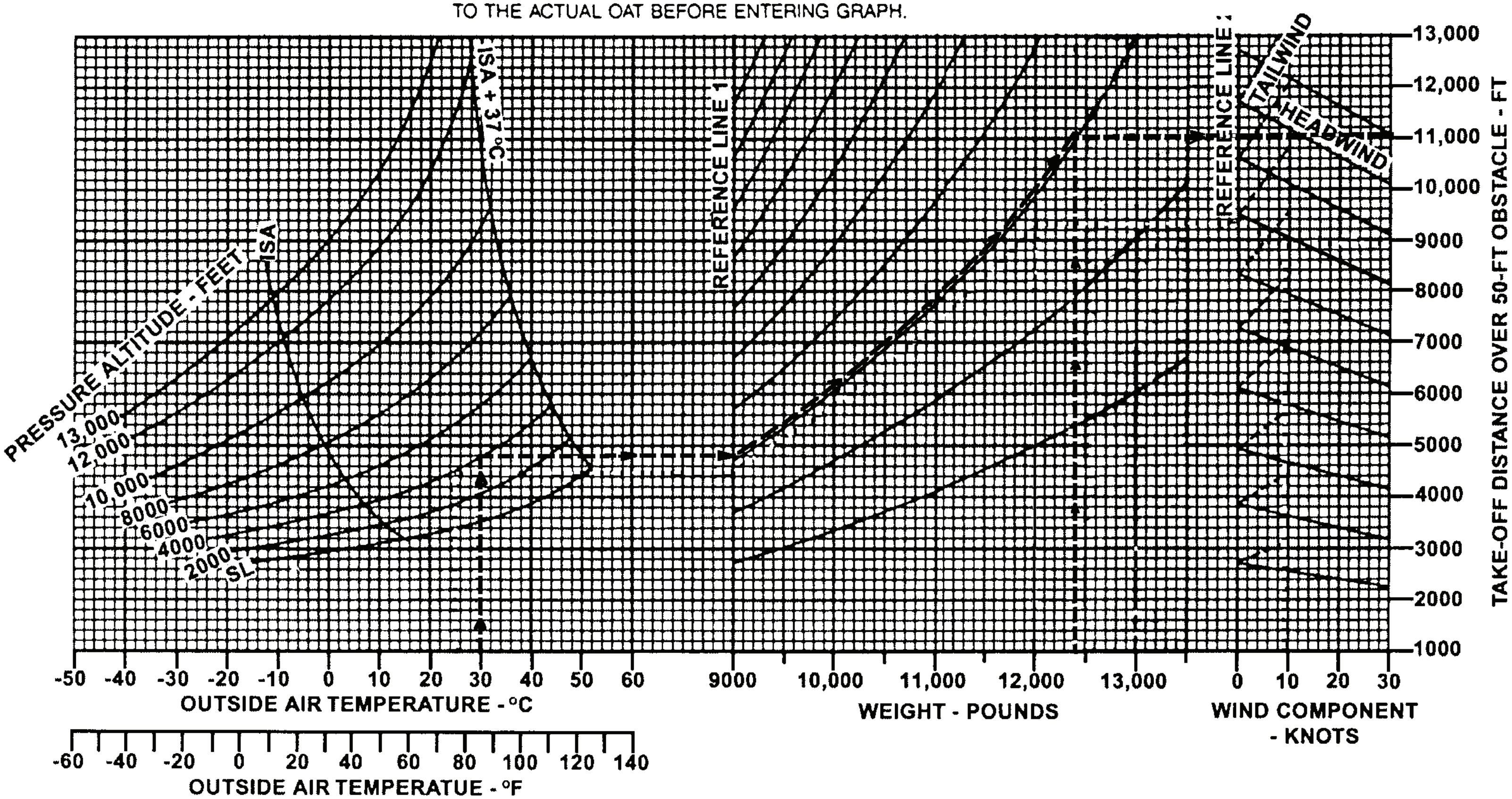


Figure 7-20. Accelerate – Go Distance – Flaps 0%

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER:	TAKEOFF POWER SET BEFORE BRAKE RELEASE
GEAR:	RETRACT AFTER LIFT OFF
RUNWAY:	PAVED, LEVEL, DRY SURFACE

WEIGHT – POUNDS	TAKEOFF SPEED – KNOTS	
	V_1	V_X
13,500	96	106
12,500	96	104
12,000	95	103
11,000	95	102
10,000	95	101
9000	95	100

NOTE

FOR OPERATION WITH ICE VANES EXTENDED, ADD 10% TO THE ACTUAL OAT BEFORE ENTERING CHART.

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT:	25°C
PRESSURE ALTITUDE:	3966 FEET
TAKEOFF WEIGHT:	12,000 LBS
HEADWIND COMPONENT:	9.5 KNOTS
GROUND ROLL:	2330 FEET
TOTAL DISTANCE OVER 50 FT OBSTACLE:	3300 FEET
TAKEOFF SPEED AT ROTATION:	95 KNOTS
AT 50 FT:	102 KNOTS

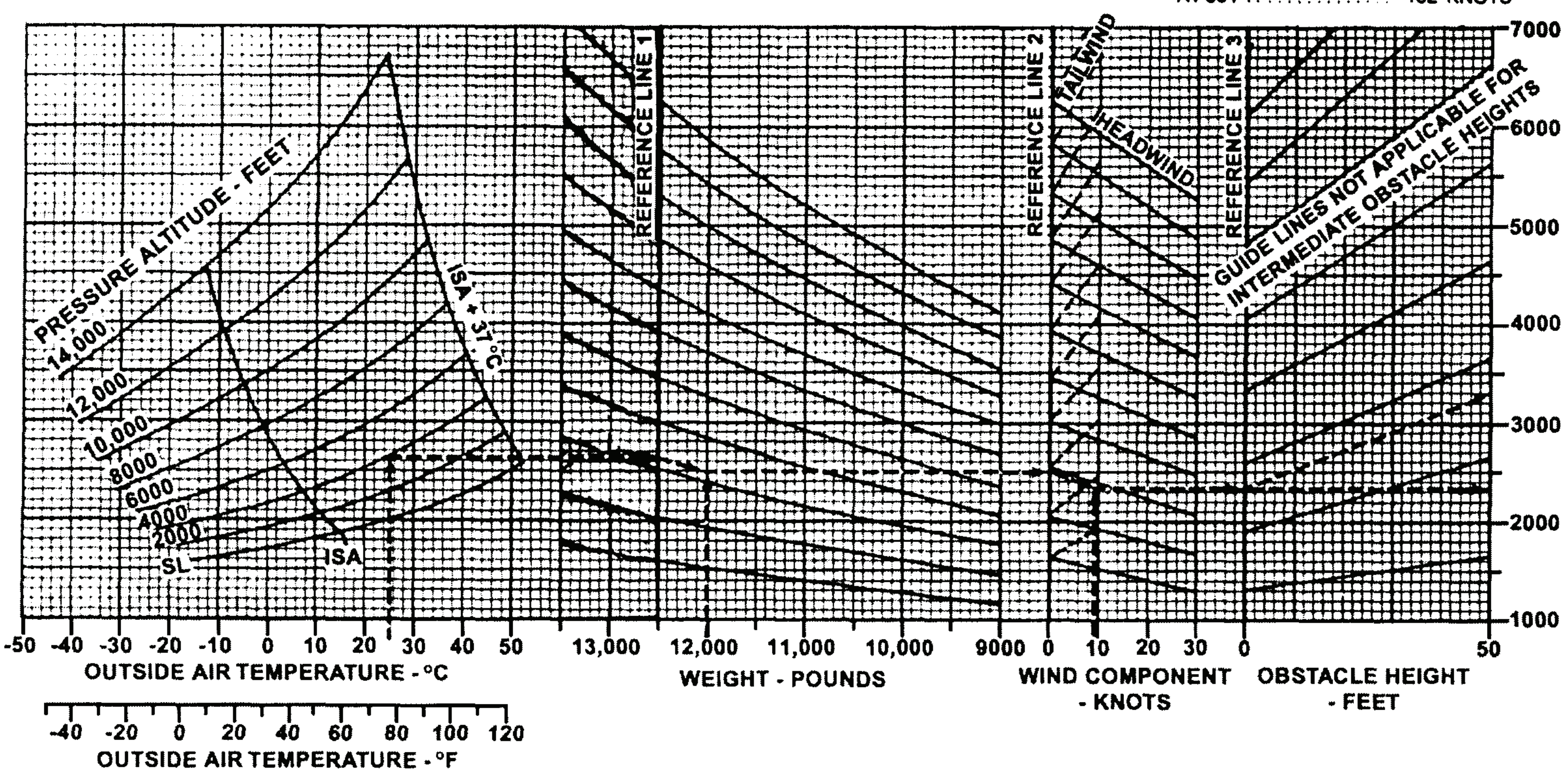


Figure 7-21. Takeoff Distance – Flaps 40%

MODEL: C-12 CD
DATE: 11 JANUARY 1988
DATA BASIS: FLIGHT TEST

WEIGHT ~ POUNDS	V_1 ~ KNOTS
13,500	96
12,500	96
12,000	95
11,000	95
10,000	95
9000	95

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

CONFIGURATION:
POWER: 1. TAKE-OFF POWER SET BEFORE BRAKE RELEASE.
2. BOTH ENGINES IDLE AT V_1 SPEED AND REVERSE OPERATING ENGINE.
FLAPS: 40%
BRAKING: MAXIMUM WITHOUT SLIDING TIRES
RUNWAY: PAVED, LEVEL, DRY SURFACE

EXAMPLE:

OAT:	30°C
PRESSURE ALTITUDE:	4000 FT
FIELD LENGTH AVAILABLE:	6000 FT
V_1:	96 KTS

NOTE

FOR OPERATION WITH ICE VANES EXTENDED, PERFORMANCE IS NOT AFFECTED.

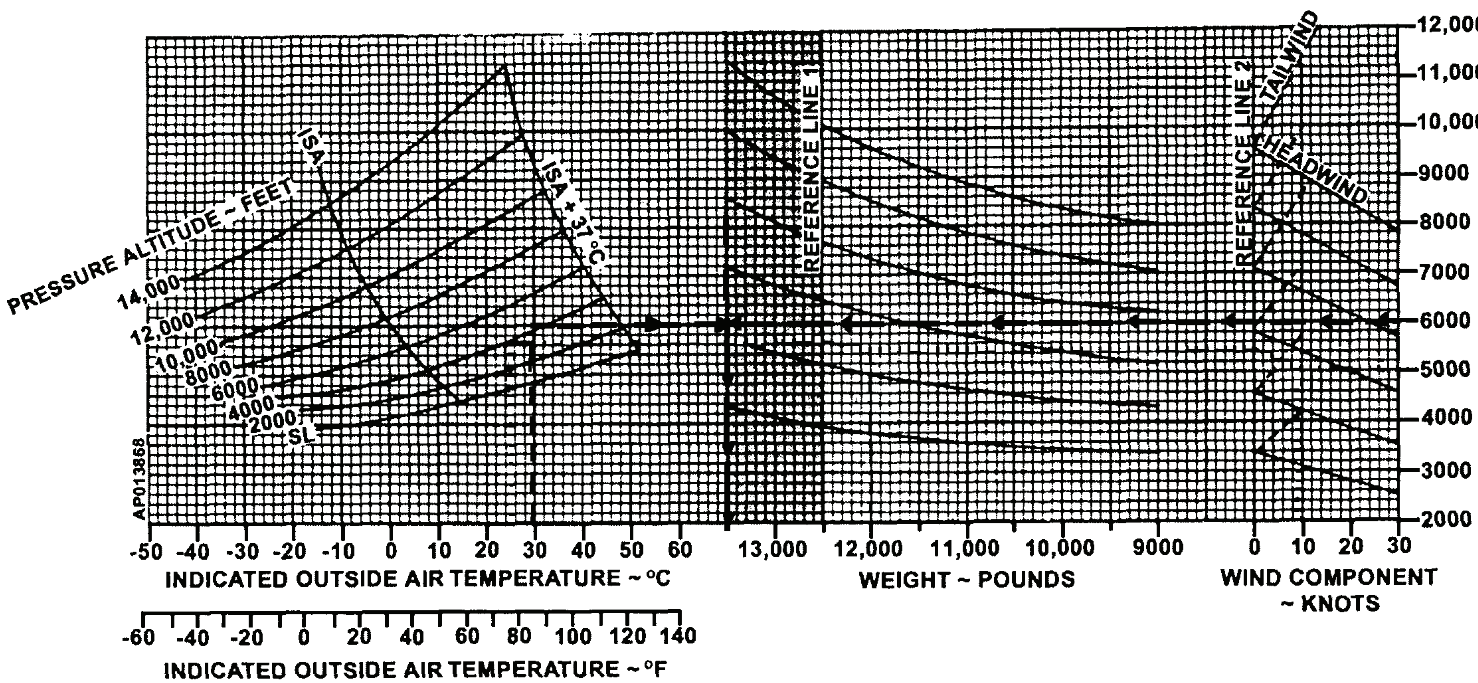


Figure 7-22. Accelerate – Stop Distance – Flaps 40%

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: . . . . TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS: 40%
LANDING GEAR: . . RETRACT AFTER LIFT-OFF
RUNWAY: . . . . . PAVED, LEVEL, DRY SURFACE
ENGINE: . . . . FAILED AT V_1

WEIGHT — POUNDS	SPEED — KNOTS
	V_1
13,500	96
12,500	96
12,000	95
11,000	95
10,000	95
9000	95

NOTES:

1. V_1 (ENGINE FAILURE SPEED) EQUALS V_R (ROTATION SPEED).
2. FOR OPERATION WITH ICE VANES EXTENDED, ADD 6°C TO THE ACTUAL OAT BEFORE ENTERING GRAPH.

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT . . . . 25°C
PRESSURE ALTITUDE . . . . 3966 FT
TAKE-OFF WEIGHT: . . . . 12,000 LBS
HEADWIND COMPONENT: . . . . 9.5 KTS

TOTAL DISTANCE OVER 50-FT OBSTACLE: . . . 7660 FT
SPEEDS: V_1 . . . . 95 KTS

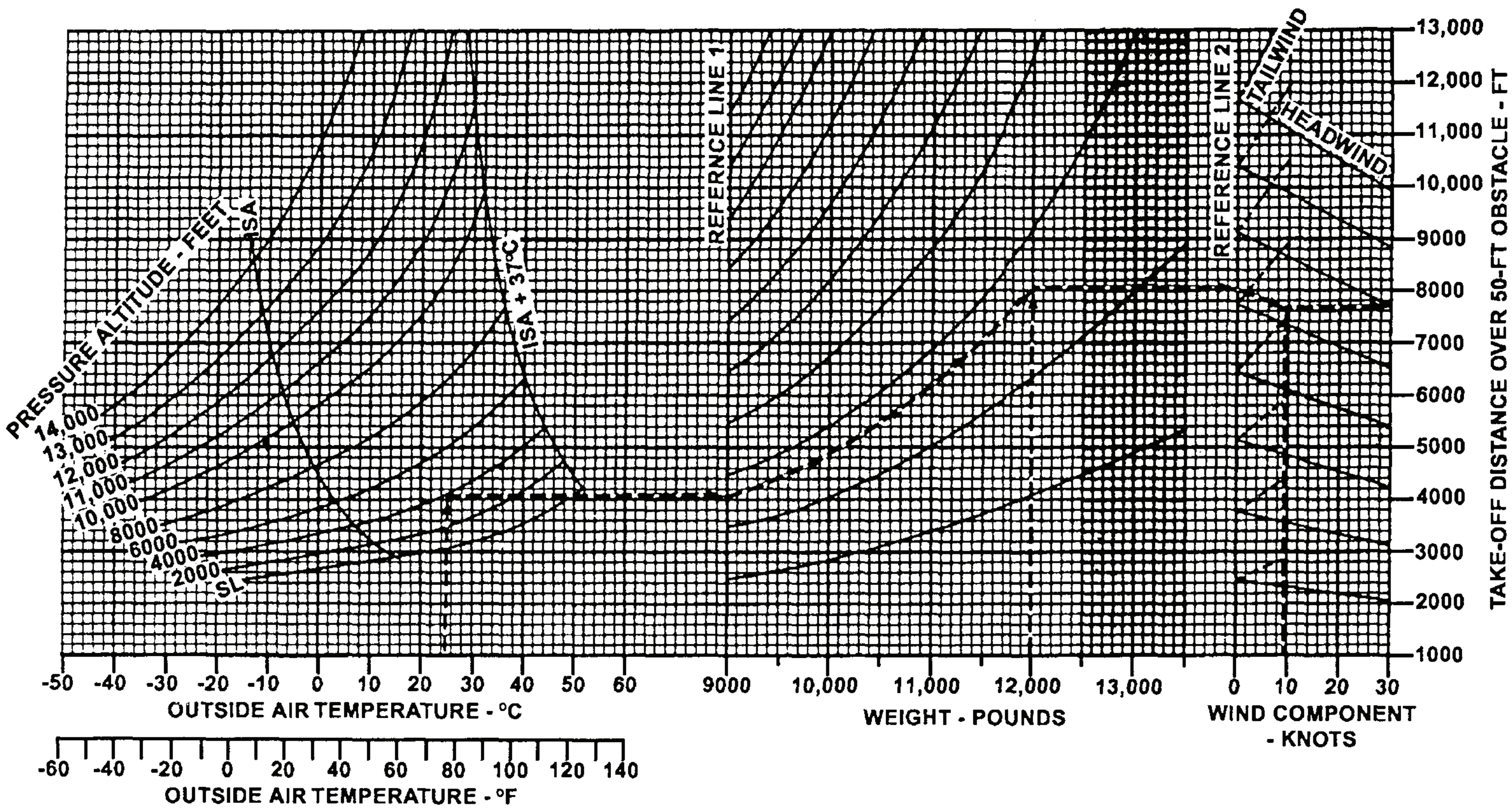


Figure 7-23. Accelerate – Go Distance – Flaps 40%

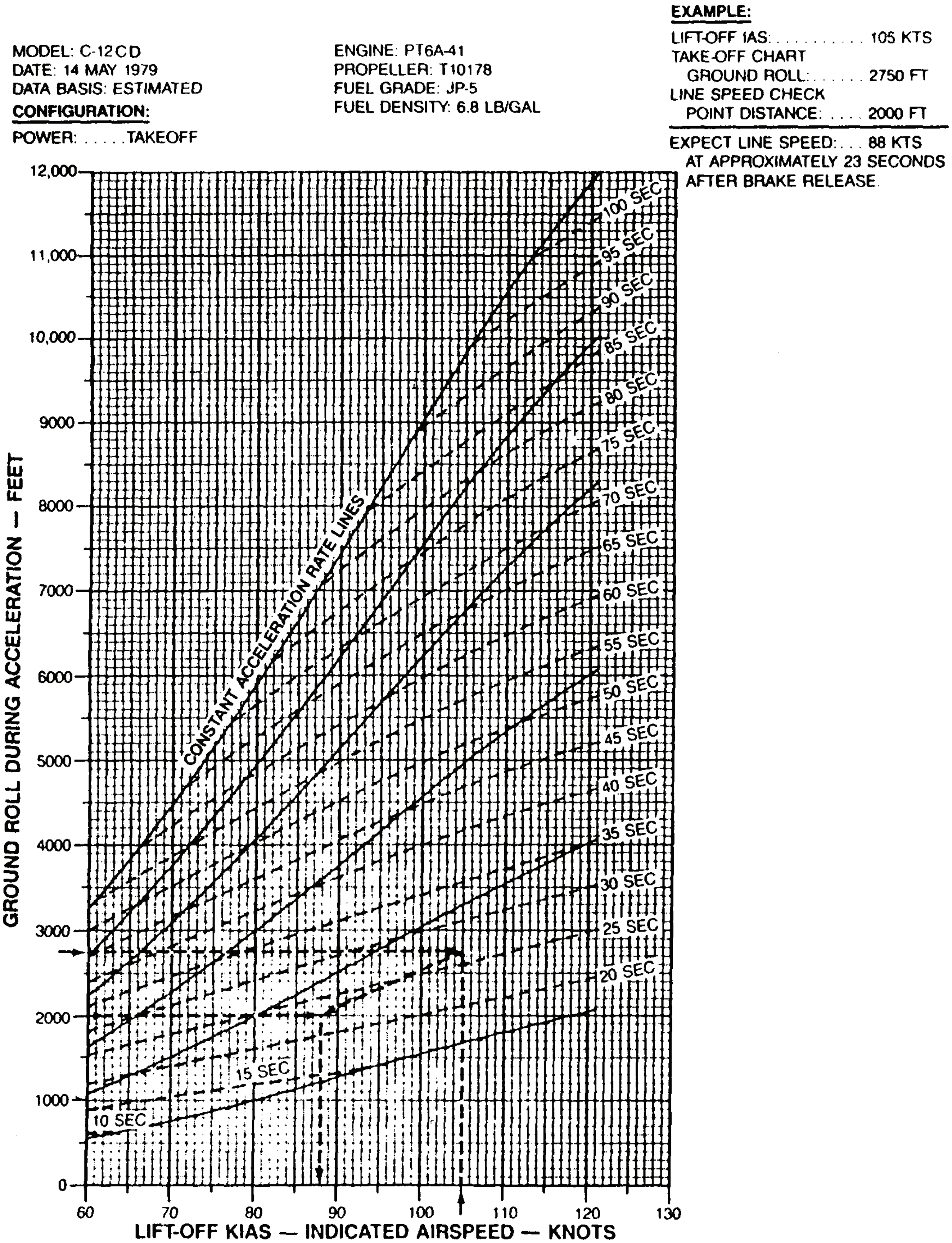


Figure 7-24. Line Speed Check During Takeoff Ground Run

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: .... NOT TO EXCEED 750°C
FLAPS: 0%
GEAR: .... UP

WEIGHT - POUNDS	AIRSPEED - KNOTS
13,500	125
13,000	123
12,000	118
11,000	115
10,000	111
9000	109

NOTE

FOR OPERATION WITH ICE VANES EXTENDED ADD 15°C TO THE ACTUAL OAT BEFORE ENTERING CHART.

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB GAL

EXAMPLE:

OAT: .... 25°C
PRESSURE ALTITUDE: .... 3966 FEET
WEIGHT: .... 12,000 LBS

RATE-OF-CLIMB: .... 2250 FEET PER MIN
CLIMB SPEED: .... 118 KNOTS

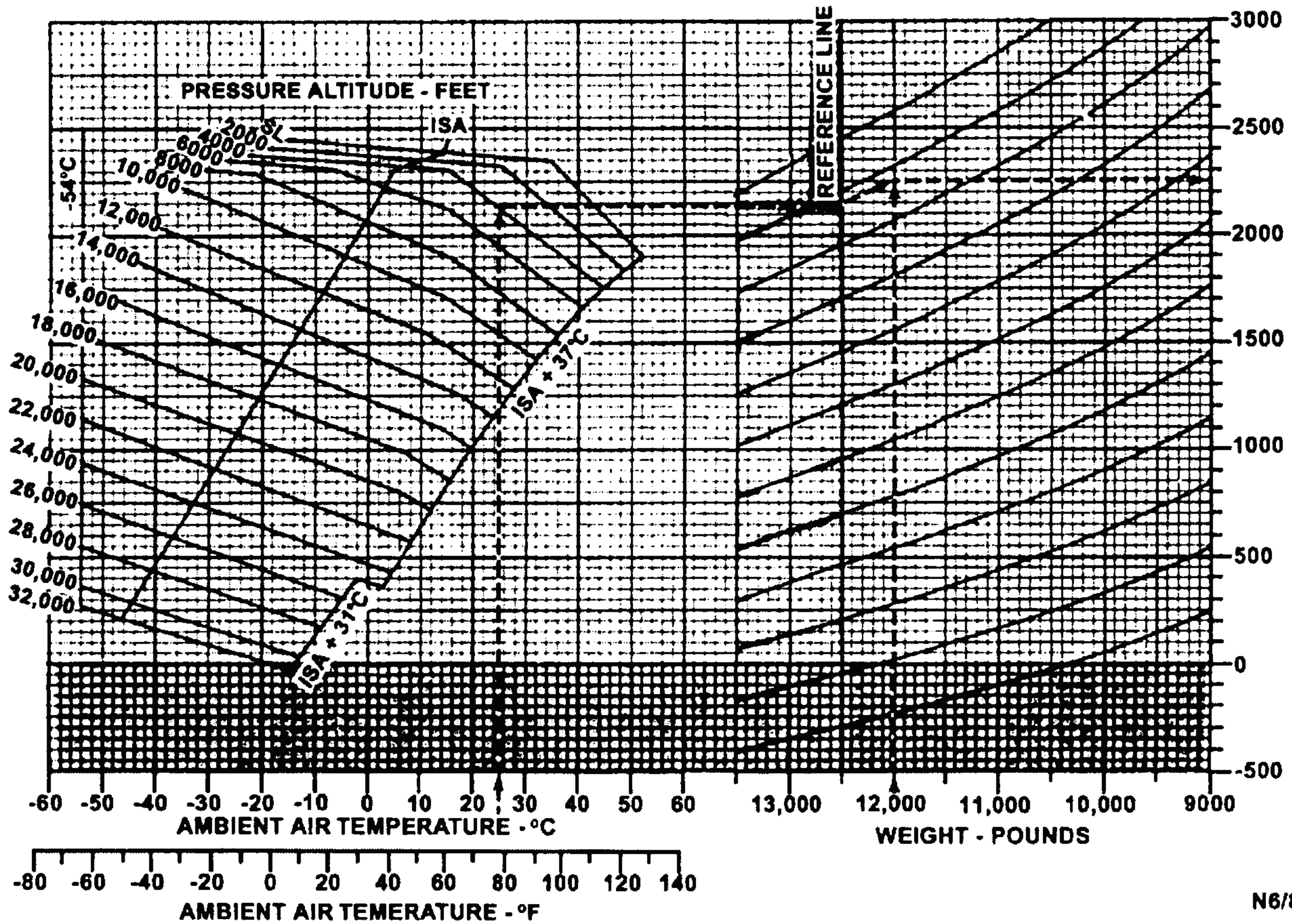


Figure 7-25. Climb – Two Engines – Flaps 0%

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: .... NOT TO EXCEED 750°C
FLAPS: 40%
GEAR: .... UP

WEIGHT – POUNDS	AIRSPEED – KNOTS
13,500	107
12,500	105
12,000	104
11,000	102
10,000	101
9000	98

NOTE

FOR OPERATION WITH ICE VANES EXTENDED, ADD 15°C TO THE ACTUAL OAT BEFORE ENTERING CHART.

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

EXAMPLE:

OAT: .... 25°C
PRESSURE ALTITUDE: .. 3966 FEET
WEIGHT: .... 12,000 LBS

RATE-OF-CLIMB ...... 1960 FEET PER MIN
CLIMB SPEED: .... 104 KNOTS

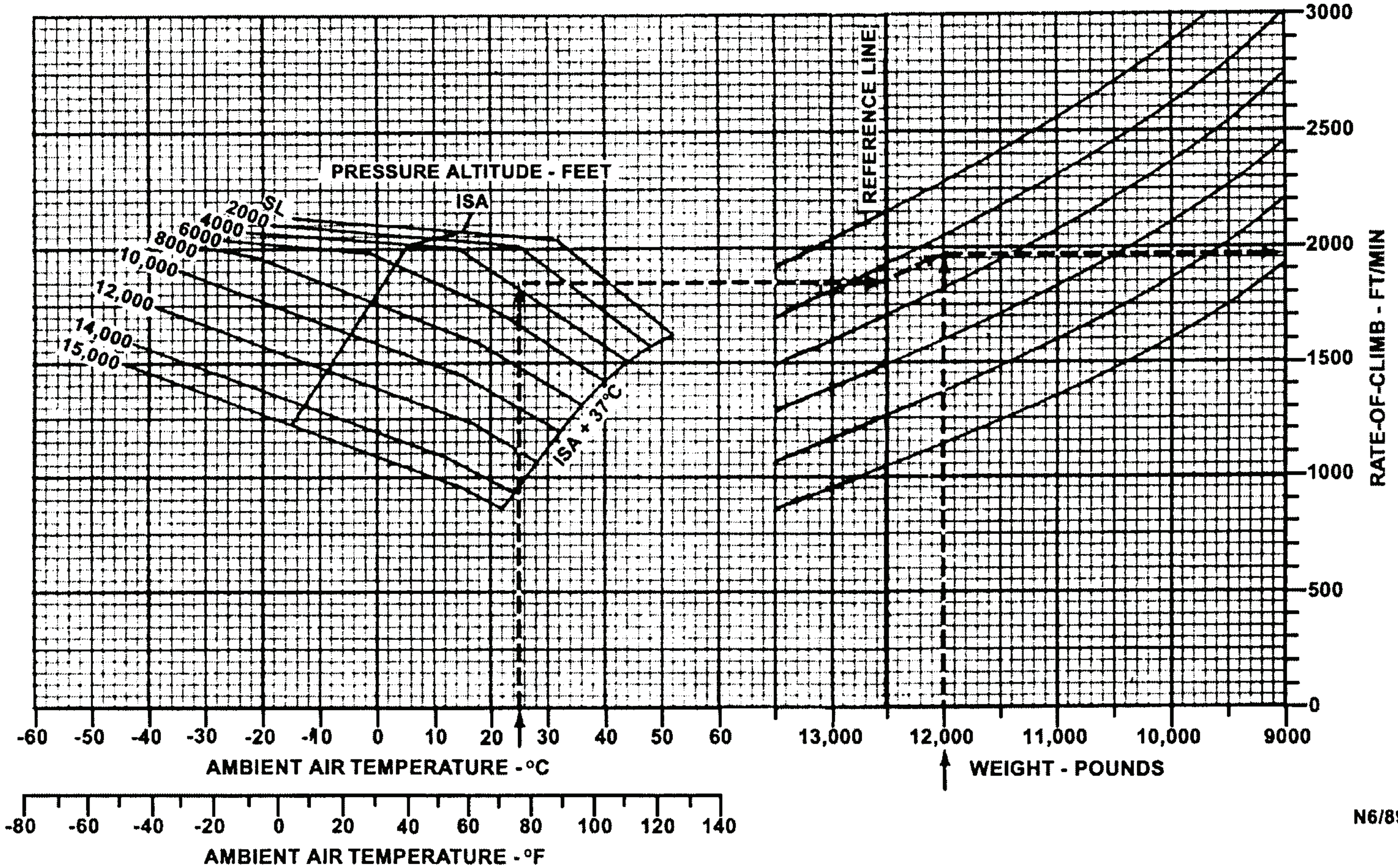


Figure 7-26. Climb – Two Engines – Flaps 40%

CLIMB - ONE ENGINE INOPERATIVE

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
FLAPS .... UP
LANDING GEAR .... UP
INOPERATIVE PROPELLER ... FEATHERED

WEIGHT ~ POUNDS	V_2 / V_{yse} ~ KNOTS
14,000	124
12,500	121
12,000	119
11,000	117
10,000	114
9000	111

EXAMPLE:

OAT .... 30 °C
PRESSURE ALTITUDE .... 4,000 FT
D.P CLIMB REQ. .... 250 FT/NM
250/6076 X 100 = 4.1% GRADIENT
CLIMB GRADIENT REQUIRED .. 4.1%

MAXIMUM WT. FOR SE CLB. GD. 12,600 LBS
CLIMB SPEED (V_2/V_{yse}) .... 122 KNOTS

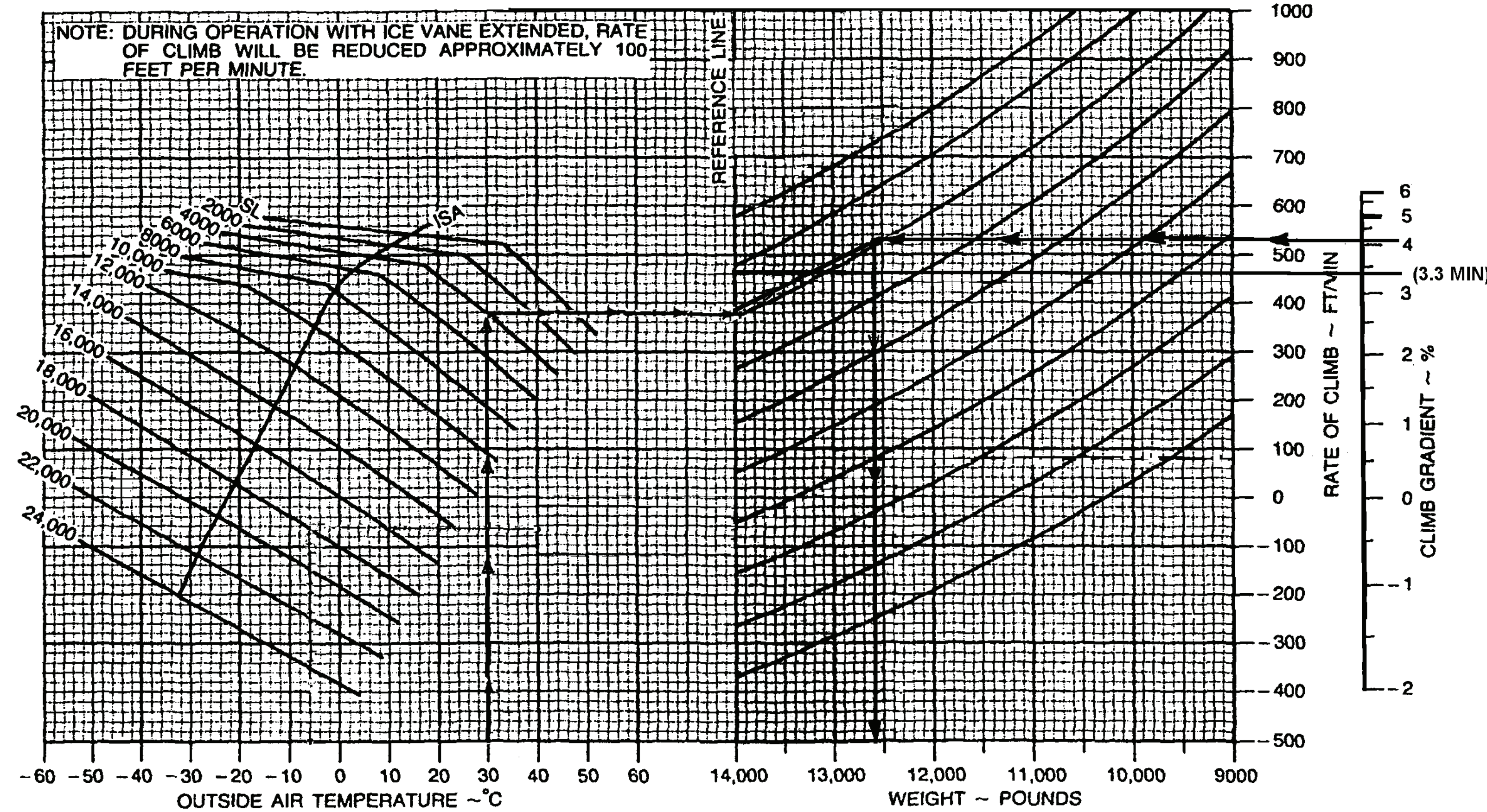


Figure 7-27. Climb – One Engine Inoperative

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

FLAPS: .... 0 %
GEAR: .... UP
PROPELLER SPEED:.. 1900 RPM
ITT:.................. NOT TO EXCEED 725 °C
TORQUE: 100%

ALTITUDE - FEET	CLIMB SPEED - KNOTS
SL TO 10,000	155
10,000 TO 20,000	135
20,000 TO 25,000	125
25,000 TO 31,000	115

NOTE

1. ADD 90 LBS FUEL FOR START, TAXI, AND TAKEOFF.
2. FOR OPERATION WITH ICE VANES EXTENDED, ADD 20°C TO THE ACTUAL OAT BEFORE ENTERING THE CHART.

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

EXAMPLE:

OAT AT TAKEOFF: ...... 25°C
OAT AT CRUISE: .... -20 °C
AIRPORT PRESSURE ALTITUDE: .... 3,966 FEET
CRUISE ALTITUDE: ..... 27,000 FEET
INITIAL CLIMB WEIGHT: . 12,000 LBS

TIME TO CLIMB:......... 22 - 2 = 20 MIN
FUEL TO CLIMB: .... 242 - 20 = 222 LBS
DISTANCE TO CLIMB: ... 60 - 4 = 56 NM

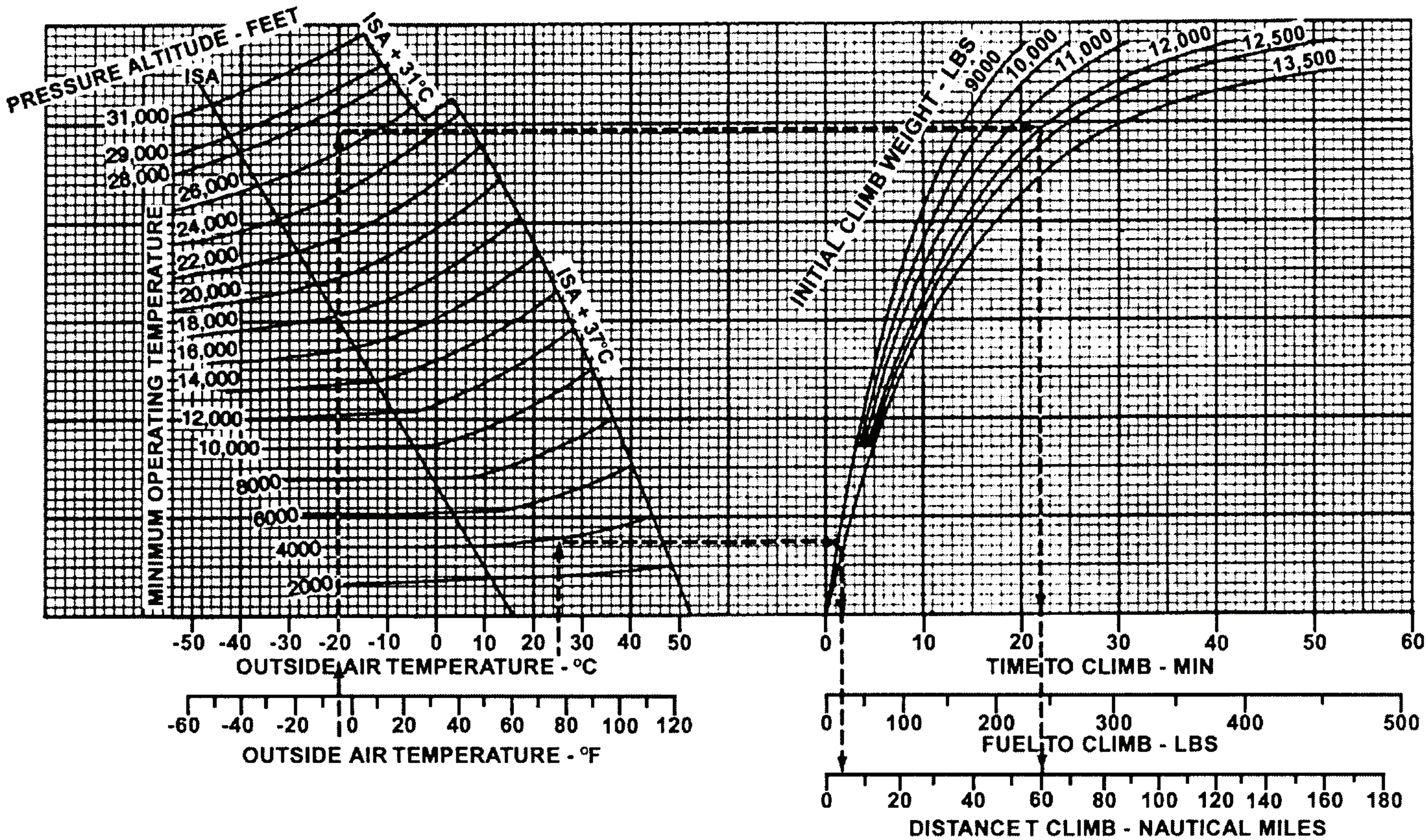


Figure 7-28. Time/Fuel/Distance to Cruise Climb

MODEL: C-12 C D
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

ENGINE: PT6A-41
PROPELLER: ¿T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

CONFIGURATION:

POWER:	MAXIMUM CONTINUOUS-ONE ENGINE
LANDING GEAR:	UP
INOPERATIVE PROPELLER:	FEATHERED
FLAPS:	UP (0%)

EXAMPLE:

OAT:	12 °C
WEIGHT:	11,500 LBS
ROUTE SEGMENT MEA:	9000 FT
SERVICE CEILING:	16,200 FT

NOTE

1. SERVICE CEILING SHOULD BE ABOVE MEA FOR FLIGHT PLANNING PURPOSES
2. SERVICE CEILING IS THE MAXIMUM PRESSURE ALTITUDE CAPABLE OF MAINTAINING 100 FT/MINUTE CLIMB WITH ONE PROPELLER FEATHERED.

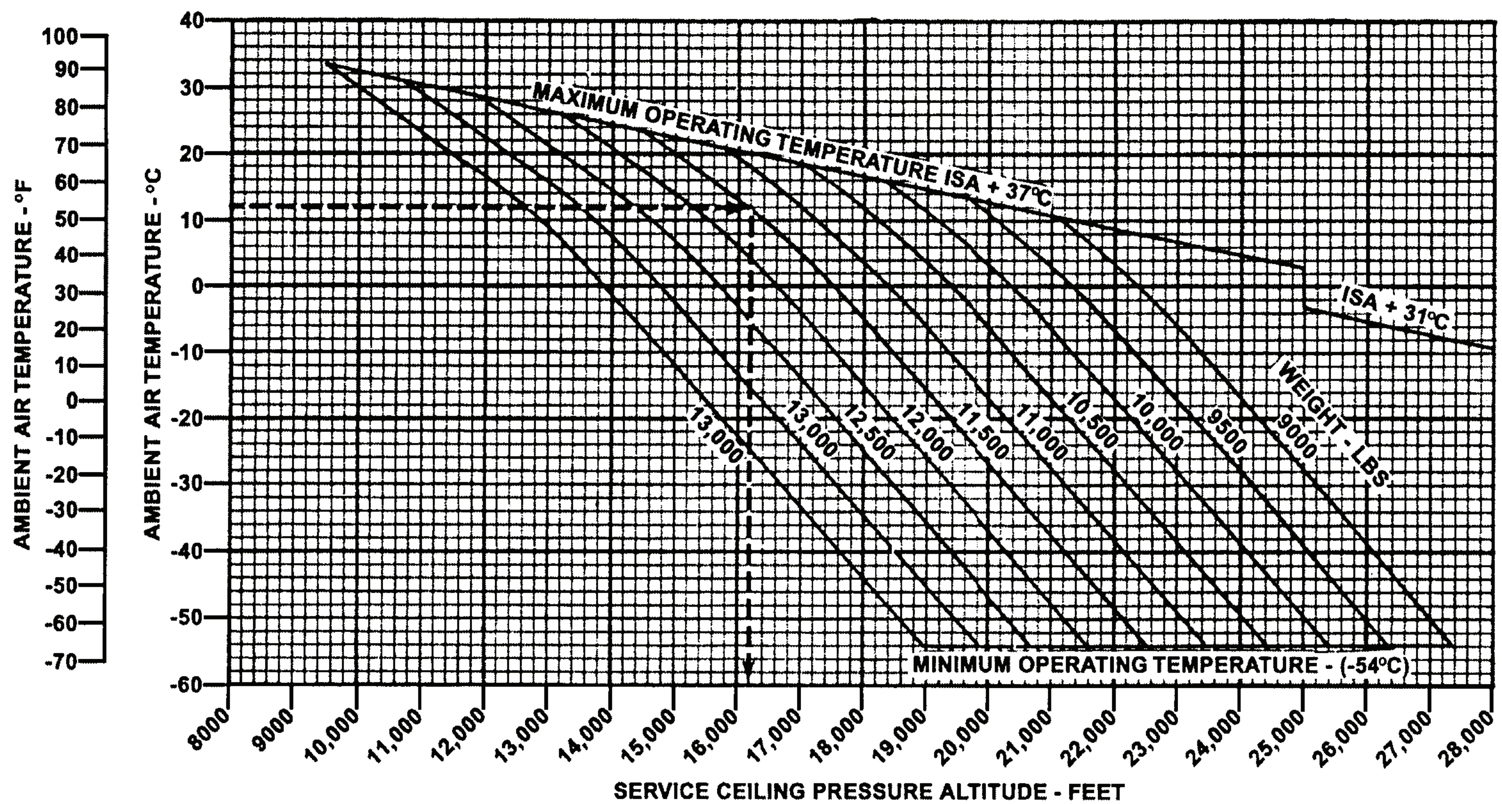


Figure 7-29. Service Ceiling – One Engine Inoperative

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: .... RETARD TO MAINTAIN 800 FT/MIN ON FINAL APPROACH
FLAPS: 100%
RUNWAY: .... PAVED LEVEL, DRY SURFACE
BRAKING: .... MAXIMUM
PROPELLER: .... HIGH RPM

WEIGHT – POUNDS	APPROACH SPEED – KNOTS
13,500	106
13,000	105
12,000	102
11,000	99
10,000	96
9000	93

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT: .... 15°C
PRESSURE ALTITUDE: .... 5651 FEET
LANDING WEIGHT: .... 10,772 LBS
HEADWIND COMPONENT: .... 10 KNOTS

GROUND ROLL: .... 1800 FEET
TOTAL OVER 50 FT. OBSTACLE: .... 2800 FEET
APPROACH SPEED: .... 98 KNOTS

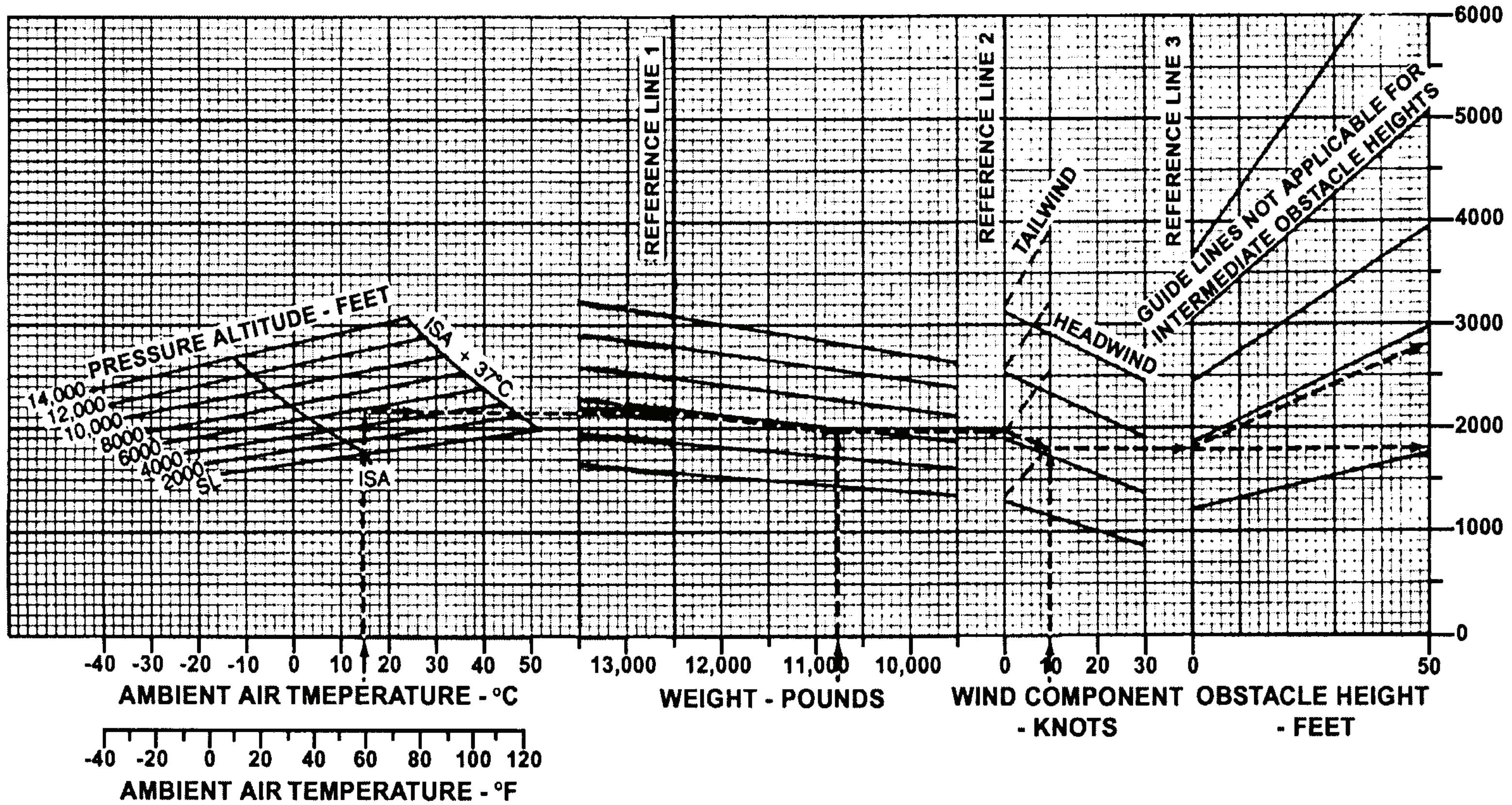


Figure 7-30. Landing Distance Without Propeller Reversing – Flaps 100%

MODEL: C-12 CD
DATE: 11 JANUARY 1988
DATA BASIS: ESTIMATED

CONFIGURATION:

POWER .... RETARD TO MAINTAIN 900 FT/MIN ON FINAL APPROACH
FLAPS 40%
RUNWAY .... PAVED, LEVEL, DRY SURFACE
BRAKING .... MAXIMUM
PROPELLER .... HIGH RPM

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
13,500	116
13,000	116
12,000	114
11,000	112
10,000	110
9000	108

ENGINE: PT6A-41
PROPELLER: T10178
•FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT	15°C
PRESSURE ALTITUDE	5651 FEET
LANDING WEIGHT	10,772 LBS
HEADWIND COMPONENT	10 KNOTS
GROUND ROLL	2200 FEET
TOTAL OVER 50-FT OBSTACLE	2995 FEET
APPROACH SPEED	112 KNOTS

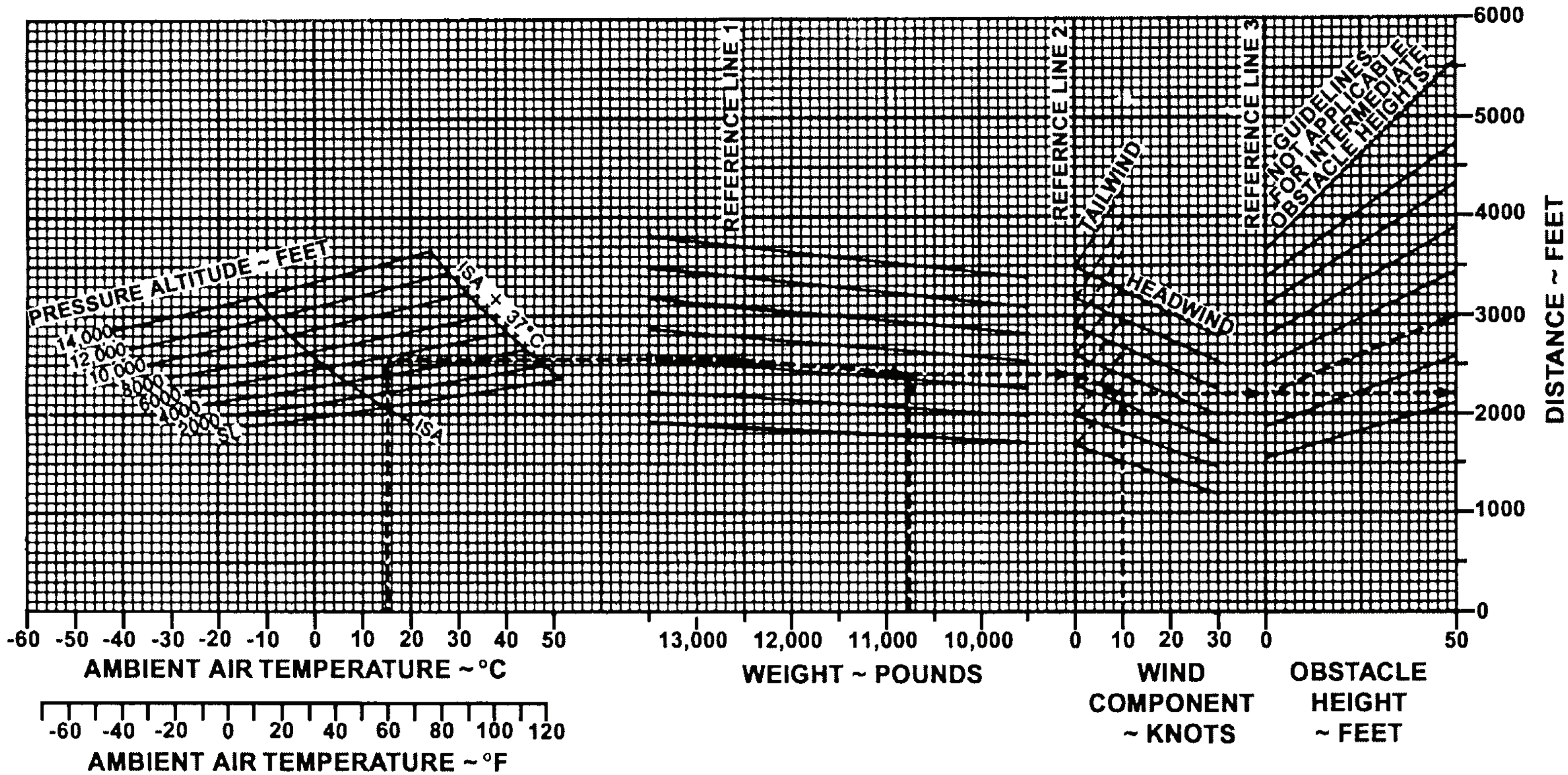


Figure 7-31. Landing Distance Without Propeller Reversing – Flaps 40%

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: .... RETARD TO MAINTAIN 900 FT/MIN ON FINAL APPROACH
FLAPS: 0%
RUNWAY: .... PAVED, LEVEL, DRY SURFACE
BRAKING: .... MAXIMUM
PROPELLLER CONTROL: .... HIGH RPM

WEIGHT – POUNDS	APPROACH SPEED – KNOTS
13,500	136
13,000	134
12,000	129
11,000	126
10,000	122
9000	117

NOTE

LANDING WITH FLAPS 100% IS PREFERRED. LANDING WITH FLAPS 0% IS PERMITTED ONLY WHEN NECESSARY.

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT: .... 15°C
PRESSURE ALTITUDE: .. 5651 FEET
LANDING WEIGHT: ..... 10,772 LBS
HEADWIND COMPONENT: ...... 10 KNOTS

GROUND ROLL: .... 2700 FEET
TOTAL OVER 50 FT OBSTACLE: .... 3800 FEET
APPROACH SPEED: ..... 125 KNOTS

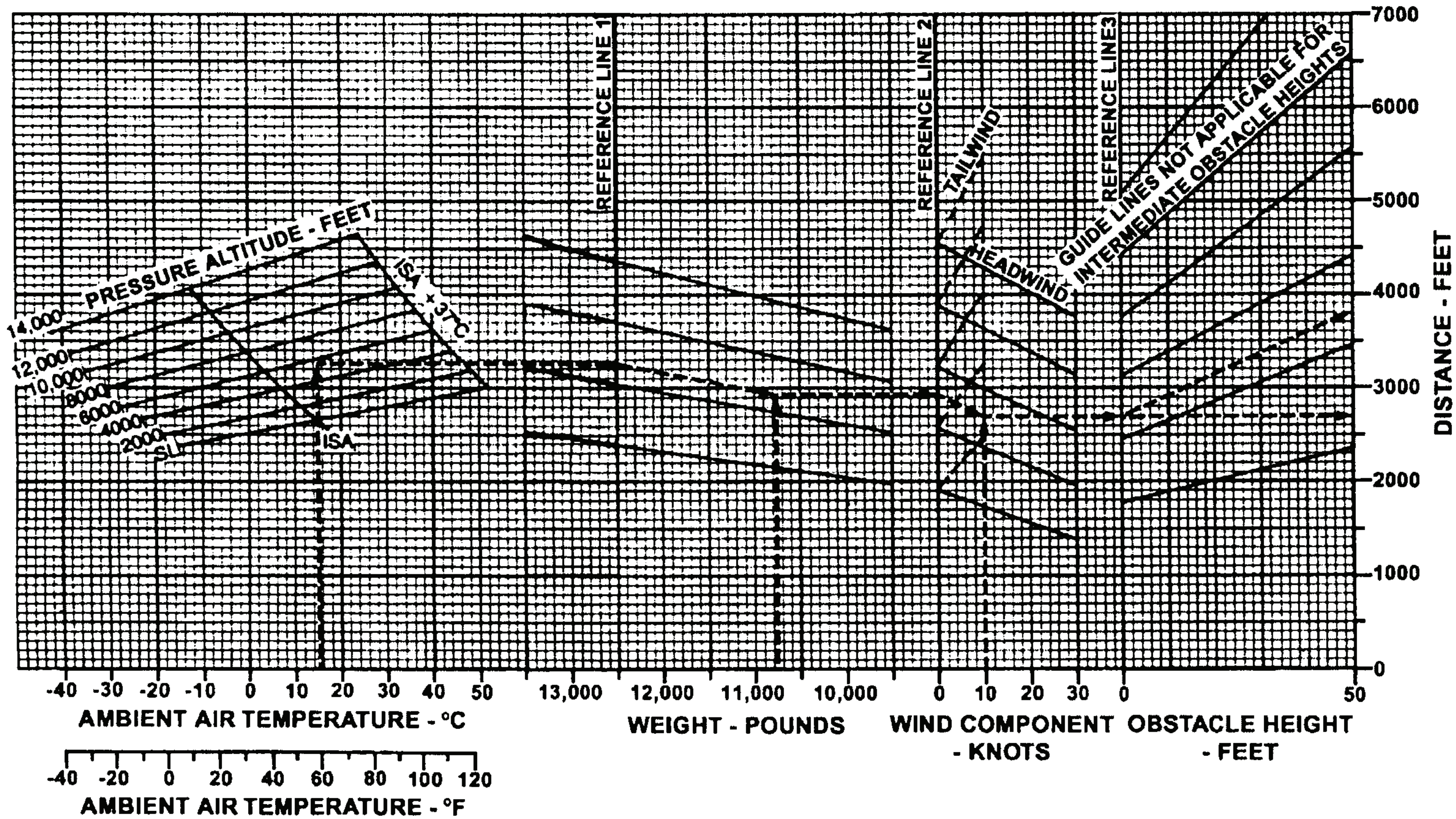


Figure 7-32. Landing Distance Without Propeller Reversing – Flaps 0%

MODEL: C-12CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: .... RETARD TO MAINTAIN 1000 FT/MIN ON FINAL APPROACH
FLAPS: 100%
RUNWAY: .... PAVED LEVEL DRY SURFACE
BRAKING: .... MAXIMUM
CONDITION LEVERS: .... HIGH IDLE
PROPELLER CONTROLS: .... FULL FORWARD
POWER LEVERS: ..... MAXIMUM REVERSE AFTER TOUCHDOWN UNTIL FULLY STOPPED

WEIGHT – POUNDS	APPROACH SPEED – KNOTS
13,500	106
13,000	105
12,000	102
11,000	99
10,000	96
9000	93

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT: .... 15° C
PRESSURE ALTITUDE: ...... 5651 FEET
LANDING WEIGHT: ...... 10,772 LBS
HEADWIND COMPONENT: .... 10 KNOTS

GROUND ROLL: ...... 1130 FEET
TOTAL OVER 50 FT OBSTACLE: .... 1860 FEET
APPROACH SPEED: ...... 98 KNOTS

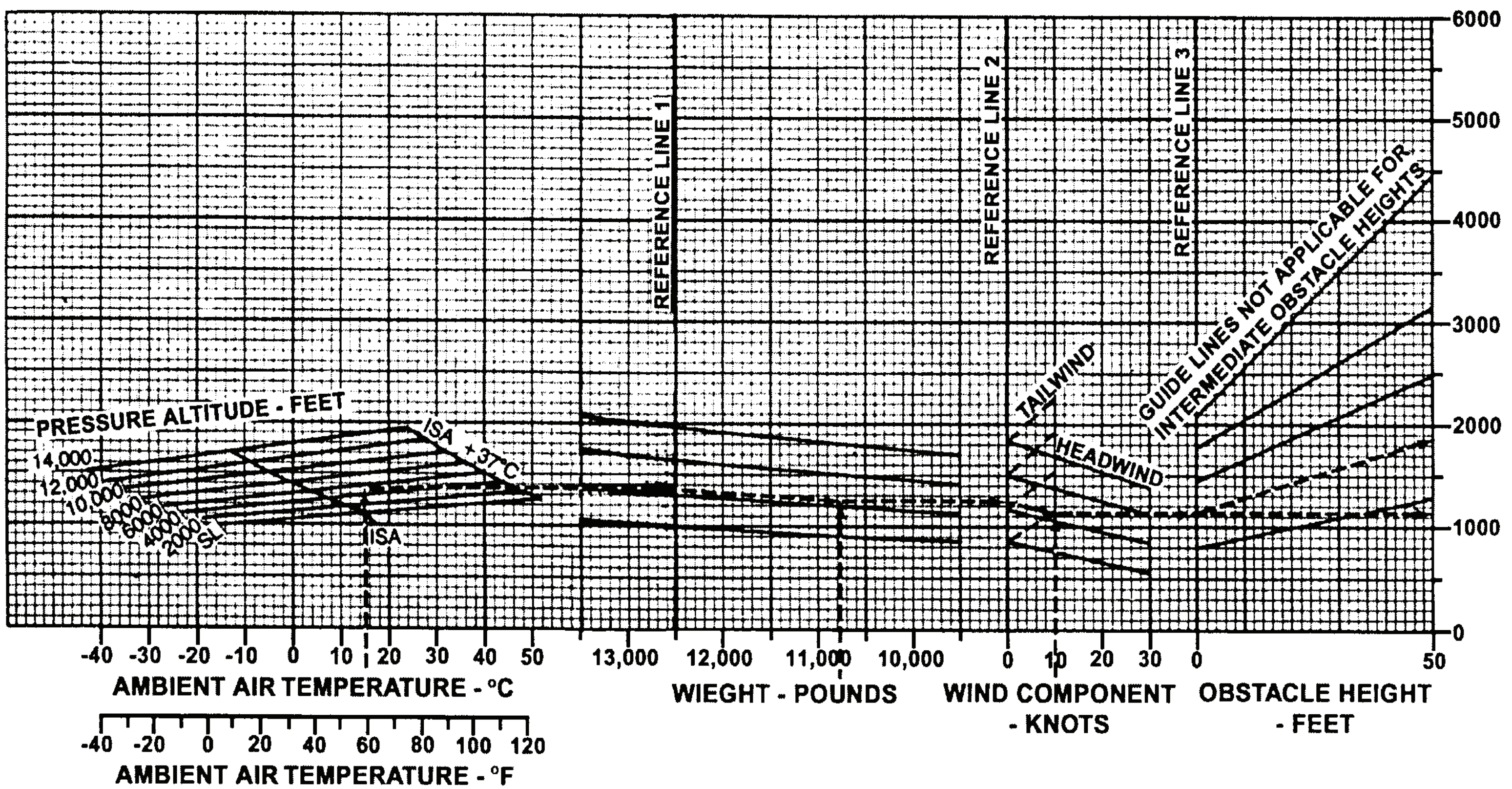


Figure 7-33. Landing Distance With Propeller Reversing – Flaps 100%

MODEL: C-12 CD
DATE: 11 JANUARY 1988
DATA BASIS: ESTIMATED

CONFIGURATION:

POWER .... RETARD TO MAINTAIN 900 FT/MIN ON FINAL APPROACH
FLAPS 40%
RUNWAY .... PAVED, LEVEL, DRY SURFACE
BRAKING .... MAXIMUM
CONDITION LEVERS .... HIGH IDLE
PROPELLER CONTROLS ...... FULL FORWARD
POWER LEVERS .... MAXIMUM REVERSE AFTER TOUCHDOWN UNTIL FULLY STOPPED

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
13,500	116
13,000	116
12,000	114
11,000	112
10,000	110
9000	108

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT .... 15°C
PRESSURE ALTITUDE .... 5651 FEET
LANDING WEIGHT .... 10,772 LBS
HEADWIND COMPONENT .... 10 KNOTS

GROUND ROLL.................... 1500 FEET
TOTAL OVER 50-FT OBSTACLE .... 2225 FEET
APPROACH SPEED.............. 112 KNOTS

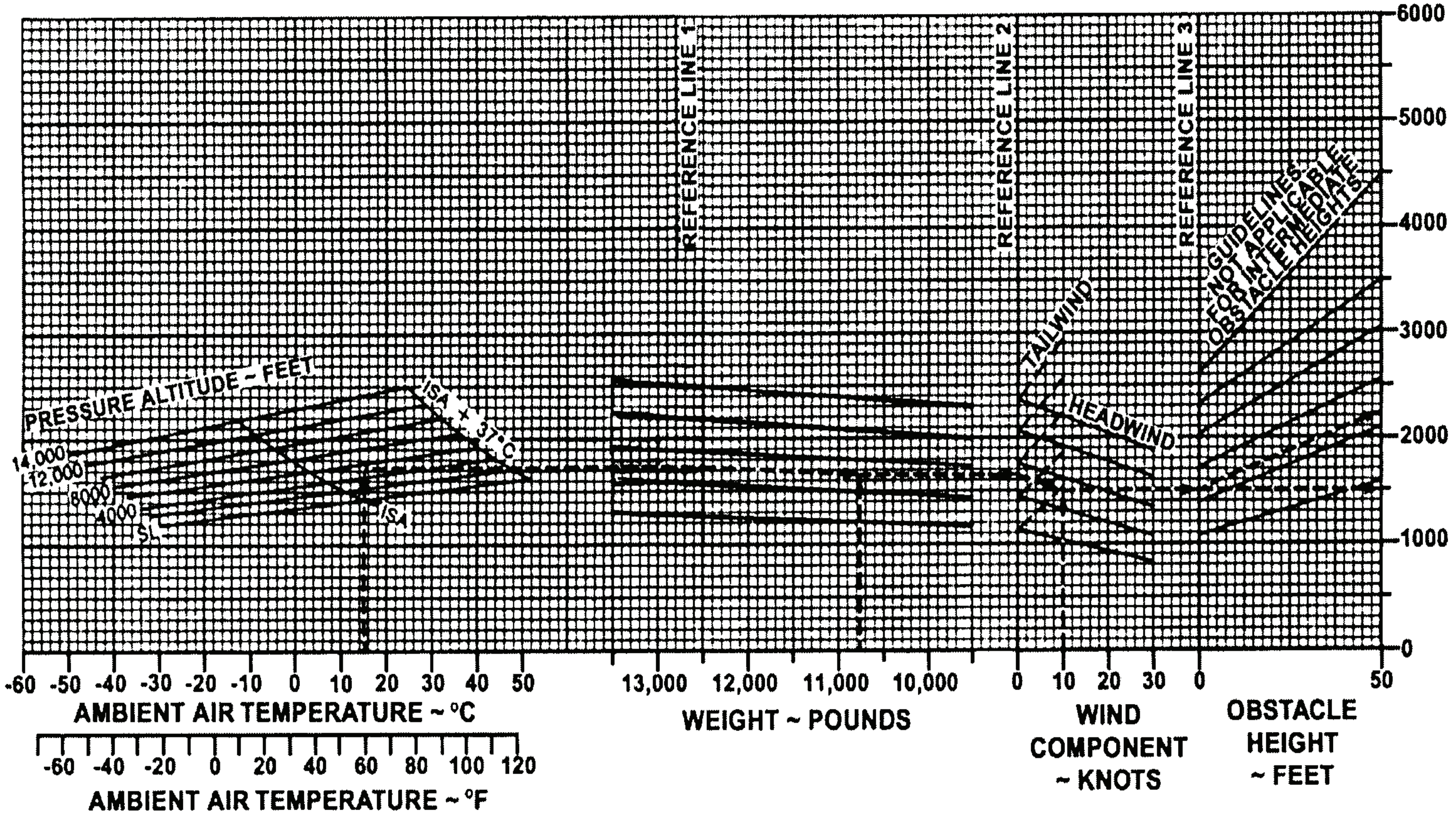


Figure 7-34. Landing Distance With Propeller Reversing – Flaps 40%

MODEL: C-12 CD
DATE: 14 MAY 1979
DATA BASIS: FLIGHT TEST

CONFIGURATION:

POWER: .... RETARD TO MAINTAIN 1000 FT/MIN ON FINAL APPROACH
FLAPS: 0%
RUNWAY: .... PAVED LEVEL DRY SURFACE
BRAKING: .... MAXIMUM
CONDITION LEVERS: .... HIGH IDLE
PROPELLER CONTROL: .... FULL FORWARD
POWER LEVERS: .... MAXIMUM REVERSE AFTER TOUCHDOWN UNTIL FULLY STOPPED

WEIGHT – POUNDS	APPROACH SPEED – KNOTS
13,500	136
13,000	134
12,000	129
11,000	126
10,000	122
9000	117

NOTE

LANDING WITH FLAPS 100% IS PREFERRED. LANDING WITH FLAPS 0% IS PERMITTED ONLY WHEN NECESSARY.

ENGINE: PT6A-41
PROPELLER: T10178
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

EXAMPLE:

OAT: .... 15°C
PRESSURE ALTITUDE: .. 5651 FEET
LANDING WEIGHT: ...... 10,772 LBS
HEADWIND COMPONENT: .... 10 KNOTS

GROUND ROLL: .... 1920 FEET
TOTAL OVER 50 FT OBSTACLE: ..... 3000 FEET
APPROACH SPEED: ..... 125 KNOTS

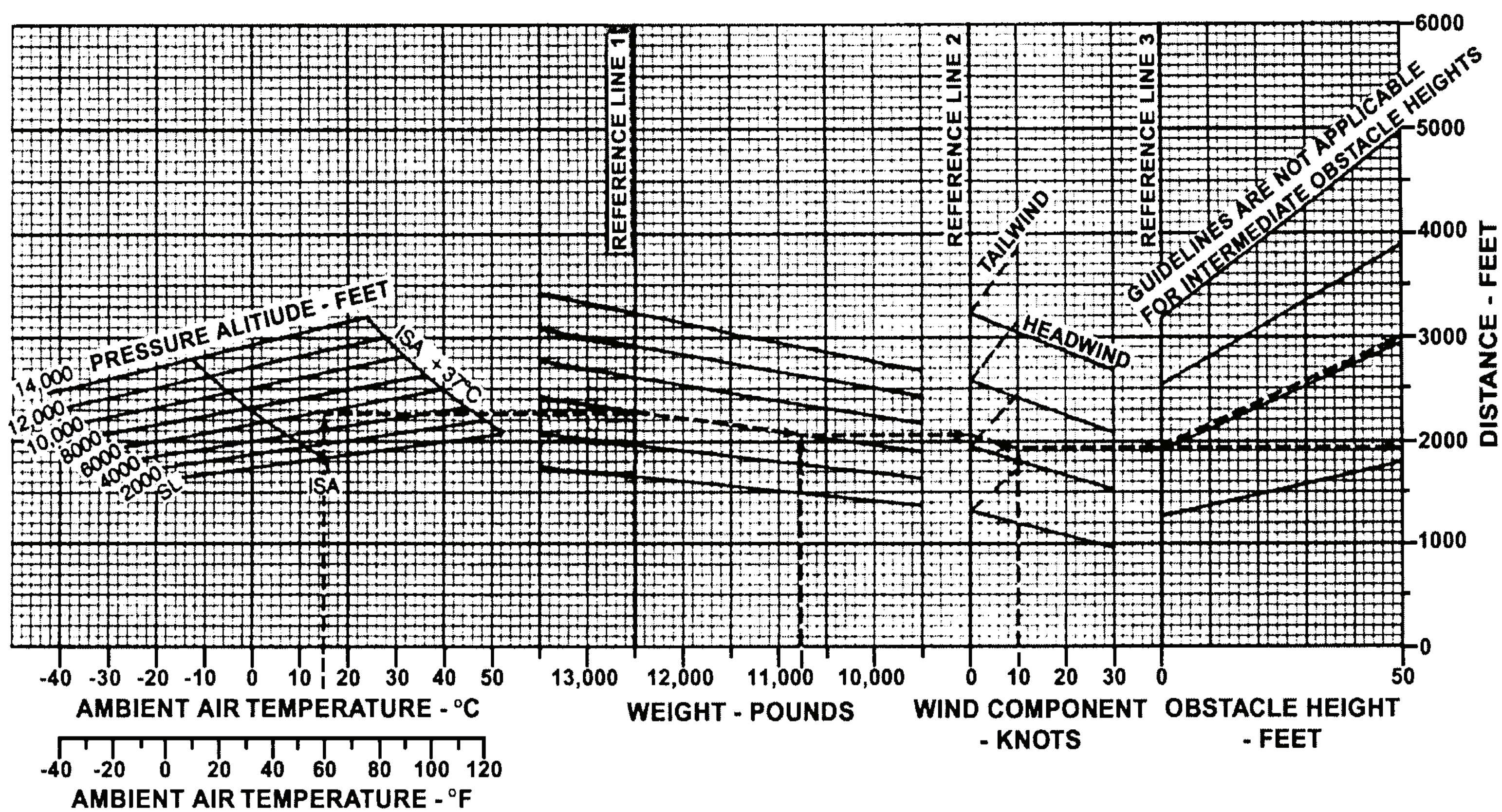


Figure 7-35. Landing Distance With Propeller Reversing – Flaps 0%

STOPPING DISTANCE FACTORS

EXAMPLE:

1. ACCELERATE-STOP DISTANCE (FLAPS UP NO REV)

OAT	25 °C
PRESSURE ALTITUDE	3968 FT
HEADWIND COMPONENT	9.5 KTS
ACCELERATE-STOP DISTANCE	5400 FT
TAKE-OFF DISTANCE	3300 FT
RUNWAY CONDITION READING	10.0
TAKE-OFF WEIGHT	13,000 LB
STOPPING FACTOR	1.37
STOPPING DISTANCE ((5400 – 3300) X 1.37)	2877 FT
TAKE-OFF DISTANCE	3300 FT
NEW RCR ACCELERATE-STOP DISTANCE (2877 + 3300)	6177 FT

2. LANDING DISTANCE (FLAPS DN NO REV)

GROUND ROLL (DRY)	1700 FT
TOTAL OVER 50 FT OBSTACLE	2700 FT
RUNWAY CONDITION READING	8.0
LANDING WEIGHT	11,180 LB
STOPPING FACTOR	1.62
LANDING DISTANCE (FACTORED) GROUND ROLL (1700 X 1.62)	2754 FT
AIR DISTANCE (2700 - 1700)	1000 FT
TOTAL OVER 50 FT OBSTACLE	3754 FT

NOTE:
1. IF RCR READING IS NOT AVAILABLE, ASSUME ICY RUNWAY RCR = 5.0 AND WET RUNWAY RCR = 12.0
2. USE "NO REV" CURVE FOR ONE ENGINE REVERSING.
3. WEIGHT REFERENCE LINE IS AT 12,500 LB. FOR WEIGHT IN EXCESS OF 12,500 LB, TRACE BACK FROM THE REFERENCE LINE ALONG THE GUIDELINE TO THE HIGHER WEIGHT AND THEN OVER TO THE RCR FACTOR.

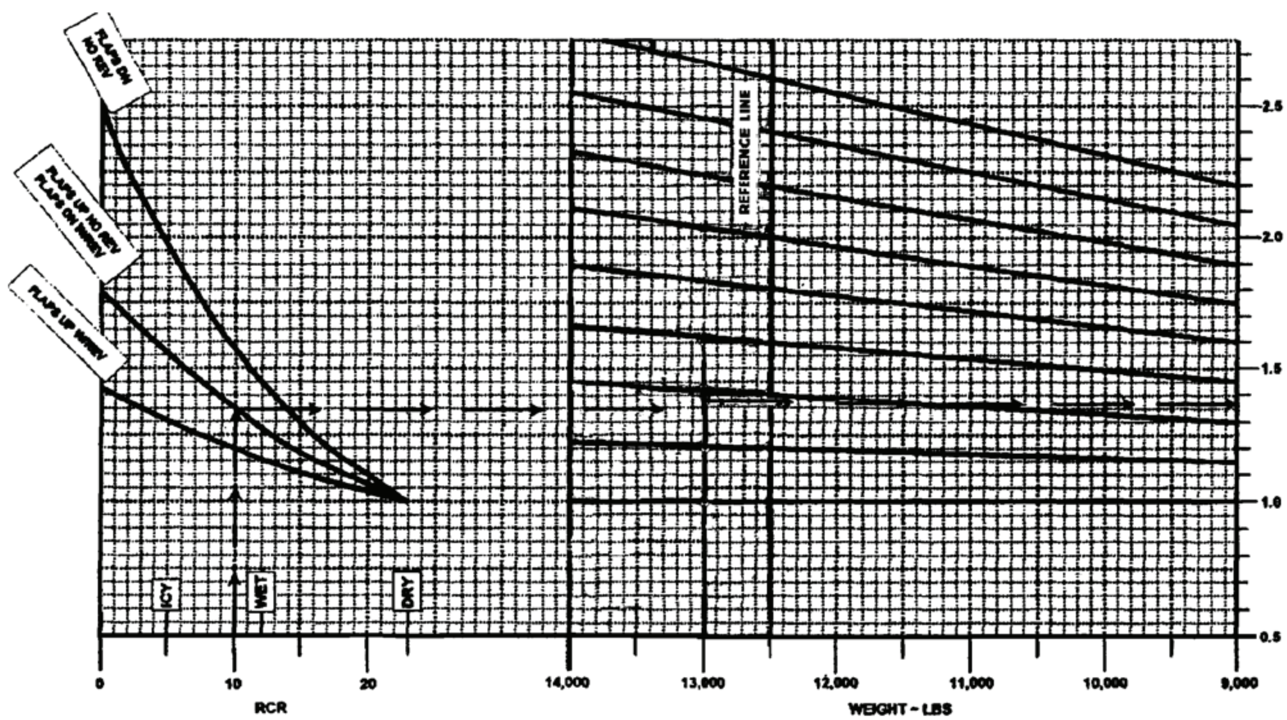


Figure 7-36. Stopping Distance Factors

CABIN ALTITUDE FOR VARIOUS AIRPLANE ALTITUDES

EXAMPLE:

AIRPLANE ALTITUDE . . . . 25,000 FT
CABIN DIFFERENTIAL PRESSURE . . . . 4.0 PSI

CABIN ALTITUDE . . . . 11,800 FT

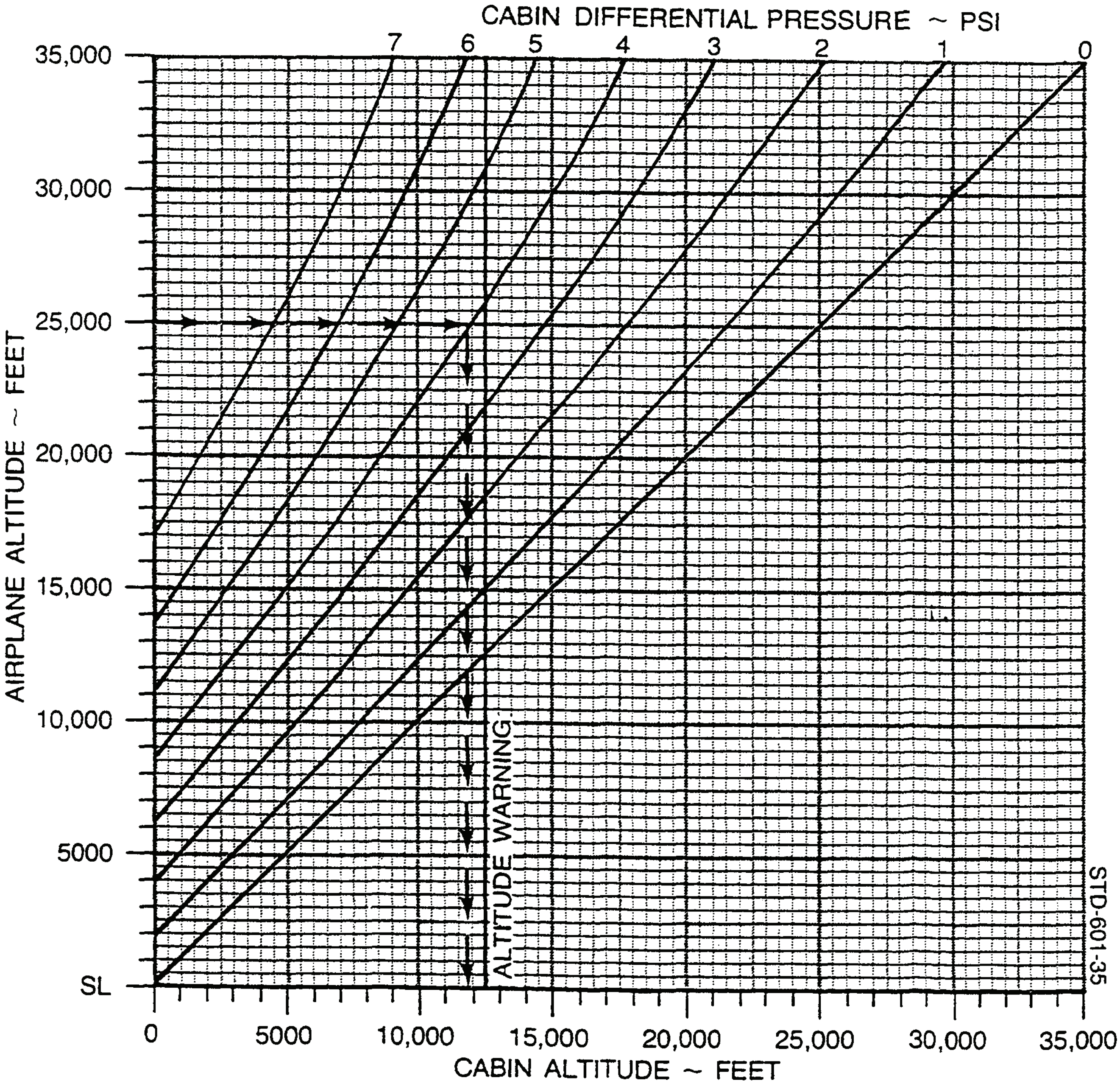


Figure 7-37. Cabin Altitude for Various Airplane Altitudes

RECOMMENDED CRUISE POWER
1700 RPM
ISA – 30 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	100	788	241	229	242	230	243	231
2,000	-14	-19	100	904	239	233	239	234	240	235
4,000	-18	-23	100	880	236	237	237	238	238	239
6,000	-21	-27	100	858	234	242	235	243	236	244
8,000	-25	-31	100	838	232	246	233	248	234	249
10,000	-39	-35	100	820	230	251	231	252	232	253
12,000	-33	-39	100	806	227	256	228	257	229	258
14,000	-36	-43	100	794	225	261	226	262	227	263
16,000	-40	-47	100	786	223	266	224	268	225	269
18,000	-44	-51	100	778	220	271	221	273	223	274
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-38. Recommended Cruise Power, 1700 RPM, ISA – 30 °C

RECOMMENDED CRUISE POWER
1700 RPM
ISA – 20 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	100	934	239	232	240	233	241	233
2,000	-4	-9	100	906	237	236	238	237	239	238
4,000	-8	-13	100	880	235	240	236	241	236	242
6,000	-11	-17	100	858	232	245	233	246	234	247
8,000	-15	-21	100	840	230	250	231	251	232	252
10,000	-19	-25	100	824	228	254	229	255	230	257
12,000	-23	-29	100	808	225	259	226	261	227	262
14,000	-26	-33	100	796	223	264	224	266	225	267
16,000	-30	-37	100	788	221	270	222	271	223	272
18,000	-34	-41	100	782	218	275	219	276	220	278
20,000	-38	-45	95	740	211	274	212	276	214	278
22,000	-42	-48	88	692	202	272	204	274	206	277
24,000	-46	-50	82	642	194	269	196	272	198	275
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-39. Recommended Cruise Power, 1700 RPM, ISA – 20 °C

RECOMMENDED CRUISE POWER
1700 RPM
ISA – 10 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	100	940	237	234	238	235	239	236
2,000	6	1	100	912	235	239	236	240	237	240
4,000	3	-3	100	888	233	243	234	244	235	245
6,000	-1	-7	100	864	231	248	232	249	233	250
8,000	-5	-11	100	842	228	253	229	254	230	255
10,000	-9	-15	100	842	226	257	227	259	228	260
12,000	-12	-19	100	812	224	262	225	264	226	265
14,000	-16	-23	100	800	221	268	222	269	223	270
16,000	-20	-27	100	792	219	273	220	274	221	276
18,000	-24	-31	97	768	213	275	215	277	216	279
20,000	-28	-35	90	714	205	272	207	275	208	277
22,000	-32	-38	84	666	196	270	199	273	200	275
24,000	-36	-42	78	618	188	367	190	270	192	273
26,000	-40	-46	72	574	179	263	181	267	184	271
28,000	-44	-50	66	532	169	258	173	263	176	267
29,000	-46	-52	64	512	165	255	169	261	172	265
31,000	-50	-56	58	474	153	247	159	255	162	261
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-40. Recommended Cruise Power, 1700 RPM, ISA – 10 °C

RECOMMENDED CRUISE POWER
1700 RPM
ISA

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	100	946	236	237	237	238	238	239
2,000	16	11	100	918	234	241	235	242	235	243
4,000	13	7	100	892	231	246	232	247	233	248
6,000	9	3	100	868	229	251	230	252	231	253
8,000	5	-1	100.	846	227	255	228	257	229	258
10,000	2	-5	100	818	224	260	225	262	226	263
12,000	-2	-9	100	812	222	265	223	267	232	268
14,000	-6	-13	100	802	219	271	221	272	222	274
16,000	-10	-17	100	792	216	276	218	277	219	279
18,000	-14	-21	94	744	208	274	210	276	211	278
20,000	-18	-25	86	688	199	271	201	273	203	276
22,000	-22	-28	80	642	191	268	193	271	195	274
24,000	-26	-32	74	596	182	265	185	268	187	272
26,000	-30	-36	69	552	173	260	176	265	178	269
28,000	-34	-40	63	512	163	255	167	260	170	265
29,000	-36	-42	59	492	158	251	162	258	166	263
31,000	-41	-48	56	456	147	242	153	252	157	259
33,000	-45	-50	51	418	127	218	141	241	148	252
35,000	-50	-54	45	380	---	---	122	218	136	242

Figure 7-41. Recommended Cruise Power, 1700 RPM - ISA

RECOMMENDED CRUISE POWER
1700 RPM
ISA + 10 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	30	25	100	950	234	239	235	240	236	241
2,000	27	21	100	924	232	244	233	245	234	246
4,000	23	17	100	898	230	249	231	250	232	251
6,000	19	13	100	874	227	253	228	254	229	256
8,000	15	9	100	852	225	258	226	259	227	261
10,000	12	5	100	832	223	263	224	265	225	266
12,000	8	1	100	818	220	269	221	270	222	274
14,000	4	-2	100	804	217	273	219	275	220	276
16,000	1	-7	95	760	210	273	212	275	213	277
18,000	-4	-11	89	714	203	272	205	274	206	276
20,000	-8	-15	84	666	195	270	197	273	199	275
22,000	-42	-18	77	620	186	267	188	270	190	273
24,000	-16	-22	71	574	177	262	179	266	182	270
26,000	-20	-26	65	532	167	257	170	262	173	266
28,000	-24	-30	60	492	157	251	161	257	165	263
29,000	-26	-32	58	474	151	246	157	254	160	261
31,000	-31	-36	53	438	138	232	146	247	151	255
33,000	-36	-40	47	400	---	---	132	231	141	217
35,000	-40	-44	44	370	---	---	---	---	128	233

Figure 7-42. Recommended Cruise Power, 1700 RPM - ISA + 10 °C

RECOMMENDED CRUISE POWER
1700 RPM
ISA + 20 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	40	35	100	958	233	242	234	243	235	244
2,000	37	31	100	930	231	246	232	248	233	249
4,000	33	27	100	904	228	251	229	252	230	253
6,000	29	23	100	880	226	256	227	257	228	258
8,000	26	19	100	858	223	261	225	262	226	263
10,000	22	15	100	838	221	266	222	268	223	269
12,000	18	11	98	812	217	270	218	271	220	273
14,000	14	7	93	764	211	569	212	271	213	273
16,000	10	3	88	718	203	269	205	271	206	273
18,000	6	-1	83	674	295	267	297	270	199	272
20,000	2	-5	78	630	187	265	190	268	192	271
22,000	-2	-8	73	590	179	263	182	266	184	270
24,000	-6	-12	67	550	171	259	174	263	177	267
26,000	-10	-16	62	510	161	254	165	260	169	265
28,000	-14	-20	57	474	151	246	156	254	160	260
29,000	-17	-22	55	456	144	240	151	251	155	258
31,000	-21	-26	50	418	126	218	139	239	146	251
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-43. Recommended Cruise Power, 1700 RPM - ISA + 20 °C

RECOMMENDED CRUISE POWER
1700 RPM
ISA + 30 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	100	964	231	244	233	245	233	246
2,000	47	41	100	936	229	249	230	250	231	251
4,000	43	37	100	908	227	254	228	255	229	256
6,000	39	33	100	882	224	259	225	260	226	261
8,000	36	29	100	856	221	263	223	264	224	266
10,000	32	25	95	810	215	264	217	266	218	267
12,000	28	21	91	766	209	264	210	266	212	268
14,000	24	17	86	720	202	263	203	266	205	268
16,000	20	13	81	676	195	262	197	265	198	267
18,000	16	9	76	634	187	261	190	264	192	267
20,000	12	5	72	594	180	259	182	263	185	266
22,000	8	2	67	556	172	256	175	261	177	265
24,000	4	-2	63	518	163	252	167	258	170	262
26,000	-1	-6	58	484	154	246	158	254	162	260
28,000	-5	-10	54	450	142	236	149	249	154	256
29,000	-7	-12	52	424	135	229	144	244	150	254
31,000	-11	-16	47	400	---	---	131	230	140	246
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-44. Recommended Cruise Power, 1700 RPM - ISA + 30 °C

RECOMMENDED CRUISE POWER
1700 RPM
ISA + 37 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	100	968	231	246	232	247	233	248
2,000	54	48	100	940	228	251	229	252	230	253
4,000	50	44	98	902	224	254	225	255	226	265
6,000	46	40	97	866	220	257	222	258	223	260
8,000	42	36	94	824	215	259	217	261	218	262
10,000	39	32	90	780	210	260	211	262	212	263
12,000	35	28	86	736	203	260	205	262	206	264
14,000	31	24	81	690	196	259	198	261	200	264
16,000	27	20	76	648	189	258	191	261	193	263
18,000	23	16	72	608	181	256	184	260	186	263
20,000	19	12	67	568	173	253	176	258	179	261
22,000	14	9	63	532	165	250	169	256	172	260
24,000	10	5	59	496	156	245	161	252	164	258
26,000	6	1	55	462	146	237	152	248	157	254
28,000	2	-3	50	430	132	224	142	240	1418	250
29,000	0	-5	48	414	123	212	136	234	144	247
31,000	-5	-9	44	382	---	---	121	216	133	238
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-45. Recommended Cruise Power, 1700 RPM - ISA + 37 °C

RECOMMENDED CRUISE SPEEDS

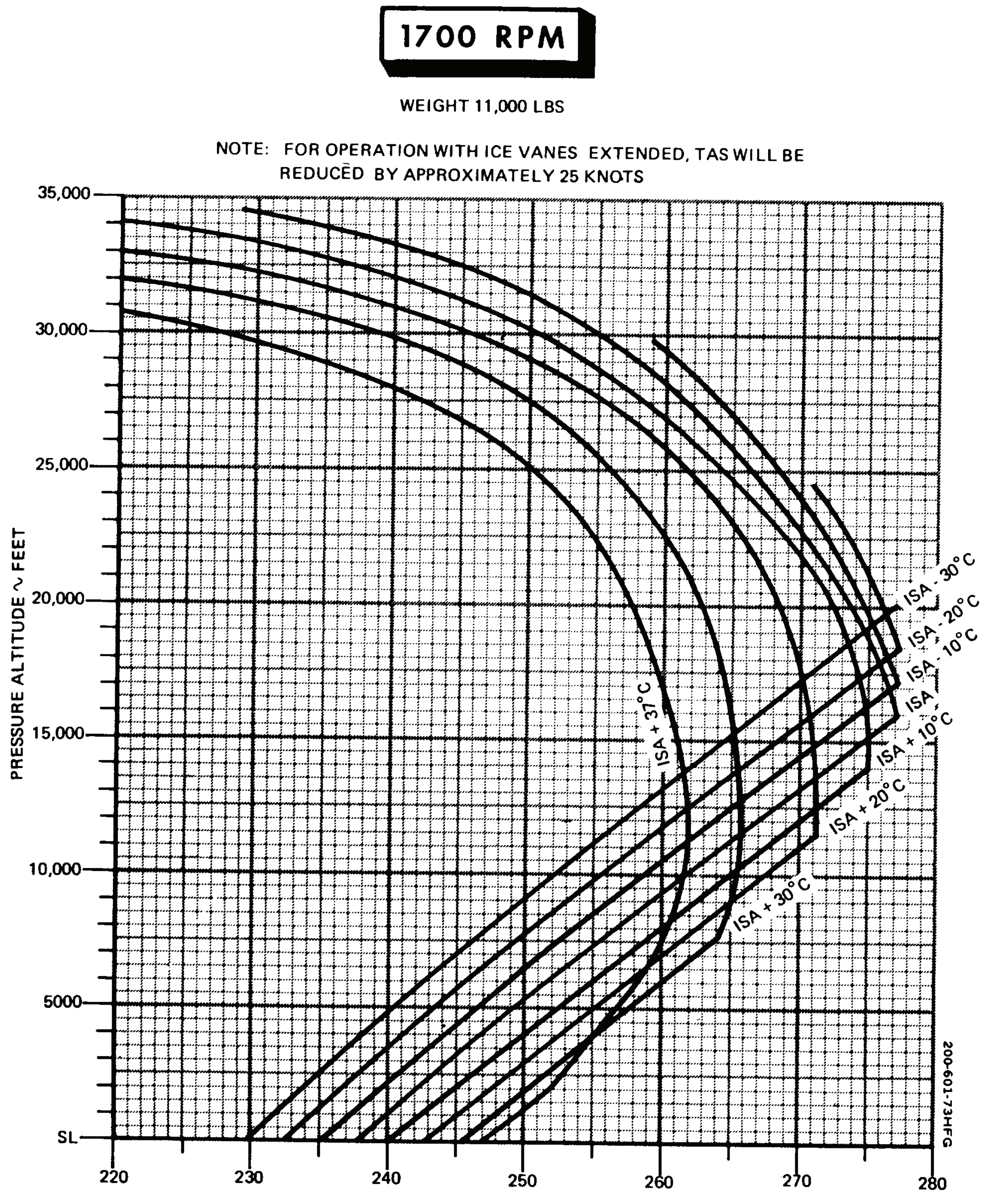


Figure 7-46. Recommended Cruise Speeds – 1700 RPM

RECOMMENDED CRUISE POWER

1700 RPM

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, ADD 35°C TO THE ACTUAL OAT BEFORE ENTERING GRAPH.

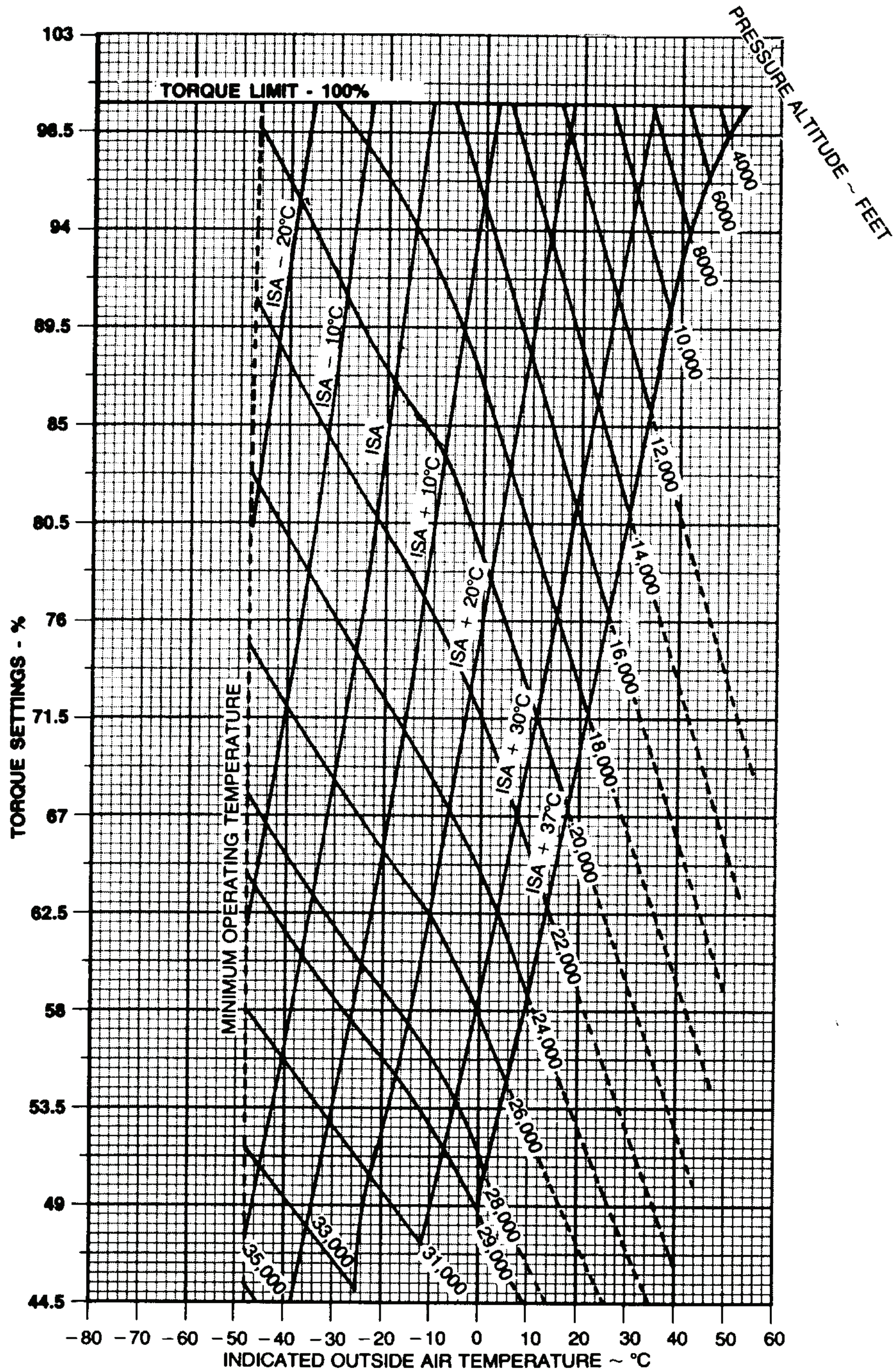


Figure 7-47. Recommended Cruise Power – 1700 RPM

FUEL FLOW AT RECOMMENDED CRUISE POWER

1700 RPM

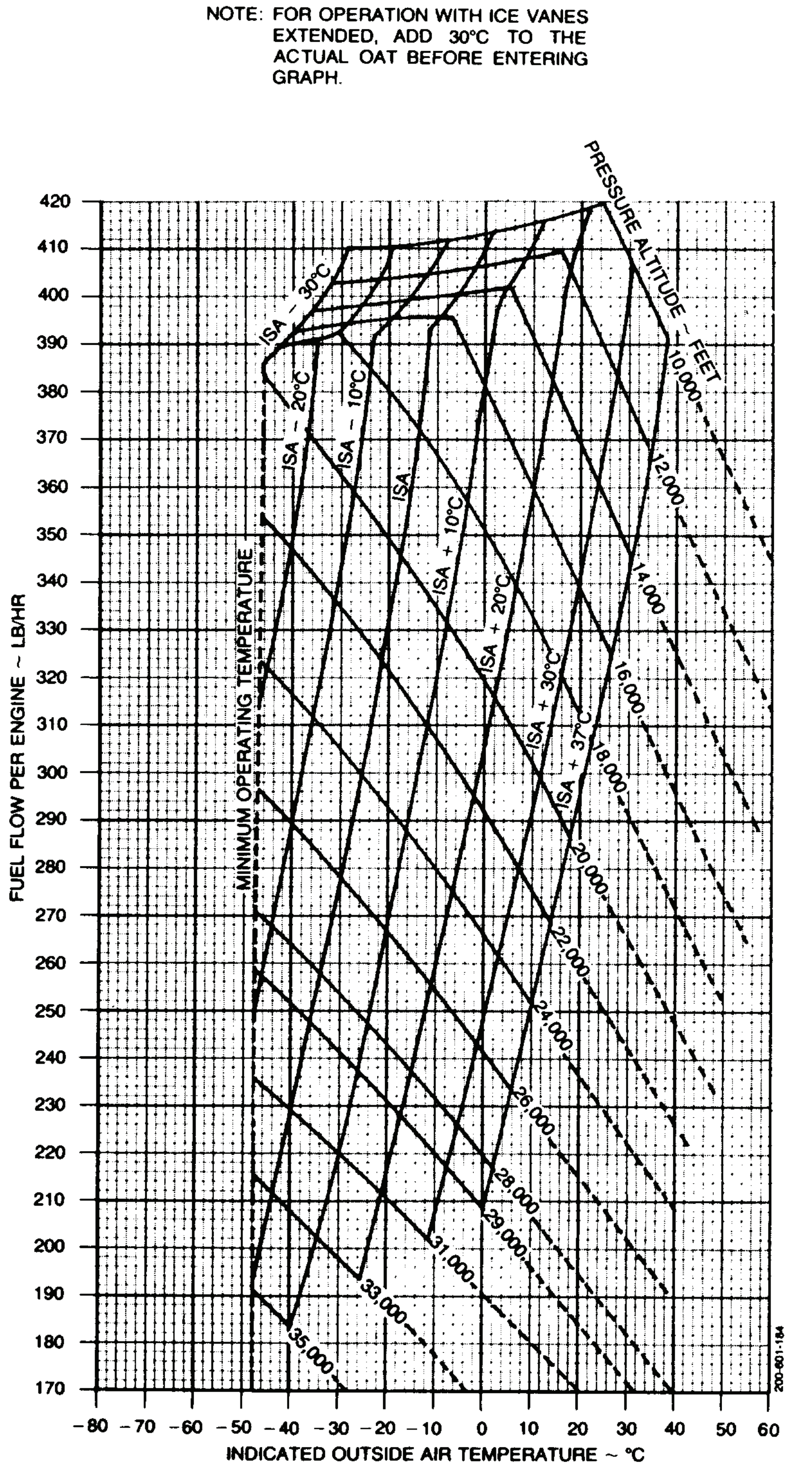


Figure 7-48. Fuel Flow at Recommended Cruise Power – 1700 RPM

RECOMMENDED CRUISE POWER
1800 RPM
ISA – 30 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	100	968	246	234	247	235	248	235
2,000	-14	-19	100	944	244	238	245	239	245	240
4,000	-17	-23	100	920	242	243	242	243	243	244
6,000	-21	-27	100	896	239	247	240	248	241	249
8,000	-25	-31	100	876	237	252	238	253	239	254
10,000	-29	-35	100	858	235	257	256	258	237	259
12,000	-32	-39	100	844	233	262	234	263	234	264
14,000	-36	-43	100	834	230	267	231	268	232	269
16,000	-40	-47	100	826	228	272	229	273	230	275
18,000	-43	-51	100	818	225	278	227	279	228	280
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-49. Recommended Cruise Power, 1800 RPM, ISA – 30 °C

RECOMMENDED CRUISE POWER
1800 RPM
ISA – 20 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	100	972	244	237	245	238	246	238
2,000	-4	-9	100	946	242	241	243	242	244	243
4,000	-7	-13	100	920	240	246	241	246	241	247
6,000	-11	-17	100	898	237	250	238	251	239	252
8,000	-15	-21	100	880	235	255	236	256	237	257
10,000	-19	-25	100	862	233	260	234	261	235	262
12,000	-22	-29	100	846	231	265	232	266	233	267
14,000	-26	-33	100	836	228	270	229	272	230	273
16,000	-30	-37	100	828	226	276	227	277	228	578
18,000	-33	-41	97	798	220	278	222	279	223	281
20,000	-38	-45	90	740	212	276	213	278	215	279
22,000	-42	-48	84	692	203	273	205	276	207	278
24,000	-46	-52	78	642	195	270	197	273	199	276
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-50. Recommended Cruise Power, 1800 RPM, ISA – 20 °C

RECOMMENDED CRUISE POWER
1800 RPM
ISA – 10 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	100	978	243	239	244	240	244	241
2,000	7	1	100	950	240	244	241	245	242	246
4,000	3	-3	100	926	238	248	239	249	240	250
6,000	-1	-7	100	902	236	253	237	254	238	255
8,000	-5	-11	100	880	233	258	234	259	235	260
10,000	-8	-15	100	862	231	263	232	264	233	265
12,000	-12	-19	100	850	229	268	230	270	231	271
14,000	-16	-23	100	840	226	274	227	275	228	276
16,000	-19	-27	99	826	223	278	224	280	226	281
18,000	-24	-31	93	770	215	276	216	278	218	280
20,000	-28	-35	86	714	206	274	208	276	209	278
22,000	-32	-38	80	666	198	272	200	275	202	277
24,000	-36	-42	74	620	189	269	191	272	193	275
26,000	-40	-46	68	574	180	265	182	268	185	272
28,000	-44	-50	63	532	170	259	174	265	177	267
29,000	-46	-52	60	512	165	256	169	262	172	267
31,000	-50	-56	55	474	153	247	159	256	163	262
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-51. Recommended Cruise Power, 1800 RPM, ISA – 10 °C

RECOMMENDED CRUISE POWER
1800 RPM
ISA

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	100	984	241	242	242	243	243	244
2,000	17	11	100	956	239	247	240	247	240	248
4,000	13	7	100	928	236	251	237	252	238	253
6,000	9	3	100	902	234	256	235	257	236	258
8,000	6	-1	100	882	232	261	233	262	234	263
10,000	2	-5	100	866	229	266	230	268	231	269
12,000	-2	-9	100	850	227	272	228	273	229	274
14,000	-6	-13	100	838	225	277	226	278	227	280
16,000	-9	-17	96	800	218	278	220	280	221	281
18,000	-14	-21	89	744	210	276	211	278	213	280
20,000	-18	-25	82	690	201	272	202	275	204	277
22,000	-22	-28	76	644	192	270	194	273	196	276
24,000	-26	-32	71	596	183	266	186	270	188	273
26,000	-30	-36	65	552	174	262	177	266	180	270
28,000	-34	-40	60	512	164	255	168	262	171	267
29,000	-36	-42	57	492	158	251	163	259	167	265
31,000	-41	-46	53	456	146	242	153	252	158	260
33,000	-45	-50	48	418	130	223	141	241	148	252
35,000	-50	-54	43	380	---	---	125	223	136	242

Figure 7-52. Recommended Cruise Power, 1800 RPM - ISA

RECOMMENDED CRUISE POWER
1800 RPM
ISA + 10 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	31	25	100	988	239	246	240	246	241	246
2,000	27	21	100	962	237	249	238	250	239	251
4,000	23	17	100	936	235	254	236	255	234	256
6,000	19	13	100	910	232	259	234	260	234	261
8,000	16	9	100	888	230	264	231	265	232	266
10,000	12	5	100	868	228	269	229	271	230	272
12,000	8	1	100	854	225	275	226	276	227	277
14,000	4	-3	96	810	219	275	220	277	221	278
16,000	0	-7	90	760	212	275	213	277	214	278
18,000	-4	-11	85	714	204	274	206	276	207	278
20,000	-8	-15	79	668	196	272	198	275	200	277
22,000	-12	-18	74	622	187	269	190	272	191	175
24,000	-16	-22	68	576	178	264	181	268	183	272
26,000	-20	-26	62	532	167	258	171	264	174	268
28,000	-24	-30	57	492	157	251	162	258	166	264
29,000	-26	-32	55	472	151	246	257	255	161	262
31,000	-31	-36	50	436	138	233	146	246	152	256
33,000	-36	-40	45	400	---	---	133	233	141	247
35,000	-41	-44	40	362	---	---	---	---	128	234

Figure 7-53. Recommended Cruise Power, 1800 RPM - ISA + 10 °C

RECOMMENDED CRUISE POWER
1800 RPM
ISA + 20 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	41	35	100	994	238	247	239	248	240	249
2,000	37	31	100	966	236	252	237	253	237	254
4,000	33	27	100	940	233	257	234	258	235	259
6,000	30	23	100	914	231	262	232	263	233	264
8,000	26	19	100	892	229	267	230	268	231	269
10,000	22	15	98	860	224	270	225	271	227	273
12,000	18	11	93	812	218	270	219	272	220	273
14,000	14	7	88	764	211	270	212	272	214	274
16,000	10	3	84	718	204	270	205	272	207	274
18,000	6	-1	79	674	196	268	198	271	200	273
20,000	2	-5	74	630	188	267	191	270	193	272
22,000	-2	-8	69	590	180	264	183	268	185	271
24,000	-6	-12	64	550	172	260	175	265	178	269
26,000	-10	-16	59	512	162	254	166	261	169	266
28,000	-14	-20	54	474	151	246	156	255	161	261
29,000	-17	-22	52	456	144	240	151	250	156	259
31,000	-21	-26	47	420	128	222	139	240	146	251
33,000	-26	-30	42	392	---	---	122	219	134	240
35,000	-30	-34	37	356	---	---	---	--	119	222

Figure 7-54. Recommended Cruise Power, 1800 RPM - ISA + 20 °C

RECOMMENDED CRUISE POWER
1800 RPM
ISA + 30 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	100	998	237	250	238	251	238	251
2,000	47	41	100	970	234	254	235	255	236	256
4,000	43	37	99	938	231	258	232	260	233	261
6,000	40	33	97	900	227	262	228	263	229	264
8,000	36	29	94	856	222	264	223	265	224	266
10,000	32	25	90	810	216	264	217	266	218	268
12,000	28	21	86	766	209	265	211	267	212	268
14,000	24	17	81	720	202	264	204	266	206	268
16,000	20	13	77	676	195	263	197	266	199	268
18,000	16	9	72	634	188	262	190	265	192	268
20,000	12	5	68	594	180	260	183	264	185	267
22,000	8	2	64	556	172	257	175	262	178	266
24,000	4	-2	59	520	163	252	167	258	170	263
26,000	-1	-6	55	484	153	246	158	254	162	260
28,000	-5	-40	51	450	142	237	149	248	154	256
29,000	-7	-12	49	434	136	231	144	244	150	254
31,000	-11	-16	45	400	---	---	131	232	141	245
33,000	-16	20	---	---	---	---	--	---	126	231
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-55. Recommended Cruise Power, 1800 RPM - ISA + 30 °C

RECOMMENDED CRUISE POWER
1800 RPM
ISA + 37 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	97	982	232	243	234	249	235	250
2,000	54	48	95	942	228	251	230	252	231	253
4,000	50	44	93	902	224	254	226	255	227	256
6,000	46	40	91	866	220	257	222	259	223	260
8,000	42	36	89	826	216	259	217	261	218	263
10,000	39	32	85	780	210	260	212	262	213	264
12,000	35	28	81	736	203	260	205	263	207	265
14,000	31	24	76	690	196	259	198	262	200	264
16,000	27	20	72	648	189	258	191	261	193	264
18,000	23	16	68	608	181	256	184	260	182	263
20,000	19	12	64	568	173	254	177	258	179	262
22,000	15	9	60	532	165	250	169	256	172	260
24,000	10	5	56	496	156	245	161	252	165	258
26,000	6	1	52	462	146	237	152	247	157	254
28,000	2	-3	48	430	134	226	142	240	148	250
29,000	0	-5	46	414	125	216	134	235	144	247
31,000	-5	-9	42	382	---	---	123	220	133	238
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-56. Recommended Cruise Power, 1800 RPM - ISA + 37 °C

RECOMMENDED CRUISE SPEEDS

1800 RPM

WEIGHT 11,000 LBS

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, TAS WILL BE REDUCED BY APPROXIMATELY 25 KNOTS.

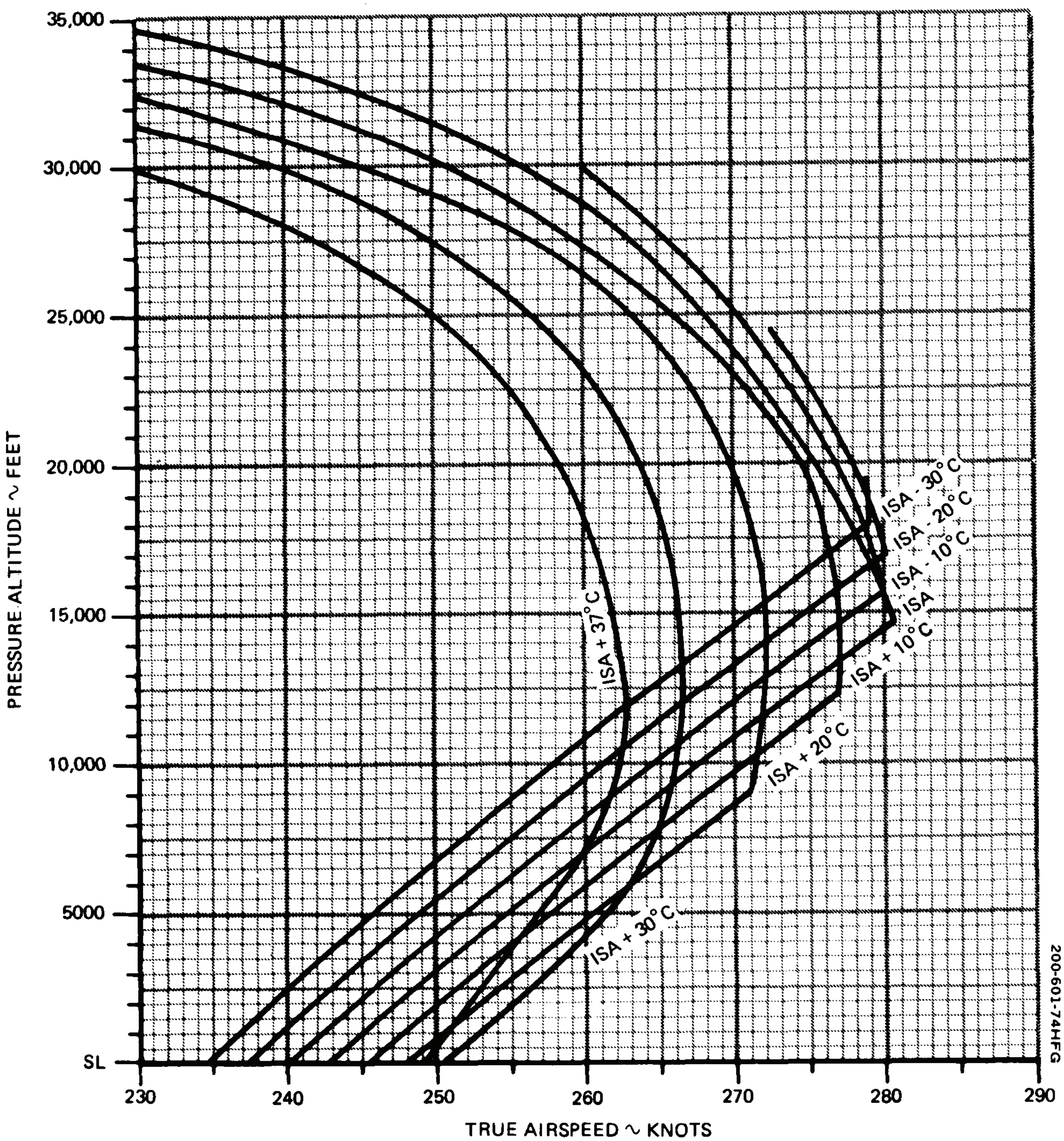


Figure 7-57. Recommended Cruise Speeds – 1800 RPM

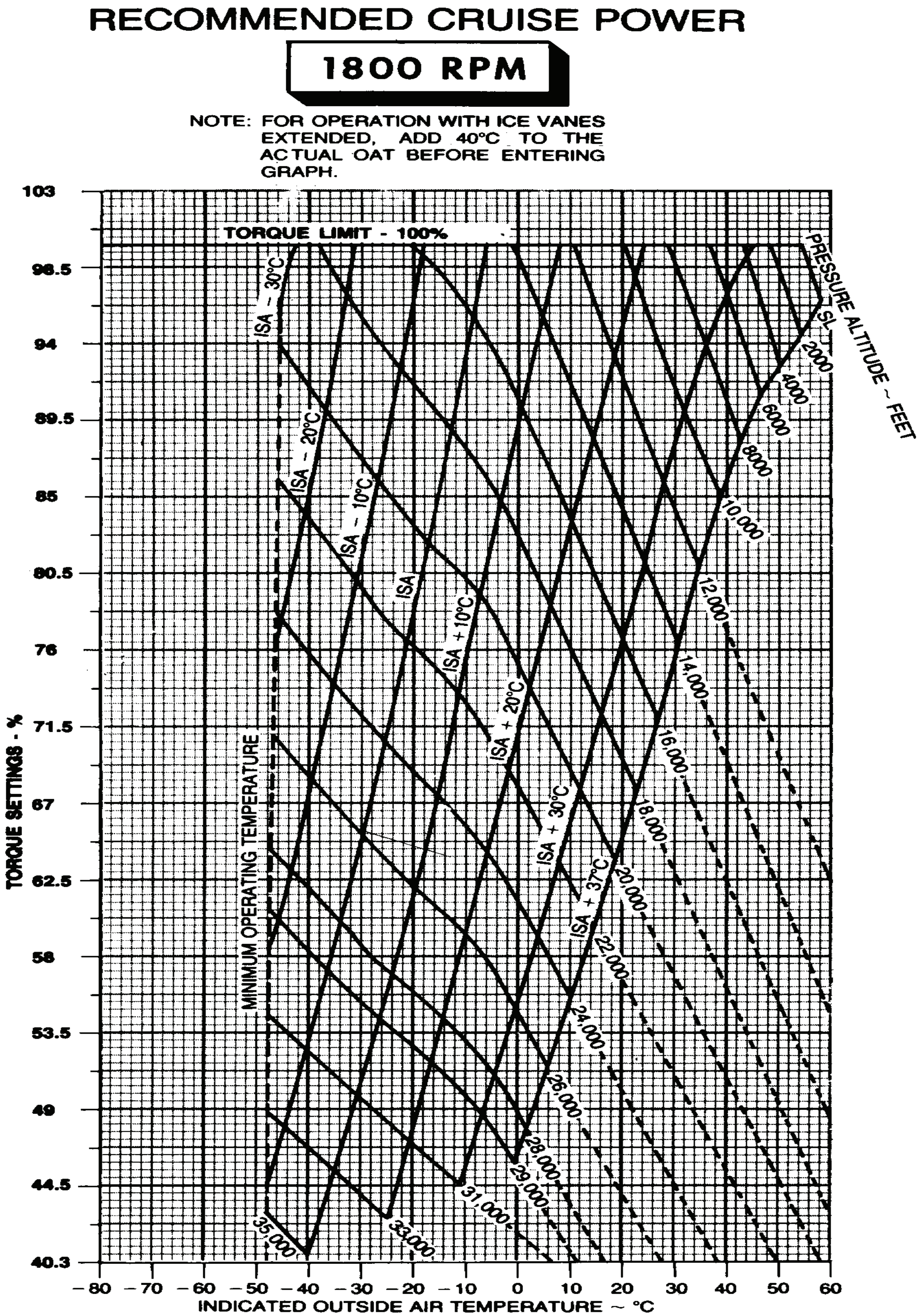


Figure 7-58. Recommended Cruise Power – 1800 RPM

FUEL FLOW AT RECOMMENDED CRUISE POWER

1800 RPM

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, ADD 30°C TO THE ACTUAL OAT BEFORE ENTERING GRAPH.

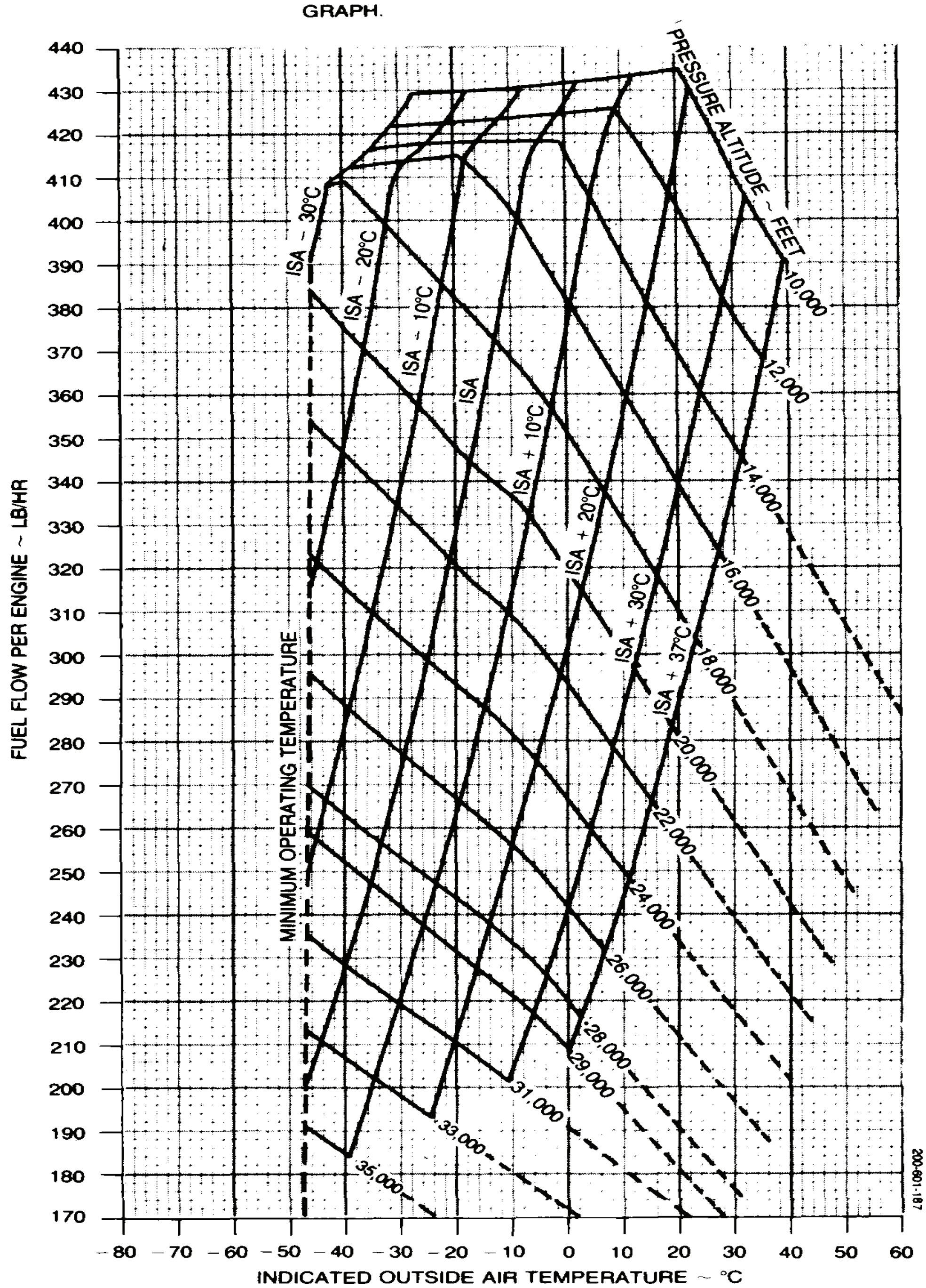


Figure 7-59. Fuel Flow at Recommended Cruise Power – 1800 RPM

MAXIMUM CRUISE POWER
1900 RPM
ISA – 30 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	100	1000	251	238	252	239	252	240
2,000	-14	-19	100	976	249	243	249	244	250	244
4,000	-17	-23	100	954	247	248	247	248	248	249
6,000	-21	-27	100	932	244	252	245	253	246	254
8,000	-25	-31	100	914	242	257	243	258	244	259
10,000	-28	-35	100	898	240	262	241	263	241	264
12,000	-32	-39	100	884	237	267	238	268	239	269
14,000	-36	-43	100	874	235	272	236	274	237	275
16,000	-40	-47	100	866	233	278	234	279	235	280
18,000	-43	-51	99	856	230	286	231	284	232	286
20,000	---	---	---	---	---	---	---	---	---	---
22,000	---	---	---	---	---	---	---	---	---	---
24,000	---	---	---	---	---	---	---	---	---	---
26,000	---	---	---	---	---	---	---	---	---	---
28,000	---	---	---	---	---	---	---	---	---	---
29,000	---	---	---	---	---	---	---	---	---	---
31,000	---	---	---	---	---	---	---	---	---	---
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-60. Maximum Cruise Power, 1900 RPM, ISA – 30 °C

MAXIMUM CRUISE POWER
1900 RPM
ISA – 20 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	100	1006	249	241	250	242	251	243
2,000	-3	-9	100	980	247	246	248	247	249	247
4,000	-7	-13	100	956	245	251	246	252	246	252
6,000	-11	-17	100	934	242	255	243	256	244	257
8,000	-15	-21	100	918	240	260	241	261	242	262
10,000	-18	-25	100	900	238	265	239	266	240	267
12,000	-22	-29	100	886	235	271	236	272	237	273
14,000	-26	-33	100	878	233	276	234	277	235	278
16,000	-29	-37	100	870	231	282	232	283	233	284
18,000	-33	-41	95	826	224	282	225	284	226	285
20,000	-37	-45	88	766	215	280	217	282	218	284
22,000	-41	-48	82	716	207	278	209	280	210	282
24,000	-45	-52	76	664	198	275	200	278	202	280
26,000	---	---	---	---	---	---	---	---	---	---
28,000	---	---	---	---	---	---	---	---	---	---
29,000	---	---	---	---	---	---	---	---	---	---
31,000	---	---	---	---	---	---	---	---	---	---
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-61. Maximum Cruise Power, 1900 RPM, ISA – 20 °C

MAXIMUM CRUISE POWER
1900 RPM
ISA – 10 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	11	5	100	1010	248	244	248	245	249	246
2,000	7	1	100	984	245	249	246	250	247	250
4,000	3	-3	100	960	213	254	244	254	245	255
6,000	-1	-7	100	936	243	258	242	259	242	260
8,000	-4	-11	100	916	238	268	239	264	240	265
10,000	-8	-15	100	900	236	269	237	270	238	271
12,000	-12	-19	100	890	234	274	235	275	236	276
14,000	-15	-23	100	880	261	280	232	281	233	282
16,000	-19	-27	98	856	227	283	228	284	229	286
18,000	-23	-31	91	798	218	281	220	283	221	284
20,000	-27	-35	85	740	210	279	211	281	213	283
22,000	-31	-38	79	690	201	276	203	279	205	281
24,000	-35	-42	73	642	192	273	195	276	197	279
26,000	-40	-46	67	594	183	269	186	273	188	276
28,000	-44	-50	62	550	173	264	177	269	179	273
29,000	-46	-52	59	530	168	261	172	266	275	271
31,000	---	---	---	---	---	---	---	---	---	---
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-62. Maximum Cruise Power, 1900 RPM, ISA – 10 °C

MAXIMUM CRUISE POWER
1900 RPM
ISA

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	21	15	100	1016	246	247	247	248	248	249
2,000	17	11	100	988	244	252	245	253	245	253
4,000	13	7	100	962	241	256	242	257	243	258
6,000	9	3	100	940	239	261	240	262	241	263
8,000	6	-1	100	922	237	267	237	268	268	269
10,000	2	-5	100	904	234	272	235	273	236	274
12,000	-2	-9	100	890	232	277	233	279	234	280
14,000	-5	-13	99	874	229	282	530	284	231	285
16,000	-9	-17	93	820	221	281	222	283	223	284
18,000	-13	-21	87	768	213	280	214	282	216	283
20,000	-17	-25	81	714	204	277	206	280	207	282
22,000	-21	-28	75	666	196	275	198	278	200	280
24,000	-26	-32	70	618	186	271	189	275	191	278
26,000	-30	-36	64	572	178	266	180	271	183	275
28,000	-34	-40	59	530	167	261	171	266	174	271
29,000	-36	-42	57	510	162	257	166	264	170	269
31,000	-40	-46	52	472	151	249	156	259	161	264
33,000	-45	-50	47	434	137	235	145	248	151	258
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-63. Maximum Cruise Power, 1900 RPM - ISA

MAXIMUM CRUISE POWER
1900 RPM
ISA + 10 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	31	25	100	1024	244	250	245	251	246	251
2,000	27	21	100	998	242	254	243	255	244	256
4,000	23	17	100	972	240	259	241	260	241	261
6,000	20	13	100	948	237	264	238	265	239	266
8,000	16	9	100	926	235	270	236	271	237	272
10,000	12	5	100	908	233	275	234	276	235	277
12,000	8	1	99	882	229	279	230	280	231	282
14,000	5	-3	93	830	222	279	223	280	224	282
16,000	1	-7	88	778	214	278	216	280	217	281
18,000	-3	-11	82	730	206	277	208	279	209	281
20,000	-8	-15	77	682	198	275	200	277	202	280
22,000	-12	-18	72	238	189	272	192	275	194	278
24,000	-16	-22	66	592	180	268	183	272	186	275
26,000	-20	-26	61	550	171	263	174	268	177	272
28,000	-24	-30	56	512	161	257	165	263	169	269
29,000	-29	-32	54	492	155	253	160	260	164	266
31,000	-30	-36	49	454	144	242	150	253	155	261
33,000	-35	-40	45	418	126	221	138	242	147	254
35,000	-40	-44	38	380	---	---	121	222	133	243

Figure 7-64. Maximum Cruise Power, 1900 RPM - ISA + 10 °C

MAXIMUM CRUISE POWER
1900 RPM
ISA + 20 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	41	35	100	1030	243	252	244	253	245	254
2,000	37	31	100	1004	241	257	241	258	242	259
4,000	33	27	100	976	238	262	239	263	240	264
6,000	30	23	100	952	236	267	237	268	238	269
8,000	26	19	400	930	233	272	234	274	235	275
10,000	22	18	96	882	227	274	228	275	230	276
12,000	18	11	91	834	220	274	222	275	223	277
14,000	14	7	86	784	213	274	215	276	216	277
16,000	10	3	82	736	206	273	208	275	210	277
18,000	6	-1	77	690	199	272	201	274	203	277
20,000	2	-5	72	646	191	270	193	273	195	276
22,000	-2	-8	67	604	182	267	185	271	188	274
24,000	-6	-12	62	564	174	263	177	268	180	272
26,000	-10	-16	58	524	164	258	168	264	171	269
28,000	-14	-20	53	486	154	251	159	258	163	265
29,000	-16	-22	51	468	148	246	153	255	158	262
31,000	-21	-26	46	432	134	232	143	246	148	255
33,000	-26	-30	42	396	---	---	129	231	138	247
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-65. Maximum Cruise Power, 1900 RPM - ISA + 20 °C

MAXIMUM CRUISE POWER
1900 RPM
ISA + 30 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	100	1036	242	255	242	256	243	257
2,000	47	41	100	1008	239	259	240	260	241	261
4,000	43	37	98	964	234	262	235	263	236	264
6,000	40	33	96	924	230	265	231	266	232	268
8,000	36	29	92	880	225	267	226	268	227	270
10,000	32	25	88	834	219	268	220	270	221	271
12,000	28	21	84	786	212	268	214	270	215	272
14,000	24	17	80	738	205	267	207	270	208	272
16,000	20	13	75	694	198	367	200	269	201	272
18,000	16	9	71	652	190	265	193	269	195	271
20,000	12	5	66	608	183	263	185	267	188	270
22,000	8	2	62	570	175	261	178	265	180	269
24,000	4	-2	58	532	166	257	170	262	173	267
26,000	0	-6	54	496	156	251	161	258	165	164
28,000	-5	-10	50	462	146	243	152	253	156	260
29,000	-7	-12	48	444	140	237	147	249	152	257
31,000	-11	-16	43	410	123	218	135	238	142	250
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-66. Maximum Cruise Power, 1900 RPM - ISA + 30 °C

MAXIMUM CRUISE POWER
1900 RPM
ISA + 37 °C

NOTE: TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	95	1012	236	252	237	253	238	254
2,000	54	48	93	970	232	255	233	256	234	257
4,000	50	44	91	928	228	258	229	259	230	260
6,000	46	40	90	890	224	261	225	262	226	264
8,000	43	36	87	848	219	263	220	265	221	266
10,000	39	32	84	502	213	264	214	266	216	268
12,000	35	28	80	756	206	264	208	266	210	268
14,000	31	22	75	710	199	263	201	266	203	268
16,000	27	18	71	666	192	262	194	265	196	268
18,000	23	14	67	624	184	260	187	264	189	267
20,000	19	10	62	584	176	258	179	262	182	266
22,000	15	7	59	546	168	255	172	260	175	264
24,000	11	3	55	510	160	250	164	257	167	262
26,000	6	-1	51	474	150	244	155	252	159	259
28,000	2	-5	47	442	138	234	146	146	151	254
29,000	0	-7	45	426	132	227	141	242	146	252
31,000	-5	-11	41	394	---	---	128	229	137	244
33,000	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---

Figure 7-67. Maximum Cruise Power, 1900 RPM - ISA + 37 °C

MAXIMUM CRUISE SPEEDS

1900 RPM

WEIGHT 11,000 LBS

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, TAS WILL BE REDUCED BY APPROXIMATELY 25 KNOTS.

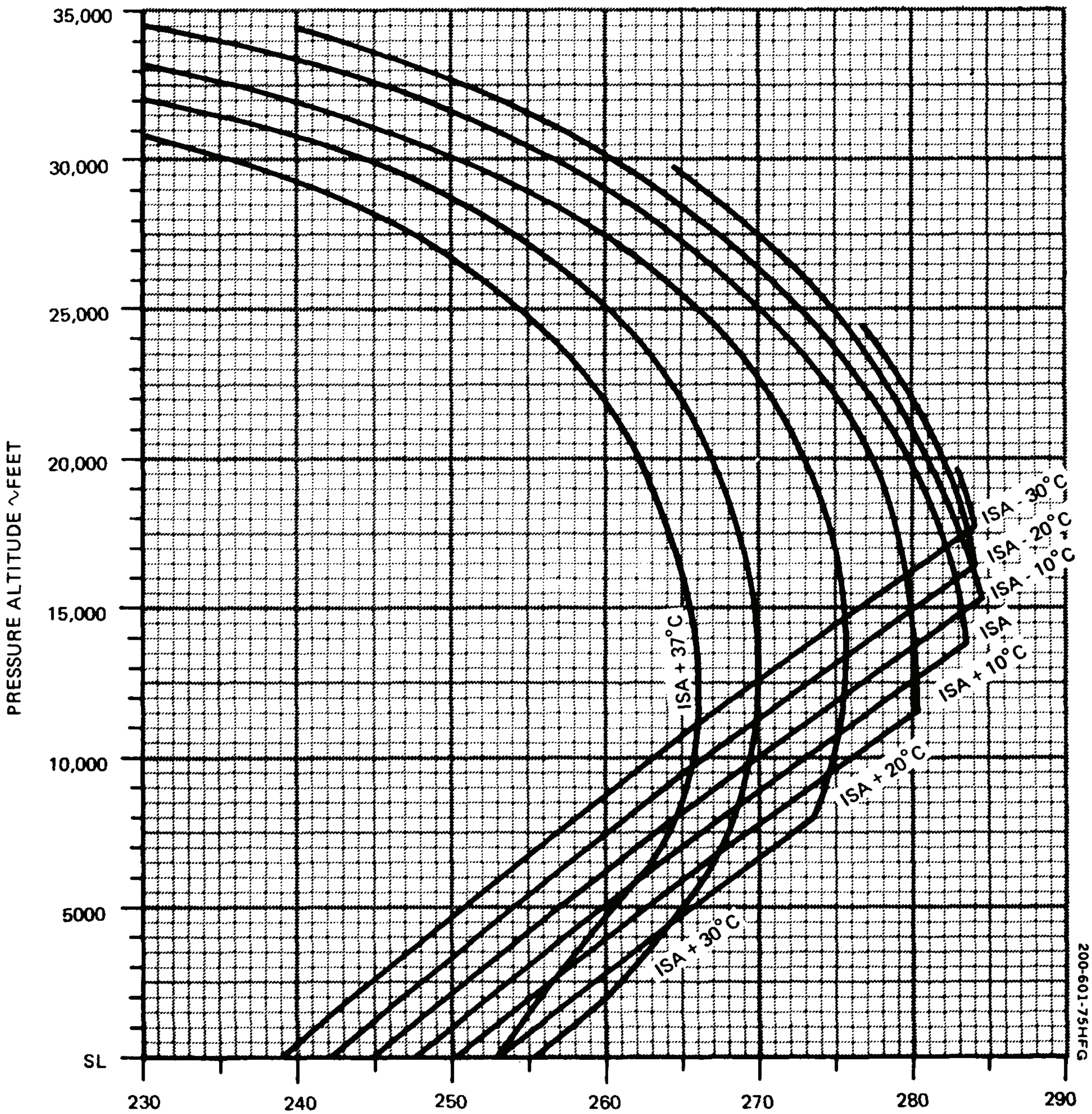


Figure 7-68. Maximum Cruise Speeds – 1900 RPM

MAXIMUM CRUISE POWER

1900 RPM

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, ADD 40°C TO THE ACTUAL OAT BEFORE ENTERING GRAPH.

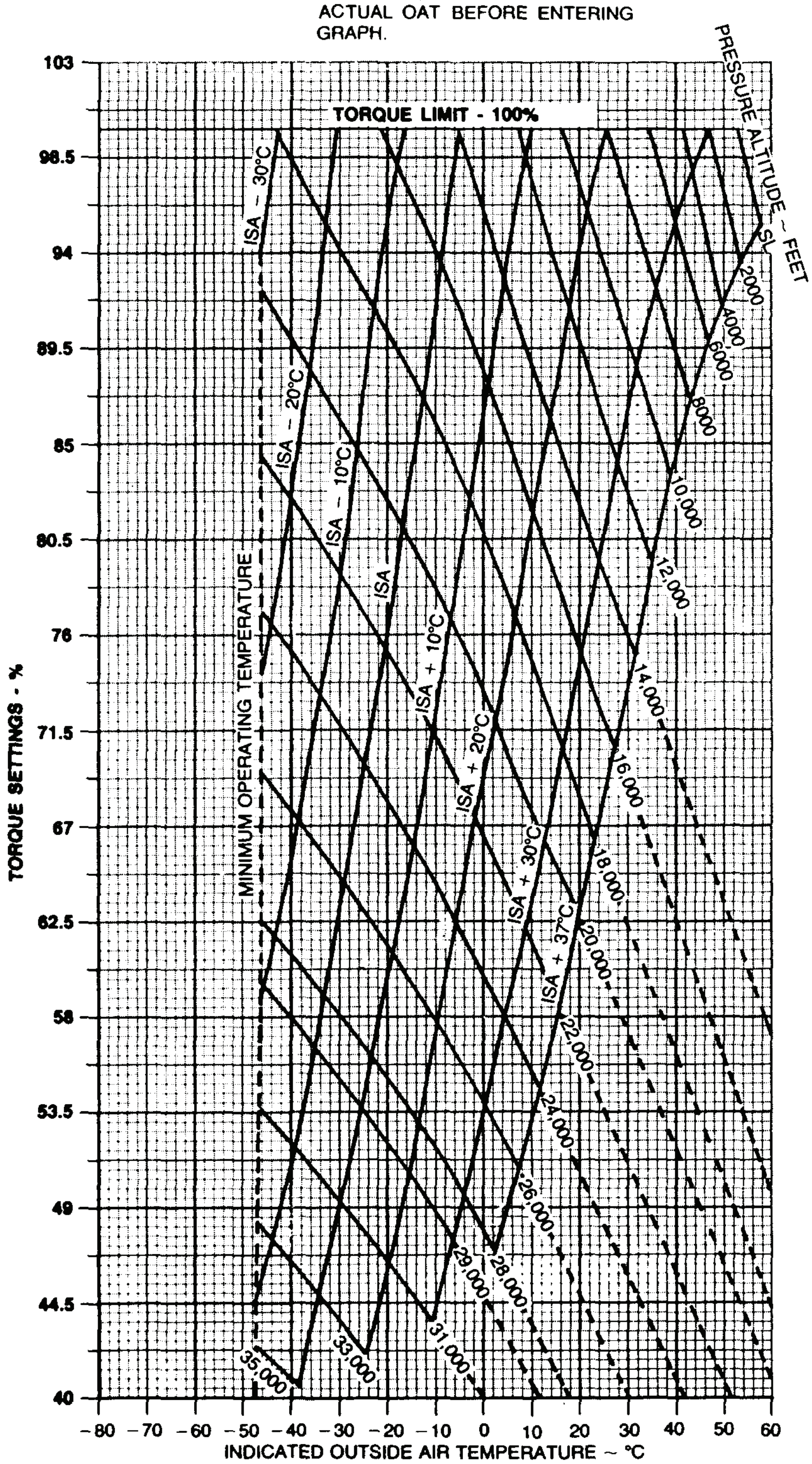


Figure 7-69. Maximum Cruise Power – 1900 PRM

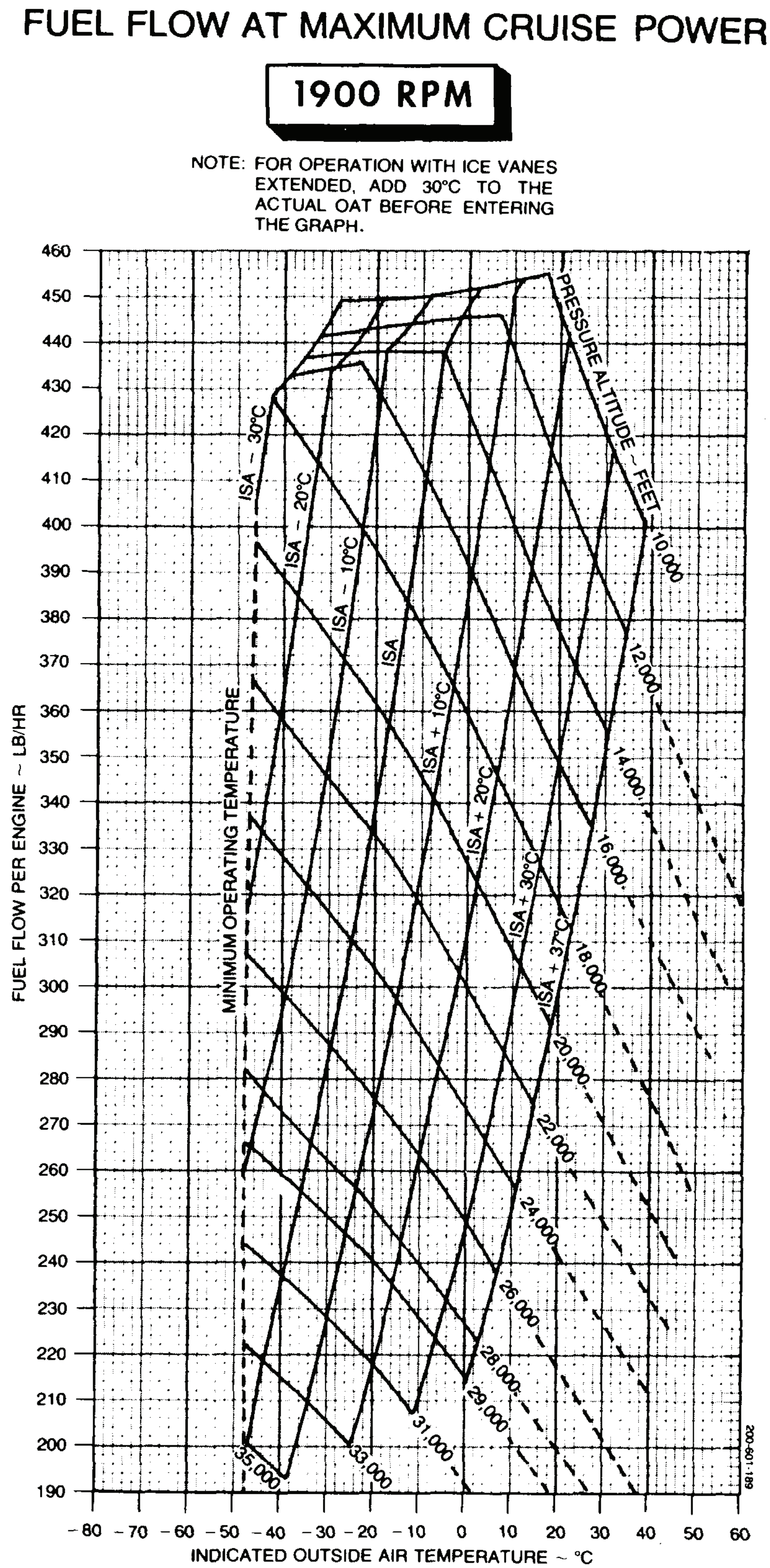


Figure 7-70. Fuel Flow at Maximum Cruise Power – 1900 RPM

MAXIMUM RANGE POWER

1700 RPM

ISA – 30°C

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, MAINTAIN SAME POWER AS WITH ICE VANES RETRACTED. FUEL FLOW WILL INCREASE APPROXIMATELY 15%.

WEIGHT →			12,000 POUNDS				11,000 POUNDS				10,000 POUNDS			
PRESSURE ALTITUDE	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS
FEET	°C	°C	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS
SL	–12	–15	66	373	746	196	62	363	726	193	57	350	700	189
2000	–16	–19	64	354	708	197	60	343	686	194	56	333	666	190
4000	–19	–23	62	336	672	198	58	326	652	195	54	315	630	191
6000	–23	–27	60	319	638	199	57	310	620	196	54	300	600	193
8000	–27	–31	59	303	606	200	56	294	588	197	52	284	568	194
10,000	–31	–35	57	287	574	201	54	277	554	198	50	268	536	195
12,000	–35	–39	56	273	546	202	52	262	524	199	49	252	504	196
14,000	–39	–43	54	260	520	204	51	249	498	200	47	239	478	197
16,000	–43	–47	54	250	500	206	50	239	478	202	46	228	456	198
18,000	–47	–51	53	242	484	208	49	230	460	204	45	219	438	200
20,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
24,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
31,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7-71. Maximum Range Power – 1700 RPM – ISA – 30 8C

MAXIMUM RANGE POWER

1700 RPM

ISA – 20°C

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, MAINTAIN SAME POWER AS WITH ICE VANES RETRACTED. FUEL FLOW WILL INCREASE APPROXIMATELY 15%.

WEIGHT →			12,000 POUNDS				11,000 POUNDS				10,000 POUNDS			
PRESSURE ALTITUDE	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS
FEET	°C	°C	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS
SL	– 2	– 5	65	372	744	197	61	360	720	194	57	350	700	191
2000	– 5	– 9	63	353	706	199	60	343	686	196	55	332	664	192
4000	– 9	– 13	61	335	670	200	58	325	650	197	53	313	626	193
6000	– 13	– 17	60	318	636	201	56	308	616	198	52	297	594	194
8000	– 17	– 21	58	301	602	202	54	291	582	199	50	280	560	195
10,000	– 21	– 25	57	286	572	203	53	276	552	200	49	265	530	196
12,000	– 25	– 29	56	273	546	205	52	262	524	201	48	251	502	197
14,000	– 29	– 33	54	260	520	206	50	249	498	202	46	238	476	198
16,000	– 33	– 37	54	250	500	209	50	238	476	204	46	227	454	200
18,000	– 37	– 41	54	243	486	212	49	230	460	207	45	219	438	203
20,000	– 41	– 45	54	236	472	215	49	222	444	210	45	210	420	205
22,000	– 44	– 48	53	230	460	220	50	219	438	215	45	205	410	209
24,000	– 48	– 52	53	224	448	221	50	215	430	220	45	201	402	213
26,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
31,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7-72. Maximum Range Power – 1700 RPM – ISA – 20 8C

MAXIMUM RANGE POWER

1700 RPM

ISA – 10°C

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, MAINTAIN SAME POWER AS WITH ICE VANES RETRACTED. FUEL FLOW WILL INCREASE APPROXIMATELY 15%.

WEIGHT →			12,000 POUNDS				11,000 POUNDS				10,000 POUNDS			
PRESSURE ALTITUDE	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS
FEET	°C	°C	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS
SL	8	5	62	367	734	196	59	359	718	194	57	351	702	192
2000	5	1	60	347	694	197	57	339	678	195	54	331	662	193
4000	1	– 3	59	329	658	198	56	320	640	196	53	312	624	194
6000	– 3	– 7	58	312	624	200	54	303	606	198	51	294	588	195
8000	– 7	– 11	57	298	596	202	53	287	574	199	50	278	556	196
10,000	– 11	– 15	56	283	566	204	51	272	544	200	48	262	524	197
12,000	– 15	– 19	54	269	538	205	50	257	514	200	46	246	492	197
14,000	– 19	– 23	53	258	516	207	49	246	492	202	45	234	468	198
16,000	– 23	– 27	54	251	502	211	49	237	474	206	44	225	450	201
18,000	– 27	– 31	54	244	488	215	50	232	464	211	45	219	438	205
20,000	– 30	– 35	53	234	468	216	50	225	450	215	46	212	424	210
22,000	– 34	– 38	51	224	448	215	49	218	436	217	46	208	416	214
24,000	– 38	– 42	50	217	434	216	48	209	418	217	46	202	404	217
26,000	– 42	– 46	51	216	432	221	46	201	402	216	44	195	390	219
28,000	– 46	– 50	52	217	434	227	46	196	392	218	43	186	372	217
29,000	– 48	– 52	52	217	434	229	47	197	394	221	42	183	366	217
31,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7-73. Maximum Range Power – 1700 RPM – ISA – 10 8C

MAXIMUM RANGE POWER

1700 RPM

ISA

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, MAINTAIN SAME POWER AS WITH ICE VANES RETRACTED. FUEL FLOW WILL INCREASE APPROXIMATELY 15%.

WEIGHT →			12,000 POUNDS				11,000 POUNDS				10,000 POUNDS			
PRESSURE ALTITUDE	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS
FEET	°C	°C	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS
SL	19	15	66	382	764	202	61	367	734	197	56	353	706	193
2000	15	11	61	351	702	199	57	339	678	195	53	330	660	192
4000	11	7	58	328	656	199	55	319	638	196	52	310	620	194
6000	7	3	57	311	622	200	53	302	604	198	50	293	586	195
8000	3	− 1	56	296	592	202	52	286	572	200	49	277	554	197
10,000	− 1	− 5	55	282	564	204	51	271	542	201	47	261	522	197
12,000	− 5	− 9	54	270	540	207	50	258	516	202	46	246	492	198
14,000	− 9	− 13	54	259	518	209	49	246	492	205	45	234	468	200
16,000	− 13	− 17	53	251	502	212	50	239	478	209	45	226	452	203
18,000	− 16	− 21	53	243	486	215	50	232	464	212	46	221	442	209
20,000	− 20	− 25	52	235	470	217	49	223	446	214	46	214	428	213
22,000	− 24	− 28	53	230	460	221	47	214	428	215	45	207	414	215
24,000	− 28	− 32	53	226	452	224	47	208	416	216	44	197	394	215
26,000	− 32	− 36	52	222	444	226	47	206	412	221	42	189	378	214
28,000	− 36	− 40	54	223	446	233	48	204	408	226	42	185	370	217
29,000	− 38	− 42	54	225	450	236	48	203	406	227	43	185	370	220
31,000	− 42	− 46	—	—	—	—	49	205	410	234	43	185	370	225
33,000	− 46	− 50	—	—	—	—	—	—	—	—	44	186	372	231
35,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7-74. Maximum Range Power – 1700 RPM – ISA

MAXIMUM RANGE POWER

1700 RPM

ISA + 10°C

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, MAINTAIN SAME POWER AS WITH ICE VANES RETRACTED. FUEL FLOW WILL INCREASE APPROXIMATELY 15%.

WEIGHT →			12,000 POUNDS				11,000 POUNDS				10,000 POUNDS			
PRESSURE ALTITUDE	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS
FEET	°C	°C	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS
SL	29	25	72	398	796	211	69	389	778	209	65	379	758	206
2000	25	21	68	373	746	211	64	362	724	207	59	348	696	202
4000	21	17	64	348	696	209	58	331	662	202	52	315	630	196
6000	17	13	59	321	642	206	54	305	610	200	49	293	586	196
8000	13	9	57	301	602	206	52	287	574	200	48	275	550	196
10,000	9	5	56	286	572	207	50	271	542	201	46	260	520	198
12,000	5	1	55	274	548	210	50	259	518	204	45	246	492	199
14,000	1	− 3	55	264	528	213	49	248	496	206	44	234	468	201
16,000	− 3	− 7	55	257	514	218	49	240	480	210	44	226	452	204
18,000	− 6	− 11	55	250	500	222	50	234	468	215	45	220	440	209
20,000	− 10	− 15	55	241	482	224	50	226	452	219	45	212	424	212
22,000	− 14	− 18	53	233	466	224	50	222	444	222	45	206	412	215
24,000	− 18	− 22	52	226	452	225	49	215	430	224	45	202	404	219
26,000	− 22	− 26	54	229	458	233	48	208	416	224	44	197	394	223
28,000	− 26	− 30	55	230	460	239	49	209	418	231	44	192	384	224
29,000	− 28	− 34	—	—	—	—	50	210	420	234	44	190	380	225
31,000	-32	− 36	—	—	—	—	—	—	—	—	44	190	380	231
33,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7-75. Maximum Range Power – 1700 RPM – ISA +10 8C

MAXIMUM RANGE POWER

1700 RPM

ISA + 20°C

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, MAINTAIN SAME POWER AS WITH ICE VANES RETRACTED. FUEL FLOW WILL INCREASE APPROXIMATELY 15%.

WEIGHT →			12,000 POUNDS				11,000 POUNDS				10,000 POUNDS			
PRESSURE ALTITUDE	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS
FEET	°C	°C	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS
SL	39	35	69	392	784	210	66	385	770	208	64	378	756	207
2000	35	31	67	373	746	211	64	365	730	210	62	358	716	209
4000	31	27	66	354	708	213	63	346	692	212	59	336	672	208
6000	27	23	65	337	674	216	60	325	650	212	55	312	624	207
8000	23	19	62	318	636	217	57	305	610	212	52	289	578	205
10,000	19	15	60	300	600	217	55	286	572	211	49	269	538	203
12,000	15	11	59	286	572	218	53	272	544	213	47	255	510	205
14,000	12	7	58	274	548	221	53	261	522	216	47	244	488	208
16,000	8	3	56	261	522	222	53	250	500	219	47	235	470	212
18,000	4	− 1	55	250	500	222	52	241	482	221	47	227	454	216
20,000	0	− 5	54	240	480	224	51	230	460	222	47	219	438	219
22,000	− 4	− 8	54	235	470	227	49	221	442	223	46	212	424	222
24,000	− 8	− 12	55	234	468	233	48	214	428	224	45	204	408	223
26,000	− 12	− 16	55	232	464	238	49	213	426	230	44	196	392	223
28,000	− 15	− 20	—	—	—	—	50	214	428	236	44	193	386	226
29,000	− 18	− 22	—	—	—	—	—	—	—	—	45	194	388	230
31,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7-76. Maximum Range Power – 1700 RPM – ISA + 20 8C

MAXIMUM RANGE POWER

1700 RPM

ISA + 30°C

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, MAINTAIN SAME POWER AS WITH ICE VANES RETRACTED. FUEL FLOW WILL INCREASE APPROXIMATELY 15%.

WEIGHT →			12,000 POUNDS				11,000 POUNDS				10,000 POUNDS			
PRESSURE ALTITUDE	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS
FEET	°C	°C	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS
SL	49	45	71	402	804	215	67	390	780	211	63	380	760	208
2000	45	41	66	372	744	212	63	364	728	210	60	355	710	207
4000	41	37	64	351	702	213	61	343	686	211	58	335	670	209
6000	37	33	63	334	668	215	60	326	652	213	57	319	638	212
8000	33	29	61	317	634	216	59	310	620	215	56	303	606	214
10,000	30	25	59	301	602	218	57	294	588	217	54	285	570	215
12,000	26	21	58	286	572	219	55	279	558	218	52	269	538	216
14,000	22	17	56	273	546	220	53	263	526	218	50	254	508	216
16,000	18	13	56	263	526	223	52	251	502	219	49	242	484	218
18,000	14	9	56	256	512	227	51	240	480	221	48	231	462	219
20,000	10	5	56	249	498	231	51	232	464	224	47	220	440	220
22,000	6	2	56	242	484	233	51	227	454	228	45	211	422	222
24,000	2	-2	55	237	474	236	51	222	444	232	45	205	410	224
26,000	-1	-6	—	—	—	—	50	217	434	234	46	201	402	229
28,000	-5	-10	—	—	—	—	—	—	—	—	46	199	398	233
29,000	-7	-12	—	—	—	—	—	—	—	—	46	198	396	236
31,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7-77. Maximum Range Power – 1700 RPM – ISA +30 8C

MAXIMUM RANGE POWER

1700 RPM

ISA +37°C

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, MAINTAIN SAME POWER AS WITH ICE VANES RETRACTED. FUEL FLOW WILL INCREASE APPROXIMATELY 15%.

WEIGHT →			12,000 POUNDS				11,000 POUNDS				10,000 POUNDS			
PRESSURE ALTITUDE	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS	TORQUE PER ENGINE	FUEL FLOW PER ENG.	FUEL FLOW TOTAL	TAS
FEET	°C	°C	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS	%	LB/HR	LB/HR	KNOTS
SL	56	52	73	406	812	218	67	392	784	213	63	380	760	209
2000	52	48	70	383	766	218	64	369	738	213	60	357	714	209
4000	48	44	66	359	718	217	61	345	690	212	57	335	670	209
6000	44	40	63	335	670	216	59	325	650	213	56	316	632	211
8000	40	36	61	318	636	218	57	308	616	215	54	299	598	213
10,000	37	32	60	304	608	220	56	292	584	216	53	283	566	214
12,000	33	28	59	291	582	222	54	277	554	218	51	269	538	216
14,000	29	24	58	279	558	225	53	265	530	220	50	254	508	216
16,000	25	20	58	269	538	228	53	255	510	222	48	241	482	218
18,000	21	16	57	260	520	230	52	246	492	226	47	231	462	220
20,000	17	12	56	249	498	231	52	238	476	229	47	222	444	222
22,000	13	10	56	244	488	234	51	230	460	231	47	216	432	226
24,000	9	6	—	—	—	—	50	222	444	232	47	210	420	230
26,000	6	2	—	—	—	—	52	222	444	240	46	204	408	231
28,000	2	−2	—	—	—	—	—	—	—	—	46	201	402	236
29,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
31,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure 7-78. Maximum Range Power – 1700 RPM – ISA +37 8C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM

ISA -30 °C

NOTE: FOR OPERATION WITH ICE VANE EXTENDED, DECREASE FUEL FLOW AND TAS BY 7%.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	-12	-15	100	512	191	182	193	183	194	185
2,000	-16	-19	100	500	189	185	191	187	192	188
4,000	-20	-23	100	488	186	188	188	190	190	191
6,000	-23	-27	100	477	184	191	186	193	188	195
8,000	-27	-31	100	467	182	194	184	196	186	198
10,000	-31	-35	100	458	179	197	182	199	184	202
12,000	-35	-39	100	452	177	200	179	203	181	205
14,000	-39	-43	100	448	171	203	177	206	179	209
16,000	-43	-47	96	431	168	202	171	206	174	209
18,000	-47	-51	90	401	159	198	163	203	167	207
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-79. One-Engine-Inoperative Maximum Cruise Power - 1900 RPM, - ISA – 30 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM

ISA -20 °C

NOTE: FOR OPERATION WITH ICE VANE EXTENDED, DECREASE FUEL FLOW AND TAS BY 7%.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	-2	-5	100	515	189	184	191	185	193	187
2,000	-6	-9	100	501	187	187	189	189	191	190
4,000	-10	-13	100	489	185	190	187	192	189	194
6,000	-13	-17	100	478	182	193	184	195	186	197
8,000	-17	-21	100	467	180	196	182	198	184	200
10,000	-21	-25	100	460	177	199	180	202	182	204
12,000	-25	-29	100	454	175	202	177	205	180	207
14,000	-29	-33	99	445	171	203	174	207	177	210
16,000	-33	-37	92	416	162	199	166	204	169	208
18,000	-37	-41	86	387	153	195	158	201	162	205
20,000	-41	-45	80	360	143	188	149	196	154	202
22,000	-45	-48	74	335	130	177	139	189	145	197
24,000	-50	-52	68	310	– – –	– – –	127	179	136	191
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-80. One-Engine-Inoperative Maximum Cruise Power - 1900 RPM, - ISA – 20 °C

ONE ENGINE INOPERATIVE MAXIMUM CRUISE POWER 1900 RPM

ISA -10 °C

NOTE: FOR OPERATION WITH ICE VANE EXTENDED, DECREASE FUEL FLOW AND TAS BY 7%.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	8	5	100	517	188	185	190	187	192	189
2,000	4	1	100	503	185	188	188	191	189	192
4,000	1	-3	100	490	183	191	185	194	187	196
6,000	-3	-7	100	479	181	195	183	197	185	199
8,000	-7	-11	100	469	178	198	181	200	183	203
10,000	-11	-15	100	461	175	201	178	204	180	206
12,000	-15	-19	100	455	173	204	175	207	178	209
14,000	-19	-23	95	430	165	201	169	205	172	209
16,000	-23	-27	86	401	157	197	161	202	164	206
18,000	-27	-31	82	374	147	191	153	198	157	203
20,000	-31	-35	76	347	135	182	143	192	148	199
22,000	-35	-38	71	323	– – –	– – –	133	184	140	194
24,000	-40	-42	65	199	– – –	– – –	– – –	– – –	130	187
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-81. One-Engine-Inoperative Maximum Cruise Power - 1900 RPM, - ISA – 10°

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM

ISA

NOTE: FOR OPERATION WITH ICE VANE EXTENDED, DECREASE FUEL FLOW AND TAS BY 7%.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	18	15	100	522	186	187	188	189	490	191
2,000	14	11	100	508	184	190	186	192	188	194
4,000	11	7	100	494	181	193	184	196	186	198
6,000	7	3	100	482	179	196	181	199	184	201
8,000	3	-1	100	472	176	200	179	202	181	205
10,000	-1	-5	100	462	174	202	176	205	179	208
12,000	-5	-9	97	445	168	203	172	206	174	210
14,000	-9	-13	91	416	160	199	164	204	167	208
16,000	-13	-17	85	388	151	194	456	200	160	205
18,000	-17	-20	79	361	141	187	147	195	152	201
20,000	-21	-25	73	334	126	173	137	188	143	196
22,000	-26	-28	67	311	– – –	– – –	125	177	134	190
24,000	-31	-32	60	283	– – –	– – –	– – –	– – –	123	181
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-82. One-Engine-Inoperative Maximum Cruise Power - 1900 RPM, - ISA

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM

ISA +10 °C

NOTE: FOR OPERATION WITH ICE VANE EXTENDED, DECREASE FUEL FLOW AND TAS BY 7%.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	28	25	100	525	185	189	187	191	189	193
2,000	25	21	100	511	182	192	185	194	187	196
4,000	21	17	100	497	180	195	182	198	184	200
6,000	17	13	100	485	177	198	180	201	182	203
8,000	13	9	100	474	175	201	177	204	180	207
10,000	9	5	96	449	168	100	172	204	174	207
12,000	5	1	91	422	161	197	165	202	168	206
14,000	1	-3	85	396	153	194	188	199	161	204
16,000	-7	-11	75	347	133	179	141	191	147	198
18,000	-12	-15	70	322	– – –	– – –	131	183	138	193
20,000	-12	-15	70	322	– – –	– – –	131	183	138	193
22,000	-16	-18	64	300	– – –	– – –	– – –	– – –	128	186
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-83. One-Engine-Inoperative Maximum Cruise Power - 1900 RPM, - ISA +10 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM

ISA + 20 °C

NOTE: FOR OPERATION WITH ICE VANE EXTENDED, DECREASE FUEL FLOW AND TAS BY 7%.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	33	35	100	529	183	191	186	193	187	195
2,000	35	31	100	514	181	194	183	196	185	198
4,000	31	27	100	499	178	196	181	199	183	202
6,000	27	23	97	476	173	197	176	200	189	203
8,000	23	19	93	451	167	196	171	200	173	203
10,000	19	15	88	425	160	194	164	199	167	202
12,000	15	11	84	400	153	191	157	196	161	201
14,000	11	7	79	375	144	186	150	193	154	199
16,000	7	3	74	352	134	179	142	189	147	196
18,000	2	-1	70	329	– – –	– – –	132	183	139	192
20,000	-2	-5	65	306	– – –	– – –	119	170	131	186
22,000	-7	-8	59	283	– – –	– – –	– – –	– – –	120	177
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-84. One-Engine-Inoperative Maximum Cruise Power - 1900 RPM, - ISA + 20 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM

ISA +30 °C

NOTE: FOR OPERATION WITH ICE VANE EXTENDED, DECREASE FUEL FLOW AND TAS BY 7%.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	48	45	95	517	178	188	181	191	483	193
2,000	44	41	94	496	174	190	177	193	179	195
4,000	41	27	92	475	170	191	173	194	176	197
6,000	37	33	89	453	165	191	169	195	171	198
8,000	33	29	86	429	159	190	163	195	166	198
10,000	29	25	82	404	152	187	157	193	160	197
12,000	25	21	77	379	144	183	150	190	154	196
14,000	20	17	73	355	134	176	142	186	147	193
16,000	16	13	69	333	– – –	– – –	133	180	141	189
18,000	12	9	64	311	– – –	– – –	121	170	131	185
20,000	7	5	58	287	– – –	– – –	– – –	– – –	121	176
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-85. One-Engine-Inoperative Maximum Cruise Power - 1900 RPM, - ISA + 30 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM

ISA +37 °C

NOTE: FOR OPERATION WITH ICE VANE EXTENDED, DECREASE FUEL FLOW AND TAS BY 7%.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	AIRSPEED ~ KNOTS					
					@12,000 LB		@11,000 LB		@10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS
SL	55	52	89	497	172	184	175	187	177	189
2,000	51	48	87	477	168	185	171	188	174	191
4,000	47	44	86	457	164	186	167	190	170	193
6,000	43	40	84	437	159	186	163	191	166	194
8,000	40	36	81	414	153	185	158	190	161	194
10,000	35	32	77	390	146	182	151	188	155	193
12,000	31	28	73	366	137	176	144	185	149	191
14,000	27	24	69	342	124	165	135	180	142	188
16,000	23	20	65	320	– – –	– – –	125	171	134	184
18,000	18	16	59	295	– – –	– – –	– – –	– – –	124	177
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7-86. One-Engine-Inoperative Maximum Cruise Power - 1900 RPM, - ISA + 37 °C

CHAPTER 7A
PERFORMANCE DATA D2 T1 T2

7A-1. INTRODUCTION TO PERFORMANCE.

The graphs and tables in this chapter present performance information for takeoff, climb, landing, and flight planning at various parameters of weight, power, altitude, and temperature. Examples explaining appropriate use are provided for performance graphs.

7A-2. HOW TO USE GRAPHS.

a. All airspeed and references to airspeeds in this chapter are indicated airspeeds unless otherwise noted.

b. A reference line indicates where to begin following the guidelines. Always project to the reference line first, then follow the guidelines to the next item by maintaining the same proportional distance between the guideline above and the guideline below the projected line. For instance, if the projected line intersects the reference line in the ratio of 30% down/70% up between the guidelines, then maintain this same 30%/70% relationship between the guidelines all the way to the next item.

c. The Airspeed Calibration - Normal System – Takeoff Ground Roll graph was used to obtain V_1 and V_r Indicated Airspeeds (IAS). All other indicated airspeeds were obtained by using the Airspeed Calibration - Normal System graph.

d. In addition to presenting the answer for a particular set of conditions, the example on a graph also presents the order in which the various scales on the graph should be used. For instance, if the first item in the example is Outside Air Temperature (OAT), then enter the graph at the known OAT. In some cases, performance planning may require entering the chart at one point in order to establish a baseline and then entering the chart at another point in order to obtain the answer. Follow the sequence of the example, or establish the necessary baseline and then follow the sequence of the example.

e. The associated conditions define the specific conditions from which performance parameters have been determined. They are not intended to be used as instructions; however, performance values determined from charts can be achieved only if the specified conditions exist.

f. Notes have been provided on various graphs and tables to approximate performance with ice vanes extended. The effect will vary, depending upon airspeed, temperature, altitude, and ambient conditions. At lower altitudes, where operation on the torque limit is possible, the effect of ice vane extension will be less, depending upon how much power can be recovered after the ice vanes have been extended.

7A-3. EXAMPLES.

The following example presents the performance decision making process for correct flight planning and completion of the Takeoff and Landing Data (TOLD) card. Weather conditions for the departure and destination airports are given to illustrate the impact on performance planning and mission capabilities. The example mission is from Airport Alpha (AAA) to Airport Bravo (BBB). The en route distance is 700 nm. The planned cruise altitude is FL240.

a. Conditions. At Airport Alpha (AAA):

OAT . . . . 85°F (+30°C)

Field Elevation . . . . 3800 feet

Altimeter Setting. . . . . .29.72 in. Hg

Wind . . . . 330° at 10 knots

NOTE

Do not use headwinds for takeoff performance planning.

Runway 35 Length . . . . .6000 feet

Weather . . . . .400 feet overcast

Visibility .1 mile, rain/haze

b. Other Than Standard Takeoff Minimums and/or (Obstacle) Departure Procedures. At Airport Alpha:

Takeoff Minimums. . . . . Rwy 35, 500-2*

*Or standard with minimum climb of 250/NM to 5000′.

c. Mission. Transport the following load (personnel, baggage, and equipment) from Airport Alpha to Airport Bravo:

Personnel – 6

(1) 185 pounds	(1) 160 pounds
(1) 200 pounds	(1) 155 pounds
(1) 170 pounds	(1) 190 pounds

Subtotal pax……………….………1060 pounds

Baggage and Equipment –

(6) baggage @ 40 pounds = 240 pounds

(1) 24″ x 24″ box = 25 pounds

Subtotal baggage and equip = 265 pounds

Total load……..………………………1325 pounds

d. Performance Planning (Back of TOLD Card). Refer to Figure 7A-1. The back side of the TOLD card is a takeoff weight worksheet. It is designed to assist the crew in the decision making process as to maximum allowable takeoff weight for the conditions and the takeoff configuration. The instructions herein are consistent with TC 1-218, Aircrew Training Manual (ATM). Complete the card as follows:

(1) Field Length Available is 6,000 feet.

NOTE

If the runway has an approved runway overrun, that distance may be added to the runway length for Accelerate/Stop calculations.

(2) Temperature (forecast for time of departure) is +30 °C.

Takeoff Weight Worksheet

FIELD LENGTH AVAILABLE: (1)		
TEMP. °C: (2)	**P.A.:** (3)	
TAKEOFF CONFIGURATION: (4) FLAPS	**UP**	**40%**
Max Wt to Achieve SE Climb	(5)	(6)
Max Wt For ACC/STOP	(7)	(8)
***Max Wt For Req. SE CLB GRAD** (Min 3.3%)	(9)	
Max Allow Takeoff Weight	________(10)_______.	

***SE Climb Conversion:**

$$\frac{\text{Ft. per nm}}{6{,}076'} \times 100 = \underline{\quad\quad}\%$$

DA FORM 4888-R (Back) **C-12 TOLD**

Figure 7A-1. TOLD Card (Back)

(3) Pressure Altitude (PA). To determine the PA, add 1000 feet to field elevation for each 1.00 in. Hg that the reported altimeter setting value is below 29.92 in. Hg, and subtract 1000 feet for each 1.00 in. Hg above 29.92 in. Hg. First, find the difference between 29.92 in. Hg and the reported altimeter setting. Then, multiply the answer by 1000 to find the difference in feet between field elevation and pressure altitude. PA is inversely proportional to barometric pressure, as the barometric pressure decreases the PA increases and as the barometric pressure increases, the PA decreases.

Pressure Altitude at AAA:

29.92 in. Hg - 29.72 in. Hg = 0.20

0.20 X 1000 feet = 200 feet

Because the barometric pressure is lower than ISA, the PA will be higher than field elevation. The pressure altitude at AAA is 200 feet above field elevation.

Pressure Altitude at AAA = Field Elevation 3800 feet + 200 feet = 4000 feet.

(4) Takeoff Configuration, Flaps 0% or 40%, will be determined by the crew after completing this side of the TOLD card.

(5) and *(6)* Maximum weight allowable to achieve a single engine climb, flaps 0% and 40%. Refer to Figures 7A-15 and 7A-16, Takeoff Weight to Achieve Positive One Engine Inoperative Climb at Liftoff, Flaps **UP** and Flaps **APPROACH**.

Enter each of the graphs at the pressure altitude of 4000 ft., trace to the right until intersecting the correct temperature line, +30 °C, then trace down vertically and read the maximum allowable takeoff weight for these conditions. For Flaps **UP** it is 14,000 pounds. For Flaps **APPROACH** it is 12,750 pounds. Enter those takeoff weight limitations in the appropriate blocks of the TOLD card.

(7) and *(8)* Maximum Weight to accomplish Accelerate and Stop distance, flaps 0% and 40%. Refer to Figures 7A-22 and 7A-26, Accelerate – Stop, Flaps **UP** and Flaps **APPROACH**.

Enter each of the graphs on the right vertical scale, ACCELERATE-STOP FIELD LENGTH ~ FEET, at the field length available. In this example there is no runway overrun, therefore the field length available is the runway length of 6000 feet. Mark that line as a baseline, it becomes the limit for maximum allowable takeoff weight.

Enter the left side of the graph at the OUTSIDE AIR TEMPERATURE ~ °C at the forecast temperature of +30°. Trace up vertically until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace to the right until intersecting the first REFERENCE LINE. Because the point on the REFERENCE LINE for Flaps **UP** is above the 6000 feet runway length, maintain the same relative distance between the guidelines and trace down until intersecting the 6000 feet field length line. From that point, trace down vertically to read the maximum allowable takeoff weight that will allow accomplishment of an acceleration to V_1 and stop. The maximum allowable takeoff weight is 12,800 pounds.

Using Figure 7A-26, utilize the chart in the same manner. In this, case the point on the REFERENCE LINE for Flaps **APPROACH** is below the 6000 feet field length line, the accelerate-stop distance is 5,100 feet and accelerate – stop can be accomplished at 14,000 pounds.

For Flaps **UP** the maximum takeoff weight to achieve Accel/Stop is 12,800 pounds. For Flaps **APPROACH** it is 14,000 pounds. Enter those takeoff weight limitations in the appropriate blocks of the TOLD card.

(9) Maximum Weight Allowable To Accomplish the Required Single Engine Climb Gradient. Refer to Figure 7A-31 Climb – One Engine Inoperative.

A 3.3% single engine climb gradient is required for all IFR takeoffs. In the absence of any Departure Procedure (DP) or other requirement, the 3.3% climb gradient line is the baseline for determining the maximum allowable takeoff weight in order to achieve that single engine climb gradient.

In this example, the weather forecast for the time of departure is 400 feet overcast and 1 mile visibility with rain and haze. The non-standard takeoff minimums for Airport A are 500 foot ceiling and 2 miles visibility. However, the departure may be accomplished using standard AR 95-1 takeoff minimums if a single engine climb gradient of 250 feet per nm can be achieved. Therefore, the maximum allowable takeoff weight to achieve a single engine climb gradient of 250 feet per nm must be determined.

In Figure 7A-31, to use the CLIMB GRADIENT ~ % scale, the required gradient of 250 feet per nautical mile must be converted to a percentage. The method is included in the Climb Conversion portion of the TOLD card. The feet per nautical mile are divided by 6076 (the number of feet in a nautical mile) and multiplied by 100, yielding the climb gradient in percent.

For this example divide 250 feet per nautical mile by 6076, then multiply by 100 in order to convert to a percentage.

$250 \div 6076 \times 100 = 4.1\%$

From the CLIMB GRADIENT ~ % scale trace horizontally from 4.1% to the left onto the graph in order to establish the baseline limit for maximum takeoff weight in order to achieve the required single engine climb gradient of 4.1%.

Now, enter the graph at the OUTSIDE AIR TEMPERATURE ~ °C scale at +30 °C. Trace up until intersecting the 4000 feet PA line, trace horizontally to the right until intersecting the REFERENCE LINE. Because the intersecting point on the reference line is below the 4.1% baseline, maintain the same relative distance between the guidelines and trace up until intersecting the 4.1% baseline. From that point, trace down to read the maximum allowable takeoff weight in order to achieve a single engine climb gradient of 4.1%.

The maximum allowable takeoff weight to achieve a 4.1% single engine climb gradient is 12,600 pounds. Enter that weight in the appropriate block on the TOLD card.

(10) Maximum Allowable Takeoff Weight. Enter the most restrictive weight from each column, including the **Max Wt For Req. SE CLB GRAD** block, in the appropriate space on the TOLD card. For Flaps **UP** the weight is 12,600 pounds. Climb, one engine inop is the most restrictive weight for this departure.

a. Completed TOLD (Back) and Decision Making. Refer to Figure 7A-2. The completed back side of the TOLD card is now used for determining the takeoff configuration (Flaps 0% or 40%) and the fuel load in order to maintain the aircraft at the maximum allowable weight for all of the conditions.

(1) For this example, the takeoff can be accomplished at an aircraft weight of 12,600 pounds with the flaps **UP** or at **APPROACH**. This takeoff is planned with Flaps **UP** at 12,600 pounds.

For this example, the aircraft Operating Weight is 9,300 pounds and the Load for the mission is 1,325 pounds therefore, the Zero Fuel Weight (Operating Weight plus the Load) is 10,625 pounds. The takeoff weight of 12,600 pounds minus the zero fuel weight of 10,625 pounds allows for 1,975 pounds of fuel for the mission.

Takeoff Weight Worksheet

FIELD LENGTH AVAILABLE:
6,000 ft.

TEMP. C°: *+30°C* **P.A.:** *4,000 ft.*

TAKEOFF CONFIGURATION:
(4)
FLAPS

	UP	**40%**
Max Wt to Achieve SE Climb	*14,000*	*12,750*
Max Wt For ACC/STOP	*12,800*	*14,000*
***Max Wt For Req. SE CLB GRAD** (Min 3.3%) *4.1%*	*12,600*	
Max Allow Takeoff Weight	*12,600*	*12,600*

***SE Climb Conversion:**

$$\frac{250 \text{ Ft. per nm}}{6{,}076'} \times 100 = 4.11\%$$

DA FORM 4888-R **C-12 TOLD (Back)**

Figure 7A-2. TOLD Card Back (Example Completed)

(2) Transpose the pertinent information to the front side of the TOLD card and complete it for the departure.

b. Performance Planning (Front of TOLD Card). Refer to Figure 7A-3. The front side of the TOLD card is used to record the critical information for conduct of the takeoff and, in the event of an emergency during the takeoff, landing data for an immediate return to the departure airport. The instructions here are consistent with the ATM. Complete the front side of the card as follows:

TAKEOFF and LANDING DATA (TOLD)	
TAKEOFF	
Station: (1)	**Field Lgth Avail:** (2)
Temp °C: (3)	**P.A.:** (4)
Takeoff Weight: (5)	
Min. Takeoff Power: ___(6)___.	
Configuration: **Flaps 0%**___ **Flaps 40%**___. (7)	
T.O. Fld. Lgth Req'd: ___(8)___.	
ACC/GO Distance: ___(9)___.	
V_1 / V_r (10). V_2 / V_{yse} (11) Vx (11a).	
Clb. Grd. Alt. ___(12)___.	
LANDING	
Rwy Lgth Available: ___(13)___.	
Landing Weight: ___(14)___.	
V_{ref} ___(15)___. Flaps 100% (1.3 X V_{so} @ Ldg. Wt.) Flaps 40% to 99%+(1.3 X V_{s1} @ Ldg. Wt.)	V_{app} ___(16)___. Inst. App. = V_{ref} + 20 KIAS Stabilized = V_{ref} + 10 KIAS Visual App = V_{ref} + 10 KIAS
LANDING DISTANCE ___(17)___.	
DA FORM 4888-R	C-12 Takeoff and Landing Data

Figure 7A-3. TOLD Card (Front)

(1) thru *(5)* were determined on the back side of the card and transposed to these blocks.

(6) Minimum Takeoff Power. Use Figure 7A-17, Minimum Takeoff Power at 2000 RPM with Ice Vanes Retracted (65 Knots) or Figure 7A-18, Minimum Takeoff Power with Ice Vanes Extended (65 Knots).

Enter the appropriate graph at the OUTSIDE AIR TEMPERATURE ~ °C. From +30 °C trace up until intersecting the correct PRESSURE ALTITUDE – FEET line, 4000 feet. Trace horizontally to the left until intersecting the ENGINE TORQUE AT 2000 RPM ~ PERCENT scale and read the Minimum Takeoff power.

In this example the minimum takeoff power is 90.2%. Enter the information on the TOLD card.

NOTE

Performance planning methodology and operational procedures for Minimum Takeoff Power takeoffs and Reduced Power takeoffs are contained in the ATM.

(7) Configuration. Mark (✓ or X) the appropriate configuration as determined on the back of the TOLD card. For this example, it was decided to takeoff with the Flaps **UP**.

(8) Takeoff Field Length Required. For this example, enter the actual ACC/STOP distance of 5,900 feet for a 12,600-pound aircraft.

If the weight to accomplish an ACC/STOP had been the most restrictive weight, then we would enter the field length that was used on the back of the TOLD card to determine the maximum takeoff weight to achieve an acceleration and stop maneuver (6000 feet).

(9) Accelerate – Go Distance. This distance is advisory only. Use Figure 7A-23. Accelerate – Go, Flaps **UP** or Figure 7A-27, Accelerate – Go, Flaps **APPROACH**.

Enter the graph at the OUTSIDE AIR TEMPERATURE ~ ºC, +30 ºC. Trace up until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace horizontally to the right until intersecting the REFERENCE LINE. Maintain the same relative distance between the guidelines and trace up until intersecting the aircraft takeoff WEIGHT ~ POUNDS line. Trace horizontally to the right and read the accelerate – go distance.

In this example, the takeoff weight is planned at 12,600 pounds. The accelerate – go distance is 8,800 feet.

Enter the distance, 8,800 feet, in the appropriate block on the TOLD card.

As already stated, Accelerate-Go distance is advisory only. However, a point 35 feet above the end of the departure runway is normally the point from which climb gradients are calculated. Therefore, regardless of all other prudent performance planning, if an engine fails at V_1 on this example departure the aircraft will not be capable of clearing all obstacles. If weather conditions are at or near minimums, the crew should consider some other options to assure the capability to accomplish an acceleration and go maneuver such as:

Decreasing the load and/or fuel.

Reducing takeoff weight and using flaps 40%.

Delaying the departure for more favorable weather conditions.

(10) V_1 (Takeoff Decision Speed) / V_r (Rotation Speed). In the C-12 aircraft V_1 and V_r are always the same speed. Use the tabular data table at the top of Figure 7A-21, Take-Off Distance, Flaps **UP** or Figure 7A-25, Take-Off Distance, Flaps **APPROACH**.

The takeoff configuration for this example is Flaps **UP**. The V_1/V_r speed is 112 KIAS.

Enter the speed, 112 KIAS, in the appropriate block on the TOLD card.

(11) V_2 / V_{yse}. Use the tabular data table at the top of Figure 7A-31, Climb – One Engine Inoperative. In accordance with the ATM, flaps are retracted just after liftoff 105 KIAS for both a normal takeoff and in the event of an engine failure after V_1. The V_2 / V_{yse} - KNOTS, Figure 7A-31, is V_{yse} and is essentially the same speed as V_2 for a takeoff with flaps at 0%. Consequently, V_2 flaps 0% and V_{yse} are used as the V_2 speed for entry on the TOLD card. V_2 / V_{yse} for a 12,600 pound aircraft is 122 KIAS.

Enter the speed in the appropriate block on the TOLD card.

(11A) If conducting an obstacle clearance climb, use the "V_x" speed from the TAKEOFF DISTANCE – FLAPS APPROACH chart.

(12) Climb Gradient Altitude. This is the altitude to which the single engine climb gradient must be continued as specified in the applicable DP. The information is advisory and intended as a reminder to the crew of the altitude to which they must climb at V_2 / V_{yse} in order to clear obstacles.

For this example, the DP specified climbing to 5000 feet MSL.

Enter the altitude, 5000 feet, in the appropriate block on the TOLD card.

NOTE

Items 13 through 17 are initially calculated at takeoff weight as a contingency for a necessary return to the takeoff airport right after departure. The items must be re-calculated for the arrival at the destination.

(13) Runway Length Available. This is the runway length available for landing.

For this example, the runway length is 6000 feet and there is no displaced threshold or other information limiting the useful landing distance of the runway.

Enter the length, 6000 feet, in the appropriate block on the TOLD card.

(14) Landing Weight. For the takeoff TOLD card, landing and takeoff weights are the same. For arrival at the destination the TOLD card must be re-calculated to reflect actual aircraft weight and airport conditions.

For this example, takeoff and landing weight is 12,600 pounds.

Enter the weight, 12,600 pounds, in the appropriate block on the TOLD card.

(15) V_{ref} Speed. This speed is 1.3 times V_{so} at the intended landing weight if the landing will be accomplished using Flaps **DN**. If the landing will be accomplished with the Flaps at **APPROACH**, or any setting greater than **APPROACH** but less than **DOWN**, then V_{ref} is 1.3 times V_{s1} (the stall speed for FLAPS **APPROACH**). Use Figure 7A-13, Stall Speeds – Power Idle to determine applicable stall speeds.

For this example, the landing weight (assuming an emergency return to the departure airport) is 12,600 pounds. A landing with the Flaps **DOWN** is planned. The V_{so} for a 12,600 pound aircraft is 75 KIAS. Therefore, V_{ref} is 1.3 times 75 = 97.5 and is rounded up to 98 KIAS.

There is another method to determine V_{ref} when the landing will be accomplished with the Flaps **DOWN**. Subtract 5 KIAS from the APPROACH SPEED ~ KNOTS obtained from the tabular data table at the top of Figure 7A-107, Landing Distance Without Propeller Reversing, Flaps **DOWN**. For a 12,600 pound aircraft the given APPROACH SPEED is 103 KIAS – 5 KIAS = 98 KIAS.

NOTE

If the aircraft will be landed with FLAPS less than full DOWN, the LANDING DISTANCE – FLAPS UP must be used to obtain the landing distance for the TOLD card. Refer to Figure 7A-108 or 7A-110.

As another example, if the landing was planned using the Flaps at **APPROACH**, or any intermediate setting short of **DOWN**, then the V_{ref} speed would be 1.3 times V_{s1} (the FLAPS APPROACH stall speed). FLAPS APPROACH stall speed for a 12,600 pound aircraft is 85 KIAS. Therefore, the V_{ref} speed is 1.3 times 85 = 110.5 and is rounded up to 111 KIAS.

For this example with Flaps **DOWN** enter the V_{ref} speed, 98 KIAS at the appropriate place on the TOLD card.

(16) V_{app} Speed. This is the intended final approach speed. It is V_{ref} plus 20 KIAS for a normal instrument approach; V_{ref} plus 10 KIAS for a stabilized approach; and, V_{ref} to V_{ref} plus 10 KIAS for a visual approach as determined by the PC.

For this example, the landing is planned with the Flaps **DOWN** so the V_{ref} is 98 KIAS. The weather conditions are such that a normal instrument approach back into the departure airport is planned in the event of a takeoff emergency. Therefore, the V_{app} will be V_{ref} plus 20 KIAS.

V_{ref} is 98 KIAS + 20 KIAS = V_{app} 118 KIAS. Enter this speed in the appropriate block on the TOLD card.

(17) Landing Distance. The distance, measured from the landing touchdown, required to land the aircraft and stop. Use Figure 7A-107, Landing Distance Without Propeller Reversing - Flaps **DOWN**.

NOTE

Do not use a headwind or headwind component in calculating landing distance. But, if a downwind landing is required, then ensure the tailwind is factored.

Enter the chart at the OUTSIDE AIR TEMPERATURE ~ ºC, +30 ºC. Trace up until intersecting the correct PRESSURE ALTITUDE ~ FEET line, 4000 feet. Trace horizontally to the right until intersecting the first REFERENCE LINE. Maintain the same relative position between the guidelines and trace down until intersecting the aircraft weight line. From that point, trace horizontally to the DISTANCE ~ FEET scale to determine the landing distance.

For this example, the landing weight is 12,600 pounds. Assuming a takeoff emergency, the landing weight may exceed the landing weight limit of 12,500 pounds.

The landing distance is 2,120 feet.

Enter that number, 2,120 feet, in the appropriate block of the TOLD card. Remember, if the landing is planned for touchdown to be at the 1000-foot markers, then 3,120 feet will be required to accomplish this landing with full flaps. Refer to Figure 7A-4 for an example of a completed TOLD card front.

TAKEOFF and LANDING DATA (TOLD)	
TAKEOFF	
Station: *AAA*	**Field Lgth Avail:** *6000 ft*
Temp C°: *+30 ºC*	**P.A.:** *4000 ft.*
Takeoff Weight: *12,600*	
Min. Takeoff Power: *90.2%* . (7) **Configuration: Flaps 0%** *X* **Flaps 40%** ___ . **T.O. Fld. Lgth Req'd:** *5900 ft* . **ACC/GO Distance:** *8800 ft* . **V_1 / V_r** *112* . **V_2 / V_{yse}** *122* . **Clb. Grd. Alt.** *5000 ft* .	
LANDING	
Rwy Lgth Available: *6000 ft* . **Landing Weight:** *12,600* .	
V_{ref} *98* . Flaps 100% (1.3 X V_{so} @ Ldg. Wt.) Flaps 40% to 99%+(1.3 X V_{s1} @ Ldg. Wt.)	**V_{app}** *118* . Inst. App. = V_{ref} + 20 KIAS Stabilized = V_{ref} + 10 KIAS Vis. App = V_{ref} to V_{ref} + 10 KIAS
LANDING DISTANCE *2,120 ft* .	
DA FORM 4888-R	**C-12 Takeoff and Landing Data**

Figure 7A-4. TOLD Card Front (Example Completed)

c. Performance Planning, Cruise. Normal Cruise Power, 1700 RPM charts beginning at Figure 7A-34 are normally used for cruise performance planning. Use Figure 7A-11, ISA Conversion, to determine the correct chart, relative to ISA, for cruise performance planning. For this example, the mission is planned to be flown at FL240.

(1) If a weather forecast provides the forecast temperature at the cruise altitude, enter Figure 7A-11 at that temperature. Trace up until intersecting the planned PRESSURE ALTITUDE ~ FEET. At that point, determine the closest ISA +/-

guideline and use the corresponding chart for planning.

If the forecast temperature for FL 240 is –10 ºC, enter the chart at that temperature. Trace up until intersecting the 24,000 feet reference line. Note which reference line is closest and use the corresponding chart for planning. If the point is exactly midway between two reference lines, use the reference line to the right of the point.

In this example, the point is between ISA + 20 and ISA + 30, and is closest to ISA + 20. Therefore, use Figure 7A-39. Normal Cruise Power, 1700 RPM - ISA +20 ºC for cruise performance planning.

Enter the chart at 24,000 feet pressure altitude and read across horizontally to determine cruise torque, fuel flow, and airspeeds.

(2) If a weather forecast does not include a temperature at the cruise altitude, then the temperature must be calculated using a standard lapse rate and the temperature at the departure airport.

In this example, the temperature at the departure airport is +30 ºC. The pressure altitude is 4000 feet and the ISA temperature at that pressure altitude would be +7 ºC.

Temperature decreases at 2 ºC per thousand feet; 4000 feet ÷ 1000 feet = 4; 4 x 2 ºC = 8 ºC decrease in temperature. Therefore, ISA at 4000 feet PA is +15 ºC (SL ISA) – 8 ºC = +7 ºC.

The actual surface temperature of +30 ºC at Airport A, PA 4000 feet, is 23º above ISA (+7 ºC). Therefore, it is ISA +23 at the airport. If it is ISA +23º at the departure surface and a standard lapse rate of 2º per thousand feet of increased altitude is used, then it will be ISA +23º at the planned cruise altitude.

On Figure 7A-11*,* ISA +23º is closest to the ISA + 20 reference line; therefore, use Figure 7A-39, Normal Cruise Power, 1700 RPM, - ISA +20 ºC for cruise performance planning.

(3) The following planning data is derived from the Figure 7A-39, Normal Cruise Power, 1700 RPM - ISA +20 ºC cruise chart for this example:

Torque per engine – 75%

Fuel flow per engine – 291 pounds/hour

Total fuel flow – 582 pounds/hour

IAS (12,000 pounds) – 179 KIAS

TAS (12,000 pounds) – 271 KTAS

The above data is used for the corresponding entries on the DD Form 175 and for flight planning.

As a general rule, the total fuel flow from the Recommended Cruise charts will sufficiently match the results of a more detailed fuel planning process using: time, fuel, and distance to climb; cruise fuel; and, time, fuel, and distance to descend. Therefore, for mission planning purposes, the total fuel flow from the appropriate cruise chart will suffice. Therefore, for this example, the total fuel in hours and minutes for entry on the DD Form 175 is 3+24 hours.

Fuel for the mission 1975 pounds
÷ fuel flow per hour 582 pounds
= 3.39 hours (3+24)

The minimum reserve fuel for the mission is 437 pounds.

Fuel flow per hour 582 pounds
x 45 minutes, .75
= 436.5 (437 pounds)

Fuel available for the mission minus required reserve is 1538 pounds.

Total mission fuel	1975	pounds
- reserve fuel	437	pounds
	= 1538	pounds

Mission endurance fuel, minus reserves, is.

Mission fuel minus reserve 1538 pounds
÷ fuel flow per hour 582 pounds
= 2.64 hours (2 + 37)

AIRSPEED CALIBRATION – NORMAL SYSTEM

TAKE-OFF GROUND ROLL

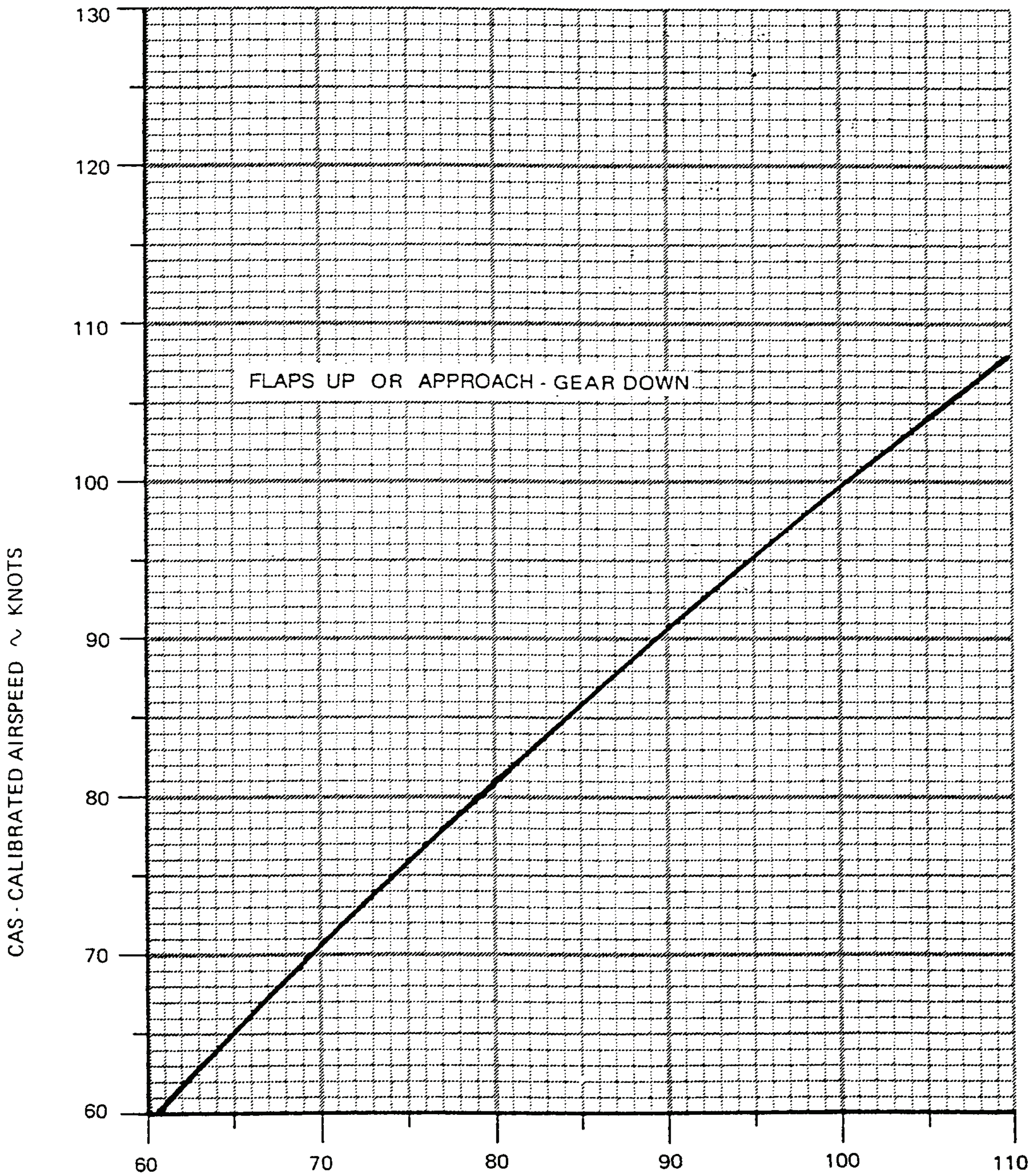


Figure 7A-5. Airspeed Calibration – Normal System, Takeoff Ground Roll

AIRSPEED CALIBRATION – NORMAL SYSTEM

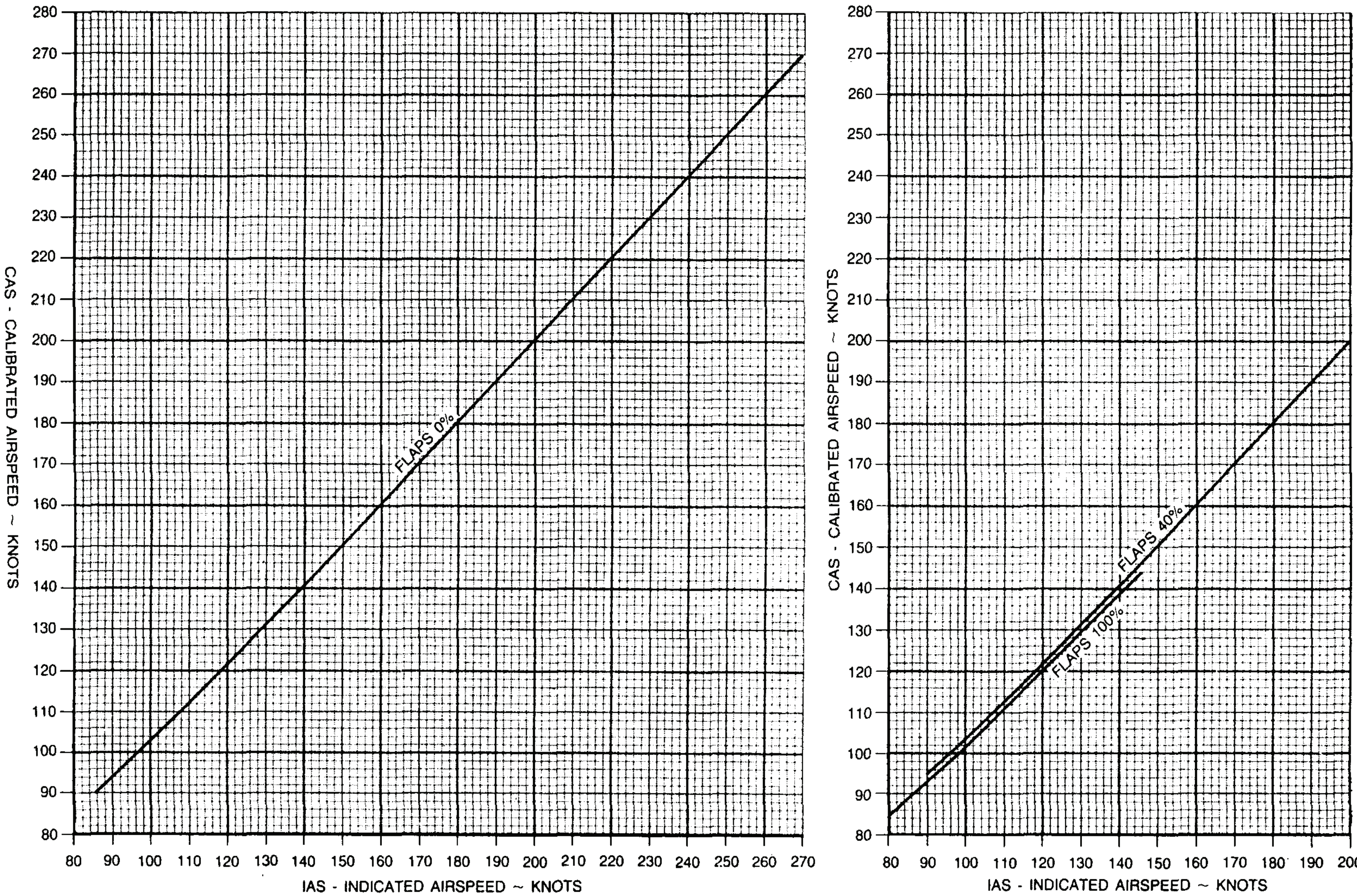


Figure 7A-6. Airspeed Calibration – Normal System

ALTIMETER CORRECTION – NORMAL SYSTEM

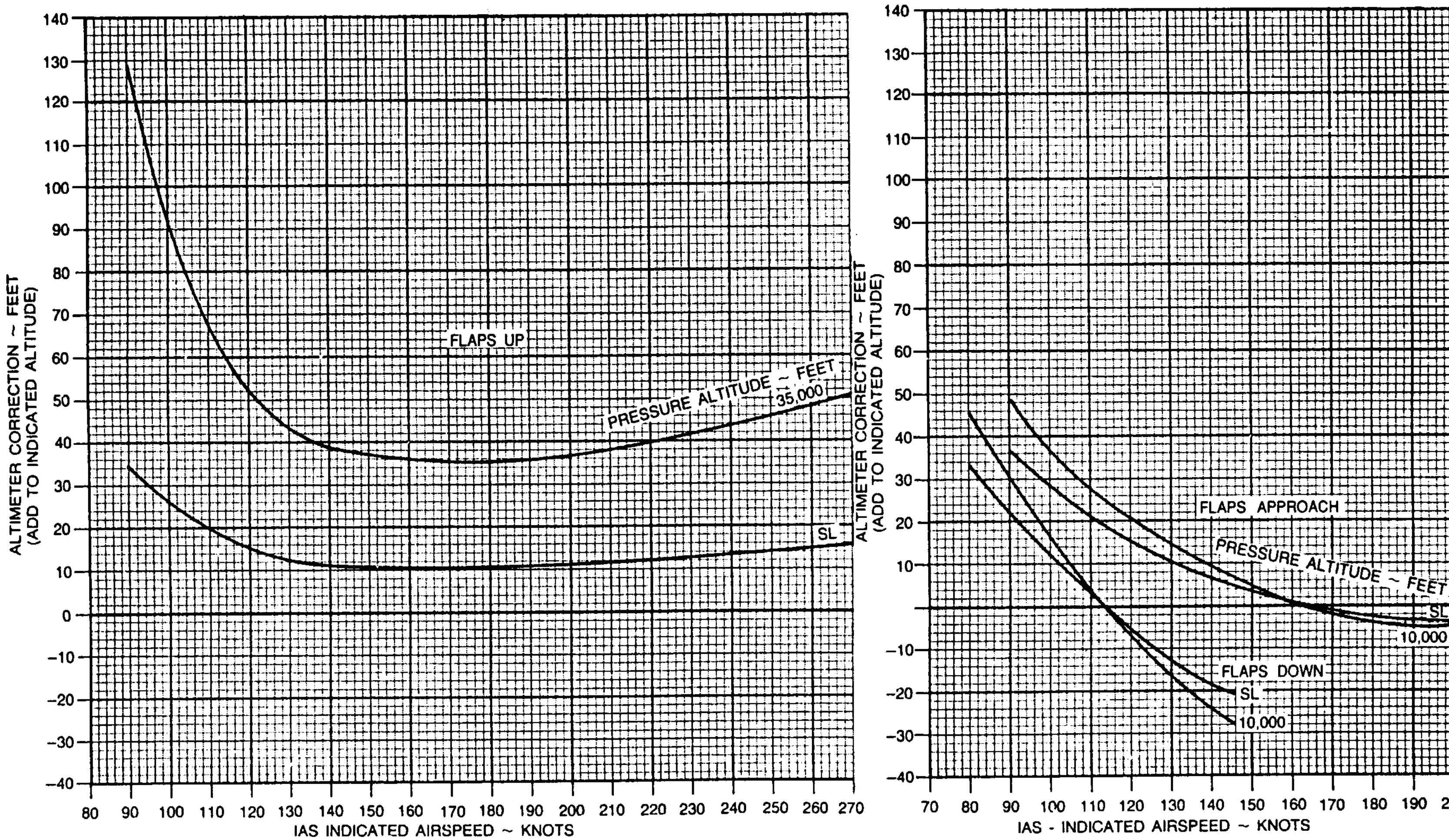


Figure 7A-7. Altimeter Correction – Normal System

AIRSPEED CALIBRATION — ALTERNATE SYSTEM

APPLICABLE FOR ALL FLAP POSITIONS

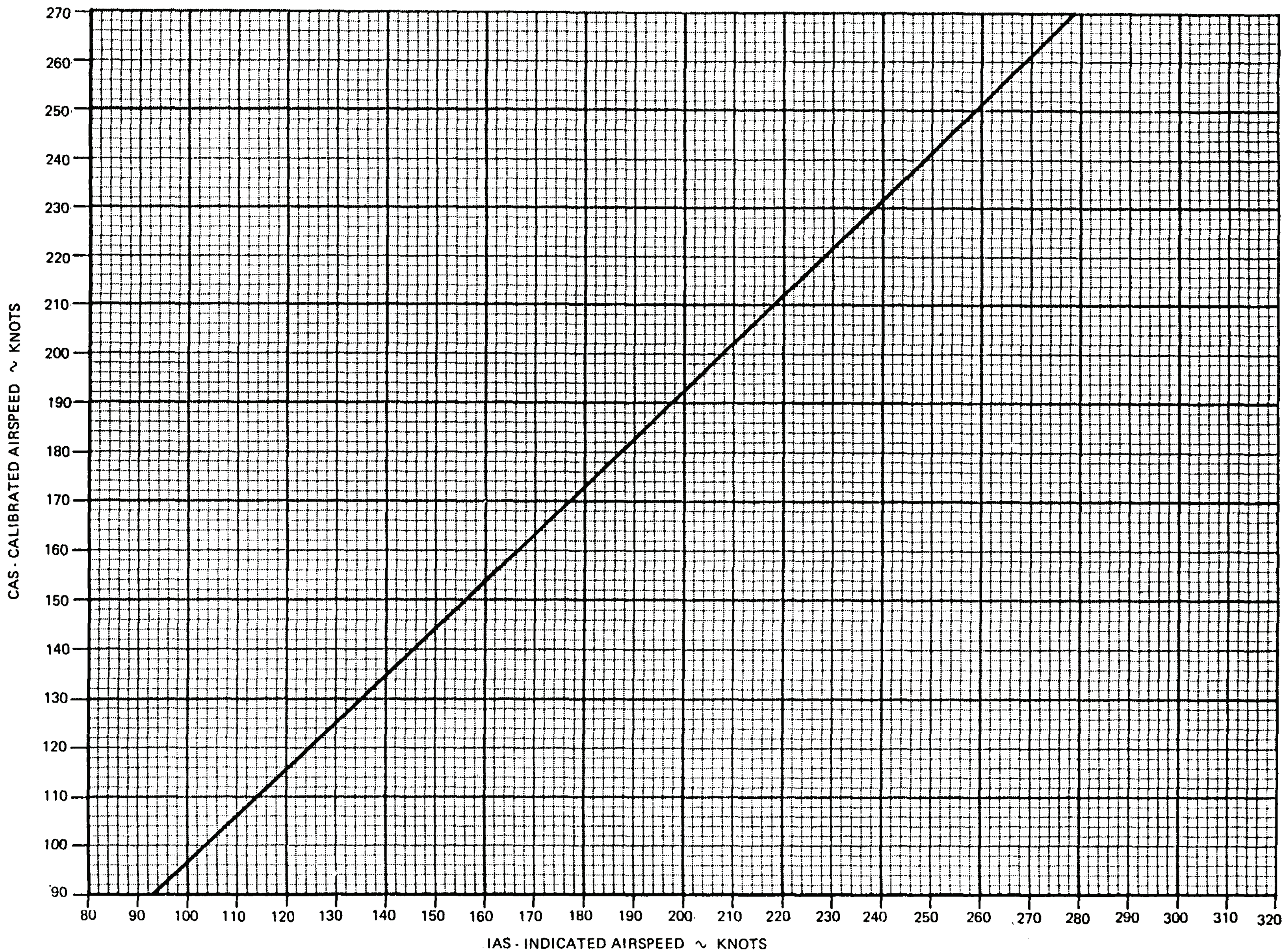


Figure 7A-8. Airspeed Calibration – Alternate System

ALTIMETER CORRECTION – ALTERNATE SYSTEM

APPLICABLE FOR ALL FLAP POSITIONS

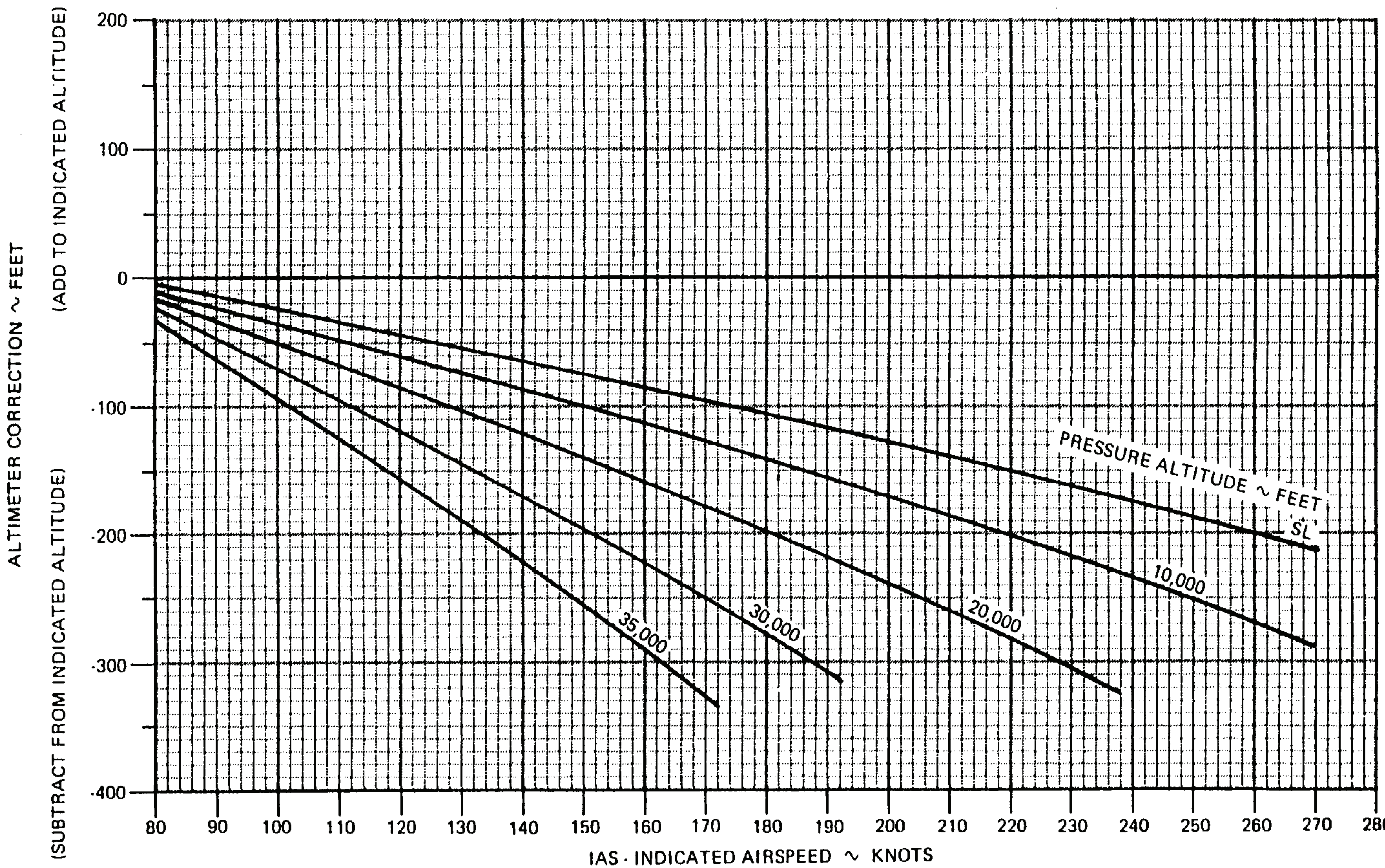


Figure 7A-9. Altimeter Correction – Alternate System

INDICATED OUTSIDE AIR TEMPERATURE CORRECTION

STANDARD DAY (ISA)

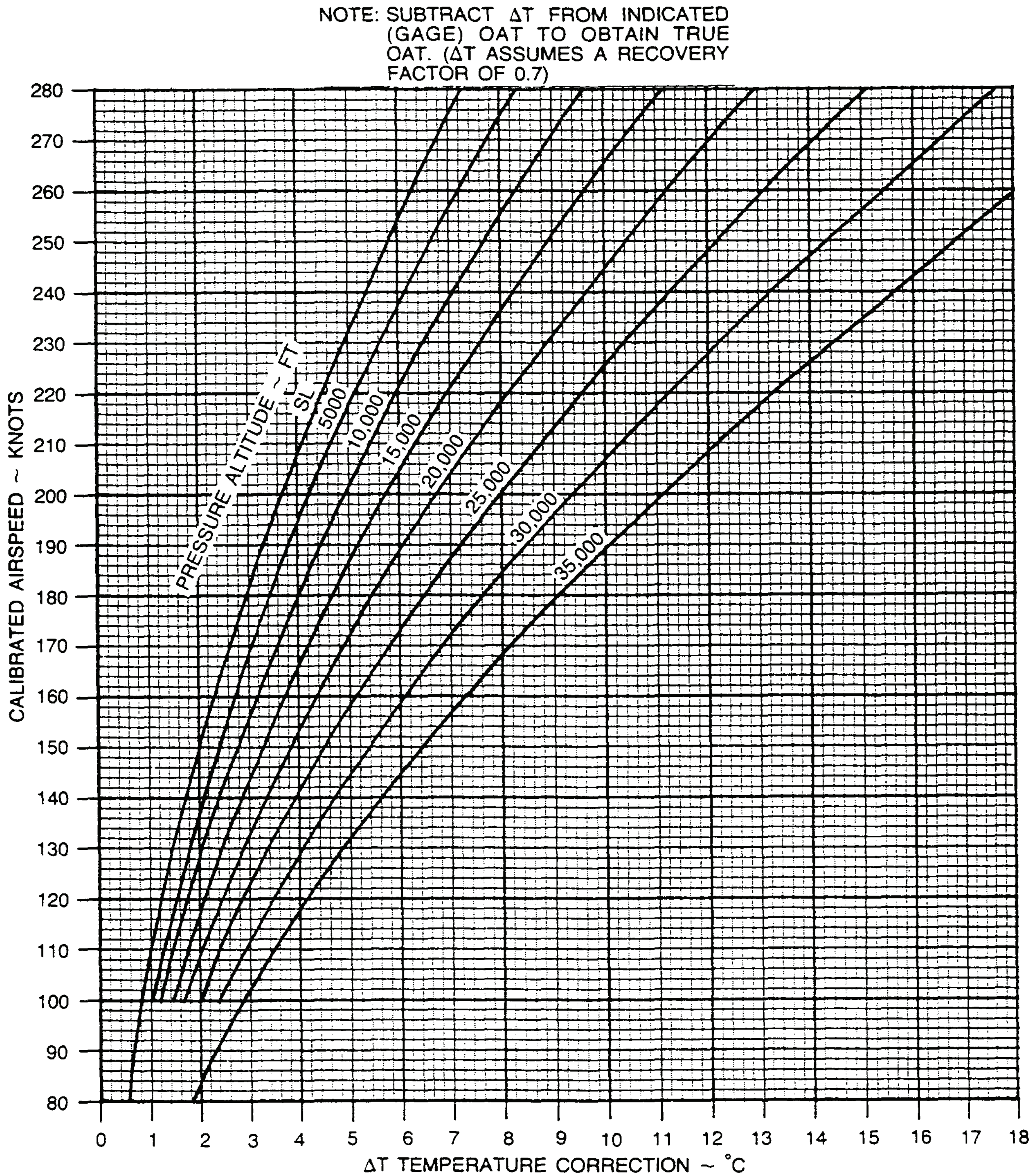


Figure 7A-10. Indicated Outside Air Temperature Correction – ISA

ISA CONVERSION

PRESSURE ALTITUDE vs OUTSIDE AIR TEMPERATURE

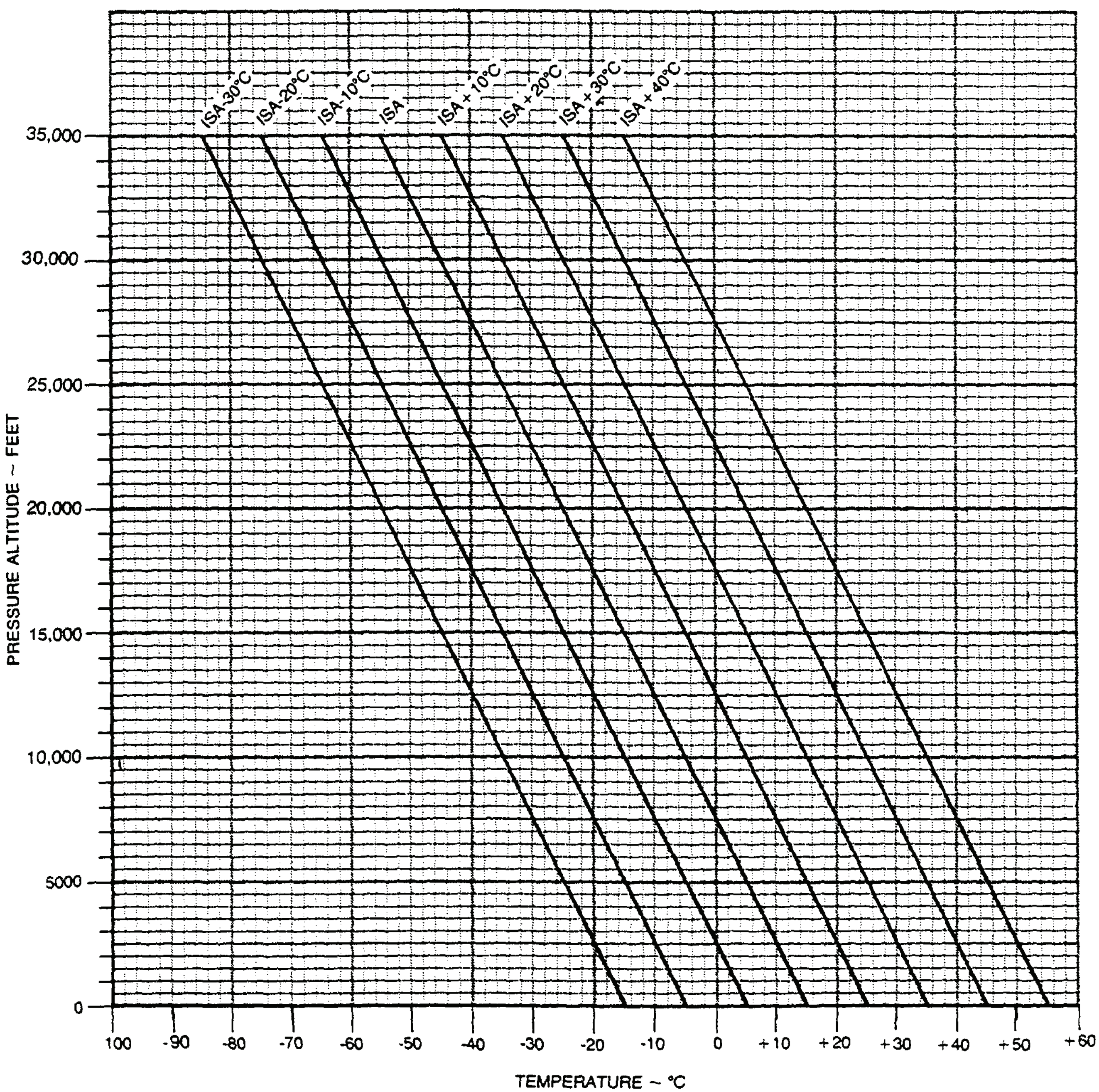


Figure 7A-11. ISA Conversion

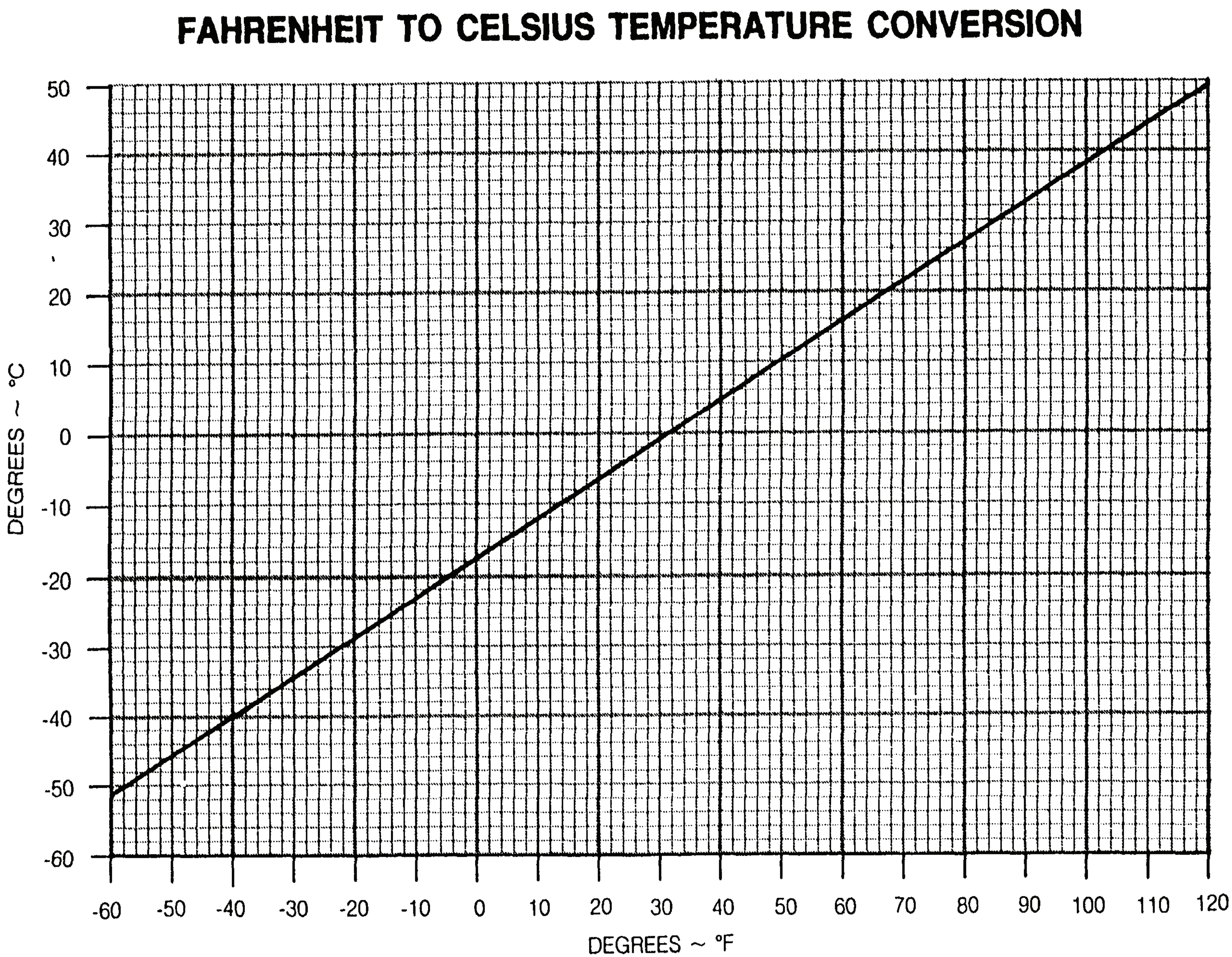


Figure 7A-12. Fahrenheit to Celsius Temperature Conversion

STALL SPEEDS-POWER IDLE

NOTES:

1. MAXIMUM ALTITUDE LOSS DURING ABNORMAL STALL RECOVERY IS APPROXIMATELY 1000 FEET.
2. MAXIMUM NOSE DOWN PITCH ATTITUDE AND ALTITUDE LOSS DURING RECOVERY FROM ONE ENGINE INOPERATIVE STALLS PER FAR 23.205 ARE APPROXIMATELY 20° AND 850 FEET RESPECTIVELY.
3. A NORMAL STALL RECOVERY TECHNIQUE MAY BE USED. THE BEST PROCEDURE IS A BRISK FORWARD WHEEL MOVEMENT TO A NOSE DOWN ATTITUDE. LEVEL THE AIRPLANE AFTER AIRSPEED HAS INCREASED APPROXIMATELY 25 KNOTS ABOVE STALL.

EXAMPLE:

WEIGHT .... 11,700 LBS
FLAPS .... APPROACH
ANGLE OF BANK .... 30°

STALL SPEED .... 95 KTS CAS
90 KTS IAS

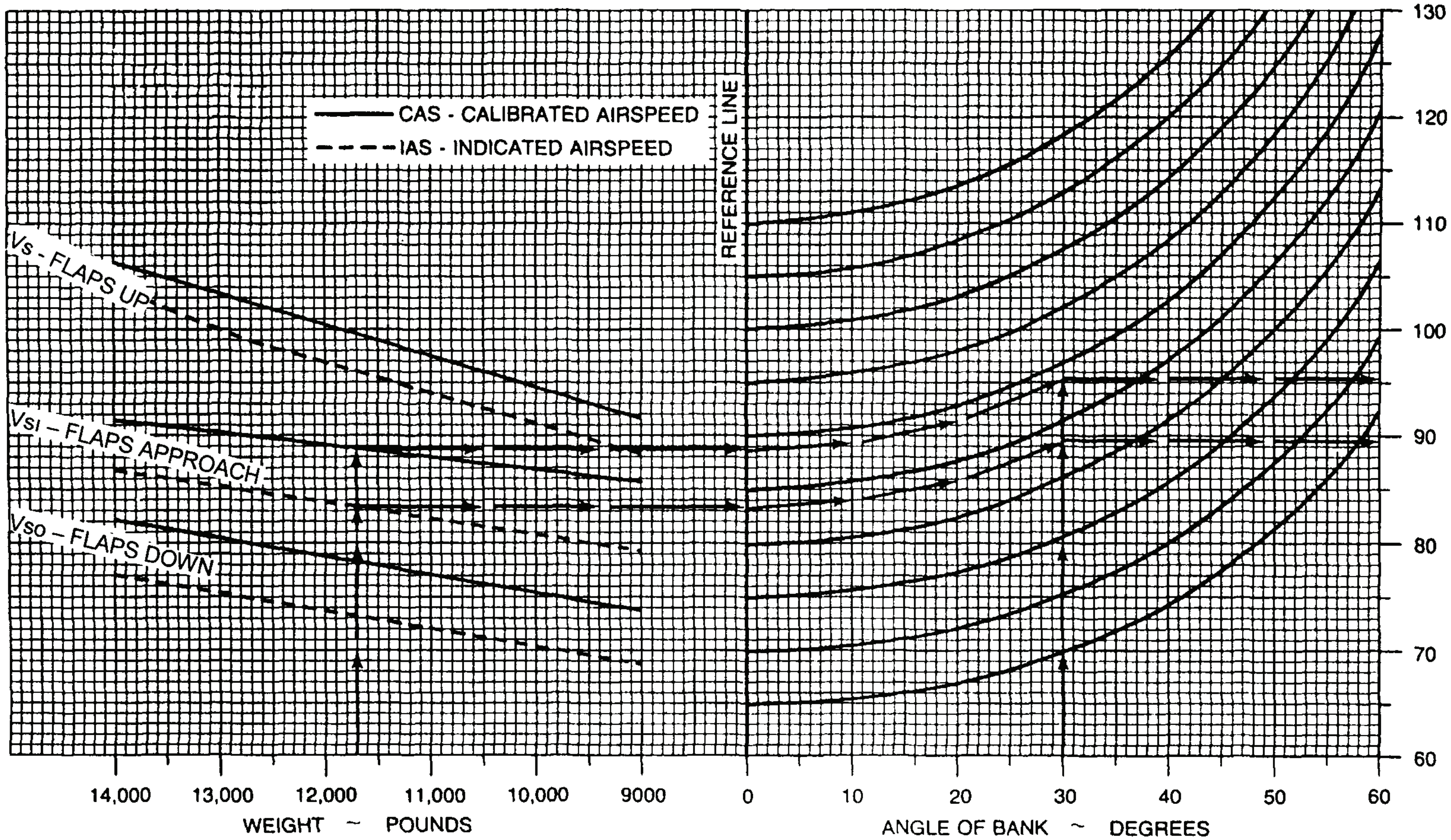


Figure 7A-13. Stall Speeds – Power Idle

CABIN ALTITUDE FOR VARIOUS AIRPLANE ALTITUDES

EXAMPLE:

AIRPLANE ALTITUDE .... 25,000 FT
CABIN DIFFERENTIAL PRESSURE .... 4.0 PSI

CABIN ALTITUDE .... 11,800 FT

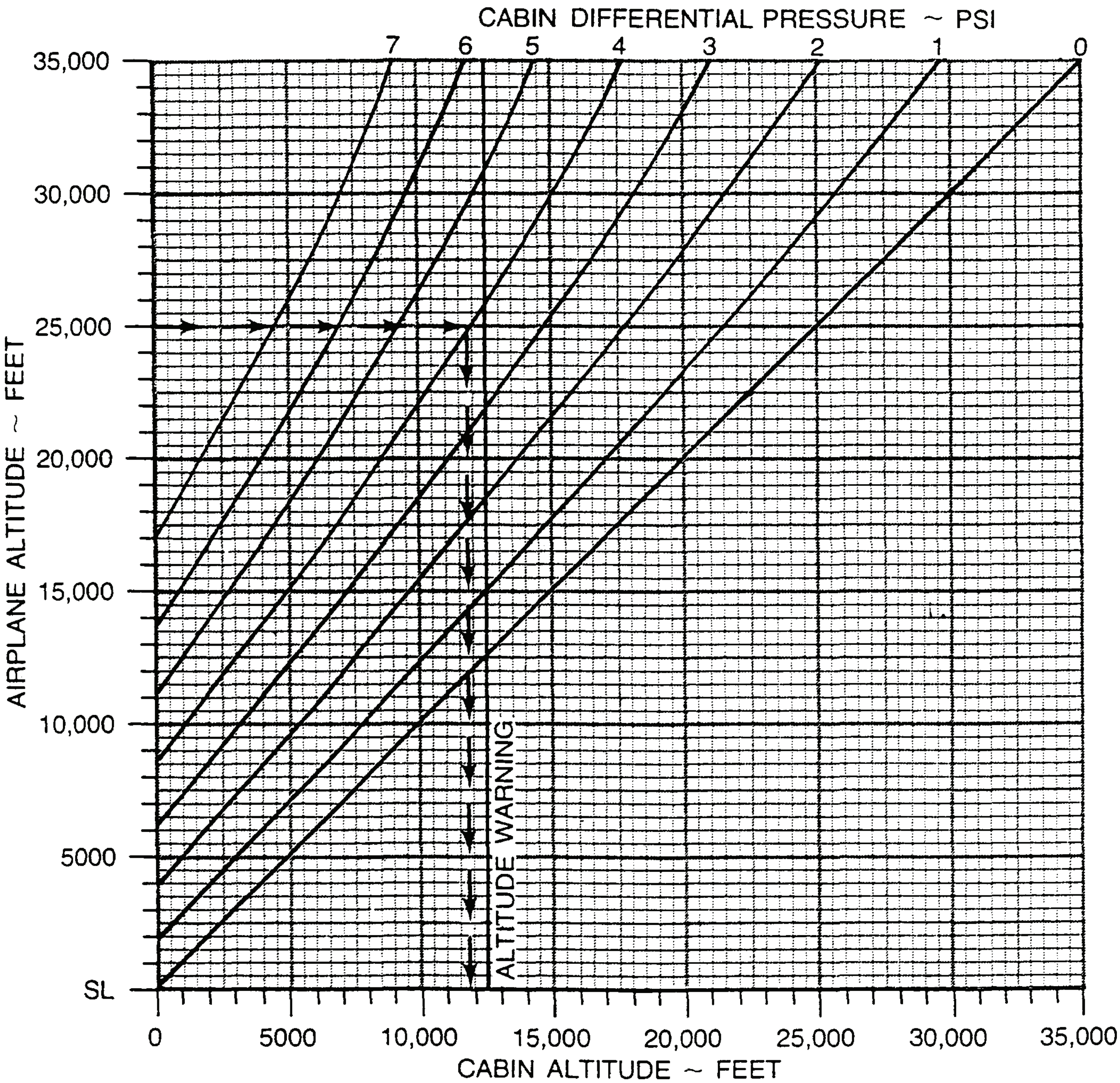


Figure 7A-14. Cabin Altitude for Various Airplane Altitudes

TAKE-OFF WEIGHT - FLAPS UP

TO ACHIEVE POSITIVE ONE-ENGINE INOPERATIVE CLIMB AT LIFT-OFF

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF
FLAPS .... UP
LANDING GEAR .... DOWN

EXAMPLE:

PRESSURE ALTITUDE .... 5433 FT
OAT .... 28°C

TAKE-OFF WEIGHT NORMAL
CATEGORY .... 13,550 LBS

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, NO OFF-LOADING IS REQUIRED.

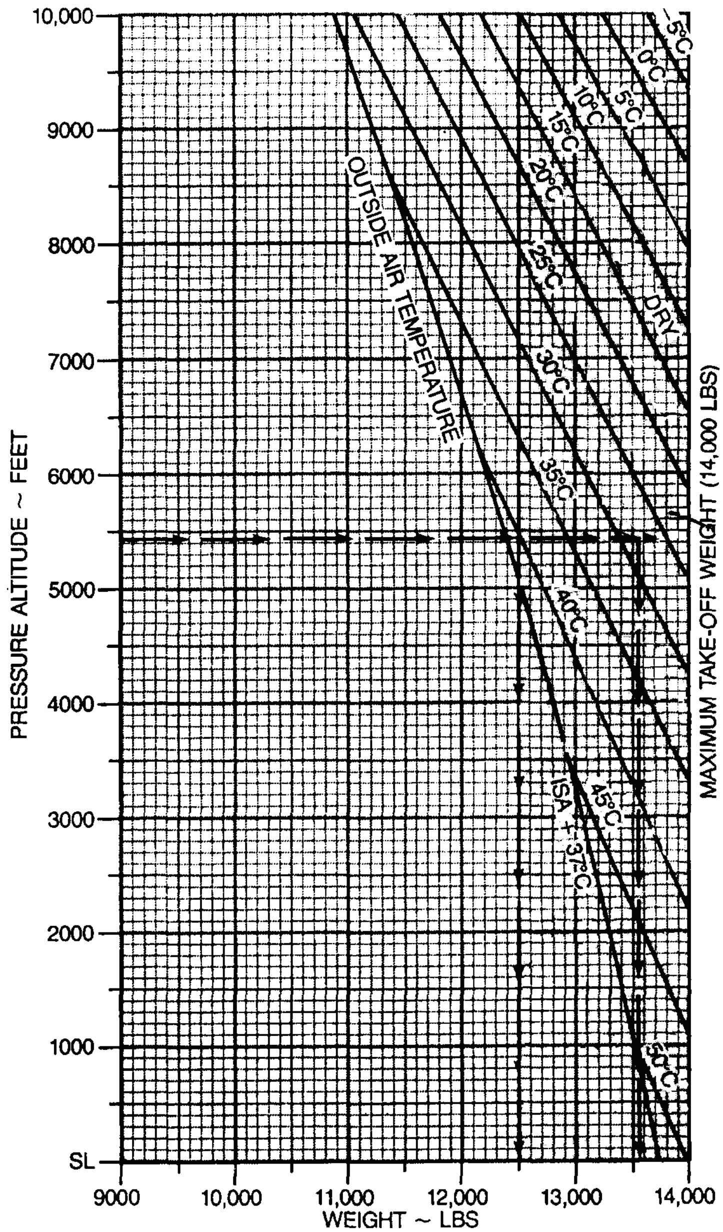


Figure 7A-15. Takeoff Weight to Achieve Positive One-Engine-Inoperative Climb at Lift-Off, Flaps UP

TAKE-OFF WEIGHT - FLAPS APPROACH

TO ACHIEVE POSITIVE ONE-ENGINE INOPERATIVE CLIMB AT LIFT-OFF

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF
FLAPS .... APPROACH
LANDING GEAR .... DOWN

EXAMPLE:

PRESSURE ALTITUDE .... 5433 FT
OAT .... 28°C

TAKE-OFF WEIGHT.................. 12,340 LBS

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, ADD 10°C TO THE ACTUAL OAT BEFORE ENTERING GRAPH

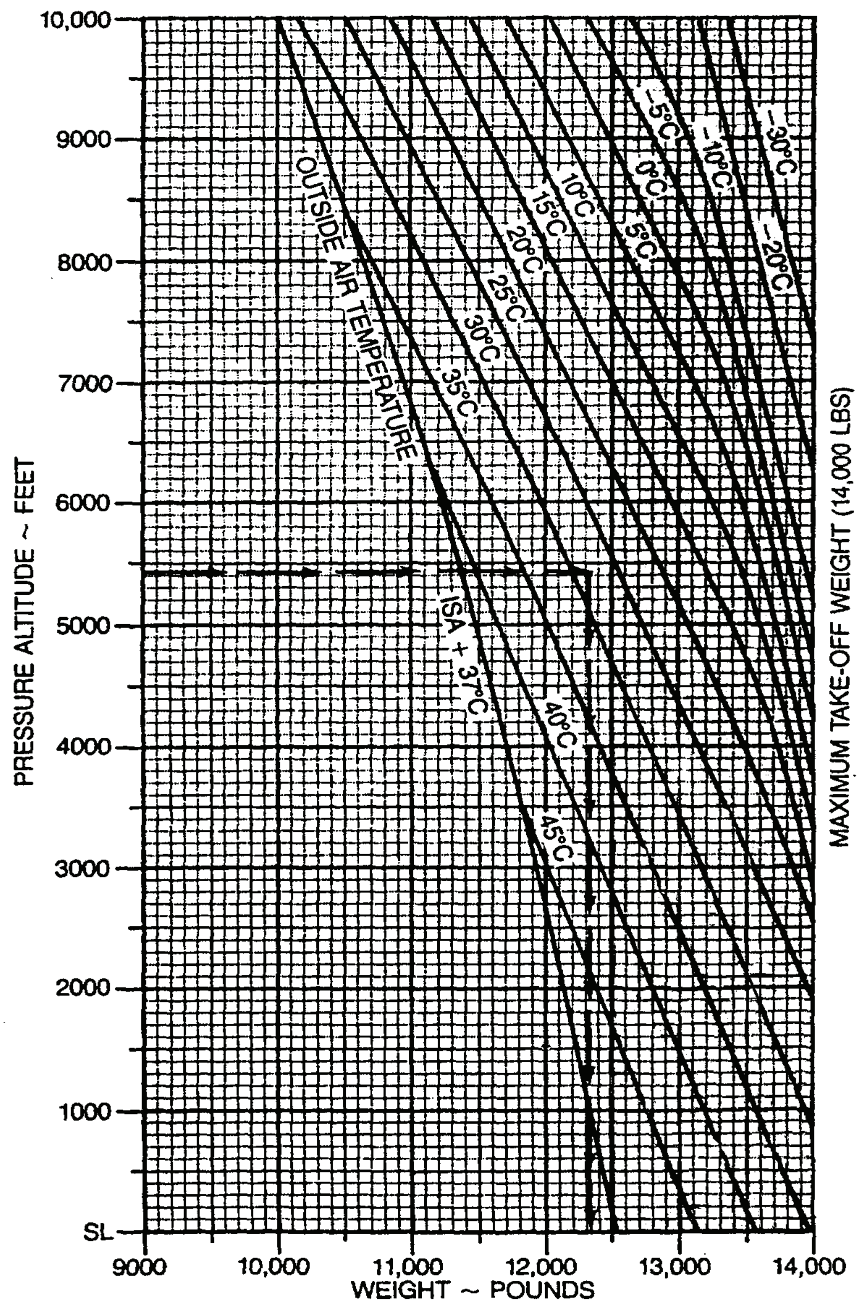


Figure 7A-16. Takeoff Weight to Achieve Positive One-Engine-Inoperative Climb at Lift-Off, Flaps APPROACH

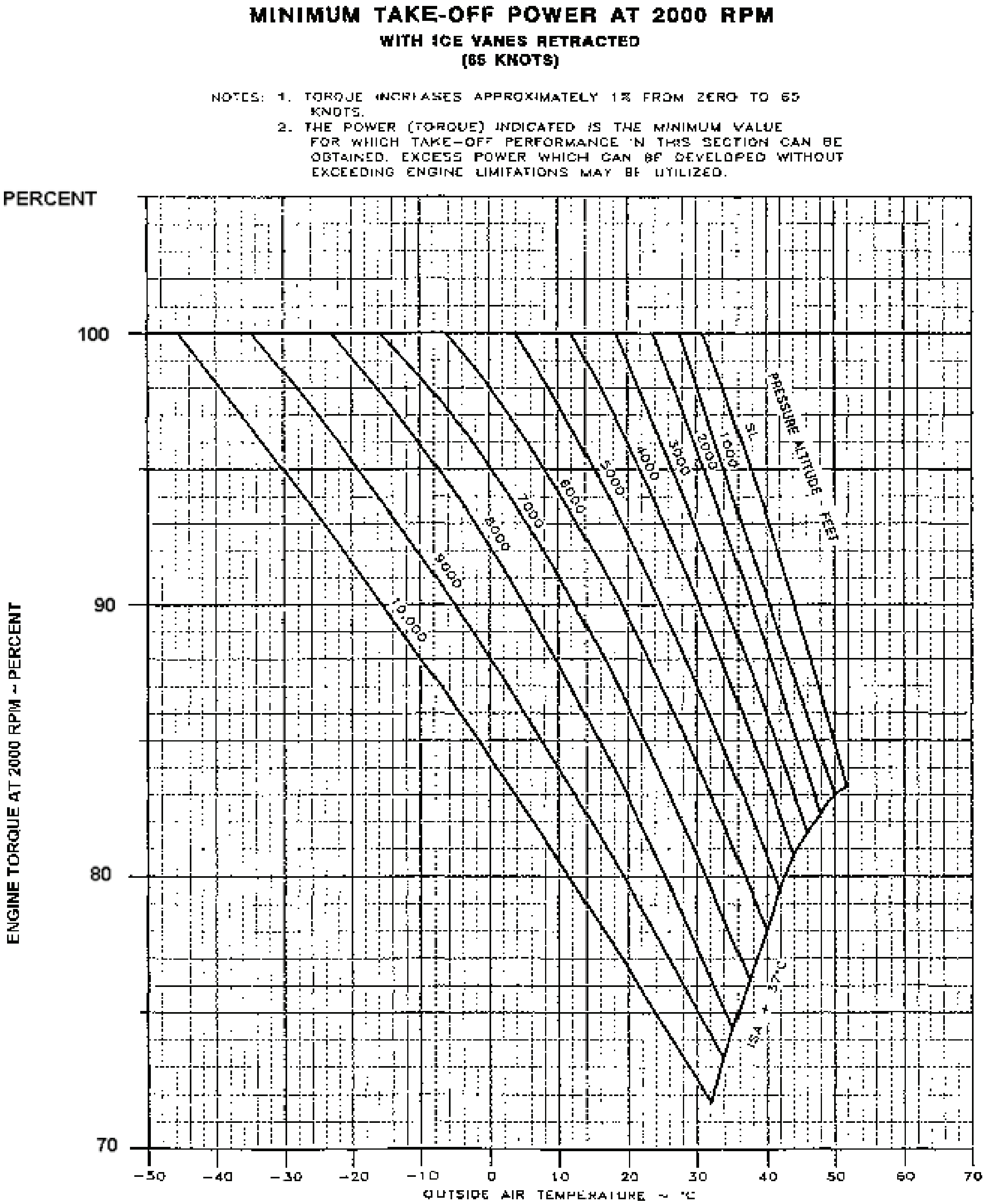


Figure 7A-17. Minimum Takeoff Power at 2000 RPM With Ice Vanes Retracted (65 Knots)

MINIMUM TAKE-OFF POWER
WITH ICE VANES EXTENDED
(65 KNOTS)

NOTES:
1. TORQUE INCREASES APPROXIMATELY 1% FROM ZERO TO 65 KNOTS.
2. THE POWER (TORQUE) INDICATED IS THE MINIMUM VALUE AT 65 KNOTS FOR WHICH TAKE-OFF PERFORMANCE IN THIS SECTION CAN BE OBTAINED. TORQUE WILL CONTINUE TO INCREASE ABOVE 65 KNOTS.
3. TAKE-OFF WITH VANES EXTENDED ABOVE +15° IS PROHIBITED.

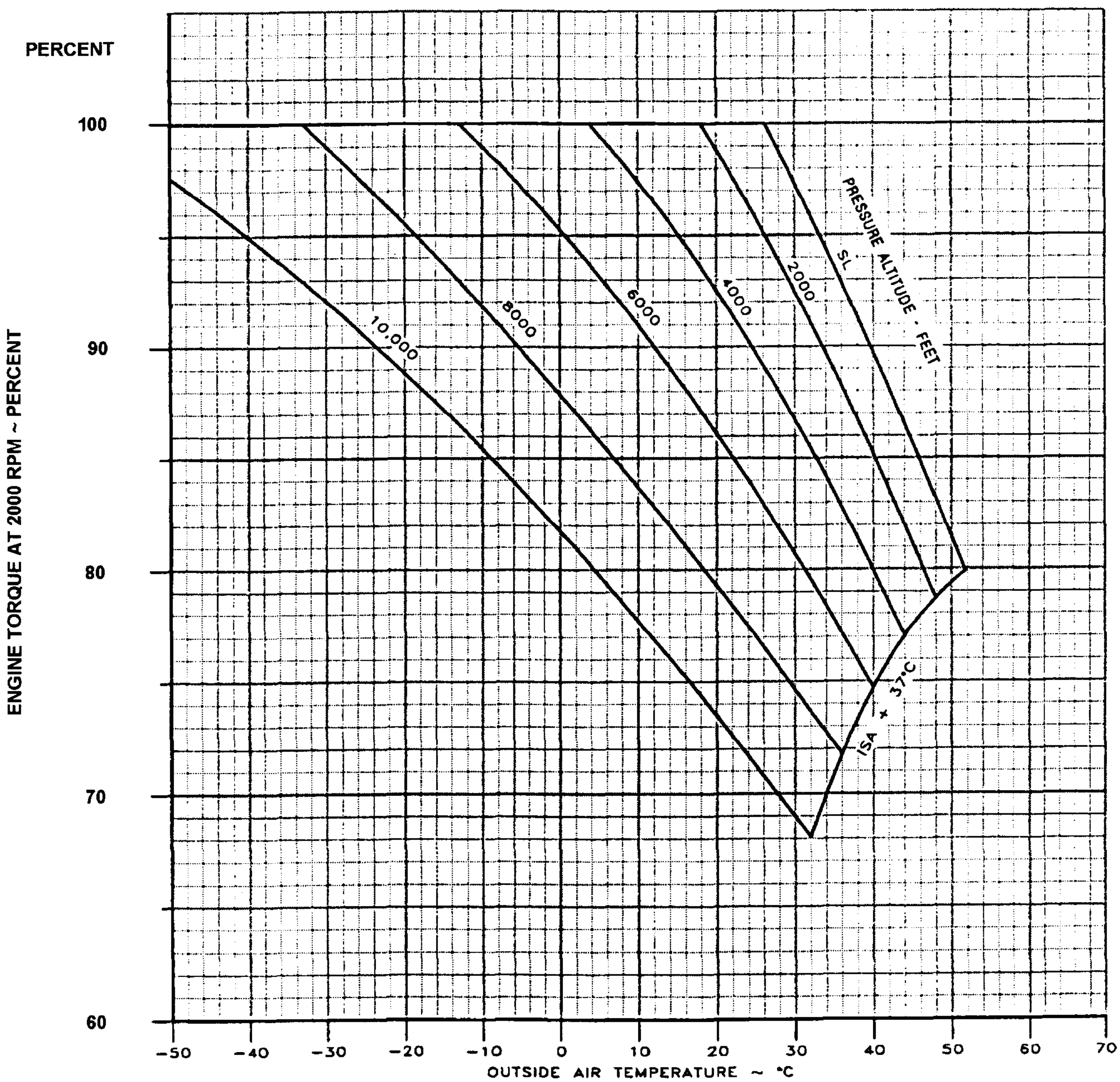


Figure 7A-18. Minimum Takeoff Power With Ice Vanes Extended (65 Knots)

TAKE-OFF FLIGHT PATH

REFERENCE ZERO: THE POINT AT THE END OF THE TAKE-OFF RUN AT WHICH THE AIRPLANE IS 35 FEET ABOVE THE RUNWAY SURFACE.

EXAMPLE:

OBSTACLE HEIGHT . . . . 175 FEET

HORIZONTAL DISTANCE FROM REFERENCE ZERO ~ FEET	MINIMUM GRADIENT OF CLIMB ~ %
2700	5.2

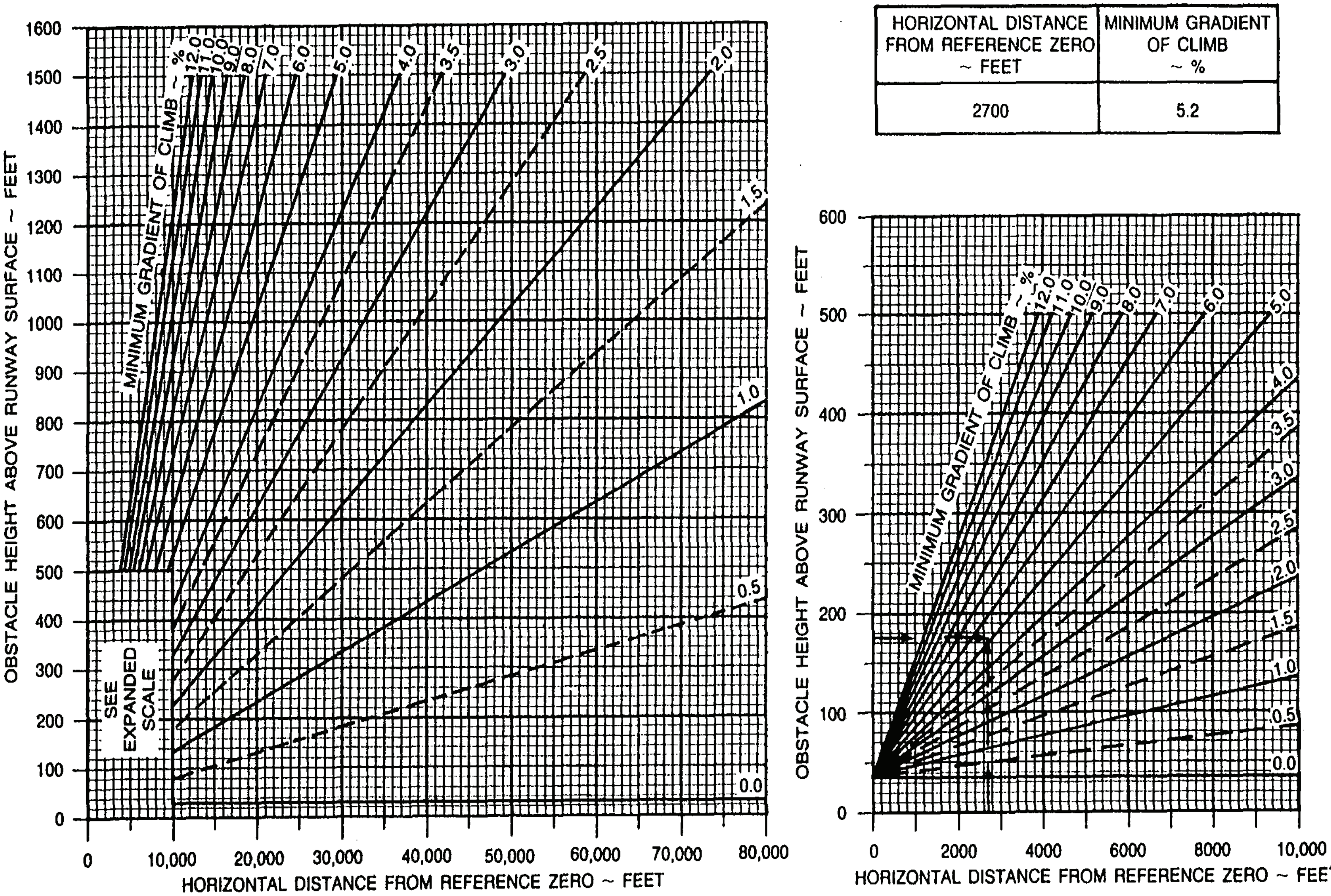


Figure 7A-19. Takeoff Flight Path

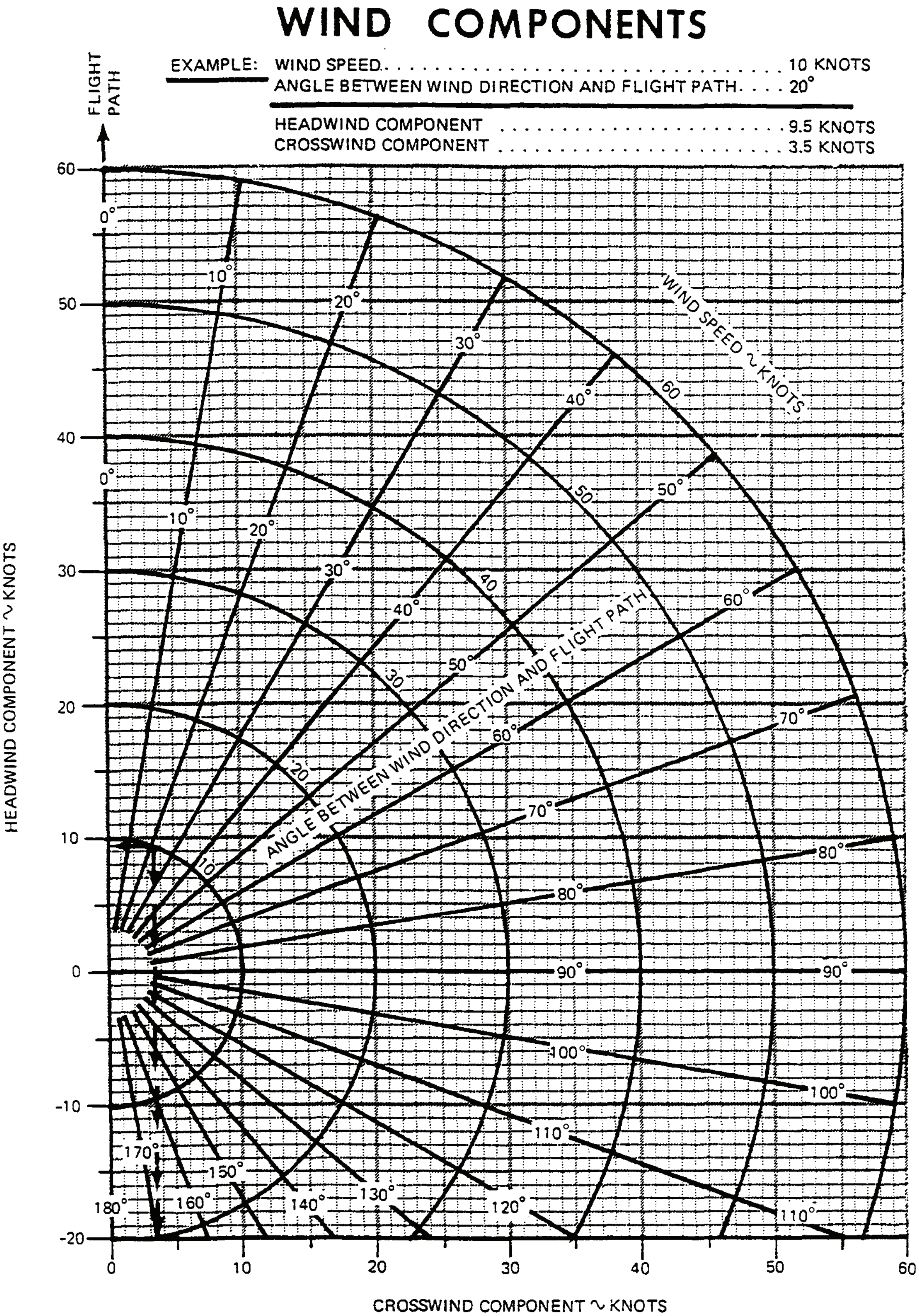


Figure 7A-20. Wind Component

TAKE-OFF DISTANCE* - FLAPS UP

ASSOCIATED CONDITIONS:

POWER............. TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS.............. UP
LANDING GEAR...... RETRACT AFTER LIFT-OFF
RUNWAY............ PAVED, LEVEL, DRY SURFACE

* NOTE: ADD OR SUBTRACT 5% OF TAKE-OFF GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE, (DOWN - SUBTRACT, UP - ADD).

WEIGHT ~ POUNDS	TAKE-OFF SPEEDS ~ KNOTS	
	V_1**	V_2
14,000	117	126
13,000	113	123
12,500	111	121
12,000	109	120
11,000	105	115
10,000	101	111
9000	98	108

** NOTE: $V_1 = V_r$

EXAMPLE:

OAT.................................. 28°C
PRESSURE ALTITUDE.................. 5433 FT
TAKE-OFF WEIGHT.................... 12,500 LBS
HEADWIND COMPONENT.............. 9.5 KTS

GROUND ROLL......................... 3800 FT
TOTAL DISTANCE OVER 50 FT OBSTACLE...................... 5100 FT
TAKE-OFF SPEED AT ROTATION........ 111 KTS
V_2.................................. 121 KTS

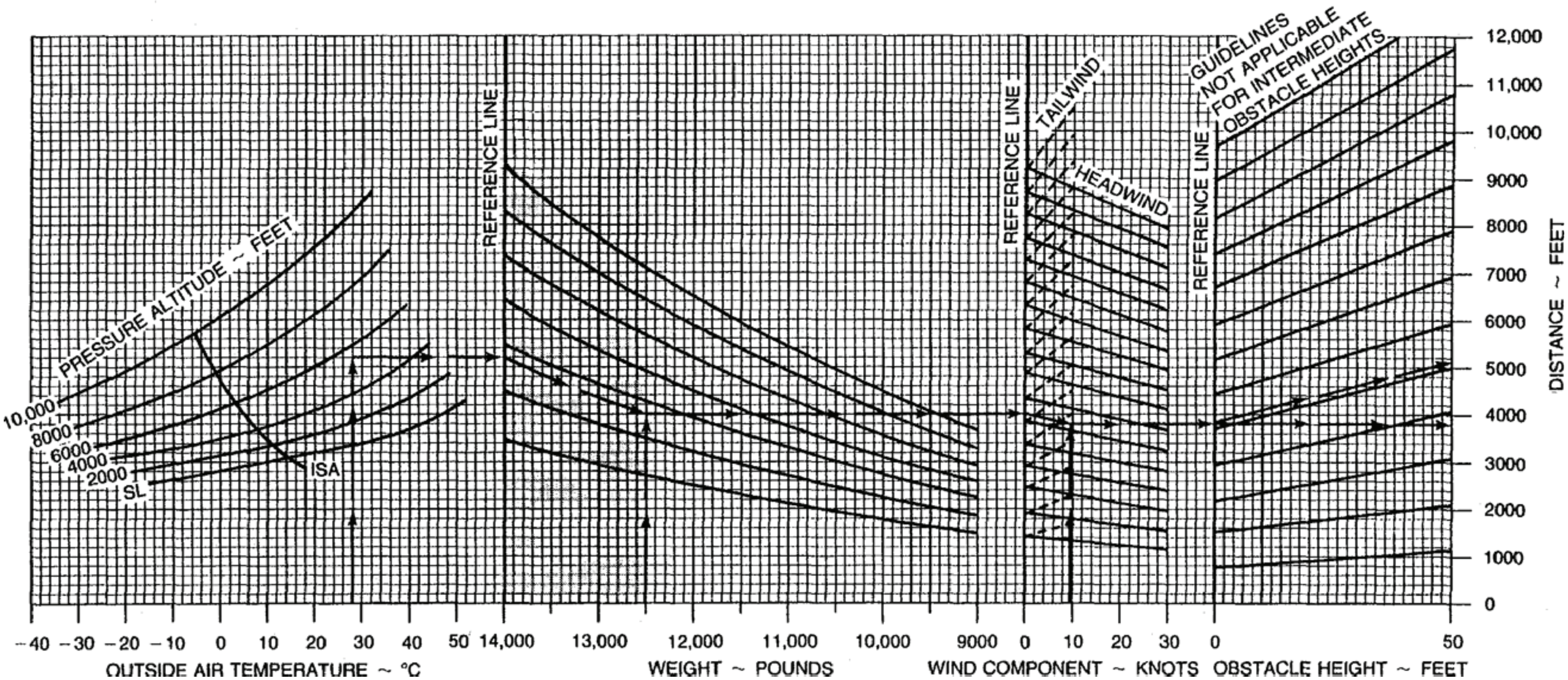


Figure 7A-21. Take-Off Distance, Flaps UP

ACCELERATE-STOP – FLAPS – UP

ASSOCIATED CONDITIONS:

POWER .... 1. TAKE-OFF POWER SET BEFORE BRAKE RELEASE
2. BOTH ENGINES IDLE AT V_1 SPEED AND REVERSE OPERATING ENGINE

FLAPS.............. UP
BRAKING.............MAXIMUM
RUNWAY.............PAVED, LEVEL DRY SURFACE

WEIGHT~POUNDS	V_1~KNOTS
14,000	117
13,000	113
12,500	111
12,000	109
11,000	105
10,000	101
9,000	98

EXAMPLE:

OAT... 30°C
PRESSURE ALTITUDE..................... 4000

FIELD LENGTH **AVAILABLE**.............. 6000
V_1 .... 112 KTS
WEIGHT 12,800 LBS

*NOTE: ADD OR SUBTRACT 2% OF TOTAL DISTANCE FOR EACH 1% OF RUNWAY SLOPE (DOWN – SUBTRACT, UP – ADD).

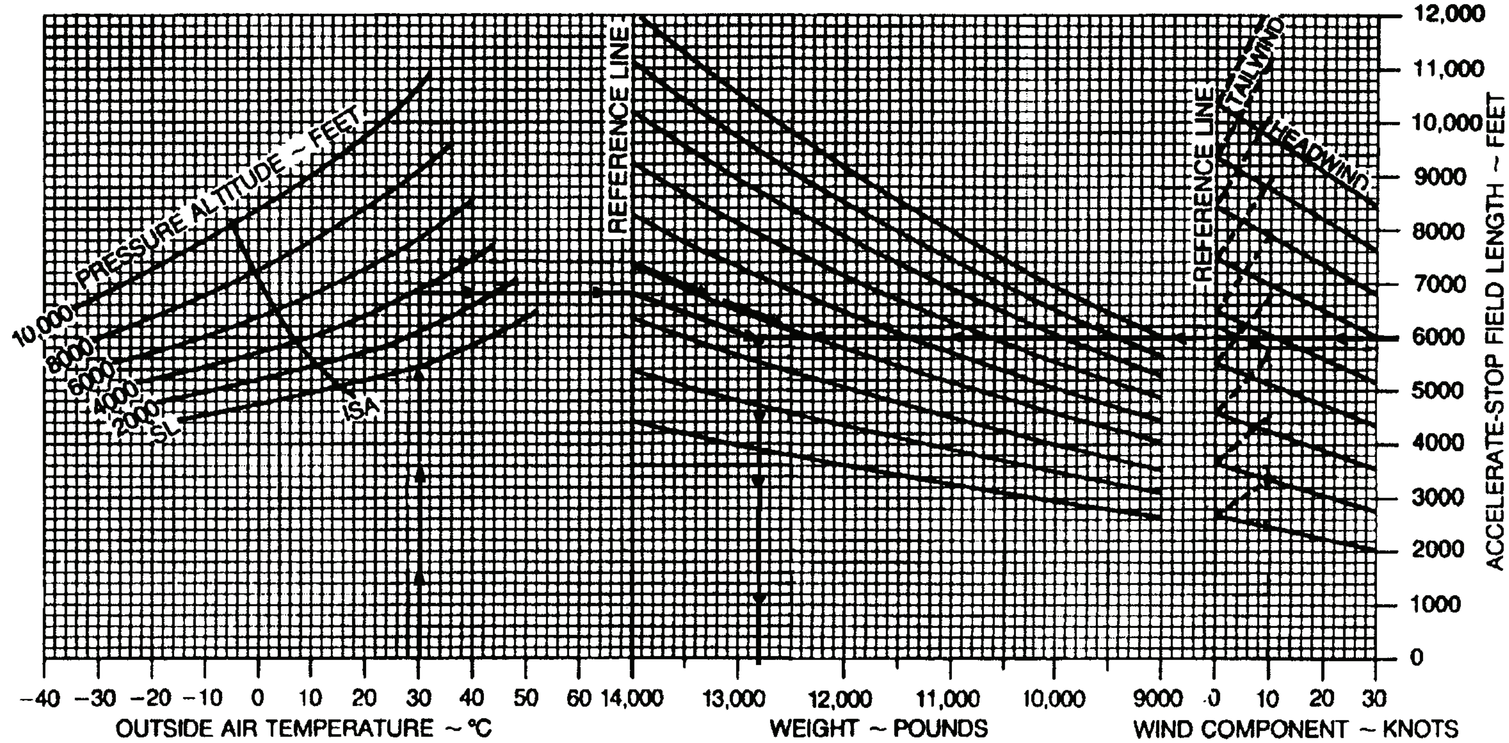


Figure 7A-22. Accelerate – Stop, Flaps UP

ACCELERATE - GO - FLAPS UP

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS .... UP
AUTOFEATHER .... ARMED
LANDING GEAR .... RETRACT AFTER LIFT-OFF
RUNWAY .... PAVED, LEVEL, DRY SURFACE

NOTES:
1. AIR DISTANCE IS 50% OF TAKE-OFF DISTANCE OVER 35-FT OBSTACLE.
2. DISTANCES ASSUME AN ENGINE FAILURE AT ROTATION SPEED AND PROPELLER IMMEDIATELY FEATHERED.
3. USABLE CLEARWAY CANNOT EXCEED 25% OF THE RUNWAY LENGTH.
4. WEIGHTS IN [hatched] AREA MAY NOT MEET FAR 25 REQUIREMENTS. REFER TO TAKE-OFF WEIGHT GRAPH TO MEET FAR 25 REQUIREMENTS.

WEIGHT ~ POUNDS	SPEED ~ KNOTS V_1*	SPEED ~ KNOTS V_2
14,000	117	126
13,000	113	125
12,500	111	121
12,000	109	120
11,000	105	115
10,000	101	111
9000	98	108

*NOTE: $V_1 = V_R$

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT
HEADWIND COMPONENT .... 9.5 KTS

TAKE-OFF WEIGHT ~ POUNDS	TAKE-OFF FIELD LENGTH ~ FEET
12,500	9600
11,280	6786
10,370	5800

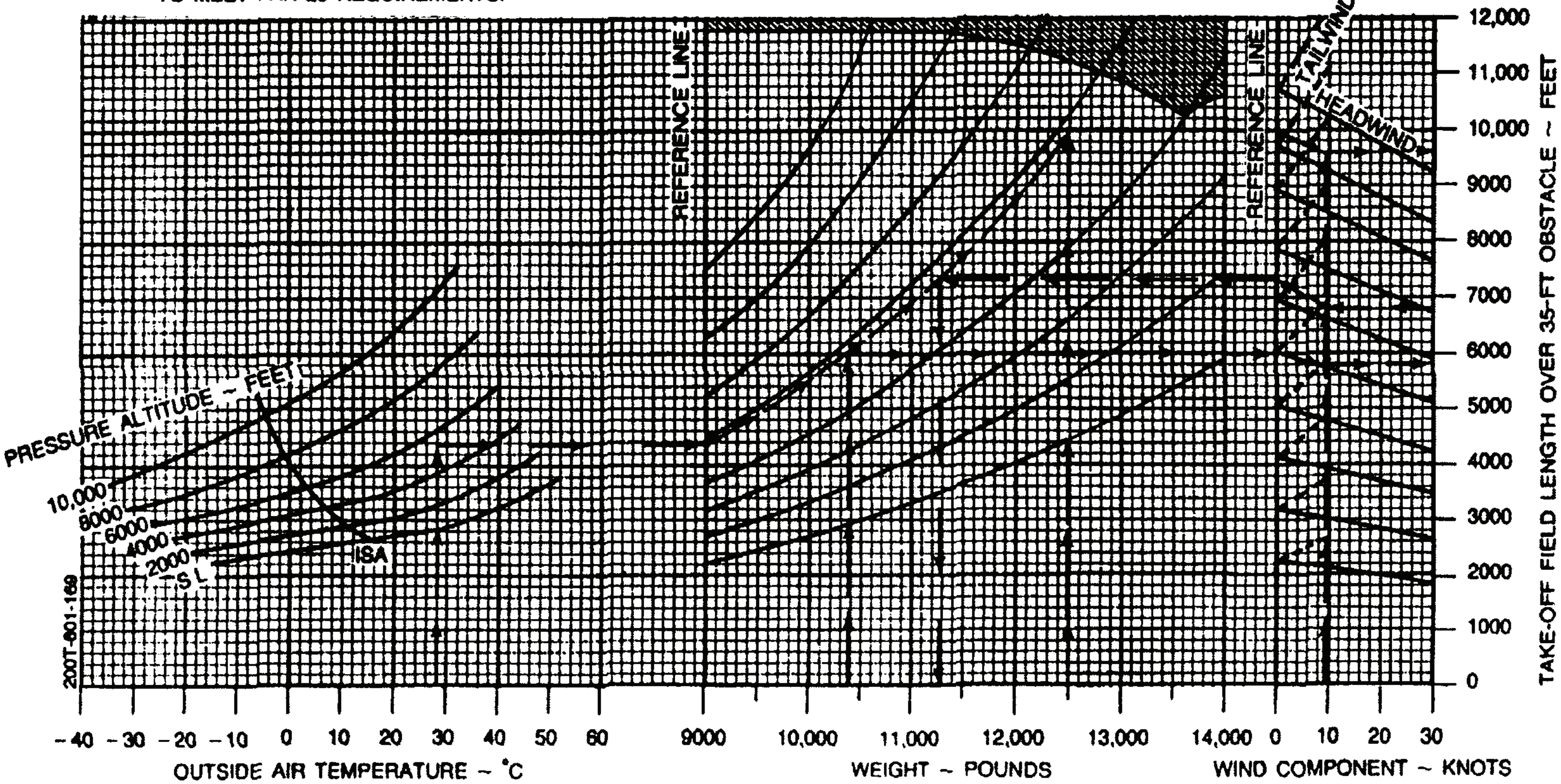


Figure 7A-23. Accelerate – Go, Flaps UP

NET GRADIENT OF CLIMB - FLAPS UP

ASSOCIATED CONDITIONS:

POWER .... TAKEOFF
FLAPS .... UP
GEAR .... UP
INOPERATIVE PROPELLER ...... FEATHERED

WEIGHT ~ POUNDS	CLIMB SPEED(V2) ~ KNOTS
14,000	126
13,000	123
12,500	121
12,000	120
11,000	115
10,000	111
9000	108

NOTE:

NET GRADIENT OF CLIMB
IS EQUAL TO ACTUAL GRADIENT OF CLIMB IN PERCENT MINUS 0.8 PERCENT

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT

TAKE-OFF WEIGHT ~ POUNDS	NET GRADIENT ~ %
11,280	3.0
9380	5.2
10,370	3.9

CLIMB SPEED @ 10,370 LBS .... 112 KTS

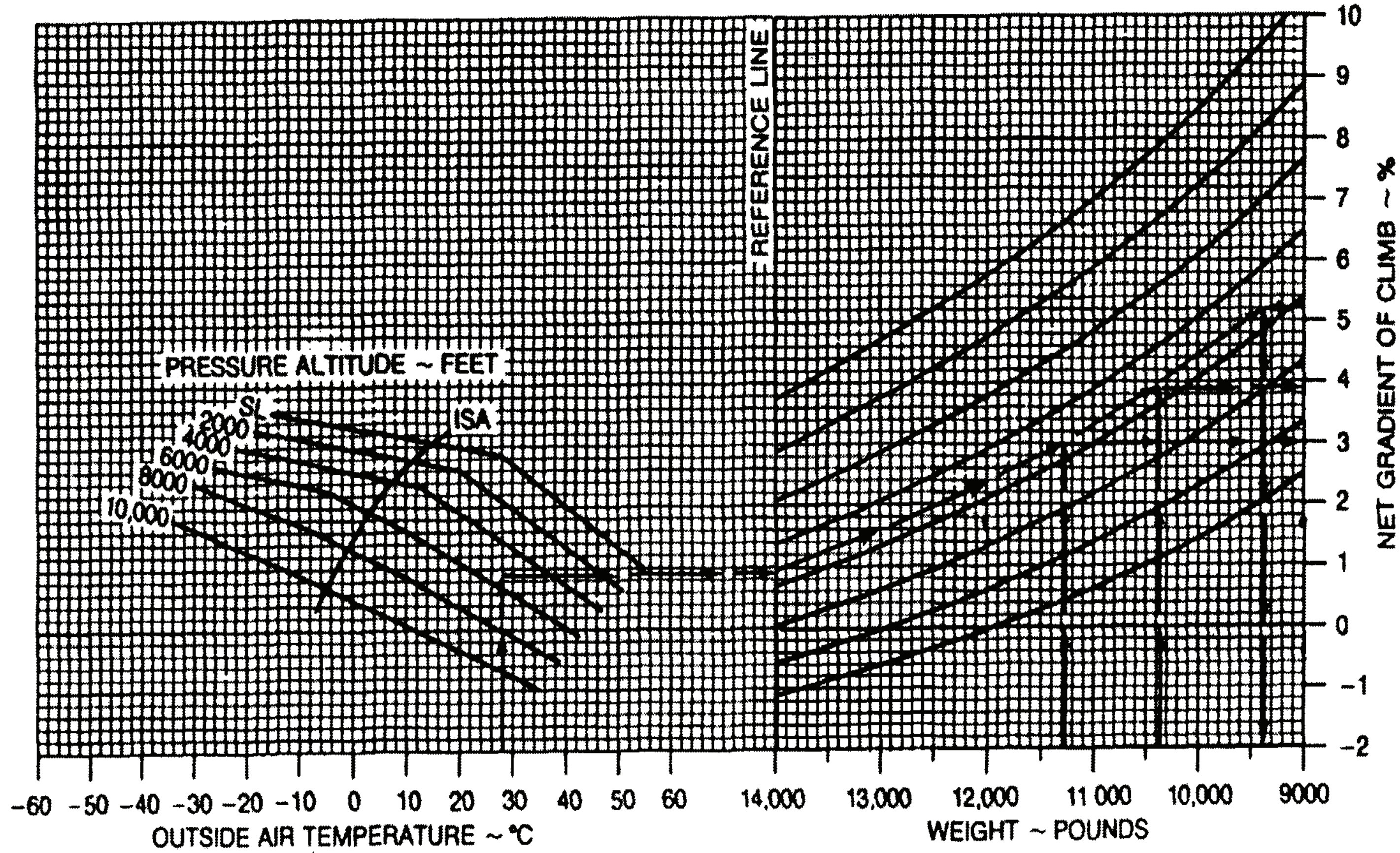


Figure 7A-24. Net Gradient of Climb, Flaps UP

TAKE-OFF DISTANCE* - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER............TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS..............APPROACH
LANDING GEAR......RETRACT AFTER LIFT-OFF
RUNWAY............PAVED, LEVEL, DRY SURFACE

* NOTE: ADD OR SUBTRACT 5% OF TAKE-OFF GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE (DOWN - SUBTRACT, UP - ADD)

WEIGHT ~ POUNDS	TAKE-OFF SPEED ~ KNOTS	
	V_1**	V_X
14,000	98	108
13,000	96	106
12,500	96	105
12,000	95	104
11,000	94	103
10,000	94	101
9000	94	99

**NOTE: $V_1 = V_r$

EXAMPLE:

OAT..............................28°C
PRESSURE ALTITUDE................5433 FT
TAKE-OFF WEIGHT..................12,500 LBS
HEADWIND COMPONENT...............9.5 KTS

GROUND ROLL......................2600 FT
TOTAL DISTANCE OVER 50 FT OBSTACLE.....3750 FT
TAKE-OFF SPEED AT V_1..............96 KTS

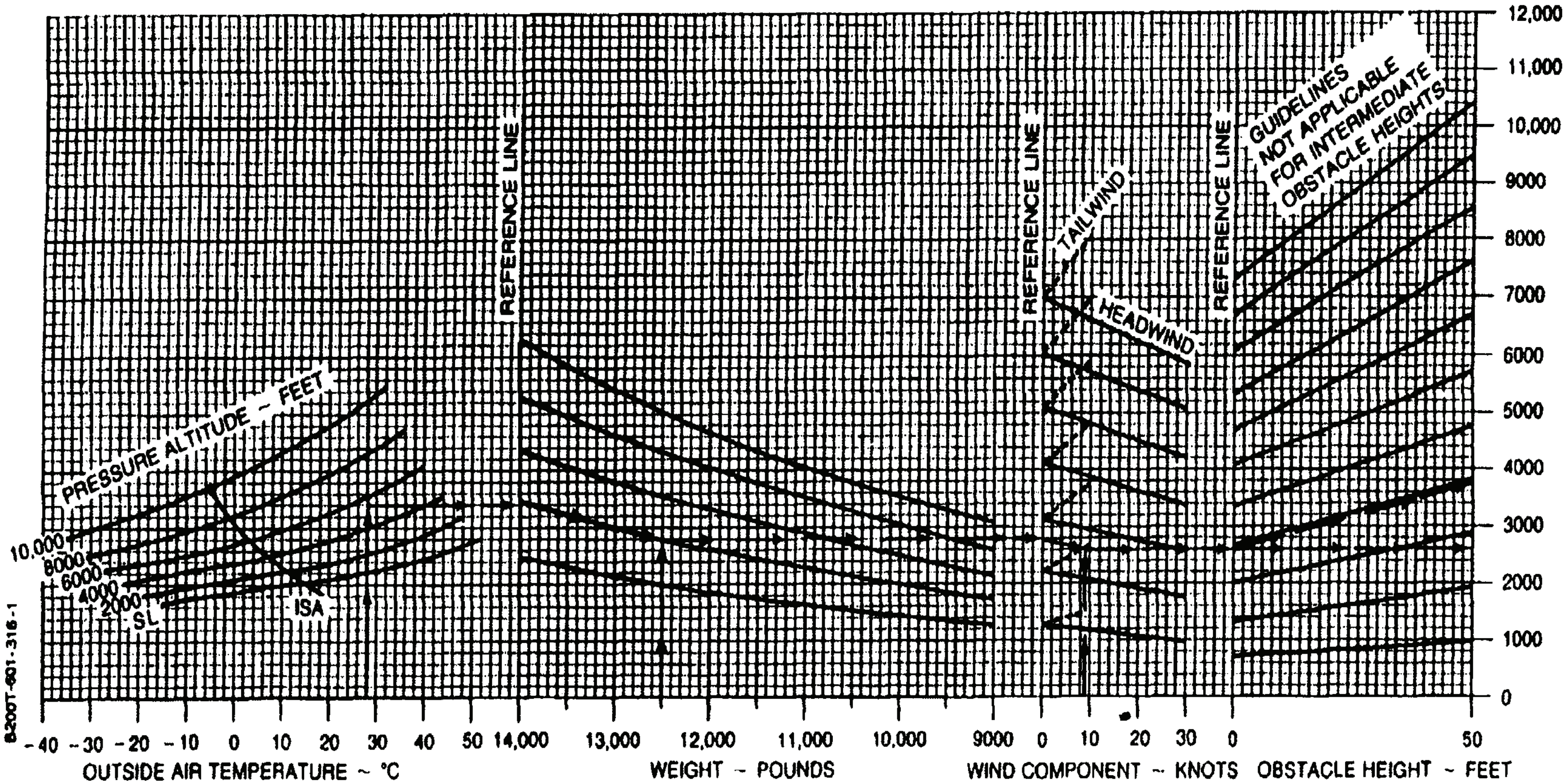


Figure 7A-25. Take-off Distance, Flaps APPROACH

ACCELERATE-STOP - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER .... 1. TAKE-OFF POWER SET BEFORE BRAKE RELEASE
2. BOTH ENGINES IDLE AT V_1 SPEED AND REVERSE OPERATING ENGINE
FLAPS .... APPROACH
AUTOFEATHER . ARMED
BRAKING .... MAXIMUM
RUNWAY .... PAVED, LEVEL, DRY SURFACE

WEIGHT ~ POUNDS	V_1 ~ KNOTS
14,000	98
13,000	98
12,500	96
12,000	95
11,000	94
10,000	94
9000	94

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT
WEIGHT .... 11,820 LBS
HEADWIND COMPONENT .... 9.5 KTS

FIELD LENGTH .... 4300 FT *
V_1 .... 95 KTS

* NOTE: ADD OR SUBTRACT 2% OF TOTAL DISTANCE FOR EACH 1% OF RUNWAY SLOPE (DOWN - SUBTRACT, UP - ADD).

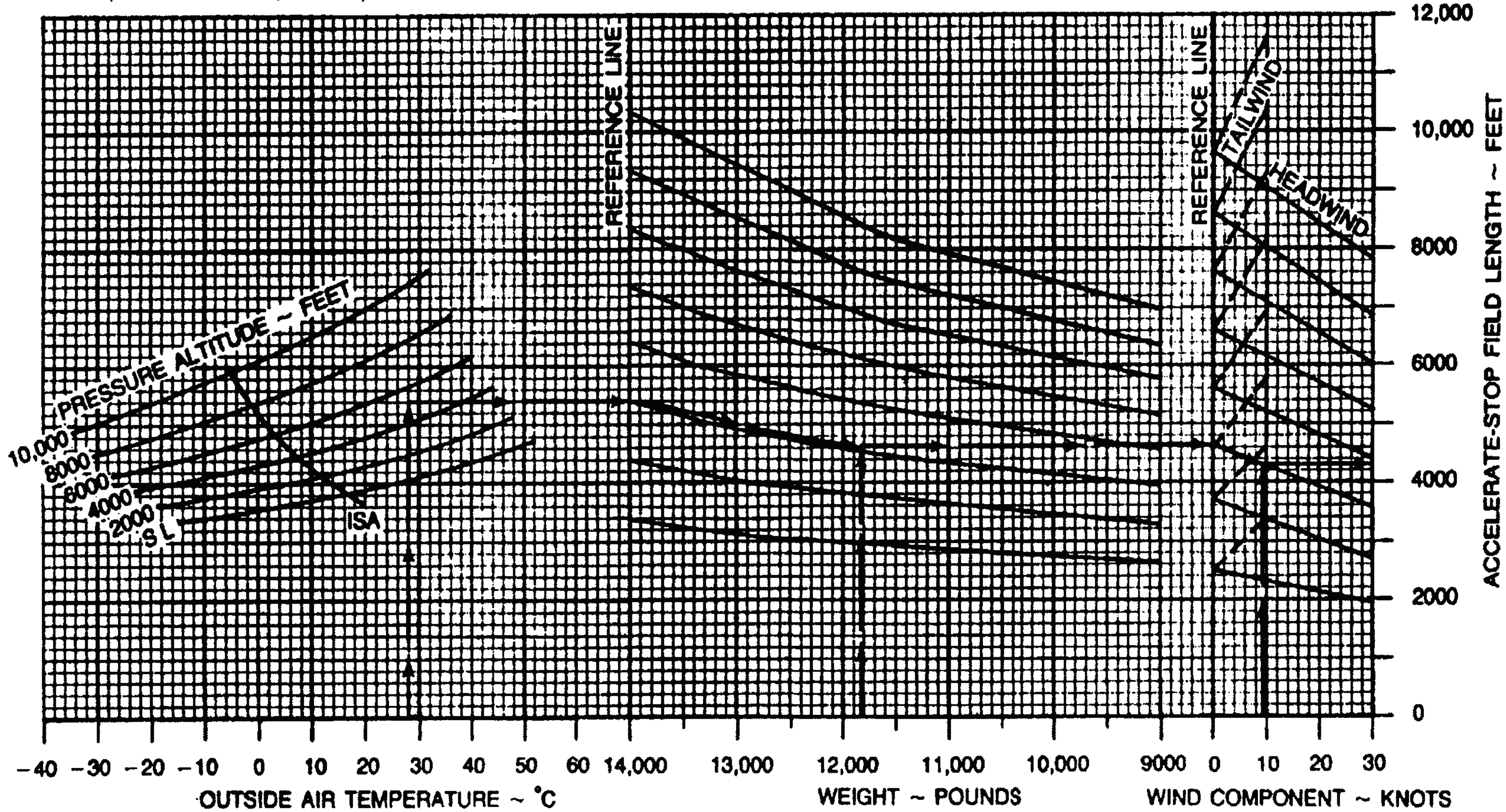


Figure 7A-26. Accelerate – Stop Flaps APPROACH

ACCELERATE-GO - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF POWER SET BEFORE BRAKE RELEASE
FLAPS .... APPROACH
AUTOFEATHER .... ARMED
LANDING GEAR .... RETRACT AFTER LIFT-OFF
RUNWAY .... PAVED, LEVEL, DRY SURFACE

NOTES:

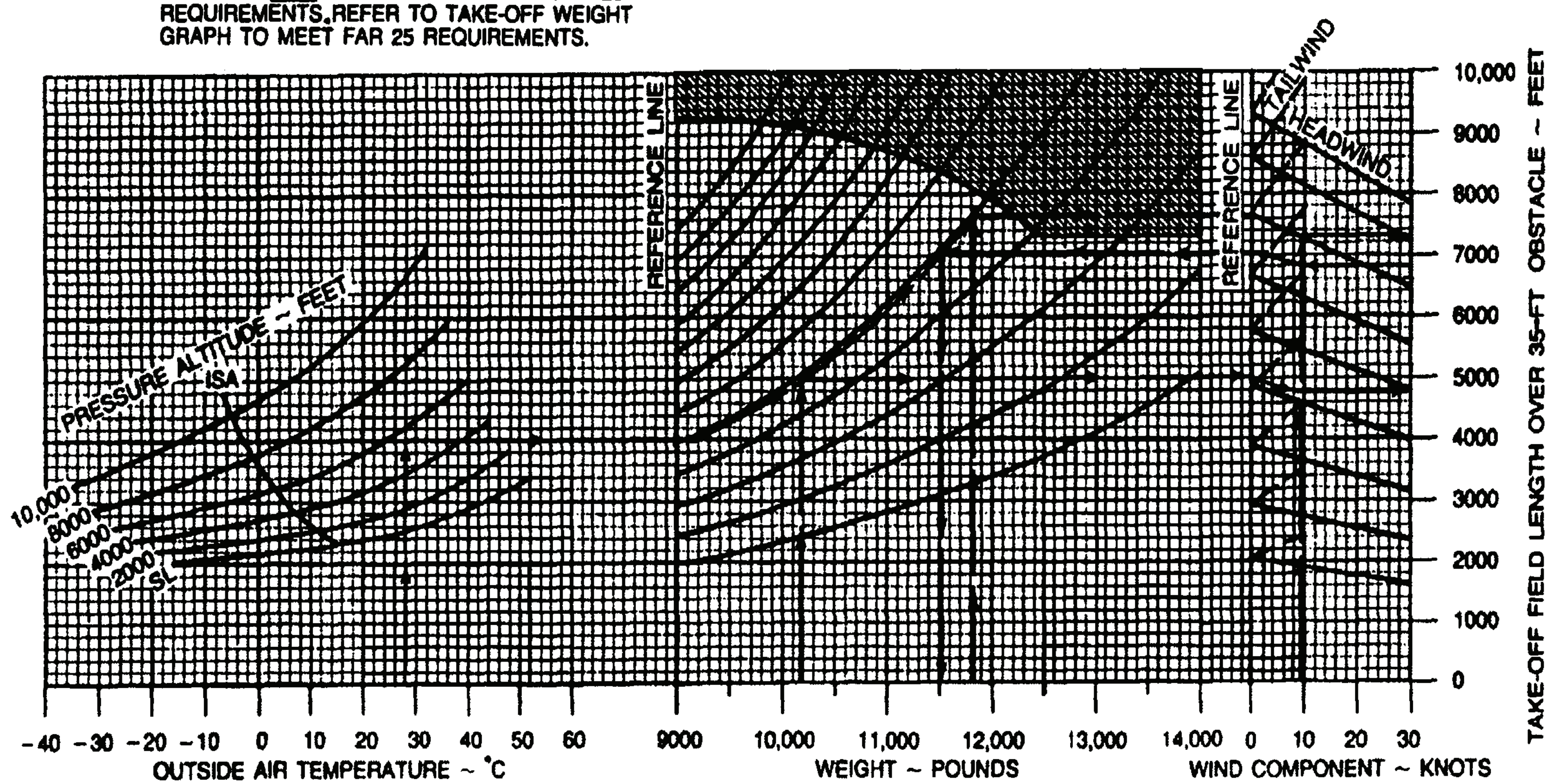
1. AIR DISTANCE IS 60% OF TAKE-OFF DISTANCE OVER 35-FT OBSTACLE.
2. DISTANCES ASSUME AN ENGINE FAILURE AT ROTATION SPEED AND PROPELLER IMMEDIATELY FEATHERED.
3. USABLE CLEARWAY CANNOT EXCEED 25% OF THE RUNWAY LENGTH.
4. WEIGHTS IN [hatched] AREA MAY NOT MEET FAR 25 REQUIREMENTS. REFER TO TAKE-OFF WEIGHT GRAPH TO MEET FAR 25 REQUIREMENTS.

WEIGHT ~ POUNDS	SPEED ~ KNOTS	
	V_1	V_2
14,000	98	108
13,000	96	106
12,500	96	105
12,000	95	104
11,000	94	103
10,000	94	101
9000	94	99

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT.
HEADWIND COMPONENT .... 9.5 KTS.

TAKE-OFF WEIGHT ~ POUNDS	TAKE-OFF FIELD LENGTH ~ FEET
11,820	7300
11,520	6786
10,175	4820



TM 1-1510-218-10

Figure 7A-27. Accelerate – Go, Flaps APPROACH

NET GRADIENT OF CLIMB - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER .... TAKE-OFF
FLAPS .... APPROACH
LANDING GEAR .... UP
INOPERATIVE
PROPELLER .... FEATHERED

WEIGHT ~ POUNDS	CLIMB SPEED V_2 ~KNOTS
14,000	108
13,000	106
12,500	105
12,000	104
11,000	103
10,000	101
9000	99

EXAMPLE:

OAT .... 28°C
PRESSURE ALTITUDE .... 5430 FT

TAKE-OFF WEIGHT ~ POUNDS	NET GRADIENT ~ %
11,520	1.5
LESS THAN 9000	5.2
10,175	3.0

CLIMB SPEED V_2
@ 10,175 LBS. .... 101 KTS

NOTE: NET GRADIENT OF CLIMB IS EQUAL TO ACTUAL GRADIENT OF CLIMB IN PERCENT MINUS 0.8 PERCENT

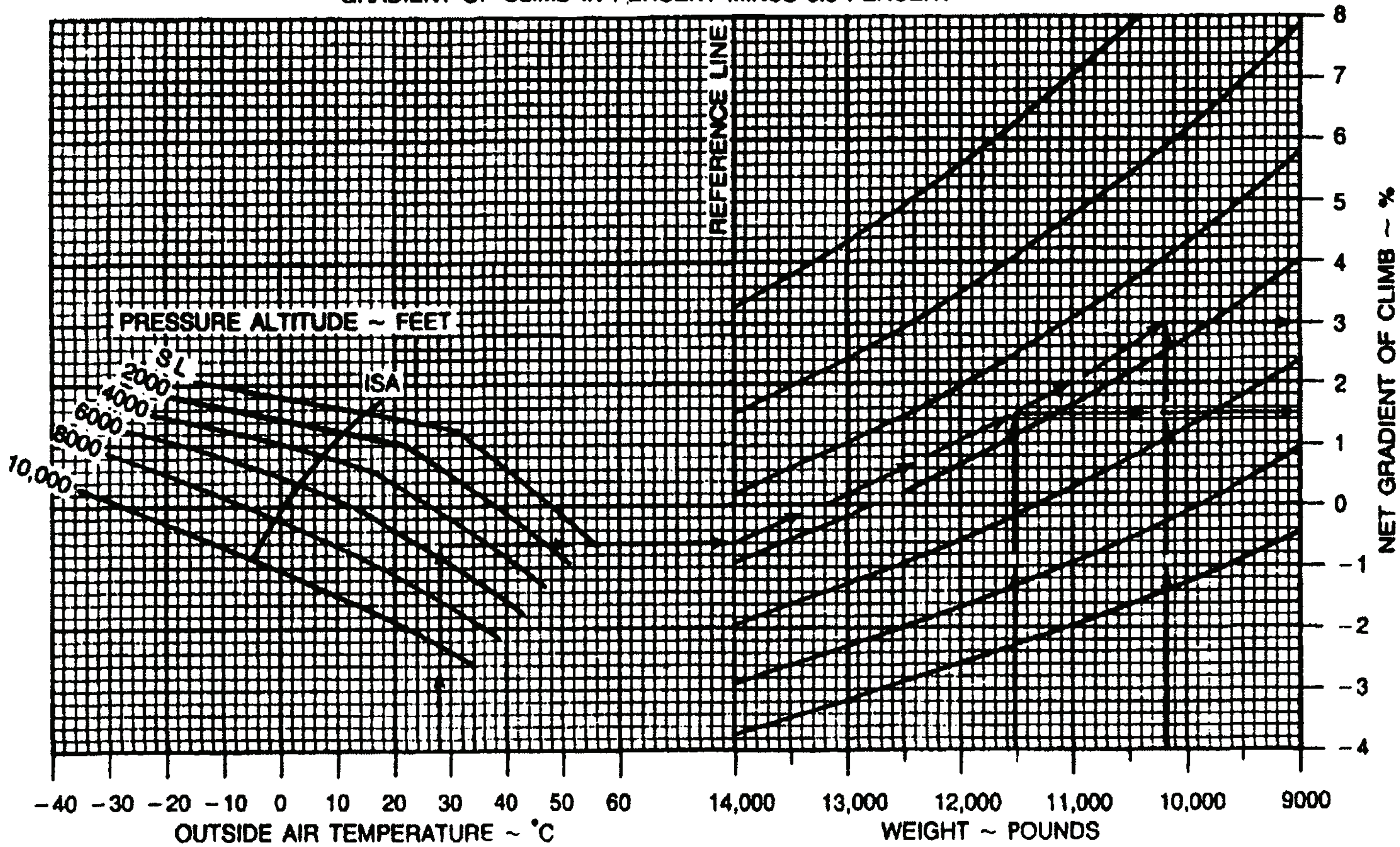


Figure 7A-28. Net Gradient of Climb, Flaps APPROACH

CLIMB - TWO ENGINES - FLAPS UP

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
FLAPS .... UP
LANDING GEAR .... UP

WEIGHT ~ POUNDS	CLIMB SPEED V_2 ~ KNOTS
14,000	129
13,000	126
12,500	125
12,000	123
11,000	121
10,000	118
9000	115

EXAMPLE:

OAT .... -6°C
PRESSURE ALTITUDE .... 18,000 FT
WEIGHT .... 12,391 LBS

RATE OF CLIMB .... 1340 FT/MIN
CLIMB GRADIENT 7.9%
CLIMB SPEED V_2.............. 125 KNOTS

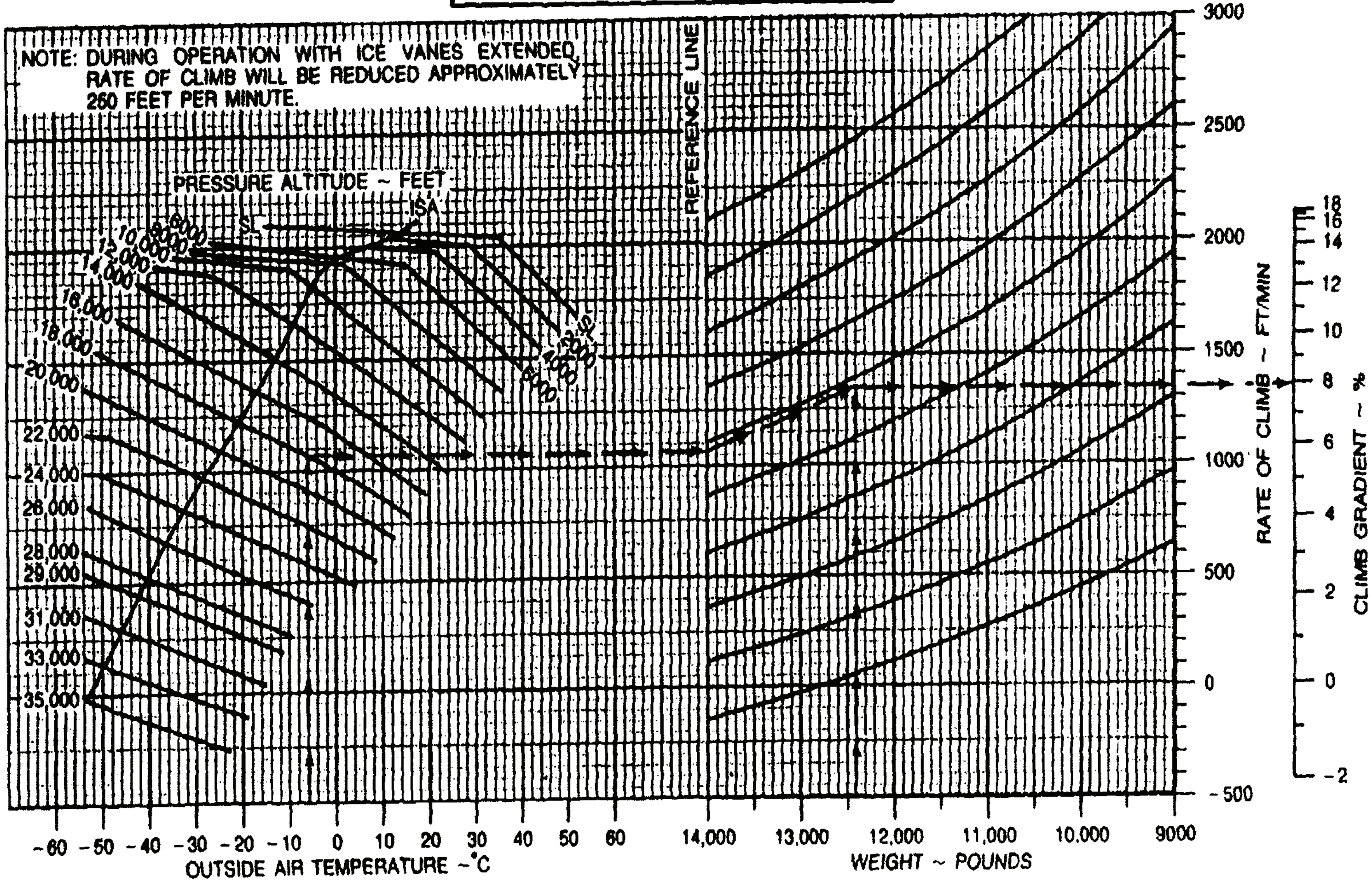


Figure 7A-29. Climb – Two Engines, Flaps UP

CLIMB - TWO ENGINES - FLAPS APPROACH

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
FLAPS .... APPROACH
LANDING GEAR .... UP

WEIGHT ~ POUNDS	CLIMB SPEED V_2 ~ KNOTS
14,000	129
13,000	126
12,500	125
12,000	123
11,000	121
10,000	118
9000	115

EXAMPLE:

OAT .... -6°C
PRESSURE ALTITUDE .... 18,000 FT
WEIGHT .... 12,391 LBS

RATE OF CLIMB .... 1135 FT/MIN
CLIMB GRADIENT 6.8%
CLIMB SPEED V_2 .... 125 KNOTS

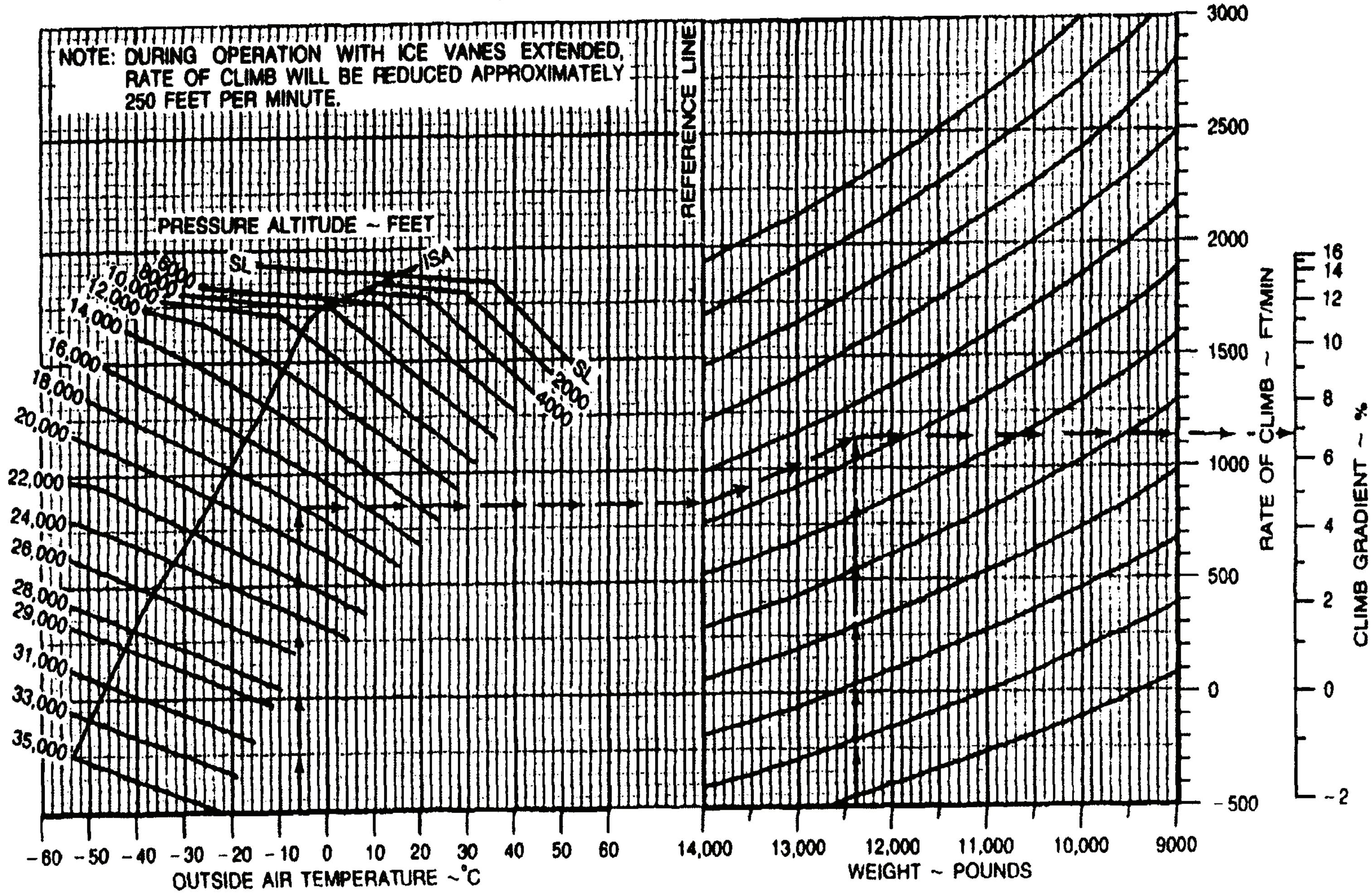


Figure 7A-30. Climb – Two Engines, Flaps APPROACH

CLIMB - ONE ENGINE INOPERATIVE

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
FLAPS .... UP
LANDING GEAR .... UP
INOPERATIVE PROPELLER ... FEATHERED

WEIGHT ~ POUNDS	V_2 / V_{yse} ~ KNOTS
14,000	124
12,500	121
12,000	119
11,000	117
10,000	114
9000	111

EXAMPLE:

OAT .... 30°C
PRESSURE ALTITUDE .... 4,000 FT
D.P CLIMB REQ. .... 250 FT/NM
250/6076 X 100 = 4.1% GRADIENT
CLIMB GRADIENT REQUIRED .. 4.1%

MAXIMUM WT. FOR SE CLB. GD. 12,600 LBS
CLIMB SPEED (V_2/V_{yse}) .... 122 KNOTS

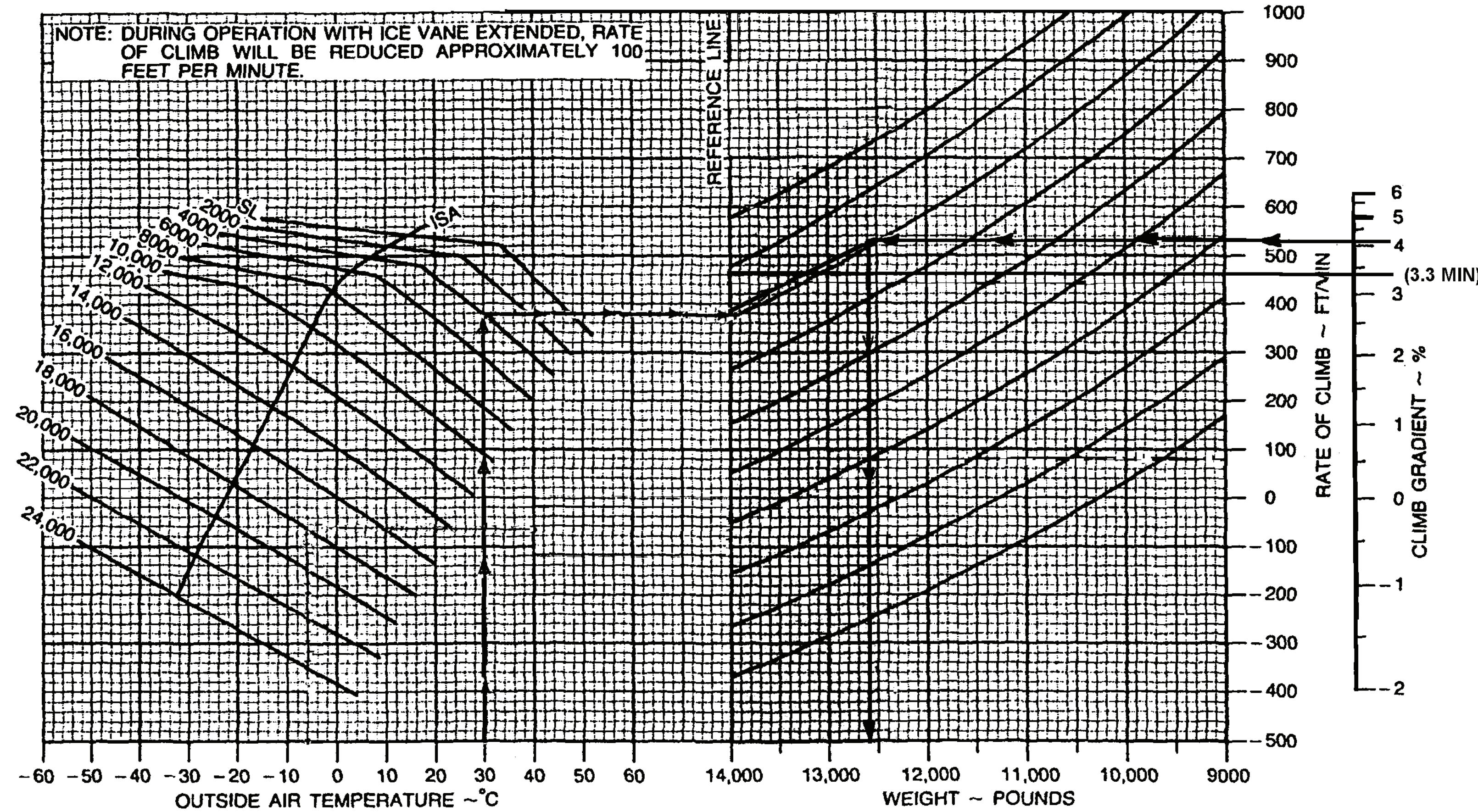


Figure 7A-31. Climb – One Engine Inoperative

SERVICE CEILING - ONE ENGINE INOPERATIVE

ASSOCIATED CONDITIONS:

POWER .... MAXIMUM CONTINUOUS
LANDING GEAR .... UP
INOPERATIVE PROPELLER ... FEATHERED
FLAPS .... UP

NOTE: SERVICE CEILING IS THE MAXIMUM PRESSURE ALTITUDE AT WHICH THE AIRPLANE IS CAPABLE OF CLIMBING 50 FT/MINUTE WITH ONE PROPELLER FEATHERED.

EXAMPLE:

OAT AT MEA (WORST LEG) .... 0°C
WEIGHT .... 12,391 LBS
ROUTE SEGMENT MEA .... 18,000 FT

SERVICE CEILING .... 18,100 FT

NOTE: SERVICE CEILING IS ABOVE ENROUTE MEA.

NOTE: DURING OPERATION WITH ICE VANE EXTENDED, SERVICE CEILING WILL BE LOWERED APPROXIMATELY 1500 FEET.

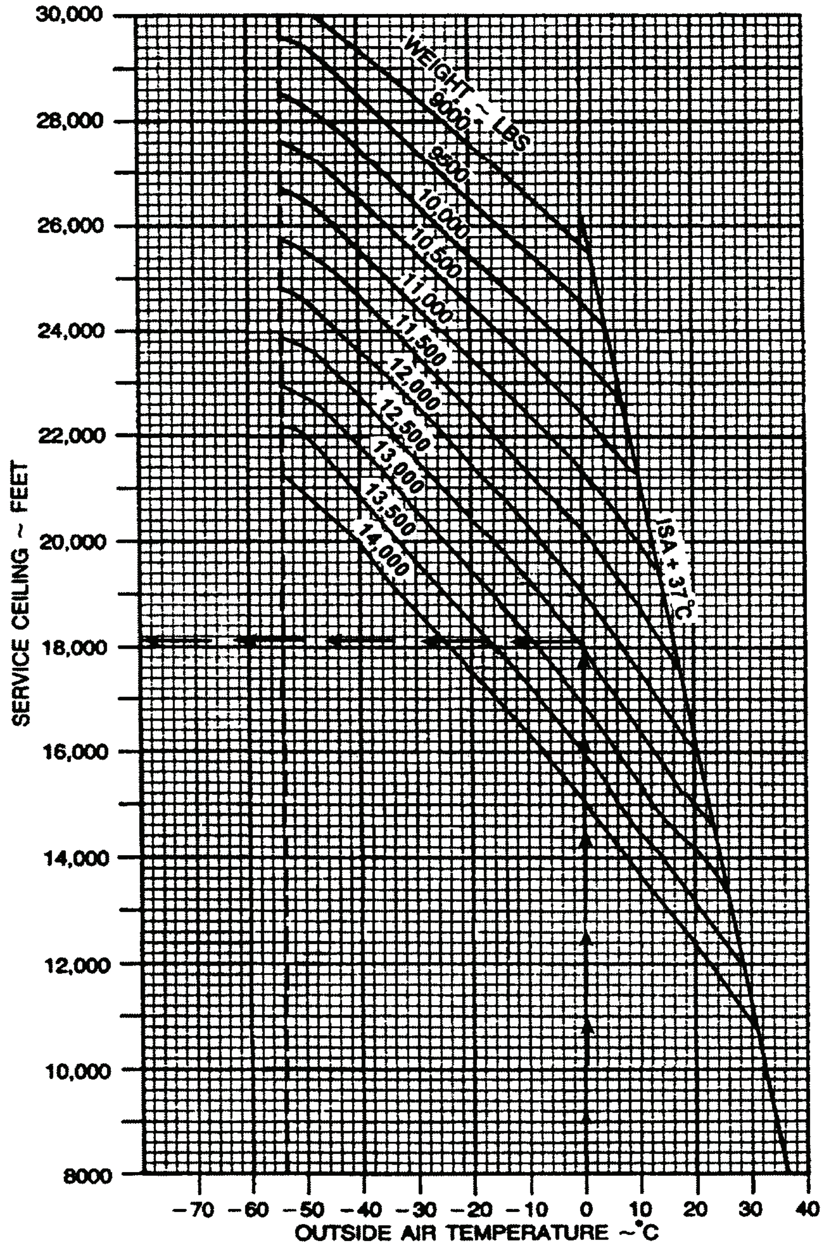


Figure 7A-32. Service Ceiling – One Engine Inoperative

TIME, FUEL, AND DISTANCE TO CLIMB

ASSOCIATED CONDITIONS:

PROPELLER SPEED .... 1900 RPM
ITT .... 770°C
OR TORQUE 100%

ALTITUDE ~ FEET	CLIMB SPEED ~ KNOTS
SL TO 10,000	160
10,000 TO 20,000	140
20,000 TO 25,000	130
25,000 TO 35,000	120

NOTE: 1. ADD 90 LBS FUEL FOR START, TAXI, AND TAKEOFF.
2. FOR OPERATION WITH ICE VANES EXTENDED, ADD 20°C TO THE ACTUAL OAT BEFORE ENTERING THE GRAPH.

EXAMPLE:

OAT AT TAKEOFF .... 28°C
OAT AT CRUISE .... −10°C
AIRPORT PRESSURE ALTITUDE ..... 5433 FT
CRUISE ALTITUDE .... 26,000 FT
INITIAL CLIMB WEIGHT .... 12,500 LBS

TIME TO CLIMB (21-3) .... 18 MIN
FUEL TO CLIMB (265-43) .... 222 LBS
DISTANCE TO CLIMB (63-8) .... 55 NM

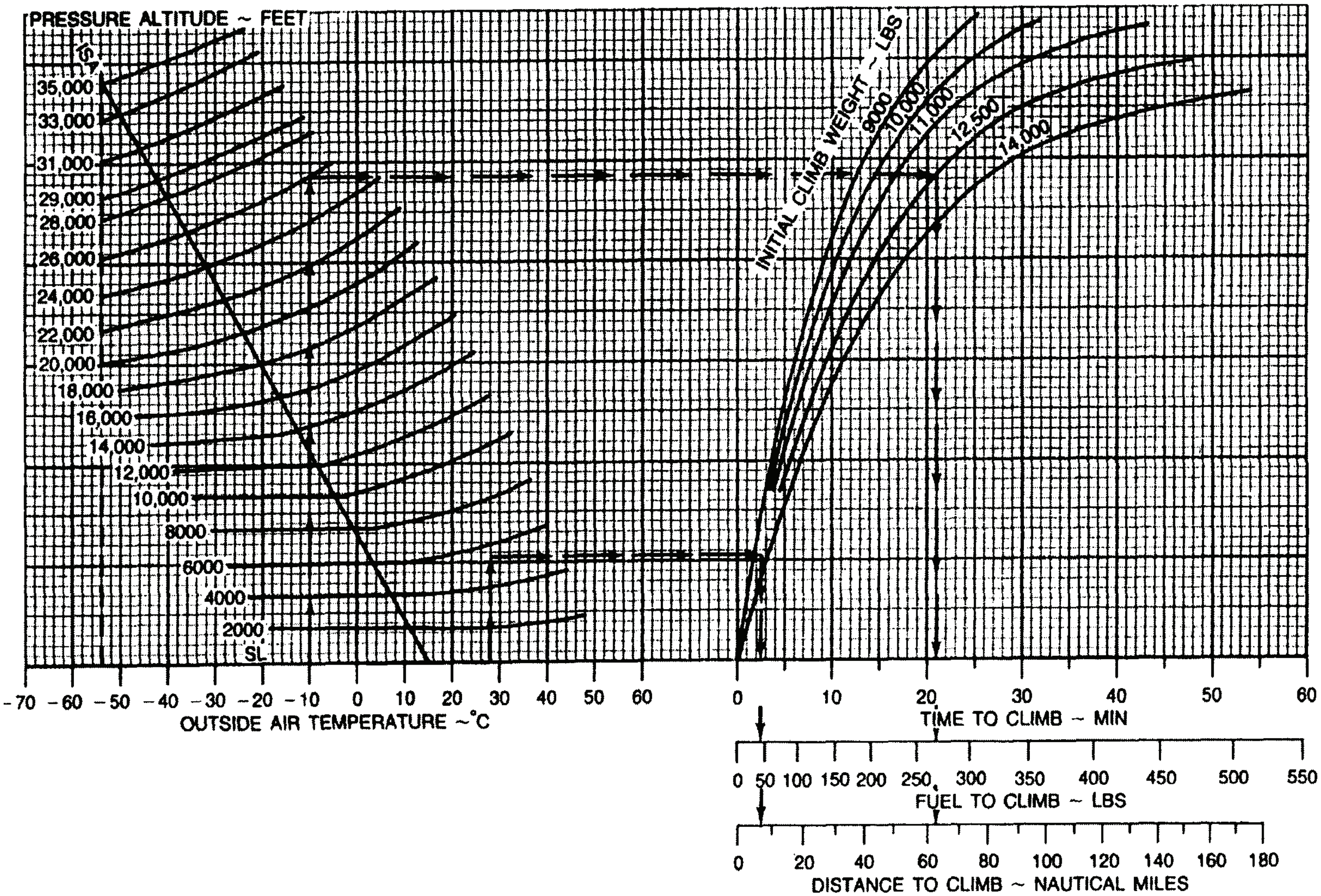


Figure 7A-33. Time, Fuel, and Distance to Climb

NORMAL CRUISE POWER
1700 RPM
ISA – 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	100	930	240	228	241	229	242	230	242	231
2000	-14	-19	100	906	237	232	238	233	239	234	240	235
4000	-18	-23	100	882	235	236	236	237	237	238	238	239
6000	-22	-27	100	858	233	241	234	242	235	243	236	244
8000	-25	-31	100	834	231	245	232	246	233	248	234	249
10,000	-29	-35	100	814	228	250	230	251	231	252	231	235
12,000	-33	-39	100	794	226	255	227	256	228	257	229	258
14,000	-36	-43	100	780	224	259	225	261	226	262	227	263
16,000	-40	-47	100	768	221	265	222	266	224	268	225	269
18,000	-44	-51	100	760	219	270	220	271	221	273	222	274
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-34. Normal Cruise Power, 1700 RPM, ISA – 30 °C

NORMAL CRUISE POWER
1700 RPM
ISA – 20 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	100	934	238	231	239	232	240	232	241	233
2000	-4	-9	100	908	236	235	237	236	238	237	239	238
4000	-8	-13	100	880	233	239	234	240	235	241	236	242
6000	-11	-17	100	858	231	244	232	245	233	246	234	247
8000	-15	-21	100	838	229	248	230	250	231	251	232	252
10,000	-19	-25	100	818	226	253	228	254	229	255	230	257
12,000	-23	-29	100	796	224	258	225	259	226	260	227	262
14,000	-26	-33	100	782	222	263	223	264	224	266	225	267
16,000	-30	-37	100	772	219	268	221	270	222	271	223	272
18,000	-34	-41	100	764	216	273	218	275	219	276	220	278
20,000	-37	-45	100	758	213	278	215	280	216	281	218	283
22,000	-41	-49	96	724	207	278	209	281	211	283	212	285
24,000	-45	-53	90	680	199	276	201	279	203	282	205	284
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-35. Normal Cruise Power, 1700 RPM, ISA – 20 °C

NORMAL CRUISE POWER
1700 RPM
ISA – 10 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	100	940	236	233	237	234	238	235	239	236
2000	6	1	100	914	234	238	235	239	236	240	237	240
4000	3	-3	100	888	232	242	233	243	234	244	235	245
6000	-1	-7	100	862	229	247	231	248	232	249	232	250
8000	-5	-11	100	840	227	251	228	253	229	254	230	255
10,000	-9	-15	100	818	225	256	226	257	227	259	228	260
12,000	-12	-19	100	800	222	261	223	262	225	264	226	265
14,000	-16	-23	100	786	220	266	221	268	222	269	223	270
16,000	-20	-27	100	776	217	271	218	273	220	274	222	276
18,000	-24	-31	100	768	214	276	216	278	217	279	218	281
20,000	-27	-35	96	734	208	276	210	279	211	281	213	283
22,000	-31	-39	92	698	201	276	203	279	205	281	207	284
24,000	-35	-43	86	652	193	274	195	277	197	280	199	283
26,000	-40	-47	80	606	184	270	187	274	189	278	191	281
28,000	-44	-51	74	558	174	265	177	270	180	275	183	278
29,000	-46	-52	71	534	168	261	172	267	176	272	179	277
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-36. Normal Cruise Power, 1700 RPM, ISA – 10 °C

NORMAL CRUISE POWER
1700 RPM
ISA

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	100	946	235	236	236	237	237	238	238	239
2000	16	11	100	920	232	240	234	241	235	242	235	243
4000	13	7	100	892	230	245	231	246	232	247	233	248
6000	9	3	100	866	228	249	229	251	230	252	231	253
8000	5	-1	100	844	225	254	226	255	228	257	228	258
10,000	1	-5	100	822	223	259	224	260	225	262	226	263
12,000	-2	-9	100	800	220	264	222	266	223	267	224	286
14,000	-6	-13	100	786	218	269	220	271	221	272	222	274
16,000	-10	-17	100	776	215	274	216	276	218	277	219	279
18,000	-14	-21	96	742	208	274	210	276	212	279	213	280
20,000	-18	-25	92	706	202	274	204	277	206	279	207	281
22,000	-21	-29	87	672	195	274	197	277	199	280	201	282
24,000	-26	-33	82	628	187	271	189	275	192	278	194	281
26,000	-30	-37	76	580	177	267	181	272	183	276	186	279
28,000	-34	-41	70	534	167	261	171	267	175	272	177	276
29,000	-36	-42	67	512	161	256	166	264	170	269	173	274
31,000	-40	-46	61	472	149	246	156	256	160	264	164	270
33,000	-45	-50	56	432	– – –	– – –	143	245	150	155	155	265
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-37. Normal Cruise Power, 1700 RPM, ISA

NORMAL CRUISE POWER
1700 RPM
ISA + 10 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	30	25	100	952	233	238	234	239	235	240	236	241
2000	27	21	100	924	231	243	232	244	233	145	234	246
4000	23	17	100	898	229	247	230	249	231	250	232	251
6000	19	13	100	874	226	252	227	253	228	255	229	256
8000	15	9	100	848	224	257	225	258	226	259	227	261
10,000	12	5	100	826	221	262	222	263	224	265	225	266
12,000	8	1	100	804	219	267	220	269	221	270	222	271
14,000	4	-3	100	790	216	272	217	273	219	275	220	276
16,000	0	-7	97	756	210	273	212	275	213	277	215	279
18,000	-4	-11	92	714	203	273	205	275	207	277	208	279
20,000	-8	-15	88	680	197	273	199	276	201	278	202	281
22,000	-12	-19	83	648	189	271	192	275	194	278	196	281
24,000	-16	-23	78	604	181	268	184	273	186	276	189	280
26,000	-20	-27	72	558	171	263	175	269	178	273	180	277
28,000	-24	-31	66	512	160	256	165	263	169	269	172	274
29,000	-26	-32	63	492	154	251	160	259	164	266	167	271
31,000	-31	-36	58	452	139	234	149	251	154	260	158	267
33,000	-36	-40	52	414	– – –	– – –	133	234	143	251	149	261
35,000	-40	-44	48	380	– – –	– – –	– – –	– – –	128	233	138	251

Figure 7A-38. Normal Cruise Power, 1700 RPM, ISA + 10 °C

NORMAL CRUISE POWER
1700 RPM
ISA + 20 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	40	35	100	958	323	241	233	242	234	243	235	244
2000	37	31	100	932	229	245	231	247	232	248	233	249
4000	33	27	100	94	227	250	228	251	229	252	230	253
6000	29	23	100	878	225	255	226	256	227	257	228	258
8000	25	19	100	854	222	260	223	261	224	262	225	263
10,000	22	15	100	832	220	265	221	266	222	268	223	269
12,000	18	11	99	806	216	269	218	271	219	272	220	274
14,000	14	7	95	762	210	269	212	271	213	273	215	274
16,000	10	3	91	722	203	269	205	272	207	274	209	276
18,000	6	-1	87	682	197	269	199	272	201	275	202	277
20,000	2	-5	84	654	191	270	194	273	195	276	197	279
22,000	-2	-9	80	624	184	270	187	274	189	277	919	280
24,000	-6	-13	75	582	175	266	179	271	182	275	184	279
26,000	-10	-17	69	536	165	260	170	266	173	271	176	275
28,000	-14	-21	63	492	153	250	159	259	163	265	167	271
29,000	-17	-22	60	472	145	242	153	254	158	262	162	268
31,000	-21	-26	55	432	– – –	– – –	140	242	149	255	153	263
33,000	-25	-30	50	400	– – –	– – –	– – –	– – –	136	243	143	258
35,000	-29	-34	46	368	– – –	– – –	– – –	– – –	– – –	– – –	131	244

Figure 7A-39. Normal Cruise Power, 1700 RPM, ISA + 20 °C

NORMAL CRUISE POWER
1700 RPM
ISA + 30 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	100	964	231	243	231	244	232	245	233	246
2000	47	41	100	936	228	248	229	249	230	250	231	251
4000	43	37	100	910	226	252	227	254	228	255	229	256
6000	39	33	100	882	223	257	224	259	225	260	226	261
8000	36	29	100	858	221	262	222	264	223	265	224	266
10,000	32	25	97	818	216	264	217	266	219	268	220	269
12,000	28	21	93	764	209	264	211	266	212	268	214	270
14,000	24	17	89	724	203	265	205	267	206	269	208	271
16,000	20	13	85	686	196	265	198	268	200	270	202	272
18,000	16	9	81	650	190	265	192	268	194	271	197	273
20,000	12	5	79	626	185	266	187	270	189	273	191	276
22,000	8	1	77	602	179	267	182	271	184	275	186	278
24,000	4	-3	71	560	169	262	173	268	176	272	179	276
26,000	0	-7	66	516	159	255	164	262	168	268	171	273
28,000	-4	-11	60	474	147	244	153	255	158	263	162	269
29,000	-7	-12	58	454	137	232	147	250	153	259	157	266
31,000	-12	-16	52	414	– – –	– – –	131	231	142	250	148	260
33,000	-16	-20	47	382	– – –	– – –	– – –	– – –	126	230	137	251
35,000	-20	-24	43	350	– – –	– – –	– – –	– – –	– – –	– – –	121	230

Figure 7A-40. Normal Cruise Power, 1700 RPM, ISA + 30 °C

NORMAL CRUISE POWER
1700 RPM
ISA + 37 °C

NOTE: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	100	968	229	245	231	246	232	247	232	248
2000	54	48	100	940	227	249	228	251	229	252	230	253
4000	50	44	100	912	225	254	226	255	227	257	228	258
6000	46	40	100	886	222	259	223	260	224	262	225	263
8000	42	36	96	838	216	260	218	262	219	263	220	265
10,000	39	32	93	790	210	261	212	263	214	265	215	267
12,000	35	28	88	738	204	261	205	263	207	265	209	267
14,000	31	24	84	700	197	261	200	264	201	266	203	268
16,000	27	20	81	664	191	261	194	265	196	267	198	270
18,000	23	16	76	630	185	261	188	265	190	268	192	271
20,000	19	12	76	606	180	263	183	267	185	270	187	273
22,000	15	8	73	582	174	263	177	268	180	272	182	275
24,000	11	4	69	542	165	258	169	264	172	270	175	274
26,000	7	0	63	500	154	251	160	259	164	266	167	271
28,000	2	-4	58	460	140	237	149	251	154	260	158	266
29,000	0	-5	55	440	– – –	– – –	142	244	149	256	154	263
31,000	-4	-9	51	406	– – –	– – –	– – –	– – –	137	245	144	257
33,000	-8	-13	47	376	– – –	– – –	– – –	– – –	– – –	– – –	133	246
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-41. Normal Cruise Power, 1700 RPM, ISA + 37 °C

NORMAL CRUISE SPEEDS

1700 RPM

WEIGHT 12,000 LBS

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 30 KNOTS IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, BUT WILL BE UNCHANGED IF THE ORIGINAL POWER IS RESET.

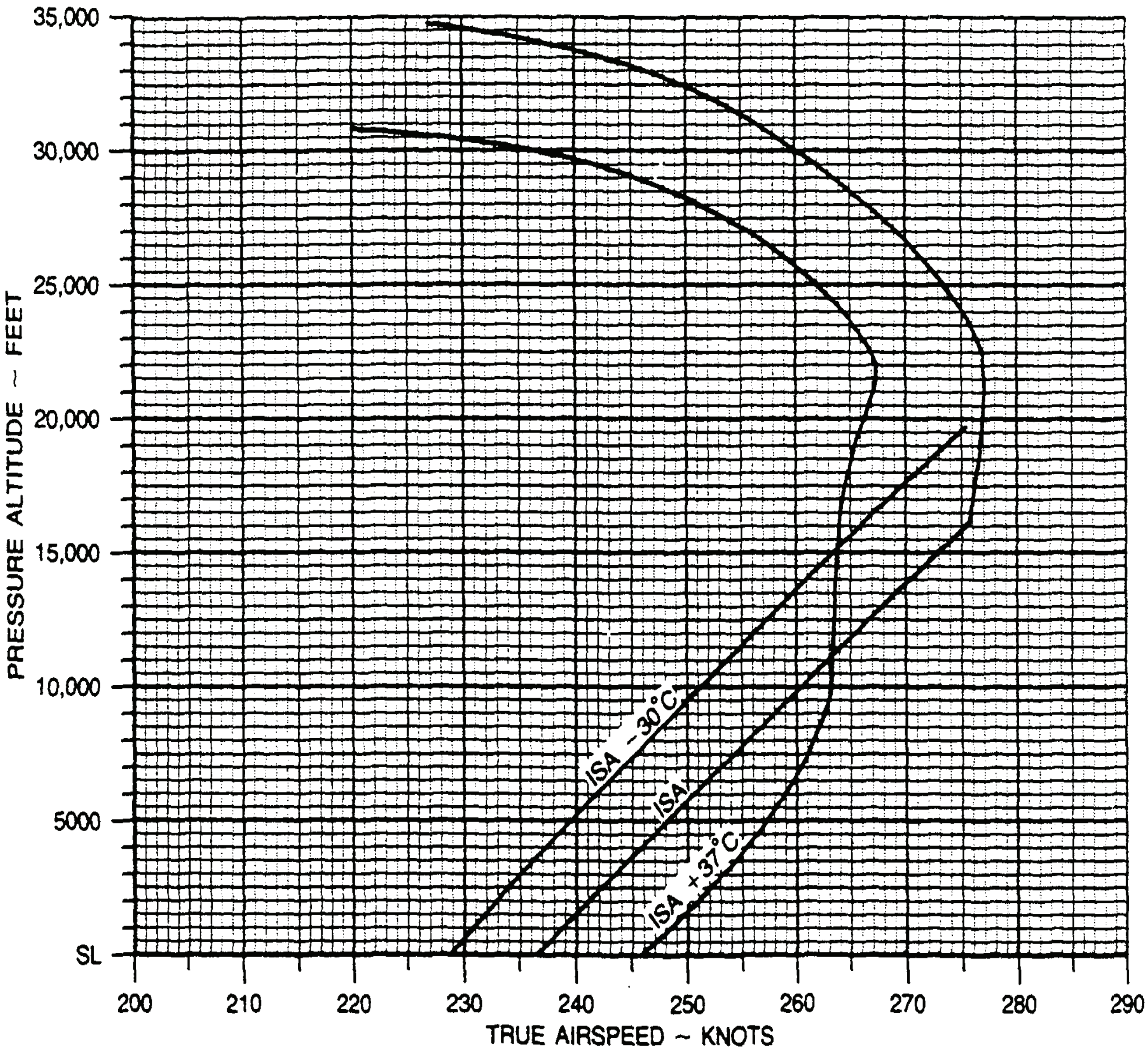


Figure 7A-42. Normal Cruise Speeds, 1700 RPM

NORMAL CRUISE POWER

1700 RPM

NOTES: 1. DURING OPERATION WITH ICE VANES EXTENDED TORQUE WILL DECREASE APPROXIMATELY 20%.

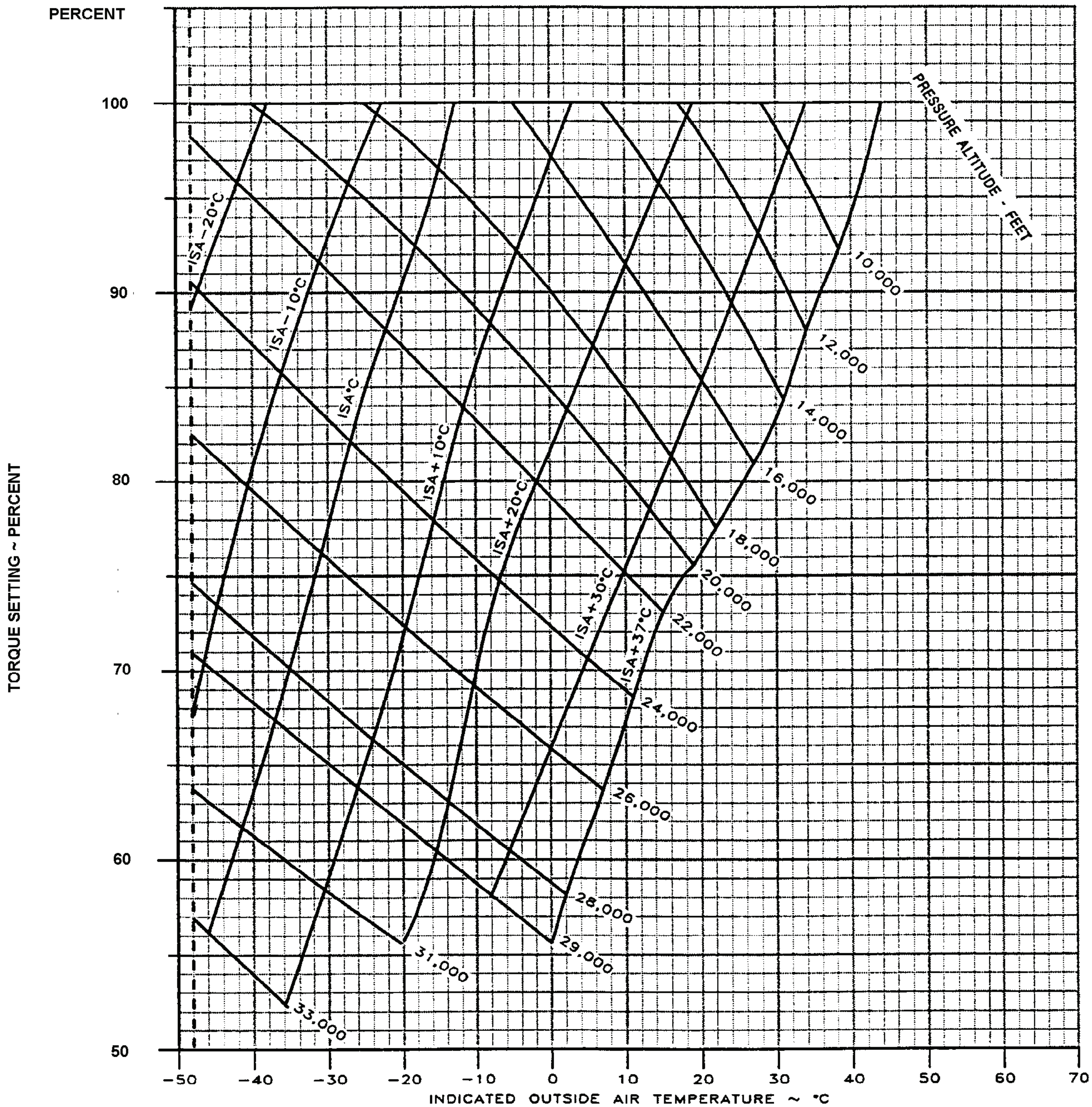


Figure 7A-43. Normal Cruise Power, 1700 RPM

FUEL FLOW AT NORMAL CRUISE POWER

1700 RPM

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, FUEL FLOW WILL DECREASE APPROXIMATELY 10% IF ORIGINAL POWER IS NOT OR CANNOT BE RESET. IF ORIGINAL POWER IS RESET, FUEL FLOW WILL INCREASE APPROXIMATELY 30 LBS/HR/ENG.

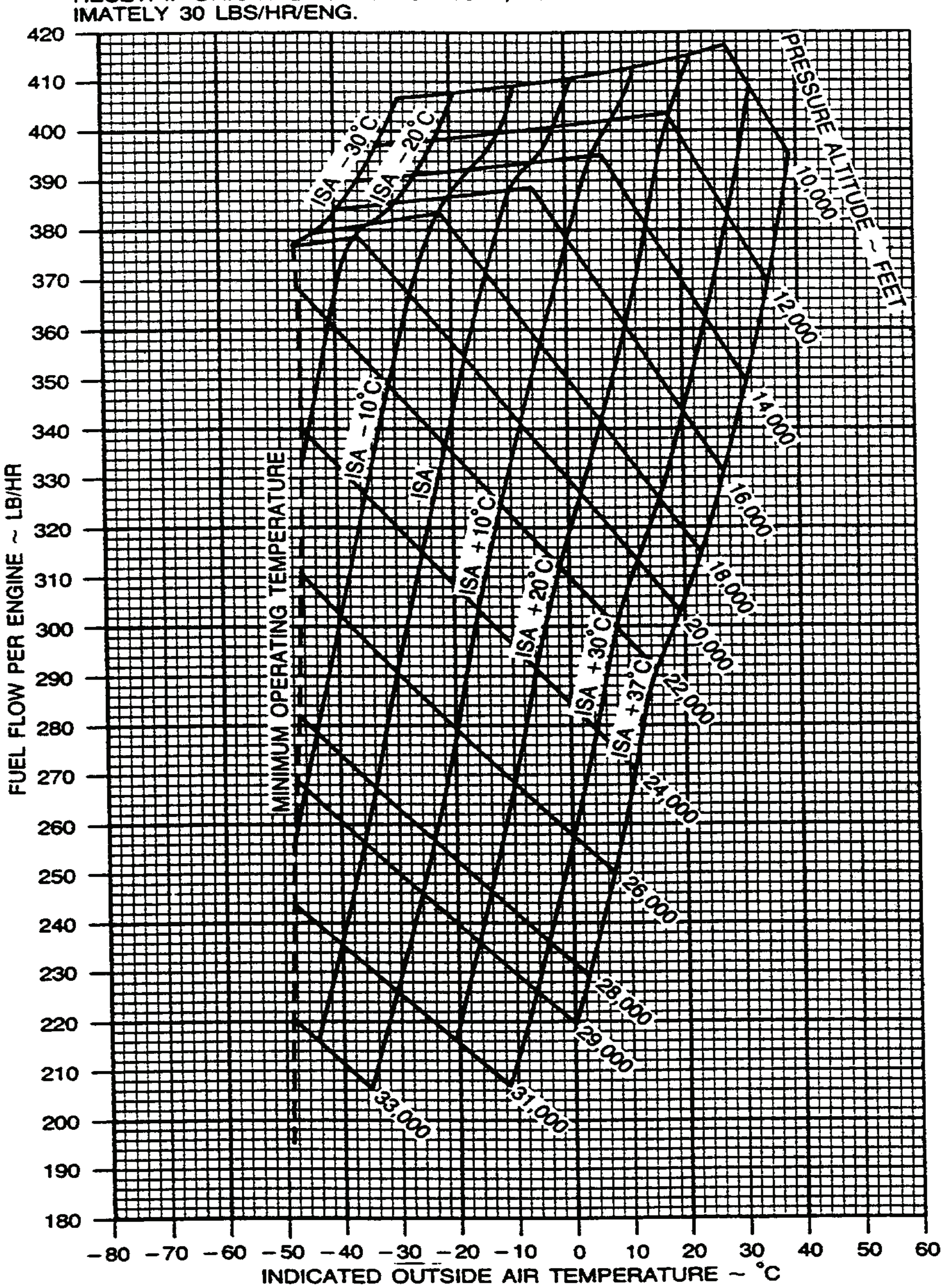


Figure 7A-44. Fuel Flow At Normal Cruise Power, 1700 RPM

RANGE PROFILE - NORMAL CRUISE POWER

1700 RPM

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS /GAL
ICE VANES .... RETRACTED

STANDARD DAY (ISA)
ZERO WIND

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT
FUEL USED .... 2586 LBS

RANGE .... 977 NM

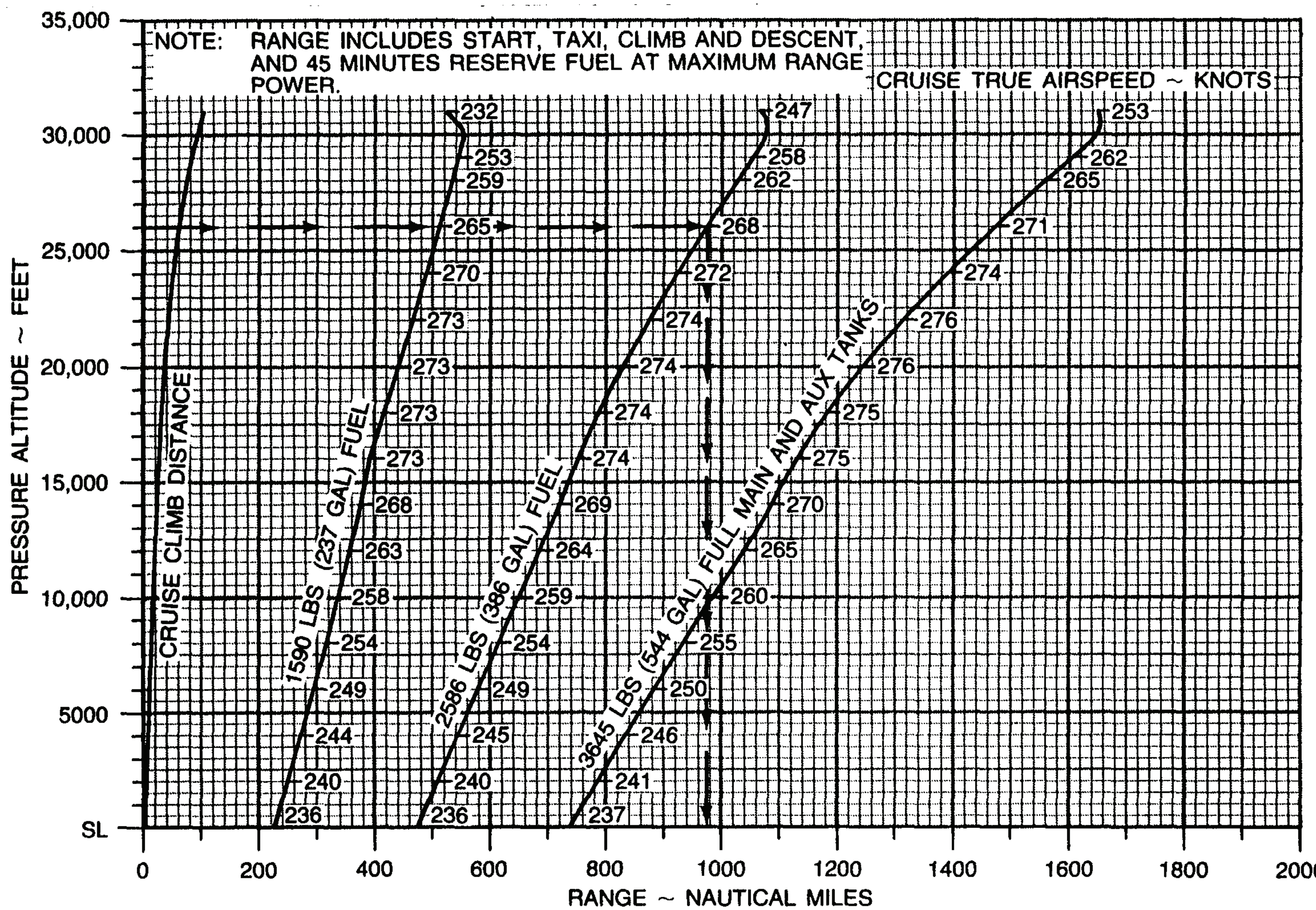


Figure 7A-45. Range Profile – Normal Cruise Power, 1700 RPM

MAXIMUM CRUISE POWER
1700 RPM
ISA – 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	100	930	240	228	241	229	242	230	242	231
2000	-14	-19	100	906	237	232	238	233	239	234	240	235
4000	-18	-23	100	882	235	236	236	237	237	238	238	239
6000	-22	-27	100	858	233	241	234	242	235	243	236	244
8000	-25	-31	100	834	231	245	232	246	233	248	234	249
10,000	-29	-35	100	814	228	250	230	251	231	252	231	235
12,000	-33	-39	100	794	226	255	227	256	228	257	229	258
14,000	-36	-43	100	780	224	259	225	261	226	262	227	263
16,000	-40	-47	100	768	221	265	222	266	224	268	225	269
18,000	-44	-51	100	760	219	270	220	271	221	273	222	274
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-46. Maximum Cruise Power, 1700 RPM, ISA – 30 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA – 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	100	934	238	231	239	232	240	232	241	233
2000	-4	-9	100	908	236	235	237	236	238	237	239	238
4000	-8	-13	100	880	233	239	234	240	235	241	236	242
6000	-11	-17	100	858	231	244	232	245	233	246	234	247
8000	-15	-21	100	838	229	248	230	250	231	251	232	252
10,000	-19	-25	100	818	226	253	228	254	229	225	230	257
12,000	-23	-29	100	796	224	258	225	259	226	260	227	262
14,000	-26	-33	100	782	222	263	223	264	224	266	225	267
16,000	-30	-37	100	772	220	268	221	270	222	271	223	272
18,000	-34	-41	100	764	216	273	218	275	219	276	220	278
20,000	-37	-45	100	758	213	278	215	280	216	281	218	283
22,000	-41	-49	100	752	210	283	212	285	214	287	215	288
24,000	-45	-53	94	704	202	280	204	283	206	286	208	288
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-47. Maximum Cruise Power, 1700 RPM, ISA – 20 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA – 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	100	940	236	233	237	234	238	235	239	236
2000	6	1	100	914	234	238	235	239	236	240	237	240
4000	3	-3	100	888	232	242	233	243	234	244	235	245
6000	-1	-7	100	862	229	247	231	248	232	249	232	250
8000	-5	-11	100	840	227	251	228	253	229	254	230	255
10,000	-9	-15	100	818	225	256	226	257	227	259	228	260
12,000	-12	-19	100	800	222	261	223	262	225	264	226	265
14,000	-16	-23	100	786	220	266	221	268	222	269	223	270
16,000	-20	-27	100	776	217	271	218	273	220	274	221	276
18,000	-24	-31	100	768	214	276	216	278	217	279	218	281
20,000	-27	-35	100	762	211	281	213	283	214	285	215	286
22,000	-31	-39	95	724	204	280	206	283	208	286	210	288
24,000	-35	-43	90	680	196	279	199	282	201	285	202	287
26,000	-40	-47	83	630	187	275	190	279	192	283	195	286
28,000	-44	-51	77	580	177	270	181	275	184	279	186	283
29,000	-46	-52	73	556	172	266	175	272	179	277	181	281
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-48. Maximum Cruise Power, 1700 RPM, ISA – 10 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	100	946	235	236	236	237	237	238	238	239
2000	16	11	100	920	232	240	234	241	235	242	235	243
4000	13	7	100	892	230	245	231	246	232	247	233	248
6000	9	3	100	866	228	249	229	251	230	252	231	253
8000	5	-1	100	844	225	254	226	255	228	257	228	258
10,000	1	-5	100	822	223	259	224	260	225	262	226	263
12,000	-2	-9	100	800	220	264	222	266	223	267	224	286
14,000	-6	-13	100	786	218	269	219	271	221	272	222	274
16,000	-10	-17	100	776	215	274	216	276	218	277	219	279
18,000	-13	-21	100	772	212	278	213	281	215	282	217	284
20,000	-17	-25	96	734	205	279	207	281	209	283	210	285
22,000	-21	-29	91	698	199	274	200	281	202	284	204	286
24,000	-25	-33	85	652	191	276	193	280	195	283	197	286
26,000	-29	-37	79	604	181	272	184	277	187	280	189	284
28,000	-34	-41	73	558	171	266	175	272	178	277	181	281
29,000	-36	-42	70	536	166	263	170	269	173	275	176	279
31,000	-40	-46	64	494	154	253	159	262	164	270	167	275
33,000	-45	-50	59	452	137	235	148	253	154	262	158	270
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-49. Maximum Cruise Power, 1700 RPM, ISA

MAXIMUM CRUISE POWER
1700 RPM
ISA + 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	30	25	100	952	233	238	234	239	235	240	236	241
2000	27	21	100	924	231	243	232	244	233	145	234	246
4000	23	17	100	898	229	247	230	249	231	250	232	251
6000	19	13	100	874	226	252	227	253	228	255	229	256
8000	15	9	100	848	224	257	225	258	226	259	227	261
10,000	12	5	100	826	221	262	222	263	224	265	225	266
12,000	8	1	100	804	219	267	220	269	221	270	222	271
14,000	4	-3	100	790	216	272	217	273	219	275	220	276
16,000	0	-7	100	778	213	277	214	278	216	280	217	282
18,000	-3	-11	96	740	206	277	209	279	210	281	211	283
20,000	-7	-15	92	706	200	277	202	280	204	282	205	285
22,000	-11	-19	87	672	192	276	195	279	197	282	199	285
24,000	-15	-23	81	628	184	273	187	277	189	281	191	284
26,000	-20	-27	76	580	175	268	178	274	181	278	184	282
28,000	-24	-31	70	536	164	262	169	269	172	274	175	279
29,000	-26	-32	67	514	158	257	163	265	167	271	171	277
31,000	-30	-36	61	474	145	245	153	257	158	265	162	272
33,000	-35	-40	56	434	– – –	– – –	140	245	148	258	153	267
35,000	-41	-44	49	388	– – –	– – –	– – –	– – –	134	245	142	259

Figure 7A-50. Maximum Cruise Power, 1700 RPM, ISA + 10 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA + 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	40	35	100	958	323	241	233	242	234	243	235	244
2000	37	31	100	932	229	245	231	247	232	248	233	249
4000	33	27	100	904	229	250	228	251	229	252	230	253
6000	29	23	100	878	225	255	226	256	227	257	228	258
8000	25	19	100	854	222	260	223	261	224	262	225	263
10,000	22	15	100	832	220	265	221	266	222	268	223	269
12,000	18	11	100	810	217	270	218	271	220	273	221	274
14,000	14	7	98	780	212	272	214	274	215	276	217	278
16,000	10	3	94	744	206	273	208	275	210	278	211	279
18,000	6	-1	91	708	200	274	202	276	204	279	206	281
20,000	3	-5	87	678	194	274	196	277	198	280	200	283
22,000	-1	-9	83	646	187	274	190	278	192	281	995	284
24,000	-6	-13	78	604	179	271	182	275	185	279	187	283
26,000	-10	-17	72	558	169	265	173	271	176	276	179	280
28,000	-14	-21	66	514	157	257	162	264	167	271	170	276
29,000	-16	-22	60	472	151	251	157	260	162	268	165	273
31,000	-21	-26	55	434	133	230	146	251	152	261	156	269
33,000	-26	-30	49	392	– – –	– – –	128	229	141	252	147	262
35,000	-29	-34	46	368	– – –	– – –	– – –	– – –	– – –	– – –	136	252

Figure 7A-51. Maximum Cruise Power, 1700 RPM, ISA + 20 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA + 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	100	964	231	243	231	244	232	245	233	246
2000	47	41	100	936	228	248	229	249	230	250	231	251
4000	43	37	100	910	226	252	227	254	228	255	229	256
6000	39	33	100	882	223	257	224	259	225	260	226	261
8000	36	29	100	858	221	262	222	264	223	265	224	266
10,000	32	25	99	830	216	266	219	268	220	270	221	271
12,000	28	21	94	774	210	266	212	268	213	270	215	271
14,000	24	17	91	740	205	267	206	269	208	272	210	273
16,000	20	13	88	706	199	268	201	271	203	273	204	275
18,000	16	9	85	674	193	269	195	272	197	275	199	277
20,000	12	5	83	650	188	271	190	274	193	277	194	288
22,000	8	1	79	620	181	271	184	275	187	278	189	281
24,000	4	-3	74	580	173	267	176	272	179	276	182	280
26,000	0	-7	69	536	163	261	167	267	171	273	174	278
28,000	-4	-11	63	494	151	252	157	261	162	268	165	274
29,000	-7	-12	61	474	144	244	151	257	157	265	161	272
31,000	-11	-16	55	434	– – –	– – –	138	243	146	257	151	266
33,000	-15	-20	51	402	– – –	– – –	– – –	– – –	133	243	141	258
35,000	-19	-24	46	370	– – –	– – –	– – –	– – –	– – –	– – –	128	243

Figure 7A-52. Maximum Cruise Power, 1700 RPM, ISA + 30 °C

MAXIMUM CRUISE POWER
1700 RPM
ISA + 37 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	100	968	229	245	231	246	232	247	232	248
2000	54	48	100	940	227	249	228	251	229	252	230	253
4000	50	44	100	912	225	254	226	255	227	257	228	258
6000	46	40	100	886	222	259	223	260	224	262	225	263
8000	43	36	98	846	217	261	219	263	220	265	221	266
10,000	39	32	94	798	211	262	213	264	215	266	216	268
12,000	35	28	89	744	204	262	206	264	208	266	209	268
14,000	31	24	86	712	200	264	201	266	203	269	205	270
16,000	27	20	84	680	194	265	196	268	198	270	200	273
18,000	23	16	81	650	188	266	191	269	193	271	195	275
20,000	19	12	79	628	183	267	186	271	188	274	190	277
22,000	15	8	76	602	177	267	180	272	183	276	185	279
24,000	11	4	71	562	168	263	172	269	175	274	178	278
26,000	7	0	66	520	158	257	163	264	167	270	170	276
28,000	3	-4	61	478	146	246	153	257	157	265	162	272
29,000	0	-5	58	458	136	234	147	252	152	261	157	2669
31,000	-5	-9	53	420	– – –	– – –	134	234	142	253	148	263
33,000	-9	-13	49	390	– – –	– – –	– – –	– – –	127	236	137	254
35,000	-13	-17	45	358	– – –	– – –	– – –	– – –	– – –	– – –	123	237

Figure 7A-53. Maximum Cruise Power, 1700 RPM, ISA + 37 °C

MAXIMUM CRUISE SPEEDS

1700 RPM

WEIGHT 12,000 LBS

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 30 KNOTS IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, BUT WILL BE UNCHANGED IF THE ORIGINAL POWER IS RESET.

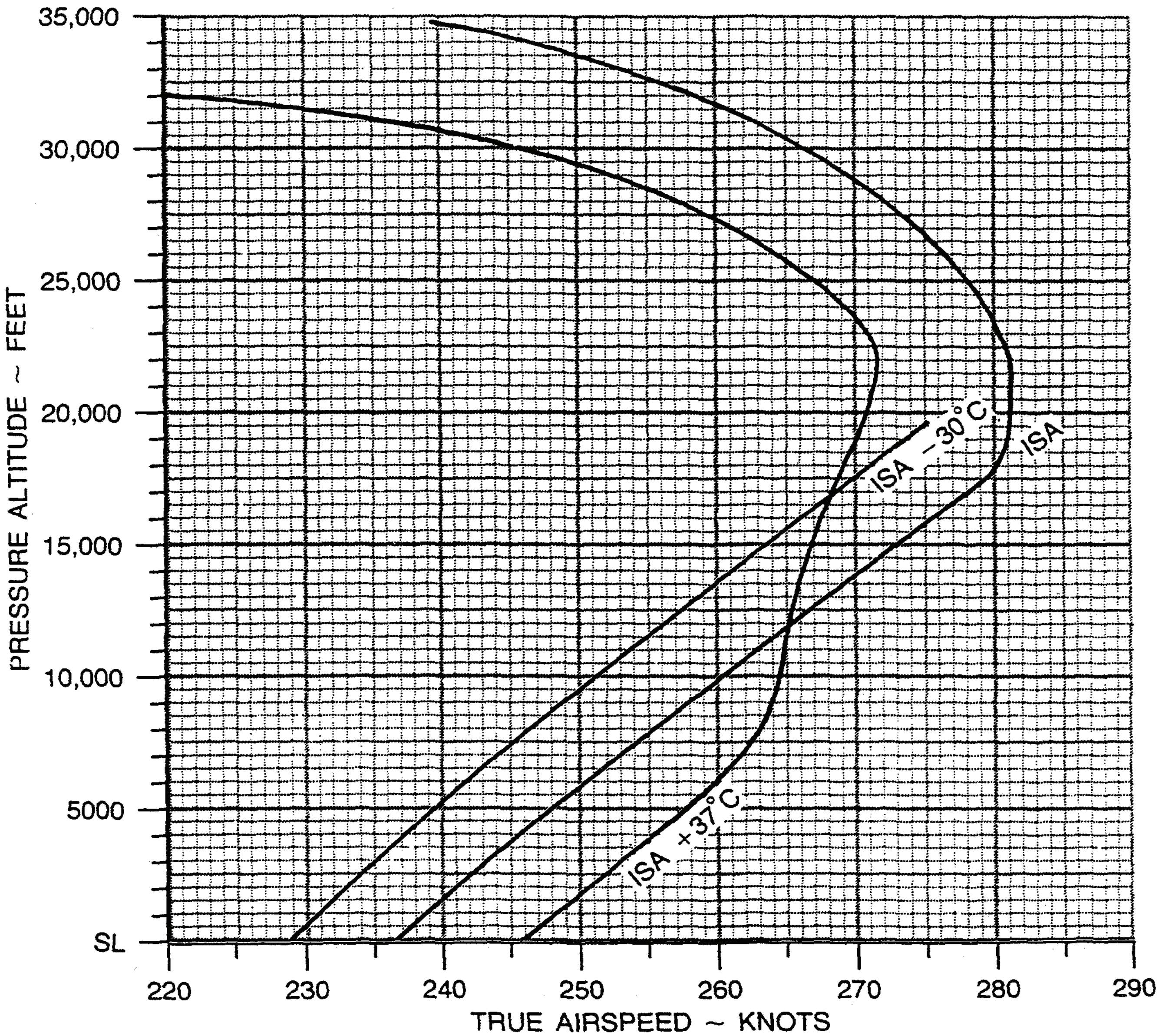


Figure 7A-54. Maximum Cruise Speeds, 1700 RPM

MAXIMUM CRUISE POWER

1700 RPM

NOTES: 1. DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE APPROXIMATELY 20%. IF DESIRED, ORIGINAL POWER MAY BE RESET, PROVIDED ITT LIMIT IS NOT EXCEEDED

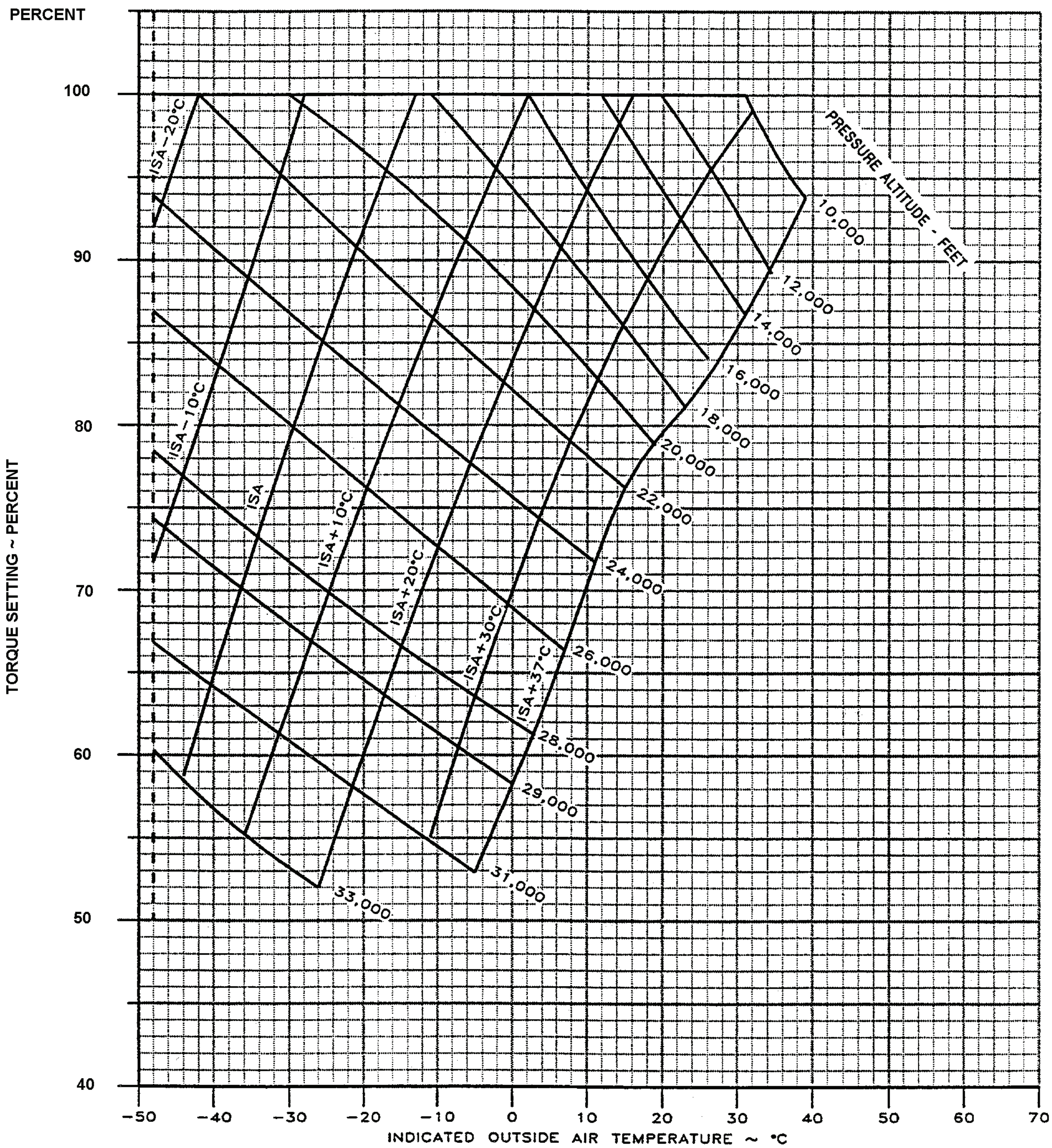


Figure 7A-55. Maximum Cruise Power, 1700 RPM

FUEL FLOW AT MAXIMUM CRUISE POWER

1700 RPM

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, FUEL FLOW WILL DECREASE APPROXIMATELY 10% IF ORIGINAL POWER IS NOT OR CANNOT BE RESET. IF ORIGINAL POWER IS RESET, FUEL FLOW WILL INCREASE APPROXIMATELY 30 LBS/HR/ENG.

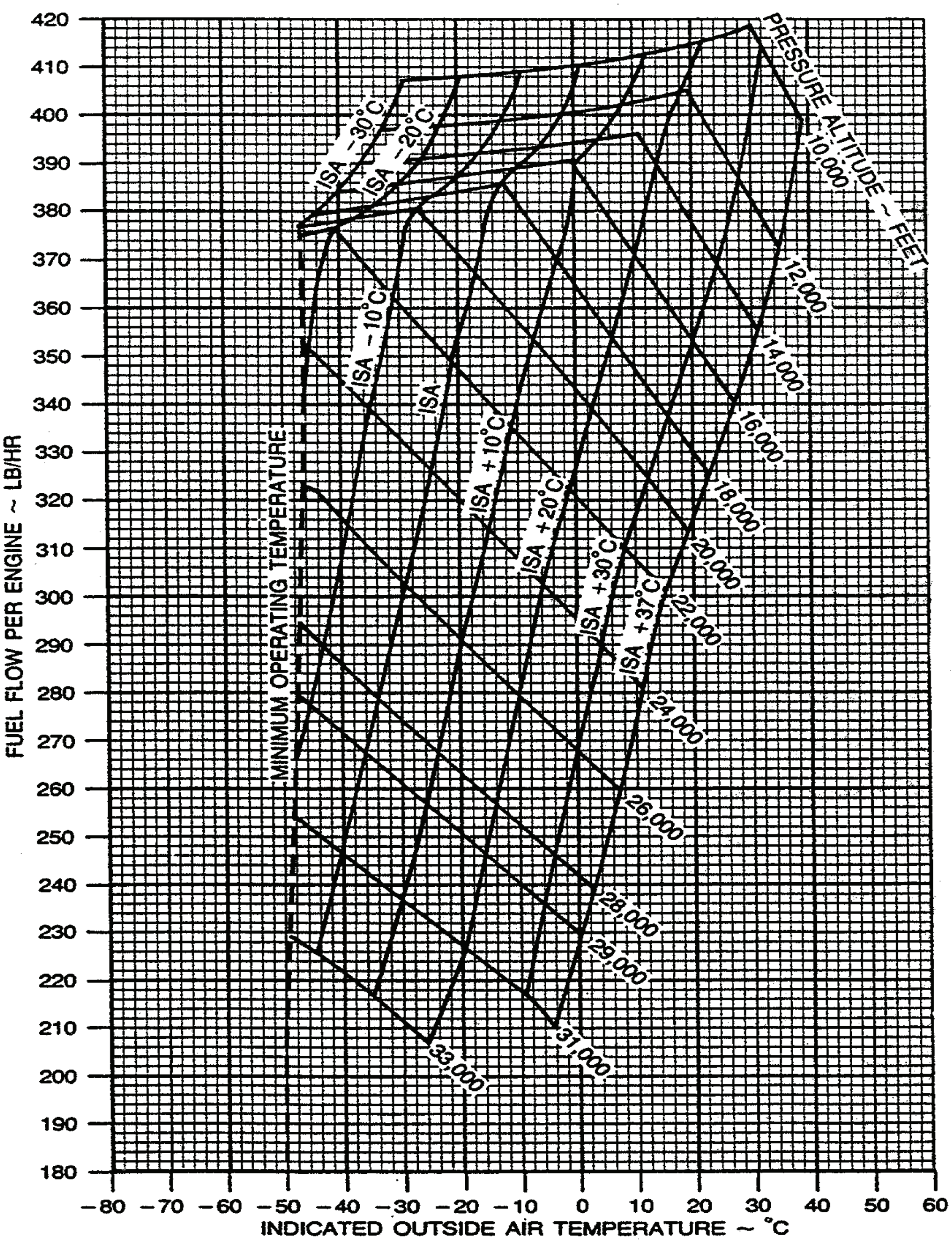


Figure 7A-56. Fuel Flow At Maximum Cruise Power, 1700 RPM

RANGE PROFILE - MAXIMUM CRUISE POWER

1700 RPM

STANDARD DAY (ISA)
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT	14,090 LBS BEFORE ENGINE START
FUEL	AVIATION KEROSENE
FUEL DENSITY	6.7 LBS/GAL
ICE VANES	RETRACTED

EXAMPLE:

PRESSURE ALTITUDE	26,000 FT
FUEL USED	2586 LBS
RANGE	960 NM

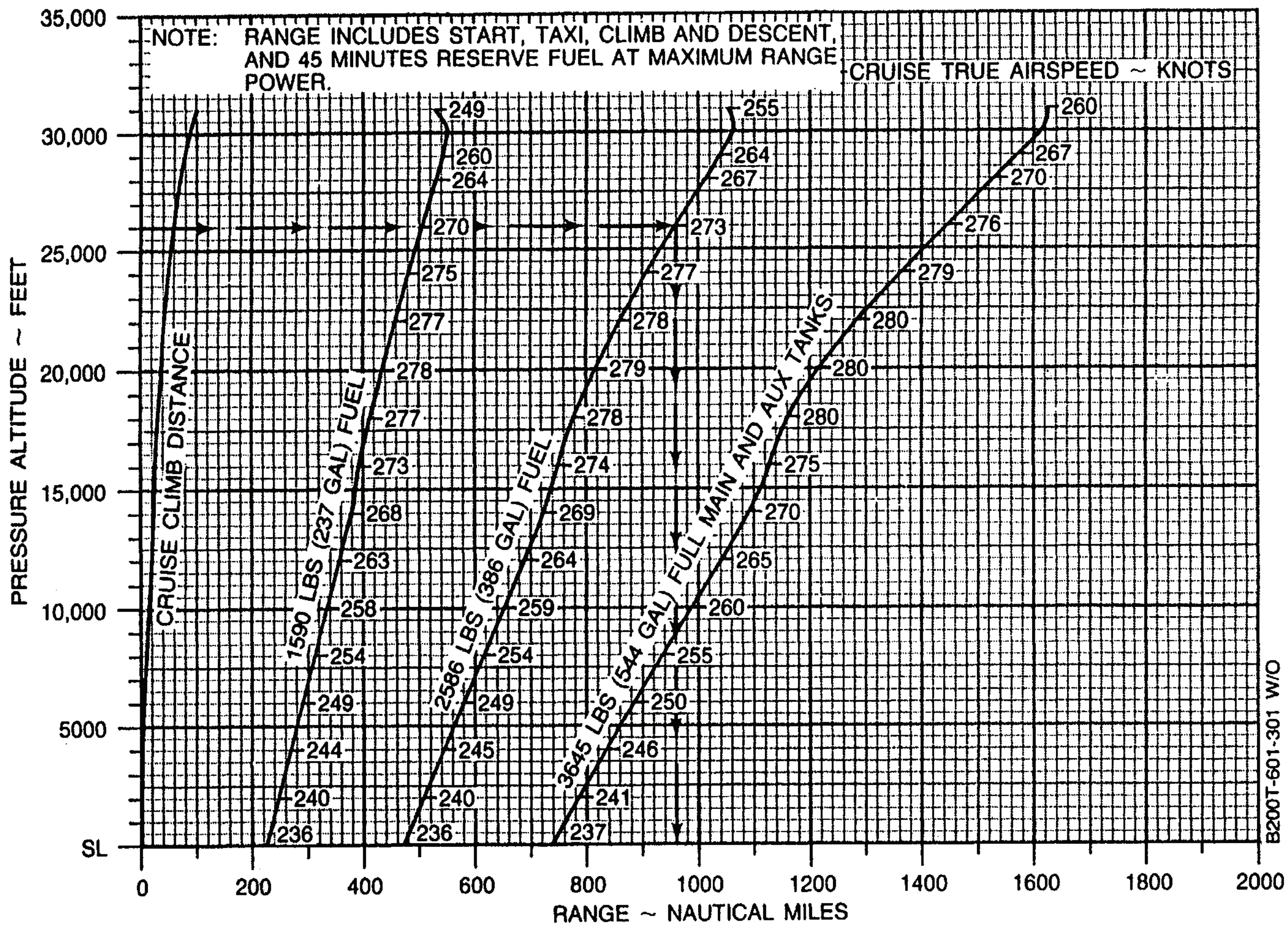


Figure 7A-57. Range Profile – Maximum Cruise Power, 1700 RPM

NORMAL CRUISE POWER
1800 RPM
ISA – 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	98	962	244	232	244	232	244	232	244	232
2000	-14	-19	100	946	243	237	244	238	244	238	244	238
4000	-18	-23	100	920	241	242	241	243	242	243	243	244
6000	-21	-27	100	896	238	246	239	247	240	248	241	249
8000	-25	-31	100	874	236	251	237	252	238	253	239	254
10,000	-29	-35	100	854	233	255	235	257	236	258	236	259
12,000	-32	-39	100	834	231	260	232	262	233	263	234	264
14,000	-36	-43	100	820	229	266	230	267	231	268	232	269
16,000	-40	-47	100	808	226	271	228	272	229	273	230	275
18,000	-44	-51	100	798	224	276	225	278	226	279	228	280
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-58. Normal Cruise Power, 1800 RPM, ISA – 30 °C

NORMAL CRUISE POWER
1800 RPM
ISA – 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	100	972	243	236	244	236	244	236	244	236
2000	-4	-9	100	948	241	240	242	241	243	242	244	243
4000	-7	-13	100	922	239	245	240	246	241	246	241	247
6000	-11	-17	100	898	236	249	237	250	238	251	239	252
8000	-15	-21	100	876	234	254	235	255	236	256	237	257
10,000	-19	-25	100	856	232	259	233	260	234	261	235	262
12,000	-22	-29	100	834	229	264	230	265	231	266	232	267
14,000	-26	-33	100	822	227	269	228	270	230	272	230	273
16,000	-30	-37	100	810	224	274	226	276	227	277	228	278
18,000	-33	-41	100	800	222	280	223	281	225	283	226	284
20,000	-37	-45	96	764	216	281	217	283	219	285	220	286
22,000	-41	-49	92	726	209	281	211	283	213	285	214	287
24,000	-45	-53	86	680	201	279	203	282	205	285	207	287
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-59. Normal Cruise Power, 1800 RPM, ISA – 20 °C

NORMAL CRUISE POWER
1800 RPM
ISA – 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	100	978	242	238	243	239	243	240	244	241
2000	7	1	100	950	239	243	240	244	241	245	242	246
4000	3	-3	100	926	237	247	238	248	239	249	240	250
6000	-1	-7	100	900	234	252	236	253	237	254	237	255
8000	-5	-11	100	878	232	257	233	258	234	259	235	260
10,000	-8	-15	100	856	230	262	231	263	232	264	233	265
12,000	-12	-19	100	838	227	267	229	268	230	270	231	271
14,000	-16	-23	100	824	225	272	226	274	227	275	228	276
16,000	-19	-27	100	812	222	278	224	279	225	281	226	282
18,000	-23	-31	96	776	216	279	218	281	219	283	221	284
20,000	-27	-35	92	734	210	279	211	281	213	283	214	285
22,000	-31	-39	87	698	203	278	205	282	207	284	208	286
24,000	-35	-43	82	654	195	277	197	281	200	283	201	286
26,000	-39	-47	76	608	186	274	189	278	191	281	194	284
28,000	-44	-51	70	560	176	269	180	274	183	278	185	282
29,000	-46	-52	67	536	171	265	175	271	178	276	181	280
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-60. Normal Cruise Power, 1800 RPM, ISA – 10 °C

NORMAL CRUISE POWER
1800 RPM
ISA

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	100	984	240	241	241	242	242	243	243	244
2000	17	11	100	956	238	246	239	247	240	248	240	248
4000	13	7	100	928	235	250	236	251	237	252	238	253
6000	9	3	100	902	233	255	234	256	235	257	236	258
8000	5	-1	100	880	230	260	232	261	233	262	234	263
10,000	2	-5	100	858	228	265	229	266	230	267	231	269
12,000	-2	-9	100	838	226	270	227	272	228	273	229	274
14,000	-6	-13	100	882	223	275	224	277	226	278	227	280
16,000	-9	-17	97	792	218	278	219	279	221	281	222	283
18,000	-13	-21	91	744	210	276	212	279	213	281	215	282
20,000	-17	-25	87	708	204	277	206	279	207	282	209	284
22,000	-21	-29	83	672	197	277	199	280	201	283	203	285
24,000	-25	-33	78	630	189	275	192	278	194	282	196	284
26,000	-29	-37	73	582	180	271	183	275	186	279	188	282
28,000	-34	-41	67	536	170	265	174	271	177	275	180	279
29,000	-36	-42	64	514	164	260	168	267	172	273	175	277
31,000	-40	-46	59	474	151	248	158	260	163	268	166	273
33,000	-45	-50	53	434	131	225	145	248	152	260	157	268
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-61. Normal Cruise Power, 1800 RPM, ISA

NORMAL CRUISE POWER
1800 RPM
ISA + 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	31	25	100	990	238	244	239	245	240	246	241	246
2000	27	21	100	962	236	248	237	249	238	250	239	251
4000	23	17	100	936	234	253	235	254	236	255	237	256
6000	19	13	100	910	231	258	232	259	233	260	234	261
8000	16	9	100	886	229	263	230	264	231	265	232	266
10,000	12	5	100	862	226	268	228	269	229	270	230	272
12,000	8	1	100	840	224	273	225	275	226	276	227	277
14,000	4	-3	97	802	218	275	220	277	221	278	222	280
16,000	0	-7	92	756	212	275	213	277	215	279	216	281
18,000	-4	-11	88	714	205	275	207	277	208	280	210	281
20,000	-7	-15	84	682	199	275	201	278	203	281	204	283
22,000	-11	-19	80	648	191	275	194	278	196	281	198	283
24,000	-15	-23	75	606	183	272	186	276	188	279	191	282
26,000	-20	-27	69	560	174	267	177	272	180	277	183	280
28,000	-24	-31	63	514	163	260	167	267	171	272	174	277
29,000	-26	-32	61	494	149	247	162	263	166	270	170	275
31,000	-31	-36	55	454	133	229	150	253	156	263	161	270
33,000	-36	-40	50	414	– – –	– – –	135	237	145	254	151	264
35,000	-40	-44	46	380	– – –	– – –	– – –	– – –	130	237	140	254

Figure 7A-62. Normal Cruise Power, 1800 RPM, ISA + 10 °C

NORMAL CRUISE POWER
1800 RPM
ISA + 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	41	35	100	994	237	246	238	247	239	248	240	249
2000	37	31	100	968	235	251	236	252	237	253	237	254
4000	33	27	100	940	232	255	233	257	234	258	235	259
6000	29	23	100	914	230	261	231	262	232	263	233	264
8000	26	19	100	890	227	266	228	267	230	268	230	269
10,000	22	15	99	862	224	270	225	271	227	273	228	274
12,000	18	11	94	806	217	270	219	271	220	273	221	275
14,000	14	7	90	762	211	270	213	273	214	274	215	276
16,000	10	3	86	722	205	271	207	273	208	276	210	277
18,000	6	-1	83	682	198	271	200	274	202	276	204	279
20,000	2	-5	80	656	193	273	195	276	197	279	199	281
22,000	-1	-9	77	626	187	273	189	277	191	280	193	283
24,000	-6	-13	72	584	178	270	181	274	184	278	186	282
26,000	-10	-17	66	538	168	264	172	270	175	274	178	279
28,000	-14	-21	60	494	155	253	161	263	165	269	169	274
29,000	-17	-22	57	472	147	245	155	257	160	266	164	272
31,000	-21	-26	52	434	– – –	– – –	142	245	150	258	155	266
33,000	-25	-30	46	380	– – –	– – –	– – –	– – –	137	245	145	259
35,000	-29	-34	44	368	– – –	– – –	– – –	– – –	– – –	– – –	132	246

Figure 7A-63. Normal Cruise Power, 1800 RPM, ISA + 20 °C

NORMAL CRUISE POWER
1800 RPM
ISA + 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	100	1000	235	249	237	250	237	251	238	251
2000	47	41	100	972	233	253	234	254	235	255	236	256
4000	43	37	100	944	231	258	232	259	233	261	234	262
6000	40	33	100	916	228	263	229	264	230	265	231	267
8000	36	29	96	868	222	264	224	266	225	267	226	268
10,000	32	25	92	818	216	265	218	267	219	269	220	270
12,000	28	21	88	766	209	265	211	267	213	269	214	271
14,000	24	17	84	724	203	265	205	268	207	270	208	272
16,000	20	13	81	686	197	266	199	269	201	271	203	273
18,000	16	9	77	652	191	267	194	270	196	273	197	275
20,000	12	5	75	626	186	269	189	272	191	275	193	278
22,000	8	1	73	602	181	270	184	274	186	277	188	281
24,000	4	-3	68	560	172	266	175	271	178	275	181	279
26,000	0	-7	63	516	161	259	166	266	170	272	173	276
28,000	-4	-11	58	474	148	247	156	259	160	266	164	272
29,000	-7	-12	55	454	140	237	149	252	155	263	159	270
31,000	-12	-16	50	414	– – –	– – –	134	236	144	253	150	263
33,000	-16	-20	45	384	– – –	– – –	– – –	– – –	128	235	139	253
35,000	-20	-24	41	352	– – –	– – –	– – –	– – –	– – –	– – –	123	234

Figure 7A-64. Normal Cruise Power, 1800 RPM, ISA + 30 °C

NORMAL CRUISE POWER
1800 RPM
ISA + 37 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	100	1002	234	250	236	251	236	252	237	253
2000	54	48	99	968	231	254	232	255	233	256	236	257
4000	50	44	97	930	227	257	228	258	229	260	231	261
6000	46	40	94	886	222	259	224	261	225	262	226	263
8000	43	36	91	838	217	260	218	262	220	264	221	265
10,000	39	32	88	792	211	262	213	264	214	266	215	267
12,000	35	28	83	738	204	261	206	264	208	266	209	268
14,000	31	24	80	700	198	262	200	265	202	267	203	269
16,000	27	20	77	664	192	262	194	265	196	268	198	270
18,000	23	16	74	630	186	263	189	266	191	269	193	272
20,000	19	12	72	606	181	265	184	269	186	272	188	275
22,000	15	8	70	584	176	266	179	271	182	274	184	278
24,000	11	4	65	544	167	262	171	268	174	273	177	277
26,000	7	0	61	502	156	254	162	263	166	269	169	274
28,000	3	-4	55	460	142	240	151	254	156	263	160	270
29,000	1	-5	53	440	130	223	143	247	151	259	156	267
31,000	-5	-9	47	400	– – –	– – –	125	223	139	247	146	260
33,000	-9	-13	44	370	– – –	– – –	– – –	– – –	121	225	134	249
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-65. Normal Cruise Power, 1800 RPM, ISA + 37 °C

NORMAL CRUISE SPEEDS

1800 RPM

WEIGHT 12,000 LBS

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 30 KNOTS IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, BUT WILL BE UNCHANGED IF THE ORIGINAL POWER IS RESET.

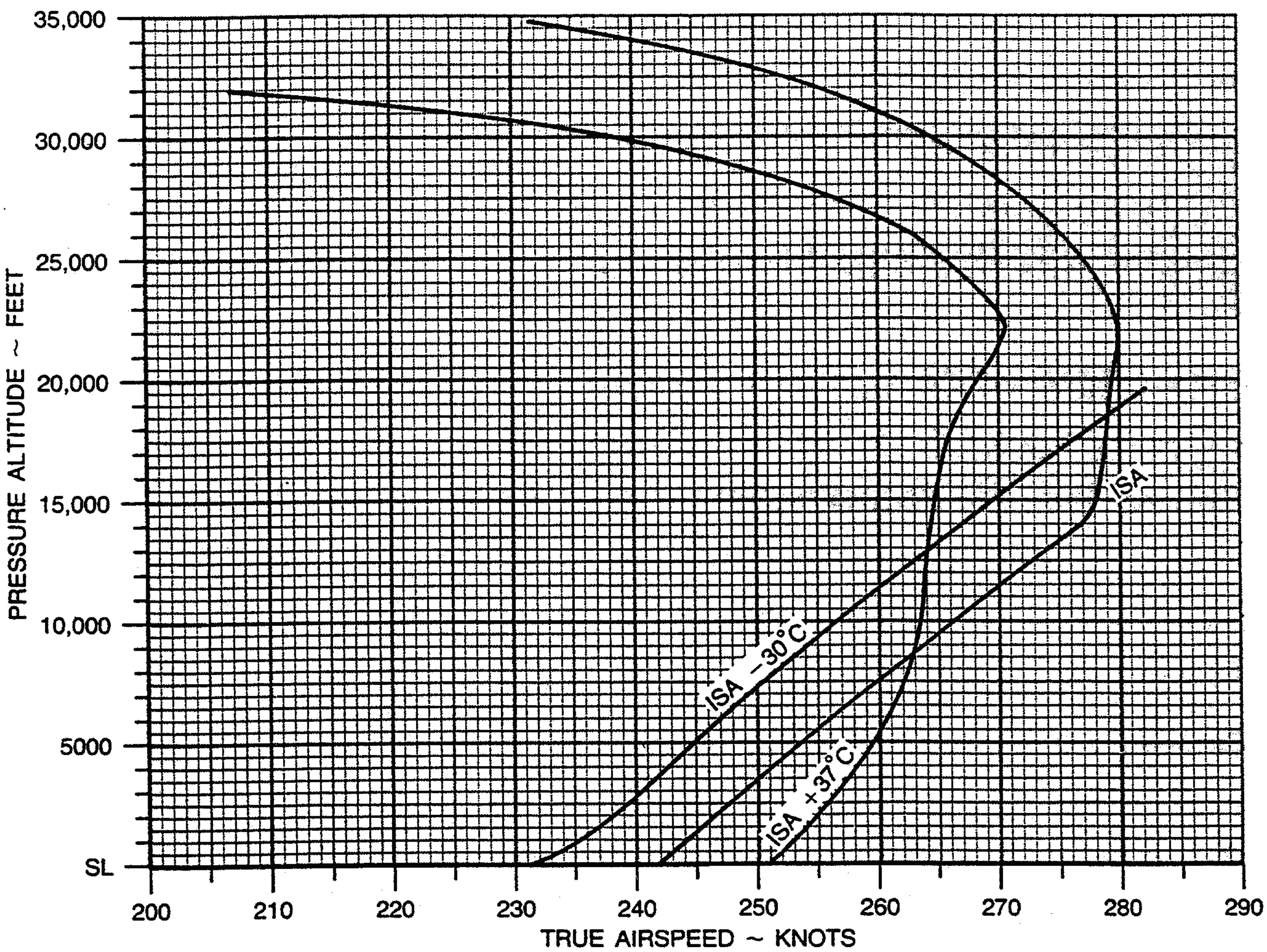


Figure 7A-66. Normal Cruise Speeds, 1800 RPM

NORMAL CRUISE POWER

1800 RPM

NOTES: 1. DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE APPROXIMATELY 20%. IF DESIRED, ORIGINAL POWER MAY BE RESET, PROVIDED ITT LIMIT IS NOT EXCEEDED.

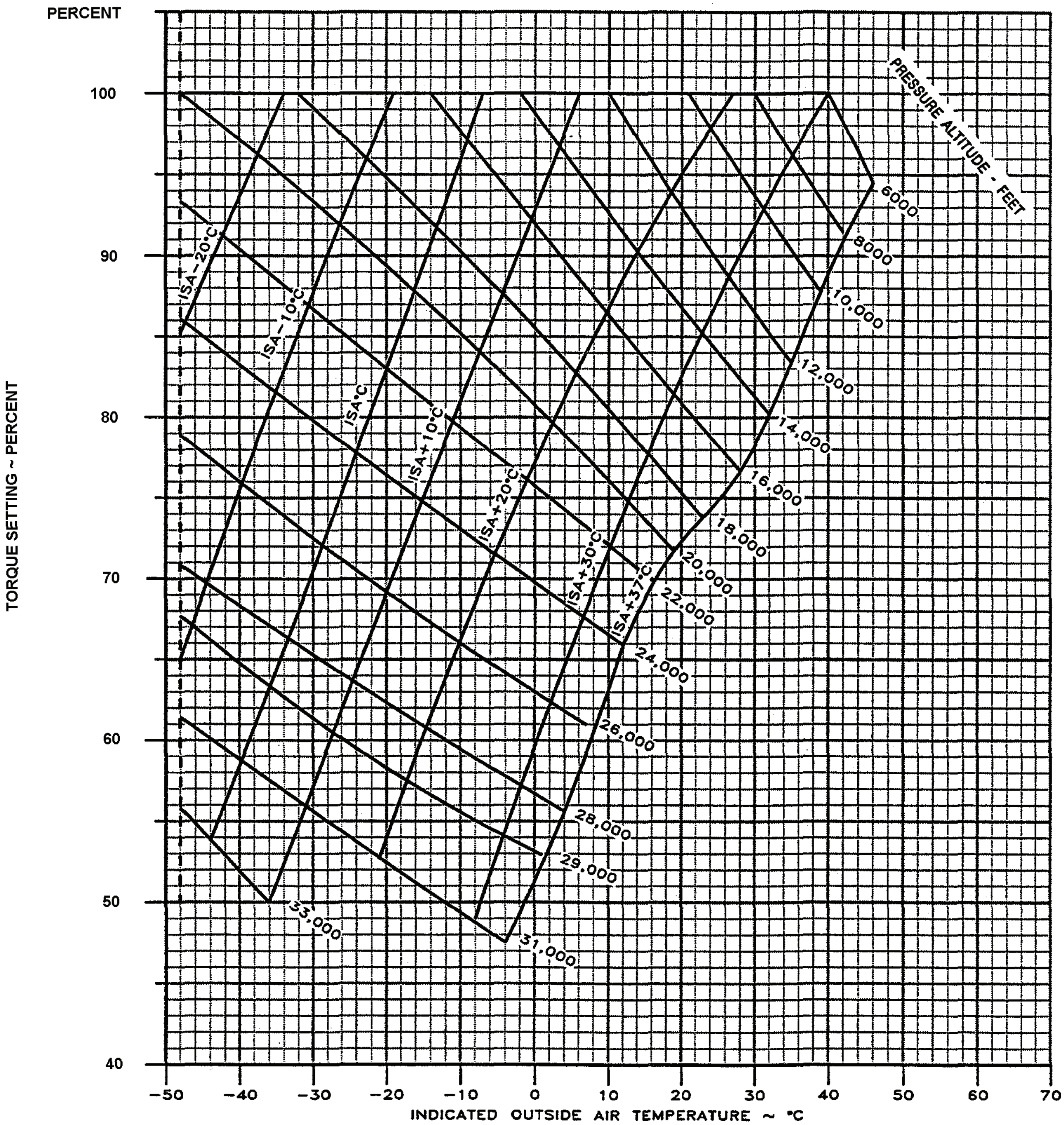


Figure 7A-67. Normal Cruise Power, 1800 RPM

FUEL FLOW AT NORMAL CRUISE POWER

1800 RPM

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, FUEL FLOW WILL DECREASE APPROXIMATELY 10% IF ORIGINAL POWER IS NOT OR CANNOT BE RESET. IF ORIGINAL POWER IS RESET, FUEL FLOW WILL INCREASE APPROXIMATELY 30 LBS/HR/ENG

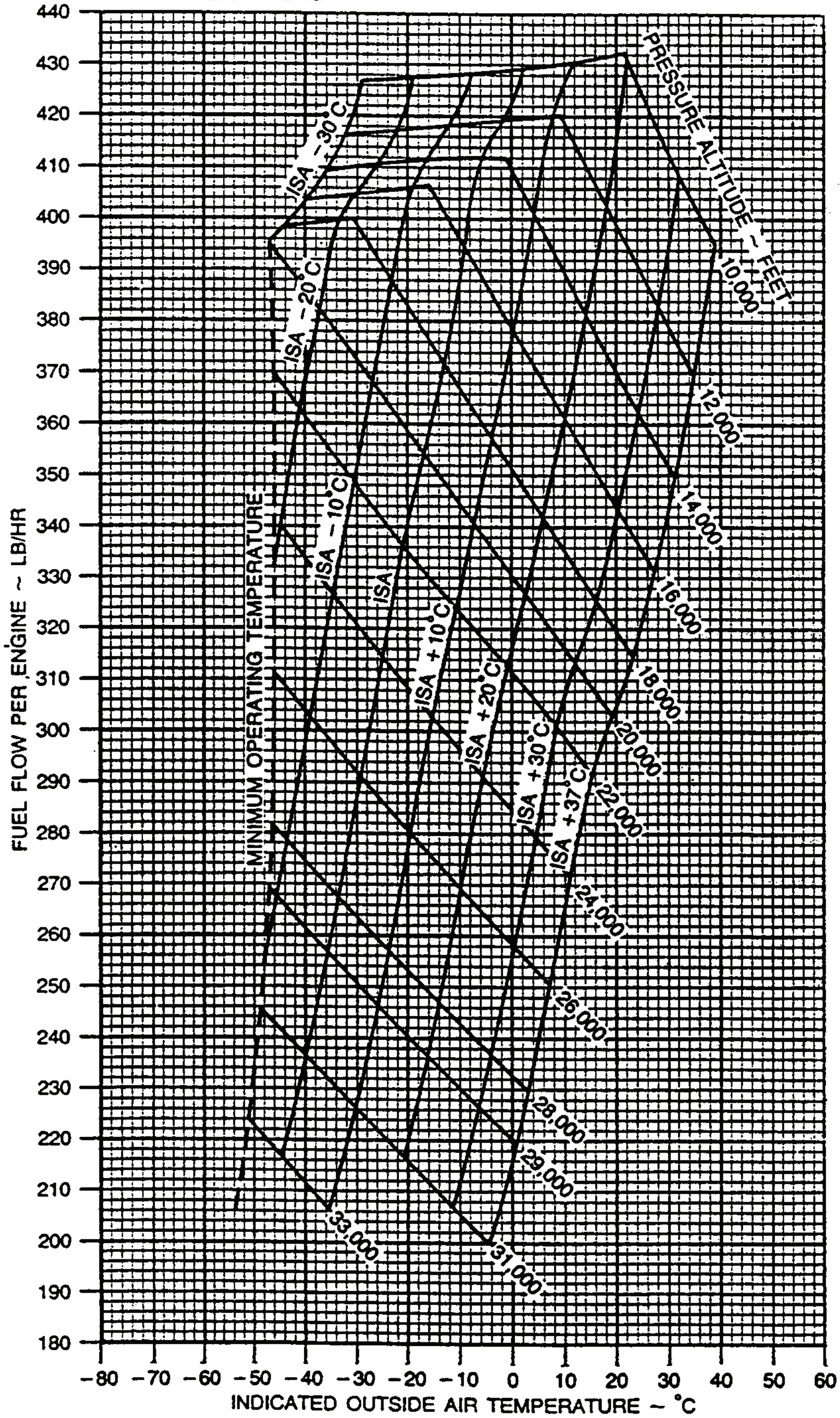


Figure 7A-68. Fuel Flow at Normal Cruise Power, 1800 RPM

RANGE PROFILE - NORMAL CRUISE POWER

1800 RPM

STANDARD DAY (ISA)
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT	14,090 LBS BEFORE ENGINE START
FUEL	AVIATION KEROSENE
FUEL DENSITY	6.7 LBS/GAL
ICE VANES	RETRACTED

EXAMPLE:

PRESSURE ALTITUDE	26,000 FT
FUEL USED	2586 LBS
RANGE	988 NM

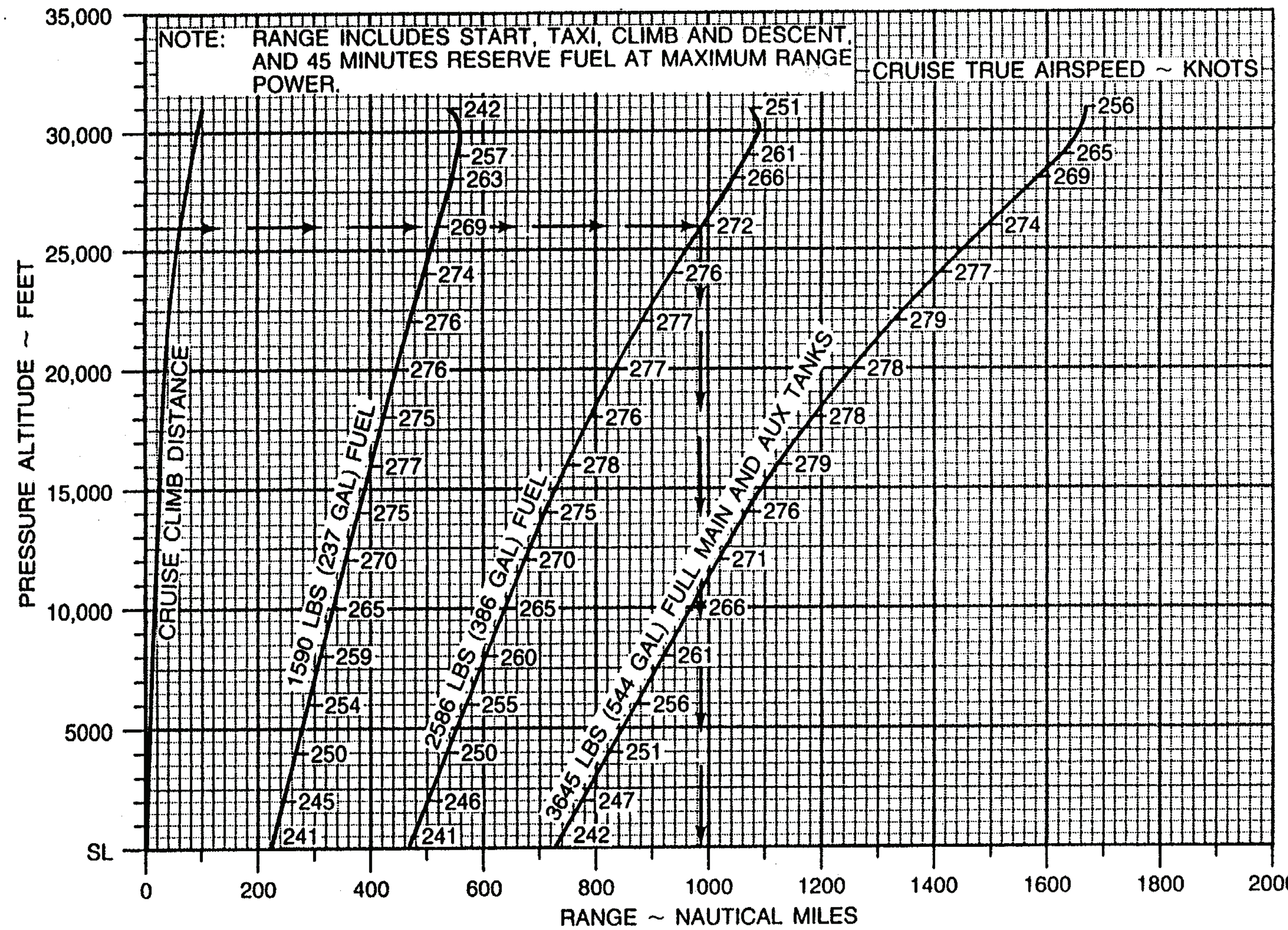


Figure 7A-69. Range Profile – Normal Cruise Power, 1800 RPM

MAXIMUM CRUISE POWER
1800 RPM
ISA – 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-10	-15	98	962	244	232	244	232	244	232	244	232
2000	-14	-19	100	946	243	237	244	238	244	238	244	238
4000	-18	-23	100	920	241	242	241	243	242	243	243	244
6000	-22	-27	100	896	238	246	239	247	240	248	241	249
8000	-25	-31	100	874	236	251	237	252	238	253	239	254
10,000	-29	-35	100	854	233	255	235	257	236	258	236	259
12,000	-33	-39	100	834	231	260	232	262	233	263	234	264
14,000	-36	-43	100	820	229	265	230	267	231	268	232	269
16,000	-40	-47	100	808	226	271	228	272	229	273	230	275
18,000	-44	-51	100	798	224	276	226	278	226	279	228	280
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-70. Maximum Cruise Power, 1800 RPM, ISA – 30 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA – 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	0	-5	100	972	243	236	244	236	244	236	244	236
2000	-4	-9	100	948	241	240	242	241	243	242	244	243
4000	-8	-13	100	922	239	245	240	246	241	246	241	247
6000	-11	-17	100	898	236	249	237	250	238	251	239	252
8000	-15	-21	100	876	234	254	235	255	236	256	237	257
10,000	-19	-25	100	856	232	259	233	260	234	261	235	262
12,000	-23	-29	100	834	229	264	230	265	231	266	232	267
14,000	-26	-33	100	822	227	269	228	270	230	272	230	273
16,000	-30	-37	100	810	224	274	226	276	227	277	228	278
18,000	-34	-41	100	800	222	280	223	281	225	283	226	284
20,000	-37	-45	100	792	220	285	221	287	222	289	223	290
22,000	-41	-49	96	726	213	286	214	288	216	290	217	292
24,000	-45	-53	90	704	204	284	206	286	208	289	210	291
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-71. Maximum Cruise Power, 1800 RPM, ISA – 20 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA – 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	10	5	100	978	242	238	243	239	243	240	244	241
2000	6	1	100	950	239	243	240	244	241	245	242	246
4000	3	-3	100	926	237	247	238	248	239	249	240	250
6000	-1	-7	100	900	234	252	236	253	237	254	237	255
8000	-5	-11	100	878	232	257	233	258	234	259	235	260
10,000	-9	-15	100	856	230	262	231	263	232	264	233	265
12,000	-12	-19	100	838	227	267	229	268	230	270	231	271
14,000	-16	-23	100	824	225	272	226	274	227	275	228	276
16,000	-20	-27	100	812	222	278	224	279	225	281	226	282
18,000	-24	-31	100	802	220	283	221	285	223	287	223	288
20,000	-27	-35	96	764	213	284	215	286	217	288	218	289
22,000	-31	-39	91	726	206	284	208	286	210	288	212	290
24,000	-35	-43	86	682	199	282	201	285	203	288	204	290
26,000	-40	-47	80	632	190	279	192	283	195	286	197	288
28,000	-44	-51	73	582	181	274	183	279	186	283	188	286
29,000	-46	-52	70	556	175	271	178	276	181	280	184	284
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-72. Maximum Cruise Power, 1800 RPM, ISA – 10 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	20	15	100	946	240	241	241	242	242	243	243	244
2000	16	11	100	920	238	246	239	247	240	248	240	248
4000	13	7	100	892	235	250	236	251	237	252	238	253
6000	9	3	100	866	233	255	234	256	235	257	236	258
8000	5	-1	100	844	230	260	232	261	233	262	234	263
10,000	1	-5	100	822	228	265	229	266	230	267	231	269
12,000	-2	-9	100	800	226	270	227	272	228	273	229	274
14,000	-6	-13	100	786	223	275	224	277	226	278	227	280
16,000	-10	-17	100	776	221	281	222	283	223	284	224	285
18,000	-13	-21	95	772	213	281	216	283	217	285	218	287
20,000	-17	-25	91	734	207	282	209	284	211	286	212	288
22,000	-21	-29	87	698	201	282	203	284	204	287	206	289
24,000	-25	-33	82	654	192	280	195	283	197	286	199	288
26,000	-29	-37	76	606	184	276	186	280	189	284	191	287
28,000	-34	-41	70	560	174	271	177	276	180	281	183	284
29,000	-36	-42	67	538	169	268	172	273	176	278	178	283
31,000	-40	-46	62	496	157	258	162	267	167	274	170	279
33,000	-45	-50	56	454	140	240	150	257	157	267	161	274
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-73. Maximum Cruise Power, 1800 RPM, ISA

MAXIMUM CRUISE POWER
1800 RPM
ISA + 10 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	31	25	100	990	238	244	239	245	240	246	241	246
2000	27	21	100	962	236	248	237	249	238	250	239	251
4000	23	17	100	936	234	253	235	254	236	255	237	256
6000	19	13	100	910	231	258	232	259	233	260	234	261
8000	16	9	100	886	229	263	230	264	231	265	232	266
10,000	12	5	100	862	226	268	228	269	229	270	230	272
12,000	8	1	100	840	224	273	225	275	226	276	227	277
14,000	5	-3	100	824	221	278	223	280	224	282	225	283
16,000	1	-7	96	782	215	279	216	281	218	283	219	284
18,000	-3	-11	91	742	208	279	210	282	212	284	213	286
20,000	-7	-15	88	708	202	280	204	283	206	285	207	287
22,000	-11	-19	83	672	195	279	197	282	199	285	201	288
24,000	-15	-23	77	628	187	277	189	281	192	284	194	287
26,000	-19	-27	72	582	177	273	181	277	183	281	186	285
28,000	-24	-31	67	536	167	267	171	273	175	278	177	282
29,000	-26	-32	64	516	161	262	166	270	170	275	173	280
31,000	-30	-36	58	474	148	250	156	262	161	270	164	276
33,000	-35	-40	53	436	– – –	– – –	143	250	150	263	155	271
35,000	-39	-44	49	402	– – –	– – –	– – –	– – –	137	249	145	263

Figure 7A-74. Maximum Cruise Power, 1800 RPM, ISA + 10 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA + 20 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	41	35	100	994	337	246	238	247	239	248	240	249
2000	37	31	100	968	235	251	236	252	237	253	237	254
4000	33	27	100	940	232	255	233	257	234	258	235	259
6000	29	23	100	914	230	261	231	262	232	263	233	264
8000	26	19	100	890	227	266	228	267	230	268	230	269
10,000	22	15	100	868	225	271	226	272	227	273	228	275
12,000	18	11	96	820	219	272	220	274	222	275	223	277
14,000	14	7	93	780	213	274	215	276	216	277	218	279
16,000	10	3	90	744	208	275	210	277	211	279	213	281
18,000	7	-1	86	710	202	276	204	279	206	281	207	283
20,000	3	-5	83	678	196	277	198	280	200	283	202	285
22,000	-1	-9	80	648	190	278	192	281	194	284	996	287
24,000	-5	-13	75	606	181	275	184	279	187	283	189	286
26,000	-9	-17	69	560	172	270	175	275	178	279	181	283
28,000	-14	-21	63	516	161	262	165	269	169	275	172	279
29,000	-16	-22	60	494	154	255	160	265	164	272	168	277
31,000	-21	-26	55	454	137	237	148	255	154	266	1559	273
33,000	-26	-30	50	416	– – –	– – –	132	237	143	256	150	267
35,000	-30	-34	46	382	– – –	– – –	– – –	– – –	127	236	138	256

Figure 7A-75. Maximum Cruise Power, 1800 RPM, ISA + 20 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA + 30 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	51	45	100	1000	235	248	236	250	237	251	238	251
2000	47	41	100	972	233	253	234	254	235	255	236	256
4000	43	37	100	944	231	258	232	259	233	261	234	262
6000	40	33	100	918	228	263	229	264	230	266	231	267
8000	36	29	98	878	224	266	225	267	226	269	227	270
10,000	32	25	94	830	218	267	219	269	221	270	222	272
12,000	28	21	89	774	211	267	212	269	214	270	215	272
14,000	24	17	86	740	205	268	207	271	209	273	210	275
16,000	20	13	84	706	200	270	202	273	204	275	205	277
18,000	16	9	81	674	195	272	197	275	199	277	201	279
20,000	13	5	78	650	190	274	182	277	194	280	196	283
22,000	9	1	76	622	184	274	187	278	189	281	191	284
24,000	5	-3	71	580	175	271	179	276	181	280	184	283
26,000	0	-7	66	538	166	266	170	272	173	277	176	281
28,000	-4	-11	61	496	154	257	161	266	164	273	168	278
29,000	-6	-12	58	476	147	248	154	261	159	269	163	276
31,000	-11	-16	53	436	– – –	– – –	141	248	149	262	154	270
33,000	-15	-20	48	404	– – –	– – –	– – –	– – –	135	248	144	262
35,000	-19	-24	44	370	– – –	– – –	– – –	– – –	– – –	– – –	130	247

Figure 7A-76. Maximum Cruise Power, 1800 RPM, ISA + 30 °C

MAXIMUM CRUISE POWER
1800 RPM
ISA + 37 °C

NOTES: IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	58	52	100	1002	234	250	236	251	236	252	237	253
2000	54	48	100	974	232	255	233	256	234	257	235	258
4000	50	44	99	940	228	258	230	260	231	261	232	262
6000	46	40	96	894	223	261	225	262	226	264	227	265
8000	43	36	92	846	218	262	219	264	221	265	222	267
10,000	39	32	89	798	212	263	214	265	215	267	216	268
12,000	35	28	84	746	205	263	207	265	209	267	210	269
14,000	31	24	82	712	200	264	202	267	204	269	205	271
16,000	27	20	79	682	195	266	197	269	199	272	201	274
18,000	23	16	77	650	190	268	192	271	194	274	196	276
20,000	19	12	75	628	185	2670	187	274	190	277	192	280
22,000	15	8	73	602	179	271	182	275	185	279	187	282
24,000	11	4	68	564	171	268	174	273	177	277	180	281
26,000	7	0	63	522	161	262	166	269	169	274	172	279
28,000	3	-4	58	480	148	250	156	262	160	269	164	275
29,000	0	-5	56	460	139	239	149	256	155	266	159	273
31,000	-4	-9	50	422	– – –	– – –	134	239	144	257	150	267
33,000	-8	-13	47	390	– – –	– – –	– – –	– – –	130	241	140	258
35,000	-12	-17	43	360	– – –	– – –	– – –	– – –	– – –	– – –	125	242

Figure 7A-77. Maximum Cruise Power, 1800 RPM, ISA + 37 °C

MAXIMUM CRUISE SPEEDS

1800 RPM

WEIGHT 12,000 LBS

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 30 KNOTS IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, BUT WILL BE UNCHANGED IF THE ORIGINAL POWER IS RESET.

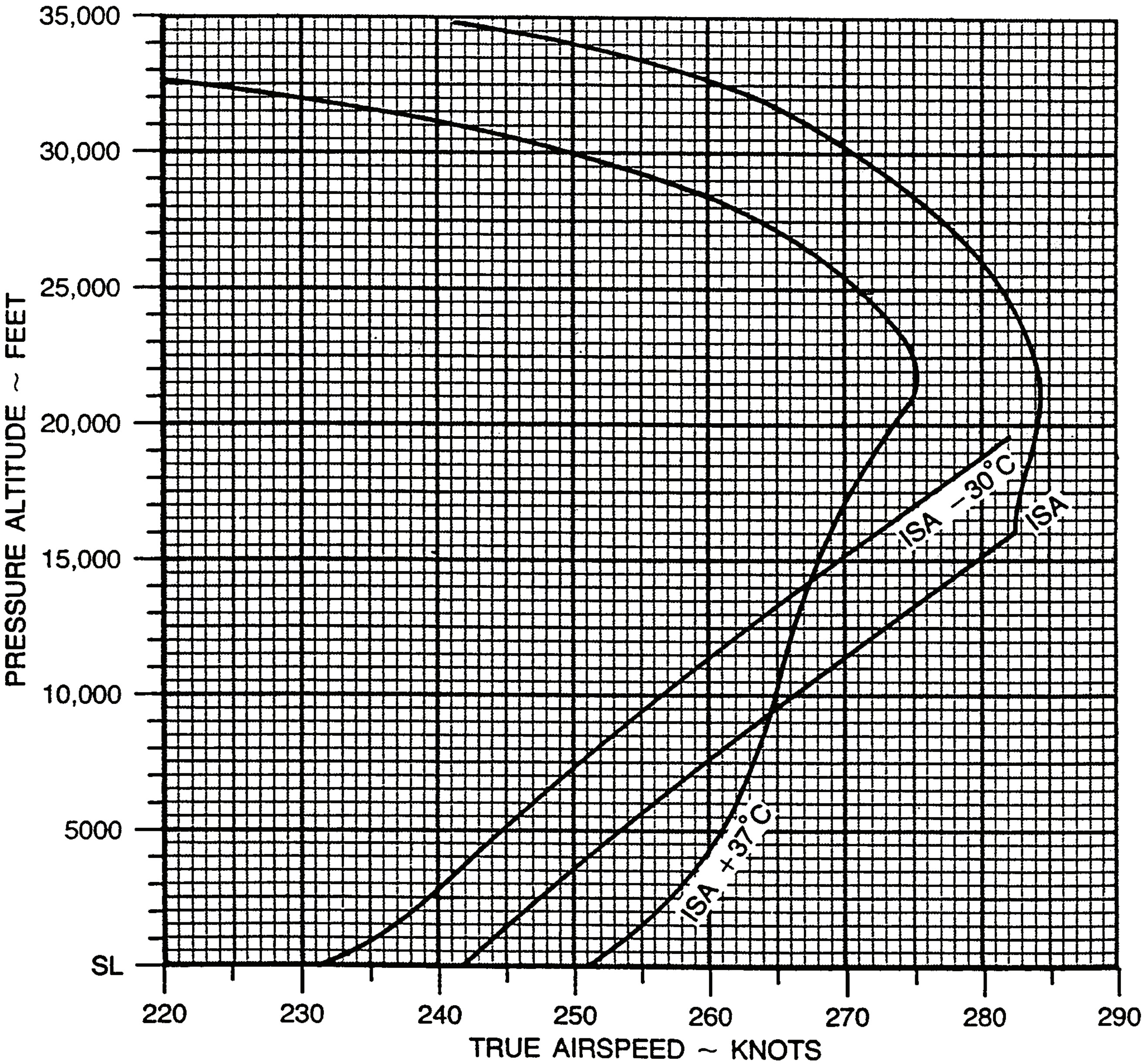


Figure 7A-78. Maximum Cruise Speeds, 1800 RPM

MAXIMUM CRUISE POWER

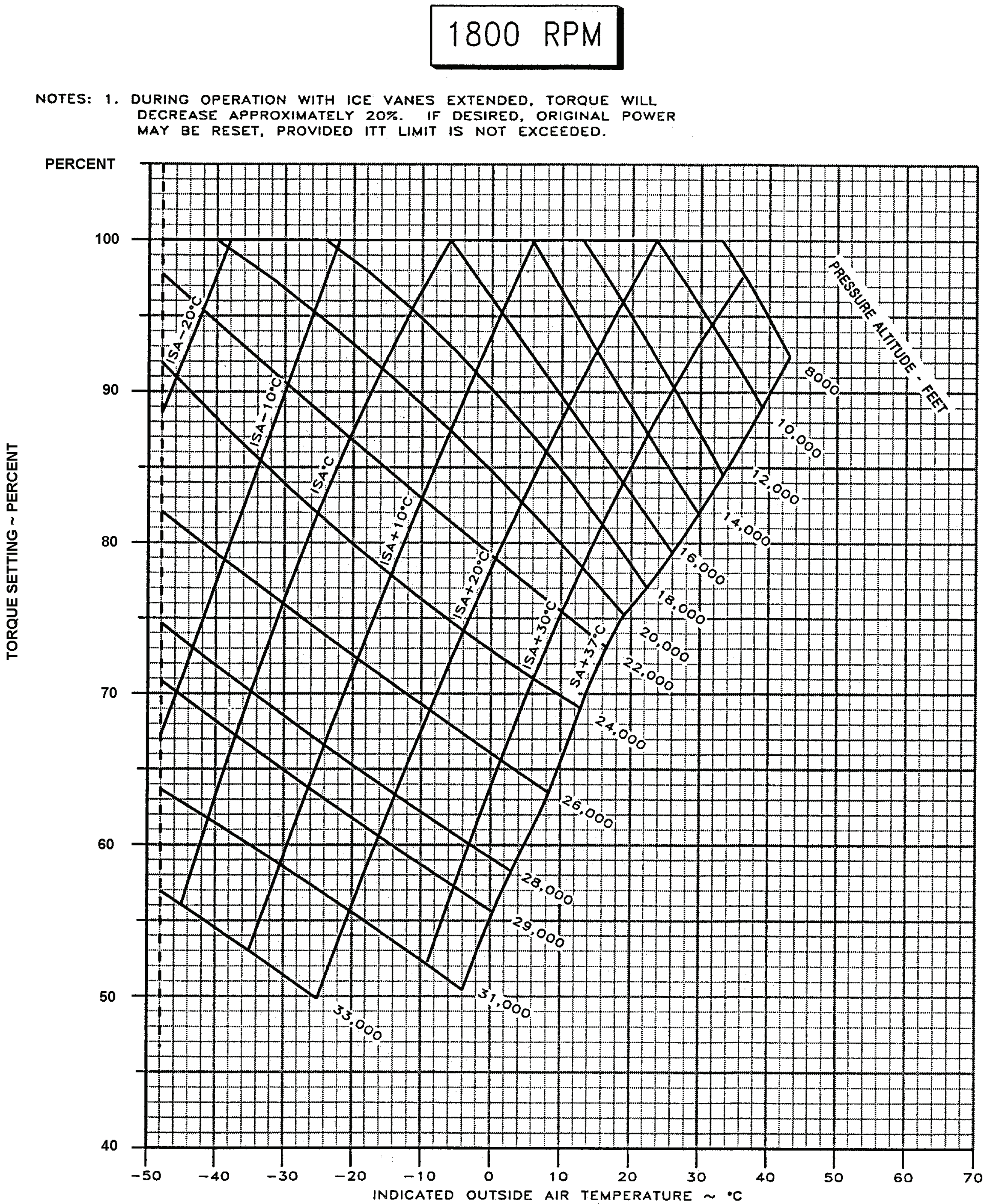


Figure 7A-79. Maximum Cruise Power, 1800 RPM

FUEL FLOW AT MAXIMUM CRUISE POWER

1800 RPM

NOTE: DURING OPERATION WITH ICE VANES EXTENDED, FUEL FLOW WILL DECREASE APPROXIMATELY 10% IF ORIGINAL POWER IS NOT OR CANNOT BE RESET. IF ORIGINAL POWER IS RESET, FUEL FLOW WILL INCREASE APPROXIMATELY 30 LBS/HR/ENG.

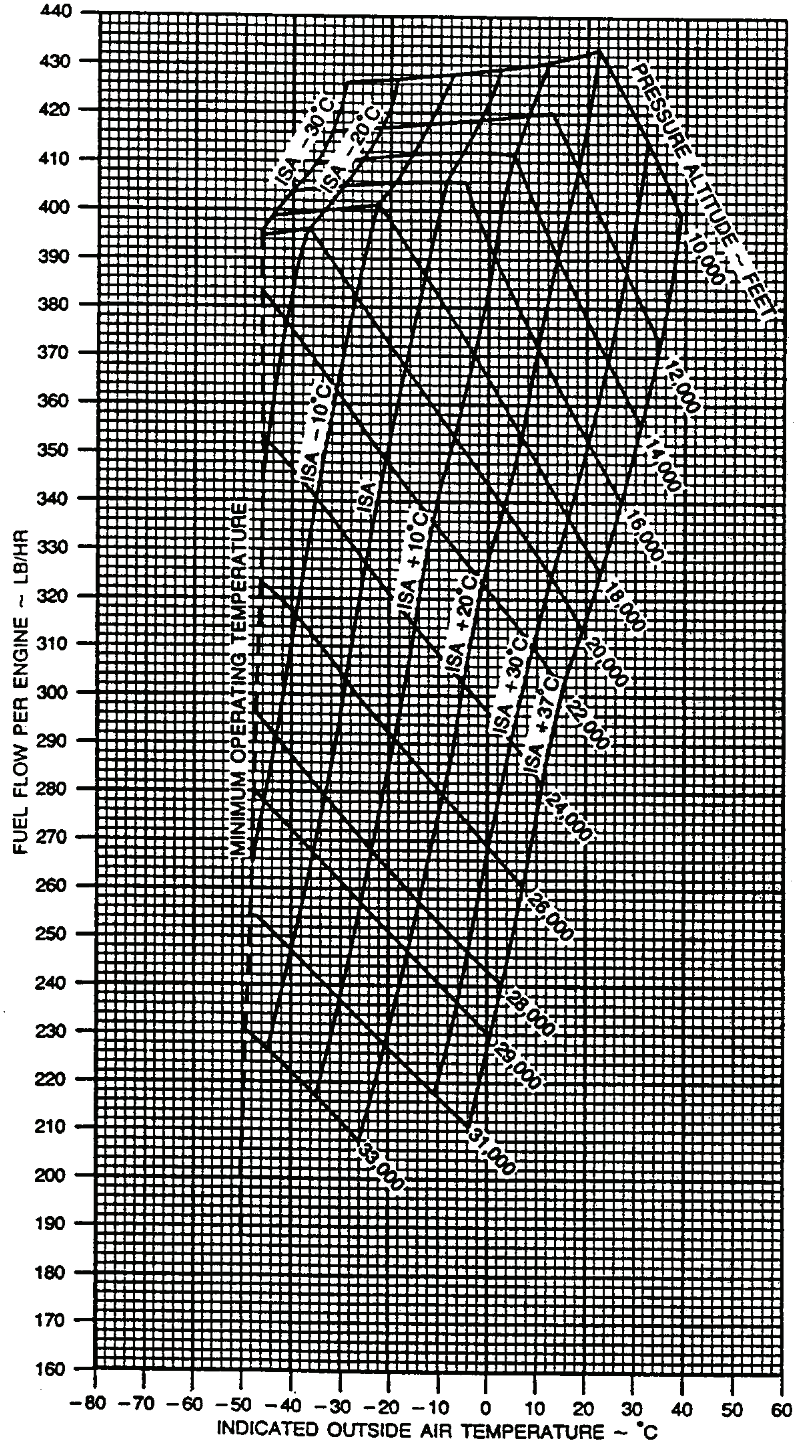


Figure 7A-80. Fuel Flow At Maximum Cruise Power, 1800 RPM

RANGE PROFILE - MAXIMUM CRUISE POWER

1800 RPM

STANDARD DAY (ISA)
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT
FUEL USED .... 2586 LBS

RANGE .... 968 NM

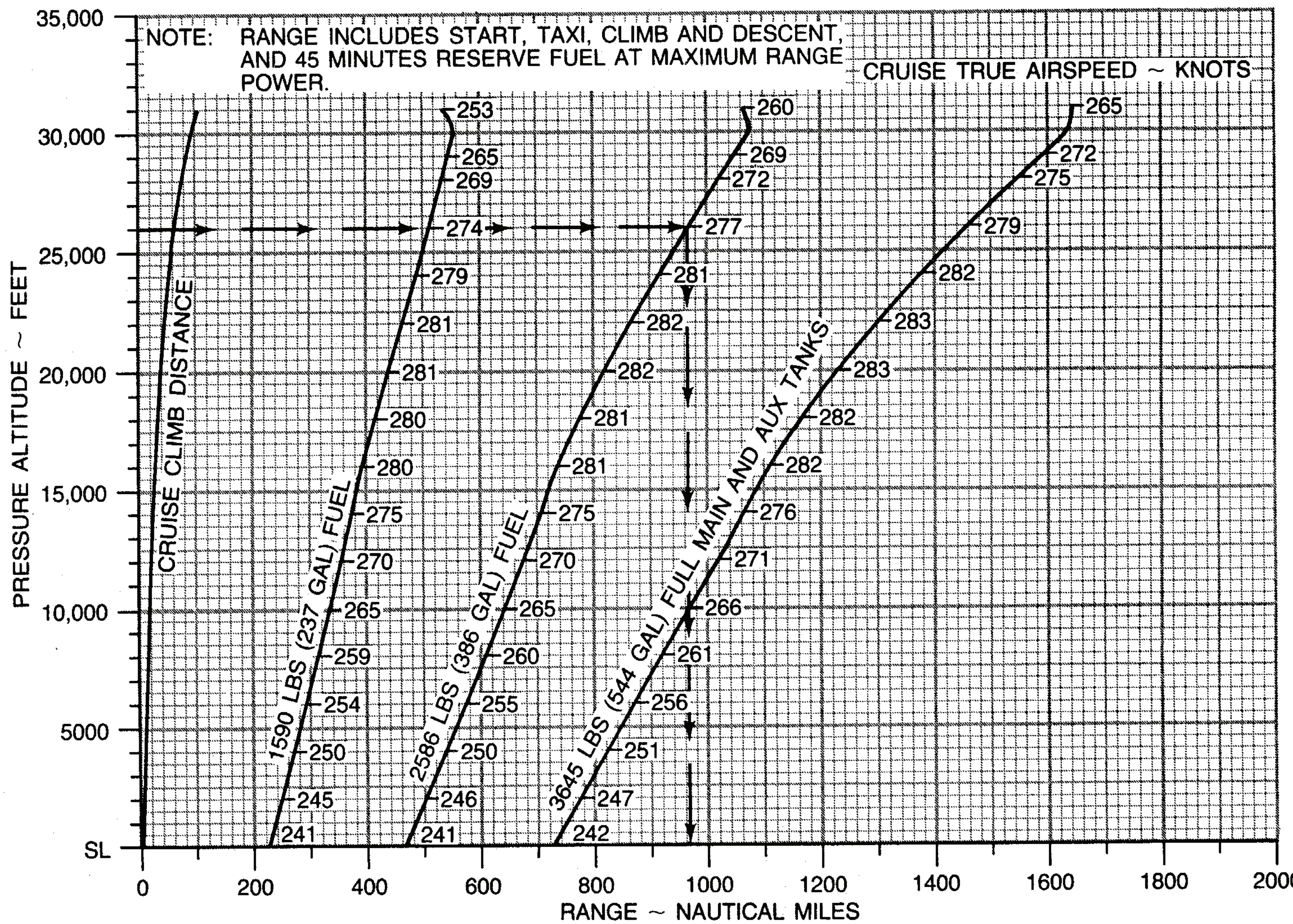


Figure 7A-81. Range Profile - Maximum Cruise Power, 1800 RPM

MAXIMUM RANGE POWER
1700 RPM
ISA – 30 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS				12,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	-11	-15	73	788	210	200	69	768	207	197
2,000	-15	-19	67	730	201	197	64	710	199	195
4,000	-20	-23	63	674	194	195	59	654	191	192
6,000	-24	-27	59	628	187	194	55	604	184	191
8,000	-28	-31	56	584	181	193	52	560	177	189
10,000	-32	-35	54	546	175	193	49	520	171	189
12,000	-35	-39	53	516	171	194	48	488	167	189
14,000	-39	-43	51	490	167	194	46	460	162	189
16,000	-43	-47	50	468	163	196	45	436	158	190
18,000	-47	-51	50	446	158	197	44	412	153	190
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-82. Maximum Range Power, 1700 RPM, ISA – 30 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 30 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➜			11,000 POUNDS				10,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	-11	-15	66	734	205	195	63	736	203	193
2,000	-15	-19	61	694	197	192	57	672	194	190
4,000	-20	-23	55	632	188	189	51	612	184	186
6,000	-24	-27	51	580	180	187	47	556	176	183
8,000	-28	-31	48	534	173	185	43	510	169	180
10,000	-32	-35	45	492	167	184	40	466	162	179
12,000	-35	-39	43	458	162	184	38	430	157	178
14,000	-39	-43	41	428	156	183	35	398	150	176
16,000	-43	-47	39	402	152	183	34	368	145	175
18,000	-47	-51	38	376	146	182	31	338	138	172
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-82. Maximum Range Power, 1700 RPM, ISA – 30 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 20 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➜			13,000 POUNDS				12,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	-1	-5	77	814	214	207	74	796	211	205
2,000	-5	-9	72	758	206	205	67	734	202	201
4,000	-9	-13	67	702	197	202	63	678	194	199
6,000	-13	-17	63	654	191	201	59	632	187	198
8,000	-17	-21	60	612	185	201	56	588	181	197
10,000	-21	-25	57	568	178	200	53	544	175	196
12,000	-25	-29	56	540	174	201	52	514	170	197
14,000	-29	-33	55	514	170	202	50	486	166	198
16,000	-33	-37	54	490	165	203	49	460	161	198
18,000	-37	-41	53	472	162	205	48	440	157	199
20,000	-41	-45	53	465	158	207	47	420	152	200
22,000	-45	-49	53	446	156	211	47	408	150	203
24,000	-49	-53	54	444	155	217	48	404	149	208
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-83. Maximum Range Power, 1700 RPM, ISA – 20 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 20 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS				10,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	-1	-5	70	776	208	202	67	760	206	200
2,000	-5	-9	64	716	199	199	61	698	197	196
4,000	-9	-13	59	660	191	196	56	642	189	194
6,000	-13	-17	56	612	185	195	52	592	182	192
8,000	-17	-21	52	568	178	194	49	546	175	191
10,000	-21	-25	49	522	171	192	45	500	168	188
12,000	-25	-29	47	490	167	193	43	466	163	188
14,000	-29	-33	46	460	162	193	41	434	157	187
16,000	-33	-37	44	432	156	192	38	402	151	186
18,000	-37	-41	42	408	152	193	37	374	145	185
20,000	-41	-45	41	384	147	192	35	348	139	183
22,000	-45	-49	41	370	143	195	34	332	136	185
24,000	-49	-53	42	366	142	200	36	328	136	191
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-83. Maximum Range Power, 1700 RPM, ISA – 20 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 10 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS				12,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	9	5	80	830	216	213	76	810	213	210
2,000	5	1	76	782	209	212	72	760	206	209
4,000	1	-3	71	728	201	210	67	704	198	207
6,000	-3	-7	67	678	194	209	63	656	191	205
8,000	-7	-11	64	634	188	208	60	610	184	204
10,000	-11	-15	61	590	181	207	57	566	178	203
12,000	-15	-19	60	562	177	209	55	536	173	204
14,000	-19	-23	58	534	173	210	53	506	168	205
16,000	-23	-27	57	514	169	212	52	482	164	206
18,000	-27	-31	57	494	165	213	51	460	159	207
20,000	-31	-35	56	480	162	217	50	442	156	209
22,000	-34	-39	57	470	160	221	50	430	153	212
24,000	-38	-43	57	464	158	226	51	426	152	218
26,000	-42	-47	58	460	156	232	52	422	151	224
28,000	-46	-51	58	452	153	234	53	420	150	230
29,000	-48	-52	59	458	153	239	53	420	149	232
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-84. Maximum Range Power, 1700 RPM, ISA – 10 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA – 10 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS				10,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	9	5	73	790	210	207	69	774	207	205
2,000	5	1	68	740	203	206	64	720	200	203
4,000	1	-3	62	682	194	203	59	660	190	199
6,000	-3	-7	59	632	187	201	55	612	184	198
8,000	-7	-11	55	586	181	200	52	566	177	197
10,000	-11	-15	52	542	174	199	49	520	171	196
12,000	-15	-19	51	510	169	200	47	488	166	196
14,000	-19	-23	49	480	164	200	44	456	160	195
16,000	-23	-27	47	454	159	200	42	428	155	195
18,000	-27	-31	45	428	154	200	40	400	149	194
20,000	-31	-35	44	408	150	201	39	378	145	194
22,000	-34	-39	44	394	147	204	38	360	141	196
24,000	-38	-43	45	388	146	209	39	352	140	200
26,000	-42	-47	46	384	145	215	40	346	138	206
28,000	-46	-51	47	382	144	221	41	344	137	211
29,000	-48	-52	48	384	144	224	41	344	137	214
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-84. Maximum Range Power, 1700 RPM, ISA – 10 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➜			13,000 POUNDS				12,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	19	15	81	840	217	218	78	822	214	215
2,000	15	11	77	790	210	217	73	770	207	214
4,000	11	7	74	748	204	217	70	724	201	214
6,000	7	3	70	696	197	216	65	672	193	211
8,000	3	-1	67	656	191	216	63	632	188	212
10,000	-1	-5	65	614	186	216	60	588	182	212
12,000	-5	-9	63	582	181	216	58	554	177	212
14,000	-9	-13	62	554	177	219	57	526	172	213
16,000	-12	-17	61	532	173	221	55	500	167	214
18,000	-16	-21	60	514	169	223	54	482	163	216
20,000	-20	-25	59	500	165	226	53	464	160	218
22,000	-24	-29	59	488	162	229	53	452	157	221
24,000	-28	-33	60	482	161	235	54	444	155	227
26,000	-31	-37	59	464	155	235	55	438	154	232
28,000	-35	-41	59	462	153	240	54	428	150	234
29,000	-37	-42	60	466	152	243	54	428	148	236
31,000	-41	-46	– – –	– – –	– – –	– – –	55	428	146	242
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-85. Maximum Range Power, 1700 RPM, ISA (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS				10,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	19	15	74	804	212	213	72	788	210	211
2,000	15	11	70	750	204	211	66	732	201	208
4,000	11	7	66	704	198	210	63	684	195	207
6,000	7	3	61	650	189	208	58	630	186	204
8,000	3	-1	59	608	184	208	55	586	180	204
10,000	-1	-5	56	564	178	207	51	542	174	203
12,000	-5	-9	54	530	173	208	50	506	169	203
14,000	-9	-13	52	498	167	207	47	472	163	202
16,000	-12	-17	50	470	162	207	45	444	157	202
18,000	-16	-21	48	448	158	209	43	420	152	202
20,000	-20	-25	47	428	153	210	42	396	147	202
22,000	-24	-29	47	414	150	212	41	380	144	204
24,000	-28	-33	48	408	149	218	41	370	142	208
26,000	-31	-37	49	402	148	224	42	364	141	214
28,000	-35	-41	50	400	147	230	43	362	141	221
29,000	-37	-42	50	396	145	232	44	362	140	224
31,000	-41	-46	49	390	142	235	45	360	139	230
33,000	-45	-50	50	392	140	240	45	356	136	233
35,000	– – –	– – –	– – –	– – –	– – –	– – –	45	356	134	238

Figure 7A-85. Maximum Range Power, 1700 RPM, ISA (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 10 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS				12,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	29	25	77	824	211	215	75	812	210	215
2,000	25	21	75	786	207	218	73	774	206	217
4,000	21	17	74	750	203	220	71	736	202	219
6,000	18	13	72	710	198	221	69	694	196	219
8,000	14	9	70	670	193	222	66	648	190	219
10,000	10	5	67	630	188	223	63	606	184	219
12,000	6	1	66	598	183	225	62	576	181	221
14,000	2	-3	64	570	179	226	60	546	176	222
16,000	-2	-7	63	546	174	228	58	520	171	223
18,000	-6	-11	62	542	170	230	57	496	167	225
20,000	-10	-15	61	508	166	232	56	478	162	226
22,000	-14	-19	61	498	163	235	56	468	159	229
24,000	-17	-23	59	478	157	235	56	458	157	233
26,000	-21	-27	60	476	156	240	55	440	152	234
28,000	-25	-31	60	472	152	243	54	434	148	237
29,000	-27	-32	61	474	151	246	55	434	147	240
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-86. Maximum Range Power, 1700 RPM, ISA + 10 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 10 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS				10,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	29	25	73	800	209	214	71	788	208	212
2,000	25	21	71	760	205	215	68	744	202	213
4,000	21	17	68	714	199	215	64	694	196	212
6,000	18	13	65	670	193	215	61	650	190	212
8,000	14	9	62	626	187	215	58	604	183	211
10,000	10	5	58	582	180	214	54	558	176	209
12,000	6	1	57	552	177	216	53	526	173	211
14,000	2	-3	55	520	171	216	50	494	167	211
16,000	-2	-7	53	490	166	217	48	462	161	210
18,000	-6	-11	51	466	161	217	46	434	155	210
20,000	-10	-15	50	444	156	218	44	410	150	209
22,000	-14	-19	50	434	153	221	44	398	147	212
24,000	-17	-23	50	424	152	226	44	390	146	218
26,000	-21	-27	51	416	150	231	45	382	144	223
28,000	-25	-31	50	404	146	234	46	376	143	229
29,000	-27	-32	50	398	144	234	46	374	142	231
31,000	-31	-36	50	398	141	239	45	364	138	233
33,000	-35	-40	51	404	140	246	45	362	135	237
35,000	-39	-44	– – –	– – –	– – –	– – –	46	368	134	244

Figure 7A-86. Maximum Range Power, 1700 RPM, ISA + 10 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 20 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS				12,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	39	35	73	810	205	213	71	798	204	212
2,000	35	31	72	722	201	215	69	758	200	214
4,000	31	27	70	734	197	217	69	726	197	217
6,000	28	23	69	698	193	219	67	688	193	219
8,000	24	19	67	660	188	220	65	650	188	221
10,000	20	15	65	622	183	222	63	610	183	222
12,000	16	11	63	588	179	223	61	578	179	223
14,000	12	7	62	562	174	224	60	550	175	225
16,000	8	3	61	538	170	226	59	526	171	227
18,000	4	-1	60	516	166	228	58	504	167	229
20,000	0	-5	60	502	163	231	58	488	163	232
22,000	-3	-9	59	490	159	234	57	472	159	234
24,000	-7	-13	60	484	157	239	55	452	154	234
26,000	-11	-17	61	484	156	245	55	444	151	238
28,000	-15	-21	61	480	152	247	56	446	149	244
29,000	-17	-22	– – –	– – –	– – –	– – –	56	444	147	245
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-87. Maximum Range Power, 1700 RPM, ISA + 20 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 20 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS				10,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	39	35	69	786	204	212	67	776	203	211
2,000	35	31	68	748	200	214	65	736	199	213
4,000	31	27	67	712	196	217	64	700	196	216
6,000	28	23	65	676	193	219	62	658	190	216
8,000	24	19	63	636	188	220	59	614	184	216
10,000	20	15	60	594	182	220	56	572	178	216
12,000	16	11	59	562	178	222	55	538	174	217
14,000	12	7	57	534	173	223	53	510	170	218
16,000	8	3	56	506	169	224	51	482	165	219
18,000	4	-1	54	482	164	226	49	454	159	219
20,000	0	-5	53	460	159	226	47	428	154	219
22,000	-3	-9	52	442	155	228	46	410	150	220
24,000	-7	-13	52	432	153	232	46	398	147	224
26,000	-11	-17	51	416	148	234	47	390	146	230
28,000	-15	-21	50	406	144	235	46	382	142	233
29,000	-17	-22	51	408	144	239	46	376	140	233
31,000	-21	-26	51	408	142	245	46	372	138	237
33,000	-25	-30	– – –	– – –	– – –	– – –	47	372	136	243
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-87. Maximum Range Power, 1700 RPM, ISA + 20 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 30 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS				12,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	49	45	75	820	205	217	70	798	202	214
2,000	45	41	70	768	198	215	67	750	196	213
4,000	41	37	68	726	193	216	65	710	192	215
6,000	37	33	66	690	189	218	64	674	188	217
8,000	34	29	64	650	184	219	62	636	183	218
10,000	30	25	62	612	179	19	60	596	178	219
12,000	26	21	61	582	174	221	59	566	174	220
14,000	22	17	60	556	170	223	57	538	169	221
16,000	18	13	60	536	167	226	56	514	165	224
18,000	14	9	60	518	163	229	56	496	162	227
20,000	10	5	59	504	160	232	56	480	159	230
22,000	6	1	60	498	159	238	55	464	155	232
24,000	3	-3	62	498	158	245	55	452	151	235
26,000	-1	-7	61	486	153	246	57	456	152	244
28,000	-5	-11	– – –	– – –	– – –	– – –	56	448	148	246
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-88. Maximum Range Power, 1700 RPM, ISA + 30 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 30 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➜			11,000 POUNDS				10,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	49	45	67	780	200	211	64	766	198	209
2,000	45	41	65	736	195	212	62	724	194	211
4,000	41	37	63	700	191	214	61	688	190	213
6,000	37	33	62	664	187	216	60	652	187	216
8,000	34	29	60	626	183	218	58	614	183	218
10,000	30	25	58	588	178	219	56	574	178	218
12,000	26	21	57	556	174	221	55	544	174	220
14,000	22	17	56	528	170	223	53	516	169	222
16,000	18	13	55	504	166	225	52	490	166	224
18,000	14	9	54	484	163	228	51	466	161	226
20,000	10	5	54	468	159	231	49	444	156	226
22,000	6	1	53	450	156	233	48	424	152	228
24,000	3	-3	51	428	150	232	48	408	149	231
26,000	-1	-7	50	410	144	232	47	392	144	232
28,000	-5	-11	52	418	146	244	45	374	139	231
29,000	-7	-12	52	414	144	244	46	376	139	236
31,000	-11	-16	52	410	140	247	47	376	138	243
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-88. Maximum Range Power, 1700 RPM, ISA + 30 °C (Sheet 2 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 37 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			13,000 POUNDS				12,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	56	52	77	840	207	222	73	814	204	218
2,000	52	48	74	790	201	221	68	760	197	216
4,000	48	44	70	740	194	220	65	714	191	216
6,000	44	40	66	694	188	220	63	670	185	216
8,000	41	36	65	656	183	221	61	632	180	217
10,000	37	32	63	620	179	222	59	594	176	218
12,000	33	28	63	592	175	225	58	564	172	220
14,000	29	24	62	568	171	227	57	538	167	222
16,000	25	20	62	548	168	230	56	516	164	224
18,000	21	16	62	534	166	235	55	496	160	227
20,000	17	12	62	522	163	239	55	482	157	230
22,000	14	8	62	512	160	243	55	470	154	234
24,000	10	4	62	498	156	245	57	468	154	242
26,000	6	0	63	496	154	250	57	458	150	245
28,000	2	-4	– – –	– – –	– – –	– – –	58	456	148	250
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-89. Maximum Range Power, 1700 RPM, ISA + 37 °C (Sheet 1 of 2)

MAXIMUM RANGE POWER
1700 RPM
ISA + 37 °C

NOTES: DURING OPERATION WITH ICE VANES EXTENDED, TORQUE WILL DECREASE. IN ORDER TO MAINTAIN MAXIMUM RANGE CONFIGURATION, DO NOT RESET POWER TO ORIGINAL SETTING. FUEL FLOW WILL REMAIN ABOUT THE SAME, BUT TRUE AIRSPEED WILL BE REDUCED APPROXIMATELY 10 KNOTS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

WEIGHT ➔			11,000 POUNDS				10,000 POUNDS			
PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS	TORQUE PER ENGINE	FUEL FLOW TOTAL	IAS	TAS
FEET	°C	°C	%	LB/HR	KTS	KTS	%	LB/HR	KTS	KTS
SL	56	52	68	788	200	214	64	766	197	210
2,000	52	48	64	738	194	213	61	720	191	210
4,000	48	44	62	696	189	214	60	682	187	212
6,000	44	40	60	654	184	215	58	644	183	214
8,000	41	36	58	618	179	216	56	606	179	216
10,000	37	32	56	580	175	217	56	568	175	217
12,000	33	28	55	548	171	219	53	536	171	219
14,000	29	24	54	520	166	220	52	510	167	221
16,000	25	20	53	496	162	222	51	486	163	223
18,000	21	16	52	476	159	225	50	464	159	226
20,000	17	12	52	462	156	229	50	448	156	229
22,000	14	8	52	446	152	231	49	430	152	231
24,000	10	4	50	426	147	232	48	408	147	232
26,000	6	0	52	424	147	239	46	386	141	231
28,000	2	-4	51	420	15	244	47	380	139	239
29,000	0	-5	52	418	143	246	47	382	137	245
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-89. Maximum Range Power, 1700 RPM, ISA + 37 °C (Sheet 2 of 2)

RANGE PROFILE - MAXIMUM RANGE POWER

1700 RPM

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

STANDARD DAY (ISA)
ZERO WIND

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT
FUEL USED .... 2586 LBS

RANGE .... 1065 NM

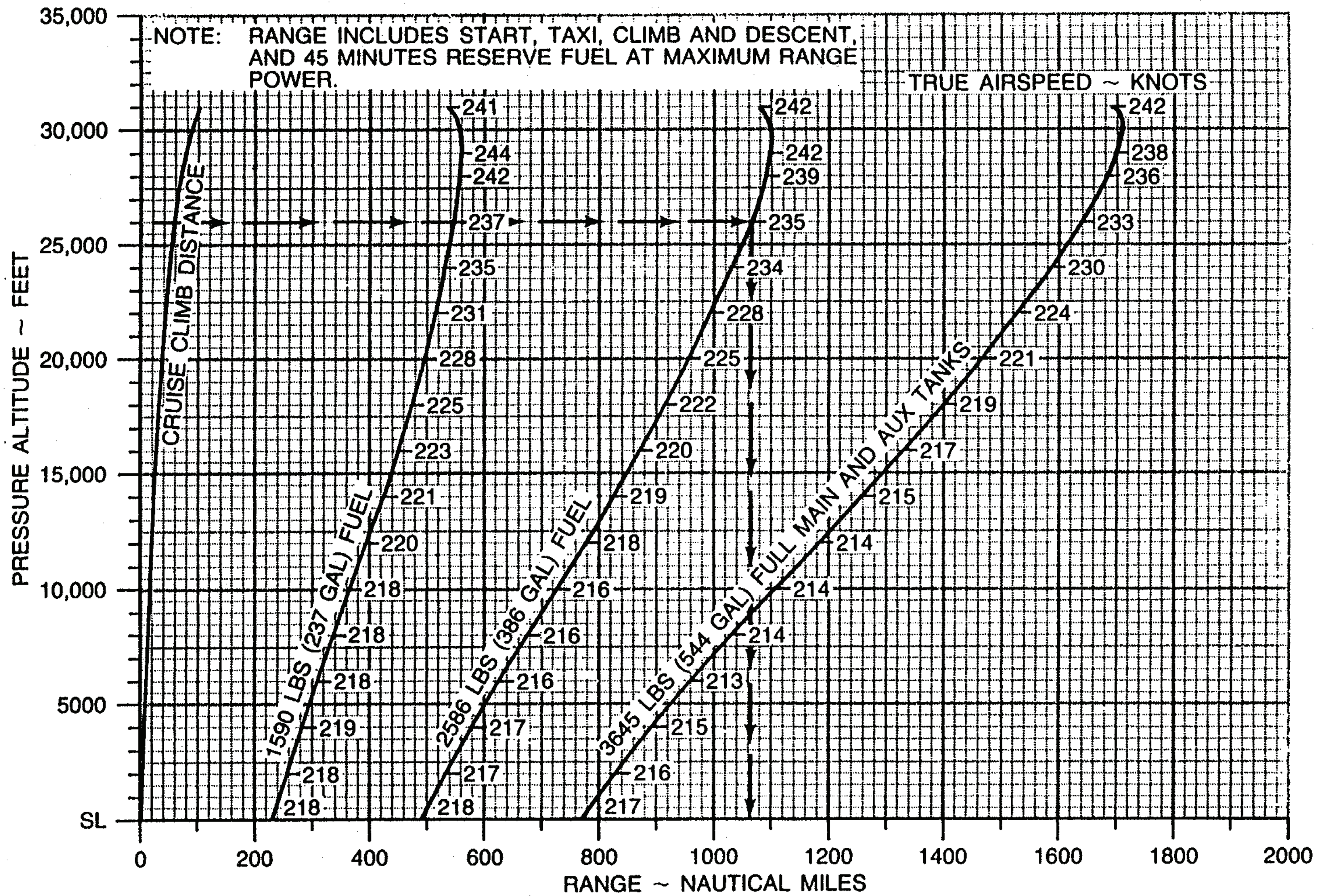


Figure 7A-90. Range Profile – Maximum Range Power, 1700 RPM

RANGE PROFILE - FULL MAIN AND AUX TANKS

STANDARD DAY
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT

RANGE @ MAX CRUISE - 1800 RPM .... 1460 NM
RANGE @ MAX RANGE - 1700 RPM .... 1640 NM

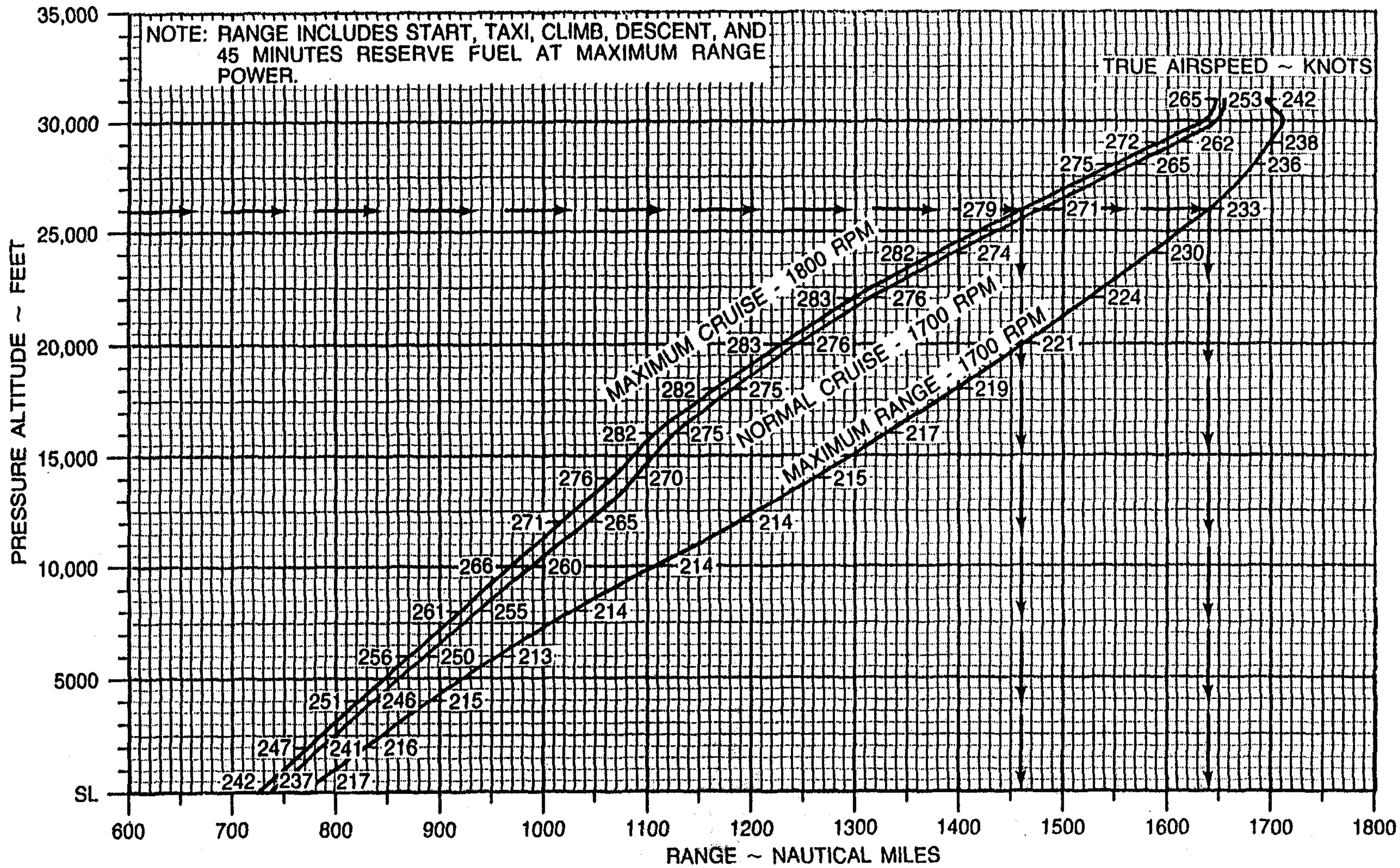


Figure 7A-91. Range Profile – Full Main and Auxiliary Tanks

ENDURANCE PROFILE - FULL MAIN AND AUX TANKS

STANDARD DAY

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT

RANGE @ MAX CRUISE - 1800 RPM .... 5.37 HRS
RANGE @ MAX RANGE - 1700 RPM .... 7.05 HRS

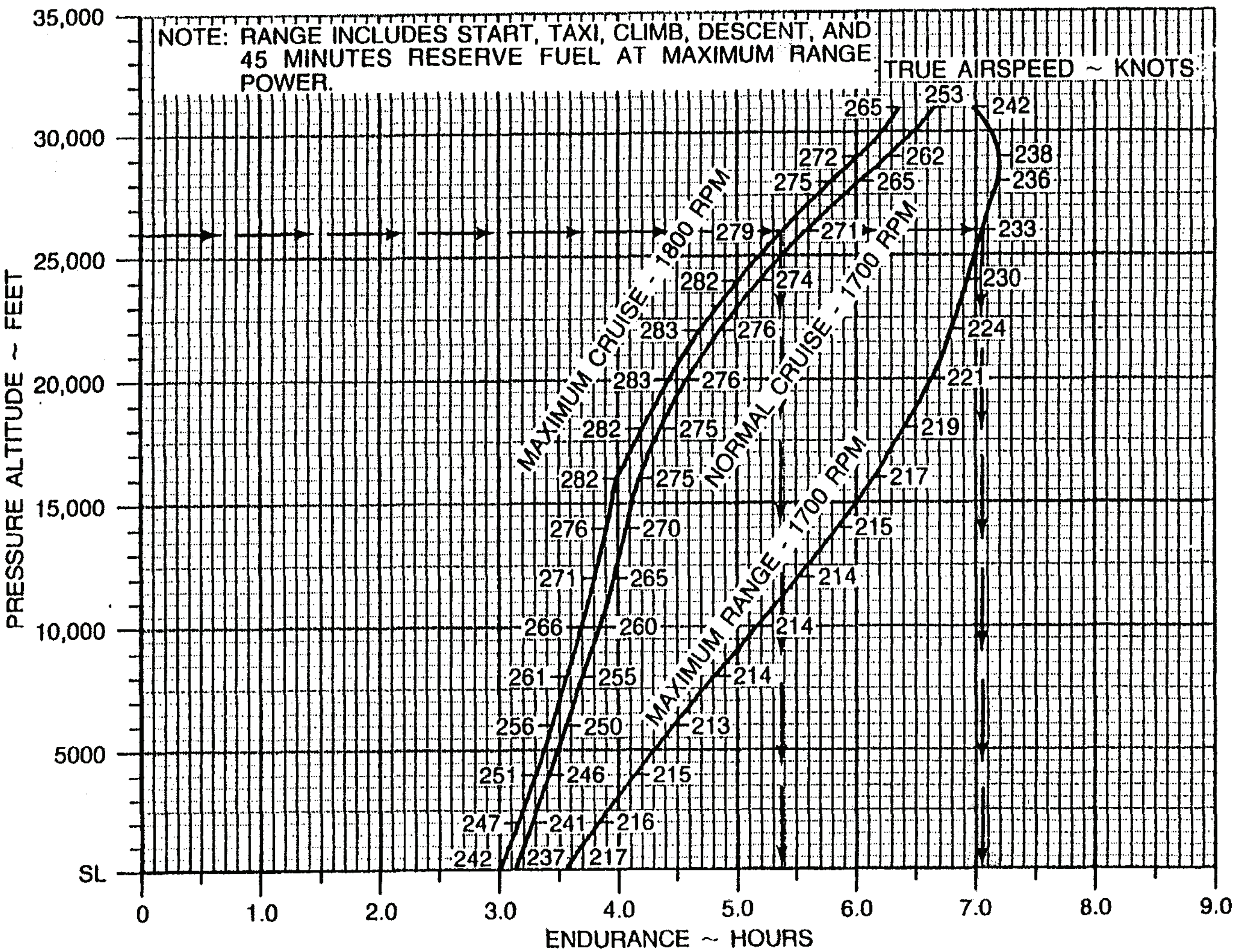


Figure 7A-92. Endurance Profile – Full Main and Auxiliary Tanks

RANGE PROFILE - FULL MAIN TANKS

STANDARD DAY
ZERO WIND

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT

RANGE @ MAX CRUISE - 1800 RPM .... 968 NM
RANGE @ MAX RANGE - 1700 RPM .... 1065 NM

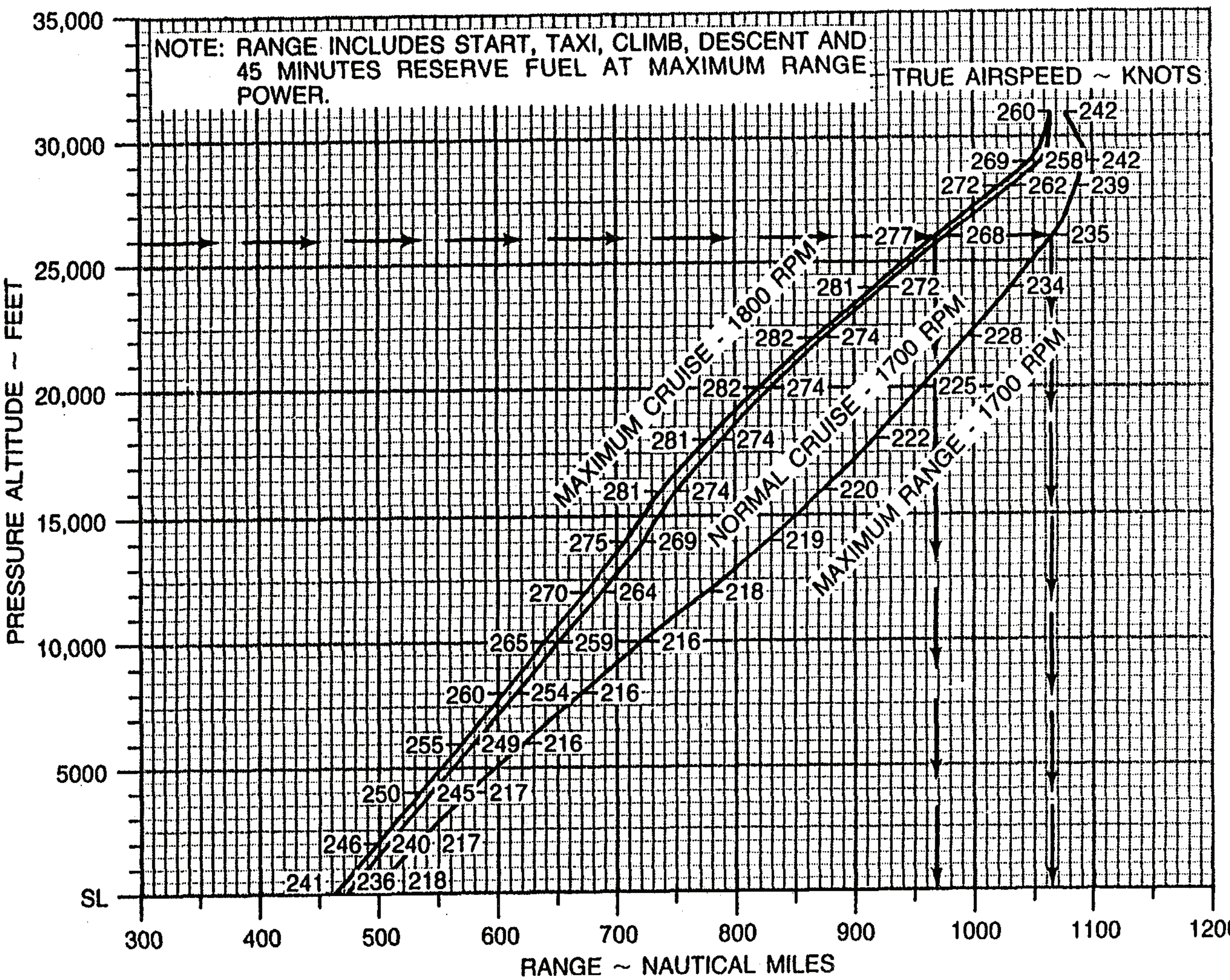


Figure 7A-93. Range Profile – Full Main Tanks

ENDURANCE PROFILE - FULL MAIN TANKS

STANDARD DAY

ASSOCIATED CONDITIONS:

WEIGHT .... 14,090 LBS BEFORE ENGINE START
FUEL .... AVIATION KEROSENE
FUEL DENSITY .... 6.7 LBS/GAL
ICE VANES .... RETRACTED

EXAMPLE:

PRESSURE ALTITUDE .... 26,000 FT

RANGE @ MAX CRUISE - 1800 RPM .... 3.62 HRS
RANGE @ MAX RANGE - 1700 RPM .... 4.57 HRS

NOTE: RANGE INCLUDES START, TAXI, CLIMB, DESCENT, AND 45 MINUTES RESERVE FUEL AT MAXIMUM RANGE POWER.

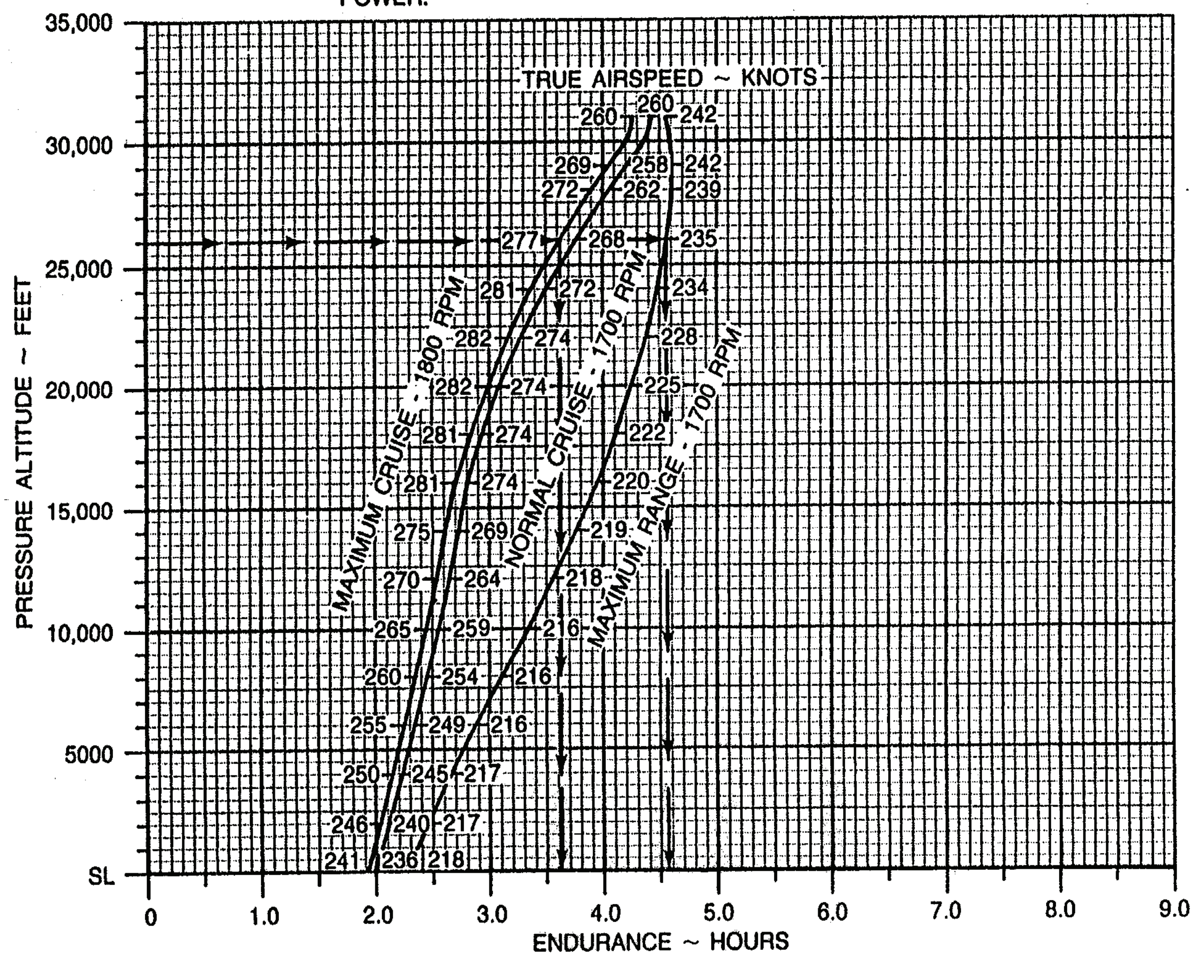


Figure 7A-94. Endurance Profile – Full Main Tanks

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA – 30 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-12-	-15	100	517	189	180	191	182	193	183	194	185
2000	-16	-19	100	505	186	182	189	185	191	187	192	188
4000	-20	-23	100	492	184	185	186	188	188	190	190	192
6000	-24	-27	100	479	181	188	184	191	186	193	188	195
8000	-27	-31	100	467	179	191	182	194	184	196	186	198
10,000	-31	-35	100	455	176	194	179	197	182	199	184	202
12,000	-35	-39	100	445	174	196	177	200	179	203	181	205
14,000	-39	-43	100	439	171	199	174	203	177	206	179	208
16,000	-43	-47	100	434	167	202	171	206	174	209	176	212
18,000	-47	-51	96	415	160	199	165	205	169	209	172	213
20,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
22,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-95. Maximum Cruise Power, 1900 RPM, ISA – 30 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA – 20 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	-2	-5	100	520	187	181	189	184	191	185	193	187
2000	-6	-9	100	505	185	184	187	187	189	189	191	190
4000	-10	-13	100	492	182	187	185	190	187	192	189	194
6000	-13	-17	100	480	180	190	182	193	184	195	186	197
8000	-17	-21	100	468	177	193	180	196	182	198	184	201
10,000	-21	-25	100	456	174	196	177	199	180	202	182	204
12,000	-25	-29	100	446	171	198	175	202	177	205	179	207
14,000	-29	-33	100	440	168	201	172	205	175	208	177	211
16,000	-33	-37	97	423	162	199	166	204	170	209	173	212
18,000	-37	-41	92	400	154	195	159	202	163	207	166	211
20,000	-41	-45	87	378	144	190	151	199	156	205	160	210
22,000	-45	-49	82	356	131	178	142	193	149	202	154	208
24,000	-50	-53	75	326	– – –	– – –	127	179	138	194	145	203
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-96. Maximum Cruise Power, 1900 RPM, ISA – 20 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA – 10 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	8	5	100	522	185	183	188	186	190	187	191	189
2000	4	1	100	508	183	186	185	188	187	191	189	192
4000	0	-3	100	494	180	189	183	191	185	194	187	196
6000	-3	-7	100	481	178	192	181	195	183	197	185	199
8000	-7	-11	100	468	175	194	178	198	181	200	183	203
10,000	-11	-15	100	456	172	197	175	201	178	204	180	206
12,000	-15	-19	100	446	169	200	173	204	175	207	178	209
14,000	-19	-23	97	428	163	198	167	203	170	207	173	211
16,000	-23	-27	92	406	155	195	160	201	165	206	167	201
18,000	-27	-31	87	384	146	190	153	198	157	204	161	209
20,000	-31	-35	83	365	135	182	145	194	151	202	155	208
22,000	-35	-39	78	343	– – –	– – –	134	187	143	198	148	206
24,000	-39	-43	73	318	– – –	– – –	– – –	– – –	132	189	140	200
26,000	-43	-47	68	294	– – –	– – –	– – –	– – –	– – –	– – –	129	192
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-97. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA – 10 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	18	15	100	525	184	185	186	187	188	189	190	191
2000	14	11	100	511	181	188	184	190	186	192	188	194
4000	11	7	100	497	179	190	181	193	184	196	186	198
6000	7	3	100	483	176	193	179	196	181	199	183	201
8000	3	-1	100	469	173	196	176	200	179	202	181	205
10,000	-1	-5	100	457	170	199	174	202	176	206	179	208
12,000	-5	-9	97	436	165	198	169	203	172	207	174	210
14,000	-9	-13	93	412	157	195	162	201	166	206	169	209
16,000	-13	-17	88	390	148	190	154	198	159	204	163	208
18,000	-17	-21	83	369	138	183	146	194	152	201	156	206
20,000	-21	-25	79	351	119	163	137	188	145	198	150	205
22,000	-26	-29	74	329	– – –	– – –	123	175	136	193	143	202
24,000	-30	-33	69	305	– – –	– – –	– – –	– – –	123	180	133	196
26,000	-33	-37	65	283	– – –	– – –	– – –	– – –	– – –	– – –	121	185
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-98. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA + 10 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	28	25	100	527	182	187	185	189	187	191	189	193
2000	24	21	100	513	180	189	182	192	185	194	186	196
4000	21	17	100	499	177	192	180	195	182	198	184	200
6000	17	13	100	484	174	195	177	198	180	200	182	203
8000	13	9	100	470	171	197	174	201	177	204	179	207
10,000	9	5	95	441	164	195	168	199	171	203	174	207
12,000	5	1	91	415	157	192	161	198	165	202	168	206
14,000	1	-3	87	395	149	189	155	196	160	202	163	206
16,000	-3	-7	84	376	141	184	148	194	153	201	158	206
18,000	-7	-11	80	355	128	173	140	189	147	198	151	205
20,000	-12	-15	76	338	– – –	– – –	130	182	139	195	145	203
22,000	-15	-19	72	319	– – –	– – –	– – –	– – –	128	186	137	198
24,000	-19	-23	67	296	– – –	– – –	– – –	– – –	– – –	– – –	126	190
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-99. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA + 10 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA + 20 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	38	35	100	530	181	188	183	191	185	193	187	195
2000	35	31	100	515	178	191	181	194	183	196	185	198
4000	31	27	100	500	176	194	178	197	181	200	183	202
6000	27	23	97	475	170	193	173	197	176	200	178	203
8000	23	19	92	447	163	191	167	196	170	200	173	203
10,000	19	15	88	418	155	188	160	194	164	198	167	202
12,000	15	11	84	394	148	185	153	192	158	197	161	202
14,000	11	7	82	376	140	180	147	190	153	197	157	202
16,000	7	3	79	359	129	172	140	187	147	196	152	202
18,000	2	-1	76	343	---	---	132	182	141	194	146	201
20,000	-1	-5	73	327	---	---	---	---	133	189	140	199
22,000	-6	-9	69	307	---	---	---	---	120	178	132	195
24,000	-9	-13	64	285	---	---	---	---	---	---	120	184
26,000	---	---	---	---	---	---	---	---	---	---	---	---
28,000	---	---	---	---	---	---	---	---	---	---	---	---
29,000	---	---	---	---	---	---	---	---	---	---	---	---
31,000	---	---	---	---	---	---	---	---	---	---	---	---
33,000	---	---	---	---	---	---	---	---	---	---	---	---
35,000	---	---	---	---	---	---	---	---	---	---	---	---

Figure 7A-100. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA + 20 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA + 30 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	48	45	97	521	176	186	179	189	182	192	184	194
2000	44	41	94	499	172	187	175	190	178	193	180	196
4000	40	37	92	478	167	188	171	192	174	195	177	198
6000	37	33	90	453	162	187	166	192	169	195	172	199
8000	33	29	86	425	154	184	159	190	163	194	166	198
10,000	28	25	82	397	146	180	152	187	157	193	160	198
12,000	24	21	78	375	137	175	145	185	151	192	155	197
14,000	20	17	76	358	126	166	138	182	145	191	150	197
16,000	16	13	73	342	– – –	– – –	130	177	139	189	145	197
18,000	13	9	72	329	– – –	– – –	– – –	– – –	133	187	140	196
20,000	8	5	70	316	– – –	– – –	– – –	– – –	125	181	134	195
22,000	5	1	66	297	– – –	– – –	– – –	– – –	– – –	– – –	125	189
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-101. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA + 30 °C

ONE ENGINE INOPERATIVE
MAXIMUM CRUISE POWER
1900 RPM
ISA + 37 °C

NOTES: DURING OPERATION WITH ICE VANE EXTENDED, TORQUE WILL DECREASE. IF ORIGINAL POWER IS NOT OR CANNOT BE RESET, TRUE AIRSPEED WILL DECREASE APPROXIMATELY 20 KNOTS AND FUEL FLOW WILL DECREASE APPROXIMATELY 7%. IF ORIGINAL POWER IS RESET, TRUE AIRSPEED WILL BE UNCHANGED AND FUEL FLOW WILL INCREASE APPROXIMATELY 30 LB/HR/ENG.

IOAT, TORQUE, AND FUEL FLOW BASED ON 12,000 POUNDS.

TO OBTAIN FUEL FLOW PER ENGINE, DIVIDE THE TOTAL FUEL FLOW VALUE FOR THE CORRESPONDING ALTITUDE BY TWO.

PRESSURE ALT	IOAT	OAT	TORQUE PER ENGINE	TOTAL FUEL FLOW	AIRSPEED ~ KNOTS							
					13,000 LB		12,000 LB		11,000 LB		10,000 LB	
FEET	°C	°C	%	LB/HR	IAS	TAS	IAS	TAS	IAS	TAS	IAS	TAS
SL	55	52	90	503	170	181	173	185	176	188	178	190
2000	51	48	88	481	165	182	169	186	172	189	174	192
4000	47	44	87	461	161	182	165	187	168	191	171	194
6000	43	40	84	438	155	181	160	187	163	190	167	195
8000	39	36	81	411	147	178	153	185	158	190	161	194
10,000	35	32	77	384	138	172	146	182	151	189	156	194
12,000	31	28	74	363	127	164	139	179	145	187	150	193
14,000	27	24	72	346	– – –	– – –	131	175	140	186	145	193
16,000	23	20	70	331	– – –	– – –	120	166	133	183	140	192
18,000	19	16	68	318	– – –	– – –	– – –	– – –	126	179	135	191
20,000	16	12	67	306	– – –	– – –	– – –	– – –	– – –	– – –	129	189
22,000	12	8	63	289	– – –	– – –	– – –	– – –	– – –	– – –	120	182
24,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
26,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
28,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
29,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
31,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
33,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
35,000	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –

Figure 7A-102. One Engine Inoperative Maximum Cruise Power, 1900 RPM, ISA + 37 °C

PRESSURIZATION CONTROLLER SETTING FOR LANDING

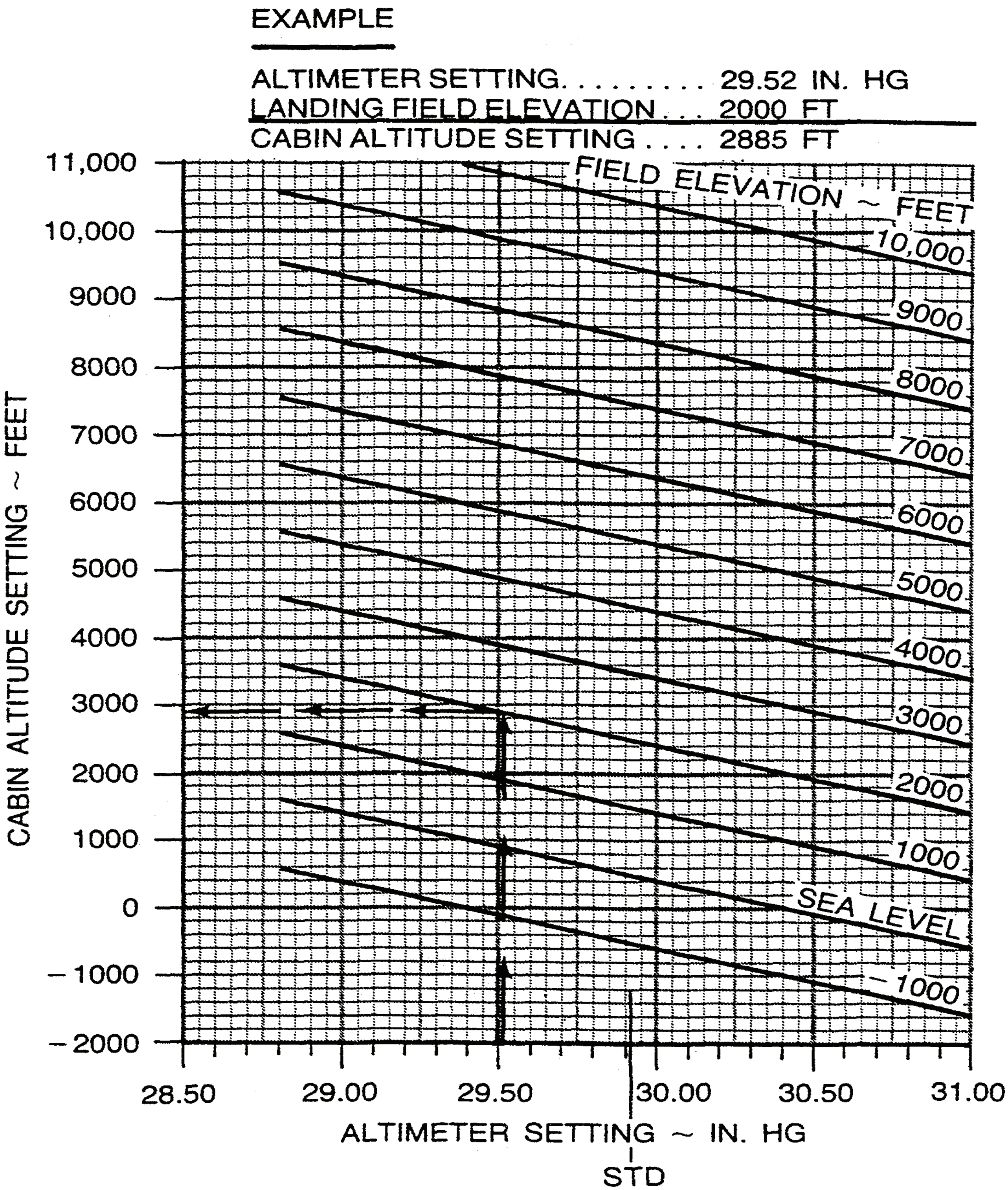


Figure 7A-103. Pressurization Controller Setting for Landing

HOLDING TIME

POWER SETTING
36% AT 1700 RPM

APPLICABLE FOR ALL TEMPERATURES

NOTE: FOR OPERATION WITH ICE VANES EXTENDED, HOLDING TIME WILL BE REDUCED APPROXIMATELY 15%.

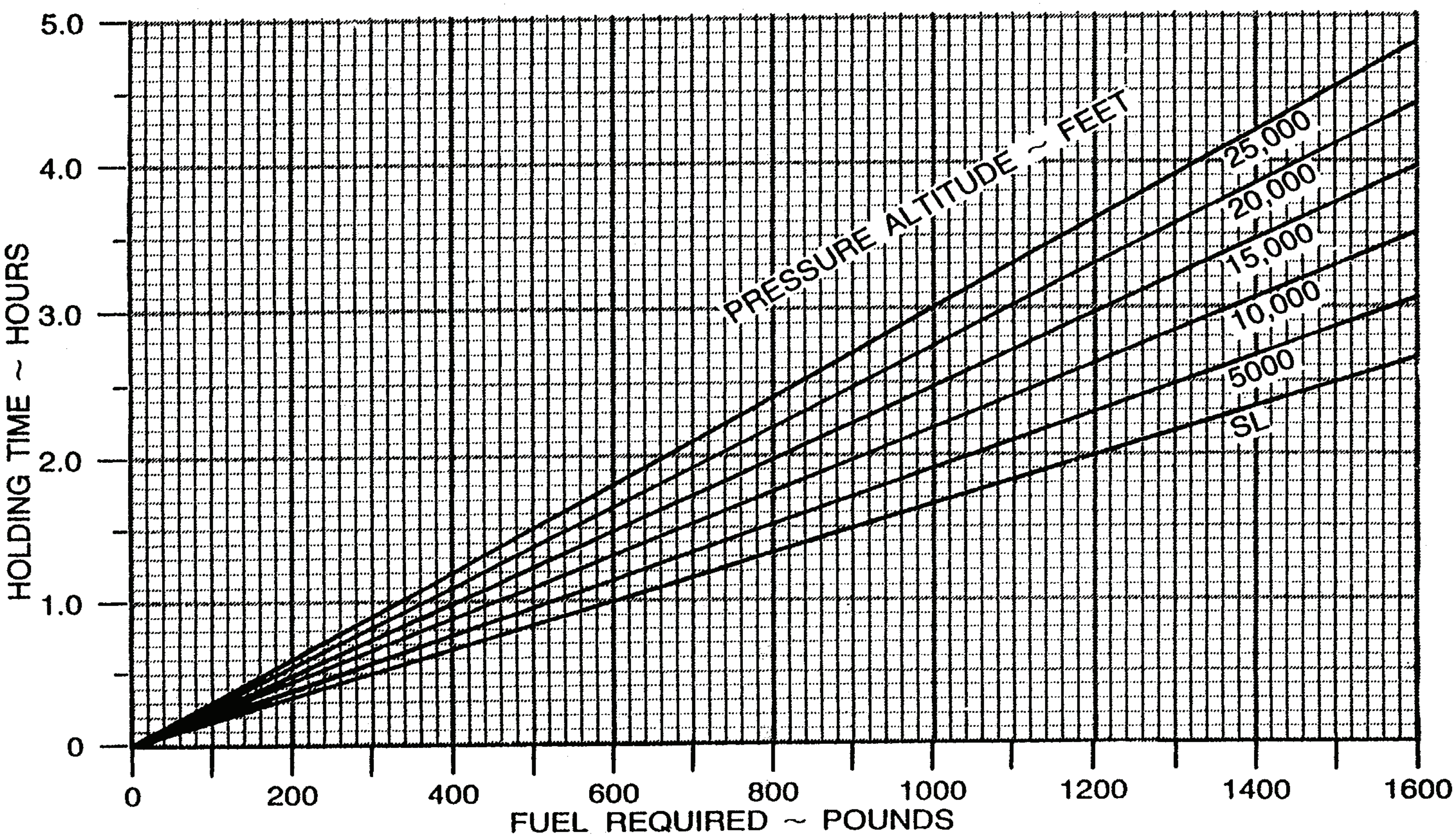


Figure 7A-104. Holding Time

TIME, FUEL, AND DISTANCE TO DESCEND

ASSOCIATED CONDITIONS:

POWER .... AS REQUIRED TO DESCEND AT 1500 FT/MIN
GEAR .... UP
FLAPS .... UP

EXAMPLE:

INITIAL ALTITUDE	26,000 FT
FINAL ALTITUDE	4732 FT
TIME TO DESCEND (17-3)	14 MIN
FUEL TO DESCEND (148-34)	114 LBS
DISTANCE TO DESCEND (78-13)	65 NM

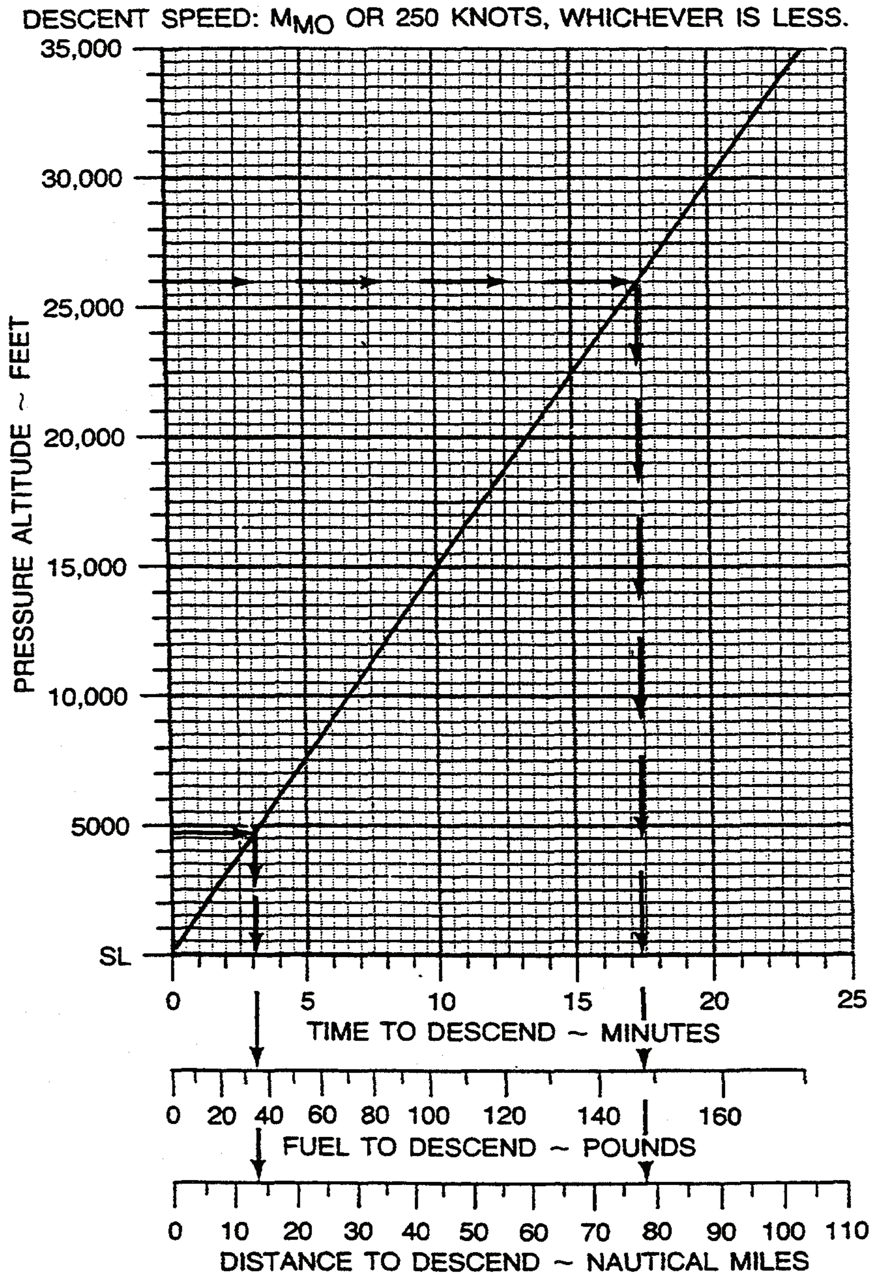


Figure 7A-105. Time, Fuel, and Distance to Descend

CLIMB-BALKED LANDING

CLIMB SPEED 100 KNOTS (ALL WEIGHTS)

ASSOCIATED CONDITIONS:

POWER . . . . TAKE-OFF
FLAPS . . . . DOWN
LANDING GEAR. . . . . DOWN

EXAMPLE:

OAT. . . . . 32°C
PRESSURE ALTITUDE. . . . . 4732 FT
WEIGHT . . . . 10,854 LBS

RATE-OF-CLIMB. . . . . 1420 FT/MIN
CLIMB GRADIENT 14.4%

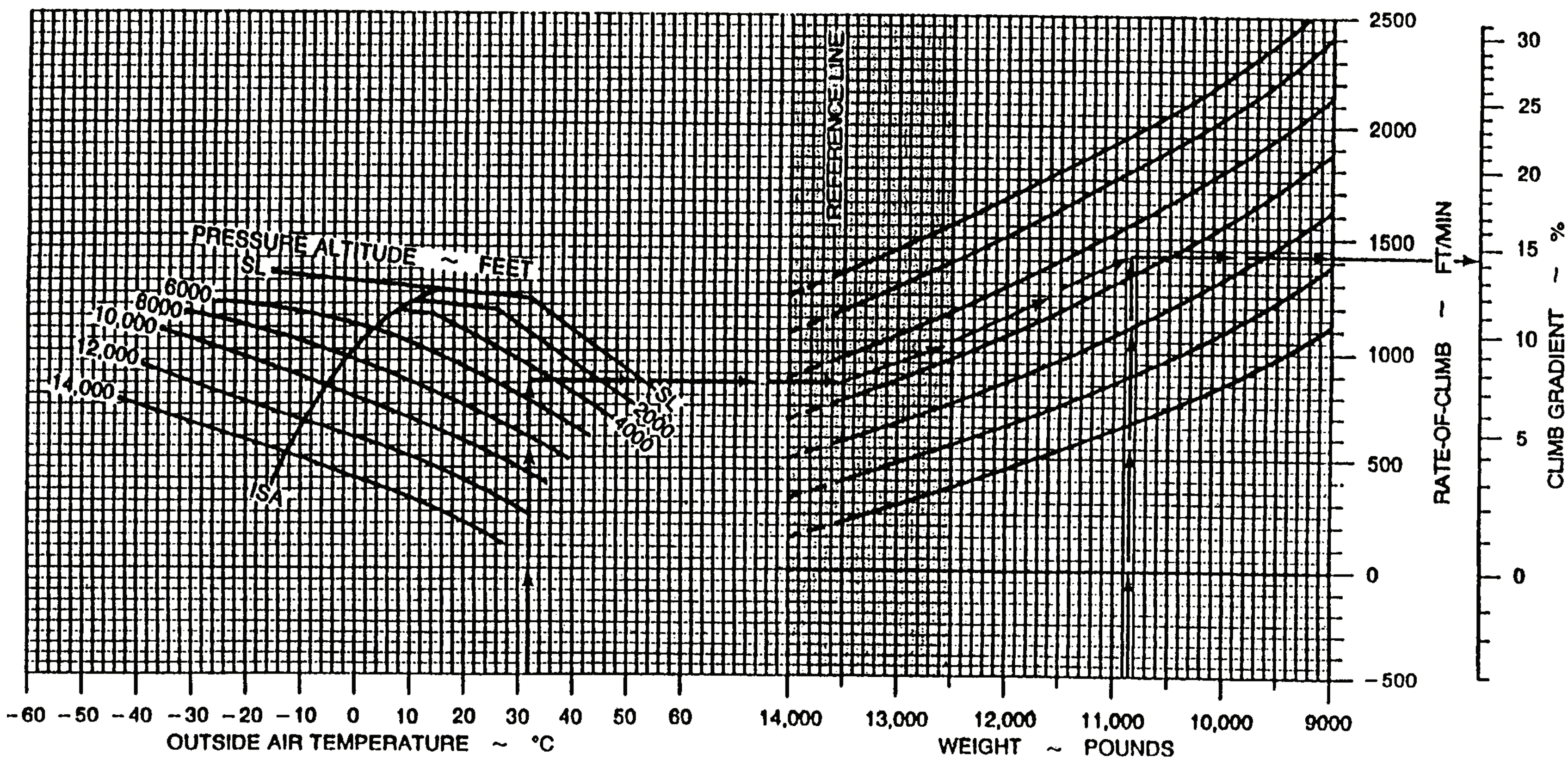


Figure 7A-106. Climb – Balked Landing

NORMAL LANDING DISTANCE* WITHOUT PROPELLER REVERSING - FLAPS DOWN

ASSOCIATED CONDITIONS:

POWER. . . . . RETARDED TO MAINTAIN 800 FT/MIN ON FINAL APPROACH
FLAPS. . . . . DOWN
RUNWAY. . . . . PAVED LEVEL DRY SURFACE
APPROACH SPEED . IAS AS TABULATED
BRAKING . . . . MAXIMUM

* ADD OR SUBRACT 4% OF TOTAL GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE, (DOWN - SUBTRACT, UP - ADD).

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
14,000	106
13,500	105
13,000	104
12,500	102
12,000	101
11,000	99
10,000	96
9000	94

EXAMPLE:

OAT. . . . . 32°C
PRESSURE ALTITUDE. . . . . 4732 FT
LANDING WEIGHT . . . . 10,854 LBS
HEADWIND COMPONENT. . . . . 4.7 KTS

GROUND ROLL . . . . 1850 FT
TOTAL OVER 50 FT OBSTACLE. . . . . 3000 FT
APPROACH SPEED . . . . 99 KTS

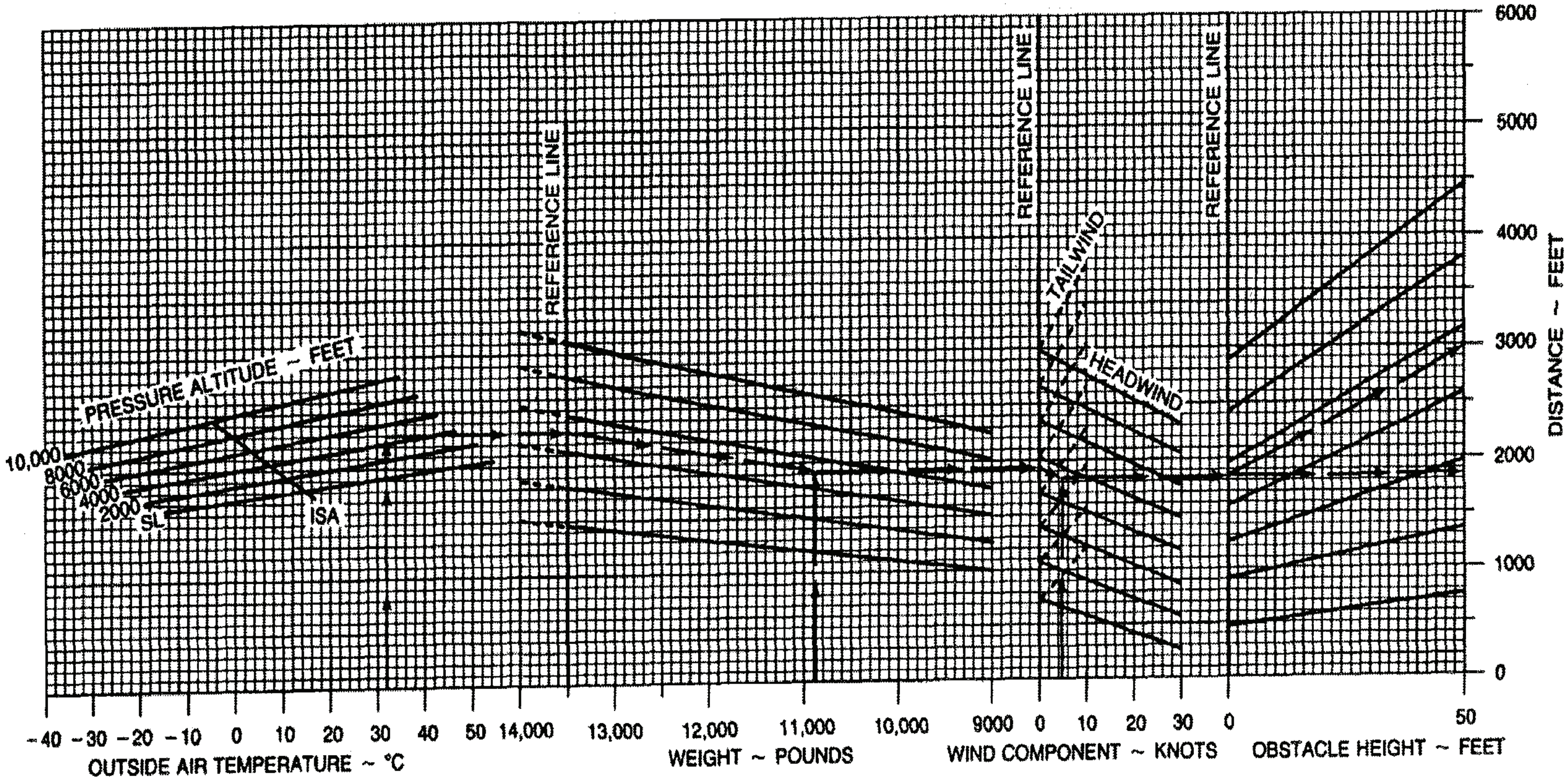


Figure 7A-107. Normal Landing Distance Without Propeller Reversing, Flaps DOWN

LANDING DISTANCE WITHOUT PROPELLER REVERSING - FLAPS UP

ASSOCIATED CONDITIONS:

POWER........... RETARDED TO MAINTAIN 900 FT/MIN ON FINAL APPROACH
FLAPS............ UP
RUNWAY.......... PAVED, LEVEL, DRY SURFACE
APPROACH SPEED. IAS AS TABULATED
BRAKING .... MAXIMUM

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
14,000	137
13,500	135
13,000	133
12,500	131
12,000	129
11,000	125
10,000	121
9,000	117

EXAMPLE:

FLAPS DOWN LANDING DISTANCE
OVER 50 FT OBSTACLE .... 3000 FT
LANDING WEIGHT .... 10,854 LBS

FLAPS UP LANDING DISTANCE
OVER 50 FT OBSTACLE .... 4150 FT
APPROACH SPEED .... 124 KTS

NOTES:
1. LANDING WITH FLAPS FULL DOWN IS NORMAL PROCEDURE. USE THIS GRAPH WHEN IT IS NECESSARY TO LAND WITH FLAPS UP.
2. TO DETERMINE FLAPS-UP LANDING DISTANCE, READ FROM THE **NORMAL LANDING DISTANCE WITHOUT PROPELLER REVERSING-FLAPS** DOWN GRAPH THE LANDING DISTANCE APPROPRIATE TO OAT, ALTITUDE, WEIGHT, WIND, AND 50-FT OBSTACLE. THEN ENTER THIS GRAPH WITH THE DERIVED VALUE AND READ THE FLAPS-UP LANDING DISTANCE.
3. *ADD OR SUBTRACT 5% OF TOTAL GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE, (DOWN - SUBTRACT, UP - ADD).

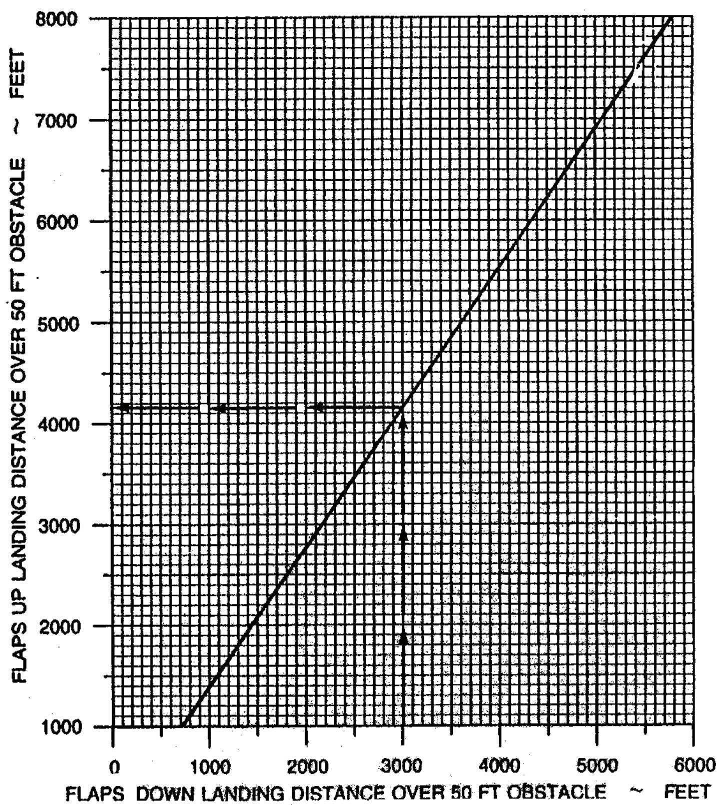


Figure 7A-108. Landing Distance Without Propeller Reversing, Flaps UP

LANDING DISTANCE* WITH PROPELLER REVERSING - FLAPS DOWN

ASSOCIATED CONDITIONS:

POWER .... RETARD TO MAINTAIN 1000 FT/MIN. ON FINAL APPROACH
FLAPS .... DOWN
RUNWAY .... PAVED, LEVEL, DRY SURFACE
APPROACH SPEED ... IAS AS TABULATED
BRAKING .... MAXIMUM
CONDITION LEVERS .. HIGH IDLE
PROPELLER CONTROLS .... FULL FORWARD
POWER LEVERS ..... MAXIMUM REVERSE AFTER TOUCHDOWN

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
14,000	106
13,500	105
13,000	104
12,500	102
12,000	101
11,000	99
10,000	96
9000	94

EXAMPLE:

OAT .... 32°C
PRESSURE ALTITUDE .... 4732 FT
LANDING WEIGHT .... 10,854 LBS
HEADWIND COMPONENT .... 4.7 KTS
GROUND ROLL .... 1100 FT
TOTAL OVER 50 FT OBSTACLE .... 2225 FT
APPROACH SPEED .... 98 KTS

* ADD OR SUBTRACT 5% OF TOTAL GROUND ROLL FOR EACH 1% OF RUNWAY SLOPE, (DOWN - SUBTRACT, UP - ADD).

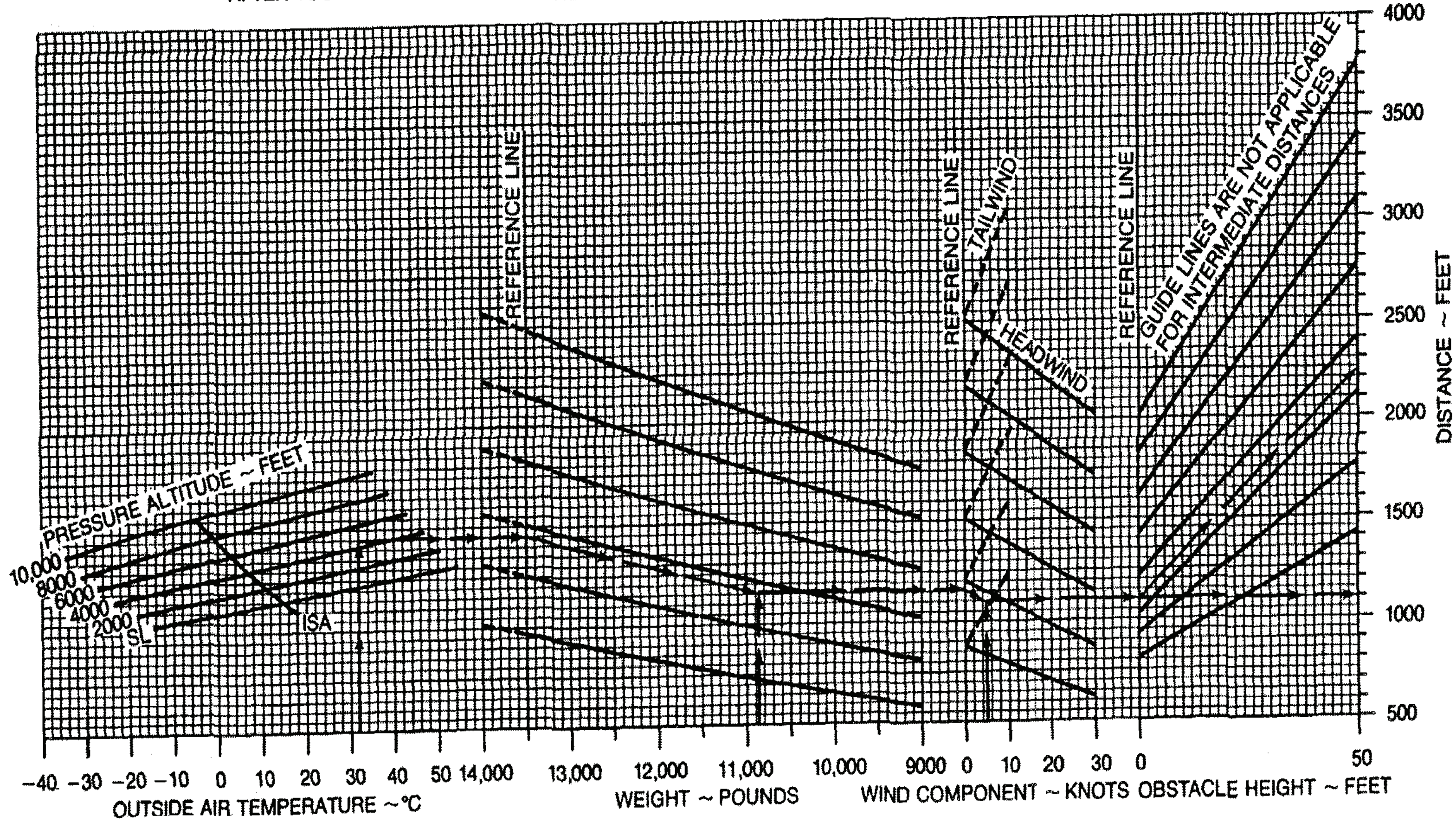


Figure 7A-109. Landing Distance With Propeller Reversing, Flaps DOWN

LANDING DISTANCE WITH PROPELLER REVERSING - FLAPS UP

ASSOCIATED CONDITIONS:

POWER .... RETARD TO MAINTAIN 1000 FT/MIN ON FINAL APPROACH
FLAPS .... UP
RUNWAY .... PAVED, LEVEL, DRY SURFACE
APPROACH SPEED ... IAS AS TABULATED
BRAKING .... MAXIMUM
CONDITION LEVERS .. HIGH IDLE
PROPELLER CONTROLS .... FULL FORWARD
POWER LEVERS ..... MAXIMUM REVERSE AFTER TOUCHDOWN

WEIGHT ~ POUNDS	APPROACH SPEED ~ KNOTS
14,000	137
13,500	135
13,000	133
12,500	131
12,000	129
11,000	125
10,000	121
9000	117

EXAMPLE:

FLAPS DOWN LANDING DISTANCE OVER 50 FOOT OBSTACLE .... 2260 FT
LANDING WEIGHT .... 10,854 LBS

FLAPS UP LANDING DISTANCE OVER 50 FOOT OBSTACLE .... 2720 FT
APPROACH SPEED .... 124 KTS

NOTES: 1. LANDING WITH FLAPS FULL DOWN IS NORMAL PROCEDURE. USE THIS GRAPH WHEN IT IS NECESSARY TO LAND WITH FLAPS UP.

2. TO DETERMINE FLAPS-UP LANDING DISTANCE, READ FROM THE **LANDING DISTANCE WITH PROPELLER REVERSING - FLAPS DOWN** GRAPH THE LANDING DISTANCE APPROPRIATE TO OAT, ALTITUDE, WEIGHT, WIND, AND 50-FT OBSTACLE. THEN ENTER THIS GRAPH WITH THE DERIVED VALUE AND READ THE FLAPS-UP LANDING DISTANCE.

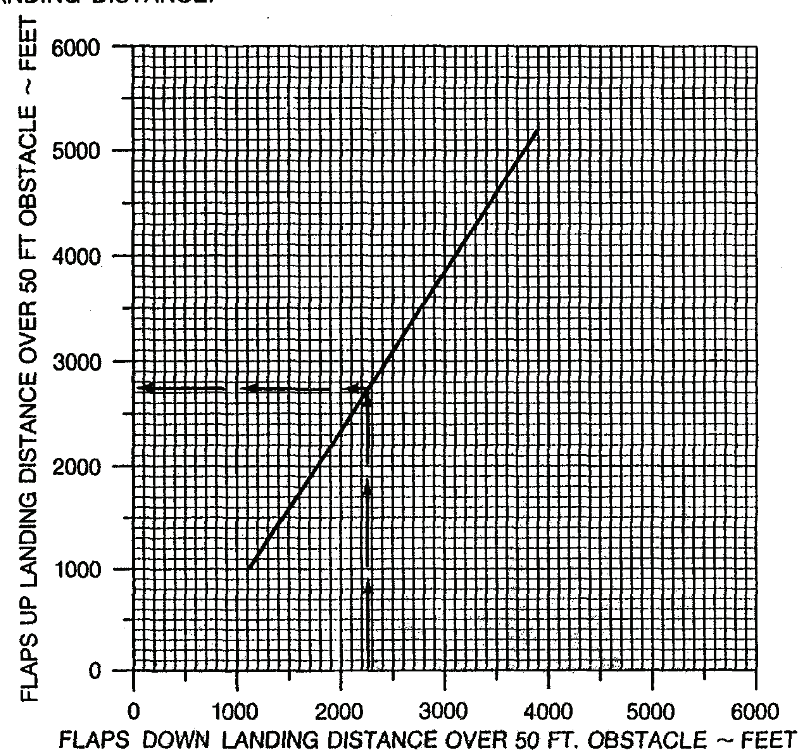


Figure 7A-110. Landing Distance With Propeller Reversing, Flaps UP

STOPPING DISTANCE FACTORS

EXAMPLE:

1. ACCELERATE-STOP DISTANCE (FLAPS UP NO REV)

OAT	25 °C
PRESSURE ALTITUDE	3968 FT
HEADWIND COMPONENT	9.5 KTS
ACCELERATE-STOP DISTANCE	5400 FT
TAKE-OFF DISTANCE	3300 FT
RUNWAY CONDITION READING	10.0
TAKE-OFF WEIGHT	13,000 LB
STOPPING FACTOR	1.37
STOPPING DISTANCE ((5400 – 3300) X 1.37)	2877 FT
TAKE-OFF DISTANCE	3300 FT
NEW RCR ACCELERATE-STOP DISTANCE (2877 + 3300)	6177 FT

2. LANDING DISTANCE (FLAPS DN NO REV)

GROUND ROLL (DRY)	1700 FT
TOTAL OVER 50 FT OBSTACLE	2700 FT
RUNWAY CONDITION READING	8.0
LANDING WEIGHT	11,180 LB
STOPPING FACTOR	1.62
LANDING DISTANCE (FACTORED) GROUND ROLL (1700 X 1.62)	2754 FT
AIR DISTANCE (2700 - 1700)	1000 FT
TOTAL OVER 50 FT OBSTACLE	3754 FT

NOTE:
1. IF RCR READING IS NOT AVAILABLE, ASSUME ICY RUNWAY RCR = 5.0 AND WET RUNWAY RCR = 12.0
2. USE "NO REV" CURVE FOR ONE ENGINE REVERSING.
3. WEIGHT REFERENCE LINE IS AT 12,500 LB. FOR WEIGHT IN EXCESS OF 12,500 LB, TRACE BACK FROM THE REFERENCE LINE ALONG THE GUIDELINE TO THE HIGHER WEIGHT AND THEN OVER TO THE RCR FACTOR.

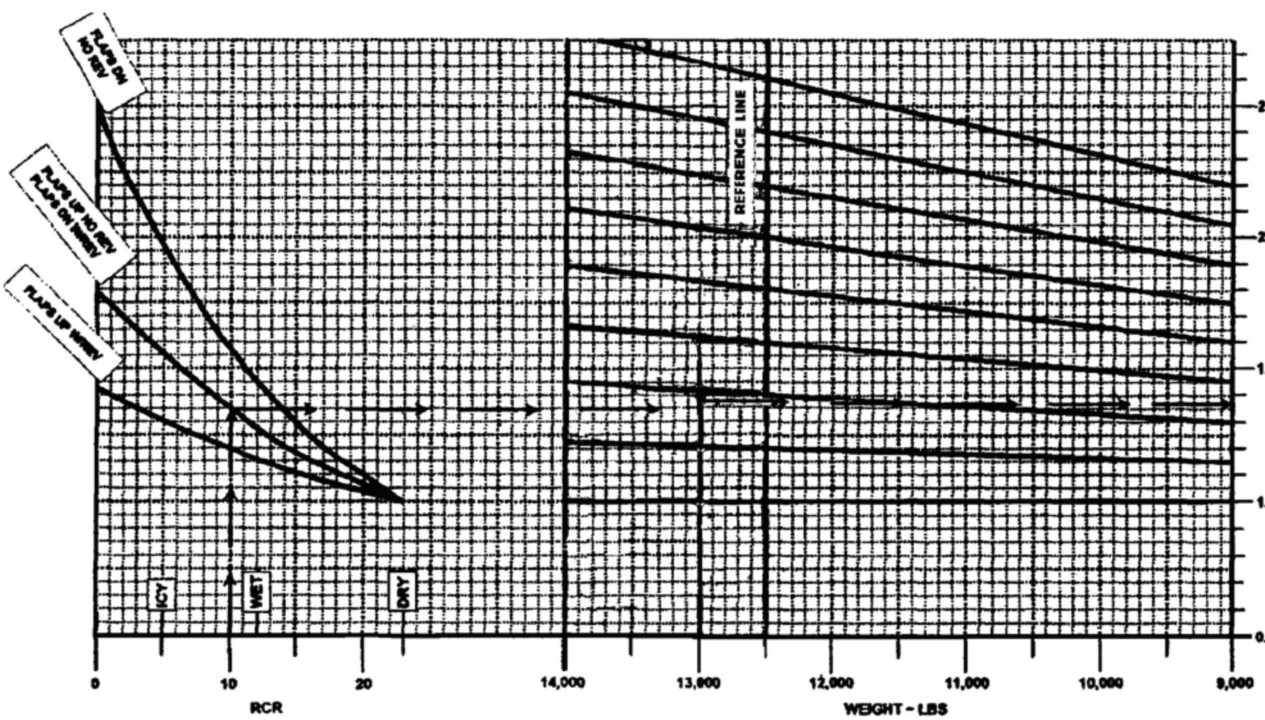


Figure 7A-111. Stopping Distance Factors

CHAPTER 8
NORMAL PROCEDURES C D1 D2

Section I. MISSION PLANNING

8-1. MISSION PLANNING.

Mission planning begins when the mission is assigned and extends to the preflight check of the aircraft.

It includes, but is not limited to, checks of operating limits and restrictions, weight/balance and loading; performance; publications; flight plan; and crew and passenger briefings. The pilot in command shall ensure compliance with the contents of this manual that are applicable to the mission.

8-2. OPERATING LIMITS AND RESTRICTIONS.

The minimum, maximum, normal, and cautionary operational ranges represent careful aerodynamic and structural calculations, substantiated by flight test data. These limitations must be adhered to during all phases of the mission. Refer to Chapter 5, Operating Limits and Restrictions, for detailed information.

8-3. WEIGHT, BALANCE, AND LOADING.

The aircraft must be loaded, cargo and passengers secured, and weight and balance verified per Chapter 6, Weight/Balance and Loading.

8-4. PERFORMANCE.

Refer to Chapter 7, Performance Data, to determine the capability of the aircraft for the entire mission. Consideration must be given to changes in performance resulting from variation in loads, temperatures, and pressure altitudes. Record the data on the Takeoff and Landing Data (TOLD) card for use in completing the flight plan and for reference throughout the mission.

8-5. FLIGHT PLAN.

A flight plan must be completed and filed per AR 95-1, DOD Flight Information Publications, and local regulations.

8-6. CREW AND PASSENGER BRIEFINGS.

A crew/passenger briefing must be conducted for a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to, copilot and ground crew responsibilities and the coordination necessary to complete the mission most efficiently. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew. Refer to Section VI for crew and passenger briefings.

Section II. OPERATING PROCEDURES AND MANEUVERS

8-7. OPERATING PROCEDURES AND MANEUVERS.

This section deals with normal procedures and includes all steps necessary for safe and efficient operation of the aircraft from the time a preflight begins until the flight is completed and the aircraft is parked and secured. Unique feel, characteristics, and reaction of the aircraft during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described, including precautions to be observed. Only the duties of the minimum crew necessary for the actual operation of the aircraft are included.

8-8. ADDITIONAL DATA.

Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section IV, Flight Characteristics, and are repeated in this section only when required for emphasis. Checks that must be made under adverse environmental conditions, such as desert and cold weather operations, supplement normal procedures checks in this section and are covered in Section V, Adverse Environmental Conditions. Additional crew duties are covered as necessary in Section VI, Crew Duties.

8-9. CHECKLIST.

Normal procedures are given primarily in checklist form and are amplified as necessary in accompanying paragraph form when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operator's and Crewmember's checklist, TM 1-1510-218-CL. To provide for easier cross-referencing, the procedural steps in the checklist are numbered to coincide with the correspondingly numbered steps in this manual.

8-10. USE OF CHECKLIST.

Although a good working knowledge of all aircraft procedures is desirable, it is not mandatory that they be committed to memory. The pilot is responsible for the initiation and accomplishment of all required checks. Checklist items, challenge and response, will be called out orally and the action verified using the pilot's checklist (-CL). The Pilot not Flying (PNF) will normally read the checklist and perform such duties as directed by the Pilot Flying (PF). "As required" will not be used as an oral response; instead the actual position or setting of the unit or item, such as "On" or "Up" or "Approach" will be stated. Upon completion of each checklist, the PNF will advise the PF that the checklist called for has been completed by announcing “Checklist complete.”

8-11. CHECKS.

a. Listed below are the symbols used in the following procedures and their associated meanings.

N — Indicates performance of step is mandatory for night flights.

I — Indicates a mandatory check for instrument flights.

O — Indicates if installed.

★ — Indicates an operational check contained in the performance section of the condensed checklist.

* — Indicates performance of step is mandatory for all through flights. The asterisk applies only to checks performed prior to takeoff.

b. Placarded items, such as switch and control positions, appear in boldface capital letters.

8-12. BEFORE EXTERIOR CHECK.

*1. Forms/publications – Check DA Forms 2408 -12, -13, -14, and -18, DD Form 365-4, locally required forms and publications, and availability of operator's manual (-10) and checklist (-CL).

*2. Oxygen system – Check that oxygen quantity is sufficient for entire mission, passenger manual override is pushed, that crew masks operate normally, and that diluter selector is set at 100%. Check that sufficient masks are available for all passengers C. Refer to Chapter 5 for oxygen requirements.

CAUTION

If high or gusty winds are present and the flight controls are unlocked, control surfaces may be damaged by buffeting.

*3. Flight controls – Unlocked and checked.

*4. Parking brake – Set.

CAUTION

The elevator trim system shall not be forced past the limits that are shown on the elevator trim indicator scale.

*5. Manual trim – Zero.

CAUTION

Do not cycle landing gear handle on the ground.

*6. **GEAR** – **DN**.

NOTE

Flaps may be extended for the pre-flight inspection, if desired.

7. **ICE VANE** handles – As desired.

8. Key lock switch – **ON**.

9. Battery switch – **ON**.

10. Lighting and Heats – Check as required to include position lights, recognition lights, beacons, emergency lights, interior lights, pitot heat, stall warning heat, and fuel vent heats, then **OFF**.

NOTE

The emergency lights override switch should be placed in the TEST position and the emergency lights checked for illumination and intensity. A dim light indicates a weak battery pack. At the completion of the check, the switch must be cycled from the TEST position to the OFF / RESET position and then placed in AUTO.

11. Fuel gauges – Check fuel quantity and gauge operation.

12. Battery switch – **OFF**.

O 13. Galley power switches – **OFF**.

14. Electric toilet – Check condition and that knife valve is open approximately 1/8 inch. Chapter 2 provides information for servicing during freezing temperatures.

15. Emergency equipment – Check that all required emergency equipment is available and that two fire extinguishers and three first-aid kits have current inspection dates.

8-13. FUEL SAMPLE.

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

NOTE

Fuel and oil quantity check may be performed prior to exterior check to preclude carrying ladder and fuel sample container around during the inspection. During warm weather, open fuel cap slowly to prevent being sprayed by fuel under thermal pressure.

1. Fuel sample – Check collective fuel sample from all drains for possible contamination. Refer to Chapter 2 for locations.

NOTE

All exterior check areas are illustrated in Figure 8-1.

8-14. LEFT WING, AREA 1.

1. Left wing area – Check.

*a. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

b. Flaps – Check for full retraction/extension (approximately 1/4-inch play) and skin damage such as buckling, splitting, distortion, or dents.

c. Fuel sump drains – Check for leaks.

d. Controls and trim tab – Check security and trim tab rig.

e. Static wicks – Check security and condition.

f. Wing tip and position lights – Check condition and for cracked lens.

g. Recognition light – Check condition.

h. Landing/taxi light – Check condition.

i. Outboard wing fuel vent – Check free of obstruction and leaks.

*j. Main tank fuel and cap – Check fuel level visually, condition of seal, and cap tight and properly installed. Locking tab aft.

k. Outboard deice boot – Check for secure bonding, cracks, loose patches, stall strip, and general condition.

l. Stall warning vane – Check free.

*m. Tiedown – Released.

n. Wing ice light – Check condition.

o. Recessed and heated fuel vents – Check free of obstruction and leaks.

2. Left main landing gear – Check.

*a. Tires – Check for cuts, bruises, wear, appearance of proper inflation, wheel condition, and that both tires have same tread design.

b. Brake assembly – Check brake lines for damage or signs of leakage and brake linings for wear. Also check brake deice assembly and bleed air hose for condition and security.

*c. Shock strut – Check for signs of leakage, minimum strut extension (4 inches C, 5.5 inches D), and that left and right strut extension is approximately equal.

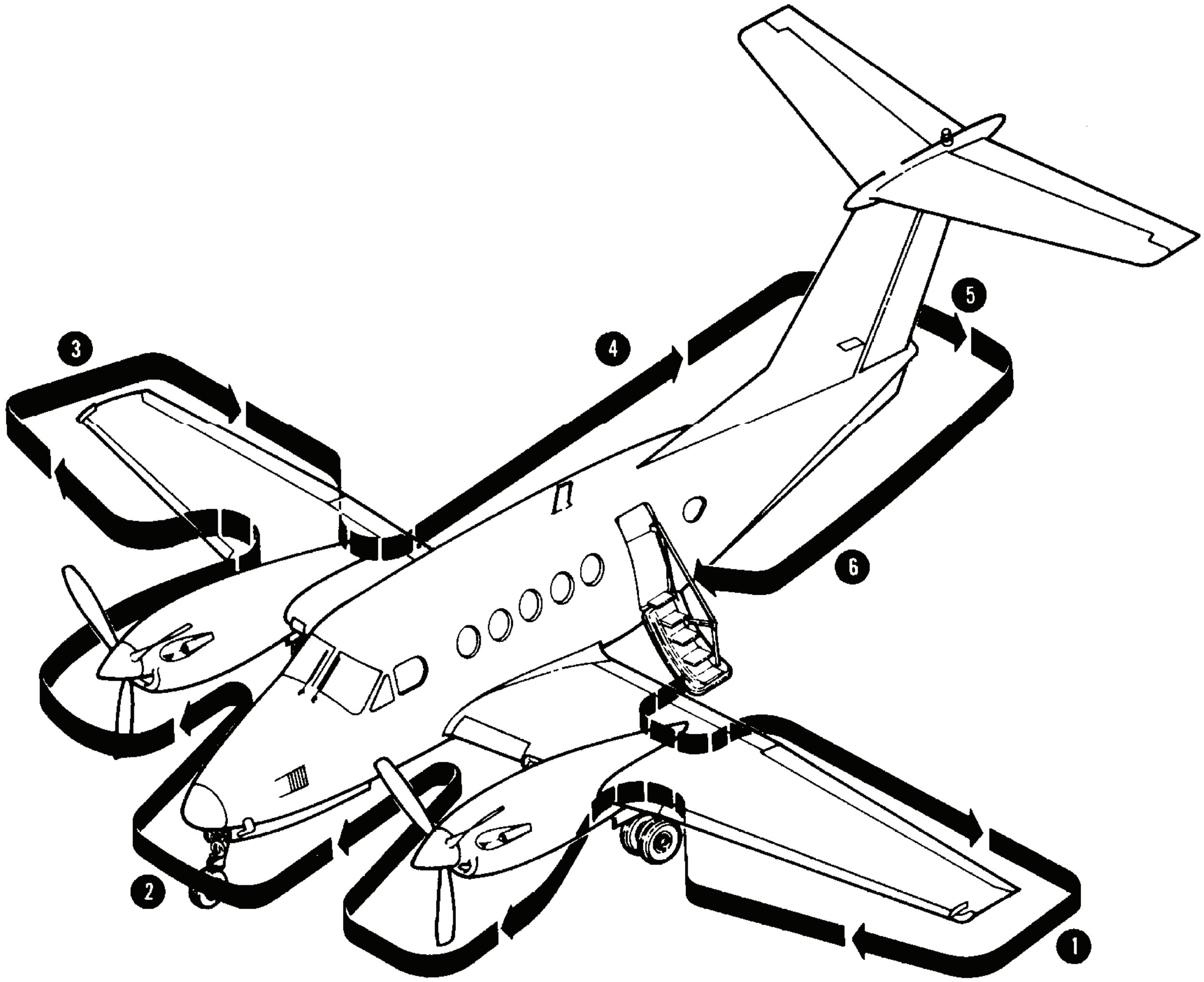
d. Torque knee – Check condition.

e. Safety switch – Check condition, wire, and security.

★ f. Fire extinguisher pressure – Check pressure within limits. Refer to Chapter 2.

g. Wheel well, doors, and linkage – Check for signs of leaks, broken wires, security, and general condition.

h. Fuel sump drains (forward) – Check for leaks.



AREA 1	LEFT WING, LANDING GEAR, ENGINE, NACELLE AND PROPELLER
AREA 2	NOSE SECTION
AREA 3	RIGHT WING, LANDING GEAR, ENGINE, NACELLE AND PROPELLER
AREA 4	FUSLAGE, RIGHT SIDE
AREA 5	EMPENNAGE AND TAIL
AREA 6	FUSELAGE, LEFT SIDE

Figure 8-1. Exterior Inspection

3. Left engine and propeller – Check as follows:

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

*a. Engine oil – Check oil level, no more than 3 quarts low, all caps secured, locking tab aft.

b. Engine compartment, left side – Check for fuel and oil leaks, security of oil cap, and general condition. Lock compartment access door.

c. Left cowl locks – Locked.

d. Left exhaust stub – Check for cracks and free of obstructions.

e. Propeller blades and spinner – Check blade condition, security of spinner and free propeller rotation.

f. Engine air inlets and ice vane – Check free of obstruction and ice vane in correct position.

g. Bypass door – Check condition and correct position.

h. Right cowl locks – Locked.

i. Right exhaust stub – Check for cracks and free of obstructions.

j. Engine compartment, right side – Check for fuel and oil leaks, ice vane linkage, and general condition. Lock compartment access door.

4. Left wing center section – Check as follows:

a. Heat exchanger inlet and outlet – Check for cracks and free of obstructions.

b. Auxiliary tank fuel sump drain – Check for leaks.

O c. Hydraulic reservoir vent and pump seal drain D2 – Check vent clear of obstructions and that no excessive fluid is present.

d. Deice boot – Check for bonding, cracks, loose patches, and general condition.

*e. Auxiliary tank fuel and cap – Check fuel level visually, condition of seal, and cap tight and properly installed.

5. Fuselage underside – Check as follows:

*a. General condition – Check for skin damage, such as buckling, splitting, distortion, dents, or fuel leaks.

b. Antennas – Check wire, security, and general condition.

8-15. NOSE SECTION, AREA 2.

1. Nose section – Check as follows:

*a. Outside air temperature probe – Check condition.

b. Avionics door, left side – Check secure.

c. Air conditioner exhaust – Check free of obstruction.

d. Wheel well – Check for signs of leaks, broken wires, and general condition.

e. Doors and linkage – Check condition, security, and alignment.

f. Nose gear turning stop – Check condition.

*g. Tire – Check for cuts, bruises, wear, appearance of proper inflation, and wheel condition.

*h. Shock strut – Check for signs of leakage and three inches minimum extension.

i. Torque knee – Check condition.

j. Shimmy damper and linkage – Check for security and condition.

k. Headset jack cover – Check installed.

l. Landing and taxi lights – Check for security and condition.

m. Pitot tubes – Check covers removed, alignment, security, and free of obstructions.

n. Radome – Check condition.

CAUTION

Do not move wipers on dry windshield or clean windshield with anything other than mild soap and water.

o. Windshields and wipers – Check windshield for cracks and cleanliness and wipers for contact with glass surface.

p. Air conditioner inlet – Check free of obstructions.

q. Avionics door, right side – Check secure.

8-16. RIGHT WING, AREA 3.

1. Right wing center section – Check as follows:

a. Deice boot – Check for secure bonding, cracks, loose patches, and general condition.

b. Battery access panel – Secure.

*c. Auxiliary tank fuel and cap – Check fuel level visually, condition of seal, and cap tight and properly installed. Check locking tab aft.

d. Battery exhaust louvers – Check free of obstruction.

e. Battery compartment drain – Check free of obstruction.

f. Battery ram air intake – Check free of obstruction.

g. Auxiliary tank fuel sump drain – Check for leaks.

h. Heat exchanger outlet and inlet – Check for cracks and free of obstructions.

2. Right engine and propeller – Check as follows:

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

*a. Engine oil – Check oil level, oil cap secure, and access door locked. Locking tab aft.

b. Engine compartment, left side – Check for fuel and oil leaks, security of oil cap, and general condition. Lock compartment access door.

c. Left cowl locks – Locked.

d. Left exhaust stub – Check for cracks and free of obstructions.

e. Propeller blades and spinner – Check blade condition, security of spinner, and free propeller rotation.

f. Engine air inlets and ice vane – Check free of obstruction and ice vane in correct position.

g. Bypass door – Check condition and correct position.

h. Right cowl locks – Locked.

i. Right exhaust stub – Check for cracks and free of obstructions.

j. Engine compartment, right side – Check for fuel and oil leaks, ice vane linkage, and general condition. Lock compartment access door.

3. Right main landing gear – Check as follows:

a. Fuel sump drains (forward) – Check for leaks.

*b. Tires – Check for cuts, bruises, wear, appearance of proper inflation, wheel condition, and that both tires have the same tread design.

c. Brake assembly – Check brake lines for damage or signs of leakage, and brake linings for wear. Also check brake deice assembly and bleed-air hose for condition and security.

*d. Shock strut – Check for signs of leakage and minimum strut extension (4 inches C, 5.5 inches D).

e. Torque knee – Check condition.

f. Safety switch – Check condition, wire, and security.

★ g. Fire extinguisher pressure – Check pressure within limits. Refer to Chapter 2.

h. Wheel well, doors, and linkage – Check for signs of leaks, broken wires, security, and general condition.

4. Right wing – Check as follows:

   a. Recessed and heated fuel vents – Check free of obstructions.

   b. GPU access door – Secured.

   c. Wing ice light – Check condition.

   d. Outboard deice boot – Check for secure bonding, cracks, loose patches, stall strip, and general condition.

   *e. Tiedown – Released.

   *f. Main tank fuel and cap – Check fuel level visually, condition of seal, and cap tight and properly installed. Locking tab aft.

   g. Outboard wing fuel vent – Check free of obstruction and leaks.

   h. Landing/taxi light – Check condition.

   i. Wing tip and position light – Check condition and for cracked lens.

   j. Recognition light – Check condition.

   k. Static wicks – Check security and condition.

   l. Controls and trim tab – Check security and condition of ground adjustable tab.

   m. Fuel sump drain (three) – Check for leaks.

   n. Flaps – Check for full retraction/extension (approximately 1/4-inch play) and skin damage, such as buckling, splitting, distortion, or dents.

   *o. General condition – Check for skin damage, such as buckling, splitting, distortion, dents, or fuel leaks.

8-17. FUSELAGE RIGHT SIDE, AREA 4.

1. Fuselage right side – Check as follows:

   a. General condition – Check for skin damage such as buckling, splitting, distortion, or dents.

   b. Emergency light – Check condition.

   c. Beacon – Check condition.

   d. Aft access door – Check secure.

   e. Oxygen filler door – Check secure.

   f. Static ports – Check clear of obstructions.

   g. Emergency locator transmitter – **ARMED**.

   h. Emergency locator transmitter antenna – Check condition.

8-18. EMPENNAGE, AREA 5.

1. Empennage – Check as follows:

   *a. Vertical stabilizer, rudder, and trim tab – Check for skin damage, such as buckling, distortion, or dents, and trim tab rig.

   b. Antennas – Check condition.

   c. Deice boots – Check for secure bonding, cracks, loose patches, and general condition.

WARNING

If the possibility of ice accumulation on the horizontal stabilizer or elevator exists, do not attempt takeoff.

   d. Horizontal stabilizer, elevator, and trim tab – Check for skin damage, such as buckling, distortion, or dents, and trim tab rig.

   e. Elevator trim tab – Verify "O" (neutral) position. The elevator trim tab “O” (neutral) position is determined by observing that the trailing edge of the elevator trim tab aligns with the trailing edge of the elevator while the elevator is resting against the downstops.

   f. Static wicks – Check.

   g. Position and beacon lights – Check condition.

8-19. FUSELAGE LEFT SIDE, AREA 6.

1. Fuselage left side – Check as follows:

   a. General condition – Check for skin damage, such as buckling, distortion, or dents.

   b. Static ports – Check clear of obstructions.

   c. Emergency light – Check condition.

   d. Cabin door – Check door seal and general condition.

   e. Fuselage topside – Check general condition.

*2. Chocks and tiedowns – Check removed.

8-20. INTERIOR CHECK.

1. Cargo/loose equipment – Check secure.

2. Cabin door – Locked and checked. Ensure that the cabin door is closed and locked. Check position of safety arm and diaphragm plunger (lift door step) and that the four sight openings on the inner facing of the door and green stripe on each locking bolt align with a pointer C . Check that each of the six rotary cam locks align within the orange sight indicators D . In addition, the following inspection and test shall be performed prior to the first flight of the day.

   a. Open cabin door – Check that the **CABIN DOOR** annunciator light is extinguished.

   b. Latch cabin door, but do not lock – Check that the **CABIN DOOR** annunciator light illuminates.

   c. Battery switch **ON** – Check that the **CABIN DOOR** annunciator light is still illuminated.

   d. Close and lock the cabin door – Check that the **CABIN DOOR** annunciator light is extinguished.

   e. Battery switch – **OFF**.

3. Cargo door D – Locked and checked. Ensure that the cargo door is closed and locked as follows:

   a. Upper handle position – Closed and locked. The orange index marks on each of the four rotary cam locks must align within the sight indicators.

   b. Lower pin latch handle position – Closed and latched. The orange colored indicator must align with orange stripe on carrier rod.

NOTE

The untapered shoulder of the latching pins extend past each attachment lug.

4. Emergency exit – Check secure and key removed.

★ 5. Crew/passenger briefing – As required. Refer to passenger briefing in Paragraph 8-66.

8-21. BEFORE STARTING ENGINES.

*1. Oxygen system – Set. **PULL ON CREW READY/SYS READY**.

2. Circuit breakers – Check circuit breakers in.

*3. Overhead panel – Check in desired sequence.

   a. **LIGHT DIMMING** controls – As required.

   b. **CABIN TEMP MODE** switch – **OFF**.

   c. **BLEED AIR VALVES** – **ENVIRO OFF**.

   d. **ICE & RAIN** switches – **OFF ICE VANE** – As required.

   e. **INST LIGHT** switches – As required.

   f. **EXTERIOR LIGHT** switches – As required.

   g. **MASTER PANEL LIGHTS** switch – As required.

   h. **INVERTER** switches – Off.

   i. **AVIONICS MASTER POWER** switch – Off.

   j. **AUTOFEATHER** switch – **OFF**.

   k. **ENVIRONMENTAL** switches – As required.

   l. #**1 ENG START** switch – **OFF**.

   m. **MASTER SWITCH** – Off.

   n. #**2 ENG START** switch – **OFF**.

*4. Fuel panel switches – Check.

   a. **STANDBY PUMP** switches – Off.

   b. Auxiliary transfer switches – **AUTO**.

   c. **CROSSFEED** switch – **OFF**.

5. Magnetic compass – Check for fluid, heading, and current deviation card.

6. **CLOCK** and **MAP** lights – **OFF**.

CAUTION

Movement of the power levers into REVERSE range while the condition levers are in FUEL CUT-OFF may result in bending and damage to control linkage.

*7. Pedestal controls – Set.

   a. **POWER** levers – **IDLE**.

NOTE

Where there is excessive gravel/debris or the ramp is slippery, the pilot may consider starting the engines with the props in feather and/or ice vanes extended, but must closely monitor ITT and oil temperature on engine start.

b. **PROP** levers – As required.

c. **CONDITION** levers – **FUEL CUTOFF**.

d. **FLAPS** – As desired.

8. Lower console switches – Set.

a. Avionics – As required.

b. **RUDDER BOOST** switch – On.

9. Gear alternate engage and ratchet handles – Stowed.

10. Free air temperature gauge – Check. Note current reading.

11. Pilot's instrument panel – Check and set.

a. **VOR/NAV** and **COMPASS** switches – **#1**.

b. **MIC** switch – **HEADSET**.

c. **GYRO** switch – **SLAVE**.

d. Flight instruments – Check instrument for protective glass, warning flags, static readings, and heading correction card.

e. Radar – Off.

f. **PROP SYN** switch – **OFF**.

g. Engine instruments – Check instrument for protective glass and static readings.

12. Copilot's instrument panel – Check and set.

a. Copilot's flight instruments – Check instruments for protective glass, warning flags, and static readings.

b. Copilot's **COMPASS** and **VOR/NAV** switches – **#2**.

c. Copilot's **MIC** switch – **HEADSET**.

d. Copilot's **GYRO** switch – **SLAVE**.

13. Subpanel – Check and set.

a. Engine **FIRE PROTECTION TEST** switch – **OFF**.

b. **LANDING, TAXI,** and **RECOG** – **OFF**.

c. **LDG GEAR CONTR** – Recheck **DN**.

CAUTION

Do not use alternate static source during takeoff and landing except in an emergency. Pilot's instruments will show a variation in airspeed and altitude.

d. **PILOT'S STATIC SOURCE** – Normal.

★ 14. Fuel pumps/crossfeed operation – Check as follows:

a. **FIRE PULL** handles – Pull.

b. **STANDBY PUMP** switches – **ON**.

c. Battery Switch – **ON**.

d. **#1** and **#2 FUEL PRESS** warning lights – Illuminated.

e. **FIRE PULL** handles – In.

f. **#1** and **#2 FUEL PRESS** warning lights – Extinguished.

g. **STANDBY PUMP** switches – **STANDBY PUMP**.

h. **#1** and **#2 FUEL PRESS** warning lights – Illuminated.

i. **CROSSFEED** – Check. Check system operation by activating switch momentarily left then right, noting that **#1** and **#2 FUEL PRESS** warning lights extinguish and that the **FUEL CROSSFEED** advisory light illuminates as switch is energized.

j. **BATT** switch – **OFF** (For GPU start).

*15. GPU – As required.

*16. **EXTERNAL POWER** advisory light – As required.

*17. Battery switch – **ON**.

18. Annunciator panels – Test.

a. Check illumination of the **MASTER CAUTION, MASTER WARNING, NO. 1 FUEL PRESS, NO. 2 FUEL PRESS, L BL AIR FAIL, R BL AIR FAIL,** and **INST AC** warning lights. Also, check illumination of **#1 DC GEN, #1 INVERTER, #2 DC GEN, #2 INVERTER**, and the **#1 NO FUEL XFR** and **#2 NO FUEL XFR** (if applicable) caution lights.

b. **ANNUNCIATOR TEST** switch – Press and hold. Check that all lights in both annunciator panels, **FIRE PULL** handle lights, marker beacon lights, **MASTER CAUTION,** and **MASTER WARNING** lights are illuminated. Release switch and check that all lights except those in step a are extinguished.

c. **MASTER CAUTION** and **MASTER WARNING** lights – Press and release. Both lights should extinguish.

★ 19. Stall and gear warning system – Check as follows:

a. **STALL WARN TEST** switch – **TEST**. Check that warning horn sounds.

b. **LDG GEAR WARN TEST** switch – **TEST**. Check that warning horn sounds and that the two **LDG GEAR CONTR** handle warning lights illuminate.

20. Engine fire protection system – Check as follows:

a. **FIRE PROTECTION TEST** switch – Rotate switch counterclockwise to check three **DETR** positions. **FIRE PULL** handles should illuminate in each position. **MASTER WARNING** must be reset in each position.

b. **FIRE DETECTOR TEST** switch – Rotate switch counterclockwise to check two **EXTGH** positions. **SQUIB OK** light, associated **EXTGH DISCH** caution light, and **MASTER CAUTION** light should illuminate in each position.

8-22. FIRST ENGINE START (BATTERY START).

Starting procedures are identical for both engines except the second engine generator is kept off line after the second engine start to allow performing the current limiters check. When making a battery start, the right engine should be started first. When making a Ground Power Unit (GPU) start, the left engine should be started first due to the GPU receptacle being located adjacent to the right engine. Normally, only one engine is started utilizing the GPU, reverting to the Battery Start procedure for the second engine start. A crewmember should monitor the outside observer throughout the engine start.

1. **EXTERIOR LIGHTS** switches – As required.

2. Propeller – Clear.

3. Engine – Start.

a. **IGNITION AND ENGINE STARTER** switch – **ON**. **IGN ON** light should illuminate and associated **FUEL PRESS** light should extinguish.

CAUTION

If the ignition does not occur within 10 seconds after moving condition lever to LOW IDLE, initiate Engine Clearing procedure. If for any reason a starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. **CONDITION** lever (after N_1 RPM stabilizes, 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor TGT to avoid a hot start. If there is a rapid rise in TGT, be prepared to abort the start before limits are exceeded. During starting, the maximum allowable TGT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8-24, and discontinue start. Enter the peak temperature and duration on DA Form 2408-13-1.

c. **TGT** and N_1 – Monitor (TGT 1000 °C maximum N_1 52% minimum).

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE STARTER** switch – **OFF** after 50% N_1 and TGT decreasing.

4. Engine and systems instruments – Check.

5. **CONDITION** lever – **HIGH IDLE**. Monitor **TGT** as the condition lever is advanced.

CAUTION

Ensure N_1 has reached at least HIGH IDLE RPM before turning on generator.

6. **GEN** switch – After N_1 reaches high idle, **RESET**, then **ON**.

8-23. SECOND ENGINE START (BATTERY START).

1. First engine generator load 50% or less – **GEN** switch **OFF**.

2. Propeller – Clear.

3. Engine – Start.

a. **IGNITION AND ENGINE STARTER** switch – **ON**. **IGN ON** light should illuminate and associated **FUEL PRESS** light should extinguish.

CAUTION

If ignition does not occur within 10 seconds after moving condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8-25. If for any reason a starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. Generator switch (first engine) – **RESET** then **ON** as N_1 reaches 12%.

c. **CONDITION** lever (after N_1 RPM stabilizes above 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor TGT to avoid a hot start. If there is a rapid rise in TGT, be prepared to abort the start before limits are exceeded. During starting, the maximum allowable TGT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8-24, and discontinue start. Enter the peak temperature and duration on DA Form 2408-13-1.

d. **TGT** and N_1 – Monitor (TGT 1000 °C maximum, N_1 52% minimum).

e. Oil pressure – Check (60 psi minimum).

f. **IGNITION AND ENGINE STARTER** switch – **OFF** after 50% N_1.and TGT decreasing.

4. Engine and systems instruments – Check.
5. **BATTERY CHARGE** light on – Check.
6. **INVERTER** switches – **ON**, check, **INVERTER** lights **OFF**.
7. Second engine generator switch – **RESET**, then **ON**.
8. **CONDITION** levers – As required.
9. Red anticollision light – Reset.

NOTE

To reset, turn OFF approximately 5 seconds, then ON.

When voltage drops below approximately 20 volts, the red anticollision light may become inoperative.

8-24. ABORT START.

1. **CONDITION** lever – **FUEL CUTOFF**.
2. **IGNITION AND ENGINE STARTER** switch – **STARTER ONLY**.
3. **TGT** – Monitor for drop in temperature.
4. Ignition and engine starter switch – **OFF** after **TGT** is below 750 °C.

8-25. ENGINE CLEARING.

1. **CONDITION** lever – **FUEL CUTOFF**.
2. **IGNITION AND ENGINE STARTER** switch – **OFF** (1-minute minimum).

CAUTION

Do not exceed starter limitation of 40 seconds on and 60 seconds off for two starting attempts and engine clearing procedure. Allow 30 minutes off before additional starter operation.

3. **IGNITION AND ENGINE STARTER** switch – **STARTER ONLY** (15 seconds minimum, 40 seconds maximum).
4. **IGNITION AND ENGINE STARTER** switch – **OFF**.

8-26. FIRST ENGINE START (GPU START).

1. **EXTERIOR LIGHT** switches – As required.
2. Propeller area – Clear.
3. Engine – Start.

a. **IGNITION AND ENGINE STARTER** switch – **ON. IGN ON** light should illuminate and associated **FUEL PRESS** light should extinguish.

CAUTION

If ignition does not occur within 10 seconds after moving condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8-25. If for any reason a starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. **CONDITION** lever (After N_1 RPM stabilizes above 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor TGT to avoid a hot start. If there is a rapid rise in TGT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable TGT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8-24, and discontinue start. Record peak temperature on DD Form 2408-13-1.

c. **TGT** and N_1 – Monitor (TGT 1000°C maximum, N_1 52% minimum).

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE STARTER** switch – **OFF**.

4. Engine and systems instruments – Check.

5. **CONDITION** lever – **HIGH IDLE**. Monitor **TGT** as the condition lever is advanced.

NOTE

After starting the first engine with a GPU, the second engine is normally started using a battery start. If a GPU start is required or desired for the second engine start, use the Second Engine Start (GPU Start) procedure, Paragraph 8-27. Otherwise, use the Second Engine Start (Battery Start) procedure, Paragraph 8-23.

6. GPU disconnect – As required. Disconnect if second engine start is to be a battery start.

CAUTION

Do not turn on generators with GPU connected.

7. **GEN** switch – **RESET**, then **ON**.

*8-27. SECOND ENGINE START (GPU START).

1. Propeller area – Clear.

2. Engine – Start.

a. **IGNITION AND ENGINE STARTER** switch **ON**. **IGN ON** light should illuminate and associated **FUEL PRESS** light should extinguish.

CAUTION

If ignition does not occur within 10 seconds after moving condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8-25. If for any reason a starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. **CONDITION** lever (after N_1 RPM stabilizes, above 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor TGT to avoid a hot start. If there is a rapid rise in TGT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable TGT is 1000 °C for 5 seconds. If this limit is exceeded, use Abort Start procedure, Paragraph 8-24, to discontinue start. Record the peak temperature and duration on DA Form 2408-13-1.

c. **TGT** and N_1.– Monitor (TGT 1000 °C maximum N_1 52% minimum).

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE STARTER** switch – **OFF** after 50% N_1.

3. Engine and systems instruments – Check.

4. Right **PROP** lever – **FEATHER**.

5. GPU – Disconnect.

6. Right **PROP** lever – **HIGH RPM**.

7. **INVERTER** switches – **ON**, check **INVERTER** lights **OFF**.

8. **GEN** switches – **RESET**, then **ON**.

9. **CONDITION** levers – As required.

10. Red anticollision light – Reset.

NOTE

To reset, turn OFF approximately 5 seconds, then ON.

When voltage drops below approximately 20 volts, the red anticollision light may become inoperative.

8-28. BEFORE TAXIING.

*1. **BLEED AIR VALVES** – As required.

*2. **BRAKE DEICE** – As required. To activate the brake deice system, proceed as follows.

a. **BLEED AIR VALVES** – **OPEN** both.

b. **CONDITION** levers – **HIGH IDLE**.

c. **BRAKE DEICE** switch – **DEICE** on. Check **BRAKE DEICE** light illuminated.

NOTE

Once brakes have been deiced, the CONDITION lever may be returned to LOW IDLE.

Brake deice control valves may become inoperative if valves are not cycled periodically. One cycle of the valves is required daily, regardless of weather conditions.

*3. **CABIN TEMP MODE** and temperature switches – Set as desired.

NOTE

For maximum cooling on the ground, turn the BLEED AIR VALVE switches to ENVIRO OFF position.

★ 4. AC/DC power – Check as follows:

a. AC frequency – 394 - 406 Hz.

b. AC voltage – 104 -124 Vac.

c. DC load – 85% maximum per generator.

d. DC voltage – 28 - 28.5 Vdc.

*5. **AVIONICS MASTER POWER** switch – **ON**.

WARNING

Do not operate radar in congested areas.

CAUTION

Do not operate the weather radar system in a confined space where the nearest metal wall is 50 feet or less from the antenna reflector. Scanning such surfaces within 50 feet of the antenna reflector may damage receiver crystals.

*6. Avionics controls – As required.

NOTE

The radar system should be tested before each flight on which the system is to be used. If no significant weather is in the immediate area of the aircraft, the system should be left in the STBY position.

★ 7. Electric elevator trim, autopilot/flight director operation **C** **D1** – When PC determines that an autopilot check is required, check as follows:

a. Pilot and copilot **PITCH TRIM** switches – Press to **NOSE UP** and **NOSE DN** positions, singularly and in pairs. Check that trim wheel moves in proper direction and operates only when trim switches are pressed in pairs. Any deviation requires that electric elevator trim be turned off and flight conducted using only manual trim.

b. **DISC TRIM** switch – Press to second detent and verify that electric trim disconnects and that **ELEC TRIM** light extinguishes.

c. Flight Director (FD) and Radio Magnetic Indicator (RMI) warning flags masked – Check.

NOTE

Since the pressure of airflow that normally opposes movement of control surfaces is absent during preflight check, it is possible to get a hard over control surface deflection if an autopilot command is allowed to remain active for any appreciable length of time. Move turn knob and pitch thumbwheel only enough to check operation, then return them to the center position.

d. Select HDG mode – Check.

e. Horizontal Situation Indicator (**HSI**) heading marker under lubber line and vertical needle centered – Set.

f. Engage autopilot and check controls stiff – Check.

g. Move **HSI** heading marker 10° left and right and verify that FD and control wheels respond in the appropriate direction – Check.

h. Press **AP/YD** disengage switch to first detent and verify that autopilot disengages and flight controls are free – Check.

i. Elevator Trim – Check on.

j. Engage autopilot – Check.

k. Command 5° trim **UP** with **AP** pitch wheel and verify that manual trim wheel moves nose **UP** and **AP** trim light indicates **UP** trim – Check.

l. Press **PITCH TRIM** switch **NOSE DN** and verify that autopilot disengages and **AUTO PILOT TRIM FAIL** and **MASTER WARNING** lights illuminate – Check.

NOTE

The AP TRIM FAIL annunciator will extinguish by pressing the AP/YD disconnect button on the control wheel to the first detent.

m. Engage autopilot – Check.

n. Move **HSI** heading marker to command a bank on FD – Check.

o. Press go-around switch and verify that **GA** light illuminates, autopilot disengages, and that FD commands a wings level, 7° nose-up attitude – Check.

p. Press **TEST** switch (pilot's HSI) and verify that attitude display indicates an additional 10° pitch up and 20° right bank – Check.

★ 8. Autopilot trim fail system **C** **D1** – Check as follows:

a. Engage autopilot command **DN** with **AP** pitch wheel and engage **AUTO PILOT TRIM TEST** switch when elevator trim wheel starts to rotate.

b. Verify that autopilot disengages and **AP TRIM FAIL** and **MASTER WARNING** lights illuminate within 10 seconds.

★ 9. Automatic flight control system **D2** – When the PC determines that an autopilot check is required, check as follows:

a. Altitude alert.

NOTE

Pause a few seconds after each step to allow time for the proper indications.

(1) Set alert controller more than 1000 feet above altitude indicated on pilot's altimeter. The pilot's altimeter alert light should be extinguished.

(2) Decrease the alert controller to within 1000 feet of the pilot's altimeter setting. The alert light should illuminate.

(3) Decrease the controller to less than 250 feet above the pilot's altimeter setting. The alert light should extinguish.

(4) Increase the controller to 300 ± 50 feet above the pilot's altimeter indication and check that the alert light illuminates.

(5) Set the desired altitude.

b. Autopilot.

(1) Autopilot controller **UP TRIM**, **DN TRIM** annunciators – Check not illuminated.

CAUTION

A steady illumination of UP TRIM or DN TRIM annunciator indicates that the automatic synchronization is not functioning and the autopilot should not be engaged.

(2) Turn knob – Center.

(3) Elevator trim control switch – ON.

(4) Control wheel – Hold to mid travel.

(5) **AP** button – Press. **AP ENGAGE** and **YD ENGAGE** annunciators on autopilot controller will flash. Servo clutches will engage. **FD** flag on ADI should be in view.

(6) Control movement – Check.

(a) Rudder pedals – Overpower slowly. **YD ENGAGE** annunciator stops flashing.

(b) Control wheel – Overpower slowly in both pitch and roll axis. **AP ENGAGE** annunciator stops flashing. **FD** flag on ADI retracts.

WARNING

If autopilot or yaw damper disengages during overpower test or if AP ENGAGE or YD ENGAGE annunciator continues to flash, the system is considered non-operative and should not be used. The elevator trim system must not be forced beyond the limits indicated on the elevator trim tab indicator.

(7) Elevator trim follow-up – Check.

(a) Control wheel – Hold aft of mid travel. Trim wheel should run nose down after approximately 3 seconds. Trim down annunciator should illuminate after approximately 8 seconds.

(b) Control wheel – Hold forward of mid travel. Trim wheel should run nose up after approximately 3 seconds, trim up annunciator should illuminate after approximately 8 seconds, and AP **TRIM FAIL** annunciator and **MASTER WARNING** lights should illuminate after approximately 15 seconds.

(8) **AP/YD & TRIM DISC** Button – Press through second level. Autopilot and yaw damper should disengage and **ELEC TRIM OFF** annunciator should illuminate. **AP ENG** and **YD ENG** annunciators on instrument panel should flash five times.

(9) Elevator trim control switch – **OFF**, then on. **ELEC TRIM OFF** annunciator should extinguish.

(10) **AP** – Re-engage and overpower another time.

(11) Turn controller – Check that control wheel follows in each applied direction, then center.

(12) Pitch wheel – Check that trim responds to pitch wheel movement. **UP TRIM** and **DN TRIM** annunciators may illuminate.

(13) Heading bug – Center and engage **HDG**. Check that control follows a turn in each direction.

(14) Disengage **AP** by selecting **GA**. Check that **AP** disengages and **FD** commands 7° nose up, wings level attitude.

10. Electric elevator trim D2 – Check.

a. Elevator trim switch – On.

b. Pilot and copilot trim switches – Check operation.

WARNING

Operation of the electric trim system should occur only by movement of pairs of switches. Any movement of the elevator trim wheel while pressing only one switch element denotes a system malfunction. The electric elevator trim control switch must then be turned OFF and flight conducted by operating the elevator trim wheel manually. Do not use autopilot.

(1) Pilot and copilot trim switches – Check individual element for no movement of trim and proper operation of both elements.

(2) Pilot trim switches – Check that pilot trim switches override copilot switches while trimming in opposite directions and trim moves in direction commanded by pilot.

c. Pilot and copilot trim switches. Check trim disconnects while activating pilot's or copilot's trim switches.

d. Elevator trim switch – **OFF** then **ON**. **ELEC TRIM OFF** annunciator extinguishes.

11. Ground Proximity Altitude Advisory System (GPAAS) – Check as follows:

NOTE

The GPAAS voice advisory must produce an operational volume at the lowest setting.

a. **GPAAS** voice advisory **VOL** control – Full counterclockwise.

b. **VOICE OFF** switch-indicator – Extinguished.

c. Audio control panel – Set listening audio level.

d. **VA FAIL** annunciator light – Extinguished.

e. Radio altimeter **DH SET** control – Set to 200 feet.

f. Radio altimeter **TEST** switch – Press and hold. "Minimum, minimum" will be announced once followed by the illumination of the **VA FAIL** light.

g. Radio altimeter **TEST** switch – Release.

12. Avionics – Check and set as required.

13. Flaps – Check.

14. Altimeters – Set and checked.

***8-29. TAXIING.**

Taxi speed can be effectively controlled by the use of power application and the use of the variable pitch propellers in the BETA range. Normal turns may be made with the steerable nose wheel; however, a turn may be tightened by using full rudder and inside brake as necessary. Turns should not be started with brakes alone, nor should the aircraft be pivoted sharply on one main gear.

If the aircraft must be taxied in conditions of mud, tall grass, or other conditions of high surface friction, taxi at a slow but steady speed using power as necessary and minimum braking. Hold the yoke full aft to reduce pressure on the nose wheel. Attempt to prevent unnecessary stops on a soft surface.

1. Brakes – Check.

CAUTION

For safety, the PF should primarily focus his attention outside the aircraft. The PNF should check the flight instruments.

2. Flight instruments – Check for normal operation.

8-30. ENGINE RUNUP.

CAUTION

Monitor oil temperature closely during ground operation with propellers in FEATHER due to lack of air flow over oil cooler.

1. Parking brake – As required.

2. Propeller feathering – Check by pulling propeller levers aft through detent to **FEATHER**. Check that propeller will feather and advance levers to the **HIGH RPM** position.

★ 3. **AUTOFEATHER/AUTO IGNITION** – Check.

a. Condition levers – **LOW IDLE**.

b. **ENG AUTO IGN** Switches – On.

c. **AUTOFEATHER** switch – Hold to **TEST**.

d. **POWER** levers – Advance until **IGN ON** lights are extinguished and **AUTOFEATHER** lights are illuminated, approximately 22% torque.

e. **#1 POWER** lever – Retard and check.

(1) At 16 – 21% torque – #2 **AUTOFEATHER** light out, #1 **IGN ON** light illuminated.

(2) At 9 – 14% torque – Both **AUTOFEATHER** lights out (propeller starts to feather).

f. **#1 POWER** lever – Approximately 22% torque.

g. Repeat steps a. through f. for #2 engine.

h. **POWER** levers – **IDLE** (both **AUTOFEATHER** lights out, neither propeller feathers and both **IGN ON** lights illuminated).

i. **AUTOFEATHER** switch – **ARMED**.

j. **ENG AUTO IGN** switches – **OFF**.

★ 4. Overspeed governors and rudder boost – Check as required.

a. **RUDDER BOOST** switch – On.

b. **PROP** levers – **HIGH RPM**.

c. **PROP GOV TEST** switch – Hold in **TEST** position.

d. Left **POWER** lever – Increase until propeller is stabilized at 1830 – 1910 RPM. Continue to increase until rudder movement is noted. Ensure prop RPM remains 1830 – 1910. (Observe **ITT** and torque limits.)

e. **POWER** lever – Retard to **IDLE**.

f. Repeat steps c., d., and e. for the right engine.

★ 5. Primary governors – Check as follows:

a. **POWER** – Set 1800 RPM.

NOTE

Reduce PROP levers gently to the detent to prevent the PROP RPM dropping abruptly below 1600 RPM.

b. **PROP** levers aft gently to detent – Set.

c. Propeller RPM 1600 to 1640 – Check.

d. **PROP** levers – **HIGH RPM**.

★ 6. Ice vanes – Check as follows, if vanes are already extended, reverse steps a and b:

a. **ICE VANE** switches – **EXTEND**. Verify torque drop, TGT increase, illumination of **VANE EXT** light and visually confirm the bypass doors are open. Maximum allowable time for the complete operation is 15 seconds – Check.

b. **ICE VANE** switches – **RETRACT**. Verify return to original torque and **TGT**, **VANE EXT** light extinguished, and visually confirm the bypass doors are closed. Maximum allowable time for the complete operation is 15 seconds – Check

7. **CONDITION** levers – **HIGH IDLE**.

8. **POWER** levers – **IDLE**.

★ 9. Anti-ice and deice systems – Check as follows:

a. **WSHLD ANTI-ICE** switches – **NORMAL**. Check **PILOT** and **COPILOT** (individually) for loadmeter rise, then **OFF**.

b. **PROP** deice – Check. When **MANUAL** mode is selected, note rise on DC loadmeter. When **AUTO** mode is selected, monitor prop ammeter for 2 minutes and ensure the indicator remains in the normal operating range the entire time.

c. **DEICE** switch – **SINGLE CYCLE AUTO**. Check for a drop in pneumatic pressure and wing deice boots inflation and after 6 seconds for a second drop in pneumatic pressure.

★ 10. Pneumatic System – Check as follows:

a. **LEFT BLEED AIR VALVE** switch – **OFF**.

b. Pneumatic pressure 12 to 20 psi – Check.

c. **L BL AIR OFF** light on – Check.

d. **RIGHT BLEED AIR VALVE** switch – **OFF**.

e. **L & R BL AIR OFF, L & R BL AIR FAIL** lights and **MASTER WARNING** light – **ON**.

f. **LEFT BLEED AIR VALVE** switch – **OPEN**.

g. **L BL AIR OFF** and **L & R BL AIR FAIL** lights – **OFF** and pneumatic pressure at 12 to 20 psi – Check.

h. **RIGHT BLEED AIR VALVE** switch – **OPEN**.

i. **R BL AIR OFF** light off – Check.

★ *11. Pressurization system – Check and set as follows:

a. **CABIN DOOR** caution light extinguished – Check.

b. Vent windows closed – Check.

c. **BLEED AIR VALVE** switches – **OPEN**.

d. Cabin altitude 500 feet lower than field pressure altitude – Set.

e. **CABIN PRESS** switch – **TEST** (hold).

f. **CABIN CLIMB** gauge descending indication – Check, then release **TEST** switch.

g. **ACFT ALT** – Set to pressure altitude plus 200 feet.

h. **RATE** control – Set between 9 and 12 o'clock.

12. **CONDITION** levers – As required.

NOTE

If windshield anti-ice is needed prior to takeoff, use normal setting for a minimum of 15 minutes prior to selecting high temperature to provide adequate preheating and minimization of effects of thermal shock.

*8-31. BEFORE TAKEOFF.

1. **AUTOFEATHER** switch – **ARM**.

2. **BLEED AIR VALVES** – As required.

3. **FUEL** panel – Check fuel quantity and switches positions.

4. Flight and engine instruments – Check for normal indications.

5. **CABIN CONTROLLER** – Set.

6. Annunciator panels – Check and note indications.

7. **PROP** levers – **HIGH RPM**.

8. **FLAPS** – As required.

9. Trim – Set.

10. Avionics – Set.

11. Flight Controls – Check.

★ 12. Departure briefing – Complete.

13. **CABIN SIGNS** switch – As required.

***8-32. LINE UP.**

1. **ICE & RAIN** switches – As required. As a minimum, the **PITOT**, **STALL WARN**, and **FUEL VENT** switches shall be **ON**.

2. Altitude alerter **D2** – Check. Set as required.

O 3. Transponder / TCAS / Weather Radar – As required.

4. **ENG AUTO IGN** switches – **ARM**.

5. Lights – As required.

6. **CONDITION** levers – **HIGH IDLE**.

7. Power stabilized – Check 27% minimum.

NOTE

Landing lights may be used for takeoff to assist in avoiding bird strikes and to make the aircraft more visible while operating in congested areas.

8-33. TAKEOFF.

To aid in planning the takeoff and obtain maximum aircraft performance, make full use of the information affecting takeoff shown in Chapter 7. The data shown was achieved by setting brakes, setting takeoff power, and releasing brakes, but this method is not required. The takeoff will be accomplished in accordance with the Aircrew Training Manual (ATM). The PNF operates the PF's controls on the extended pedestal from the beginning of the takeoff roll until the After Takeoff check is completed or the AP is engaged, whichever comes first.

a. Normal Takeoff. After the line up procedure has been completed, release the brakes and smoothly apply power to within 5% of minimum takeoff power. Power should be applied at a rate that will produce required takeoff power by 50% V_1/V_r. Maintain directional control with nose wheel steering, rudder, and differential power while maintaining wings level with ailerons. The PF should retain a light hold on the power levers throughout the takeoff roll and be ready to initiate abort procedures if required. The PNF should ensure that the **AUTOFEATHER** advisory lights are illuminated (if applicable), adjust and maintain power at the exact takeoff power settings, and monitor all engine instruments. Rotate at the recommended rotation speed V_1/V_r and establish the climb attitude (no greater than 15°) that will attain best climb airspeed (V_2 + 10 KIAS) during the initial climb. Rotation should be at a rate that will allow liftoff at liftoff airspeed.

NOTE

Maximum demonstrated crosswind component is 25 knots.

b. Crosswind Takeoff. Position the aileron control into the wind at the start of the takeoff roll to maintain a wings level attitude. Under strong crosswind conditions, leading with upwind power at the beginning of the takeoff roll will assist in maintaining directional control. As the nose wheel comes off the ground, the rudder is used as necessary to prevent turning (crabbing) into the wind. Rotate in a positive manner to keep from side-skipping as weight is lifted from the shock struts. To prevent damage to the landing gear in the event that the aircraft were to settle back onto the runway, remain in "slipping" flight until well clear of the ground and, as the landing gear is retracted, crab into the wind to continue a straight flight path. Refer to Chapter 7, Wind Components Chart.

c. Minimum Run Takeoff.

WARNING

Spectacular takeoff performance can be obtained by lifting off at speeds below those recommended in Chapter 7. However, control of the aircraft will be lost if an engine failure occurs immediately following liftoff until a safe speed can be attained. Except during soft field takeoff, liftoff below recommended speeds will not be performed.

Minimum run takeoffs are performed with flaps extended to 40%.

To compensate for torque effect during the beginning of the takeoff roll, align the aircraft with the nose approximately 10° right of centerline. After the line up procedure has been completed, hold brakes firmly and apply takeoff power, allowing for some increase in power as airspeed increases during the takeoff roll. PNF action is the same as for normal takeoff. Release the brakes and maintain directional control with nose wheel steering and rudder. Do not use brakes unless absolutely necessary. Hold the elevators in a neutral position, maintaining wings level with ailerons. Allow the aircraft to roll with its full weight on the wheels until V_1/V_r is reached. At this speed rotate smoothly and firmly at a rate that will allow liftoff at liftoff air speed (V_{lof}). After noting a positive climb, direct the PNF to retract the landing gear.

d. Obstacle Clearance Climb. Follow procedures as outlined for a minimum run takeoff, to the point of actual liftoff. When flight is assured, retract the landing gear and establish a wings level climb attitude, maintaining the computed obstacle clearance airspeed (V_x). Climb at this speed until clear of the obstacle. After the obstacle is cleared, lower the nose slowly and accelerate to V_y. Retract flaps after attaining 105 KIAS.

NOTE

The best angle-of-climb speed (V_x) is very close to single-engine, power-off stall speed. To provide for a margin of safety in the event of engine failure immediately after takeoff, the obstacle clearance airspeed value is used in lieu of true V_x for maximum angle takeoff climbs. Takeoff performance data shown in Chapter 7 is based on the use of obstacle clearance climb speed.

e. Soft Field Takeoff. If a takeoff must be made in conditions of mud, snow, tall grass, rough surface or other conditions of high surface friction, the following procedure should be used. Set flaps at **TAKEOFF** (40%), align the aircraft with the runway, and with the yoke held firmly aft, begin a slow steady acceleration, avoiding rapid or transient accelerations. Continue to hold full aft yoke to transfer the weight of the aircraft from the wheels to the wings as soon as possible. When the aircraft rotates, control pitch attitude (nose) to lift off from the soft surface at the slowest possible speed. When airborne, level off immediately in ground effect just above the surface, and accelerate to V_{lof} before rotating to climb attitude and retracting the landing gear. Consider the effects of snow or mud on gear retraction as applicable.

8-34. AFTER TAKEOFF.

WARNING

During takeoff and climb, the pilot flying the aircraft should avoid adjusting controls located on the aft portion of the extended pedestal to preclude inducing spatial disorientation.

After the aircraft is positively airborne and flight is assured, retract the landing gear. Adjust pitch attitude as required (no greater than 15°) to maintain V_2 + 10 KIAS. If required, limit climb attitude to 15° and accept a higher airspeed during the initial climb. Retract flaps after attaining 105 KIAS. The PNF should continue to maintain power at the computed setting and to monitor instruments. At safe single-engine maneuvering attitude, adjust pitch attitude to obtain cruise climb airspeed (or slow cruise if required). As cruise climb airspeed is attained, adjust power to the climb power setting (maximum continuous, maximum climb, or as required.) The PNF then activates the yaw damp on the PF's request and checks that the cabin is pressurizing. Both pilots check the wings and nacelles for fuel or oil leaks. The procedural steps after takeoff are as follows.

1. **GEAR** – **UP**.
2. **FLAPS** (105 KIAS) – **UP**.
3. **LANDING LIGHTS** – **OFF**.
4. Climb power – Set.
5. **PROP SYNC** switch – As required.

8-35. CLIMB.

a. Cruise Climb. Cruise climb is performed at a speed that is the best combination of climb, fuel burn-off, and distance covered. Set propellers at 1900 RPM and torque at 100% (or maximum climb TGT). Adhere to the following airspeed schedule as closely as possible.

SL to 10,000 feet....……..…………155 KIAS

10,000 to 20,000 feet……………...135 KIAS

20,000 to 25,000 feet……………...125 KIAS

25,000 to 31,000 feet……………..115 KIAS

Maneuvering should be held to a minimum and climbing turns should not exceed 20-25° bank angle. Banks of more than 25° materially affect climb performance, reducing rate of climb through loss of vertical lift, while banks of 30° or more may cause passenger discomfort due to imposing high load factors.

b. Climb Maximum Rate. Maximum rate of climb performance is obtained by setting propellers at 2000 RPM, torque at 100% (or maximum climb TGT), and maintaining best rate-of-climb airspeed. This airspeed will vary with gross weight and must also be reduced as available power is reduced with altitude. As a rule of thumb, reduce airspeed approximately one knot for each 2,000 feet of altitude above that altitude where maximum power cannot be maintained. Refer to Chapter 7 for rate of-climb airspeed for specific weights.

1. **YD** switch – As required.
2. Cabin pressurization – Check. Adjust **RATE** control knob so that cabin rate-of-climb equals one-third aircraft rate-of-climb.
3. **AUTOFEATHER** switch – As required.
4. **BRAKE DEICE** – As required.

NOTE

Turn the windshield heat on to NORMAL when passing 10,000 feet MSL or prior to entering the freezing level, whichever comes first. Leave on until no longer required during descent for landing. HIGH temperature may be selected as required after a minimum warmup period of 15 minutes.

5. **WSHLD ANTI-ICE** – As required.
6. Wings and nacelles – Check.
7. O **TCAS** – Set range.

8-36. CRUISE.

Cruise power settings are entirely dependent upon the prevailing circumstances and the type of mission being flown. Refer to Chapter 7 for airspeed, power settings, and fuel flow information. The following procedures are applicable to all cruise requirements.

1. Power – Set. Refer to the cruise power graphs contained in Chapter 7. To account for ram air temperature increase, it is essential that temperature be obtained at stabilized cruise airspeed. Power is set using RPM and torque as the primary control. Maximum allowable torque must not be exceeded and TGT must also be observed as a separate limit.

NOTE

A new engine operated at the torque value presented in the cruise power charts will show a TGT margin below the maximum cruise limit for the torque value presented in the charts. With ice vanes retracted, if cruise torque settings shown on the cruise power charts cannot be obtained without exceeding TGT limits, the engine should be inspected.

2. **ICE & RAIN** switches – As required. Ensure that anti-ice equipment is activated before entering icing conditions.

NOTE

Ice vanes must be extended when operating in visible moisture at +5 °C or less. Visible moisture is any form of clouds, ice crystals, snow, rain, sleet, hail, or any combination of these.

3. **CABIN SIGNS** switch – As required.
4. **AUXILIARY** fuel gauges – Monitor. Ensure that fuel is being transferred from auxiliary tanks. (Chapter 2, Section IV.)
5. Altimeters – Check. Verify that altimeter setting complies with transition altitude requirement.
6. Engine instrument indications – Noted. Check all engine instruments for normal indications.
7. **RECOG** lights – As required.
8. O **TCAS** – Set for en route.

8-37. DESCENT.

Descent from cruising altitude should normally be made by letting down at cruise airspeed with reduced power. Refer to Chapter 7 for power settings and rates of descent.

NOTE

Cabin pressure controller should be adjusted prior to starting descent.

a. DESCENT – Max Rate (Clean). To obtain the maximum rate of descent in clean configuration, perform the following.

1. Cabin pressurization – Set. Adjust **CABIN CONTROLLER** dial as required and adjust **RATE** control knob so that cabin rate of descent equals one-third aircraft rate of descent.

2. **CABIN SIGNS** switch – As required.
3. **POWER** levers – **IDLE**.
4. **PROP** levers – **HIGH RPM**.
5. **GEAR** – **UP**.
6. **FLAPS** – **UP**.
7. Airspeed – V_{mo} maximum.
8. **ICE & RAIN** switches – As required.
9. **RECOG** lights – As required.

b. DESCENT – Max Rate (Landing Configuration). If required to descend at a low airspeed (e.g., to conserve airspace or in turbulence), approach flaps and landing gear may be extended to increase the rate and angle of descent while maintaining the slower airspeed. To perform the maximum rate of descent in landing configuration, perform the following.

1. Cabin pressurization – Set. Adjust **CABIN CONTROLLER** dial as required and adjust **RATE** control knob so that cabin rate of descent equals one-third aircraft rate of descent.
2. **CABIN SIGNS** switch – As required.
3. **POWER** levers – **IDLE**.
4. **PROP** levers – **HIGH RPM**.
5. **FLAPS** – **APPROACH**.
6. **GEAR** – **DN**.
7. Airspeed – 181 KIAS maximum.
8. **ICE & RAIN** switches – As required.
9. **RECOG** lights – As required.

8-38. DESCENT - ARRIVAL.

Perform the following checks prior to the descent for landing.

1. Cabin pressurization – Set. Adjust **CABIN CONTROLLER** dial as required.
2. **CABIN SIGNS** switch – As required.
3. **ICE & RAIN** switches – As required.
4. **WSHLD ANTI-ICE** – As required.

NOTE

Set windshield anti-ice to normal or high as required well before descent into icing conditions or into warm moist air to aid in defogging. Turn off windshield anti-ice when descent is completed to lower altitudes and when heating is no longer required. This will preclude possible windscreen distortions.

5. **RECOG** lights – **ON**.
6. Radio altimeter – As required.
7. Altimeters – Set to current altimeter setting.

O 8. **TCAS** – Set as required.

★ 9. Arrival briefing – Complete. Refer to Paragraph 8-68 for arrival briefing outline.

8-39. APPROACH.

1. **HSI NAV SOURCE** – As required.
   a. Ensure the correct navigational source for the approach has been selected.

O 2. **TCAS** – Set as required.

8-40. BEFORE LANDING.

1. **CABIN SIGNS** switch – **BOTH**.
2. **PROP SYNC** switch – **OFF**.
3. **AUTOFEATHER** switch – **ARM**.
4. **BRAKE DEICE** – As required.
5. **PROP** levers – As required.

NOTE

During approach, propellers should be set at least to 1900 RPM to prevent glideslope interference (ILS approach), provide better power response during approach, and minimize attitude change when advancing propeller levers for landing.

6. **FLAPS** (below 199 KIAS) – **APPROACH**.
7. **GEAR** (below 181 KIAS) – **DN**.
8. **LANDING/TAXI** lights – As required.
9. **CONDITION** levers – **HIGH IDLE**.

O 10. **TCAS** – Set as required.

8-41. OBSTACLE CLEARANCE APPROACH AND MINIMUM RUN LANDING.

When landing over obstacles that require a steeper than normal approach path or when greater precision is required due to restricted runway lengths, a stabilized approach/precision landing technique should be employed. Prior to intercepting the descent path, complete the landing check and stabilize airspeed at V_{ref}. After intercepting the desired approach angle, maintain a constant descent by controlling the descent with power and airspeed with elevator. Transition smoothly from approach to landing attitude. Touchdown should be made on the main gear with the nose slightly high, with power as required to control rate of descent for a smooth touchdown. Immediately after touchdown, allow the nose wheel to make ground contact and, if necessary, apply full reverse power and braking, as required. If possible, remove reverse thrust as the aircraft slows to 40 KIAS to minimize propeller blade erosion.

8-42. LANDING.

Performance data charts for landing computations assume that the runway is paved, level, and dry. Additional runway must be allowed when these conditions are not met. Refer to Chapter 7 for landing data. Do not consider headwind during landing computations; however, if landing must be downwind, include the tailwind in landing distance computations. Plan the final approach to arrive at 50 feet over the landing area at V_{ref} plus one-half wind gust speed. Perform the following procedures as the aircraft nears the runway.

1. **AP & YD** – Disengaged.
2. **GEAR DOWN** lights – Check.
3. **PROP** levers – **HIGH RPM**.

a. Normal Landing. As the aircraft nears the runway, flare slightly to break the rate of descent and reduce power smoothly to **IDLE** as the nose of the aircraft is rotated to landing attitude. Avoid the tendency to ride the ground effect cushion while waiting for the aircraft to slow down to a soft landing. As the aircraft touches down, gently lower the nose-wheel to the runway and use reversing, brakes, or beta range, as required. Normally, reversing will not be used unless required, but if it is used, remove reverse power as the aircraft slows to 40 KIAS. This will help minimize propeller blade erosion.

b. Crosswind Landing. When landing in very strong crosswinds, flaps extension should be limited to obtain a faster approach and landing speed. Use the "crab-into-the-wind" method to correct for drift during final approach. The "crab" is changed to a slip (aileron into wind and top rudder) to correct for drift during flare and touchdown. After landing, position ailerons as required to correct for crosswind effect.

c. Soft Field Landing. When landing on a soft or unprepared surface such as mud, tall grass, or snow, plan a normal power approach with flaps fully extended. Decelerate to the slowest possible airspeed just prior to touchdown, using power to control the final rate of descent to as slow as possible. Do not stall prior to touchdown as the nose attitude and rate of descent will become unacceptable. On touchdown, apply full back (aft) elevator and reduce power slowly. Do not use brakes unless absolutely necessary. Every precaution must be taken to prevent the nose wheel from digging into the surface.

d. Touch and Go Landings. The PNF should select a point on the runway where all pre-takeoff procedures will have been completed prior to the pilot's initial application of power. In selecting this point, prime consideration shall be given to the required accelerate-stop distance pre-computed for the runway in use. The nose wheel should be on the runway and rolling straight before the touch-and-go procedures are initiated. After the PF applies power to within 5% of target, the PNF's actions are the same as during a normal takeoff. If training authorizing touch-and-go landings is approved, use the following procedure.

1. **PROP** levers – **HIGH RPM**.
2. **FLAPS** – As required.
3. Trim – Set.
4. Power stabilized – Check 27% minimum.
5. Takeoff power – Set.

8-43. GO AROUND.

When a go-around is started before the landing check, use power as required to climb to or maintain the desired altitude and airspeed. If the go-around is started after the landing check, apply maximum allowable power and simultaneously increase pitch attitude to stop the descent. Retract the flaps to **APPROACH**, adjusting pitch attitude simultaneously to avoid an altitude loss. Retract the landing gear after ensuring that the aircraft will not touch the ground. Accelerate to V_2+10, retracting flaps fully after attaining 105 KIAS. Safety and recoverability are greatly enhanced by ensuring the **CONDITION** levers are at **HIGH IDLE** before initiating the final approach. Perform the following checks.

1. Power – As required.
2. **FLAPS** – Retract to **APPROACH**.
3. **GEAR** (Positive climb) – **UP**.
4. **FLAPS** (105 KIAS) – **UP**.
5. **LANDING LIGHTS** – **OFF**.
6. Climb power – Set.
7. **YD** – As required.
8. **BRAKE DEICE** – **OFF**.

8-44. AFTER LANDING.

Complete the following procedures after the aircraft has cleared the runway.

1. **CONDITION** levers – As required.
2. **ENG AUTO IGN** – **OFF**.
3. **ICE & RAIN** switches – As required.
4. **FLAPS** – As required.
5. **XPNDR** – Standby.
6. **RADAR** – Standby.
7. **LIGHTS** – As required.

8-45. ENGINE SHUTDOWN.

NOTE

To prevent sustained loads on rudder shock links, the aircraft should be parked with the nose gear centered.

1. **BRAKE DEICE** – **OFF**.
2. Parking brake – Set.
3. **LANDING/TAXI** light – **OFF**.
4. **CABIN TEMP MODE** switch – **OFF**.
5. **AUTOFEATHER** switch – **OFF**.
6. **VENT** and **AFT VENT BLOWER** switches – **AUTO**.
7. **INVERTER** switches – **OFF**.
8. Battery condition – Check as required. If **BATTERY CHARGE** light is illuminated during engine shutdown, turn **BATT** switch **OFF** momentarily and note loadmeter reading. After 90 seconds, momentarily turn switch **OFF** again and note loadmeter reading. Battery condition is unsatisfactory if **BATTERY CHARGE** light remains illuminated and charge current fails to decrease between checks.

CAUTION

Monitor TGT/ITT during shutdown. If sustained combustion is observed, proceed immediately to Abort Start procedure, Paragraph 8-24.

9. **TGT/ITT** – Check. **TGT/ITT** must be 660 °C or below for 1 minute prior to shutdown.
10. **CONDITION** levers – **FUEL CUTOFF**.
11. **PROP** levers – **FEATHER**.

WARNING

Do not turn EXTERIOR LIGHTS off until propeller rotation has stopped.

12. **EXTERIOR LIGHTS** – Off.
13. **MASTER PANEL LIGHTS** – Off.
14. **AVIONICS MASTER** switch – Off.
15. **MASTER SWITCH** – Off.
16. Key lock switch – **OFF**.
17. Oxygen system – **OFF**.
18. Chocks – As required.
19. Parking brake – As required.
20. Control locks – As required.

8-46. BEFORE LEAVING AIRCRAFT.

1. Wheels – Chocked.

NOTE

Brakes should be released after chocks are in place, ramp conditions permitting.

2. Parking brake – As required.
3. Flight controls – As required.

N 4. **OVERHEAD FLOOD LIGHTS** – **OFF**.

5. **STANDBY PUMPS** – **OFF**.
6. Windows C – As required. Do not leave passenger windows in polarized (dark) position.
7. Emergency exit lock – As required.
8. Galley power switches – **OFF**.
9. Aft cabin light – **OFF**.
10. Door light – **OFF**.

CAUTION

If strong winds are anticipated while the aircraft is unattended, the propellers shall be secured to prevent their windmilling with zero engine oil pressure.

11. Walk-around inspection – Complete. Conduct a thorough walk-around inspection, checking for damage, fluid leaks, and levels. Check that covers, tiedowns, restraints, and chocks are installed as required.
12. Aircraft forms – Complete. In addition to established requirements for reporting any system defects, unusual and excessive operation such as hard landings, etc., the flight crew will also make entries on DA Form 2408-13 to indicate when limits in the Operator's Manual have been exceeded.
13. Aircraft secured – Check; lock cabin door as required.

Section III. INSTRUMENT FLIGHT

8-47. GENERAL.

This aircraft is qualified for operation in instrument meteorological conditions (IMC). Flight handling, stability characteristics, and range are approximately the same during instrument flight conditions as when under visual flight conditions (VMC.

8-48. INSTRUMENT FLIGHT PROCEDURES.

Refer to FM 1-5, FM 1-230; FLIP; AR 95-1; TC 1-218; FAR 91 (sub parts A and B) or applicable foreign government regulations and procedures described in this manual.

8-49. INSTRUMENT TAKEOFF.

Complete the Before Takeoff check. Engage the **HDG** mode on the FD. Do not engage autopilot. Align the aircraft with the runway centerline, ensuring that the nose wheel is straight before stopping aircraft. Set HDG marker to runway heading. If an altitude selector is installed, set the initial climb altitude and arm the **ALT SEL** on the FD. Hold brakes and complete the lineup check. Ensure that the roll steering bar is centered. Power application and PNF duties are identical to those prescribed for a "visual" takeoff. After the brakes are released, initial directional control should be accomplished predominantly with the aid of outside visual references. As the takeoff progresses, the crosscheck should transition from outside references to the ADI and airspeed indicator. The rate of transition is directly proportional to the rate at which the outside references deteriorate. At rotation speed, press the **PITCH SYNC & CWS** switch and hold, establish takeoff attitude, once the desired pitch attitude is attained release **PITCH SYNC & CWS** switch. Maintain this pitch attitude and wings-level attitude until the aircraft becomes airborne. When both the vertical velocity indicator and altimeter show positive climb indications, retract the landing gear. After the landing gear is retracted, adjust the pitch attitude as required to attain V_2 + 10 KIAS. Use **PITCH SYNC & CWS** as required to reposition the FD pitch steering bar. Retract flaps after attaining 105 KIAS airspeed and readjust pitch as required. Control the bank attitudes to maintain the desired heading. Support FD indications throughout the maneuver by cross-checking "raw data" information displayed on supporting instruments.

NOTE

Due to possible precession error, the pitch steering bar may slightly lower during acceleration, causing the pitch attitude to appear higher than actual pitch attitude. To avoid lowering the nose prematurely, crosscheck the vertical velocity and altimeter to ensure proper climb performance. The erection system will automatically remove the error after the acceleration ceases.

8-50. INSTRUMENT CLIMB.

Instrument climb procedures are the same as those for visual climb. En route instrument climbs are normally performed at cruise climb airspeeds.

8-51. INSTRUMENT CRUISE.

There are no unusual flight characteristics during cruise in instrument meteorological conditions.

8-52. INSTRUMENT DESCENT.

When a descent at slower than recommended speed is desired, slow the aircraft to the desired speed before initiating the descent. Normal descent to approach altitude can be made using cruise airspeed. Normally, descent will be made with the aircraft in a cruise configuration, maintaining desired speed by reducing power as required. The aircraft is completely controllable in a high rate descent.

8-53. INSTRUMENT APPROACHES.

There are no unusual preparations or control techniques required for instrument approaches. The approaches are normally flown at an airspeed of V_{ref} to V_{ref} + 20 KIAS until transitioning to visual flight. Approach speeds are increased appropriately for potential wind shear and gusty wind conditions IAW the ATM.

8-54. AUTOPILOT COUPLED APPROACHES.

There are no special preparations required for placing the aircraft under autopilot control. Refer to Chapter 3 for procedures to be followed for coupled approaches.

NOTE

The ILS localizer and glideslope warning flags indicate insufficient signal strength to the receiver. Certain electrical mechanical malfunctions between the receiver and indicators may result in erroneous localizer /glideslope information without a warning flag. It is recommended that ILS information be cross-checked with other flight instruments prior to and during final approach. Utilization of NAV TEST prior to the final approach fix may detect certain malfunctions not indicated by the warning flags.

Section IV. FLIGHT CHARACTERISTICS

8-55. STALLS.

A pre-stall warning in the form of a very light buffeting can be felt when a stall is approached. A mechanical warning is also provided by a warning horn. The warning horn starts to alarm approximately 5 to 10 knots above stall speed with the aircraft in any configuration. If correct stall recovery technique is used, very little altitude will be lost during the stall recovery. For the purpose of this section, the term "power-on" means that both engines and propellers of the aircraft are operating normally and are responsive to pilot control. The term "power-off" means that both engines are operating at idle power. Landing gear position has no effect on stall speed.

a. Power-On Stalls. The power-on stall attitude is very steep and, unless this high-pitch attitude is maintained, the aircraft will generally "settle" or "mush" instead of stall. It is difficult to stall the aircraft inadvertently in any normal maneuver. A light buffet precedes most stalls and the first indication of approaching stall is generally a decrease in control effectiveness, accompanied by a "chirping" tone from the stall warning horn. The stall itself is characterized by a rolling tendency if the aircraft is allowed to yaw. The proper use of rudder will prevent the tendency to roll. A slight pitching tendency will develop if the aircraft is held in the stall, resulting in the nose dropping sharply, then pitching up toward the horizon; this cycle is repeated until recovery is made. Control is regained very quickly with little altitude loss, providing the nose is not lowered excessively. Begin recovery with forward movement of the control wheel and a gradual return to level flight. The roll tendency caused by yaw is more pronounced in power-on stalls, as is the pitching tendency; however, both are easily controlled after the initial entry. Power-on stall characteristics are not greatly affected by wing flap position, except that stalling speed is reduced in proportion to the degree of wing flap extension.

b. Power-Off Stalls. The roll tendency is considerably less pronounced in power-off stalls, in any configuration, and is more easily prevented or corrected by adequate rudder and aileron control, respectively. The nose will generally drop straight through with some tendency to pitch up again if recovery is not made immediately. With wing flaps down, there is little or no roll tendency and stalling speed is much slower than with wing flaps up. The Stall Speed Chart, Figure 8-2, shows the indicated power-off stall speeds with aircraft in various configurations. Altitude loss during a full stall will be approximately 800 feet. Safety and recoverability are greatly enhanced by placing the **CONDITION** levers at **HIGH IDLE** before performing power-off stalls.

c. Accelerated Stalls. The aircraft gives noticeable stall warning in the form of buffeting when the stall occurs. The stall warning and buffet can be demonstrated in turns by applying excessive back pressure on the control wheel.

STALL SPEEDS – POWER IDLE

NOTES:

1. MAXIMUM ALITUDE LOSS DURING A NORMAL STALL RECOVERY IS APPROXIMATELY 1000 FEET.
2. MAXIMUM NOSE DOWN PITCH ATTITUDE AND ALTITUDE LOSS DURING RECOVERY FROM ONE ENGINE INSOPERATIVE STALLS PER FAR 23.205 ARE APPROXIMATELY 20° AND 850 FEET RESPECTIVELY
3. A NORMAL STALL RECOVERY TECHNIQUE MAY BE USED. THE BEST PROCEDURE IS A BRISK FORWARD WHEEL MOVEMENT TO A NOSE DOWN ATTITUDE. LEVEL THE AIRPLANE AFTER AIRSPEED HAS INCREASED APPROXIMETELY 25 KNOTS ABOVE STALL.

EXAMPLE:

WEIGHT. . . . . .11,700 LBS
FLAPS . . . . APPROACH
ANGLE OF BANK . . . . 30°

STALL SPEED . . . . .95 KTS CAS
90 KTS IAS

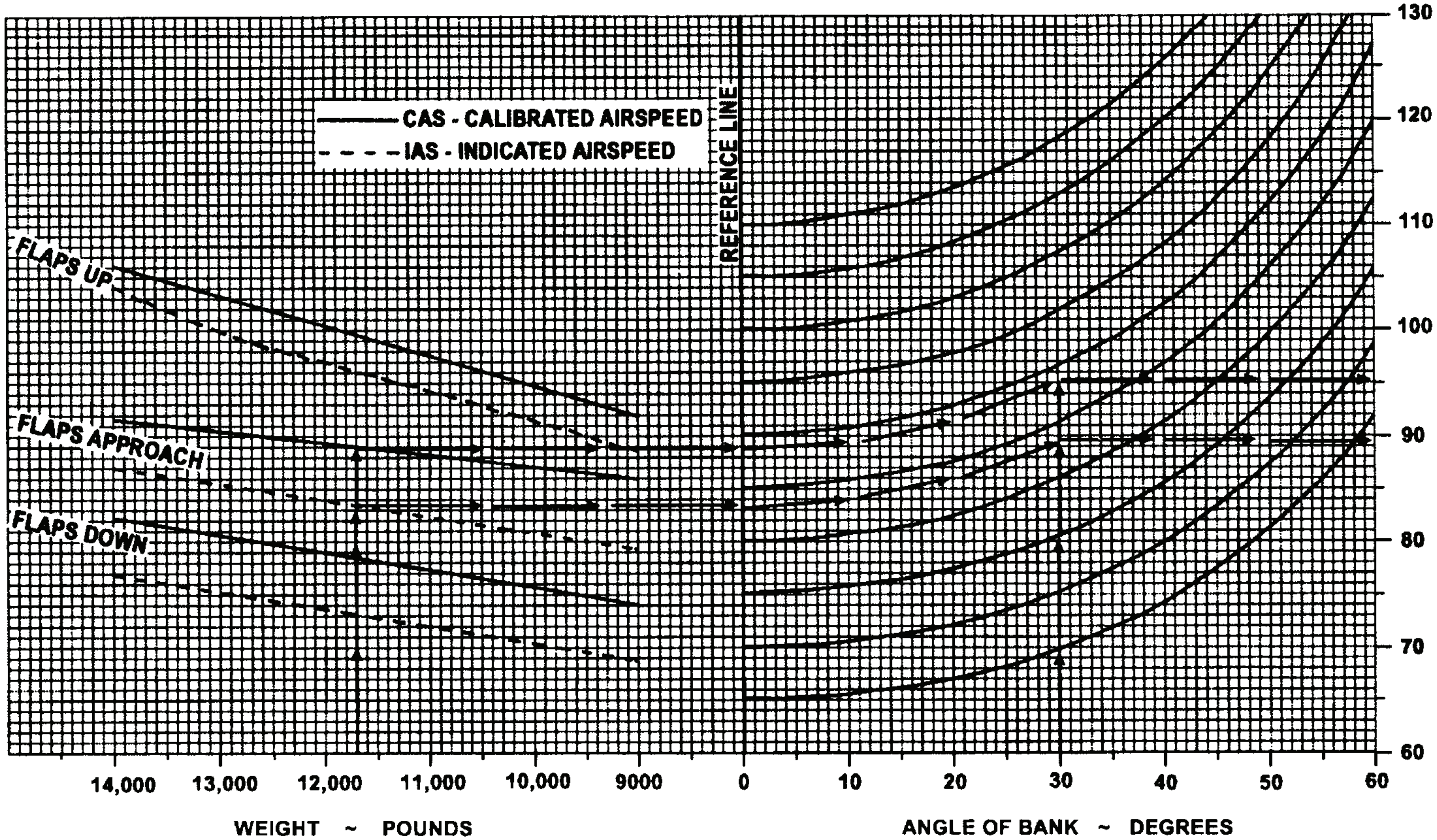


Figure 8-2. Stall Speed

8-56. SPINS.

Intentional spins are prohibited. If a spin is inadvertently entered, use the following recovery procedure. The first three actions should be as nearly simultaneous as possible.

NOTE

Spin demonstrations have not been conducted. The recovery technique is based on the best available information.

1. **POWER** levers – **IDLE**.

2. Apply full rudder opposite the direction of spin rotation.

3. Simultaneously with rudder application, push the control wheel forward and neutralize ailerons.

4. When rotation stops, neutralize rudder.

CAUTION

Do not pull out of the resulting dive too abruptly, as this could cause excessive wing loads and a possible secondary stall.

5. Pull out of dive by exerting a smooth, steady back pressure on the control wheel, avoiding an accelerated stall and excessive aircraft stresses.

8-57. DIVING.

Maximum diving airspeed (red line) V_{mo}/M_{mo} is 260 KIAS or .52 Mach. Flight characteristics are conventional throughout a dive maneuver; however, caution should be used if rough air is encountered after maximum allowable dive speed has been reached, since it is difficult to reduce speed in dive configuration. Dive recovery should be very gentle to avoid excessive aircraft stresses.

8-58. MANEUVERING FLIGHT.

The maximum speed (V_a) at which abrupt full control inputs can be applied without exceeding the design load factor of the aircraft is shown in Chapter 5. There are no unusual characteristics under accelerated flight.

8-59. FLIGHT CONTROLS.

The aircraft is stable under all normal flight conditions. Aileron, elevator, rudder, and trim tab controls function effectively throughout all normal flight conditions. Elevator control forces are relatively light in the extreme aft CG condition, progressing to moderately high with CG at the forward limit. Extending and retracting the landing gear causes only slight changes in control pressure. Control pressures, resulting from changes in power settings or the repositioning of the wing flaps are not excessive in the landing configuration at the most forward CG. The minimum speed at which the aircraft can be fully trimmed is 92 KIAS (gear and flaps down, propellers at high RPM). Control forces produced by changes in speed, power setting, wing flap position, and landing gear position are light and can be overcome with one hand on the control wheel. Trim tabs permit the pilot to reduce these forces to zero. During single engine operation, the rudder-boost system aids in relieving the relatively high rudder pressures resulting from the large variation in power.

8-60. LEVEL FLIGHT CHARACTERISTICS.

All fight characteristics are conventional throughout the level flight speed range.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

8-61. INTRODUCTION.

The purpose of this section is to inform the pilot of the special precautions and procedures to be followed during the various weather conditions that may be encountered in flight. This part is primarily narrative and only those checklists that cover specific procedures characteristic of weather operations are included. The checklist in Section II provides for normal environmental operations.

The procedures defined here are supplementary procedures and are to be performed in addition to the normal procedures outlined in Section II.

8-62. COLD WEATHER OPERATIONS.

Operational difficulties may be encountered during extremely cold weather, unless proper steps are taken prior to or immediately after flight. All personnel should understand, and be fully aware of, the necessary procedures and precautions involved.

a. Preparation for Flight.

CAUTION

For ground operations conducive to ice accumulation on landing gear structure, use undiluted defrosting fluid on brakes and tires to reduce the tendency of ice accumulation during taxi, takeoff, and subsequent landing.

Accumulations of snow, ice, or frost on aircraft surfaces will adversely affect takeoff distance, climb performance, and stall speed to a dangerous degree. Such accumulations must be removed before flight. In addition to the normal exterior checks, also check the removal of ice, snow, or frost and inspect wing and empennage surfaces to verify that these remain sufficiently cleared. Move all control surfaces to confirm full freedom of movement. Assure that tires are not frozen to wheel chocks or to the ground. Use ground heaters, anti-ice solution, or brake deice to free frozen tires. When heat is applied to release tires, the temperature should not exceed 71 °C (160 °F). Refer to Chapter 2 for anti-icing, deicing, and defrosting treatment.

b. Engine Starting. When starting engines on ramps covered with ice, propeller levers should be in the **FEATHER** position to prevent the tires from sliding. To prevent exceeding torque limits when advancing **CONDITION** levers to **HIGH IDLE** during the starting procedure, place the power lever in **BETA** and the propeller lever in **HIGH RPM** before advancing the condition lever to **HIGH IDLE**.

c. Warmup and Ground Test. The warmup procedures and ground test are the same as those outlined in Section II.

d. Taxiing. Whenever possible, taxiing in deep snow, light-weight dry snow, or slush should be avoided, particularly in colder FAT conditions. If it is necessary to taxi through snow or slush, do not set the parking brake when stopped. If possible, do not park the aircraft in snow or slush deep enough to reach the brake assemblies. Chocks or sand bags should be used to prevent the aircraft from rolling while parked. Before attempting to taxi, activate the brake deice system, ensuring that the bleed air valves are **OPEN** and that the condition levers are in **HIGH IDLE**. An outside observer should visually check wheel rotation to ensure brake assemblies have been deiced. The condition levers may be returned to **LOW IDLE** as soon as the brakes are free of ice.

e. Before Takeoff.

CAUTION

If the possibility of ice accumulation on the horizontal stabilizer or elevator exists, takeoff will not be attempted.

If icing conditions are expected, activate all anti-ice systems before takeoff, allowing sufficient time for the equipment to become effective.

f. Takeoff.

NOTE

Following takeoff from runways covered with snow or slush, it is advisable to delay gear retraction and to cycle the gear a few times to dislodge ice accumulated from the spray of slush and water.

Takeoff procedures for cold weather operations are the same as for normal takeoff. Taking off with temperature at or below freezing with water, slush, or snow on the runway, can cause ice to accumulate on the landing gear and can throw ice into the wheel well areas. Such takeoffs shall be made with brake deice on and with the ice vanes extended to preclude the possibility of ice build-up on engine air inlets. Monitor oil temperature to ensure operation within limits. Before flight into icing conditions, the pilot's and copilot's **WSHLD ANTI-ICE** switches should be set at the **NORMAL** position.

g. During Flight.

(1) After take off from a runway covered with snow or slush, it may be advisable to leave brake deice **ON** to dislodge ice accumulated from the spray of slush or water. Monitor the **BRAKE DEICE** annunciator for automatic termination of system operation and then turn the switch **OFF**. During flight, trim tabs and controls should also be exercised periodically to prevent freezing. Ensure that anti-icing systems are activated before entering icing conditions. Do not activate the surface deice system until ice has accumulated 1/2 inch to an inch. The propeller deice system operates effectively as an anti-ice system and it may be operated continuously in flight. If propeller imbalance due to ice does occur, it may be relieved by increasing RPM briefly, then returning to desired setting.

(2) Ice vanes must be extended when operating in visible moisture or when freedom from visible moisture cannot be assured, at +5 °C FAT or less. Ice vanes are designed as an anti-ice system, not a deice system. After the engine air inlet screens

are blocked, lowering the ice vanes will not rectify the condition. Ice vanes should be retracted at +15 °C FAT and above to assure adequate engine oil cooling.

(3) Stalling airspeeds should be expected to increase when ice has accumulated on the aircraft causing distortion of the wing airfoil. For the same reason, stall-warning devices are not accurate and should not be relied upon. Keep a comfortable margin of airspeed above the normal stall airspeed. Maintain a minimum of 140 knots during sustained icing conditions to prevent ice accumulation on unprotected surfaces of the wing. In the event of windshield icing, reduce airspeed to 226 knots or below.

h. Descent. Brake icing should be considered if moisture was encountered during previous ground operations or in flight in icing conditions with gear extended.

i. Landing. Landing on an icy runway should be attempted only when absolutely necessary and should not be attempted unless the wind is within 10° of runway heading. Application of brakes without skidding the tires on ice is very difficult, due to the sensitive brakes. In order not to impair pilot visibility, reverse thrust should be used with caution when landing on a runway covered with snow or standing water.

j. Engine Shutdown. Engine shutdown is the same as in normal conditions.

k. Before Leaving the Aircraft. When the aircraft is parked outside on ice or in a fluctuating freeze-thaw temperature condition, the following procedures should be followed. After wheel chocks are in place, release the brakes to prevent freezing. Fill fuel tanks to minimize condensation, remove any accumulation of dirt and ice from the landing gear shock struts, and install protective covers to guard against possible collection of snow and ice.

8-63. DESERT OPERATION AND HOT WEATHER OPERATION.

Dust, sand, and high temperatures encountered during desert operation can sharply reduce the operational life of the aircraft and its equipment. The abrasive qualities of dust and sand on turbine blades and moving parts of the aircraft and the destructive effect of heat upon the aircraft instruments will necessitate hours of maintenance if basic preventive measures are not followed. In flight, the hazards of dust and sand will be difficult to escape, since dust clouds over a desert may be found at altitudes up to 10,000 feet. During hot weather operations, the principle difficulties encountered are high TGT's during engine starting, over-heating of brakes, and longer takeoff and landing rolls due to the higher density altitudes. In areas where high humidity is encountered, electrical equipment (such as communication equipment and instruments) will be subject to malfunction by corrosion, fungi, and moisture absorption by nonmetallic materials.

a. Preparation for Flight. Check the position of the aircraft in relation to other aircraft. Propeller sandblast can damage closely parked aircraft. Check that the landing gear shock struts are free of dust and sand. Check instrument panel and general interior for dust and sand accumulation. Open main entrance door and cockpit vent storm windows to ventilate the aircraft.

CAUTION

N_1 speeds of 70% or higher may be required to keep oil temperature within limits.

b. Engine Starting. Engine starting under conditions of high ambient temperatures may produce a higher than normal TGT during the start. The **TGT** should be closely monitored when the condition lever is moved to the **LOW IDLE** position. If over temperature tendencies are encountered, the condition lever should be moved to **IDLE CUTOFF** position periodically during acceleration of gas generator **RPM (N_1)**. Be prepared to abort the start before temperature limitations are exceeded.

c. Warmup Ground Tests. To minimize the possibility of damage to the engines during dusty/sandy conditions, activate **ICE VANES**.

d. Taxiing. When practical, avoid taxiing over sandy terrain to minimize propeller damage and engine deterioration that results from impingement of sand and gravel. During hot weather operation, use minimum braking action to prevent overheating.

e. Takeoff. Avoid taking off in the wake of another aircraft if the runway surface is sandy or dusty.

f. During Flight. During flight operation is the same as in normal conditions.

g. Descent. Descent operations are the same as in normal conditions.

h. Landing. Landing operations are the same as in normal conditions.

i. Engine Shutdown. Engine shutdown is the same as in normal conditions.

CAUTION

During hot weather, if fuel tanks are completely filled, fuel expansion may cause overflow, thereby creating a fire hazard.

j. Before Leaving Aircraft. Take extreme care to prevent sand or dust from entering the fuel and oil system during servicing. During hot weather, release the brake immediately after installing wheel chocks to prevent brake disc warpage.

8-64. TURBULENCE AND THUNDERSTORM OPERATION.

CAUTION

Due to the comparatively light wing loading, control in severe turbulence and thunderstorms is critical. Since turbulence imposes heavy loads on the aircraft structure, make all necessary changes in aircraft attitude with the least amount of control pressures to avoid excessive loads on the aircraft's structure.

Thunderstorms and areas of severe turbulence should be avoided. If such areas are to be penetrated, it will be necessary to counter rapid changes in attitude and accept major indicated altitude variations. Penetration should be at an altitude that provides adequate maneuvering margins as a loss or gain of several thousand feet of altitude may be expected. The recommended penetration speed in severe turbulence is 170 KIAS. Pitch attitude and constant power settings are vital to proper flight technique. Establish recommended penetration speed and proper attitude prior to entering turbulent air to minimize most difficulties. False indications by the pressure instruments, due to barometric pressure variations within the storm, make them unreliable. Maintaining a pre-established attitude will result in a fairly constant airspeed. Turn cockpit and cabin lights on to minimize the blinding effects of lightning. Do not use autopilot altitude hold. Maintain constant power settings and pitch attitude, regardless of airspeed or altitude indications. Concentrate on maintaining a level attitude by reference to the FD/Attitude Indicator. Maintain original heading and don't make any turns unless absolutely necessary.

8-65. ICE AND RAIN (TYPICAL).

While in icing conditions, if there is an unexplained 30% increase of torque needed to maintain airspeed in level flight, a cumulative total of 2 or more inches of ice accumulation on the wing, an unexplained decrease of 15 KIAS, or an unexplained deviation between pilot's and copilot's airspeed indicators, the icing environment should be exited as soon as practicable. Ice accumulation on the pitot tube assemblies could cause a complete loss of airspeed indication.

a. The following conditions indicate a possible accumulation of ice on the pitot tube assemblies and unprotected airplane surfaces. If any of these conditions are observed, the icing environment should be exited as soon as practicable.

1. Total ice accumulation of 2 inches or more on the wing surfaces. Determination of ice thickness can be accomplished by summing the estimated ice thickness on the wing prior to each pneumatic boot deice cycle (e.g., four cycles of minimum recommended 1/2-inch accumulation).

2. A 30% increase in torque per engine required to maintain a desired airspeed in level flight, not to exceed 85% torque, when operating at recommended holding/loiter speed.

3. A decrease in indicated airspeed of 15 knots after entering the icing condition (not slower than 1.4 power off stall speed) if maintaining original power setting in level flight. This can be determined by comparing pre-icing condition entry speed to the indicated speed after a surface, deice cycle is completed.

4. Any variations from normal indicated airspeed between the pilot's and copilot's airspeed indicators.

b. Typical Icing. Typical icing occurs because of supercooled water vapor such as fog, clouds, or rain. The most severe icing occurs on aircraft surfaces in visible moisture or precipitation with a true outside air temperature between –5 °C and +1 °C; however, under some circumstances, dangerous icing conditions may be encountered with temperatures below -10 °C. The surface of the aircraft must be at a temperature of freezing or below for it to stick. If severe icing conditions are encountered, ascend or descend to altitudes where these conditions do not prevail. If flight into icing conditions is unavoidable, proper use of aircraft anti-icing and deicing systems may minimize the problems encountered. Approximately 15 minutes prior to flight into temperature conditions that could produce frost or icing conditions, the pilot's and copilot's windshield anti-ice switches should be set at **NORMAL** or **HIGH** temperature position (after preheating) as necessary to eliminate windshield ice. Stalling airspeeds should be expected to increase when ice has accumulated on the aircraft, causing distortion of the wing airfoil. For the same reason, stall-warning devices are not accurate and should not be relied upon. Keep a comfortable margin of airspeed above the normal stall airspeed with ice on the aircraft. Maintain a minimum of 140 knots during sustained icing conditions to prevent ice accumulation on unprotected surfaces of the wing. In the event of windshield icing, reduce airspeed to 226 knots or below.

c. Rain. Rain presents no particular problems other than restricted visibility and occasional incorrect airspeed indications.

d. Taxiing. Extreme care must be exercised when taxiing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

e. Takeoff. Extreme care must be exercised during takeoff from ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

f. Climb. Keep aircraft attitude as flat as possible and climb with higher airspeed than usual so that the lower surfaces of the aircraft will not be iced by flight at a high angle of attack.

g. Cruise Flight. Prevention of ice formation is far more effective and satisfactory than attempts to dislodge the ice after it has formed. If icing conditions are inadvertently encountered, turn on the anti-icing systems prior to the first sign of ice formation. Do not operate deicer boots continuously. Allow at least 1/2-inch of ice on the boots before activating the deicer boots to remove the ice. Continued flight in severe icing conditions should not be attempted. If ice forms on the wing area aft of the deicer boots, climb or descend to an altitude where conditions are less severe.

h. Landing. Extreme care must be exercised when landing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid. Ice accumulation on the aircraft will result in higher stalling airspeeds due to the change in aerodynamic characteristics and increased weight of the aircraft due to ice buildup. Approach and landing airspeeds must be increased accordingly.

NOTE

When operating on wet or icy runways, refer to Stopping Distance Factors Chart shown in Chapter 7.

8-66. ICING (SEVERE).

a. The following weather conditions may be conducive to severe in-flight icing.

1. Visible rain at temperatures below 0 °C ambient air temperature.

2. Droplets that splash or splatter on impact at temperatures below 0 °C ambient air temperature.

b. The following procedure for exiting a severe icing environment is applicable to all flight phases from takeoff to landing.

1. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as –18 °C, increased vigilance is warranted at temperatures around freezing with visible moisture present.

2. Upon observing the visual cues specified in the limitations section for the identification of severe icing conditions indicated in Chapter 5, accomplish the following:

   a. Immediately request priority handling from ATC to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certified.

   b. Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.

   c. Do not engage the autopilot.

   d. If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.

e. If an unusual roll response or uncommanded roll control movement is observed, reduce the angle-of-attack.

f. Do not extend flaps during extended operation in icing conditions. Operations with flaps extended can result in a reduced angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.

g. If the flaps are extended, do not retract them until the airframe is clear of ice.

h. Report these weather conditions to ATC.

Section VI. CREW DUTIES

★8-67. CREW/PASSENGER BRIEFING.

The following guide should be used in accomplishing the required passenger briefings. Items that do not pertain to a specific mission may be omitted.

1. Crew Introduction.

2. Equipment.

   a. Personnel to include ID tags.

   b. Professional (medical equipment, etc.).

   c. Survival.

3. Flight Data.

   a. Route.

   b. Altitude.

   c. Time en route.

   d. Weather.

4. Normal Procedures.

   a. Entry and exit of aircraft.

   b. Seating and seat position.

   c. Seat belts.

   d. Movement in aircraft.

   e. Internal communications.

   f. Security of equipment.

   g. Smoking.

   h. Oxygen.

   i. Refueling.

   j. Weapons and prohibited items.

   k. Protective masks.

   l. Toilet.

   m. Polarized windows.

5. Emergency Procedures.

   a. Emergency exits.

   b. Emergency equipment.

   c. Emergency landing / ditching procedures.

★8-68. DEPARTURE BRIEFING.

The following is a guide that should be used as applicable in accomplishing the required crew briefing prior to takeoff. However, if the crew has operated together previously (thru-flight) and the pilot is certain that the copilot understands all items of the briefing, the pilot may omit the briefing by stating, "Standard briefing" when the briefing is called for during the Before Takeoff check.

1. ATC clearance – Review.

   a. Routing.

   b. Initial altitude.

2. Departure procedure – Review.

   a. Named departure procedure.

   b. Obstacle clearance departure procedure / noise abatement procedure.

   c. Visual flight rules departure route.

3. Copilot's duties – Review.

   a. Adjust takeoff power.

   b. Monitor engine instruments.

   c. Power check at 65 knots.

   d. Call out engine malfunctions.

   e. Tune/identify all nav/comm radios.

   f. Make all radio calls.

   g. Adjust transponder and radar as required.

   h. Complete flight log during flight and note altitudes and headings.

   i. Note departure time.

   j. Retract gear and flaps as directed.

4. TOLD card – Review.

   a. Takeoff power.

   b. V_1/V_r.

   c. V_2 + 10 (climb to 1500 feet AGL).

   d. V_2/V_{yse}.

★8-69. ARRIVAL BRIEFING.

The following is a guide that should be used as applicable in accomplishing the required crew briefing prior to landing. However, if the crew has operated together previously (thru-flight) and the pilot is certain that the copilot understands all items of the briefing, the pilot may omit the briefing by stating, "Standard briefing" when the briefing is called for during the Descent-Arrival check.

1. Weather/altimeter setting.

2. Airfield/facilities – Review.

   a. Field elevation.

   b. Runway length.

   c. Runway condition.

3. Approach procedure – Review.

   a. Approach plan/profile.

   b. Altitude restrictions/VDP.

   c. Missed approach.

      (1) Point.

      (2) Time.

      (3) Intentions.

   d. Decision height or minimum descent altitude.

   e. Lost communications.

4. Backup approach/frequencies.

5. Copilot's duties – Review.

   a. Nav/comm set-up.

   b. Monitor altitude and airspeeds.

   c. Monitor approach.

   d. Call out visual/field in sight.

6. Landing performance data – Review.

   a. Approach speed.

   b. Runway required.

7. Passenger briefing – As required.

CHAPTER 8A
NORMAL PROCEDURES T1 T2

Section I. MISSION PLANNING

8A-1. MISSION PLANNING.

Mission planning begins when the mission is assigned and extends to the preflight check of the aircraft. It includes, but is not limited to, checks of operating limits and restrictions, weight/balance and loading, performance, publications, flight plan, and crew/passenger briefings.

8A-2. OPERATING LIMITS AND RESTRICTIONS.

The minimum, maximum, normal, and cautionary operational ranges represent careful aerodynamic and structural calculations, substantiated by flight test data. These limitations must be adhered to during all phases of the mission. Refer to Chapter 5, Operating Limits and Restrictions, for detailed information.

8A-3. WEIGHT, BALANCE, AND LOADING.

The aircraft must be loaded, cargo and passengers secured, and weight and balance verified per Chapter 6, Weight/Balance and Loading.

8A-4. PERFORMANCE.

Refer to Chapter 7, Performance Data, to determine the capability of the aircraft for the entire mission. Consideration must be given to changes in performance resulting from variation in loads, temperatures, and pressure altitudes.

8A-5. FLIGHT PLAN.

A flight plan must be completed and filed per AR 95-1, DOD Flight Information Publications, and local regulations.

8A-6. CREW AND PASSENGER BRIEFINGS.

A crew/passenger briefing must be conducted for a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to, copilot and ground crew responsibilities and the coordination necessary to complete the mission most efficiently. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew. Refer to Section VI for crew and passenger briefings.

Section II. OPERATING PROCEDURES AND MANEUVERS

8A-7. OPERATING PROCEDURES AND MANEUVERS.

This section deals with normal procedures and includes all steps necessary for safe and efficient operation of the aircraft from the time a preflight begins until the flight is completed and the aircraft is parked and secured. Unique feel, characteristics, and reaction of the aircraft during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described, including precautions to be observed. Only the duties of the minimum crew necessary for the actual operation of the aircraft are included.

8A-8. ADDITIONAL DATA.

Procedures specifically related to instrument flight that are different from normal procedures are covered in this section, following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section IV, Flight Characteristics, and are repeated in this section only when required for emphasis. Checks that must be made under adverse environmental conditions, such as desert and cold weather operations, are covered in Section V, Adverse Environmental Conditions, and supplement normal procedures checks in this section. Crew duties are covered in Section VI.

8A-9. CHECKLIST.

Normal procedures are given primarily in checklist form and are amplified as necessary in accompanying paragraph form when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operator’s and Crewmember’s Checklist, TM 1-1510-218-CL. To provide for easier cross-referencing, the procedural steps in the checklist are numbered to coincide with the correspondingly numbered steps in this manual.

8A-10. USE OF CHECKLIST.

Although a good working knowledge of all aircraft procedures is desirable, it is not mandatory that they be committed to memory. The pilot is responsible for the initiation and accomplishment of all required checks. Checklist items will be called out orally and the action verified using the checklist (-CL). Normally, the pilot not flying (PNF) will call out the checklist, both challenge and response, and perform such duties as directed by the pilot flying (PF). “As required” will not be used as a response; instead the actual position or setting of the unit or item, such as "On" or "Up" or "Approach" will be stated. Upon completion of each checklist, the crewmember reading the checklist will announce “Checklist complete.”

8A-11. CHECKS.

a. Listed below are the symbols used in the following procedures and their associated meanings.

N — Indicates performance of step is mandatory for night flights.

I — Indicates a mandatory check for instrument flights.

O — Indicates if installed.

★ — Indicates an operational check contained in the performance section of the condensed checklist.

* — Indicates performance of step is mandatory for all through flights. The asterisk applies only to checks performed prior to takeoff.

b. Placarded items such as switch and control positions appear in boldface capital letters.

8A-12. BEFORE EXTERIOR CHECK

*1. Forms/publications – Check DA Forms 2408 -12, -13, -14, and -18, DD Form 365-4, locally required forms and publications, and availability of operator's manual (-10) and checklist (-CL).

*2. Oxygen system – Check. Refer to Table 8A-1 Oxygen Duration and Figure 8A-1.

CAUTION

If high or gusty winds are present, and the flight controls are unlocked, control surfaces may be damaged by buffeting.

*3. Flight Controls – Unlocked and checked.

*4. Parking brake – As required.

CAUTION

The elevator trim shall not be forced past the limits that are shown on the elevator trim indicator scale.

5. Manual trim – Check through the entire range and set to zero.

CAUTION

Do not cycle landing gear handle on the ground.

*6. **LDG GEAR CONTR** – **DN**.

*7. **EFIS POWER** – **OFF**.

★ 8. Fuel pumps/crossfeed operation – Check.

a. **FIRE PULL** handles – Pull.

b. **STANDBY PUMPS** – **ON**.

c. **BATT** switch **– ON (#1** and **#2 FUEL PRESS** lights illuminated.

d. **FIRE PULL HANDLES – IN.**

e. **#1** and **#2 FUEL PRESS** annunciators – Extinguished.

f. **STANDBY PUMPS –** Off.

g. **#1** and **#2 FUEL PRESS** annunciators – illuminated.

h. **CROSSFEED** flow alternately left and right (**FUEL CROSSFEED** annunciator illuminated, **#1** and **#2 FUEL PRESS** annunciators extinguished).

i. **CROSSFEED** flow – **OFF**.

j. **AUX TRANSFER – AUTO**.

*9. Fuel gauges – Check quantity.

★ *10. **EFIS POWER** and **INVERTERS** – **ON**, check, **OFF**.

a. **EFIS POWER** – Push **ON**.

b. Turn **ON** either **INVERTER**.

c. Ensure both pilots’ EADI and EHSI are fully operational.

d. **EFIS POWER** and **INVERTERS** – Off.

11. Subpanel – Check and set. Including Stall and Gear Warning tests.

Table 8A-1. Oxygen Duration

OXYGEN DURATION WITH FULL BOTTLE (100% CAPACITY)									
STATED CYLINDER SIZE (CU FT)	**NUMBER OF PEOPLE USING								
	1	2	3	4	5	6	7	8	9
	DURATION IN MINUTES								
22	144	72	48	36	26	24	20	18	16
50	317	158	105	79	63	52	45	39	35
77	488	244	182	122	97	81	69	61	54
115	732	366	244	183	146	122	104	91	81
STATED CYLINDER SIZE (CU FT)	**NUMBER OF PEOPLE USING								
	10	11	12	13	14	15	**16	**17	
	DURATION IN MINUTES								
22	14	13	12	11	10	*	*	*	
50	31	28	26	24	22	21	19	18	
77	48	44	40	37	34	32	30	28	
115	73	66	61	56	52	48	45	43	

* Will not meet oxygen requirements.

** For oxygen duration computations, count each diluter-demand crew mask in use as two (e.g., with four passengers and a crew of two, enter the table at eight people using).

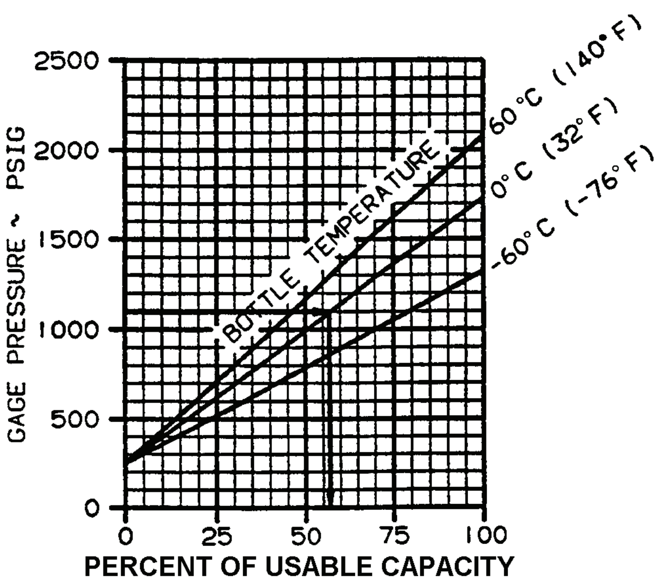


Figure 8A-1. Percent of Usable Capacity

a. **ICE VANE** handles – In.

b. **LDG GEAR CONTR** – **DN**.

c. **GEAR DOWN** lights – Check illuminated.

d. **HYD FLUID SENSOR** – **TEST**.

(1) Hold test switch to **TEST** position.

(2) **HYD FLUID LOW** annunciator – illuminated.

NOTE

It takes approximately 8 seconds for the annunciator to illuminate and to extinguish after release.

(3) Release the **TEST** switch – **HYD FLUID LOW** annunciator extinguished.

e. Fire Detection System – Checked.

12. Lighting and Heating Systems – Check.

a. Turn on **LANDING**, **TAXI**, **ICE**, **NAV**, **RECOG**, **STROBES**, and **BEACON** lights.

b. Turn on **PITOT**, **FUEL VENTS**, and **STALL WARN** heats.

c. Check all lights and heats, then – Off.

13. **BATT** switch – **OFF**.

14. Galley power switches – Off.

15. Toilet – Check.

16. Emergency equipment – Check that all required emergency equipment is available and that fire extinguishers and first aid kits have current inspection date.

a. Survival kit(s).

b. First aid kits (3).

c. Baggage compartment fire extinguisher.

d. Emergency lighting.

e. Emergency exit.

f. Cockpit fire extinguisher.

8A-13. FUEL SAMPLE AND OIL CHECK.

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

NOTE

Fuel and oil quantity checks may be performed prior to Exterior Check to preclude carrying a ladder and fuel sample container during the balance of the preflight. During warm weather, open fuel caps slowly to prevent being sprayed by fuel under pressure.

1. Fuel sample – Check collective fuel sample from all drains for possible contamination. Refer to Chapter 2 for locations.

NOTE

All exterior check areas are illustrated in Figure 8A-2.

8A-14. LEFT WING, AREA 1.

1. Left wing – Check as follows:

*a. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

b. Flaps – Check for full extension or retraction (approximately 1/4-inch play) and skin damage, such as buckling, splitting, distortion, or dents.

c. Fuel sump drains – Check for leaks.

d. Ailerons and trim tab – Check security and trim tab rig.

e. Static wicks – Check security and condition.

f. Wing tip and position lights – Check condition and for cracked lens.

g. Recognition/strobe light – Check condition.

h. Outboard wing fuel vent – Check free of obstruction and for fuel leakage.

*i. Main tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

j. Outboard deice boot – Check for secure bonding, cracks, loose patches, and stall strip.

k. Stall warning vane – Check free.

*l. Tiedown – Released.

m. Wing ice light – Check condition.

n. Recessed and heated fuel vents – Check free of obstructions.

2. Left main landing gear – Check as follows:

*a. Tires – Check for cuts, bruises, wear, appearance of proper inflation, wheel condition, and that both tires have the same tread design.

b. Brake assembly – Check brake lines for damage or signs of leakage and brake linings for wear. Also check the brake deice assembly and bleed air hose for condition and security.

*c. Shock strut – Check for signs of leakage, minimum strut extension (5.5 inches), and that left and right extension is approximately equal.

d. Torque knee – Check condition.

e. Safety switch – Check condition, wire, and security.

★ f. Fire extinguisher pressure – Check pressure within limits (Chapter 2).

g. Wheel well, doors, and linkage – Check for signs of leakage, broken wires, security, and general condition.

h. Fuel sump drains – Check for leaks.

3. Left engine and propeller – Check as follows:

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

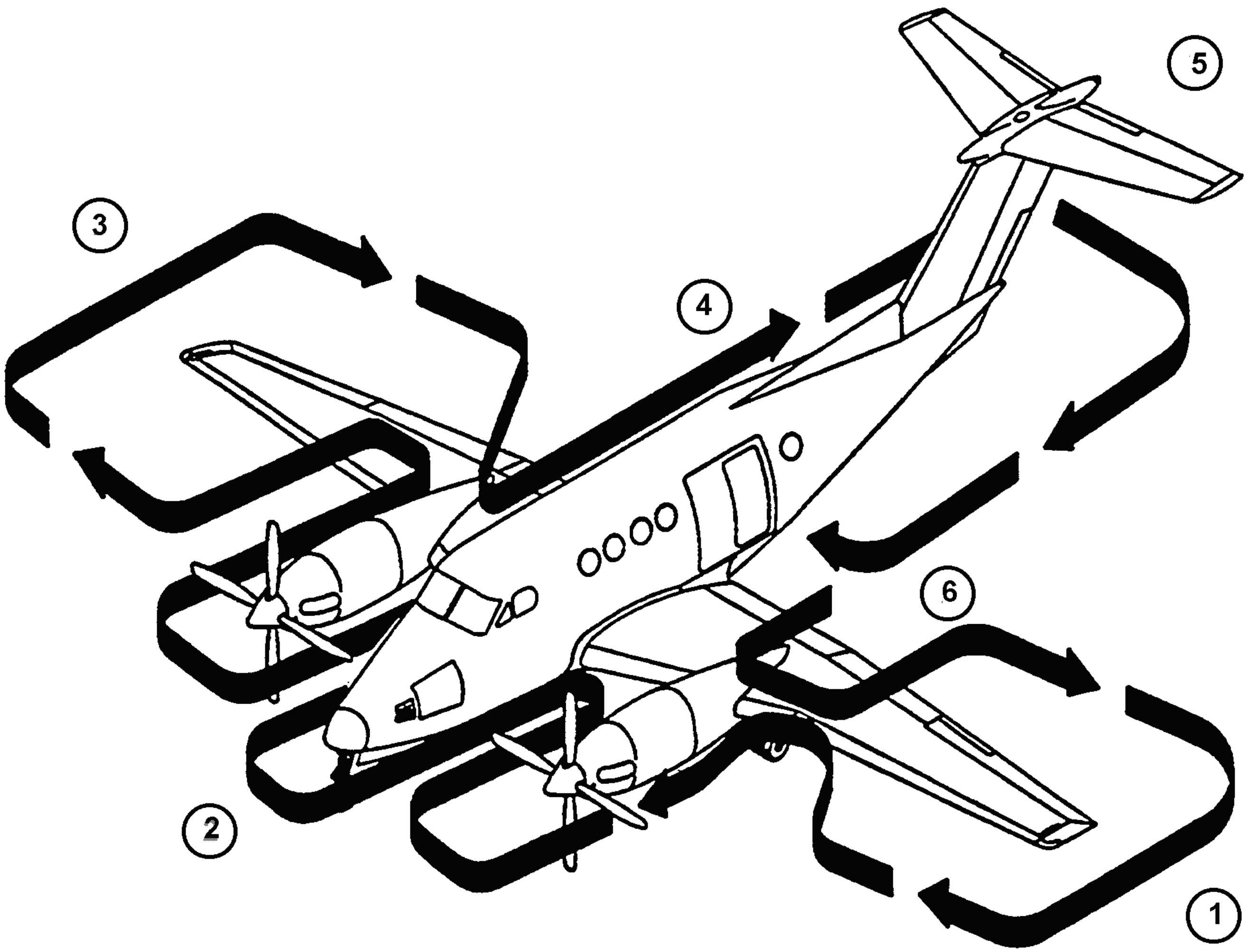
*a. Engine oil – Check oil level, normally no more than 3 quarts low, cap secured, and locking tab aft.

b. Engine compartment, left side – Check for fuel and oil leaks, security of oil cap, door, and general condition. Lock compartment access door.

c. Left cowl locks – Locked.

d. Left exhaust stub – Check for cracks and free of obstructions.

e. Propeller blades and spinner – Check blade condition, deice boot, security of spinner, and free propeller rotation.



AREA 1	LEFT WING LANDING GEAR, ENGINE, NACELLE, AND PROPELLER
AREA 2	NOSE SECTION
AREA 3	RIGHT WING LANDING GEAR, ENGINE, NACELLE, AND PROPELLER
AREA 4	FUSELAGE, RIGHT SIDE
AREA 5	EMPENNAGE
AREA 6	FUSELAGE, LEFT SIDE

Figure 8A-2. Figure Exterior Check

f. Engine air inlets and ice vanes – Check free of obstruction and correct ice vane position.

g. Bypass door – Check condition and correct position.

h. Right cowl locks – Locked.

i. Right exhaust stub – Check for cracks and free of obstructions.

j. Engine compartment, right side – Check for fuel and oil leaks, ice vane linkage, door, and general condition. Lock compartment access door.

4. Left wing center section – Check as follows:

a. Heat exchanger inlet and outlet – Check for cracks and free of obstructions.

b. Auxiliary tank fuel sump drain – Check for leaks.

c. Hydraulic reservoir vent and pump seal drain – Check vent clear of obstructions, and no excessive fluid is present. Hydraulic landing gear service door secure.

d. Deice boot – Check for bonding, cracks, loose patches, and general condition.

*e. Auxiliary tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

5. Fuselage underside – Check.

*a. General condition – Check for skin damage such as buckling, splitting, distortion, dents, or fuel leaks.

b. Antennas – Check security and general condition.

8A-15. NOSE SECTION, AREA 2.

1. Nose section – Check as follows:

a. Outside air temperature probe – Check condition.

b. Avionics door, left side – Check secure.

c. Air conditioner exhaust – Check free of obstruction.

d. Wheel well condition – Check for signs of leakage, broken wires, and condition.

e. Doors and linkage – Check condition, security, and alignment.

f. Nose gear turning stop – Check condition.

*g. Tire – Check for cuts, bruises, wear, appearance of proper inflation, and wheel condition.

*h. Shock strut – Check for signs of leakage and 3 inches minimum extension.

i. Torque knee – Check condition.

j. Shimmy damper and linkage – Check for security and condition.

k. Headset jack cover – Check installed.

l. Landing and taxi lights – Check for security and condition.

m. Pitot tubes – Check covers removed, alignment, security, and free of obstructions.

n. Radome – Check condition.

o. Air data computer sensor – Check free of obstructions.

CAUTION

Do not move wipers on dry windshield or clean windshield with anything other than mild soap and water.

p. Windshields and wipers – Check windshields for cracks and cleanliness and wipers for contact with glass surface.

q. Air conditioner inlet – Check free of obstructions.

r. Avionics door, right side – Check secure.

8A-16. RIGHT WING, AREA 3.

1. Right wing center section – Check as follows:

a. Deice boot – Check for secure bonding cracks, loose patches, and general condition.

b. Battery access panel – Secure.

*c. Auxiliary tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

d. Battery exhaust louvers – Check free of obstructions.

e. Battery compartment drain – Check free of obstruction and check-valve free.

f. Battery ram air intake – Check free of obstruction.

g. Auxiliary tank fuel sump drain – Check for leaks.

h. Heat exchanger outlet and inlet – Check for cracks and free of obstructions.

2. Right engine and propeller – Check as follows:

CAUTION

A cold oil check is unreliable. Oil should be checked within 10 minutes after stopping engine. If more than 10 minutes have elapsed, motor engine for 40 seconds, then recheck. If more than 10 hours have elapsed, run engine for 2 minutes, then recheck. Add oil as required. Do not overfill.

*a. Engine oil – Check oil level, normally, no more than 3 quarts low, and locking tab aft.

b. Engine compartment, left side – Check for fuel and oil leaks, security of oil cap, door, and general condition. Lock compartment access door.

c. Left cowl locks – Locked.

d. Left exhaust stub – Check for cracks and free of obstructions.

e. Propeller blades and spinner – Check blade condition, security of deice boot, spinner security, and free propeller rotation.

f. Engine air inlets and ice vane – Check free of obstructions and correct position.

g. Bypass door – Check condition and correct position.

h. Right cowl locks – Locked.

i. Right exhaust stub – Check for cracks and free of obstructions.

j. Engine compartment, right side – Check for fuel and oil leaks, ice vane linkage, door, and general condition. Lock compartment access door.

3. Right main landing gear – Check as follows:

a. Fuel sump drains – Check for leaks.

*b. Tires – Check for cuts, bruises, wear, appearance of proper inflation, wheel condition, and that both tires have the same tread design.

c. Brake assembly – Check lines for damage or signs of leakage and brake linings for wear. Also check brake deice assembly and bleed-air hose for condition and security.

*d. Shock strut – Check for signs of leakage and minimum strut extension (5.5 inches) and left and right extension is approximately equal.

e. Torque knee – Check condition.

f. Safety switch – Check condition, wire, and security.

★ g. Fire extinguisher pressure – Check pressure within limits (Chapter 2).

h. Wheel well, doors, and linkage – Check for signs of leakage, broken wires, security, and general condition.

4. Right wing – Check as follows:

a. Recessed and heated fuel vents – Check free of obstructions.

b. GPU access door – Secured.

c. Wing ice light – Check condition.

d. Outboard deice boot – Check for secure bonding, cracks, loose patches, stall strip, and general condition.

*e. Tiedown – Released.

*f. Main tank fuel and cap – Check fuel level, condition of seal, cap tight and properly installed. Locking tab aft.

g. Outboard wing fuel vent – Check free of obstruction and for fuel leakage.

h. Wing tip and position light – Check condition and for cracked lens.

i. Recognition/strobe light – Check condition.

j. Static wicks – Check security and condition.

k. Ailerons and trim tab – Check security and condition of ground adjustable tab.

l. Fuel sump drains – Check for leaks.

m. Flaps – Check for full extension or retraction (approximately 1/4-inch play) and skin damage such as buckling, splitting, distortion, or dents.

*n. General condition – Check for skin

damage such as buckling, splitting, distortion, dents, or fuel leaks.

8A-17. FUSELAGE RIGHT SIDE, AREA 4.

1. Fuselage right side – Check as follows:

*a. General condition – Check for skin damage such as buckling, splitting, distortion, or dents.

b. Beacon – Check condition.

c. Emergency light – Check.

d. Aft access door – Check condition.

e. Cabin air exhaust – Clear.

f. Oxygen filler door – Check secure.

g. Static ports – Check clear of obstructions.

h. Emergency locator transmitter – Armed and antenna check.

8A-18. EMPENNAGE, AREA 5.

1. Empennage – Check as follows:

a. Vertical stabilizer, rudder, and trim tab – Check for skin damage such as buckling, splitting, distortion, or dents, and trim tab rig.

b. Antennas – Check condition.

c. Deice boots – Check for secure bonding, cracks, loose patches, and general condition.

WARNING

If the possibility of ice accumulation on the horizontal stabilizer or elevator exists, do not take off.

d. Horizontal stabilizer, elevator, and trim tab – Check for skin damage such as buckling, splitting, distortion, or dents, and trim tab rig.

e. Elevator trim tab – Verify "0" (neutral) position. The elevator trim tab "0" (neutral) position is determined by observing that the trailing edge of the trim tab aligns with the trailing edge of the elevator while the elevator is resting against the downstops.

f. Static wicks – Check.

g. Position and beacon lights – Check condition.

8A-19. FUSELAGE, LEFT SIDE, AREA 6.

1. Fuselage left side – Check as follows:

*a. General condition – Check for skin damage such as buckling, splitting distortion, or dents.

b. Static ports – Check clear of obstructions.

c. Emergency light – Check.

d. Cabin door – Check seal and general condition.

e. Fuselage top side – Check general condition.

*2. Chocks and tiedowns – Removed.

8A-20. INTERIOR CHECK.

1. Cargo/loose equipment – Check secure.

★ 2. Cabin door – Locked and checked. Ensure the cabin door is closed and locked as follows: check the position of safety arm and diaphragm plunger (lift door step) and each of the six rotary cam locks align within the orange sight indicators. In addition, the following inspection and test shall be performed prior to the first flight of the day.

a. Open cabin door – Check that **CABIN DOOR** annunciator is extinguished.

b. Latch cabin door, but do not lock – Check that **CABIN DOOR** annunciator illuminates.

c. **BATT** switch – **ON**. Check that **CABIN DOOR** annunciator is still illuminated.

d. Close and lock cabin door – Check that **CABIN DOOR** annunciator is extinguished.

e. **BATT** switch – **OFF**.

3. Cargo door – Locked and checked.

a. Upper handle position – Closed and locked. Orange index marks on each of the four rotary cam locks must align within the sight indicators.

b. Lower pin latch handle position – Closed and latched. Orange indicator must align with orange stripe on carrier rod.

NOTE

The untapered shoulder of the latching pins should extend past each attachment lug.

4. Emergency exit – Check.

★ 5. Crew/passenger briefing – Complete.

8A-21. BEFORE STARTING ENGINES.

NOTE

GPU engine starts are the preferred starting method.

* 1. Parking brake – Set.
* 2. Oxygen system –Set.
3. Circuit breakers – Check.
* 4. Overhead panel – Check.
* 5. Fuel panel switches – Check.
6. Magnetic compass – Check.
7. **CLOCK** and **MAP** lights – Off.
* 8. Pedestal controls – Set.
   a. **POWER** levers – **IDLE.**
   b. **PROP** levers – **HIGH RPM**.

NOTE

Where there is excessive gravel/debris or the ramp is slippery, the pilot may consider starting the engines with the props in feather and/or ice vanes extended, but must closely monitor ITT and oil temperature on engine start.

   c. **CONDITION** levers – **FUEL CUTOFF**.
   d. Trim tabs – Set.
9. Lower console switches – Set.
   a. Avionics – As required.
   b. **RUDDER BOOST** switch – On.
10. Gear ratchet handle – Stowed.
11. Free air temperature gauge – Check.
12. Pilot's instrument panel – Check and set.
   a. **COMPASS** control – **SLAVE**.
   b. **EFIS POWER** – **OFF**.
13. Copilot's instrument panel – Check and set.
   a. **COMPASS** control – **SLAVE**.

8A-22. FIRST ENGINE START (BATTERY START).

Starting procedures are identical for both engines except the second engine generator is kept off line after the second engine start to allow performing the current limiters check. When making a battery start, the right engine should be started first. A crewmember should monitor the outside observer throughout the engine start.

1. **BATT** switch – **ON**.
2. **EXTERIOR LIGHTS** – As required.
3. Propeller – Clear.
4. Engine – Start.
   a. **IGNITION AND ENGINE START** switch – **ON. IGN ON** annunciator should illuminate and associated **FUEL PRESS** annunciator extinguished.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE initiate Engine Clearing procedure, Paragraph 8A-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

   b. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds minimum) – **LOW IDLE**.

CAUTION

Monitor ITT/TGT to avoid a hot start. If there is a rapid rise in ITT/TGT, be prepared to abort the start before limits are exceeded. During starting, the maximum allowable ITT/TGT is 1000 °C for 5 seconds. If this limit is exceeded, discontinue start and use the Abort Start procedure, Paragraph 8A-24. Record the peak temperature and duration on DA Form 2408-13-1.

   c. ITT/TGT and N_1 – Monitor. ITT/TGT 1000 °C maximum. N_1 minimum 56%.
   d. Oil pressure – Check (60 psi minimum).
   e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and TGT/ITT decreasing.
5. Engine and systems instruments – Check.

6. **CONDITION** lever – **HIGH IDLE**. Monitor ITT/TGT as the condition lever is advanced.

NOTE

Ensure N_1 is at high idle before turning on generator.

7. **GEN** switch – **RESET**, then **ON**.

   a. **BATTERY CHG** light – Monitor.

NOTE

The engine anti-ice system (ice vanes) should be ON (extended) for all ground operations to minimize ingestion of ground debris. Turn off engine anti-ice (retract ice vanes) to maintain engine temperatures within limits.

8A-23. SECOND ENGINE START (BATTERY START).

1. First engine generator load 50% or less – **GEN** switch **OFF**.
2. Propeller area – Clear.
3. Engine – Start.

   a. **IGNITION AND ENGINE START** switch– **ON. IGN ON** light should illuminate and **FUEL PRESS** light should extinguish.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8A-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

   b. First engine **GEN** switch – **RESET** then **ON** when N_1 reaches 12 %.

   c. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds minimum) – **LOW IDLE.**

CAUTION

Monitor ITT/TGT to avoid a hot start. If there is a rapid rise in ITT/TGT, be prepared to abort the start before limits are exceeded. During starting, the maximum allowable ITT/TGT is 1000 °C for 5 seconds. If this limit is exceeded, discontinue start and use Abort Start procedure, Paragraph 8A-24. Enter the peak temperature and duration on DA Form 2408-13-1.

   d. ITT/TGT and N_1 – Monitor. ITT/TGT 1000 °C maximum. N_1 minimum 56%.

   e. Oil pressure – Check (60 psi minimum).

   f. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT/TGT decreasing.

4. Engine and systems instruments – Check.
5. **BATTERY CHARGE** light on – Check.
6. **INVERTER** switches – **ON**, check **INVERTER** lights off.
7. Second engine **GEN** switch – **RESET**, then **ON**.

   a. AC/DC power – Check frequencies, volts and loads.

   b. Frequency and Volts:

      (1) AC frequency – 394 to 406 Hz.

      (2) AC voltage – 104 to 124 Vac.

      (3) DC voltage – 28.0 to 28.5 Vdc.

   c. DC loads: Parallel within 10%.

      (1) 75% maximum – **LOW IDLE**.

      (2) 85% maximum – **HIGH IDLE**.

      (3) 85% maximum – Ground operations.

8. **CONDITION** levers – As required.
9. Red anticollision light – Reset.

NOTE

To reset, turn off approximately 5 seconds, then to the NIGHT (red) position. When voltage drops below approximately 20 volts, the anticollision light may become inoperative. Normally, NIGHT (red) strobe is used for ground operations and DAY (white) is used for flight operations.

8A-24. ABORT START.

1. **CONDITION** lever – **FUEL CUTOFF**.
2. **IGNITION AND ENGINE START** switch – **STARTER ONLY**.
3. ITT/TGT – Monitor for drop in temperature.
4. **IGNITION AND ENGINE START** switch – **OFF**.

8A-25. ENGINE CLEARING.

1. **CONDITION** lever – **FUEL CUTOFF**.
2. **IGNITION AND ENGINE START** switch – **OFF** (1-minute minimum).

CAUTION

Do not exceed starter limitation of 40 seconds on and 60 seconds off for two starting attempts. Allow 30 minutes off before additional starter operation.

3. **IGNITION AND ENGINE START** switch – **STARTER ONLY** (15 seconds minimum, 40 seconds maximum).
4. **IGNITION AND ENGINE START** switch – **OFF**.

* 8A-26. FIRST ENGINE START (GPU START).

When making a Ground Power Unit (GPU) start, the left engine should be started first due to the GPU receptacle being located adjacent to the right engine. Normally, only one engine is started utilizing the GPU, reverting to the Battery Start procedure for the second engine start.

CAUTION

Never connect an external power source to the aircraft unless a battery indicating a charge of at least 20 volts is in the aircraft. If the battery voltage is less than 20 volts, the battery must be recharged or replaced with a battery indicating at least 20 volts before connecting external power. Use only an external power source fitted with an AN-type plug.

The **BATT** switch must be **OFF** prior to connecting an auxiliary power unit. An **EXTERNAL POWER** annunciator alerts the crew when an external power plug is connected to the aircraft.

NOTE

If the battery is partially discharged, the BATTERY CHARGE annunciator will illuminate approximately 6 seconds after external power is on-line. If the annunciator does not extinguish within 5 minutes, refer to the BATTERY CHARGE Light Illuminated procedure, Paragraph 9-28d.

1. **BATT** switch – **OFF**.
2. GPU – Connect.
3. **EXTERNAL POWER** advisory light – On.
4. **BATT** switch – **ON**.
5. **EXTERIOR LIGHTS** switches – As required.
6. Propeller – Clear.
7. Engine – Start.
   a. **IGNITION AND ENGINE START** switch – **ON. IGN ON** light illuminated and associated. **FUEL PRESS** light extinguished.

CAUTION

If ignition does not occur within 10 seconds after moving the condition lever to LOW IDLE, initiate Engine Clearing procedure, Paragraph 8A-25. If for any reason the starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

   b. **CONDITION** lever (after N_1 stabilizes at or above 12% for 5 seconds) – **LOW IDLE**.

CAUTION

Monitor ITT/TGT to avoid a hot start. If there is a rapid rise in ITT/TGT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable ITT/TGT is 1000 °C for 5 seconds. If this limit is exceeded, discontinue start and use Abort Start procedure, Paragraph 8A-24. Record the peak temperature and duration on DA Form 2408-13-1.

c. ITT/TGT and N_1 – Monitor ITT/TGT 1000 °C maximum. N_1 minimum 56%.

d. Oil pressure – Check (60 psi minimum).

e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT/TGT decreasing.

8. Engine and systems instruments – Check.

9. **CONDITION** lever – **HIGH IDLE**. Monitor ITT/TGT as the condition lever is advanced.

10. GPU disconnect – As required.

CAUTION

Do not turn on generators with GPU connected.

11. **GEN** switch – **RESET** then **ON**.

12. **BATTERY CHARGE** light – Monitor.

NOTE

After starting the first engine with a GPU, the second engine is normally started using a battery start. If a GPU start is required or desired for the second engine start, use the Second Engine Start (GPU Start) procedure, Paragraph 8A-27; otherwise, use the Second Engine Start (Battery Start) procedure, Paragraph 8A-23.

* 8A-27. SECOND ENGINE START (GPU START).

1. Propeller area – Clear.

2. Engine – Start.

a. **IGNITION AND ENGINE START** switch – **ON. IGN ON** light illuminated and the associated **FUEL PRESS** light extinguished.

CAUTION

If ignition does not occur within 10 seconds after moving condition lever to low idle, initiate Engine Clearing procedure, Paragraph 8A-25. If for any reason a starting attempt is discontinued, the entire starting sequence must be repeated after allowing the engine to come to a complete stop (1-minute minimum).

b. **CONDITION** lever (after N_1 RPM stabilizes at or above 12% for 5 seconds) – **LOW IDLE**.

CAUTION

Monitor ITT/TGT to avoid a hot start. If there is a rapid rise in ITT/TGT, be prepared to abort the start before limits are exceeded. During engine start, the maximum allowable ITT/TGT is 1000 °C for 5 seconds. If this limit is exceeded, discontinue start and use Abort Start procedure, Paragraph 8A-24. Record the peak temperature and duration on DA Form 2408-13-1.

c. ITT/TGT and N_1 – Monitor. ITT /TGT 1000 °C maximum. N_1 minimum 56%.

d. Oil pressure – Check 60 psi minimum.

e. **IGNITION AND ENGINE START** switch – **OFF** after 50% N_1 and ITT/TGT decreasing.

3. Engine and systems instruments – Check.

4. Right **PROP** lever – **FEATHER**.

5. GPU – Disconnect.

6. Right **PROP** lever – **HIGH RPM**.

7. **INVERTER** switches – **ON**, check **INVERTER** lights **OFF**.

8. **GEN** switches – **RESET,** then **ON**.

a. AC/DC power – Check frequencies, volts and loads.

b. Frequency and Volts:

(1) AC frequency 394 to 406 Hz.

(2) AC voltage – 104 to 124 Vac.

(3) DC voltage – 28.0 to 28.5 Vdc.

c. DC loads: Parallel within 10%.

(1) 75% maximum – **LOW IDLE**.

(2) 85% maximum – **HIGH IDLE**.

(3) 85% maximum – Ground Operations.

9. **CONDITION** levers – As required.
10. Red anticollision light – Reset.

NOTE

To reset, turn off approximately 5 seconds, then to the NIGHT (red) position. When voltage drops below approximately 20 volts, the anticollision light may become inoperative. Normally, NIGHT (red) strobe is used for ground operations and DAY (white) is used for flight operations.

8A-28. BEFORE TAXIING.

* 1. AC/DC power – Check.

* 2. **AVIONICS MASTER POWER** – **ON**.

* 3. **EFIS POWER** – **ON**.

* 4. **CABIN AIR/TEMP MODE** and **CABIN AIR/TEMP** switches – Set as desired.

* 5. **BLEED AIR VALVES** – As required.

CAUTION

Do not leave brake deice on longer than required to check function of annunciators when ambient temperatures are above 15 °C.

NOTE

Brake deice control valves may become inoperative if valves are not cycled periodically. One cycle of the valves is required daily, regardless of the weather conditions.

* 6. **BRAKE DEICE** switch – As required.

7. Avionics – Check and set as required.

* 8. **TCAS** – **TEST** and set.

9. **FLAPS** – Check.

10. . Altimeters – Set and Check.

* 8A-29. TAXIING.

CAUTION

Never taxi with a flat tire or a flat shock strut. During taxi operations, particular attention should be given to propeller tip clearance. Extreme caution is required when operating on unimproved or irregular surfaces or when high winds exist. If operations produce a propeller RPM over 1600, retard propeller levers to the detent to limit RPM to 1600 to help reduce the possibility of ingestion of ground debris.

1. Brakes – Check.
2. Flight instruments – Check.

8A-30. ENGINE RUNUP.

1. Parking brake – As required.
2. Propeller feathering – Check.

★ 3. **AUTOFEATHER/AUTO IGN** – Check as required.

a. **AUTO IGN** switches – **ARM**. **IGN ON** annunciators illuminated.

b. **POWER** levers – 22% torque. **IGN ON** annunciators extinguish.

c. **AUTOFEATHER** switch – Hold to **TEST**. Both **AUTOFEATHER** annunciators illuminated.

d. **POWER** levers – Retard individually.

(1) Approximately 16% – 21% torque, opposite **AUTOFEATHER** annunciator extinguishes, **IGN ON** annunciator illuminated.

(2) Approximately 9% – 14% torque, both **AUTOFEATHER** annunciators extinguished (prop begins to feather). **IGN ON** annunciator illuminated.

NOTE

AUTOFEATHER annunciators will illuminate and extinguish with each fluctuation of torque as the propeller attempts to feather.

(3) Return **POWER** lever to 22% torque.

e. Repeat procedure with other engine.

f. **POWER** levers – **IDLE** (Both **AUTOFEATHER** lights extinguished, props do not feather).

g. **AUTOFEATHER** switch – **ARM**.

h. **AUTO IGN** switches – Off.

★ 4. Overspeed governors and rudder boost – Check as required.

a. **RUDDER BOOST** switch – On.

b. **PROP** levers – **HIGH RPM**.

c. **LEFT PROP GOV TEST** switch – Hold in **TEST** position.

d. Left **POWER** lever – Increase until propeller is stabilized at 1830 RPM – 1910 RPM. Continue to increase until rudder movement is noted. Observe ITT/TGT and torque limits and PROP remains stabilized at 1830 RPM – 1910 RPM.

e. **POWER** lever – Retard to **IDLE**.

f. Repeat steps c., d., and e. for the right engine.

★ 5. Primary governors – Check as required.

a. **POWER** levers – Set 1800 RPM.

b. **PROP** levers – Retard to **FEATHER** detent. Note propellers stabilize between 1600 and 1640 RPM.

c. **PROP** levers – **HIGH RPM**. Note propellers return to 1800 RPM.

★ 6. Engine ice vanes – Check. If already extended, reverse steps a and b.

a. **ICE VANES** – On/**EXTENDED**.

(1) Both advisory lights illuminated.

(2) Both bypass doors extended.

(3) Maximum time for (1) and (2) is 15 seconds.

b. **ICE VANES** – Off/**RETRACTED**.

(1) Both advisory lights extinguish.

(2) Both bypass doors retracted.

(3) Maximum time for (1) and (2) is 15 seconds.

7. **CONDITION** levers – **HIGH IDLE**.

8. **POWER** levers – **IDLE**.

★ 9. Anti-ice/deice systems – Check.

a. Prop deice – Check. When **MANUAL** mode is selected, note rise on DC loadmeter. When **AUTO** mode is selected, monitor prop ammeter for the appropriate number of seconds and ensure the indicator remains in the normal operating range the entire time.

b. Windshield heat – Check. Note increases on the loadmeter and cycle through both normal and high settings.

NOTE

If windshield heat is needed prior to takeoff, use NORMAL setting for a minimum of 15 minutes prior to selecting HIGH to provide adequate preheating and minimize the effects of thermal shock. The windshield heat thermostat will invalidate the check in OAT above 20° to 30 °C.

c. All anti-ice/deice switches – **OFF**.

d. Surface deice system – Check.

★ 10. Vacuum and pneumatic system – Check.

a. **LEFT BLEED AIR VALVE** – **OFF**.

(1) Pneumatic and suction pressures remain normal.

(2) **L BL AIR OFF** annunciator illuminates.

(3) Both **BL AIR FAIL** annunciators remain extinguished.

b. **RIGHT BLEED AIR VALVE** – **OFF**.

(1) Pneumatic and suction pressures read zero.

(2) Both **BL AIR OFF** and **BL AIR FAIL** annunciators illuminated.

c. **LEFT BLEED AIR VALVE** – **ON/OPEN**.

(1) Pneumatic and suction pressures return to normal.

(2) **L BL AIR FAIL** and **BL AIR OFF** annunciators extinguished.

d. **RIGHT BLEED AIR VALVE – ON/OPEN**.

(1) **R BL AIR OFF** annunciator extinguished.

(2) Both **BL AIR FAIL** annunciators extinguished.

★ 11. Automatic Flight Control System – Engage the AP, then press the red disconnect button and ensure AP disengages. When the PC determines that an autopilot check is required, check as follows:

a. Altitude alert.

NOTE

Pause a few seconds after each step to allow time for the proper indications.

(1) Set alert controller more than 1000 feet above altitude indicated on pilot's altimeter. The pilot's altimeter alert light should be extinguished.

(2) Decrease the alert controller to within 1000 feet of the pilot's altimeter setting. The alert light should illuminate.

(3) Decrease the controller to less than 250 feet above the pilot's altimeter setting. The alert light should extinguish.

(4) Increase the controller to 300 ± 50 feet above the pilot's altimeter indication and check that the alert light illuminates.

(5) Set the desired altitude.

b. Autopilot.

(1) Autopilot controller **UP TRIM** and **DN TRIM** annunciators – Check not illuminated.

CAUTION

A steady illumination of UP TRIM or DN TRIM annunciator indicates that the automatic synchronization is not functioning and the autopilot should not be engaged.

(2) Turn knob – Center.

(3) **ELEV TRIM** switch – On.

(4) Control wheel – Hold to mid travel.

(5) **AP** button – Press. **AP ENGAGE** and **YD ENGAGE** annunciators on autopilot controller will flash. Servo clutches will engage. FD flag on ADI should be in view.

(6) Control movement – Check.

(a) Rudder pedals – Overpower slowly. **YD ENGAGE** annunciator stops flashing.

(b) Control wheel – Overpower slowly in both pitch and roll axis. **AP ENGAGE** annunciator stops flashing. FD flag on ADI retracts.

WARNING

If autopilot or yaw damper disengages during overpower test or if AP ENGAGE or YD ENGAGE annunciator continues to flash, the system is considered non-operative and should not be used. The elevator trim system must not be forced beyond the limits that are indicated on the elevator trim tab indicator.

(7) Elevator trim follow-up – Check.

(a) Control wheel – Hold aft of mid travel. Trim wheel should run nose down after approximately 3 seconds. Trim down annunciator should illuminate after approximately 8 seconds.

(b) Control wheel – Hold forward of mid travel. Trim wheel should run nose up after approximately 3 seconds, trim up annunciator should illuminate after approximately 8 seconds, and **AP TRIM FAIL** annunciator and **MASTER WARNING** lights should illuminate after approximately 15 seconds.

(8) **AP/YD & TRIM DISC** button – Press through second level. Autopilot and yaw damper should disengage and **ELEV TRIM OFF** annunciator should illuminate. **AP ENG** and **YD ENG** annunciators on instrument panel should flash five times.

(9) **ELEV TRIM** switch – **OFF**, then On. **ELEV TRIM OFF** annunciator should extinguish.

(10) **AP** – Re-engage and overpower another time.

(11) Turn controller – Check that control wheel follows in each applied direction and center.

(12) Pitch wheel – Check that trim responds to pitch wheel movement. **UP TRIM** and **DN TRIM** annunciators may illuminate.

(13) Heading bug – Center and engage HDG. Check that control follows a turn in each direction.

(14) Disengage **AP** by selecting **GA**. Check that **AP** disengages and **FD** commands 7° nose up, wings level attitude.

12. Electric elevator trim – Check.

a. **ELEV TRIM** switch – On.

b. Pilot and copilot trim switches – Check operation.

WARNING

Operation of the electric trim system should occur only by movement of pairs of switches. Any movement of the elevator trim wheel while pressing only one switch element denotes a system malfunction. The electric elevator trim control switch must then be turned OFF and flight conducted by operating the elevator trim wheel manually. Do not use autopilot.

(1) Pilot and copilot. Check individual element for no movement of trim, then check proper operation of both elements.

(2) Check pilot switches override copilot switches while trimming in opposite directions and trim moves in direction commanded by pilot.

c. Check pilot and copilot trim disconnects while activating trim.

d. **ELEV TRIM** switch – **OFF** then On. **ELEC TRIM OFF** annunciator extinguishes.

★ * 13. Pressurization – Check and set.

a. **BLEED AIR VALVES** – Both **ON/OPEN**.

b. **CABIN ALT** – Set 500 feet lower than field pressure altitude.

c. **CABIN PRESS** switch – **TEST**. Cabin climb/descent gauge indicates a descent.

d. **CABIN PRESS** switch – Release. Cabin climb/descent gauge indicates a climb, then stabilizes at zero climb.

e. Altitude selector – Set as required. Pressure altitude plus 200 feet.

14. **CONDITION** levers – As required.

15. Ground Proximity Altitude Advisory System (GPAAS) – Check as follows:

NOTE

The GPAAS voice advisory must produce an operational volume at the lowest setting.

a. GPAAS voice advisory **VOL** control – Full counterclockwise.

b. **VOICE OFF** switch-indicator – Extinguished.

c. Audio control panel – Set listening audio level.

d. **VA FAIL** annunciator light – Extinguished.

e. Radio altimeter **DH SET** control – Set to 200 feet.

f. Radio altimeter **TEST** switch – Press and hold. "Minimum, minimum" will be announced once followed by the illumination of the **VA FAIL** light.

g. Radio altimeter **TEST** switch – Release.

h. Repeat steps a through g on the copilot's side.

* 8A-31. BEFORE TAKEOFF.

1. **AUTOFEATHER** switch – **ARM**.
2. **BLEED AIR VALVES** – As required.
3. **FUEL** panel – Check fuel quantity and positions of switches.
4. Flight and engine instruments – Check.
5. **CABIN ALT** – Set PA + 200 feet.
6. Annunciator panels – Check.
7. **PROP** levers – **HIGH RPM**.
8. **FLAPS** – As required.
9. Trim and AP – Set. Ensure AP control is set to PF side.
10. Avionics – Set.
11. Flight controls – Check.
12. ★ Departure briefing – Complete.
13. **CABIN SIGNS** switch – As required.

*8A-32. LINE UP.

1. **ICE & RAIN** switches – As required.

2. Altitude alerter – Check.
3. Transponder/TCAS/Wx radar – As required.
4. **ENG AUTO IGN** – **ARM**.
5. Lights – As required.
6. **CONDITION** levers – **HIGH IDLE**.
7. **POWER** – Stabilized 27% minimum.

8A-33. TAKEOFF.

To aid in planning the takeoff and obtain maximum aircraft performance, make full use of the information affecting takeoff shown in Chapter 7. The data shown was achieved by setting brakes, setting takeoff power, and releasing brakes, but this method is not required. The takeoff will be accomplished in accordance with the Aircrew Training Manual (ATM). The PNF operates the PF's controls on the extended pedestal from the beginning of the takeoff roll until the After Takeoff check is completed or the AP is engaged, whichever comes first.

8A-34. AFTER TAKEOFF.

WARNING

During the takeoff roll and after takeoff, the pilot flying the aircraft should avoid adjusting controls located on the extended pedestal to preclude inducing spatial disorientation.

1. **GEAR** – **UP**.
2. **FLAPS** (105 KIAS) – **UP**.
3. **LANDING/TAXI** lights – **OFF**.
4. Climb power – Set.

8A-35. CLIMB.

a. Cruise Climb. Cruise climb is performed at a speed that is the best combination of climb, fuel burn-off, and distance covered. Set propellers at 1900 RPM and torque at maximum allowable (or maximum climb ITT, monitor N_1). Adhere to the following airspeed schedule as closely as possible unless a V_y climb is required.

SL to 10,000 feet....……..…………155 KIAS

10,000 to 20,000 feet……………...135 KIAS

20,000 to 25,000 feet……………...125 KIAS

25,000 to 31,000 feet……………..115 KIAS

b. Climb – Maximum Rate. Maximum rate of climb performance is obtained by setting propellers at 2000 RPM, torque at maximum allowable (or maximum climb ITT/TGT, monitor N_1), and maintaining V_y. Refer to Chapter 7 for V_y for specific weights.

c. Climb Checklist. Complete as follows:

1. **YAW DAMP** – As required.
2. Cabin pressurization – Check. Adjust rate control knob so that cabin rate-of-climb equals one third of aircraft rate-of-climb.
3. **AUTOFEATHER** switch– As required.
4. **BRAKE DEICE** switch – As required.

NOTE

Turn the windshield heat on to NORMAL when passing 10,000 feet MSL or prior to entering the freezing level, whichever comes first. Leave on until no longer required during descent for landing. HIGH temperature may be selected as required after a minimum warmup period of 15 minutes.

5. **WSHLD ANTI-ICE** – As required.
6. Wings and nacelles – Check.
7. **TCAS** – Set range.

8A-36. CRUISE.

1. **POWER** – Set. Refer to the cruise power graphs contained in Chapter 7.

NOTE

A new engine operated at the torque value presented in the cruise power charts will show an ITT/TGT margin below the maximum cruise limit for the torque value presented in the charts. With ice vanes retracted (ICE VANES OFF), if cruise torque settings shown on the power charts cannot be obtained without exceeding ITT/TGT limits, the engine should be inspected.

2. **ICE & RAIN** switches – As required. Ensure anti-ice equipment is activated before entering icing conditions.
3. **CABIN SIGNS** switch – As required.
4. Auxiliary fuel gauges – Monitor. Ensure fuel is being transferred from auxiliary tanks. (Chapter 2, Section IV).
5. Altimeters – Check. Verify altimeter settings are correct.

6. Engine instruments – Check. Note indications.
7. **RECOG** lights – As required.
8. **TCAS** – Set for enroute.

8A-37. DESCENT – ARRIVAL.

Perform the following checks prior to the descent into the terminal area for landing:

1. Cabin pressurization – Set. Adjust cabin controller dial as required.
2. **CABIN SIGNS** switch – As required.
3. **ICE & RAIN** switches – As required.

NOTE

Set windshield heat to NORMAL or HIGH as required well before descent into icing conditions or into warm moist air to aid in defogging. Turn off windshield heat when descent is completed to lower altitudes and when heating is no longer required. This will preclude possible windshield distortions.

4. **WSHLD ANTI-ICE** – As required.
5. **RECOG** lights – **ON**.
6. Radio altimeter – As required.
7. Altimeters – Set to current setting.
8. **TCAS** – Set as required.
9. ★ Arrival briefing – Complete.

8A-38. DESCENT.

Descent from cruise altitude should normally be made by letting down at cruise airspeed with reduced power. Refer to Chapter 7 for power settings and rates of descent.

NOTE

Cabin pressure controller should be adjusted prior to starting descent.

a. Descent – Maximum Rate (Clean). To obtain the maximum rate of descent in clean configuration, perform the following:

1. Cabin pressurization – Set. Adjust cabin controller dial as required. While descending, adjust rate control knob so that cabin rate of descent equals one-third aircraft rate of descent.
2. **CABIN SIGNS** switch – As required.
3. **POWER** levers – **IDLE**.
4. **PROP** levers – **HIGH RPM**.
5. **GEAR** – **UP**.
6. **FLAPS** – **UP**.
7. Airspeed – V_{mo} maximum.
8. **ICE & RAIN** switches – As required.
9. **RECOG** lights – As required.

b. Descent – Maximum Rate (Landing Configuration). If required to descend at a low airspeed (e.g., to conserve airspace or in turbulence), approach flaps and landing gear may be extended to increase the rate and angle of descent while maintaining a slower airspeed. To perform, use the following procedure:

1. Cabin pressurization – Set. Adjust cabin controller dial as required. While descending, adjust rate control knob so that cabin rate of descent equals one-third aircraft rate of descent.
2. **CABIN SIGNS** switch – As required.
3. **POWER** levers – **IDLE**.
4. **PROP** levers – **HIGH RPM**.
5. **FLAPS** – **APPROACH**.
6. **GEAR** – **DN**.
7. Airspeed – 181 KIAS maximum.
8. **ICE & RAIN** switches – As required.
9. **RECOG** lights – As required.

8A-39. APPROACH.

1. **EHSI NAV SOURCE** – As required.

   Ensure the correct navigational source for the approach has been selected.

2. **TCAS** – Set as required.

8A-40. BEFORE LANDING.

1. **CABIN SIGNS** switch – **BOTH**.
2. **AUTOFEATHER** switch – **ARM**.
3. **BRAKE DEICE** switch – As required.
4. **PROP** levers – As required.

NOTE

During approach, propellers should be set at 1900 RPM to prevent glideslope interference (ILS approach), provide better power response during approach, and minimize attitude change when advancing propeller levers for landing.

5. **FLAPS** (below 199 KIAS) – **APPROACH**.
6. **GEAR** (below 181 KIAS) – **DN**, confirm.
7. **LANDING LIGHTS** – As required.
8. **CONDITION** levers – **HIGH IDLE**.
9. **TCAS** – Set as required.

8A-41. LANDING.

Performance data charts for landing computations assume the runway is paved, level, and dry. Additional runway must be allowed when these conditions are not met. Do not consider headwind during landing computations; however, if landing must be downwind, include the tailwind in landing distance computation. Conduct all landings in accordance with the appropriate ATM. Perform the following procedure as the aircraft nears the runway.

1. **AP & YD** – Disengaged.
2. **GEAR DOWN** lights – Check/confirm.
3. **PROP** levers – **HIGH RPM**.

8A-42. TOUCH AND GO LANDING.

The instructor should select a point on the runway where all pre-takeoff procedures will have been completed prior to the pilot's initial application of power. In selecting this point, prime consideration shall be given to the required accelerate-stop distance pre-computed on a current Takeoff and Landing Data (TOLD) card. The nose wheel should be on the runway and rolling straight before the power is advanced. After the pilot applies power to within 5% of the takeoff power, the instructor's actions are the same as during a normal takeoff. Use the following procedure.

1. **PROP** levers – **HIGH RPM**.
2. **FLAPS** – As required.
3. Trim – Set.
4. Power stabilized – Check 27% minimum.
5. Takeoff power – Set.

8A-43. GO-AROUND/MISSED APPROACH.

Accomplish the maneuver in accordance with the appropriate ATM.

1. Power – As required.
2. **FLAPS** – Retract to **APPROACH**.
3. **GEAR** (Positive climb) – **UP**.
4. **FLAPS** (105 KIAS) – **UP**.
5. **LANDING/TAXI LIGHTS** – **OFF**.
6. Climb power – Set.
7. **YAW DAMP** – As required.
8. **BRAKE DEICE** switch – Off.

8A-44. AFTER LANDING.

Complete the following procedures after the landing rollout is complete and normal taxi speed is attained.

1. **CONDITION** levers – As required.
2. **AUTO IGN** – Off.
3. **ICE & RAIN** switches – Off.
4. **FLAPS** – **UP**.
5. **XPNDR** – As required.
6. Radar – As required.
7. Lights – As required.
   a. Strobe lights – Off.
   b. **RECOG** – **OFF**.
   c. **LANDING/TAXI LIGHTS** – As required.

8A-45. ENGINE SHUTDOWN.

NOTE

To prevent sustained loads on rudder shock links, the aircraft should be parked with the nose gear centered.

1. **BRAKE DEICE** switch – Off.
2. Parking brake – Set.
3. **LANDING/TAXI** lights – **OFF**.
4. **EFIS POWER** – **OFF**.
5. **INVERTERS** – **OFF**.
6. **AUTOFEATHER** switch – **OFF**.
7. **CABIN AIR/TEMP MODE** switch – **OFF**.

8. **VENT** and **AFT VENT BLOWER** switch – **AUTO**.
9. **BATT** condition – Check. Battery charge light should be extinguished. If it is illuminated, note loadmeter reading, turn the battery switch off momentarily, and turn the battery switch **ON** and wait approximately 90 seconds. Turn the battery switch off and note loadmeter reading. Battery condition is unsatisfactory if the battery charge light remains illuminated and charge current fails to decrease between checks.
10. ITT/TGT – Check. Must be 750 or below for 1 minute prior to shutdown.

CAUTION

Monitor ITT/TGT during shutdown. If sustained combustion is observed, proceed immediately to Abort Start procedure, Paragraph 8A-24.

11. **CONDITION** levers – **FUEL CUTOFF**.
12. **PROP** levers – **FEATHER**.

Do not turn off exterior lights until propeller rotation has stopped.

13. **AVIONICS MASTER POWER** – **OFF**.
14. **MASTER PANEL LIGHTS** – Off.
15. **EXTERIOR LIGHTS** – **OFF**.
16. **MASTER SWITCH** – Off.
17. Key lock switch – **OFF**.
18. Oxygen system – **OFF**.
19. Chocks – As required.
20. Parking brake – As required.
21. Control locks – As required.

8A-46. BEFORE LEAVING AIRCRAFT.

1. Wheel chocks – As required.

NOTE

Brakes should be released after chocks are in place, ramp conditions permitting.

2. Parking brake – As required.
3. Flight controls – As required.
4. **OVERHEAD FLOOD LIGHT** – **OFF**.
5. **STANDBY PUMPS** – Off.
6. **MAP** lights – **OFF**.
7. Windows – As required.
8. Emergency exit lock – As required.
9. Galley power switches – **OFF**.
10. Aft cabin light – **OFF**.
11. Door light – **OFF**.

CAUTION

If strong winds are anticipated while the aircraft is unattended, the propellers shall be secured to prevent windmilling with zero engine oil pressure.

12. Walk-around inspection – Complete.
13. Aircraft forms – Complete.
14. Aircraft secured – Check.

Section III. INSTRUMENT FLIGHT

8A-47. GENERAL.

This aircraft is qualified for operation in instrument flight meteorological conditions. Flight handling, stability characteristics, and range are the same during instrument flight conditions as when under visual flight conditions.

8A-48. INSTRUMENT FLIGHT PROCEDURES.

Refer to FM 1-240, FM 1-230, FLIP, AR 95-1, FC 1-218, FAR 91 (subparts A and B), applicable foreign government regulations, and procedures described in this manual. Accomplish all instrument flight tasks in accordance with the appropriate ATM.

Section IV. FLIGHT CHARACTERISTIC

8A-49. STALLS.

A pre-stall warning in the form of very light buffeting can be felt when a stall is approached. A mechanical warning is also provided by a warning horn. The warning horn starts to alarm approximately 5 to 10 knots above stall speed with the aircraft in any configuration. If correct stall recovery technique is used, little altitude will be lost during the stall recovery. For the purpose of this section, the term “power on” means that both engines and propellers are operating normally and are responsive to pilot control. The term “power off” means that both engines are operating at idle power. Landing gear position has no effect on stall speed.

a. Power-On Stalls. The power on stall attitude is steep and, unless this high pitch attitude is maintained, the aircraft will generally “settle” or “mush” instead of stall. It is difficult to stall the aircraft inadvertently in any normal maneuver. A light buffet precedes most stalls, and the first indication of approaching stall is generally a decrease in control effectiveness, accompanied by a stall warning horn. The stall itself is characterized by a rolling tendency if the aircraft is allowed to yaw. The proper use of rudder will minimize the tendency to roll. A slight pitching tendency will develop if the aircraft is held in the stall, resulting in the nose dropping sharply, then pitching up toward the horizon; this cycle is repeated until recovery is made. Control is regained very quickly with little altitude loss, providing the nose is not lowered excessively. Begin recovery with forward movement of the control wheel and a gradual return to level flight. The roll tendency caused by yaw is more pronounced in power-on stalls, as is the pitching tendency. However, both are easily controlled after the initial entry. Power-on stall characteristics are not greatly affected by flap position, except that stalling speed is reduced in proportion to flap extension.

b. Power-Off Stalls. The roll tendency is considerably less pronounced in power-off stalls, in any configuration, and is more easily prevented or corrected by adequate rudder and aileron control. The nose will generally drop straight through, with some tendency to pitch up again if recovery is not made immediately. With flaps down, there is little or no roll tendency and stalling speed is much slower than with flaps up. The stall speeds graph shows the indicated power-off stall speeds with aircraft in various configurations. Refer to Figure 8A-3. Altitude loss during a full stall may be as much as 1000 feet. Safety and recoverability are enhanced greatly by placing the **CONDITION** levers at **HIGH IDLE** before attempting the power-off stall.

c. Accelerated Stalls. The aircraft gives noticeable stall warning in the form of buffeting before the stall occurs. The stall warning and buffet can be demonstrated in turns by applying excessive back pressure on the control wheel.

8A-50. SPINS.

a. Intentional spins are prohibited. If a spin is inadvertently entered, use the following recovery procedure.

NOTE

Spin demonstrations have not been conducted. The recovery technique is based on the best available information.

b. The first three actions should be as nearly simultaneous as possible.

1. **POWER** levers – **IDLE**.
2. Apply full rudder opposite direction of spin rotation.
3. Simultaneously with rudder application, push the control wheel forward and neutralize ailerons.
4. When rotation stops, neutralize rudder.

CAUTION

Do not pull out of the resulting dive too abruptly. This could cause excessive wing loads and possibly a secondary stall.

5. Pull out of dive by exerting a smooth, steady back pressure on control wheel, avoiding an accelerated stall and excessive aircraft stresses.

8A-51. DIVING.

Maximum airspeed (red line) V_{mo}/M_{mo} is 260 KIAS or .52 Mach. Flight characteristics are conventional throughout a dive maneuver; however, caution should be used if rough air is encountered after maximum allowable dive speed has been reached. Dive recovery should be very gentle to avoid excessive aircraft stresses.

8A-52. MANEUVERING FLIGHT.

Maneuvering speed (V_a) at which full abrupt control inputs can be applied without exceeding the design load factor of the aircraft is shown in Chapter 5. There are no unusual characteristics during accelerated flight.

8A-53. FLIGHT CONTROLS.

The aircraft is stable under all normal flight conditions. Aileron, elevator, rudder, and trim tab controls function effectively throughout all normal flight conditions. Elevator control forces are relatively light in the extreme aft CG condition, progressing to moderately high with CG at the forward limit. Extending and retracting the landing gear causes only slight changes in control pressure. Control pressures resulting from changing power settings or repositioning the flaps are not excessive in the landing configuration at the most forward CG. The minimum speed at which the aircraft can be fully trimmed is 92 KIAS (gear and flaps down, propellers at high RPM). Control forces produced by changes in speed, power setting, flap position, and landing gear position are light and can be overcome with one hand on the control wheel. Trim tabs permit the pilot to reduce control forces to zero. During single-engine operation, the rudder-boost system aids in relieving the relatively high rudder pressures resulting from the large asymmetry in power.

STALL SPEEDS – POWER IDLE

NOTES:

1. MAXIMUM ALTITUDE LOSS DURING A NORMAL STALL RECOVERY IS APPROXIMATELY 1000 FEET.
2. MAXIMUM NOSE DOWN PITCH ATTITUDE AND ALTITUDE LOSS DURING RECOVERY FROM ONE ENGINE INOPERATIVE STALLS PER FAR 23.205 ARE APPROXIMATELY 20° AND 850 FEET RESPECTIVELY.
3. A NORMAL STALL RECOVERY TECHNIQUE MAY BE USED. THE BEST PROCEDURE IS A BRISK FORWARD WHEEL MOVEMENT TO A NOSE DOWN ATTITUDE. LEVEL THE AIRPLANE AFTER AIRSPEED HAS INCREASED APPROXIMATELY 25 KNOTS ABOVE STALL.

EXAMPLE:

WEIGHT........................11,700 LB

FLAPS........................APPROACH

ANGLE OF BANK...............30°

STALL SPEED..................95 KTS CAS

................90 KTS IAS

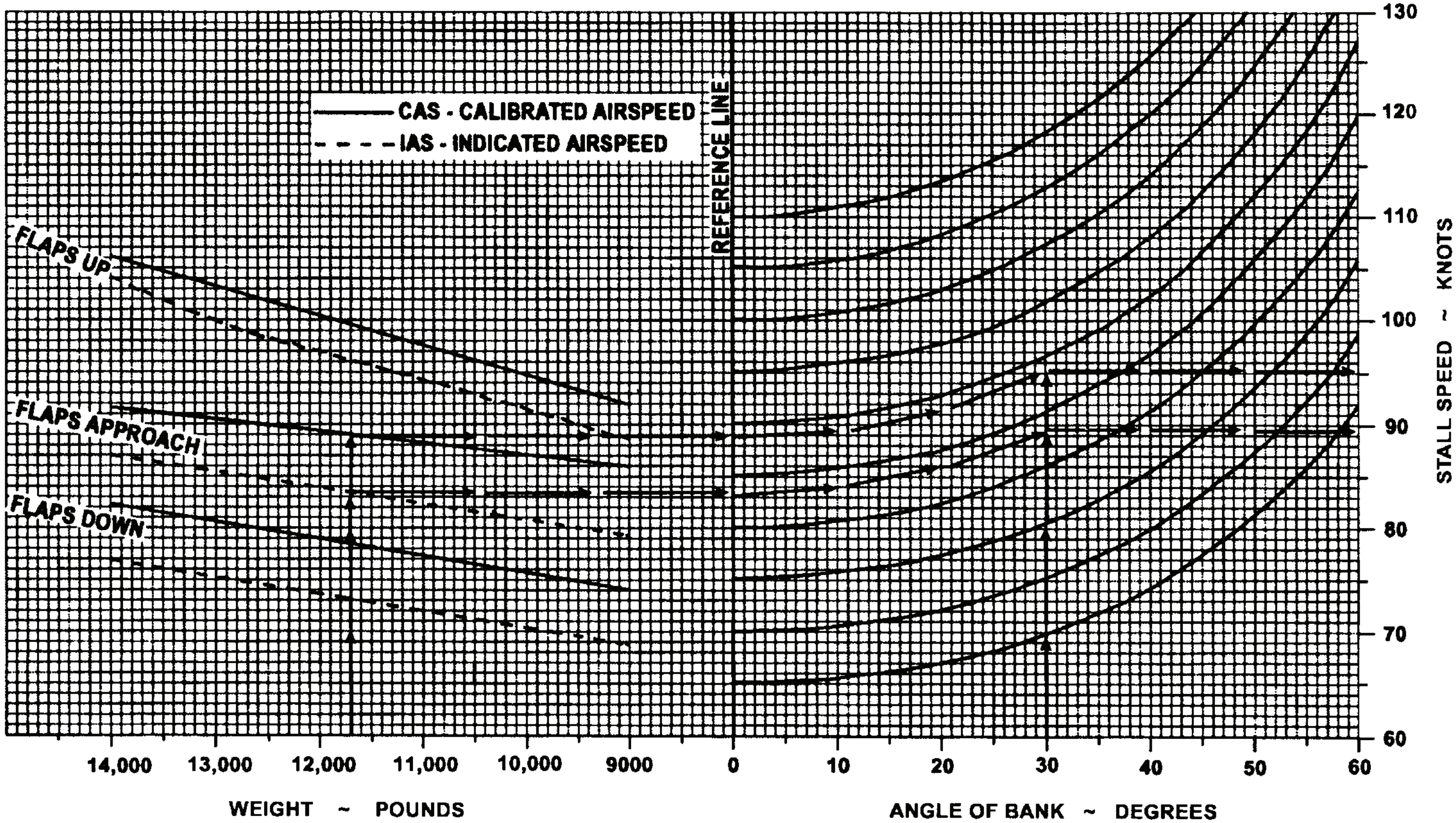


Figure 8A-3. Figure Stall Speeds – Power Idle

8A-54. LEVEL FLIGHT CHARACTERISTICS.

All flight characteristics are conventional throughout the level flight speed range.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

8A-55. INTRODUCTION.

This section is to inform the pilot of the special precautions and procedures to be followed during the various weather conditions that may be encountered in flight. This section is primarily narrative and only those checklists that cover specific procedures characteristic of weather operations are included. The Checklist in Section II provides for normal environmental operations.

The procedures defined here are supplementary procedures and are to be performed in addition to the normal procedures in Section II.

8A-56. COLD WEATHER OPERATIONS.

Operational difficulties may be encountered during extremely cold weather, unless proper steps are taken prior to or immediately after flight. All personnel should understand, and be fully aware of, the necessary procedures and precautions involved.

CAUTION

For ground operations conducive to ice accumulation on landing gear structure, use undiluted defrosting fluid on brakes and tires to reduce the tendency of ice accumulation during taxi, takeoff, and subsequent landing.

a. Preparation for Flight. Accumulations of snow, ice, or frost on aircraft surfaces will adversely affect takeoff distance, climb performance, and stall speed to a dangerous degree. Such accumulations must be removed before flight. In addition to the normal exterior checks, following the removal of ice, snow, or frost, inspect wing and empennage surfaces to verify that these surfaces remain sufficiently cleared. Also, move all control surfaces to confirm full freedom of movement. Assure that tires are not frozen to wheel chocks or to the ground. Use ground heaters, anti-ice solution, or brake deice to free frozen tires. When heat is applied to release tires, the temperature should not exceed 71 °C (160 °F). Refer to Chapter 2 for anti-icing, deicing, and defrosting treatment.

b. Engine Starting. When starting engines on ramps covered with ice, propeller levers should be in the **FEATHER** position to prevent the tires from sliding. To prevent exceeding torque limits when advancing condition levers to **HIGH IDLE** during the starting procedure, place the power lever in **BETA** and the propeller lever in **HIGH RPM** before advancing the condition lever to **HIGH IDLE**.

c. Before Taxi and Engine Runup. Before taxi and engine runup are the same as those in Section II. When the engine runup areas are slippery, the crew may not be able to safely accomplish the runup procedures without causing the aircraft to begin sliding. Under those conditions, the pilot on the controls must use his judgment to determine which runup procedures will be accomplished.

d. Taxiing. Whenever possible, taxiing in deep snow, lightweight dry snow, or slush, should be avoided, particularly in colder OAT conditions. If it is necessary to taxi through snow or slush, do not set the parking brake when stopped. If possible, do not park the aircraft in snow or slush deep enough to reach the brake assemblies. Chocks or sandbags should be used to prevent the aircraft from rolling while parked. Before attempting to taxi, activate the brake deice system, ensuring that the bleed air valves are open and that the condition levers are in **HIGH IDLE**. An outside observer should visually check wheel rotation to ensure brake assemblies have been deiced. The condition levers may be returned to **LOW IDLE** as soon as the brakes are free of ice.

e. Before Takeoff.

CAUTION

If the possibility of ice accumulation on the horizontal stabilizer or elevator exists, do not attempt takeoff.

If icing conditions are expected, activate all anti-ice systems before takeoff, allowing sufficient time for the equipment to become effective.

f. Takeoff.

NOTE

Following takeoff from runways covered with snow or slush, consideration should be given to operating the landing gear through several complete cycles, within limits, to dislodge ice accumulated from the spray of slush and water and to prevent gear freezing in the retracted position.

Takeoff procedures for cold weather operations are the same as for normal takeoff. Taking off with temperature at or below freezing, with water, slush, or snow on the runway, can cause ice to accumulate on the landing gear and can throw ice into the wheel well areas. Such takeoffs shall be made with brake deice on and with the ice vanes extended to preclude the possibility of ice build-up on engine air inlets. Monitor oil temperature to ensure operation within limits. Before flight into icing conditions, the pilot's and copilot's **WSHLD ANTI-ICE** switches should be set at **NORMAL** position.

g. During Flight.

(1) After takeoff from a runway covered with snow or slush, it may be advisable to leave brake deice on to dislodge ice accumulated from the spray of slush or water. Monitor **BRAKE DEICE ON** annunciator for automatic termination of system operation and then turn the switch off. During flight, trim tabs and controls should also be exercised periodically to prevent freezing. Ensure that anti-icing systems are activated before entering icing conditions. Do not activate the surface deice system until ice has accumulated 1/2 inch. The propeller deice system operates effectively as an anti-ice system and it may be operated continuously in flight. If propeller imbalance due to ice does occur, it may be relieved by increasing RPM briefly, then returning to desired setting.

(2) Ice vanes must be extended when operating in visible moisture or when freedom from visible moisture cannot be assured, at +5 °C OAT or less. Ice vanes are designed as an anti-ice system, not a deice system. After the engine air inlet screens are blocked, extending the ice vanes will not rectify the condition. Ice vanes should be retracted at +15 °C OAT and above to assure adequate engine oil cooling.

(3) Stalling airspeeds should be expected to increase when ice has accumulated on the aircraft causing distortion of the wing airfoil. For the same reason, stall warning devices are not accurate and should not be relied upon. Keep a comfortable margin of airspeed above the normal stall airspeed. Maintain a minimum of 140 knots during sustained icing conditions to prevent ice accumulation on unprotected surfaces of the wing. In the event of windshield icing, reduce airspeed to 226 knots or below.

h. Descent. Use normal procedures in Section II. Brake deicing should be considered if moisture was encountered during previous ground operations or in flight, in icing conditions with gear extended.

i. Landing. Landing on an icy runway should be attempted only when absolutely necessary and should not be attempted unless the wind is within 10° of runway heading. Application of brakes without skidding the tires on ice is difficult. In order not to impair pilot visibility, reverse thrust should be used with caution when landing on a runway covered with snow or standing water. Use normal procedures in Section II.

j. Engine Shutdown. Use normal procedures in Section II.

k. Before Leaving Aircraft. When the aircraft is parked outside on ice or in a fluctuating freeze/thaw temperature condition, the following procedures should be followed. After wheel chocks are in place, release the brakes to prevent freezing. Fill fuel tanks to minimize condensation, remove any accumulation of dirt and ice from the landing gear shock struts, and install protective covers to guard against possible collection of snow and ice.

8A-57. DESERT OPERATION AND HOT WEATHER OPERATION.

Dust, sand, and high temperatures encountered during desert operation can sharply reduce the operational life of the aircraft and its equipment. The abrasive qualities of dust and sand on turbine blades and other moving parts of the aircraft and the destructive effect of heat upon the aircraft instruments will necessitate hours of maintenance if basic preventive measures are not followed. In flight, the hazards of dust and sand will be difficult to escape, since dust clouds over a desert may be found at altitudes up to 10,000 feet. During hot weather operations, the principal difficulties encountered are high turbine gas temperatures (TGT/ITT) during engine starting, overheating of brakes, and longer takeoff and landing rolls due to the higher density altitudes. In areas where high humidity is encountered, electrical equipment, such as communication equipment and instruments, will be subject to malfunction by corrosion, fungi, and moisture absorption by nonmetallic materials.

a. Preparation for Flight. Check the position of the aircraft in relation to other aircraft. Propeller sand blast can damage closely parked aircraft. Check that the landing gear shock struts are free of dust and sand. Check the instrument panel and general interior for dust and sand accumulation. Open main entrance door and cockpit vent storm windows to ventilate the aircraft.

CAUTION

N_1 speeds of 70% or higher may be required to keep oil temperatures within limits.

b. Engine Starting. Use normal procedures in Section II. Engine starting under conditions of high ambient temperatures may produce a higher than normal ITT/TGT during the start. The ITT/TGT should be closely monitored when the condition lever is moved to the **LOW IDLE** position. If over temperature tendencies are encountered, the condition lever should be moved to **IDLE CUTOFF** position periodically during acceleration of gas generator RPM (N_1). Be prepared to abort the start before temperature limitations are exceeded.

c. Before Taxi and Engine Runup. Use normal procedures in Section II. To minimize the possibility of damage to the engines during dusty/sandy conditions, activate ice vanes. When the engine runup areas are slippery, the crew may not be able to safely accomplish the runup procedures without causing the aircraft to begin sliding. Under those conditions, the pilot on the controls must use his judgment to determine which runup procedures will be accomplished.

d. Taxiing. Use normal procedures in Section II. When practical, avoid taxiing over sandy terrain to minimize propeller damage and engine deterioration that results from impingement of sand and gravel. During hot weather operation, use minimum braking action to prevent brake overheating.

e. Takeoff. Use normal procedures in Section II. Avoid taking off in the wake of another aircraft if the runway surface is sandy or dusty.

f. During Flight. Use normal procedures in Section II.

g. Descent. Use normal procedures in Section II.

h. Landing. Use normal procedures in Section II.

i. Engine Shutdown. Use normal procedures in Section II.

CAUTION

During hot weather, if fuel tanks are completely filled, fuel expansion may cause overflow, thereby creating a fire hazard.

j. Before Leaving Aircraft. Use normal procedures in Section II. Take extreme care to prevent sand or dust from entering the fuel and oil system during servicing. During hot weather, release the brakes immediately after installing wheel chocks to prevent brake disc warpage.

8A-58. TURBULENCE AND THUNDERSTORM OPERATION.

CAUTION

Due to the comparatively light wing loading, control in severe turbulence and thunderstorms is critical. Since turbulence imposes heavy loads on the aircraft structure, make all necessary changes in aircraft attitude with the least amount of control pressures to avoid excessive loads on the aircraft structure.

Thunderstorms and areas of severe turbulence should be avoided. If such areas are to be penetrated, it will be necessary to counter rapid changes in attitude and accept major indicated altitude variations. Penetration should be at an altitude that provides adequate maneuvering margins as a loss or gain of several thousand feet of altitude may be expected. The recommended penetration speed in severe turbulence is 170 KIAS. Pitch attitude and constant power settings are vital to proper flight technique. Establish recommended penetration speed and proper attitude prior to entering turbulent air to minimize most difficulties. False indications by the pressure instruments due to barometric pressure variations within the storm make the instruments unreliable. Maintaining a pre-established attitude will result in a fairly constant airspeed. Turn cockpit and cabin lights on to minimize the blinding effects of lightning and do not use autopilot altitude hold. Maintain constant power settings and pitch attitude regardless of airspeed or altitude indications. Concentrate on maintaining a level attitude by reference to the FD/attitude indicator. Maintain original heading and don't make ant turns, unless absolutely necessary.

8A-59. ICE AND RAIN (TYPICAL).

WARNING

While in icing conditions, if there is an unexplained 30% increase of torque needed to maintain airspeed in level flight, a cumulative total of 2 or more inches of ice accumulation on the wing, an unexplained decrease of 15 KIAS, or an unexplained deviation between pilot's and copilot's airspeed indicators, the icing environment should be exited as soon as practicable. Ice accumulation on the pitot tube assemblies could cause a complete loss of airspeed indication.

a. The following conditions indicate a possible accumulation of ice on the pitot tube assemblies and unprotected aircraft surfaces. If any of the following conditions are observed, the icing environment should be exited as soon as practicable.

1. Total ice accumulation of 2 inches or more on the wing surfaces. Determination of ice thickness can be accomplished by summing the estimated ice thickness on the wing prior to each pneumatic boot deice cycle (e.g., four cycles of minimum recommended 1/2 inch accumulation).

2. A 30% increase in torque per engine required to maintain desired airspeed in level flight, not to exceed 85% torque, when operating at recommended holding/loiter speed.

3. A decrease in indicated airspeed of 15 knots after entering the icing condition (not slower than 1.4 power off stall speed) if maintaining original power setting in level flight. This can be determined by comparing pre-icing condition entry speed to the indicated speed after a surface-deice cycle is completed.

4. Any variations from normal indicated airspeed between the pilot's and copilot's airspeed indicators.

b. Typical Icing. Icing occurs because of super-cooled water vapor such as fog, clouds, or rain. The most severe icing occurs on aircraft surfaces in visible moisture or precipitation with a true outside air temperature between -5 °C and +1 °C; however, under some circumstances, dangerous icing conditions may be encountered with temperatures below –10 °C. The surface of the aircraft must be at a temperature of freezing or below for ice to stick. If severe icing conditions are encountered, ascend or descend to altitudes where these conditions do not prevail. If flight into icing conditions is unavoidable, proper use of aircraft anti-icing and deicing systems may minimize the problems encountered. Approximately 15 minutes prior to flight into temperature conditions that could produce frost or icing conditions, the pilot's and copilot's windshield anti-ice switches should be set at **NORMAL** or **HIGH** temperature position (after preheating) as necessary to eliminate windshield ice. Stalling airspeeds should be expected to increase when ice has accumulated on the aircraft causing distortion of the wing airfoil. For the same reason, stall-warning devices are not accurate and should not be relied upon. Keep a comfortable margin of airspeed above the normal stall airspeed with ice on the aircraft. Maintain a minimum of 140 knots during sustained icing conditions to prevent ice accumulation on unprotected surfaces of the wing. In the event of windshield icing, reduce airspeed to 226 knots or below.

c. Rain. Rain presents no particular problems other than slippery runways, restricted visibility, and occasional incorrect airspeed indications.

d. Taxiing. Extreme care must be exercised when taxiing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

e. Takeoff. Extreme care must be exercised during takeoff from ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

f. Climb. Keep aircraft attitude as flat as possible and climb with higher airspeed than usual, so that the lower surfaces of the aircraft will not be iced by flight at a high angle of attack.

g. Cruise Flight. Prevention of ice formation is far more effective and satisfactory than attempts to dislodge the ice after it has formed. If icing conditions are inadvertently encountered, turn on the anti-icing systems prior to the first sign of ice formation. Do not operate deicer boots continuously. Allow at least 1/2-inch of ice on the wing deicer boots before activating the deicer boots. Continued flight in severe icing conditions should not be attempted. If ice forms on the wing area aft of the deicer boots, climb or descend to an altitude where conditions are less severe.

h. Landing. Extreme care must be exercised when landing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid. Ice accumulation on the aircraft will result in higher stalling airspeeds due to the change in aerodynamic characteristics and increased weight of the aircraft due to ice buildup. Approach and landing airspeeds must be increased accordingly.

8A-60. ICING (SEVERE).

a. The following weather conditions may be conducive to severe in-flight icing.

1. Visible rain at temperatures below 0 °C ambient air temperature.

2. Droplets that splash or splatter on impact at temperatures below 0 °C ambient air temperature.

b. The following procedures for exiting a severe icing environment are applicable to all flight phases from takeoff to landing.

1. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as –18 °C, increased vigilance is warranted at temperatures around freezing with visible moisture present.

2. Upon observing the visual cues specified in the limitations section of this manual for the identification of severe icing conditions, proceed as follows.

   a. Immediately request priority handling from air traffic control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the aircraft has been certified.

   b. Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.

   c. Do not engage the autopilot.

   d. If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.

   e. If an unusual roll response or uncommanded roll control movement is observed reduce the angle-of-attack.

   f. Do not extend flaps during extended operation in icing conditions. Operations with flaps extended can result in a reduced angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.

   g. If the flaps are extended, do not retract them until the airframe is clear of ice.

   h. Report these weather conditions to air traffic control.

Section VI. CREW DUTIES

★ 8A-61. CREW/PASSENGER BRIEFING.

The following guide should be used in accomplishing the required passenger briefings. Items that do not pertain to a specific mission may be omitted.

1. Crew introduction.

2. Equipment.

   a. Personnel to include ID tags.

   b. Professional (medical equipment, etc.).

   c. Survival.

3. Flight data.

   a. Route.

   b. Altitude.

   c. Time en route.

   d. Weather.

4. Normal procedures.

   a. Entry and exit of aircraft.

   b. Seating and seat position.

   c. Seat belts.

   d. Movement in aircraft.

   e. Internal communications.

   f. Security of equipment.

g. Smoking.

h. Oxygen.

i. Refueling.

j. Weapons and prohibited items.

k. Protective masks.

l. Toilet.

5. Emergency procedures.

a. Emergency exits.

b. Emergency equipment.

c. Emergency landing / ditching procedures.

★ 8A-62. DEPARTURE BRIEFING.

The following is a guide that should be used, as applicable, in accomplishing the required crew briefing prior to takeoff. However, if the crew has operated together previously (through flight) and the pilot is certain that the copilot understands all items of the briefing, the pilot may omit the briefing by stating “Standard briefing” when the briefing is called for during the Before Takeoff check.

1. ATC clearance – Review.

a. Routing.

b. Initial altitude.

2. Departure procedure – Review.

a. Named departure procedure.

b. Obstacle clearance departure procedure/noise abatement procedure.

c. VFR departure route.

3. Copilot's duties – Review.

a. Adjust takeoff power.

b. Monitor engine instruments.

c. Power check at 65 knots.

d. Call out engine malfunctions.

e. Tune/identify all nav/comm radios.

f. Make all radio calls.

g. Adjust transponder and radar as required.

h. Complete flight log during flight and note altitudes and headings.

i. Note departure time.

j. Retract gear and flaps as directed.

4. TOLD Card – Review.

a. Takeoff power.

b. V_1/V_r.

c. V_2 + 10 KIAS (climb to 1500 feet AGL).

d. V_2/V_{yse}.

★ 8A-63. ARRIVAL BRIEFING.

The following is a guide that should be used, as applicable, in accomplishing the required crew briefing prior to landing. However, if the crew has operated together previously (through flight) and the pilot is certain that the copilot understands all items of the briefing, the pilot may omit the briefing by stating “Standard briefing” when the briefing is called for during the Descent-Arrival check.

1. Weather/altimeter setting.

2. Airfield/facilities – Review.

a. Field elevation.

b. Runway length.

c. Runway condition.

3. Approach procedure – Review.

a. Approach plan/profile.

b. Altitude restrictions/VDP.

c. Missed approach.

1 Point.

2 Time.

3 Intentions.

d. Decision height or minimum descent altitude.

e. Lost communications.

4. Backup approach/frequencies.

5. Copilot's duties – Review.

a. Nav/comm set-up.

b. Monitor altitude and airspeeds.

c. Monitor approach.

d. Call out visual/field in sight.

6. Landing performance data – Review.

a. Approach speed.

b. Runway required.

7. Passenger briefing – As required.

CHAPTER 9

EMERGENCY PROCEDURES

Section I. AIRCRAFT SYSTEMS

9-1. AIRCRAFT SYSTEMS.

This section describes the aircraft's systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is in the Operator's and Crew member's Checklist, TM 1-1510-218-CL. Emergency operations of avionics equipment are covered when appropriate in Chapter 3, Avionics, and are repeated in this section only as safety of flight is affected.

9-2. IMMEDIATE ACTION EMERGENCY CHECKS.

Immediate action emergency items are underlined for your reference and shall be committed to memory. During an emergency, the checklist will be called for to verify the memory steps performed and to assist in completing any additional emergency procedures.

NOTE

The urgency of certain emergencies requires immediate action by the pilot. The most important single consideration is aircraft control. All procedures are subordinate to this requirement. Reset MASTER CAUTION after each malfunction to allow systems to respond to subsequent malfunctions.

9-3. DEFINITION OF LANDING TERMS.

The term, "Land as soon as possible" is defined as landing at the nearest suitable landing area (e.g., open field) without delay. The primary consideration is to ensure the survival of the occupants.

The term, "Land as soon as practicable" is defined as landing at the nearest suitable airfield. The primary consideration is the urgency of the emergency.

9-4. AFTER EMERGENCY ACTION.

After a malfunction has occurred, appropriate emergency actions have been taken, and the aircraft is on the ground, an entry shall be made in the remarks section of DA Form 2408-13-1 describing the malfunction.

9-5. EMERGENCY EXITS AND EQUIPMENT.

Emergency exits and equipment are shown in Figure 9-1.

9-6. EMERGENCY ENTRANCE.

Entry may be made through the cabin emergency hatch. The hatch may be released by pulling on its flush-mounted, pull out handle, placarded **EMERGENCY EXIT PULL HANDLE TO RELEASE**. The hatch is of the non-hinged plug type that removes completely from the frame when the latches are released. After the latches are released, the hatch may be pushed into the aircraft.

9-7. ENGINE MALFUNCTION.

a. Flight Characteristics Under Partial Power Conditions. There are no unusual flight characteristics during single-engine operation as long as airspeed is maintained at or above minimum control speed (V_{mc}) and power-off stall speeds. The capability of the aircraft to climb or maintain level flight depends on configuration, gross weight, altitude, and free air temperature. Performance and control will improve by feathering the propeller of the inoperative engine, retracting the landing gear and flaps, and establishing the appropriate single-engine best rate-of-climb speed (V_2/V_{yse}). Minimum control speed (V_{mc}) with flaps retracted is approximately 1 knot higher than with flaps at takeoff (40%) position.

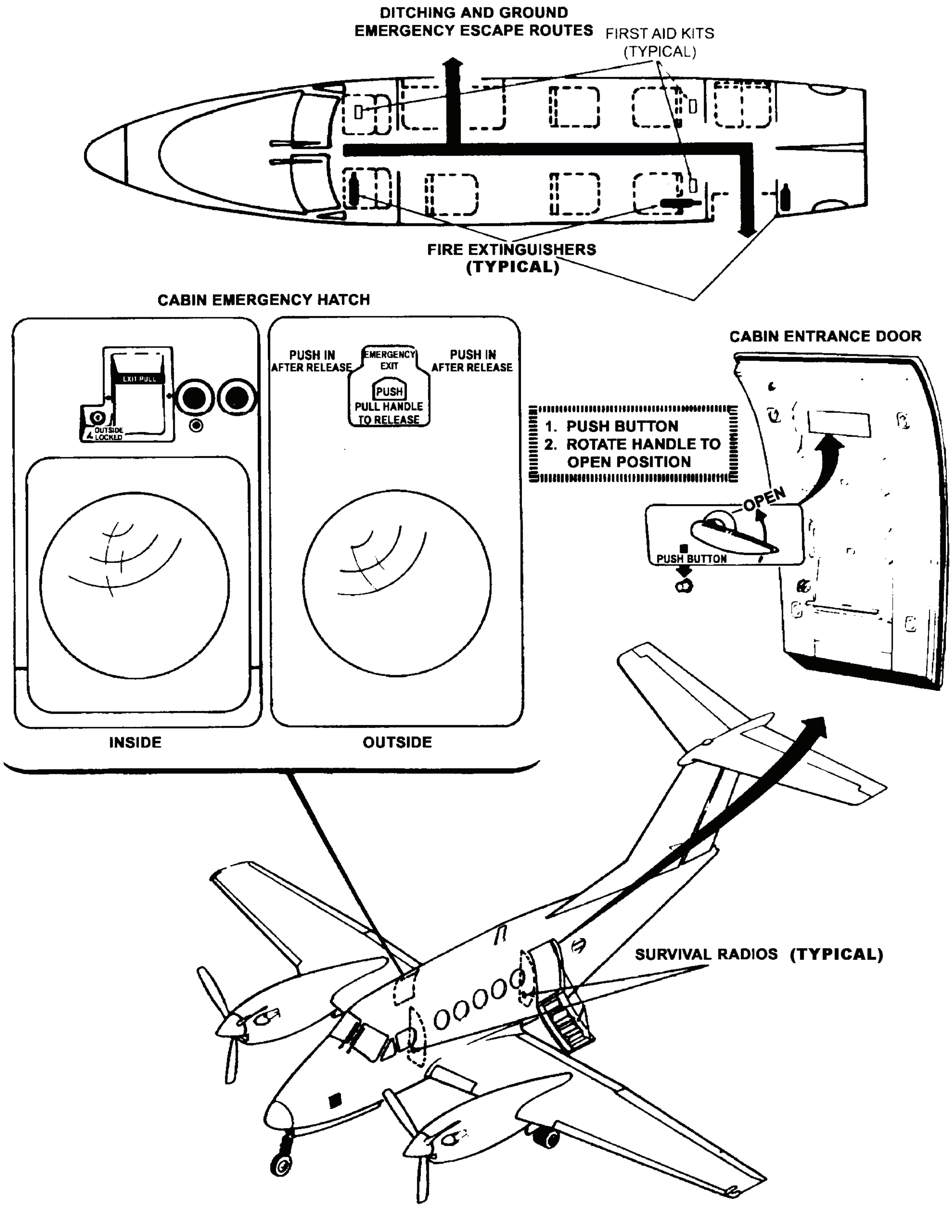


Figure 9-1. Emergency Exits and Equipment

b. Engine Malfunction During and After Takeoff. The action to be taken in the event of an engine malfunction during takeoff depends upon whether or not decision speed (V_1) has been attained. If an engine fails immediately after V_1, the takeoff will be continued single-engine. The PNF may feather the propeller on the failed engine as directed by the PF.

c. Engine Malfunction Before V_1 (Abort). If an engine fails and the aircraft has not accelerated to recommended decision speed (V_1), retard **POWER** levers immediately to **IDLE** and stop the aircraft with brakes and if necessary reverse thrust. Perform the following:

1. **POWER** levers – **IDLE**.
2. Braking – As required.

d. Engine Malfunction after V_1.

1. **GEAR** (positive climb) **– UP**.
2. **POWER –** As required.
3. **FLAPS** (105 KIAS) – **UP**.

IF THE PROP DID NOT FEATHER, PERFORM STEP 4**.** May be accomplished by the PNF as directed by the PF.

4. **PROP** (dead engine) – **FEATHER**.

ONCE THE PROP IS FEATHERED, PERFORM STEPS 5 THROUGH 8.

O 5. **TCAS** – Set **TA**.
6. **LANDING/TAXI LIGHTS – OFF**.
7. **BRAKE DEICE – OFF**.
8. Engine cleanup – Perform.

NOTE

Holding 3° to 5° bank (1/4 to 1/2 ball width) toward the operating engine will assist in maintaining directional control and improving aircraft performance.

e. Engine Malfunction During Flight. If an engine malfunctions during flight, maintain control of the aircraft while maintaining heading or turn as required. Add power as required to keep airspeed from decaying excessively and to maintain altitude. Identify the failed engine by feel (when holding rudder pressure to keep the aircraft from yawing, the rudder being pressed indicates the good engine) and engine instruments and, after confirming the failed engine, retard the propeller lever to feather the propeller. Refer to Chapter 7 for single-engine cruise information. If one engine malfunctions during flight, perform the following procedure.

1. Autopilot/yaw damp – Disengage.
2. **POWER** – As required.
3. Dead engine – Identify.
4. **PROP** lever (dead engine) – **FEATHER**.
5. **GEAR** – As required.
6. **FLAPS** – As required.

O 7. **TCAS** – Set **TA**.
8. Power – Set as required.
9. Engine cleanup – Perform.

NOTE

At V_2/V_{yse} speeds, holding 3° to 5° bank (1/2 ball width) towards the operating engine will assist in maintaining directional control, establishing zero-sideslip, and improving aircraft performance.

f. Engine Malfunction During Final Approach. If an engine malfunctions during final approach, the propeller should not be feathered unless time, distance, and altitude permit or conditions require it. If time, distance, and altitude are sufficient, perform the Engine Malfunction During Flight Procedure. Otherwise continue approach using the following procedure.

1. **POWER** – As required.
2. **GEAR** – **DN**.

g. Engine Malfunction (Second Engine). If the second engine fails, do not feather the propeller if an engine restart not using the starter is to be attempted. Engine restart without starter assist cannot be accomplished with a feathered propeller and the propeller will not unfeather without the engine operating. 140 KIAS is recommended as the best all around glide speed (considering engine restart, distance covered, transition to landing configuration, etc.), although it does not necessarily result in the minimum rate of descent. Perform the following procedure if the second engine fails during flight.

1. Airspeed – As required.
2. **PROP** lever – As required.

9-8. ENGINE SHUTDOWN IN FLIGHT.

1. **POWER** lever – **IDLE**.
2. **PROP** lever – **FEATHER**.
3. **CONDITION** lever – **FUEL CUTOFF**.
4. Engine cleanup – Perform.

9-9. ENGINE CLEANUP.

The engine cleanup procedure is to be used after engine malfunction, shutdown, or an unsuccessful restart.

1. **CONDITION** lever – **FUEL CUTOFF**.
2. **ENG AUTO IGN** – **OFF**.
3. **AUTOFEATHER** switch – **OFF**.
4. **GEN** switch – **OFF**.
5. **PROP SYNC** switch – **OFF**.
6. **ICE VANE** (failed engine) – **EXTEND**.

9-10. ENGINE RESTART DURING FLIGHT (USING STARTER) N_1 GREATER THAN ZERO.

CAUTION

The pilot should determine the reason for engine failure before attempting an engine restart during flight. Do not attempt an engine restart if N_1 indicates zero.

Engine restarts may be attempted at all altitudes. If a restart is attempted, perform the following:

1. **CABIN AIR/TEMP MODE** switch – **OFF**.
2. Electrical load – Reduce to minimum.
3. **FIRE PULL** handle – In.
4. **POWER** lever – **IDLE**.
5. **PROP** lever – **FEATHER**.
6. **CONDITION** lever – **FUEL CUTOFF**.
7. **TGT** (operating engine) – 700 ºC or less.
8. Engine – Start.
   a. **IGNITION AND ENGINE START** switch – **ON**.
   b. **CONDITION** lever – **LOW IDLE**.

   NOTE

   If a rise in TGT does not occur within 10 seconds after moving the CONDITION lever to LOW IDLE, abort the start.

   c. **TGT** – 1000 °C, 5 seconds maximum.

   NOTE

   If N_1 is below 12%, starting temperatures tend to be higher than normal. To preclude overtemperature (1000 °C or above) during engine acceleration to idle speed, periodically move the CONDITION lever into FUEL CUTOFF position, as necessary.

   d. Oil pressure – Check.
   e. **IGNITION AND ENGINE START** switch – **OFF** at 50% N_1.
9. **GEN** switch – **RESET**, then **ON**.
10. Engine cleanup – Perform if engine restart is unsuccessful.
11. **CABIN AIR/TEMP MODE** switch – As required.
12. Electrical equipment – As required.
13. **ENG AUTO IGN** switch – **ARM**.
14. **PROP SYNC** switch – As required.
15. **POWER** – As required.

9-11. ENGINE RESTART DURING FLIGHT (NOT USING STARTER).

A restart without starter assist may be accomplished provided airspeed is at or above 140 KIAS, altitude is below 20,000 feet, and the propeller is not feathered. If altitude permits, diving the aircraft will increase N_1 and assist in restart.

1. **CABIN AIR/TEMP MODE** switch – **OFF**.

2. Electrical load – Reduce to minimum.

3. **GEN** switch (affected engine) – **OFF**.

4. **FIRE PULL** handle – In.

5. **POWER** lever – **IDLE**.

6. **PROP** lever – **HIGH RPM**.

7. **CONDITION** lever – **FUEL CUTOFF**.

8. Airspeed – 140 KIAS minimum.

9. Altitude – Below 20,000 feet.

10. **ENG AUTO IGN** switch – **ARM**.

11. **CONDITION** lever – **LOW IDLE**.

NOTE

If a rise in TGT does not occur within 10 seconds after moving the CONDITION lever to LOW IDLE, abort the start.

12. **TGT** – 1000 ° 5 seconds maximum.

13. Oil pressure – Check.

14. **GEN** switch – **RESET**, then **ON**.

15. Engine cleanup – Perform if engine restart is unsuccessful.

16. **CABIN AIR/TEMP MODE** switch – As required.

17. Electrical equipment – As required.

18. Propellers – Synchronized.

19. **POWER** – As required.

NOTE

When N_1 is below 12%, starting temperatures tend to be higher than normal. To preclude overtemperature (1000 °C or above) during engine acceleration to idle speed, periodically move the condition lever into the FUEL CUTOFF position, as necessary.

9-12. MAXIMUM GLIDE.

In the event of failure of both engines, maximum gliding distance can be obtained by feathering both propellers to reduce propeller drag and by maintaining the appropriate airspeed with the gear and flaps up. Figure 9-2 gives the approximate gliding distances in relation to altitude.

9-13. LANDING WITH TWO ENGINES INOPERATIVE.

Maintain best glide speed, Figure 9-2. If sufficient altitude remains after reaching a suitable landing area, a circular pattern will provide best observation of surface conditions, wind velocity, and direction. When the condition of the terrain has been noted and the landing area selected, set up a rectangular pattern. Extending **APPROACH** flaps and landing gear early in the pattern will give an indication of glide performance sooner and will allow more time to make adjustments for the added drag. Fly the base leg as necessary to control point of touchdown. Plan to overshoot rather than undershoot, then use flaps as necessary to arrive at the selected landing point. Keep in mind that, with both propellers feathered the normal tendency is to overshoot due to less drag. In the event a positive gear down indication cannot be determined, prepare for a gear-up landing; also, unless the surface of the landing area is hard and smooth, the landing should be made with the landing gear up. If landing on a rough terrain, land in a slightly tail-low attitude to keep nacelles from possibly digging in.

9-14. LOW OIL PRESSURE.

In the event of a low oil pressure indication, perform procedures as applicable.

1. Torque – 49% maximum. Oil pressure less than 105 psi below 21,000 feet or 85 psi 21,000 feet and above.

2. Oil pressure below 60 psi. Perform engine shutdown or land as soon as practicable using minimum power to ensure safe arrival.

9-15. CHIP DETECTOR WARNING LIGHT ILLUMINATED.

If a **CHIP DET** warning light illuminates and safe single-engine flight can be maintained, perform engine shutdown.

MAXIMUM GLIDE DISTANCE

C-12
PT6A

ASSOCIATE CONDITIONS:
1. POWER OFF (PROPELLERS FEATHERED).
2. GEAR AND FLAPS UP.
3. ZERO WIND, STANDARD DAY.
4. AIRSPEED AND WEIGHT COMBINATIONS SHOWN PRODUCE MAXIMUM GLIDE DISTANCE.

WEIGHT – LBS	BEST GLIDE SPEED - KIAS
12,500	124
11,000	119
10,000	112
9000	105

EXAMPLE

WANTED
MAXIMUM GLIDE DISTANCE

KNOWN
HEIGHT ABOVE TERRAIN = 7500FT.

METHOD
ENTER HEIGHT ABOVE TERRAIN HERE.
MOVE RIGHT TO REFERENCE LINE.
MOVE DOWN, READ MAXIMUM GLIDE DISTANCE = 18 NM.

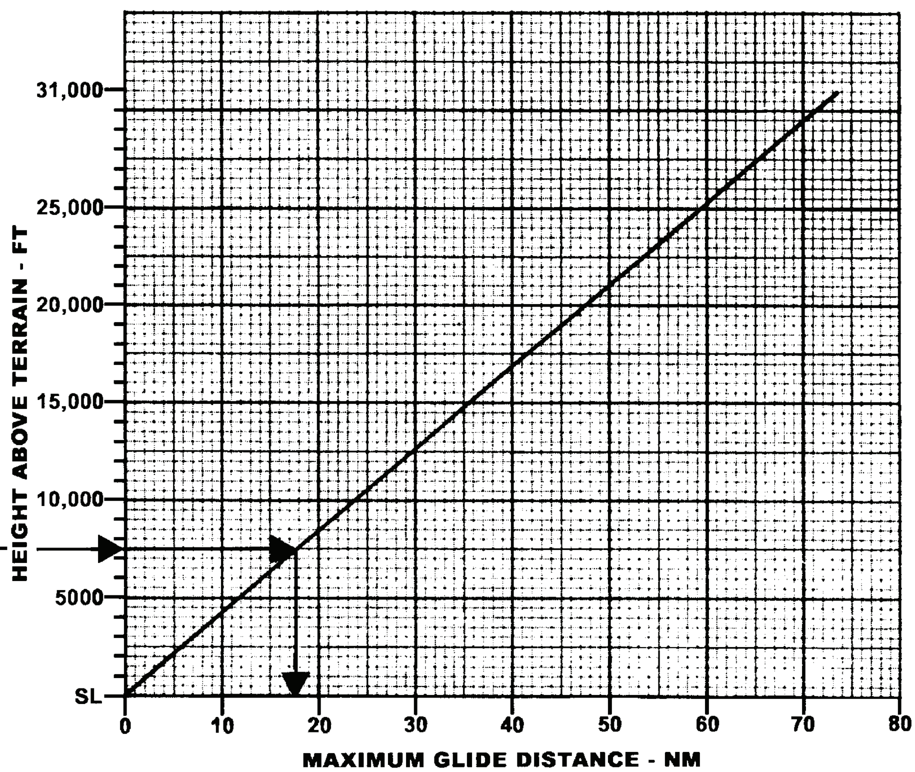


Figure 9-2. Maximum Glide Distance

9-16. DUCT OVERTEMP CAUTION LIGHT ILLUMINATED.

Ensure the cabin floor outlets are open and unobstructed and perform the following steps in sequence until the light is extinguished. Allow approximately 30 seconds after each adjustment for the system temperature to stabilize. The over temperature condition is considered corrected at any point during the procedure that the light goes out.

1. **CABIN AIR** control – In.
2. **CABIN AIR/TEMP MODE** switch – **AUTO**.
3. **CABIN AIR/TEMP** switch – Decrease.
4. **VENT BLOWER** switch – **HI**.
5. **CABIN AIR/TEMP MODE** switch – **MAN COOL**.
6. **MANUAL TEMP** switch – **DECREASE** (hold).
7. **LEFT BLEED AIR VALVE** switch – **PNEU & ENVIRO OFF**.
8. Light still illuminated (30 seconds) **LEFT BLEED AIR VALVE** switch – **OPEN**.
9. **RIGHT BLEED AIR VALVE** switch – **PNEU & ENVIRO OFF**.
10. Light still illuminated (30 seconds) **RIGHT BLEED AIR VALVE** switch – **OPEN**.

NOTE

If the over temperature light has not extinguished after completing the above procedure, the warning system has malfunctioned.

9-17. ICE VANE FAILURE.

Ice vane failure is indicated by a **VANE FAIL** caution light illumination. If an ice vane fails to operate electrically, perform the following:

CAUTION

Do not operate vanes electrically after manual extension.

1. Airspeed – 160 KIAS or below.
2. **ICE VANE CONTR** circuit breaker – Pull.
3. **ICE VANE** – Operate manually.
4. Airspeed – Resume normal airspeed.

9-18. ENGINE BLEED AIR SYSTEM MALFUNCTION.

a. BLEED AIR FAILURE Light Illuminated. Steady illumination of the warning light in flight indicates a possible ruptured bleed-air line aft of the engine firewall. The light will remain illuminated for the remainder of flight. Perform the following:

NOTE

BLEED AIR FAIL annunciators may momentarily illuminate during simultaneous surface deice and brake deice operation at low N_1 speed.

1. **BRAKE DEICE** switch – Off.
2. **TGT** and **TORQUE** – Monitor (note readings).
3. **BLEED AIR VALVE** switch – **OFF**.

NOTE

Brake deice, on the affected side, and rudder boost will not be available with BLEED AIR VALVE switch off.

4. Cabin pressurization – Check.

b. Excessive Differential Pressure. If cabin differential pressure exceeds 6.1 psi **C D T1** and 6.5 psi **T2**, perform the following procedure:

1. Cabin pressurization controller – Select higher setting.

IF CONDITION PERSISTS:

2. Oxygen (crew and passengers) – As required.
3. **LEFT BLEED AIR VALVE** switch – **ENVIRO OFF** (light illuminated).

IF CONDITION STILL PERSISTS:

4. **RIGHT BLEED AIR VALVE** switch – **ENVIRO OFF** (light illuminated).
5. Descend – As required.

IF CONDITION STILL PERSISTS:

6. Oxygen masks – **100%** and on.

7. **CABIN PRESS** switch – **DUMP**.

8. **BLEED AIR VALVE** switches – **OPEN** (if cabin heating is required).

9-19. LOSS OF PRESSURIZATION (ABOVE 10,000 FEET).

If cabin pressurization is lost when operating above 10,000 feet or the **ALTITUDE** warning light illuminates, perform the following:

1. Crew oxygen masks – **100%** and on.

2. Passenger oxygen – **ON** and checked to ensure all passengers have oxygen masks on and are receiving supplemental oxygen if required.

9-20. CABIN DOOR CAUTION LIGHT ILLUMINATED.

Remain clear of cabin door and perform the following procedure.

1. **CABIN SIGNS** switch – **BOTH**.

2. **BLEED AIR VALVE** switches – **ENVIRO OFF**.

3. Descend below 14,000 feet as soon as practicable.

4. Oxygen – As required.

9-21. SINGLE-ENGINE DESCENT/ARRIVAL.

NOTE

Approximately 85% N_1 is required to maintain pressurization schedule.

Perform the following procedure prior to the final descent for landing.

1. **CABIN CONTROLLER** – Set.

2. **CABIN SIGNS** switch – As required.

3. **ICE & RAIN** switches – As required.

4. Altimeters – Set.

5. **RECOG/BEACON/NAV** lights – **ON**.

★ 6. Arrival briefing – Complete. Refer to Chapter 8, Paragraph 8-68.

9-22. SINGLE-ENGINE BEFORE LANDING.

1. **CABIN SIGNS** switch – **BOTH**.

2. **BRAKE DEICE** – Off.

3. **PROP** lever – As required.

NOTE

During approach, propeller should be set at 2000 RPM to prevent glideslope interference (ILS approach), provide better power response during approach, and minimize attitude change when advancing propeller levers for landing.

4. **FLAPS** (Below 199 KIAS) – **APPROACH**.

5. **GEAR** (Below 181 KIAS)– **DN**.

6. **LANDING/TAXI LIGHTS** – As required.

7. **CONDITION LEVER** (Operating Engine) – **HIGH IDLE**.

9-23. SINGLE-ENGINE LANDING CHECK.

Perform the following procedure during final approach to runway.

1. **AP/YD** – Disengaged.

2. **GEAR DOWN** lights – Check.

3. **PROP** lever (live engine) – **HIGH RPM**.

NOTE

To ensure constant reversing characteristics, the propeller control must be in the HIGH RPM position.

9-24. SINGLE-ENGINE GO-AROUND.

The decision to go around must be made as early as possible. Elevator forces at the start of a go around are very high and a considerable amount of rudder control will also be required at low airspeeds. Re-trim as required. If rudder application is insufficient or applied too slowly, directional control cannot be maintained. If control difficulties are experienced, reduce power on the operating engine immediately. Ensure that the aircraft will not touch the ground before retracting the landing gear. Retract the flaps only as safe airspeed permits (**TAKEOFF** position until

105 KIAS) then **UP**. Perform single-engine go-around as follows:

NOTE

Once flaps are fully extended, a single-engine go-around may not be possible when close to ground under conditions of high gross weights and/or high-density altitude.

1. **POWER** – As required.
2. **FLAPS –** Retract to **APPROACH**.
3. **GEAR** (Positive climb) – **UP**.
4. **FLAPS** (105 KIAS) – **UP**.
5. **LANDING/TAXI LIGHTS** – **OFF**.
6. Climb power – Set.
7. **YD** – As required.

9-25. PROPELLER FAILURE (OVER 2120 RPM).

If an overspeed condition occurs that cannot be controlled with the propeller lever or by reducing power, perform the following procedure.

1. **POWER** lever (affected engine) – **IDLE**.
2. **PROP** lever – **FEATHER**.
3. **CONDITION** lever – As required.
4. Engine cleanup – As required.

9-26. FIRE.

The safety of aircraft occupants is the primary consideration when a fire occurs; therefore, it is imperative that every effort be made by the flight crew to put the fire out. On the ground, it is essential that the engines be shut down, crew and passengers evacuated, and fire fighting begun immediately. If the aircraft is airborne when a fire occurs, the most important single action that can be taken by the pilot is to land safely as soon as possible.

a. Engine Fire. The following procedures shall be taken in case of an engine fire:

(1) Engine/Nacelle Fire During Start or Ground Operations. If engine/nacelle fire is identified during start or ground operation, perform the following procedure.

1. **PROP** levers – **FEATHER**.
2. **CONDITION** levers – **FUEL CUTOFF**.
3. **FIRE PULL** handle – Pull.

CAUTION

If fire extinguisher has been used to extinguish an engine fire, do not attempt to restart until maintenance personnel have inspected the aircraft and released it for flight.

4. **PUSH TO EXTINGUISH** switch – Push.
5. **MASTER SWITCH** – **OFF**.

(2) Engine Fire in Flight (Identified). If an engine fire is confirmed in flight, perform the following procedure.

CAUTION

Due to the possibilities of fire warning system malfunctions, the fire should be visually identified before the engine is secured and the extinguisher actuated.

1. **POWER** lever – **IDLE**.
2. **PROP** lever – **FEATHER**.
3. **CONDITION** lever – **FUEL CUTOFF**.
4. **FIRE PULL** handle – Pull.
5. Fire extinguisher – Actuate as required.
6. Engine cleanup – Perform.

b. Fuselage Fire. If a fuselage fire occurs, perform the following:

WARNING

The extinguisher agent (Bromochloro-difluoromethane) in the fire extinguisher can produce toxic effects if inhaled.

1. Fight the fire.
2. Land as soon as possible if fire continues.

c. Wing Fire. There is little that can be done to control a wing fire, except to shut off fuel and electrical systems that may be contributing to the fire or that could aggravate it. Diving and slipping the aircraft away from the burning wing may help. If a wing fire occurs, perform the following:

1. Perform engine shutdown on affected side.
2. Land as soon as possible if fire continues.

d. Electrical Fire. Upon noting the existence or indications of an electrical fire, turn off all affected electrical circuits, if known. If electrical fire source is unknown, perform the following procedure.

1. Crew oxygen masks – As required.
2. Passenger oxygen – As required.
3. **MASTER SWITCH** – **OFF**. (Visual conditions only).
4. All nonessential electrical equipment – **OFF**.

NOTE

With the loss of dc electrical power, the aircraft will depressurize. All electrical instruments, with the exception of the Prop RPM, N_1 RPM, and TGT gauges, will be inoperative.

5. **BATT** switch – **ON**.
6. Generator switches (individually) – **RESET**, then **ON**.
7. Circuit breakers – Check for indication of defective circuit.

CAUTION

As each electrical switch is returned to ON, note load meter reading and check for evidence of fire.

8. Essential electrical equipment – **ON** (individually until fire source is isolated).
9. Land as soon as practicable.

e. Smoke and Fume Elimination.

1. Crew oxygen masks – **100%** and on.
2. Passenger oxygen – **ON**.
3. **BLEED AIR VALVE** switches – **ENVIRO OFF**.
4. **VENT BLOWER** switch – **AUTO**.
5. **AFT VENT BLOWER** switch – **OFF**.
6. **CABIN AIR/TEMP MODE** switch – **OFF**.
7. If smoke and fumes are not eliminated, **CABIN PRESS** switch – **DUMP**.

NOTE

Opening the storm window, after depressurizing, will facilitate smoke and fume removal.

8. Passenger oxygen masks – Check. Confirm that all passengers are receiving supplemental oxygen.
9. Engine oil pressure – Monitor.

9-27. FUEL SYSTEM.

a. Fuel Press Warning Light Illuminated. Illumination of the **No. 1** or **No. 2 FUEL PRESS** warning light usually indicates failure of the respective engine driven boost pump. Perform the following:

1. **STANDBY PUMP** switch – **ON**.
2. **FUEL PRESS** light out – Check.
3. **FUEL PRESS** light still on – Record unboosted time.

b. No Fuel Transfer Caution Light Illuminated. Illumination of a **No 1** or **No 2 NO FUEL XFR** light, with fuel remaining in the respective auxiliary fuel tank, indicates a failure of that automatic fuel transfer system. Proceed as follows:

1. **AUX TRANSFER** switch (affected side) – **OVERRIDE**.
2. Auxiliary fuel quantity – Monitor.
3. **AUX TRANSFER** switch (after respective auxiliary fuel has completely transferred) – **AUTO**.

c. Nacelle Fuel Leak. If nacelle fuel leaks are evident, perform following procedure.

1. Perform engine shutdown.

2. **FIRE PULL** handle – Pull.

3. Land as soon as practicable.

d. Fuel Crossfeed. Fuel crossfeed is normally used only during single-engine operation. The fuel from the dead engine side may be used to supply the live engine by routing the fuel through the crossfeed system. During extended flights, this method of fuel usage will provide a more balanced lateral load condition in the aircraft. For fuel crossfeed, perform the following procedure:

1. **AUX TRANSFER** switches – **AUTO**.

NOTE

With the FIRE PULL handle pulled, the fuel in the auxiliary tank for that side will not be available (usable) for crossfeed.

2. **STANDBY PUMPS** – **OFF**.

3. **CROSSFEED** switch – As required.

4. **FUEL CROSSFEED** annunciator illuminated – Check.

NOTE

With the FIRE PULL handle pulled, the FUEL PRESS light will remain illuminated on the side supplying fuel.

5. **FUEL PRESS** light extinguished – Check.

6. Fuel quantity – Monitor.

e. NAC LOW Light Illuminated. Illumination of the **#1** and **#2 NAC LOW** caution light indicates that the affected tank has 20 minutes C 30 minutes D T of usable fuel remaining at sea level, at normal cruise power consumption rate. Proceed as follows:

WARNING

Failure of the fuel tank venting system will prevent the fuel in the wing tanks from gravity feeding into the nacelle tank. Fuel vent system failure may be indicated by illumination of the #1 or #2 NAC LOW caution light with greater than 20 minutes C 30 minutes D T of usable fuel indicated in the main tank fuel system. The total usable fuel remaining in the main fuel supply system with the LOW FUEL caution light illuminated may be as little as 114 pounds, regardless of the total fuel quantity indicated. Continued flight may result in engine flameout due to fuel starvation.

1. Usable fuel remaining – Confirm.

2. Land as soon as possible.

9-28. ELECTRICAL SYSTEM EMERGENCIES.

a. DC GEN Light Illuminated. Illumination of a **#1** or **#2 DC GEN** caution light indicates failure of a generator or one of its associated circuits, generator control unit. If one generator system becomes inoperative, all nonessential electrical equipment should be used judiciously to avoid overloading the remaining generator. The use of accessories that create a very high drain should be avoided. If both generators are shut off due to either generator system failure or engine failure, all nonessential equipment should be turned off to preserve battery power for extending the landing gear and wing flaps. When a **DC GEN** light illuminates, perform the following:

1. **GEN** switch – **OFF**, **RESET**, then **ON**.

IF THE GENERATOR DOES NOT RESET:

2. **GEN** switch (no reset) – **OFF**.

3. Operating loadmeter – 100% maximum.

b. Both DC GEN Lights Illuminated.

1. All nonessential equipment – Off.

2. Land as soon as practicable.

c. Excessive Loadmeter Indication (Over 100%). If either loadmeter indicates over 100%, perform the following procedure.

1. Loadmeter – Monitor.

2. **BATT** switch – **OFF** (monitor loadmeter).

IF LOADMETER STILL INDICATES ABOVE 100%:

3. Nonessential electrical equipment – off.

IF LOADMETER INDICATES 100% OR BELOW:

4. **BATT** switch – **ON**.

d. INVERTER Light Illuminated. Illumination of the **#1** or **#2 INVERTER** caution light indicates failure of the affected inverter. When either inverter fails, the total ac load is automatically switched to the remaining inverter. When a **#1** or **#2 INVERTER** light illuminates, perform the following:

1. Affected **INVERTER** switch – **OFF**.

e. INST AC Light Illuminated. Illumination of the **INST AC** warning light indicates that both 26-Vac transformer circuits are inoperative. The primary power-indicating instruments, torque, and fuel flow will be inoperative. Under these conditions, power must be controlled by indications of the N_1 and **TGT** gauges. Perform the following:

1. N_1 and TGT indications – Check.

2. Other engine instruments – Monitor.

f. Circuit Breaker Tripped. If the circuit breaker is for a nonessential item, do not reset in flight. If the circuit breaker is for an essential item, the circuit breaker may be reset once. If a bus feeder circuit breaker (on the overhead circuit breaker panel) trips, a short is indicated. Do not reset in flight. If a circuit breaker trips, perform the following:

1. **BUS FEEDER** breaker tripped – Do not reset.

2. Nonessential circuit – Do not reset.

3. Essential circuit – Reset once.

NOTE

Circuit breakers should not be reset more than once until the cause of circuit malfunction has been determined and corrected. Do not reset dual-fed bus feeder circuit breakers.

g. BATTERY CHARGE Light Illuminated. If the **BATTERY CHARGE** caution light illuminates during normal flight, perform the following procedure.

1. Loadmeter – Check and note indication.

2. **BATT** switch – **OFF**.

3. Loadmeter – Check. If loadmeter indicates less than 2.5% change (one needle width), turn **BATT** switch **ON** and monitor for increasing load. If load continues to increase, turn **BATT** switch **OFF**.

NOTE

The battery may be turned back ON only for gear and flap extension and approach to landing. Battery may be usable after a 15 to 20-minute cool down period.

4. **BATT** switch (landing gear/flap extension only) – **ON**.

h. AVIONICS MASTER POWER Switch Failure. If the **AVIONICS MASTER POWER** switch fails to operate in the **ON** position, perform the following procedure.

NOTE

The avionics power relay is normally hot. Pulling the AVIONICS MASTER CONTR circuit breaker will remove power to the relay, thus allowing electrical power to the associated buses.

1. **AVIONICS MASTER CONTR** circuit breaker – Pull.

9-29. EMERGENCY DESCENT.

Emergency descent is a maximum effort in which damage to the aircraft must be considered secondary to getting the aircraft down. The following procedure assumes the structural integrity of the aircraft and smooth flight conditions. If structural integrity is in doubt, limit speed as much as possible, reduce rate of descent if necessary, and avoid high maneuvering loads. For emergency descent, perform the following:

1. **POWER** levers – **IDLE**.

2. **PROP** levers – **HIGH RPM**.

3. **FLAPS – APPROACH**.

4. **GEAR – DN**.

5. Airspeed – 181 KIAS maximum.

NOTE

Windshield defogging may be required.

9-30. LANDING EMERGENCIES.

WARNING

Structural damage may exist after landing with brake, tire, or landing gear malfunctions. Under no circumstances shall an attempt be made to inspect the aircraft until jacks have been installed.

a. Landing Gear Unsafe Indication C D1 Should one or more of the landing gear fail to indicate a safe condition, the following steps should be taken before proceeding manually to extend the gear.

1. **LDG GEAR CONTR** switch – **DN**.
2. **LANDING GEAR RELAY** and **LANDING GEAR IND** circuit breakers – Check in.
3. **GEAR DOWN** lights – Check.

IF INDICATOR REMAINS UNSAFE:

4. Landing gear emergency extension – Perform.

NOTE

If gear continues to indicate unsafe, attempt to verify position visually.

b. Landing Gear Unsafe Indication D2 T. Should one or more of the landing gear fail to indicate a safe condition, the following steps should be taken before proceeding manually to extend the gear.

1. **LDG GEAR CONTROL** switch – Check **DN**.
2. **LANDING GEAR CONTROL** and **LANDING GEAR IND** circuit breakers – Check in.
3. **GEAR DOWN** lights illuminated – Check.

IF INDICATOR REMAINS UNSAFE:

4. Landing gear emergency extension – Perform.

NOTE

If gear continues to indicate unsafe, attempt to verify position visually.

c. Landing Gear Emergency Extension C D1.

CAUTION

Continued pumping of the handle after GEAR DOWN position indicator lights are illuminated could damage the drive mechanism and prevent subsequent gear retraction.

After an emergency landing gear extension has been made, do not stow the gear ratchet handle or move any landing gear controls or reset any switches or circuit breakers until the cause of the malfunction has been corrected.

1. Airspeed – 130 KIAS.
2. **LANDING GEAR RELAY** circuit breaker – Out.
3. **LDG GEAR CONTR** switch – **DN**.
4. Landing gear alternate engage handle – Lift and turn clockwise to the stop.
5. Alternate landing gear extension handle – Pump.
6. **GEAR DOWN** lights illuminated – Check.

d. Landing Gear Emergency Extension D2 T .

NOTE

It could require as many as 80 strokes or more to achieve full extension. Allow additional time during the approach phase to assure gear extension prior to landing.

1. Airspeed – Below 181 KIAS.
2. **LANDING GEAR CONTROL** circuit breaker – Pull.
3. **LDG GEAR CONTR** switch – **DN**.
4. Alternate extension lever – Unstow.
5. Alternate extension lever – Pump up and down until the three green **GEAR DOWN** lights illuminate or resistance is felt.

CAUTION

If, for any reason, the green GEAR DOWN lights do not all illuminate continue pumping until sufficient resistance is felt to ensure the GEAR is DOWN. Do not stow the alternate extension lever, leave it in the up position.

6. Alternate extension lever – As required.
   a. Stowed if all three green **GEAR DOWN** lights are illuminated.
   b. Unstowed if all three green **GEAR DOWN** lights are not all illuminated.

e. Gear-Up Landing (Gear Up or Unlocked). Due to decreased drag with the gear up, the tendency will be to overshoot the approach. The center of gravity with the gear retracted is aft of the main wheels. This condition will allow the aircraft to be landed with the gear retracted and should result in a minimum amount of structural damage to the aircraft, providing the wings are kept level. It is recommended that the fuel load be reduced and the landing made with flaps fully extended on a hard surface runway. Landing on soft ground or dirt is not recommended as sod has a tendency to roll up into chunks, damaging the underside of the aircraft's structure. When fuel load has been reduced, prepare for a gear up landing as follows:

1. Fuel load – Reduce.
2. Personnel emergency briefing – Completed.
3. Loose equipment – Stowed.
4. **BLEED AIR VALVES** – **ENVIRO OFF**.
5. **CABIN PRESS** switch – **DUMP**.
6. **CABIN SIGNS** switch – **BOTH**.
7. Cabin emergency hatch – Remove and stow.
8. Seat belts and harnesses – Secured.
9. O Landing gear alternate engage handle – Disengaged.
10. Alternate landing gear extension handle – Stowed.
11. **LANDING GEAR RELAY** circuit breaker – In.
12. **GEAR** – **UP**.
13. Nonessential electrical equipment – **OFF**.
14. Flaps – As required (**DOWN** for landing).

NOTE

Fly a normal approach to touchdown. Avoid touching down in a nose-high attitude.

15. **POWER** levers (runway assured) – **IDLE**.
16. **CONDITION** levers – **FUEL CUTOFF**.
17. **FIRE PULL** handles – Pull.
18. **MASTER SWITCH** – **OFF**.

f. Landing With Nose Gear Unsafe. If the **LDG GEAR CONTROL** warning light is illuminated and the **NOSE GEAR DOWN** light shows an unsafe condition, try to determine the position of the gear. This may be accomplished by a tower flyby or any other means available.

CAUTION

Do not attempt a MAIN GEAR DOWN, NOSE GEAR UP landing on a grass/sod runway, unprepared runway, or areas adjacent to the runway.

1. Fuel load – Reduce.
2. Crew and passenger briefings – Complete.
3. Loose equipment – Stow/secure.
4. **BLEED AIR VALVES** – **ENVIR OFF** (below 10,000 feet).
5. Cabin pressure switch – **DUMP** (after cabin has depressurized).

WARNING

Prior to removing the emergency exit hatch, slow to a safe airspeed (approximately 160 KIAS or below) and ensure passengers are seated with seat belts fastened and all loose equipment secured.

6. Emergency exit hatch – Remove and secure.
7. Seat belts and harnesses – Fasten.
8. Extension handle – Stow.
9. **LDG GEAR CONTROL** – **DN**.
10. **LANDING GEAR RELAY** circuit breaker – Pull.
11. **LANDING GEAR WARN** horn circuit breaker – Pull.

WARNING

Make a normal approach but hold the nose up as long as possible after touchdown, then ease the nose gently to the runway prior to loss of elevator control. Preventing a sudden drop will minimize structural damage. Use rudder and brakes for directional control. Do not use brakes until the nose is on the runway.

NOTE

Landing light may not be usable with nose gear in unsafe condition.

12. Before landing checklist – Complete.

AFTER TOUCHDOWN:

13. **POWER** levers – **IDLE**.
14. **PROP** levers – **FEATHER**.
15. **CONDITION** levers – **FUEL CUTOFF**.

AFTER STOPPING:

16. **FIRE PULL HANDLES –** Pull.
17. **MASTER SWITCH – OFF**.

NOTE

If landing is to be performed at night, the pilot may elect to turn on the baggage compartment light or other cabin lighting to assist in aircraft evacuation. If cabin lighting is desired, leave the MASTER SWITCH ON. The baggage compartment light is wired directly to the battery and will illuminate with the MASTER SWITCH OFF.

g. Landing With One Main Gear Unsafe. If one main landing gear fails to extend, retract the other gear and make a gear up landing. If all efforts to retract the extended gear fail, land the aircraft on a hard runway surface, touching down on the same edge of the runway as the extended gear. Roll on the down and locked gear, holding the opposite wing up and the nose gear straight as long as possible. If the gear has extended, but is unsafe, apply brakes lightly on the unsafe side to assist in locking the gear. If the gear has not extended or does not lock, allow the wing to lower slowly to the runway. Use the following procedures:

1. Retract the gear and make a gear up landing.

IF THE GEAR WILL NOT RETRACT

2. Fuel load – Reduce.
3. Personnel emergency briefing – Completed.
4. Loose equipment – Stowed.
5. **BLEED AIR VALVES** – **ENVIRO OFF**.
6. **CABIN PRESS** switch – **DUMP**.
7. **CABIN SIGNS** switch – **BOTH**.
8. Cabin emergency hatch – Remove and stow.
9. Seat belts and harnesses – Secured.
10. Nonessential electrical equipment – **OFF**.
11. Touchdown – On safe main gear first.

NOTE

Fly a normal approach to touchdown. After landing, continue with the procedure.

12. **POWER** levers – **IDLE**.

13. **CONDITION** levers – **FUEL CUTOFF**.

14. **FIRE PULL** handles – Pull.

15. **MASTER SWITCH** – **OFF**.

h. Landing With Flat Tire(s). If aware that a main gear tire(s) is flat, a landing close to the edge of the runway opposite the flat tire will help avoid veering off the runway. If the nose wheel tire is flat, use minimum braking.

9-31. LANDING WITH INOPERATIVE WING FLAPS (UP).

The aircraft does not exhibit any unusual characteristics when landing with the wings flaps up. The approach angle will be shallow and the touchdown speed will be higher resulting in a longer landing roll.

9-32. CRACKED WINDSHIELD.

a. External Crack. If an external windshield crack is noted, no action is required in flight.

NOTE

Heating elements may be inoperative in areas of crack.

b. Internal Crack. If an internal crack occurs, perform the following procedure.

1. Descend – Below 25,000 feet.
2. Cabin Pressure – Reset pressure differential to 4 psi or less within 10 minutes.

9-33. CRACKED CABIN WINDOW.

If crack(s) in a cabin window ply(s) occurs, perform the following procedure.

1. Crew oxygen masks – **100%** and on, if above 10,000 feet.
2. **CABIN SIGNS** switch – **BOTH**.
3. Passenger oxygen – **ON** and checked, if above 10,000 feet. The copilot should confirm that all passengers have oxygen masks on and are receiving supplemental oxygen if required.
4. Cabin pressure – Depressurize.
5. Land as soon as practicable. If both plys of a cabin window have developed cracks, the aircraft shall not be flown, once landed, without proper ferry flight authorization.

NOTE

Treat outer ply cracks which are linear, not circular, or cracks that touch the frame as an inner ply crack.

9-34. DITCHING.

If a decision to ditch is made, immediately alert all personnel to prepare for ditching. Plan the approach into the wind, if the wind is high and the seas are heavy. If the swells are heavy but the wind is light, land parallel to the swells. Set up a minimum rate descent (power on or off, as the situation dictates airspeed 110 to 120 KIAS). Do not try to flare as in a normal landing, as it is very difficult to judge altitude over water, particularly in a slick sea. Leveling off too high may cause a nose low "drop in," while having the tail too low in impact may result in the aircraft pitching forward and "digging in." Expect more than one impact shock and several skips before the final hard shock. There may be nothing but spray visible for several seconds while the aircraft is decelerating. To prevent cartwheeling, it is important that the wings be level when the aircraft hits the water. After the aircraft is at rest, supervise evacuation of passengers and exit the aircraft as quickly as possible. In a planned ditching, the life raft and first-aid kits should be secured close to the cabin emergency hatch for easy access when evacuating; however, do not remove the raft from its carrying case inside the aircraft. After exiting the aircraft, keep the raft from any damaged surfaces that might tear or puncture the fabric. The length of time that the aircraft will float depends on the fuel level and the extent of aircraft damage caused by the ditching. Figure 9-3 illustrates the appropriate body positions for ditching, Figure 9-4 shows wind swell information, and Table 9-1 lists the appropriate duties for crew and occupants for planned and immediate ditchings. Perform the following procedures:

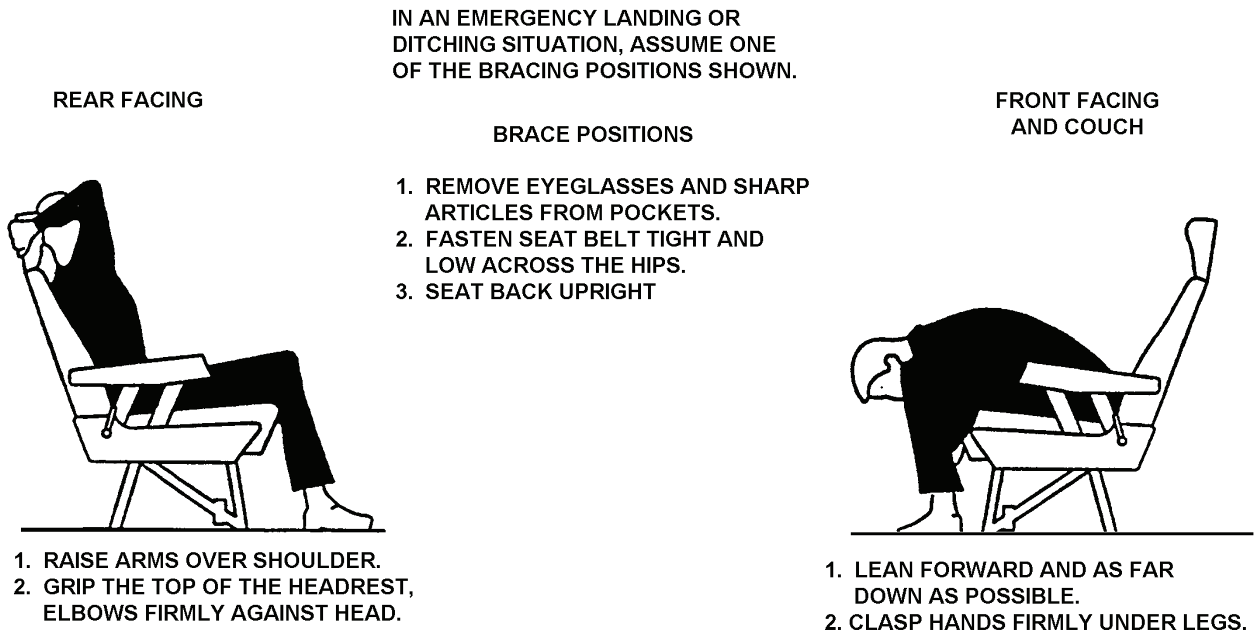


Figure 9-3. Emergency Body Positions

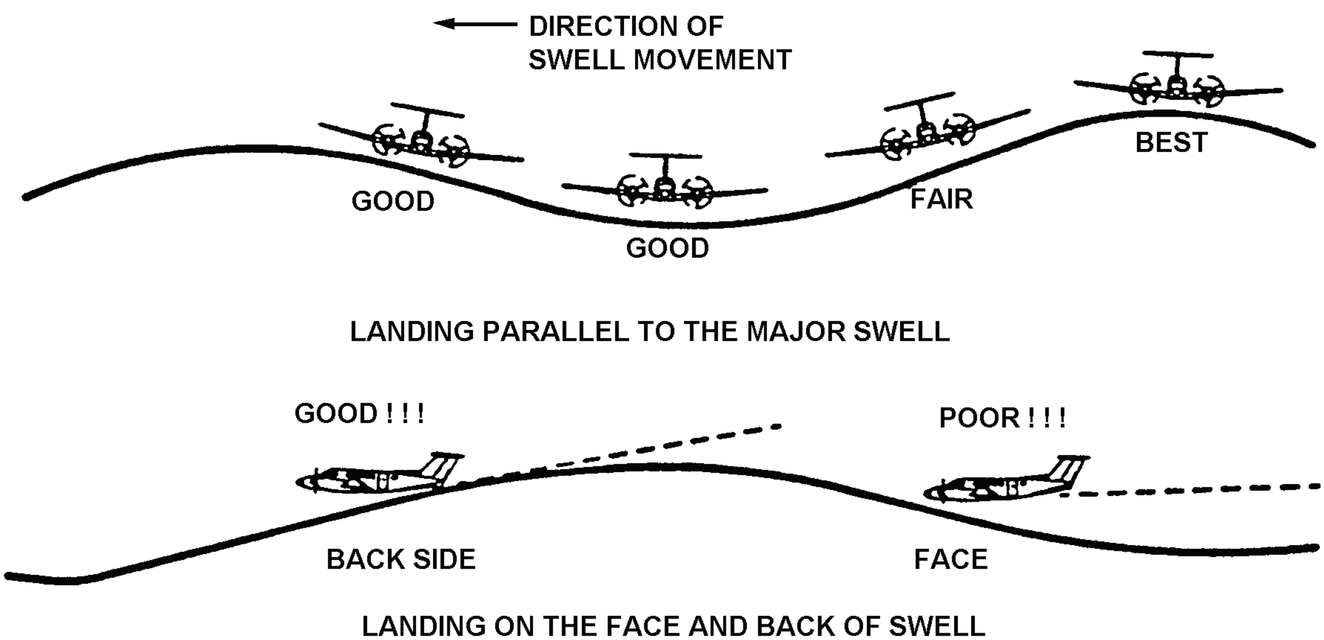


Figure 9-4. Wing Swell Ditch Heading Evaluation

Table 9-1. Ditching

PLANNED DITCHING	IMMEDIATE DITCHING
PILOT	**PILOT**
A. ALERT OCCUPANTS	A. WARN OCCUPANTS
B. ORDER TO PREPARE SURVIVAL GEAR FOR AERIAL DROP	B. TRANSMIT DISTRESS MESSAGE
C. TRANSMIT DISTRESS MESSAGE	C. LIFE VEST – CHECK (DO NOT INFLATE)
D. LIFE VEST – CHECK (DO NOT INFLATE)	D. APPROACH – NORMAL
E. DISCHARGE MARKER	E. NOTIFY OCCUPANTS TO BRACE FOR DITCHING
F. DITCH AIRCRAFT	F. DITCH AIRCRAFT
G. ABANDON AIRCRAFT	G. ABANDON AIRCRAFT AFTER COPILOT THROUGH CABIN EMERGENCY HATCH
COPILOT	**COPILOT**
A. REMOVE CABIN EMERGENCY HATCH	A. REMOVE CABIN EMERGENCY HATCH
B. LIFE VEST – CHECK (DO NOT INFLATE)	B. LIFE VEST – CHECK (DO NOT INFLATE)
C. ABANDON AIRCRAFT (TAKE LIFE RAFT AND FIRST AID KIT)	C. ABANDON AIRCRAFT (TAKE LIFE RAFT AND FIRST AID KIT)
PASSENGERS	**PASSENGERS**
A. SEAT BELTS – FASTEN	A. SEAT BELTS – FASTEN
B. LIFE VEST – CHECK (DO NOT INFLATE)	B. LIFE VEST – CHECK (DO NOT INFLATE)
C. ON PILOTS SIGNAL – BRACE FOR DITCHING	C. ON PILOTS SIGNAL – BRACE FOR DITCHING
D. ABANDON AIRCRAFT THROUGH CABIN DOOR (TAKE LIFE RAFT AND FIRST AID KIT)	D. ABANDON AIRCRAFT THROUGH CABIN DOOR (TAKE LIFE RAFT AND FIRST AID KIT)

WARNING

Do not unstrap from the seat until all motion stops. The possibility of injury and disorientation requires that evacuation not be attempted until the aircraft comes to a complete stop.

1. Radio calls/transponder – As required.
2. Personnel emergency briefing – As required.
3. **BLEED AIR VALVES – ENVIRO OFF/PNEU ONLY**.
4. **CABIN PRESS** switch – **DUMP**.
5. **CABIN SIGNS** switch – **BOTH**.
6. Cabin emergency hatch – Remove and stow.
7. Seat belts and harnesses – Secured.
8. **GEAR** – **UP**.
9. **FLAPS** – **DN**.
10. Nonessential electrical equipment – **OFF**.
11. Approach – Normal, power on.

12. Emergency lights – As required.

9-35. FLIGHT CONTROLS MALFUNCTION.

Use the following procedures, as applicable, for flight control malfunctions.

a. Unscheduled Rudder Boost Activation. Rudder boost operation without a large variation of power between engines indicates a failure of the system.

1. **RUDDER BOOST** – **OFF**.

NOTE

The rudder boost system may not operate when the brake deice system is in use. Availability of the rudder boost system will be restored to normal when the BRAKE DEICE switch is set to OFF.

IF CONDITION PERSISTS:

2. **RUDDER BOOST** circuit breaker – Pull.
3. **BLEED AIR VALVE** – **OFF** (Below 10,000 feet).
4. Rudder trim – Adjust.

b. Unscheduled Electric Elevator Trim. In the event of unscheduled electric elevator trim, perform the following procedure.

1. Control wheel disconnect switch – Depress.
2. **ELEV TRIM** switch – **OFF**.
3. **ELEC TRIM** circuit breaker – **OUT**.

c. Electric Elevator Trim Controls Frozen in Flight. Moisture entering or condensing in the elevator trim control clutch assembly can freeze in flight locking the trim in a cruise position. This condition is first noticed when preparing for descent or retrimming at altitude. Flight in above freezing temperatures will normally clear the problem before landing, however if the elevator control is still frozen during the approach, control forces must be overcome manually. Descend using power reduction to keep heavy control forces caused by airspeed increases to a minimum. If trim control freedom has not been attained prior to landing, consider a no flaps approach and landing to ease control back pressure.

APPENDIX A
REFERENCES

AR 70 –50	Designating And Naming Defense Equipment, Rockets, And Guided Missiles
AR 95-1	Army Aviation – General Provisions And Flight Regulations
AR 385-40	Accident Reporting And Records
DA PAM 738-751	Functional User's Manual For The Army Maintenance Management System – Aviation (TAMMS-A)
FAR PART 91	Federal Aviation Regulation, General Operating And Flight Rules
FM 1-230	Meteorology For Army Aviators
FM 1-240	Instrument Flying And Navigation For Army Aviators
TC1-218	Aircrew Training Manual (ATM)
TM 1-1510-225-CL	Operator's And Crewmember's Checklist, Army Model C-12R Aircraft, C-12T3 Aircraft, C-12F3 Aircraft
TM 55-1500-204-25/1	General Aircraft Maintenance Manual
TM 55-1500-342-23	Army Aviation Maintenance Manual – Weight And Balance
TM 750-244-1-5	Procedures For The Destruction Of Aircraft And Associated Equipment To Prevent Enemy Use

APPENDIX B
ABBREVIATIONS AND TERMS

For the purpose of this manual, the following abbreviations and terms apply. See appropriate technical manuals for additional terms and limits:

B-1. AIRSPEED TERMINOLOGY

CAS	Calibrated airspeed is indicated airspeed corrected for position and instrument error.
GS	Ground speed is the speed of the aircraft relative to the ground
IAS	Indicated airspeed is the speed as shown on the airspeed indicator and assumes no instrument error
KTS	Knots
M	Mach number. The ratio of true airspeed to the speed of sound.
M_{mo}	Maximum operating Mach number. M_{mo} varies with altitude.
TAS	True airspeed is calibrated airspeed corrected for altitude, temperature, pressure, and compressibility effects
V_1	Takeoff decision speed. The maximum speed below which the pilot must initiate the first action (brake application) to discontinue the takeoff. Above V_1, the takeoff must be continued.
V_2	Takeoff Safety Speed. Must be attained at 35 feet above the runway and is the speed to be maintained during climb to clear an obstacle
V_a	Maneuvering speed is the maximum speed at which application of full available aerodynamic control will not overstress the aircraft.
V_{enr}	One engine inoperative enroute climb speed with the remaining engine at maximum continuous power setting for the condition, landing gear and flaps retracted.
V_f	Design flap speed is the highest speed permissible at which wing flaps may be actuated.
V_{fe}	Maximum flap extended speed is the highest speed permissible with wing flaps in a prescribed extended position.
V_{le}	Maximum landing gear extended speed is the maximum speed at which an aircraft can be safely flown with the landing gear extended.
V_{lo}	Maximum landing gear operating speed is the maximum speed at which the landing gear can be safely extended or retracted.
V_{mca}	The minimum flight speed at which the aircraft is directionally controllable as determined in accordance with Federal Aviation Regulations. Aircraft Certification conditions include one engine becoming inoperative and propeller windmilling; up to a 5° bank toward the operative engine; takeoff power on operative engine; landing gear up; flaps up; and most rearward CG. This speed has been demonstrated to provide satisfactory control above power off stall speed (which varied with weight, configuration, and flight attitude).
V_{mcg}	Ground minimum control speed.
V mo	Maximum operating limit speed. Not deliberately exceeded in any phase of flight (climb, cruise, descent) unless a higher speed is specifically authorized for flight test or pilot training.
V_{ne}	Never exceed speed.
V_r	Rotation speed. The speed at which aircraft rotation is initiated. Varies with weight, altitude, and temperature.
V_{ref}	The indicated airspeed that the aircraft should be at when 50 feet above the runway in the landing configuration.
V_s	Power off stalling speed or the minimum steady flight speed at which the aircraft is controllable.

V_{so} — Stalling speed or the minimum steady flight speed in the landing configuration.

V_{sse} — The safe one-engine inoperative speed selected to provide a reasonable margin against the occurrence of an unintentional stall when making intentional engine cuts.

V_{yse} — The best single-engine rate-of-climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible time with one engine inoperative, gear and flaps up.

B-2. METEOROLOGICAL TERMINOLOGY

Altimeter Setting — Barometric pressure corrected to sea level.

°C — Degrees Celsius.

°F — Degrees Fahrenheit.

FAT — Free air temperature is the free air static temperature, obtained either from ground meteorological sources or from in-flight temperature indications adjusted for compressibility effects.

Indicated Pressure Altitude — The number actually read from an altimeter when the barometric scale (Kollsman window) has been set to 29.92 inches of mercury (1013 millibars).

ISA — International Standard Atmosphere in which:

The air is a dry perfect gas.

The temperature at sea level is 59 °F, 15 °C.

The pressure at sea level is 29.92 inches Hg.

The temperature gradient is -0.003566 °F per foot from sea level to the altitude at which the temperature is –69.7 °F, and 0° above that altitude.

Pressure Altitude — Indicated pressure altitude corrected for altimeter error.

SL — Sea level.

Wind — The wind velocities recorded as variables on the charts of this manual are to be understood as the headwind or tailwind components of the actual winds at 50 feet above runway surface (tower winds).

B-3. POWER TERMINOLOGY

Beta Range — The region of the **POWER** lever control which is aft of the **IDLE** stop and forward of reversing range where blade pitch angle can be changed without changing gas generator speed.

Cruise Climb — The maximum power approved for normal climb. This power is torque or temperature (ITT) limited.

GROUND FINE — The region of the **POWER** lever control, which is aft of the **IDLE** stop and forward of **REVERSE** range, where propeller blade pitch angle and gas generator RPM can be changed. Use to provide deceleration on the ground during landing accelerate-stop conditions.

HIGH IDLE — The region of **CONDITION** lever control placarded as the **HIGH IDLE** position. This limits the power operation to a minimum of 70% of N_1 RPM.

LOW IDLE — The region of **CONDITION** lever control placarded as the **LOW IDLE** position. This limits the power operation to a minimum of 62% of N_1 RPM.

Maximum Cruise Power — The highest power rating for cruise that is not time limited.

Maximum Continuous Power — The maximum power available from an engine for use during an emergency operation.

Normal Rated Climb Power — The maximum power available from an engine for continuous normal climb operations.

Normal Rated Power — The maximum power available from an engine for continuous operation in cruise (with lower ITT limit than normal rated climb power).

Reverse Thrust	The region of the **POWER** lever control that is aft of the Beta and **GROUND FINE** range and controls engine power through **GROUND FINE** and **REVERSE** range.
RPM	Revolutions Per Minute
SHP	Shaft horsepower. The horsepower imparted to the propeller shaft.
Static Power	The power which must be available for takeoff without exceeding engine limitations.
Takeoff Power	The maximum power permissible for a takeoff.

B-4. CONTROL AND INSTRUMENT TERMINOLOGY

CONDITION Lever (Fuel Shut-off Lever)	The fuel shut-off lever actuates a valve in the fuel control unit that controls the flow of fuel at the fuel control outlet and regulates the **IDLE** range from **LOW** to **HIGH**.
N_1 Tachometer (Gas Generator RPM)	The tachometer registers the RPM of the gas generator with 100% representing a gas generator speed of 37,500 RPM.
POWER Lever (Gas Generator N_1 RPM)	The **POWER** lever serves to modulate engine power from full reverse thrust to takeoff. The position for **IDLE** represents the lowest recommended level of power for flight operation.
Propeller Control Lever (N_2 RPM)	The propeller control lever is used to control the RPM setting of the propeller governor. Movement of the lever results in an increase of decrease in propeller RPM. Propeller feathering is the result of lever movement beyond the detents at the low RPM (high pitch) end of the lever travel.
Propeller Governor	The propeller governor senses changes in RPM and hydraulically changes propeller blade angle to compensate for the changes in RPM. Constant propeller RPM is thereby maintained at the selected RPM setting.
Torque-meter	The torquemeter system determines the shaft output torque. Torque values are obtained by tapping into two outlets on the reduction gear case and recording the differential pressure from the outlets.
Interstage Turbine Temperature (ITT)	The temperature of the gases present between the compressor turbine and power turbine.

B-5. GRAPH AND TABULAR TERMINOLOGY

AGL	Above ground level
Best Angle-of-Climb	The best angle-of-climb speed is the airspeed that delivers the greatest gain of altitude in the shortest possible horizontal distance with gear and Flaps up.
Best Rate-of-Climb	The best rate-of-climb speed is the airspeed that delivers the greatest gain of altitude in the shortest possible time with gear and flaps up.
Clean Configu-ration	Gear and **FLAPS UP**.
Demon-strated Crosswind	The maximum 90° crosswind component for which adequate control of the aircraft during takeoff and landing was actually demonstrated during certification tests.
Gradient	The ratio of the change in height to the horizontal distance, usually expressed in percent.
Landing Weight	The weight of the aircraft at landing touchdown.
Maximum Zero Fuel Weight	Any weight above the value given must be loaded as fuel.
MEA	Minimum Enroute Altitude
Ramp Weight	The gross weight of the aircraft before engine start. Included is the takeoff weight plus a fuel allowance for start, taxi, run-up and take-off ground roll to lift-off.
Route Segment	A part of a route. Each end of that part is identified by a geographic location or a point at which a definite radio fix can be established.

Service Ceiling	The altitude at which the maximum rate-of-climb of 100 fpm can be attained for existing aircraft weight.
Takeoff Weight	The weight of the aircraft at lift-off from the runway.

B-6. WEIGHT AND BALANCE TERMINOLOGY

Approved Loading Envelope	Those combinations of aircraft weight and center of gravity that define the limits beyond which loading is not approved.
Arm	The distance from the center of gravity of an object to a line about which moments are to be computed.
Basic Empty Weight	The aircraft weight with fixed ballast, unusable fuel, engine oil, engine coolant, hydraulic fluid, and in other respects as required by applicable regulatory standards.
Center of Gravity (CG)	A point at which the weight of an object may be considered concentrated for weight and balance purposed.
CG Limits	CG limits are the extremes of movement that the CG can have without making the aircraft unsafe to fly. The CG of the loaded aircraft must be within these limits at takeoff, in the air, and on landing.
Datum	A vertical plane perpendicular to the aircraft longitudinal axis from which fore and aft (usually aft) measurements are made for weight and balance purposes.
Engine Oil	That portion of the engine oil that can be drained from the engine.
Landing Weight	The weight of the aircraft at landing touchdown.
Maximum Weight	The largest weight allowed by design, structural, performance or other limitations.
Maximum Zero Fuel Weight	Any weight above the value must be loaded as fuel.
Moment	A measure of the rotational tendency of a weight, about a specified line, mathematically equal to the product of the weight and the arm.
Operating Weight	Basic empty weight plus crew, crew's baggage, publications, and any other equipment (not listed on Chart C) that will remain with the crew throughout the mission.
Standard	Weights corresponding to the aircraft as offered with seating and interior, avionics, accessories, fixed ballast and other equipment specified by the manufacturer as composing a standard aircraft.
Station	The longitudinal distance from some point to the zero datum or zero fuselage station.
Takeoff Weight	The weight of the aircraft at liftoff.
Unusable Fuel	The fuel remaining after consumption of usable fuel.
Usable Fuel	The portion of the total fuel load that is available for consumption as determined in accordance with applicable regulatory standards.
Useful Load	The difference between the aircraft ramp weight and basic empty weight.
Zero Fuel Weight	Operating weight plus the load equals zero fuel weight.

B-7. MISCELLANEOUS ABBREVIATIONS.

@	At
AAS	Aeronautical Advisory Service
AC	Alternating Current
ACFT	Aircraft
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
AETM	Army Engine Trend Monitoring System
AFCS	Automatic Flight Control System
AFIS	Airborne Flight Information System
AGRAS	Air/Ground Radiotelephone Automated Service
ALT	Altitude
ALTSEL	Altitude Select

AM	Amplitude Modulation
ANG	Army National Guard
ANN	Annunciator
ANT	Antenna
AP, A/P	Autopilot
APRCH, APR	Approach
ARINC	Aeronautical Radio, Inc.
ARP	Airport Reference Point
ARTCC	Air Route Traffic Control Center
AS, A/S	Airspeed
ATC	Air Traffic Control
AUTO	Automatic
AUX	Auxiliary
AVGAS	Aviation Gasoline
AWOS	Automatic Weather Observing Station
BARO	Barometric
BAT, BATT	Battery
BC	Back Course, Bus Controller
BCN	Beacon
BFO	Beat Frequency Oscillator
BIT	Built-In Test
BL	Bleed
BOS	Beginning Of Stack
BOT	Bottom
BRG	Bearing
BRT	Bright
BTPS	Body Temperature And Pressure Saturated
BU	Backup, Battery Unit
CAP	Capture
CDI	Course Deviation Indicator
CDU	Control-Display Unit
CH, CHAN	Channel
CHG	Charge
CL, CKLST	Checklist
CLE	Clear Entry
CLIMB GAD	Current Aircraft Climb Performance
CLR	Clear
CMPST	Composite
COMM	Communications
COMSEC	Communications Secure
COND	Conditioning
COPLT	Copilot
CR	Cursor Return
CRS	Course
CRUISE ALT	Cruise Altitude
CTAF	Common Traffic Advisory Frequency
CVR	Cockpit Voice Recorder
CW	Continuous Wave
CWS	Control Wheel Steering
CYCL	Cycle
DB	Database
DC	Direct Current
DECR	Decrease
DEF	Default
DEG	Degrees
DEL	Delete
DEN	Density
DET	Detector
DG	Directional Gyro
DH	Decision Height
DIAG	Diagnostic
DIF	Difference
DIR	Direct
DIS	Distance
DISC	Disconnect
DISP	Display
DME	Distance Measuring Equipment
DN	Down
DR	Dear Reckoning
DTRK, DTK	Desired Track
E	East
EADI	Electronic Attitude Director Indicator

EAROM	Electronically Alterable Read Only Memory
EFIS	Electronic Flight Instrument System
EFWS	Electronic Failure Warning System
EGPWS	Enhanced Ground Proximity Warning System
EHSI	Electronic Horizontal Situation Indicator
ELEC	Electric
ELEV	Elevation
ELT	Emergency Locator Transmitter
EMERG	Emergency
ENG	Engine
ENRTE	En Route
ENVIR	Environment
EPE	Estimated Position Error
ESA	Enroute Safe Altitude
EST CROSSING	Estimated Crossing Altitude
ET	Elapsed Time
ETA	Estimated Time Of Arrival
ETA@	Estimated Time Of Arrival At Destination
ETE	Estimated Time En Route
ETM	Engine Trend Monitor
ETMS	Engine Trend Monitor System
EXP	Expired
EXT	Extinguisher, External
FAA	Federal Aviation Administration
FCU	Fuel Control Unit
FD	Flight Director
FH	Frequency Hopping
FHDG	Free Heading
FH-M	Frequency Hopping-Master
FL	Flight Level
FLIP	Flight Information Publications
FLT	Flight
FM	Frequency Modulation
FMS	Flight Management System
FOB	Fuel On Board
FPA	Flight Path Angle
FPL	Flight Plan
FPM	Feet Per Minute
FR	From Waypoint
FREQ	Frequency
FS	Fuselage Station
FSB	Fasten Seat Belt
FSS	Flight Service Station
FT	Foot, Feet
FT/MIN	Feet Per Minute
FT-LB	Foot-Pounds
G	Gravity
GA, G/A	Go-Around
GAL	Gallons
GCAS	Ground Collision Avoidance System
GEN	Generator
GLS	Glideslope System
GMAP	Ground Mapping
GMT	Greenwich Mean Time
GND	Ground
GOV	Governor
GPAAS	Ground Proximity Altitude Advisory System
GPS	Global Positioning System
GPU	Ground Power Unit
GPWS	Ground Proximity Warning System
GRI	Group Repetition Interval
GS	Glideslope
GTOW	Gross Takeoff Weight
GYRO	Gyroscope
HC	Home Cursor
HDG	Heading
HDL	Handle
HDWND	Headwind
HF	High Frequency
Hg	Mercury
HP	Holding Pattern

HR	Hours
HRZN	Horizontal
HSI	Horizontal Situation Indicator
HYD	Hydraulic
IAS	Indicated Air Speed
I/P	Identification Of Position
IC	Intercom
ICAO	International Civil Aviation Organization
IDENT	Identification
IDX	Index
IFF	Identification, Friend Or Foe
IFR	Instrument Flight Rules
IGN	Ignition
ILS	Instrument Landing System
IM	Inner Marker
IMC	Instrument Meteorological Conditions
IN	Inch
INBOUND CRS	Inbound Holding Course
INC	Increment
INCR	Increase
IND	Indicator
INF	Information
INSTR	Instrument
INTPH	Interphone
INTRPT	Interrupt
IOAT	Indicated Outside Air Temperature
IP	Identification Pulse
ITU	International Telecommunications Union
kHz	Kilohertz
KIAS	Knots Indicated Airspeed
L	Left
LB	Pounds
LC	Local Time
LDA	Localize Directional Aid
LDG	Landing
LEG DIST	Leg Distance
LH	Left Hand
LOC	Localizer
LONG	Longitude
LPM	Liters Per Minute
LSB	Lower Sideband
LT	Light
MAG	Magnetic
MAN	Manual
MAP	Missed Approach Point
MAX	Maximum
Mb	Millibars
MDA	Minimum Descent Altitude
MEM	Memory
MF	Mandatory Frequency
MFD	Multifunction Display
MHz	Megahertz
MIC	Microphone
MIN	Minimum
MKR	Marker
MM	Middle Marker
MNTR	Monitor
MPEL	Maximum Permissible Exposure Level
MPGS	Mission Planning Ground Station
MSA	Minimum Safe Altitude
MSG	Message
MSL	Mean Sea Level
N	North
NAV	Navigation
NAVAID	Navigation Aid
NDB	Non-Directional Beacon, Navigation Database
NM	Nautical Miles
NORM	Normal
NTPD	Normal Temperature And Pressure, Dry
NX	Next Waypoint
OAT	Outside Air Temperature

OBS	Omni Bearing Selector
OFST	Offset
OM	Outer Marker
OROCA	Off-Route Obstacle Clearance Altitude
OSA	Operational Support Aircraft
OVHD	Overhead
OXY	Oxygen
PC	Printed Circuit
PFD	Primary Flight Display
PGM	Program
PITCH SYNC	Pitch Synchronization
PLT	Pilot
PNEU	Pneumatic
PNL	Panel
POS	Position
#PRESL	Pre-Selected Altitude Profile Point
PRESEL ALT	Pre-Select Altitude
PRN	Pseudo Random Nose
PROP	Propeller
PRESS, PRS	Pressure
PRV	Previous
PSI	Per Square Inch
PT	Procedure Turn
PTT	Push To Talk
PVT	Private
PWR	Power
R	Right
RAD	Radial
RAIM	Receiver Autonomous Integrity Monitoring
RCL	Recall
RCV	Receiver
RDO	Radio
REC	Receiver
RECOG	Recognition
REL	Release
REM, REM@	Remaining
REQ FPM	Require Feet Per Minute
RES	Reserve
RMI	Radio Magnetic Indicator
RNAV	Area Navigation
RNG	Range
RPU	Receiver Processor Unit
RST	Reset
RT	Receiver/Transmitter
RW	Runway
S	South
SAT	Static Air Temperature
SBS	Set Beginning Of Stack
SDF	Simplified Directional Facility
SENS	Sensitivity
SF	Special Function
SHP	Shaft Horsepower
SID	Standard Instrument Departure
SMK	Smoking
SN, SNR	Signal To Noise Ratio
SPKR	Speaker
SQ	Squelch
STAR	Standard Terminal Arrival Route
STBY	Standby
STO	Store
SUA	Special Use Airspace
SUBPNL	Subpanel
SXTK	Selected Crosstrack
SYN	Synchroscope
SYNC	Synchronization
SYS	System
TACAN	Tactical Air Navigation
TAS	True Air Speed
TAT	Total Air Temperature
TBO	Time Between Overhaul

TCAS	Traffic Alert And Collision Avoidance System
TCN	Tactical Air Navigation
TCS	Touch Control Steering
TEMP	Temperature
TK	Track Angle
TLWND	Tailwind
#TOC	Top Of Climb Profile Point
#TOD	Top Of Descent Profile Point
TRANS LEVEL	Transition Level
TRI	Trip-Planning Pages
TRMNL	Terminal
TTG	Time To Go To Next Waypoint
TX	Transmit
TX CMDS	Transmit Channel Discrete
UHF	Ultra High Frequency
USB	Upper Sideband
UT	Universal Time Or Greenwich Mean Time
UTC	Coordinated Universal Time
VA	Voice Advisory
Vac	Volts, alternating current
VAR	Magnetic Variation
Vdc	Volts, direct current
VERT DEV	Vertical Deviation
VFR	Visual Flight Rules
VHF	Very High Frequency
VIP	Video Integrated Processor
VNAV	Vertical Navigation
VNVINACTV	VNAV Inactive
VOL	Volume
VOR	VHF Omni Range
VORTAC	Collocated VOR And TACAN Station
VS	Vertical Speed
VSI	Vertical Speed Indicator
W	West
WPT	Waypoint
WSHLD	Windshield
WX	Weather Radar
WXD	Radar Returns
XFR	Transfer
XMTR	Transmitter
XPDR, XPONDER	Transponder
XTK	Crosstrack
YD, Y/D	Yaw Damper

ALPHABETICAL INDEX

Subject	Paragraph, Figure, Table Number

NOTE

Reminder: Chapter 3 covers avionics common to all C-12C, C-12D, C-12T1, and C-12T2 model aircraft; Chapter 3A addresses C-12C and C-12D1-specific equipment; Chapter 3B addresses C-12D2-specific equipment; and Chapter 3C addresses C-12T1 and C-12T2-specific equipment.

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Subject	Paragraph, Figure, Table Number

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By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
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Official:

JOYCE E. MORROW
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8. ***Pub Number:*** TM 1-1510-218-10
9. *Pub Title:* Operator's Manual for Army C-12C/D/T1/T2 Aircraft
10. ***Pub Date*****: 30 Oct 99**
11. *Change Number:* Basic
12. *Submitter Rank:* MSG
13. ***Submitter FName:*** Joe
14. *Submitter MName:* T
15. ***Submitter LName:*** Smith
16. ***Submitter Phone:*** 123-456-7890
17. ***Problem:*** 1
18. *Page:* 2
19. *Paragraph:* 3
20. *Line:* 4
21. *NSN: 5*
22. *Reference:* 6
23. *Figure:* 7
24. *Table:* 8
25. *Item:* 9
26. *Total:* 123
27. ***Text:***

This is the text for the problem below line 27.

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25--30; the proponent agency is ODISC4.	Use Part II (*reverse*) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE 8/30/02

TO: (*Forward to proponent of publication or form)(Include ZIP Code*)	FROM: (*Activity and location)(Include ZIP Code*)
Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM--MMA--NP Redstone Arsenal, AL 35898	MSG, Jane Q. Doe 1234 Any Street Nowhere Town, AL 34565

PART 1 - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 9-1005-433-24	16 Sep 2002	Organizational, Direct Support, And General Support Maintenance Manual for Machine Gun, .50 Caliber M3P and M3P Machine Gun Electrical Test Set Used On Avenger Air Defense Weapon System

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON
1	WP0005 PG 3		2			Test or Corrective Action column should identify a different WP number.

EXAMPLE

* *Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, Jane Q. Doe, SFC	788-1234	

TO: (Forward direct to addressee listed in publication) Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM-MMA-NP Redstone Arsenal, AL 35898	FROM: (Activity and location) (Include ZIP Code) MSG, Jane Q. Doe 1234 Any Street Nowhere Town, AL 34565	DATE 8/30/02

PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III - REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.*)

EXAMPLE

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, Jane Q. Doe, SFC	788-1234	

USAPA V3.01

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25--30; the proponent agency is ODISC4.	Use PartII(*reverse*) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE
TO*: (Forward to proponent of publication or form)(Include ZIP Code)* Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM-MMA-NP Redstone Arsenal, AL 35898	FROM*: (Activity and location)(Include ZIP Code)*	

PART 1 --ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE

ITEM NO.	PAGE NO.	PARA- GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON

* *Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE

TO: *(Forward direct to addressee listed in publication)* Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM-MMA-NP Redstone Arsenal, AL 35898	**FROM:** *(Activity and location) (Include ZIP Code)*	**DATE**

PART II --REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III --REMARKS *(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

METRIC SYSTEM AND EQUIVALENTS CHART

Linear Measure	Liquid Measure
1 centimeter = 10 millimeters = .39 inches 1 decimeter = 10 centimeters = 3.94 inches 1 meter = 10 decimeters = 39.37 inches 1 dekameter = 10 meters = 32.8 feet 1 hectometer = 10 dekameters = 328.08 feet 1 kilometer = 10 hectometers = 3,280.8 feet	1 centiliter = 10 milliliters = .34 fl. ounce 1 deciliter = 10 centiliters = 3.38 fl. ounces 1 liter = 10 deciliters = 33.81 fl. ounces 1 dekaliter = 10 liters = 2.64 gallons 1 hectoliter = 10 dekaliters = 26.42 gallons 1 kiloliter = 10 hetoliters = 264.18 gallons
Weights	**Square Measure**
1 centigram = 10 milligrams = .15 grain 1 decigram = 10 centigrams - 1.54 grains 1 gram = 10 decigrams = .035 ounce 1 dekagram = 10 grams = .35 ounce 1 hectogram = 10 dekagrams = 3.52 ounces 1 kilogram = 10 hectograms = 2.2 pounds 1 quintal = 100 kilograms = 220.46 pounds 1 metric ton = 10 quintals = 1.1 short tons	1 sq. centimeter = 100 sq. millimeters = .155 sq. inch 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches 1 sq. meter (centare) = 100 sq. decimeter = 10.76 sq. feet 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile
	Cubic Measure
	1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

APPROXIMATE CONVERSION CHART

APPROXIMATE CONVERSION FACTORS					
To change	**To**	**Multiply by**	**To change**	**To**	**Multiply by**
inches	centimeters	2.540	ounce-inches	newton-inches	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.496
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	1.308
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)				
ºF	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	ºC

PIN: 079163-000