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PA46-350P Mirage
1989-1995
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PIPER

MALIBU

INFORMATION MANUAL

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PA-46-350P

HANDBOOK PART NO. 761 825

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APPLICABILITY

Application of this handbook is limited to the specific Piper PA-46-350P model airplane designated by serial number and registration number on the face of the title page of this handbook.

This handbook cannot be used for operational purposes unless kept in a current status.

REVISIONS

The information compiled in the Pilot's Operating Handbook, with the exception of the equipment list, will be kept current by revisions distributed to the airplane owners. The equipment list was current at the time the airplane was licensed by the manufacturer and thereafter must be maintained by the owner.

Revision material will consist of information necessary to update the text of the present handbook and/or to add information to cover added airplane equipment.

I. Revisions

Revisions will be distributed whenever necessary as complete page replacements or additions and shall be inserted into the handbook in accordance with the instructions given below:

1. Revision pages will replace only pages with the same page number.
2. Insert all additional pages in proper numerical order within each section.
3. Insert page numbers followed by a small letter in direct sequence with the same common numbered page.

II. Identification of Revised Material

Each handbook page is dated at the bottom of the page showing the date of original issue and the date of the latest revision. Revised text and illustrations are indicated by a black vertical line located along the outside margin of each revised page opposite the revised, added, or deleted information. A vertical line next to the page number indicates that an entire page has been changed or added.

Vertical black lines indicate current revisions only. Correction of typographical or grammatical errors or the physical relocation of information on a page will not be indicated by a symbol.

ORIGINAL PAGES ISSUED

The original pages issued for this handbook prior to revision are given below:

Title, ii through vii, 1-1 through 1-12, 2-1 through 2-16, 3-1 through 3-30, 4-1 through 4-40, 5-1 through 5-32, 6-1 through 6-20, 7-1 through 7-50, 8-1 through 8-22, 9-1 through 9-62, and 10-1 through 10-2.

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS

Current Revisions to the PA-46-350P Malibu Pilot's Operating Handbook, REPORT: VB-1332 issued June 15, 1988.

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 1	Title	Revised name.	
(PR880915)	iv	Para. deleted.	
	4-15	Revised Caution.	
	5-11	Fig. 5-1 redrawn.	
	5-12	Fig. 5-3 redrawn.	
	5-15	Fig. 5-9 added.	
	5-19	Fig. 5-17 redrawn	
	5-21	Fig. 5-21 redrawn	
	5-30	Fig. 5-30 redrawn.	
	5-31	Revised associated conditions format on fig. 5-39.	D.H. Trompler
	6-i	Table of Contents revised.	Sept. 16, 1988
			Date
Rev. 2	2-3	Revised para. 2.7.	
(PR881212)	2-13	Revised para. 2.35.	
	2-14	Revised para. no. Revised para. 2.35.	
	2-15	Revised para. no.	
	2-16	Revised para. no. Added info. to para. 2.35.	
	3-i thru 3-iii	Revised T.O.C.	
	3-12	Relocated info. from p. 3-13. Moved info. to p. 3-13. Revised amplified para. no.	
	3-13	Relocated info. from p. 3-12. Revised amplified para. no.	
	3-14a	Added page. Added para. 3.3aa.	
	3-14b	Added page.	
	3-27	Revised para. 3.45.	
	3-30	Added para. 3.59. Removed blank page note.	
	4-12	Revised para. 4.5g.	

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 2 (cont)	4-16	Revised para. 4.5m	
	4-28	Revised para. 4.21	
	4-31	Revised para. 4.27.	
	4-33	Revised para. 4.31.	
	5-9	Revised para. 5.7.	
	5-24a	Added page. Added Fig. 5.26.	
	5-24b	Added page.	
	7-13	Revised Fig. 7-9.	
	7-24	Revised Fig. 7-17.	
	7-25	Revised Fig. 7-19.	
	7-27	Revised Fig. 7-23b.	
	7-30	Revised Fig. 7-25.	
	9-i	Revised T.O.C.	
	9-42	Moved info. to p. 9-43.	
	9-43	Added info. and Note to p. 9-43. Relocated info. from p. 9-42. Moved info. to p. 9-44.	
	9-44	Relocated info. from p. 9-43. Moved info. to p. 9-45.	
	9-45	Relocated info. from p. 9-44. Revised Fig. 7-1.	
	9-60	Revised Fig. 7-1.	
	9-61	Revised Fig. 7-2.	
	9-63 thru 9-92	Added Supplement 7.	
	9-93 thru 9-100	Added Supplement 8.	
	9-101 thru 9-104	Added Supplement 9.	
	9-105 thru 9-110	Added Supplement 10.	
	9-111 thru 9-116	Added Supplement 11.	D.H. Trompler D.H. Trompler Dec. 12, 1988 Date

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GENERAL

SECTION 1

GENERAL

1.1 INTRODUCTION

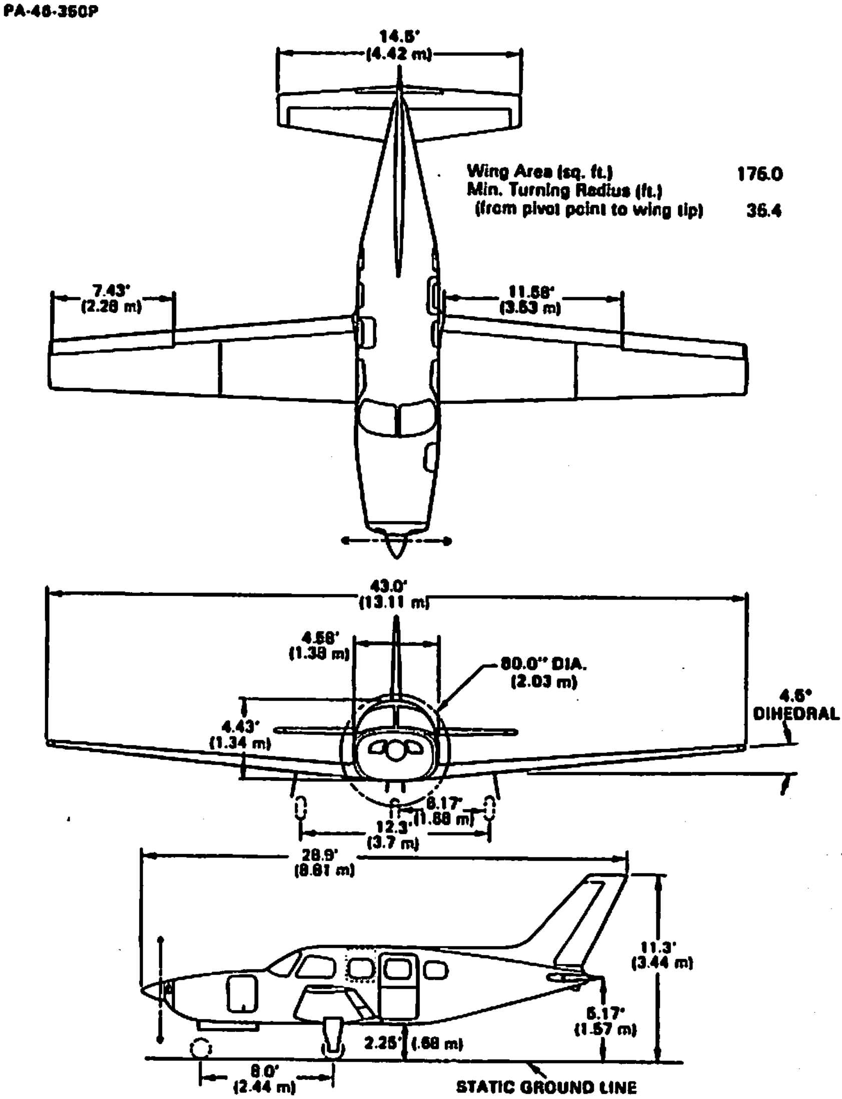
This Pilot's Operating Handbook is designed for maximum utilization as an operating guide for the pilot. It includes the material required to be furnished to the pilot by the Federal Aviation Regulations and additional information provided by the manufacturer and constitutes the FAA Approved Airplane Flight Manual.

This handbook is not designed as a substitute for adequate and competent flight instruction, knowledge of current airworthiness directives, applicable federal air regulations or advisory circulars. It is not intended to be a guide for basic flight instruction or a training manual and should not be used for operational purposes unless kept in a current status.

Assurance that the airplane is in an airworthy condition is the responsibility of the owner. The pilot in command is responsible for determining that the airplane is safe for flight. The pilot is also responsible for remaining within the operating limitations as outlined by instrument markings, placards, and this handbook.

Although the arrangement of this handbook is intended to increase its in-flight capabilities, it should not be used solely as an occasional operating reference. The pilot should study the entire handbook to familiarize himself with the limitations, performance, procedures and operational handling characteristics of the airplane before flight.

The handbook has been divided into numbered (arabic) sections each provided with a finger-tip tab divider for quick reference. The limitations and emergency procedures have been placed ahead of the normal procedures, performance and other sections to provide easier access to information that may be required in flight. The Emergency Procedures Section has been furnished with a red tab divider to present an instant reference to the section. Provisions for expansion of the handbook have been made by the deliberate omission of certain paragraph numbers, figure numbers, item numbers and pages noted as being intentionally left blank.



THREE VIEW
Figure 1-1

1.3 ENGINE

(a) Number of Engines	1
(b) Engine Manufacturer	Textron Lycoming
(c) Engine Model Number	TIO-540-AE2A
(d) Rated Horsepower	350
(e) Rated Speed (rpm)	2500
(f) Maximum Manifold Pressure (in. Hg.)	42.0
(g) Bore (inches)	5.125
(h) Stroke (inches)	4.375
(i) Displacement (cubic inches)	541.5
(j) Compression Ratio	7.3:1
(k) Engine Type	Six Cylinder, Direct Drive, Horizontally Opposed, Air Cooled, Turbocharged, Fuel Injected

1.5 PROPELLER

(a) Number of Propellers	1
(b) Propeller Manufacturer	Hartzell
(c) Blade Model	F8074 Standard F8074K Optional
(d) Number of Blades	2
(e) Hub Model	HC-I2YR-1BF
(f) Propeller Diameter (inches)	
(1) Minimum	79
(2) Maximum	80
(g) Propeller Type	Constant Speed, Hydraulically Actuated

1.7 FUEL

AVGAS ONLY

(a) Fuel Capacity (U.S. gal.) (total)	122
(b) Usable Fuel (U.S. gal.) (total)	120
(c) Fuel	
(1) Minimum Grade	100- Green or 100LL Blue Aviation Grade
(2) Alternate Fuels	Refer to latest revision of Lycoming Service Instruction 1070, except alcohol is *not* approved for use in this airplane.

1.9 OIL

(a) Oil Capacity (U.S. quarts) 12
(b) Oil Specification Refer to latest revision of Lycoming Service Instruction 1014.
(c) Oil Viscosity per Average Ambient Temperature for Starting

Average Ambient Temperature	MIL-L-6082B SAE Grade	MIL-L-22851 Ashless Dispersant SAE Grades
All Temperatures	--	15W-50 or 20W-50
Above 80°F	60	60
Above 60°F	50	40 or 50
30°F to 90°F	40	40
0°F to 70°F	30	30, 40 or 20W-40
Below 10°F	20	30 or 20W-30

When operating temperatures overlap indicated ranges, use the lighter grade oil.

1.11 MAXIMUM WEIGHTS

(a) Maximum Ramp Weight (lb) 4318
(b) Maximum Takeoff Weight (lb) 4300
(c) Maximum Landing Weight (lb) 4100
(d) Maximum Zero Fuel Weight (lb) 4100
(e) Maximum Weights in Baggage Compartments (lb)
   (1) Forward 100
   (2) Aft 100

1.13 STANDARD AIRPLANE WEIGHTS

Refer to Figure 6-5 for the Standard Empty Weight and the Useful Load.

1.15 CABIN AND ENTRY DIMENSIONS (IN.)

(a) Cabin Width (max.)	49.5
(b) Cabin Length (Instrument panel to rear bulkhead)	148
(c) Cabin Height (max.)	47
(d) Entry Width	24
(e) Entry Height	46

1.17 BAGGAGE SPACE AND ENTRY DIMENSIONS

(a) Compartment Volume (cu. ft.)	
(1) Forward	13
(2) Aft	20
(b) Entry Dimensions (in.)	
(1) Forward	19 x 23
(2) Aft	24 x 46

1.19 SPECIFIC LOADING

(a) Wing Loading (lbs. per sq. ft.)	24.6
(b) Power Loading (lbs. per hp)	12.3

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1.21 SYMBOLS, ABBREVIATIONS AND TERMINOLOGY

The following definitions are of symbols, abbreviations and terminology used throughout the handbook and those which may be of added operational significance to the pilot.

(a) General Airspeed Terminology and Symbols

CAS	Calibrated Airspeed means the indicated speed of an aircraft, corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.
KCAS	Calibrated Airspeed expressed in "Knots."
GS	Ground Speed is the speed of an airplane relative to the ground.
IAS	Indicated Airspeed is the speed of an aircraft as shown on the airspeed indicator when corrected for instrument error. IAS values published in this handbook assume zero instrument error.
KIAS	Indicated Airspeed expressed in "Knots."
M	Mach Number is the ratio of true airspeed to the speed of sound.
TAS	True Airspeed is the airspeed of an airplane relative to undisturbed air which is the CAS corrected for altitude, temperature and compressibility.
V_A	Maneuvering Speed is the maximum speed at which application of full available aerodynamic control will not overstress the airplane.
V_{FE}	Maximum Flap Extended Speed is the highest speed permissible with wing flaps in a prescribed extended position.

1.21 SYMBOLS, ABBREVIATIONS AND TERMINOLOGY (Continued)

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_{NE}/M_{NE}	Never Exceed Speed or Mach Number is the speed limit that may not be exceeded at any time.
V_{NO}	Maximum Structural Cruising Speed is the speed that should not be exceeded except in smooth air and then only with caution.
V_S	Stalling Speed or the minimum steady flight speed at which the airplane is controllable.
V_{SO}	Stalling Speed or the minimum steady flight speed at which the airplane is controllable in the landing configuration at maximum gross weight.
V_X	Best Angle-of-Climb Speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance.
V_Y	Best Rate-of-Climb Speed is the airspeed which delivers the greatest gain in altitude in the shortest possible time.

1.21 SYMBOLS, ABBREVIATIONS AND TERMINOLOGY (Continued)

(b) Meteorological Terminology

ISA	International Standard Atmosphere in which: (1) The air is a dry perfect gas; (2) The temperature at sea level is 15° Celsius (59° Fahrenheit); (3) The pressure at sea level is 29.92 inches hg. (1013.2 mb); (4) The temperature gradient from sea level to the altitude at which the temperature is -56.5° C (-69.7° F) is -0.00198° C (-0.003564° F) per foot and zero above that altitude.
OAT	Outside Air Temperature is the free air static temperature obtained either from inflight temperature indications or ground meteorological sources, adjusted for instrument error and compressibility effects.
Indicated Pressure Altitude	The number actually read from an altimeter when the barometric subscale has been set to 29.92 inches of mercury (1013.2 millibars).
Pressure Altitude	Altitude measured from standard sea-level pressure (29.92 in. Hg) by a pressure or barometric altimeter. It is the indicated pressure altitude corrected for position and instrument error. In this handbook, altimeter instrument errors are assumed to be zero.
Station Pressure	Actual atmospheric pressure at field elevation.
Wind	The wind velocities recorded as variables on the charts of this handbook are to be understood as the headwind or tailwind components of the reported winds.

1.21 SYMBOLS, ABBREVIATIONS AND TERMINOLOGY (Continued)

(c) Power Terminology

Takeoff Power	Maximum power permissible for takeoff.
Maximum Continuous Power	Maximum power permissible continuously during flight.
Maximum Climb Power	Maximum power permissible during climb.
Maximum Cruise Power	Maximum power permissible during cruise.

(d) Engine Instruments

T.I.T. Gauge	Turbine Inlet Temperature

(e) Airplane Performance and Flight Planning Terminology

Climb Gradient	The demonstrated ratio of the change in height during a portion of a climb, to the horizontal distance traversed in the same time interval.
Demonstrated Crosswind Velocity	The demonstrated crosswind velocity is the velocity of the crosswind component for which adequate control of the airplane during takeoff and landing was actually demonstrated during certification tests.
Accelerate-Stop Distance	The distance required to accelerate an airplane to a specified speed and, assuming failure of an engine at the instant that speed is attained, to bring the airplane to a stop.
Route Segment	A part of a route. Each end of that part is identified by (1) a geographical location or (2) a point at which a definite radio fix can be established.

1.21 SYMBOLS, ABBREVIATIONS AND TERMINOLOGY (Continued)

(f) Weight and Balance Terminology

Reference Datum	An imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Station	A location along the airplane fuselage usually given in terms of distance from the reference datum.
Arm	The horizontal distance from the reference datum to the center of gravity (C.G.) of an item.
Moment	The product of the weight of an item multiplied by its arm. (Moment divided by a constant is used to simplify balance calculations by reducing the number of digits.)
Center of Gravity (C.G.)	The point at which an airplane would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.
C.G. Arm	The arm obtained by adding the airplane's individual moments and dividing the sum by the total weight.
C.G. Limits	The extreme center of gravity locations within which the airplane must be operated at a given weight.
Usable Fuel	Fuel available for flight planning.
Unusable Fuel	Fuel remaining after a runout test has been completed in accordance with governmental regulations.
Standard Empty Weight	Weight of a standard airplane including unusable fuel, full operating fluids and full oil.

1.21 SYMBOLS, ABBREVIATIONS AND TERMINOLOGY (Continued)

Basic Empty Weight	Standard empty weight plus optional equipment.
Payload	Weight of occupants, cargo and baggage.
Useful Load	Difference between takeoff weight, or ramp weight if applicable, and basic empty weight.
Maximum Ramp Weight	Maximum weight approved for ground maneuver. (It includes weight of start, taxi and run up fuel.)
Maximum Takeoff Weight	Maximum Weight approved for the start of the takeoff run.
Maximum Landing Weight	Maximum weight approved for the landing touchdown.
Maximum Zero Fuel Weight	Maximum weight exclusive of usable fuel.

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SECTION 2

LIMITATIONS

SECTION 2

LIMITATIONS

2.1 GENERAL

This section provides the FAA Approved operating limitations, instrument markings, color coding and basic placards necessary for operation of the airplane and its systems.

Limitations associated with those optional systems and equipment which require handbook supplements can be found in Section 9 (Supplements).

2.3 AIRSPEED LIMITATIONS

SPEED	KIAS	KCAS
Never Exceed Speed (V_{NE}) - Do not exceed this speed in any operation.	198	200
Maximum Structural Cruising Speed (V_{NO}) - Do not exceed this speed except in smooth air and then only with caution.	168	170
Design Maneuvering Speed (V_A) - Do not make full or abrupt control movements above this speed.		
At 4300 LBS. Gross Weight	133	135
At 2450 LBS. Gross Weight	100	102

CAUTION

Maneuvering speed decreases at lighter weight as the effects of aerodynamic forces become more pronounced. Linear interpolation may be used for intermediate gross weights. Maneuvering speed should not be exceeded while operating in rough air.

2.3 AIRSPEED LIMITATIONS (Continued)

SPEED	KIAS	KCAS
Maximum Speed for Pneumatic Boot Inflation.	178	180
Maximum Flaps Extended Speed (V_{FE}) - Do not exceed this speed at the given flap setting.		
10°	165	167
20°	130	132
36°	116	115
Maximum Landing Gear Extension Speed (V_{LO}) - Do not exceed this speed when extending the landing gear.	165	167
Maximum Landing Gear Retraction Speed (V_{LO}) - Do not exceed this speed when retracting the landing gear.	126	128
Maximum Landing Gear Extended Speed (V_{LE}) Do not exceed this speed with the landing gear extended.	195	197

2.5 AIRSPEED INDICATOR MARKINGS

MARKING	IAS
Red Radial Line (Never Exceed)	198 KTS
Yellow Arc (Caution Range - Smooth Air Only)	168 KTS to 198 KTS
Green Arc (Normal Operating Range)	69 KTS to 168 KTS
White Arc (Flap Down)	58 KTS to 116 KTS

2.7 POWER PLANT LIMITATIONS

(a) Number of Engines	1
(b) Engine Manufacturer	Textron Lycoming
(c) Engine Model No.	TIO-540-AE2A
(d) Engine Operating Limits	
(1) Maximum Engine Speed	2500 RPM
(2) Maximum Oil Temperature	245° F
(3) Maximum Cylinder Head Temperature	500° F
(4) Maximum Turbine Inlet Temperature	1750° F
(5) Maximum Manifold Pressure (inches of mercury)	
To 20,000 feet	42
20,000 to 25,000 feet	42 -1.6 per 1000 foot increase
(e) Oil Pressure	
Minimum (red line)	25 PSI
Maximum (red line)	115 PSI
(f) Fuel (AVGAS ONLY) (minimum grade)	100 or 100LL Aviation Grade
(g) Number of Propellers	1
(h) Propeller Manufacturer	Hartzell
(i) Propeller Hub and Blade Model	
Standard	HC-I2YR-1BF/F8074
Optional	HC-I2YR-1BF/F8074K
(j) Propeller Diameter (inches)	
Minimum	79
Maximum	80
(k) Blade Angle Limits	
Low Pitch Stop	17.6° +/- 0.2°
High Pitch Stop	40.5° +/- 0.5°

2.9 LEANING LIMITATIONS

Mixture full RICH at all engine powers above high speed cruise power.

2.11 POWER PLANT INSTRUMENT MARKINGS

(a) Tachometer	
Green Arc (Normal Operating Range)	600 to 2500 RPM
Red Line (Maximum)	2500 RPM
(b) Manifold Pressure	
Green Arc (Normal Operating Range)	10 to 42.0 in. Hg
Red Line (Takeoff Power)	42.0 in. Hg
(c) Oil Temperature	
Green Arc (Normal Cruise Range)	100° to 245°F
Red Line (Maximum)	245°F
(d) Oil Pressure	
Green Arc (Normal Cruise Range)	55 PSI to 95 PSI
Yellow Arc (Caution Range) (Idle)	25 PSI to 55 PSI
Yellow Arc (Caution Range) (Start and Warm Up)	95 PSI to 115 PSI
Red Line (Minimum)	25 PSI
Red Line (Maximum)	115 PSI
(e) Turbine Inlet Temperature	
Green Arc (Normal Operating Range)	1200°F to 1750°F
Red Line (Maximum)	1750°F
(f) Cylinder Head Temperature	
Green Arc (Normal Operating Range)	200°F to 500°F
Red Line (Maximum)	500°F

2.13 WEIGHT LIMITS

(a) Maximum Ramp Weight	4318 LB
(b) Maximum Takeoff Weight	4300 LB
(c) Maximum Landing Weight	4100 LB
(d) Maximum Zero Fuel Weight	4100 LB
(e) Maximum Baggage (100 lb each compartment)	200 LB

NOTE

Refer to Section 5 (Performance) for maximum weight as limited by performance.

2.15 CENTER OF GRAVITY LIMITS

Weight Pounds	Forward Limit Inches Aft of Datum	Rearward Limit Inches Aft of Datum
4300	143.3	147.1
4100	139.1	147.1
4000	137.0	
2450 (and less)	130.7	
2400		137.3

NOTES

Straight line variation between points given.

The datum used is 100.0 inches ahead of the forward pressure bulkhead.

It is the responsibility of the airplane owner and the pilot to insure that the airplane is properly loaded. See Section 6 (Weight and Balance) for proper loading instructions.

2.17 MANEUVER LIMITS

No acrobatic maneuvers including spins approved.

2.19 FLIGHT LOAD FACTORS

(a) Positive Load Factor (Maximum)	
(1) Flaps Up	3.8 G
(2) Flaps Down	2.0 G
(b) Negative Load Factor (Maximum)	No inverted maneuvers approved

2.21 KINDS OF OPERATION EQUIPMENT LIST

This airplane may be operated in day or night VFR, day or night IFR and known icing when the appropriate equipment is installed and operable.

The following equipment list identifies the systems and equipment upon which type certification for each kind of operation was predicated and must be installed and operable for the particular kind of operation indicated.

NOTE

The following system and equipment list does not include specific flight instruments and communication/navigation equipment required by the FAR Part 91 and 135 operating requirements.

System	Number Required	Types of Operation and Remarks (DAY, NIGHT, VFR, IFR and ICING Conditions)
1. ELECTRICAL		
Alternators	1	DAY, NIGHT, VFR, IFR
DC Voltmeter	1	DAY, NIGHT, VFR, IFR, ICING
Ammeters	2	DAY, NIGHT, VFR, IFR, ICING
ALT INOP Annunciator	2	DAY, NIGHT, VFR, IFR, ICING
LO BUS VOLT Annunciator	1	DAY, NIGHT, VFR, IFR, ICING
Propeller Heat Ammeter	1	ICING
Stall Warning	1	DAY, NIGHT, VFR, IFR, ICING
2. EQUIPMENT/ FURNISHINGS		
Safety Restraint Each Occupant	AR	DAY, NIGHT, VFR, IFR, ICING

2.21 KINDS OF OPERATION EQUIPMENT LIST (Continued)

System	Number Required	Types of Operation and Remarks (DAY, NIGHT, VFR, IFR and ICING Conditions)
3. FLIGHT CONTROLS		
Flap Position Indicator	1	DAY, NIGHT, VFR, IFR, ICING
Elevator and Rudder Trim Position Indicator	1 ea.	DAY, NIGHT, VFR, IFR, ICING
4. FUEL		
Fuel Quantity Indicating System	2	DAY, NIGHT, VFR, IFR, ICING
BOOST PUMP Annunciator	1	DAY, NIGHT, VFR, IFR, ICING
FUEL PRESS Annunciator	1	DAY, NIGHT, VFR, IFR, ICING
5. ICE PROTECTION		
Pneumatic Deice System (Wing and Empennage Protection)	1	ICING
Wing Ice Protection Light	1	ICING
Electrothermal Propeller Deice Pads	1 per Blade	ICING
Heated Windshield	1	ICING

2.21 KINDS OF OPERATION EQUIPMENT LIST (Continued)

System	Number Required	Types of Operation and Remarks (DAY, NIGHT, VFR, IFR and ICING Conditions)
5. ICE PROTECTION (Continued)		
Heated Stall Warning Transducer	1	ICING
Heated Pitot Head	1	ICING
Alternate Static Source	1	ICING
WSHLD HEAT Annunciator	1	ICING
Vac Pump	2	ICING
SURF DEICE Annunciator	1	ICING
Alternator	2	ICING
6. INSTRUMENTATION - ENGINE		
Tachometer	1	DAY, NIGHT, VFR, IFR, ICING
Oil Pressure Indicator	1	DAY, NIGHT, VFR, IFR, ICING
Oil Temperature Indicator	1	DAY, NIGHT, VFR, IFR, ICING
Manifold Pressure Indicator	1	DAY, NIGHT, VFR, IFR, ICING
Cylinder Head Temperature Indicator	1	DAY, NIGHT, VFR, IFR, ICING
Turbine Inlet Temperature Indicator	1	DAY, NIGHT, VFR, IFR, ICING

2.21 KINDS OF OPERATION EQUIPMENT LIST (Continued)

System	Number Required	Types of Operation and Remarks (DAY, NIGHT, VFR, IFR and ICING Conditions)
7. INSTRUMENTATION - FLIGHT		
Airspeed Indicator	1	DAY, NIGHT, VFR, IFR, ICING
Altimeter	1	DAY, NIGHT, VFR, IFR, ICING
Free Air Temperature Gauge	1	DAY, NIGHT, VFR, IFR, ICING
Gyroscopic Attitude Indicator	1	IFR, ICING
Gyroscopic Heading Indicator	1	IFR, ICING
Turn Coordinator	1	IFR, ICING
8. LANDING GEAR		
Hydraulic Pump	1	DAY, NIGHT, VFR, IFR, ICING
HYD PUMP Annunciator	1	DAY, NIGHT, VFR, IFR, ICING
Landing Gear Down Position Indicating Lights	3	DAY, NIGHT, VFR, IFR, ICING
Landing Gear Warning Horn	1	DAY, NIGHT, VFR, IFR, ICING
GEAR WARN Annunciator	1	DAY, NIGHT, VFR, IFR, ICING

2.21 KINDS OF OPERATION EQUIPMENT LIST (Continued)

System	Number Required	Types of Operation and Remarks (DAY, NIGHT, VFR, IFR and ICING Conditions)
9. LIGHTS - EXTERNAL		
Position Lights a. Left Wing - Red and White	1 ea.	NIGHT
b. Right Wing - Green and White	1 ea.	NIGHT
Anti-Collision (Strobe) Lights	2	NIGHT
10. LIGHTS - COCKPIT		
Instrument Panel Switch Lights	AR	NIGHT
Instrument Lights	AR	NIGHT
Map Lights	2	NIGHT
11. PNEUMATIC/ VACUUM		
Vacuum Pumps	1	IFR
Gyro Suction Indicator	1	IFR, ICING

2.21 KINDS OF OPERATION EQUIPMENT LIST (Continued)

System	Number Required	Types of Operation and Remarks (DAY, NIGHT, VFR, IFR and ICING Conditions)
12. PRESSURIZED FLIGHT		
Cabin Altimeter	1	DAY, NIGHT, VFR, IFR, ICING
Cabin Differential Pressure Indicator	1	DAY, NIGHT, VFR, IFR ICING
Cabin Vertical Speed Indicator	1	DAY, NIGHT, VFR, IFR ICING
Pressure Control Valve	1	DAY, NIGHT, VFR, IFR ICING
Pressure Relief Safety Valve	1	DAY, NIGHT, VFR, IFR ICING
Pressurization Controller	1	DAY, NIGHT, VFR, IFR ICING
CAB ALT Annunciator	1	DAY, NIGHT, VFR, IFR ICING
Vacuum Pump	1	DAY, NIGHT, VFR, IFR ICING
13. MISCELLANEOUS		
Stall Warning System	1	DAY, NIGHT, VFR, IFR, ICING
STALL WARN FAIL Annunciator	1	DAY, NIGHT, VFR, IFR, ICING
Annunciator Test System	1	DAY, NIGHT, VFR, IFR, ICING

2.23 FUEL LIMITATIONS

(a) Minimum Aviation Fuel Grade 100LL/100
(b) Total Capacity .... 122 U.S. GAL.
(c) Unusable Fuel .... 2 U.S. GAL.
The unusable fuel for this airplane has been determined as 1.0 gallon in each wing in critical flight attitudes.
(d) Usable Fuel .... 120 U.S. GAL.
The usable fuel in this airplane has been determined as 60 gallons in each wing.
(e) Fuel Imbalance
Maximum fuel imbalance is 10 gallons.

2.25 OPERATING ALTITUDE LIMITATIONS

Flight above 25,000 feet pressure altitude is not approved. Flight up to and including 25,000 feet is approved if equipped with avionics in accordance with FAR 91 or FAR 135.

2.27 CABIN PRESSURIZATION LIMITS

(a) Pressurized flight operation approved at maximum cabin differential pressure of 5.5 psi.
(b) Pressurized landing not approved.

2.29 AIR CONDITIONING SYSTEM LIMITATIONS

AIR COND/BLWR switch in OFF or BLWR position for takeoffs and landings.

NOTE

REC BLWR switch may be in HIGH or LOW position.

2.31 ELECTRIC AUXILIARY CABIN HEATER LIMITATIONS

(a) Both alternators must be functioning.
(b) The low voltage monitor system and annunciator must be functional.
(c) The Vent/Defog Fan must be operational for heater ground operation.
(d) Maximum ambient temperature for heater operation is 20°C (68°F).

2.33 MAXIMUM SEATING CONFIGURATION

The maximum seating capacity is 6 (six) persons.

2.35 PLACARDS

In full view of the pilot:

The markings and placards installed in this airplane contain operating limitations which must be complied with when operating this airplane in the normal category. Other operating limitations which must be complied with when operating this airplane in this category are contained in the airplane flight manual. No aerobatic maneuvers, including spins, approved.

This aircraft approved for V.F.R., I.F.R., day and night icing flight when equipped in accordance with the Airplane Flight Manual.

In full view of the pilot, the following takeoff and landing checklists will be installed:

TAKEOFF CHECKLIST

Fuel on Proper Tank	Fasten Belts/Harnesses
Engine Gauges Checked	Flaps Set
Induction Air - Primary	Trim Set
Seat Backs Erect	Controls Free
Armrests Stowed	Door Secured
Mixture Set	Air Conditioner - Off
Propeller Set	Pressurization System - Set
Emergency Fuel Pump - On	

LANDING CHECKLIST

Fuel on Proper Tank	Emergency Fuel Pump - On
Seat Backs Erect	Gear Down
Armrests Stowed	Flaps Set
Fasten Belts/Harnesses	Air Conditioner - Off
Mixture - Rich	Cabin Pressure - Depressurized
Propeller - Set	

2.35 PLACARDS (Continued)

On the instrument panel in full view of the pilot:

V_A 133 KIAS at 4300 LBS.
(See A.F.M.)

In full view of the pilot:

V_{LO} 165 DN, 126 UP
V_{LE} 195 MAX

Near emergency gear release:

EMERGENCY GEAR EXTENSION
PULL TO RELEASE. SEE A.F.M.
BEFORE RE-ENGAGEMENT

In full view of the pilot:

WARNING

TURN OFF STROBE LIGHTS WHEN IN CLOSE PROXIMITY TO GROUND OR DURING FLIGHT THROUGH CLOUD, FOG OR HAZE.

Near the magnetic compass:

CAUTION - COMPASS CAL. MAY BE IN ERROR WITH ELECT. EQUIPMENT OTHER THAN AVIONICS ON.

2.35 PLACARDS (Continued)

In full view of the pilot when the air conditioner is installed:

WARNING — AIR CONDITIONER MUST BE OFF TO INSURE NORMAL TAKEOFF CLIMB PERFORMANCE.

On the inside of the forward baggage door:

MAXIMUM BAGGAGE THIS COMPARTMENT 100 LBS.

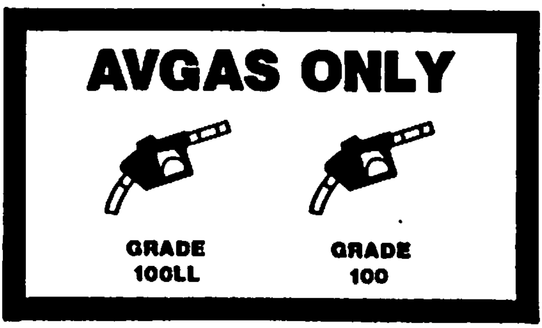
On aft baggage closeout:

MAXIMUM BAGGAGE THIS COMPARTMENT 100 LBS.

In full view of the pilot:

PRESSURIZED LANDING NOT APPROVED

Adjacent to fuel tank filler caps:



2.35 PLACARDS (Continued)

Over emergency exit handle:

EMERGENCY EXIT
REMOVE GLASS
PULL DOOR IN - LIFT UP

On aft baggage closeout:

MAXIMUM LOAD EACH COAT HOOK 8 LBS

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SECTION 3

EMERGENCY PROCEDURES

3.1 GENERAL

This section provides the recommended procedures for coping with various emergency or critical situations. All of the emergency procedures required by the FAA as well as those necessary for operation of the airplane, as determined by the operating and design features of the airplane, are presented.

Emergency procedures associated with optional systems and equipment which require handbook supplements are presented in Section 9, Supplements.

This section is divided into two basic parts. The first part contains the emergency procedures checklists. These checklists supply an immediate action sequence to be followed during critical situations with little emphasis on the operation of the systems. The numbers located in parentheses after each checklist heading indicate where the corresponding paragraph in the amplified procedures can be found.

The second part of the section provides amplified emergency procedures corresponding to the emergency procedures checklist items. These amplified emergency procedures contain additional information to provide the pilot with a more complete description of the procedures so they may be more easily understood. The numbers located in parentheses after each paragraph heading indicates the corresponding checklist paragraph.

Pilots must familiarize themselves with the procedures given in this section and must be prepared to take the appropriate action should an emergency situation arise. The procedures are offered as a course of action for coping with the particular situation or condition described. They are not a substitute for sound judgement and common sense.

Most basic emergency procedures are a normal part of pilot training. The information presented in this section is not intended to replace this training. This information is intended to provide a source of reference for the procedures which are applicable to this airplane. The pilot should review standard emergency procedures periodically to remain proficient in them.

3.3 EMERGENCY PROCEDURES CHECKLIST

3.3a ENGINE FIRE DURING START (3.7)

Starter (crank engine) .... PUSH
Mixture .... IDLE CUT-OFF
Throttle .... OPEN
Fuel Selector .... OFF
Emergency (EMERG) Fuel Pump .... CHECK OFF
Abandon if fire continues

3.3b ENGINE POWER LOSS DURING TAKEOFF (3.9)

If sufficient runway remains for a normal landing, leave gear down and land straight ahead.

If area ahead is rough, or if it is necessary to clear obstructions:

Landing Gear Selector .... UP
Mixture .... IDLE CUT-OFF
Emergency (EMERG) Fuel Pump .... OFF
Fuel Selector .... OFF
Battery Master (after
gear retraction) .... OFF

If sufficient altitude has been gained to attempt a restart:

Maintain Safe Airspeed
Emergency (EMERG) Fuel Pump .... Check ON
Fuel Selector .... SWITCH to tank containing fuel
Mixture .... FULL RICH
Induction Air .... ALTERNATE

CAUTION

If normal engine operation and fuel flow are not reestablished, the emergency (EMERG) fuel pump should be turned OFF. The lack of a fuel flow indication could indicate a leak in the fuel system. If fuel system leak is verified, switch fuel selector to OFF.

If power is not regained:

Prepare for power off landing.

3.3c ENGINE POWER LOSS IN FLIGHT (3.11)

Trim for 90 KIAS

Emergency (EMERG) Fuel Pump .... ON
Fuel selector .... SWITCH to tank containing fuel
Mixture .... RICH
Induction Air .... ALTERNATE
Engine Gauges .... CHECK for indication of cause of power loss

If power is restored:

Induction Air .... PRIMARY
Emergency (EMERG) Fuel Pump (Except in case of engine driven pump failure) .... OFF
Mixture .... AS REQUIRED
Land as soon as practical and investigate cause of power loss.

CAUTION

If normal engine operation and fuel flow are not reestablished, the emergency (EMERG) fuel pump should be turned OFF. The lack of a fuel flow indication could indicate a leak in the fuel system. If fuel system leak is verified, switch fuel selector to OFF.

If power is not restored:

Prepare for power off landing.

3.3d POWER OFF LANDING (3.13)

Propeller Control .... FULL DECREASE

Best gliding angle 90 KIAS.
Locate suitable field.
Establish spiral pattern.
1000 ft. above field at downwind position for normal landing approach.
When field can easily be reached slow to 77 KIAS for shortest landing.

Touchdowns should normally be made at lowest possible airspeed with flaps fully extended.

3.3d POWER OFF LANDING (3.13) (Continued)

When committed to landing:

Landing Gear Selector .... AS REQUIRED
Throttle .... CLOSED
Mixture .... IDLE CUT-OFF
Magneto Switches .... OFF
Emergency (EMERG) Fuel Pump .... OFF
Fuel Selector .... OFF
Flaps .... AS REQUIRED
Battery Master Switch .... OFF
ALTR Switches .... OFF
Seat Belt and Harness .... TIGHT

NOTE

If the battery master and alternator switches are OFF, the gear position lights and flaps will be inoperative.

3.3e FIRE IN FLIGHT (3.15)

Source Of Fire .... CHECK

NOTE

If pressurized, the following procedure will result in an immediate loss of pressurization and the cabin altitude will rise at an uncontrolled rate.

Electrical Fire (smoke in cabin):

Cabin Pressure Dump/Normal Switch .... DUMP
Cabin Pressurization Control .... PULL to unpressurize

After 5 second delay:

Battery Master Switch .... OFF
ALTR Switches .... OFF
Cabin Heat .... OFF

3.3e FIRE IN FLIGHT (3.15) (Continued)

CAUTION

The cabin pressure dump valve will remain open if the cabin pressure dump/normal switch is positioned to DUMP prior to turning the aircraft electrical system OFF. This provides maximum airflow through the cabin for smoke evacuation. Do not turn the cabin pressure dump/normal switch to NORM. The dump valve will close and cannot be reactivated unless electrical power is turned on.

Emergency descent ....TO A SAFE ALTITUDE CONSISTENT WITH TERRAIN
Land as soon as possible.

WARNING

If emergency oxygen is installed, use ONLY if flames and heat are not present.

Engine fire:

Throttle .... CLOSED
Mixture ....IDLE CUT-OFF
Fuel Selector .... OFF
Magneto Switches.. OFF
Emergency (EMERG) Fuel Pump.................... CHECK OFF
Vent Defog Fan .... OFF
Temperature Control Knob .... PUSH OFF
Auxiliary Heat Switch .... OFF
Proceed with power off landing procedure (3.3d).

3.3f LOSS OF OIL PRESSURE (3.17)

Land as soon as possible and investigate cause. Prepare for power off landing.

3.3g LOSS OF FUEL FLOW (3.19)

CAUTION

Turn emergency (EMERG) fuel pump OFF if fuel flow and power is not immediately restored. The lack of fuel flow indication could indicate a leak in the fuel system. If fuel system leak is verified, switch fuel selector to OFF.

3.3g LOSS OF FUEL FLOW (3.19) (Continued)

Emergency (EMERG) Fuel Pump .... ON
Fuel Selector .... CHECK on tank containing usable fuel

If power restored:
Emergency (EMERG) Fuel Pump (except in case of engine driven pump failure) .... OFF
Mixture .... AS REQUIRED

If power not restored:
Emergency (EMERG) Fuel Pump .... OFF
Fuel Selector .... OFF
Proceed with power off landing procedure (3.3d).

3.3h ENGINE DRIVEN FUEL PUMP FAILURE (FUEL PRESS light illuminated - annunciator panel) (3.21)

Throttle .... RETARD
Emergency (EMERG) Fuel Pump .... ON
Throttle .... RESET AS REQUIRED
Mixture .... RESET AS REQUIRED

CAUTION

If normal engine operation and fuel flow are not reestablished the emergency (EMERG) fuel pump should be turned OFF. The lack of a fuel flow indication could indicate a leak in the fuel system. If system leak is verified, switch fuel selector to OFF.

If power is not restored, proceed with power off landing procedure (3.3d).

3.3i HIGH OIL TEMPERATURE (3.23)

Power .... REDUCE
Mixture .... ENRICH, if practical
Airspeed .... INCREASE, if practical

If condition is not corrected:

Land at nearest airport and investigate the problem. Prepare for power off landing.

3.3j HIGH CYLINDER HEAD TEMPERATURE (3.25)

Power .... REDUCE
Mixture .... ENRICH, if practical
Airspeed .... INCREASE, if practical

If condition is not corrected:

Land at nearest airport and investigate problem.

3.3k ELECTRICAL FAILURES (3.27)

Single Alternator Failure (Zero amps or ALTERNATOR #1 or #2 INOP light illuminated - annunciator panel).

NOTE

Anytime total tie bus voltage is below 25 Vdc, the LOW BUS VOLTAGE annunciator will illuminate.

Verify failure .... CHECK AMMETER

Electrical Load (if LOW BUS VOLTAGE annunciator illuminated) .... REDUCE until total load is less than 70 amps & LOW BUS VOLTAGE annunciator extinguished
Failed ALTR Switch .... OFF
Failed ALTR Circuit Breaker.................. CHECK and RESET as required
Failed ALTR Switch (after OFF at least one second) .... ON

If power not restored:
Failed ALTR Switch .... OFF
Ammeter .... MONITOR and maintain BELOW 70 AMPS

While one alternator will supply sufficient current for minimum required avionics and cockpit lighting, use of deicing equipment, particularly windshield or propeller heat, may be limited. Immediate action should be taken to avoid or exit icing conditions. Under no circumstances may the total electrical load exceed 70 amps. The supplemental electric cabin heater, cabin recirculation blowers, and position, strobe, and landing lights should not be used unless absolutely necessary.

3.3k ELECTRICAL FAILURES (3.27) (Continued)

Dual Alternator Failure (Zero amps both ammeters or ALTERNATOR #1 or #2 INOP lights illuminated - annunciator panel).

NOTE

Anytime total tie bus voltage is below 25 Vdc, the LOW BUS VOLTAGE annunciator will illuminate.

Electrical Load .... REDUCE TO MINIMUM required for safe flight
ALTR NO. 1 and NO. 2 Switches .... OFF
ALTR NO. 1 and NO. 2 Circuit Breakers .... CHECK and RESET as required
ALTR NO. 1 Switch (after OFF at least one second) .... ON
ALTR NO. 2 Switch (after OFF at least one second) .... ON

If only one alternator resets:
Operating ALTR Switch .... ON
Failed ALTR Switch .... OFF
Electrical Load .... MAINTAIN LESS THAN 70 AMPS
Ammeter .... MONITOR

If neither alternator resets:
Both ALTR Switches .... OFF

Continue flight with reduced electrical load on battery power only.

NOTE

LOW BUS VOLTAGE annunciator will be illuminated.

Land as soon as practical. Anticipate complete electrical failure. Duration of battery power available will be dependent on electrical load and battery condition prior to failure.

NOTE

If the battery is depleted, the landing gear must be lowered using the emergency extension procedure. The gear position lights will be inoperative. The flaps will also be inoperative and a flaps up landing will be required.

3.3k ELECTRICAL FAILURES (3.27) (Continued)

Supplemental Heater Control Circuit Failure (Heater Continues to Operate With AUX CABIN and VENT/DEFOG FAN switches OFF):

VENT DEFOG Circuit Breaker .... PULL

If the heater still operates:

BATT MASTER Switch .... OFF
ALTR Switches .... OFF

Land as soon as practical.

3.3m PROPELLER OVERSPEED (3.29)

Throttle .... RETARD
Oil Pressure .... CHECK
Propeller Control .... FULL DECREASE rpm, then set if any control available
Airspeed .... REDUCE
Throttle .... AS REQUIRED to remain below 2500 rpm

Land as soon as practical and investigate cause of overspeed.

3.3n EMERGENCY LANDING GEAR EXTENSION (3.31)

If emergency gear extension is required due to electrical power failure, the gear position indicator lights will not illuminate.

Prior to emergency extension procedure:

Battery Master Switch .... CHECK ON
Circuit Breakers .... CHECK
DAY/NIGHT Dimming Switch (in daytime) .... DAY

If landing gear does not check down and locked:

Airspeed .... BELOW 90 KIAS
Hydraulic Pump Power Circuit Breaker (25 amp) .... PULL
Landing Gear Selector .... DOWN
Emergency Gear Extend Control .... PULL (while fishtailing airplane)

3.3o SPIN RECOVERY (3.33)

Rudder .... FULL OPPOSITE to DIRECTION of ROTATION
Control Wheel .... FULL FORWARD while NEUTRALIZING AILERONS
Throttle .... CLOSED
Rudder (when rotation stops) .... NEUTRAL
Control Wheel .... AS REQUIRED to smoothly regain level flight attitude

3.3p ENGINE ROUGHNESS (3.35)

Mixture .... ADJUST FOR MAXIMUM SMOOTHNESS
Induction Air .... ALTERNATE
Emergency (EMERG) Fuel Pump .... ON
Fuel Selector .... SELECT ANOTHER TANK

3.3q EMERGENCY DESCENT (3.37)

NOTE

If pressurized, the following procedure will result in an immediate loss of pressurization and the cabin altitude will rise at an uncontrolled rate.

Throttle .... CLOSED
Propeller Control .... FULL INCREASE
Mixture .... AS REQUIRED
Landing Gear .... DOWN (165 KIAS maximum)
Flaps .... UP

SMOOTH AIR

Airspeed After Landing Gear Is Fully Extended .... 180-195 KIAS

ROUGH AIR

Airspeed After Landing Gear Is Fully Extended .... 4300 lbs. 133 KIAS
2450 lbs. 100 KIAS

3.3r PRESSURIZATION SYSTEM MALFUNCTION (3.39)

Should the differential pressure rise above 5.5 psi maximum or a structural failure appear imminent, proceed as follows:

Cabin Pressure Dump/Normal Switch .... DUMP
Cabin Pressurization Control .... PULL to unpressurize
Emergency Descent .... TO A SAFE ALTITUDE CONSISTENT WITH TERRAIN

NOTE

If emergency oxygen is installed, don masks, activate oxygen generators, check flow, and descend.

Should the aircraft suddenly lose pressurization, proceed as follows:

Cabin Pressure Dump/Normal Switch .... CHECK NORM
Cabin Pressurization Control .... CHECK IN
Emergency Descent .... TO A SAFE ALTITUDE CONSISTENT WITH TERRAIN

NOTE

If emergency oxygen is installed, don masks, activate oxygen generators, check flow, and descend.

3.3s CABIN AIR CONTAMINATION/SMOKE EVACUATION (3.41) (Pressurized)

Cabin Pressure Dump/Normal Switch .... DUMP
Cabin Pressurization Control .... PULL to unpressurize
Auxiliary Cabin Heat Switch .... OFF
Vent/Defog Blower Switch .... ON
Cabin Recirculation Blower Switch .... OFF
Storm Window .... closed
Emergency Descent .... TO A SAFE ALTITUDE CONSISTENT WITH TERRAIN

Land as soon as practical.

NOTE

If emergency oxygen is installed, don masks, activate oxygen generators, check flow, and descend.

3.3s CABIN AIR CONTAMINATION/SMOKE EVACUATION (3.41) (Pressurized) (Continued)

NOTE

If fumes/smoke dissipate land as soon as practical to investigate problem. If fumes/smoke persist, refer to Fire in Flight paragraph 3.3e.

3.3t VACUUM SYSTEM FAILURE (3.43)

Single Vacuum System Failure (Reduced suction pressure and left or right vacuum flow button extended.

Gyro Suction Gauge........................CHECK 4.5 to 5.2 in. Hg
Operating Pump Flow Button .... RETRACTED
VACUUM LOW Annunciator..................... EXTINGUISHED

Although either vacuum pump independently has sufficient capacity to operate the flight instruments and the deice boots in a normal manner, intentional or continued operation in icing conditions is not recommended. Immediate action should be taken to avoid or exit icing conditions.

Dual Vacuum System Failure (Suction below 4.0 in. Hg, both vacuum flow buttons extended, and VACUUM LOW annunciator illuminated - annunciator panel.

If both vacuum systems are inoperable, the turn coordinator will be the only usable gyroscopic flight instrument, wing and tail deicer boots will be inoperative, and loss of cabin pressure control is possible. Manually dump cabin pressure before landing. A precautionary landing should be considered depending on operating conditions.

3.3u INADVERTENT ICING ENCOUNTER (3.45)

WARNING

Flight into known icing conditions is prohibited unless Ice Protection System is installed and fully operational. Refer to Section 9, Supplement 6.

Induction Air.....................................ALTERNATE
Pitot Heat .... ON
Stall Warning Heat .... ON
Windshield Defrost.................................... ON

3.3u INADVERTENT ICING ENCOUNTER (3.45) (Continued)

Vent/Defog Fan .... ON
Electric Windshield Heat
(if installed) .... LOW or HIGH, as required

Change heading and/or altitude to exit icing conditions.

3.3v HYDRAULIC SYSTEM MALFUNCTION (3.49)

HYDRAULIC PUMP annunciator light illuminates continuously, or cycles on and off rapidly:

HYDRAULIC PUMP POWER Circuit Breaker .... PULL
Land as soon as practical and investigate the cause.

Prior to landing, the HYDRAULIC PUMP POWER circuit breaker must be reset in order to extend the landing gear. If pump continues to run after gear is locked down, pull the HYDRAULIC PUMP POWER circuit breaker. If gear fails to extend, refer to Emergency Landing Gear Extension (3.3n).

3.3w FLAP SYSTEM MALFUNCTION (3.51)

FLAPS annunciator light illuminated:

FLAP WARN circuit breaker ....PULL and RESET
VERIFY Normal Flap Operation.

If FLAPS annunciator light remains illuminated:

FLAP MOTOR Circuit Breaker .... PULL

CAUTION

Higher than normal approach and landing speeds may be required if full symmetrical flap extension is not available. Longer landing distances than shown in Section 5 will result from increased airspeed approaches.

Land as soon as practical and investigate the cause.

3.3x FUEL TANK SUBMERGED PUMP FAILURE (BOOST PUMP light illuminated - annunciator panel) (3.53)

Boost Pump Circuit Breaker........................ CHECK - RESET if necessary
BOOST PUMP Annunciator Light................ EXTINGUISHED

If circuit breaker does not remain closed or annunciator remains lit:

Fuel Selector ....SWITCH to tank with operating boost pump
BOOST PUMP Annunciator Light................ EXTINGUISHED

Land as soon as practical. Have inoperative pump repaired prior to further flight.

3.3y STALL WARNING FAILURE (STALL WARN FAIL light illuminated - annunciator panel) (3.55)

STALL WARN Circuit Breaker .... CHECK - RESET if necessary

If circuit breaker does not remain closed, or STALL WARN annunciator does not extinguish, the stall warning system will be inoperative for remainder of flight. After landing, have system repaired prior to further flight.

3.3z ANNUNCIATOR LIGHT PANEL FAILURE (ANNUNCIATOR INOP light illuminated - annunciator panel) (3.57)

ANNUN Circuit Breaker......................... CHECK - RESET if necessary
ANNUNCIATOR INOP Light .... EXTINGUISHED

If ANNUN circuit breaker not open:

Annunciator Test Switch.......................................PUSH

If annunciator lights illuminate, annunciator panel is functioning properly. ANNUNCIATOR INOP will remain lit.

If ANNUN circuit breaker does not remain closed, or lights fail to illuminate when tested, annunciator lights will be inoperative for remainder of flight.

System should be repaired prior to further flight.

3.3aa EMERGENCY EXIT (3.59)

Exit (second window from front
on right side .... LOCATE

NOTE

The cabin must be depressurized before attempting to open the emergency exit.

Plexiglas Cover .... REMOVE
Handle .... PULL
Emergency Exit Window .... PULL IN

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3.5 AMPLIFIED EMERGENCY PROCEDURES (GENERAL)

The following paragraphs are presented to supply additional information for the purpose of providing the pilot with a more complete understanding of the recommended course of action and probable cause of an emergency situation.

3.7 ENGINE FIRE DURING START (3.3a)

Engine fires during start are usually the result of overpriming. The first attempt to extinguish the fire is to try to start the engine and draw the excess fuel back into the induction system.

If a fire is present before the engine has started, move the mixture control to idle cut-off, open the throttle and crank the engine. This is an attempt to draw the fire back into the engine.

If the engine has started, continue operating to try to pull the fire into the engine.

In either case (above), if fire continues more than a few seconds, the fire should be extinguished by the best available external means.

Turn OFF the emergency fuel pump. The fuel selector valve should be OFF and the mixture at idle cut-off if an external fire extinguishing method is to be used.

3.9 ENGINE POWER LOSS DURING TAKEOFF (3.3b)

The proper action to be taken if loss of power occurs during takeoff will depend on the circumstances of the particular situation.

If sufficient runway remains to complete a normal landing, leave the landing gear down and land straight ahead.

If the area ahead is rough, or if it is necessary to clear obstructions, move the landing gear selector switch to the UP position and prepare for a gear up landing. If time permits, move mixture control to idle cut-off, turn OFF the emergency (EMERG) fuel pump, move the fuel selector to OFF and, after the landing gear is retracted, turn battery master switch OFF.

3.9 ENGINE POWER LOSS DURING TAKEOFF (3.3b) (Continued)

If sufficient altitude has been gained to attempt a restart, maintain a safe airspeed, turn the emergency fuel pump ON, and switch the fuel selector to another tank containing fuel. Ensure the mixture is full RICH and move the induction air lever to the ALTERNATE position.

CAUTION

If normal engine operation and fuel flow are not reestablished, the emergency (EMERG) fuel pump should be turned OFF. The lack of a fuel flow indication could indicate a leak in the fuel system. If fuel system leak is verified, switch fuel selector to OFF.

If engine failure was caused by fuel exhaustion, power will not be regained after switching fuel tanks until the empty fuel lines are filled. This may require up to ten seconds.

If power is not regained, proceed with Power Off Landing procedure (refer to paragraph 3.13).

3.11 ENGINE POWER LOSS IN FLIGHT (3.3c)

Complete engine power loss is usually caused by fuel flow interruption and power will be restored shortly after fuel flow is restored. The first step is to prepare for a power off landing (refer to paragraph 3.13). An airspeed of at least 90 KIAS should be maintained.

If altitude permits, turn the emergency (EMERG) fuel pump ON and switch the fuel selector to another tank containing fuel. Reset the mixture control to RICH and move the induction air lever to ALTERNATE. Check the engine gauges for an indication of the cause of the power loss. If no fuel flow is indicated, check the tank selector position to be sure it is on a tank containing fuel.

3.11 ENGINE POWER LOSS IN FLIGHT (3.3c) (Continued)

If power is restored move the induction air to the PRIMARY position (unless induction ice is suspected). Turn OFF the emergency (EMERG) fuel pump (except in case of engine driven fuel pump failure) and adjust the mixture control as necessary. Land as soon as practical and investigate cause of power loss.

CAUTION

If normal engine operation and fuel flow are not reestablished, the emergency (EMERG) fuel pump should be turned OFF. The lack of a fuel flow indication could indicate a leak in the fuel system. If fuel system leak is verified, switch fuel selector to OFF.

If the preceding steps do not restore power, prepare for a power off landing.

If previous procedure has not restored power and time permits, secure one magneto at a time, then back to both ON. Move the throttle and mixture control levers to different settings. This may restore power if the problem is too rich or too lean a mixture or if there is a partial fuel system restriction. Water in the fuel could take some time to be used up, and allowing the engine to windmill may restore power. If power loss is due to water, fuel flow indications will be normal.

If engine failure was caused by fuel exhaustion, power will not be restored after switching fuel tanks until the empty fuel lines are filled. This may require up to ten seconds.

If power is not regained, proceed with the Power Off Landing procedure (refer to paragraph 3.13).

3.13 POWER OFF LANDING (3.3d)

If loss of power occurs at altitude, trim the aircraft for best gliding angle (90 KIAS) and look for a suitable field. If measures taken to restore power are not effective, and if time permits, check your charts for airports in the immediate vicinity; it may be possible to land at one if you have sufficient altitude. At best gliding angle, with no wind, with the engine windmilling and the propeller control in full DECREASE rpm, the aircraft will travel approximately 2 miles for each thousand feet of altitude. If possible, notify the FAA or any other authority by radio of your difficulty and intentions. If another pilot or passenger is aboard, let them help.

When you have located a suitable field, establish a spiral pattern around this field. Try to be at 1000 feet above the field at the downwind position, to make a normal landing approach. When the field can easily be reached, slow to 77 KIAS with flaps down for the shortest landing. Excess altitude may be lost by widening your pattern, using flaps or slipping, or a combination of these.

Whether to attempt a landing with gear up or down depends on many factors. If the field chosen is obviously smooth and firm, and long enough to bring the plane to a stop, the gear should be down. If there are stumps or rocks or other large obstacles in the field, the gear in the down position will better protect the occupants of the aircraft. If however, the field is suspected to be excessively soft or short, or when landing in water of any depth, a wheels-up landing will normally be safer and do less damage to the airplane.

Touchdowns should normally be made at the lowest possible airspeed with flaps fully extended.

When committed to landing, verify the landing gear selector position as required by field conditions. Close the throttle, move the mixture to idle cut-off, shut OFF the magneto switches, and ensure the emergency (EMERG) fuel pump is OFF. Move the fuel selector valve to OFF. After final flap setting, turn the battery master and alternator switches OFF. The seat belts and shoulder harness should be tightened.

NOTE

If the battery master and alternator switches are OFF, the gear position lights and flaps will be inoperative.

3.15 FIRE IN FLIGHT (3.3e)

The presence of fire is noted through smoke, smell, and heat in the cabin. It is essential that the source of the fire be promptly identified through instrument readings, character of smoke, or other indications since the action to be taken differs somewhat in each case.

Check for the source of the fire first.

If an electrical fire is indicated (smoke in cockpit), place the cabin pressure dump/normal switch in the DUMP position and PULL the cabin pressurization control to clear the smoke. After a delay of 5 seconds turn off the battery master and alternator switches. The cabin heat should also be turned OFF.

CAUTION

The cabin pressure dump valve will remain open if the cabin pressure dump/normal switch is positioned to DUMP prior to turning the aircraft electrical system OFF. This provides maximum airflow through the cabin for smoke evacuation. Do not set the cabin pressure dump/normal switch to NORM. The dump valve will close and cannot be reactivated unless electrical power is turned ON.

An emergency descent should be executed to a safe altitude consistent with terrain and a landing made as soon as possible.

WARNING

If emergency oxygen is installed, use ONLY if flames and heat are not present.

If an engine fire is present, close the throttle, move the mixture control to idle cut-off and place the fuel selector in the OFF position. Turn the magneto switches OFF and check that the emergency (EMERG) fuel pump is OFF. In all cases, the heater and defroster should be OFF. If radio communication is not required turn the battery master and alternator switches OFF. If the terrain permits, a landing should be made immediately (refer to Power Off Landing procedure paragraph 3.13). Because the flaps and landing gear position lights will become inoperative, be sure final flap and gear selection is made before turning the battery master and alternator switches OFF.

3.17 LOSS OF OIL PRESSURE (3.3f)

Loss of oil pressure may be either partial or complete. A partial loss of oil pressure usually indicates a malfunction in the oil pressure regulating system, and a landing should be made as soon as possible to investigate the cause and prevent engine damage.

A complete loss of oil pressure indication may signify oil exhaustion or may be the result of a faulty gauge. In either case, proceed toward the nearest airport and be prepared for a forced landing. If the problem is not a pressure gauge malfunction, the engine may stop suddenly. Maintain altitude until such time as a power off landing can be accomplished. Do not change power settings unnecessarily, as this may hasten complete power loss.

Depending on the circumstances, it may be advisable to make an off airport landing while power is still available, particularly if other indications of actual oil pressure loss, such as sudden increases in temperatures, or oil smoke, are apparent, and an airport is not close.

If engine stoppage occurs, proceed with Power Off Landing procedure (refer to paragraph 3.13).

3.19 LOSS OF FUEL FLOW (3.3g)

CAUTION

Turn emergency (EMERG) fuel pump OFF if fuel flow and power is not immediately restored. The lack of a fuel flow indication could indicate a leak in the fuel system. If fuel system leak is verified, switch fuel selector OFF.

The most probable cause of loss of fuel flow is either fuel depletion in the fuel tank selected or failure of the engine driven fuel pump. If loss of fuel flow occurs, turn the emergency (EMERG) fuel pump ON and check that the fuel selector is on a tank containing usable fuel.

3.19 LOSS OF FUEL FLOW (3.3g) (Continued)

If power is restored, turn OFF the emergency (EMERG) fuel pump (except in the case of an engine driven fuel pump failure). Adjust the mixture control as necessary.

If power is not restored, turn the emergency (EMERG) fuel pump and the fuel selector OFF, and proceed with Power Off Landing procedure (refer to paragraph 3.13).

3.21 ENGINE DRIVEN FUEL PUMP FAILURE (FUEL PRESS light illuminated - annunciator panel) (3.3h)

If an engine driven fuel pump failure is indicated, retard the throttle and turn the emergency (EMERG) fuel pump ON. The throttle and mixture should then be reset as required. A landing should be made at the nearest appropriate airport as soon as possible and the cause of the failure investigated.

CAUTION

If normal engine operation and fuel flow are not reestablished, the emergency (EMERG) fuel pump should be turned OFF. The lack of a fuel flow indication could indicate a leak in the fuel system. If fuel system leak is verified, switch fuel selector to OFF.

3.23 HIGH OIL TEMPERATURE (3.3i)

An abnormally high oil temperature indication may be caused by a low oil level, an obstruction in the oil cooler, damaged or improper baffle seals, a defective gauge, or other causes. Reduce power and/or enrich the mixture, and increase airspeed if practical. If condition is not corrected, land as soon as practical at an appropriate airport and have the cause investigated.

A steady rapid rise in oil temperature is a sign of trouble. Land at the nearest airport and let a mechanic investigate the problem. Watch the oil pressure gauge for an accompanying loss of pressure.

3.25 HIGH CYLINDER HEAD TEMPERATURE (3.3j)

Excessive cylinder head temperature may parallel excessive oil temperature. In any case, reduce power and/or enrich the mixture, and increase airspeed if practical. If the problem persists, land as soon as practical at an appropriate airport and have the cause investigated.

3.27 ELECTRICAL FAILURES (3.3k)

SINGLE ALTERNATOR FAILURE (Zero amps or ALTERNATOR #1 or #2 INOP light illuminated - annunciator panel)

NOTE

Anytime total tie bus voltage is below 25 Vdc, the LOW BUS VOLTAGE annunciator will illuminate.

Loss of either alternator is indicated by a zero reading on the appropriate ammeter and the illumination of the associated annunciator (ALTERNATOR #1 INOP or ALTERNATOR #2 INOP).

If the LOW BUS VOLTAGE annunciator is illuminated, first reduce the electrical load to less than 70 amps, which should extinguish the LOW BUS VOLTAGE annunciator, and prevent overloading the operating alternator.

Next, turn the failed alternator (ALTR NO. 1 or ALTR NO. 2) switch OFF for at least one second. Check the inoperative alternator (ALTNR NO. 1 or ALTNR NO. 2) circuit breaker and reset as required.

If the trouble was caused by a momentary overvoltage condition, the alternator control unit can now be reset by turning the failed alternator switch ON.

If the affected alternator's ammeter continues to read zero, and the annunciator remains lit, turn the failed alternator's switch OFF. Continue flight and monitor the operating alternator's ammeter to ensure the electrical load does not exceed 70 amps. The annunciator of the failed alternator will remain lit.

While one alternator will supply sufficient current for minimum required avionics and cockpit lighting, use of deicing equipment, particularly windshield or propeller heat, may be limited. Immediate action should be taken to avoid or exit icing conditions. Under no circumstances may the total electrical load exceed 70 amps. The electric cabin heater, cabin recirculation blowers, and position, strobe, and landing lights should not be used unless absolutely necessary.

3.27 ELECTRICAL FAILURES (3.3k) (Continued)

DUAL ALTERNATOR FAILURE (Zero amps both ammeters or ALTERNATOR #1 and #2 INOP lights illuminated - annunciator panel)

NOTE

> Anytime total tie bus voltage is below 25 Vdc, the LOW BUS VOLTAGE annunciator will illuminate.

In the event that both alternators indicate failure simultaneously, reduce electrical load to minimum required for safe flight by turning OFF switches and pulling circuit breakers for all nonessential electrical equipment. Maintain only that equipment required to provide heading, attitude, and altitude information, plus one navigation radio and one communications radio for emergency use only.

Attempt to re-establish alternator power on each alternator individually by first turning OFF both alternators for at least one second, resetting any tripped alternator (ALTR) control circuit breakers, and then turning each alternator ON, one at a time.

If only one alternator can be restored, reinstate electrical load as desired to a maximum of 70 amps. Land as soon as practical for proper repairs.

If neither alternator can be restored to operation, continue flight with reduced electrical load on battery power only.

NOTE

> LOW BUS VOLTAGE annunciator will be illuminated.

Land as soon as safely practical, as battery power duration is dependent upon the condition of the battery at the time of failure.

NOTE

> If battery is depleted, the landing gear must be lowered using the emergency extension procedure. The gear position lights will be inoperative. The flaps will also be inoperative and a flaps up landing will be required.

3.27 ELECTRICAL FAILURES (3.3k) (Continued)

SUPPLEMENTAL HEATER CONTROL CIRCUIT FAILURE (Heater Continues to Operate With AUX CABIN and VENT/DEFOG FAN Switches OFF)

Pull the VENT DEFOG circuit breaker. If the heater still operates, turn the BATT MASTER and ALTR switches OFF. Land as soon as practical.

3.29 PROPELLER OVERSPEED (3.3m)

Propeller overspeed is caused by a malfunction in the propeller governor or low oil pressure which allows the propeller blades to rotate to full low pitch.

If propeller overspeed should occur, retard the throttle and check the oil pressure. The propeller control should be moved to full DECREASE rpm and then reset if any control is available. Airspeed should be reduced and throttle used to maintain 2500 RPM. Land as soon as practical and investigate cause of overspeed.

3.31 EMERGENCY LANDING GEAR EXTENSION (3.3n)

Prior to proceeding with an emergency gear extension, check to ensure that the battery master switch (BATT MSTR) is ON and that the circuit breakers have not popped. If it is daytime, the Day/Night dimmer switch should be in the DAY position.

If the landing gear does not check down and locked, reduce the airspeed to below 90 KIAS, pull out the HYDRAULIC PUMP POWER circuit breaker, place the landing gear selector in the DOWN position, pull the emergency gear extend control OUT and fishtail the airplane. Verify the landing gear position lights indicate down and locked.

If all electrical power has been lost, the landing gear must be extended using the above procedures. The gear position indicator lights will not illuminate.

3.33 SPIN RECOVERY (3.3o)

Intentional spins are prohibited in this airplane. If a spin is inadvertently entered, immediately apply full rudder opposite to the direction of rotation. Move the control wheel full forward while neutralizing the ailerons. CLOSE the throttle. When the rotation stops, neutralize the rudder and relax forward pressure on the control wheel as required to smoothly regain a level flight altitude.

3.35 ENGINE ROUGHNESS (3.3p)

Engine roughness may be caused by dirt in the injector nozzles, induction filter icing, ignition problems, or other causes.

First adjust the mixture for maximum smoothness. The engine will run rough if the mixture is too rich or too lean.

Move the induction air to ALTERNATE and turn the emergency (EMERG) fuel pump ON.

Switch the fuel selector to another tank to determine if fuel contamination is the problem.

Check the engine gauges for abnormal readings. If any gauge readings are abnormal proceed accordingly.

The magneto switches should then be turned OFF individually and then both turned back ON. If operation is satisfactory on only one magneto, proceed on the good magneto at reduced power to a landing at the first available airport.

If roughness persists, prepare for a precautionary landing at pilot's discretion.

3.37 EMERGENCY DESCENT (3.3q)

NOTE

If pressurized, the following procedure will result in the immediate loss of pressurization and the cabin altitude will rise at an uncontrolled rate.

In the event an emergency descent becomes necessary, retard the throttle to idle and move the propeller control to the full INCREASE position. The mixture should be reset as required to ensure the engine will continue operating. Lower the landing gear and immediately initiate a descent. If in smooth air, descend at 180 to 195 KIAS maximum. If extremely rough air is encountered, the airspeed should be limited according to the following airspeed versus Gross Weight Table:

4300 lb — 133 KIAS
2450 lb — 100 KIAS

Use straight line variation between points.

After reaching a safe altitude, advance the throttle and adjust mixture and propeller controls for power as required.

3.39 PRESSURIZATION SYSTEM MALFUNCTION (3.3r)

Should the differential pressure rise above 5.5 psi maximum or a structural failure appear imminent, an immediate decrease in differential pressure is required. To accomplish this, select DUMP on the cabin pressure dump/normal switch and PULL the cabin pressurization (CABIN PRESS) control. This will cause the cabin altitude to rise at an uncontrolled rate and cabin differential pressure to decrease, subsequently relieving the overpressure condition. If emergency oxygen is not installed execute an emergency descent to a safe altitude consistent with terrain. If emergency oxygen is installed, don the oxygen masks, activate the oxygen generators and descend to a safe altitude consistent with terrain.

Should the aircraft suddenly lose pressurization, check that the cabin pressure dump/normal switch is in the NORM position and that the cabin pressurization (CABIN PRESS) control is pushed in. If the aircraft does not begin to repressurize and emergency oxygen is not installed, execute an emergency descent to a safe altitude consistent with terrain. If emergency oxygen is installed, don the oxygen masks, activate the oxygen generators and descend to a safe altitude consistent with terrain.

3.41 CABIN AIR CONTAMINATION/SMOKE EVACUATION (3.3s)

Strong fumes or smoke in the cabin may indicate a malfunction in the pressurization system or a fire. In any event, the primary concern is to establish maximum airflow through the cabin in order to vent the fumes or smoke. To accomplish this, set the cabin pressure dump/normal switch to DUMP and PULL the cabin pressurization (CABIN PRESS) control out. Turn OFF the auxiliary cabin heater. Turn ON the vent/defog blower and turn OFF the cabin air recirculation blower. Do not open the storm window. This procedure will provide the maximum flow of outside ram air through the cabin. If emergency oxygen is not installed, execute an emergency descent to a safe altitude consistent with terrain. If emergency oxygen is installed, don the oxygen masks, activate the oxygen generators and descend to a safe altitude consistent with terrain. Land as soon as practical and investigate the cause. If the fumes or smoke persist the problem may be a fire (see paragraph 3.15, Fire In Flight).

3.43 VACUUM SYSTEM FAILURE (3.3t)

A malfunction of either vacuum pump is indicated by a decreased suction reading combined with the extension of the left or right flow button.

In the event one vacuum pump fails, check that the suction gauge still indicates 4.5 to 5.2 inches of mercury, and that the operating pump's flow button is retracted. The VACUUM LOW annunciator should be extinguished.

Although either vacuum pump independently has sufficient capacity to operate the flight instruments and the deice boots in a normal manner, intentional or continued operation in icing conditions is not recommended. Immediate action should be taken to avoid or exit icing conditions.

Failure of both vacuum pumps is indicated by the suction gauge reading less than 4.0 inches of mercury, extension of both flow buttons, and illumination of the VACUUM LOW annunciator.

If both vacuum systems are inoperable, the turn coordinator will be the only usable gyroscopic flight instrument. The wing and tail deicer boots will be inoperative. Also, loss of cabin pressure control is possible; the cabin pressure will have to be dumped manually before landing. A precautionary landing should be considered depending on operating conditions.

3.45 INADVERTENT ICING ENCOUNTER (3.3u)

WARNING

Flight into known icing conditions is prohibited unless Ice Protection System is installed and fully operational. Refer to Section 9, Supplement 6.

If icing conditions are inadvertently encountered, select ALTERNATE induction air and adjust manifold pressure as required. Turn the pitot and stall warning heat ON. Pull ON the windshield defrost and turn the windshield vent/defog fan ON to keep the windshield as clear as possible. If installed, turn the electric windshield heat ON. Change aircraft heading and/or altitude to exit icing conditions as soon as possible.

3.49 HYDRAULIC SYSTEM MALFUNCTION (3.3v)

A hydraulic system malfunction, which causes the hydraulic pump to either run continuously (more than 15-20 seconds), or cycle on and off rapidly (more than 6-8 times), may be detected by the illumination of the HYDRAULIC PUMP amber annunciator light. Pull the HYDRAULIC PUMP POWER circuit breaker to stop operation. The pump is not designed for continuous duty and will fail if left running. Land as soon as practical and investigate the cause. Prior to landing, the HYDRAULIC PUMP POWER circuit breaker must be reset in order to extend the landing gear. If the pump continues to run after the gear is locked down, again pull the HYDRAULIC PUMP POWER circuit breaker. If the gear fails to extend, refer to Emergency Landing Gear Extension (3.31).

3.51 FLAP SYSTEM MALFUNCTION (3.3w)

Illumination of the FLAPS annunciator would normally be the result of an overcurrent condition in the flap motor/actuator circuit. If an overcurrent fault occurs the flap protection circuit will sense the malfunctic and automatically remove power from the flap motor/actuator and fla operation will stop. Pulling and resetting the FLAP WARN circuit breaker will restore flap power to normal operation.

After resetting, normal operation of the flaps should be verified.

CAUTION

> Higher than normal approach and landing speeds may be required if full symmetrical flap extension is not available. Longer landing distances than shown in Section 5 will result from increased airspeed approaches.

If normal flap operation is not regained, or the FLAPS annunciator remains illuminated, pull the FLAP MOTOR circuit breaker and land as soon as practical to ascertain the cause of the problem. The flaps will remain in the same position as when the malfunction occurred.

3.53 FUEL TANK SUBMERGED PUMP FAILURE (BOOST PUMP light illuminated - annunciator panel) (3.3x)

Illumination of the BOOST PUMP annunciator light indicates the selected fuel tank's submerged fuel boost pump has failed. Immediately check the appropriate FUEL PUMPS (L BOOST or R BOOST) circuit breaker located on the pilot's forward breaker panel; reset as necessary. Check that the BOOST PUMP annunciator is extinguished.

If the FUEL PUMPS circuit breaker does not remain closed, or the BOOST PUMP annunciator remains lit, set the fuel selector to the tank having an operating boost pump, which should extinguish the annunciator light. Land as soon as possible; have the inoperative boost pump repaired prior to further flight.

3.55 STALL WARNING FAILURE (STALL WARN FAIL light illuminated - annunciator panel) (3.3y)

Illumination of the STALL WARN FAIL annunciator light means the lift computer has failed. Check, and if necessary, reset the STALL WARN circuit breaker located on the pilot's forward circuit breaker panel. If the breaker does not remain closed, or if the STALL WARN FAIL annunciator light does not extinguish, the stall warning system will be inoperative for the remainder of the flight. After landing, have the system repaired before further flight.

3.57 ANNUNCIATOR LIGHT PANEL FAILURE (ANNUNCIATOR INOP light illuminated - annunciator panel) (3.3z)

Should the ANNUNCIATOR INOP light illuminate, check the ANNUN circuit breaker located on the pilot's aft circuit breaker panel. Reset, if necessary, and the ANNUNCIATOR INOP light should extinguish.

If the ANNUN circuit breaker is not open, the annunciator fail relay switch is faulty. Push the annunciator test switch; if all lights illuminate, the annunciator panel is functioning properly. The ANNUNCIATOR INOP light will remain lit.

Should the ANNUN circuit breaker fail to remain closed, or the annunciators fail to illuminate when tested, the annunciator lights will be inoperative for the remainder of the flight. Also, the landing gear position lights cannot be tested nor dimmed. The system should be repaired prior to further flight.

3.59 EMERGENCY EXIT (3.3aa)

The second window aft of the windshield on the right side of the fuselage is an emergency exit.

NOTE

The cabin must be depressurized before attempting to open the emergency exit.

To use the emergency exit, remove the plexiglas cover over the handle, pull the handle, and pull in on the exit window.

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NORMAL PROCEDURES

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NORMAL PROCEDURES

SECTION 4

NORMAL PROCEDURES

4.1 GENERAL

This section provides the normal operating procedures for the PA-46-350P, Malibu airplane. All of the normal operating procedures required by the FAA as well as those procedures which have been determined as necessary for the operation of the airplane, as determined by the operating and designed features of the airplane, are presented.

Normal operating procedures associated with optional systems and equipment which require handbook supplements are presented in Section 9, Supplements.

These procedures are provided to supply information on procedures which are not the same for all airplanes and as a source of reference and review. Pilots should familiarize themselves with these procedures to become proficient in the normal operation of the airplane.

This section is divided into two parts. The first part is a short form checklist supplying an action - reaction sequence for normal procedures with little emphasis on the operation of the systems. Numbers in parentheses after each checklist section indicate the paragraph where the corresponding amplified procedure can be found.

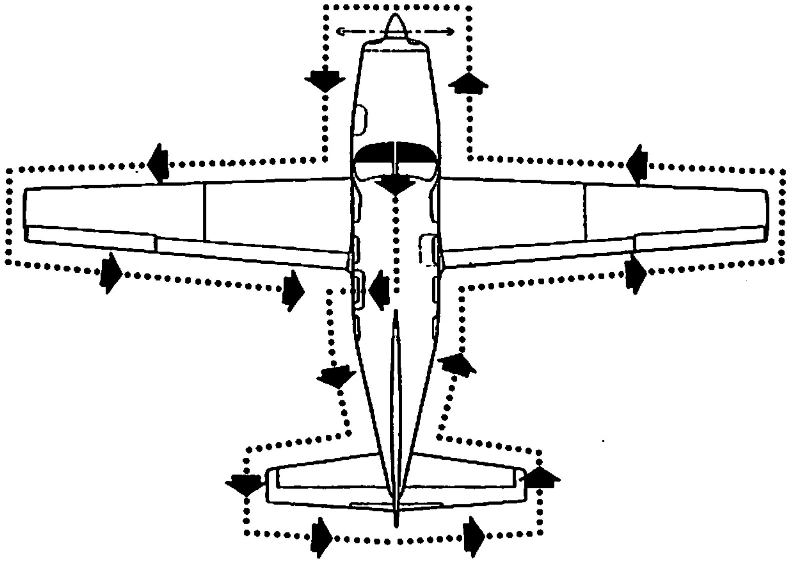
The second part of this section contains the amplified normal procedures which provide detailed information and explanations of the procedures and how to perform them. This portion of the section is not intended for use as an inflight reference due to the lengthy explanation. The short form checklists should be used on the ground and in flight. Numbers in parentheses after each paragraph title indicate where the corresponding checklist can be found.

4.3 AIRSPEEDS FOR SAFE OPERATIONS

The following airspeeds are those which are significant to the safe operation of the airplane. These figures are for standard airplanes flown at gross weight under standard conditions at sea level.

Performance for a specific airplane may vary from published figures depending upon the equipment installed, the condition of the engine, airplane and equipment, atmospheric conditions and piloting technique.

(a) Best Rate of Climb Speed .... 110 KIAS
(b) Best Angle of Climb Speed .... 81 KIAS
(c) Turbulent Air Operating Speed (See Subsection 2.3).. 133 KIAS
(d) Landing Final Approach Speed (Full Flaps)........... 77 KIAS
(e) Maximum Demonstrated Crosswind Velocity........... 17 KTS
(f) Maximum Flaps Extended Speed
    10° .... 165 KIAS
    20° .... 130 KIAS
    Full Flaps (36°)............................... 116 KIAS



WALK-AROUND
Figure 4-1

4.5 NORMAL PROCEDURES CHECKLIST

4.5a Preflight Checklists (4.9)

COCKPIT (4.9a)

Control wheel .... release restraints
Parking Brake .... SET
Gear Handle .... DOWN
All Switches .... OFF
Magneto Switches .... OFF
Radio Master Switch .... OFF
Mixture .... IDLE CUT-OFF
Battery Master Switch .... ON

CAUTION

See fuel imbalance limitations, 2.23.

Fuel Gauges .... check QUANTITY & IMBALANCE

4.5a Preflight Checklist (4.9) (Continued)

COCKPIT (4.9a) (Continued)

Annunciator Panel .... CHECK
Oxygen Light (if installed) .... CHECK
Stall Warning System .... TEST
Flaps .... EXTEND
Battery Master Switch .... OFF
Primary Flight Controls .... PROPER OPERATION
Trim .... NEUTRAL
Static System .... DRAIN
Alternate Static System .... CHECK PLACARD
Emergency Exit .... CHECK
Windows .... check CLEAN
Required Papers .... check ON BOARD
Baggage .... STOW PROPERLY - SECURE

EMPENNAGE (4.9b)

Antennas .... CHECK
Surface Condition .... CLEAR of ICE, FROST, SNOW
Left Static Port .... CLEAR
Alternate and Pressurization Static Ports .... CLEAR
Elevator .... CHECK
Elevator Trim Tab .... CHECK
Rudder .... CHECK
Static Wicks .... CHECK
Tie Down .... REMOVE
Right Static Port .... CLEAR

RIGHT WING (4.9c)

Surface Condition .... CLEAR of ICE, FROST, SNOW
Flap and Hinges .... CHECK
Aileron and Hinges .... CHECK
Static Wicks .... CHECK
Wing Tip and Lights .... CHECK
Fuel Tank .... CHECK supply
visually - SECURE CAP
Fuel Tank Vent .... CLEAR
Tie Down and Chock .... REMOVE
Main Gear Strut .... PROPER
INFLATION (3.44 +/- 0.25 in.)
Tire .... CHECK
Brake Block and Disc .... CHECK

4.5a Preflight Checklist (4.9) (Continued)

RIGHT WING (4.9c) (Continued)

CAUTION

When draining any amount of fuel, care should be taken to ensure that no fire hazard exists before starting engine.

Fuel Tank Sump .... DRAIN and CHECK for water, sediment and proper fuel

NOSE SECTION (4.9d)

General Condition .... CHECK
Fuel Filter Sump .... DRAIN and CHECK for water, sediment and proper fuel
Cowling .... SECURE
Windshield .... CLEAN
Propeller and Spinner .... CHECK
Air Inlets .... CLEAR
Landing Light .... CHECK
Chock .... REMOVE
Nose Gear Strut .... PROPER INFLATION (1.65 +/- 0.25 in.)
Nose Wheel Tire .... CHECK
Engine Baffle Seals .... CHECK
Oil .... CHECK QUANTITY
Oil Filler/Dipstick Cap .... PROPERLY SEATED and SECURE
Cowl Oil Door .... CLOSED
Tow Bar .... STOW properly - SECURE
Baggage Door .... CLOSE and SECURE

LEFT WING (4.9e)

Surface Condition .... CLEAR of ICE, FROST, SNOW

4.5a Preflight Checklist (4.9) (Continued)

LEFT WING (4.9e) (Continued)

CAUTION

When draining any amount of fuel, care should be taken to ensure that no fire hazard exists before starting engine.

Fuel Tank Sump........................ DRAIN and CHECK for water, sediment and proper fuel
Tie Down and Chock.............................. REMOVE
Main Gear Strut...................... PROPER INFLATION (3.44 +/- 0.25 in.)
Tire.. CHECK
Brake Block and Disc .... CHECK
Pitot Head .... HOLES CLEAR
Fuel Tank .... CHECK supply visually - SECURE CAP
Fuel Tank Vent.................................. CLEAR
Wing Tip and Lights .... CHECK
Aileron and Hinges .... CHECK
Flap and Hinges.................................. CHECK
Static Wicks..................................... CHECK

MISCELLANEOUS (4.9f)

Oxygen System (if installed)....... CHECK MASKS and HOSES
Battery Master Switch .... ON
Flaps....................................... RETRACT
Interior Lighting .... ON and CHECK
Pitot Heat Switch................................... ON
Stall Warning Heat Switch .... ON

CAUTION

Care should be taken when an operational check of the heated pitot head is being performed. The unit becomes very hot. Ground operation should be limited to three minutes maximum to avoid damaging the heating elements.

4.5a Preflight Checklist (4.9) (CONTINUED)

MISCELLANEOUS (4.9f) (Continued)

Exterior Lighting Switches .... ON and CHECK
Pitot ....check - WARM
Stall Warning Heat .... CHECK WARM
All Lighting Switches................................... OFF
Pitot Heat Switch.. OFF
Stall Warning Heat Switch.............................. OFF
Battery Master Switch.................................. OFF
Passengers ....BOARD
Door ....CLOSE and LATCH

WARNING

Do not attempt pressurized flight if all four door pin indicators are not green and/or the DOOR AJAR annunciator is lit.

Door Pins .... all INDICATORS GREEN
Seat Belts and Harness .... FASTEN/ADJUST
CHECK inertia reel

4.5b Before Starting Engine Checklist (4.11)

BEFORE STARTING ENGINE (4.11)

Parking Brake...SET
Propeller Control ....FULL INCREASE
Fuel Selector .... DESIRED TANK
Circuit Breakers ....check IN
Radios .... OFF
Alternators.. ON
Cabin Altitude Selector..................................SET
Altitude Rate Control ....SET
Cabin Pressurization Control...........................SET
Cabin Pressure Dump/Normal Switch.................NORM
Induction Air Control .... CHECK
then PRIMARY

4.5c Engine Start Checklist (4.13)

ENGINE START - GENERAL (4.13a)

CAUTION

Do not attempt flight if there is no indication of alternator output.

CAUTION

The STARTER Engaged annunciator will illuminate during engine cranking. If the annunciator remains lit after the engine is running, stop the engine and determine the cause.

CAUTION

If a positive oil pressure is not indicated within 30 seconds following an engine start, stop the engine and determine the trouble. In cold weather it will take a few seconds longer to get a positive oil pressure indication.

NOTE

Starter manufacturers recommend that starter cranking periods be limited to 30 seconds with a two minute rest period between cranking periods. Longer cranking periods will shorten the life of the starter.

NORMAL START - COLD ENGINE (4.13b)

Throttle .... 1/2 INCH OPEN
Battery Master Switch .... ON
Emergency (EMERG) Fuel Pump .... OFF
Mixture .... RICH - then IDLE CUT-OFF

4.5c Engine Start Checklist (4.13) (Continued)

NORMAL START - COLD ENGINE (4.13b) (Continued)

NOTE

The amount of prime depends on engine temperature. Familiarity and practice will enable the operator to estimate the amount of prime required.

Magneto Switches.. ON
Starter..ENGAGE
Mixture (when engine fires) .... ADVANCE
Throttle .... ADJUST
Oil Pressure .... CHECK
Alternators............................... CHECK AMMETER
Gyro Suction .... CHECK

NORMAL START - HOT ENGINE (4.13c)

Throttle .... 1/2 INCH OPEN
Battery Master Switch .... ON
Emergency (EMERG) Fuel Pump .... OFF
Mixture ....IDLE CUT-OFF
Magneto Switches.. ON
Starter..ENGAGE
Mixture (when engine fires) .... ADVANCE
Throttle .... ADJUST
Oil Pressure .... CHECK
Alternators............................... CHECK AMMETER
Gyro Suction .... CHECK

ENGINE START WHEN FLOODED (4.13d)

Throttle ....OPEN FULL
Battery Master Switch .... ON
Emergency (EMERG) Fuel Pump .... OFF
Mixture ....IDLE CUT-OFF
Magneto Switches.. ON
Starter..ENGAGE
Mixture (when engine fires) .... ADVANCE
Throttle ....RETARD
Oil Pressure .... CHECK
Alternators............................... CHECK AMMETER
Gyro Suction .... CHECK

4.5c Engine Start Checklist (4.13) (Continued)

ENGINE START WITH EXTERNAL POWER SOURCE (4.13e)

Battery Master Switch .... OFF
Alternators .... OFF
All Electrical Equipment .... OFF
External Power Plug .... INSERT in receptacle

Proceed with normal start.

NOTE

For all normal operations using an external power source, the battery master switch should be OFF, but it is possible to use the ship's battery in parallel by turning the battery master switch ON. This will give longer cranking capabilitiess, but will not increase amperage.

CAUTION

Care should be exercised because if the ship's battery has been depleted, the external power supply can be reduced to the level of the ship's battery. This can be tested by turning the battery master switch ON momentarily while the starter is engaged. If cranking speed increases, the ship's battery is at a higher level than the external power supply.

Throttle .... LOWEST POSSIBLE RPM
External Power Plug ....DISCONNECT from receptacle
Baggage Door .... CLOSED and SECURE
Battery Master Switch .... ON
Voltmeter .... CHECK
Alternators .... ON
Ammeters .... CHECK
Throttle .... ADVANCE to 1000 RPM
Oil Pressure .... CHECK
Gyro Suction .... CHECK

4.5d Before Taxiing Checklist (4.15)

BEFORE TAXIING (4.15)

CAUTION

Do not operate engine above 1200 RPM with cabin doors open.

Throttle .... 1000 to 1200 RPM
Radio Master Switch .... ON
Environmental System .... AS DESIRED
Supplemental Electric Heater .... AS DESIRED

4.5e Taxiing Checklist (4.17)

TAXIING (4.17)

Taxi Area .... CLEAR
Chocks .... REMOVED
Parking Brake .... RELEASED
Propeller Control .... FULL INCREASE
Throttle .... APPLY SLOWLY
Brakes .... CHECK
Steering .... CHECK
Flight Instruments .... CHECK

4.5f Ground Check Checklist (4.19)

GROUND CHECK (4.19)

CAUTION

Alternate air is unfiltered. Use of alternate air during ground or flight operations, when dust or other contaminants are present, may result in engine damage from particle ingestion.

Parking Brake .... SET
Propeller Control .... FULL INCREASE
Throttle .... 2000 RPM
Magnetos .... max. drop 175 RPM
- max. diff. 50 RPM
Gyro Suction .... 4.5 to 5.2 in. Hg.

4.5f Ground Check Checklist (4.19) (Continued)

GROUND CHECK (4.19) (CONTINUED)

Voltmeter............ CHECK
Ammeters............ CHECK
Oil Temperature............ CHECK
Oil Pressure............ CHECK
Propeller............ EXERCISE - then FULL INCREASE
Fuel Flow............ CHECK
Throttle............ RETARD
Annunciator Panel............ PRESS-TO-TEST
Manifold Pressure Line............ DRAIN

4.5g Before Takeoff Checklist (4.21)

BEFORE TAKEOFF (4.21)

Battery Master Switch............ ON
Alternators............ ON - CHECK AMMETERS
Pressurization Controls............ S[illegible]
Flight Instruments............ CHECK
Fuel Selector............ PROPER TANK
Emergency (EMERG) Fuel Pump............ ON
Engine Gauges............ CHECK
Induction Air............ PRIMARY
Seat Backs............ ERECT
Armrests............ STOWED
Mixture............ FULL RICH
Propeller Control............ FULL INCREASE
Belts/ Harness............ FASTENED/ ADJUSTED
Empty Seats............ SEAT BELTS SNUGLY FASTENED
Flaps............ SET
Trim............ SET
Controls............ FREE
Door............ LATCHED
Air Conditioner............ OFF
Parking Brake............ RELEASED

4.5h Takeoff Checklist (4.23)

NORMAL TECHNIQUE (4.23a)

Flaps............ RETRACTED

4.5h Takeoff Checklist (4.23) (Continued)

NORMAL TECHNIQUE (4.23a) (Continued)

Trim .... SET
Throttle .... FULL POWER

NOTE

Takeoffs are normally made with full throttle. However, under some off standard conditions, the manifold pressure indication can exceed its indicated limit at full throttle. Limit manifold pressure to 42 in. Hg maximum. (See Section 7).

Accelerate to 78 KIAS.
Control Wheel .... back pressure to ROTATE smoothly to CLIMB ATTITUDE
Landing Gear (when straight ahead landing on runway not possible) .... UP

NOTE

During landing gear operation it is normal for the HYDRAULIC PUMP annunciator light to illuminate until full system pressure is restored.

SHORT FIELD, OBSTACLE CLEARANCE TECHNIQUE (4.23b)

INFORMATION PENDING

4.5l Climb Checklist (4.25)

TAKEOFF CLIMB (4.25a)

Mixture .... FULL RICH
Propeller Speed .... 2500 RPM
Manifold Pressure .... FULL POWER
Climb Speed
  Best Angle .... 81 KIAS
  Best Rate .... 110 KIAS
Pressurization Controls .... SET
Emergency (EMERG) Fuel Pump .... OFF at safe altitude

CRUISE CLIMB (4.25b)

INFORMATION PENDING

4.5j Cruise Checklist (4.27)

CRUISE (4.27)

WARNING

Operation above 25,000 ft is not approved.

CAUTION

To maintain lateral balance, alternate between right and left fuel tanks. See paragraphs 2.23 and 7.17.

Reference Section 5 power setting table and performance charts.

Cruise Power .... SET per power table
Mixture (Refer to para. 4.27) .... ADJUST
Pressurization Controls .... CHECK

4.5k Descent Checklist (4.29)

NORMAL DESCENT (4.29)

Power .... CRUISE
Mixture .... CRUISE SETTING
Airspeed .... AS REQUIRED
Pressurization Controls .... SET
Altimeter .... SET
Windshield Defrost .... AS REQUIRED

REDUCED POWER DESCENT (4.29)

Throttle .... AT or ABOVE 20 in. Hg.
Mixture .... MAINTAIN 1350 TIT
Propeller Speed .... CRUISE SETTING
Pressurization Controls .... SET
Altimeter .... SET
Windshield Defrost .... AS REQUIRED

4.5m Approach And Landing Checklist (4.31)

APPROACH AND LANDING (4.31)

Fuel Selector.................................. PROPER TANK
Seat Backs...ERECT
Armrests .... STOWED
Belts/Harness .... FASTEN/ADJUST
Emergency (EMERG) Fuel Pump .... ON
Cabin Pressure .... DEPRESSURIZED
Mixture .... RICH
Propeller Control..SET
Gear .... DOWN - 165 KIAS max.

NOTE

During landing gear operation it is normal for the HYDRAULIC PUMP annunciator light to illuminate until full system pressure is restored.

Flaps ....SET
Air Conditioner .... OFF
Toe Brakes .... DEPRESS to check

WARNING

After pumping several times, if one or both toe brakes are inoperative, DO NOT attempt landing on a short field.

NORMAL TECHNIQUE (4.31a)

Flaps ....FULL DOWN
Airspeed..77 KIAS
Throttle ....AS REQUIRED

SHORT FIELD TECHNIQUE (4.31b)

INFORMATION PENDING

4.5n Go-around Checklist (4.33)

GO-AROUND (4.33)

Mixture .... FULL RICH
Propeller Control .... FULL INCREASE
Throttle .... FULL POWER
Control Wheel .... back pressure to
ROTATE to CLIMB ATTITUDE
Airspeed .... 80 KIAS
Gear .... UP
Flaps .... RETRACT SLOWLY
Trim .... AS REQUIRED

4.5o After Landing Checklist (4.35)

AFTER LANDING CHECKLIST (4.35)

Induction Air Control .... PRIMARY
Flaps .... RETRACT
Air Conditioner .... AS DESIRED
Radar .... OFF
Emergency (EMERG) Fuel Pump .... OFF
Strobe Lights .... OFF
Landing/Taxi Lights .... AS REQUIRED

4.5p Stopping Engine (4.37)

STOPPING ENGINE (4.37)

Radios and Electrical Equipment .... OFF
External Lights .... OFF
Air Conditioner .... OFF
Propeller Control .... FULL INCREASE
Throttle .... CLOSED
Mixture .... IDLE CUT-OFF
Magnetos .... OFF
Alternators .... OFF
Battery Master Switch .... OFF

4.5q Mooring Checklist (4.39)

MOORING (4.39)

Parking Brake ....SET
Control Wheel .... SECURED with belts
Flaps .... FULL UP
Wheel Chocks ....IN PLACE
Tie Downs .... SECURE

4.7 AMPLIFIED NORMAL PROCEDURES (GENERAL)

The following paragraphs are provided to supply detailed information and the explanation of the normal procedures for operation of the airplane.

4.9 PREFLIGHT CHECK (4.5a)

The airplane should be given a thorough preflight and walk-around check. The preflight should include a check of the airplane's operational status, computation of weight and C.G. limits, takeoff distance and in-flight performance. A weather briefing should be obtained for the intended flight path, and any other factors relating to a safe flight should be checked before takeoff.

4.9a Cockpit (4.5a)

Upon entering the cockpit, release the seat belts securing the control wheel.

Set the parking brake by first depressing and holding the toe brake pedals and then pull the parking brake knob.

Check that the landing gear selector is in the DOWN position. Ensure that all electrical switches and the magneto switches are OFF. Turn OFF the radio master switch. The mixture should be in idle cut-off. Turn the battery master switch ON.

CAUTION

See fuel imbalance limitations, 2.23.

Check the fuel quantity gauges for adequate supply and fuel imbalance (sec. 2.23). Check that the annunciator panel illuminates. If the supplemental oxygen system is installed and its annunciator is lit, the expended canisters must be replaced if oxygen capability is desired for the flight. Press the stall warning test switch and note that the stall warning horn sounds. Extend the flaps for the walk-around inspection. Turn OFF the battery master switch. Check the primary flight controls for proper operation and set the elevator and rudder trim to neutral. Open the static system drain to remove any moisture that has accumulated in the lines. Verify that the alternate static system valve is in the normal position. Check that the emergency exit is in place and securely latched. Check the windows for cleanliness and that the required papers are on board. Properly stow any baggage and secure.

4.9 PREFLIGHT CHECK (4.5a) (Continued)

4.9b Empennage (4.5a)

Begin the walk-around at the left side of the aft fuselage. Check the condition of any antennas located on the fuselage. All surfaces of the empennage must be clear of ice, frost, snow or other extraneous substances. Fairings and access covers should be attached properly. Ensure that the primary static system ports on the left and right side of the aft fuselage and the alternate and pressurization static ports on the underside of the aft fuselage are clear of obstructions. The elevator and rudder should be operational and free from damage or interference of any type. Elevator and rudder static wicks should be firmly attached and in good condition. Check the condition of the tab and ensure that all hinges and push rods are sound and operational. If the tail has been tied down, remove the tiedown rope.

4.9c Right Wing (4.5a)

Check that the wing surface and control surfaces are clear of ice, frost, snow or other extraneous substances. Check the flap, aileron and hinges for damage and operational interference. Static wicks should be firmly attached and in good condition. Check the wing tip and lights for damage.

Open the fuel cap and visually check the fuel color. The quantity should match the indication that was on the fuel quantity gauge. Replace cap securely. The fuel tank vent should be clear of obstructions.

Remove the tiedown and chock.

Next, complete a check of the landing gear. Check the gear strut for proper inflation. There should be 3.44 +/- 0.25 inches of strut exposure under a normal static load. Check for hydraulic leaks. Check the tire for cuts, wear, and proper inflation. Make a visual check of the brake block and disc.

Drain the fuel tank sump through the quick drain located on the lower surface of the wing just inboard of the gear well, making sure that enough fuel has been drained to ensure that all water and sediment is removed. The fuel system should be drained daily prior to the first flight and after each refueling.

CAUTION

When draining any amount of fuel, care should be taken to ensure that no fire hazard exists before starting engine.

4.9 PREFLIGHT CHECK (4.5a) (Continued)

4.9d Nose Section (4.5a)

Check the general condition of the nose section; look for oil or fluid leakage and that the cowling is secure. Drain the fuel filter sump located on the lower fuselage aft of the cowling. Check the windshield and clean if necessary. The propeller and spinner should be checked for detrimental nicks, cracks, or other defects. The air inlets should be clear of obstructions. The landing light should be clean and intact.

Remove the chock and check the nose gear strut for proper inflation. There should be 1.65 +/- 0.25 inches of strut exposure under a normal static load. Check the tire for cuts, wear, and proper inflation. Check the engine baffle seals. Check the oil level; maximum endurance flights should begin with 12 quarts of oil. Make sure that the oil filler/dipstick cap has been properly seated and secured, and that the cowl oil door is closed. Ensure that the tow bar is secured in the nose baggage area.

Close and secure the nose baggage door.

4.9e Left Wing (4.5a)

The wing surface should be clear of ice, frost, snow, or other extraneous substances. Drain the left fuel tank sump in the same manner as the right wing. Remove the tiedown and chock. Check the main gear strut for proper inflation: there should be 3.44 +/- 0.25 inches of strut exposure under a normal static load. Check for hydraulic leaks. Check the tire and the brake block and disc.

If installed, remove the cover from the pitot head on the underside of the wing. Make sure the holes are open and clear of obstructions.

Open the fuel cap and visually check the fuel color. The quantity should match the indication that was on the fuel quantity gauge. Replace cap securely. The fuel tank vent should be clear of obstructions.

Check the wing tip and lights for damage. Check the aileron, flap, and hinges for damage and operational interference and that the static wicks are firmly attached and in good condition.

4.9 PREFLIGHT CHECK (4.5a) (Continued)

4.9f Miscellaneous (4.5a)

Enter the cockpit and, if installed, check oxygen masks and hoses.

Turn the battery master switch ON and retract the flaps. Check the interior lights by turning ON the necessary switches. After the interior lights are checked, turn ON the pitot heat, stall warning heat, and the exterior light switches. Next, perform a walk-around check on the exterior lights and check the heated pitot head and stall warning vane for proper heating.

CAUTION

Care should be taken when an operational check of the heated pitot head is being performed. The unit becomes very hot. Ground operation should be limited to three minutes maximum to avoid damaging the heating elements.

Reenter the cockpit and turn all switches OFF. When all passengers are on board, the pilot should check that the cabin door is properly closed and latched, and visually check that all four door pin indicators are green.

WARNING

Do not attempt pressurized flight if all four door pin indicators are not green and/or the DOOR AJAR annunciator is lit.

Seat belts on empty seats should be snugly fastened. All passengers should fasten their seat belts and shoulder harnesses. A pull test of the inertia reel locking restraint feature should be performed.

4.11 BEFORE STARTING ENGINE (4.5b)

Before starting the engine, the parking brake should be set and the propeller control moved to the full INCREASE position. The fuel selector should then be moved to the desired tank. Check to make sure all the circuit breakers are in and the radios are OFF. Turn the alternator switches ON.

4.11 BEFORE STARTING ENGINE (4.5b) (Continued)

If the flight is to be made unpressurized, the cabin pressurization control should be pulled out to dump bleed air overboard and the cabin pressure dump/normal switch should be in the DUMP position in order to provide maximum cabin airflow. If pressurization is to be used during the flight, set the cabin altitude selector to 500 feet above the field elevation and the cabin altitude rate control to the 9 o'clock position. The cabin pressurization control must be pushed in and the cabin pressure dump/normal switch must be in the NORM position.

Check induction air control for freedom of movement by moving lever to ALTERNATE and back to PRIMARY.

4.13 ENGINE START (4.5c)

4.13a Engine Start - General (4.5c)

CAUTION

Do not attempt flight if there is no indication of alternator output.

CAUTION

The STARTER ENGAGED annunciator will illuminate during engine cranking. If the annunciator remains lit after the engine is running, stop the engine and determine the cause.

CAUTION

If a positive oil pressure is not indicated within 30 seconds following an engine start, stop the engine and determine the trouble. In cold weather it will take a few seconds longer to get a positive oil pressure indication.

NOTE

Starter manufacturers recommend that starter cranking periods be limited to 30 seconds with a two minute rest period between cranking periods. Longer cranking periods will shorten the life of the starter.

4.13 ENGINE START (4.5c) (Continued)

4.13b Normal Start - Cold Engine (4.5c)

Open the throttle lever approximately ½ inch. Turn the battery master switch ON, and check that the emergency (EMERG) fuel pump is OFF. Move the mixture control to full RICH for approximately four seconds then to idle cut-off. The engine is now primed.

NOTE

The amount of prime depends on engine temperature. Familiarity and practice will enable the operator to estimate the amount of prime required.

Turn both magneto switches ON and engage the starter. When the engine fires advance the mixture control to full RICH. Move the throttle to the desired setting and check the oil pressure for a positive indication. Confirm that the alternators are on by checking the ammeters for output. Check the gyro suction gauge for a positive indication and that the flow buttons are retracted.

4.13c Normal Start - Hot Engine (4.5c)

Open the throttle ½ inch. Turn the battery master switch ON and check that the emergency (EMERG) fuel pump is OFF. Verify the mixture control is at idle cut-off. Turn both magneto switches ON and engage the starter. When the engine fires, slowly advance the mixture control. Move the throttle to the desired setting and check for a positive indication of oil pressure. Confirm that the alternators are on by checking the ammeters for output. Check the gyro suction gauge for a positive indication and that the flow buttons are retracted.

4.13d Engine Start When Flooded (4.5c)

The throttle lever should be full open. Turn the battery master switch ON and check that the emergency (EMERG) fuel pump is OFF. Verify the mixture control is at idle cut-off. Turn both magneto switches ON and engage the starter. When the engine fires, advance the mixture control, retard the throttle, and check for a positive indication of oil pressure. Confirm that the alternators are on by checking the ammeters for output. Check the gyro suction gauge for a positive indication and that the flow buttons are retracted.

4.13 ENGINE START (4.5c) (Continued)

4.13e Engine Start With External Power Source (4.5c)

An optional feature allows the operator to use an external power source to crank the engine without having to gain access to the airplane's battery.

Turn the battery master and alternator switches OFF and turn all electrical equipment OFF. If using an auxiliary power unit, plug the unit into the socket located inside the forward baggage door. If using an external battery, connect the RED lead of the jumper cable to the POSITIVE (+) terminal of an external 24-volt battery and the BLACK lead to the NEGATIVE (-) terminal. Note that, after the plug is inserted, the airplane's electrical system is ON. Proceed with the normal starting technique.

NOTE

For all normal operations using an external power source, the battery master switch should be OFF, but it is possible to use the ship's battery in parallel by turning the battery master switch ON. This will give longer cranking capabilities, but will not increase the amperage.

CAUTION

Care should be exercised because if the ship's battery has been depleted, the external power supply can be reduced to the level of the ship's battery. This can be tested by turning the battery switch ON momentarily while the starter is engaged. If cranking speed increases, the ship's battery is at a higher level than the external power supply.

After the engine has started, retard the throttle to the lowest possible rpm to reduce sparking. Disconnect the external power source from the aircraft and secure the baggage door. Turn the battery master and alternator switches ON and check the voltmeter and ammeters for an indication of output.

When the engine is firing evenly, advance the throttle to 1000 rpm and check for a positive indication of oil pressure. Check gyro suction gauge for a positive indication, and that the flow buttons are retracted.

4.15 BEFORE TAXIING (4.5d)

CAUTION

Do not operate engine above 1200 rpm with cabin doors open.

Warm up the engine at 1000 to 1200 rpm. Avoid prolonged idling at low rpm, as this practice may result in fouled spark plugs. Turn the radio master switch ON, and set environmental system as desired. Refer to paragraph 4.47; set the supplemental heater as desired.

Takeoff may be made as soon as the ground check is completed and the engine is warm.

Care should be taken not to run up the engine over a surface containing loose stones, gravel or any loose material that may cause damage to the propeller blades.

4.17 TAXIING (4.5e)

Non-pilot personnel should not attempt to taxi the airplane until they have been instructed in taxiing procedures and technique by a qualified person authorized by the owner.

Determine that the propeller back blast and taxi areas are clear.

Release the parking brake by first depressing and holding the toe brake pedals and then push in on the parking brake knob. Taxi with the propeller control set to full INCREASE. Power should be applied slowly to start the taxi roll. Taxi a few feet forward and apply the brakes to determine their effectiveness. While taxiing, make slight turns to ascertain the effectiveness of the steering and to check the flight instruments.

Observe wing clearances when taxiing near buildings or other stationary objects. If possible, station an observer outside the airplane.

Avoid holes and ruts when taxiing over uneven ground.

Do not operate the engine at high rpm when taxiing over ground containing loose stones, gravel or any loose material that may cause damage to the propeller blades.

4.19 GROUND CHECK (4.5f)

CAUTION

Alternate air is unfiltered. Use of alternate air during ground or flight operations when dust or other contaminants are present may result in damage from particle ingestion.

Set the parking brake. The magnetos should be checked at 2000 rpm with the propeller control set at full INCREASE. Drop off on either magneto should not exceed 175 rpm and the difference between the magnetos should not exceed 50 rpm. Operation on one magneto should not exceed 10 seconds.

Check the suction gauge; the indicator should read 4.5 to 5.2 in. Hg at 2000 rpm. Check that both red flow buttons are pulled in.

Check the voltmeter and ammeters for proper voltage and alternator outputs. Check oil temperature and oil pressure. The temperature may be low for some time if the engine is being run for the first time of the day.

The propeller control should be moved through its complete range to check for proper operation and then placed in full INCREASE rpm for takeoff. Do not allow a drop of more than 500 rpm during this check. In cold weather, the propeller control should be cycled from high to low rpm at least three times before takeoff to make sure that warm engine oil has circulated.

Check that the fuel flow gauge is functioning, then retard the throttle. Check the annunciator panel lights with the press-to-test button.

Drain the manifold pressure line by running the engine at 1000 rpm and depressing the drain valve, located on the left side of the control pedestal under the instrument panel, for 5 seconds. Do not depress the valve when the manifold pressure exceeds 25 inches Hg.

4.21 BEFORE TAKEOFF (4.5g)

Ensure that the battery master and alternator switches are ON. Check that the cabin pressurization controls are properly set. Check and set all of the fight instruments as required. Check the fuel selector to make sure it is on the proper tank. Ensure emergency fuel pump is ON. Check all engine gauges. The induction air should be in the PRIMARY position.

All seat backs should be erect and armrests stowed.

The mixture control should be set to full RICH and propeller control should be set to full INCREASE. Seat belts and shoulder harnesses should be fastened. Fasten the seat belts snugly around the empty seats.

Set the flaps and trim. Ensure proper flight control movement and response. The door should be properly latched and the door ajar annunciator light out. The air conditioner must be OFF to ensure normal takeoff climb performance. Release the parking brake.

4.23 TAKEOFF (4.5h)

4.23a Normal Technique (4.5h)

When the available runway length is well in excess of that required and obstacle clearance is no factor, the normal takeoff technique may be used. The flaps should be set in the retracted position and the pitch trim set slightly aft of neutral. Align the airplane with the runway, apply full power, and accelerate to 78 KIAS.

NOTE

Takeoffs are normally made with full throttle. However, under some off standard conditions the manifold pressure indication can exceed its indicated limit at full throttle. Limit manifold pressure to 42 in. Hg maximum. (See Section 7.)

4.23 TAKEOFF (4.5h) (Continued)

4.23a Normal Technique (4.5h) (Continued)

Apply back pressure to the control wheel to lift off, then control pitch attitude as required to attain the desired climb speed. Retract the landing gear when a straight-ahead landing on the runway is no longer possible.

NOTE

During landing gear operation, it is normal for the HYDRAULIC PUMP annunciator light to illuminate until full system pressure is restored.

4.23b Short Field, Obstacle Clearance Technique (4.5h)

INFORMATION PENDING

4.25 CLIMB (4.5i)

4.25a Takeoff Climb (4.5i)

The best rate of climb at gross weight and maximum continuous power will be obtained at 110 KIAS. The best angle of climb may be obtained at 81 KIAS. The recommended procedure for climb is to use maximum power with the mixture full RICH. Under some off standard conditions the manifold pressure indication will exceed its indicated limits at full throttle. Adjust power to remain within limits. Set the cabin pressurization controls in accordance with paragraph 4.45. The emergency (EMERG) fuel pump should be OFF when reaching a safe altitude.

4.25b Cruise Climb (4.5i)

INFORMATION PENDING

4.27 · CRUISE (4.5j)

WARNING

Operation above 25,000 feet is not approved.

CAUTION

To maintain lateral balance, alternate between right and left fuel tanks. See paragraphs 2.23 and 7.17.

4.27 CRUISE (4.5j) (Continued)

The cruising speed is determined by many factors, including power setting, altitude, temperature, loading, and equipment installed on the airplane. When leveling off at cruise altitude, the pilot may reduce to a cruise power setting in accordance with the *Power Setting Table in Section 5 of this Manual. Proper leaning during cruise is essential for smooth engine operation and optimum fuel economy. This is especially important during power reductions, such as level off, to prevent rough engine operation . For cruise, mixture should be leaned to peak TIT. Always use the TIT gauge for leaning.

For maximum service life, cylinder head temperature should be maintained below 435°F during cruise operation. If cylinder head temperatures become too high during flight, reduce them by adjusting the mixture, reducing power, or any combination of these methods.

Following level-off for cruise, the airplane should be trimmed and the pressurization system checked.

During flight, keep account of time and fuel used in connection with power settings to determine how the fuel flow and fuel quantity gauging systems are operating.

The emergency (EMERG) fuel pump should always be turned ON before switching tanks, and should be left on for a short period thereafter. To preclude making a hasty selection, and to provide continuity of flow, the selector should be changed to another tank before fuel is exhausted from the tank in use.

NOTE

The BOOST PUMP annunciator will momentarily illuminate when switching fuel tanks.

*To obtain the performance presented in the Performance Section of this handbook, all conditions listed on the performance charts must be met.

4.27 CRUISE (4.5j) (Continued)

During cruise, use the following procedure to maintain lateral balance, and stay within the fuel imbalance limitations of 2.31:

(a) When starting with a symmetrical fuel load, use the left tank first until 10 gallons are burned, then alternate tanks at approximately one hour intervals.
(b) When starting with an unsymmetrical fuel load, care must be taken not to allow the fuel imbalance to exceed 10 gallons.

The emergency (EMERG) fuel pump should normally be OFF so that any malfunction of the engine driven fuel pump is immediately apparent. Loss of fuel pressure to the fuel injector is indicated by the illumination of the FUEL PRESS annunciator. If signs of fuel starvation should occur at any time during flight, fuel exhaustion should be suspected, at which time the fuel selector should be immediately positioned to the fullest tank and the electric fuel pump switched to the ON position. If excessive fuel vapor is suspected, usually indicated by fluctuating fuel flow, turn the emergency (EMERG) fuel pump ON until the fuel flow indications are smooth.

The pilot should monitor weather conditions while flying, and be alert for meteorological conditions which might lead to icing. Even aircraft equipped with a complete deicing option are not approved for flight in heavy icing or freezing rain. (See Section 9.) Immediate steps shall be taken to exit any area where such icing conditions are inadvertently encountered. Saturated air accelerating through the induction system filter can form ice although ambient temperatures are above freezing. If induction system icing is suspected, place the induction air control in the ALTERNATE position. Alternate air should also be selected before entering clouds. Manifold pressure may decrease significantly when alternate air is selected depending on altitude, power setting, and other factors. If ice is forming on the filter, manifold pressure could continue to deteriorate after selecting alternate air. When manifold pressure stabilizes reestablish cruise power. The primary filter may retain ice after leaving icing conditions, making the selection of PRIMARY induction air impractical until ice melts or sublimates.

There are no mechanical uplocks in the landing gear system. In the event of a hydraulic system malfunction, check valves should prevent the gear from extending. However, some hydraulic system malfunctions may cause the gear to free-fall to the gear down position. The true airspeed with gear down is approximately 70% of the gear retracted airspeed for any given power setting. Allowances for the reduction in airspeed and range should be made when planning extended flight between remote airfields or flight over water.

4.29 DESCENT (4.5k)

The recommended procedure for descent is to leave the engine controls at the cruise settings and increase the airspeed to give the desired rate of descent. Monitor the manifold pressure and adjust to maintain the cruise setting. Leave the mixture leaned to the cruise setting. This will prevent rapid engine cooling which may damage the engine. Should additional rate of descent be required, power can be reduced to 20 in. Hg. while maintaining cabin pressurization. At reduced power maintain at least 1350° F TIT in order to keep engine temperatures from cooling too rapidly. If descending with the gear retracted does not provide the desired rate of descent the gear may be extended at speeds up to 165 KIAS and the aircraft operated at speeds up to 195 KIAS with the gear extended. This procedure will significantly increase rate of descent.

Shortly after letdown is initiated, set the Cabin Altitude Controller to 500 feet above the pressure altitude of the landing field. Adjust the rate control high enough to allow the cabin to descend to the landing setting before the aircraft descends to that altitude. For normal letdown the rate knob should be at the nine o'clock position. A higher setting should be selected for rapid descents so that the aircraft altitude does not catch up with cabin altitude.

Set the altimeter. Adjust the windshield defrost as required during descent.

4.31 APPROACH AND LANDING (4.5m)

Accomplish the Landing Checklist early in the landing approach.

The fuel selector should be on the fullest tank. Seat backs must be fully erect, armrests stowed, and seat belts and shoulder harnesses fastened and properly adjusted. The emergency (EMERG) fuel pump should be ON. Check to ensure that the cabin is depressurized. The mixture should be RICH and propeller control should be set. The landing gear may be lowered at speeds up to 165 KIAS and the flaps at speeds as follows:

10° 165 KIAS maximum
20° 130 KIAS maximum
36° 116 KIAS maximum

4.31 APPROACH AND LANDING (4.5m) (Continued)

NOTE

During landing gear operation, it is normal for the HYDRAULIC PUMP annunciator light to illuminate until full system pressure is restored.

The air conditioner should be OFF to ensure maximum rate of climb in the event of a go-around. Pump toe brakes to ensure that the system is capable of uniform braking during landing rollout.

WARNING

After pumping several times, if one or both toe brakes are inoperative, DO NOT attempt landing on a short field.

Depending on the field length and other factors the following procedures are appropriate:

4.31a Normal Technique (4.5m)

The aircraft should be flown down the final approach course at 77 KIAS with full flaps extended, and power required to maintain the desired approach angle. When descending through 50 feet agl, reduce power to idle. Make normal landing, and brake as required during ground roll.

4.31b Short Field Technique (4.5m)

INFORMATION PENDING

4.33 GO-AROUND (4.5n)

To initiate a go-around from a landing approach, the mixture should be set to full RICH, the propeller control should be at full INCREASE, and the throttle should be advanced to full power while the pitch attitude is increased to obtain the balked landing climb speed of 80 KIAS. Retract the landing gear and slowly retract the flaps when a positive climb is established. Allow the airplane to accelerate to the best angle of climb speed (81 KIAS) for obstacle clearance or to the best rate of climb speed (110 KIAS) if obstacles are not a factor. Reset the longitudinal trim as required.

4.35 AFTER LANDING CHECKLIST (4.5o)

When clear of the active runway, move the induction air control to PRIMARY, retract the flaps, and turn the air conditioner on as desired. Turn OFF the radar, emergency (EMERG) fuel pump, and strobe lights. Turn OFF the landing and taxi lights as required.

4.37 STOPPING ENGINE (4.5p)

Prior to shutdown all radio and electrical equipment and external lights should be turned OFF.

The air conditioner should be turned OFF, the propeller control set in the full INCREASE position, and the throttle should be CLOSED to avoid engine vibration while stopping. Stop the engine by pulling the mixture control back to idle cut-off. After the engine stops, both magneto switches, alternator switches, and battery master switches must be turned OFF.

4.39 MOORING (4.5q)

If necessary, the airplane should be moved on the ground with the aid of the nose wheel tow bar.

The parking brake should be set and the aileron and elevator controls should be secured by looping the safety belt through the control wheel and pulling it snug. The flaps should be fully retracted. Wheel chocks should be positioned in place.

Tiedowns can be secured to the wing tiedown rings and to the tail skid. The rudder is held in position by its connections to the nose wheel steering and normally does not have to be secured.

4.41 STALLS

The stall characteristics of the Malibu are conventional. An approaching stall is indicated by a stall warning horn which is activated between five and ten knots above stall speed. Mild airframe buffeting and pitching may also precede the stall.

The gross weight stalling speed with power off, landing gear extended, and full flaps is 58 KIAS. With the landing gear retracted and flaps up, this speed is increased to 69 KIAS. Loss of altitude during stalls can be as great as 700 feet, depending on configuration and power.

NOTE

The stall warning system is inoperative with the battery and alternator switches OFF.

During preflight, the stall warning system should be checked by turning the battery switch on and pressing the stall warning test switch to determine if the horn is actuated.

4.43 TURBULENT AIR OPERATION

In keeping with good operating practice used in all aircraft, it is recommended that when turbulent air is encountered or expected, the airspeed be reduced to maneuvering speed to reduce the structural loads caused by gusts and to allow for inadvertent speed build-ups which may occur as a result of the turbulence or of distractions caused by the conditions. (Refer to paragraph 2.3 for maneuvering speeds.)

4.45 CABIN PRESSURIZATION SYSTEM

Cabin pressurization system controls, gauges and switches are located in the lower left instrument panel. (Refer to Section 7, Figure 7-25.)

The cabin pressurization system controls, gauges and switches are as follows:

(a) Cabin Altitude Controller with Rate of Change Control
(b) Cabin Pressure Altitude/Differential Pressure/Rate of Climb Gauge
(c) Cabin Pressure Dump/Normal Switch
(d) Cabin Pressurization Control

Prior to starting engines, check the operation of the cabin pressurization control. Note that a firm effort is required to move the lever out of either the outside air or the pressurized air position. If little effort is required to move the lever, be suspicious of a broken control cable. If a cable is broken, the air control valve may have failed in either the open or closed position. If failed open, pressurized flight will not be possible, but unpressurized flight will be possible. If failed closed, pressurized flight would be possible but should not be attempted, as it would not be possible to bring in fresh air should contamination occur.

Set *cabin* altitude (outer scale) on the cabin altitude controller to 500 feet above the field pressure altitude before takeoff. (Cabin pressurization will begin as the cabin passes through the altitude selected.) If no further adjustments are made, cabin altitude will remain at the selected altitude until maximum cabin differential (5.5 PSI) is reached, at which time the cabin altitude will begin to climb until at 25,000 feet aircraft pressure altitude the cabin pressure altitude will be approximately 8000 feet.

4.45 CABIN PRESSURIZATION SYSTEM (Continued)

For flight below an airplane altitude of 12,500 feet, the cabin altitude control should be left at the takeoff setting. For flight above 12,500 feet, at which point maximum differential will be achieved, smoother operation will result by setting the *cabin* altitude (outer scale) on the cabin altitude controller to 500 feet above field elevation for takeoff. Once the cabin has begun to pressurize and the controller has captured isobaric control, reset the *aircraft* altitude (inner scale) on the cabin altitude controller to 500 feet above the cruise altitude and adjust the cabin rate of climb as desired. The normal 9 o'clock position should provide a cabin rate of climb of approximately 500 feet per minute. No additional adjustment should be required prior to descent unless cruise altitude is changed, at which point the *aircraft* altitude (inner scale) should be reset to 500 feet above the new cruise altitude.

To descend for landing be certain that the selected *cabin* altitude (outer scale) is higher than the pressure altitude of the landing field. Shortly after letdown is initiated, set the *cabin* altitude (outer scale) to 500 feet above the pressure altitude of the landing field and adjust the rate of control high enough to allow the cabin to descend to the landing setting before the aircraft descends to that altitude. For normal letdown the rate knob should be at the normal 9 o'clock position. A higher setting should be selected for rapid descents so that the aircraft altitude does not catch up with the cabin altitude.

WARNING

Do not land with aircraft pressurized.

To repressurize while in flight push the pressurization control in and set the cabin pressure dump/normal switch to NORM.

4.47 SUPPLEMENTAL ELECTRIC HEATER

AFTER ENGINE START

BATT MASTER Switch .... ON
Alternator Switches .... OFF
VENT/DEFOG FAN Switch .... ON
Airflow .... CHECK
Voltmeter .... LESS than 25 Vdc (increase electrical load as necessary to lower voltage)
LO BUS Annunciator .... ILLUMINATED
Electrical Switches .... OFF
VENT/DEFOG FAN Switch .... OFF
Alternator Switches .... ON

NOTE

Low voltage monitor system and annunciator must be checked operational before heater operation. VENT/DEFOG FAN must be checked operational before heater ground operation.

HEATER OPERATION

VENT/DEFOG FAN .... ON
AUX CABIN HEAT Switch .... ON

For maximum heat:

REC BLWR Switch .... OFF
CABIN TEMP Control .... FULL OUT
DEFROST Control .... AS REQUIRED to CLEAR WINDSHIELD; then FULL IN

NOTE

This unit should be considered primarily as an auxiliary backup to the standard heating system. There is no external control over the heat produced by the unit.

4.49 NOISE LEVEL

The corrected noise level of this aircraft is 74.7 dB(A).

No determination has been made by the Federal Aviation Administration that the noise levels of this airplane are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

The above statement notwithstanding, the noise level stated above has been verified by and approved by the Federal Aviation Administration in noise level test flights conducted in accordance with F.A.R. 36, Noise Standards - Aircraft Type and Airworthiness Certification. This aircraft model is in compliance with all F.A.R. 36 noise standards applicable to this type.

TABLE OF CONTENTS

SECTION 5

PERFORMANCE

SECTION 5

PERFORMANCE

5.1 GENERAL

All of the required (FAA regulations) and complementary performance information is provided by this section.

Performance information associated with those optional systems and equipment which require handbook supplements is provided by Section 9 (Supplements).

5.3 INTRODUCTION - PERFORMANCE AND FLIGHT PLANNING

The performance information presented in this section is based on measured Flight Test Data corrected to I.C.A.O. standard day conditions and analytically expanded for the various parameters of weight, altitude, temperature, etc.

The performance charts are unfactored and do not make any allowance for varying degrees of pilot proficiency or mechanical deterioration of the aircraft. This performance, however, can be duplicated by following the stated procedures in a properly maintained airplane.

Effects of conditions not considered on the charts must be evaluated by the pilot, such as the effect of soft or grass runway surface on takeoff and landing performance, or the effect of winds aloft on cruise and range performance. Endurance can be grossly affected by improper leaning procedures, and inflight fuel flow and quantity checks are recommended.

REMEMBER! To get chart performance, follow the chart procedures.

5.3 INTRODUCTION - PERFORMANCE AND FLIGHT PLANNING (cont.)

The information provided by paragraph 5.5 (Flight Planning Example) outlines a detailed flight plan using performance charts in this section. Each chart includes its own example to show how it is used.

WARNING

Performance information derived by extrapolation beyond the limits shown on the charts should not be used for flight planning purposes.

5.5 FLIGHT PLANNING EXAMPLE

(a) Aircraft Loading

The first step in planning the flight is to calculate the airplane weight and center of gravity by utilizing the information provided by Section 6 (Weight and Balance) of this handbook.

The basic empty weight for the airplane as licensed at the factory has been entered in Figure 6-5. If any alterations to the airplane have been made affecting weight and balance, reference to the aircraft logbook and Weight and Balance Record (Figure 6-7) should be made to determine the current basic empty weight of the airplane.

Make use of the Weight and Balance Loading Form (Figure 6-11) and the C.G. Range and Weight graph (Figure 6-15) to determine the total weight of the airplane and the center of gravity position.

After proper utilization of the information provided, the following weights have been determined for consideration in the flight planning example.

The landing weight cannot be determined until the weight of the fuel to be used has been established (refer to item (g) (1).

(1) Basic Empty Weight	2745
(2) Occupants (5 x 170 lbs.)	850
(3) Baggage and Cargo	170
(4) Zero Fuel Weight	3765
(5) Fuel (6 lb/gal. x 92)	552
(6) Ramp Weight	4317
(7) Fuel for Engine Start, Taxi, and Runup	-18
(8) Takeoff Weight	4299
(9) Landing Weight (a)(5) minus (g)(1),	TBD

The takeoff weight is below the maximum of 4300 lbs. and the weight and balance calculations have determined the C.G. position within the approved limits.

5.5 FLIGHT PLANNING EXAMPLE (cont.)

(b) Takeoff and Landing

Now that the aircraft loading has been determined, all aspects of the takeoff and landing must be considered.

All of the existing conditions at the departure and destination airport must be acquired, evaluated and maintained throughout the flight.

Apply the departure airport conditions and takeoff weight to the appropriate Takeoff Ground Roll and Takeoff Distance (Figures 5-9, 5-11, 5-13 and 5-15) to determine the length of runway necessary for the takeoff and/or the obstacle clearance.

The landing distance calculations are performed in the same manner using the existing conditions at the destination airport and, when established, the landing weight.

The conditions and calculations for the example flight are listed below. The takeoff and landing distances required for the flight have fallen well below the available runway lengths.

	Departure Airport	Destination Airport
(1) Pressure Altitude	500 ft.	2000 ft.
(2) Temperature	15°C	12°C
(3) Wind Component (Headwind)	10 KTS	0 KTS
(4) Runway Length Available	3400 ft.	5000 ft.
(5) Takeoff and Landing Distance Required	TBD*	TBD**

*reference Figures 5-9, 5-11, 5-13, 5-15
**reference Figures 5-33, 5-35

5.5 FLIGHT PLANNING EXAMPLE (cont.)

NOTE

The remainder of the performance charts used in this flight plan example assume a no wind condition. The effect of winds aloft must be considered by the pilot when computing climb, cruise and descent performance.

(c) Climb

The next step in the flight plan is to determine the necessary climb segment components.

The desired cruise pressure altitude and corresponding cruise outside air temperature values are the first variables to be considered in determining the climb components from the Time, Distance, and Fuel to Climb graph (Figure 5-19). After the fuel, distance and time for the cruise pressure altitude and outside air temperature values have been established, apply the existing conditions at the departure field to graph (Figure 5-19). Now, subtract the values obtained from the graph for the field of departure conditions from those for the cruise pressure altitude.

The remaining values are the true fuel, distance and time components for the climb segment of the flight plan corrected for field pressure altitude and temperature.

The following values were determined from the above instructions in the flight planning example.

(1) Cruise Pressure Altitude	20000 ft.
(2) Cruise OAT	-15° C
(3) Time to Climb	TBD*
(4) Distance to Climb	TBD*
(5) Fuel to Climb	TBD*

*reference Figure 5-19

5.5 FLIGHT PLANNING EXAMPLE (cont.)

(d) Descent

The descent data will be determined prior to the cruise data to provide the descent distance for establishing the total cruise distance.

Utilizing the cruise pressure altitude and OAT, determine the basic time, distance and fuel for descent (Figure 5-27). These figures must be adjusted for the field pressure altitude and temperature at the destination airport. To find the necessary adjustment values, use the existing pressure altitude and temperature conditions at the destination airport as variables to find the fuel, distance and time values from the graph (Figure 5-27). Now, subtract the values obtained from the field conditions from the values obtained from the cruise conditions to find the true fuel, distance and time values needed for the descent segment of the flight plan.

The values obtained by proper utilization of the graphs for the descent segment of the example are shown below.

(1) Time to Descend .... TBD*
(2) Distance to Descend .... TBD*
(3) Fuel to Descend .... TBD*

(e) Cruise

Using the total distance to be traveled during the flight, subtract the previously calculated distance to climb and distance to descend to establish the total cruise distance. Refer to the appropriate Textron Lycoming Manual and the Cruise Performance Table (refer to page 5-22) when selecting the cruise power setting. The established pressure altitude and temperature values and the selected cruise power should now be utilized to determine the true airspeed from the Cruise Vs. Altitude (Figure 5-21).

*reference Figure 5-27

5.5 FLIGHT PLANNING EXAMPLE (cont.)

Calculate the cruise fuel consumption for the cruise power setting from the information provided by the Textron Lycoming Manual and the Cruise Performance Table (refer to page 5-22).

The cruise time is found by dividing the cruise distance by the cruise speed and the cruise fuel is found by multiplying the cruise fuel consumption by the cruise time.

The cruise calculations established for the cruise segment of the flight planning example are as follows:

(1) Total Distance	400 nautical miles
(2) Cruise Distance (e)(1) minus (c)(4) minus (d)(2)	TBD
(3) Cruise Power	High speed cruise
(4) Cruise Speed	TBD*
(5) Cruise Fuel Consumption	TBD*
(6) Cruise Time (e)(2) divided by (e)(4)	TBD
(7) Cruise Fuel (e)(5) multiplied by (e)(6)	TBD

(f) Total Flight Time

The total flight time is determined by adding the time to climb, the time to descend and the cruise time. Remember! The time values taken from the climb and descent graphs are in minutes and must be converted to hours before adding them to the cruise time.

*reference Figure 5-21 and Page 5-22

5.5 FLIGHT PLANNING EXAMPLE (cont.)

The following flight time is required for the flight planning example:

(1) Total Flight Time
(c)(3) plus (d)(1) plus (e)(6) TBD

(g) Total Fuel Required

Determine the total fuel required by adding the fuel for start, taxi, and runup (3.0 gal., calculated by allowing 5 minutes of fuel flow at takeoff power), the fuel to climb, the fuel to descend, and the cruise fuel. When the total fuel (in gallons) is determined, multiply this value by 6 lb/gal to determine the total fuel weight used for the flight.

The total fuel calculations for the example flight plan are shown below.

(1) Total Fuel Required
Fuel for Start, Taxi and Takeoff plus
(c)(5) plus (d)(3) plus (e)(7) TBD

5.7 PERFORMANCE GRAPHS

LIST OF FIGURES

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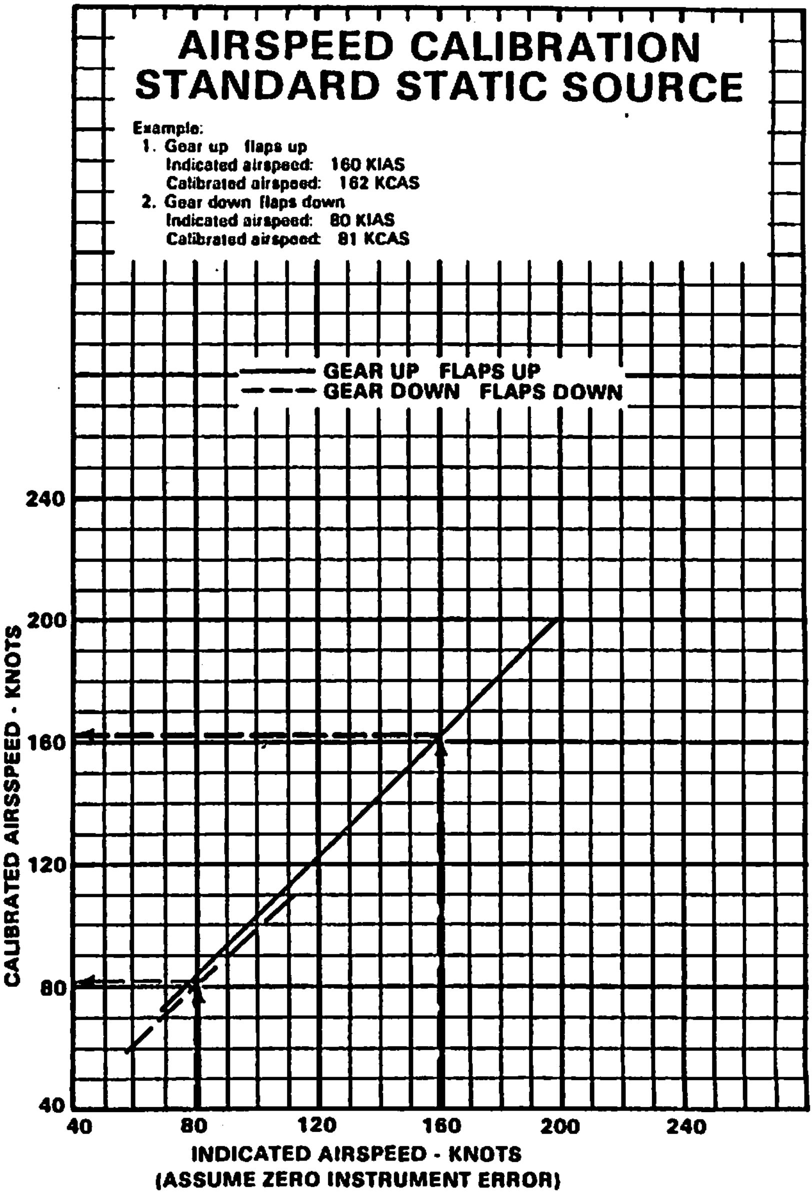
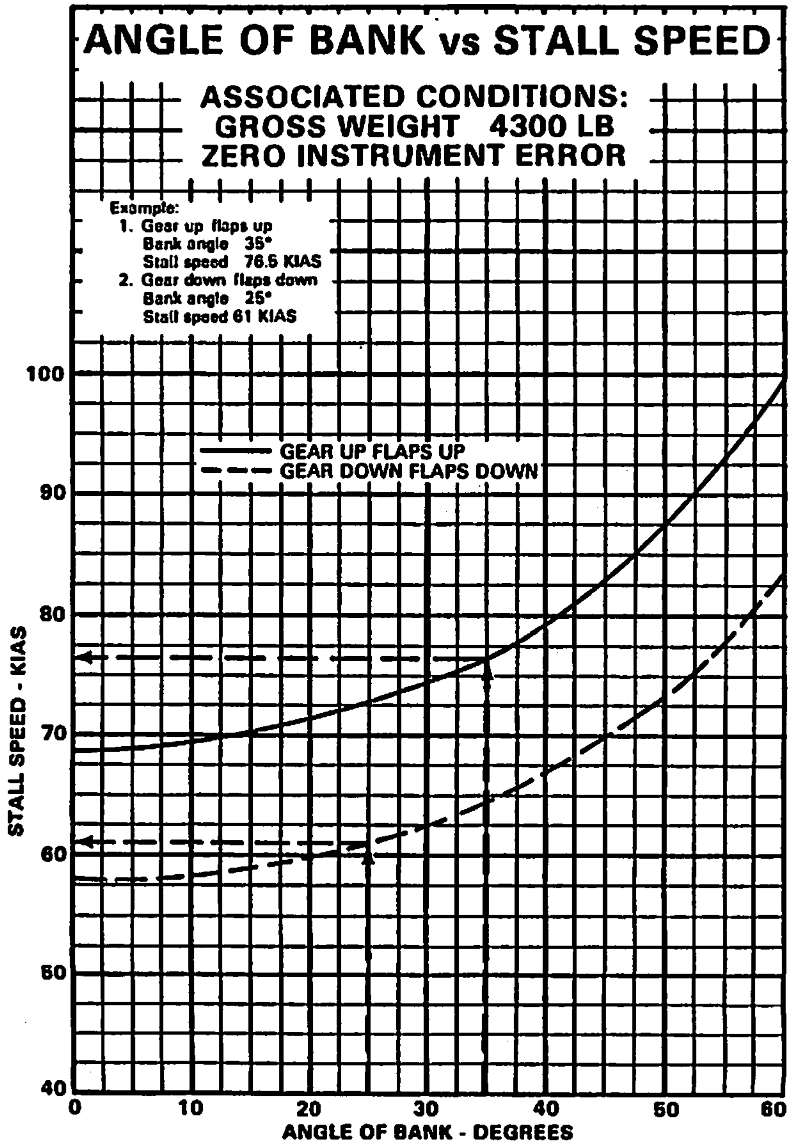
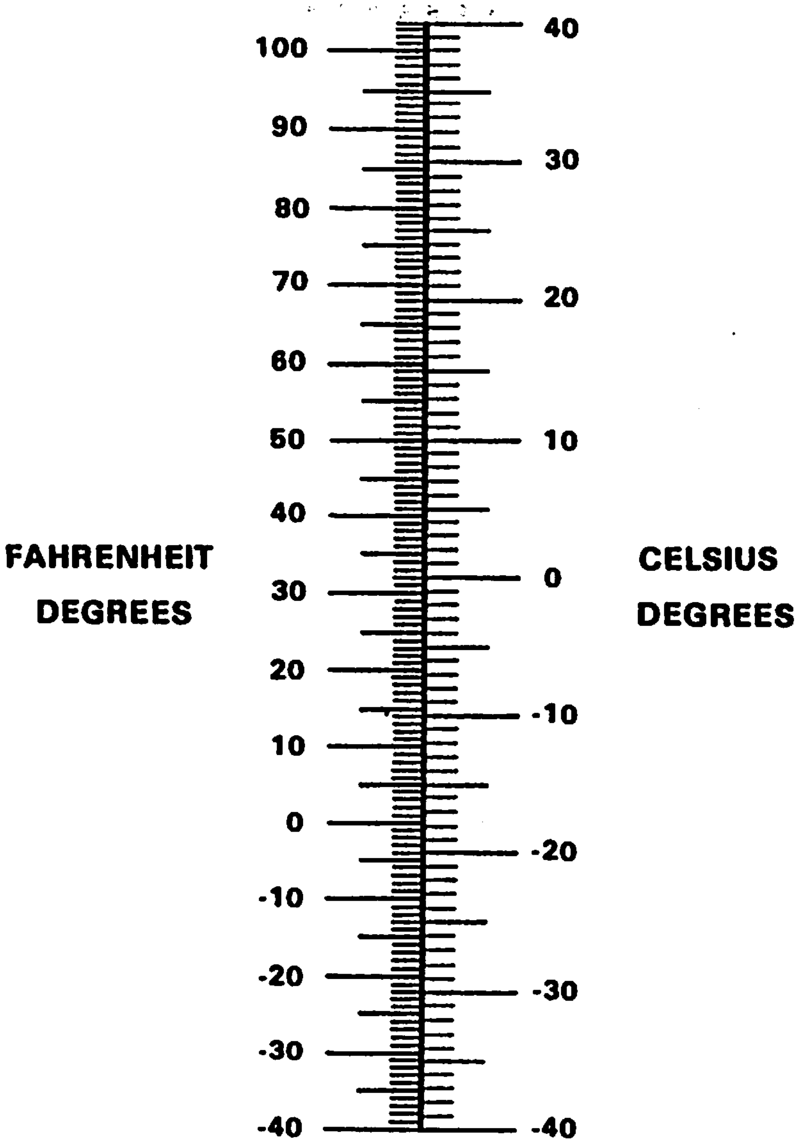


AIRSPEED CALIBRATION
Figure 5-1



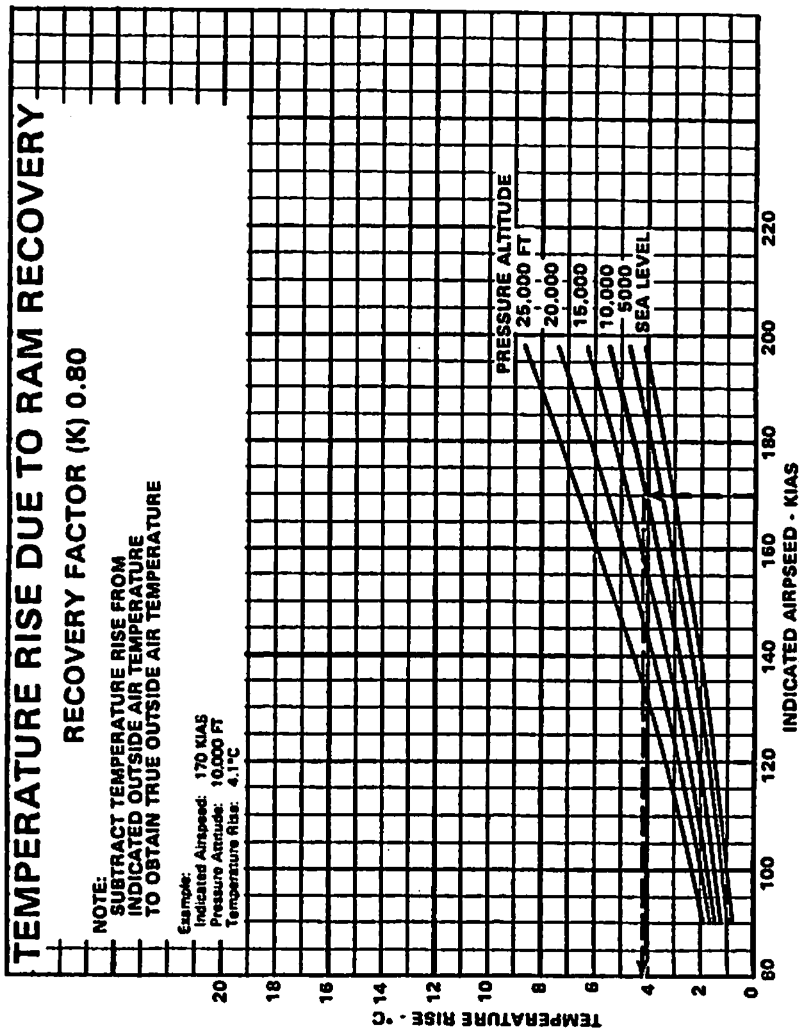
ANGLE OF BANK VS. STALL SPEED
Figure 5-3



TEMPERATURE CONVERSION
Figure 5-5

INFORMATION PENDING

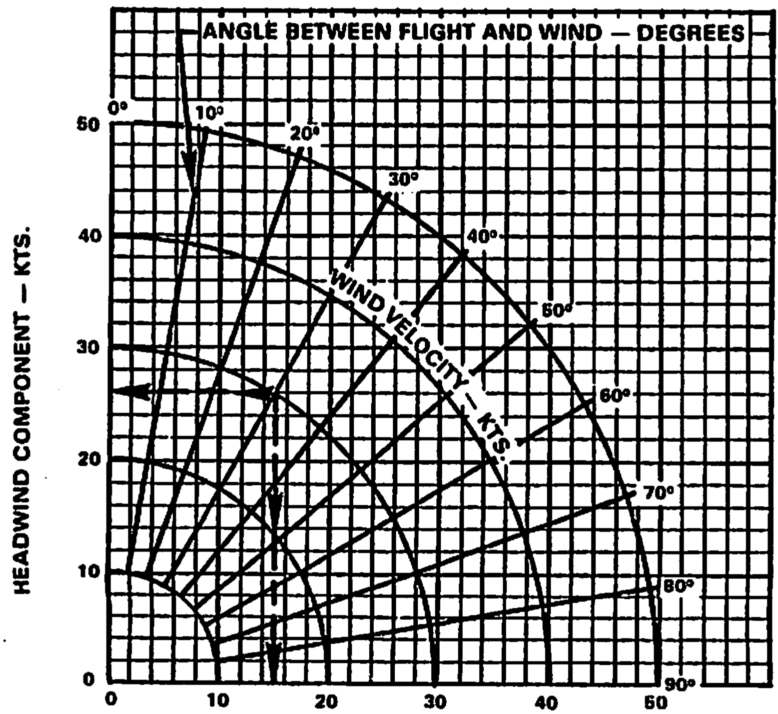
**PRESSURE ALTITUDE
VS
OUTSIDE AIR TEMPERATURE**
Figure 5-7



TEMPERATURE RISE DUE TO
RAM RECOVERY
Figure 5-9

WIND COMPONENTS

Example:
Wind velocity: 30 knots
Angle between flight path and wind: 30°
Headwind component: 26 knots
Crosswind components: 15 knots



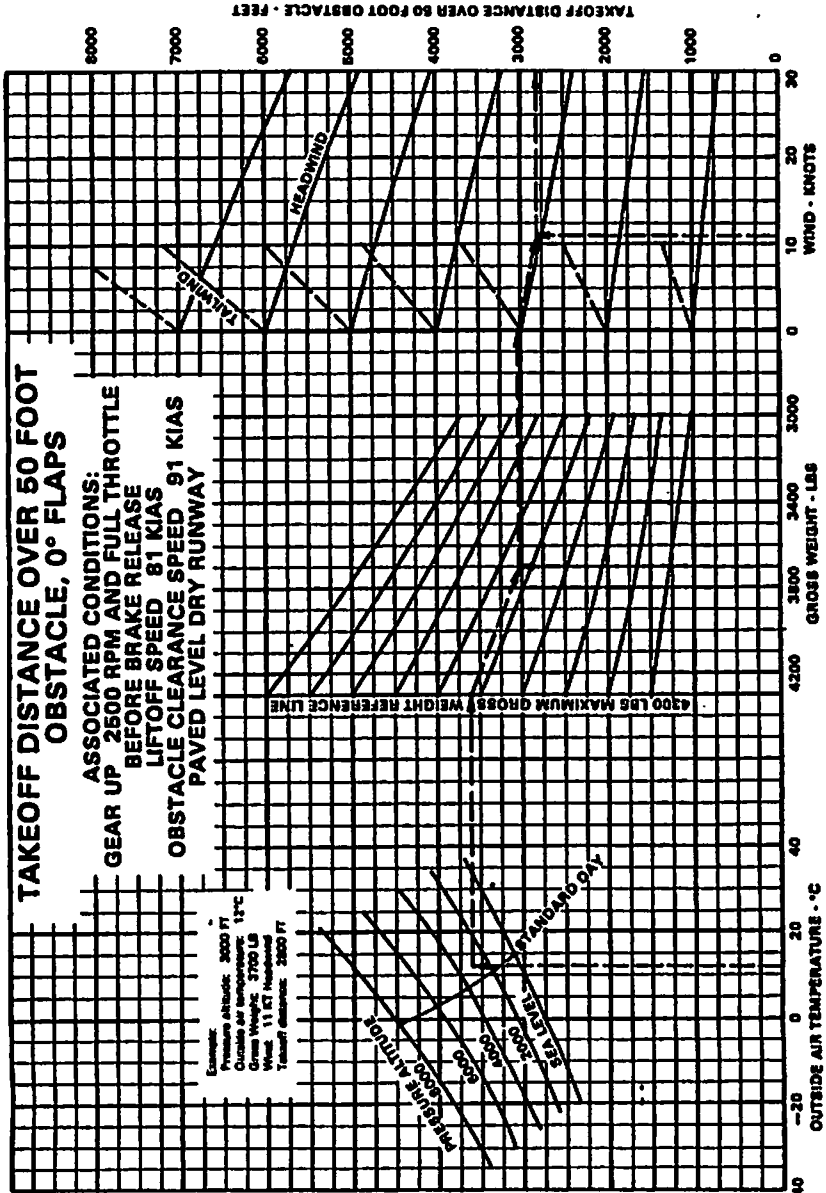
WIND COMPONENTS
Figure 5-11

INFORMATION PENDING

TAKEOFF GROUND ROLL, 0° FLAPS
Figure 5-13

INFORMATION PENDING

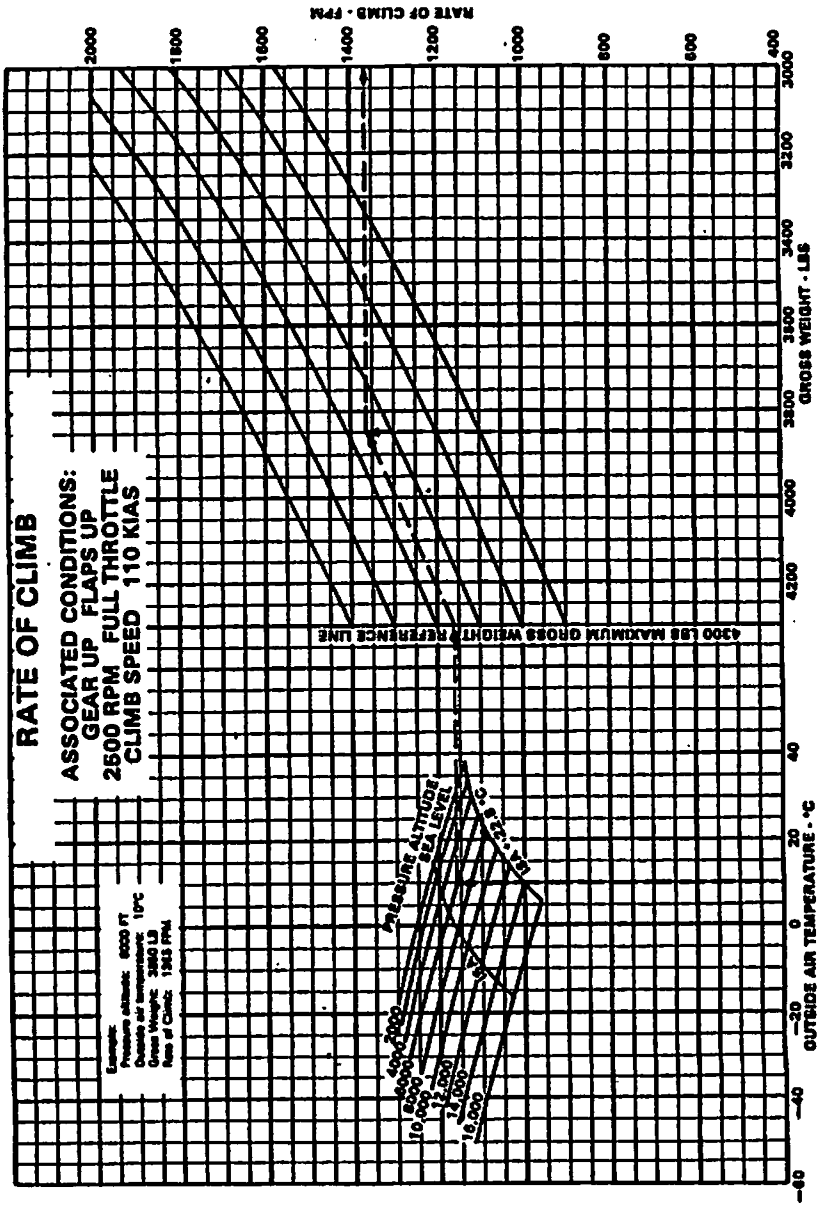
TAKEOFF GROUND ROLL, 20° FLAPS
Figure 5-15



TAKEOFF DISTANCE OVER 50 FT. OBSTACLE, 0° FLAPS
Figure 5-17

RESERVED

Figure 5-19



RATE OF CLIMB
Figure 5-21

INFORMATION PENDING

**MAXIMUM CONTINUOUS POWER
TIME, DISTANCE AND FUEL TO CLIMB
Figure 5-23**

INFORMATION PENDING

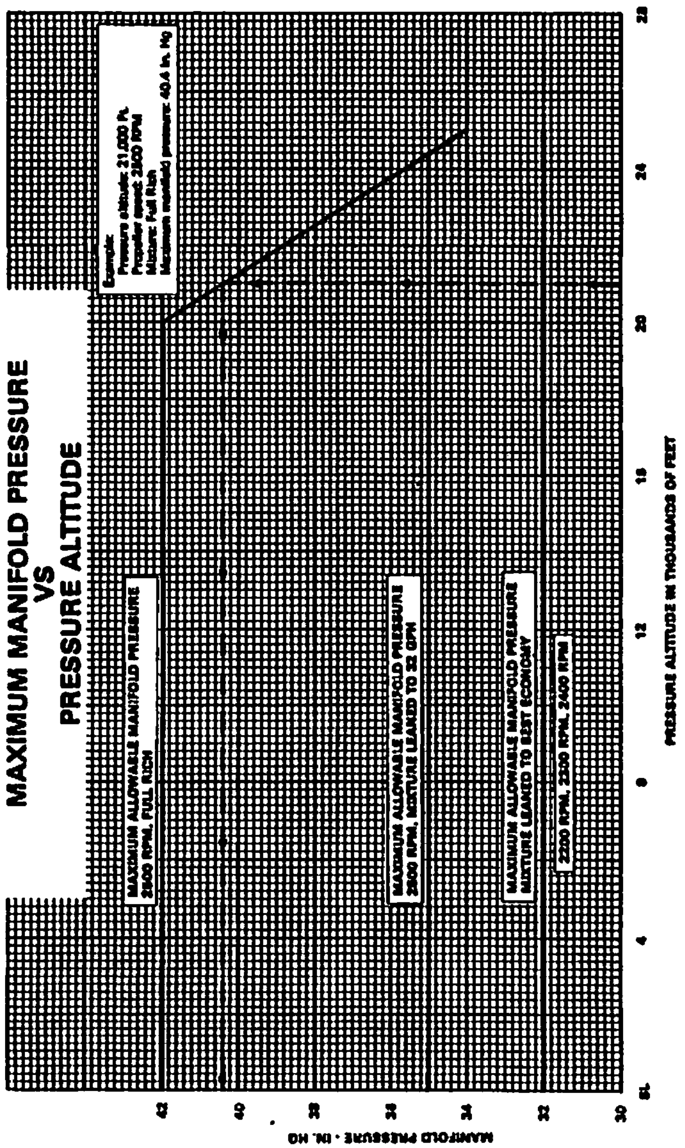
CRUISE CLIMB
TIME, DISTANCE AND FUEL TO CLIMB
Figure 5-25

POWER SETTING TABLE
REFERENCE FIG. 5-27

ASSOCIATED CONDITIONS

	RPM	Man. Press.	Approx. Fuel Flow	TIT
High Speed Cruise				
Economy Cruise			INFORMATION PENDING	
Long Range Cruise				
Holding				

INFORMATION PENDING



MAXIMUM MANIFOLD PRESSURE
Vs. PRESSURE ALTITUDE
Figure 5-26

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INFORMATION PENDING

CRUISE SPEED VS. ALTITUDE
Figure 5-27

INFORMATION PENDING

RANGE
Figure 5-29

INFORMATION PENDING

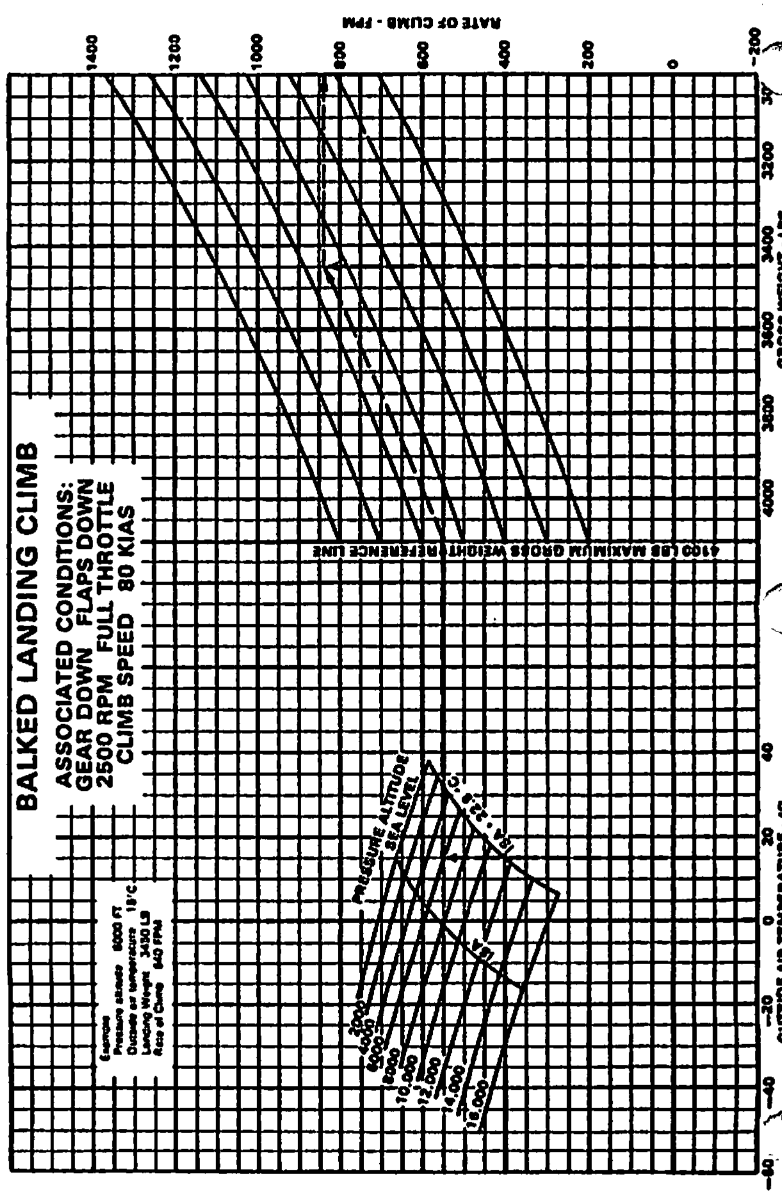
ENDURANCE
Figure 5-31

INFORMATION PENDING

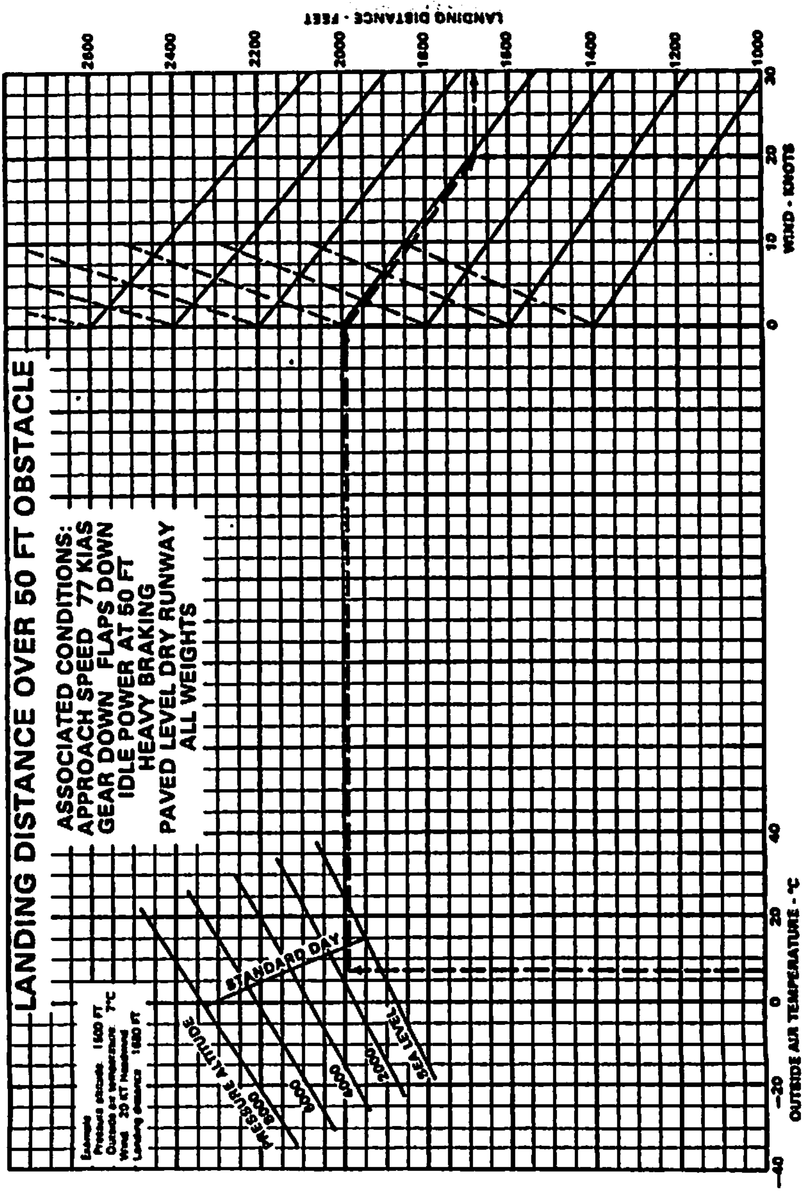
TIME, DISTANCE AND FUEL TO DESCEND
Figure 5-33

INFORMATION PENDING

GLIDE TIME AND DISTANCE
Figure 5-35



BALKED LANDING CLIMB
Figure 5-37



LANDING DISTANCE OVER 50 FT. OBSTACLE
Figure 5-39

INFORMATION PENDING

LANDING GROUND ROLL
Figure 5-41

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SECTION 6

WEIGHT AND BALANCE

SECTION 6

WEIGHT AND BALANCE

6.1 GENERAL

In order to achieve the performance and flying characteristics which are designed into the airplane, it must be flown with the weight and center of gravity (C.G.) position within the approved operating range (envelope). Although the airplane offers flexibility of loading, it cannot be flown with the maximum number of adult passengers, full fuel tanks and maximum baggage. With the flexibility comes responsibility. The pilot must ensure that the airplane is loaded within the loading envelope before he makes a takeoff.

Misloading carries consequences for any aircraft. An overloaded airplane will not take off, climb or cruise as well as a properly loaded one. The heavier the airplane is loaded, the less climb performance it will have.

Center of gravity is a determining factor in flight characteristics. If the C.G. is too far forward in any airplane, it may be difficult to rotate for takeoff or landing. If the C.G. is too far aft, the airplane may rotate prematurely on takeoff or tend to pitch up during climb. Longitudinal stability will be reduced. This can lead to inadvertent stalls and even spins; and spin recovery becomes more difficult as the center of gravity moves aft of the approved limit.

A properly loaded airplane, however, will perform as intended. Before the airplane is licensed, a basic empty weight and C.G. location is computed (basic empty weight consists of the standard empty weight of the airplane plus the optional equipment). Using the basic empty weight and C.G. location, the pilot can determine the weight and C.G. position for the loaded airplane by computing the total weight and moment and then determining whether they are within the approved envelope.

6.1 GENERAL (Continued)

The basic empty weight and C.G. location are recorded in the Weight and Balance Data Form (Figure 6-5) and the Weight and Balance Record (Figure 6-7). The current values should always be used. Whenever new equipment is added or any modification work is done, the mechanic responsible for the work is required to compute a new basic empty weight and C.G. position and to write these in the Aircraft Log Book and the Weight and Balance Record. The owner should make sure that it is done.

A weight and balance calculation is necessary in determining how much fuel or baggage can be boarded so as to keep within allowable limits. Check calculations prior to adding fuel to insure against improper loading.

The following pages are forms used in weighing an airplane in production and in computing basic empty weight, C.G. position, and useful load. Note that the useful load includes usable fuel, baggage, cargo and passengers. Following this is the method for computing takeoff weight and C.G.

6.3 AIRPLANE WEIGHING PROCEDURE

At the time of licensing, Piper Aircraft Corporation provides each airplane with the basic empty weight and center of gravity location. This data is supplied by Figure 6-5.

The removal or addition of equipment or airplane modifications can affect the basic empty weight and center of gravity. The following is a weighing procedure to determine this basic empty weight and center of gravity location:

(a) Preparation

(1) Be certain that all items checked in the airplane equipment list are installed in the proper location in the airplane.

(2) Remove excessive dirt, grease, moisture, and foreign items such as rags and tools, from the airplane before weighing.

(3) Defuel airplane. Then open all fuel drains until all remaining fuel is drained. Operate engine on each tank until all undrainable fuel is used and engine stops. Then add the unusable fuel (2 gallons total, 1 gallon each wing).

6.3 AIRPLANE WEIGHING PROCEDURE (Continued)

CAUTION

Whenever the fuel system is completely drained and fuel is replenished it will be necessary to run the engine for a minimum of three minutes at 1000 rpm on each tank to insure that no air exists in the fuel supply lines.

(4) Fill with oil to full capacity.

(5) Place pilot and copilot seats in fifth (5th) notch, aft of forward position. Put flaps in the fully retracted position and all control surfaces in the neutral position . Tow bar should be in the proper location and all entrance and baggage doors closed.

(6) Weigh the airplane inside a closed building to prevent errors in scale readings due to wind.

(b) Leveling

(1) With the airplane on scales, insert a 3.4-inch spacer on each of the main gear struts and a 3.0-inch spacer on the nose gear strut.

(2) Level airplane (refer to Figure 6-3) deflating (or inflating, as required) nose wheel tire, to center bubble on level.

(c) Weighing - Airplane Basic Empty Weight

(1) With the airplane level and brakes released, record the weight shown on each scale. Deduct the tare, if any, from each reading.

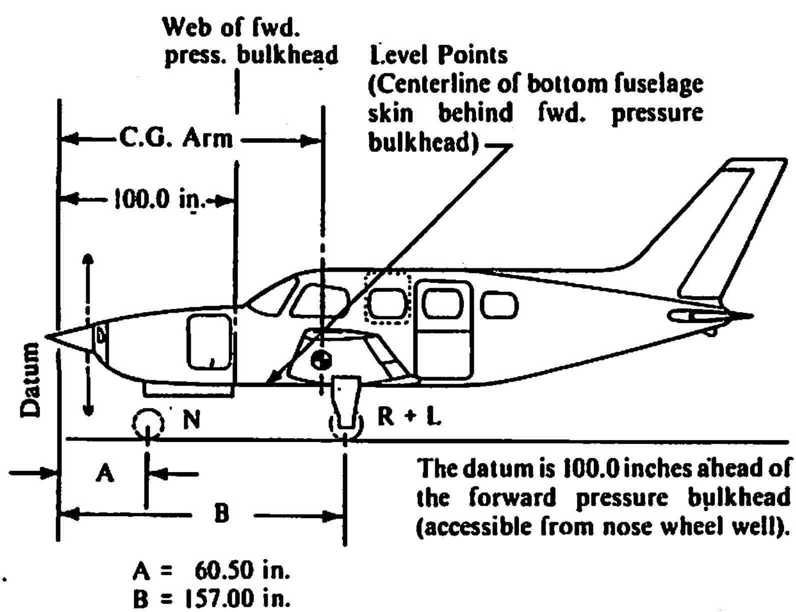
6.3 AIRPLANE WEIGHING PROCEDURE (Continued)

Scale Position and Symbol		Scale Reading	Tare	Net Weight
Nose Wheel	(N)			
Right Main Wheel	(R)			
Left Main Wheel	(L)			
Basic Empty Weight, as Weighed	(T)			

WEIGHING FORM
Figure 6-1

(d) Basic Empty Weight Center of Gravity

(1) The following geometry applies to the airplane when it is level. Refer to Leveling paragraph 6.3 (b).



LEVELING DIAGRAM
Figure 6-3

6.3 AIRPLANE WEIGHING PROCEDURE (Continued)

(2) The basic empty weight center of gravity (as weighed including optional equipment, full oil and unusable fuel) can be determined by the following formula:

$$\text{C.G. Arm} = \frac{N\,(A) + (R + L)\,(B)}{T} \quad \text{inches}$$

Where: $T = N + R + L$

6.5 WEIGHT AND BALANCE DATA AND RECORD

The Basic Empty Weight, Center of Gravity Location and Useful Load listed in Figure 6-5 are for the airplane as licensed at the factory. These figures apply only to the specific airplane serial number and registration number shown.

The basic empty weight of the airplane as licensed at the factory has been entered in the Weight and Balance Record (Figure 6-7). This form is provided to present the current status of the airplane basic empty weight and a complete history of previous modifications. Any change to the permanently installed equipment or modification which affects weight or moment must be entered in the Weight and Balance Record.

6.5 WEIGHT AND BALANCE DATA AND RECORD (Continued)

MODEL PA-46-350P MALIBU

Airplane Serial Number________________________

Registration Number ________________________

Date________________________

AIRPLANE BASIC EMPTY WEIGHT

Item	Weight (Lbs)	x C.G. Arm (Inches Aft of Datum)	= Moment (In-Lbs)
Standard Empty Weight* Actual / Computed			
Optional Equipment			
Basic Empty Weight			

*The standard empty weight includes full oil capacity and 2.0 gallons of unusable fuel.

AIRPLANE USEFUL LOAD - NORMAL CATEGORY OPERATION

(Ramp Weight) - (Basic Empty Weight) = Useful Load

(4318 lbs) - (lbs) = lbs.

THIS BASIC EMPTY WEIGHT, C.G. AND USEFUL LOAD ARE FOR THE AIRPLANE AS LICENSED AT THE FACTORY. REFER TO APPROPRIATE AIRCRAFT RECORD WHEN ALTERATIONS HAVE BEEN MADE.

WEIGHT AND BALANCE DATA FORM
Figure 6-5

6.5 WEIGHT AND BALANCE DATA AND RECORD (Continued)

PA-46-350P	Serial Number			Registration Number			Page Number	
Date	Item No.	Description of Article or Modification	Added (+) Removed (-)	Weight Change			Running Basic Empty Weight	
				Wt. (Lb.)	Arm (In.)	Moment /100	Wt. (Lb.)	Moment /100

WEIGHT AND BALANCE RECORD
Figure 6-7

6.5 WEIGHT AND BALANCE DATA AND RECORD (Continued)

PA-46-350P	Serial Number			Registration Number			Page Number	
Date	Item No.	Description of Article or Modification	Added (+) / Removed (-)	Weight Change			Running Basic Empty Weight	
				Wt. (Lb.)	Arm (In.)	Moment /100	Wt. (Lb.)	Moment /100

WEIGHT AND BALANCE RECORD (cont)
Figure 6-7 (cont)

6.7 GENERAL LOADING RECOMMENDATIONS

For all airplane configurations, it is the responsibility of the pilot in command to make sure that the airplane always remains within the allowable weight vs. center of gravity while in flight.

The following general loading recommendation is intended only as a guide. The charts, graphs, instructions and plotter should be checked to assure that the airplane is within the allowable weight vs. center of gravity envelope.

(a) Pilot Only
Load rear baggage compartment first.

(b) 2 Occupants - Pilot and Passenger in Front
Load rear baggage compartment first. Without aft baggage, fuel load may be limited by forward envelope for some combinations of optional equipment.

(c) 3 Occupants - 2 in front, 1 in rear
Baggage in nose may be limited by forward envelope.

(d) 4 Occupants - 2 in front, 2 in rear
Fuel may be limited for some combinations of optional equipment.

(e) 5 Occupants - 2 in front, 1 in middle, 2 in rear
Investigation is required to determine optimum baggage load.

(f) 6 Occupants - 2 in front, 2 in middle, 2 in rear
With six occupants fuel and/or baggage may be limited by envelope. Load forward baggage compartment first.

NOTE

With takeoff loadings falling near the aft limit, it is important to check anticipated landing loadings since fuel burn could result in a final loading outside of the approved envelope.

Always load the fuel equally between the right and left tanks.

6.9 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT

(a) Add the weight of all items to be loaded, except fuel, to the basic empty weight to determine zero fuel weight.

(b) Use the Loading Graph (Figure 6-13) to determine the moment of all items to be carried in the airplane.

(c) Add the moment of all items to be loaded to the basic empty weight moment.

(d) Divide the total moment by the total weight to determine the zero fuel weight C.G. location.

(e) By using the figures of item (a) and item (d) (above), locate a point on the C.G. range and weight graph (Figure 6-15). If the point falls within the C.G. envelope, the loading meets the weight and balance requirements.

(f) Add the weight of the fuel to be loaded to the total weight calculated for item (a) to determine ramp weight.

(g) Use the loading graph (Figure 6-13) to determine the moment of the fuel to be loaded and add to the total moment determined for item (c).

(h) Subtract the weight and moment of the fuel allowance for engine start, taxi, and runup.

(i) Divide the total moment by the total weight to determine takeoff C.G.

(j) Locate the takeoff weight center of gravity on the C.G. Range and Weight Graph (Figure 6-15). If the point falls within the C.G. envelope, the loading meets the weight and balance requirements.

(k) Subtract the Estimated Fuel Burnoff from the Takeoff Weight to determine the Landing Weight C.G.

(l) Locate the landing weight center of gravity on the C.G. Range and Weight Graph (Figure 6-15). If the point falls within the C.G. envelope, the loading meets the weight and balance requirements.

6.9 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT (Continued)

	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight	2745	133.70	367007
Pilot and Front Passenger	340	135.50	46070
Passengers (Center Seats)	170	177.00	30090
Passengers (Rear Seats)	340	218.75	74375
Baggage (Forward) (100 Lb Limit)	100	88.60	8860
Baggage (Aft) (100 Lb Limit)	70	248.23	17376
Zero Fuel Weight (4100 Lbs Max)	3765		543778
Fuel (120 Gal./720 Lbs Max Usable)	552	150.31	82971
Ramp Weight (4318 Lbs Max)	4317	145.19	626749
Fuel Allowance for Engine Start, Taxi & Runup (3 Gal/18 Lbs Max)	-18	150.31	-2706
Takeoff Weight (4300 Lbs Max)	4299	145.16	624043

The center of gravity (C.G.) for the takeoff weight of this sample loading problem is at 145.16 inches aft of the datum line. Locate this point (145.16) on the C.G. range and weight graph (Figure 6-15). Since this point falls within the weight - C.G. envelope, this loading meets the weight and balance requirements.

Takeoff Weight	4299	145.16	624043
Minus Estimated Fuel Burn-off (climb & cruise) @ 6.0 Lbs/Gal	-480	150.31	-72149
Landing Weight	3819	144.51	551894

Locate the center of gravity of the landing weight on the C.G. range and weight graph (Figure 6-15). Since this point falls within the weight - C.G. envelope, the loading is acceptable for landing.

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO ENSURE THAT THE AIRPLANE IS LOADED PROPERLY AT ALL TIMES.

SAMPLE LOADING PROBLEM
(NORMAL CATEGORY)
Figure 6-9

6.9 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT (Continued)

	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In.-Lbs)
Basic Empty Weight			
Pilot and Front Passenger		135.50	
Passengers (Center Seats)		177.00	
Passengers (Rear Seats)		218.75	
Baggage - Forward (100 Lb Limit)		88.60	
Baggage - Aft (100 Lb Limit)		248.23	
Zero Fuel Weight (4100 Lbs Max)			
Fuel (120 Gal/720 Lbs Max Usable)		150.31	
Ramp Weight (4318 Lbs Max)			
Fuel Allowance for Engine Start, Taxi & Runup (3 Gal/18 Lbs Max)	-20	150.31	-3006
Takeoff Weight (4300 Lbs Max)			

The center of gravity (C.G.) for the takeoff weight of this loading problem is at inches aft of the datum line. Locate this point ( ) on the C.G. range and weight graph (Figure 6-15). If this point falls within the weight - C.G. envelope, this loading meets the weight and balance requirements.

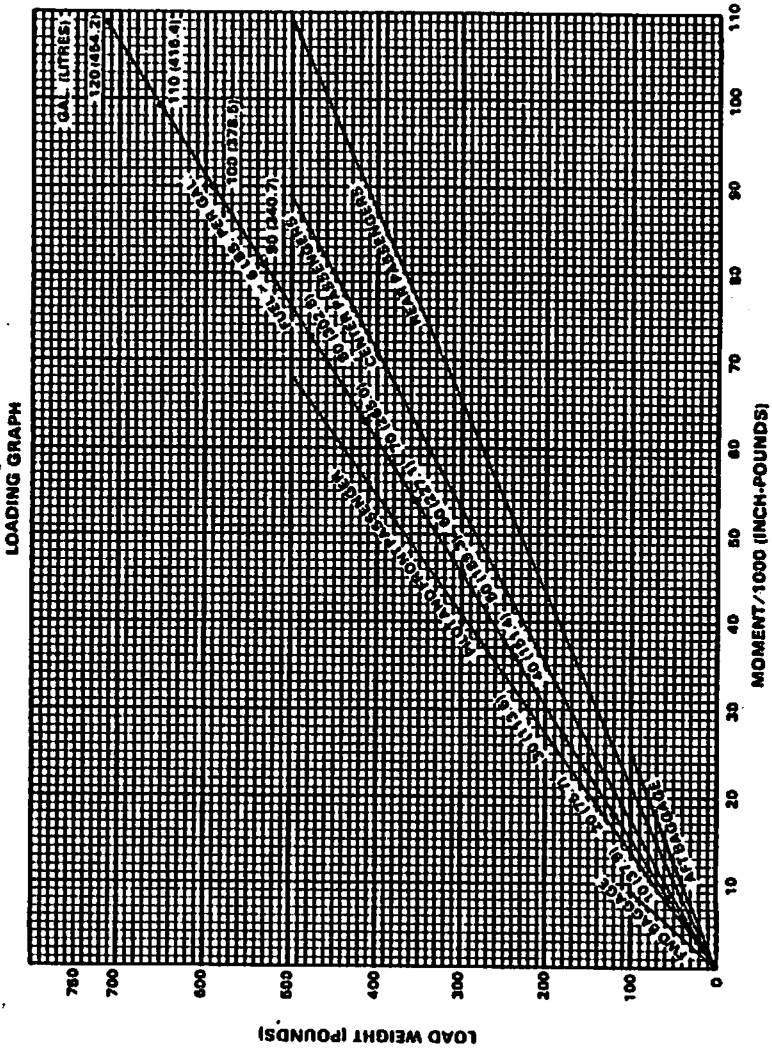
Takeoff Weight			
Minus Estimated Fuel Burnoff (climb & cruise) @ 6.0 Lbs/Gal		150.31	
Landing Weight			

Locate the center of gravity of the landing weight on the C.G. range and weight graph (Figure 6-15). If this point falls within the weight - C.G. envelope, the loading is acceptable for landing.

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO ENSURE THAT THE AIRPLANE IS LOADED PROPERLY AT ALL TIMES.

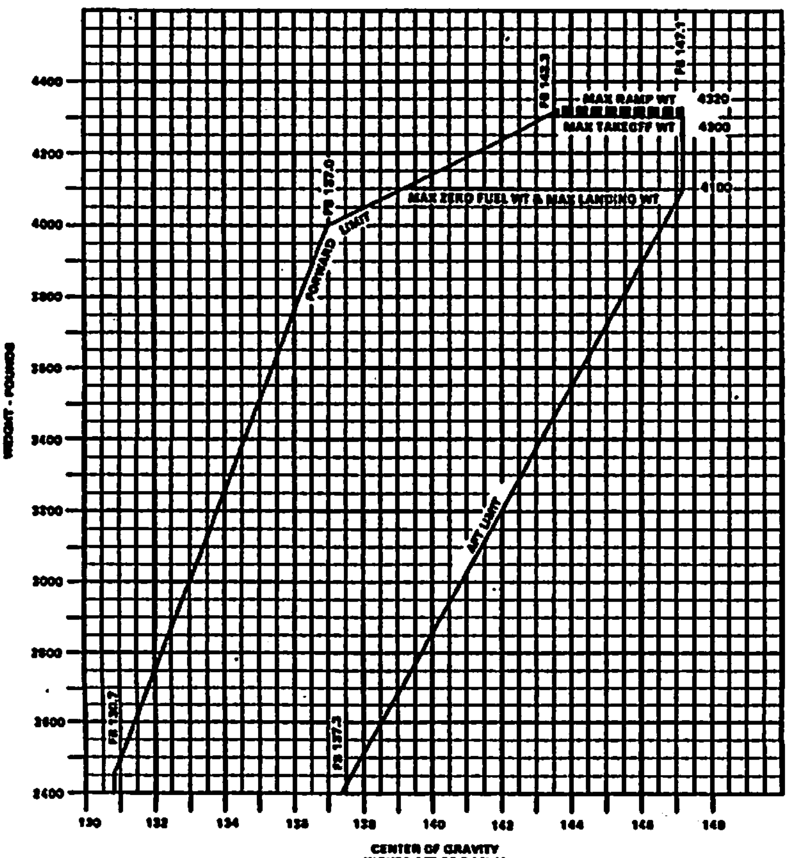
WEIGHT AND BALANCE LOADING FORM
(NORMAL CATEGORY)
Figure 6-11

6.9 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT (Continued)



LOADING GRAPH
Figure 6-13

6.9 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT (Continued)



C.G. RANGE AND WEIGHT GRAPH
Figure 6-15

6.11 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER

This plotter is provided to enable the pilot quickly and conveniently to:

(a) Determine the total weight and C.G. position.
(b) Decide how to change his load if his first loading is not within the allowable envelope.

Heat can warp or ruin the plotter if it is left in the sunlight. Replacement plotters may be purchased from Piper dealers and distributors.

The "Basic Empty Weight and Center of Gravity" location is taken from the Weight and Balance Form (Figure 6-5), the Weight and Balance Record (Figure 6-7) or the latest FAA major repair or alteration form.

The plotter enables the user to add weights and corresponding moments graphically. The effect of adding or disposing of useful load can easily be seen. The plotter does not cover the situation where cargo is loaded in locations other than on the seats or in the baggage compartments.

Brief instructions are given on the plotter itself. To use it, first plot a point on the grid to locate the basic weight and C.G. location. This can be put on more or less permanently because it will not change until the airplane is modified. Next, position the zero weight end of any one of the loading slots over this point. Using a pencil, draw a line along the slot to the weight which will be carried in that location. Then position the zero weight end of the next slot over the end of this line and draw another line representing the weight which will be located in this second position. When all the loads, except fuel, have been drawn in this manner, the end of the segmented line locates the load and the C.G. position of the airplane for zero fuel weight. If this point is not within the allowable envelope it will be necessary to remove baggage or passengers, and/or to rearrange baggage and passengers to get the point to fall within the envelope.

Position the zero weight end of the fuel slot over this point and draw a line representing fuel load. The end of the segmented line locates the load and C.G. position of the airplane for Ramp Weight. If this is not within the allowable envelope it will be necessary to remove fuel, baggage, or passengers and/or to rearrange baggage and passengers to get this final point to fall within the envelope.

Fuel allowance for engine start, taxi, and runup is 18 pounds.

Subtract the Estimated Fuel Burnoff from the Takeoff Weight to determine the Landing Weight C.G.

Gear movement does not significantly affect the center of gravity.

6.11 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER (Continued)

SAMPLE PROBLEM

INFORMATION PENDING

6.11 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER (Continued)

INFORMATION PENDING

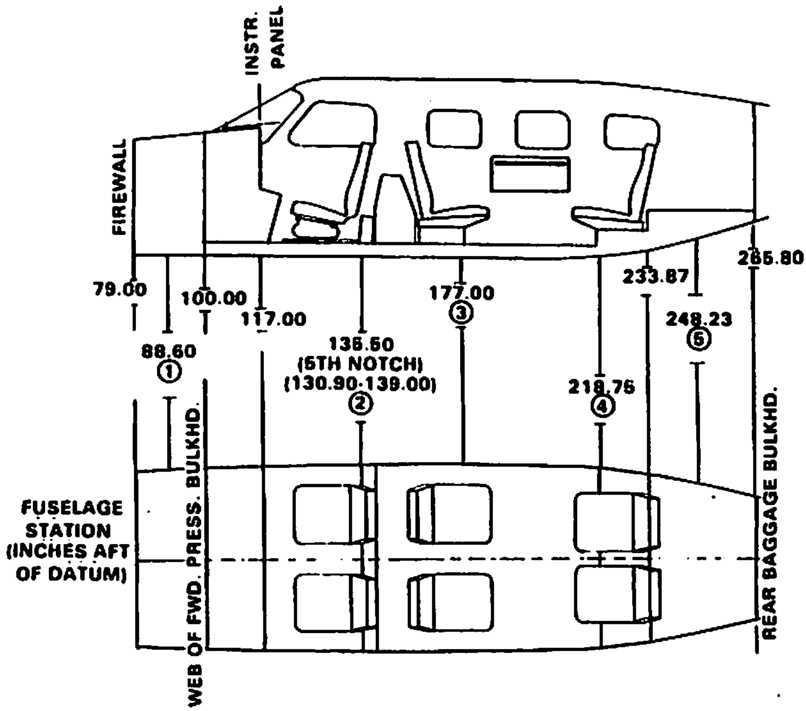
SAMPLE PROBLEM
Figure 6-17

6.11 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER (Continued)

INFORMATION PENDING

WEIGHT AND BALANCE PLOTTER
Figure 6-19

6.11 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER (Continued)



1 CENTROID OF FORWARD BAGGAGE AREA
2 PILOT AND PASSENGER C.G. ON HORIZONTALLY ADJUSTABLE SEATS POSITIONED FOR AVERAGE OCCUPANT. NUMBERS IN PARENTHESES INDICATE FORWARD AND AFT LIMITS OF OCCUPANT C.G.
3 C.G. OF CENTER OCCUPANTS
4 C.G. OF REAR OCCUPANTS
5 CENTROID OF REAR BAGGAGE AREA

LOADING ARRANGEMENTS
Figure 6-21

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SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

7.1 THE AIRPLANE

The PA-46-350P Malibu is a single engine, all metal, retractable landing gear, low wing, turbocharged airplane. It has a pressurized cabin with seating for six occupants and two separate luggage compartments.

7.3 THE AIRFRAME

The primary airframe is of aluminum alloy construction, with a steel combination engine mount - nose gear support structure. The nose cowl is also made of aluminum. The rear section of the dorsal fairing is fiberglass.

The fuselage is an all metal, semi-monocoque structure with flush riveted skin. The skin has internally bonded doublers and is butt jointed at all seams not in the airflow direction. There are three basic fuselage sections: the forward baggage section, the pressurized cabin section, and the tail cone section. The cabin section is sealed to maintain pressurization.

The seating arrangement includes two crew seats and four passenger seats. The forward passenger seats face aft, and all passenger seats have adjustable backs with built-in headrests. An inside baggage area is provided aft of the rear passenger seats.

Cabin access is through the main cabin door, located on the left side, aft of the wing. The main door is a horizontally split door with retractable steps in the lower half. The upper half is held open by a gas spring. A plug type, inward releasing, emergency egress door is located on the right side adjacent to the aft facing seat.

Windows include a two-piece windshield, pilot and copilot windows, a storm window in the pilot's window, and three passenger windows on each side.

The forward baggage compartment is unpressurized and has a locking door on the left side, forward of the wing.

7.3 THE AIRFRAME (Continued)

The wing is in effect a three section structure. The center section built-up main spar extends through the lower fuselage and outboard of each main landing gear. This section has a forward spar and a rear spar which are pin jointed at the fuselage sides. The main landing gear retracts inward into recesses located aft of the main spar. The outboard section of each wing, to within approximately 18 inches of the tip, is a sealed integral fuel cell. Portions of the wing structure are adhesively bonded, and skins are butt jointed and flush riveted for a smooth airfoil surface.

The all-metal flaps are electrically actuated through a mechanical linkage. The flaps extend aft and down on three tracks and have four preselect positions.

The all-metal ailerons are mass balanced and operated by a cable system mounted on the aft wing spar.

Tiedown rings are installed on the bottom of each wing outboard of the main landing gear. The rings, which pivot about their forward edge, are spring loaded to retract into the lower wing surface when not in use. When retracted, a small ring protuberance extends below the wing surface. Applying a slight forward pulling force to the protrusion will extend the ring.

The empennage is of conventional fin and rudder, stabilizer and elevator design with aerodynamic and mass balanced control surfaces. Surfaces are of all-metal construction and the single-piece elevator assembly carries a center-mounted trim tab. This tab operates to combine anti-servo and trim functions.

Various access panels on the fuselage, wings and empennage are removable for service or inspection purposes.

Electrical bonding is provided to ensure good electrical continuity between components. Lightning strike protection is provided in accordance with presently accepted practices. Anti-static wicks are provided on trailing edges of ailerons, elevator and rudder to discharge static electricity that might cause avionics interference.

7.5 ENGINE AND PROPELLER

ENGINE

The Malibu is powered by a Textron Lycoming TIO-540-AE2A engine. It is a direct drive, horizontally opposed, overhead valve, fuel injected, air cooled, turbocharged-intercooled engine with variable absolute pressure controller. Maximum rated power is 350 HP @ 2500 rpm and 42.0 in. Hg.

7.5 ENGINE AND PROPELLER (Continued)

manifold pressure. Accessories include a starter, two magnetos, a propeller governor, two belt driven alternators, two gear driven vacuum pumps, a belt driven air conditioner compressor, an oil filter, and an air/oil separator in the crankcase breather system.

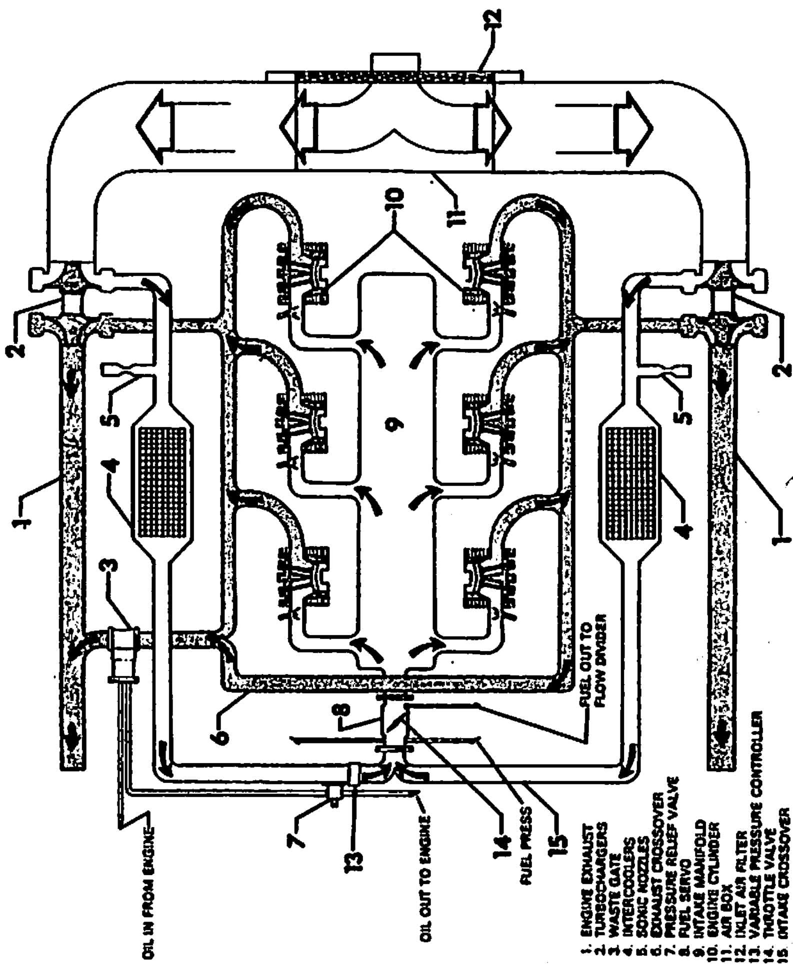
Turbocharging (Figure 7-1) is accomplished by two Garrett - A.I.D. turbo-compressors, one located on each side of the engine. Turbochargers extract energy from engine cylinder exhaust gases and use this energy to compress engine induction air. This allows the engine to maintain rated manifold pressure at altitude. When engine induction air is compressed by the turbocharger, the air temperature is increased. The elevated air temperature is reduced by air intercoolers located on each side of the engine. This aids in engine cooling and improves engine power and efficiency.

Each turbocharger extracts exhaust energy from its respective bank of cylinders to pressurize the induction air. Air flows through the induction inlet louvers into the induction air box, where it is filtered and divided for distribution to the left and right turbo compressors. At the compressor, air pressure and temperature are increased. Pressure increases air density making a greater mass of air available to the engine cylinders on each intake stroke. Air then flows through an intercooler where air temperature is reduced, further increasing the density of air available to each cylinder. Downstream the intercoolers, air flow joins at the "Y" junction of intake tubes at the lower back of the engine, then passes through the fuel injector, into the intake manifold, where it is divided to individual intake pipes flowing to each cylinder. Metered fuel is injected into the cylinder head, upstream of the intake valve. After the fuel burns in the cylinder, exhaust gases flow into the exhaust manifold and then to turbocharger turbines where exhaust energy is extracted to drive the compressor.

Turbo compressed air is throttled across the throttle butterfly valve as set by the throttle lever. A control system monitors pressure and uses engine oil pressure to automatically position the waste gate valve. The waste gate bleeds excess exhaust gas from the exhaust manifold crossover pipe and out the left exhaust stack, bypassing the turbocharger. Thus the controller automatically maintains manifold pressure.

The engine is well protected against overboost damage from excessive manifold pressure. The waste gate controller senses manifold pressure and will continually adjust turbocharger output, maintaining the manifold pressure set by the throttle. The controller automatically protects the engine

7.5 ENGINE AND PROPELLER (continued)



TURBO-INDUCTION SYSTEM
Figure 7-1

7.5 ENGINE AND PROPELLER (continued)

from overboost damage by limiting manifold pressure to 42.0 in. Hg. In the event of a controller malfunction, there is a pressure relief valve on the induction manifold which will relieve manifold pressure and prevent an overboost.

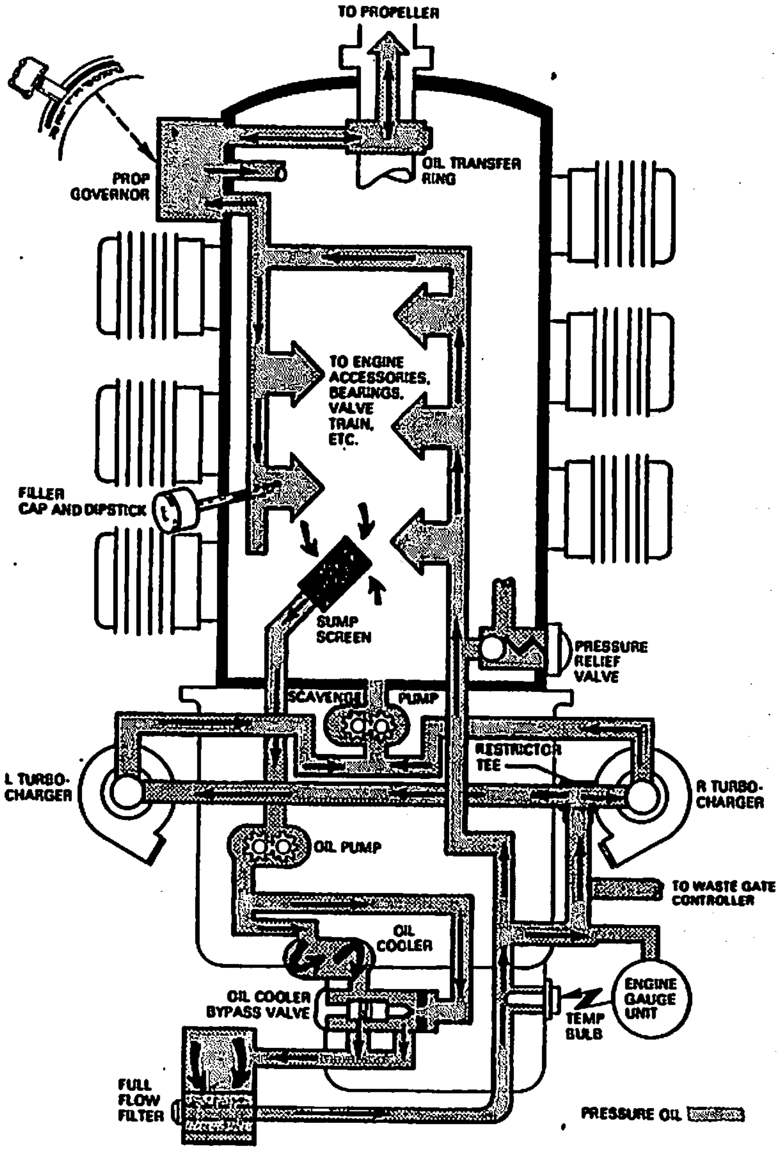
When descending from altitude, care should be exercised to maintain engine power and temperatures (oil, CHT). Turbocharger compressors supply air for cabin pressurization and power reduction below that recommended could cause a decrease in cabin pressure. Sudden cooling or gradual extreme cooling of engine cylinders will accelerate engine wear. Follow normal descent procedures described in Section 4.

The engine is equipped with a Bendix RSA-10ED1 fuel injection system. An engine-driven fuel pump supplies fuel under pressure to the fuel injection regulator, which measures air flow and meters the correct proportion of fuel to a flow divider. The flow divider then directs the fuel to each of the individual cylinder injector nozzles. A fuel vent system provides a common reference vent pressure to the fuel pressure switch, engine-driven fuel pump and injection nozzles. The vent source is taken downstream of the turbochargers to ensure proper vent pressure during turbocharger operation.

The engine employs a full pressure, 12 quart wet sump lubrication system (Figure 7-3). Maximum endurance flights should begin with 12 quarts of oil. The sump is filled through a combination dipstick oil filler cap. Lubricating oil is drawn through the oil sump inlet screen by the engine oil pump and directly to the oil cooler and a thermostatic bypass valve. When engine oil is cold, the thermostatic bypass valve will open allowing oil to flow directly to the full flow oil filter bypassing the cooler. As the oil warms up, the bypass valve will close thereby forcing more oil to circulate through the cooler prior to entering the oil filter. From the oil filter, the oil passes through an oil pressure relief valve which regulates system oil pressure. The regulated oil is then routed to the waste gate actuator, turbochargers, and through the main oil galleries to the various engine bearings, piston oil cooling nozzles, valve mechanisms, and moving parts. Gavity returns the oil to the sump.

The turbochargers are also lubricated by the regulated oil from the engine system. Oil circulated through the turbochargers is returned to the sump by a scavenge pump attached to the hydraulic pump accessory pad. Oil from the oil pump is also supplied directly to the waste gate control system.

7.7 ENGINE CONTROLS (Continued)



ENGINE OIL SYSTEM SCHEMATIC
Figure 7-3

7.5 ENGINE AND PROPELLER (Continued)

Oil temperature and pressure information is available from the combination gauge on the lower right of the pilot's instrument panel. Engine crankcase gases are discharged to an air/oil separator behind the left rear cylinder, and then vented out the left exhaust stack.

PROPELLER

The propeller is a Hartzell, all metal, two blade, constant speed unit with an 80-inch diameter. Constant propeller rotational speed (rpm) is maintained by a balance of air load and engine rotational forces. The Hartzell propeller governor, mounted on the left front of the engine, pressurizes and regulates the flow of engine oil to a piston in the propeller dome. The piston is linked by a sliding rod and fork arrangement to propeller blades. Governor oil pressure against the piston works to increase propeller blade pitch, thus decreasing propeller and engine rpm. Centrifugal twisting moments on the propeller blades work to decrease propeller blade pitch and increase rpm. Simple control of the interaction of these and other forces to maintain a constant rpm is provided by the propeller control lever in the cockpit.

The propeller control lever, linked by cable to the propeller governor, determines a wide range of in-flight rpm. Governor range is more limited during ground operation. Pushing the lever forward selects increased or higher rpm. Pulling the lever aft selects decreased or lower rpm. When in flight the rpm should not fluctuate significantly from that set, regardless of throttle setting.

The propeller may be operated within the full range of rpm indicated by the tachometer, up to the red radial line. In cruise, always use the power setting charts provided. Avoid exceeding maximum rpm and excessive engine stress by moving propeller and throttle levers in smooth deliberate motions. On cold days during run-up, exercise the propeller several times to flow warm oil into the propeller hub. This assures propeller governing for takeoff.

7.7 ENGINE CONTROLS

The engine is controlled by throttle, propeller and mixture control levers, located on the control quadrant on the lower central instrument panel (Figure 7-5). The controls utilize teflon-lined control cables to reduce friction and binding.

7.7 ENGINE CONTROLS (Continued)

The throttle lever is used to control engine power by simultaneously moving the butterfly valve in the fuel-air control unit and the variable absolute pressure controller, thus adjusting manifold pressure. The throttle lever incorporates a gear-up warning horn switch, which is activated during the last portion of travel of the throttle lever to the low power position. If the landing gear is not locked down, the horn will sound until the gear is down and locked, or until the power setting is increased. This is a safety feature to warn the pilot of an inadvertent gear-up landing. All throttle operations should be made with a smooth, deliberate movement to prevent unnecessary engine wear or damage and to allow time for the turbocharger speed to stabilize.

The propeller control lever is used to adjust engine speed (rpm) at the propeller governor. Propeller speed controls power availability, which is increased by increasing rpm when the lever is moved forward. The lever is moved aft to reduce rpm. Propeller operations should be smooth and deliberate to avoid unnecessary wear.

The mixture control lever is used to adjust the fuel-to-air ratio at the fuel-air control unit. Full forward is rich mixture. Normal engine shutdown is accomplished by placing the mixture in the full aft position.

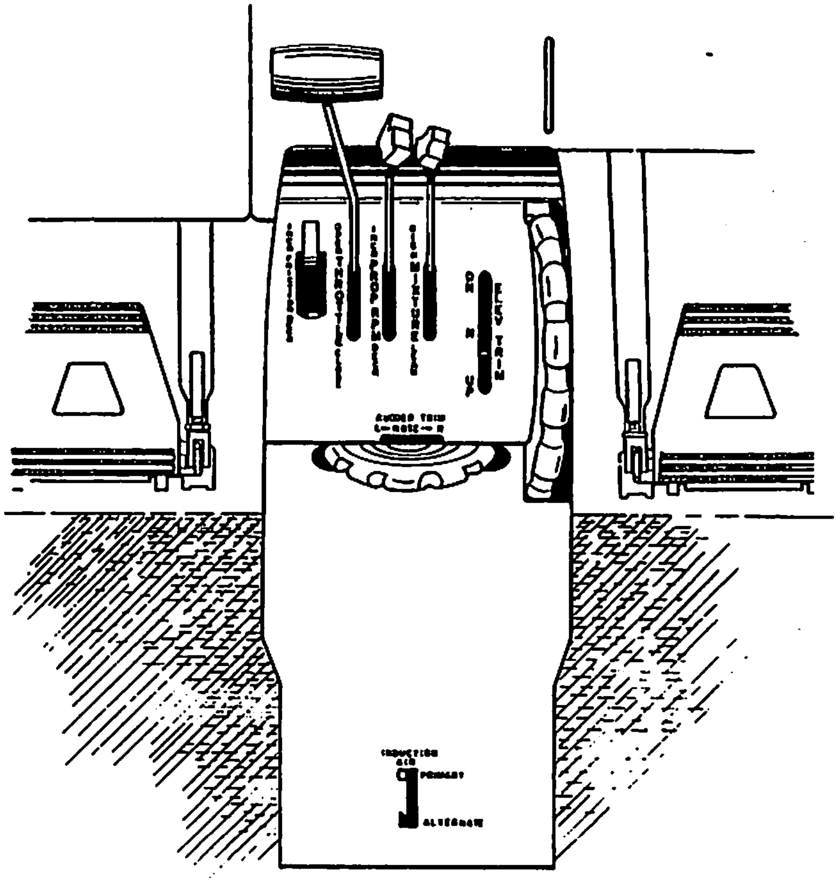
The friction adjustment lever, located on the far left of the control quadrant, may be adjusted to increase or decrease the friction holding the throttle, propeller and mixture controls.

CAUTION

Alternate air is unfiltered. Use of alternate air during ground or flight operations when dust or other contaminants are present may result in engine damage from particle injestion.

The induction air control is located on the center console just below the engine control quadrant. When the induction air lever is up, or on primary air, the engine is operating on filtered air, drawn through the forward facing ram air louvers below the propeller. When the lever is down, or on alternate air, the engine is operating on unfiltered air, drawn through the aft facing louvers below the ram air louvers. Should the primary air source become blocked, the pilot must manually select alternate air to restore power. No change of engine rpm may occur if a ground check of alternate air is performed. In flight its effect might be noticed as a half-inch or more manifold pressure drop depending on altitude. Normal operation should be on primary air.

7.7 ENGINE CONTROLS (Continued)



CONTROL PEDESTAL
Figure 7-5

7.9 HYDRAULIC SYSTEM

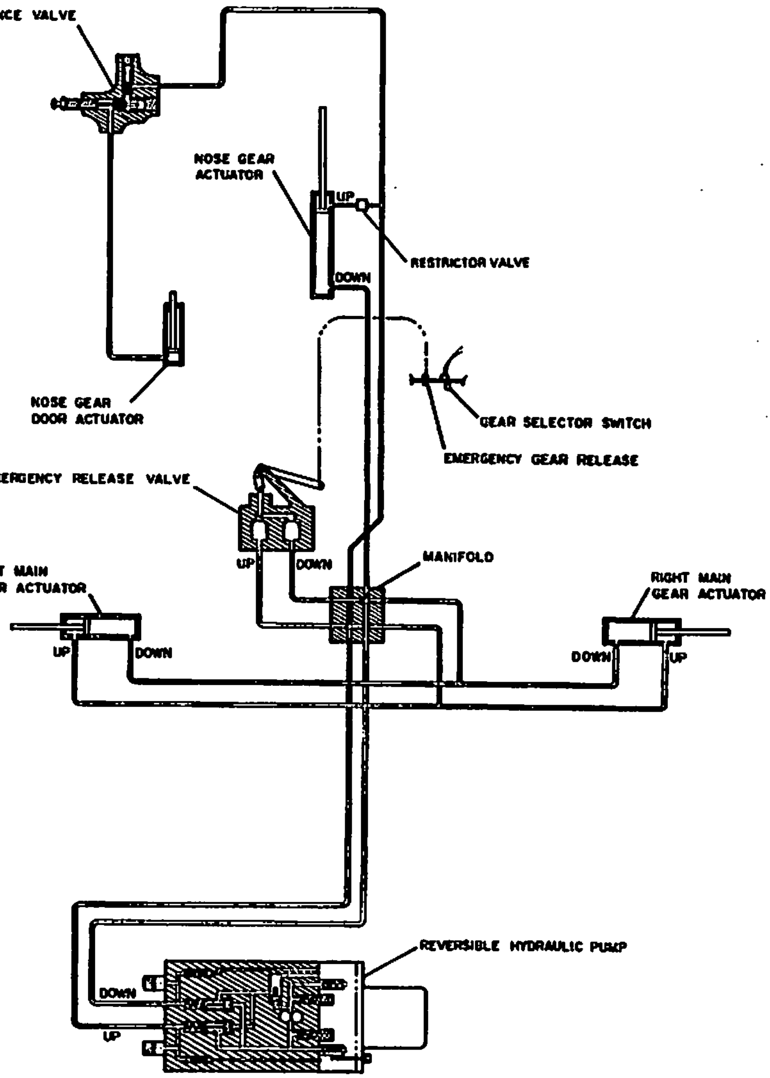
The hydraulic system (refer to Figure 7-7) provides the power to retract and extend the landing gear.

The electric motor driven hydraulic pump assembly is located aft of the rear baggage compartment and is accessible through the baggage compartment aft closeout panel. The pump assembly has an integral reservoir with filler plug, sight gauge and vent. The pump assembly incorporates pressure switches, bypass relief valves, and thermal relief valves in both the UP and DOWN sides. A shuttle valve is also incorporated to allow for unequal volumes of hydraulic fluid displaced during UP and DOWN gear actuation. Normal system operating pressure is controlled by the pressure switches. Maximum system operating pressure is limited by the bypass relief valves, and maximum system holding or trapped pressure is limited by the thermal relief valves.

The motor which drives the hydraulic pump is reversible and runs in one direction to supply gear UP pressure and in the opposite direction to supply gear DOWN pressure. The direction in which the pump runs is controlled electrically by the position of the gear selector switch on the instrument panel.

Other major components of the hydraulic system are the three gear actuators and the emergency gear extension valve. Operation of these components is covered in the landing gear section.

7.9 HYDRAULIC SYSTEM (Continued)



HYDRAULIC SYSTEM
Figure 7-7

7.11 LANDING GEAR

The aircraft is equipped with hydraulically operated, fully retractable, tricycle landing gear.

Locking-type actuators are used for main and nose gears. The actuator assembly provides mechanical gear-down locking at the fully extended position and is hydraulically unlocked. The actuator also acts as the gear brace in the extended position.

The main gear retracts inboard into the wing root area. A mechanically linked door covers the strut assembly.

Hydraulic pressure for gear operation is furnished by an electrically driven hydraulic pump (refer to Figures 7-7 and 7-11). Gear operation is initiated by a two position selector with a wheel shaped knob located to the left of the engine control quadrant (Figure 7-9). Three green lights, which are individually activated as each gear mechanically locks into the DOWN position are located above the landing gear selector.

NOTE

> Day/night dimmer switch must be in the DAY position to obtain full intensity of the gear position indicator lights during daytime flying. When aircraft is operated at night, the switch should be in the NIGHT position to dim the gear lights.

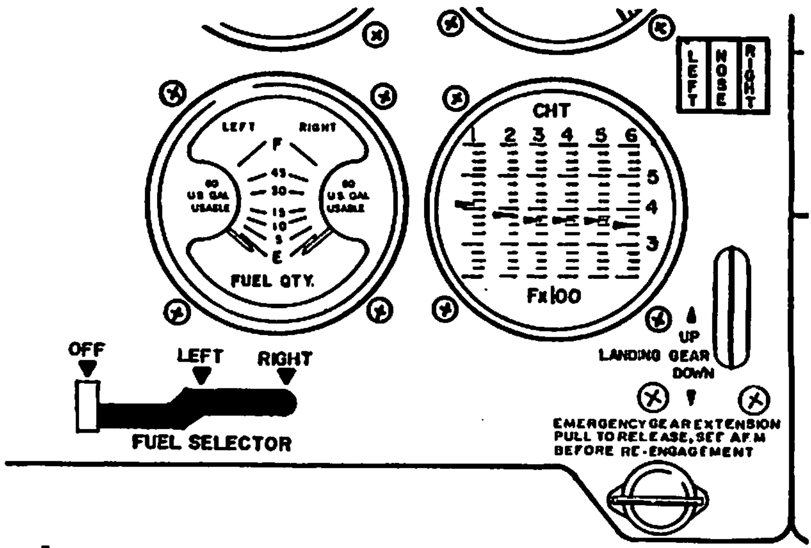
The landing gear selector knob must be pulled outward to release it from a detent in the DOWN position prior to moving it to the UP position. In addition, there is a squat switch on the left main gear which prevents operation of the gear UP electrical circuit when the aircraft weight is on the gear. If the landing gear selector is placed in the UP position with the aircraft weight on the gear, the gear warning horn will sound, and the red GEAR WARN annunciator will illuminate.

The landing gear is held in the UP position by hydraulic pressure which is trapped in the system UP lines by a check valve in the pump assembly. When normal pump operation is stopped by the pressure switch, a check valve in the pump assembly closes to trap fluid pressure in the UP side of the system. Emergency gear extension is accomplished by a manually actuated valve which relieves the pressure in the UP side and bypasses fluid to the DOWN side of the system. The additional fluid required for DOWN operation comes directly from the reservoir.

7.11 LANDING GEAR (continued)

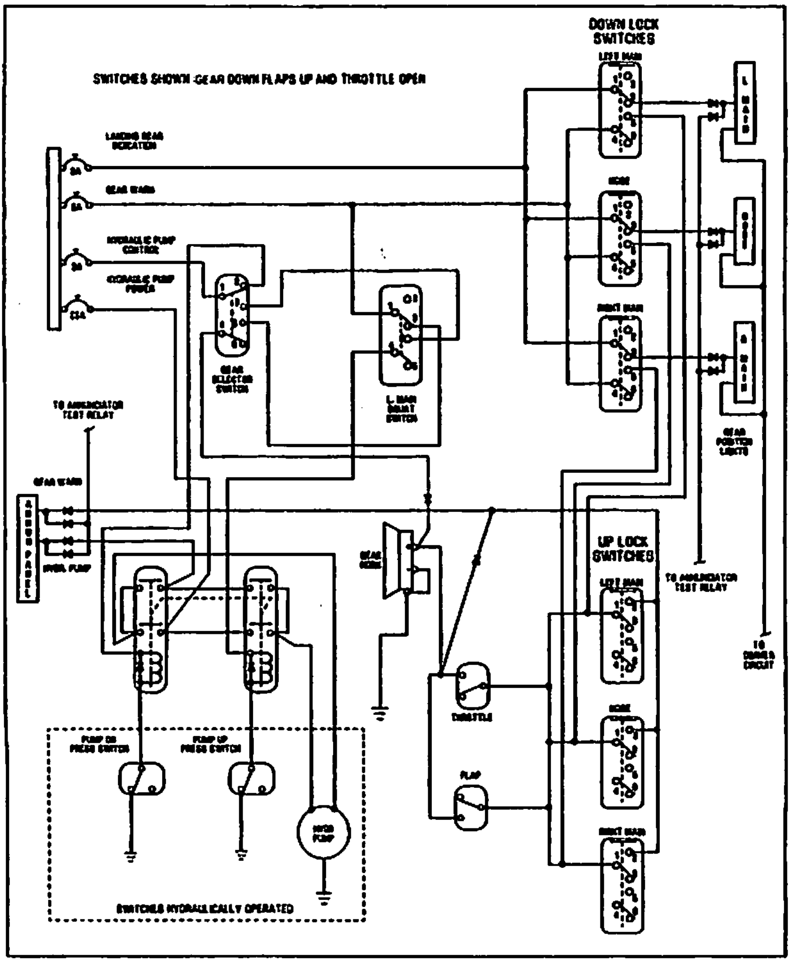
The landing gear is held in the DOWN position by spring loaded mechanical locking mechanisms built into each of the three actuating cylinders. The individual gear safe light switches are also mechanically operated when each mechanism is in the LOCKED position. With the hydraulic pump and system operating normally, hydraulic pressure is also trapped in the DOWN side of the system. This DOWN pressure is not required to mechanically lock the cylinders and is not available if the hydraulic pump is inoperative.

The EMERGENCY GEAR extension system allows the landing gear to free fall, with spring assist on the nose gear, into the extended position where the mechanical locks engage. Approximately 25 pounds of force is required to pull the EMERGENCY GEAR extension control. If a gear system malfunction has been indicated and the EMERGENCY GEAR extension system used, it is recommended that the EMERGENCY GEAR extension control and the HYD PUMP circuit breaker be left in the pulled position until the aircraft is safely on jacks. See the Service Manual for proper landing gear system check-out procedures. If the aircraft is being used for training purposes or a pilot check-out flight the EMERGENCY GEAR extension control and HYD PUMP circuit breaker must be reset in order for hydraulic pressure to be generated in the UP side of the system and the gear retracted.



LANDING GEAR SELECTOR
Figure 7-9

7.11 LANDING GEAR (Continued)



LANDING GEAR ELECTRICAL DIAGRAM
Figure 7-11

7.11 LANDING GEAR (Continued)

The annunciator panel contains two lights pertaining to landing gear operation. A red GEAR WARN annunciator is activated whenever all three gears are not fully down and locked, or not fully up with the gear doors closed. This annunciator comes on during normal gear operation to indicate that the gear is in transit. If it does not go out within approximately 10 seconds during normal gear operation or illuminates steadily during flight with the landing gear selector in the UP position, a system malfunction is indicated. There is also an amber HYD PUMP annunciator which indicates that the hydraulic pump motor is being supplied with electrical power. The annunciator is illuminated during normal landing gear operation for approximately the same duration as the GEAR WARN annunciator. If the light remains on or begins cycling intermittently after gear operation, a system malfunction is indicated.

The red GEAR WARN annunciator and gear warning horn will operate simultaneously under the following conditions:

(a) In flight when the throttle is reduced to the point at which manifold pressure is approximately 14 inches of mercury or below and the landing gear are not in the DOWN position.
(b) In flight when the flaps are extended more than 10° and the landing gear are not in the DOWN position.
(c) On the ground when the landing gear selector is in the UP position. The landing gear squat switch activates to prevent operation of the retract side of the hydraulic pump on the ground.

7.13 BRAKE SYSTEM

The brake system is designed to meet all normal braking needs. Two single-disc, double puck brake assemblies, one on each main gear, are actuated by toe brake pedals mounted on both the pilot's and copilot's rudder pedals. A brake system reservoir, independent of the hydraulic system reservoir, is located behind the aft access panel in the forward baggage compartment. Brake fluid should be maintained at the level marked on the reservoir. For further information see BRAKE SERVICE in Section 8 of this handbook.

7.13 BRAKE SYSTEM (Continued)

The parking brake knob is located just below the left control column. To set the parking brake, first depress and hold the toe brake pedals and then pull the parking brake knob. To release the parking brake, first depress and hold the toe brake pedals and then push in on the parking brake knob.

7.15 FLIGHT CONTROL SYSTEM

The primary flight controls are conventional and are operated by dual control wheels and rudder pedals. The control wheel operates the ailerons and elevator. The rudder pedals actuate the rudder and nose wheel steering. The toe brakes, which are an integral part of the pedals, operate the wheel brakes. The ailerons and rudder are interconnected through a spring system, which is activated only when controls are out of harmony. In normal coordinated flight the system is inactive. All flight control systems are operated by closed circuit cable systems.

Secondary control is by elevator and rudder trim. The controls are located on the pedestal (Figure 7-5). Aileron trim is provided by a fixed, ground-adjustable tab. The elevator trim control wheel is located on the right side of the pedestal. The wheel is rotated forward for nose-down trim and aft for nose-up trim. The rudder trim wheel is located on the aft face of the pedestal. The wheel is rotated to the right (counterclockwise) for nose right and left (clockwise) for nose left. Trim indications for the individual systems are located on the pedestal.

The wing flaps are electrically controlled by a selector lever mounted on the instrument panel immediately to the right of the control pedestal. The flap position indicator is located to the left of the selector lever. The flaps may be set to four positions; up (0°), 10°, 20°, and full down (36°). Each position is detented on the flap selector panel. The flaps will automatically move to the selected position, which can be confirmed by referring to the position indicator. The flaps may be extended to 10° at airspeeds below 165 KIAS, 20° below 130 KIAS, and 36° flap extension is limited to airspeeds below 116 KIAS. When extending the flap with the landing gear retracted, prior to the flap reaching the 20° position, the landing gear warning horn will sound, and the GEAR WARN annunciator will illuminate. A FLAPS annunciator light is provided as part of the annunciator panel located in the upper portion of the pilots instrument panel. If the annunciator light illuminates, it is indicative of a system malfunction in which case the flap protection circuit automatically removes power from the electric flap motor. Resetting of the FLAP WARN/RESET circuit breaker will restore normal operating power to the flap motor. If, after resetting, and operation of the flaps, the annunciator illuminates again then a system malfunction is indicated and the flap motor circuit breaker should be pulled.

7.17 FUEL SYSTEM

Fuel is stored in two main integral wing tanks (see Figure 7-13), located outboard of the mid-wing splice. Fuel quantity held by each wing tank is 60 usable gallons with one gallon of unusable fuel, for a total of 122 gallons. The minimum fuel grade is 100 or 100LL aviation grade. Each tank gravity feeds fuel through finger screens into three lines leading to collector/sump tanks located at the root of each wing, just aft of the main spar. During preflight the collector/sump tank and one of the three lines can be inspected in each main wheel well. Collector/sump tanks vent back to the main tanks by a fourth line located forward of the main spar. The main tanks vent to the atmosphere by non-icing vents installed in the most outboard forward access panels of each wing tank. Reverse fuel flow from collector tanks to main tanks is prevented by 2 flapper check valves installed in each collector tank. Collector tank sumps are the lowest points in the fuel system, and each has a drain valve for draining collector and main tanks.

WARNING

Avoid prolonged uncoordinated flight to prevent uncovering of fuel tank outlets and subsequent fuel starvation.

Each tank separately vents air in and fumes out to equalize pressure with ambient conditions. This is accomplished through combination valves in non-icing fuel tank vents located at the most outboard, forward tank access panels.

CAUTION

Do not insert objects into the wing vent as damage to the combination valve could result in fuel leakage.

CAUTION

A plugged vent could result in fuel starvation. If a restricted vent is suspected, select the opposite tank immediately. Monitor the suspect wing and land as soon as possible.

7.17 FUEL SYSTEM (Continued)

NOTE

When opening the fuel tank filler cap, a rush of air will normally be heard and felt. This is caused by the large volume of vapor space in the wing tank, which is under a slight pressure differential. This pressure is the minimum required to open the combination valve in the vent and does not represent a hazard.

Fuel quantity is indicated by gauges located above the fuel selector handle. Each tank has two sensor sending units. Gauges are electrical and will operate when the battery switch is ON. Fuel tanks can be visually confirmed full if fuel level is up to the filler neck.

NOTE

Removal of the fuel filler cap from a wing tank that is sitting low or from an overfilled tank caused by thermal expansion could result in fuel spillage.

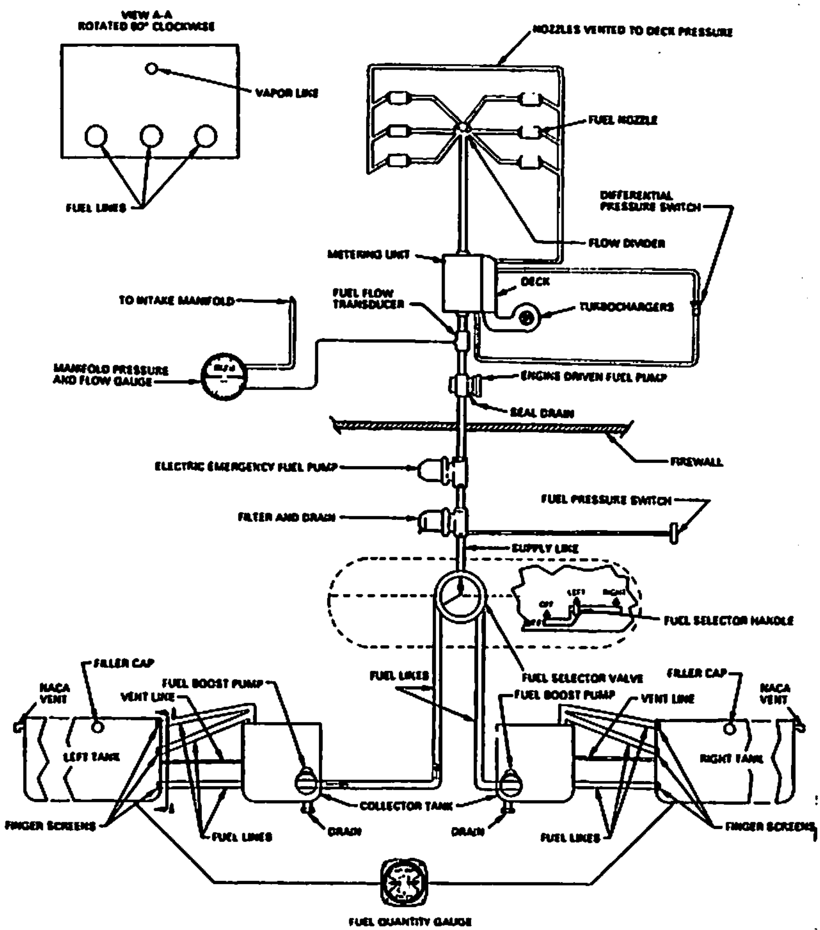
Quantity gauges should be monitored at regular intervals during flight. Fuel tank selection should be alternated accordingly to maintain fuel and wing balance. See fuel imbalance limitations (2.23(e)).

NOTE

Airplane should be fueled symmetrically in a wings level condition. At times, this will require alternate filling of left and right tanks until the full condition is reached.

Each collector/sump tank has a submerged, electrically operated, centrifugal fuel boost pump to suppress fuel vaporization in the fuel lines between the fuel tanks and the engine fuel pump. When the battery master switch is ON, the appropriate boost pump is turned on when the fuel selector is set to the LEFT or RIGHT position. Thus, the boost pump of the selected fuel tank operates continuously during engine start, and normal engine operations on the ground or in flight. Neither pump will operate if the fuel selector is set to OFF, or positioned between the LEFT and RIGHT detents.

7.17 FUEL SYSTEM (Continued)



FUEL SYSTEM SCHEMATIC
Figure 7-13

7.17 FUEL SYSTEM (Continued)

Should the fuel boost pump in the fuel tank being used fail to produce sufficient pressure, the BOOST PUMP light on the annunciator panel will illuminate. In this event, confirm that the fuel selector is properly seated in the detent for the selected tank. If the selector is properly seated, and the annunciator remains lit, select the opposite tank. Since there may be difficulty in obtaining the fuel from the tank with the malfunctioning boost pump, a precautionary landing at the nearest suitable airport should be considered to identify and correct the problem.

Should the engine driven fuel pump fail to produce sufficient pressure to sustain engine performance, the FUEL PRESS light on the annunciator panel will illuminate. Immediately select the emergency fuel pump ON. The FUEL PRESS annunciator will extinguish when adequate fuel pressure is restored. The emergency fuel pump should also be turned ON during takeoff and landing.

Fuel leaving the left or right collector/sump tank flows to a selector valve which is located on the right fuselage side behind the copilot's seat in a non-pressurized compartment. All fuel lines passing through the pressurized cabin are metal tubes surrounded by plastic cushion and encased by a second metal tube. This second tube is sealed from the cabin environment to preclude fuel from entering the cabin area or pressurized cabin air from entering fuel lines in the event of a leak.

The selector valve is cable controlled by a thumbsized handle just below the fuel quantity gauges. The detented selections are OFF, LEFT, RIGHT. LEFT or RIGHT positions direct fuel flow to the engine from the tank selected. To select OFF the fuel selector must be moved to the left tank position, moved down against spring pressure, then moved to the far left, or OFF position.

Fuel flows from the fuel selector forward to the fuel filter located below the baggage floor on the right side. The filter drain is a nylon tube located on the right side of the aircraft, forward of the wing. To drain fuel simply push in the nylon tube. If contaminants clog the filter, an internal relief valve will allow fuel to bypass the filter. This will allow unfiltered fuel to reach the engine and could contaminate the fuel distribution system in the engine.

NOTE

Regular servicing of the filter and examination of fuel samples for contamination is required.

Fuel flows from the filter, forward through the emergency fuel pump and firewall, into the engine compartment, to the engine-driven pump.

7.17 FUEL SYSTEM (Continued)

When beginning flight operations with an equal amount of fuel in each tank, start, taxi, takeoff, and climb on the left tank. When beginning operations with unequal amounts of fuel in each tank, care must be taken not to exceed the fuel imbalance limitations specified in paragraph 2.23(e).

After established in the cruise configuration, the mixture should be leaned. See Section 4 for proper leaning procedure. To maintain lateral balance, it is suggested that alternate tanks be selected in 20 gallon (approximately 60 minute) increments, thus requiring minimal aileron force to keep the wings level. In any case, the fuel imbalance limitations in Section 2 must not be exceeded. The pilot must monitor the fuel gauges and switch tanks as required. Fuel cannot be used from both tanks at the same time.

7.19 ELECTRICAL SYSTEM

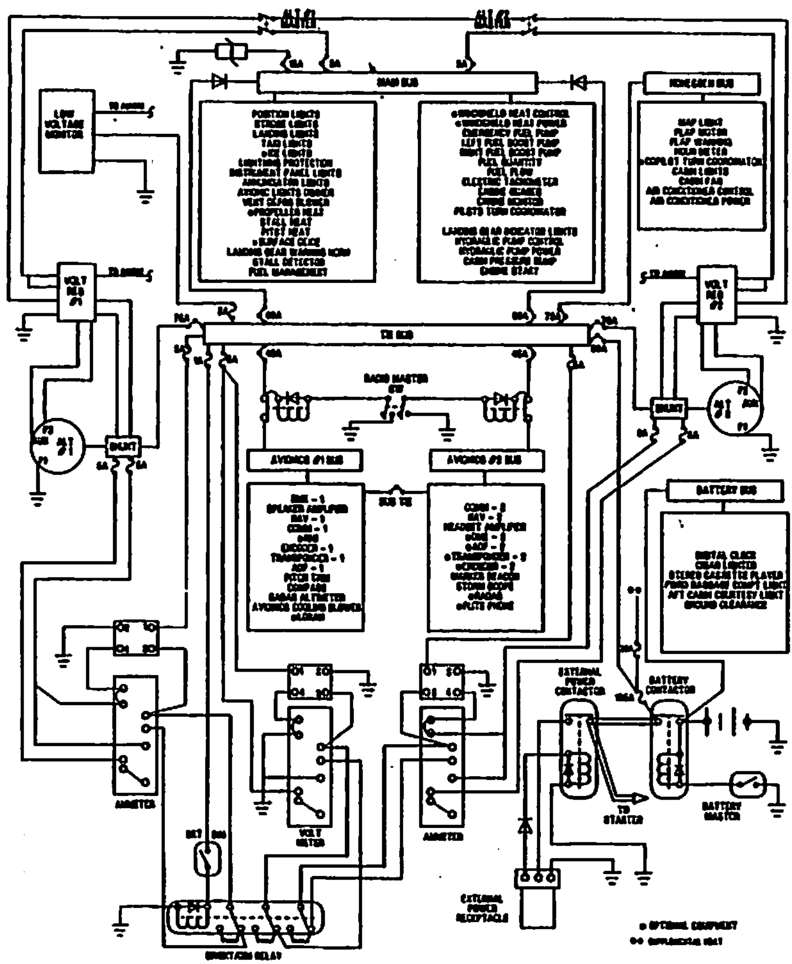
Power for the 28 Vdc, negative ground, dual fed split bus electrical system (Figure 7-15) is supplied by two belt driven, parallel connected, 28 Vdc 70 ampere self exciting alternators mounted on the forward section of the engine. When both alternators are operating and turned ON, a maximum continuous output of 140 amps is available. A 24 Vdc, 15.5 ampere hour lead acid battery, located beneath the left floor panel of the forward baggage compartment, provides power for engine starting. The battery also serves as a source of emergency electrical power in the event both alternators fail. The battery is vented to the atmosphere via an acid recovery system.

Electrical switches are located in one of four switch panels:

(a) A main switch panel (Figure 7-17) located on the lower center section of the pilot's instrument panel.
(b) A deice and anti-ice switch panel (Figure 7-19a) located on the lower left section of the copilot's instrument panel.
(c) An environmental control switch panel (Figure 7-19b) located on the lower left section of the copilot's instrument panel below the control wheel.
(d) An avionics switch panel (Figure 7-19c) located on the top center section of the instrument panel just above the radios.

A battery bus, located in the battery compartment, provides a continuous source of power for the digital clock, cigar lighter, stereo cassette player, ground clearance, forward baggage compartment light, and aft cabin courtesy light. Because the battery bus is connected directly to the battery, power is available for these functions even when the Battery Master switch is OFF. Fuses located on the battery bus are used to protect these circuits.

7.19 ELECTRICAL SYSTEM (Continued)



ELECTRICAL POWER DISTRIBUTION SYSTEM
Figure 7-15

7.19 ELECTRICAL SYSTEM (Continued)

When the Battery Master switch, located on the main switch panel, is turned ON, the battery solenoid contactor closes, enabling current to flow from the battery to both the starter solenoid contactor and the tie bus located on the lower left section of the pilot's instrument panel (Figures 7-23b and 7-25). Should the airplane's battery be depleted, a receptacle located inside the forward baggage compartment door permits using an external 24 Vdc power supply for engine start. With the Battery Master switch OFF, connecting an appropriate external power source completes a circuit that closes the external power solenoid contactor, permitting current to flow from the external source direct to the starter contactor and the tie bus. Whether using the airplane's battery, or external power, tie bus overcurrent protection is provided by the 80 amp tie bus BATTERY circuit breaker and a 100 amp in line current limiter fuse.

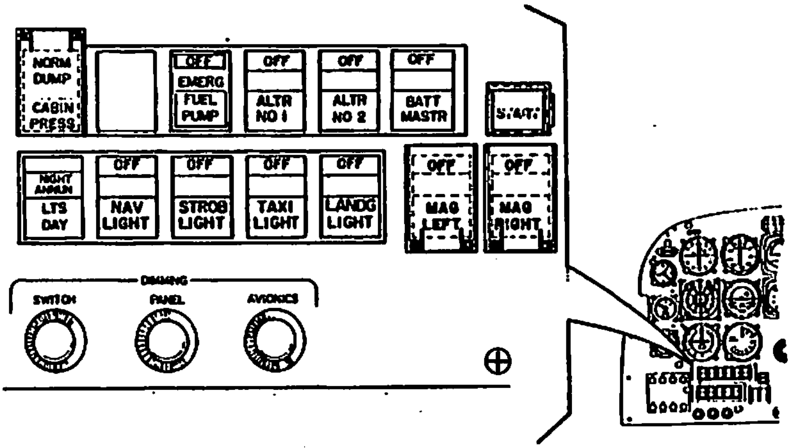
A single 0-30 Vdc voltmeter, located on the lower center section of the instrument panel (Figure 7-25), is connected to the tie bus to indicate battery voltage and system voltage. A low voltage monitor, also connected to the tie bus, will illuminate the LO BUS VOLT annunciator light when system voltage is less than 25 Vdc. Both units are provided overload protection by independent 5 amp fuses located on the tie bus panel.

NOTE

When utilizing just the airplane's battery, or just a 24 volt external power source, the LOW BUS VOLTAGE annunciator will be illuminated. Check the voltmeter for correct voltage.

Each alternator system is provided an independent ON-OFF switch, located on the main switch panel, and a solid state voltage regulator that automatically regulates alternator field current. When selected ON, the positive output of each alternator is fed through individual shunts to the tie bus. Overcurrent protection is provided by the 70 amp tie bus ALTR 1 and ALTR 2 circuit breakers. Two ammeters, located on the lower center section of the instrument panel (Figure 7-25), are fed from taps on each shunt resistor, and indicate the individual electrical load of each alternator. Should an overvoltage condition occur in either alternator, its voltage regulator will shut off the field winding voltage of that alternator; thus overvoltage relays are not required. Output from either alternator can be shut off manually by turning that alternator's switch OFF. When either alternator fails, or is selected OFF, the appropriate ALT INOP annunciator light will illuminate.

7.19 ELECTRICAL SYSTEM (Continued)



MAIN ELECTRICAL SWITCH PANEL
Figure 7-17

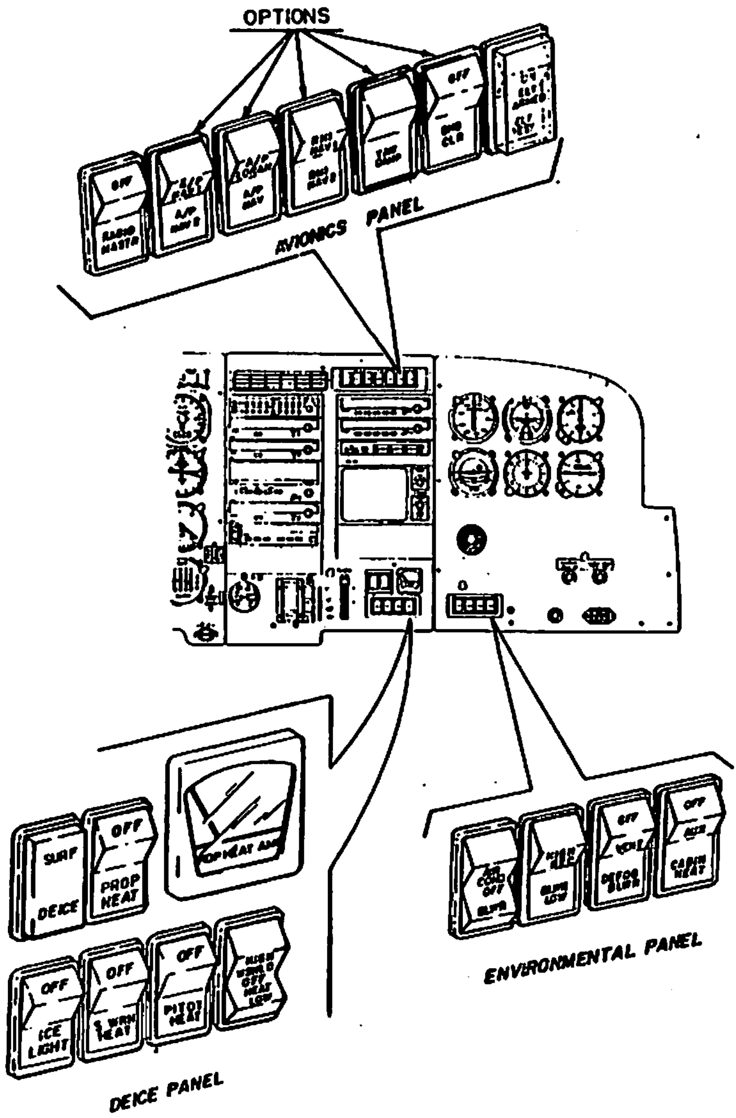
A main bus and a nonessential bus (Figure 7-21), with associated circuit breakers, are located on the pilot's left side panel. Two avionics buses, with associated circuit breakers (Figure 7-23a), are located on the copilot's right side panel. The two avionics buses are interconnected through the avionics bus 25 amp BUS TIE circuit breaker.

Current is fed from the tie bus to the main bus by two conductors. In line diodes prevent reverse current flow to the tie bus. Two tie bus 60 amp MAIN BUS circuit breakers (Figure 7-23b) protect the main bus from an overload.

Current from the tie bus is fed to each avionics bus through independent solenoid contactors. When the Radio Master switch, located on the avionics switch panel, is selected ON, both solenoid contactors close, permitting current flow to both avionics buses. Avionics bus overload protection is provided by the 40 amp tie bus AV NO. 1 and AV NO. 2 circuit breakers (Figure 7-23b). Should the need arise, either avionics bus can be isolated by pulling out the avionics bus BUS TIE circuit breaker and the appropriate tie bus avionics circuit breaker.

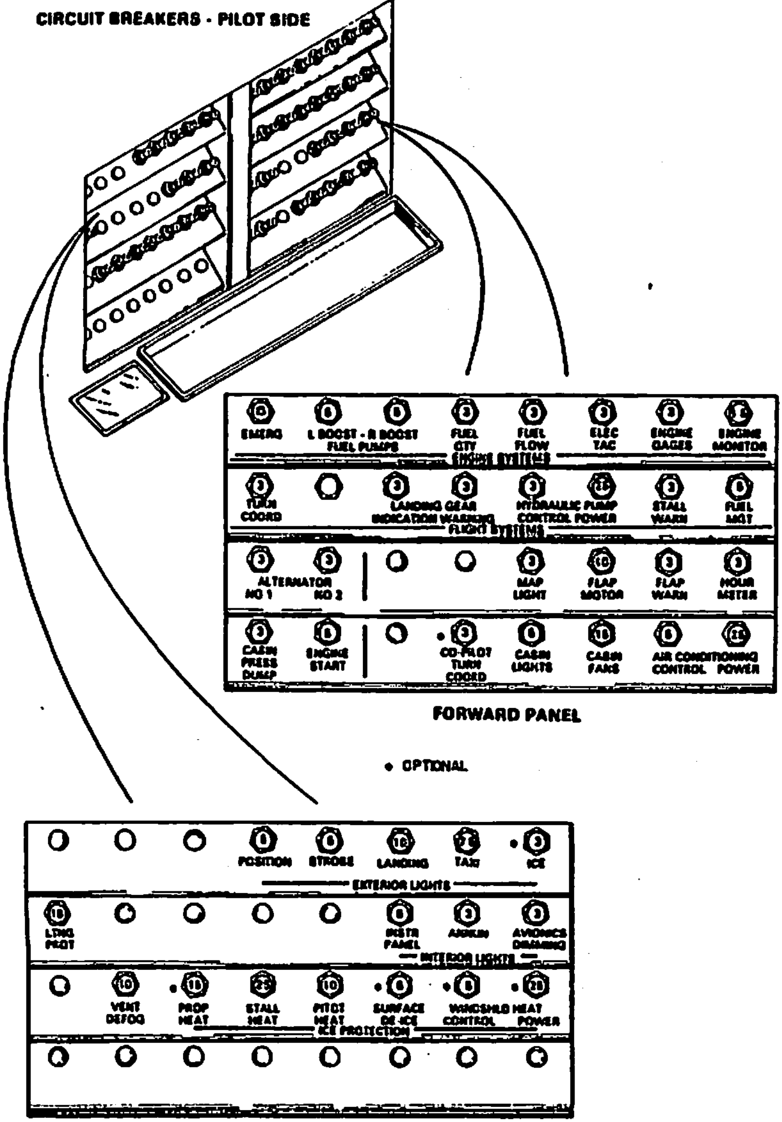
The nonessential bus is also fed from the tie bus. Overload protection is provided by the tie bus 70 amp NON-ESSEN circuit breaker (Figure 7-23b).

7.19 ELECTRICAL SYSTEM (Continued)



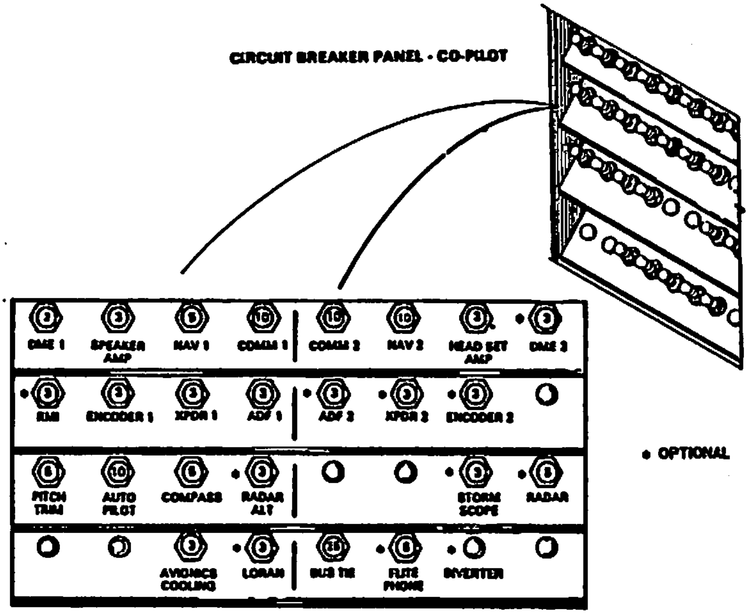
AUXILIARY SWITCH PANELS
Figure 7-19

7.19 ELECTRICAL SYSTEM (Continued)

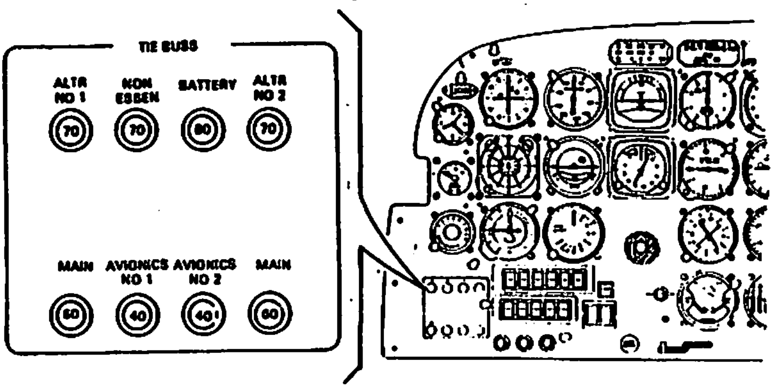


MAIN AND NONESSENTIAL C/B PANELS
Figure 7-21

7.19 ELECTRICAL SYSTEM (Continued)



AVIONICS - C/B PANEL
Figure 7-23a



TIE BUS - C/B PANEL
Figure 7-23b

7.21 INSTRUMENT PANEL

The instrument panel is designed to accommodate the customary advanced flight instruments and the normally required power plant instruments. The artificial horizon is vacuum operated and located in the center of the left instrument panel. The vacuum gauge is located on the left side of the pilot's instrument panel. The pilot's directional gyro, and turn coordinator, are electrically operated.

Knobs and switches for controlling cabin comfort and windshield defogging are located on the lower right side and lower center section of the copilot's instrument panel. The three-in-one cabin pressure monitoring gauge, providing information on cabin rate of climb, cabin altitude, and cabin differential pressure, along with the cabin pressurization controller, are located to the extreme left of the pilot's control wheel.

The radios are contained in the center section of the panel. The main and nonessential bus circuit breakers are on the left side panel. Circuit breakers for the avionics buses are located on the right side panel. A radio master switch is located on the top of the center instrument panel. It controls the power to all radios through the radio master contactor.

An annunciator panel consisting of a group of warning lights is located across the upper left instrument panel. Monitored functions include: ALTERNATOR #1 INOP, BOOST PUMP, FUEL PRESS, LOW BUS VOLTAGE, CABIN ALTITUDE, STALL WARN FAIL, ALTERNATOR #2 INOP, GEAR WARN, DOOR AJAR, FLAPS, STARTER ENGAGE, ANNUNCIATOR INOP, OXYGEN, VACUUM LOW, OIL PRESS, HYDRAULIC PUMP, SURFACE DE-ICE and WINDSHIELD HEAT FAIL.

A ground clearance energy saver system is available to provide direct power to Comm #1 and speaker amplifier without turning on the battery switch. The ground clearance switch is located on the top center instrument panel. When the switch is engaged, direct aircraft battery power is applied to Comm #1 and audio amplifier (speaker). The switch must be turned OFF or depletion of the battery could result.

7.21 INSTRUMENT PANEL (Continued)

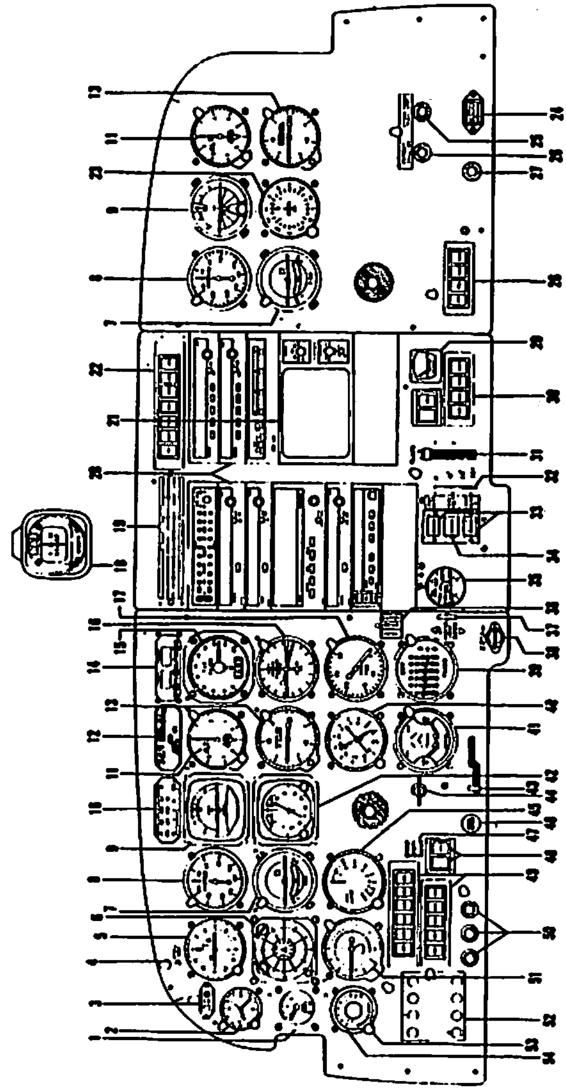
The manifold pressure line has a drain valve located on the left side of the center console, below and forward of the instrument panel, normally above the pilot's right knee. This allows any moisture which may have collected from condensation to be pulled into the engine. This is accomplished by depressing the valve for 5 seconds while operating the engine at 1000 rpm. The manifold pressure gauge will increase to approximately 30 in. Hg when the valve is depressed.

NOTE

Do not depress the valve when manifold pressure exceeds 25 inches Hg.

The column of gauges on the right side of the pilot's panel are engine related instruments. From top to bottom they are turbine inlet temperature (TIT), combination manifold pressure/fuel flow, tachometer (rpm), combination oil pressure, oil temperature, and a six channel cylinder head temperature (CHT). The normal operating range for ground and flight operation is indicated on the instruments by a green arc. Yellow arcs indicate either a takeoff or precautionary range. Red radial lines identify the established maximum or minimum limits. When an instrument needle point touches the edge of the red radial nearest the yellow or green arc, the limit is met.

7.21 INSTRUMENT PANEL (Continued)



INSTRUMENT PANEL
Figure 7-25

7.21 INSTRUMENT PANEL (Continued)

1. GYRO SUCTION
2. CLOCK
3. A/P SLAVING CONTROL
4. STALL WARNING TEST
5. VHF NAV NO. 2 INDICATOR
6. STORMSCOPE
7. TURN COORDINATOR
8. AIRSPEED INDICATOR
9. ATTITUDE INDICATOR
10. A/P ANNUNCIATOR
11. PRESSURE ALTIMETER
12. DME
13. VERTICAL SPEED INDICATOR
14. FUEL MANAGEMENT
15. TURBINE INLET TEMP.
16. MP AND FUEL FLOW
17. TACHOMETER
18. MAGNETIC COMPASS
19. ANNUNCIATOR PANEL
20. AVIONICS INSTALLATION
21. WEATHER RADAR
22. AVIONICS SWITCH PANEL
23. HEADING INDICATOR
24. HOUR METER
25. CABIN TEMP. CONTROL
26. WSHLD DEFOG CONTROL
27. CIGAR LIGHTER
28. ENVIRONMENTAL SWITCH PANEL
29. PROP. HEAT AMMETER
30. DEICE SWITCH PANEL
31. FLAP SELECTOR
32. FLAP POSITION INDICATOR
33. AMMETERS
34. VOLTMETER
35. OIL PRESS./OIL TEMP.
36. GEAR INDICATOR LIGHTS
37. GEAR SELECTOR
38. EMERGENCY GEAR EXTENSION
39. COMBUSTION ANALYZER
40. ADF/RMI
41. FUEL QUANTITY GAUGE
42. HORIZONTAL SITUATION INDICATOR
43. FUEL SELECTOR
44. CABIN PRESSURE CONTROL
45. RADAR ALTIMETER
46. PARKING BRAKE KNOB
47. ENGINE START SWITCH
48. MAGNETO SWITCHES
49. MAIN SWITCH PANEL
50. DIMMER CONTROLS
51. TRIPLE INDICATOR
    a. CABIN VERTICAL KNOB
    b. CABIN ALTITUDE
    c. DIFFERENTIAL PRESSURE
52. TIE BUS CIRCUIT BREAKERS
53. CABIN RATE CHANGE
54. CABIN PRESSURE CONTROLLER

INSTRUMENT PANEL (cont)
Figure 7-25 (cont)

7.23 PITOT STATIC SYSTEM

Pitot pressure for the airspeed indicator is sensed by a heated pitot head installed on the bottom of the left wing and is carried through lines within the wing and fuselage to the gauge on the instrument panel (refer to Figure 7-25). Static pressure for the altimeter, vertical speed and airspeed indicators is sensed by two static source pads, one on each side of the rear fuselage forward of the elevator. They connect to a single line leading to the instruments. The dual pickups balance out differences in static pressure caused by slight side slips or skids. Static pressure for the pressurization system outflow valve is sensed by a separate static pad located on the aft bottom of the aircraft in close proximity to the alternate static pad.

An alternate static source control valve is located below the instrument panel to the left of the pilot. For normal operation, the lever remains down. To select alternate static source, place the lever in the up position. When the alternate static source is selected the airspeed and altimeter and vertical speed indicator are vented to the alternate static pad on the bottom aft fuselage. During alternate static source operation, these instruments may give slightly different readings. The pilot can determine the effects of the alternate static source on instrument readings by switching from standard to alternate sources at different airspeeds.

If one or more of the pitot static instruments malfunction, the system should be checked for dirt, leaks or moisture. The static lines may be drained by a valve located on the side panel next to the pilot's seat. The pitot system drains through the pitot mast.

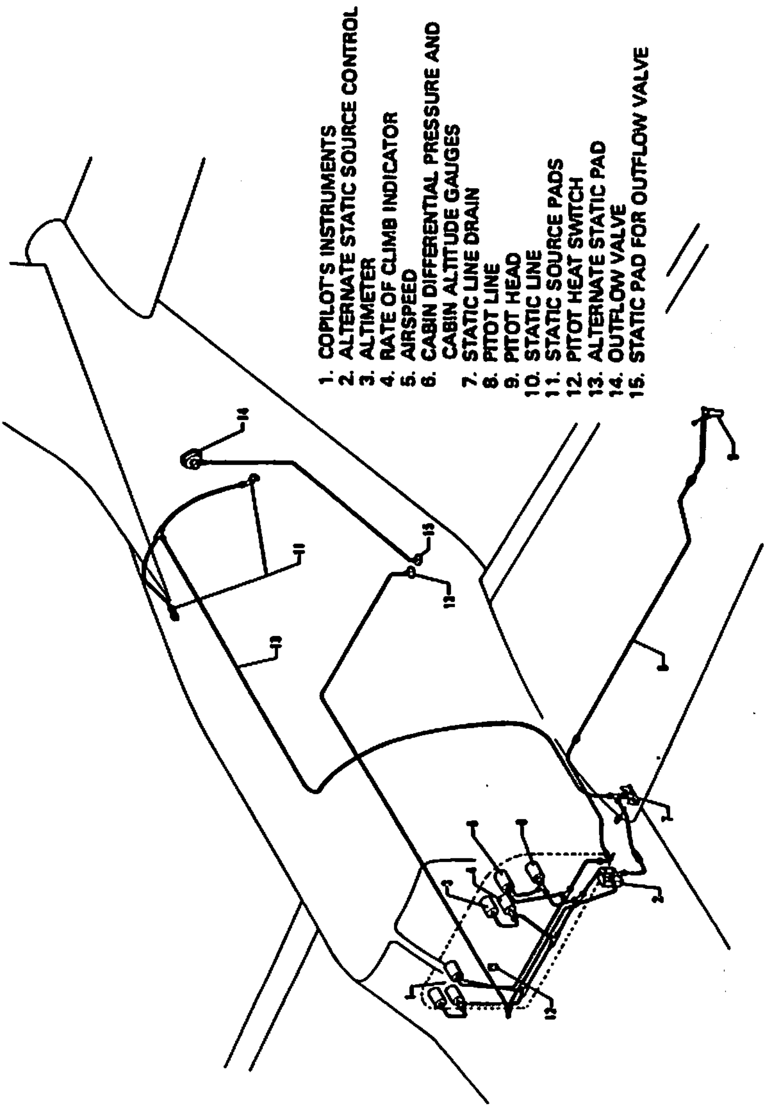
WARNING

Do not attempt to drain static system during pressurized flight.

The holes in the sensors for pitot and static pressure must be fully open and free from blockage. Blocked sensor holes will give erratic or zero readings on the instruments.

The heated pitot head, which alleviates problems with icing and heavy rain, is standard equipment and the switch for pitot heat is located on the lower center instrument panel. Static source pads have been demonstrated to be non-icing; however, in the event icing does occur, selecting the alternate static source will alleviate the problem.

7.23 PITOT STATIC SYSTEM (Continued)



PITOT AND STATIC PRESSURE SYSTEMS
Figure 7-27

7.25 ENVIRONMENTAL SYSTEM (Refer to Figure 7-29)

The environmental system consists of:

(a) A compressor bleed air and conditioning system.
(b) The ventilating air system.
(c) A supplemental electric cabin heater.
(d) An air conditioning system.
(e) The cabin air distribution system.
(f) The pressurization and control system.

Switches and push-pull knobs used to control and regulate the various systems are located below the control wheel on the lower left and lower center sections of the copilot's instrument panel.

Compressor bleed air from the engine turbochargers supplies air for pressurizing and heating the cabin during flight and ground operations. The bleed air is first routed through an air-to-air heat exchanger, and then into the cabin through the lower left and right cabin side panel ducts. The heat exchanger utilizes ambient ram air to cool the bleed air, or hot air from an exhaust shroud to heat the bleed air. Desired cabin comfort is maintained by using the CABIN TEMP push-pull knob to manually adjust a flapper type control valve located forward of the firewall. The position of this valve will allow ambient air, or hot air, or a mixture of both, to enter the heat exchanger.

The cabin pressurization system isobaric outflow valve provides the means by which smoke and impurities are vented from the cabin.

Cabin ventilating air during ground or unpressurized low altitude flight operations is provided by the ambient ram air source to the bleed air heat exchanger. An electric vane-axial ventilation/defog blower, located in the left cabin air inlet duct below the forward baggage compartment floor, is used to produce an air flow to the windshield defogger, and to supplement the inflow of ventilating air during ground operations. The blower is activated by selecting the VENT/DEFOG switch ON. Incoming ventilating air can be heated by mixing it with hot air from the exhaust shroud.

NOTE

If electric supplemental heat is not used, maximum cabin heat for ground operations and unpressurized low altitude flight will be obtained with the CABIN PRESS control full out.

7.25 ENVIROMENTAL SYSTEM (Continued)

The supplemental electric heater consists of a resistance type heat element, a dual hermetically sealed bimetallic type overtemperature protection, a power relay, and a 35 amp in line current limiter fuse. Its function is to provide additional heat for maintaining desired cabin comfort during ground or flight operations under temperature conditions when fully heated bleed air or ventilating air is inadequate. When an external power source is used, the supplemental heater can also be used to preheat the cabin prior to engine start. See Section 2 for limitations on use of the supplemental heater.

The supplemental heater heat element is installed forward of the pressure bulkhead in the left bleed air duct immediately downstream of the ventilation/defog blower. Because the ventilation/defog blower must be operating whenever supplemental heat is used, both the VENT/DEFOG and CABIN HEAT switches must be ON to supply power to the heating element.

Both the heater control circuit and the vent/defog fan circuit utilize the 0 amp VENT DEFOG circuit breaker located on the ENVIRONMENTAL circuit breaker panel. Heater element power is supplied from the battery master solenoid through the 35 amp heater fuse and the heater power relay. The 35 amp heater fuse is not accessible to the pilot. The electrical lead imposed by the heater and the vent/defog fan is 40.35 amps. Operation is limited to airplanes with both alternators functioning.

Cabin air conditioning is provided by a vapor cycle system. The freon compressor is belt driven by the engine. Condenser cooling airflow is provided by a continuous duty motor driven fan. Cabin air is recirculated across the evaporators to provide cool air at each seat outlet.

The condenser and its cooling air fan are located in the tailcone immediately aft of the rear pressure bulkhead. Cooling air from outside the tailcone is drawn into the cooling air duct through a flush opening in the skin, routed across the condenser coil, and discharged overboard through the tailcone exit opening.

Two recirculation blowers and evaporator assemblies are located aft of each rear seat below the rear baggage compartment floor. The recirculation blowers draw air into each evaporator coil through grills in the floor structure behind the rear seats and discharges it into the upper left and right cabin side panel ducts. Adjustable eyeball outlets are located at each seat in the airplane.

7.25 ENVIRONMENTAL SYSTEM (Continued)

The AIR COND/OFF/BLWR and REC BLWR HI/LO switches, located on the copilot's lower instrument panel to the left of the control wheel, are used to control the air conditioning system.

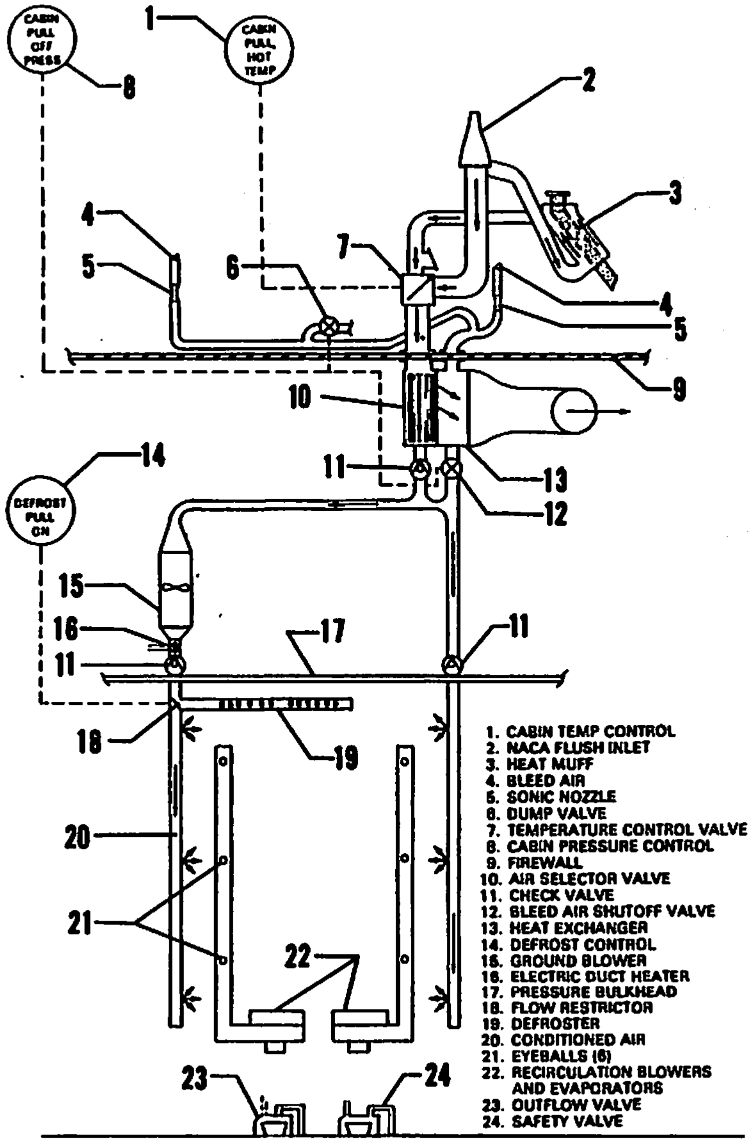
When the AIR COND/OFF/BLWR switch is positioned to AIR COND, the compressor belt drive is electrically clutched, the condenser blower motor relay switch is closed, and both recirculation blowers are activated. The recirculation blowers can be operated independently of the air conditioner by setting the AIR COND/OFF/BLWR switch to BLWR. In either situation, the REC BLWR switch is used only to select a HI or LO recirculation blower motor speed. The AIR COND/OFF/BLWR switch must be set to the center OFF position to shut off the recirculation blower motors. Overcurrent protection is provided by the 10 amp CABIN BLOWERS, 5 amp AIR CONDITIONER CONTROL, and 25 amp AIR CONDITIONER POWER circuit breakers on the nonessential bus panel.

The freon portion of the system incorporates a receiver dryer, a sight gauge, suction and discharge service valves, and 265 psi high pressure and 40 psi low pressure switches. Should the compressor discharge pressure increase above 265 psi, or decrease below 40 psi, the applicable pressure switch will open, disengaging the freon compressor clutch.

The cabin pressurization and control system consists of an isobaric outflow valve, a safety outflow valve, cabin altitude and rate selector, electrically operated vacuum solenoid valve, surge tank, and associated interconnecting plumbing and wiring. Cabin altitude, differential pressure, and rate of change are displayed on a single three inch diameter indicator. Should cabin pressure altitude exceed 10,000 feet, the CABIN ALTITUDE annunciator will illuminate to warn the pilot.

Refer to paragraph 7.27, BLEED AIR, CONDITIONING AND PRESSURIZATION SYSTEM, for a more complete description of the pressurization system and use of related controls and switches.

7.25 ENVIROMENTAL SYSTEM (Continued)



ENVIRONMENTAL SYSTEM
Figure 7-29

7.27 BLEED AIR, CONDITIONING AND PRESSURIZATION SYSTEM

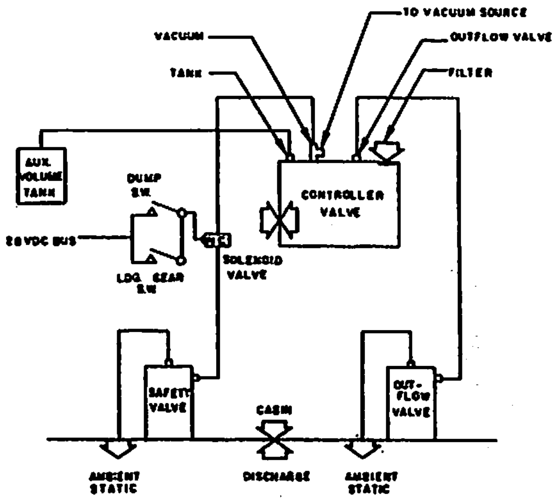
Air for cabin pressure is obtained from the engine turbocharger induction air system through two sonic venturi tubes. Bleed air is routed through the bleed air heat exchanger for the temperature conditioning to provide the desired cabin comfort level. Ram ambient air is routed across the heat exchanger to cool the bleed air, and hot ambient air from the heat muff is routed across the heat exchanger to heat the bleed air. Mixtures of ram ambient and heated ambient air may also be selected.

Cabin air is controlled by a push-pull knob labled CABIN PRESS located beneath the control wheel on the pilot's instrument panel. Bleed air for pressurizing the cabin is provided when the control is fully in. Unpressurized ambient air is provided for ventilating the cabin when the control is fully out. This control operates three valves: the bleed air shutoff valve, the bleed air dump valve, and the ram air selector valve. When pushed fully in, the bleed air shutoff valve is open, the bleed air dump valve is closed, and the ram air selector valve is positioned to route ambient air across the bleed air heat exchanger. When the control is pulled completely out, the bleed air shutoff valve is closed, the bleed air dump valve is open, and the ram air selector valve is positioned to route ambient air into the conditioned air ducts through the check valve and into the cabin.

Controls and switches needed to operate the cabin pressurization system are located on the lower section of the pilot's instrument panel to the left of and beneath the control wheel, and on the lower right side of the copilot's instrument panel. In addition to the CABIN PRESS and CABIN TEMP controls, they include the cabin pressure and rate controller located just above the tie bus circuit breakers on the pilot's instrument panel, and the CABIN PRESS DUMP/NORM switch located on the pilot's main switch panel.

For pressurized flight, set the cabin pressure controller at 500 feet above the airport pressure altitude, CABIN PRESS control knob full in and the CABIN PRESS DUMP/NORM switch to NORM. The rate of cabin ascent and descent change is controlled with the rate knob (left lower corner of the cabin pressure controller, Figure 7-31), and may be adjusted between approximately 200 and 2000 feet per minute, as desired. Setting the rate knob arrow to the 9 o'clock position provides a cabin rate of change of approximately 500 feet per minute. This position gives a comfortable rate for normal operations.

7.27 BLEED AIR, CONDITIONING AND PRESSURIZATION SYSTEM (Continued)



PRESSURIZATION CONTROL SCHEMATIC
Figure 7-31

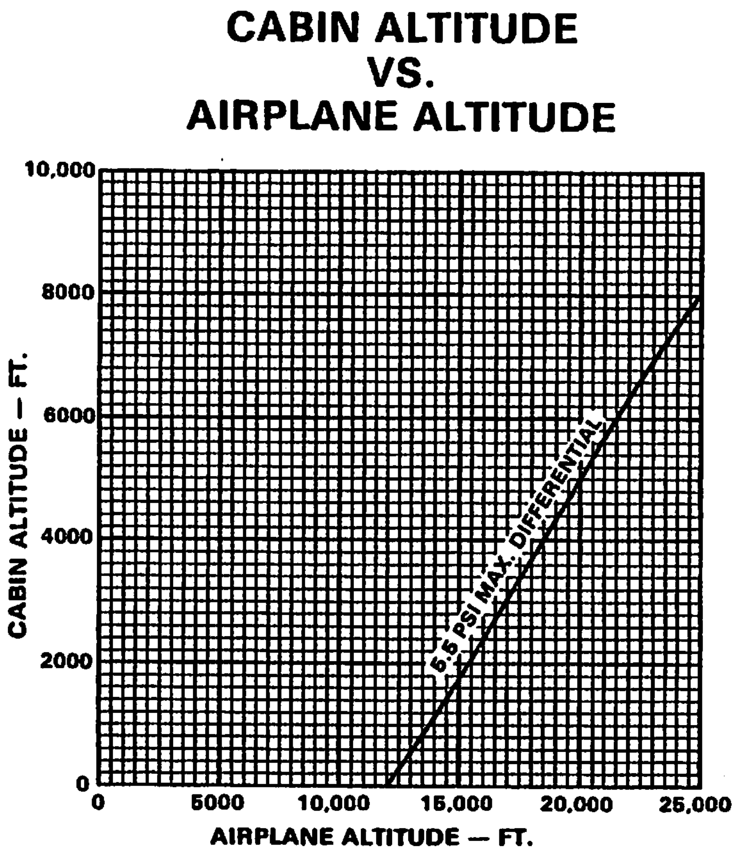
Next to the cabin pressure controller, a triple indicator simplifies monitoring the system's operation. The triple indicator displays the cabin altitude, cabin rate of change and the differential pressure between the cabin and the outside atmosphere. Maximum cabin differential pressure is 5.5 psi.

A CABIN ALTITUDE warning light on the annunciator display warns the pilot when the cabin altitude is above 10,000 feet. Cabin pressure is automatically regulated to a maximum of 5.5 psi pressure differential. Should the cabin outflow valve malfunction, the cabin safety valve will maintain a maximum of 5.6 cabin differential pressure. The landing gear squat switch, on the left main landing gear, prevents the cabin from being pressurized while the airplane is on the ground.

For complete instructions on the operation of the cabin pressurization system, refer to Section 4, Normal Procedures.

The CABIN PRESS DUMP/NORM switch, when set to DUMP, electrically opens a solenoid valve allowing vacuum suction pressure to open the safety valve and rapidly dump cabin pressure to ambient pressure.

7.27 BLEED AIR, CONDITIONING AND PRESSURIZATION SYSTEM (Continued)



CABIN ALTITUDE VS. AIRPLANE ALTITUDE
Figure 7-33

7.27 BLEED AIR, CONDITIONING AND PRESSURIZATION SYSTEM (Continued)

For unpressurized flight the CABIN PRESS control should be pulled fully out. Activating the cabin dump switch will provide maximum airflow through the cabin. Cabin temperature will continue to be controlled by the CABIN TEMP control.

For complete instructions on pressurization malfunctions, refer to Section 3 - Emergency Procedures.

7.29 VACUUM SYSTEM

Vacuum for the system is provided by two continuously operating engine driven dry air vacuum pumps; one rotating clockwise and one rotating counterclockwise. Either pump can independently support the system. Also included are two regulators, a low vacuum switch, an inlet air filter, and a manifold that connects the autopilot, attitude indicator, cabin pressure controller, and vacuum solenoid valve. The latter two components are part of the cabin pressurization system.

The two vacuum regulators are mounted on the forward pressure bulkhead in the forward baggage compartment. The total system vacuum, which is displayed on the vacuum gauge, is regulated between 4.5 and 5.2 inches of mercury.

A vacuum gauge, incorporating two red flow buttons, mounted on the left side of the pilot's instrument panel (Figure 7-35), provides information to the pilot regarding the operation of both pumps. When both pumps are operating satisfactorily, neither flow button is visible. The left flow button will protrude should the clockwise rotating pump fail, while the right flow button will protrude should the counterclockwise rotating pump fail.

The low vacuum switch is mounted upstream of the manifold check valve. It illuminates the VAC LOW annunciator light when the system vacuum falls to 4.0 +/- 0.25 inches of mercury.

Any decrease in system vacuum may indicate a dirty filter, dirty screens, sticking vacuum regulator, or a leak in the system.

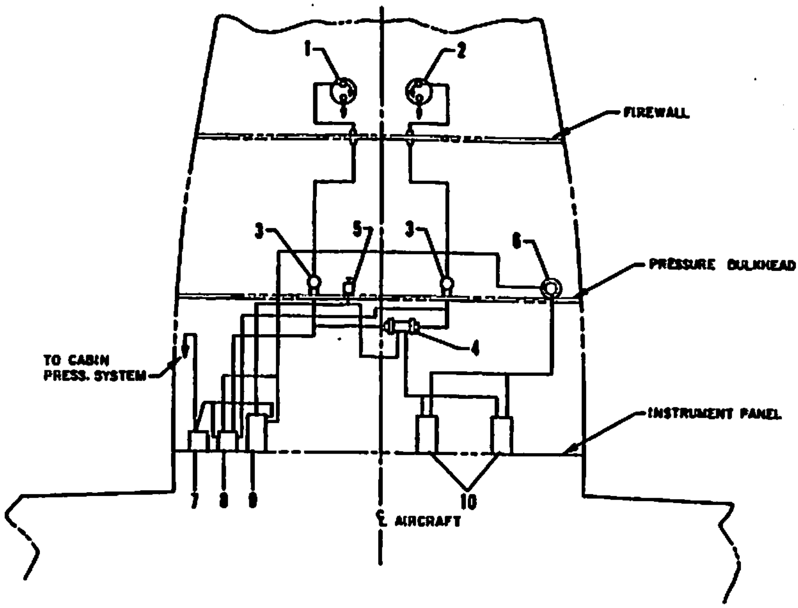
7.29 VACUUM SYSTEM (Continued)

A zero gauge reading, combined with the illumination of the VAC LOW annunciator light, indicates both pump drives may have sheared. A zero gauge reading without the VAC LOW annunciator illuminating may indicate a defective gauge. Either condition could be caused by a collapsed vacuum line.

Upon completion of the flight, all system abnormalities or malfunctions should be checked by a mechanic, and necessary repairs made, prior to further pressurized flight or flight under IFR.

Operators of airplanes equipped with wing and tail deicers should refer to Section 9, Supplement 7, for additional information concerning the vacuum system.

7.29 VACUUM SYSTEM (Continued)



1. CLOCKWISE ROTATING VACUUM PUMP
2. COUNTERCLOCKWISE ROTATING VACUUM PUMP
3. VACUUM REGULATOR
4. VACUUM MANIFOLD/CHECK VALVE
5. VACUUM PRESSURE SWITCH
6. INLINE FILTER
7. CABIN PRESSURE CONTROLLER
8. VACUUM GAUGE
9. PILOT'S ATTITUDE GYRO
10. COPILOT'S AIR DRIVEN GYROS (OPTIONAL)

VACUUM SYSTEM
Figure 7-35

7.31 CABIN FEATURES

The front seats are adjustable fore and aft and vertically. Pivoting armrests are provided on the inboard side of each seat.

Shoulder harnesses with inertia reels are standard equipment for all seats. The inertia reel should be checked by tugging sharply on the strap. The reel will lock in place under this test and prevent the strap from extending. Under normal movement the strap will extend and retract as required.

The shoulder harness is routed over the shoulder adjacent to the windows and attached to the lap belt buckle.

Shoulder harnesses shall be worn during takeoff, landing and during an emergency situation.

Standard cabin features include a pilot's storm window, ash trays, map pockets, cup holders, a cigar lighter, sun visors, stowage drawers under the aft facing seats and a baggage restraint net behind the rear seats.

Two combination instrument panel flood/map lights are provided forward, and four passenger reading lights are provided aft. A cabin entrance flood light is located above the door.

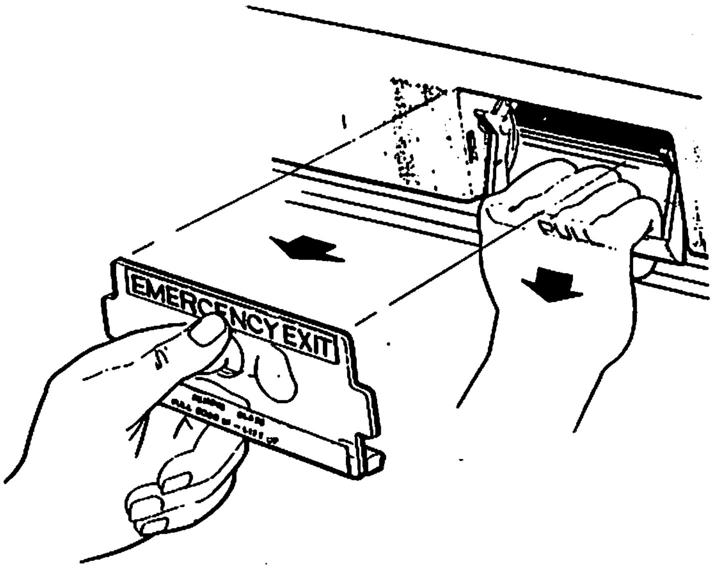
The four passenger seats with folding armrests and headrests are positioned in a club seating arrangement. The center seats face aft. The seat backs recline by pushing a button mounted in the outboard armrest.

An optional conference table located between the right passenger seats is available. The table is extended by pulling in on the upper edge of the leaf and then upward. The leaf is then rotated down into position and unfolded. Reverse this procedure for stowage.

Optional cabinets located behind the pilot seats are available. The right cabinet is designed for Jeppesen manual stowage in the bottom and contains a drawer for general use.

The left cabinet contains a removable ice chest, a tray, space for six canned drinks, and a fold down cup holder in the lower drawer. The upper drawer has space for thermos containers, cups and miscellaneous items.

7.31 CABIN FEATURES (Continued)



EMERGENCY EXIT
Figure 7-37

Optional passenger oxygen generators and masks are available and, if installed, are located in a drawer under the right aft facing seat.

Crew oxygen is located under the copilot's seat, readily available to either crew member. An annunciator light illuminates when any of the three generators have been activated. The light remains illuminated with the battery switch ON, until the system is serviced.

An optional fire extinguisher is available and, if installed, is located either behind the spar or on top of the right cabinet.

The emergency exit is located on the right side of the fuselage, adjacent to the aft facing seat. Instructions for opening the emergency exit are placarded on the cover over the handle. To open, remove the cover and pull the handle. The window releases inward. The cabin must be unpressurized to open the exit.

7.33 BAGGAGE AREA

The airplane has two separate baggage areas each with a 100-pound capacity. A 13-cubic-foot forward baggage compartment, located just aft of the firewall, is accessible through a 19 x 23 inch door on the left side of the fuselage. An aft baggage compartment, which is accessible from inside the cabin, is located behind the back seats.

A forward baggage door annunciation system senses the baggage door latch position. If the baggage door is not closed and latched, the DOOR AJAR annunciator light will illuminate on the annunciator panel.

NOTE

It is the pilot's responsibility to be sure when the baggage is loaded that the airplane's C.G. falls within the allowable C.G. range (refer to Section 6, Weight and Balance).

7.35 FINISH

All exterior surfaces are primed and finished with polyurethane. To keep the finish attractive looking, polyurethane touch-up paint is available from Piper Factory Authorized Service Centers.

7.37 STALL WARNING

An approaching stall is indicated by a stall warning horn sounding a continuous tone, as opposed to the landing gear horn's beeping tone. Mild airframe buffeting may also precede a stall.

The stall warning is activated by a lift transducer installed in the leading edge of the left wing. An onboard computer will distinguish between power on, power off, and flap position conditions during normal stalls, causing the horn to sound five to ten knots above the stall speed.

A graph showing stall speeds at various angles of bank is contained in Section 5.

7.39 EMERGENCY LOCATOR TRANSMITTER

The Emergency Locator Transmitter (ELT) meets the requirements of FAR 91.52. It operates on self-contained batteries and is located in the aft fuselage section. It is accessible through a cover on the bottom right side.

A battery replacement date is marked on the transmitter. To comply with FAA regulations, the battery must be replaced on or before this date. The battery must also be replaced if the transmitter has been used in an emergency situation, if the accumulated test time exceeds one hour, or if the unit has been inadvertently activated for an undetermined time period.

NOTE

If for any reason a test transmission is necessary, the test transmission should be conducted only in the first five minutes of any hour and limited to three audio sweeps. If a test must be made at any other time, the test should be coordinated with the nearest FAA tower or flight service station.

NARCO ELT 10 OPERATION

Located on the ELT unit is a three position switch placarded ON, OFF and ARM. The ARM position sets the ELT so that it will transmit after impact and will continue to transmit until its battery is drained. The ARM position is selected when the ELT is installed in the airplane and it should remain in that position.

To use the ELT as a portable unit in an emergency, remove the cover and unlatch the unit from its mounting base. The antenna cable is disconnected by a left quarter-turn of the knurled nut and a pull. A sharp tug on the two small wires will break them loose. Deploy the self-contained antenna by pulling the plastic tab marked PULL FULLY TO EXTEND ANTENNA. Move the switch to ON to activate the transmitter.

In the event the transmitter is activated by an impact, it can only be turned off by moving the switch on the ELT unit to OFF. Normal operation can then be restored by pressing the small clear plastic reset button located on the top of the front face of the ELT and then moving the switch to ARM.

7.39 EMERGENCY LOCATOR TRANSMITTER (Continued)

A covered three position rocker type switch, located in the avionics switch panel, allows the pilot to remotely activate the ELT transmitter from inside the cabin. The switch is labeled ON and TEST. The cover is labeled ELT ARMED. Normally the switch is in the center, or ARMED position, with the cover down. Should a test of the transmitter be required, left the cover and hold the switch in the TEST (down) position. When the test is completed, simply release the switch; it is spring loaded to return to the ARMED (center) position. If continuous operation is desired, lift the cover and select the ON (up) position. Unless the impact switch has been activated, returning the remote switch to the ARMED (center) position will turn the transmitter off.

The ELT should be checked to make certain the unit has not been activated during the ground check. Check by selecting 121.50 mHz on an operating receiver. If there is an oscillating chirping sound, the ELT may have been activated and should be turned off immediately. This requires removal of the access cover and moving the switch to OFF, then press the reset button and return the switch to ARM. Recheck with the receiver to ascertain the transmitter is silent.

7.41 EXTERNAL POWER

The external power receptacle allows the airplane engine to be started from an external power source without the necessity of gaining access to the airplane battery. The cable from the external power source can be attached to a receptacle, located on the aft side of the forward baggage compartment. Instructions on a placard located on the cover of the receptacle should be followed when starting with external power. For instructions on the use of external power, refer to Starting Engines in Section 4.

7.43 RADAR*

A weather radar system can be installed in this airplane. The basic components of this installation are a Receiver-Transmitter Antenna and a cockpit indicator. The function of the weather radar system is to detect weather conditions along the flight path and to visually display a continuous weather outline on the cockpit indicator. Through interpretation of the advance warning given on the display, the pilot can make an early decision on the most desirable weather avoidance course.

*Optional equipment

7.43 RADAR* (Continued)

NOTE

When operating weather avoidance radar systems inside of moderate to heavy precipitation, it is advisable to set the range scale of the radar to its lowest scale.

For detailed information on the weather radar system and for procedures to follow in operating and adjusting the system to its optimum efficiency, refer to Section 9, Supplements, or the appropriate operating and service manuals provided by the radar system manufacturer.

WARNING

Heating and radiation effects of radar can cause serious damage to the eyes and tender organs of the body. Personnel should not be allowed within fifteen feet of the area being scanned by the antenna while the system is transmitting. Do not operate the radar during refueling or in the vicinity of trucks or containers accommodating explosives or flammables. Flashbulbs can be exploded by radar energy. Before operating the radar, direct the nose of the airplane so that the forward 120 degree sector is free of any metal objects such as other aircraft or hangars for a distance of at least 100 yards, and tilt the antenna upward 12 degrees. Do not operate the radar while the airplane is in a hangar or other enclosure.

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TABLE OF CONTENTS

SECTION 8

AIRPLANE HANDLING, SERVICING AND MAINTENANCE

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SECTION 8

AIRPLANE HANDLING, SERVICING AND MAINTENANCE

8.1 GENERAL

This section provides general guidelines relating to handling, servicing and maintenance.

Every owner should stay in close contact with his Piper dealer or distributor and Authorized Piper Service Center to obtain the latest information pertaining to his aircraft and to avail himself of the Piper Aircraft Service Backup.

Piper Aircraft Corporation takes a continuing interest in having the owner get the most efficient use from his aircraft and keeping it in the best mechanical condition. Consequently, Piper Aircraft from time to time issues Service Bulletins, Service Letters and Service Spares Letters relating to the aircraft.

Piper Service Bulletins are of special importance and Piper considers compliance mandatory. These are sent to the latest registered owners, distributors and dealers. Depending on the nature of the bulletin, material and labor allowances may apply, and will be addressed in the body of the Bulletin.

Service Letters deal with product improvements and service hints pertaining to the aircraft. They are sent to dealers, distributors and occasionally (at the factory's discretion) to latest registered owners, so they can properly service the aircraft and keep it up to date with the latest changes. Owners should give careful attention to the Service Letter information.

Service Spares Letters offer improved parts, kits and optional equipment which were not available originally and which may be of interest to the owner.

If an owner is not having his aircraft serviced by an Authorized Piper Service Center, he should periodically check with a Piper dealer or distributor to find out the latest information to keep his aircraft up to date.

8.1 GENERAL (continued)

Piper Aircraft Corporation has a Subscription Service for the Service Bulletins, Service Letters and Service Spares Letters. This service is offered to interested persons such as owners, pilots and mechanics, at a nominal fee, and may be obtained through Piper dealers and distributors.

A service manual, parts catalog, and revisions to both, are available from your Piper dealer or distributor. Any correspondence regarding the airplane should include the airplane model and serial number to ensure proper response.

8.3 AIRPLANE INSPECTION PERIODS

Piper Aircraft Corporation has developed inspection items and required inspection intervals (i.e.: 50, 100, 500, and 1000 hours) for the specific model aircraft. Appropriate forms are contained in the applicable Piper Service/Maintenance Manual, and should be complied with by a properly trained, knowledgeable, and qualified mechanic at a Piper Authorized Service Center or a reputable repair shop. Piper Aircraft Corporation cannot accept responsibility for the continued airworthiness of any aircraft not maintained to these standards, and/or not brought into compliance with applicable Service Bulletins issued by Piper Aircraft Corporation, instructions issued by the engine, propeller, or accessory manufacturers, or Airworthiness Directives issued by the FAA.

A programmed inspection, approved by the Federal Aviation Administration (FAA), is also available to the owner. This involves routine and detailed inspections to allow maximum utilization of the airplane. Maintenance inspection costs are reduced, and the maximum standard of continued airworthiness is maintained. Complete details are available from Piper Aircraft Corporation.

In addition, but in conjunction with the above, the FAA requires periodic inspections on all aircraft to keep the Airworthiness Certificate in effect. The owner is responsible for assuring compliance with these inspection requirements and for maintaining proper documentation in logbooks and/or maintenance records.

8.3 AIRPLANE INSPECTION PERIODS (continued)

A spectographic analysis of the engine oil is available from several sources. This inspection, if performed properly, provides a good check of the internal condition of the engine. To be accurate, induction air filters must be cleaned or changed regularly, and oil samples must be taken and sent in at regular intervals.

8.5 PREVENTIVE MAINTENANCE

The holder of a Pilot Certificate issued under FAR Part 61 may perform certain preventive maintenance described in FAR Part 43. This maintenance may be performed only on an aircraft which the pilot owns or operates and which is not used to carry persons or property for hire, except as provided in applicable FAR's. Although such maintenance is allowed by law, each individual should make a self-analysis as to whether he has the ability to perform the work.

All other maintenance required on the airplane should be accomplished by appropriately licensed personnel.

If maintenance is accomplished, an entry must be made in the appropriate logbook. The entry should contain:

(a) The date the work was accomplished.
(b) Description of the work.
(c) Number of hours on the aircraft.
(d) The certificate number of pilot performing the work.
(e) Signature of the individual doing the work.

8.7 AIRPLANE ALTERATIONS

If the owner desires to have his aircraft modified, he must obtain FAA approval for the alteration. Major alterations accomplished in accordance with advisory Circular 43.13-2, when performed by an A & P mechanic, may be approved by the local FAA office. Major alterations to the basic airframe or systems not covered by AC 43.13-2 require a Supplemental Type Certificate.

8.7 AIRPLANE ALTERATIONS (continued)

The owner or pilot is required to ascertain that the following aircraft papers are in order and in the aircraft.

(a) To be displayed in the aircraft at all times:
- (1) Aircraft Airworthiness Certificate Form FAA-8100-2.
- (2) Aircraft Registration Certificate Form FAA-8050-3.
- (3) Aircraft Radio Station License if transmitters are installed.

(b) To be carried in the aircraft at all times:
- (1) Pilot's Operating Handbook.
- (2) Weight and Balance data plus a copy of the latest Repair and Alteration Form FAA-337, if applicable.
- (3) Aircraft equipment list.

Although the aircraft and engine logbooks are not required to be in the aircraft, they should be made available upon request. Logbooks should be complete and up to date. Good records will reduce maintenance cost by giving the mechanic information about what has or has not been accomplished.

8.9 GROUND HANDLING

(a) Towing

The airplane may be moved on the ground by the use of the nose wheel steering bar that is stowed in the forward baggage compartment or by power equipment that will not damage or excessively strain the nose gear steering assembly.

CAUTION

When towing with power equipment, do not turn the nose gear beyond its steering limit in either direction, as this will result in damage to the nose gear and steering mechanism.

CAUTION

Do not tow the airplane when the controls are secured.

In the event towing lines are necessary, ropes should be attached to both main gear struts as high up on the tubes as possible. Lines should be long enough to clear the nose and/or tail

8.9 GROUND HANDLING (continued)

by not less than fifteen feet, and a qualified person should ride in the pilot's seat to maintain control by use of the brakes.

(b) Taxiing

CAUTION

Do not operate engine above 1200 rpm with cabin doors open.

Before attempting to taxi the airplane, ground personnel should be instructed and approved by a qualified person authorized by the owner. Engine starting and shut-down procedures as well as taxi techniques should be covered. When it is ascertained that the propeller back blast and taxi areas are clear, power should be applied to start the taxi roll, and the following checks should be performed:

(1) Taxi a few feet forward and apply the brakes to determine their effectiveness.
(2) Taxi with the propeller set in low pitch, high rpm setting.
(3) While taxiing, make slight turns to ascertain the effectiveness of the steering.
(4) Observe wing clearance when taxiing near buildings or other stationary objects. If possible, station an observer outside the airplane.
(5) When taxiing over uneven ground, avoid holes and ruts.
(6) Do not operate the engine at high rpm when running up or taxiing over ground containing loose stones, gravel, or any loose material that may cause damage to the propeller blades.

(c) Parking

When parking the airplane, be sure that it is sufficiently protected from adverse weather conditions and that it presents no danger to other aircraft. When parking the airplane for any length of time or overnight, it is suggested that it be moored securely.

(1) To park the airplane, head it into the wind if possible.
(2) The parking brake knob is located just below the left control column. To set the parking brake, first depress and hold the toe brakes and then pull out on the parking brake knob. To release the parking brake, first depress the brake pedals and then push in on the parking brake knob.

8.9 GROUND HANDLING (continued)

CAUTION

Care should be taken when setting brakes that are overheated or during cold weather when accumulated moisture may freeze a brake.

(3) Aileron and elevator controls should be secured with the front seat belt and chocks used to properly block the wheels.

(d) Mooring

The airplane should be moored for immovability, security and protection. The following procedures should be used for the proper mooring of the airplane:

(1) Head the airplane into the wind if possible.
(2) Retract the flaps.
(3) Immobilize the ailerons and elevator by looping the seat belt through the control wheel and pulling it snug.
(4) Block the wheels.
(5) Secure tiedown ropes to wing and tail tiedown rings at approximately 45 degree angles to the ground. When using rope of non-synthetic material, leave sufficient slack to avoid damage to the airplane should the ropes contract.

CAUTION

Use bowline knots, square knots or locked slip knots. Do not use plain slip knots.

NOTE

Additional preparations for high winds include using tiedown ropes from the nose landing gear and securing the rudder.

8.9 GROUND HANDLING (continued)

(6) Install a pitot head cover if available. Be sure to remove the pitot head cover before flight.
(7) Cabin and baggage door should be locked when the airplane is unattended.

8.11 ENGINE INDUCTION AIR FILTER

(a) Removing Induction Air Filter

(1) Remove louvered induction air panel assembly at nose of aircraft by removing screws.
(2) Remove screws around perimeter of filter on induction air inlet to withdraw inlet and filter.

(b) Cleaning Induction Air Filter

The induction air filter must be cleaned at least once every 50 hours, and more often, even daily, when operating in dusty conditions. Extra filters are inexpensive, and a spare should be kept on hand for use as a rapid replacement.

To clean the filter:
(1) Tap filter gently to remove dirt particles. Do not use compressed air or cleaning solvents.
(2) Inspect filter. If paper element is torn or ruptured or gasket is damaged, the filter should be replaced. The usable life of the filter should be restricted to one year or 500 hours, whichever comes first.
(3) After cleaning check all components for dirt and damage. Wipe the filter and inlet clean. Do not oil the filter.

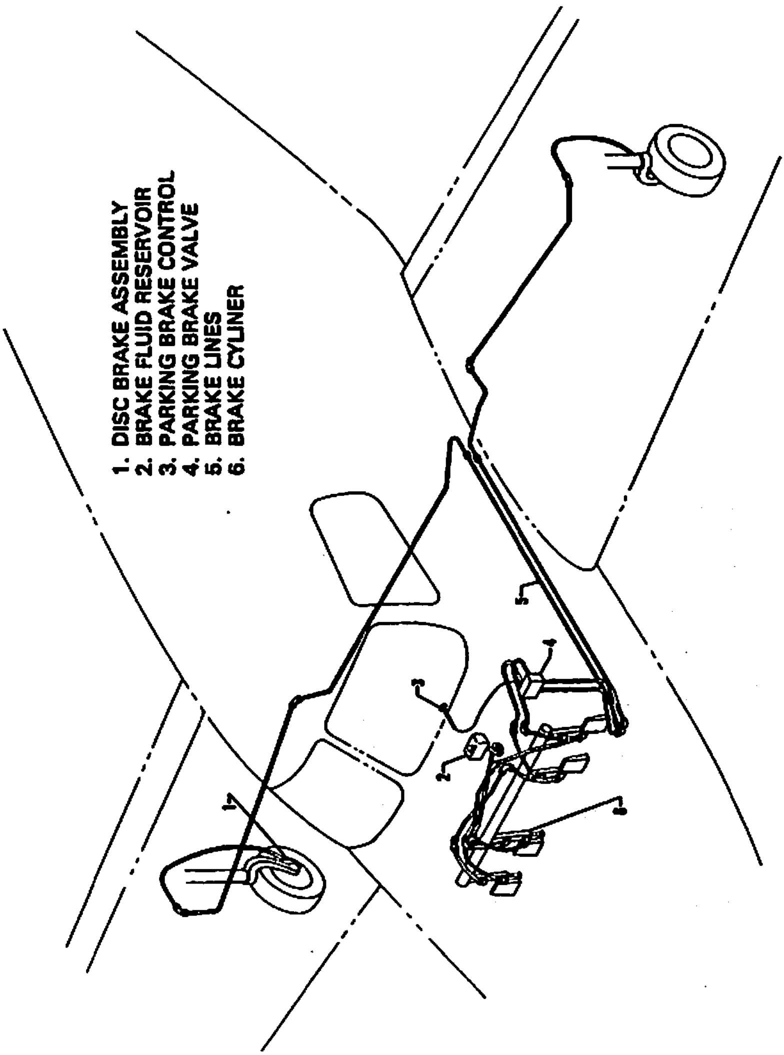
(c) Installation of Induction Air Filter

Replace filter, inlet and screws. Reinstall induction air panel assembly.

8.13 BRAKE SERVICE

The brake system is filled with MIL-H-5606 (petroleum base) hydraulic fluid. The fluid level should be checked periodically or at every 100 hour inspection and replenished when necessary. The brake fluid reservoir is

8.13 BRAKE SERVICE (continued)



BRAKE SYSTEM
Figure 8-1

8.13 BRAKE SERVICE (continued)

located behind the aft access panel in the forward baggage compartment. If the entire system must be refilled, fill with fluid under pressure from the brake end of the system. This will eliminate air from the system.

No adjustment of the brake clearances is necessary. If, after extended service, brake blocks become excessively worn they should be replaced with new segments.

8.15 HYDRAULIC SYSTEM SERVICE

The hydraulic system reservoir is an integral part of the electric hydraulic pump assembly. It is located aft of the aft cabin baggage compartment and is accessible through the baggage compartment aft closeout panel. Fill the reservoir with MIL-H-5606 hydraulic fluid. The fluid level should be checked periodically or every 100 hour inspection and replenished when necessary. With the landing gear down and the system up to pressure, fill to the FULL line on the sight gauge.

8.17 LANDING GEAR SERVICE

The main landing gear uses Cleveland Aircraft Products 6.00 x 6 wheels with 6.00 x 6, eight-ply rating tires and tubes. The nose wheel uses a McCauley or a Cleveland Aircraft Products 5.00 x 5 wheel with a 5.00 x 5 six-ply rating, type III tire and tube. (Refer to paragraph 8.25.)

Wheels are removed by taking off the hub cap, cotter pin, axle nut, and the two bolts holding the brake segment in place. Mark tire and wheel for reinstallation; then dismount by deflating the tire, removing the three through-bolts from the wheel and separating the wheel halves.

Landing gear oleos should be serviced according to the instructions on the units. The main oleos should be extended under normal static load until 3.44 +/- 0.25 inches of oleo piston tube is exposed, and the nose gear should show 1.65 +/- 0.25 inches. To add air to the oleo struts, attach a strut pump to the valve assembly near the top of the oleo strut housing and pump the oleo to the desired position. To add oil, jack the aircraft, release the air pressure in the strut, remove the valve core and add oil through this opening with the strut extended. After the strut is full, compress it slowly and fully to allow excess air and oil to escape. With the strut still compressed reinsert the valve core and pump up the strut as above.

8.17 LANDING GEAR SERVICE (continued)

In jacking the aircraft for landing gear or other service, two hydraulic jacks and a tail stand should be used. At least 400 pounds of ballast should be placed on the base of the tail stand before the airplane is jacked up. The hydraulic jacks should be placed under the jack points on the bottom of the wing and the airplane jacked up until the tail skid is at the right height to attach the tail stand. After the tail stand is attached and the ballast added, jacking may be continued until the airplane is at the height desired.

The steering rods from the rudder pedals to the transverse bellcrank in the nose wheel tunnel are factory adjusted and should be readjusted only in accordance with the applicable rigging specification. Nose wheel alignment is accomplished by adjusting the rod end(s) on the steering bungee assembly in such a way that the nose wheel is in line with the fore and aft axis of the plane when the rudder pedals are centered. Alignment of the nose wheel can be checked by pushing the airplane back and forth with the rudder two degrees to the right to determine that the plane follows a straight line. The turning arc of the nose wheel is 30° +/- 1° in either direction and is limited by stops at the trunnion forging or the forward steering contact arm mounted on the engine mount.

NOTE

The rudder is set to 2° right with the rudder pedals neutralized and the nose wheel centered.

8.19 PROPELLER SERVICE

The spinner and backing plate should be cleaned and inspected for cracks frequently. Before each flight the propeller should be inspected for nicks, scratches, and corrosion. Significant damage must be repaired by a qualified mechanic prior to flight. Nicks or scratches cause an area of increased stress which can lead to serious cracks or the loss of a propeller tip. The back face of the blades should be painted when necessary with flat black paint to retard glare. To prevent corrosion, the surface should be cleaned and waxed periodically.

8.21 OIL REQUIREMENTS

The oil capacity of the Textron Lycoming TIO-540-AE2A engine is 12 quarts with an inflight minimum quantity of approximately 2.75 quarts. Maximum endurance flights should begin with 12 quarts of oil. For all shorter flights, it is recommended that oil be added if the quantity falls to 10 quarts. It is recommended that engine oil be drained and renewed every 50 hours, or sooner under unfavorable conditions. Full flow cartridge type oil filters should be replaced each 50 hours of operation. The following grades are required for temperatures:

Average Ambient Temperature	MIL-L-6082B SAE Grade	MIL-L-22851 Ashless Dispersant SAE Grades
All Temperatures	—	15W-50 or 20W-50
Above 80°F	60	60
Above 60°F	50	40 or 50
30°F to 90°F	40	40
0°F to 70°F	30	30, 40 or 20W-40
Below 10°F	20	30 or 20W-30

When operating temperatures overlap indicated ranges, use the lighter grade oil.

NOTE

Refer to the latest issued of Lycoming Service Instruction 1014 (Lubricating Oil Recommendations) for further information.

8.23 FUEL SYSTEM

(a) Servicing Fuel System

At every 50 hour inspection or 90 day interval, whichever occurs first, the fuel filter in the strainer must be cleaned. The fuel strainer is located below the floor on the lower right side of the forward baggage compartment.

(b) Fuel Requirements (AVGAS ONLY)

The minimum aviation grade fuel is 100. Since the use of lower grades can cause serious engine damage in a short period of time, the engine warranty is invalidated by the use of lower octanes.

Whenever 100 or 100LL grade fuel is not available, commercial grade 100/130 should be used. (See Fuel Grade Comparison Chart.) Refer to the latest issue of Lycoming Service Instruction No. 1070 (Avco Lycoming Specified Fuels).

A summary of the current grades as well as the previous fuel designations is shown in the following chart:

FUEL GRADE COMPARISON CHART

Previous Commercial Fuel Grades (ASTM-D910)			Current Commercial Fuel Grades (ASTM-D910-75)			Current Military Fuel Grades (MIL-G-5572E) Amendment No. 3		
Grade	Color	Max. TEL ml/U.S. gal.	Grade	Color	Max. TEL ml/U.S. gal.	Grade	Color	Max. TEL ml/U.S. gal.
80/87	red	0.5	80	red	0.5	80/87	red	0.5
91/98	blue	2.0	*100LL	blue	2.0	none	none	none
100/130	green	3.0	100	green	**3.0	100/130	green	**3.0
115/145	purple	4.6	none	none	none	115/145	purple	4.6

* -Grade 100LL fuel in some overseas countries is currently colored green and designated as "100L."
**-Commercial fuel grade 100 and grade 100/130 (both of which are colored green) having TEL content of up to 4 ml/U.S. gallon are approved for use in all engines certificated for use with grade 100/130 fuel.

8.23 FUEL SYSTEM (continued)

The operation of the aircraft is approved with an anti-icing additive in the fuel. When an anti-icing additive is used it must meet the specification MIL-I-27686, must be uniformly blended with the fuel while refueling, must not exceed .15% by volume of the refueled quantity, and to ensure its effectiveness should be blended at not less than .10% by volume. One and one half liquid ounces per ten gallons of fuel would fall within this range. A blender supplied by the additive manufacturer should be used. Except for the information contained in this section, the manufacturer's mixing or blending instructions should be carefully followed.

CAUTIONS

Assure that the additive is directed into the flowing fuel stream. The additive flow should start after and stop before the fuel flow. Do not permit the concentrated additive to come in contact with the aircraft painted surfaces or the interior surfaces of the fuel tanks.

Some fuels have anti-icing additives pre-blended in the fuel at the refinery, so no further blending should be performed.

Fuel additive can not be used as a substitute for preflight draining of the fuel system drains.

(c) Filling Fuel Tanks

WARNINGS

Do not operate any avionics or electrical equipment on the airplane during refueling. Do not allow open flame or smoking in the vicinity of the airplane while refueling.

During all refueling operations, fire fighting equipment must be available. Two ground wires from different points on the airplane to separate approved grounding stakes shall be used.

8.23 FUEL SYSTEM (continued)

Observe all safety precautions required when handling gasoline. Fill the fuel tanks through the filler located on the forward slope of the wing. Each wing holds a maximum of 60 U.S. gallons. When using less than the standard 120 gallon capacity, fuel should be distributed equally between each side.

NOTE

Aircraft should be refueled in a wing level condition. At times this will require alternate filling of left and right tanks until the full condition is reached.

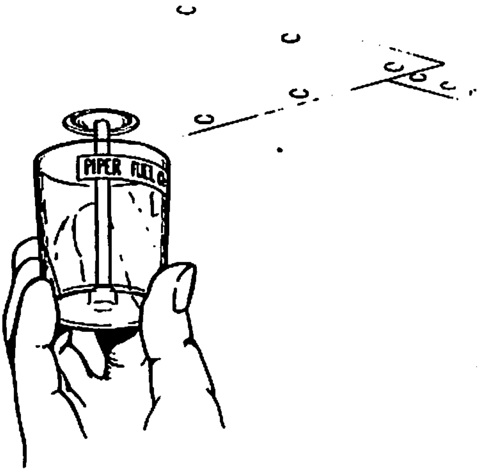
(d) Draining Fuel Strainer, Sumps and Lines

The fuel tank sumps and filter should be drained before the first flight of the day and after refueling. Set fuel selector on left or right tank before draining. The fuel collector/sump tanks, located at the root of each wing, are the lowest points in the system. Each tank drain is accessible through a hole in the bottom wing skin adjacent to the wheel well. The fuel filter drain is located on the right hand side of the fuselage several feet forward of the wing. Sumps and filter should be drained until sufficient fuel has flowed to ensure the removal of any contaminants. When draining sumps, use the end on sampler cup to push in valve, catching fuel in the cup. (Refer to Figure 8-3) To drain filter, hold sampler cup under nylon tube and push in tube. Always inspect fuel for contaminants, water and fuel grade (color). Assure that valves have sealed after draining.

NOTE

Sump drains will lock open if valve is pushed in and turned. Continue turning to release lock.

8.23 FUEL SYSTEM (continued)



FUEL TANK DRAIN
Figure 8-3

(e) Emptying Fuel System

Drain the bulk of fuel at sump tanks. Set fuel selector on left or right tank. Push in sump drain valves and twist ¼ turn to lock open. Remaining fuel may be drained through the filter drain. Close sump drain valves before refueling.

CAUTION

Whenever the fuel system is completely drained and fuel is replenished it will be necessary to run the engine for a minimum of three minutes at 1000 rpm on each tank to insure that no air exists in the fuel supply lines.

8.25 TIRE INFLATION

For maximum service, keep tires inflated to the proper pressure: 50 psi for the nose tire and 55 psi for the main tires. All wheels and tires are balanced before original installation, and the relationship of tire, tube, and wheel should be maintained upon reinstallation. Unbalanced wheels can cause extreme vibration in the landing gear; therefore, in the installation of new components, it may be necessary to rebalance the wheels with the tires mounted. When checking tire pressure, examine the tires for wear, cuts, bruises, and slippage.

8.27 BATTERY SERVICE

Access to the 24-volt battery is gained by opening the forward baggage door and removing the left floor of the forward baggage compartment. The battery should be checked for proper fluid level. DO NOT fill the battery above the baffle plates. DO NOT fill the battery with acid - use water only. A hydrometer check will determine the percent of charge in the battery.

Inspect overflow sump for presence of battery fluid. Fluid in the sump is not a normal condition and indicates either a battery or charging system problem. If fluid is present, the electrical system must be serviced to eliminate cause and the neutralizer media in the sump jar replaced.

If the battery is not up to charge, recharge starting at a 3 amp rate and finishing with a 1.5 amp rate. Quick charges are not recommended.

8.29 EMERGENCY OXYGEN SYSTEM (OPTIONAL)

The optional emergency oxygen system must be serviced if used. The canister generators must be replaced with new units to restore the emergency system to a useable condition.

8.31 PRESSURIZATION SYSTEM

The system should be given an operational check before each flight. Should the operational check show any malfunction of the pressurization system, refer to the Malibu Service Manual.

8.33 LUBRICATION

For lubricating instructions, a chart showing lubrication points and types of lubricants to be used, and lubrication methods, refer to the Malibu Service Manual.

8.35 CLEANING

(a) Cleaning Engine Compartment

(1) Place a large pan under the engine to catch waste.
(2) With the engine cowling removed, spray or brush the engine with solvent or a mixture of solvent and degreaser. In order to remove especially heavy dirt and grease deposits, it may be necessary to brush areas that were sprayed.

CAUTION

Do not spray solvent into the alternator, vacuum pump, starter, or air intakes.

(3) Allow the solvent to remain on the engine from five to ten minutes. Then rinse the engine clean with additional solvent and allow it to dry.

CAUTION

Do not operate the engine until excess solvent has evaporated or otherwise been removed.

(4) Lubricate the controls, bearing surfaces, etc., in accordance with the Lubrication Chart in the applicable Service Manual.

8.35 CLEANING (continued)

(b) Cleaning Landing Gear

Before cleaning the landing gear, place a plastic cover or similar material over the wheel and brake assembly.

(1) Place a pan under the gear to catch waste.
(2) Spray or brush the gear area with solvent or a mixture of solvent and degreaser, as desired. Where heavy grease and dirt deposits have collected, it may be necessary to brush areas that were sprayed, in order to clean them.
(3) Allow the solvent to remain on the gear from five to ten minutes. Then rinse the gear with additional solvent and allow to dry.
(4) Remove the cover from the wheel and remove the catch pan.
(5) Lubricate the gear in accordance with the Lubrication Chart.

CAUTION

Do not brush the micro switches.

(c) Cleaning Exterior Surfaces

The airplane should be washed with a mild soap and water. Harsh abrasives or alkaline soaps or detergents could make scratches on painted or plastic surfaces or could cause corrosion of metal. Cover areas where cleaning solutions could cause damage. To wash the airplane, use the following procedure:

(1) Flush away loose dirt with water.
(2) Apply cleaning solution with a soft cloth, a sponge or a soft bristle brush.
(3) To remove exhaust stains, allow the solution to remain on the surface longer.
(4) To remove stubborn oil and grease, use a cloth dampened with naphtha.
(5) Rinse all surfaces thoroughly.
(6) Any good automative wax may be used to preserve painted surfaces. Soft cleaning cloths or a chamois should be used to prevent scratches when cleaning or polishing. A heavier coating of wax on the leading surfaces will reduce the abrasion problems in these areas.

8.35 CLEANING (continued)

(d) Cleaning Windshield and Windows

CAUTION

Use only mild soap and water when cleaning the heated windshield. Use of ANY other cleaning agent or material may cause distortion or damage to windshield coatings.

(1) Remove dirt, mud and other loose particles from exterior surfaces with clean water.
(2) Wash with mild soap and warm water or with aircraft plastic cleaner. Use a soft cloth or sponge in a straight back and forth motion. Do not rub harshly.
(3) Remove oil and grease with a cloth moistened with kerosene.

CAUTION

Do not use gasoline, alcohol, benzene, carbon tetrachloride, thinner, acetone, or window cleaning sprays.

(4) After cleaning plastic surfaces, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion.
(5) A minor scratch or mar in plastic can be removed by rubbing out the scratch with jeweler's rouge. Smooth both sides and apply wax. Deep scratches may lead to failure when pressurized.
(6) If a deep scratch or crack is found in any of the windshields or windows, do not pressurize cabin until serviced at authorized repair station.

(e) Cleaning Headliner, Side Panels and Seats

(1) For normal soiling and smudges, simply use the dry cleaning pad provided. This pad contains an exclusive grit-free powder with unusual power to absorb dirt.

Squeeze and twist the pad so the powder sifts through the meshes and adheres to the cloth. Then rub the soiled part in any direction, as hard as necessary to clean.

Even though the pad eventually becomes soiled, this soil will not transfer back to the headliner.

8.35 CLEANING (continued)

(2) For simple stains (e.g. coffee, cola) clean headliner with a sponge and a common household suds detergent (e.g. Tide). Dirty grease stains should be first spot cleaned with a lighter fluid containing Naphtha to remove the solvent soluble matter. Any stain residue should then be shampooed with a household upholstery cleaner (e.g. Carbona upholstery and rug shampoo).

With proper care, your Malibu headliner will provide years of excellent appearance and durability.

CAUTION

Solvent cleaners require adequate ventilation.

(3) Leather should be cleaned with saddle soap or a mild hand soap and water.

(f) Cleaning Carpets

To clean carpets, first remove loose dirt with a whisk broom or vacuum. For soiled spots and stubborn stains use a noninflammable dry cleaning fluid. Floor carpets may be cleaned like any household carpet.

(g) Cleaning Oxygen Equipment

(1) Clean the mask assemblies with a suitable oil-free disinfectant.
(2) Wipe dirt and foreign particles from the unit with a clean, dry, lint-free cloth.

(h) Cleaning Surface Deicing Equipment*

The deicers should be cleaned when the aircraft is washed using a mild soap and water solution.

In cold weather, wash the boots with the airplane inside a warm hangar if possible. If the cleaning is to be done outdoors, heat the soap and water solution before taking it out to the

*Optional equipment

8.35 CLEANING (continued)

airplane. If difficulty is encountered with the water freezing on boots, direct a blast of warm air along the region being cleaned using a portable ground heater.

Petroleum products are injurious to rubber and their use as cleaning agents should be avoided. Limited use of Mineral Spirits or non-leaded (NOT LOW LEAD) gasoline is not harmful in cleaning the deicers, if the cloth is dampened (not dripping) with solvent, and a dry cloth is used to wipe the deicer before the solvent has time to soak into the rubber.

With the deicer boots properly cleaned, a coating of Agemaster No. 1 should be applied as described in the Malibu Service Manual. This treatment helps protect the boot rubber from ozone attack, aging and weathering.

After the Agemaster coating is dry, a coating of B.F. Goodrich Icex may be applied to the boots if icing conditions are anticipated. For specific instructions refer to the Malibu Service Manual.

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SUPPLEMENTS

SECTION 9

SUPPLEMENTS

9.1 GENERAL

This section provides information in the form of supplements which are necessary for efficient operation of the airplane when it is equipped with one or more of the various optional systems and equipment not approved with the standard airplane.

All of the supplements provided in this section are FAA Approved and consecutively numbered as a permanent part of this handbook. The information contained in each supplement applies only when the related equipment is installed in the airplane.

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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 1 FOR KING KNS-80 AREA NAVIGATION SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King KNS-80 Area Navigation System is installed per Piper Drawing No. 89964-2. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL August 26, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King KNS-80 Area Navigation System is installed in accordance with FAA Approved Piper data.

SECTION 2 - LIMITATIONS

(a) The Area Navigation or VOR PAR mode can only be used with co-located facilities (VOR and DME signals originating from the same geographical location).

SECTION 3 - EMERGENCY PROCEDURES

No change.

SECTION 4 - NORMAL PROCEDURES

GROUND TEST PROCEDURES

The following test can be used to determine if the system is operating properly.

(a) Tune the KNS 80 to a VORTAC (VOR/DME) within 25 NM of the airplane.

(b) Place the KNS 80 in VOR mode and rotate the OBS until the course deviation needle centers with the TO/FROM flag giving a FROM indication.

(c) Using the appropriate controls, select a value for the waypoint radial equal to the OBS value determined in Step (b). In addition, select a value for the waypoint distance equal to the indicated DME value in Step (b).

(d) Place the KNS 80 in RNAV ENR mode. The system is operating properly if the distance to station is +/- 1.0 NM and the course deviation needle is within a dot of being centered.

ENROUTE NAVIGATION

(a) Load Waypoint 1 Data

(1) Put waypoint 1 in the DSP window by depressing the DSP button. (If there is a 2 in the DSP window initially, push the DSP button three times to go through the 2-3-4-1 sequence to reach 1.)

The previously selected frequency (stored in memory) for waypoint 1 will be displayed and "1" will be flashing unless USE and DSP are the same.

(2) Select a waypoint 1 frequency using the data input controls which are the two concentric knobs on the right. The smaller of the 2 knobs controls the .1 MHz and .05 MHz digits. The outer knob changes the 1 MHz and 10MHz displays. The selected frequency will appear in the display and be placed in memory.

(3) Select a waypoint 1 radial by first depressing the DATA button. This will cause the radial for the previous waypoint 1 to appear in the data display over the annunciation RAD. Select the radial with the data input controls. The outer knob controls the 10° and 100° digits; the center knob IN position controls the 1° and the center knob OUT position controls the 0.1° digit. The selected radial will appear in the display and be placed in memory.

(4) Select a waypoint 1 distance by again depressing the DATA button, causing display of the previous waypoint 1 distance in the data display over the annunciation DST. Select the distance with the data input controls. The outer knob controls the 10 NM digit, the center knob IN position controls the 1 NM digit, and the center knob OUT position controls the 0.1 NM digit. The selected distance will appear in the display and be placed in memory.

NOTE

Throughout this sequence, the number 1 over DSP annunciation will blink. It will stop blinking and remain steady only when the waypoint number in DSP is the same as the waypoint number in USE. This is a safety feature.

(b) Load Remaining Waypoint Data

(1) Put waypoint 2 in the DSP window by depressing DSP button. The data display will automatically display the frequency of the last selected number 2 waypoint and FRQ will be annunciated. All other displays will remain as before. Waypoint 2 may now be loaded the same as waypoint 1 was previously.

(2) The remaining waypoints may be loaded in a similar manner.

(c) Takeoff and Fly to Waypoint 1

Before takeoff, check to be sure that RNV/ENR is still the active mode, then depress the DSP button to place waypoint 1 in the DSP position. The selected waypoint 1 frequency will automatically appear in the data display.

Depress the DATA button to check the radial, and again to check distance in the data display.

Now depress the USE button to place waypoint 1 in the USE position. The number 1 in the DSP position will stop blinking, indicating that the displayed data and "in use" data are the same.

After takeoff, and line of sight altitude is reached, the DME will lock on. The dashes that were present in the distance display of the KNS 80 will disappear and display distance to waypoint 1. CDI or HSI will also be flagged until both VOR and DME are valid.

Ground speed and time-to-station information will not be accurate unless flying directly to or from the VORTAC or waypoint.

CAUTION

When installed, an RMI will continue to display the bearing to the VOR station; it will not display bearing to the RNAV waypoint.

Soon after being on course direct to waypoint 1, ground speed and TTS will become accurate.

At this point you may also want to check the ident of the VOR by pulling the ON/OFF/ Volume switch to place it in the OUT position. When satisfied, return the switch to the IN position to mute the ident tones.

(d) Change Over to Waypoint 2

Depress the DSP button and the number 2 will appear (blinking) over the DSP annunciation and the waypoint 2 frequency will appear in the data display. The DME display will not change because waypoint 1 data is still "in use". At this point, if desired, waypoint 2 radial and distance data may be rechecked by depressing the DSP button for each.

When satisfied, depress the USE button to put waypoint 2 data "in use". The number 2 will appear in the USE annunciated space; the number 2 in the DSP space will stop blinking. Waypoint 2 frequency will automatically appear.

Following VOR/DME receiver acquisition of the new VORTAC frequency, distance display will begin reading distance (NM), ground speed (KT) and TTS (MIN) to waypoint 2. The CDI TO/FROM flag will move to the TO position and continue flying course directly to waypoint 2.

(e) Flying Direct to a VOR/DME Facility

(1) Depress the VOR button and RNV/ENR will disappear from the mode annunciator and VOR will appear. The distance display will change to show distance to the VORTAC instead of to the waypoint. Ground speed (KTS) and time-to-station (MIN) displays will also change accordingly.

Center the needle to the CDI and you will be on a course direct to the VORTAC. However, the CDI will display conventional (angular) crosstrack deviation of +/- 10° full scale.

(2) Push the VOR button again and VOR/PAR mode will appear with linear crosstrack deviation displayed on the CDI as +/- 5 NM full scale (as in RNV/ENR). This permits flying accurately direct to the station or on a parallel course up to 5 NM either side of the direct course.

CAUTION

Whenever flying directy to or from a VORTAC facility, always select either the VOR or VOR/PAR mode.

(f) Tune an ILS Frequency Without Losing DME

To retain DME, depress the HOLD button. Now select the ILS frequency using the data input controls and checking it in the data display. HLD will now annunciate. The distance will continue to read to the VORTAC and VOR/PAR function will remain annunciated along with the active ILS function.

Now reselect the same VOR and the ILS annunciation will cancel and it will revert back to VOR/PAR mode. HLD will cancel since VOR and DME frequency are again the same. The DME HOLD button will remain depressed (it is a two position button). Thus the HOLD button functions as a Hold ARM when in the IN position and actual Hold (HLD) annunciation occurs only when VOR/ILS and DME frequencies are different.

If the HOLD function is mistakenly used in the RNAV modes, as soon as the frequency is changed, the HLD function will annunciate, DME displays (NM, KT, and MIN) will flag (display dashes) and the CDI or HSI will flag since this is not a valid RNAV signal. Use of HOLD in VOR PAR mode will result in a CDI or HSI flag and the DME displays will be to the VORTAC on HOLD.

(g) RNAV Approach

The RNV APR mode may be used for runway location (by placing a waypoint at the approach end of the runway) during an approach to an airport.

If in the RNV ENR mode, depress the RNAV pushbutton and RNV APR mode is immediately activated. In RNV APR the deviation needle on the CDI will display crosstrack deviation as +/- 1¼ NM full scale, or ¼ NM (1519 ft.) per dot. All other aspects of the RNV APR mode are identical with the RNV ENR mode.

Prior to beginning the approach, it is recommended that the waypoints and corresponding waypoint numbers be assigned as follows to reduce pilot workload during the final approach segment:

Waypoint Number	
1	Use repetitively for initial and intermediate fixes. See note below.
2	Final Approach Fix (FAF) Coordinates.
3	Missed Approach Point (MAP) Coordinates.
4	Missed Approach Fix (MAF) Coordinates.

NOTE

If flying an autopilot coupled approach, the pilot should revert to HEADING mode at the waypoint to make the required course corrections while revising the KNS 80 waypoint number 1. Do not adjust the controls for setting waypoint when in RNAV mode or the VOR frequency when USE and DSP are showing the same number and the autopilot is coupled to the KNS 80 system.

FINAL APPROACH PLANNING

If the length of the final approach segment for a given angle of intercept is less than the figures given below, a satisfactory approach will not be obtainable. The figures are in accordance with FAA Advisory Circular 90-45A, Appendix D, guidelines for establishment of IFR approaches.

MINIMUM LENGTH OF FINAL APPROACH SEGMENT IN NAUTICAL MILES

Approach Category	Category Approach Speed Requirements	Magnitude of Turn Over Final Approach Waypoint (Intercept Angle)					
		10°	20°	30°	40°	50°	60°
A	Less than 91 knots	1.0	1.5	2.0	3.0	4.0	5.0
B	91 to 120 knots	1.5	2.0	2.5	3.5	4.5	5.5
C	121 to 140 knots	2.0	2.5	3.0	4.0	5.0	6.0

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the basic Pilot's Operating Handbook.

SECTION 7 - DESCRIPTION AND OPERATION

The KNS 80 is a panel mounted navigation system consisting of a VOR/Localizer Receiver, DME Interrogator, RNAV Computer, and Glide Slope Receiver in a single unit. When combined with an appropriate CDI Indicator, the unit becomes a complete navigation system featuring two modes of VOR, two modes of RNAV, and ILS. The unit also simultaneously displays distance to station (waypoint), velocity to station (waypoint), time to station (waypoint), and chosen parameter (frequency, radial or distance) of one of the four waypoints. Separate system flexibility is maintained with a DME HOLD button which allows "freezing" the DME frequency while tuning to a different ILS or VOR frequency. The various modes, (VOR, VOR PAR, RNV ENR, and RNV APR), are selected by pressing the appropriate VOR or RNAV pushbutton. If an ILS frequency is placed in the active data, the system will automatically go to the ILS mode. When switched out of an ILS frequency the system will revert back to the mode in which it was at the time the ILS frequency was selected.

When energized, the system will go to the mode in which it was when switched off. In addition, it will retain all waypoint data through a power shutdown.

Additional features include an automatic dimming circuit to compensate for changes in ambient light level, and a CMOS memory powered by two silver-oxide watch cells enabling long term waypoint storage (2 years typical cell life). If the batteries should become weak, waypoint storage will be lost and the radio will tune to 110.00 MHz, waypoint 1 in USE and DSP, VOR mode, and dashes in the DME display. The unit may then be operated normally during the flight, but no memory will be retained after turning the radio master switch OFF.

The KNS 80 Digital Area Navigation System consists of the following controls and displays:

DISPLAYS

(a) NM Display
  (1) VOR and VOR PAR (VOR Parallel) Modes
  Displays DME distance.
  0 to 99.9 NM in 0.1 NM steps, 100 to 200 NM in 1 NM steps.
  Most significant digit is zero blanked.
  Displays dashes whenever DME goes into search.

(2) RNV APR and RNV ENR Modes
Displays RNAV distance to waypoint.
0 to 99.9 NM in 0.1 NM steps, 100 to 400 NM in 1 NM steps.
Displays dashes if DME is in search, if VOR flags, if DME and VOR are tuned to different frequencies.

(b) KT Display
(1) VOR and VOR PAR Modes
Displays ground speed to the DME ground station.
0 to 999 knots in 1 knot steps.
Update rate is once per second.
Most significant digit is zero blanked.
Displays dashes whenever DME goes into search.
(2) RNV APR and RNV ENR Modes
Displays ground speed to the active waypoint.
0 to 999 knots in 1 knot steps.
Update rate is once per second.
Most significant digit is zero blanked.
Displays dashes whenever DME goes into search.

(c) ILS Display
Indicates that the frequency in use is an ILS frequency.

(d) MIN Display
(1) VOR and VOR PAR Modes
Displays time to DME ground station.
0 to 99 minutes in 1 minute steps.
Most significant digit is zero blanked.
Displays dashes whenever DME goes into search or when calculated value exceeds 99 minutes.
(2) RNV APR and RNV ENR Modes
Displays time to the active waypoint.
0 to 99 minutes in 1 minute steps.
Most significant digit is zero blanked.
Displays dashes if DME is in search, if VOR flags, if DME and VOR are tuned to different frequencies, or if calculated value exceeds 99 minutes.

(e) FRQ, RAD, DST Display
(1) FRQ Mode
Displays frequency from 108.00 to 117. 95 MHz.
1 MHz digit overflows into (or underflows from) 10 MHz digit.
Rolls over from 118 to 108 or vice versa.
Least significant digit displays only zero or five.
(2) RAD Mode
Displays ground station radial on which the waypoint is located from 0.0 to 359.9 degrees.
The two most significant digits are zero blanked.
10 degree digit overflows into (or underflows from) 100 degree digit.
(3) DST Mode
Displays the distance offset of the waypoint from the ground station over range of 0.0 to 199.9 NM.
The two most significant digits are zero blanked.
10 NM digit overflows into (or underflows from) 100 NM digit.
The two most significant digits roll over from 190 to 0 NM and vice versa.

(f) USE Display
Displays waypoint number of data actually being used by system.
In VOR Modes only the frequency has meaning.
Range 1 to 4.
When changed always takes on new value equal to DSP value.

(g) DSP Display
Displays waypoint number of data being displayed.
Range 1 to 4.
When changed increments by 1.
Rolls over at 4 and blinks when not equal to USE value.

(h) PAR, VOR, ENR, APR, RNV Displays
System status lights.

(i) HLD Display
Indicates when the frequency to which the DME is actually tuned is different from the frequency to which the VOR is tuned.

(j) Course Deviation
Located on remote indicator. When flagged, the needle centers.
(1) VOR Mode
Full scale sensitivity equals +/- 10°.

(2) VOR PAR Mode
Full scale sensitivity equals +/- 5 NM.
Flagged if VOR or DME data is invalid, or if the VOR and DME are tuned to different channels.

(3) RNV ENR Mode
Full scale sensitivity equals +/- 5 NM.
Flagged if VOR or DME data is invalid, or if the VOR and DME are tuned to different channels.

(4) RNV APR Mode
Full scale sensitivity equals +/- 1.25 NM.
Flagged if the VOR or DME data is invalid, or if the VOR and and DME are tuned to different channels.

(5) ILS Mode
Full scale sensitivity equals 3 to 6 degrees (depending upon ground facility).
Flagged if localizer data is invalid.

CONTROLS

(a) VOR Button
Momentary pushbutton.
When pushed while system is in either RNV mode causes system to go to VOR mode.
When pushed while system is in either VOR mode causes system to toggle between VOR and VOR PAR modes.

(b) RNAV Button
Momentary pushbutton.
When pushed while system is in either VOR mode causes system to go to RNV ENR mode.
When pushed while system is in either RNV mode causes system to toggle between RNV ENR and RNV APR modes.

(c) HOLD Button
Two position pushbutton.
When in depressed position inhibits DME from channeling to new frequency.

(d) USE Button
Momentary pushbutton.
Causes active waypoint to take on same value as displayed waypoint and data display to go to FRQ mode.

(e) DSP Button
Momentary pushbutton.
Causes displayed waypoint to increment by 1 and data display to go to FRQ mode.

(f) DATA Button
Momentary pushbutton.
Causes waypoint data display to change from FRQ to RAD to DST and back to FRQ.

(g) OFF/ON/Ident Control
(1) Power OFF-ON/Volume Function
Rotate clockwise for power ON.
(2) VOR Audio Level Control
Rotate clockwise for increased audio level.
(3) VOR IDENT Mute Function
Push-Pull switch.
Enables the VOR Ident tone to be heard in OUT position.

(h) Data Input Control
Dual concentric knobs. Center knob has IN and OUT positions.
(1) Frequency Data
Outer knob varies 1 MHz digit.
A carry occurs from units to tens position.
Rollover occurs from 117 to 108.
Center knob varies frequency in 50 KHz steps.
(2) Radial Data
Outer knob varies 10 degrees digit.
A carry occurs from the tens to hundreds position.
Rollover to zero occurs at 200 NM.
Center knob IN position varies 1 NM digit.
Center knob OUT position varies 0.1 NM digit.
(3) Distance Data
Outer knob varies 10 NM digits.
A carry occurs from the tens to hundreds place.
A rollover to zero occurs at 200 NM.
Center knob IN position varies 1 NM digit.
Center knob OUT position varies 0.1 NM digit.

(i) Course Select Knob
Located in remote unit.
Selects desired course through the VOR ground station or waypoint.

For additional information consult the King KNS-80 Pilot's Guide.

PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 2
FOR
KING KNS-81 AREA NAVIGATION SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King KNS-81 Area Navigation System is installed per Piper Drawing No. 89953-2. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL August 26, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King KNS-81 Area Navigation System is installed in accordance with FAA Approved Piper data.

SECTION 2 - LIMITATIONS

(a) The Area Navigation may be used as the primary navigation system under IFR conditions on approved approach procedures, approved airways, or random area navigation routes only when approved by Air Traffic Control.
(b) The Area Navigation (RNAV) modes and the VOR PAR mode may only be used with co-located facilities (VOR and DME signals originate from the same geographical location).

SECTION 3 - EMERGENCY PROCEDURES

No change.

SECTION 4 - NORMAL PROCEDURES

AREA NAVIGATION FUNCTIONAL TEST

The following procedure applies only to airports equipped with, or in range of, a co-located VOR/DME station.

(a) Place the KNS 81 in VOR mode.
(b) Find and record the angle from the VOR station by centering the course deviation needle and the TO/FROM flag giving a FROM indication.
(c) Program a waypoint radial angle equal to the OBS value determined in Step (b).
(d) Program a waypoint distance equal to the indicated DME value.
(e) Place the KNS 81 in RNV.
The KNS 81 is operating properly if the distance to waypoint is 0 +/- 1.0 NM and the course deviation needle is within a dot of being centered.

PROGRAMMING

Pertinent information (waypoint number, station frequency, waypoint radial, and waypoint distance) for up to nine waypoints is entered into the memory. Programming may be completed prior to takeoff or during the flight. Any combination of navigational facilities (RNAV waypoint, VOR/DME, ILS) may be loaded into the computer; however, it is desirable that each facility be numbered and loaded into the computer in the sequence it will be used.

(a) RNAV WAYPOINTS
- (1) Turn the system on by rotating the ON/OFF switch clockwise.
- (2) Put waypoint 1 in the WPT window by turning the WPT knob. Turn the knob in either direction to get "1".
- (3) Select the waypoint 1 frequency using the data input controls.
- (4) Select the waypoint 1 radial by depressing the DATA button. This will move the >< (caret) from FRQ to RAD. Select the new radial with the data input controls.
- (5) Select the waypoint 1 distance by again depressing the DATA button. This will move the >< from RAD to DST. Select the new distance with the data input controls.
- (6) This completes the programming for the first waypoint. Follow these procedures for all selected waypoints up to a maximum of nine.

(b) CONVENTIONAL VOR
- (1) The programming technique for conventional navigation directly toward or away from a VOR facility without a colocated DME is similar to that for RNAV waypoints. Inputting the waypoint number and frequency into the memory is accomplished in the same manner. The RAD and DST displays will display dashes during VOR and VOR PAR operation.

(c) ILS APPROACH (Front course and Back course)
- (1) Programming an ILS approach is accomplished in the same manner as programming conventional VOR.

(d) MISSED APPROACH
- (1) If the published missed approach utilizes an RNAV waypoint or VOR facility, it may be entered into the memory any time prior to the approach. This is accomplished in the same manner set forth in CONVENTIONAL VOR and RNAV WAYPOINTS in this section.

(e) INFLIGHT

(1) Preset waypoints may be recalled from memory and put into active use as required.
Turn the WPT knob as required to select the desired waypoint. The preset waypoint number, frequency, radial and distance will appear in their respective displays. The WPT display will blink to indicate that the waypoint displayed is other than the active waypoint.

(2) Verify that the data is correct.

NOTE

Revisions to the waypoint data can be programmed at this time by entering the new waypoint parameters.

(3) When return to the active waypoint is desired press the RTN button. The active waypoint, along with its data, will be displayed.

(4) When navigation to the displayed (blinking WPT) waypoint is desired, press the USE button. The WPT display will cease blinking and the displayed waypoint becomes the active waypoint.

RNAV OPERATION

If the system is receiving valid signals from a co-located VOR-DME facility, it will supply linear deviation information to the Horizontal Situation Indicator (or Course Deviation Indicator). Enroute (RNV) sensitivity, available by turning the MODE selector knob until RNV is displayed, provides a constant course width of +/- 5 NM full scale.

Approach (RNV APR) sensitivity, available by turning the MODE selector knob until RNV APR is displayed, provides a constant course width of +/- 1¼ NM full scale. Approach sensitivity should be selected just prior to final approach course interception. Time and distance to the station, and computed ground speed are displayed on the DME display.

CONVENTIONAL VOR OPERATION

VOR or VOR-PAR modes are selected by turning the MODE selector knob until VOR or VOR PAR is displayed. In VOR mode the remote DME is automatically tuned when the KNS 81 is selected as the tuning source. Upon Lock-on, distance, ground speed and time to the VORTAC station will be displayed on the DME display. The HSI (CDI) will display conventional angular crosstrack deviation from the selected course (+/- 10° full scale). In VOR-PAR mode, operation is identical to VOR except the HSI (CDI) will display crosstrack deviation of +/- 5 NM full scale from the selected course. Course width will be constant irrespective of distance from the VORTAC.

Anytime the RAD button is engaged, the radial from the station will be displayed on the DME knots display along with an "F" on the DME time to station display.

NOTE

The RAD switch is not the momentary type, therefore, the switch must be pressed again for the normal DME information to be displayed.

CAUTION

Whenever flying directly to or from a VORTAC facility, always select either the VOR or VOR PAR mode.

ILS OPERATION

Whenever an ILS Frequency is put "IN USE" the mode display will remain the same (either VOR, VOR PAR, RNAV, RNAV APR displayed) but the RAD and DST displays will be blanked. Absence of the LOC/GS functions is annunciated by the NAV and GS flags in the HSI (CDI). Only angular deviation is provided in the ILS mode.

RNAV APPROACH

The RNAV Approach (RNV APR) mode may be used for runway location (by placing a waypoint at the approach end of the runway) during an approach to an airport. Turn the MODE selector knob to select RNV APR. In RNV APR the deviation needle on the HSI (CDI) will display crosstrack deviation of +/- 1¼ NM full scale or ¼ NM (1519 ft) per dot. All other aspects of the RNV APR mode are identical to the RNV mode.

NOTE

Prior to beginning an approach (ILS, RNAV, VOR, etc.), it is recommended that the missed approach navigation fixes be programmed into the KNS 81. This will reduce pilot workload during the final approach segment and subsequent missed approach should this become necessary.

FINAL APPROACH PLANNING

If the length of the final approach segment for a given angle of intercept is less than the figures given below, a satisfactory approach will not be obtainable. The figures are in accordance with FAA Advisory Circular 90-45A, Appendix D Guidelines for Establishment of IFR Approaches.

MINIMUM LENGTH OF FINAL APPROACH SEGMENT
IN NAUTICAL MILES

Approach Category	Category Approach Speed Requirements	Magnitude of Turn Over Final Approach Waypoint (Intercept Angle)					
		10°	20°	30°	40°	50°	60°
A	Less than 91 knots	1.0	1.5	2.0	3.0	4.0	5.0
B	91 to 120 knots	1.5	2.0	2.5	3.5	4.5	5.5
C	121 to 140 knots	2.0	2.5	3.0	4.0	5.0	6.0

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the basic Pilot's Operating Handbook.

SECTION 7 - DESCRIPTION AND OPERATION

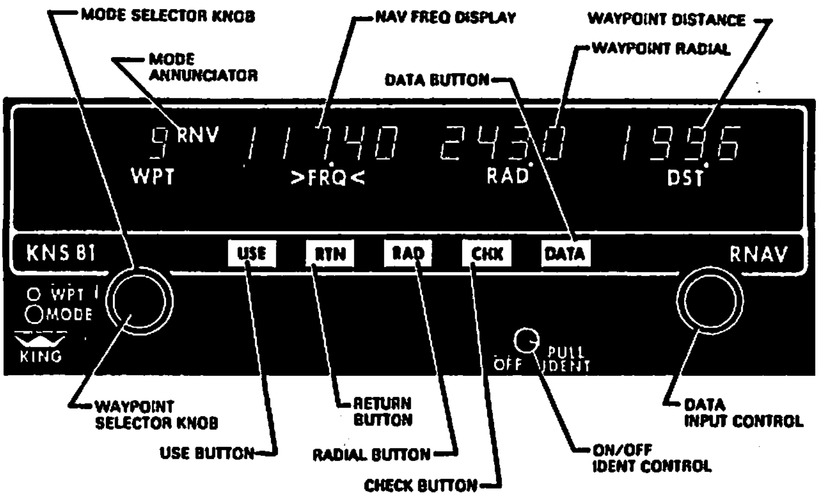
The King KNS 81 is a navigation system combining a 200 channel VOR/Localizer receiver, a 40 channel glide slope receiver and a digital RNAV computer with a capability of preselection and storage of 9 VOR/LOC frequencies and 9 sets of RNAV waypoint parameters. A DME System must be used in conjunction with the KNS 81.

The KNS 81 can be operated in any one of three basic modes: VOR, RNAV, or ILS. To change from one mode to another, the rotary MODE selector knob on the left side of panel is used. The ILS Mode is entered automatically whenever an ILS frequency is channeled as the ACTIVE frequency. The display will annunciate the mode by lighting a message beside the WPT display, except in the ILS mode. In this case, the RAD and DST displays are blanked to denote the ILS mode. In addition to the standard VOR and RNAV enroute (RNV) modes, the KNS 81 has a constant course width, or parallel, VOR mode (VOR PAR) and an RNAV approach mode (RNV APR). The same rotary MODE selector knob is used to place the unit in either of these secondary modes.

All waypoint information, station frequency, waypoint distance, and waypoint radial are entered with the increment/decrement rotary switch on the right side of the panel and displayed in their respective displays. The small knob affects the least significant digits while the large knob changes the most significant digits. The tenth's position of waypoint radial and distance can be changed by pulling the small knob to the OUT position. The type of data being selected is indicated by the illuminated carets (><) located by either FRQ, RAD, or DST. Frequency, radial or distance information for a waypoint can be selected sequentially by pressing the DATA push button. The increment/decrement switch changes only the information being displayed with the carets.

The KNS 81 can store frequency, radial, and distance information for up to nine waypoints. The waypoint number of the data being displayed is located above the message WPT. The waypoint number is changed by rotating the WPT selector knob (small center knob) on the left side of the panel. If the waypoint in use is different than the displayed waypoint (WPT blinking), pressing the USE button will cause the displayed WPT to become the waypoint in use. Additional features include an automatic dimming circuit to compensate for changes in ambient light level and a non-volatile memory. When energized, the system will go to the mode in which it was when switched off. In addition, it will retain all waypoint data through a power shutdown. A non-volatile memory enables indefinite waypoint storage with no batteries required.

The KNS 81 Digital Area Navigation System consists of the following displays and controls:



KNS 81 DIGITAL AREA NAVIGATION SYSTEM
Figure 7-1

DISPLAY

(a) FRQ, RAD, DST Display
  (1) FRQ Display
  Displays frequency from 108.00 to 117.95 MHz in increments of .05 MHz.
  Least significant digit displays only zero or five.
  Rolls over from 117 to 108 or vice versa.
  1 MHz digit overflows into (or underflows from) 10 MHz digit.
  (2) RAD Display
  Displays ground station radial on which the waypoint is located from 0.0 to 359.9 degrees.
  The two most significant digits are zero blanked.
  Displays radial from VOR station when CHK button is depressed.
  10 degree digit overflows into (or underflows from) 100 degree digit.
  Display is dashed in VOR modes and blanked if an ILS frequency is selected.

(3) DST Display
Displays the offset distance of the waypoint from the ground station over a range of 0.0 to 199.9 NM.
The two most significant digits are zero blanked.
The two most significant digits roll over from 190 to 0 NM and vice versa.
Displays distance from the VORTAC (blanked if VOR) station when CHK button is depressed.
Display is dashed in VOR modes and blanked if an ILS frequency is selected.

(b) VOR, PAR, RNAV, RNV APR Displays
System mode lights.

(c) WPT Display
Displays waypoint number (1 to 9) of data being displayed.
WPT display blinks when waypoint number displayed is not the same as that being used.

(d) Carets (><) Display
Indicates which waypoint data (FRQ, RAD, or DST) the increment/decrement rotary switch will change.
Display is cycled by depressing the DATA button.

(e) DME Display (Remote)
Displays NM to/from the waypoint/station, KT ground speed and MIN time to the waypoint/station.
Displays bearing from the waypoint/station instead of ground speed when the KNS 81 RAD button is depressed.
Displays F (for FROM) instead of MIN when the KNS 81 RAD button is depressed.

(f) RMI Display (Optional)
Displays the bearing to the waypoint/station.

(g) Course Deviation Display
Located on remote indicator. When flagged, the needle centers.
(1) VOR Mode
Full scale sensitivity equals +/- 10°.
(2) VOR PAR and RNV Modes
Full scale sensitivity equals +/- 5 NM.
Flagged if VOR or DME data is invalid or if VOR and DME are tuned to different frequencies.

(3) RNV APR Mode
Full scale sensitivity equals +/- 1.25 NM.
Flagged if VOR or DME data is invalid or if VOR and DME or tuned to different frequencies.

(4) ILS Mode
Full scale sensitivity equals +/- 3 to 6 degrees (depending upon ground facility).
Flagged if Localizer data is invalid.
Glide Slope only flagged if GS data is invalid.

CONTROLS

(a) WPT/Mode Control
Dual concentric knobs.

(1) The outer knob selects the MODE of unit operation. Turning the knob clockwise causes the mode to sequence through VOR, VOR PAR, RNV, RNV APR and then back to the VOR mode.

(2) The center knob selects the WPT to be displayed. Turning the knob causes the displayed waypoint to increment by one through the waypoint sequence of 1,2,.....8,9,1.

(b) USE Button
Momentary pushbutton which, when pressed, causes the active waypoint to take on the same value as the displayed waypoint.

(c) RTN Button
Momentary pushbutton which, when pressed, causes the active waypoint to return to the display.

(d) RAD Button
The KNS 81 is normally operated with the RAD button not depressed. Push on; push off button which, when pushed on, causes the radial from the waypoint/station to be displayed instead of ground speed and F to be displayed instead of time on the remote DME display.

(e) CHK Button
Momentary pushbutton which, when pressed, causes the raw radio data from the NAV Receiver and DME to be displayed. The radial from the VOR Ground Station will be displayed on the RAD display and the distance from the station will be displayed on the DST display. There is no effect on any other data output.

(f) DATA Button
Momentary pushbutton which, when pressed, causes the caret (><) display to change from FRQ to RAD to DST and back to FRQ.

(g) OFF/PULL ID Control
Rotary switch/potentiometer which, when turned clockwise, applies power to the KNS 81 and increases NAV audio level. The switch may be pulled out to hear VOR ident.

(h) DATA INPUT Control
Dual concentric knobs with the center knob having an IN and OUT position.

(1) Frequency Data
The outer knob varies the 1 MHz and 10 MHz digits and the center knob varies the frequency in .05 MHz increments with carry to/from the .1 MHz digit regardless of whether the switch is in its IN or OUT position.

(2) Distance Data
The outer knob varies the 10 NM digit with a carryover occurring from the tens to hundreds place. The center knob in the IN position varies the 1 NM digit and in the OUT position varies to 0.1 NM digit.

For additional information consult the King KNS-81 Pilot's Guide.

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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 3 FOR MINNEAPOLIS HONEYWELL WEATHERSCOUT WEATHER RADAR SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Minneapolis Honeywell WeatherScout Weather Radar System is installed per Piper Drawing 84398-8. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler

D. H. TROMPLER
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL August 26, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Minneapolis Honeywell WeatherScout Weather Radar System is installed.

SECTION 2 - LIMITATIONS

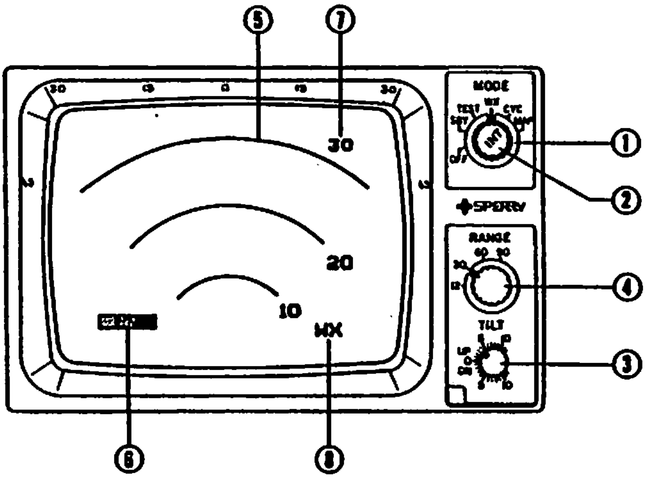
Do not operate the radar during refueling operations or in the vicinity of trucks or containers accommoding flammables or explosives. Do not allow personnel within 15 feet of area being scanned by antenna when system is transmitting.

SECTION 3 - EMERGENCY PROCEDURES

No change.

SECTION 4 - NORMAL PROCEDURES

(a) SYSTEM CONTROLS



INDICATOR CONTROLS AND DISPLAY FEATURES
Figure 4-1

(1)	MODE Selector	
	a. OFF	All power is off.
	b. SBY	Standby mode is used for system warmup. The antenna is not radiating energy in SBY.
	c. TEST	Weather colors are displayed for preflight test.
	d. WX	Normal weather detection mode.
	e. CYC	Cyclic contour mode activated alternate flashing of red, intense storm cells, with a black background color for added warming emphasis.
	f. MAP	Activates groundmapping for identification of prominent terrain features.
(2)	INT	Rotary control used to regulate brightness (INTensity) of display.

(3)	TILT	Rotary control used to adjust antenna elevation position. Control indexes increments of tilt from 0 to 12 degrees up or down.
(4)	RANGE 12/30/60/90	Rotary switch used to select one of four ranges.
(5)	Range Field	Maximum selected range is displayed. Maximum range is always displayed when indicator is in on-condition.
(6)	Test Field	Test block displays three illumination levels.
(7)	Range Mark Identifier	Individual label displayed for each range mark.
(8)	Mode Field	Operating mode is displayed as WX or CYC. When system is first turned on, WAIT is displayed until system times out (30-40 seconds).

(b) PRELIMINARY CONTROL SETTINGS
Place the Indicator controls in the following positions before applying power from the aircraft electrical system:

MODE selector.. OFF
INTensity control..................... Fully counterclockwise
TILT control................................. Fully upward
RANGE switch.......................... 12 nautical miles

(c) OPERATIONAL CONTROL SETTINGS
(1) Rotate MODE selector clockwise to SBY to bring system into ON condition.
(2) Note that WAIT is displayed during warm-up period of 30-40 seconds.
(3) Rotate MODE selector to desired operating mode.
(4) Set RANGE switch to desired range.
(5) Adjust TILT control for desired forward scan area.

(d) PRECAUTIONS

(1) If the radar is to be operated while the aircraft is on the ground, direct nose of aircraft such that antenna scan sector is free of large metallic objects (hangars, other aircraft) for a distance of 100 yards (90 meters), and tilt antenna fully upward.

WARNING

Do not operate the radar during refueling operations or in the vicinity of trucks or containers accommodating flammables or explosives; do not allow personnel within 15 feet of area being scanned by antenna when system is transmitting.

(2) Flash bulbs can be exploded by radar energy.

(3) Since storm patterns are never stationary, the display is constantly changing. Continued observation is always advisable in stormy areas.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the basic Pilot's Operating Handbook.

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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 4 FOR EMERGENCY OXYGEN SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Emergency Oxygen System is installed per Piper Drawing No. 83985-2. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

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SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Emergency Oxygen System is installed in accordance with FAA Approved Piper Data.

SECTION 2 - LIMITATIONS

The following placard is installed on the right cabin side panel, immediately forward of the copilot's air vent, and the right aft facing seat, aft ofthe air vent.

EMERGENCY OXYGEN

IN DRAWER UNDER SEAT PULL MASK
OUT OF DRAWER FULLY AT FULL
EXTENSION GIVE CORD A TUG
MAXIMUM DURATION — 15 MINS
SEE POH
NO SMOKING WHILE IN USE

SECTION 3 - EMERGENCY PROCEDURES

In the event that the emergency oxygen system is needed, proceed as follows:

Mask compartment(s) .... OPEN
Masks.............................. REMOVE and extend lanyard to full length; tug to activate generator. Unfold and don mask(s).
Flow Indicator(s) .... green area in bottom of accumulator INFLATES, indicating oxygen flow.
Cabin Altitude .... REDUCE to a safe altitude consistent with terrain before the 15 minute oxygen supply is fully depleted.

NOTE

Descent should be started as soon as possible in order to assure that flow rate remains adequate throughout the descent. Refer to SECTION 3 of the basic POH and FAA Approved AFM for emergency descent procedures. This system, once activated, cannot be turned off.

WARNING

No smoking while oxygen is in use. Remove oil and grease (including lipstick, chapstick, makeup, etc.) before using oxygen.

SECTION 4 - NORMAL PROCEDURES

Prior to each flight, turn on the master switch and check that the amber OXYGEN annunciator light is not illuminated. If the annunciator is illuminated, one or more of the oxygen generators should be replaced. In addition, check the oxygen masks and hoses for accessibility and condition.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the Airplane Flight Manual.

SECTION 7 - DESCRIPTION AND OPERATION OF THE EMERGENCY OXYGEN SYSTEM

The optional emergency oxygen system consists of three "two-man" chemical oxygen generators, which provide sufficient oxygen flow for six people, during a descent from 25,000 feet to 12,000 feet or below, for a 15 minute time period. Once an oxygen generator is activated, it will continue to produce oxygen until depleted; no shut-off provisions are provided. Each generator has two oxygen masks connected, either of which is capable of activating the generator. The masks are accessible from each crew/passenger seat.

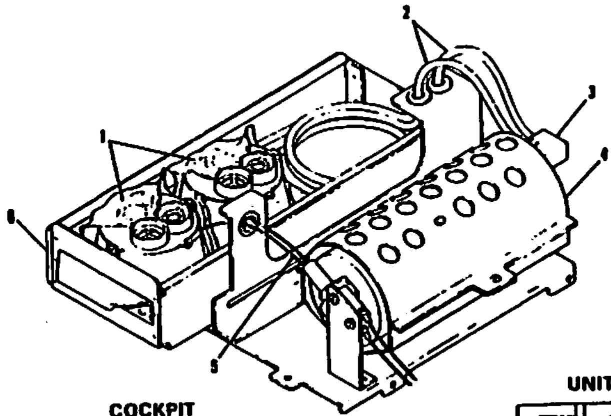
The system consists of two major assemblies, the crew assembly and the passenger assembly.

The crew assembly is located under the copilot's seat and contains one two-man oxygen generator and two masks mounted on a sliding tray. The tray is accessible from the aisle between the pilot's and copilot's seats and is pulled out from under the seat to expose the two masks. Each mask is connected to the generator with a clear plastic tube and lanyard. The tube delivers oxygen to the mask when the lanyard is pulled out, releasing the firing mechanism, which activates a chemical reaction within the oxygen generator. Each generator has two over-pressure relief valves to prevent excessive pressure in the generator, in the event of a malfunction or delivery tube restriction. When activated, the generator delivers oxygen to both attached masks simulataneously.

The passenger assembly is located in the drawer in the right aft facing passenger seat base. The drawer is accessible from the aft side of the base, under the seat bottom and is pulled aft to expose the four masks. The two inboard masks are attached to one generator, while the two outboard masks are attached to the second generator. Either of the four masks will reach any of the four passenger seat locations. Activation of the generators is the same as the crew installation; pulling out the lanyard attached to the mask. Operation of the passenger provisions are identical to that of the crew.

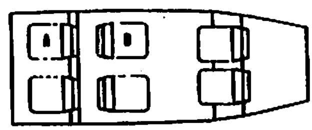
Placards are provided on the side panel outboard of the copilot's seat and the right aft facing seat, stating the location and operation of the oxygen system, and that smoking is prohibited while oxygen is in use.

An amber OXYGEN annunciator is provided to inform the crew whenever either of the three oxygen generators has been activated. The annunciator light is operated by a micro switch adjacent to each generator firing mechanism. The light will continue to be illuminated until the generator is replaced with a full one with an untripped firing mechanism.

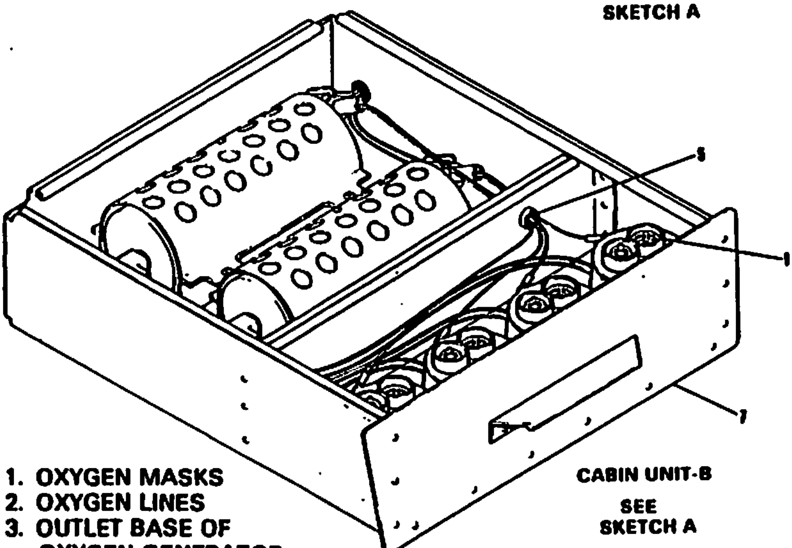


COCKPIT
UNIT-A
SEE SKETCH A

UNIT LOCATION



SKETCH A



1. OXYGEN MASKS
2. OXYGEN LINES
3. OUTLET BASE OF OXYGEN GENERATOR
4. PROTECTIVE COVER
5. LANYARDS
6. COCKPIT UNIT
7. CABIN UNIT

CABIN UNIT-B
SEE
SKETCH A

OXYGEN SYSTEM INSTALLATION
Figure 7-1.

PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 5
FOR
PROPELLER HEAT, HEATED WINDSHIELD AND WING ICE DETECTION LIGHT

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when any or all of the following equipment is installed per the appropriate Piper Drawing: Prop Heat - Dwg. No. 89664, Heated Windshield - Dwg. No. 82288 and Wing Ice Detection Light - Dwg. No. 83978.

The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

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SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional propeller heat, heated windshield, and wing ice detection light are installed in accordance with FAA Approved Piper data.

SECTION 2 - LIMITATIONS

(a) This aircraft is not approved for flight in icing conditions.
(b) Under no circumstances should the heated windshield be turned on for a period exceeding 20 seconds unless the aircraft is in flight.

SECTION 3 - EMERGENCY PROCEDURES

No change.

SECTION 4 - NORMAL PROCEDURES

The equipment should be functionally checked for proper operation prior to flight.

A check of the heated propeller can be performed by turning the PROP HEAT switch ON and feeling the deice pads. The pads should become warm to the touch.

CAUTION

To avoid possible windshield distortion during ground operations, or during testing, do not position the WSHLD HEAT switch to HIGH for more than 20 seconds.

An operational check of the heated windshield may be done only if the ambient temperature of the windshield is *less* than 115° F (46° C), and the engine is running. To accomplish the check, turn one alternator OFF. Then, while observing the operating alternator's ammeter, position the WSHLD HEAT switch, first to LOW, and then to HIGH. A load increase of approximately 13 amps when set to LOW, with an approximate 10 amp *additional* increase when set to HIGH, indicates normal operation.

When in visible moisture at temperatures at or below +5° C and icing conditions are anticipated, set the windshield heat switch to LOW. If low windshield heat is inadequate or if icing is encountered at temperatures at or below -15° C, set the windshield heat switch to HIGH.

NOTE

Depending on ambient temperatures, when switching from HIGH to LOW windshield heat, a WINDSHIELD HEAT FAIL annunciation may occur until the windshield surface temperature cools to the low heat temperature range.

Windshield heat may be used to help clear the windshield during descent from high altitude.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the Airplane Flight Manual.

SECTION 7 - DESCRIPTION AND OPERATION OF PROPELLER HEAT, HEATED WINDSHIELD, AND WING ICE DETECTION LIGHT

The presence of one or more items of deicing equipment does not imply the capability to fly into forecast or known icing. The equipment is provided to enlarge the options available to the pilot as he takes appropriate action to avoid icing that is inadvertently encountered.

Controls for the components are located to the right of the control quadrant on the auxiliary switch panel (Figure 7-1).

WING ICE DETECTION LIGHT

Wing icing conditions may be detected during night flight by use of an ice detection light installed on the left side of the forward fuselage. The light is controlled by an ICE LIGHT switch (Figure 7-1) located on the deice switch panel. Circuit protection is provided by an ICE circuit breaker located in the EXTERIOR LIGHTS section of the pilot's circuit breaker panel.

PROPELLER HEAT

Electrothermal propeller heat pads are bonded to a portion of the leading edges of the propeller blades. The system is controlled by an ON-OFF type PROP HEAT switch (Figure 7-1) located on the auxiliary switch panel. Power for the propeller heat is supplied by the aircraft electrical system through a PROP HEAT circuit breaker on the circuit breaker panel. When the PROP HEAT switch is actuated, power is applied to a timer through the PROP HEAT ammeter which monitors the current through the propeller heat system.

Power from the timer is cycled to brush assemblies which distribute power to slip rings. The current is then supplied from the slip rings directly to the electrothermal propeller heat pads.

The Hartzell propeller is heated in a cycle which applies power to the heat pads for approximately 90 seconds and then shuts off for approximately 90 seconds. Once begun, cycling will proceed in the above sequence and will continue until the system is turned off. The PROP HEAT ammeter should indicate within the green shaded area during the portion of the cycle when power is being applied. This indicates proper operation of the system.

The propeller designation is: HC-I2YR-1BF/F8074K

ELECTRIC HEATED WINDSHIELD

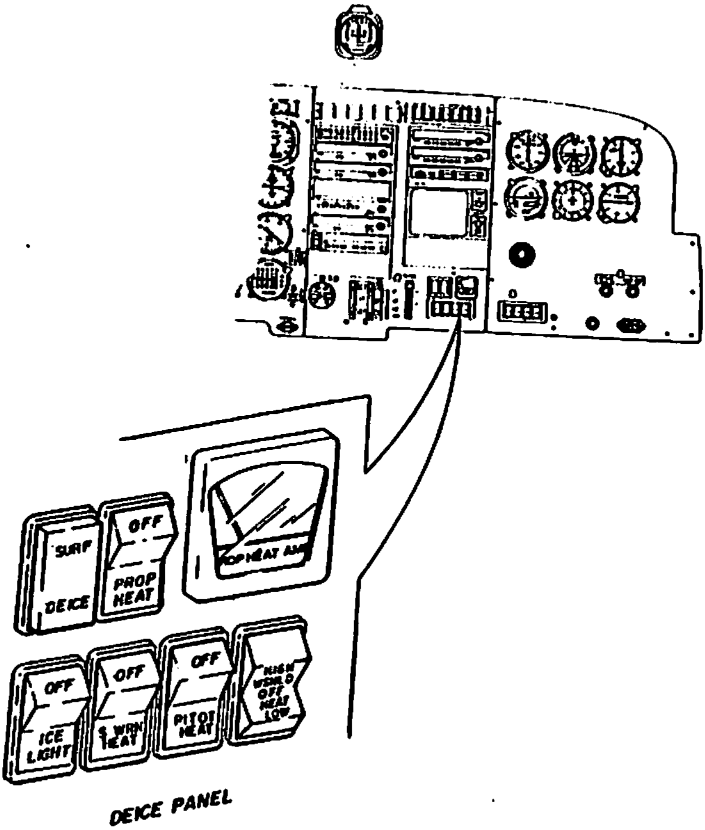
WARNING

Flight into known or forecast icing is not approved. If icing is encountered, take avoidance action immediately.

The electrically heated left windshield is controlled by a HIGH-OFF-LOW rocker type switch located on the deice switch panel. Circuit protection is provided by the windshield CONTROL and POWER breakers in the ICE PROTECTION section of the pilot's circuit breaker panel.

CAUTION

To avoid posible windshield distortion during ground operations, or during testing, do not position the WSHLD HEAT switch to HIGH for more than 20 seconds.



DEICE SWITCH PANEL
Figure 7-1

A pre-takeoff operational check of the heated windshield may be done only if the ambient temperature of the windshield is *less* than 115° F (46° C), and the engine is running. To accomplish the check, turn one alternator OFF. Then, while observing the operating alternator's ammeter, position the WSHLD HEAT switch, first to LOW, and then to HIGH. A load increase of approximately 13 amps when set to LOW, with an approximate 10 amp *additional* increase when set to HIGH, indicates normal operation.

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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 6 FOR ICE PROTECTION SYSTEM (APPROVED FOR FLIGHT INTO KNOWN ICING CONDITIONS)

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when Ice Protection System, per Piper Drawing No. 89695-2, is installed. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL August 26, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Ice Protection System is installed in accordance with FAA Approved Piper data.

SECTION 2 - LIMITATIONS

(a) The ice protection system was designed and tested for operation in the meteorological conditions of FAR 25, Appendix C, for continuous maximum and intermittent maximum icing conditions. The ice protection system was not designed or tested for flight in freezing rain and/or mixed conditions or for icing conditions more severe than those of FAR 25, Appendix C. Therefore, flight in those conditions may exceed the capabilities of the ice protection system.

(b) Equipment required for flight into known or forecast icing:
  (1) Pneumatic wing and empennage boots and SURF DEICE annunciation.
  (2) Wing ice detection light.
  (3) Electrothermal propeller deice pads on the propeller blades.
  (4) Electrically heated windshield and WSHLD HEAT annunciation.
  (5) Heated lift detector.
  (6) Heated pitot head.
  (7) Dual alternators.
  (8) Dual vacuum pumps.
  (9) Alternate static source.
  (10) All equipment required for night IFR flight.

(c) If all the equipment listed is not installed and operative, the following placard must be installed in full view of the pilot.

WARNING

THIS AIRCRAFT IS NOT APPROVED FOR FLIGHT IN ICING CONDITIONS.

SECTION 3 - EMERGENCY PROCEDURES

WARNING

The malfunction of any required deice equipment requires immediate action to exit icing conditions. Depending on the severity of the icing encounter, failure to take immediate positive action can lead to performance losses severe enough to make level flight impossible. Therefore, upon verification of a system malfunction or failure, climb or descend out of icing conditions if this provides the shortest route. If exit must be made in level flight, consider the use of maximum power and exit by the most direct route. The effect of the additional fuel burned at higher power settings on aircraft range must be considered and an alternate airport chosen if necessary.

ALTERNATOR FAILURE IN ICING CONDITIONS (ALTERNATOR #1 INOP or ALTERNATOR #2 INOP annunciator light illuminated)

NOTE

Anytime total tie bus voltage is below 25 Vdc, the LOW BUS VOLTAGE annunciator will illuminate.

Verify failure .... CHECK AMMETER
Electrical load (if Low Bus Voltage annunciator illuminated) .... Reduce until load is less than 70 amps & LOW BUS VOLTAGE annunciator extinguished.
Failed ALTR switch .... OFF
Failed ALTR circuit breaker .... CHECK and RESET as required
Failed ALTR switch (after OFF at least one second)... ON

If power not restored:
Failed ALTR switch.. OFF
Ammeter .... Monitor and maintain below 70 amps

While one alternator will supply sufficient current for minimum required avionics and cockpit lighting, use of deicing equipment, particularly windshield or propeller heat, may be limited. Immediate action should be taken to avoid or exit icing conditions. Under no circumstances may the total electrical load exceed 70 amps. The electric cabin heater, cabin recirculation blowers, and position, strobe, and landing lights should not be used unless absolutely necessary.

SINGLE VACUUM PUMP FAILURE IN ICING CONDITIONS
(Reduced suction pressure and left or right flow button extended)

VACUUM LOW Annunciator .... EXTINGUISHED

Although either vacuum pump has sufficient capacity to operate the deice boots and flight instruments in a normal manner, immediate action should be taken to exit icing conditions.

PROPELLER HEAT SYSTEM MALFUNCTION

Excessive vibration may be an indication that the propeller heat is not functioning properly.
Propeller control .... exercise
Propeller heat ammeter .... check for proper indications:
(a) ON (needle in green arc) for approx. 90 seconds)
(b) OFF for approx. 90 seconds
A reading below the green arc during the ON cycle is an indication that the propeller blades may not be deicing properly.
PROP HEAT switch .... OFF if failure is indicated

WARNING

> It is imperative that the PROP HEAT switch be turned OFF if vibration persists. This can be a symptom of uneven blade deicing which can lead to propeller unbalance and engine failure.

Immediate action should be taken to exit icing conditions.

SURFACE DEICE MALFUNCTION

If SURFACE DE-ICE annunciator light remains illuminated more than 30 seconds, pull the surface deice circuit breaker. Immediate action should be taken to exit icing conditions.

WINDSHIELD ANTI-ICE HEAT MALFUNCTION

If WINDSHIELD HEAT FAIL annunciator illuminates, immediately select WSHLD HEAT switch to OFF. Take immediate action to exit icing conditions.

SECTION 4 - NORMAL PROCEDURES

The Piper Malibu is approved for flight into known icing conditions when equipped with the complete Piper Ice Protection System. Operating in icing conditions of Continuous Maximum and Intermittent Maximum as defined in FAR 25, Appendix C has been substantiated; however, there is no correlation between these conditions and forecasts of reported "Light, Moderate and Severe" conditions. Flight into severe icing is not approved.

Icing conditions can exist in any clouds when the temperature is below freezing; therefore it is necessary to closely monitor outside air temperature when flying in clouds or precipitation. Clouds which are dark and have sharply defined edges usually have high water content and should be avoided whenever possible. Freezing rain must always be avoided.

Pneumatic boots must be cleaned regularly for proper operation in icing. The exterior surfaces of the aircraft should be checked prior to flight. Do not attempt flight with frost, ice or snow adhering to the exterior surfaces of the aircraft or landing gear.

Prior to dispatch into forecast icing conditions all ice protection equipment should be functionally checked for proper operation.

PREFLIGHT

CAUTION

To avoid possible windshield distortion during ground operations, or during testing, do not position the WSHLD HEAT switch to HIGH for more than 20 seconds.

(a) A check of the heated propeller should be performed by turning the PROP HEAT switch ON and feeling the deice pads. The pads should become warm to the touch.

(b) A check of the heated pitot head and lift detector should be performed by turning the S. WRN HEAT and PITOT HEAT switches ON and touching the units.

CAUTION

Care should be taken when an operational check of the heated pitot head and heated lift detector is being performed. The units become very hot.

(c) The surface boots should be checked prior to flight for damage and cleanliness. If necessary, damage should be repaired and boots cleaned prior to flight. An operational check of the boot system should be performed during engine run-up at 2000 RPM as follows:
   (1) Actuate the momentary SURF DE-ICE switch - the boots will inflate through three phases: empennage, lower wing and upper wing with a duration of approximately six seconds per phase. The surface boot system then remains off until the switch is activated again. A green SURFACE DE-ICE annunciator light will remain on for approximately eighteen seconds.
   (2) Visually check to insure that the boots have fully deflated to indicate proper operation of the vacuum portion of the pneumatic boot pump system.

(d) An operational check of the heated windshield may be done only if the ambient temperature of the windshield if *less* than 115° F (46° C), and the engine is running. To accomplish the check, turn one alternator OFF. Then, while observing the operating alternator's ammeter, position the WSHLD HEAT switch, first to LOW, and then to HIGH. A load increase of approximately 13 amps when set to LOW, with an approximate 10 amp *additional* increase when set to HIGH, indicates normal operation.

(e) Check the operation of both alternators by observing that both ammeters indicate an output.

(f) During engine run-up, check that both vacuum pumps are operating by observing that both the left and right red flow buttons on the gyro suction gauge are retracted.

INFLIGHT

Icing conditions of any kind should be avoided whenever possible, since any minor malfunction which may occur is potentially more serious in icing conditions. Continuous attention of the pilot is required to monitor the rate of ice build-up in order to effect the boot cycle at the optimum time. Boots should be cycled when ice has built to between ¼ and ½ inch thickness on the leading edge to assure proper ice removal. Repeated boot cycles at less than ¼ inch can cause a cavity to form under the ice and prevent removal; boot cycles at thicknesses greater than ½ inch may also fail to remove ice.

Before entering probable icing conditions use the following procedures:

(a) INDUCTION AIR .... ALTERNATE
(b) PITOT HEAT switch .... ON
(c) S. WRN HEAT switch .... ON
(d) WSHLD HEAT switch .... LOW (on HIGH in actual ice)
(e) PROP HEAT switch .... ON
(f) DEFROST knob .... OUT
(g) VENT/DEFOG BLWR switch .... ON, if additional defrost is desired
(h) SURF DEICE switch .... activate after ¼ to ½ inch accumulation
(i) Relieve propeller unbalance (if required) by exercising propeller control briefly. Repeat as required.

NOTE

For accurate magnetic compass readings, turn the WSHLD HEAT, PROP HEAT and PITOT HEAT switches OFF momentarily.

WARNING

Do not cycle surface boots with less than ¼ inch of ice accumulation. Operation of boots with less than ¼ inch of ice accumulation can result in failure to remove ice. Do not hold the momentary SURF DEICE switch on.

WARNING

Elevator movement should be periodically checked prior to the first surface boot inflation in order to prevent an ice cap from forming between the elevator and stabilizer.

Both airplane ammeters should be monitored whenever the deice equipment is in use. An excessive indication shows an excessive electrical load, which may cause a battery discharging condition that could eventually lead to battery depletion. Nonessential electrical equipment should be turned off to correct or prevent this condition.

NOTE

Anytime total tie bus voltage is below 25 Vdc, the LOW BUS VOLTAGE annunciator will illuminate.

When ice has accumulated on the unprotected surfaces of the airplane, aerodynamic buffet commences 5 to 10 knots before the stall. A substantial margin of airspeed should be maintained above the normal stall speed, since the stall speed will increase in prolonged icing encounters. For the same reason stall warning devices are not accurate and should not be relied upon.

If ice is remaining on the unprotected surfaces of the airplane at the termination of the flight, the landing should be made using full flaps and carrying a slight amount of power whenever practical. Approach speeds should be increased by 10 to 15 knots. Allow for increased landing distance due to the higher approach speeds.

CAUTION

If cruise airspeed drops below 130 knots in icing conditions increase power to maintain 130 knots. If maximum continuous power is required to maintain 130 knots immediate action should be taken to exit icing conditions.

NOTE

An icing encounter can render the aircraft radar unreliable due to beam reflection off of the ice layer on the radome. Also there may be a degradation of communication and navigation equipment due to ice accumulation on antennas.

SECTION 5 - PERFORMANCE

Climb speed should be increased to 130 knots when icing conditions are encountered during climb.

Cruise speeds are reduced approximately 5 knots when the surface boots are installed.

CAUTION

Ice accumulation on the unprotected surfaces can result in significant performance loss. During cruise, loss of airspeed can be as much as 30 knots or more.

NOTE

When icing conditions are encountered, loss of cruise airspeed and increased fuel flow resulting from higher than normal power settings to maintain altitude will reduce the aircraft range significantly. The use of an alternate airport should be considered if fuel quantity appears marginal.

CAUTION

If cruise airspeed drops below 130 knots in icing conditions increase power to maintain 130 knots. If maximum continuous power is required to maintain 130 knots immediate action should be taken to exit icing conditions.

NOTE

For additional general information on inflight icing refer to FAA Advisory Circular 91-51, Airplane Deice and Anti-ice Systems.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the Airplane Flight Manual.

SECTION 7 - DESCRIPTION AND OPERATION OF THE ICE PROTECTION SYSTEM AND EQUIPMENT

For flight into known icing conditions (FIKI), a complete ice protection system is required on the Malibu.

The complete ice protection system consists of the following components: Pneumatic wing and empennage boots, wing ice detection light, electrothermal propeller deice pads, electrically heated windshield, heated lift detector, heated pitot head, two operating alternators, two operating vacuum pumps and the alternate static source. Alternator controls are located on the main switch panel on the left side of the instrument panel. Controls for the ice protection components are located to the right of the control quadrant on the deice switch panel (Figure 7-1).

A single component or a combination of components may be installed. However, the warning placard specified in Section 2 of this supplement is required when the complete system is not installed. Such a placard is also required if any component is inoperative.

The aircraft is designed to allow operation in the meteorological conditions of the FAR 25 envelopes for continuous maximum and intermittent maximum icing. The airplane is not designed to operate for an indefinite period of time in every icing condition encountered in nature. Activation of the ice protection system prior to entering icing conditions and attempting to minimize the length of the icing encounter will contribute significantly to the ice flying capabilities of the airplane.

WING AND EMPENNAGE BOOTS

Pneumatic deice boots are installed on the leading edges of the wing, the vertical stabilizer and the horizontal stabilizer. During normal operation, when the surface deice system is turned off, the engine driven vacuum pumps applies a constant suction to the boots to provide smooth, streamlined leading edges. The boots are inflated by a momentary ON type SURF DE-ICE switch (Figure 7-1) located on the deice switch panel. Actuation of the SURF DE-ICE switch activates two pressure regulator valves (one for each vacuum pump) which energizes three (tail, lower wing & upper wing) deice flow valves for approximately six seconds. The boot solenoid valves are activated and air pressure is released to the boots, sequentially inflating the surface deicers. A SURFACE DE-ICE indicator light, located on the annunciator panel illuminates when the boots inflate. When the cycle is complete, the deicer solenoid valves permit automatic overboard exhaustion of pressurized air. Suction is then reapplied to the boots.

Circuit protection for the surface deice system is provided by a SURF DEICE circuit breaker located on the circuit breaker panel.

WING ICE DETECTION LIGHT

Wing icing conditions may be detected during night flight by use of an ice detection light installed on the left side of the forward fuselage. The light is controlled by an ICE LIGHT switch (Figure 7-1) located on the deice switch panel. Circuit protection is provided by an ICE circuit breaker located in the LIGHT section of the circuit breaker panel.

ELECTRIC PROPELLER DEICE

Electrothermal propeller deice pads are bonded to a portion of the leading edges of the propeller blades. The system is controlled by an ON-OFF type PROP HEAT switch (Figure 7-1) located on the deice switch panel. Power for the propeller deicers is supplied by the aircraft electrical system through a PROP HEAT circuit breaker on the circuit breaker panel. When the PROP HEAT switch is actuated, power is applied to a timer through the PROP HEAT ammeter which monitors the current through the propeller deice system.

Power from the timer is cycled to brush assemblies which distribute power to slip rings. The current is then supplied from the slip rings directly to the electrothermal propeller deice pads.

The Hartzell propeller is deiced in a cycle which applies power to the deice pads for approximately 90 seconds and then shuts off for approximately 90 seconds. Once begun, cycling will proceed in the above sequence and will continue until the system is turned off. The PROP HEAT ammeter should indicate within the green shaded area during the portion of the cycle when power is being applied. This indicates proper operation of the system.

The propeller designation is: HC-I2YR-1BF/F8074K.

The heat provided by the deice pads reduces the adhesion between the ice and the propeller so that centrifugal force and the blast of the airstream cause the ice to be thrown off the propeller blades in small pieces.

ELECTRICALLY HEATED WINDSHIELD

The electrically heated left windshield is heated by current from the aircraft electrical system. It is controlled by HIGH-OFF-LOW rocker type switch located on the deice switch panel. Circuit protection is provided by the windshield CONTROL and POWER circuit breakers in the ICE PROTECTION section of pilot's circuit breaker panel.

CAUTION

To avoid possible windshield distortion during ground operations, or during testing, do not position the WSHLD HEAT switch to HIGH for more than 20 seconds.

Windshield heat is an anti-ice device, which must be activated prior to entering suspected icing. Sudden penetration into icing conditions, with the heat OFF, will greatly reduce its effectiveness to prevent or eliminate windshield ice. Windshield heat can also be used to prevent windshield fog.

An overtemperature sensor is included as an integral part of the heated windshield. A system failure causing an overtemperature condition will illuminate the WINDSHIELD HEAT FAIL light located in the annunciator panel. In this eventuality the heated windshield should immediately be selected OFF.

HEATED LIFT DETECTOR

A heated lift detector is installed on the left wing. It is controlled by a S. WRN HEAT switch located on the deice switch panel and is protected by a STALL HEAT circuit breaker located on the ice protection circuit breaker panel. The lift detector has an in-line resistor activated by the main gear squat switch which limits the ground electrical load to approximately 33 percent of the inflight load. This allows the lift detector to be ground checked and activated prior to flight without damaging the unit.

HEATED PITOT HEAD

A heated AN type head is installed under the left wing. It is controlled by an ON-OFF type PITOT HEAT switch located on the deice switch panel and is protected by a PITOT HEAT circuit breaker located on the ice protection circuit breaker panel.

CAUTION

Care should be taken when an operational check of the heated pitot head is being performed on the ground. The unit becomes very hot.

DUAL ALTERNATORS

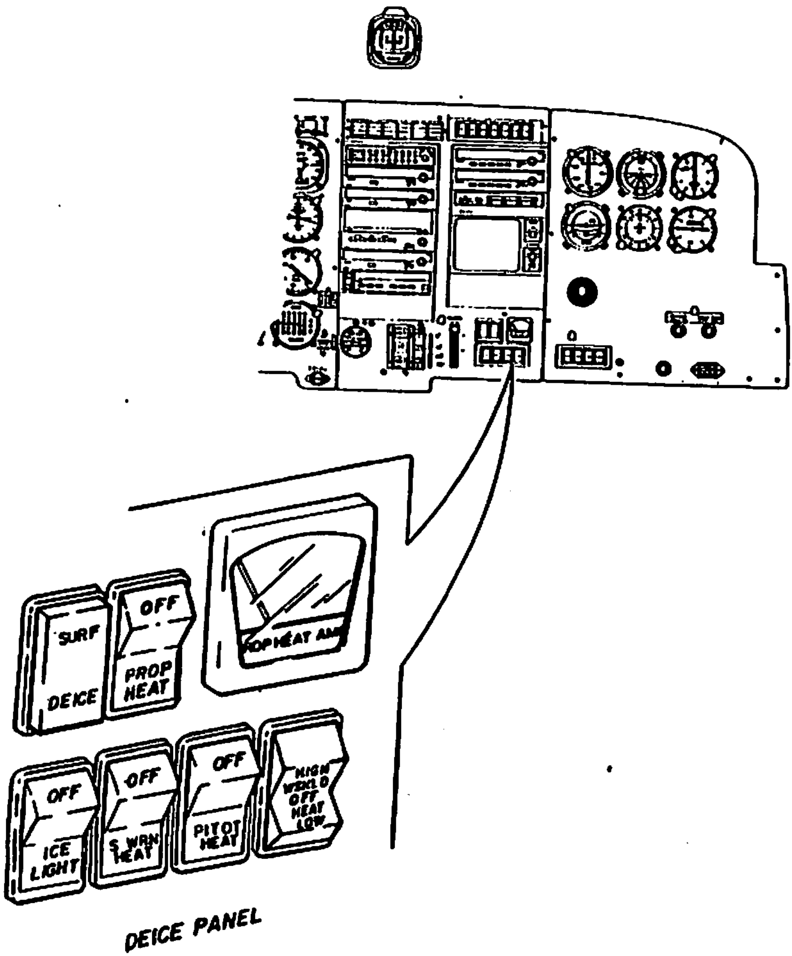
Dual 28 volt, 70 amp alternators are installed as standard equipment. Both alternators must be operational for flight in icing conditions. They are controlled by ON-OFF type switches labeled ALTR NO 1 and ALTR NO 2 located on the main switch panel (Figure 7-2). Circuit protection is provided by similarly labeled circuit breakers located on the TIE BUS circuit breaker panel. During normal operation both alternators must be turned ON. The system is designed so that the alternators will share the total load equally. If either ALTR switch is turned OFF the appropriate annunciator light (ALTERNATOR #1 INOP or ALTERNATOR #2 INOP) will illuminate and remain lit.

DUAL VACUUM PUMPS

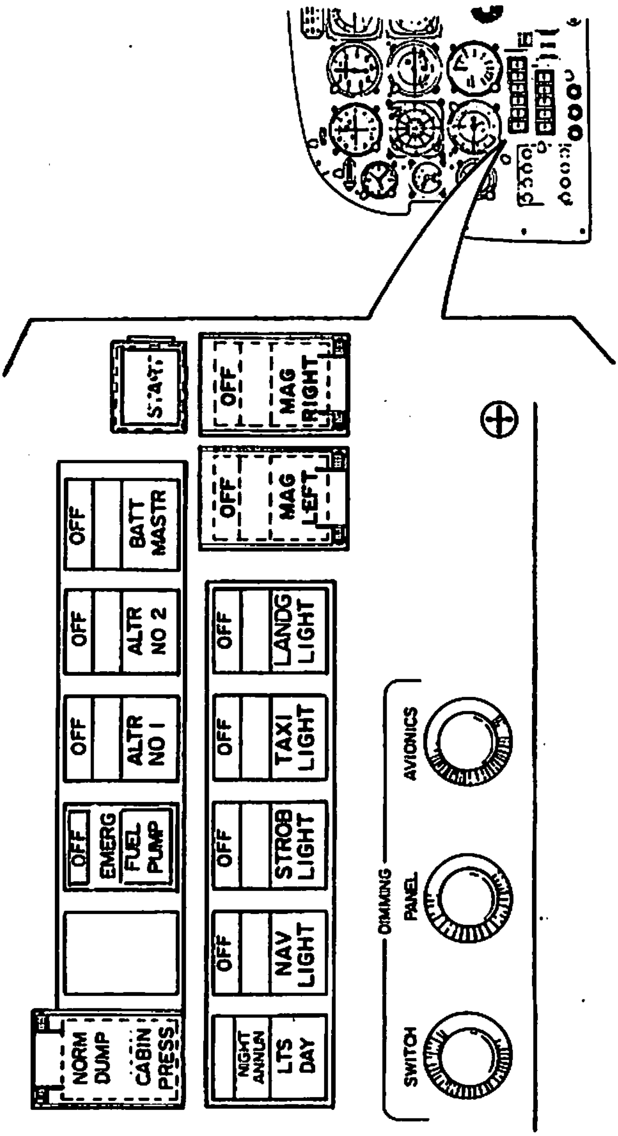
Dual engine driven vacuum pumps are installed as standard equipment. Both pumps operate continuously when the engine is running. While either pump independently is capable of operating the surface deice system, intentional or continued operations in icing conditions with only one operating vacuum pump is not recommended.

ALTERNATE STATIC SOURCE

An alternate static source control valve is located below the instrument panel to the left of the pilot. For normal operation, the lever remains down. To select alternate static source, place the lever in the up position. When the alternate static source is selected the airspeed and altimeter and vertical speed indicator are vented to the alternate static pad on the bottom aft fuselage. During alternate static source operation, these instruments may give slightly different readings. The pilot can determine the effects of the alternate sources at different airspeeds. Static source pads have been demonstrated to be non-icing; however, in the event icing does occur, selecting the alternate static source will alleviate the problem.



DEICE SWITCH PANEL
Figure 7-1



MAIN SWITCH PANEL
Figure 7-2

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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 7 FOR KING 150 SERIES FLIGHT CONTROL SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King 150 Series Flight Control System is installed per STC SA1778CE-D. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL December 12, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King 150 Series Flight Control System is installed. The Flight Control System must be operated within the limitations herein specified. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been FAA Approved as a permanent part of this handbook and must remain in this handbook at all times when the optional King 150 Series Flight Control System is installed.

SECTION 2 - LIMITATIONS

A. During autopilot operation, a pilot with seat belt fastened must be seated at the left pilot position.
B. The autopilot and yaw damper must be OFF during takeoff and landing.
C. The system is approved for Category I operation only (Approach mode selected).
D. Autopilot airspeed limitations: Maximum 185 KIAS
E. Maximum fuel imbalance: In the absence of a more restrictive limit (see the Airplane Flight Manual) - 20 gallons.

NOTE

In accordance with FAA recommendation (AC00-24A), use of basic Pitch Attitude Hold mode is recommended during operation in severe turbulence.

SECTION 3 - EMERGENCY PROCEDURES

A. In case of Autopilot malfunction: (accomplish items 1. and 2. simultaneously)
   1. Airplane Control Wheel - GRASP FIRMLY and regain aircraft control.
   2. AP DISC/TRIM INTER Switch - PRESS and HOLD.
   3. AP DISC/TRIM INTER Switch - RELEASE while observing pitch trim wheel. If pitch trim wheel is in motion, follow the Electric Trim Malfunction Procedure.

B. In case of Electric Trim Malfunction (either manual electric or autotrim):
   1. AP DISC/TRIM INTER Switch - PRESS and HOLD throughout recovery.
   2. PITCH TRIM Circuit Breaker - PULL.
   3. Aircraft - RETRIM manually.

CAUTION

When disconnecting the autopilot after a trim malfunction, hold the control wheel firmly; up to 45 pounds of force on the control wheel may be necessary to hold the aircraft level.

Maximum Altitude losses due to autopilot malfunction:

Configuration	Alt Loss
Cruise, Climb, Descent	480 ft.
Maneuvering	80 ft.
APPR	80 ft.

SECTION 4 - NORMAL PROCEDURES

A. PREFLIGHT (PERFORM PRIOR TO EACH FLIGHT)
   1. GYROS - Allow 3-4 minutes for gyros to come up to speed.
   2. RADIO POWER/AVIONICS MASTER - ON.
   3. PREFLIGHT TEST BUTTON - PRESS momentarily and NOTE:
      a. All annunciator lights on (TRIM annunciator flashing).
      b. When equipped with KAS 297B, all legends and digits are displayed on the KAS 297B.
      c. After approximately 5 seconds, all annunciator lights off except AP which will flash approximately 12 times and then remain off.

NOTE

If trim warning light stays on then the autotrim did not pass preflight test. The autopilot circuit breakers should be pulled. Manual electric trim can be used.

4. MANUAL ELECTRIC TRIM - TEST as follows:
   a. Actuate left side of split switch unit to the fore and aft positions. The trim wheel should not move on its own. Rotate the trim wheel manually against the engaged clutch to check the pilot's trim overpower capability.
   b. Actuate right side of split switch unit to the fore and aft positions. The trim wheel should not move on its own and normal trim wheel force is required to move it manually.
   c. Press the AP DISC/TRIM INTER switch down and hold. Manual Electric Trim should not operate either nose up or nose down.
5. FLIGHT DIRECTOR (KFC 150 ONLY) - ENGAGE by pressing FD or CWS button.
6. AUTOPILOT/YAW DAMPER - ENGAGE by pressing AP ENG button.
7. CONTROL WHEEL - MOVE fore, aft, left and right to verify that the autopilot and yaw damper can be overpowered.
8. AP DISC/TRIM INTER Switch - PRESS. Verify that the autopilot and yaw damper disconnects and all flight director modes are cancelled.
9. TRIM - SET to take off position.

B. AUTOPILOT OPERATION

1. Before takeoff
   AP DISC/TRIM INTER Switch - PRESS.
2. Autopilot Engagement
   a. FD Mode Selector Button (KFC 150 Only) - PRESS.
   b. AP ENG Button - PRESS. Note AP and YD annunciator on. If no other modes are selected the autopilot will operate in wings level and pitch attitude hold.

CAUTION

DO NOT HELP THE AUTOPILOT AS THE AUTOPILOT WILL RUN THE PITCH TRIM TO OPPOSE YOUR HELP.

3. Climb or Descent
   a. Using CWS
      (1) CWS Button - PRESS and MOVE aircraft nose to the desired attitude.
      (2) CWS Button - RELEASE. Autopilot will maintain aircraft pitch attitude up to the pitch limits of +15° or -10°.

b. Using Vertical Trim
   (1) VERTICAL TRIM Control - PRESS either up or down to modify aircraft attitude at a rate of .7 deg/sec. up to the pitch limits of +15° or -10°.
   (2) VERTICAL TRIM Control - RELEASE when desired aircraft attitude is reached. The autopilot will maintain the desired pitch attitude.

4. Altitude Hold
   a. ALT Mode Selector Button - PRESS. Note ALT mode annunciator ON. Autopilot will maintain the selected pressure altitude.
   b. Change selected altitudes
      (1) Using CWS (recommended for altitude changes greater than 100 ft.)
         (a) CWS Button - PRESS and fly aircraft to desired pressure altitude.
         (b) CWS Button - RELEASE when desired pressure altitude is reached. The autopilot will maintain the desired pressure altitude.
      (2) Using Vertical Trim (Recommended for altitude changes less than 100 ft.)
         (a) VERTICAL TRIM Control - PRESS either up or down. Vertical Trim will seek an altitude rate of change of 500 fpm.
         (b) VERTICAL TRIM Control - RELEASE when desired pressure altitude is reached. The autopilot will maintain the desired pressure altitude.

5. Heading Changes
   a. Manual Heading Changes
      (1) CWS Button - PRESS and MANEUVER aircraft to the desired heading.
      (2) CWS Button - RELEASE. Autopilot will maintain aircraft in wings level attitude.

NOTE

Aircraft heading may change in the wings level mode due to an aircraft out of trim condition.

b. Heading Hold
   (1) Heading Selector Knob - SET BUG to desired heading.
   (2) HDG Mode Selector Button - PRESS. Note HDG mode annunciator ON. Autopilot will automatically turn the aircraft to the selected heading.
c. Command Turns (Heading Hold mode ON)
   (1) HEADING Selector Knob - MOVE BUG to the desired heading. Autopilot will automatically turn the aircraft to the new selected heading.

6. NAV Coupling
   a. When equipped with HSI.
      (1) Course Bearing Pointer - SET to desired course.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the desired course.

      (2) HEADING Selector Knob - SET BUG to provide desired intercept angle.
      (3) NAV Mode Selector Button - PRESS.
         (a) If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with the NAV annunciator flashing; when the computed capture point is reached the HDG will disengage, the NAV annunciator will illuminate steady and the selected course will be automatically captured and tracked.
         (b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting NAV mode; the NAV annunciator will illuminate steady and the capture/track sequence will automatically begin.
   b. When equipped with DG
      (1) OBS Knob - SELECT desired course.
      (2) NAV Mode Selector Button - PRESS.

(3) Heading Selector Knob - ROTATE BUG to agree with OBS course.

NOTE

When NAV is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be automatically established based on the position of the bug.

(a) If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG mode (unless HDG not selected and NAV flashing; when the computed capture point is reached the HDG annunciator will go out, the NAV annunciator will illuminate steady and the selected course will be automatically captured and tracked.
(b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting NAV mode; the NAV annunciator will illuminate steady and the capture/track sequence will automatically begin.

7. Approach (APR) Coupling
   a. When equipped with HSI
      (1) Course Bearing Pointer - SET to desired course.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the desired course.

(2) HEADING Selector Knob - SET BUG to provide desired intercept angle.
(3) APR Mode Selector Button - PRESS.
(a) If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with the APR annunciator flashing; when the computed capture point is reached the HDG will disengage, the APR annunciator will illuminate steady and the selected course will be automatically captured and tracked.

(b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting APR mode; the APR annunciator will illuminate steady and the capture/track sequence will automatically begin.

b. When equipped with DG
   (1) OBS Knob - SELECT desired approach course.
   (2) APR Mode Selector Button - PRESS.
   (3) Heading Selector Knob - ROTATE Bug to agree with OBS course.

NOTE

When APR is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be automatically established based on the position of the bug.

(a) If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG mode (unless HDG not selected and APR flashing; when the computed capture point is reached the HDG annunciator will go out, the APR annunciator will illuminate steady and the selected course will be automatically captured and tracked.

(b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting APR mode; the APR annunciator will illuminate steady and the capture/track sequence will automatically begin.

8. BC Approach Coupling
   a. When equipped with HSI
      (1) Course Bearing Pointer - SET to the ILS front course inbound heading.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the ILS front course inbound heading.

(2) HEADING Selector Knob - SET BUG to provide desired intercept angle.
(3) BC Mode Selector Button - PRESS.
  (a) If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with BC annunciated steady and APR annunciator flashing; when the computed capture point is reached the HDG will disengage, and the BC and APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.
  (b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the BC and APR annunciators will illuminate steady and the capture/track sequence will automatically begin.

b. When equipped with DG
  (1) OBS Knob - SELECT the ILS front course inbound heading.
  (2) BC Mode Selector Button - PRESS.
  (3) Heading Selector Knob - ROTATE Bug to the ILS front course inbound heading.

NOTE

When BC is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be established based on the position of the bug.

  (a) If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG (unless HDG not selected) and BC modes with APR flashing; when the computed capture point is reached the HDG annunciators will go out, the BC and APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.

(b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the BC and APR annunciators will illuminate steady and the capture/track sequence will automatically begin.

9. Glideslope Coupling

NOTE

Glide slope coupling is inhibited when operating in NAV or APR BC modes. Glideslope coupling occurs automatically in the APR mode.

a. APR Mode - ENGAGED.
b. At glide slope centering - NOTE GS annunciator ON.

NOTE

Autopilot can capture glideslope from above or below the beam while operating in either pitch attitude hold or ALT hold modes.

10. Missed Approach
    a. AP DISC/TRIM INTER Switch - PRESS to disengage AP and YD.
    b. MISSED APPROACH - EXECUTE.
    c. CWS Button - PRESS (KFC 150 Systems only) as desired to activate FD mode during go-around maneuver.
    d. AP ENG Button - PRESS (if AP operation is desired). Note AP and YD annunciators ON.

NOTE

If it is desired to track the ILS course outbound as part of the missed approach procedure, use the NAV mode to prevent inadvertent GS coupling.

11. Before Landing
    a. AP DISC/TRIM INTER Switch - PRESS to disengage AP and YD.

C. FLIGHT DIRECTOR OPERATION (KFC 150 SYSTEMS ONLY)

NOTE

The flight director modes of operation are the same as those used for autopilot operations except the autopilot is not engaged and the pilot must maneuver the aircraft to satisfy the flight director commands.

D. YAW DAMPER OPERATION

1. With Yaw Damper Switch Installed
   a. Before takeoff
      (1) AP DISC Switch - PRESS to disengage AP and YD.
   b. Yaw damper engagement
      (1) YD Switch - PRESS. Note YD annunciator ON.

NOTE

Yaw damper engagement will occur automatically with autopilot engagement. The yaw damper may be disengaged by pressing the YD switch.

   c. Before landing
      (1) AP DISC Switch - PRESS to disengage AP and YD.
2. Without Yaw Damper Switch Installed
   a. Before takeoff
      (1) AP DISC Switch - PRESS to disengage AP and YD.
   b. Yaw damper engagement
      (1) FD mode selector button (KFC 150 only) - PRESS.
      (2) AP ENG Button - PRESS. Note AP and YD annunciators ON.

NOTE

For yaw damper operation without the autopilot, disengage the autopilot by pressing the AP ENG button or manual electric trim control switches.

   c. Before landing
      (1) AP DISC Switch - PRESS to disengage AP and YD.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the basic Pilot's Operating Handbook.

SECTION 7 - DESCRIPTION AND OPERATION

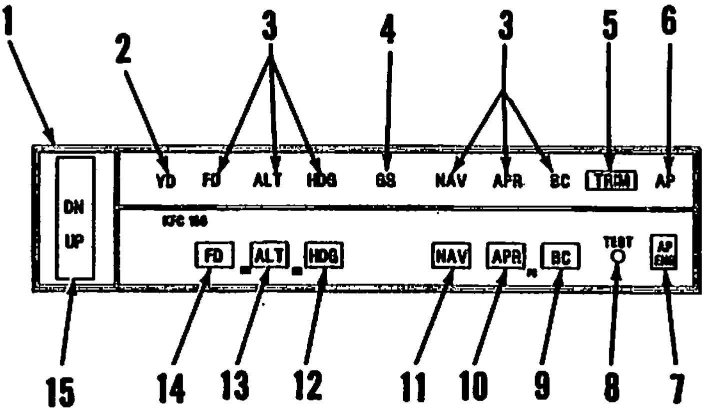
The 150 Series AFCS is certified in this airplane with 2 axis autopilot control, pitch and roll, or 3 axis control if the optional yaw damper is installed. The 3rd axis (Yaw), when installed, provides yaw damping and turn coordination whenever the autopilot is engaged. With installation of the optional Yaw Damper Switch, yaw damping and turn coordination are available with or without initially engaging the autopilot. The various instruments and the controls for the operation of the 150 System are described in Figures 7-1 thru 7-17.

The 150 Series AFCS has an electric pitch trim system which provides autotrim during autopilot operation and manual electric trim for the pilot. The trim system is designed to withstand any single inflight malfunction. Trim faults are visually and aurally annunciated.

A lockout device prevents autopilot engagement until the system has been successfully preflight tested.

The following conditions will cause the Autopilot to automatically disengage:

A. Power failure.
B. Internal Flight Control System failure.
C. With the KCS 55A Compass System, a loss of compass valid (displaying HDG flag) disengages the Autopilot when a mode using heading information is engaged. With the HDG flag present, the Autopilot may be re-engaged in the basic wings level mode along with any vertical mode.
D. Roll rates in excess of 14° per second will cause the autopilot to disengage except when the CWS switch is held depressed.
E. Pitch rates in excess of 8° per second will cause the autopilot to disengage except when the CWS switch is held depressed.



KC 192 AUTOPILOT & FLIGHT DIRECTOR COMPUTER
Figure 7-1

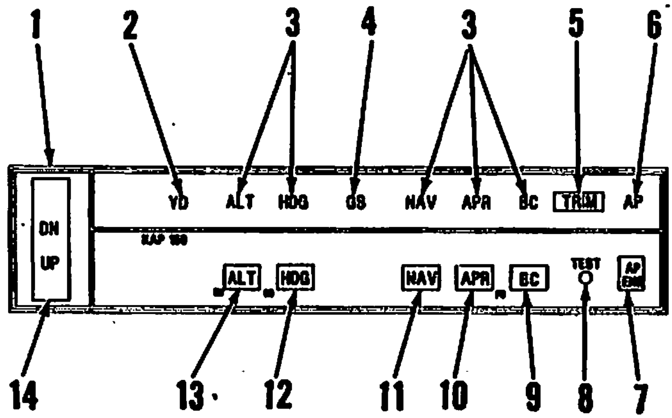
1. KFC 150 SYSTEM KC 192 AUTOPILOT COMPUTER - Complete Flight Director and Autopilot computer includes system mode annunciators and system controls.
2. YAW DAMPER (YD) ANNUNCIATOR - Illuminates continuously when the optional Yaw Damper is engaged.
3. MODE ANNUNCIATORS - Illuminates when a mode is selected by the corresponding mode selector button (PUSH ON - PUSH OFF) or when the glideslope (GS) mode is automatically engaged.
4. GLIDESLOPE (GS) ANNUNCIATOR - Illuminates continuously whenever the autopilot is coupled to the glideslope signal. The GS annunciator will flash if the glideslope signal is lost (GS flag in CDI or absence of glideslope pointers in KI 525A). The autopilot reverts to pitch attitude hold operation. If a valid glideslope signal returns within six seconds, the autopilot will automatically recouple in the GS mode. If the valid signal does not return within six seconds, the autopilot will remain in pitch attitude hold mode until such time that a valid glideslope returns *and* the aircraft passes thru the glideslope. At that point GS couple will reoccur.

Figure 7-1 (cont)

5. TRIM WARNING LIGHT (TRIM) - Illuminates continuously whenever trim power is not on or the system has not been preflight tested. The TRIM warning light flashes and is accompanied by an audible warning whenever a manual trim fault is detected. The Manual Trim System is monitored for the trim servo running without a command. The TRIM warning light will illuminate steady and be accompanied by a steady audible tone whenever an autotrim failure occurs. The autotrim system is monitored for the following failures: trim servo running without a command; trim servo not running when commanded to run; trim servo running in the wrong direction. The pitch trim circuit breaker may be cycled off then on to silence the continuous tone but the trim fail light will remain on. Manual Electric Trim may be used but the autopilot should not be engaged.
6. AUTOPILOT ANNUNCIATOR (AP) - Illuminates continuously whenever the autopilot is engaged. Flashes approximately 12 times whenever the autopilot is disengaged (an aural alert will also sound for 2 seconds).
7. AUTOPILOT ENGAGE (AP ENG) BUTTON - When pushed, engages autopilot if all logic conditions are met. Also engages the Yaw Damper if installed. If the Yaw Damper is installed without the Yaw Damper Switch option, Yaw Damper operation without the autopilot may be accomplished by first engaging the autopilot (and Yaw Damper) and then disengaging the autopilot by depressing the AP ENG button a second time. The Yaw Damper will remain engaged. Momentary activation of manual electric trim also will disengage the autopilot leaving the Yaw Damper engaged.
8. PREFLIGHT TEST (TEST) BUTTON - When momentarily pushed, initiates preflight test sequence which automatically turns on all annunciator lights, tests the roll and pitch rate monitors, tests the autotrim fault monitor, checks the manual trim drive voltage and tests all autopilot valid and dump logic. If the preflight is successfully passed, the AP annunciator light will flash for approximately 6 seconds (an aural tone will also sound simultaneously with the annunciator flashes). The autopilot cannot be engaged until the autopilot preflight tests are successfully passed.

Figure 7-1 (cont)

9. BACK COURSE APPROACH (BC) MODE SELECTOR BUTTON - When pushed, will select the Back Course Approach mode. This mode functions identically to the approach mode except that response to LOC signals is reversed. Glideslope coupling is inhibited in the Back Course Approach mode.
10. APPROACH (APR) MODE SELECTOR BUTTON - When pushed, will select the Approach mode. This mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals plus glideslope coupling in the case of an ILS. The tracking gain of the APR mode is greater than the gain in the NAV mode. The APR annunciator will flash until the automatic capture sequence is initiated.
11. NAVIGATION (NAV) MODE SELECTOR BUTTON - When pushed, will select the Navigation mode. The mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals. The NAV annunciator will flash until the automatic capture sequence is initiated.
12. HEADING (HDG) MODE SELECTOR BUTTON - When pushed, will select the Heading mode, which commands the airplane to turn to and maintain the heading selected by the heading bug on the DG or HSI. A new heading may be selected at any time and will result in the airplane turning to the new heading with a maximum bank angle of about 22°. Selecting HDG mode will cancel NAV, APR or BC track modes.
13. ALTITUDE HOLD (ALT) MODE SELECTOR BUTTON - When pushed, will select the Altitude Hold mode, which commands the airplane to maintain the pressure altitude existing at the moment of selection. Engagement may be accomplished in climb, descent, or level flight. In the APR mode, altitude hold will automatically disengage when the glideslope is captured.
14. FLIGHT DIRECTOR (FD) MODE SELECTOR BUTTON - When pushed, will select the Flight Director mode (with KC 192 Autopilot Computer only), bringing the Command Bar in view on the KI 256 and will command wings level and pitch attitude hold. The FD mode must be selected prior to Autopilot engagement.
15. VERTICAL TRIM CONTROL - A spring loaded to center rocker switch which will provide up or down pitch command changes: while in ALT will adjust altitude at rate of about 500 fpm; when not in ALT will adjust pitch attitude at a rate of 0.7 deg/sec. Will cancel GS couple. The aircraft must pass through the glideslope again to allow GSrecouple.



KC 191 AUTOPILOT COMPUTER
Figure 7-3

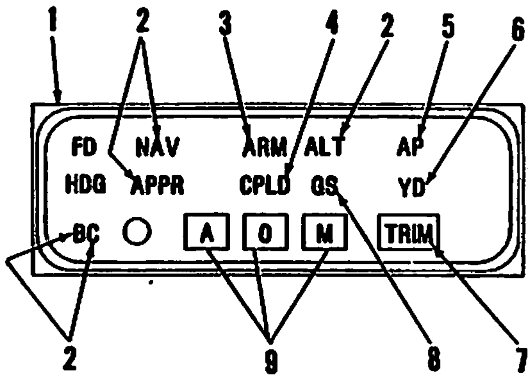
1. KAP 150 SYSTEM KC 191 AUTOPILOT COMPUTER - Complete Autopilot computer to include system mode annunciators and system controls.
2. YAW DAMPER (YD) ANNUNCIATOR - Illuminates continu- when the optional yaw damper is engaged.
3. MODE ANNUNCIATORS - Illuminate when a mode is selected by the corresponding mode selector button (PUSH ON - PUSH OFF) or when the glideslope (GS) mode is automatically engaged.
4. GLIDESLOPE (GS) ANNUNCIATOR - Illuminates continuously whenever the autopilot is coupled to the glideslope signal. The GS annunciator will flash if the glideslope signal is lost (GS flag in CDI or absence of glideslope pointers in KI 525A). The autopilot reverts to pitch attitude hold operation. If a valid glideslope signal returns within six seconds, the autopilot will automatically recouple in the GS mode. If the valid signal does not return within six seconds, the autopilot will remain in pitch attitude hold mode until such time that a valid glideslope returns *and* the aircraft passes thru the glideslope. At that point GS couple will reoccur.

Figure 7-3 (cont)

5. TRIM WARNING LIGHT (TRIM) - Illuminates continuously whenever trim power is not on or the system has not been preflight tested. The TRIM warning light flashes and is accompanied by an audible warning whenever a manual trim fault is detected. The Manual Trim System is monitored for the trim servo running without a command. The TRIM warning light will illuminate steady and be accompanied by a steady audible tone whenever an autotrim failure occurs. The autotrim system is monitored for the following failures: trim servo running without a command; trim servo not running when commanded to run; trim servo running in the wrong direction. The pitch trim circuit breaker may be cycled off then on to silence the continuous tone but the trim fail light will remain on. The manual electric trim may be used but the autopilot should not be engaged.
6. AUTOPILOT ANNUNCIATOR (AP) - Illuminates continuously whenever the autopilot is engaged. Flashes approximately 12 times whenever the autopilot is disengaged (an aural alert will also sound for 2 seconds).
7. AUTOPILOT ENGAGE (AP ENG) BUTTON - When pushed, engages autopilot if all logic conditions are met. Also engages the Yaw Damper if installed. If the Yaw Damper is installed without the Yaw Damper Switch option, Yaw Damper operation without the autopilot may be accomplished by first engaging the autopilot (and Yaw Damper) and then disengaging the autopilot by depressing the AP ENG button a second time. The Yaw Damper will remain engaged. Momentary activation of manual electric trim also will disengage the autopilot leaving the Yaw Damper engaged.
8. PREFLIGHT TEST (TEST) BUTTON - When momentarily pushed, initiates preflight test sequence which automatically turns on all annunciator lights, tests the roll and pitch rate monitors, tests the autotrim fault monitor, checks the manual trim drive voltage and tests all autopilot valid and dump logic. If the preflight is successfully passed, the AP annunciator light will flash for approximately 6 seconds (an aural tone will also sound simultaneously with the annunciator flashes). The autopilot cannot be engaged until the autopilot preflight tests are successfully passed.
9. BACK COURSE APPROACH (BC) MODE SELECTOR BUTTON - When pushed, will select the Back Course Approach mode. This mode functions identically to the approach mode except that response to LOC signals is reversed. Glide slope coupling is inhibited in the Back Course Approach mode.

Figure 7-3 (cont)

10. APPROACH (APR) MODE SELECTOR BUTTON - When pushed, will select the Approach mode. This mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals plus glideslope coupling in the case of an ILS. The tracking gain of the APR mode is greater than the gain in the NAV mode. The APR annunciator will flash until the automatic capture sequence is initiated.
11. NAVIGATION (NAV) MODE SELECTOR BUTTON - When pushed, will select the Navigation mode. The mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals. The NAV annunciator will flash until the automatic capture sequence is initiated.
12. HEADING (HDG) MODE SELECTOR BUTTON - When pushed, will select the Heading mode, which commands the airplane to turn to and maintain the heading selected by the heading bug on the DG or HSI. A new heading may be selected at any time and will result in the airplane turning to the new heading with a maximum bank angle of about 22°. Selecting HDG mode will cancel NAV, APR or BC track modes.
13. ALTITUDE HOLD (ALT) MODE SELECTOR BUTTON - When pushed, will select the Altitude Hold mode, which commands the airplane to maintain the pressure altitude existing at the moment of selection. Engagement may be accomplished in climb, descent, or level flight. In the APR mode, altitude hold will automatically disengage when the glideslope is captured.
14. VERTICAL TRIM CONTROL - A spring loaded to center rocker switch which will provide up or down pitch command changes: while in ALT will adjust altitude at rate of about 500 fpm; when not in ALT will adjust pitch attitude at a rate of .7 deg/sec. Will cancel GS couple. The aircraft must pass through the glide slope again to allow GS recouple.



KA 185 REMOTE MODE ANNUNCIATOR (OPTIONAL)
Figure 7-5

1. KA 185 REMOTE MODE ANNUNCIATOR (OPTIONAL) - Provides mode annunciation in the pilots' primary scan area as well as three Marker Beacon Lights.
2. MODE ANNUNCIATORS - Illuminate when a mode is selected by the corresponding mode selector button (PUSH ON - PUSH OFF.
3. ARMED (ARM) ANNUNCIATOR - Illuminates continuously along with NAV or APR when either the NAV or APR mode selector button is depressed. The ARM annunciator will continue to illuminate until the automatic capture sequence is initiated at which time ARM will extinguish and CPLD will annunciate.
4. COUPLED (CPLD) ANNUNCIATOR - Illuminates continuously along with NAV or APR at the initiation of automatic beam capture sequence in either the NAV or APR modes. Normally the CPLD condition follows an ARM condition but may be entered into directly if the beam capture criteria is met when NAV or APR is selected.
5. AUTOPILOT (AP) ANNUNCIATOR - Illuminates continuously whenever the autopilot is engaged. Flashes approximately 12 times whenever the autopilot is disengaged (an aural alert will also sound for 2 seconds).
6. YAW DAMPER (YD) ANNUNCIATOR - Illuminates continuously when the optional Yaw Damper is engaged.
7. TRIM WARNING LIGHT (TRIM) - Illuminates continuously whenever trim power is not on or the system has not been preflight tested. The TRIM warning light illuminates and is accompanied by an audible warning whenever a manual trim fault is detected. The Manual Trim System is monitored is

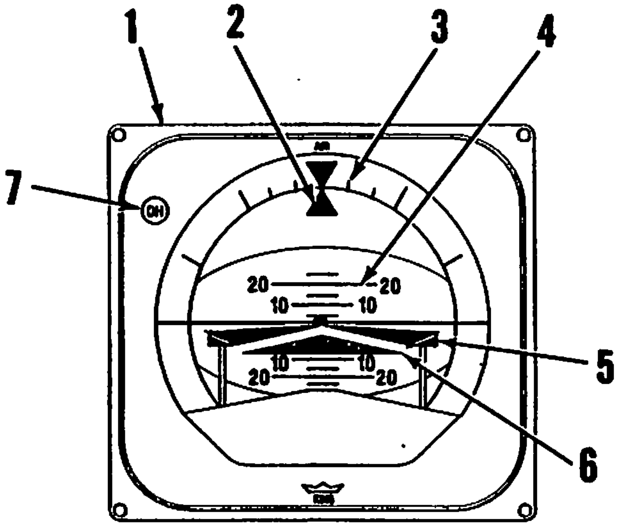
Figure 7-5 (cont)

monitored for the Trim Servo running without a command. The TRIM warning light will illuminate and be accompanied by a steady audible tone whenever an autotrim failure occurs. The autotrim system is monitored for the following failures: trim servo running without a command; trim servo not running when commanded to run; trim servo running in the wrong direction. The Pitch Trim Circuit Breaker may be pulled off, then reset on, to silence the continuous tone, but the trim fail light will remain on. Manual Electric Trim may be used but the autopilot should not be engaged.

8. GLIDESLOPE (GS) ANNUNCIATOR - Illuminates continuously whenever the autopilot is coupled to the glideslope signal. The GS annunciator will flash if the glideslope signal is lost (GS flag in CDI or absence of glideslope pointers in KI 525A. The autopilot reverts to pitch attitude hold operation. If a valid glideslope signal returns within six seconds, the autopilot will automatically recouple in the GS mode. If the valid signal does not return within six seconds, the autopilot will remain in pitch attitude hold mode until such time that a valid glideslope returns and the aircraft passes thru the glideslope. At that point GS couple will reoccur.
9. REMOTE MARKER BEACON LIGHTS - Remote Airway, Outer and Middle Marker Beacon Lights driven by the Marker Beacon receiver.

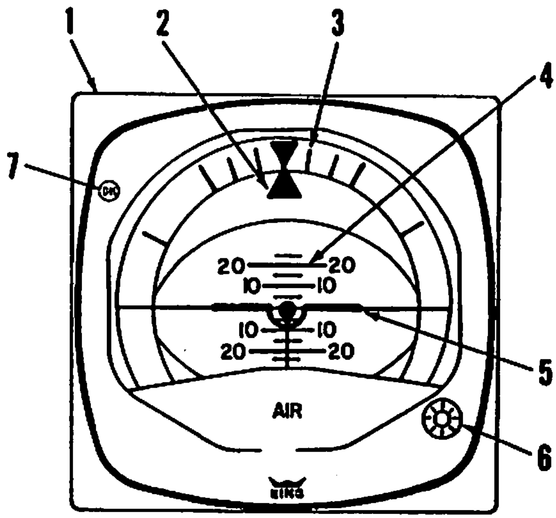
YAW DAMPER SWITCH (OPTIONAL)
Figure 7-7

The optional Yaw Damper Switch, when installed, may be used to engage and disengage the Yaw Damper idependent of the autopilot. (This switch is not required for Yaw Damper installation and is a convenience option.)



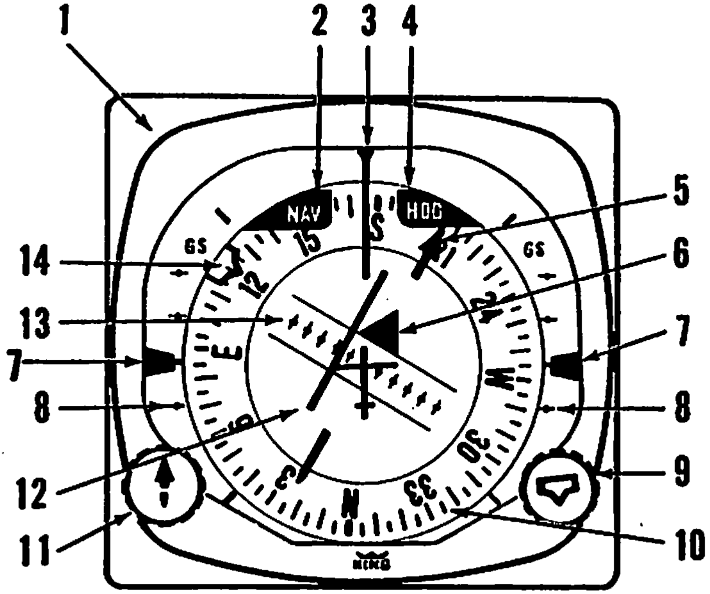
KI 256 FLIGHT COMMAND INDICATOR
Figure 7-9

1. KI 256 FLIGHT COMMAND INDICATOR (FCI) - Displays airplane attitude as a conventional attitude gyro and displays commands for flight director operation. The gyro is air driven.
2. ROLL ATTITUDE INDEX - Displays airplane roll attitude with respect to the roll attitude scale.
3. ROLL ATTITUDE SCALE - Scale marked at 0 +/- 10, 20, 30, 60, and 90 degrees.
4. PITCH ATTITUDE SCALE - Moves with respect to the symbolic airplane to present pitch attitude. Scale graduated at 0 +/- 5, 10, 15, 20, and 25 degrees.
5. COMMAND BAR - Displays computed steering commands referenced to the symbolic airplane. The command bar is visible only when FD mode is selected. The command bar will be biased out of view whenever the system is invalid or a Flight Director mode is not engaged.
6. FCI SYMBOLIC AIRPLANE - Airplane pitch and roll attitude is displayed by the relationship between the fixed symbolic airplane and the movable background. During flight director operation, the symbolic airplane is flown to align it with the command bar to satisfy the flight director commands.
7. DECISION HEIGHT (DH) ANNUNCIATOR LIGHT - Optional light for use with the aircraft's optional radar altimeter.



KG 258 VERTICAL GYRO
Figure 7-11

1. KG 258 VERTICAL GYRO - Displays airplane attitude as a conventional attitude gyro. The gyro is air driven.
2. ROLL ATTITUDE INDEX - Displays airplane roll attitude with respect to the roll attitude scale.
3. ROLL ATTITUDE SCALE - Scale marked at 0 +/- 10, 20, 30, 60, and 90 degrees.
4. PITCH ATTITUDE SCALE - Moves with respect to the symbolic airplane to present pitch attitude. Scale graduated at 0 +/- 5, 10, 15, 20, and 25 degrees.
5. SYMBOLIC AIRPLANE - Serves as a stationary symbol of the aircraft. Aircraft pitch and roll attitudes are displayed by the relationship between the fixed symbolic aircraft and the movable background.
6. SYMBOLIC AIRCRAFT ALIGNMENT KNOB - Provides manual positioning of the symbolic aircraft for level flight under various load conditions. (Not applicable for some aircraft of foreign registry.)
7. DECISION HEIGHT (DH) ANNUNCIATOR LIGHT - Optional light for use with the aircraft's optional radar altimeter.

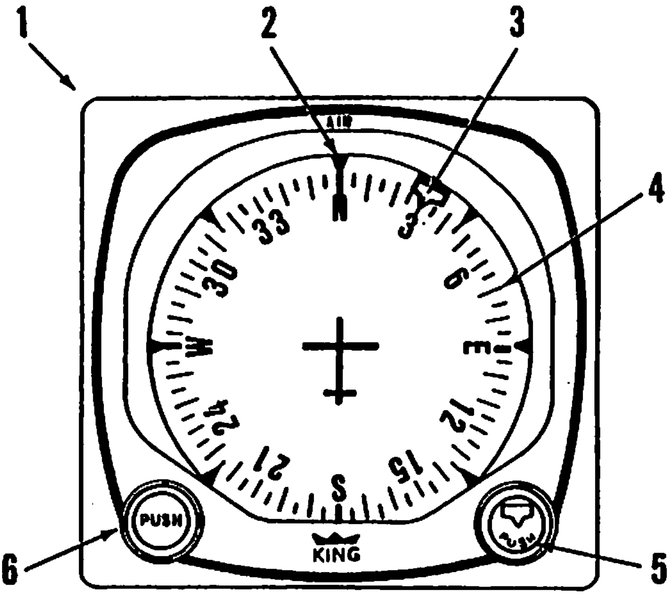


KI 525A HORIZONTAL SITUATION INDICATOR
Figure 7-13

1. KI 525A HORIZONTAL SITUATION INDICATOR (HSI) - Provides a pictorial presentation of aircraft deviation relative to VOR radials or localizer beams. It also displays glide slope deviations and gives heading reference with respect to magnetic north.
2. NAV FLAG - Flag is in view when the NAV receiver signal is inadequate. When a NAV flag is present in the navigation indicator (CDI or KI 525A) the autopilot operation is not affected. The pilot must monitor the navigation indicators for NAV flags to ensure that the Autopilot and/or Flight Director are tracking valid navigation information.
3. LUBBER LINE - Indicates aircraft magnetic heading on compass card (10).
4. HEADING WARNING FLAG (HDG) - When flag is in view, the heading display is invalid. If a HDG flag appears and a lateral mode (HDG, NAV, APR or APR BC) is selected, the Autopilot will be disengaged. The Autopilot may be re-engaged in the basic wings level mode along with any vertical mode. The CWS switch would be used to manually maneuver the aircraft laterally.

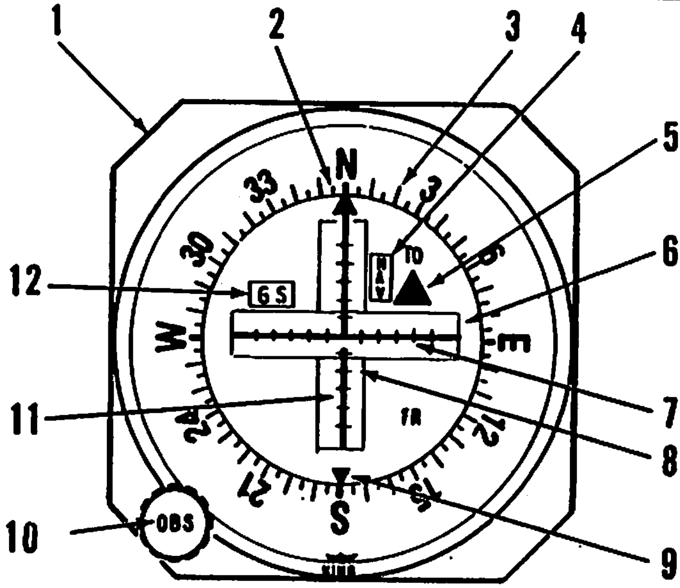
Figure 7-13 (cont)

5. COURSE BEARING POINTER - Indicates selected VOR course or localizer course on compass card (10). The selected VOR radial or localizer heading remains set on the compass card when the compass card (10) rotates.
6. TO/FROM INDICATOR FLAG - Indicates direction of VOR station relative to selected course.
7. DUAL GLIDE SLOPE POINTERS - Indicate on glide slope scale (8) aircraft displacement from glide slope beam center. Glide slope pointers in view indicate a usable glide slope signal is being received.
8. GLIDE SLOPE SCALES - Indicate displacement from glide slope beam center. A glide slope deviation bar displacement of 2 dots, represents full scale (0.7°) deviation above or below glide slope beam centerline.
9. HEADING SELECTOR KNOB ( ) - Positions heading bug (14) on compass card (10) by rotating the heading selector knob. The Bug rotates with the compass card.
10. COMPASS CARD - Rotates to display heading of airplane with reference to lubber line (3).
11. COURSE SELECTOR KNOB - Positions course bearing pointer (5) on the compass card (10) by rotating the course selector knob.
12. COURSE DEVIATION BAR (D-BAR) - The center portion of omni bearing pointer moves laterally to pictorially indicate the relationship of aircraft to the selected course. It indicates degrees of angular displacement from VOR radials and localizer beams, or displacement in nautical miles from RNAV courses.
13. COURSE DEVIATION SCALE - A course deviation bar displacement of 5 dots represents full scale (VOR = +/- 10°, LOC = +/- 2 1/2°, RNAV = +/- 5NM, RNAV APR = +/- 1 1/4NM) deviation from beam centerline.
14. HEADING BUG - Moved by ( ) knob (9) to select desired heading.



KG 107 NON-SLAVED DIRECTIONAL GYRO
Figure 7-15

1. KG 107 NON-SLAVED DIRECTIONAL GYRO (DG) - Provides a stable visual indication of aircraft heading to the pilot. The gyro is air driven.
2. LUBBER LINE - Indicates aircraft magnetic heading on compass card (4).
3. HEADING BUG - Moved by ( ) knob (5) to select desired heading.
4. COMPASS CARD - Rotates to display heading of airplane with reference to lubber line (2).
5. HEADING SELECTOR KNOB ( ) - Positions heading bug (3) on compass card (4) by rotating the heading selector knob. The Bug rotates with the compass card.
6. GYRO ADJUSTMENT KNOB (PUSH) - When pushed in, allows the pilot to manually rotate the gyro compass card (4) to correspond with the magnetic heading indicated by the magnetic compass. The unslaved compass card must be manually reset periodically to compensate for precessional errors in the gyro.

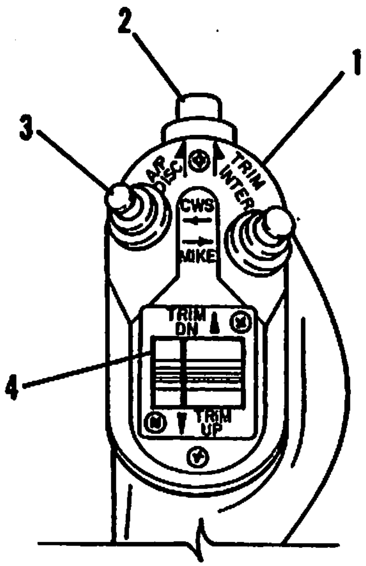


KI 204/206 VOR/LOC/
GLIDESLOPE INDICATOR (TYPICAL)
Figure 7-17

1. KI 204/206 GLIDESLOPE INDICATOR - Provides rectilinear display of VOR/LOC and glideslope deviation.
2. COURSE INDEX - Indicates selected VOR course.
3. COURSE CARD - Indicates selected VOR course under course index.
4. NAV FLAG - Flag is in view when the NAV receiver signal is inadequate. When a NAV flag is present in the navigation indicator (CDI or KI 525A), the autopilot operation is not affected. The pilot must monitor the navigation indicators for NAV flags to ensure that the Autopilot and/or Flight Director are tracking valid navigation information.
5. TO/FROM INDICATOR FLAG - Indicates direction of VOR station relative to selected course.
6. GLIDESLOPE DEVIATION NEEDLE - Indicates deviation from ILS glideslope.
7. COURSE DEVIATION SCALE - A course deviation bar displacement of 5 dots represents full scale (VOR = +/-10°, LOC = +/-2 1/2°, RNAV = +/-5NM, RNAV APR = +/-1 1/4NM) deviation from beam centerline.

Figure 7-17 (cont)

8. GLIDESLOPE SCALE - Indicates displacement from glideslope beam center. A glideslope deviation needle displacement of 5 dots, represents full scale (0.7°) deviation above or below glideslope beam centerline.
9. RECIPROCAL COURSE INDEX - Indicates reciprocal of selected VOR course.
10. OMNI BEARING SELECTOR (OBS) KNOB - Rotates course card to selected course.
11. COURSE DEVIATION NEEDLE - Indicates course deviation from selected omni course or localizer centerline.
12. GLIDESLOPE (GS) FLAG - Flag is in view when the GS receiver signal is inadequate.



AUTOPILOT CONTROL WHEEL SWITCH CAP
Figure 7-19

Figure 7-19 (cont)

1. AUTOPILOT CONTROL WHEEL SWITCH CAP - Molded plastic unit mounted on the left horn of the pilot's control wheel which provides mounting for three switch units associated with the autopilot and manual electric trim systems.
2. MANUAL ELECTRIC TRIM CONTROL SWITCHES - A split switch unit in which the left half provides power to engage the trim servo clutch and the right half to control the direction of motion of the trim servo motor. Both halves of the split trim switch must be actuated in order for the manual trim to operate in the desired direction. When the autopilot is engaged, operation of the manual electric trim will automatically disconnect the autopilot but not the yaw damper.
3. CONTROL WHEEL STEERING (CWS) BUTTON - When depressed, allows pilot to manually control the aircraft (disengages the servos) without cancellation of any of the selected modes. Will engage the Flight Director mode if not previously engaged (KFC 150 only). Automatically synchronizes the Flight Director/ Autopilot to the pitch attitude present when the CWS switch is released, or to the present pressure altitude when operating in the ALT hold mode. Will cancel GS couple. The aircraft must pass through the glideslope again to allow GS recouple. The CWS button will not disengage the yaw damper servo.
4. AUTOPILOT DISCONNECT/TRIM INTERRUPT (AP DISC/ TRIM INTER) Switch - When depressed and released will disengage the autopilot and cancel all operating Flight Director modes. When depressed and held will interrupt all electric trim power (stop trim motion), disengage the autopilot, and cancel all operating Flight Director modes.

The airplane BATT MASTR switch function is unchanged and can be used in an emergency to shut off electrical power to all flight control systems while the problem is isolated.

The RADIO MASTR switch supplies power to the avionics bus bar of the radio circuit breakers and the autopilot circuit breaker.

The following circuit breakers are used to protect the following elements of the King 150 Series Autopilot:

AUTOPILOT - Supplies power to the KC 192 or the KC 191 Computer, the autopilot pitch and roll servos, and the Pitch Trim Circuit Breaker. It also applies power to the KC 296 yaw computer and the yaw servo when installed.

PITCH TRIM - Supplies power to the autotrim and manual electric pitch trim systems.

COMPASS - Supplies power to the optional KCS 55A Compass System and the optional KRG 331 Yaw Rate Gyro if the airplane is not equipped with an inverter.

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PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 8
FOR
KING KAS 297B VERTICAL SPEED AND ALTITUDE SELECTOR

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King KAS 297B Vertical Speed And Altitude Selector is installed per STC SA1778CE-D. The information contained herein supplements or supersedes the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL December 12, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King KAS 297B Vertical Speed And Altitude Selector is added to the King KFC 150 or a KAP 150 Flight Control System. The Vertical Speed And Altitude Selector must be operated within the limitations herein specified. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been FAA Approved as a permanent part of this handbook and must remain in this handbook at all times when the optional King KAS 297B Vertical Speed And Altitude Selector is installed.

SECTION 2 - LIMITATIONS

Altitude select captures below 800 feet agl are prohibited.

SECTION 3 - EMERGENCY PROCEDURES

No change.

SECTION 4 - NORMAL PROCEDURES

A. PREFLIGHT

1. PREFLIGHT TEST BUTTON (KC192 OR KC 191) - PRESS momentarily and NOTE:
   a. All legends and digits are displayed on the KAS 297B.

B. VERTICAL SPEED AND ALTITUDE SELECTOR OPERATION

1. Vertical Speed Select
   a. VERTICAL SPEED SELECT knob - PULL small knob to the OUT position.
   b. VERTICAL SPEED SELECT knob - ROTATE until vertical speed is displayed.
   c. VERTICAL SPEED MODE (ENG) button - PUSH to engage the Vertical Speed Hold mode.

2. Changing Vertical Speed
   a. Using CWS
      (1) CWS button - PRESS and HOLD.
      (2) Airplane - Establish desired vertical speed.
      (3) CWS button - RELEASE.

   b. Using Vertical Trim Control
      (1) VERTICAL TRIM CONTROL - PRESS either up or down to increase or decrease the vertical speed. Displayed vertical speed changes 100 fpm for every second control is held down.

CAUTION

When operating at or near the best rate of climb airspeed and using vertical speed hold, it is easy to decelerate to an airspeed on the back side of the power curve (a decrease in airspeed results in a reduced rate of climb). Continued operation on the back side of the power curve in vertical speed hold mode will result in a stall.

CAUTION

When operating at or near the maximum autopilot speed, it will be necessary to reduce power in order to maintain the desired rate of descent and not exceed the maximum autopilot speed.

C. ALTITUDE PRESELECT

1. ALTITUDE SELECT knob - PUSH small knob to the IN position.
2. ALTITUDE SELECT knob - ROTATE until the desired altitude is displayed.
3. ALTITUDE SELECT MODE (ARM) button - PUSH to arm the altitude select mode.
4. Airplane - ESTABLISH ATTITUDE necessary to intercept the selected altitude.

SECTION 5 - PERFORMANCE

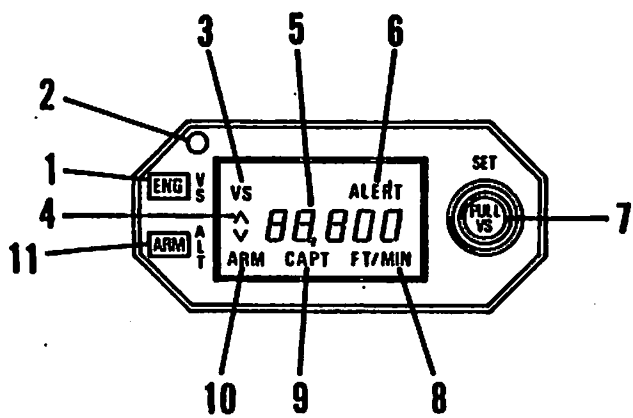
No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the basic Pilot's Operating Handbook.

SECTION 7 - DESCRIPTION AND OPERATION

The KAS 297B provides the pilot with the following features: ability to select vertical speed hold; ability to select, arm and, upon approaching the selected altitude, automatically transfer into Altitude Hold; altitude alerting as specified by F.A.R. 91.51. The KAS 297B controls and display are further described in Figure 7-1.



KAS 297B VERTICAL SPEED AND ALTITUDE SELECTOR
Figure 7-1

Figure 7-1 (continued)

1. VERTICAL SPEED MODE (ENG) BUTTON - When pressed will engage the vertical speed hold mode. When pressed a second time will disengage the vertical speed hold mode. When pressed with altitude displayed, will engage the vertical speed hold mode and re-sync the vertical speed hold mode to the current vertical speed of the airplane.
2. PHOTOCELL - Automatically dims display according to the cockpit ambient light.
3. VERTICAL SPEED (VS) ANNUNCIATOR - Illuminates when the vertical speed hold mode is engaged.
4. VERTICAL SPEED UP/DOWN CARETS (◊) - Indicates whether the selected vertical speed is up or down.
5. GAS DISCHARGE DISPLAY - Displays selected altitude from 100 to 35,000 feet or the selected vertical speed from 0 to 3,000 feet per minute up or down.
6. ALTITUDE ALERT (ALERT) ANNUNCIATOR - The ALERT annunciator is illuminated 1000 feet prior to the selected altitude, goes out 300 feet prior to the selected altitude and illuminates momentarily when the selected altitude is reached. Once the selected altitude is reached the light signified that the 300 feet "safe band" has been exceed and will remain on until 1000 feet from the selected altitude. The alert light is accompanied by a 2 second aural tone anytime the light initially comes on or the selected altitude is reached.
7. VERTICAL SPEED/ALTITUDE SELECT KNOB - Concentric knobs which allow easy setting of altitude or vertical speed. The small knob (inner) has an in and out position.

   Altitude is displayed and selected when the small knob is in the IN position. When rotated the small knob selects altitude in 100 foot increments with roll over into the 1000 digits. The larger knob (outer) selects altitude in 1000 foot increments with roll over into the 10,000 digits.

   Vertical speed is displayed and selected when the small knob is in the OUT position. When rotated the small knob selects vertical speed in 100 fpm increments. The larger knob selects vertical speed in 1000 fpm increments up to a maximum of 3000 fpm.
8. MODE (FT or FT/MIN) ANNUNCIATOR - Indicates FT/MIN when in the vertical speed hold mode and FT when in the altitude select mode.

Figure 7-1 (continued)

9. ALTITUDE CAPTURE (CAPT) ANNUNCIATOR - Indicates the KAS 297B has switched the autopilot from pitch attitude hold or vertical speed hold mode into the pitch round out mode (CAPT). The point, just prior to transfer into altitude hold, at which the CAPT mode becomes active varies with the vertical speed, i.e. The higher the rate of climb, the sooner the CAPT mode becomes active; at low rates of climb the activation of the CAPT mode and transfer to altitude hold occur almost simultaneously.
10. ALTITUDE SELECT ARM (ARM) ANNUNCIATOR - Indicates that the altitude select mode is armed to capture the selected altitude.
11. ALTITUDE SELECT MODE (ARM) BUTTON - When pressed and the selected altitude is displayed, will arm the altitude select mode. The altitude select (ARM) mode will cancel altitude hold (ALT) if ALT is already engaged. If altitude select (ARM) mode is present when GS couple occurs, the GS mode will cancel altitude select (ARM) mode. The engagement of ALT by the pilot's use of the ALT switch will cancel the altitude select (ARM) mode. Reselection of a new altitude will also cycle the altitude select (ARM) mode off.
12. CONTROL WHEEL STEERING (CWS) BUTTON (Not Shown) - When pressed, in addition to the normal autopilot functions the CWS also interfaces with the KAS 297B. When operating in the vertical speed hold mode, the CWS will re-sync the vertical speed hold mode to the current vertical speed of the airplane. If altitude is displayed when the CWS is pressed, the display will automatically display vertical speed as long as the CWS is depressed. CWS does not affect the altitude select mode.
13. VERTICAL TRIM CONTROL (Not Shown) - When in the vertical speed hold mode this control can be used to slew the vertical speed up or down at 100 fpm for every second the rocker switch is held. If altitude is being displayed at the time the rocker switch is depressed, vertical speed will be displayed for 1 to 2 seconds after the rocker switch is released.

The following circuit breakers are used to protect the following elements of the King KAS 297B.

LABEL	FUNCTION
AUTOPILOT	Supplies power to the KC 192 or the KC 191 computer, the autopilot pitch and roll servos, the Elv Trim Switch/ Circuit Breaker, and the KAS 297B
ENCODING ALT (ENCODER 1)	Supplies power to the King KEA 130A Altimeter.

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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 9 FOR NORTHSTAR M1 LORAN C NAVIGATOR WITH KAP/KFC 150 AUTOPILOT SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the optional Northstar M1 Loran C Navigator is installed per the Equipment List. The information contained herein supplements or supersedes the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL December 12, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Northstar M1 Loran C Navigator System is installed. The navigator system must be operated within the limitations herein specified. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been FAA Approved as a permanent part of this handbook and must remain in this handbook at all times when the Northstar M1 Loran C Navigator System is installed.

SECTION 2 - LIMITATIONS

(a) Northstar M1 Loran C Navigator Operator's Manual (P/N 041086, latest revision) must be immediately available to the flight crew whenever navigation is predicated on the use of the Northstar M1.

(b) The Northstar M1 Loran C Navigator is approved for VFR only.

(c) During operation no flight operation shall be predicated upon the Northstar M1 Loran C Navigator whenever a NAV flag is displayed by the CDI.

(d) The following placard is located on the pilot's instrument panel adjacent to the HSI.

LORAN C APPROVED FOR VFR ONLY

SECTION 3 - EMERGENCY PROCEDURES

No changes to the basic Emergency Procedures provided by Section 3 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 4 - NORMAL PROCEDURES

(a) OPERATION

Normal operating procedures are outlined in the Northstar M1 Loran C Navigator Operator's Manual (P/N 041086, latest revision).

(b) NAV-COUPLED MODE

When operating the KAP/KFC 150 flight control system in either the navigation (NAV) or approach (APR) mode and the A/P LORAN/A/P NAV switch has been set to the Northstar M1 as the navigation source, all operational procedures which are applicable to these two modes, as described in the KAP/KFC 150 Operator's Manual and Flight Manual Supplement, still apply, with the following notations or exceptions:

(1) Northstar M1 is approved for VFR only.
(2) Course deviation data for the autopilot is derived from the Northstar M1.
(3) For course intercept or course tracking, set the HSI course needle to the Loran C course to be flown. This setting provides course datum to the autopilot.
(4) Autopilot Nav Select Switch Positions:

A/P LORAN A/P NAV SW	A/P NAV 1 A/P NAV 2 SW	SELECTIONS
A/P NAV	A/P NAV 1	NAV #1 coupled to A/P Displayed on HSI
A/P NAV	A/P NAV 2	NAV #2 coupled to A/P displayed on NAV #2 indicator
A/P LORAN	*	LORAN coupled to A/P displayed on HSI (Blue Indicator light)
*When the A/P LORAN/A/P NAV switch is in the Loran mode the A/P NAV 1/A/P NAV 2 autopilot coupling switch is inactive.		

(c) NAVIGATION DISPLAYS

The Loran C System drives the pilot's HSI display when manually selected by the A/P LORAN/A/P NAV switch. This configuration is annunciated by a mode light adjacent to the HSI. The HSI will only display left or right course information and a NAV flag indication from the Northstar M1. The course selector pointer must be manually set to the Loran C course. (Actual course cannot be determined on the HSI by rotating the course selector pointer).

When Loran has been selected for display on the HSI, the bearing pointer will continue displaying the bearing to a previous selected VOR or RNAV waypoint or NDB. Caution must be used in noting that the pointer will not indicate the bearing to the Loran waypoint.

(d) WAYPOINT ALERT ANNUNCIATOR

Becomes active within a one-minute radius of a waypoint.

(e) PARALLEL OFFSET ANNUNCIATOR

Becomes active whenever a parallel offset is in effect.

SECTION 5 - PERFORMANCE

Installation of the Northstar M1 Loran C Navigator does not affect the basic performance information presented in Section 5 of this Pilot's Operating Handbook.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the Pilot's Operating Handbook.

PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 10
FOR
II MORROW, INC.,
APOLLO II, MODEL 612, LORAN C
NAVIGATION SYSTEM
WITH KAP/KFC 150 AUTOPILOT SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the optional II Morrow, Inc., Apollo II, Model 612, Loran C Navigator is installed per the Equipment List. The information contained herein supplements or supersedes the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL December 12, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional II Morrow, Inc., Apollo II, Model 612, Loran C Navigation System is installed. The navigation system must be operated within the limitations herein specified. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been FAA Approved as a permanent part of this handbook and must remain in this handbook at all times when the Apollo II, Model 612, Loran C Navigation System is installed.

SECTION 2 - LIMITATIONS

(a) II Morrow, Inc., Apollo II, Model 612, Loran C Navigation System, Pilot's Operating Handbook (P/N 560-0022B latest revision) must be immediately available to the flight crew whenever navigation is predicated on the use of the Apollo II.

(b) The Apollo II, Loran C Navigation System is not approved for IFR approaches.

(c) IFR RNAV operation is limited to the 48 contiguous states, and the District of Columbia. (See Pilot's Operating Handbook P/N 560-0022B latest revision.)

(d) During RNAV operation of the Apollo II, Model 612 additional navigation equipment required for the specific type of operation must be installed and operable.

(e) The Apollo II, Model 612 Loran C Navigation System must be checked for accuracy (reasonableness) prior to use as a means of navigation after acquisition of a new GRI, or re-acquisition of the same GRI.

(f) During the Apollo II, Model 612 system start-up test the pilot must check the following items for proper operation prior to each IFR flight: External LORAN WARN annunciator, external LORAN VFR annunciator, CDI needle, and CDI flag. The pilot shall verify that all of the dots in the alpha-numeric displays are functioning. The pilot shall verify that both lamps are operational in the LORAN VFR and LORAN WARN external annunciators.

(g) No flight operation shall be predicated on the use of the Apollo II, Model 612, Loran C Navigation System whenever a NAV OFF flag is displayed by the CDI. In addition, no IFR flight shall be predicated on the use of the Apollo II, Model 612, Loran C Navigation System whenever the external LORAN WARN or LORAN VFR annunciators are lighted, or the accuracy reasonableness check has a consistently greater position error than 3.0 nautical miles or any failure observed during the system start-up test.

(h) The pilot must verify the coordinates of each waypoint to be used during an IFR flight, including those waypoints used from the FLYBRARY data base.

(i) The Apollo II, Model 612 Loran C Navigation System may not be used for IFR flight, during icing conditions.

(j) IFR operation is permitted only if, in the Software Version pages of the SETUP Mode, the following Operating System and Front Panel software versions appear:
  (1) OP 2.6 or 2.7
  (2) FP 1.5

(k) The following placard is located on the pilot's instrument panel adjacent to the HSI:

LORAN C NOT APPROVED FOR APPROACH

(l) If a GRI change is required while in flight, the following Caution should be noted:

CAUTION

When changing GRI in flight, expect to navigate DR for approximately 2 minutes waiting for acquisition of new GRI.

SECTION 3 - EMERGENCY PROCEDURES

No changes to the basic Emergency Procedures provided by Section 3 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 4 - NORMAL PROCEDURES

(a) OPERATION

Normal operating procedures are outlined in the II Morrow Inc., Apollo II, Loran C Pilot's Operating Handbook (P/N 560-0022B, latest revision.

(b) NAV-COUPLED MODE

When operating the KAP/KFC 150 Flight Control System in either the Navigation (NAV) or Approach (APR) Mode and the A/P LORAN/A/P NAV switch has been set to the Apollo II as the navigation source, all operational procedures which are applicable to these two modes, as described in the KAP/KFC 150 Operators Manual and Flight Manual Supplement, still apply, with the following notations or exceptions:

(1) Apollo II, Model 612, Loran C is not approved for IFR approaches.
(2) Course deviation data for the autopilot is derived from the Apollo II.
(3) For course intercept or course tracking, set the HSI course needle to the Loran C course to be flown. This setting provides course datum to the autopilot.
(4) Autopilot Nav Select Switch Positions:

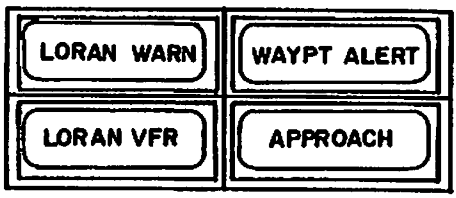
<table>
<tr><th>A/P LORAN
A/P NAV
SW</th><th>A/P NAV 1
A/P NAV 2
SW</th><th>SELECTIONS</th></tr>
<tr><td>A/P NAV</td><td>A/P NAV 1</td><td>NAV #1 coupled to A/P
Displayed on HSI</td></tr>
<tr><td>A/P NAV</td><td>A/P NAV 2</td><td>NAV #2 coupled to A/P
displayed on NAV #2 indicator</td></tr>
<tr><td>A/P LORAN</td><td>*</td><td>LORAN coupled to A/P displayed
on HSI (Blue Indicator light)</td></tr>
<tr><td colspan="3">*When the A/P LORAN/A/P NAV switch is in the Loran mode the A/P NAV 1/ A/P NAV 2 autopilot coupling switch is inactive.</td></tr>
</table>

(c) NAVIGATION DISPLAYS

The Loran C System drives the pilot's HSI display when manually selected by the A/P LORAN/A/P NAV switch. This configuration is annunciated by a mode light adjacent to the HSI. The HSI will only display left or right course information, to/from flags and an Off/Warning flag indication from the Apollo II. The course selector pointer must be manually set to the Loran C course. (Actual course cannot be determined on the HSI by rotating the course selector pointer.)

When Loran has been selected for display on the HSI, the bearing pointer will continue displaying the bearing to a previous selected VOR or RNAV waypoint or NDB. Caution must be used in noting that the pointer will not indicate the bearing to the Loran waypoint.

(d) External Annunciators



The Apollo II also provides status information to four externally mounted annunciators: LORAN WARN, WAYPT ALERT, LORAN VFR, and APPROACH.

LORAN WARN	The LORAN WARN annunciator will light whenever the internal WARN annunciator lights. The LORAN is not usable for navigation.
WAYPT ALERT	The WAYPT ALERT annunciator will light whenever the internal ARIV annunciator lights. You are nearing your destination.

LORAN VFR	When the LORAN VFR annunciator lights you may not use the APOLLO II for IFR navigation. This annunciator will light when the criteria for IFR navigation is not met.

The LORAN VFR annunciator may light while the LORAN WARN annunciator is not lighted. VFR navigation is still permitted.

The LORAN VFR annunciator will light due to the following reasons:

1. You have selected a course offset, ASF factors, Approach CDI resolution.
2. You have manually selected the triad or magnetic variation.
3. Accuracy does not meet IFR standards due to poor geometry, low signal, or high noise.

APPROACH	The APPROACH annunciator will light when the internal APP annunciator is lighted. Approach CDI resolution (1.25 nm full scale) has been selected.

SECTION 5 - PERFORMANCE

Installation of the Apollo II Loran C does not affect the basic performance information in Section 5 of this Pilot's Operating Handbook.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the Pilot's Operating Handbook.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 11 FOR SHADIN FUEL MANAGEMENT SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Shadin Fuel Management System is installed per Piper Drawing No. 89860-2. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D. H. Trompler
D. H. TROMPLER
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL December 12, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Shadin Fuel Management System is installed in accordance with FAA Approved Piper data.

SECTION 2 - LIMITATIONS

(a) Prior to each flight, the fuel management system must be tested operational with the message GOOD appearing in the display. The system is not approved for use if the BAD message appears and must be disabled by pulling its circuit breaker.

(b) The aircraft fuel quantity indicator must be used to determine the actual fuel load on board the aircraft.

SECTION 3 - EMERGENCY PROCEDURES

FUEL MGT Circuit Breaker .... PULL

SECTION 4 - NORMAL PROCEDURES

(a) TEST PROCEDURE

Press the TEST button. All digits will display "8" sequentially for 10 seconds. If the computer checks out the word GOOD will show. (If the test is not successful, the word BAD will be displayed. In such case, the unit must be considered unusable until a correcting action is done.) Followed by:

(1) Software basic number and revision level.

(2) The K-factor setting for the flow transducer in the flow window.

(3) Maximum usable fuel setting in the right window.

NOTE

Using the test function while the engine is running will cause the computer to lose 13 seconds of fuel count.

(b) INITIAL PROGRAMMING

Initial programming is intended to enter the total usable fuel figure into the memory as defined in the Airplane Flight Manual. It can then be recalled whenever the fuel tanks are filled up to the maximum usable fuel level.

(1) PROCEDURE:

a. Power the unit by switching the aircraft master switch on.

b. Move the toggle switch to FULL FUEL position and hold for the entire procedure.

c. Move the toggle to the GAL. REM. and press ENTER/TEST button simultaneously for 30 seconds.

d. The code message FUL will be displayed in the left flow window and the current full fuel value will be displayed in the right window. Release the ENTER button and then GAL. REM. toggle switch. Keep holding FULL FUEL toggle switch.

e. Move the toggle to GAL. REM. position to increment the full fuel number or to GAL. USED position to decrement (the longer you hold, the faster the updating).

f. After reaching the correct total usable fuel figure, press the ENTER button and the computer will store that number as full fuel. The word FUL disappears and the computer will return to the operate mode. Release the FULL FUEL toggle switch.

g. To verify that the data is stored properly, press the TEST button. The computer will run the diagnostic check and then display GOOD. If the test is successful, then it will display the maximum usable fuel value.

(c) PREFLIGHT PROCEDURES

The fuel management system is a fuel flow measuring system and NOT a quantity sensing device and cannot determine the amount of usable fuel. Therefore, it is important than an accurate usable fuel quantity be entered into the system to ensure accurate readings.

(1) NO FUEL ADDED

As data is already stored, no action is needed.

(2) MAXIMUM USABLE FUEL (FULL TANK):

a. Move the toggle switch to the FULL FUEL position and hold. The maximum usable fuel figure will be displayed in the right window.

b. Press the ENTER button.

c. Return the toggle switch to the center position.

d. To verify, move the toggle to GAL. REM. Total usable fuel will be displayed in the right window.

(3) PARTIAL FUEL ADDED

a. Move the toggle switch to the ADD FUEL position and hold.

b. Move the toggle switch to GAL. REM. position to increment fuel added figure. When the amount of fuel added figure is reached, release the GAL. REM. toggle switch. If the correct figure has been exceeded, move the toggle switch to the GAL. USED position to decrement the added fuel figure.

c. Press ENTER button.

d. Return the ADD FUEL toggle switch to the center position. The computer will add the additional fuel to the fuel remaining and use the total as the current fuel remaining.

e. To verify, move the toggle to GAL. REM; current usable fuel remaining will be displayed in the right window.

(d) CORRECTING INPUT ERROR:

In case an error has been made by exceeding the correct amount in entering the number of total usable fuel, select and hold GAL. USED toggle switch and simultaneously press ENTER/TEST button. Fuel used will be reset and the fuel remaining will appear and pause on display for 4 seconds. The figure will decrement and when the correct figure is reached (the longer the press, the faster the decrementing), release both GAL. USED toggle switch and ENTER button. To avoid repeating the 4 second pause during the decrementing, do not release the GAL. USED toggle switch but use the ENTER button to control the decrementing.

(e) IN FLIGHT OPERATION

WARNING

In case of an inflight electrical power failure, the instrument will cease to function. After restoring power, the left window will resume accurate fuel flow reading, but the Time Remaining, Fuel Used, and Fuel Remaining figures will not be accurate unless the duration of the power failure is known and the fuel consumption during the electric power failure is calculated and subtracted from the Fuel Remaining.

The fuel flow is continuously displayed in the left window. The right window displays the time remaining in hours and minutes, or the fuel remaining or used, depending on the position of the toggle switch.

The fuel used may be reset at any time by moving the toggle switch to the GAL. USED position and momentarily pressing the ENTER/TEST button no longer than 4 seconds. Otherwise, the computer will start decreasing the fuel remaining.

NOTE

The time remaining display digits will flash whenever the endurance drops below 30 minutes.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

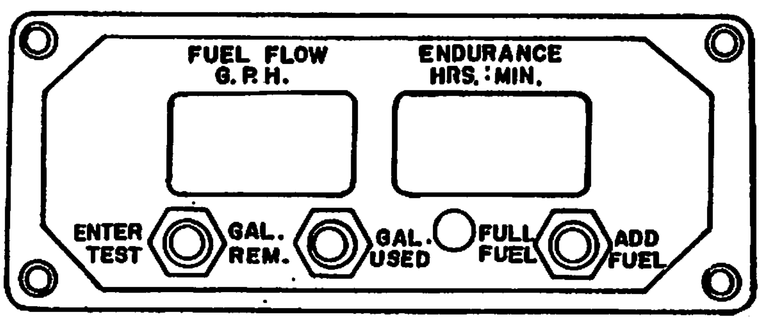
Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the Airplane Flight Manual.

SECTION 7 - DESCRIPTION AND OPERATION OF THE FUEL MANAGEMENT SYSTEM

The fuel management system is designed to improve fuel monitoring and management through the use of a microprocessor to display fuel flow, fuel remaining, fuel used, and time remaining. A transducer mounted in the fuel line measures fuel flow and generates electrical pulses directly proportional to the amount of fuel flow. The microprocessor receives the pulses and displays fuel flow in the left window. Time remaining, fuel used, and fuel remaining are continuously computed and either displayed or stored for later display in the right window. Time remaining calculations are based on fuel remaining and actual fuel flow, which means that reducing the power or leaning the mixture will result in increasing the time remaining. If the calculated time remaining at any particular power setting drops below 30 minutes, the Time Remaining digits in the display window will start flashing.

After shutdown, the amount of fuel remaining is stored in a non-volatile memory which requires no power to retain the data.

Display dimming is controlled by the DAY/NIGHT switch.



FUEL MANAGEMENT SYSTEM
Figure 7-1

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OPERATING TIPS

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SECTION 10

OPERATING TIPS

10.1 GENERAL

This section provides operating tips of particular value in the operation of the Malibu.

10.3 OPERATING TIPS

(a) Learn to trim for takeoff so that only a very light back pressure on the control wheel is required to lift the airplane off the ground.

(b) The best speed for takeoff is 80 to 85 KIAS under normal conditions. Trying to pull the airplane off the ground at too low an airspeed decreases the controllability of the airplane in the event of engine failure.

(c) 10° of flaps may be lowered at airspeeds up to 165 KIAS and full flaps up to 116 KIAS, but to reduce flap operating loads, it is desirable to have the airplane at a slower speed before extending the flaps.

(d) Before attempting to reset any circuit breaker, allow a two to five minute cooling off period.

(e) Before starting the engine, check that all radio switches, light switches and the pitot heat switch are in the off position so as not to create an overloaded condition when the starter is engaged.

(f) Anti-collision lights should not be operating when flying through cloud, fog or haze, since reflected light can produce spatial disorientation. Strobe lights should not be used in close proximity to the ground, such as during taxiing, takeoff or landing.

10.3 OPERATING TIPS (continued)

(g) In an effort to avoid accidents, pilots should obtain and study the safety related information made available in FAA publications, such as regulations, advisory circulars, Aviation News, AIM and safety aids.

(h) Prolonged slips or skids which result in excess of 2000 feet of altitude loss or other radical or extreme maneuvers which could cause uncovering of the fuel outlet must be avoided as fuel flow interruption may occur when the tank being used is not full.

(i) Pilots who fly above 10,000 feet should be aware of the need for special physiological training. Appropriate training is available for a small fee at approximately twenty-three Air Force Bases throughout the United States. The training is free at the NASA Center in Houston and at the FAA Aeronautical Center in Oklahoma.

Forms to be completed (Physiological Training Application and Agreement) for application for the training course may be obtained by writing to the following address:

Chief of Physiological Training, AAC-143
FAA Aeronautical Center
P.O. Box 25082
Oklahoma City, Oklahoma 73125

It is recommended that all pilots who plan to fly above 10,000 feet take this training before flying this high and then take refresher training every two or three years.