NAVAJO

PA-31

PILOT'S OPERATING HANDBOOK

AND

FAA APPROVED AIRPLANE FLIGHT MANUAL

DUPLICATE

AIRPLANE SERIAL NO. 31-8112074

AIRPLANE REGIST. NO. CC-KKG

PA-31
REPORT: LK-1206 FAA APPROVED BY: D. H. Trompler

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D.O.A. NO. SO-2
PIPER AIRCRAFT CORPORATION
LAKELAND, FLORIDA

DATE OF APPROVAL:
SEPTEMBER 18, 1979

FAA APPROVED IN NORMAL CATEGORY BASED ON CAR 3 AND FAR PART 21, SUBPART J. THIS DOCUMENT INCLUDES THE MATERIAL REQUIRED TO BE FURNISHED TO THE PILOT BY CAR 3 AND FAR PART 21, SUBPART J AND CONSTITUTES THE APPROVED AIRPLANE FLIGHT MANUAL AND MUST BE CARRIED IN THE AIRPLANE AT ALL TIMES.

PIPER

WARNING

XTREME CARE MUST BE EXERCISED TO LIMIT THE USE OF
HIS HANDBOOK TO APPLICABLE AIRCRAFT. THIS
ANDBOOK IS VALID FOR USE WITH THE AIRPLANE
ENTIFIED ON THE FACE OF THE TITLE PAGE. SUBSEQUENT
EVISIONS SUPPLIED BY PIPER AIRCRAFT CORPORATION
UST BE PROPERLY INSERTED.

Published by
PUBLICATIONS DEPARTMENT
Piper Aircraft Corporation
Issued: September 18, 1979

ORT: LK-1206

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SECTION 1

GENERAL

1.1 INTRODUCTION

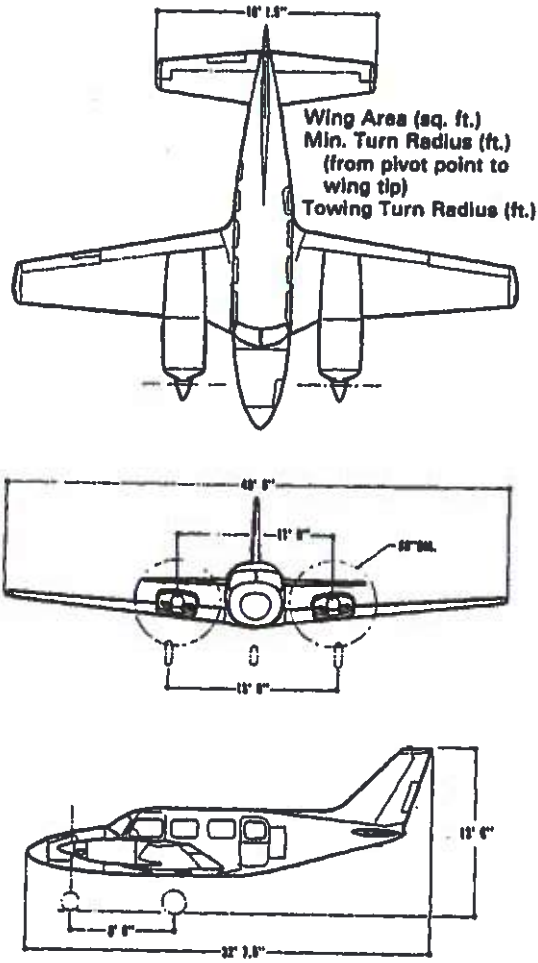
This Pilot's Operating Handbook is designed for maximum utilization as an operating guide for the pilot. It includes the material required to be furnished to the pilot by C.A.R. 3 and FAR Part 21 Subpart J. It also contains supplemental data supplied by the airplane manufacturer.

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 ENGINES

(a) Number of Engines	2
(b) Engine Manufacturer	Lycoming
(c) Engine Model Number	TIO-540-A2C
(d) Rated Horsepower	310
(e) Rated Speed (rpm)	2575
(f) Bore (inches)	5.125
(g) Stroke (inches)	4.375
(h) Displacement (cubic inches)	541.5
(i) Compression Ratio	7.3:1
(j) Engine Type	Six Cylinder, Direct Drive, Fuel Inj., Turbocharged, Horizontally Opposed, Air Cooled

1.5 PROPELLERS

(a) Number of Propellers	2
(b) Propeller Manufacturer	Hartzell
(c) Blade Model	FC8468-6R
(d) Number of Blades	3
(e) Hub Model	HC-E3YR-2ATF
(f) Propeller Diameter (inches)	
(1) Maximum	80
(2) Minimum	78
(g) Propeller Type	Feathering Constant Speed, Hydraulically Actuated

FUEL

a) Fuel Capacity (U.S. gal) (total)	192
b) Usable Fuel (U.S. gal) (total)	187.3
c) Fuel Grade Aviation *	
(1) Minimum Octane	100/130 - Green
(2) Specified Octane	100/130 - Green 100 - Green 100 LL - Blue
(3) Alternate Fuels **	115/145 - Purple Refer to Lycoming Service Instruction 1070, Revision J or later.

OIL

a) Oil Capacity (U.S. quarts) (each engine)	12
b) Oil Specification	Refer to latest issue of Avco-Lycoming Service Instruction 1014.
c) Oil Viscosity per Average Ambient Temp. for Starting	Refer to Section 8, Paragraph 8.23.

MAXIMUM WEIGHTS

a) Maximum Ramp Weight (lbs)	6536
b) Maximum Takeoff Weight (lbs)	6500
c) Maximum Landing Weight (lbs)	6500
d) Maximum Zero Fuel Weight (lbs)	6200
e) Maximum Weights in Baggage Compartments (lbs)	
(1) Forward (Nose)	150
(2) Aft	200

i-icing additive per MIL-I-27686 is approved for use in the above fuels he amount by volume 0.15% maximum. (See Section 8 for blending handling procedures.)

rnate Fuels refers to military grade with 4.6 ml of TEL. See Section 5 concerning use of alternate fuel grades.

1.13 STANDARD AIRPLANE WEIGHT*

(a) Standard Empty Weight (lbs): Weight of a standard airplane including unusable fuel, full operating fluids and full oil;	4003
(b) Maximum Useful Load (lbs): The difference between the Maximum Ramp Weight and the Standard Empty Weight.	2533

1.15 BAGGAGE SPACE

	FORWARD	AFT
(a) Compartment Volume (cubic feet)	14	22
(b) Entry Width (inches)	26.5	27.5**
(c) Entry Height (inches)	20	47

1.17 SPECIFIC LOADINGS

(a) Wing Loading (lbs per sq ft)	28.4
(b) Power Loading (lbs per hp)	10.5

* These values are approximate and vary from one aircraft to another. Refer to Figure 6-7 for the Standard Empty Weight value and the Useful Load value to be used for C.G. calculations for the aircraft specified.

** Aft cargo entry width is increased to 45 inches when optional cargo door is installed.

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1.19 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.

V_{LE}	Maximum Landing Gear Extended Speed is the maximum speed at which an aircraft can be safely flown with the landing gear extended.
V_{LO}	Maximum Landing Gear Operating Speed is the maximum speed at which the landing gear can be safely extended or retracted.
V_{MCA}	Air Minimum Control Speed is the minimum flight speed at which the airplane is directionally controllable as determined in accordance with Federal Aviation Regulations. Airplane certification conditions include one engine becoming inoperative and windmilling; not more than a 5° bank towards the operative engine; takeoff power on operative engine; landing gear up; flaps in takeoff position; and most rearward C.G.
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.
V_{SSE}	Intentional One Engine Inoperative Speed is a minimum speed selected by the manufacturer for intentionally rendering one engine inoperative in flight for pilot training.

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.

(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 component of the reported winds.

c) Power Terminology (Specific)

Maximum Continuous Power	Maximum power permissible continuously during takeoff, one engine inoperative, and emergency operations only.
Maximum Normal Operating Power	Maximum power permissible continuously during all normal operations.

d) Engine Instruments

EGT Gauge	Exhaust Gas Temperature Gauge

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.
BSFC	Brake Specific Fuel Consumption (BSFC) is the number of pounds of fuel burned per hour to produce one horsepower.

(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.
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

2.1 GENERAL

This section provides the "FAA Approved" operating limitations, instrument markings, color coding and basic placards necessary for the operation of the PA-31 Navajo 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	KCAS	KIAS
Never Exceed Speed (V_{NE}) - Do not exceed this speed in any operation.	236	236
Maximum Structural Cruising Speed (V_{NO}) - Do not exceed this speed except in smooth air and then only with caution.	187	188
Design Maneuvering Speed (V_A) - Do not make full or abrupt control movements above this speed.	159	159
Maximum Flaps Extended Speed (V_{FE}) - Do not exceed this speed with a given flap setting.		
Flaps extended speeds		
15° flap	160	174
25° flap	160	174
40° flap	130	140

	KCAS	KIAS
Maximum Gear Extended Speed (V_{LE}) - Do not exceed this speed with landing gear extended.	156	156
Maximum Landing Gear Operating Speed (V_{LO}) - Do not extend or retract landing gear above this speed.		
Extend	156	156
Retract	130	129
Air Minimum Control Speed (V_{MCA}) - Lowest airspeed at which airplane is controllable with one engine operating and takeoff flaps.	74	76
Stall Speed (full flaps, gear down, power off, 6500 lbs.) (See Section 5, Performance, for stall speeds at reduced weights.)	63	70

NOTE

The maximum altitude loss during a single-engine stall, gear and flaps retracted is 500 feet. Altitude loss is less for other aircraft configurations.

Demonstrated Crosswind Velocity 20 KTS

2.5 AIRSPEED INDICATOR MARKINGS

MARKING	KIAS
Green Arc (Normal Operating Range)	77 to 188
Yellow Arc (Caution Range - Smooth Air)	188 to 236
White Arc (Flaps Extended Range)	70 to 140
Radial Red Line (Never Exceed - Smooth Air)	236
Radial Red Line (Minimum Control Speed - Single Engine)	76
Radial Blue Line (Best Rate of Climb Speed - Single Engine)	94

2.7 POWER PLANT LIMITATIONS

(a) Number of Engines	2
(b) Engine Manufacturer	Lycoming
(c) Engine Model Number	TIO-540-A2C
(d) Engine Operating Limits	
(1) Maximum Continuous Power	
(a) Maximum Horsepower	310
(b) Maximum Rotational Speed (RPM)	2575
(c) Maximum Manifold Pressure (Inches of Mercury)	
To 15,800 feet	46.0
15,800 to 24,000 feet	46.0 minus 1.6 per 1000 feet increase
(d) Maximum Cylinder Head Temperature	500°F
(2) Maximum Normal Operating Power (Top of Tachometer and Manifold Pressure Gauge Green Arc)	
(a) Maximum Horsepower	275
(b) Maximum Rotational Speed	2400
(c) Maximum Manifold Pressure (Inches of Mercury)	
To 19,700 feet	39.5
19,700 to 24,000 feet	39.5 minus 1.6 per 1000 feet increase
(d) Maximum Cylinder Head Temperature	475°F
(3) Maximum Oil Temperature	245°F
(4) Maximum Exhaust Gas Temperature	1650°F

e) Oil Pressure	
Minimum (red line)	25 PSI
Maximum (red line)	100 PSI
f) Fuel Pressure	
Normal Operating Range (green arc)	25 PSI to 45 PSI
Minimum (red line)	25 PSI
Maximum (red line)	45 PSI
g) Fuel Grade (minimum octane)	100/130 - Green
h) Number of Propellers	2
i) Propeller Manufacturer	Hartzell
j) Propeller Hub Model	HC-E3YR-2ATF
k) Propeller Blade Model	FC8468-6R
l) Propeller Diameter	
Maximum	80 IN.
Minimum	78 IN.
m) Propeller Pitch Settings at 30 Inch Station	
Low Pitch Stop	13.2° ± 0.1°
High Pitch Stop (Feathered)	82.0° ± 1.0°

POWER PLANT INSTRUMENT MARKINGS

a) Tachometer	
Green Arc (Normal Operating Range)	500 RPM to 2400 RPM
Radial Red Line (Maximum)	2575 RPM
b) Fuel Pressure	
Green Arc (Normal Operating Range)	25 PSI to 45 PSI
Radial Red Line	
Minimum	25 PSI
Maximum	45 PSI
c) Cylinder Head Temperature	
Green Arc (Normal Range)	100°F to 475°F
Yellow Arc (Caution)	475°F to 500°F
Radial Red Line (Never Exceed)	500°F
d) Oil Temperature	
Green Arc (Normal Operating Range)	120°F to 245°F
Yellow Arc (Caution)	50°F to 120°F
Radial Red Line (Maximum)	245°F

(e) Oil Pressure	
Green Arc (Normal Operating Range)	60 PSI to 90 PSI
Yellow Arc (Caution)	25 PSI to 60 PSI and 90 PSI to 100 PSI
Radial Red Line (Minimum)	25 PSI
Radial Red Line (Maximum)	100 PSI
(f) Exhaust Gas Temperature	
Green Arc (Normal Operating Range)	Zero or lower scale limit to 1650°F
Radial Red Line (Never Exceed)	1650°F
(g) Manifold Pressure	
Radial Red Line (Never Exceed)	46 IN. HG.
Green Arc (Normal Operating Range)	18 IN. HG. to 39.5 IN. HG.

2.11 WEIGHT LIMITS

(a) Maximum Ramp Weight	6536 LBS
(b) Maximum Takeoff Weight	6500 LBS
(c) Maximum Landing Weight	6500 LBS
(d) Maximum Zero Fuel Weight	6200 LBS
(e) Maximum Weight in Baggage Compartments	
Forward (Nose)	150 LBS
Aft	200 LBS

NOTE

It is the responsibility of the airplane owner and the pilot to insure that the airplane is properly loaded. Maximum allowable takeoff and landing weight is 6500 lbs. Maximum allowable ramp weight is 6536 lbs. See Section 6 (Weight and Balance) for proper loading instructions.

2.12 FUEL LIMITATIONS

(a) Fuel Capacity (U.S. gal.) (total)	192
(b) Usable Fuel (U.S. gal.) (total)	187.3

CENTER OF GRAVITY LIMITS (GEAR EXTENDED)

Weight Pounds	Forward Limit Inches Aft of Datum	Rearward Limit Inches Aft of Datum
(Max. Ramp Weight)	134.0	138
(Max. Takeoff Weight)	134.0	138
	128.5	138
r less	120.0	138

NOTES

Straight line variation between the points given.

Datum line is located 137 inches ahead of the wing main spar centerline.

MANEUVER LIMITS

his is a normal category airplane. All intentional acrobatic maneuvers ling spins) are prohibited.

FLIGHT LOAD FACTOR LIMITS (MANEUVERS)

Positive Load Factor (Maximum)	3.6 G
Negative Load Factor (Maximum) (No Inverted Maneuvers Approved)	-1.44 G
Positive Load Factor (Flaps down) (Maximum)	2.00 G

COWL FLAPS LIMITATIONS

wl flaps are provided to allow control of engine tempertures. The aps should be open during ground operations and in climbs. In no ould the cylinder head temperature be allowed to exceed 500°F or the perature to exceed 245°F.

2.21 MINIMUM CREW

The minimum crew for operating this airplane is one pilot unless the type of operation (air taxi, for example - see FAR's) requires a copilot.

2.23 MAXIMUM OPERATING ALTITUDE

24,000 feet

2.25 TYPES OF OPERATION LIMITS

The Federal Aviation Regulations make the operator of an aircraft responsible for insuring that sufficient and proper instruments and equipment are installed, operating, and calibrated for the type of flight being undertaken. These regulations (for example, see FAR 91.3(a), 91.25, 91.33, 91.97 and 91.170) also specify the minimum instruments and equipment which must be available for the various types of flight such as VFR, IFR, night, commercial, air taxi, high altitude, icing and so on. It is recommended that pilots of this aircraft make themselves familiar with these regulations in order to avoid violating them. While the regulations list minimum instruments and equipment, experienced pilots realize that the minimum practical instruments and equipment depends on the pilot's capability, weather, terrain, the flight plan, facilities to be used, whether flight is during daylight or night, at high or low altitude, for hire or not, in icing conditions or not, and so on. Pilots are cautioned to consider all factors in determining whether they have all the required equipment for making a particular flight.

When properly equipped this airplane may be flown day or night, VFR or IFR, and in known icing.

The certificating regulations of the FAA for this airplane require the manufacturer to specify in the Pilot's Operating Handbook the types of operation for which the airplane is equipped.

The equipment installed in this aircraft has been substantiated to 24,000 feet.

/hen this airplane was licensed it contained the properly installed nent listed in the Weight and Balance Section of this Handbook and, ore was satisfactory for the types of operation indicated below by an ik.

)_____ Day VFR

)_____ Night VFR

)_____ Day and night IFR after adequate communication and navigation radio has been installed in an FAA approved manner.

)_____ Day and night IFR

)_____ Known icing after deicing and icing equipment listed on a following page for operation in known icing conditions has been installed in accordance with Piper drawings or in an FAA approved manner.

)_____ Known icing.

perators are warned that if any of the equipment listed as having been ed at time of licensing is changed, not operating, or not properly ined and calibrated, the airplane may not be properly equipped for all nditions noted above. It is the responsibility of the pilot to determine r the lack of a piece of equipment limits the conditions under which he y the airplane.

AIRCRAFT

_____ _____

TRATION NO. SERIAL NO.

wners desiring to make changes or additions to the equipment must hese modifications done in an FAA-approved manner. All PA-31 t are licensed equipped for day and night VFR flight, and for IFR except when there may be insufficient communications or navigation quipment installed.

e performance, handling qualities and structure of the airplane are ed for instrument flight.

If an owner of an airplane which is approved for VFR flight only desires to extend his operations to IFR, he should have radio equipment installed in accordance with Piper-approved drawings or other FAA-approved data (or data approved by the aviation agency of the country of registration). The owner should insure that the radio equipment is adequate for the ground facilities to be used, is of sufficiently high quality and reliability, is properly functioning, adjusted and calibrated, and that it is compatible with previously installed equipment before authorizing it to be flown under instrument conditions.

This airplane is approved for day and night VFR and IFR flight when all of the following conditions have been met: the required equipment or FAA-approved equivalent is installed either originally by Piper or in an FAA-approved manner, is functioning properly, and is calibrated in accordance with Federal Aviation Regulations; and adequate radio communications and navigation equipment is installed in the same manner as indicated above.

If the airplane is approved for night IFR, but is not approved for flight in icing conditions when licensed, it will be necessary for an owner to add all the equipment listed in this section as required for flight in icing conditions if he desires to operate in icing conditions. If this equipment is properly installed in accordance with Piper-approved drawings and all the other equipment required for night IFR flight is installed in an FAA-approved manner, is adequate for the ground facilities to be used, is of sufficient quality, is functioning properly, and is calibrated in accordance with the FAR's, the airplane is approved for IFR flight in known icing conditions. If anti-icing and deicing equipment is not installed in accordance with Piper drawings, FAA approval or approval of the aviation agency of the country of registry must be obtained in order to legally conduct flight in icing conditions.

Flight through any icing conditions is prohibited if any of the anti-icing or deicing equipment is missing or not functioning.

Pilot's are reminded that oxygen must be available to passengers and crew during high altitude flight and that special electronic equipment is required for flight above specified altitude.

FAR 135 places special requirements on air taxi and commercial operators.

accordance with the FAR's, this airplane is not properly equipped for ndition of flight indicated if any of the equipment listed below is not rly installed, functioning, properly maintained and calibrated ling to the FAR's. The pilot is responsible for assuring compliance he latest ammendments to FAR 91 concerning required equipment.

) Day VFR
(1) Airspeed indicator
(2) Altimeter
(3) Magnetic direction indicator
(4) Tachometer - each engine
(5) Oil pressure gauge - each engine
(6) Stall warning indicator
(7) Oil temperature gauge - each engine
(8) Manifold pressure gauge - each engine
(9) Fuel gauges
(10) Fuel pressure indicator - each engine
(11) Exhaust gas temperature gauge - each engine
(12) Landing gear position indicator
(13) Seat belts - each occupant
(14) Emergency locator transmitter
(15) Above 12,500 feet - transponder with automatic altitude reporting capability.
(16) Starter - each engine

Night VFR
(1) All equipment required for Day VFR
(2) Position lights
(3) Strobe lights or rotating beacon
(4) Alternator - each engine
(5) Instrument lights
(6) Landing light, if for hire

(c) Day IFR
- (1) All equipment required for Day VFR
- (2) Two-way radio for communication
- (3) Suitable and adequate navigation radio equipment
- (4) Gyroscopic rate of turn indicator
- (5) Bank indicator
- (6) Clock with sweep second hand
- (7) Sensitive altimeter adjustable for barometric pressure
- (8) Alternators - each engine
- (9) Gyroscopic bank and pitch indicator
- (10) Gyroscopic direction indicator
- (11) Free air temperature indicator

(d) Night IFR
- (1) All equipment required for Day and Night VFR
- (2) All equipment required for Day IFR

(e) Flight in Positive Control Areas
- (1) Transponder

(f) Known Icing

For flight in known icing conditions the following equipment must be installed in accordance with Piper drawings or in a FAA approved manner:
- (1) All equipment required for Night IFR
- (2) Pneumatic wing and empennage boots (including inboard wing boots)
- (3) Electrothermal propeller boots
- (4) Pilot side heated windshield
- (5) Heated pitot
- (6) Ice detection light
- (7) Heated stall warning transmitter
- (8) Non-icing heater air inlet
- (9) Heater combustion air alternate source
- (10) Forward heater
- (11) Ice shields
- (12) Prop control deicer boot
- (13) 'A' - 'B' pneumatic system

The following equipment is required and is normally part of the standard airplane:

(1) Alternate static system
(2) Elevator balance boot
(3) Direct vision window

) Flight with Third and/or Fourth Seats in the Aft Facing Position

(1) When the third and/or fourth seats are installed in the aft facing position, 10 inch minimum height headrests must be installed.

NOISE LEVEL

he corrected Noise level of this aircraft is 75.4 dB(A) determined at the num Normal Operating Power of 2400 RPM and 39.5 inches of old pressure.

o determination has been made by the Federal Aviation nistration that the noise levels of this airplane are or should be table or unacceptable for operation at, into or out of, any airport.

he above statement not withstanding, the noise level stated above has verified by and approved by the Federal Aviation Administration in level test flights conducted in accordance with FAR 36. "Noise ards: Aircraft Type and Airworthiness Certification". The aircraft is in compliance with all FAR 36 noise standards applicable to this

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PLACARDS

On top right side of instrument panel:

THIS AIRCRAFT MUST BE OPERATED AS A NORMAL CATEGORY AIRPLANE IN COMPLIANCE WITH THE OPERATING LIMITATIONS STATED IN THE FORM OF PLACARDS, MARKINGS AND MANUALS. NO ACROBATIC MANEUVERS (INCLUDING SPINS) APPROVED.

FOR TYPES OF OPERATION SEE PILOT'S OPERATING HANDBOOK

On top left side of instrument panel:

MINIMUM CONTROL SPEED	76 KIAS
MAXIMUM SP. LG - RET. 129 KIAS	EXTEND 156 KIAS
DESIGN MANEUVERING SPEED	159 KIAS

SEE PILOT'S OPERATING HANDBOOK
FOR ADDITIONAL SPEEDS

On floor between pilot and copilot seats:

EMERGENCY GEAR EXTENSION
REMOVE COVER
EXTENSION INSTRUCTIONS ON REVERSE SIDE

On underside of emergency gear extension door:

EMERGENCY GEAR EXTENSION

1. PLACE GEAR SELECTOR HANDLE IN DOWN POSITION
2. PULL EMERGENCY PUMP HANDLE OUT AS FAR AS POSSIBLE
3. PUMP HANDLE UP AND DOWN UNTIL ALL 3 GREEN LIGHTS COME ON. CONTINUE PUMPING UNTIL PRESSURE BUILDS UP AND SELECTOR HANDLE RETURNS TO NEUTRAL.

On fuel system console:

(a) On right end of fuel system control console:

RIGHT FIREWALL
FUEL
SHUT OFF

(b) On both ends of fuel system control console:

OFF

(c) On left end of fuel system control console:

LEFT FIREWALL
FUEL
SHUT OFF

(d) On the fuel control console for outboard tank:

LEVEL FLIGHT ONLY

On window post between the second and third window on the right side of cabin:

EMERGENCY EXIT RELEASE
REMOVE COVER
PULL HANDLE DOWN
PUSH EMERGENCY
EXIT OUT

At top of emergency exit window on moulding:

EMERGENCY EXIT

On forward baggage compartment door:

BAGGAGE CAPACITY
150 LBS MAX
SEE LOADING SCHEDULE

n rear bulkhead in rear baggage compartment:

MAXIMUM BAGGAGE 200 LBS
SEE LOADING SCHEDULE

n the pilot's window moulding:

WARNING

TURN OFF ANTI-COLLISION LIGHTS WHEN TAXIING IN VICINITY OF OTHER AIRCRAFT OR DURING FLIGHT THROUGH CLOUD, FOG OR HAZE. STANDARD POSITION LIGHTS TO BE TURNED ON FOR ALL NIGHT OPERATIONS.

n window moulding adjacent third and fourth passenger seats:

IREMENTS FOR OCCUPANCY OF AFT FACING SEAT
1. SEAT HEADREST (10" MIN HT.) INSTALLED.
2. SEAT BACK BOLTED IN UPRIGHT POSITION.

n pilot's door window moulding (when pilot's door is installed):

OPEN DOOR CLOSED
CLOSE DOOR PRIOR TO STARTING ENGINES

THEFT LOCK
PULL TO UNLOCK
PRIOR TO FLIGHT

On lower left instrument panel (when windshield wiper is installed):

WINDSHIELD WIPER
DO NOT OPERATE ABOVE 126 KIAS
OR ON DRY WINDSHIELD

On inside of nacelle locker doors:

BAGGAGE CAPACITY
150 LBS. MAX.
SEE LOADING SCHEDULE
DO NOT EXCEED
10 LBS./SQ. FT. FLOOR LOADING
OR 100 LBS. DIFF. BETWEEN LOCKERS

1 top center of aft cabin panel (cargo loading placard):

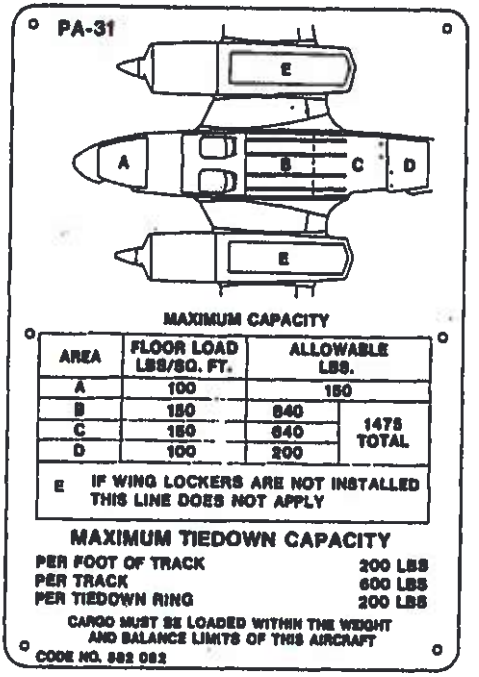


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SECTION 3

EMERGENCY PROCEDURES

3.1 GENERAL

The recommended procedures for coping with various types of emergencies and critical situations are provided in this section. All of the required (FAA regulations) emergency procedures and those necessary for the operation of the airplane as determined by the operating and design features of the airplane are presented.

Emergency procedures associated with those optional systems and equipment which require handbook supplements are provided in Section 9 (Supplements).

The first portion of this section consists of an abbreviated emergency checklist which supplies an action sequence for critical situations with little emphasis on the operation of systems.

The remainder of the section presents amplified emergency procedures containing additional information to provide the pilot with a more complete understanding of the procedures.

These procedures are suggested as a course of action for coping with the particular condition described, but are not a substitute for sound judgment and common sense. Pilots should familiarize themselves with the procedures given in this section and be prepared to take appropriate action should an emergency arise.

Most basic emergency procedures, such as power off landings, are a normal part of pilot training. Although these emergencies are discussed here, this information is not intended to replace such training, but only to provide a source of reference and review, and to provide information on procedures which are not the same for all aircraft. It is suggested that the pilot review standard emergency procedures periodically to remain proficient in them.

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3.3 EMERGENCY CHECKLIST

SPEEDS

Air Minimum Control	76 KIAS
Best Single Engine Angle of Climb	90 KIAS
Best Single Engine Rate of Climb	94 KIAS
Maneuvering	159 KIAS
Never Exceed	236 KIAS

ENGINE INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE
(FEATHERING PROCEDURE)

VOLAR El Avión

Throttle	close
Propeller	FEATHER (1000 RPM min.)
Mixture	IDLE CUT-OFF
Cowl flaps	close
Magneto switch	OFF
Emergency fuel pump	OFF
Fuel selector	OFF (detent)
Alternator CB switch	OFF
Prop. Sync	OFF
Electrical load	reduced
Crossfeed	if required

ENGINE FAILURE DURING NORMAL TAKEOFF (BELOW 83 KIAS)

If sufficient runway remains for a safe stop:

Throttles	CLOSE immediately
Brakes	as required

Stop straight ahead

If insufficient runway remains for a safe stop:

Throttles	CLOSE immediately
Brakes	as required
Mixture	IDLE CUT-OFF
Master switch	OFF
Fuel selectors	OFF
Magneto switches	OFF

NOTE

Maintain directional control and maneuver to avoid obstacles.

INE FAILURE DURING NORMAL TAKEOFF (83 KIAS or above)

ctional control.....Maintain
r (operating engine).....Max. continuous
eller control (inop. engine).....FEATHER
(in level or climbing flight).....RETRACT
.....5° into operative engine
peed.....Accelerate to 89 KIAS
flap (inop. engine).....CLOSE
peed.....94 KIAS after all obstacles have been cleared

ne Securing Procedure
nop. engine).....complete
.....as required

NOTE

Land as soon as practical at nearest suitable airport.

WARNINGS

Negative climb performance may result from an engine failure occurring after lift-off and until the gear has been retracted, the failed engine propeller has been feathered and the cowl flap on the failed engine is closed. Refer to "Single Engine Climb" chart, Figure 5-21, for clean configuration positive climb performance.

Certain combinations of aircraft weight, configuration, ambient conditions and airspeeds will result in negative climb performance. (Refer to specific chart in Performance Section.)

ENGINE FAILURE DURING SHORT FIELD TAKEOFF
(Below 91 KIAS)

If sufficient runway remains for a safe stop:

Throttles.....CLOSE immediately
Land (if airborne).....on remaining runway
Brakes.....as required

If insufficient runway remains for a safe stop:

Throttles.....CLOSE immediately
Mixtures.....IDLE CUT-OFF
Master switch.....OFF
Fuel selectors.....OFF
Magneto switches.....OFF
Land (if airborne) avoiding obstacles

ENGINE FAILURE DURING SHORT FIELD TAKEOFF
(91 KIAS or above)

If sufficient runway remains for a safe stop:

Throttles.....CLOSE immediately
Land.....on remaining runway
Brakes.....as required

If insufficient runway remains and the decision is made to abort the takeoff:

Throttles.....CLOSE immediately
Landing gear.....Extend

NOTE

Depending on terrain, it may be advisable to land with the gear retracted.

Flaps.....Extend
Airspeed.....89 KIAS min.
Mixtures.....IDLE CUT-OFF
Master switch.....OFF

selectors.....OFF
eto switches.....OFF
avoiding obstacles

ufficient runway remains, the terrain ahead is unsuitable for a safe
ıg and the decision is made to continue the takeoff:

tional control.....Maintain
r (operating engine).....Max. Continuous
ller control (inoperative engine).....FEATHER
ng gear (in level or climbing flight).....Retract
.....5° into operating engine
.....Retract in increments
ed.....Maintain 91 KIAS until
all obstacles have been cleared
then accelerate to 94 KIAS
e securing procedures.....accomplish

WARNINGS

Negative climb performance may result from an engine failure occurring after lift-off and until the gear and flaps have been retracted, the failed engine propeller has been feathered and the cowl flap on the failed engine is closed. Refer to "Single Engine Climb" chart, Figure 5-21, for clean configuration positive climb performance.

Certain combinations of aircraft weight, configuration, ambient conditions and airspeeds will result in negative climb performance. (Refer to specific chart in Performance Section.)

ENGINE FAILURE DURING CLIMB

Airspeed ..... maintain 94 KIAS
Directional control ..... maintain
Inop. engine ..... identify and verify
Inop. engine ..... complete Engine Securing Procedure

Land as soon as practical at nearest suitable airport.

ENGINE FAILURE DURING FLIGHT (Below 76 KIAS)

Rudder ..... apply towards operative engine
Throttles (both engines) ..... retard to stop turn
Pitch attitude ..... lower nose to accelerate above 76 KIAS
Operative eng. ..... increase power as airspeed increases above 76 KIAS

If altitude permits, a restart may be attempted.

If restart fails or altitude does not permit:
Inop. eng. prop ..... FEATHER
Trim ..... adjusted (5° bank into operative eng.)
Inop. eng. ..... complete Engine Securing Procedure
Cowl flap (operative end.) ..... as required

ENGINE FAILURE DURING FLIGHT (Above 76 KIAS)

Inop. eng. ..... identify
Operative eng. ..... adjust as required
Airspeed ..... attain and maintain at least 94 KIAS

e securing inop. engine:
flow.....check (if deficient - emergency fuel pump ON)
quantity.....check
selector (inop. eng.).....switch to other tank containing fuel
essure and temp.....check
eto switches.....check
art.....attempt

ine does not start, complete Engine Securing Procedure.

r (operative eng.).....as required
re (operative eng.).....full rich
quantity (operative eng. tank).....sufficient
gency fuel pump
erative eng.).....as required
flap (operative eng.).....as required
.....adjusted (5° bank into operative eng.)
ical load.....decrease to min. required

as soon as practical at nearest suitable airport.

LE ENGINE LANDING

ngine.....Engine Securing Procedure complete
ulic pump.....check
elts/harnesses.....secure
.....FAN position
ency fuel pump (operative eng.).....ON
re (operative eng.).....RICH
ler (operative eng.).....full FORWARD
elector on
rative engine side.....ON INBOARD tank
eed.....OFF
lap (operative eng.).....as required
ed.....maintain 104 KIAS min. until landing is assured
le.....higher than normal until landing is assured

When landing is assured:

Gear ..... DOWN
Flaps ..... DOWN
Power ..... retard slowly and flare airplane
Trim ..... as power is reduced (airplane will yaw in direction of operative engine)

SINGLE ENGINE GO-AROUND

(Not possible from a full flap position unless sufficient altitude is available to raise flaps in a descent.)

Avoid, if possible, if necessary:

Airspeed ..... hold 94 KIAS
Power ..... max. on operating engine
Flaps ..... retract
Landing gear ..... retract
Cowl flaps on operative engine ..... as required
Trim ..... as required

AIR START (UNFEATHERING PROCEDURE)

Fuel selector ..... ON
Magnetos ..... ON
Throttle ..... open 1/2 inch
Propeller ..... 1/2 forward
Mixture ..... forward
Starter ..... engage until prop unfeathers
Propeller ..... pull back to low RPM position as propeller speed accelerates through 1000 RPM
Throttle ..... reduced power until warm; 2000 RPM max.
Alternator ..... ON
Engine instruments ..... check
Air conditioner ..... (as desired) ON
Propeller ..... manual sync with operating engine
Throttle ..... set as desired
Prop Sync ..... (as desired) ON

GINE ROUGHNESS

ergency fuel pumps.....ON
gine instruments.....scan for cause
cture.....adjust as required
ernate air.....OPEN
vl flaps.....adjust for proper CHT
l.....Switch tanks if fuel in second tank
gnetos.....check

WARNING

If either the right or left fuel flow warning light illuminates and the fuel gauge indicates fuel remaining in the corresponding inboard tank, this will indicate a malfunction of the flapper door in the inboard tank. Immediately select the outboard tank or select crossfeed to avoid fuel flow interruption.

GINE OVERHEAT

l flaps.....OPEN
ture.....richen
er.....reduce
peed.....increase (if altitude permits)

S OF OIL PRESSURE

ne.....secure per Engine Securing Procedure

JGH AIR OPERATION

to manuevering speed or slightly less (6500 lbs. 159 KIAS).
ıttitude and avoid abrupt manuevers.
belt and shoulder harness - tighten.

ENGINE FIRE ON GROUND (Engine start, taxi and takeoff with sufficient distance remaining to stop)

Firewall fuel shutoff ..... OFF
Emergency fuel pump ..... OFF
Brakes ..... as required
Throttle (affected engine) ..... OPEN
Radio ..... call for assistance
Mixture (if fire persists) ..... IDLE CUT-OFF
External fire extinguisher ..... use

NOTES

If fire continues, shut down both engines and evacuate.
If fire is on the ground, it may be possible to taxi away.

ENGINE FIRE IN FLIGHT

Fire wall fuel shutoff ..... OFF
Throttle ..... IDLE
Propeller ..... FEATHER
Mixture ..... IDLE CUT-OFF
Inoperative engine ..... complete Engine Securing Procedure

Land as soon as possible.

ELECTRICAL FIRE

Flashlight (at night) ..... located
Master switch ..... OFF
Circuit breakers ..... checked & pulled
All electrical switches ..... OFF
Master switch ..... ON
CB and switch for each unit (one at a time) ..... ON
CB and switch for failed unit ..... OFF

CROSSFEED

Fuel selector (inop. eng.) level flight ..... either tank
Emergency fuel pump (inop. eng.) ..... ON
Crossfeed ..... ON
Fuel selector (op. eng.) ..... OFF
Emergency fuel pump (op. eng.) ..... OFF

ING OUT OF CROSSFEED
)R TO LANDING)

elector (op. eng.) ..... INBOARD tank
ency fuel pump (op. eng.) ..... ON
eed ..... OFF
ency fuel pump (inop. eng.) ..... OFF
elector (inop. eng.) ..... OFF

ALTERNATOR INOP. LIGHT ON

cal load ..... reduced
). side of master switch ..... OFF
d CBs ..... reset
). side of master switch ..... ON
oad (if light goes out) ..... reinstated
remains lit or alt. CB has tripped:
). side of master switch ..... OFF
al load ..... reduction continued

ALTERNATOR INOP. LIGHTS ON

above procedure for each side.
lights stay on:
switch (both sides) ..... ON
tor CB switches ..... OFF
al load ..... minimum
soon as practical.

PROPELLER/GOVERNOR MALFUNCTIONS

RPM UNDERSPEED

Power ..... reduced
Mixture ..... RICH
If prop. moves to feather:
Mixture ..... IDLE CUT-OFF
Prop control ..... FEATHER
Engine ..... Engine Securing Procedures complete

NOTE

Propeller will move to feather if engine oil pressure is lost.

RPM OVERSPEED

Power ..... reduced
Airspeed ..... reduced
Prop control (if prop speed cannot be kept below 2575 RPM) ..... FEATHERED

NOTE

If prop will not feather, do not shut down engine.

Engine ..... Engine Securing Procedures complete if prop will feather

EMERGENCY GEAR EXTENSION

Airspeed ..... 156 KIAS max.
Gear selector ..... DOWN
Emerg. gear extender cover ..... opened
Emerg. gear extender ..... extended
Extender handle (till 3 green lights and selector returns to neutral) ..... pumped

RGENCY EXIT

econd window from
nt on right side) ..... locate
las cover ..... remove
e ..... pull down
ency exit window ..... push out

T UP LANDING

d personnel ..... inform (if possible)
..... burn off (if time allows)
igers ..... briefed
il landing checklist ..... complete
elector ..... UP
ilot ..... OFF
switch (daytime) ..... OFF
a normal approach
runway is made and landing assured:
es ..... IDLE CUT-OFF
ontrols ..... FEATHER
all fuel shutoffs ..... OFF
lectors ..... OFF
lown at minimum airspeed and level attitude
switch (night) ..... OFF
ite

NOTE

If nose gear is not extended, the landing light will not be functioning.

FLAP SYSTEM MALFUNCTION

ANNUNCIATOR LIGHT ON

Flap selector ..... reposition slightly
If flaps move ..... replace amplifier prior to next flight
If flaps do not move ..... check for split flaps
If flaps are split ..... pull flap motor CB and land in this condition
If flaps are not split ..... pull and reset flap motor CB
If flaps still do not operate ..... pull flap motor CB and land in this condition

FLAPS FAIL TO RESPOND TO FLAP SELECTOR (WITH FLAP INDICATOR POINTING TO OFF)

Flap control CB ..... pull and reset
If indicator remains "OFF" ..... the flap control is inoperative and flaps cannot be repositioned for landing or go-around
If indicator shows flap position ..... use following checklist

FLAPS FAIL TO RESPOND TO FLAP SELECTOR (WITH FLAP INDICATOR POINTING TO FLAP POSITION)

Flap test switch ..... push
If annunciator fails to light ..... follow ANNUNCIATOR LIGHT ON checklist
If annunciator lights ..... pull and reset flap motor CB
If flaps fail to respond ..... a flap drive fault may exist and further effort to reposition flaps may cause damage

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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 INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE (FEATHERING PROCEDURE)

The engine securing procedure should always be accomplished in a sequential order according to the nature of the engine failure (ie., practice, engine failure during takeoff, engine failure during climb, etc.).

Begin the securing procedure by closing the throttle of the inoperative engine and moving its propeller control to FEATHER (fully aft) before the propeller speed drops below 1000 rpm. The inoperative engine mixture control should be moved fully aft to the IDLE CUT-OFF position. CLOSE its cowl flaps to reduce drag and turn OFF the magneto switch, the emergency fuel pump switch and the fuel selector. Turn OFF the alternator circuit breaker switch of the inoperative engine. The propeller synchrophaser (if installed) should be OFF. Complete the procedure by reducing the electrical load and considering the use of the fuel crossfeed if the fuel quantity dictates.

ENGINE FAILURE DURING NORMAL TAKEOFF (Below 83 KIAS)

A preflight determination of runway length and computation of accelerate/stop distance will aid in determining the best course of action in the event of an engine failure during takeoff. If engine failure occurs while sufficient runway remains for a deceleration and a safe stop, cut power immediately and stop straight ahead.

If an engine failure occurs before an airspeed of 83 KIAS is attained, and there is not adequate runway remaining for deceleration and stop, immediately retard the throttle and mixture levers fully aft and brakes as required. Turn OFF the master switch, the fuel selectors, and the magneto switches. During these procedures, maintain directional control and maneuver to avoid obstacles if necessary.

GINE FAILURE DURING NORMAL TAKEOFF (83 KIAS or above)

If an engine fails during takeoff at an airspeed of 83 KIAS or above, the t must decide whether to abort following the preceding procedures or to inue the takeoff and climb on a single engine. The pilot's decision must ased on a personal judgment, taking into consideration such factors as aining runway, obstacles, the type of terrain beyond the runway, density ude, weight and loading, weather, other associated conditions, airplane dition, aircraft configuration and the pilot's own proficiency and ibility.

WARNINGS

Negative climb performance may result from an engine failure occurring after lift-off and until the gear has been retracted, the failed engine propeller has been feathered and the cowl flap on the failed engine is closed. Refer to "Single Engine Climb" chart, Figure 5-21, for clean configuration positive climb performance.

Certain combinations of aircraft weight, configuration, ambient conditions and airspeeds will result in negative climb performance. (Refer to specific chart in Performance Section.)

f takeoff is continued the airplane will tend to turn in the direction of ioperative engine, since one engine will be inoperative and the other at mum power. Rudder pedal force on the side of the operating engine will ecessary to maintain directional control. If rotation for takeoff has n or the aircraft is just airborne, maintain the takeoff attitude. If rne, the aircraft may skip along the runway or settle back to the run- Do not force the aircraft off the ground or raise the gear, but nue to maintain maximum power on the operating engine and the aft directionally aligned with the runway. Once the affected engine is ified and its power loss verified, feather its propeller. The drag tion resulting from feathering the windmilling propeller will provide of climb increment which will allow the aircraft to accelerate to and in airborne at the 50 foot barrier airspeed (89 KIAS). If the aircraft naintain level flight or a positive rate of climb, retract the landing gear. tain 89 KIAS until clear of obstacles and close the cowl flap on the

inoperative engine. When above all obstacles accelerate to the best single engine rate of climb speed (94 KIAS). Trim as necessary and close the cowl flaps on the operating engine as much as possible without exceeding engine temperature limits. After a climb has been established, complete the "Engine Securing Procedure" on the inoperative engine.

ENGINE FAILURE DURING SHORT FIELD TAKEOFF
(BELOW 91 KIAS)

Should an engine failure occur prior to reaching the barrier speed (91 KIAS), the takeoff should be aborted. If the failure occurs while the aircraft is still on the ground and sufficient runway or suitable overrun remains, retard the throttles and apply braking as necessary. If insufficient runway or suitable overrun exists, retard the throttles, apply braking as required, pull the mixtures to idle cut-off, turn the master switch, fuel selectors, magneto switches off and steer the aircraft to avoid obstacles.

Should the engine failure occur after the aircraft is airborne, lower the nose to maintain airspeed, retard the throttles and land on the remaining runway, the runway overrun or the most suitable area straight ahead avoiding obstacles. If the landing cannot be accomplished on the remaining runway or overrun prior to touchdown, pull mixtures to idle cut-off, turn the master switch, fuel selectors and magneto switches to the off position.

ENGINE FAILURE DURING SHORT FIELD TAKEOFF
(91 KIAS or above)

Should an engine failure occur at the barrier speed of 91 KIAS or above, the decision to abort or continue the takeoff will be based on several factors including altitude, aircraft weight, suitable landing areas, pilot proficiency and ambient conditions. The two most important considerations; however, are the altitude gained prior to the engine failure and the availability of suitable landing areas ahead of the aircraft at the time of the failure. The pilot's decision must be based on a personal judgement, taking into consideration such factors as remaining runway, obstacles, the type of terrain beyond the runway, density altitude, weight and loading, weather, other associated conditions, airplane condition, airplane configuration and the pilot's own proficiency and capability.

Should a suitable landing area (remaining runway, overrun or an area relatively free of obstructions) be accessible from the point where the engine failure occurs, the takeoff should be immediately aborted and a power-off landing should he accomplished within that area.

If a suitable landing area is not available and sufficient altitude has been ained, the pilot may elect to continue the takeoff. Should the decision be de to continue the takeoff, it is of the utmost importance to realize that aircraft will have negative single engine climb performance until the in- :rative engine's propeller has been feathered and the gear and flaps have n retracted. As altitude may be lost during gear and flap retraction, the ision to continue the takeoff should primarily be based on the altitude ned prior to the failure. Flight tests have indicated that as much as 100 feet y be lost during gear and flap retraction. The altitude loss is a difficult iable to quantify and is primarily predicted on pilot proficiency; however :raft weight and ambient conditions must also be considered. Prior to eoff, the pilot should always review the performance section to determine t adequate single engine climb performance exists for the takeoff weight associated ambient conditions.

Should the decision be made to abort the takeoff, the throttles should :losed, the landing gear extended (terrain permitting), the flaps extended a minimum airspeed of 89 KIAS should be maintained. If possible, plan and in an area free of obstructions. Prior to touchdown, position the :ture controls to idle cut-off and turn the master switch, fuel selectors magneto switches off.

Should the decision be made to continue the takeoff, maintain direc- ıal control, identify and then feather the inoperative engine. In level or ıbing flight, retract the landing gear. Apply 5° of bank into the operating ine and retract the flaps incrementally (recommend 3-5° increments). intain 91 KIAS until all obstacles have been cleared and then accelerate 4 KIAS. Complete the engine securing procedures and land at the nearest able airport.

WARNING

Negative climb performance may result from an engine failure occurring after lift off and until the gear and flaps have been retracted, the failed engine propeller has been feathered and the cowl flap on the failed engine is closed. Refer to "Single Engine Climb" chart, Figure 5-21, for clean configuration positive climb performance.

WARNING

Certain combinations of aircraft weight, configuration, ambient conditions and airspeeds will result in negative climb performance. (Refer to specific chart in Performance Section.)

ENGINE FAILURE DURING CLIMB

If engine failure occurs during climb, a minimum airspeed of 94 KIAS should be maintained. Since one engine will be inoperative and the other will be at maximum power, the airplane will have a tendency to turn in the direction of the inoperative engine. Rudder pedal force on the side of the operating engine will be necessary to maintain directional control. After the affected engine has been identified and power loss verified, complete the "Engine Securing Procedures." Continue a straight ahead climb until sufficient altitude (minimum of 1000 feet above ground elevation) is reached to execute a "Single Engine Landing" procedure at the nearest suitable airport.

During climbs, the best single-engine rate of climb speed of 94 KIAS is recommended; however, in high ambient temperatures, airspeed may be increased to 103 KIAS if necessary for improved cooling. Normally, cylinder head temperatures can be maintained within limits through cowl flap adjustments. Climb rate will be reduced by approximately 50 FPM.

NE FAILURE DURING FLIGHT (Below 76 KIAS)

ıould an engine fail during flight at an airspeed below 76 KIAS, apply · towards the operative engine to maintain directional control. The les should be retarded to stop the yaw force produced by the ative engine. Lower the nose of the aircraft to accelerate above 76 and increase the power on the operative engine as the airspeed exceeds \S.

fter an airspeed above 76 KIAS has been established, an engine restart t may be made if altitude permits. If the restart has failed, or altitude ot permit, the engine should be secured. Move the propeller control of ɔperative engine to FEATHER and complete the "Engine Securing ure." Adjust the trim to a 5° bank into the operating engine. The cowl ı the operative engine should be adjusted as required to maintain temperature within allowable limits.

NE FAILURE DURING FLIGHT (Above 76 KIAS)

an engine fails at an airspeed above 76 KIAS during flight, begin tive response by identifying the inoperative engine. The operative should be adjusted as required after the loss of power has been d. Attain and maintain an airspeed of 94 KIAS. Once the inoperative has been identified and the operating engine adjusted properly, an restart may be attempted if altitude permits.

ior to securing the inoperative engine, check to make sure the fuel flow engine is sufficient. If the fuel flow is deficient, turn ON the emergency mp. Check the fuel quantity on the inoperative engine side and switch l selector to the other tank if a sufficient supply is indicated. Check the ssure and oil temperature and insure that the magneto switches are

the engine fails to start it should be secured using the "Engine Securing ure."

After the inoperative engine has been secured, the operative engine can be adjusted. Power should be maintained as required and the mixture control should be adjusted for power. Check the fuel supply and turn ON the emergency fuel pump if necessary. The cowl flaps on the operative engine should be adjusted as required to maintain engine temperatures within allowable limits. Adjust the trim to a 5° bank into the operating engine. The electrical load should be decreased to a required minimum. Land as soon as practical at the nearest suitable airport.

SINGLE ENGINE LANDING

If a single-engine landing is necessary, a check should be performed to determine whether or not the hydraulic pump is functioning for normal gear extension. This check is accomplished by placing the landing gear control in the UP position with the gear retracted. If the hydraulic pump is functioning, pressure will return the control to the neutral position. This check should be performed before entering the traffic pattern so that there will be time to pump the gear down with the hand pump if necessary.

The "Engine Securing Procedure" should be complete on the inoperative engine. Fasten the seat belts and shoulder harnesses and select the FAN position of the heater switch. The operative engine emergency pump should be ON and the mixture RICH. Advance the propeller control (operative engine) full forward. Check to ensure that the fuel selector is ON the main (inboard) tank on the same side as the operating engine. The fuel crossfeed valve should be OFF. The cowl flaps on the operative engine should be adjusted as required.

Maintain an airspeed of 104 KIAS or above and an altitude higher than normal until a landing is assured. When a landing is assured, extend the gear and flaps. Slowly retard the power on the operative engine and flare out the airplane for a normal landing. Trim as necessary as power is reduced. The airplane will tend to yaw toward the operative engine.

3 ENGINE GO-AROUND

ingle engine go-around should be avoided if at all possible. A go- from a full flap position is not possible unless sufficient altitude is e to raise flaps in a descent. A final approach speed above 94 KIAS ıce the airplane in the best configuration should a go-around be ry.

execute a single engine go-around, advance mixture, propeller, and controls fully forward for maximum power on the operating engine. flaps and landing gear. Maintain the airspeed at or above 94 KIAS. :rim and cowl flaps as required.

WARNING

A go-around should not be attempted after the airspeed is decreased below the best single engine angle of climb speed (90 KIAS).

ing climbs, the best single engine rate of climb speed of 94 KIAS is ıended; however, in high ambient temperatures, airspeed may be d to 103 KIAS if necessary for improved cooling. Normally, cylinder mperatures can be maintained within limits through cowl flap ents. Climb rate will be reduced by approximately 50 FPM.

ART (UNFEATHERING PROCEDURE)

n ON the fuel selector of the inoperative engine side, turn ON the ɔs and open the throttle 1/2 inch. Move the propeller control one ward, and open the mixture control, full forward. Engage the starter : propeller is unfeathered. As the RPM passes 1000 coming out of pull the propeller control back to the low RPM position to prevent ve engine speed. Maintain the engine speed between 1800 and 2000 ot exceeding 2000 RPM. This low power setting must be held until ine is warmed up and oil pressure and temperature are stabilized imits. Turn the alternator ON and check the engine instruments. The r synchrophaser (if installed) can then be turned ON.

3.9 ENGINE ROUGHNESS

If an engine falters or runs erratically, the cause may be fuel flow interruption, fuel contamination, icing or air starvation, or ignition problems. If roughness occurs, turn the emergency fuel pumps ON. Scan the engine instruments to see if the cause can be determined. Adjust the mixture controls for maximum smoothness; if the mixture is too rich or too lean, engine roughness may result. Open the alternate air control; a blocked induction system can cause roughness. If cylinder head temperatures are too high or too low, adjust the cowl flaps as required.

If the problem is in the fuel system, selecting another tank containing fuel may remedy the situation. A check of the magnetos will determine if they are operating properly.

WARNING

If either the right or left fuel flow warning light illuminates and the fuel gauge indicates fuel remaining in the corresponding inboard tank, this will indicate a malfunction of the flapper door in the inboard tank. Immediately select the outboard tank or select crossfeed to avoid fuel flow interruption.

3.11 ENGINE OVERHEAT

If the engine temperatures become excessive, open the cowl flaps. Enriching the mixture and reducing power will also reduce engine temperature. If a more rapid reduction of engine temperature is desired, increase the airspeed by establishing a shallow dive.

3.13 LOSS OF OIL PRESSURE

Loss of oil pressure could be caused by a faulty pump, oil exhaustion, or a leak. A loss of oil pressure indication could be the result of a faulty gauge. In any event, continued operation of the engine could result in a serious emergency situation or severe engine damage.

Complete the "Engine Securing Procedure" (paragraph 3.7) on the affected engine.

If engine oil is depleted, the engine will seize and if feathering is not initiated before 1000 RPM is reached, propeller will not feather

:OUGH AIR OPERATION

conditions of extreme turbulence, slow the airplane to maneuvering
ır slightly less. Maneuvering speed will decrease with the weight of the
: - e.g., 159 KIAS at 6500 lbs., 151 KIAS at 5400 lbs. A reduction in
vill ease the stress to which the airplane is subjected by turbulence. Fly
e and avoid abrupt maneuvers. Fasten seat belts and shoulder
ies as a precaution against buffeting and lurching. When flying in
: turbulence or strong vertical currents and using the autopilot, the
-hold should not be used.

NGINE FIRE ON GROUND (Engine start, ıxi and takeoff with sufficient distance remaining to stop)

e first step to extinguish the fire is to move the fire wall fuel shutoff
) OFF. Next, turn OFF the emergency fuel pump. This will stop the
' fuel to the burning engine. The brakes should be used as required.
the throttle and use the radio to call for assistance.

he fire persists, move the mixture control to IDLE CUT-OFF, shut
he engines and evacuate; the fire should be extinguished by an
l means.

he fire is on the ground near the airplane, it may be possible to taxi to

NGINE FIRE IN FLIGHT

ın engine fire occurs in flight, position the fire wall fuel shutoff valve
aulty engine to off. Then, close the throttle, feather the propeller, and
mixture control to idle cut-off. Use the Engine Securing Procedure
aph 3.7) to complete the engine shutdown. Land as soon as possible.

3.21 ELECTRICAL FIRE

The presence of smoke in the cabin or the distinctive odor of smoldering insulation are indications of an electrical fire. The first step in coping with an electrical fire is to turn the master switch OFF. During night flight, be sure that a flashlight is in hand before turning off the master switch. Check for open circuit breakers; then pull all circuit breakers, and turn OFF all electrical switches and avionics switches.

Return the master switch to ON and, one unit at a time, turn ON the electrical switches and press in the circuit breakers for the individual units required for flight. When the affected unit is located, pull its circuit breaker and turn its switch OFF. The failed unit should be left OFF for the remainder of the flight.

3.23 CROSSFEED

Crossfeed should be employed only when necessary to extend range during single-engine operation or when necessary to operate the combustion heater after the right engine has been shutdown in flight (Refer to paragraph 7.39). Crossfeed must be OFF for takeoffs and landings.

To activate the crossfeed system, place the fuel selector valve of the inoperative engine side on either of the tanks on that side containing sufficient fuel quantity. Turn ON the emergency fuel pump of the inoperative engine.

Turn ON the crossfeed valve located at the base of the control pedestal. Then, on the side of the operating engine, turn OFF the fuel selector, and turn OFF the emergency fuel pump.

3.25 COMING OUT OF CROSSFEED (PRIOR TO LANDING)

To return to normal operation during a single-engine landing when the crossfeed system has been in use, first place the fuel selector on the operating engine side in the INBOARD tank position. Turn ON the emergency fuel pump for the operating engine side and turn OFF the crossfeed valve. Then, on the inoperative side, turn OFF the emergency fuel pump and the fuel selector. It is recommended that the fuel system be returned to normal in sufficient time to determine normal operation prior to entering the landing pattern.

NE ALTERNATOR INOPERATIVE LIGHT ON

he event one of the alternator inoperative warning lights on the ent panel illuminates, indicating an alternator failure, reduce the l load to the minimum necessary to sustain a safe flight. Turn OFF of the master switch corresponding to the side of the inoperative r. This will open the field circuit of the inoperative alternator. Reset uit breakers which may have popped. Return the appropriate side of er switch to the ON position, and, if the alternator inoperative light guished, reinstate the electrical load. If the warning light remains lit alternator circuit breaker has tripped, return the corresponding side aster switch to the OFF position, and continue the flight with a electrical load.

VO ALTERNATOR INOPERATIVE LIGHTS ON

oth alternator inoperative lights come on, repeat the above re individually for each side. Should both warning lights remain lit r corrective action, turn ON both sides of the master switch and turn h alternator circuit breaker switches. Reduce electrical load to an minimum and terminate the flight as soon as possible, since all l power is being supplied by the airplane battery.

CAUTION

The alternator circuit breaker switches should not be opened manually when the alternators are functioning properly.

ase of the loss of both alternators, reduce electrical load by cting the following equipment, as appropriate to the airplane:

Turn OFF switches for the following:

(1) Right pitot heat
(2) Cabin heater
(3) Heated windshield
(4) Autopilot
(5) All unnecessary avionic equipment
(6) Prop deicing
(7) Alternator field switches

(b) Open the following circuit breakers:
(1) Right turn indicator
(2) Trim indicating system
(3) Instrument panel lighting (use flashlight)
(4) Map lights
(5) Cabin reading lights

CAUTION

If load shedding procedures have been carried out, the battery will provide electric power for approximately 35 minutes to complete a landing under IFR conditions including only a single flap extension and use of landing lights for a limited time. The above time depends upon the condition of the battery, temperature, and the time elapsed between alternator failure and load shedding.

3.31 PROPELLER/GOVERNOR MALFUNCTIONS

An internal malfunction of the propeller or governor could cause loss of RPM control and uncommanded movement of the propeller blades into high pitch or feather, or against the low pitch blade stop. A proper preflight check of the propeller governing and feather functions should indicate such malfunctions before takeoff. Should such a failure occur while airborne, the following actions are recommended:

PROPELLER RPM UNDERSPEED

If an uncommanded RPM decrease occurs while operating at high power settings, immediately retard the throttle to a low cruise power setting and advance the mixture control to full RICH. If the propeller moves to feather, as indicated by a very low RPM and attendant vibration, shut down the engine with the mixture control (idle cut-off) and move the propeller control to FEATHER. (Refer to Engine Securing Procedures.)

NOTE

The propeller will move to feather if engine oil pressure is lost.

PELLER RPM OVERSPEED

An uncommanded RPM increase could indicate an internal failure that ıused the propeller to move to full low pitch. Initiate corrective action mediately reducing the throttle setting and decreasing the airspeed with e-up attitude. If the propeller has moved to the low pitch stop, it is vely a very low pitch fixed-pitch propeller and will exceed the 2575 limit until both airspeed and manifold pressure have been reduced.

At idle throttle, airspeed must be reduced below 127 KIAS to maintain ·opeller speed below 2575 RPM. Once airspeed has been reduced, power for low-speed cruise (near single engine best rate of climb and approach will be available without exceeding 2575 RPM.

nce the propeller speed has been reduced to 2575 RPM by airspeed ower reductions, the pilot can test for regained RPM control with the ller lever.

he engine should not be shut down if the propeller cannot be feathered ıigh drag would result from a windmilling propeller in low pitch. If shut down is desired, the pilot should first test for feathering ability he engine running at idle throttle. (Refer to Engine Securing lures if propeller will feather.)

NOTE

Do not secure the engine if the propeller cannot be feathered.

MERGENCY GEAR EXTENSION

the landing gear fails to extend when the gear selector is placed in the N position, the hand-operated emergency gear extender should be ed. The emergency gear extender is located beneath the access plate cabin floor, between the crew seats.

fore the gear is extended, the airspeed must be reduced below a um of 156 KIAS. To extend the gear by use of the emergency r, the gear selector must be in the DOWN position.

When the emergency gear extender cover is lifted, note that instructions are printed inside. Extend the emergency gear handle completely, and pump the handle until the three green lights on the instrument panel indicate that all three gear are locked down (approximately 50 full strokes will be required to complete this operation). The master switch must be ON for the gear lights to illuminate. Continue pumping until hydraulic pressure builds and the gear selector returns to the neutral position.

3.35 EMERGENCY EXIT

An emergency exit is located on the right side of the fuselage, and is the second window from the front. With the cockpit-cabin divider installed, the emergency window will appear as the most forward window on the right side of the cabin.

To use the emergency exit, remove the plexiglas cover over the handle; then pull the handle and push out on the window.

3.37 GEAR UP LANDING

If all normal and emergency gear extension procedures have failed, a gear up landing will be necessary. Select a suitable landing area. If possible, inform ground personnel of the emergency situation. If time allows, burn off excess fuel. Brief passengers on the use of the emergency exit and be sure that all occupants have seat belts and shoulder harnesses secured properly.

When ready to land, complete the landing checklist as for a normal landing, except that the gear selector should be in the UP position. Turn OFF the autopilot, and, in daylight, turn OFF the master switch. During a night landing when the master switch is left ON, the gear warning horn may sound when the throttles are retarded.

Make a normal approach, and when the runway is "made" and landing is assured, place mixtures in IDLE CUT-OFF, FEATHER the propellers, and turn OFF the fire wall fuel shutoffs and fuel selectors. Land smoothly, touching down in a level attitude. At night, turn OFF the master switch after touchdown. All occupants should evacuate as soon as the airplane has stopped.

NOTE

The landing light is attached to the nose gear. Therefore, if the nose gear is not extended, the landing light will not be functioning.

AP SYSTEM MALFUNCTION

e event of a flap system failure which causes asymmetric ("Split") flap drive stops automatically and the "flap" annunciator lights difference between the flaps reaches five degrees. If this occurs, no ontrol of the flaps is provided and the remainder of the flight the landing and go-around if necessary, must be planned without ing the flaps. Asymmetric flaps may usually be identified by a ndency, depending on the lift characteristics of the flaps at the where they fail.

LAP" annunciator warning without asymmetric flaps can be a failed amplifier. In this case, the flight may be continued with the e that, in the event of asymmetric flaps, no further annunciator vill exist. The amplifier should be replaced prior to the next flight.

re of the flaps to move without an asymmetric condition can be a tripped flap control circuit breaker or flap motor circuit breaker uit breaker panel on the left wall of the cockpit. If neither circuit s tripped, a fault exists in the flap drive and further effort to the flaps should be carefully considered so as not to compound m.

lap malfunction should occur and the flap control circuit breaker o motor circuit breaker is not tripped, proceed accordingly to the y Procedure Checklist on page 3-13.

CAUTION

Do not reset a tripped flap motor circuit breaker if a split flap condition exists.

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SECTION 4

NORMAL PROCEDURES

4.1 GENERAL

This section describes the recommended procedures for the conduct of normal operations for PA-31 Navajo airplane. All of the required (FAA regulations) procedures and those necessary for the operation of the airplane as determined by the operating and design features of the airplane are presented

Normal procedures associated with those optional systems and equipment which require handbook supplements are presented in Section 9 (Supplements).

These procedures are provided as a source of reference and review and to supply information on procedures which are not the same for all aircraft. Pilots should familiarize themselves with the procedures given in this section in order to become proficient in the normal operations of the airplane.

The first portion of this section is a short form checklist which supplies an action sequence for normal procedures with little emphasis on the operation of the systems.

The remainder of the section is devoted to 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 in-flight reference due to the lengthly explanations. The short form checklist should be used in flight.

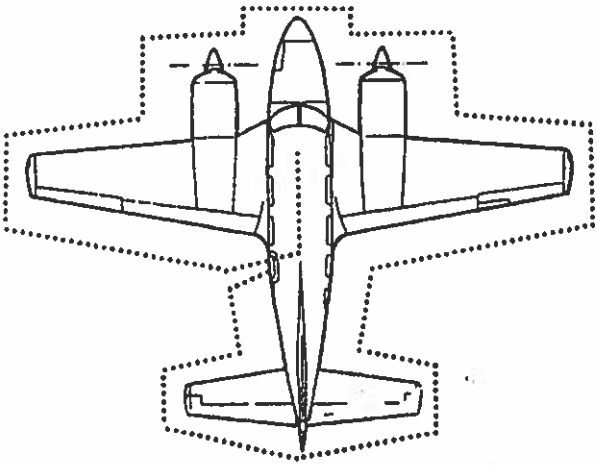
The pilot should use the full Maximum Continuous Power rating of the engine when safety considerations so dictate.

PEEDS FOR SAFE OPERATION

llowing airspeeds are those which are significant to the operation lane. These figures are for standard airplanes flown at gross weight nal conditions at sea level. For additional airspeed information 1 2.

mance for a specific airplane may vary from published figures ; upon the equipment installed, the condition of the engines, ind equipment, atmospheric conditions and piloting technique.

ever Exceed Speed	236 KIAS
laximum Structural Cruising Speed	188 KIAS
esign Maneuvering Speed	159 KIAS
laximum Flaps Extended Speed	
25° Flaps	174 KIAS
Full Flaps (40°)	140 KIAS
aximum Gear Extended Speed	156 KIAS
laximum Gear Operating Speed	
Extend	156 KIAS
Retract	129 KIAS
est Rate of Climb Speed	
0° Flaps	94 KIAS
est Angle of Climb Speed	80 KIAS
nal Approach Speed	100 KIAS
tentional One Engine Inoperative Speed	90 KIAS
aximum Demonstrated Crosswind	20 KTS



WALK-AROUND
Figure 4-1

4.5 NORMAL PROCEDURES CHECK LIST

PREFLIGHT CHECK

COCKPIT

Controls ..... release
Magneto switches ..... OFF
Electrical switches ..... OFF
Flap switch ..... OFF
Mixtures ..... IDLE CUT-OFF
Master switch ..... ON
Gear lights ..... 3 green
Fuel quantity ..... sufficient
Trim ..... neutral
Cowl flaps ..... OPEN
Master switch ..... OFF
Airplane papers ..... checked
Emergency window ..... secure
Oxygen pressure ..... sufficient
Oxygen masks ..... in place

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idition.....checked
ip tracks.....checked
.....checked
and filler caps.....checked
ents.....clear
.....removed
(4).....drain and check for water sediment and proper fuel
ar.....checked
.....removed
.....checked

UTION: Check that the four screws securing the nose l are present and secure. A screw driver may be needed to this. Check that the six (three per side) side cowling eners are present and secure. Check for both the proper nment of the paint stripes on the cowling and fastener and the extension of the locking pin indicator in the fastener slot.

RNING: Failure to insure the presence and security of e bowl and cowl side fasteners may result in inflight cowl aration and loss of aircraft control.

.....checked
rea.....checked
.....checked
ection (engine).....checked
.....checked

TION

idition.....checked
.....secure
or.....Locked
ts.....clear
.....checked
.....removed
.....clear
hts.....checked

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r left wing (3 fuel drains).

FUSELAGE (RIGHT SIDE)

General condition.....checked
Static openings.....clear
Antennas.....checkedHinges and push rods.....checked

FUSELAGE (LEFT SIDE)

General condition.....checked
Static openings.....clear
Doors.....checked

BEFORE STARTING ENGINES

Preflight inspection.....completed
Cabin doors.....secure
Passenger briefing.....completed
Seats.....adjusted
Belts and harness.....secure

WARNING

No braking will occur if handle is pulled prior to brake application.

Parking brake.....set
Controls.....checked
Fuel selectors.....INBOARD
Crossfeed.....OFF
Fuel fire wall shutoffs.....ON
Alternate air.....OFF (in)
Circuit breakers.....checked
Electrical switches.....OFF
Alternator CB switches.....ON
Avionics switches.....OFF
Alternate static source.....OFF
Mixtures.....IDLE CUT-OFF
Master switch.....ON
Cowl flaps.....OPEN
Gear lights.....3 green
Annunciator panel.....press-to-test
Alternator inop. lights.....ON
Pneumatic source malf. lights.....ON
Door ajar lights.....OUT
Fuel flow lights.....checked
Emergency fuel pumps.....OFF
Prop sync.....OFF

itch .....OFF
and no smoking sign .....ON

START

START

itch off when using APU.)
.....open 1/2 inch
ol.....forward
nes .....ON
.....RICH
Fuel Pump .....ON till 6 gph then OFF
.....IDLE CUT-OFF
.....clear
.....engaged
hen eng. starts) .....advance
l pressure .....checked
inop. light .....OUT
malf. light.....OUT
le (hydraulic check) .....DOWN then returns to neutral
gine.....repeat first 10 steps thru "pneumatic malf. light - OUT"

RT

.....open 1/2 inch
ol.....forward
hes .....ON
fuel pump.....ON (do not prime)
.....clear
.....engaged
hen eng. starts) .....advance
fuel pumps .....OFF after approx. 3 min.
art procedure .....complete

START

.....IDLE CUT-OFF
hes .....ON
.....full OPEN
.....clear
.....engaged

When engine starts:
Mixture .....advance
Throttle .....1000 RPM

BEFORE TAXIING

APU .....removed
Master switch .....ON
Lights .....as required
Heater .....as required
Avionics switches .....ON
Gyros .....set
Altimeter and clock .....set
Electric trim .....ON and checked
Autopilot .....checked and OFF
Fuel valves (all positions) .....checked
Radios .....checked
Parking brake .....release

TAXIING

Brakes .....checked
Flight instruments .....checked

ENGINE RUN-UP

WARNING

No braking will occur if handle is pulled prior to brake application.

Parking brake .....set
Mixtures .....RICH
Prop controls .....forward
Cowl flaps .....OPEN
Engine instruments .....checked
Throttles .....1500 RPM
Prop controls (max. drop 500 RPM) .....feather checked
Gyro pressure (in green arc) .....checked
Alternator output .....checked
Alternator inop. lights .....OUT
Annunciator panel lights .....OUT

.....2300 RPM
x. drop 175 RPM;
ff. 50 RPM).....checked
ols (max. drop 300 RPM) .....exercised
600-650 RPM).....idle checked
.....1000 RPM
ck .....set

TAKEOFF

and no smoking sign .....ON
ors .....INBOARD
ity .....sufficient
nd props.....forward
.....checked and set 0° for normal takeoff
checked and set 15° for short field takeoff
.....OFF
.....set
ice .....OFF
rop heat.....as required
l heat.....as required
.....as required
ndicator.....set
.....as desired
er.....as required
.....checked
/ fuel pumps.....ON
.....OFF
ake.....release

TAKEOFF

.....apply and hold
.....full forward
ressure .....checked
l .....2575 RPM
.....release
.....83 KIAS min.
.....UP
to.....barrier speed (89 KIAS)

SHORT FIELD TAKEOFF

Brakes.....apply and hold
Throttles.....full forward
Manifold pressure.....checked
Prop speed.....2575 RPM
Brakes.....release
Rotate.....76 KIAS min.
Accelerate to.....barrier speed (91 KIAS)

After the barrier has been cleared:

Gear.....retract
Flaps.....retract
Accelerate to.....Best Single Engine Rate of Climb Speed (94 KIAS)

CLIMB

Maximum Normal Operating Power (when safely clear of obstacles or terrain).....39.5" MP, 2400 RPM
Mixture (28 GPH min, 475° CHT max., 1450° EGT max.).....LEAN
Cowl flaps.....as required
Emergency fuel pumps.....OFF
Seat belts and no smoking sign.....ON
Oxygen.....as required

CRUISE

Emergency fuel pumps.....as required
Fuel selectors.....OUTBOARD OR INBOARD
Power.....set
Cowl flaps.....as required
Mixture.....leaned

DESCENT

Mixtures.....min. 1350° EGT
Fuel selectors.....INBOARD
Power.....as required
Oxygen (below 10,000 ft.).....OFF
Pitot and windshield heat.....as required

E LANDING

s and no smoking sign ..... ON
cy fuel pumps ..... ON
..... RICH
c ..... OFF
trols ..... 2400 RPM
ow 156 KIAS) ..... DOWN
its ..... 3 green
ror ..... checked
ssure ..... checked
t ..... OFF
os ..... as required
AS max. to 25°)
AS max. 40°)
Lights ..... as required
..... OFF

) LANDING

..... full forward
..... as required
os ..... 15° in steps
..... UP
os ..... UP in steps
..... 94 KIAS min.

LANDING (CLEAR OF RUNWAY)

os ..... OPEN
os ..... UP
iel pumps ..... OFF
/itch (if used) ..... FAN
rols ..... forward
..... OFF

SHUTDOWN

WARNING

No braking will occur if handle is pulled prior to brake application.

Parking brake	set
Avionics	OFF
AP/FD	OFF
Throttles	IDLE
Mag grounding	checked
Throttles	1000 RPM
Lights	OFF
Heater switch	OFF
Electrical equipment	OFF
Mixture (1st eng. started)	IDLE CUT-OFF
Gear handle	DOWN
Gear handle (hydraulic check)	returned to neutral
Mixture (2nd eng.)	IDLE CUT-OFF
Mags	OFF
Master switch	OFF

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4.7 AMPLIFIED NORMAL PROCEDURES (GENERAL)

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

4.9 PREFLIGHT CHECK

The airplane should be given a thorough preflight and walk-around check. The preflight should include a determination of the airplane's operational status, a check that necessary papers are onboard and in order, and a computation of weight and C.G. limits, takeoff distance, and in-flight performance. Baggage should be weighed, stowed, and tied down. A weather briefing for the intended flight path should be obtained, and other factors relating to a safe flight should be checked before takeoff.

COCKPIT

Upon entering the cockpit, release the controls if they have been secured. After ensuring that magneto switches, electrical switches and flap switch are OFF and that mixture levers are in IDLE CUT-OFF, turn the master switch ON. Check that the fuel quantity gauges are operating and that there is sufficient fuel for the flight. Fuel quantity gauges indicate the amount of fuel in the tanks selected on the fuel selector valves. Check that the three green gear position lights illuminate. Set all trim controls to neutral and fully open the cowl flaps. Turn OFF the master switch.

While still inside the airplane, check that the emergency window is secure and that an oxygen mask is present and operational and properly stowed if installed. Check the oxygen pressure gauge on the lower left instrument panel to ascertain that the oxygen supply is sufficient. Check that the oxygen control knob is pushed into the OFF position.

A complete walk-around check should be routinely performed during each preflight. A set pattern should be established, starting at the cabin door and proceeding forward, completely around the airplane, and terminating upon return to the cabin door.

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ed first along the trailing edge of the left wing, checking the wings, rfaces, and hinges for damage and operational interference. The d control surfaces should be free of ice, snow, frost, or other us substances. Static wicks should be in place and in good The fuel supply should be checked visually, and fuel caps securely Fuel vents should be clear of obstructions. If surface deicing is the boots should be free from defects and flat against the wing If tie-downs and chocks have been employed, they should be before flight. The wing tip and lights should show no signs of

e underside of the left wing are four fuel drains which should be ained during the preflight check to allow the removal of any ccumulation of moisture or sediment in the fuel system, and to l octane by checking the color. Pushing up on the arm of each fuel e for a few seconds should allow sufficient fuel to flow to allow the f contaminants. Collecting drained fuel in a clear container and ; it visually is recommended.

anding gear should be examined. The strut should he inflated to out 3.25 inches of piston tube when supporting an empty airplane fuel tanks and full oil and operating fluids. The condition of ts of the strut, the gear doors, the brakes, the gear micro switch, ld appear sound, and fittings, attachments, screws, hinges, etc., : secure. The tire should be inflated to 60 psi, and should be for breaks, cuts, bruises, cracks, and excessive wear.

: engine nacelle, access panels should be secure. The engine cowl wheel wells, and nacelle intakes should be clear of debris, bird Oil quantity can be checked through the access door on the top of :. The oil filler must be replaced securely.

ropeller blades and spinner should be checked for nicks, cracks, ther defects. There should be no indication of leakage of oil, fuel, uids in the area of the wing or on or about the nacelle and landing ard of the nacelle, the gear mirror should be clean and intact, and oot fillet should show no signs of stress.

NOSE SECTION

Continue from the left wing forward around the nose section of the airplane. All access plates should be secure, and the general condition of the nose section should appear sound. Baggage should be securely stowed and the baggage compartment door completely closed and locked. Battery vents and heater inlets and outlets should be open and clear. The nose gear should be checked in the same manner as the main gear, with a proper strut piston tube exposure of about 3.25 inches, and a proper tire inflation of 42 psi. No leakage of hydraulic or brake fluid should be present. If a chock has been employed, it should be removed. Landing and taxi lights should be clean and intact.

If pitot tube covers have been installed, they must be removed, and the pitot head opening checked and ensured clear of insects, dirt, or other obstructions. When pitot heat operation is to be checked, the master switch and pitot heat switch must be turned on, and the pitot head found hot to touch. Be careful, as the pitot tube gets extremely hot.

The windshield and pilot and copilot side windows should be clean and the windshield wipers in good condition.

RIGHT WING

Continuing aft and around the right wing, the same checks and procedures as performed on the left wing should be completed in reverse order. There are three fuel valves which must be drained under the right wing. The right aileron includes a trim tab which must be checked.

FUSELAGE (RIGHT SIDE)

Check the general condition of the right side of the fuselage. The emergency exit window should be secure and flush with the fuselage skin, and all side windows should be clean and without defects. Antennas and cables should be in place and securely attached. The openings in the static pads should be clean and unobstructed.

EMPENNAGE

All surfaces of the empennage should be examined for damage and operational interference. Fairings and access covers should be attached and in good condition. Deicer boots should be in good condition and flat against the surface. The elevator and rudder should be free and in good condition.

trim controls set neutral, all trim tabs should be neutral. Check the of the tabs, and ensure that all hinges and push rods are secure and ondition. If the tail has been tied down, remove the tie-down rope.

GE (LEFT SIDE)

ıe left side of the fuselage, the static openings should be clear, side ; clean and sound, and cabin door attachments and hinges al. If night flight is anticipated, before completing the walk-around ıt all exterior lights are operational; the master switch must be ON ıeck.

ı all occupants are boarded, the pilot should check that all cabin properly closed and latched. The door support cables should be sition, if necessary, so that they will not interfere with the closing of

ORE STARTING ENGINES

preflight interior and exterior checks have been completed and ne has been determined ready for flight, the cabin door should be ınd all occupants seated. Check that the aft baggage compartment bin cargo area if it is loaded are secure and that tie-downs are used essary. Passengers should be briefed on the use of seat belts and ıarnesses, the emergency exit, supplementary oxygen, ventilation eat adjustment, comfort facilities, etc. The pilot should advise the s when smoking is prohibited and caution them against handling equipment, door handles, and the emergency exit. It may be to inform passengers of sounds or sensations which may not be o them, but which are associated with normal flight. All seats adjusted and secured in position and seat belts and shoulder properly fastened.

ıe parking brake by first depressing and holding the toe brake ı then pulling out the parking brake handle.

WARNING

No braking will occur if handle is pulled prior to brake application.

Check that control levers move smoothly, and adjust the friction control as desired. Fuel selectors should be set on the inboard tank position, the crossfeed turned OFF, and the fuel fire wall shutoffs checked open.

Check that the manual alternate air controls on the lower instrument panel are pushed in and OFF. All circuit breakers should be IN and alternator circuit breaker switches ON. All other electrical switches and all avionics switches should be OFF. Check that all radio switches, light switches, and the pitot heat switch are OFF to avoid an electrical overload when the starter is engaged. The alternate static source control under the left side of the instrument panel should be OFF, and the mixture controls should be in the IDLE CUT-OFF position.

Turn ON the master switch. Three green gear lights should illuminate. The alternator inoperative lights and pneumatic source malfunction lights should come on and remain on until the engines are started. The door ajar lights on the overhead panel should both be out. Check that both cowl flaps are open. Check the function of the fuel flow warning lights by using the press-to-test feature. Check the annunciator panel by using the press-to-test switch. Before starting the engines, turn ON the seat belt and no smoking signs, and check that passengers comply.

4.13 ENGINE START

NORMAL START

If an external auxiliary power unit (APU) is used for starting, the master switch and all avionics switches should be OFF until both engines are running and the power unit is removed. When an APU is used, it is recommended that the right engine be started first. Open the throttle of the first engine to be started about 1/2 inch, advance the propeller control forward, and turn the magneto switches ON. Advance the mixture control to RICH and turn ON the emergency fuel pump to prime the engine until a fuel flow of 6 gallons per hour is indicated, then pull the mixture control aft to IDLE CUT-OFF. Visually confirm that the propeller area is clear, and engage the starter. When the engine starts, advance the mixture control slowly toward the RICH position. Adjust the throttle as necessary to maintain a speed below 1000 RPM. Check the oil pressure gauge for an indication. Normally there should be an indication of oil pressure within 30 seconds. In cold weather it may take a few seconds longer. If after allowing sufficient time there is no oil pressure, shut down the engine until the cause is determined and remedied. Check the fuel pressure gauge.

c to see that the alternator inoperative light and the pneumatic on light for the running engine are extinguished. To check the of the hydraulic pump of the first engine started, place the gear ver in the DOWN position. If the pump is functioning properly, ver will automatically return to neutral.

the second engine following the same procedure. The hydraulic ck should be eliminated from the starting procedures for the gine. When both engines are running, all warning lights should be ed.

RT

engines are still warm from previous operation, the mixture ould remain in IDLE CUT-OFF and the priming steps eliminated. throttle 1/2 inch, and advance the propeller control. Turn ON the witch and the emergency fuel pump. Do not prime! Engage the hen the engine starts, advance the mixture control. Leave the fuel pump on for approximately 3 minutes to purge the fuel lines ne and proceed as in a Normal Start (see above).

TART

engine is flooded (by overpriming, for example), the mixture pulled to IDLE CUT-OFF. After turning ON the magneto advance the throttle to the fully OPEN position and engage the lvance the mixture control only after the engine has started, and throttle lever to 1000 RPM.

ORE TAXIING

APU has been used for start, it should he disconnected and the itch turned ON.

and heater may be turned on as desired. Set gyros and clocks as Set the altimeter to field elevation. Turn ON and check electric ON the avionics master switch. Check the autopilot (sec Section m it OFF. Cheek the fuel selectors in all positions, at the same time that fuel warning lights should not illuminate. Check the radios, em as desired. Release the parking brake by first depressing and ie toe brake pedals and then pushing in on the parking brake

4.17 TAXIING

While taxiing, apply the brakes to determine their effectiveness. Check the flight instruments to see that they are functioning.

4.19 ENGINE RUN-UP

WARNING

No braking will occur if handle is pulled prior to brake application.

Set the parking brake. Advance mixture and propeller controls, and open the cowl flaps. Check engine instruments to see that they are functional and that readings are within limitations. (See Section 2.)

The engines are equipped with a dynamic counterweight system and must be operated accordingly. Use smooth steady movements of the throttle controls, and avoid rapid opening and closing. Set the throttles to an engine speed of 1500 RPM. Retard the propeller controls aft to check feathering; however, do not allow a drop of more than 500 RPM. Check that the gyro pressure gauge is reading within the green arc.

Check alternator output by pressing first one and then the other momentary push button located on either side of the ammeter. Alternator output readings should be approximately equal.

Advance the throttles until engine speed reaches 2300 RPM. Check the magnetos on each engine by turning OFF, then ON, each of the four magneto switches in turn. The normal drop when a magneto is turned off is about 90 RPM. The maximum allowable drop is 175 RPM. The maximum differential between the magnetos on one engine is 50 RPM. After checking one magneto, do not check the next until the engine speed returns to 2300 RPM. Operation of an engine on one magneto should be kept to a minimum.

Exercise the propeller levers through their range to check their operation. Response should be normal. Do not allow speed to drop more than 300 RPM.

Retard the throttles to 600-650 RPM to check idling. Set the throttles at 1000 RPM; recheck the flight instruments, and reset them if necessary. Set the desired amount of friction on the engine control levers.

:FORE TAKEOFF

belts and no smoking signs should be ON for takeoff. Inboard fuel ıst be used for takeoff; therefore ensure that both fuel selectors are board tank positions and that the fuel quantity is sufficient. Check l is in OFF position.

:k that the mixture and propeller controls are full forward. Check flaps for proper operation. Extend wing flaps 15°. Visually confirm t and left wing flaps are equally extended. Retract the flaps. After begin to move, press and hold the flap test switch. The flaps should the FLAP annunciator should illuminate. Release the flap test the annunciator should extinguish and the flaps retract to 0°. flaps are at 0° for a normal takeoff or 15° for a short field takeoff.) be sure that the propeller synchrophaser, autopilot, and surface re OFF if installed. Set trim for takeoff.

ıeck alternator output. Turn pitot, propeller, and windshield heat :essary. Set avionics as required. Set the direction indicator if / and set the transponder as required. Make certain that controls and that all engine instruments are reading within limits. Turn :y fuel pumps ON for takeoff and release the parking brake. Check arning lights are illuminated. Do not take off if a fuel flow warning luminated.

:EOFF

L

e holding the brakes with the mixture and propeller levers full advance the throttles slowly to a manifold pressure of 30 inches of then continue to advance the throttles at a normal rate and release s. Do not allow manifold pressure to exceed 46 inches. Use smooth, rottle movements, and avoid rapid opening and closing. Propeller takeoff should be 2575 RPM.

:ngines are adjusted to provide 40 inches Hg. manifold pressure at tle in standard temperature at sea level. Depending upon altitude erature it is possible to reach higher (up to 46 inches) or lower pressures.

Each engine density controller is set to produce rated takeoff power for that engine. The takeoff power manifold pressure for each engine will not necessarily be the same. However, if the spread in manifold pressure exceeds 1.5 inches during a full throttle climb, the density controller settings should be checked and serviced.

At 83 KIAS, rotate the aircraft and allow it to fly off. Maintain a pitch attitude which will result in acceleration of the aircraft to 89 KIAS at 50 feet. Before the airspeed exceeds 129 KIAS, retract the landing gear. Continue to accelerate to the desired climb airspeed.

SHORT FIELD

The initial segment of the short field takeoff procedure is identical to the normal procedure except that the brakes shall be held until it has been determined that each engine is operating normally at maximum continuous power. After it has been determined that each engine is operating normally at maximum continuous power, release the brakes, neutralize the elevator control and initiate the takeoff roll. Maintain directional control with the nose wheel steering system only. Avoid making steering inputs with the brakes as this may result in increasing the takeoff ground roll distance.

At 76 KIAS, rotate the aircraft to achieve an attitude that will result in an initial climb airspeed of 91 KIAS. Maintain 91 KIAS until the barrier has been cleared. After the barrier has been cleared, retract the landing gear, the flaps and accelerate to 94 KIAS (best single engine rate of climb).

4.24 CLIMB

When clearance above obstacles and terrain permits, reduce to maximum normal operating power by setting the throttles to 39.5 inches Hg. manifold pressure and the propellers to 2400 RPM. Lean the mixture to a minimum fuel flow of 28 gallons per hour at a maximum exhaust gas temperature of 1450°F and maximum cylinder head temperature of 475°F. Adjust the cowl flaps and mixture as necessary to maintain engine temperature within limits.

Turn the emergency fuel pumps off one at a time, and check the fuel gauges and warning lights. At power settings above 75%, maintain the mixture controls in the full rich position except with maximum normal operating power setting when the mixture may be leaned as stated in the preceding paragraph.

ıough the maximum approved operating altitude for this airplane is 'eet, under standard atmospheric conditions and at maximum gross he multi-engine service ceiling and absolute ceiling are 26,300 feet 00 feet, respectively.

RUISE

ing cruise, it is recommended that when the airplane is loaded to a l C.G., fuel from the outboard tanks be used first. This will tend to e C.G. forward with fuel burn-off. Outboard tanks should be used :oordinated level flight only. If outboard tanks are used during descents or prolonged uncoordinated level flight, power loss may en if there is appreciable fuel remaining.

:e inboard tanks must be used for landing, be sure to retain sufficient :he inboard tanks for normal descent and landing in addition to fuel for a possible go-around. It may be necessary to turn ON the cy fuel pumps during cruise to stabilize fuel pressure.

cruising speed of the Navajo is determined by many factors, ıg power setting, altitude, temperature, load and equipment d. Refer to Section 5 - Performance - for power settings and ance under various conditions.

Lycoming engines on this airplane can be cruised at any power level) BHP to 170 BHP. An engine speed of 2500 RPM, may be used for n cruise and performance, while a lower engine speed down to 2200 ay be used for more economical cruising conditions. (Refer to the etting Table in Section 5 - Performance - for recommended power .

ing power changes, move the throttles slowly to the desired power wait a few seconds for the system to stabilize, and then make ents, if necessary, after leaning the engines. Always return the s to full rich before increasing power. To increase power, always RPM (propeller control) before increasing manifold pressure control). To decrease power, always decrease manifold pressure n RPM.

maximum service life from the engines, maintain cylinder head :ures below 435°F during high performance cruise operation and)0°F for economy cruise power. At high altitudes the cylinder head

temperatures can be maintained within normal limits through careful leaning and proper adjustment of the cowl flaps. It may be necessary at high altitudes to enrich the mixture, with partial cowl flap, to maintain normal temperatures.

Do not lean the engines above 75% power. Never exceed 1650°F EGT. Refer to Paragraph 4.37 for Leaning Procedures.

Fuel flow warning lights indicate an impending fuel flow interruption which could result in power loss. Any time fuel pressure drops below 25 psi the emergency fuel pump should be turned ON.

During cruise, propellers should be synchronized as close as possible. The control levers can be secured in their settings by use of the friction knob on the right side of the control pedestal. During flight, monitor fuel gauges and engine gauges.

4.27 DESCENT

During power reduction for descent, be sure EGT is maintained at minimum of 1350°F. Throttling back at high altitudes (above 15,000 feet) without first checking that the mixture has been so leaned could result in engine power loss.

Set fuel selectors on INBOARD tanks and set power as required for descent. Adjust cowl flaps as necessary to maintain engine temperatures within limits.

At altitudes below 10,000 feet, turn OFF the oxygen system. The pitot heat and windshield heat may be used as required.

4.29 BEFORE LANDING

When preparing for landing, turn ON seat belt and no smoking signs and ensure that all occupants comply. Turn ON emergency fuel pumps, and set mixture controls to full RICH. If a propeller synchrophaser system is installed, turn it OFF.

Set the propeller controls to 2400 RPM. Landing gear may be lowered at airspeeds below 156 KIAS. Determine landing gear extension by checking the gear position lights. Secondary indications of gear extension are the

f the selector lever to a neutral position and the appearance of the ır in the gear mirror on the inboard side of the left nacelle.

rate the toe brakes to determine if there is sufficient pressure for braking and make sure that the parking brake is not set. Should eeze-up (caused by icing of the brake assembly during flight) be :d, it is recommended that maximum brake pressure be applied times to "break-up" possible ice accumulation. The autopilot and r synchrophaser should be OFF for landing.

:nd the wing flaps as required. The maximum speed for up to 25° of :nsion is 174 KIAS; the maximum speed for 40° flap extension is .S.

ding lights should be turned on as required. Radar should be OFF ng.

.LKED LANDING

balked landing situation, set props full forward and apply power ed, set the flaps to 15° and retract the landing gear. Flaps should 15° until obstacles are cleared. A minimum airspeed of 94 KIAS e attained.

Before Landing checklist should be completed before all landings; ıfter go-arounds or balked landings are no exception.

TER LANDING (CLEAR OF RUNWAY)

n the airplane is taxied clear of the active runway, cowl flaps should ɔpened, wing flaps should be fully retracted, and trim set to neutral. rgency fuel pumps and strobe lights should be turned OFF.

ay be necessary to use emergency fuel pumps during ground when the outside air temperature is above 75°F.

e heater is in use, place the heater switch in the FAN position for a utes to allow the heater to cool down before turning it off. This lown period is only necessary during ground operation, not when r is turned off in flight.

with the propeller controls full forward. Unnecessary radio and equipment may be shut down.

4.35 SHUTDOWN

WARNING

No braking will occur if handle is pulled prior to brake application.

After the airplane is taxied to a stop, set the parking brake. If the temperature is below freezing and the brakes are wet, they should not be set if there is a possibility of the brakes being frozen. Turn OFF avionics and the autopilot AP/FD master switch. The heater switch may be turned OFF after it has cooled down. Turn OFF all other electrical equipment.

Retard the throttle levers to idle power before checking magneto grounding. Turn both magnetos on one engine OFF, then immediately back ON. An engine will stop briefly if magnetos are grounded. During this check, do not allow engines to come to a complete stop.

Advance the throttles to 1000 RPM to check the battery. With both engines turning 1000 RPM and all electrical equipment off, if the ammeter shows a battery charge rate in excess of 25 amps, the battery has a low charge. In this case, do not stop engines until current drops below 25 amps or there may not be sufficient battery current for starting.

Leave throttles at 1000 RPM. Since one engine's hydraulic pump was tested at start, the other should be tested at shutdown. Place the mixture control of the first engine started in IDLE CUT-OFF. When the engine has stopped, place the gear selector handle DOWN. If the hydraulic pump on the running engine is functioning, the selector will return to neutral. After this check, place the mixture control of the second engine in IDLE CUT-OFF. Switch magnetos OFF, and, lastly, turn the airplane master switch OFF.

For mooring instructions refer to Paragraph 8.9.

4.37 LEANING PROCEDURES

When leaning below best power is permitted (refer to Maximum Manifold Pressure Vs. Altitude graph in Section 5 - Performance), the engines may be operated at peak EGT or on the lean side of peak EGT as long as stable engine operation results without exceeding any engine limitations during steady state or transient conditions.

BEST POWER

To lean the mixture to best power, proceed as follows:

(a) Lean the mixture slowly until EGT has stabilized at peak.

NOTE

Do not exceed 1650°F EGT.

Enrich the mixture 125°F.
At high power setting if 1650°F is reached before peak EGT, refer to Lycoming Operator's Manual for correct procedure.

CONOMY

lean the mixture to best economy, proceed as follows:
Lean the mixture slowly until EGT has stabilized at peak.

NOTE

Do not exceed 1650°F EGT.

IDE OF PEAK

ean the mixture on the lean side of peak, proceed as follows:
At the desired power setting, lean the mixture slowly until EGT has stabilized at peak.

NOTE

Do not exceed 1650°F EGT.

If peak EGT is 1650°F or less, continue to lean until a maximum of 50° reduction in EGT is obtained. Readjust manifold pressure as necessary to maintain the desired power setting

If 1650°F EGT is reached before peak EGT is obtained, lean according to the following procedure

(1) With the mixture leaned to 1650°F, reduce manifold pressure until EGT is reduced approximately 75°.
(2) Lean the mixture slowly until peak EGT is obtained.
(3) Lean the mixture additionally until 50°-100° on the lean side of peak is obtained. Do not lean into engine roughness.
(4) Slowly increase manifold pressure to the desired power setting without permitting EGT to exceed 1650°F.
(5) Carefully adjust the mixture until EGT is 1625° to 1650°F.

NOTE

Enriching the mixture will increase the EGT when operating on the lean side of peak EGT.

(6) Before enriching the mixture, reduce the manifold pressure as in step (1) to prevent exceeding 1650°F EGT.

4.39 VSSE - INTENTIONAL ONE ENGINE INOPERATIVE SPEED

VSSE is a speed selected by the aircraft manufacturer as a training aid for pilots in the handling of multi-engine aircraft. It is the minimum speed for intentionally rendering one engine inoperative in flight. This minimum speed provides the margin the manufacturer recommends for use when intentionally performing engine inoperative maneuvers during training in the particular airplane.

The intentional one engine inoperative speed, VSSE, for the PA-31 is 90 KIAS.

4.41 VMCA - AIR MINIMUM CONTROL SPEED

VMCA is the minimum flight speed at which a twin-engine airplane is directionally controllable as determined in accordance with Federal Aviation Regulations. Airplane certification conditions include one engine becoming inoperative and windmilling; not more than a 5° bank toward the operative engine; landing gear up; flaps up; and most rearward center of gravity.

VMCA for the PA-31 has been determined to be 76 KIAS.

The VMCA demonstration, which may be required for the FAA flight test for the multi-engine rating, approaches an uncontrolled flight condition with power reduced on one engine. The demonstration and all intentional one engine operations should not be performed at an altitude of less than 5000 feet above the ground. The recommended procedure for VMCA demonstration is to reduce the power to idle on the simulated inoperative engine at or above the intentional one engine inoperative speed, VSSE and slow down at approximately one knot per second until the FAA Required Demonstration Speed, VMCA or stall warning is obtained.

$_B$ is a minimum speed selected by the manufacturer for intentionally g one engine inoperative in flight for pilot training.

$_B$ for the PA-31 is 90 KIAS.

EMONSTRATION

Landing Gear	UP
Flaps	UP
Airspeed	at or above 90 KIAS (V_{SSB})
Propeller Controls	HIGH RPM
Throttle (Simulated Inoperative Engine)	IDLE
Throttle (Other Engine)	MAX ALLOWABLE
Airspeed	reduce approximately 1 knot per second until either V_{MCA} or STALL WARNING is obtained

CAUTIONS

Use rudder to maintain directional control (heading) and ailerons to maintain 5° bank towards the operative engine (lateral attitude). At the first sign of either V_{MCA} or stall warning (which may be evidenced by: Inability to maintain heading or lateral attitude, aerodynamic stall buffet, or stall warning horn) immediately initiate recovery; reduce power to idle on the operative engine, and immediately lower the nose to regain V_{SSE}.

One engine inoperative stalls are not recommended.

der no circumstances should an attempt be made to fly at a speed $/_{MCA}$ with only one engine operating.

4.43 SIMULATED SINGLE ENGINE ZERO THRUST

To approximate single engine flight conditions without intentionally rendering an engine inoperative, use the following power settings to simulate zero thrust (feathered) conditions.

Mixture control (inop. engine) .....full rich
Propeller control (inop. engine).....high RPM
Throttle (inop. engine).....adjust to achieve RPM listed below

ZERO THRUST

KTAS	RPM
80	1600
90	1800
100	2000
110	2200
120	2400
125	2500

Straight line variation between points.

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SECTION 5

PERFORMANCE

5.1 GENERAL

All of the required (FAA regulations) and complementary performance information applicable to the Navajo is provided in this section.

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

The pilot should use the full Maximum Continuous Power rating of the engine when safety considerations so dictate.

5.3 INTRODUCTION - PERFORMANCE AND FLIGHT PLANNING

The performance information 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 airplane. This performance can, however, be duplicated by following the stated procedures in a properly maintained airplane.

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

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

: information provided in item 5.5 (Flight Planning Example) a detailed flight plan using the performance charts in this section. art includes its own example to show how it is used.

IGHT PLANNING EXAMPLE

: following Flight Planning Example illustrates the correct on of pertinent data presented in this section of the manual.

Associated Conditions

Certain basic information must be gathered when planning a flight. This information includes departure and destination airport conditions, en route conditions, and basic aircraft conditions. Such factors as weather, the status of the runway, the distance of the flight, the number of passengers, etc., must be determined. Assume, for example, the following conditions:

(1) Departure Airport Conditions

Outside Air Temperature	17°C
Pressure Altitude	2000 ft.
Wind and Direction	15 kts at 360°
Runway Direction	300°

(2) Cruise Conditions

Outside Air Temperature	-5°C
Pressure Altitude	10,000 ft.
En route Distance	500 naut. mi.
Power Setting	200 BHP
Mixture Setting	Best Economy

(3) Destination Airport Conditions

Outside Air Temperature	20°C
Pressure Altitude	2000 ft.
Wind and Direction	10 kts. at 330°
Runway Direction	270°

(4) Aircraft Configuration

Basic Weight (assumed for example)	4000 lbs.
Fuel Tanks (total capacity)	187 gal.
Occupants	6 at 170 lbs. each
Baggage	350 lbs.

(b) Aircraft Loading

The airplane weight and center of gravity may be determined by utilizing the information given in 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 6-7. If any alterations to the airplane affecting weight and balance have been made, reference to the aircraft logbook, Weight and Balance Record (Figure 6-9) or latest FAA Major Repair or Alteration Form should be made to determine the current basic empty weight of the airplane.

Use the Weight and Balance Loading Chart (Figure 6-15) and the Weight, Moment and C.G. Limit graph (Figure 6-17) to determine the total weight of the airplane and the center of gravity position.

After proper utilization of the information provided, assume that the following weights have been determined for consideration in the Flight Planning Example:

(1) Basic Weight (assumed for example)	4000 lbs.
(2) Occupants (6 at 170 lbs. each)	1020 lbs.
(3) Baggage	350 lbs.
(4) Fuel (187 gal. at 6 lbs./gal.)	1122 lbs.
(5) Ramp Weight (total of above)	6492 lbs.
(6) Landing Weight (takeoff weight minus item (h), Total Fuel Required)	5975 lbs.

The landing weight cannot be determined until the weight of the fuel to be used has been established.

Ramp weight is below the approved maximum of 6536 lbs. Determine that weight and balance calculations have shown the C.G. position to be within the approved limits.

Takeoff Distance

After determining the aircraft loading, all aspects of takeoff must be considered. Conditions of the departure airport and takeoff weight should be applied to the appropriate Takeoff Distance graph to determine the length of runway necessary. Takeoff conditions for the Flight Planning Example are listed below:

(1) Wind	15 kts. at 360°
(2) Angle between Flight Path and Wind	360° -300° = 60°
(3) Head Wind Component (from Wind Component Graphs Figure 5-13)	8 kts.
(4) Outside Air Temperature	17°C
(5) Pressure Altitude	2000 ft.

Using the Normal Takeoff over 50 Feet graph (Figure 5-14) the takeoff distances are as follows:

Total Distance	2230 ft.
Ground Run	1650 ft.

Climb

Entering the example conditions of the departure airport and the cruise altitude into the Time, Fuel and Distance to Climb graph (Figure 5-25) yields the following:

(1) Time to Climb	8.1 - 1.5	=	6.6 minutes
(2) Fuel to Climb	47.0 - 9.0	=	38.0 lbs.
(3) Distance to Climb	15.0 - 3.0	=	12.0 naut. miles

NOTE

The effect of winds aloft must be considered by the pilot when computing climb, cruise. and descent performance.

Descent

Entering the cruise and destination airport conditions into the Time, Distance and Fuel to Descend graph (Figure 5-43) yields the following:

(1) Time to Descend	10 - 2	=	8 minutes
(2) Distance to Descend	30.0 - 3.5	=	26.5 naut. miles
(3) Fuel to Descend	17.0 - 4.0	=	13.0 lbs.

(f) Cruise

Subtracting the previously calculated distance to climb and distance to descend figures from the total en route distance yields the total cruise distance. For example:

Cruise Distance
= En route Distance - Climb Distance - Descent Distance
= 500 - 12.0 - 26.5
= 461.5 naut. miles

From the True Airspeed Vs. Pressure Altitude Graphs (Figure 5-27 and 5-29) for 200 BHP, Best Economy Mixture, the cruise airspeeds are 175 kts at 6500 lbs. and 180 kts at 5500 lbs.

The average cruise weight is estimated as:

Average Cruise Weight
= Takeoff Wt. - $\frac{\text{Cruise Distance x Cruise Fuel Flow}}{\text{Cruise Airspeed at 6500 lbs. x 2}}$
= 6492 - $\frac{500 \times 164}{175 \times 2}$

= 6258 lbs.

Interpolating these values for 6258 lbs. (preliminary cruise weight), the cruise speed is 176 kts.

Fuel Flow is 27.3 gallons/hour (164 lbs./hr.).

Cruise time and fuel may be calculated by the following formula:

Cruise Time = Cruise Distance/Cruise speed
= 461.5/176
= 2.622 hours or 157 minutes

Cruise Fuel = Fuel Flow x Cruise Time
= 164 x 2.634
= 430 lbs.

The previous data can be used to calculate an average cruise weight in the following manner:

Average Cruise Weight
= Takeoff Wt. - Ramp Fuel - Climb Fuel - $\frac{\text{Cruise Fuel}}{2}$
= 6492-36-38-$\frac{430}{2}$
= 6203 lbs.

If the average cruise weight was found to be significantly different from the estimated cruise weight, the cruise airspeed would be changed to coincide with this weight by interpolating between the appropriate two aircraft weights. For example, had the average cruise weight been found to be 5700 lbs., then the cruise speed would be corrected to 179 kts.

Total Flight Time

The total flight time is determined by adding the time to climb, cruise time, and time to descend. The following flight time is required for this Flight Planning Example:

Total Flight Time
= Time to Climb + Cruise Time + Time to Descend
= 6.6 + 158 + 8.0
= 172.6 minutes

Total Fuel Required

Determine the total fuel required by adding fuel for taxi and takeoff, fuel to climb, cruise fuel, and fuel to descend. When the total fuel (in pounds) is determined, dividing this value by 6 lbs./gal. will give the total fuel in gallons to be used for the flight. Total fuel calculations for the Flight Planning Example are shown below:

Total Fuel Required
= Fuel for taxi and takeoff + Fuel to Climb + Cruise Fuel + Fuel to Descend
= 36+ 38+432+ 13
= 519 lbs. (86.5 gallons)

(i) Landing Distance

Subtracting the total fuel required from the takeoff weight of the airplane gives the landing weight:

Landing Weight
= Takeoff Weight - Total Fuel Required
= 6492 - 519
= 5973 lbs.

Destination airport conditions applied to the Wind Component graph (Figure 5-13) gives the following headwind component for the Flight Planning Example:

The angle between the flight path and wind is 330° -270° or 60°.
Therefore, the Headwind Component is 5 kts.

From the Landing Distance over 50 Feet graph (Figure 5-47), with the destination airport conditions, the distances required for landing for the Flight Planning Example are as follows:

(1) Total Distance	2030 ft.
(2) Ground Roll	1620 ft.

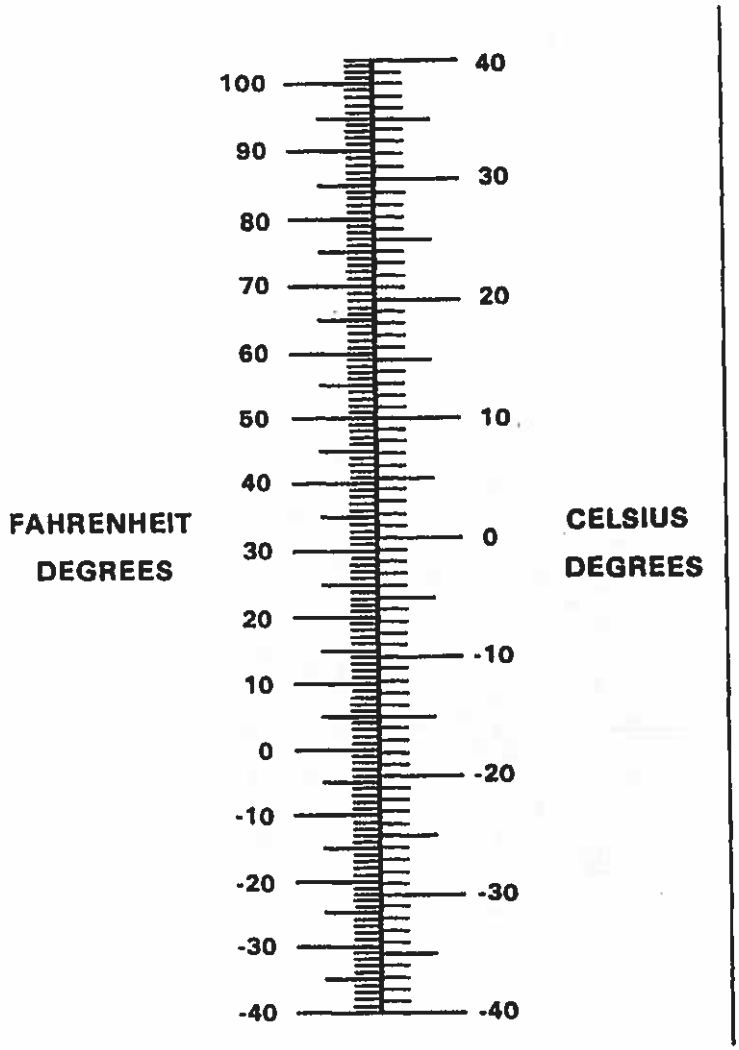
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5.7 PERFORMANCE GRAPHS

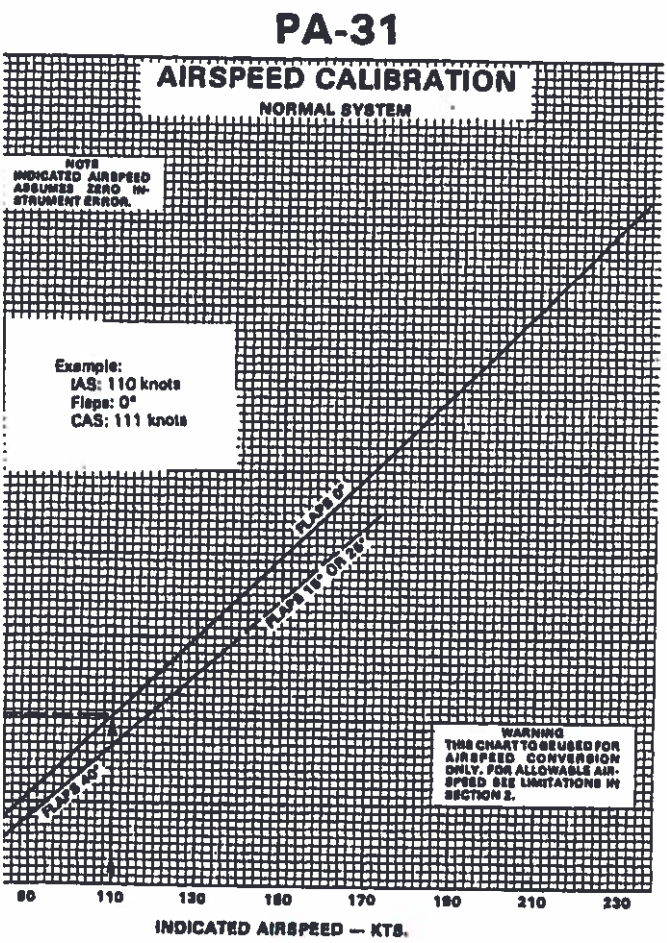
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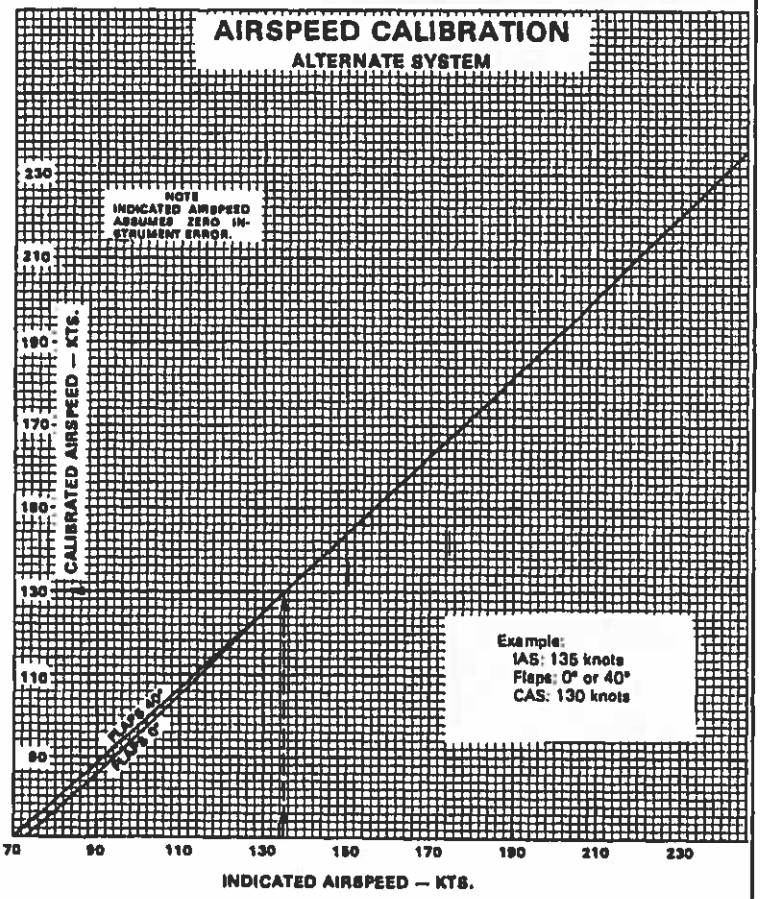


TEMPERATURE CONVERSION
Figure 5-1

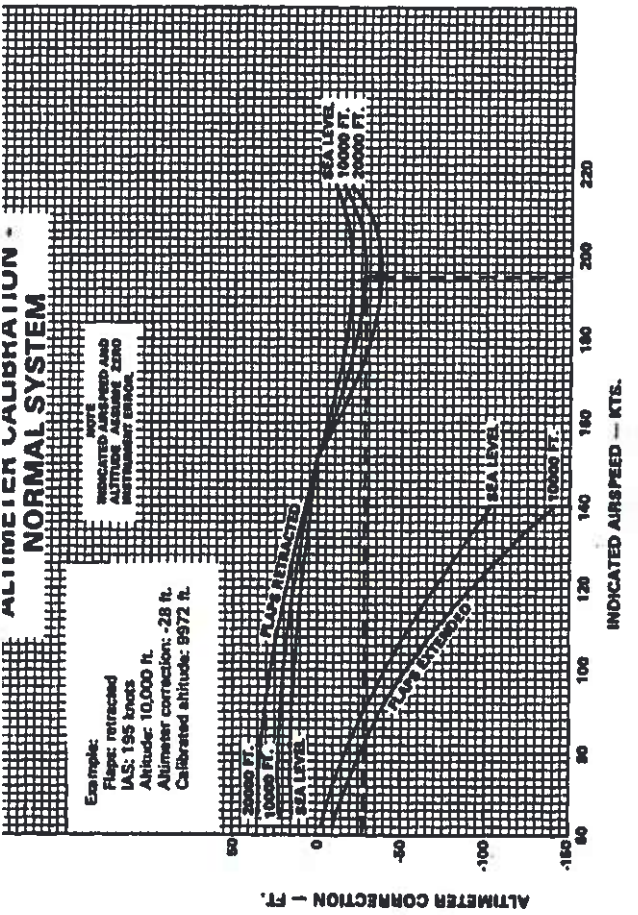


AIRSPEED CALIBRATION - NORMAL SYSTEM
Figure 5-3

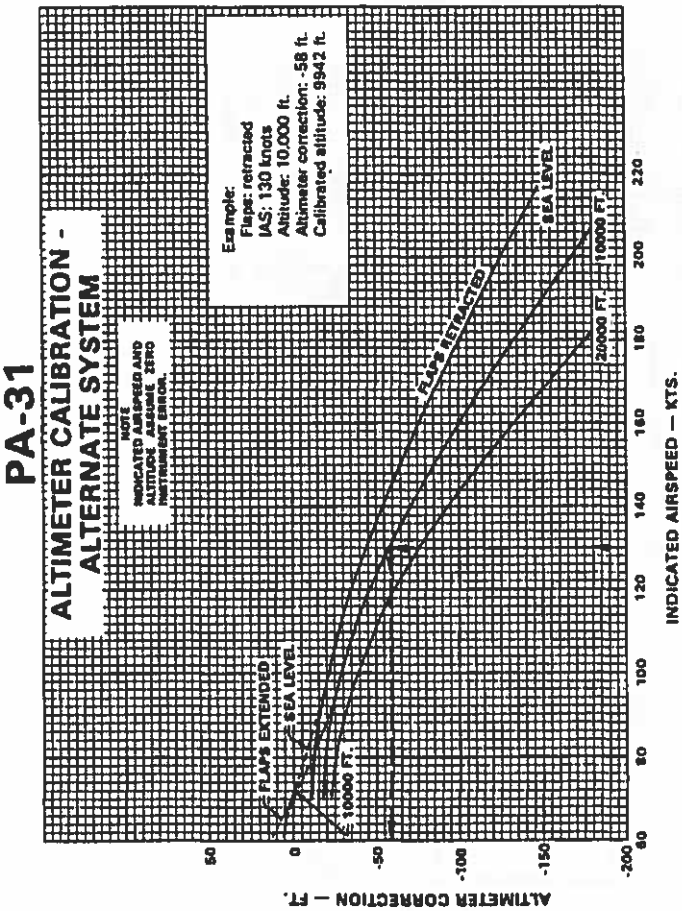
PA-31



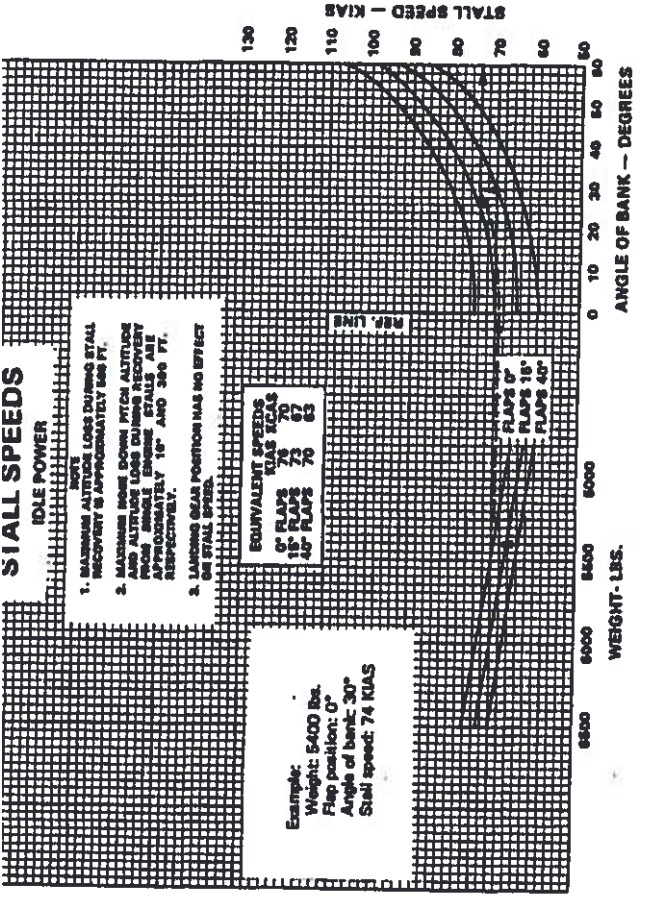
AIRSPEED CALIBRATION - ALTERNATE SYSTEM
Figure 5-5



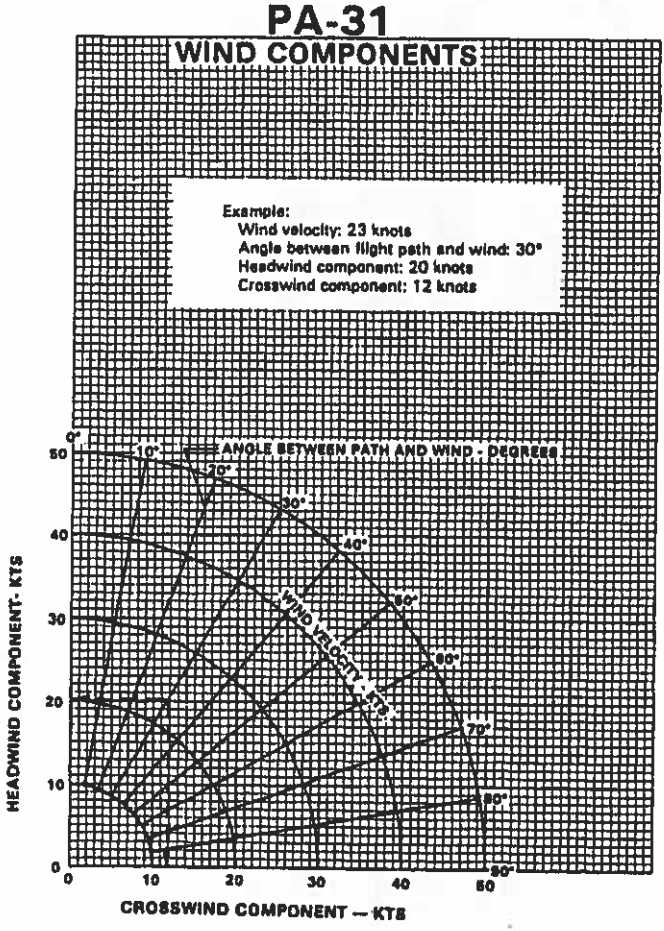
ALTIMETER CALIBRATION - NORMAL SYSTEM
Figure 5-7



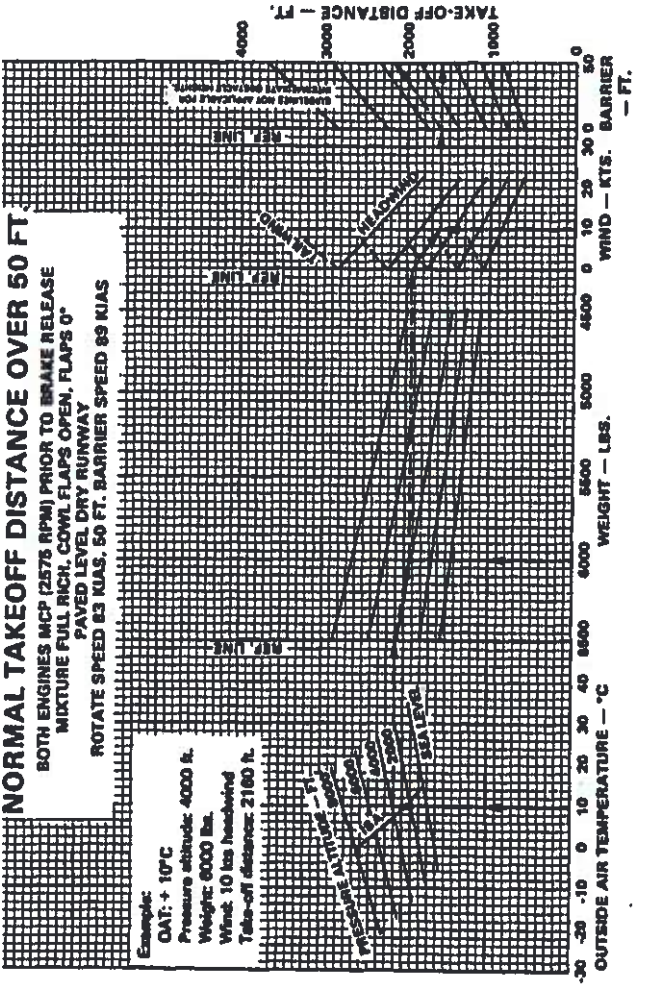
ALTIMETER CALIBRATION - ALTERNATE SYSTEM
Figure 5-9



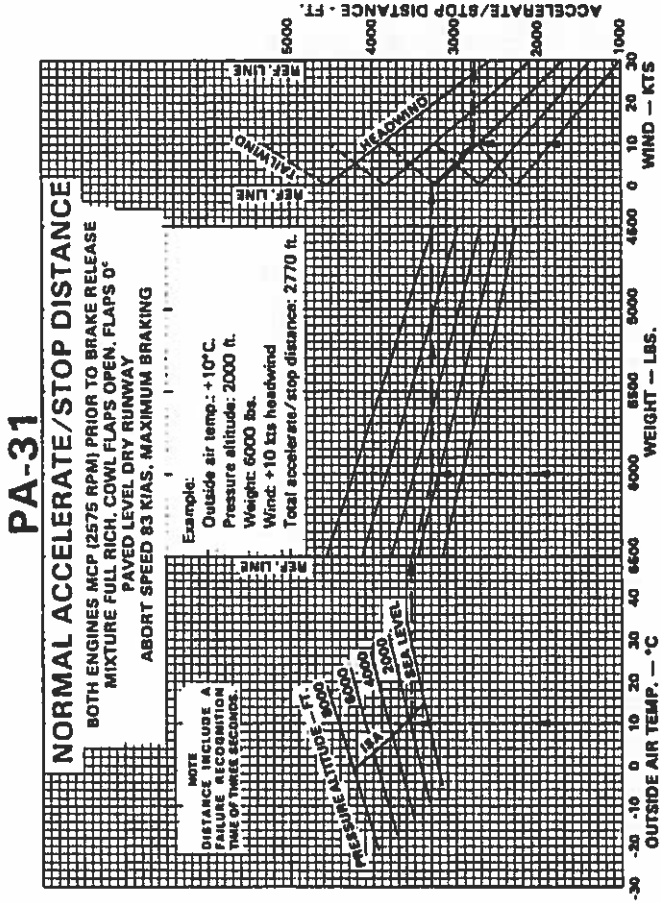
STALL SPEEDS
Figure 5-11



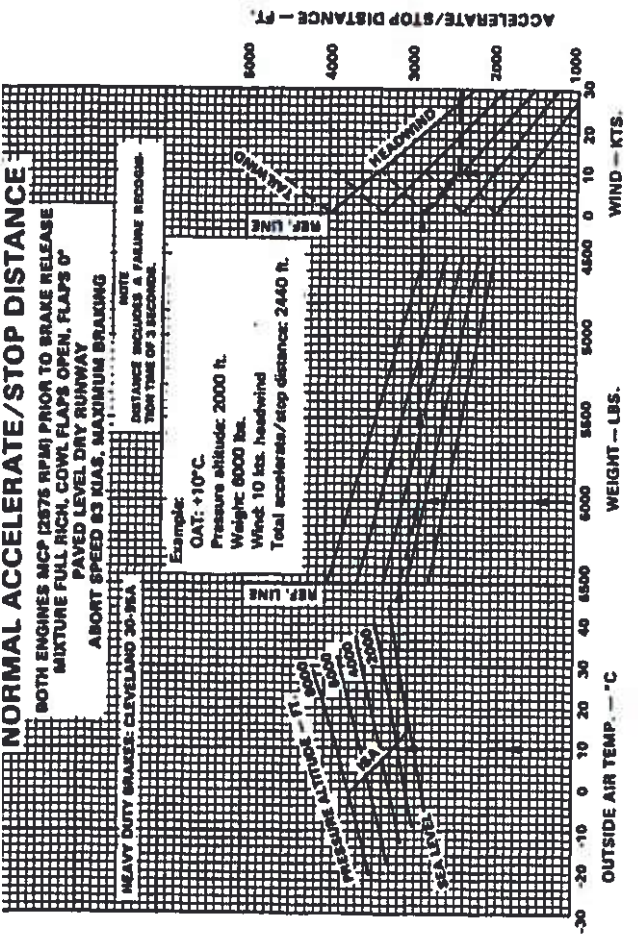
WIND COMPONENTS
Figure 5-13



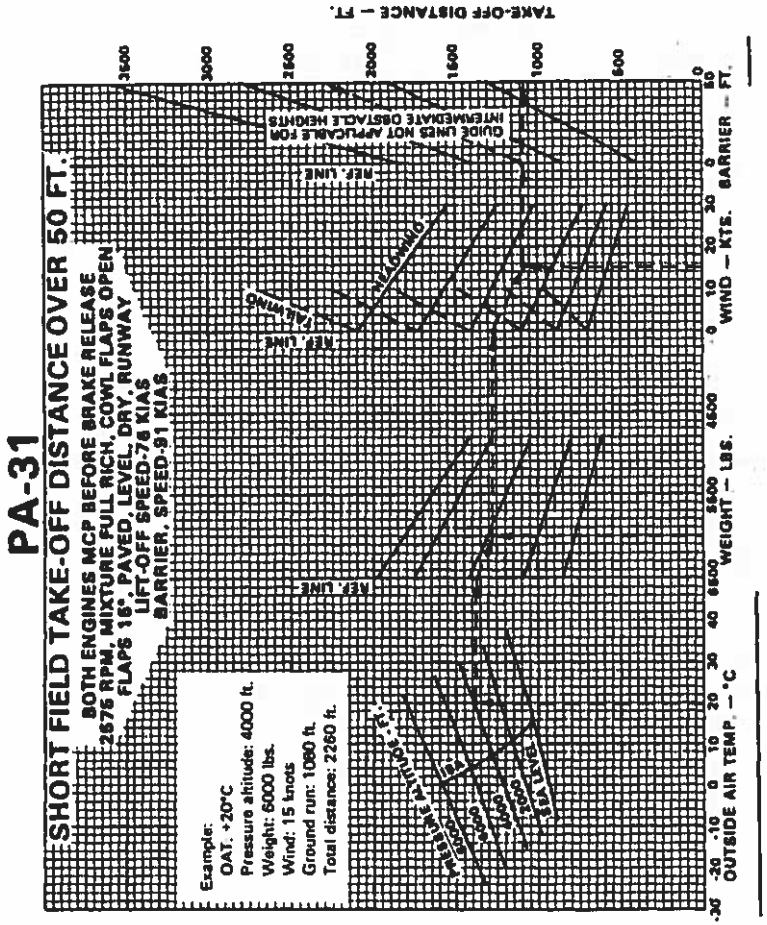
NORMAL TAKEOFF DISTANCE OVER 50 FEET
Figure 5-14



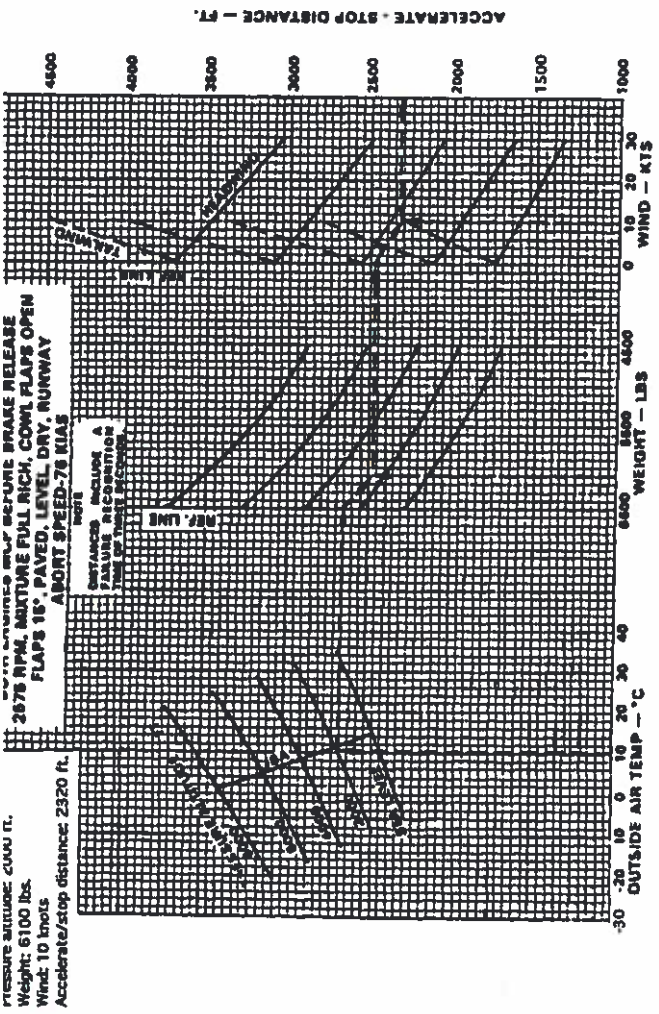
NORMAL ACCELERATE/STOP DISTANCE
Figure 5-15



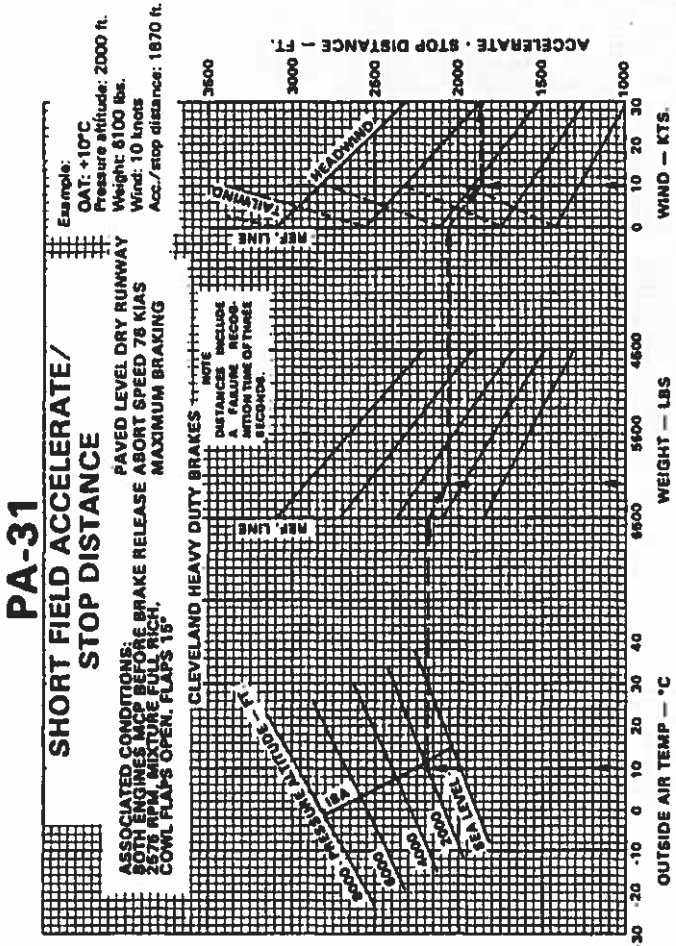
NORMAL ACCELERATE - STOP DISTANCE
(CLEVELAND HEAVY DUTY BRAKES)
Figure 5-16



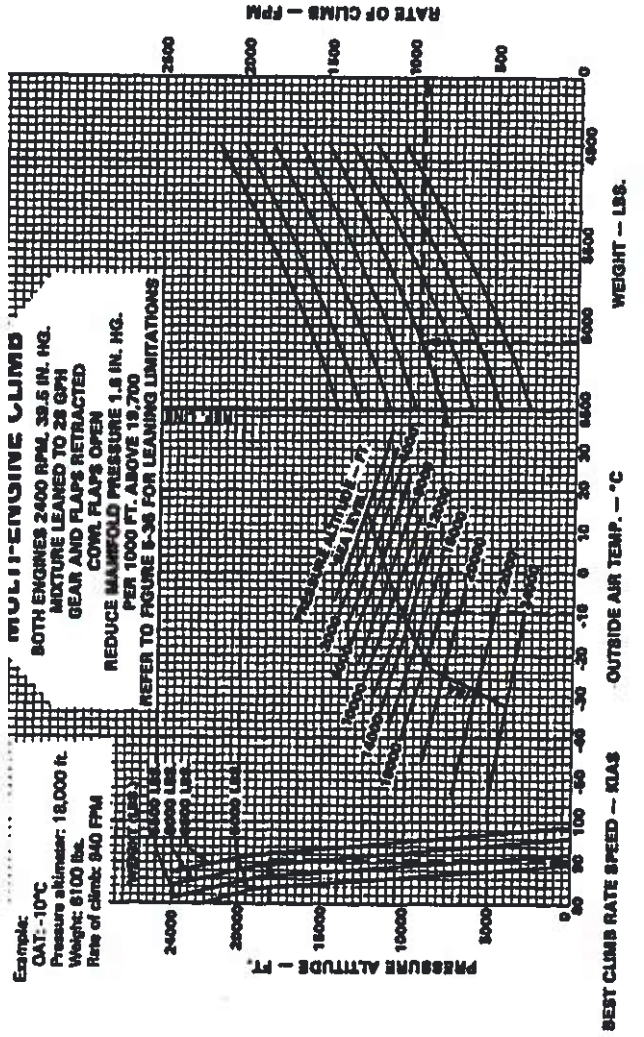
SHORT FIELD TAKEOFF DISTANCE OVER 50 FEET
Figure 5-17



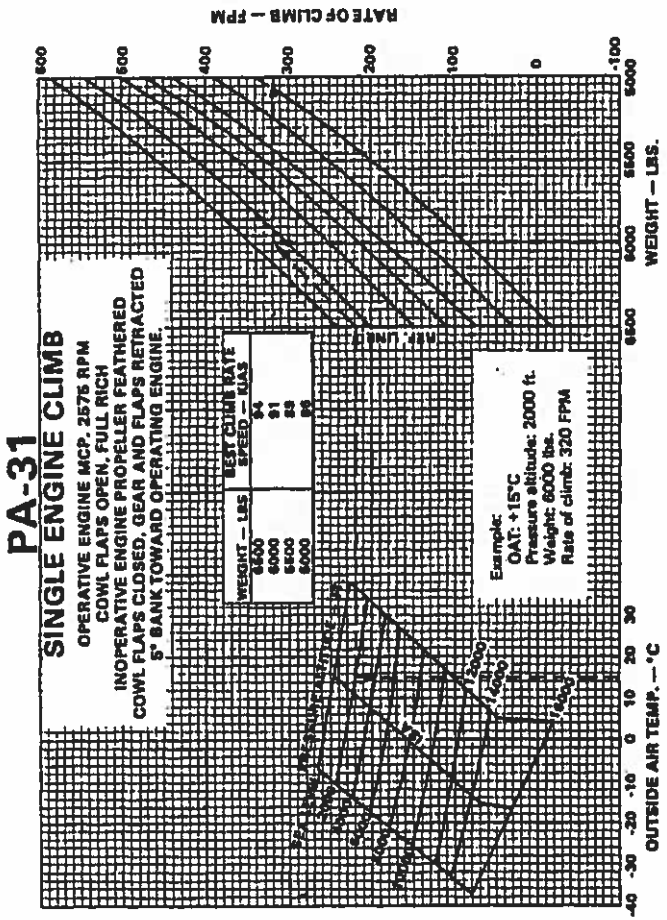
SHORT FIELD ACCELERATE - STOP DISTANCE
Figure 5-18



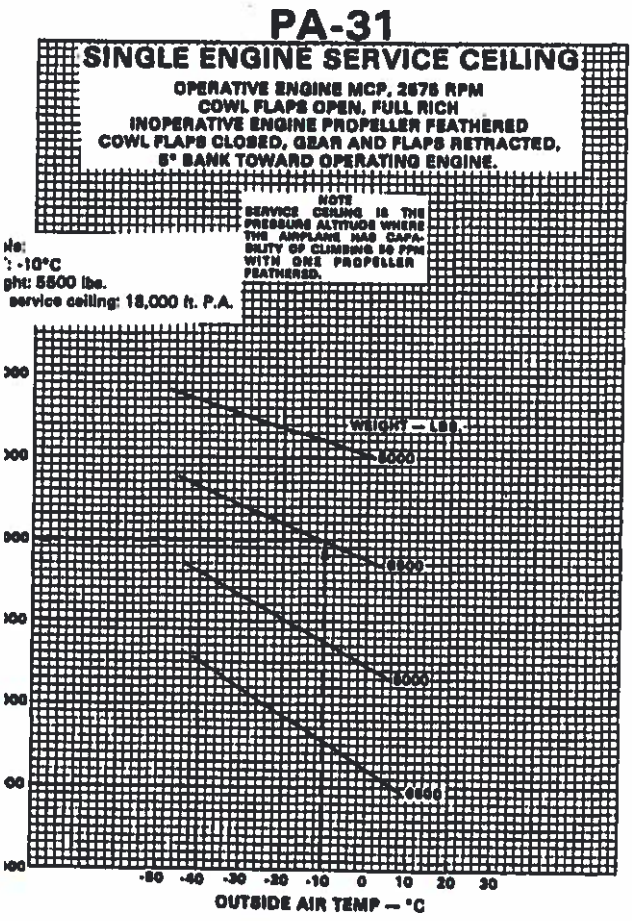
SHORT FIELD ACCELERATE- STOP DISTANCE
(CLEVELAND HEAVY DUTY BRAKES)
Figure 5-19



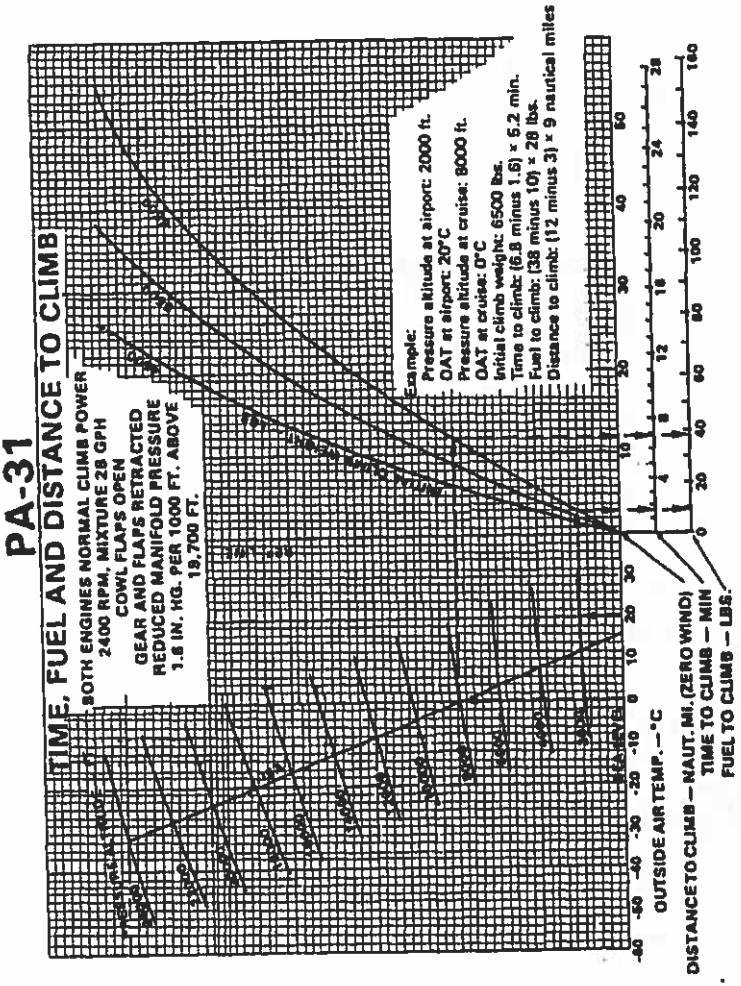
MULTI-ENGINE CLIMB
(MAXIMUM NORMAL OPERATING POWER)
Figure 5-20



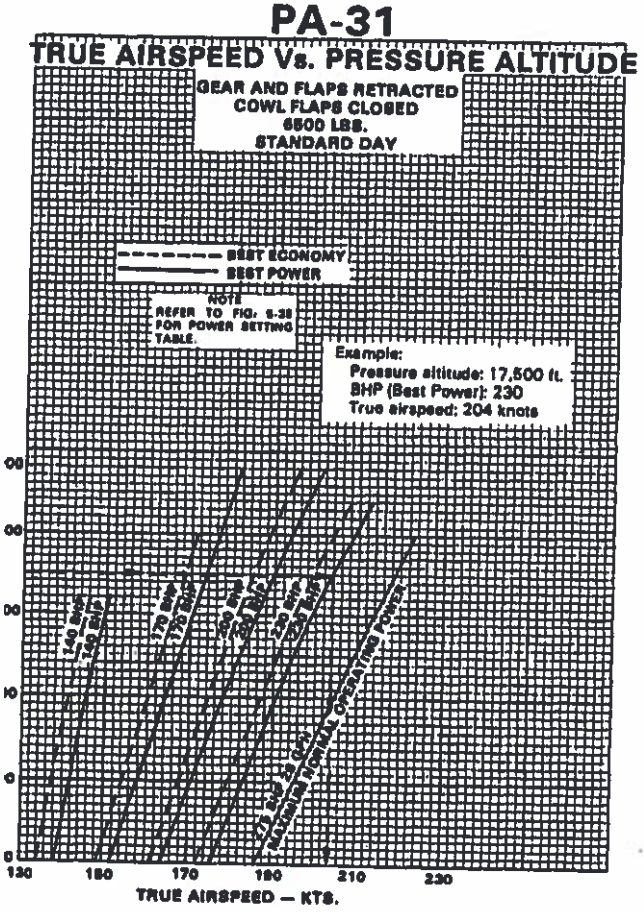
SINGLE ENGINE CLIMB
Figure 5-21



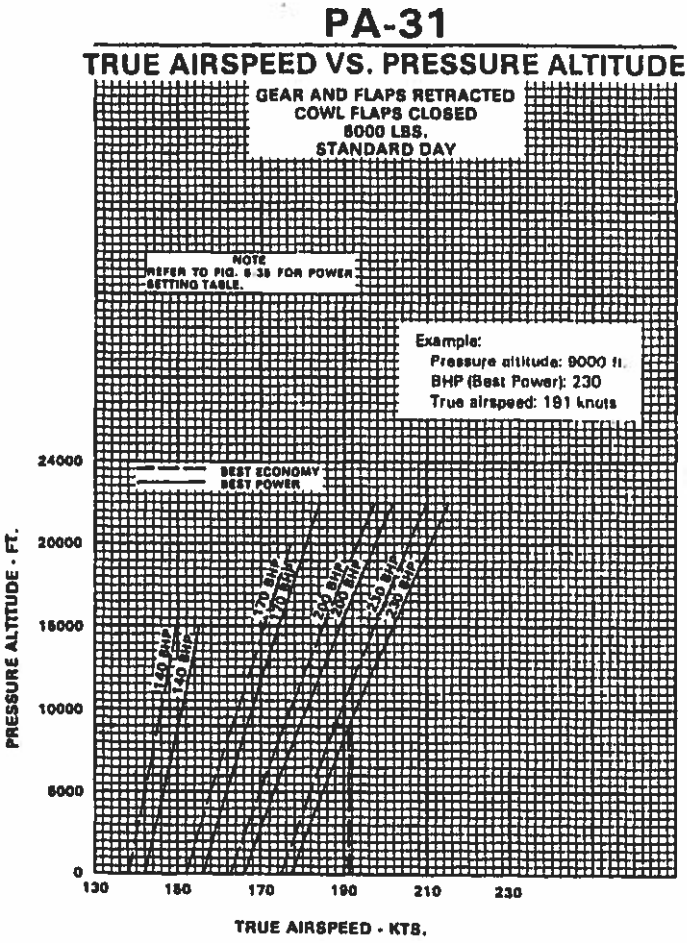
SINGLE ENGINE SERVICE CEILING
Figure 5-23



TIME, FUEL AND DISTANCE TO CLIMB
(MAXIMUM NORMAL OPERATING POWER)
Figure 5-25

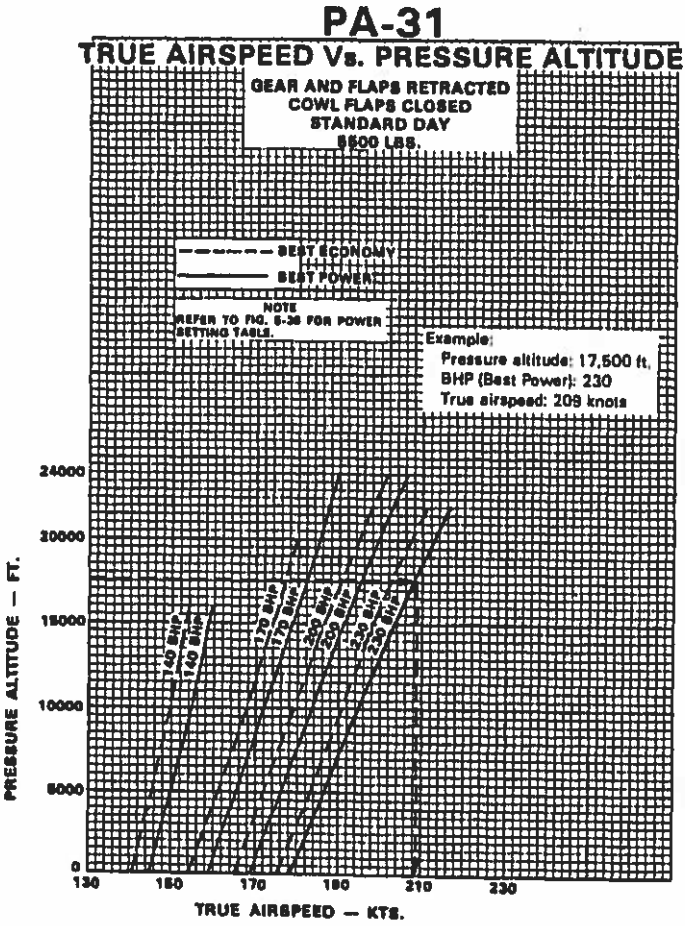


RUE AIRSPEED VS. PRESSURE ALTITUDE - 6500 LB.
Figure 5-27



TRUE AIRSPEED VS. PRESSURE ALTITUDE - 6000 LB.
Figure 5-28

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TRUE AIRSPEED VS. PRESSURE ALTITUDE - 5500 LB.
Figure 5-29

	Pressure Altitude Feet	OAT °C	Fuel Flow GPH Total B.P./B.E.	Cruise True Airspeed - Kts.							
				6500 Lbs.		6000 Lbs.		5500 Lbs.	
				Best Power	Best Economy	Best Power	Best Economy	Best Power	Best Economy
ISA +20°C	SL	35.0	38.6/32.6	179	176	181	178	183	180
	5000	25.1	38.6/32.6	187	184	189	190	191	182
	10000	15.2	38.6/32.6	195	191	197	193	199	195
	15000	5.3	38.6/32.6	203	199	205	201	209	203
ISA	SL	15.0	38.6/32.6	175	172	177	174	179	176
	5000	5.1	38.6/32.6	183	180	185	182	187	184
	10000	-4.8	38.6/32.6	191	187	193	189	195	191
	15000	-14.7	38.6/32.6	199	195	201	197	203	199
	20000	-24.6	38.6/32.6	209	205	211	207	213	208
ISA -20°C	SL	-5.0	38.6/32.6	171	168	173	171	175	172
	5000	-14.9	38.6/32.6	179	176	181	178	183	180
	10000	-24.8	38.6/32.6	187	182	189	185	190	197
	15000	-34.7	38.6/32.6	195	191	197	192	198	198
	20000	-44.6	38.6/32.6	205	201	207	203	209	205

UISE PERFORMANCE - 230 BHP - 2400 RPM (Approx. 75%)
Figure 5-30

	Pressure Altitude Feet	OAT °C	Fuel Flow GPH Total B.P./B.E.	Cruise True Airspeed - Kts.					
				6500 Lbs.		6000 Lbs.		5500 Lbs.	
				Best Power	Best Economy	Best Power	Best Economy	Best Power	Best Economy
ISA +20°C	SL	35.0	35.2/28.2	168	165	170	167	172	169
	5000	25.1	35.2/28.2	175	163	177	174	180	176
	10000	15.2	35.2/28.2	182	179	185	181	188	183
	15000	5.3	35.2/28.2	190	186	193	187	196	190
	20000	-4.6	35.2/28.2	198	193	201	196	204	199
ISA	SL	15.0	35.2/28.2	164	161	166	163	168	165
	5000	5.1	35.2/28.2	171	168	173	170	176	172
	10000	-4.8	35.2/28.2	178	175	181	177	184	179
	15000	-14.7	35.2/28.2	186	182	189	184	192	186
	20000	-24.6	35.2/28.2	194	189	197	192	200	195
ISA -20°C	SL	-5.0	35.2/28.2	160	157	162	159	164	161
	5000	-14.9	35.2/28.2	167	164	169	166	172	168
	10000	-24.8	35.2/28.2	174	171	177	173	180	175
	15000	-34.7	35.2/28.2	182	178	185	180	188	182
	20000	-44.6	35.2/28.2	190	185	193	188	196	191

CRUISE PERFORMANCE - 200 BHP - 2300 RPM (Approx. 65%)
Figure 5-31

	Pressure Altitude Feet	OAT °C	Fuel Flow GPH Total B.P/B.E.	Cruise True Airspeed - Kts.					
				6500 Lbs.		6000 Lbs.		5500 Lbs.	
				Best Power	Best Economy	Best Power	Best Economy	Best Power	Best Economy
ISA +20°C	SL	35.0	29.0/24.2	156	152	160	155	163	158
	5000	25.1	29.0/24.2	162	158	166	162	170	165
	10000	15.2	29.0/24.2	169	164	173	168	177	172
	15000	5.3	29.0/24.2	175	171	179	175	183	177
ISA	SL	15.0	29.0/24.2	152	148	156	151	159	154
	5000	5.1	29.0/24.2	158	154	162	158	166	161
	10000	-4.8	29.0/24.2	165	160	169	164	173	168
	15000	-14.7	29.0/24.2	171	167	175	171	179	174
	20000	-24.6	29.0/24.2	177	173	181	177	186	180
ISA -20°C	SL	-5.0	29.0/24.2	148	144	152	147	155	150
	5000	-14.9	29.0/24.2	154	150	158	154	162	157
	10000	-24.8	29.0/24.2	161	156	165	160	169	164
	15000	-34.7	29.0/24.2	167	163	171	167	175	170
	20000	-44.6	29.0/24.2	173	169	177	173	182	176

UISE PERFORMANCE - 170 BHP - 2200 RPM (Approx. 55%)
Figure 5-32

	Pressure Altitude Feet	OAT °C	Fuel Flow GPH Total B.P./B.E.	Cruise True Airspeed - Kts.					
				6500 Lbs.		6000 Lbs.		5500 Lbs.	
				Best Power	Best Economy	Best Power	Best Economy	Best Power	Best Economy
ISA +20°C	SL	35.0	25.2/20.1	142	138	146	142	149	145
	5000	25.1	25.2/20.1	146	142	150	146	154	150
	10000	15.2	25.2/20.1	150	146	154	150	159	154
	15000	5.3	25.2/20.1	154	150	159	154	164	159
ISA	SL	15.0	25.2/20.1	138	134	142	138	145	141
	5000	5.1	25.2/20.1	142	138	146	142	150	146
	10000	-4.8	25.2/20.1	146	142	150	146	155	150
	15000	-14.7	25.2/20.1	150	146	155	150	160	155
ISA -20°C	SL	-5.0	25.2/20.1	134	130	138	134	141	137
	5000	-14.9	25.2/20.1	138	134	142	138	146	142
	10000	-24.8	25.2/20.1	142	138	146	142	151	146
	15000	-34.7	25.2/20.1	146	150	151	146	156	151

CRUISE PERFORMANCE - 140 BHP - 2200 RPM (Approx. 45%)
Figure 5-33

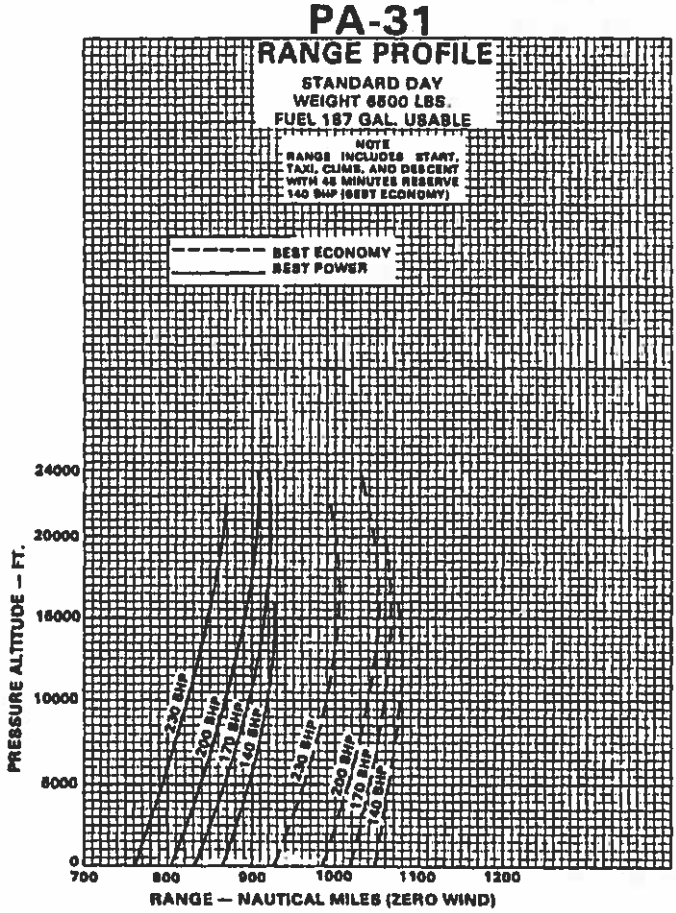
Press. Alt. Feet	Std Alt. Temp. °F	Approx. 140 BHP (45%) RPM			Approx. 170 BHP (55%) RPM			Approx. 200 BHP (65%) RPM			Approx. 230 BHP (75%) RPM			Press Alt. Feet
		2200	2300	2400	2200	2300	2400	2200	2300	2400	2300	2400	2500	
SL	59	27.7	25.0	23.9	30.0	28.5	27.3	32.1	31.3	30.5	35.5	34.1	32.7	SL
2,000	52	25.8	23.2	22.0	28.3	26.8	25.7	31.6	30.4	29.3	34.3	33.1	31.9	2,000
4,000	45	24.5	22.3	21.1	27.4	26.0	24.9	30.9	29.3	28.0	33.2	32.1	31.1	4,000
6,000	38	23.2	21.0	19.8	26.7	24.8	23.7	30.4	28.8	27.6	32.8	31.6	30.5	6,000
8,000	31	22.4	20.2	19.1	26.2	24.4	23.3	30.2	28.7	27.4	32.8	31.5	30.3	8,000
10,000	23	22.6	20.3	19.2	26.2	24.4	23.2	30.3	28.6	27.2	33.1	31.6	30.3	10,000
12,000	16	22.9	20.4	19.3	26.4	24.7	23.2	30.8	28.9	27.3	33.3	31.8	30.4	12,000
14,000	9	24.4	20.5	19.4	26.7	24.9	23.3	31.2	29.2	27.5	33.6	32.0	30.6	14,000
16,000	2	—	—	—	27.2	25.1	23.4	31.9	29.6	27.6	34.2	32.4	30.9	16,000
18,000	-5	—	—	—	27.7	25.5	23.6	32.3	30.0	27.9	35.0	33.0	31.2	18,000
20,000	-12	—	—	—	28.3	26.3	24.3	33.1	30.6	28.4	F.T.	33.5	31.6	20,000

1. To maintain constant power, correct manifold pressure approximately 0.25" Hg for each 10°F variation in outside air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard; subtract for temperatures below standard.
2. Do not exceed 46" Hg up to 15,800 feet. Above 15,800 feet the following manifold limits must be observed:

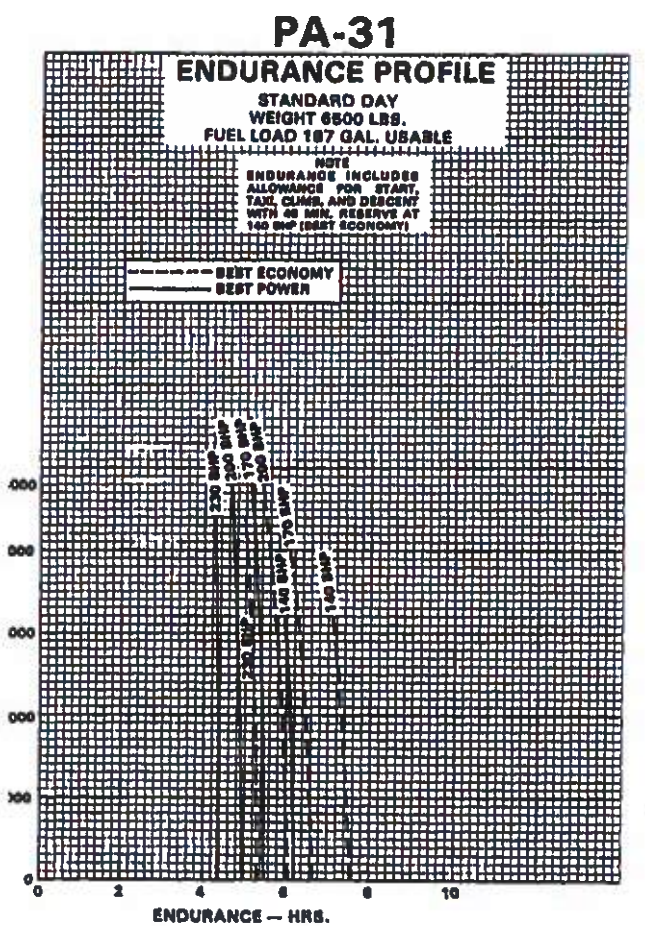
Altitude	M.P.	Altitude	M.P.
18,000 Ft.	42.4"	24,000 Ft.	32.7"
20,000 Ft.	39.2"		
22,000 Ft.	36.0"		

3. Maximum Normal Operating Power 2400 RPM at 39.5 IN. HG. to 19,700 feet (permissible to lean to 1450° EGT or 28 GPH fuel flow, whichever occurs first, provided cylinder head temperatures (475°) and oil temperatures (245°) remain within limits). Above 19,700 feet maintain maximum allowable manifold pressure (turbine speed limit).

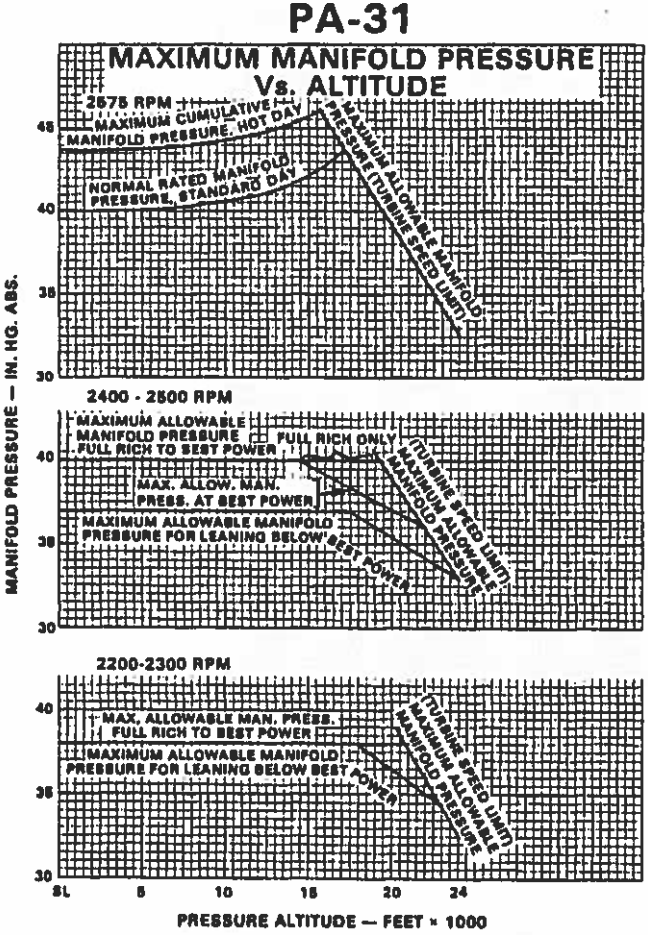
POWER SETTING TABLE
Figure 5-35



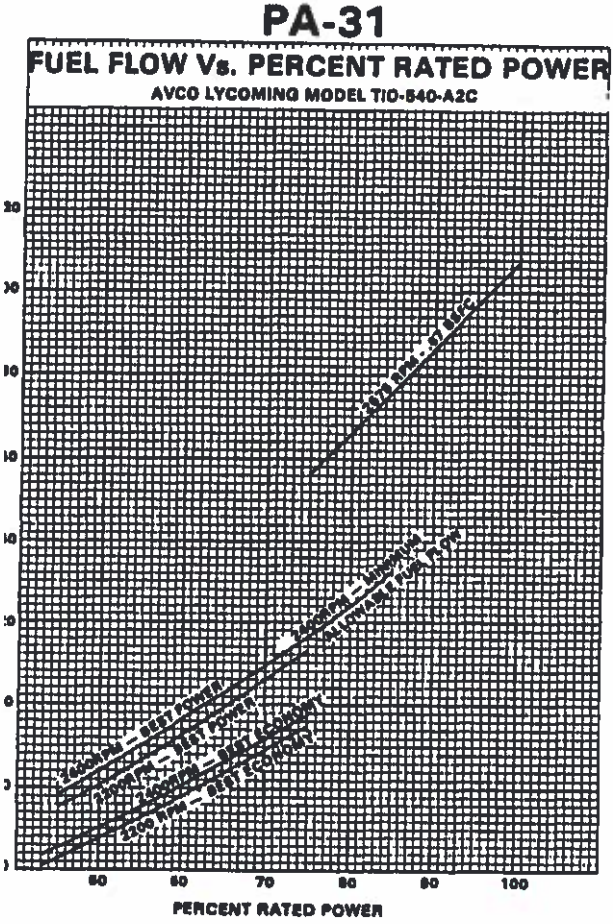
RANGE PROFILE
Figure 5-36



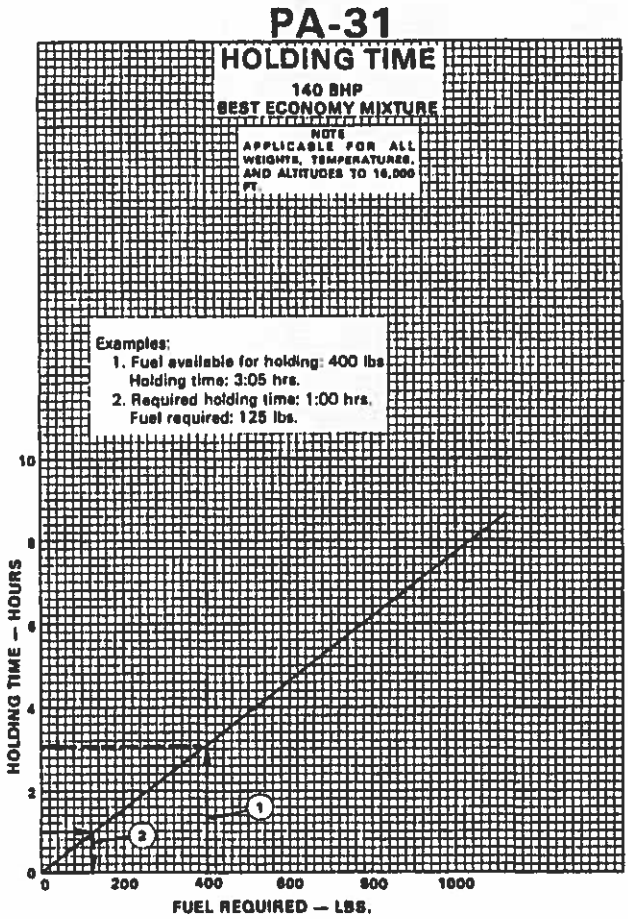
ENDURANCE PROFILE
Figure 5-37



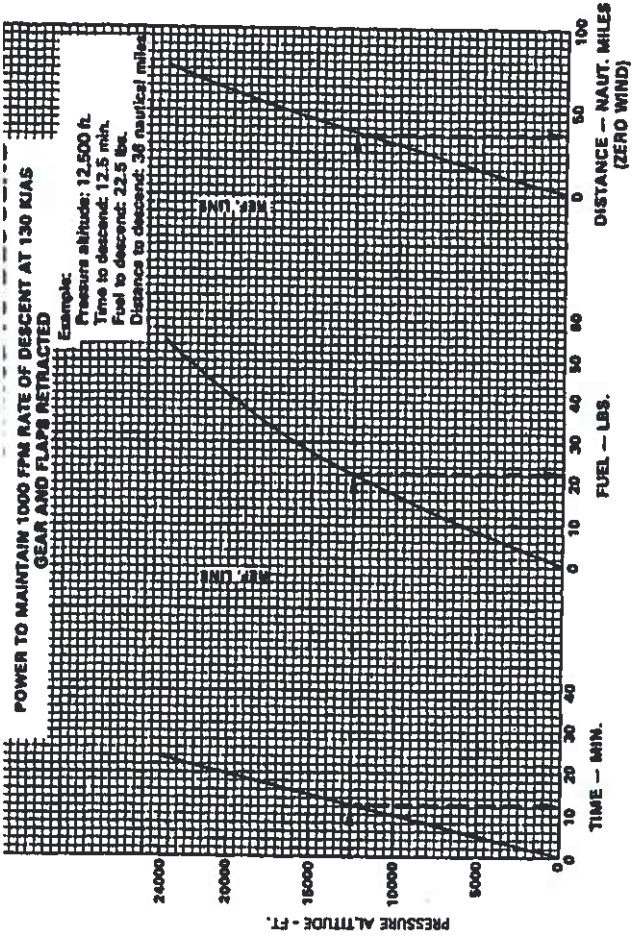
MAXIMUM MANIFOLD PRESSURE VS. ALTITUDE
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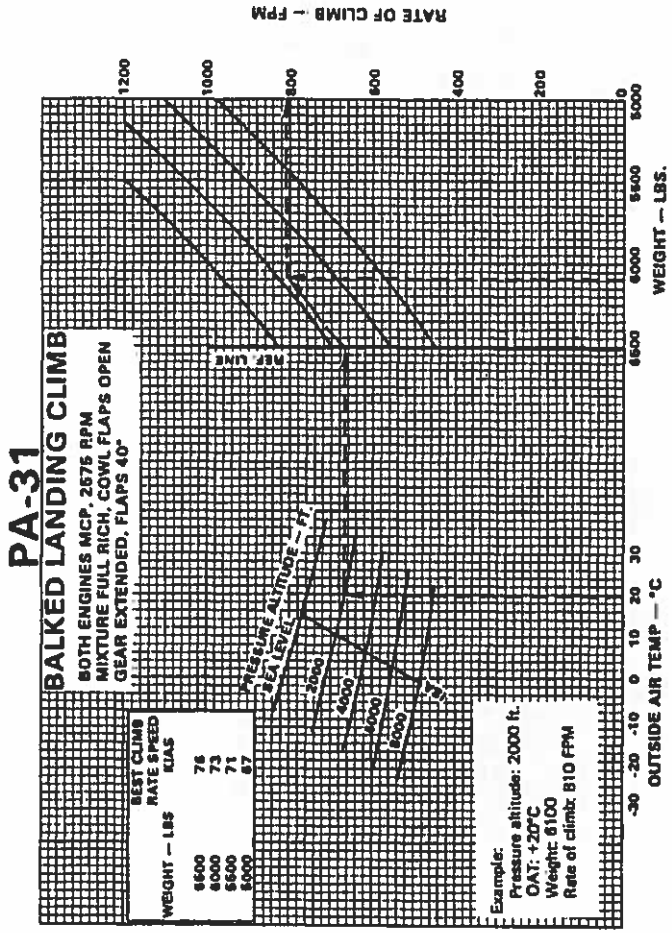
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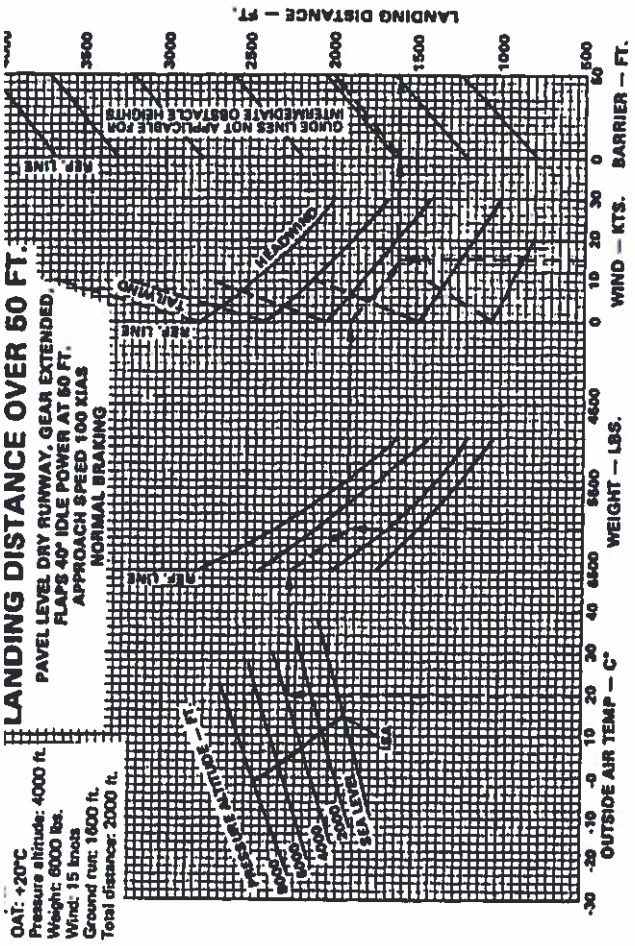
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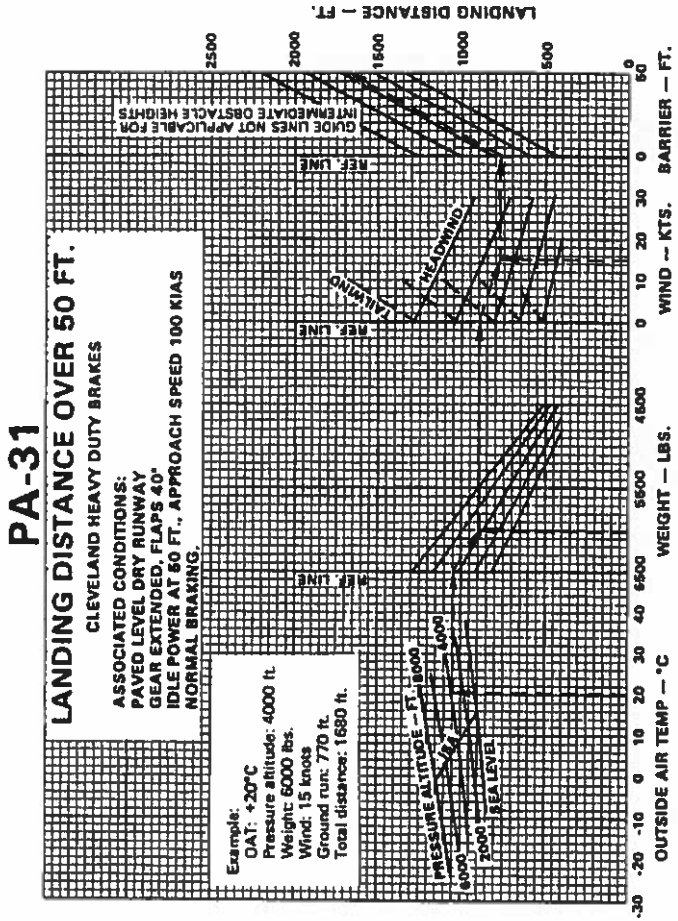
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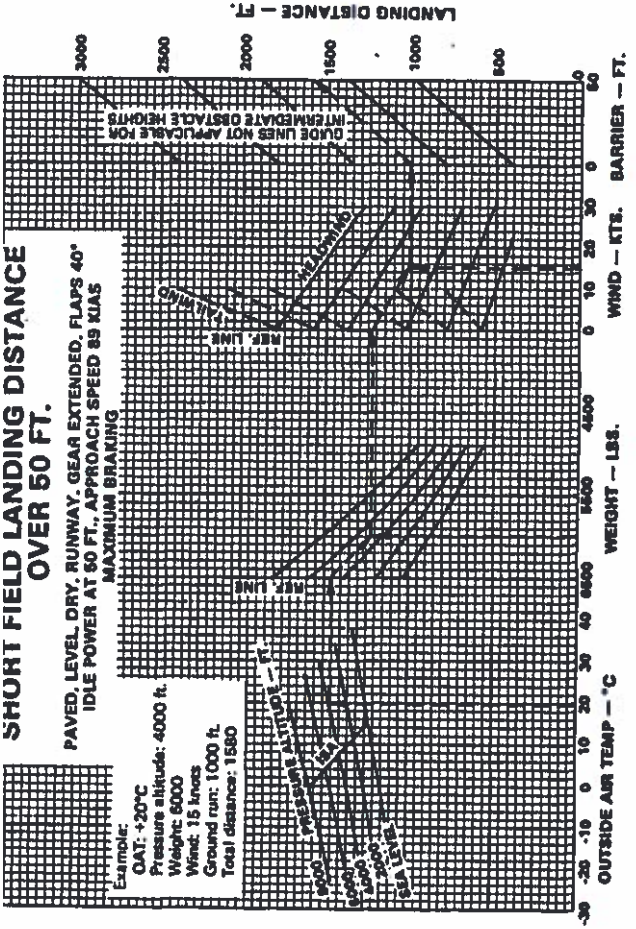
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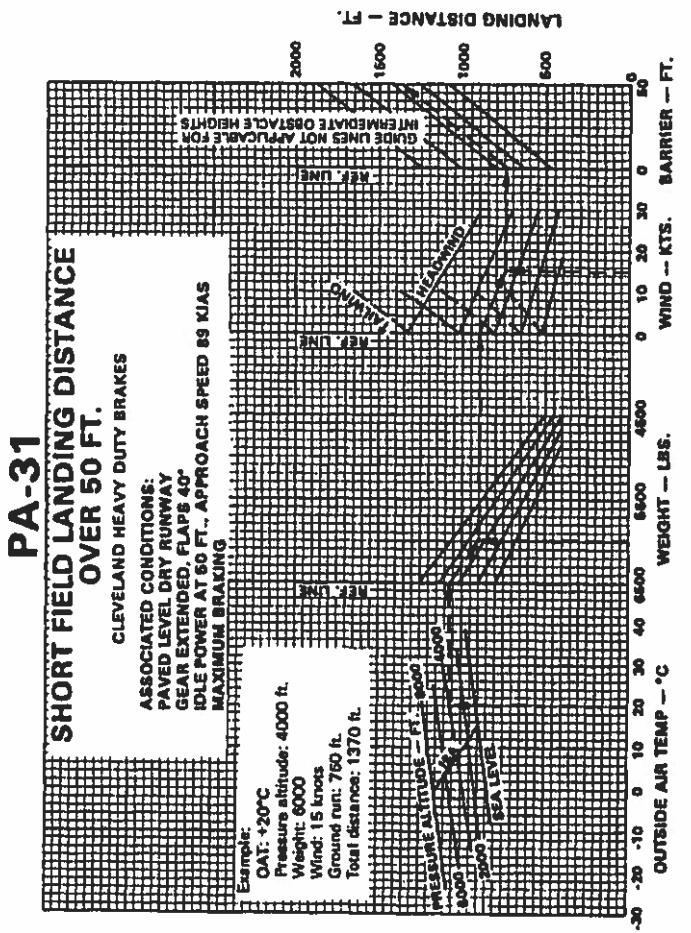
LANDING DISTANCE OVER 50 FEET
Figure 5-47



LANDING DISTANCE OVER 50 FEET
(CLEVELAND HEAVY DUTY BRAKES)
Figure 5-49



SHORT FIELD LANDING DISTANCE OVER 50 FEET
Figure 5-51



SHORT FIELD LANDING DISTANCE OVER 50 FEET
(CLEVELAND HEAVY DUTY BRAKES)
Figure 5-53

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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 a flexibility of loading, it cannot be flown with the maximum number of adult passengers, full fuel tanks and maximum baggage. With this loading flexibility comes responsibility. The pilot must insure that the airplane is loaded within the loading envelope before 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 it is weighed, and 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. locations the pilot can easily 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.

he basic empty weight and C.G. location are recorded in the Weight alance Data Form (Figure 6-7) and the Weight and Balance Record re 6-9). The current values should always be used. Whenever new ment is added or any modification work is done, the mechanic nsible for the work is required to compute a new basic empty weight .G. position and to write these in the Aircraft Log Book and the t and Balance Record. The owner should make sure that it is done.

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

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

IRPLANE WEIGHING PROCEDURES

t the time of licensing, Piper Aircraft Corporation provides each ne with the basic empty weight and center of gravity location. This s supplied by Figure 6-7.

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

) 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, 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.

(4) Fill to full capacity with oil and operating fluids.

(5) Place pilot and copilot seats in a center position on the seat tracks. 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 airplane on scales, block main gear oleo pistons in the fully extended position.

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

(c) Weighing Airplane

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

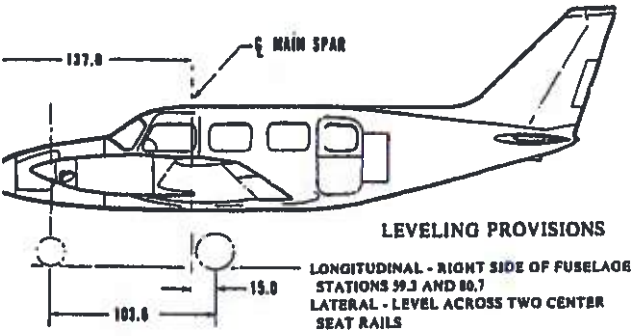
AIRPLANE AS WEIGHED
(Including full oil and operating fluids but no fuel)

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

WEIGHING FORM
Figure 6-1

Center of Gravity

(1) The following geometry applies to the PA-31 airplane when it is level. Refer to Leveling paragraph 6.3 (b).



LEVELING DIAGRAM
Figure 6-3

(2) C.G. Arm of airplane as weighed =

$$(137 + 15) - \frac{(103.6)\,(N)}{T} =$$

Inches Aft of Datum

(e) Basic Empty Weight

Item	Weight (Lbs)	x	Arm (Inches Aft of Datum)	=	Moment (In-Lbs)
Weight (as Weighed)					
Unusable Fuel (4.7 gal.)	28.2		137.0		3863
Basic Empty Weight					

BASIC EMPTY WEIGHT
Figure 6-5

6.5 WEIGHT AND BALANCE DATA RECORD

The Basic Empty Weight, Center of Gravity Location and Useful Load listed in Figure 6-7 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 6-9). 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.

MODEL PA-31 NAVAJO

Airplane Serial Number 31-8112074

Registration Number _____

Date _____

AIRPLANE BASIC EMPTY WEIGHT

Item	Weight (Lbs)	x	C.G. Arm (Inches Aft of Datum)	=	Moment (In-Lbs)
d Empty Weight*					
l Equipment (if applicable)					
mpty Weight					

:andard empty weight includes full oil capacity, full operating fluids 7 gallons of unusable fuel.

PLANE USEFUL LOAD - NORMAL CATEGORY OPERATION

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

36 lbs.) - (lbs.) = lbs.

IS BASIC EMPTY WEIGHT, C.G. AND USEFUL LOAD ARE HE AIRPLANE AS LICENSED AT THE FACTORY. REFER PROPRIATE AIRCRAFT RECORD WHEN ALTERATIONS BEEN MADE.

WEIGHT AND BALANCE DATA FORM
Figure 6-7

PA-31	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
		As licensed						

WEIGHT AND BALANCE RECORD
Figure 6-9

Date	Item No.	Description of Article or Modification	Added (+) Removed (-)	Weight Change			Running Basic Empty Weight	
				WL (Lb.)	Arm (In.)	Moment /100	WL (Lb.)	Moment /100

WEIGHT AND BALANCE RECORD (cont)
Figure 6-9 (cont)

6.7 GENERAL LOADING RECOMMENDATIONS

(a) When carrying 1 to 5 occupants in forward seats, rear baggage may be requied to bring the loaded airplane's C.G. within allowable limits.

(b) When carrying more than 5 occupants, fuel and/or baggage may have to be reduced.

(c) When carrying 6 occupants, distribute load between front and rear baggage compartments.

(d) When carrying 7 or 8 occupants, load forward baggage compartment first and locate heaviest occupants forward.

(e) When carrying 8 occupants, forward baggage may be required to bring the loaded airplane's C.G. within allowable limits.

(f) Observe zero fuel weight limitations.

NOTE

These general loading recommendations suggest normal proper loading procedures. The charts, graphs, instructions, and plotter should be checked to assure that the airplane is within the allowable weight vs. center of gravity envelope.

CENTER OF GRAVITY RANGE (Gear Extended)

(+134.0) to (+138.0) to 6536 lb. (Max. Ramp Weight)
(+134.0) to (+138.0) to 6500 lb. (Max. Takeoff Weight)
(+128.5) to (+138.0) to 6000 lb.
(+120.0) to (+138.0) to 4800 lb. or lower
Straight line variation between points given

EIGHT AND BALANCE DETERMINATION FOR FLIGHT

Add the weight of all items to be loaded to the Basic Empty Weight.

Use the Loading Chart (Figure 6-15) to determine the moment of all items to be carried in the airplane.

Add the moment of all items to be loaded to the Basic Empty Weight moment.

Divide the total moment by the total weight to determine the C.G. location.

By using the figures of item (a) and item (d) (above), locate a point on the Weight, Moment and C.G. Limits graph (Figure 6-17). If the point falls within the C.G. envelope, the loading meets the weight and balance requirements.

Location of the point on the Weight, Moment, and C.G. Limits graph indicates whether the airplane is slightly nose heavy or slightly tail heavy and can assist in setting pitch trim for takeoff.

IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT
:R TO INSURE THAT THE AIRPLANE IS LOADED
ERLY. THE CHARTS, GRAPHS, INSTRUCTIONS, AND
TER SHOULD BE CHECKED TO ASSURE THAT THE
ANE IS WITHIN THE ALLOWABLE WEIGHT VS. CENTER
AVITY ENVELOPE.

ITEM	WT. LBS.	ARM-IN.	MOMENT
Basic Airplane	4 3 4 9	128.0	5 5 6 6 0 0
Revised Airplane			
Pilot's Seat	1 7 5	119.0	2 0 8 0 0
Copilot's Seat	1 3 0	119.0	1 5 5 0 0
Seat No. 3	1 4 0	166/159 (Reversed)	2 3 2 0 0
Seat No. 4	1 6 0	166/159 (Reversed)	2 6 6 0 0
Seat No. 5		198.0	
Seat No. 6		198.0	
Seat No. 7		229.0	
Seat No. 8		242.0	
Fwd. Baggage		43.0	
Rear Baggage	1 5 0	255.0	3 8 3 0 0
Inbd. Fuel	6 0 0	126.8	7 6 1 0 0
Outbd. Fuel	4 5 6	148.0	6 7 5 0 0
Other			
Total Wt.	6 1 6 0	Total Moment	8 2 4 6 0 0

C.G. Location for Take-off 133.9 from Figure 6-19

SAMPLE LOADING PROBLEM
Figure 6-11

ITEM	WT. LBS.	ARM-IN.	MOMENT
Airplane			
ed Airplane			
s Seat		119.0	
ot's Seat		119.0	
No. 3		166/159 (Reversed)	
No. 4		166/159 (Reversed)	
No. 5		198.0	
No. 6		198.0	
No. 7		229.0	
No. 8		242.0	
Baggage		43.0	
Baggage		255.0	
Fuel		126.8	
l. Fuel		148.0	
otal Wt.		Total Moment	

C.G. Location for Take-off

WORK SHEET
Figure 6-13

OCCUPANTS
EXECUTIVE SEATING

Weight	Pilot, Copilot Arm 119	Seats 3 & 4 Fwd Facing Arm 166	Seats 3 & 4 Aft Facing Arm 159	Seats 5 & 6 Arm 198	Seat 7 Arm 229	Seat 8 Arm 242
	Moment / 100					
120	143	199	191	238	275	290
130	155	216	207	257	298	315
140	167	232	223	277	321	339
150	179	249	239	297	344	363
160	190	266	254	317	366	387
170	202	282	270	337	389	411
180	214	299	286	356	412	436
190	226	315	302	376	435	460
200	238	332	318	396	458	484

LOADING CHART
Figure 6-15

BAGGAGE

	Fwd Baggage Arm 43	Rear Baggage Arm 255
ght	Moment / 100	
)	4	26
)	9	51
)	13	77
)	17	102
)	22	128
)	26	153
)	30	179
)	34	204
)	39	230
)	43	255
)	47	281
)	52	306
)	56	332
)	60	357
)	65	383
)	—	408
)	—	434
)	—	459
)	—	485
)	—	510

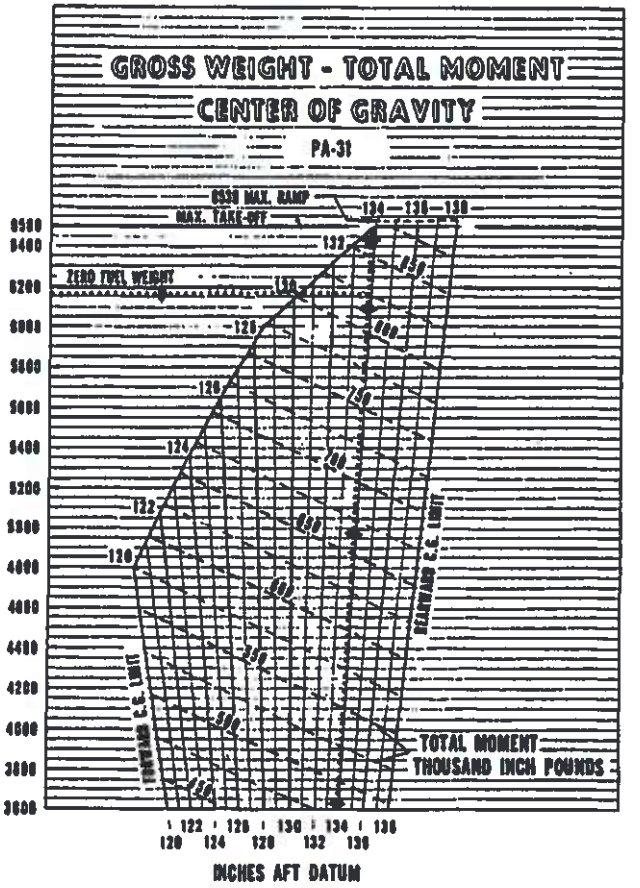
LOADING CHART (cont)
Figure 6-15 (cont)

FUEL

Gallons	Weight Lbs.	Inboard Tanks Arm = 126.8	Outboard Tanks Arm - 148.0
		Moment / 100	
5	30	38	44
10	60	76	89
15	90	114	133
20	120	152	178
25	150	190	222
30	180	228	266
35	210	266	311
40	240	304	355
45	270	342	400
50	300	380	444
55	330	418	488
60	360	456	533
65	390	495	577
70	420	533	622
75	450	571	666
77.7	466	—	690
80	480	609	—
85	510	647	—
90	540	685	—
95	570	723	—
100	600	761	—
105	630	799	—
109.6	658	834	—

1.2 gals. unusable fuel in each inboard tank and 1.15 gals. unusable fuel in each outboard tank included in basic weight (28.2 lbs., 3863 in. lbs. total)

LOADING CHART (cont)
Figure 6-15 (cont)



WEIGHT, MOMENT AND C.G. LIMITS
Figure 6-17

6.11 WEIGHT AND BALANCE VISUAL PLOTTER

The Weight and Balance Visual Plotter furnished with this airplane is a weight and center of gravity computing device.

The face of the plotter displays the slots used for plotting and the graphic center of gravity envelope. On the back of the plotter are printed instructions for use and general loading recommendations. The center of gravity envelope on the face shows all allowable moment conditions between 3600 and 6500 pounds, with the limits outlined in red.

The "Basic Empty Weight and Center of Gravity" location is taken from the Weight and Balane Form (Figure 6-7), the Weight and Balance Record (Figure 6-9) or the latest FAA major repair or alteration form.

CAUTION

It is the responsibility of the owner and pilot to ascertain that the airplane always remains within the allowable weight vs. center of gravity envelope while in flight.

6.13 INSTRUCTION FOR USING PLOTTER

(a) Instructions for using the plotter are printed on the back of each plotter. To use the plotter, proceed as follows:

1. Locate point on plotter face corresponding to the"Basic Empty Weight" and "C.G." location.

2. "Zero" the "Occupants, 1 st & 2nd" slot over the "Basic Empty Weight" point; Establish new point at weight corresponding to occupants' weight.

3. For 3rd & 4th Seats, repeat step 2 from point 2, using proper slot for aft or forward facing seats.

4. For 5th & 6th Seats, repeat step 3 from point 3.

5. For 7th Seat, repeat step 4 from point 4.

6. For 8th Seat, repeat step 5 from point 5.

7. Zero the "Front Baggage" slot over point 6: Establish new point at weight corresponding to front baggage weight.

8. For "Rear Baggage" repeat step 7 from point 7.

9. For "Nacelle Locker Baggage" zero "Nac Locker Rear" slot over point 8: Establish new point "R" corresponding to the total baggage weight in the rear half of both lockers.

   Zero "Nac Locker Fwd" slot over point "R": Establish new point "F" corresponding to the total baggage weight in the forward half of both lockers.

10. "Zero" the "Inboard Fuel" slot over point "F": Establish new point at fuel quantity desired.

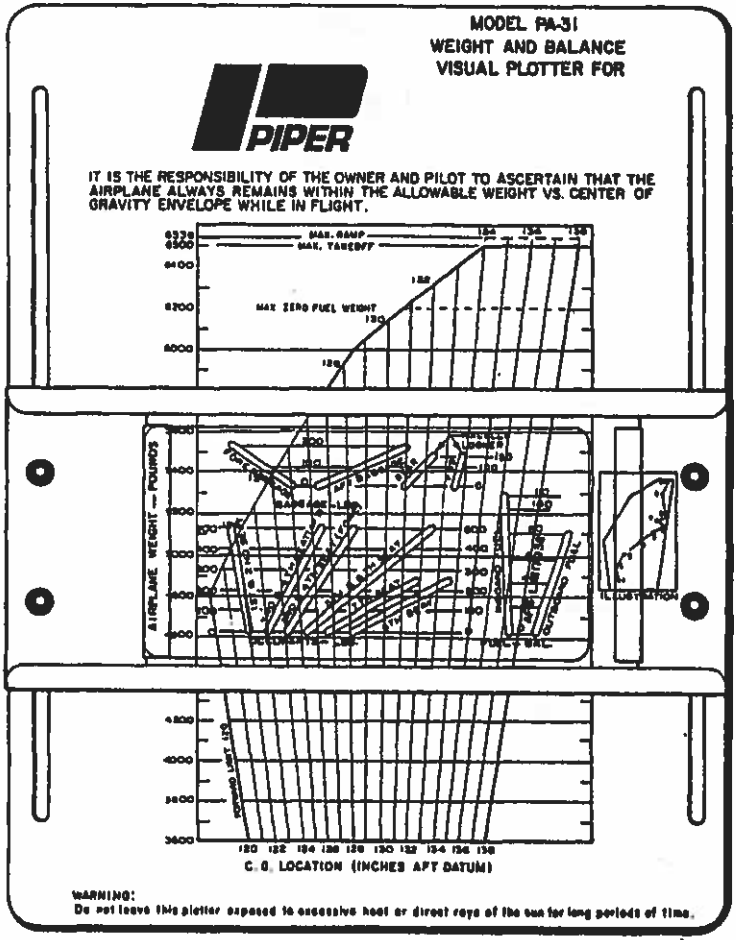
11. For "Outboard Fuel" repeat step 10 from point 10.

NOTES

Should the fuel slot leave the "C.G. Envelope" (outlined in red) between 134 and 138 inches, the fuel indicated at the exit point is maximum allowable.

Should the fuel slot leave the "C.G. Envelope" other than between 134 and 138 inches, the baggage or passenger load should be redistributed forward or aft as required, to allow a higher load.

) Refer to paragraph 6.7 for General Loading Recommendations.



WEIGHT AND BALANCE VISUAL PLOTTER
Figure 6-19

CARGO LOADING

hen seats are removed for cargo stowage, the Basic Empty Weight rresponding C.G. must be corrected prior to determination of the g schedule. The weights and arms for these seats are:

Item	Weight	Arm	Moment/ 100
4th Seat Facing (each)	26	166	43
4th Seat acing (each)	26	159	41
6th Seat (each)	26	198	51
eat	26.0	229	60
eat	25.0	242	61

large cargo door can be installed adjacent to the main cabin entrance o facilitate cargo loading. The door provides an additional fuselage g (17 inches long and 29 inches wide) which results in a total access of over 44 inches. A quick disconnect pin is provided on the main entrance door cable which permits maximum utilization of the nal opening provided by the optional cargo door.

e cargo barrier installation provides the necessary equipment to load the cabin area of the fuselage, establishes a protective barrier for ckpit area, and presents instructions for cargo loading and weight ons. This optional installation includes cargo rollers, tie down straps, et, equipment container and a cargo blanket.

loading placard (Figure 6-21) is mounted in the rear of the aft baggage rtment and clearly defines the limitations and procedures for cargo g. This information should be used in conjunction with the ation presented in the Weight and Balance section to assure a weight ter of gravity within the limits of the airplane.

rgo barriers and restraining equipment are limited as follows:

Cargo barriers - Maximum restraining capacity of 1280 lbs. at 24 in. C.G. height of cargo.

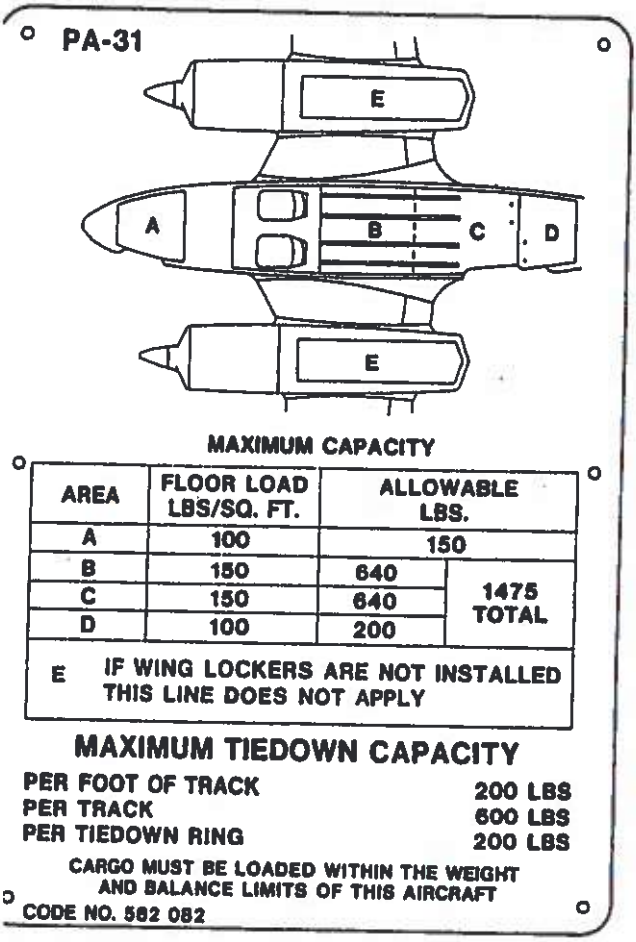
Cargo net - maximum restraining capacity of 1280 lbs. at 24 in. C.G. height of cargo.

(c) Cargo straps - maximum restraining capacity of 150 lbs. at 12 in. C.G. height of cargo.

(d) Baggage tie down rings attached to seat tracks - maximum restraining capacity of 200 lbs. each.

(e) Baggage tie down rings attached to Wedjit plates - maximum tie down capacity of 200 lbs. each.

Weight and C.G. computations of individual items should be calculated before actual loading. When loading items of identical weight with an even weight distribution, the C.G. can be determined for all the items in the center of the load. All items of unequal weight should be figured separately. Also, compute the load weight and C.G. first; then compute fuel weight and total C.G. to allow for the possibility of the C.G. moving aft of the allowable aft C.G. limit while burning off fuel.



CARGO LOADING PLACARD
Figure 6-21

Generally, heavier items should be loaded in section B (see cargo loading placard) and lighter items in sections C and D.

NOTE

When loading heavy items, it is recommended to install a post under the tail skid to prevent the tail from settling while loading. The parking brakes should also be set.

In most cases the forward baggage compartment must be loaded in order to utilize sections C and D. The empty weight of the airplane does not include the cargo barrier installation equipment; however, the cargo barrier equipment was included and the passengers' seats removed in the basic airplane weight and C.G. in the following loading example:

(a) Example loading:

	Weight	X	Arm	=	Moment
A/C Basic Weight	4354		127.4		554,700
Pilot	170		119.0		20,230
Load Section A	50		43.0		2,150
Load Section B	400		147.0		58,800
Load Section C	250		210.0		52,500
Load Section D	150		255.0		38,250
Load Section E	100		192.0		19,200
TOTAL	5474		136.2		745,830
Inboard Fuel 107.4 gal	644		126.8		81,659
Outboard Fuel 63.6 gal	382		148.0		56,536
	6500		136.0		884,025

In the above example, the aircraft falls within the limits (both C.G. weight and zero fuel gross weight).

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SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

7.1 THE AIRPLANE

The PA-31 Navajo is a twin-engine, retractable landing gear, multi-purpose airplane. Its spacious cabin is available with a variety of optional cabin arrangements and furnishings to allow the airplane to be equipped to serve the individual needs of the owner.

Pilot and passenger comfort accessories, custom seating arrangements and flexible loading accommodations coupled with air navigational equipment, flight safety aids, speed and range, avail the PA-31 Navajo for use in a variety of operational situations.

7.3 AIRFRAME

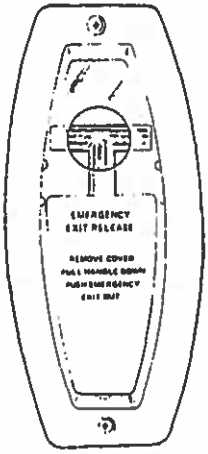
A primary structure of reinforced and stress tested metal construction provides the basis for the rugged Navajo airframe. The nose, tail cone, and other flight surface extremities are of tough fiberglass.

The fuselage is an all metal, semi-monocoque structure with riveted skin. It consists of three basic units: the nose section, the cabin section, and the tail section. Removable access plates and inspection panels are incorporated into the fuselage skin to aid in equipment inspection and repair.

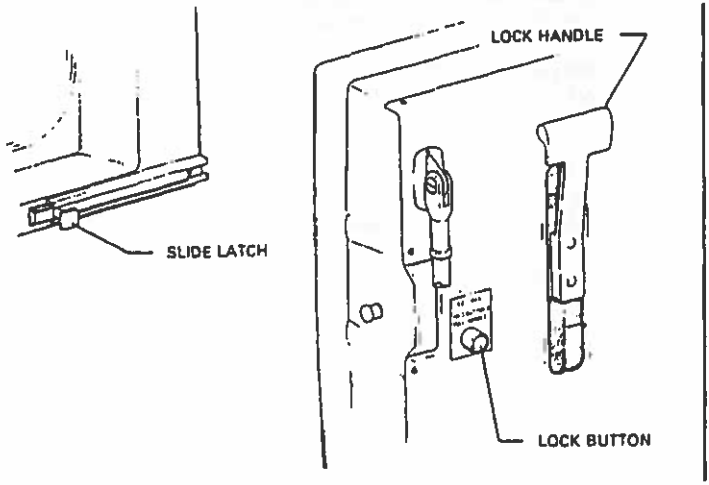
arge panoramic windows, which include a two-piece windshield, five indows and pilot and copilot storm windows, furnish an unobstructed rom the cockpit or cabin areas. The four forward windows on each side fuselage are of double-pane construction to reduce window fogging. ilot and copilot storm windows are located in the forward lower section h pilot's side window. To open, release the latch on the lower portion of indow and swing the storm window in and forward. The storm ws are easily removed by pulling the hinge pin. A heated pilot's hield is offered as optional equipment to prevent windshield fogging ing.

n the right side, the second side window aft of the copilot's windshield mbination window emergency exit. As a safety feature, the exit can be ed by removing the plexiglas cover from the release mechanism (aft of ndow), pulling the release handle down and pushing out on the exit e 7-1).

or ease of entry and exit, a large, two-piece cabin entrance door is led on the left side of the fuselage, just aft of the wing. The door tes in the middle with the upper half, which incorporates the aft gular side window, swinging upward and the lower half, which houses bin entrance steps, swinging downward. To open the door from the e, push on the upper portion of the door handle and pull upward on wer portion of the handle. With the lock mechanism now released, the bottom half of the door and pull out the steps. (Later models are ed with an automatic step extender.) On earlier models, raise the half of the door until it locks. The door is closed from the outside by g upward on the knurled cylinder on the upper door support and ng the upper half of the door. On later models, pull the upper half out- few inches and release it. From this position the gas spring support sh the door fully open and support it in the open position. To close, e upper door down and push it into the closed position. Next, raise the half of the door, making sure the door support cords do not catch in or frame, and push in on the door halves and the door handle until the securely latched. As a safety feature, a locking bolt is attached to the of the upper half of the entrance door. When the door is closed from the cabin, the bolt is moved to the right across the metal strike plate ment on the door frame. This feature provides added protection in the he cabin door should unlatch during flight due to improper latching. en the door from the inside, pull the bolt to the left, push in and hold k button (adjacent to the door handle, Figure 7-3), pull the handle, the bottom half of the door and lower the steps. (Later models are ed with an automatic step extender.) On earlier models, raise the



EMERGENCY EXIT RELEASE
Figure 7-1



CABIN ENTRANCE DOOR LATCH
Figure 7-3

r half to the locked position. On later models, push the upper half ard a few inches and release it. The gas spring support will push the fully open. Closing the door from the inside is performed similarly to utside closing procedure. The door should be checked to insure proper ng by trying to pull the handle to the open position without pushing the button and checking that the bolt has been properly attached.

Each wing is an all-metal, full-cantilever type construction with a vable fiberglass tip. The wing panels incorporate an I-beam main spar xtends into the center of the fuselage, where the spars are joined with strength butt fittings, making in effect, one continuous main spar. This spar is also attached at each side of the fuselage as are the front and rear spars. The main landing gear is housed in wheel wells built into the r surface of the wings and is enclosed by doors when the gear is ted. Two flexible bladder-type fuel cells in each wing house the fuel.

Ailerons are all metal and are fully balanced. The right aileron porates a trim tab that is adjustable through a control in the cockpit.

The all-metal flaps are electrically activated by an airfoil-shaped control e instrument panel. When the flap control is moved to the UP or DN on, power is transferred from an electric motor to a screw transmission gh a flexible shaft. A flap indicator, mounted on the instrument panel the flap control, is used to position the flaps to the desired setting.

The engine nacelles are an integral part of the wing. They provide a nlined structure for the engines.

The empennage consists of a vertical stabilizer (fin), a rudder, a ontal stabilizer and elevators. The rudder and elevators both have trim which are controlled from the cockpit. The empennage group onents are metal cantilever structures with removable fiberglass tips. the vertical and horizontal stabilizers incorporate two-channel main that run the length of the stabilizer and attach to the aft bulkhead ibly of the fuselage.

All structural components are completely zinc chromate-primed and the or surfaces are coated with polyurethane paint.

7.5 ENGINES AND ACCESSORIES

The PA-31 Navajo is powered by two six-cylinder, fuel injected, turbocharged Lycoming engines rated at 310 HP at 2575 RPM. Both engines are air-cooled and have top side exhaust incorporating oil jets for internal piston cooling.

Both engines are Lycoming TIO-540-A2C Series. They are equipped with geared starters, two magnetos (each engine), 28-volt 70-amp self rectifying alternators, shielded ignition systems, turbochargers, hydraulic pumps, oil filters, oil coolers, pneumatic pressure pumps and three bladed propellers. The alternators are belt-driven by pulleys mounted on the starter ring gear.

The turbocharger (Figure 7-5) is designed to increase the power output and efficiency of the engine by supplying compressed air to the engine intake manifold. This allows the engines to operate at peak power at much higher altitudes than normally aspirated engines. Power to drive the turbocharger is extracted from energy in the exhaust gases, which are ducted through the turbine and then exhausted overboard at the bottom of the nacelles in the area of the cowl flaps.

The fuel injection system is based on the principle of measuring engine air consumption by use of a venturi tube and using the airflow forces to control fuel flow to the engines. Fuel distribution to the individual cylinders is obtained by the use of a fuel flow divider and air bleed nozzles. Idle cut-offs are incorporated in the injectors and should always be used to stop the engines. This is accomplished by pulling the mixture control levers to the rearmost position.

An automatic alternate air induction system is provided for each engine. In the event the induction air filters become obstructed by ice or other foreign particles, the induction air doors will open automatically to prove air to the engine.

Two manual alternate air controls are located to the right of the control pedestal to allow the pilot to select alternate air if the automatic feature should fail.

The cowl flaps, located on the bottom of the engine nacelles, are electrically operated by switches located on the bottom of the control pedestal. Cowl flaps should be positioned to maintain temperatures within the normal operating range. Remote indicating gauges, located next to the switches, give the pilot a visual indication of cowl flap position.

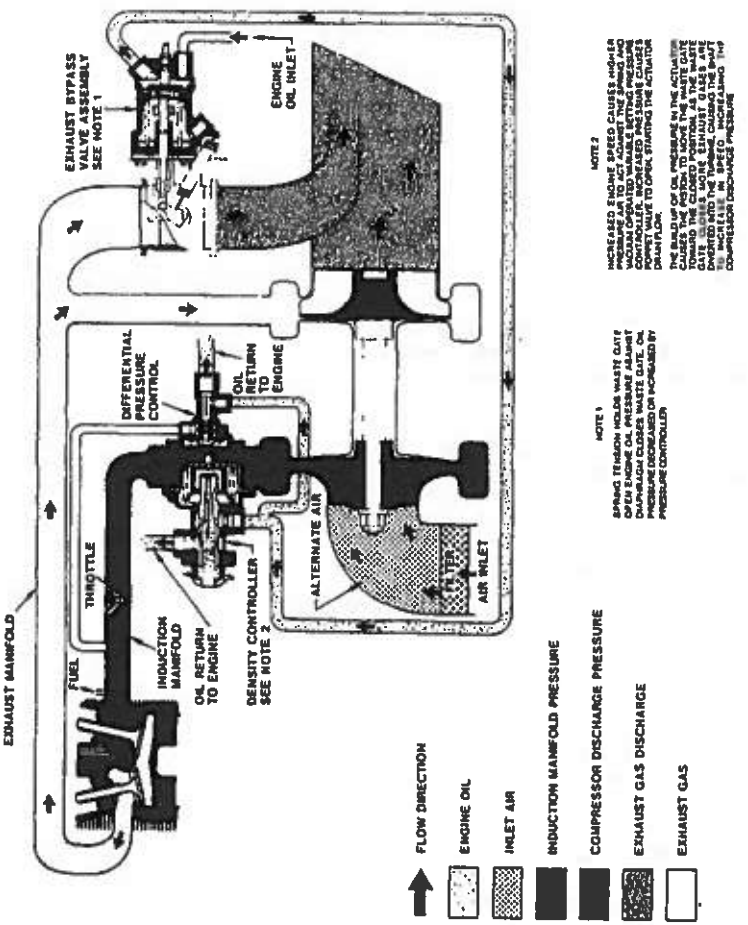
he engines are equipped with doors on the induction housings which, event of a turbocharger compressor failure, automatically revert the es to normally aspirated air. Under these conditions approximately of normal rated power, or 232 HP, will be at sea level.

ngine mounts are of steel tube construction incorporating vibration ing dynafocal mounts. The engine cowlings are cantilever structures ucted of a combination of fiberglass and metal attached at the fire Quick release fasteners provide prompt removal of the top cowl. To e the bottom cowl, the cowl flap must first be disconnected.

ıe lubrication system is of the pressure wet sump type. The oil pump is located in the accessory housing, draws oil from the oil suction located in the sump. The oil from the pump then enters the accessory g which feeds the oil to a connection on the rear face of the accessory g, where a flexible line leads the oil to the external oil cooler. An oil is attached to the engine mounts on the lower left side below each . Oil under pressure from the cooler returns to a second connection on :essory housing from which point a passage conducts the oil to the oil re filter. Oil flow to the oil cooler is controlled by a thermostatic valve. ılve is normally open with cold oil so that the oil will by-pass the cooler cker warm up. As the oil is warmed, the valve closes causing the oil to ıru the oil cooler.

ıe oil filter element, located on the accessory housing, provides a of filtering from the oil any solid particles that may have passed h the suction screen in the sump. After being filtered, the oil is fed n a passage to the oil pressure relief valve, located in the upper right the crankcase in front of the accessory housing. This relief valve es the engine oil pressure by allowing excessive oil to return to the while the balance of the pressure oil is fed to the main oil gallery in the alf of the crankcase. Residual oil is returned by gravity to the sump, ıfter in passing through a screen it is again circulated through the engine.

gine instruments are either mounted horizontally across the top of ter instrument panel or stacked vertically at the right side of the center Additional engine gauges are located in the right instrument panel.



TURBOCHARGER SYSTEM SCHEMATIC
Figure 7-5

he recommended period for engine overhaul is at 1800 hours. This is based on Avco-Lycoming service experience. From time to time ming revises the recommended overhaul period through a Service ction. The pilot should check with his dealer for the latest overhaul d on his engines and any additional Lycoming service information. ation beyond the recommended overhaul period is at the discretion of perator.

n order to obtain maximum engine efficiency and time between auls, the pilot should read and follow the procedures recommended by vco-Lycoming Operator's Manual for his engines.

NGINE CONTROLS

ngine controls include a throttle, a propeller control, and a mixture ol for each engine (refer to Figure 7-13). These controls are located on a ol pedestal in the center of the cockpit below the instrument panel, they are accessible to both pilot and copilot.

he throttle levers, on the far left of the control pedestal, are used to manifold pressure. The throttle levers adjust from fully open in the ore) position, through the idle position, to fully closed at the bottom of their travel. The throttle controls incorporate switches which activate r unsafe horn if the gear is not in the Down-Locked position and the is reduced to 12 inches of manifold pressure. If the gear is not locked , the horn will sound until the gear is down and locked or until the setting is increased. This is a safety feature to prevent an inadvertent p landing.

he propeller controls are located in the center of the control pedestal. are used to adjust the propeller speed from increase RPM at the top of ravel, through decrease RPM, to the feathered position at the bottom ir travel. A governor maintains a constant propeller speed once the ller control is set.

he mixture controls at the far right of the control pedestal adjust the fuel ratio. The full rich position is at the top position and the full lean to ut-off positions at the bottom. The mixture controls are also used to own the engines in the fully aft or idle cut-off position.

A friction adjustment knob on the right side of the control pedestal may be adjusted to increase or decrease the effort needed to move the control levers or to hold the controls in a selected position.

7.9 PROPELLERS

The propellers are Hartzell, three-blade, constant speed, controllable pitch and full feathering. The propellers incorporate a Hartzell FC8468-6R blade with HC-E3YR-2ATF hubs. Propellers are independently controlled by propeller governors, one mounted on each engine, and its corresponding propeller control lever in the center of the control quadrant on the pedestal.

A combination of nitrogen or air pressure, a spring, blade counter-weights and governor regulated oil pressure is utilized to change the pitch of the propeller blades. Nitrogen or air pressure is supplied from the precharged propeller chamber. (Refer to Section 8 - Airplane Handling, Servicing and Maintenance). The nitrogen or air pressure, spring and blade counter-weight force is utilized to move the blades to the high pitch (decreased RPM) and feathered position and the opposing governor regulated oil pressure moves the blades to the low pitch (increased RPM) position. As the propeller control lever is moved forward, which increases the propeller RPM, a valve in the propeller governor allows increased oil pressure to enter the propeller hub and move the blades to the low pitch (increased RPM) position. Moving the propeller control lever aft decreases the propeller RPM as the propeller governor decreases the oil pressure to the hub and the nitrogen or air pressure, spring and blade counter-weights move the propeller blades to the high pitch (decreased RPM) or, if selected, the feathered position.

Feathering is accomplished by moving the propeller control lever full aft, through the low RPM detent, into the feathering position. Feathering takes place in approximately seven seconds. The low RPM detent is incorporated to prevent inadvertent feathering. To unfeather the propeller (in flight), move the propeller control lever forward, beyond the low RPM detent, to increased RPM position and engage the starter. As the engine cranks over the governor will begin to unfeather the blades and windmilling, which speeds up the process of unfeathering, will take place.

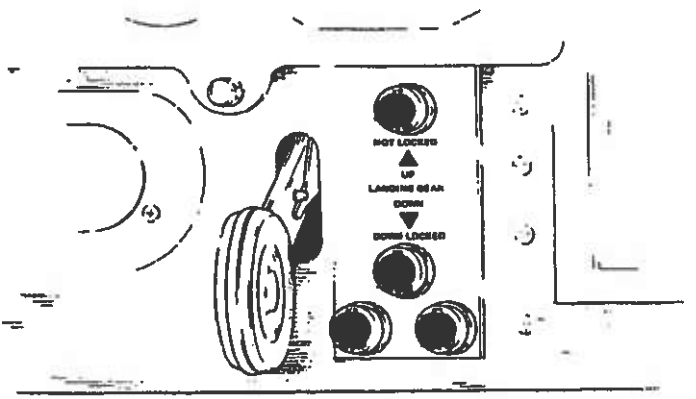
When the engines are shut down, the propeller control levers should be n the increased RPM position. The nitrogen pressure will move the s to the decreased RPM position by forcing most of the oil from the This prevents damage to the propeller during cold weather starts. The pitch stops will prevent the nitrogen pressure from moving the blades to athered position.

ull propeller feathering and unfeathering should not be practiced on round due to excessive vibration of the power plant installation. In feathering should be practiced only to familiarize the pilot with the r procedures. In the event feathering becomes necessary during flight, eathering and Unfeathering procedure outlined in Section 3 - gency Procedures should be followed.

LANDING GEAR

he Navajo is equipped with a hydraulically actuated, fully retractable, le landing gear system. The gear incorporate air-oil type oleo struts. avel of the strut from the fully extended to fully compressed position is es on the nose gear and 9 inches on the main, with a required extension 5 inches of strut exposure under a normal static load condition. When ted, the nose gear, which retracts aft into the nose and the main gear, retract inboard into the wings, are fully protected by gear doors. Nose doors and the outboard doors on the main gear are operated by a nical linkage with the gear and remain in the open position when the s extended. The inboard main gear doors are hydraulically operated ose when the main gear is lately extended or fully retracted.

he nose gear is steerable by use of the rudder pedals. The total nose turning arc when steered with the rudder pedals is normally 40°. ever, a feature is incorporated which allows the nose gear to rarily disengage from the rudder pedal steering linkage, permitting the to be turned an additional 20° in each direction during towing ions, thus extending the turning arc to a full 80°. A spring-loaded cam e will return the nose gear to within the center 40° arc, where it atically re-engages with the steering linkage. Although this device is led for use during towing, while taxiing through tight turns with ential engine power and braking the nose gear can disengage itself, tting a shorter turning radius. Should this occur, the rudder pedal change and accompanying noise in the nose gear is normal and should interpreted as a malfunction.



LANDING GEAR SELECTOR
Figure 7-7

NOTE

Avoid unnecessary sharp turns, as excessive tire wear will result.

The nose gear is also equipped with a shimmy dampening device mounted to the bottom of the outer housing. As the nose gear retracts, the steering linkage separates from the nose gear to reduce the inflight rudder pedal forces.

The landing gear selector(Figure 7-7) is located on the instrument panel to the right of the pilot's control wheel and is provided with a wheel-shaped knob to differentiate it from the flap control, which has an airfoil shape. To guard against inadvertent gear retraction on the ground a solenoid latch is incorporated in the landing gear selector control. An anti-retraction (squat) switch on the left main gear must actuate this solenoid latch before the landing gear selector can be moved to the UP position. When the selector is moved to either the UP or DOWN position, the handle will remain locked in this position until the gear has fully extended or retracted. At this time the selector handle will return to the neutral position. To raise or lower the gear in flight the handle must first be pulled aft.

)n the instrument panel to the right of the gear selector, are one red and green indicator lights with Press to Test features. An illuminated red indicates when the gear is in transit between the up-locked and down-d positions. A red light indication will also occur during flight if the rd gear doors remain open when the gear is retracted or extended. The lights illuminate to indicate when each gear is down and locked. The ıtor lights can be dimmed by turning each light. There is no light ıtion when the gear is up and locked. For added protection, a gear : horn will sound if the power in one or both of the engines is reduced 12 inches of manifold pressure while the landing gear is not in the n-Locked" position. If the gear selector has been forced into the up or utral position while on the ground, the gear unsafe horn will sound the master switch is on.

NOTE

In the event of an electrical failure, or with the master switch OFF, there will not be an indication of the down and locked position of the gear.

ıe main wheels are 6.50 x 10 Cleveland Aircraft Products units with pe brakes and are fitted with 6.50 x 10 eight-ply rated tires. The nose is a Cleveland 6.00 x 6 model with a 6.00 x 6 six-ply rated tire. Proper :ssure is printed on the wheels.

BRAKE SYSTEM

ıe brakes are hydraulically operated by individual master cylinders :d on the left set of rudder pedals. They are actuated by applying toe :e against the top of the rudder pedals. There are provisions for an ıl dual brake installation with brake cylinders attached to the copilot's pedals.

hydraulic brake fluid reservoir, which is separate from the main lic system, supplies fluid to each master cylinder. The reservoir is ble through an access door atop the fuselage nose section.

WARNING

No braking will occur if handle is pulled prior to brake application.

Hydraulic fluid is routed from the master cylinders through lines and hoses to a parking brake valve, located on the left aft side of the forward cabin bulkhead, then through the cabin and wings to the brake assembly on each main landing gear. The parking brake handle is located on the lower left instrument panel. To set the parking brake, first depress and hold the toe brake pedals, and then pull out the parking brake handle. To release the parking brake, first depress and hold the toe brake pedals, and then push in on the parking brake handle.

The brakes are Cleveland Aircraft Products, single disc, single housing, multi-piston assemblies. They are self adjusting and utilize bonded linings for maximum strength and durability.

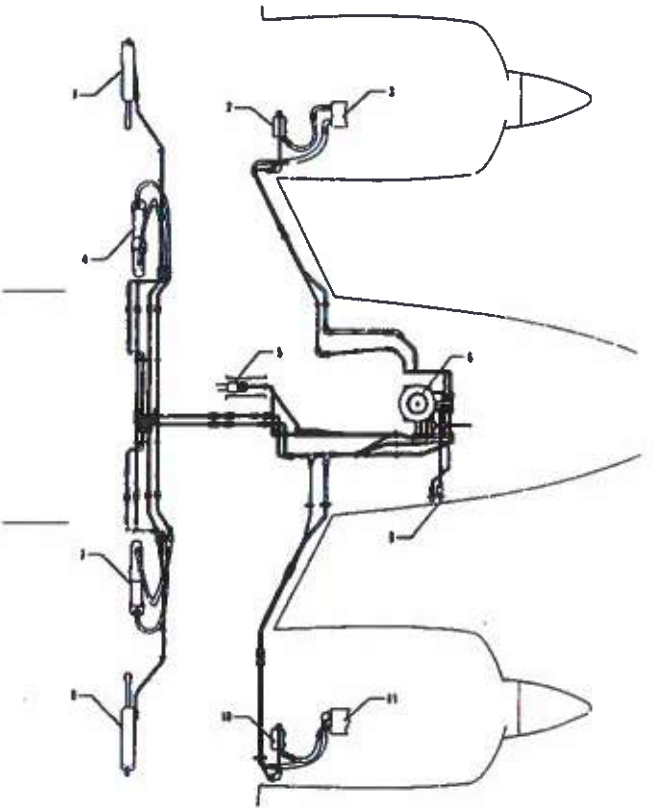
7.15 HYDRAULIC SYSTEM

A hydraulic system consisting of two hydraulic pumps, a power pack, an emergency hand pump, actuating cylinders and filters, supplies pressure for the smooth extension and retraction of the landing gear. (Refer Figure 7-9).

The hydraulic pumps, which develop pressure for the system, are engine driven and mounted on the rear of each engine. The hydraulic power pack, located in the fuselage nose section just aft of the nose baggage compartment, is the central control unit for the hydraulic system. It contains the valves, manifold, fluid reservoir and necessary controls which work in conjunction with various electrical switches and solenoid valves to perform the desired sequences of operation as sleeted by the cockpit control lever. Access to the power pack may be gained through the nose baggage compartment door or an access panel just aft of the baggage door.

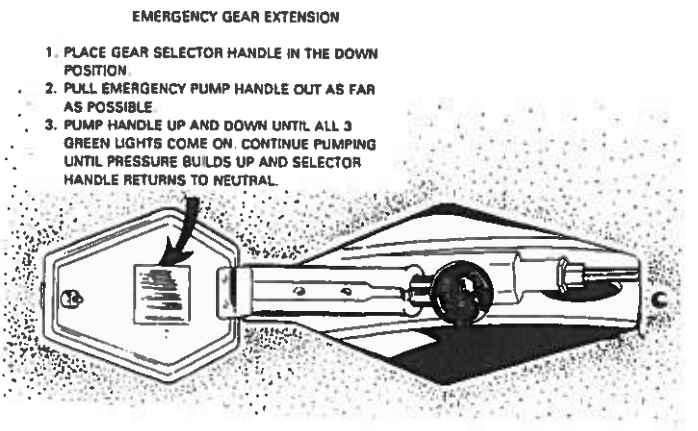
Fluid is drawn from the power pack reservoir by the engine driven pumps and pumped through the system filters and check valves back to the pressure port of the power pack. Fluid within the power pack is then directed to the appropriate actuator depending upon the sequence and selector position.

As a safety precaution, the reservoir contains a standpipe, which in the event of severe leakage of fluid retains a sufficient quantity of fluid for gear extension by means of the emergency hand pump. The engine driven pumps are supplied with fluid through the standpipe; so if a severe system leak would develop, the continued operation of the engine driven pumps would drop the fluid level below the top of the standpipe and the system would be



' MAIN GEAR ACTUATING CYLINDER
' HYDRAULIC PUMP FILTER
' HYDRAULIC PUMP
' GEAR DOOR ACTUATING CYLINDER
RGENCY HAND PUMP
'ER PACK ASSEMBLY
7. RIGHT GEAR OR ACTUATING CYLINDER
8. CHECK VALVES
9. RIGHT MAN GEAR ACTUATING CYLINDER
10. RIGHT HYDRAULIC PUMP FILTER
11. RIGHT HYDRAULIC PUMP

HYDRAULIC SYSTEM SCHEMATIC
Figure 7-9



EMERGENCY LANDING GEAR HAND PUMP
Figure 7-11

denied operational fluid from the reservoir. If this occurs, operation would be limited to pressure obtained through the use of the emergency hand pump and fluid retained in the standpipe.

A door solenoid valve, mounted in the power pack, is electrically operated and spring loaded to the door open position. Should an electrical failure occur, the solenoid valve will move to the door open position to allow the gear to be lowered normally or with the hand pump.

A system pressure port/check valve and a suction, fill and drain valve are located on the right side of the fuselage nose section, accessible through an access panel. (Refer to Section 8 - Airplane Handling, Servicing and Maintenance.)

To operate the gear, pull out the wheel shaped gear selector mounted on the instrument panel to the right of the pilot's control wheel and move it from the neutral position to the UP landing gear or DOWN landing gear position. When the desired position of the gear is obtained, the handle is forced back to the neutral position by hydraulic pressure in the selector valve. The hydraulic fluid then circulates freely between the pump and control unit.

retraction or extension will occur normally in approximately 6 ds.

NOTE

In the event of electrical failure or when the master switch is OFF, the selector handle will not return to neutral and the gear doors will not close.

'hen the selector handle returns to neutral, it relieves all pressure in the n. The gear is held in position by mechanical locks. Return of the ol handle to the neutral position is an indication that the components eached full extension or retraction; however, the landing gear position should be used as primary indications.

CAUTION

When retracting the landing gear, be sure that the gear unsafe light is out before exceeding the maximum gear operating speed.

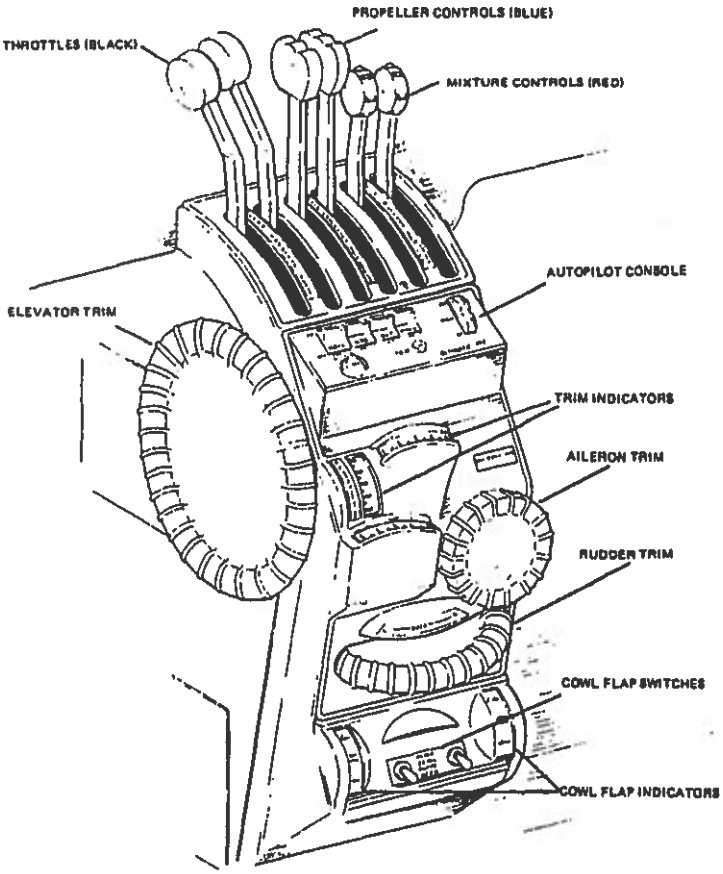
ie emergency hydraulic hand pump (Figure 7-11) is used to obtain ulic pressure in the event of failure of the engine driven hydraulic i. This hand pump is located between the pilot's and copilot's seats. An cover marked "Emergency Gear Extension" must be lifted to gain to the pump handle. Follow instructions on the underside of the plate to lower the gear. The hand pump should not be used to retract ar in flight or to perform gear retractions while aircraft is on jacks.

NOTE

To perform an emergency gear extension. Approximately 50 full strokes will be required.

'LIGHT CONTROL SYSTEM

ie primary flight controls are operated by dual control wheels and pedals assuring complete operational control by the pilot or copilot. ntrol wheel operates the ailerons and elevators; the rudder pedals e the rudder, the nose wheel steering and the toe brakes. The toe , which are an integral part of the pedals, operate the wheel brakes. erons and rudder are interconnected through a cable-spring system to e coordination in normal turns.



CONTROL PEDESTAL
Figure 7-13

Secondary control is provided by aileron, elevator and rudder trim tabs. is operated by knobs or wheels on the control pedestal (Figure 7-13) h turn cable-wrapped drums located inside the pedestal. With rotation e drums, screws are moved forward or aft to position the trim tabs. The on trim wheel, for right wing down or left wing down (roll) correction, is ed below the power controls. The rudder trim wheel, for nose left or right correction, is located below the aileron trim wheel. The elevator wheel, for nose up or nose down correction, is located on the left side of edestal. To show the position of the trim tab, and indicator is mounted to each trim control on the control pedestal.

Wing flap position is controlled by a selector switch mounted on the ument panel immediately to the right of the control pedestal. The flap ion indicator is located to the right and below the selector switch. An position is provided on the flap position indicator to indicate zero (0) ge to the system. The selector switch provides for variable wing flap ioning in as little as 2° increments from 0° to 40°. Detent positions are ded at the most commonly used positions of 0°, 15°, and 40°. A wing position change is made by moving the selector handle to any desired ion (marked on the switch selector guard). The flaps will automatically to the selected position and indicator will display the actual flap on. The flaps may be extended to 25° at airspeeds below 174 KIAS. 40° extension is limited to airspeeds below 140 KIAS. The entire system is onically monitored for system component failures and will prevent an metric flap position greater than 5° differential.

The basic electronic control system consists of an amplifier, three tats, two power solenoids and one motor. The motor is of a D.C. anent magnet type and extends or retracts the flaps through a pair of le shafts attached to jackscrew, transmission assemblies located on wing flap.

The amplifier is the heart of the control system. It provides a regulated ge supply for the three external rheostats, circuit logic to analyze the n condition and position; provides commands to the power solenoids uate the motor for extensions and retractions and contains its own oring system to ascertain the condition of critical circuit components.

The three rheostats feed back to the amplifier the signals necessary to operate the system. One rheostat is located in the flap position selector and one each is located so as to sense the positions of the right and left flaps independently. The selector rheostat signals the amplifier, activating the motor, which positions the flaps. The left flap rheostat controls flap position in relation to the selector rheostat position and provides information to the amplifier to drive the position indicator. The right flap rheostat must agree with the left flap rheostat within 5° at all times or the system will shut down and cannot be reactivated until the imbalance and/or the cause has been corrected.

The system also incorporates a FLAP annunciator light that will illuminate when an imbalance exists between the right and left wing flap rheostats or a critical component of the amplifier has failed.

Before takeoff, the operation of the FLAP annunciator may be checked while the flaps are in transit, by pushing the test switch located adjacent to the flap position indicator.

7.19 FUEL SYSTEM

The fuel system consists of fuel cells, engine driven fuel pumps, emergency fuel pumps, fuel injectors, control valves, fuel filters, fuel pressure and flow gauges, fuel drains and non-icing NACA fuel tank vents and a fuel selector panel. (Figure 7-15). Lockable filler caps are available as optional equipment.

Fuel is stored in four flexible fuel cells, two in each wing. The outboard fuel cells have a capacity of 40 U.S. gallons each, and the inboard cells have a capacity of 56 U.S. gallons each, providing a total fuel capacity of 192 gallons, 183.4 of which are usable. Each individual fuel cell incorporates its own fuel senders, screened outlet, sump drain valve, vent line check valves and filler assemblies available with optional lightning shielded caps.

The four fuel sump drains for the fuel tanks are located along the bottom of the wings: one just outboard of each wheel well and one on the inboard of each wing near the wing root fillet plate assemblies. On the fuel filter assemblies, attached to the inboard wing ribs, are fuel filter drains, accessible through a door on the bottom of the wing root fillet plate. A crossfeed drain is located on the left wing root fillet plate inboard of the tank drain. All of the fuel drains incorporate quick drain valves to provide speedy fuel contamination checks. (Refer to Section 8 - Airplane Handling, Servicing and Maintenance.)

The right and left wing fuel systems are independent of each other and onnected only when the crossfeed system is activated. Under normal tion, fuel is routed from the fuel cells through the selector valve and lter. Fuel from the fuel boost pump travels through the emergency fuel pump e wall shutoff valve and the engine driven fuel pump to the fuel injector ien to the cylinders.

mergency fuel pumps are installed to provide fuel pressure in the event gine driven pump fails. The emergency fuel pumps are also used under il conditions for takeoff landing and priming the engines. It may also cessary to turn on the emergency fuel pumps during climb, cruise or taxiing to stabilize fuel pressure. Left and right emergency fuel pump ies are located on the overhead panel to the right of the fuel gauges.

Wo electric fuel quantity gauges are mounted in the overhead switch . The right fuel quantity gauge indicates the quantity of fuel in the ed right fuel system tank (right inboard or right outboard) and the left uantity gauge indicates the quantity of fuel in the selected left fuel n tank (left inboard or left outboard). The fuel gauges are connected ically to micro switches mounted in the fuel selector console. The fuel rs are also connected electrically to the micro switches. When a fuel s selected its corresponding micro switch is actuated, completing the t between the fuel senders and the fuel quantity gauge, providing a l reading of the fuel quantity in the selected tank. The gauges are nated and the lights are controlled by a rheostat switch on the left side overhead switch panel.

uel flow and fuel pressure for the left and right engine fuel systems are ored by a dual fuel flow gauge and a dual fuel pressure gauge. The fuel gauge mounted on the instrument panel above and to the right of the l pedestal, measures both the right and left engine fuel system fuel flow S. gallons per hour. The fuel pressure gauge, mounted on the ment panel above and to the right of the copilot's control column, ires the fuel pressure in pounds per square inch for both the left and ngine fuel systems.

FUEL SYSTEM SCHEMATIC
Figure 7-15

WARNING

If either the right or left fuel flow warning light illuminates and the fuel gauge indicates fuel remaining in the corresponding inboard tank, this will indicate a malfunction of the flapper door in the inboard tank. Immediately select the outboard tank or select crossfeed to avoid fuel flow interruption.

ight and left fuel flow warning lights illuminate to warn the pilot of an ıding fuel flow interruption. The lights are activated by a sensing probe ted near each inboard fuel tank outlet. In the event the fuel level near nk outlet drops to a point where a fuel flow interruption and power loss occur, the sensing probe will illuminate its corresponding warning The warning light will be on for a minimum of 10 seconds and will n on if the cause is not corrected. The warning lights are incorporated annunciator panel. For press-to-test procedures, refer to Paragraph

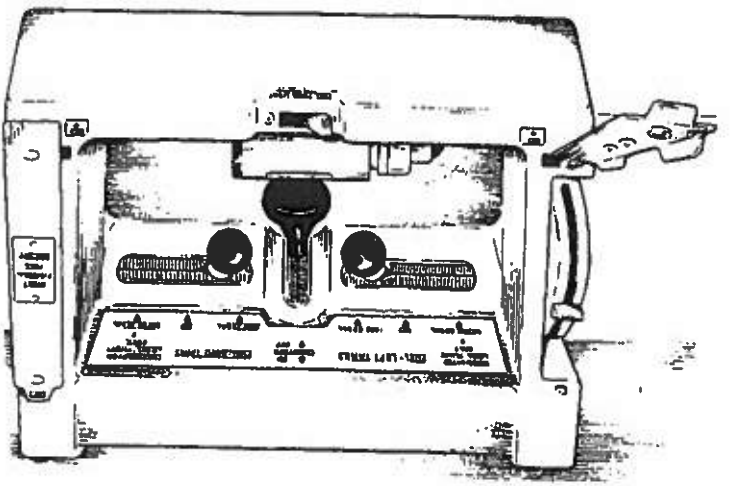
he fuel management controls (Figure 7-17) are located in the fuel n control panel mounted between the front seats on the forward edge wing spar carry-through cover. Located on the fuel control panel are el tank selectors, fire wall fuel shutoffs and the crossfeed controls. A ontrol panel light and switch are mounted at the top of the panel.

uring normal operation of the fuel system, each engine is supplied uel from its respective fuel supply. Selection of the controls on the side of the control panel provides fuel from the right inboard or ard fuel cells to the right engine and left fuel control selection es fuel from the left inboard or outboard fuel cells to the left engine.

or emergencies, fuel from one system can supply the opposite engine h the use of the crossfeed system. The crossfeed valve is located at board rib assembly of the left wing butt area and is intended for ency use only. The crossfeed is controlled by a knob in the center of el control panel, and under all normal conditions should be in the off osition.

NOTE

The crossfeed system is not intended for normal operation. When the crossfeed valve is on, be certain the fuel selector valve on the tank not in use is off, and the procedures outlined in Section 3 - Emergency Procedures are followed.



FUEL SYSTEM CONTROL PANEL
Figure 7-17

Emergency fire wall fuel shutoff valves are installed in both the right left engine fuel systems. The valves are actuated by controls on the left right sides of the fuel system control panel. Since the fire wall shutoff ves are intended for emergency use only, they are provided with covers ch must be lifted before the valves can be turned off. The covers are igned to prevent them from being closed when the fire wall shutoff valve trols are in the off position, preventing inadvertent activation and ıring a normal valve-open position with the cover closed. The valves are n when the lever is down.

Fuel to supply the combustion heater is provided by the right engine system. (Refer to paragraph 7.39 in this section.)

ELECTRICAL SYSTEM

Electrical power is supplied by a 28-volt, direct current, negative ground trical system. Standard electrical supply equipment includes alternators, ters, voltage regulators, overvoltage relays, an ammeter, a battery, an ernal power receptacle, circuit breakers, warning lights, switches and noids.

The electrical system is controlled by switches located in the overhead el (Figure 7-23 or 7-24) and the circuit breaker control panel (Figure 7-21). circuit breaker control panel, located on the side panel to the left of the t, provides circuit protection and control for a complement of standard optional electrical equipment and accessories. All switches and circuit ıkers are marked to their individual functions. Switches are mainly of the gle or rocker type and circuit breakers are of the push to reset or circuit ıker switch type. If a circuit breaker pops, automatically opening the rloaded circuit, it is recommended that the breaker be allowed to cool ore resetting. The circuit breakers can be manually tripped by pulling out he reset button.

CAUTION

The alternator output circuit breaker switches (black), located on the lower left portion of the circuit breaker panel, should not be opened manually when the alternators are functioning normally.

The starters are energized by a rocket type switch labeled ENGINE STARTER located on the overhead switch panel between the left and right magneto switches. To activate, push on the side of the switch which corresponds to the engine to be started and hold until the selected engine has started. When released, the switch should return to the off position. A warning light (optional), mounted on the overhead switch panel below the starter switch, illuminates when either starter is energized.

NOTE

Starters should not be energized for more than 30 seconds of continuous cranking. Allow to cool between starting attempts.

The primary electrical sources are two 28-volt, 70-ampere alternators. The alternators are controlled independently by two voltage regulators which are interconnected electrically to provide parallel outputs at normal engine operating speeds. Alternator circuit protection is supplied by left and right alternator circuit breaker switches on the bottom left of the circuit breaker control panel and alternator inoperative lights in the annunciator panel. When an alternator fails to provide voltage, its respective alternator inoperative light will illuminate. The lights can be checked by using the annunciator press-to-test procedure. If a light fails to illuminate, the bulb should be replaced. Whenever the engines are operating at high differential RPM, the alternator inoperative light for the slower engine may illuminate.

NOTE

In the event of an alternator inoperative indication, refer to Section 3 - Emergency Procedures.

The ammeter, located in the center of the overhead switch panel, monitors the battery charging current. When the needle pointer indicates left of center, the battery is discharging, and when the needle pointer indicates right of center the battery is charging.

To check the output of each alternator, two test switches are provided cent to the ammeter in the overhead switch panel. The right switch, n depressed, will cause the ammeter to indicate the output of the right nator, and the left switch, when depressed, will cause the ammeter to cate the left alternator output. The switches are momentary-on type must be depressed when reading the ammeter. (Refer to Section 4 - mal Procedures for preflight alternator check procedure.)

The MASTER SWITCH is located on the bottom left of the circuit ker control panel. It is a split rocker type switch to avail the pilot with a rate control over the field of each alternator.

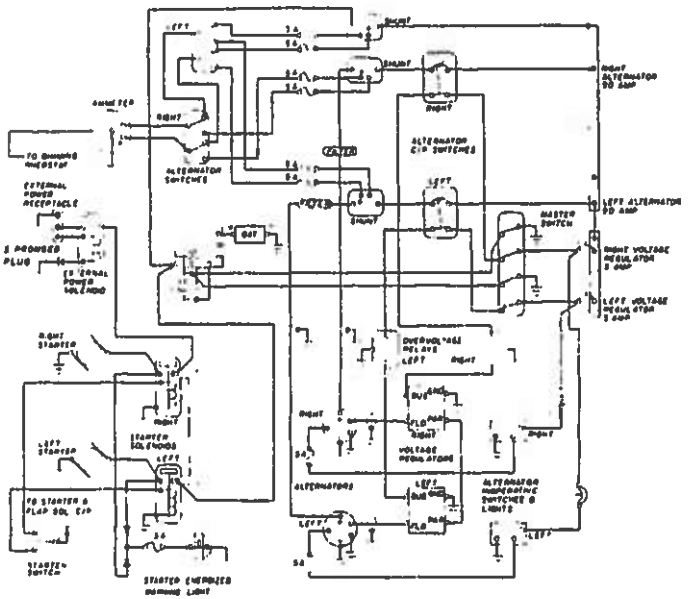
Secondary electrical power is supplied by a 24-volt, 17-ampere hour ry. The battery is enclosed in a stainless steel box accessible through the baggage compartment. A 24-volt, 25-ampere hour battery is offered as nal equipment.

NOTE

The airplane battery must be removed before recharging.

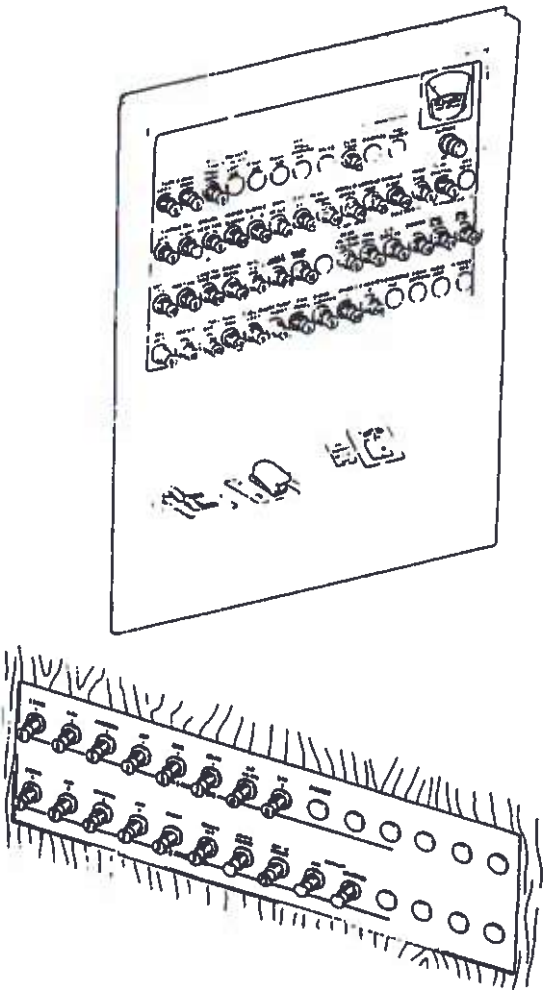
An external power source receptacle is installed in the lower left side of iselage nose section. It is designed to utilize a 24-volt DC external power e when the aircraft battery is low or during cold weather to prevent battery discharge due to extended starting procedures. It can also be to save the battery when ground checking the airplane systems. (Refer ction 4 - Normal Procedures for external power starting procedures.)

osition/strobe light assemblies are installed in each wing tip. The right tip incorporates a green position light and a white strobe light and the ing tip, a red position light and a white strobe light. A white position white strobe light are also installed on the tail cone of the airplane. The on lights and the strobe lights are controlled by switches on the ead switch panel.



CONDUCTORS - CROSSING AND JUNCTION OF CONDUCTORS. THE DOT AT THE INTERSECTION INDICATES A JOINING OF CONDUCTORS.

ALTERNATOR AND STARTER SCHEMATIC
Figure 7-19



TYPICAL CIRCUIT BREAKER CONTROL PANEL
Figure 7-21

WARNING

Anti-collision lights should not be operating when flying through cloud, fog or haze, since the 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.

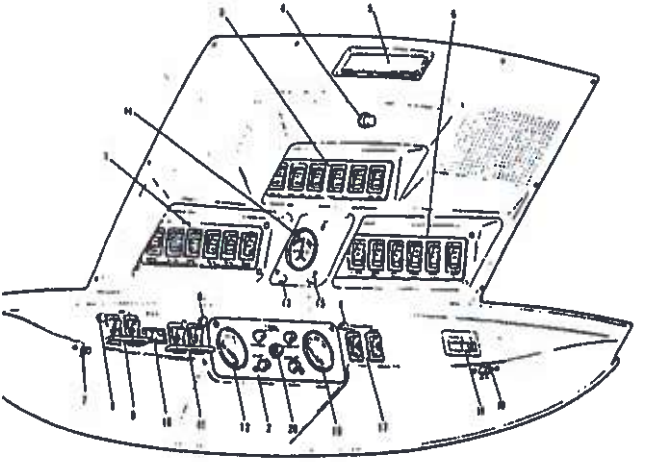
A landing and a taxi light, also controlled by switches on the overhead switch panel, are mounted on the nose gear strut housing. Both lights retract with the nose gear and will automatically turn out if the switches are left on. Nevertheless, the pilot should turn the lights off before or soon after retracting the gear.

Cabin and cockpit lighting consists of forward and center dome lights, map lights, reading lights - mounted above each passenger seat, a cabin exit light, instrument panel lighting and various indicator lights. For added courtesy and convenience, the center dome light and the cabin exit light may be illuminated by a switch just inside the cabin door, or by a switch located in the overhead switch panel.

The master switch does not have to be on to use the baggage compartment, exit and cockpit dome lights. Make sure they are off when leaving the aircraft. Leaving the lights on for an extended period of time could cause depletion of the battery.

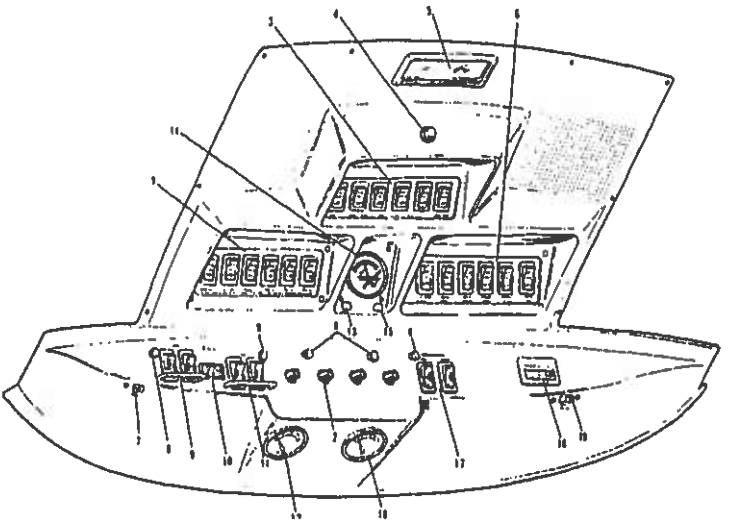
As a safety feature, the baggage door and the cabin entrance door are equipped with a door ajar warning system. Switches at the doors activate respective lights warning the pilot that the baggage door or the cabin entrance door has not been secured.

Other standard and optional electrical accessories include pitot heat, wing ice detection light, heated pilot's windshield, a gear warning horn, a stall warning horn, a rheostat switch to control instrument panel lighting and other assorted systems, controls and lights.



1. LIGHT SWITCH PANEL
2. RHEOSTAT SWITCHES
3. ELECTRICAL SWITCHES
4. DOME LIGHT SWITCH
5. DOME LIGHT
6. VARIOUS DEICING SYSTEM SWITCHES
7. LEFT MAP LIGHT SWITCH
8. POST LIGHTS
9. LEFT ENGINE MAGNETO SWITCHES
10. STARTER SWITCH
11. RIGHT ENGINE MAGNETO SWITCHES
12. LEFT FUEL GAUGE
13. LEFT ALTERNATOR PRESS-TO-TEST SWITCH
14. AMMETER
15. RIGHT ALTERNATOR PRESS-TO-TEST SWITCH
16. RIGHT FUEL GAUGE
17. FUEL PUMP SWITCHES
18. ENGINE HOUR METER
19. RIGHT MAP LIGHT SWITCH
20. DIAL LIGHT

OVERHEAD SWITCH PANEL
(AIRCRAFT WITH S/N 31-8012001 THRU 31-8212034)
Figure 7-23



1. LIGHT SWITCH PANEL
2. RHEOSTAT SWITCHES
3. ELECTRICAL SWITCHES
4. DOME LIGHT SWITCH
5. DOME LIGHT
6. VARIOUS DEICING SYSTEM SWITCHES
7. LEFT MAP LIGHT SWITCH
8. POST LIGHTS
9. LEFT ENGINE MAGNETO SWITCHES
10. STARTER SWITCH
11. RIGHT ENGINE MAGNETO SWITCHES
12. LEFT FUEL GAUGE
13. LEFT ALTERNATOR PRESS-TO TEST SWITCH
14. AMMETER
15. RIGHT ALTERNATOR PRESS TO TEST SWITCH
16. RIGHT FUEL GAUGE
17. FUEL PUMP SWITCHES
18. ENGINE HOUR METER
19. RIGHT MAP LIGHT SWITCH

OVERHEAD SWITCH PANEL
(AIRCRAFT WITH S/N 31-8212035 AND UP)
Figure 7-24

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7.23 INSTRUMENT PANEL

An instrument panel designed to accommodate a full compliment of instrumentation is a standard for the PA-31 Navajo. The instrument panel (Figure 7-25) is divided into three segments: the left segment - pilot, the center segment, and the right segment - copilot.

Complete flight instruments are installed on the left segment of the panel for direct pilot reference. The flight group is shock mounted in a removable sub-panel. Duplicate flight instrumentation is available on the copilot's side as optional equipment. The directional gyro and the attitude gyro in the flight group are operated by a pressure system incorporating pneumatic pumps. An electrically operated turn and bank indicator is also a standard in the flight group. Pitot and Static pressure for operation of the airspeed indicator is provided by a pitot/static system utilizing a pitot head and dual static pads for pressure pickups. Static pressure is also provided to the rate of climb indicator and the altimeter. An alternate static source control is mounted beneath the extreme left side of the instrument panel. Airspeed and altimeter indicator calibrations may be made with the use of charts provided in Section 5 - Performance.

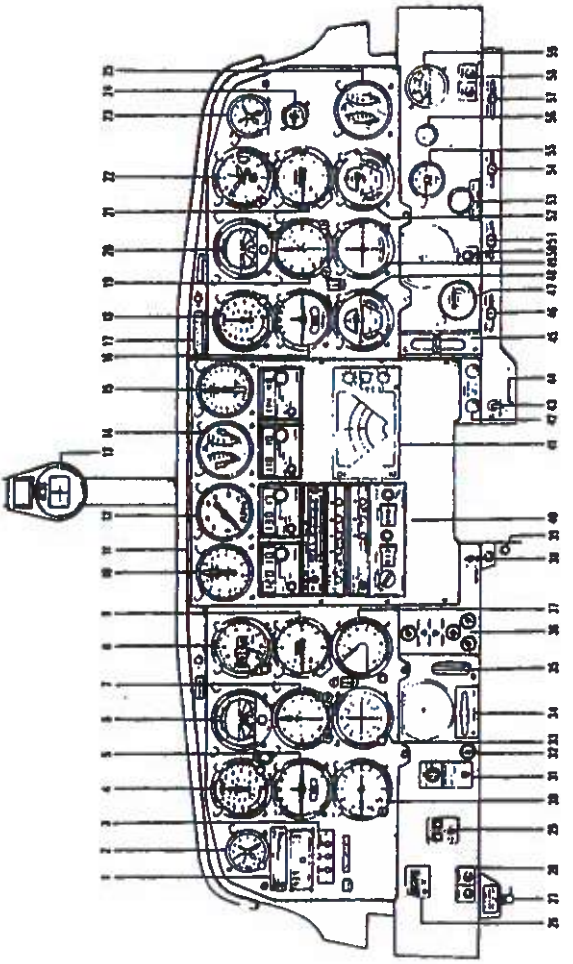
An eight day clock, installed in the upper left corner of the panel, is equipped with dummy hands for time settings and calculations. An optional clock is available on the right panel segment.

Alternator inoperative lights provide a visual indication of inadequate output from the respective alternator. The lights are included in the annunciator panel.

The right side of the instrument panel has provisions for installing a variety of optional extras.

Engine monitoring gauges are either mounted horizontally across the top of the center instrument panel or stacked vertically at the right edge of the center instrument panel. There are four engine gauges in the group; a manifold pressure gauge, a tachometer, an exhaust gas temperature gauge and a fuel flow gauge.

The center segment offers space for an arrangement of navigation and communications equipment including weather radar.



TYPICAL INSTRUMENT PANEL
Figure 7-25

1. AIRSPEED PLACARD
2. CLOCK
3. DME
4. AIRSPEED INDICATOR
5. TURN AND BANK INDICATOR
6. ATTITUDE GYRO
7. DIRECTIONAL GYRO
8. ALTIMETER
9. RATE OF CLIMB INDICATOR
10. DUAL MANIFOLD PRESSURE GAUGE
11. ANNUNCIATOR PANEL
12. DUAL TACHOMETER
13. COMPASS
14. DUAL EGT GAUGE
15. DUAL FUEL FLOW GAUGE
16. TURN AND BANK INDICATOR - COPILOT
17. CATEGORY PLACARD
18. AIRSPEED INDICATOR - COPILOT
19. DIRECTIONAL GYRO - COPILOT
20. ATTITUDE GYRO - COPILOT
21. RATE OF CLIMB INDICATOR - COPILOT
22. ALTIMETER - COPILOT
23. CLOCK
24. GYRO PRESSURE GAUGE
25. DUAL FUEL PRESSURE GAUGE
26. EMERGENCY LOCATOR TRANSMITTER
27. ALTERNATE STATIC SOURCE VALVE
28. MIKE AND PHONE JACKS - PILOT
29. AUTOPILOT CONTROLS
30. ADF
31. WINDSHEILD WIPER CONTROL/
    EMERGENCY BATTERY PACK
32. CIGAR LIGHTER
33. NAV
34. PARKING BRAKE
35. GEAR SELECTOR
36. GEAR INDICATOR LIGHTS
37. RADAR ALTIMETER
38. AVIONICS MASTER SWITCH
39. PA VOLUME CONTROL/ON-OFF KNOB (1980 MODELS ONLY)
40. AVIONICS
41. RADAR
42. MANUAL ALTERNATE AIR CONTROLS
43. HEATER CONTROL SWITCH
44. HEATER START/RESET SWITCH
45. WING FLAP SELECTOR SWITCH
46. CABIN TEMP. CONTROL
47. WING FLAP POSITION INDICATOR
48. OIL PRESS., CYL. HEAD TEMP., AND
    OIL TEMP. - LEFT ENGINE
49. NAV COPILOT
50. FLAP TEST SWITCH
51. DEFROSTER CONTROL
52. OIL PRESS. - CYL. HEAD TEMP., AND
    OIL TEMP. - RIGHT ENGINE
53. CABIN EXHAUST CONTROL KNOB
54. CABIN AIR CONTROL LEVER
55. OXYGEN SUPPLY PRESSURE GAUGE
56. OXYGEN CONTROL KNOB
57. COCKPIT AIR CONTROL LEVER
58. MIKE AND PHONE JACKS COPILOT
59. VOLTMETER

TYPICAL INSTRUMENT PANEL
Figure 7-25 (cont)

The upper portion of the right instrument panel segment nmodates the optional copilot's flight instruments, a gyro pressure (standard) and the remainder of the engine monitoring gauges lard). The gyro pressure gauge is on the far right of the right segment. pressure should remain constant in flight. The additional engine oring gauges are mounted in a row above the copilot's control wheel. consist of two combination oil pressure-cylinder head temperature-oil rature gauges and a fuel pressure gauge.

Pilot and copilot microphone and headphone jacks are mounted at the n of the left and right panel segments near the sidewalls. Autopilot ols and indicators are mounted below the control quadrant on the tal and on the left instrument panel segment.

nstrument lighting is provided by individual post lamps mounted nt to each instrument. These lights are controlled by a rheostat switch overhead panel. The lights illuminate by the first movement of the and intensity increases with further rotation.

ilot and copilot map lights are installed in the overhead switch panel n the instrument panel to provide reference lighting during night ion. Two white map lights are mounted in the horizontal surface on ottom side of the overhead switch panel. Separate on-off control es are mounted above each light. A red (pilot) and a white (copilot) ght are mounted below the instrument panel eyebrow in the center of ht and left segments. A control switch is mounted on top of the panel ow above each light.

n engine hour meter installed on the overhead switch panel records resents the total hours of engine operation. A magnetic compass is ed above the instrument panel on the windshield center post panel.

arious other standard and optional operational controls, switches and tors for windshield wiper, parking brake, landing gear, manual ite air, wing flaps, heating, ventilating, defrost and synchrophaser are ed on the instrument panel.

Deviations in the location of certain instruments and gauges may result from the installation of optional avionics and radio packages.

7.25 ANNUNCIATOR PANEL

The warning lights are grouped together in an annunciator panel which extends across the upper center of the instrument panel. Monitored functions include the pneumatic system, low fuel flow, flap condition, alternator operation, combustion heater temperature, and cabin and baggage door security. There are also provisions in the annunciator panel for the addition of warning lights for various optional systems.

To the left of the annunciator display is a press-to-test switch. With the master switch ON, depressing the test switch will illuminate all of the annunciator lights except the FLAP light. A separate flap annunciator test switch is located adjacent to the flap position gauge. (See paragraph 7.17, Flight Control System.) Failure of a light to illuminate is an indication of a burnt out bulb or other annunciator system abnormality. The switch should be held for at least 3 seconds, as the low fuel flow warning light will take a few seconds longer than the others to illuminate and will remain lit for as long as 10 seconds after the others have extinguished. To the right of the annunciator display is a dimmer switch which raises or lowers the intensity of the lights in the display. During the press-to-test procedure, the lights will test either bright or dim, depending upon the position of the dimmer switch. During daylight operations, the annunciator lights should be in the bright mode.

7.27 RADIO OPERATION

Electrical power for avionics equipment is controlled by a master switch located in the center of the instrument panel below the radios. The audio control panel allows the pilot to select radio audio individually. This allows pre-setting of frequencies or volume and also provides the option of listening with either the speaker or the headphones.

An Emergency Avionics Bus Power circuit breaker switch is located below the left circuit breaker panel. The switch is protected from inadvertent activation by a red switch guard.

In normal operating conditions, the switch is in the OFF position and the guard is closed. The ON position is for emergency use only and causes power from the primary bus to go directly to the number 1 avionics bus. In this configuration, number 1 avionics bus power is independent of the avionics master circuit breaker number 1.

NOTE

To avoid chatter in the speaker with the Emergency Avionics Bus Power ON, pull the avionics master number I circuit breaker before turning the Emergency Avionics Bus Power ON.

public address (PA) volume control knob is mounted on the left side pedestal below and forward of the propeller synchrophaser switch. ıtrol is a rheostat providing variable volume control through the rear · system. If operation with oxygen masks is required and the airplane pped with Collins radios and Scott Duo-Seal oxygen masks, ınications between the pilot and copilot are possible through the ones by selecting the PA mode and turning down the rear speaker . This will allow the pilot and copilot to communicate and still receive ng communications. Starting with the 1981 models the PA system s at a fixed volume level with passengers able to monitor the crew ations mentioned above.

ground clearance energy saver system is available to provide direct o #1 Comm without turning on the master switch. An internally lit :ton switch, located on the instrument panel provides annunciation agement of the system. When the button is engaged direct aircraft power is applied to #1 Comm, the pilot's mike and audio amplifier r). The system is reset to the OFF position by activating the aircraft switch.

[TOT/STATIC SYSTEM

ıamic and static air pressure for operation of the airspeed indicator ied by the pitot static system (Figure 7-27). The system also supplies r pressure to the altimeter and the vertical speed indicator.

eated pitot head is mounted under the nose section, forward of the ar doors. Total pressure is extracted by the pitot head and routed to the airspeed indicator. Provisions have been made for installation ditional pitot head if dual instruments are desired. The second pitot mounted to the right of the existing head under the nose.

Static source pads (pickups) are located on both sides of the fuselage forward of the horizontal tail. They connect to a single line leading to the instruments. Dual pickups are provided to reduce side slip effects on the airspeed indicator.

An alternate static source valve is mounted below the left segment of the instrument panel near the pilot's left knee. To actuate, push the lever up and to the left, locking the valve in the open position. When the alternate static source is selected, the pilot's airspeed indicator, altimeter and rate of climb indicator utilize cabin air for static pressure. Under these conditions the altimeter and airspeed indicator readings will be higher than normal, (refer to Section 5 - Performance for correction chart).

Pitot heat is provided to prevent ice accumulations from blocking the pitot head pressure inlet and restricting pressure to the airspeed indicator. Switches for the pitot heat are located in the overhead switch panel. Pitot covers are provided with each pitot head and should be installed when the airplane is parked to prevent bugs and rain from entering the pitot head. A partially or completely blocked pitot system will cause erratic or zero readings on the airspeed indicator.

NOTE

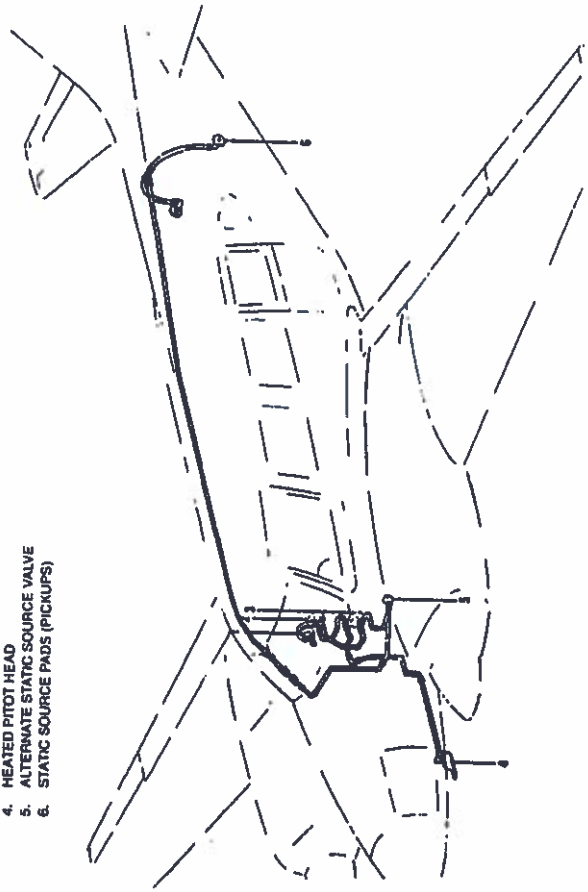
Before each flight, insure that pitot covers have been removed.

7.31 PNEUMATIC SYSTEM*

The pneumatic system (Figure 7-29) supplies air pressure to operate the air driven gyros. Pressure is also supplied to the surface deicing boots when the wing and empennage deicing system (optional) is installed.

Basically, the pneumatic system is divided into two independently operated pressure supply systems: the left engine supply and the right engine supply. Both systems utilize a common manifold check valve and pressure gauge. Each side of the pneumatic system incorporates its own inlet, inlet filter, engine driven pneumatic pump, regulator and inline filter. Recessed inlets, just aft of the fire wall on the bottom-outboard side of the engine nacelle, extract constant supplies of outside air, which are passed through inlet filters and directed to the left and right engine driven pneumatic pumps. Air pressure from each pump is then routed to its respective pressure

*Optional equipment



PITOT/STATIC SYSTEM
Figure 7-27

regulator. Each pressure regulator has its own adjustment to provide a means of setting the pump outlet pressure. Any airflow supplied by the pumps in excess of the adjusted setting is expelled from the system at the regulators. Regulated air pressure is then passed through a .3 micron inline filter for further protection against contaminated air reaching the instruments. Once filtered, pressure from the left engine supply and pressure from the right engine supply are united in a manifold check valve, common to both sides of the system. The manifold check valve supplies a single outlet line to the gyros. In the event one of the engine driven pneumatic pumps fail, the other side of the system can maintain air pressure to the gyros and or deicers. Air pressure supplied by the system is utilized to operate the attitude gyro and the directional gyro and exhausted through a bulkhead forward of the instrument panel.

Each pressure pump is capable of operating the air driven gyros and the pneumatic deicers up to single engine service ceiling and with both pumps operating normally, up to the maximum approved altitude of the airplane.

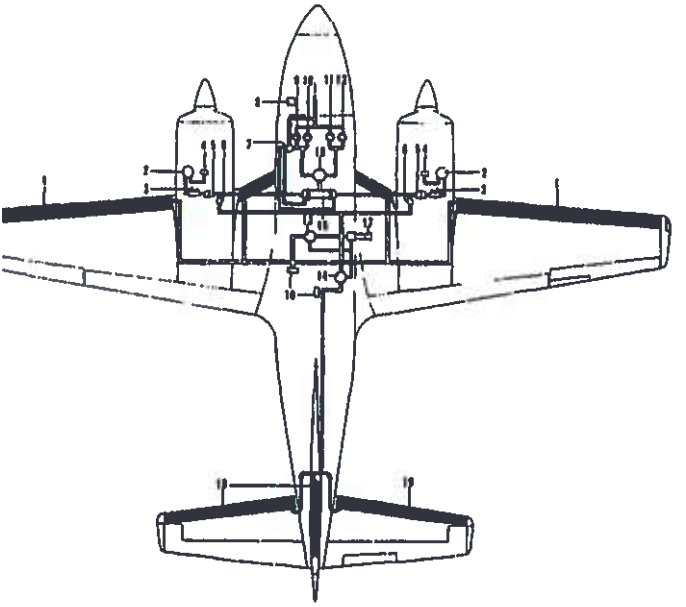
A gyro pressure gauge, mounted in the right segment of the instrument panel, indicates system pressure in inches of mercury. A graduated green arc on the face of the gauge indicates pressure readings within normal operating limits. Two annunciator lights, mounted in the annunciator panel, provide a visual warning to the pilot that either the right or left pneumatic source is inoperative. The lights are placarded, L. PNEU. INOP. and R. PNEU. INOP.

7.33 WING AND EMPENNAGE DEICING*

Pneumatic wing and empennage boots are installed on the leading edges of the wings, the vertical stabilizer (fin) and the horizontal stabilizer. A constant suction is applied to all of the surface deicer boots by an ejector to provide smooth streamlined leading edges during normal operations with the deicing system off. The ejector assembly utilizes air pressure supplied by the pneumatic system to obtain a vacuum to hold the boots in the flat, deflated condition.

The deicing system is controlled by a "momentary on" type control switch. When this WING DEICE switch is actuated, the boots perform one complete inflation cycle. The switch must be actuated for each additional inflation cycle. This allows the pilot to manually select boot inflation in any desired time interval that icing conditions require. After each inflation cycle, the timer automatically resets to allow the inflation cycle to begin when the switch is actuated.

*Optional equipment



ING DEICER BOOT
NEUMATIC PUMP
UAL REGULATOR - SOLENOID VALVE
ISET AIR FILTER
ILINE FILTER
HECK VALVE
RESSURE GAUGE
EICER CYCLE TIMER
IRECTIONAL GYRO - PILOT
ITITUDE GYRO - PILOT
11. DIRECTIONAL GYRO - COPILOT
12. ATTITUDE GYRO - COPILOT
13. "A" SYSTEM (WING) SOLENOID VALVE
14. "B" SYSTEM (TAIL) SOLENOID VALVE
15. MANIFOLD CHECK VALVE
16. PRESSURE SWITCH
17. EJECTOR
18. PNEUMATIC PRESSURE REGULATOR (RELAY VALVE)
19. EMPENNAGE DEICING BOOT

PNEUMATIC/WING AND EMPENNAGE DEICING
Figure 7-29

Actuation of the momentary switch triggers a system cycle timer, which in turn shifts the two stage regulators to high pressure (18 psi), opens the 'A' system solenoid valve to send air to the wing boots, and cuts off air to the copilot's gyros (when installed). After six seconds the 'A' system solenoid is closed and the 'B' system solenoid is opened to send air to the tail boots for six seconds. At the completion of the tail cycle, the 'B' system solenoid closes, the two stage regulators return to low pressure (gyro pres.) and the copilot's air supply resumes.

When the inflation cycle is complete, the deicer solenoid valves permit overboard exhaustion of the pressurized boots. Suction is then reapplied to the deicer boots to hold them close to the airfoil surface.

Two blue indicator lights with press-to-test and dimming features, illuminate when each surface deicer boot system inflates to a predetermined pressure. Illumination of the indicator light is controlled by a pressure sensitive switch connected to the deicer pressure lines (one in the 'A' system, and one in the 'B' system).

To insure good ice shedding, the boots should be clean and free of any oils or dirt and in good condition. No special coating is required; but ice shedding may be slightly improved by the application of B.F. Goodrich 'Icex'. It is authorized for use and has been tested in natural icing. The manufacturer's instructions (B.F. Goodrich) must be followed explicitly.

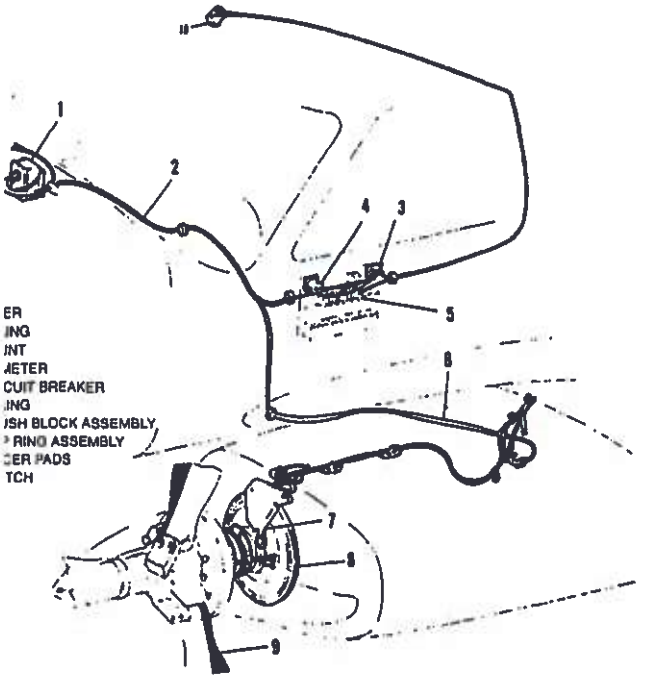
7.35 ICE DETECTION LIGHT*

Wing ice may be detected during night flight with the use of an ice detection light installed in the outboard side of the left engine nacelle. The light is controlled by a WING INSPECTION switch mounted in the overhead switch panel. Circuit protection for the ice detection light system is provided in the circuit breaker panel by a push-to-reset circuit breaker.

7.37 ELECTRIC PROPELLER DEICERS*

Electrothermal propeller deicer pads are bonded to the leading edges of the propeller blades. Each deicer pad has two separate heaters, one for the outboard and one for the inboard half. (Refer to Figure 7-31.)

*Optional equipment



ELECTRIC PROPELLER DEICING SYSTEM
Figure 7-31

he system is controlled by an on-off type PROP DE-ICE circuit switch d in the overhead switch panel and the circuit is protected through a it breaker in the circuit breaker control panel. When the switch is ted, power is supplied to the system timer. The PROP DE-ICER ter is connected in series between the switch and the timer to monitor rrent through the propeller deicing system. With the propeller deicing n ON, the ammeter needle should be within the green are on the face of nmeter for a normal reading.

ower from the timer is cycled to brush assemblies which distribute r to modified starter ring gears incorporating slip rings. The current is supplied through the slip rings directly to the electrothermal propeller r pads.

Deicing is accomplished by heating the outboard and then the inboard half of the deicer pads in a sequence controlled by the timer. The heating sequence of the deicer pads is according to the following cycle:

a. Outboard halves of the propeller deicer pads on the right engine. (30 seconds)
b. Inboard halves of the propeller deicer pads on the right engine. (30 seconds)
c. Outboard halves of the propeller deicer pads on the left engine. (30 seconds)
d. Inboard halves of the propeller deicer pads on the left engine. (30 seconds)

When the system is turned on, heating may, begin on any one of the above steps, depending upon the positioning of the timer switch when the system was turned off from previous use. Once begun, cycling will proceed in the above sequence and will continue until the system is turned off.

A preflight check of the propeller deicers can be performed by turning the PROP DE-ICE switch on and feeling the deicer pads for proper heating sequence. The deicer pads should be warm to the touch.

A less vigorous test may be accomplished by turning the PROP DE-ICE switch on with the engines operating at idle and noting that the ammeter needle remains in the green are for one complete cycle (2 minutes).

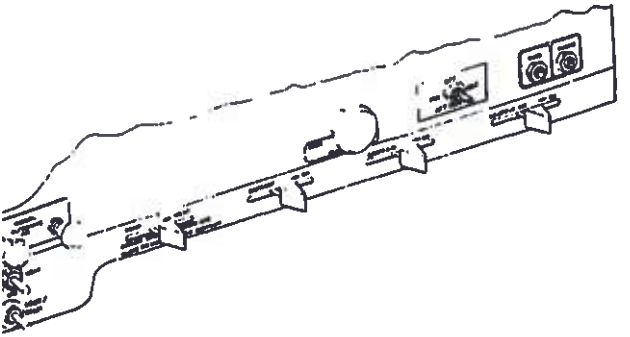
The heat provided by the deicer pads reduces the adhesion between the ice and the propeller so that centrifugal force and the blast of airstream cause the ice to be thrown off the propeller blades in very small pieces. The ice can produce minor damage to the fuselage if ice shields* have not been installed.

*Optional Equipment

CAUTIONS

When conducting the above described ground test, do not operate system longer than two compete cycles.

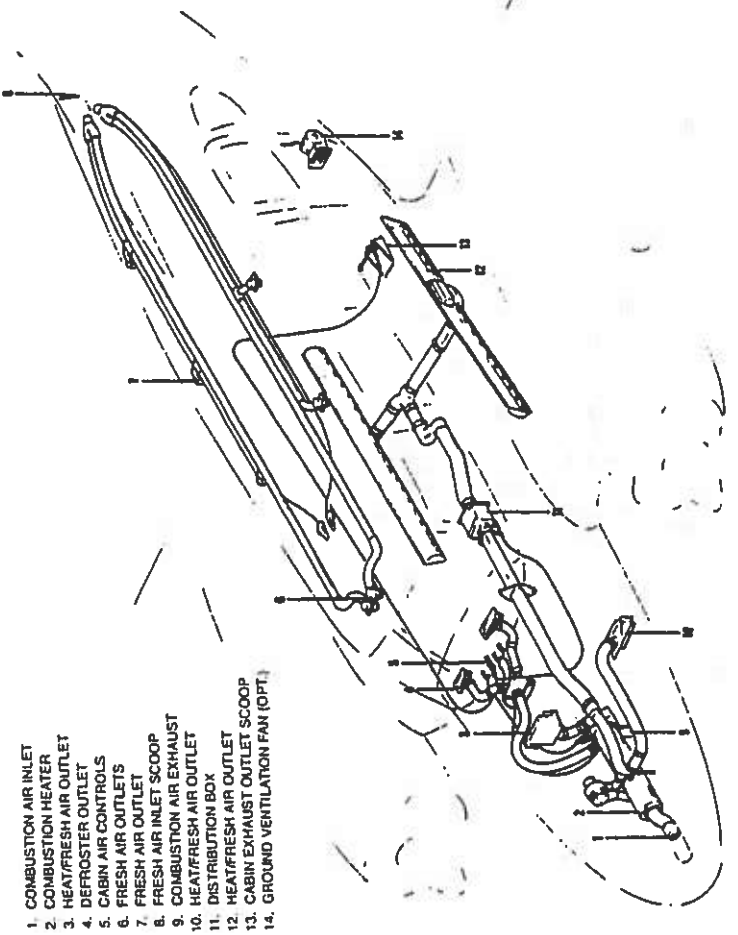
If' the ammeter reading is less than in the green arc, one or more of the pads is not functioning. If propeller deice is used under this condition, the pilot can expect an uneven buildup of ice with consequent undesirable vibration.



CABIN AIR CONTROL PANEL
Figure 7-33

HEATING, VENTILATING AND DEFROSTING

ontrols to regulate cabin air temperature and provide fresh air ation and heated air for defrosting are mounted in the cabin air control below the right segment of the instrument panel (Figure 7-33). They e a three-position forward heater switch and temperature, defroster, air and cockpit air control levers. A cabin exhaust control is mounted y above the cabin air control panel. Provisions for mounting an aft (optional) switch have also been made adjacent to this location.



HEATING, VENTILATING, AND DEFROSTING
Figure 7-35

The heating system (Figure 7-35) is designed to provide maximum nfort for the occupants during winter and cool weather flights. A 35,000 T.U. Janitrol combustion heater furnishes the hot air source for cabin ting and windshield defrosting. The heater is mounted in the nose section is accessible through a removable panel on the right side.

Forward heater operation is controlled by two switches mounted one ow the other and located in the lower right panel just to the right of the estal. The upper switch has three positions: FAN, OFF and HEAT. The er switch is a momentary on type and is marked START/RESET. ection of the HEAT position and depression momentarily of the .RT/RESET switch activates the heater regulator/shutoff valve, wing fuel to flow from the right fuel cell to the combustion heater, and ltaneously ignites the heater.

A recessed inlet in the bottom right side of the nose section supplies a tant source of outside air for operation of the combustion heater. Air the inlet passes through the combustion heater to a distribution box hen to the heater outlets and/or the defroster outlets, depending upon ositions selected on the control panel. Heat outlets are mounted in the pit and cabin areas, furnishing a complete interior heat flow. Cockpit r outlets are forward and below the instrument panel and cabin heater s are along the floor on the left and right sides of the fuselage. Two ter outlets are mounted in the cover atop the instrument panel to allow en airflow to each windshield. Interior hot air regulation is controlled e TEMP control lever mounted in the cabin air control panel. To se the cockpit and cabin air temperature, move the lever to the right.

NOTE

For ground operation, takeoff and climb, do not exceed midpoint.

froster air is turned on by moving the DEFROST lever in the cabin air panel to the right. Air from the distribution box is ducted directly to roster outlets; thus, the defroster control should be turned on full (far ntil the windshield is defrosted and then moved toward the off (far osition until just enough air is flowing to keep the windshield d.

Windshield defrosting can be regulated by various settings of the defroster lever. In severe windshield fogging or icing conditions it may be necessary to restrict the heater air, since this will drive more air through the defroster outlets.

Since the combustion heater utilizes fuel extracted from either right fuel cell, it will not operate with the right engine secured and the fire wall shutoff valve off. To operate the heater with the right engine shut down, select a left tank, turn the crossfeed on, move the right engine mixture control to idle-off, open the right fuel shutoff valve (down), turn the left emergency fuel pump on and the right fuel tank selector off.

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CAUTION

The fuel crossfeed should not be used to operate the heater with the right engine shut down if the engine was shut down due to an emergency situation such as a fuel leak or fire.

Heat may be supplied to warm the cabin before engine start by turning on the master switch, moving the mixture control to idle cut-off, turning on the right emergency fuel pump and starting the heater. This operation should not be performed in such a manner as to deplete the battery.

A circulating fan is attached to the inlet end of the combustion heater. This fan is partially controlled by a landing gear safety(squat) switch during ground operation. When the three position heater switch is turned to HEAT, the circulating fan automatically draws outside air from the inlet for heater operation (ground operation only). Selection of the FAN position will also operate the heater circulating fan. This position allows air circulation through the heater ducts and windshield defogging on the ground when heat is not desired. The FAN position of the heater switch is also used for heater cooling to prevent the heater duct limit switch from tripping after use on the ground. When the combustion heater is turned off after use on the ground, the switch should be turned to the FAN position for a few minutes to cool the heater before the master switch is turned off. When the heater is turned off during flight it is not necessary to select the FAN position due to the automatic heater cooling provided by inlet air.

The heater is protected from overheating by a heat limit switch. If the heater temperature reaches a predetermined setting, the limit switch opens and the heater becomes inoperative. This is indicated by the illumination of the HTR FAIL warning light in the annunciator panel. The heat limit switch will automatically reset when sufficient time is allowed for the heater to cool. By depressing the START/RESET switch momentarily, the heater can be restarted. Heater restart is indicated by the HTR FAIL warning light extinguishing after the START/RESET switch is released. Prior to restarting the heater, ensure the following precautions are followed:

(a) Open all heater outlets to the full open position.

(b) The TEMP HEAT lever should only be half open.

(c) Immediately shut off heater if annunciator comes on again after attempting to restart. Do not operate heater again until it has been serviced by a qualified repair station.

WARNING

Operating a defective heater may be a serious fire hazard.

d) After heater has restarted, wait approximately 5 minutes and then, if desired, the temperature lever may be moved to a higher selection.

'abin temperature and air circulation can be maintained by using us combinations of control settings to suit individual desires. To ıize the feeling of drafts, a low airflow-high heat combination should :d.

ABIN AIR and COCKPIT AIR control levers mounted in the cabin ıtrol panel allow independent selection of cooling air to the cabin and it areas. Movement of either lever to the right increases the amount of ir to the cabin or cockpit during flight or on the ground. When cooling lesired on the ground, the FAN position of the heater switch must be :d and the control levers moved toward the on position (far right). flight, the heater air inlet provides a constant supply of ram air to the ution box. By selecting the OFF position of the heater switch and ; the COCKPIT AIR and/or CABIN AIR levers to the right, fresh air ibuted through the heater ducts for cockpit and cabin cooling.

lividual fresh air outlets are provided by the overhead ventilating to provide maximum in-flight cabin and cockpit ventilation. An air mounted on the tail fin fairing, extracts outside air which is passed ı lines under the headliner and released at the outlets. Left and right controls for overhead ventilation are mounted on the pilot's speaker- ınel. Each of the individual outlets, located above the seats, are ole to the desired airflow setting.

abin exhaust is located in the raised floor panel in the aft cabin area ıir distribution within the cabin. A retractable exhaust outlet is in the lower aft section of the fuselage just aft of the main cabin door. ion or extension of the outlet is controlled by the CABIN JST push-pull knob mounted above the cabin air control panel on ument panel. To extend the outlet, allowing cabin air exhaustion, the control knob. The outlet should be open when the heater is g and, if desired, to facilitate cabin ventilation. A ground ventilation vailable for installation into the cabin exhaust system as optional nt.

7.41 GROUND VENTILATION FAN*

To aid in cabin ventilation during ground operation, a ground ventilation fan is installed aft of the cabin exhaust in the raised floor panel in the aft cabin area. An on-off switch labeled GROUND VENT FAN is mounted in the overhead switch panel. The fan extracts air from beneath the cabin floorboards and expells it into the cabin through the ventilating grill.

7.43 AFT CABIN HEATER*

In addition to the standard combustion heater mounted in the nose section, an aft cabin heater can be installed at the aft cabin bulkhead as optional equipment to provide an even hot air distribution through the cabin.

The 35,000 B.T.U. Janitrol combustion heater utilizes an electric fuel pump, independent from the standard fuel system, to extract fuel through a tee fitting in the fuel line from the right fuel cells. If the fuel supply in the right cells is exhausted the aft cabin heater will not operate.

Operation of the heater is controlled by a three position AFT HEATER switch mounted adjacent to the cabin exhaust control. The three positions are FAN, OFF and HEAT. Selection of the FAN position activates the ventilating fan within the heater inlet. This position should be used to cool the heater after use to prevent the heat limit switch from tripping. Also, the FAN position can be used to recirculate cabin air when heat is not desired. Air is extracted from the cabin in the rear baggage compartment through an inlet on the right side, passed through the heater and released into the cabin at an adjustable outlet on the opposite side of the baggage compartment. Outside air, for heater operation within the combustion chamber, is drawn through an inlet on the bottom of the fuselage by the heater blower (separate from the heater ventilating fan). The air is used for heater combustion and expelled overboard through a heater exhaust outlet to the left of the inlet.

Selection of the HEAT position automatically activates the heater fue pump and ignition occurs instantly. The off position automatically shuts of the fuel to the heater. Since the aft heater does not incorporate a temperatur control, the pilot must manually regulate the amount of heat through the us of the three position switch.

*Optional equipment

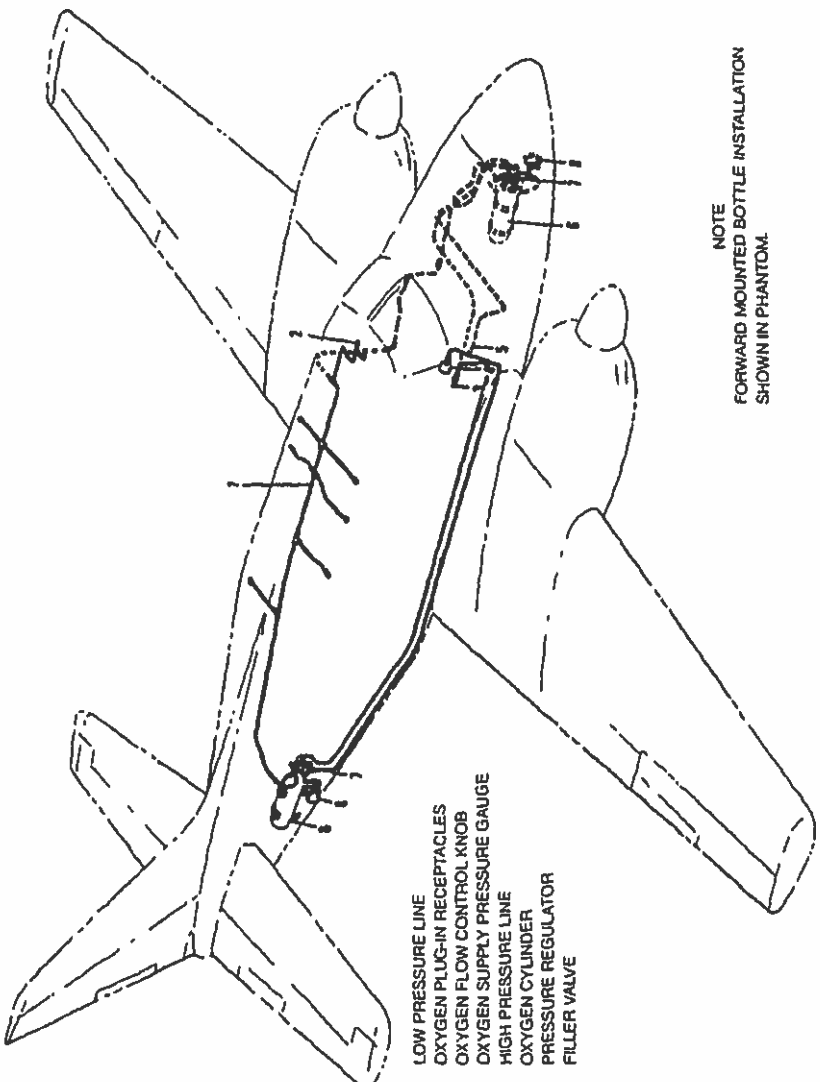
Crew	Passengers	Oxygen Supply Range in Hours
1		25.76
1	1	12.88
1	2	8.58
1	3	6.44
1	4	5.15
1	5	4.29
1	6	3.68
1	7	3.22

With 2 Pilot's Masks		Oxygen Supply Range in Hours
2		12.88
2	1	8.58
2	2	6.44
2	3	5.15
2	4	4.29
2	5	3.68
2	6	3.22

OXYGEN DURATION TABLE
Figure 7-37

absence of the red pellet, which is forced toward the mask. The pilot's, copilot's and the passengers' masks are stowed under their respective seats. A mask for the eighth seat is stowed behind the seat.

Always remove fittings from the receptacles and stow the masks when not in use. Oxygen will flow through the mask whenever the fitting is in the receptacle, and the control knob is pulled out (ON position). Masks may become damaged if not properly cleaned and stowed after use.



OXYGEN SYSTEM
Figure 7-39

7.47 CABIN FEATURES

The cabin interior has been designed for multi-purpose use. Standard seating includes two pilot seats and reclining, adjustable passenger seats, each equipped with adjustable headrests and armrests. Ash trays, individual reading lights, ventilation controls, pilot and copilot map lights and cigar lighter are also standard cabin features.

CAUTION

Do not use cigar lighter receptacles as power sources for any devices other than the cigar lighters supplied with the airplane. Any other devices plugged into these receptacles may be damaged.

Two additional passenger seats can be installed for increased passenger capacity. The standard seats are track mounted to allow movement fore and aft and are easily removed for cargo loading or reversed (refer to Section 2 - Limitations for requirements on certain seating arrangements). Pilot and copilot seats are adjustable fore and aft, up and down and to a reclining position. The hand lever nearest the floor allows the seat to move fore and aft; the center handle controls the movement up and down, and the smaller top handle allows the seat to be reclined. To adjust the seat fore or aft, pull up on the handle and move the seat to the desired position; then release the handle. Move the seat slightly to insure that the locking pin is engaged in the seat track or until the pin engages into the track. To raise the seat, relieve some of the weight on the seat, pull the handle and the seat will rise. Raise the handle and apply weight to the seat to lower it to the desired position. Make sure the locking pin engages the vertical track when the handle is released after adjustment. Adjusting the seat to a reclining position is accomplished by pulling on the handle, applying pressure to the back of the seat and releasing the handle. To erect, pull forward on the seat back.

The forward baggage compartment in the nose section has a loading capacity of 150 pounds and a volume of 14 cubic feet. Access to the spacious compartment is gained through a large hinged door on the left side of the nose. A placard on the inner side of the door clearly indicates the maximum allowable baggage weight. To open, unlock, push in on the forward end of the door handle, pull out on the aft end and raise the door until it latches in the up position. To lower, the latch (placarded PUSH TO RELEASE) must be pushed in, the door lowered and the handle pushed in and locked.The nose compartment is equipped with a courtesy light for night loading. This light will illuminate even if the master switch is off.

Access to the aft baggage compartment is gained through the main cabin entrance door or, if installed, a cargo door* mounted aft of the main cabin door. The compartment has a volume of 22 cubic feet and will accommodate up to 200 pounds of cargo. The complete area is finished to match the cabin interior including carpeting fabric and leather or vinyl upholstering. A placard attached to the walnut panel in the rear of the compartment indicates the maximum loading capacity of the aft compartment. The compartment is conveniently accessible from the cabin even in flight.

Baggage tie down straps should be used in all baggage areas for safe and secure stowage or baggage.

The optional cargo barrier installation includes cargo rollers, tie down straps, cargo net, equipment container and a cargo blanket. A placard located in the aft baggage compartment completely defines the cargo loading for the airplane.

NOTE

It is the pilot's responsibility to insure that the airplane is properly loaded and that the airplane C.G. falls within the allowable C.G. range (refer to Section 6 - Weight and Balance).

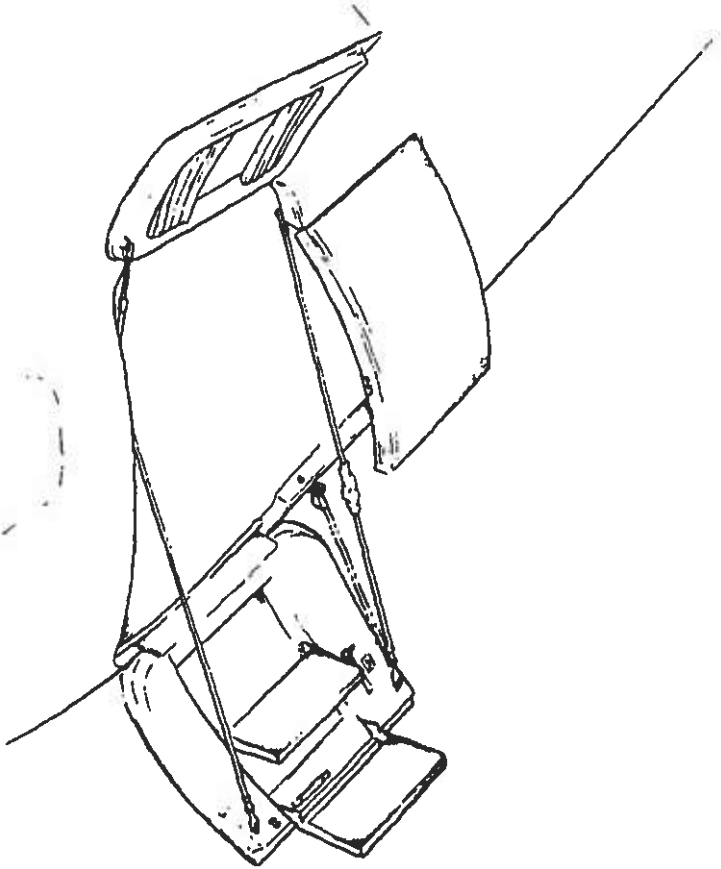
*Optional equipment

7.53 PILOT'S DOOR*

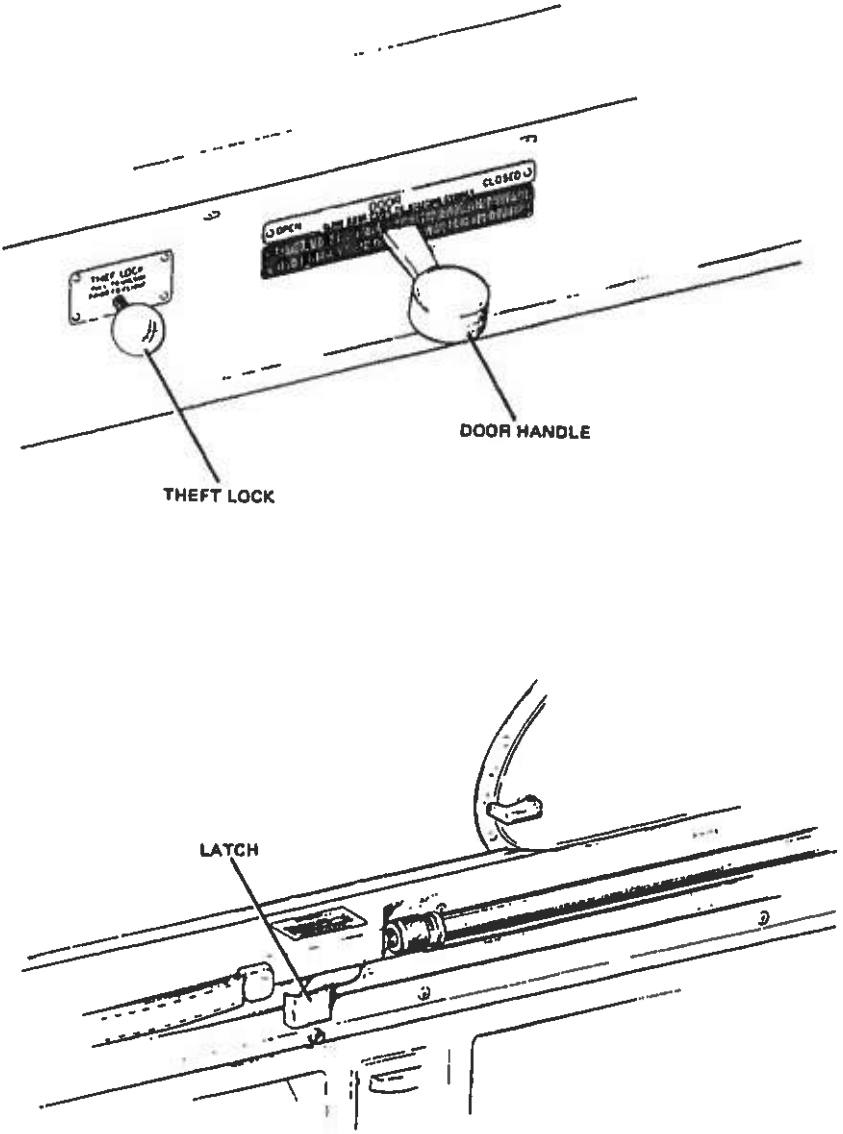
The pilot door installation provides direct access to the pilot compartment from the left side of the fuselage. This feature permits convenient pilot entry when the cabin is loaded with cargo.

The door incorporates the pilot's side window and storm window. A door handle, theft lock and latching mechanism are provided on the inside of the pilot's door to maintain a secure theft-proof cockpit (Figure 7-43). To open the door from within the cockpit, release the latch on the bottom edge of the door and move the door handle to the OPEN position (aft). This will allow the door to be pushed out and forward until it latches in place. The door is held in place by a support arm which must be released before the door can be closed. This is accomplished by pushing upward on the adjustment knob attached to the support arm.

*Optional equipment



CABIN ENTRANCE DOOR AND CARGO DOOR
Figure 7-41



PILOT'S DOOR
Figure 7-43

For Cruise:

Synchronize the propellers as close as possible manually; then set the synchrophaser switch in the Prop Sync. position.

NOTE

Normally, propeller synchrophasing is achieved in a few seconds but occasionally it may take a full minute to achieve full propeller synchrophasing.

If a change in power setting is desired, set the synchrophaser switch to MAN. position; wait 30 seconds. Adjust the power setting; then set the synchrophaser switch in the Prop Sync. position.

Propeller "Phase" is preset at the factory. For further information on Phase control and the Propeller Synchrophasing System, consult the aircraft service manual.

NOTES

Should it be necessary to completely deactivate the Prop Sync. system the circuit breaker must be pulled.

Each time a propeller RPM differential greater than 50 RPM occurs, it will be necessary to recycle the system to MAN. for 30 to 40 seconds. Manually resynchronize propellers; then turn switch to Prop Sync. position.

In the event of an electrical system failure or if the master switch is off, the slave engine will return to the controlled selected RPM plus approximately 25 RPM regardless of the position of the synchrophaser switch (out of synchronization).

For all single engine operations set the synchrophaser switch to the manual position.

CCC CIR 11 OPERATION

On the unit itself is a three position selector switch placarded OFF, ARM and ON. The ARM position is provided to set the unit to the automatic position so that it will transmit only after impact and will continue to transmit until the battery is drained to depletion or until the switch is manually moved to the OFF position. The ARM position should be selected whenever the unit is in the airplane. The ON position is provided so the unit can be used as a portable transmitter or in the event the automatic feature was not triggered by impact or to periodically test the function of the transmitter.

Select the OFF position when changing the battery, when rearming the unit if it has been activated for any reason, or to discontinue transmission.

NOTE

If the switch has been placed in the ON position for any reason, the OFF position has to be selected before selecting ARM. If ARM is selected directly from the ON position, the unit will continue to transmit in the ARM position.

A pilot's remote switch, located on the lower left instrument panel allows the transmitter to be controlled from inside the cabin. The pilot's remote switch is placarded ON, ARM (Normal Flight Position), RESET. If the pilot's remote switch has been placed in the ON position for any reason, the momentary RESET position must be selected for 3 seconds before allowing it to return to the ARM position. If for any reason the impact switch becomes inadvertently activated, it may be reset by selecting the momentary RESET position for 3 seconds before allowing it to return to the ARM position.

NOTE

When operating weather avoidance radar systems in moderate to heavy precipitation, it is advisable to set the range scale 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 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 organs of the body. Personnel should not he 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 direct the nose of the airplane away from buildings, large metal structures or other aircraft within a distance of 100 yards to prevent the return of reflected energy to the system. Do not operate the radar while the airplane is in a hangar or other enclosure.

7.67 ELECTRICALLY HEATED WINDSHIELD*

An electrically heated pilot's windshield can be installed on the PA-31 Navajo as optional equipment.

The electric windshield, used to prevent and or remove icing and fogging is controlled by a WINDSHIELD HEAT circuit breaker switch mounted in the circuit breaker control panel. With the engines running a preflight check can he made by activating the control switch The windshield is operating properly if it feels warm to the touch.

*Optional equipment

WARNING

The concentrated agent from extinguishers using Halon 1211 or the by-products when applied to a fire are toxic when inhaled. Ventilate the cabin as soon as possible after fire is extinguished to remove smoke or fumes. Use oxygen, if necessary.

7.73 CABINETRY*

Among the optional interior appointments available in the Navajo is a variety of cabinet installations (Figure 7-45).

Storage cabinets or a combination storage cabinet and refreshment unit may be installed aft of the crew seats, between the cockpit and the main cabin areas. The storage cabinet units include slots for map, chart, or manual storage and several slide-out drawers. The refreshment unit may include storage drawers and two one quart thermos pitchers with or without a portable carrying ease. The area between the cabinets and the cabin ceiling may be closed off with cabin dividers, and the walkway between the cabinet units equipped with a draw curtain to allow the cockpit area to be completely separated from the main cabin.

Cabinetry available for the aft cabin area includes storage cabinets, vanity, and refreshment units which may be installed in the aft cabin area forward of the rear baggage area. Among the optional vanity and refreshment facilities available with rear cabinetry installations are a mirror, an ice chest, a beverage container, thermos pitchers, a half-gallon electrically heated liquid unit, an ash tray, a pull-out work surface, and storage drawers. The aft cabinets are mounted on vertical dividers extending the height of the cabin, and several are available with privacy curtains or folding doors to allow the aft cabin to be closed off from the passenger area.

7.75 FOLDING TABLES*

Folding tables (Figure 7-45) can be installed on either or both sides of the cabin between the second and third windows. A table can be used only when the first seat in the passenger area is installed facing aft, conference style. The drop-leaf table pulls up from its wall rack and folds down into position. The table installation includes ash trays, glass holders, and recesses for holding small items.

*Optional equipment

7.77 TOILET INSTALLATION*

A self-contained toilet can be installed in the aft section of the cabin (Figure 7-45). In either the side-facing or the forward-facing seventh seat position, the unit may be used as a passenger seat. The seat cushion conceals the toilet. Either a folding door or a draw curtain may be installed forward of the toilet to close off the aft cabin, assuring the occupant of privacy.

Plastic disposable bags which are available from Piper dealers should be placed in the toilet receptacle. After use, remove the plastic bag, close it with a wire tie, and, after landing, dispose of it in the proper field facilities. Do not attempt to flush the bag in a toilet.

A relief tube is exposed when the toilet seat is raised. The relief tube also serves as a vent for the toilet; therefore, be sure that the tube system is not blocked or obstructed.

7.79 ANTI-STATIC WICKS*

Anti-static wicks can be installed on the trailing edges of the wing panels and the tail surfaces to aid in clearing the airplane of surface static electricity which may disrupt LF reception, cause a loss of ADF indication or cause VHF interference. A total of eighteen wicks are attached to the airplane: three on each aileron; three outboard, and one inboard on each elevator; and three on the upper part and one on the lower part of the rudder.

7.81 RAMP HAILER*

The ramp hailer is controlled by a transmitter selector switch on the radio master control panel mounted on the center segment of the instrument panel. An external speaker mounted beneath the floor of the nose baggage compartment allows the pilot to speak to ground personnel. To operate, turn ON the airplane master switch and the radio master switch, select EXT on the transmitter selector switch on the radio control panel and key the microphone. The ramp hailer works best when the engines are idling or shut down.

*Optional equipment

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SECTION 8

AIRPLANE HANDLING, SERVICING AND MAINTENANCE

8.1 GENERAL

This section provides guidelines relating to the handling, servicing, and maintenance of the Navajo. For complete maintenance instructions, refer to the PA-31 Maintenance Manual.

WARNING

Inspection, maintenance and parts requirements for all non-PIPER approved STC installations are not included in this handbook. When a non-PIPER approved STC installation is incorporated on the airplane, those portions of the airplane affected by the installation must be inspected in accordance with the inspection program published by the owner of the STC. Since non-PIPER approved STC installations may change systems interface, operating characteristics and component loads or stresses on adjacent structures, PIPER provided inspection criteria may not be valid for airplanes with non-PIPER approved STC installations.

WARNING

Modifications must be approved in writing by PIPER prior to installation. Any and all other installations, whatsoever, of any kind will void this warranty in it's entirety.

8.1 GENERAL (CONTINUED)

Every owner should stay in close contact with an authorized Piper Service Center or Piper's Customer Service Department to obtain the latest information pertaining to their airplane, and to avail themselves of Piper's support systems.

Piper takes a continuing interest in having owners get the most efficient use from their airplane and keeping it in the best mechanical condition. Consequently, Piper, from time to time, issues service releases including Service Bulletins, Service Letters, Service Spares letters, and others relating to the airplane.

Service Bulletins are of special importance and Piper considers compliance mandatory. These are sent directly to the latest FAA-registered owners in the United States (U.S.) and Piper Service Centers worldwide. Depending on the nature of the release, material and labor allowances may apply. This information is provided to all authorized Piper Service Centers.

Service Letters deal with product improvements and servicing techniques pertaining to the airplane. They are sent to Piper Service Centers and, if necessary, to the latest FAA-registered owners in the U.S. Owners should give careful attention to 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.

Piper offers a subscription service for Service Bulletins, Service Letters, and Service Spares Letters. This service is available to interested persons, such as owners, pilots, and mechanics at a nominal fee, and may be obtained through an authorized Piper Service Center or Piper's Customer Service Department.

Maintenance manuals, parts catalogs, and revisions to both, are available from Piper Service Centers or Piper's Customer Service Department.

Any correspondence regarding the airplane should include the airplane model and serial number to ensure proper response.

8.5 PREVENTIVE MAINTENANCE

The holder of a pilot certificate issued under Federal Aviation Regulations (FAR) Part 61 may perform certain preventive maintenance as defined in the FARs. This maintenance may be performed only on an aircraft which the pilot owns and operates, and which is not used in air carrier or air taxi/commercial operations service.

All other aircraft maintenance must be accomplished by a person or facility appropriately certificated by the Federal Aviation Administration (FAA) to perform that work.

Anytime maintenance is accomplished, an entry must be made in the appropriate aircraft maintenance records. The entry shall include:

(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.

8.9 GROUND HANDLING

(a) Towing

The airplane may be towed by use of the nose wheel tow bar stowed in the baggage area or with 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 turning radius in either direction, as this may result in damage to the nose gear and steering mechanism. Turn limits are marked on a placard on the nose gear strut assembly.

CAUTION

Do not tow the airplane when the controls are secured. Do not push or pull on the propeller or the control surfaces when handling the airplane on the ground.

(b) Taxiing

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 and taxiing 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 procedures should be followed:

(1) Taxi with the propeller in the low pitch, high RPM setting.
(2) When taxiing on uneven ground, avoid holes and ruts.
(3) Observe wing clearances when taxiing near buildings or other stationery objects. If possible, station an observer outside to guide the airplane.
(4) Do not operate the engines at high RPM when running up or taxiing over ground containing loose stones, gravel, or any loose material that might cause damage to the propeller blades.

When excessive moisture/freezing temperature conditions exist, parked aircraft should have their brakes in the OFF condition and wheel chocks properly positioned. If brake freeze-up is suspected, actuate the brakes several times using maximum pressure.

(3) Aileron and elevator controls may be secured with the front seat belts. Wheels should be blocked if chocks are available.

(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 belts through the control wheel and pulling it snug.
(4) Block the wheels.
(5) Secure tie-down ropes to the wing tie-down rings and the tail skid 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 tie-down ropes from the landing gear forks and securing the rudder.

(6) Install the pitot head cover(s) if available. Be sure to remove the pitot head cover(s) before flight.
(7) Cabin and baggage doors should be locked when the airplane is unattended.



8.11 SERVICING AIR FILTERS

Induction air filters should be cleaned and examined at least once every fifty hours. Filters should be replaced if the paper filter material is torn or ruptured, if the housing is damaged, or if the filter is excessively dirty. The usable life of an air filter should be restricted to one year or 500 hours, whichever comes first. Depending on the conditions in which the airplane is operated. Filters may have to be cleaned or replaced at shorter intervals.

(a) Remove the screws from the securing brackets on both sides of the filter box and remove the filter.
(b) Check the filter. If it's damaged or excessively dirty, replace it immediately.
(c) Clean the filter by one of the two following methods:
    (1) Keeping the air nozzles at least one inch from the filter, direct a jet of air not exceeding 100 psi up and down the pleats on the clean air side of the filter. This method will remove grit, dust, and sand from the filter.
    (2) If carbon, soot, or oil remain on the filter after completing the above procedure, soak the filter for 15 minutes in a good non-sudsing detergent; then swish it gently in the solution for about two minutes. Rinse the filter with a stream of water not exceeding 40 psi until the rinse water is clear. Dry the filter thoroughly before reinstalling, but do not use light bulbs or extreme heat for drying.
(d) Recheck the filter for damage, and if it is found to be clean and sound, reinstall the filter.
(e) Before reinstalling the filter, examine the filter gasket. It should have no tears and should be securely in place.

8.13 BRAKE SERVICE

The brake system is filled with MIL-H-5606 (petroleum base, red) hydraulic fluid. This should be checked at every 50 hour inspection and replenished when necessary.

Do not use vegetable base brake fluids (blue) when refilling the system. The brake fluid reservoir is filled by opening the access door, which is located above the forward access panel on the right side of the fuselage, and removing the filler cap. Then add fluid to the reservoir to the required level.

If it is necessary to bleed the brake system to get air out of the lines, fluid should be added under pressure at the bleeder attachment on the brake unit.

NOTE

The exposed portion of the strut piston should be wiped down regularly with hydraulic fluid. This can contribute to the service life of the strut seals.

To add air to the oleo struts, a strut pump is attached at the air valve and the oleo pumped up until 3.25 inches of piston tube is exposed with normal static weight on the gears. To add hydraulic fluid, first place the airplane on jacks; then release all the air through the valves, allowing the oleo to extend fully. Next, remove the air valve and fill the unit through this opening. Compress the oleo again to within 1/4 inch of full compression, allowing excess hydraulic fluid to overflow and working out trapped air. Then reinsert the valve core and pump up the strut

The turning arc of the nose wheel is 20 degrees in either direction and is factory adjusted at stops on the bottom of the forging. The turning radius of the nose wheel is approximately 25 feet.

NOTE

See service manual for rigging and adjustment of landing gear.

8.19 TIRE SERVICE

For maximum service from the tires, keep them inflated to the proper pressure of 42 psi for the nose wheel and 60 psi for the main wheels. When inflating the tires, visually inspect them for cracks and breaks. If necessary, reverse the tires on the wheels or interchange them for even wear. All tires and wheels are balanced before original installation, and the relationship of tire, wheel, and tube should be maintained upon reinstallation. If new components are installed, it may be necessary to rebalance the wheels with the tires mounted. Out-of-balance wheels can cause extreme vibration during takeoff and landing.

It is recommended that single or multi viscosity aviation grade oils in accordance with latest issue of Avco-Lycoming Service Instruction 1014 be used. The following seasonal aviation oil grades and seasonal ambient temperature ranges are recommended.

LUBRICATING OIL RECOMMENDATIONS
USE AVIATION ENGINE OIL FOR PISTON ENGINES

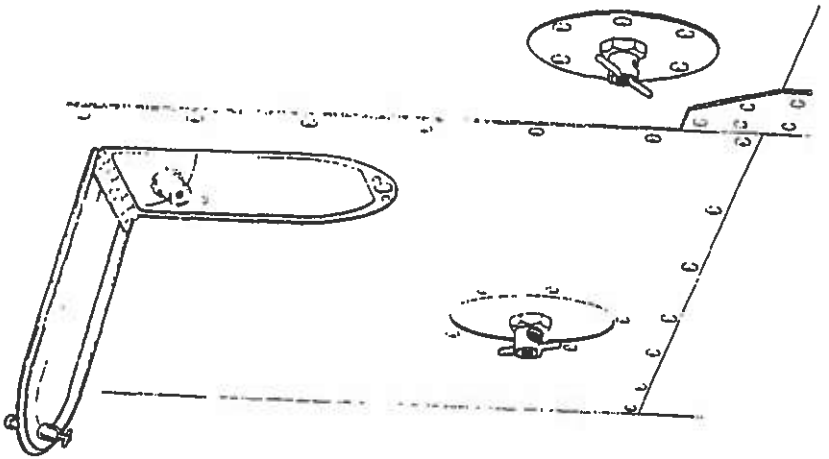
Average Ambient Temperature	MIL-L-6082B Straight Mineral SAE Grade	MIL-L-22851 Ashless Dispersant SAE Grades
All Temperatures	—	15W-50 or 20W-50
Above 80°F	60	60
Above 60°F	50	40 or 50
30°F to 90°F	40	40
0°F to 70°F	30	30, 40 or 20W-40
0°F to 90°F	20W50	20W50 or 15W50
Below 10°F	20	30 or 20W-30

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

(Refer to the Lycoming S. I. 1014 latest revision when changing from straight mineral to ashless dispersant oil.)

NOTE

When checking oil level, read right engine side of dipstick for right engine, and left engine side of dipstick for left engine.



FUEL DRAINS
Figure 8-3

(c) Filling Fuel Cells

The fuel supply is carried in two 56 gallon main cells and two 40 gallon auxiliary cells. A filler neck is provided in the upper center section of each wing for servicing the main cells, while another filler neck in the upper outboard section of each wing is provided for servicing the auxiliary cells. Observe all safety precautions required when handling gasoline

When refueling the Navajo, ground the refueling hose before beginning the transfer of fuel. Secure the filler cap immediately after servicing each cell. The optional lockable filler cap need not be locked to be secure.

NOTE

Never leave the fuel cells completely dry, or the cell inner liners may dry out and crack, permitting fuel to diffuse through the walls of the cell after refueling. If the cell is to be left empty for a week or more, spray the inner liner with a light coat of engine oil.

8.27 BATTERY SERVICE

Access to the battery is through the forward baggage compartment opening. The stainless steel battery box has a plastic drain tube, located on the bottom right rear corner, which is equipped with a shut-off clamp to be opened at least every 30 days to drain off any electrolyte that may have overflowed into the box.

Corrosion on the battery terminals and connections may be neutralized by applying a solution of baking soda and water mixed to the consistency of thin cream. Do not allow any of this soda solution to enter the battery. Repeat this application until all bubbling action has ceased before washing battery and box with clean water. Dry battery and box and close drain tube clamp.

Whenever checking the battery, ascertain that all connections are clean and tight and the fluid level is above the baffle plates. If it is necessary to add fluid, use distilled water.

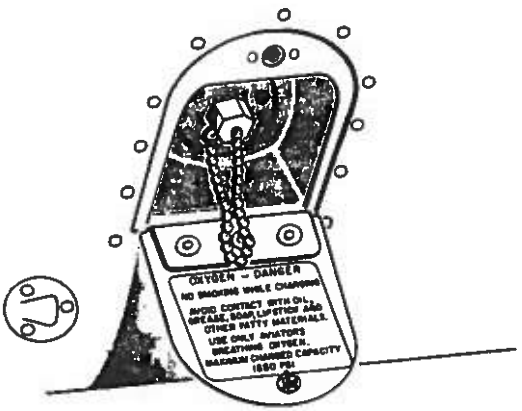
A hydrometer check should be performed to determine the percentage of charge present in the battery.

Hydrometer Readings	Percent of Charge
1280	100
1250	75
1220	50
1190	25
1160	Very little useful capacity
1130 or below	Discharged

The battery should be removed for recharging. Starting recharge current should be 2 amperes. Finishing current should be 1 ampere.

8.29 PRESSURE GYRO SYSTEM

The pressure gyro system operates at a pressure of 4.3 to 6.1 inches of mercury. The system obtains the regulated pressure from the engine driven pressure pumps. The filters on the pumps should be inspected regularly and changed every 100 hours. The setting of the pressure regulators should be performed by an experienced mechanic.



OXYGEN FILLER
Figure 8-5

8.35 OXYGEN SYSTEM SERVICE*

The filler valve for the oxygen cylinder is serviced by opening the access panel on the lower left nose section just aft of the forward baggage compartment door. To charge the oxygen system, remove the protective cap from the filler valve and attach the fitting from an oxygen cart. Refer to Figure 8-5.

WARNING

Inspect the filler connection for cleanliness before attaching it to the filler valve. Be sure your hands, tools and clothing are very clean and free from grease and oil since these contaminants will ignite when in contact with pure oxygen under pressure.

*Optional equipment

(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 the solvent has evaporated or otherwise been removed.

(4) Remove the protective covers from the magnetos.
(5) Lubricate the controls, bearing surfaces, etc., in accordance with the Lubrication Chart in the Service Manual.

(b) Cleaning Landing Gear

Before cleaning the landing gear, place a cover of plastic or a similar waterproof material over the wheel and brake assembly.

(1) Place a pan under the gear to catch waste.
(2) Spray or brush the gear with solvent or a mixture of solvent and degreaser. To remove especially heavy dirt and grease deposits, it may be necessary to brush areas that were sprayed.
(3) Allow the solvent to remain on the gear from five to ten minutes. Then rinse the gear with additional solvent and allow it to dry.
(4) Remove the protective cover and the catch pan.
(5) Lubricate the gear in accordance with the Lubrication Chart in the Service Manual.

CAUTION

Do not brush the micro switches.

(3) Remove oil and grease with a cloth dampened with kerosene.

CAUTION

Do not use gasoline, alcohol, benzene, carbon tetrachloride, thinner, acetone, other strong solvents, or window cleaning sprays. Do not use plastic cleaner on heated glass windshields.

(4) A severe scratch or mar in plastic can be removed by rubbing out the scratch with jeweler's rouge.
(5) When windows are clean, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion. Do not apply wax on the optional heated windshield.

(c) Cleaning Interior

(1) Headliners and other vinyl interior surfaces may be cleaned with a damp cloth and mild soap and water solution.
(2) Window curtains may be dry cleaned but it is not recommended that they be laundered.
(3) Leather may be cleaned with a mild hand soap and water solution or with saddle soap. Follow the precautions which apply to the cleaning of any fine leather product. Avoid saturation and never use detergents or harsh cleaning solutions on leather.
(4) Wood surfaces may be cleaned with any good household liquid or spray cleaner/polish manufactured for this purpose.
(5) All upholstery fabrics are "Scotchgard" treated and may be cleaned as follows:

Spilled oily and watery liquids will generally bead up on the fabric and can be blotted away leaving little or no stain. Blot spills up as quickly as possible with an absorbent cloth, tissue or sponge. If the material is a solid or semi-solid, such as butter, remove the excess by gentle scraping with a table knife. Often, blotting with remove all traces of stain but if the staining agent is not completely removed by blotting, the following techniques are suggested:

To remove residual detergent left on the fabric, wipe the entire fabric surface with a cloth dampened with water. The cloth should be rinsed in clean water several times. This procedure will ensure that the treatment will continue to function.

CAUTION

Solvent cleaners require adequate ventilation.

(f) Cleaning Carpets

Use a small whisk broom or vacuum cleaner to remove dirt. For soiled spots, use a nonflammable dry cleaning fluid. Floor carpets may be removed and cleaned like any household carpet.

(g) Cleaning Toilet*

(1) To dispose of the sanitary bag, pull the top of the bag from the pail and close with a wire tie. Remove it from the airplane in the covered pail and dispose of according to field facilities. Do not attempt to flush the bag in a toilet.
(2) To clean and deodorize the airplane's toilet, mix a solution of disinfectant type cleaner. Using a soft bristled brush, rag and solution, wash the toilet pail and seat. The toilet may be removed for cleaning by disconnecting the two fasteners at the inside forward end of the unit. Slide it back and lift from the floor.
(3) When offensive odor remains, use a stronger solution and reclean.
(4) Rinse with fresh water and dry.
(5) To install a new sanitary bag, place it over the top edge of the pail and push it into the bottom of the pail.

*Optional equipment

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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.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 1 FOR OXYGEN SYSTEM INSTALLATION

SECTION 1 - GENERAL

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Oxygen System is installed per Section 6, Paragraph 6.17, "Equipment List." The information contained herein supple-ments 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.

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IN-FLIGHT

(a) Oxygen - "ON" (Pull control knob out, this allows the flow of oxygen to all receptacles.)
(b) Insert fitting into receptacle. (This allows flow of oxygen through mask.)
(c) Don mask. (Check oxygen flow indicator frequently.)
(d) Oxygen pressure - monitor to determine supply.
(e) If the oxygen tank has a pressure of 1850 psi when the use of oxygen is begun, oxygen will be available as shown below:

Crew	Passengers	Oxygen Supply Range in Hours
1		25.76
1	1	12.88
1	2	8.58
1	3	6.44
1	4	5.15
1	5	4.29
1	6	3.68
1	7	3.22

With 2 Pilot's Masks		Oxygen Supply Range in Hours
2		12.88
2	1	8.58
2	2	6.44
2	3	5.15
2	4	4.29
2	5	3.68
2	6	3.22

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 2 FOR ICE PROTECTION SYSTEM (Approved for Flight into Known Icing Conditions)

SECTION 1 - GENERAL

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when Ice Protection System is installed per Piper Drawing 71155. 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

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p. Position lights
q. Anti-collision lights
r. Alternator - each engine
s. Gyroscopic bank and pitch indicator
t. Instrument lights
u. Landing light, if for hire
v. Two-way radio for communication
w. Suitable and adequate navigation radio equipment
x. Gyroscopic rate of turn indicator
y. Bank indicator
z. Clock with sweep second hand
aa. Sensitive altimeter adjustable for barometric pressure
ab. Gyroscopic direction indicator
ac. Free air temperature indicator

(2) Flight in positive control areas
a. Transponder

(3) The following additional equipment must be installed in accordance with Piper drawings or in an FAA approved manner. (Refer. Piper Dwg. No. 71155-2)
a. Pneumatic wing and empennage boots (including inboard wing boots)
b. Electrothermal propeller boots
c. Pilot's heated windshield
d. Heated pitot
e. Ice detection light
f. Heated stall warning transmitter
g. Non-icing heater air inlet
h. Heater combustion air alternate source
i. Forward heater
j. Ice shields
k. Prop control deicer boot
l. 'A' - 'B' pneumatic system

(4) The following equipment is required and is normally part of the standard airplane:
a. Alternate static system
b. Elevator balance boot
c. Direct vision window

SECTION 4 - NORMAL PROCEDURES

(a) Prior to dispatch into known icing conditions all ice protection equipment should be functionally checked.

NOTE

The heating element for the stall warning operates on reduced power on the ground.

(b) Prior to entering suspected icing conditions (visible moisture below 32°F) activate the following equipment:
(1) Pitot Heat/Stall Warning
(2) Windshield Heat
(3) Propeller Deice

(c) Activate the following while encountering icing at pilot's discretion.
(1) Pneumatic Deicer Boots

WARNING

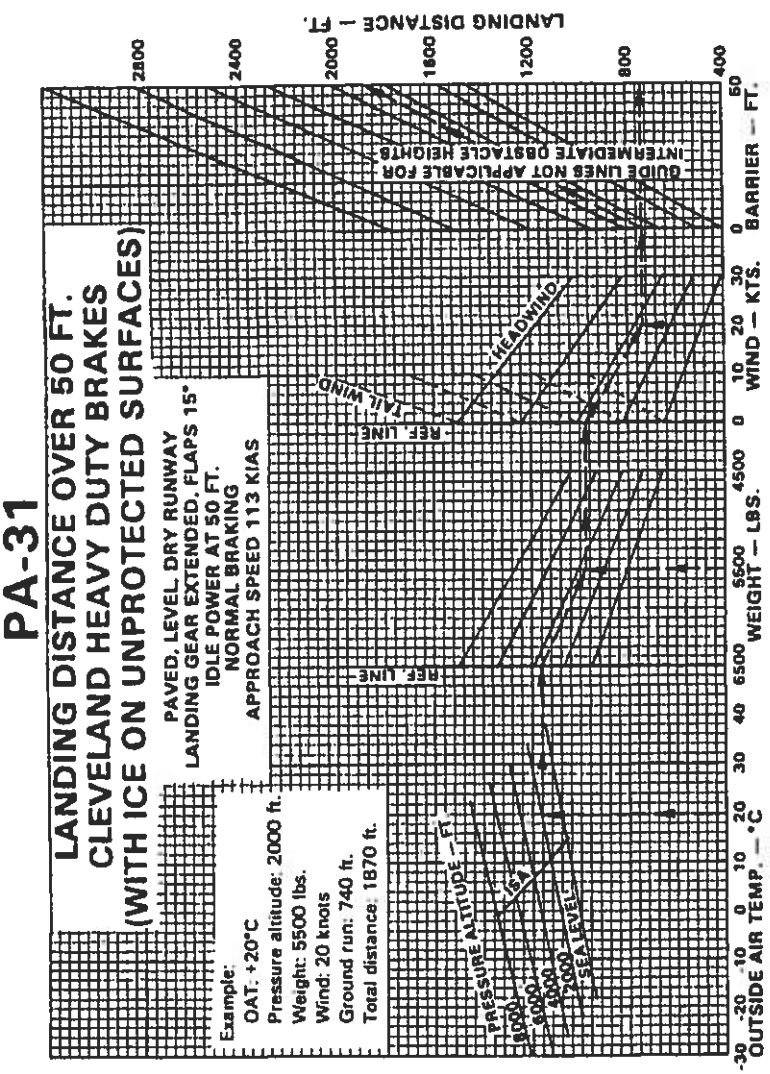
Do not cycle boots with less than 1/4 to 3/8 inch of ice accumulation. Continuous cycling of boots during some types of ice encounters may result in failure to remove ice.

(2) Heater and Defroster
(3) Ice Detection Light (night as required)
(4) Engine Alternate Air (only if loss of power is suspected).

SECTION 5 - PERFORMANCE

Some handling and performance changes can be experienced with ice buildup on unprotected surfaces. At exactly what point the handling and performance changes become noticeable cannot be determined; therefore, if two boot cycles have been required (approximately 1/2 to 3/4 inch buildup), the following procedures and performance degradation should be observed:

(a) Climb Performance:
Climb performance may be significantly reduced in prolonged icing encounters. Multi-engine and single engine service ceilings may be reduced below 24,000 feet and 12,000 feet respectively.



LANDING DISTANCE OVER 50 FT.
CLEVELAND HEAVY DUTY BRAKES
(With Ice On Unprotected Surfaces)
Figure 9-3

icing conditions require. After each inflation cycle, the timer automatically resets to allow the inflation cycle to begin when the switch is actuated.

Actuation of the momentary switch triggers a system cycle timer, which in turn shifts the two stage regulators to high pressure (18 psi), opens the 'A' system solenoid valve to send air to the wing boots, and cuts off air to the copilot's gyros (when installed). After six seconds, the 'A' system solenoid is closed and the 'B' system solenoid is opened to send air to the tail boots for six seconds. At the completion of the tail cycle, the 'B' system solenoid closes, the two stage regulators return to low pressure (gyro pres.) and the copilot's air supply resumes.

When the inflation cycle is completed, the deicer solenoid valves permit overboard exhaustion of the pressurized boots. Suction is then reapplied to the deicer boots to hold them close to the airfoil surface.

Two blue indicator lights with press-to-test and dimming features, illuminate when each surface deicer boot system inflates to a predetermined pressure. Illumination of the indicator light is controlled by a pressure sensitive switch connected to the deicer pressure lines (one in the 'A' system and one in the 'B' system).

To insure good ice shedding, the boots should be clean and free of any oils or dirt and in good condition. No special coating is required.

Ice shedding may be slightly improved by the application of B.F. Goodrich Icex. It is authorized for use and has been tested in natural icing. The manufacturer's instructions (B.F. Goodrich) must be followed explicitly.

(b) ELECTRIC PROPELLER DEICERS

Electrothermal propeller deicer pads are bonded to the leading edges of the propeller blades. Each deicer pad has two separate heaters, one for the outboard and one for the inboard half. (Refer to Figure 9-5.)

The system is controlled by an on-off type PROP DE-ICE switch located in the overhead switch panel and the circuit is protected through a circuit breaker in the circuit breaker control panel.

The heat provided by the deicer pads reduces the adhesion between the ice and the propeller so that centrifugal force and the blast of airstream cause the ice to be thrown off the propeller blades in very small pieces. This ice can produce minor damage to the fuselage if ice shields have not been installed.

CAUTIONS

When conducting the above described ground test, do not operate system longer than two complete cycles.

If the ammeter reading is less than in the green arc this indicates that one or more of the pads is not functioning. If propeller deice is used under this condition the pilot can expect an uneven build up of ice with consequent undesirable vibration.

Ice shields are installed on both sides of the fuselage nose adjacent to the propeller. These are installed to prevent excessive damage due to slivers of ice shed from the propeller impacting on the nose skin.

(c) ELECTRICALLY HEATED WINDSHIELD

The electrically heated windshield, used to prevent exterior icing and interior fogging, is controlled by the WINDSHIELD HEAT switch. With the engines running, a preflight check can be made by activating the control switch. The windshield is operating properly if it feels warm to the touch.

Ground operation should be kept to a minimum to prevent overheating of the windshield. Distorted vision or small bubbles in the plastic of the windshield may indicate an overheat condition.

The exterior surface of the windshield has a Nesa coating to prevent static discharge. Use care when cleaning (refer to Section 8 - Airplane Handling, Servicing and Maintenance).

Windshield heat must be activated prior to entering suspected icing. Sudden penetration into a severe encounter with the heat off may cause a rapid build that will bridge the heating element when it is turned on.

NOTE

If windshield wipers are installed, do not operate them during or after an ice encounter when ice is accumulated on either the wiper or windshield.

(d) PITOT STATIC SYSTEM

Dynamic and static air pressure for operation of the airspeed indicator is supplied by the pitot static system (Refer to Figure 7-27). The system also supplies static air pressure to the altimeter and the vertical speed indicator.

A heated pitot head is mounted under the nose section, forward of the nose gear doors. Total pressure is extracted by the pitot head and routed directly to the airspeed indicator. Provisions have been made for installation of an additional pitot head if dual instruments are desired. The second pitot head is mounted to the right of the existing head under the nose.

Static source pads (pickups) are located on both sides of the fuselage forward of the horizontal tail. They connect to a single line leading to the instruments. Dual pickups are provided to reduce side slip effects on the airspeed indicator.

An alternate static source valve is mounted below the left segment of the instrument panel near the pilot's left knee. To actuate, push the lever up and to the left, locking the valve in the open position. When the alternate static source is selected, the pilot's airspeed indicator, altimeter and rate of climb indicator utilize cabin air for static pressure. Under these conditions the altimeter and airspeed indicator readings will be higher than normal.

(g) HEATING VENTILATING AND DEFROSTING (Refer to Figure 7-33.)

Controls to regulate cabin air temperature and provide fresh air ventilation and heated air for defrosting are mounted in the cabin air control panel below the right segment of the instrument panel. They include a three position forward heater switch, a momentary on START/RESET switch and temperature, defroster, heater air inlet and outside air control levers. A cabin exhaust control is mounted directly above the cabin air control panel. Provision for mounting an aft heater (optional) switch have also been made on the panel.

The heating system is designed to provide maximum comfort for the occupants during winter and cool weather flights. A 35,000 B.T.U./Hr. Janitrol combustion heater furnishes the hot air source for cabin heating and windshield defrosting. The heater is mounted in the nose section and is accessible through a removable panel on the right side.

Operation of the heater is controlled by two switches: a three-position forward heater switch marked FAN, OFF and HEAT and a momentary on switch marked START/RESET. Selecting the HEAT position and momentarily depressing the START/RESET switch activates the heater regulator/shut off valve, allowing fuel to flow from the right fuel cell to the combustion heater, and simultaneously ignites the heater.

The heated windshield will generally maintain the inner surface of the windshield clear of fog, however the heater and defroster should be engaged upon entering icing conditions.

(h) PNEUMATIC SYSTEM (Refer to Figure 7-29.)

The pneumatic system supplies air pressure to operate the air driven gyros. Pressure is also supplied to the surface deicing boots.

Basically, the pneumatic system is divided into two independently operated pressure supply systems: the left engine supply and the right engine supply. Both systems utilize a common manifold check valve and pressure gauge. Each side of the pneumatic system incorporates its own inlet, inlet filter, engine driven pneumatic pump, regulator and inline filter. Recessed inlets, just aft of the fire wall on the bottom-outboard side of the engine nacelle, extract constant supplies of outside air, which are passed through inlet filters and directed to the left and right engine driven pneumatic pumps. Air pressure from each pump is then routed to its respective pressure regulator. Each pressure regulator has its own adjustment to provide a means of setting the pump outlet pressure. Any airflow supplied by the pumps in excess of the adjusted setting is expelled from the system at the regulators. Regulated air pressure is then passed through a .3 micron inline filter for further protection against contaminated air reaching the instruments. Once filtered, pressure from the left engine supply and pressure from the right engine supply are united in a manifold check valve, common to both sides of the system. The manifold check valve supplies a single outlet line to the gyros. In the event one of the engine driven pneumatic pumps fail, the other side of the system can maintain air pressure to the gyros and/or deicers. Air pressure supplied by the system is utilized to operate the attitude gyro and the directional gyro and exhausted through a bulkhead forward of the instrument panel.

Each pressure pump is capable of operating the air driven gyros and the pneumatic deicers up to single engine service ceiling and with both pumps operating normally, up to the maximum approved altitude of the airplane.

A gyro pressure gauge, mounted in the right segment of the instrument panel, indicates system pressure in inches of mercury. A graduated green arc on the face of the gauge indicates pressure readings within normal operating limits. Two annunciator lights, mounted in the annunciator panel, provide a visual warning to the pilot that either the right or left pneumatic source is inoperative. The lights are placarded, R. PNEU. INOP. and L. PNEU. INOP.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 3 FOR FCS-810 AFCS WITH FLIGHT DIRECTOR INSTALLATION

SECTION 1 - GENERAL

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the FCS-810 with the FC-823F Flight Controller is installed per Section 6, Paragraph 6.17 "Equipment List." The infor-mation 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.

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LAKELAND, FLORIDA

(b) Single-Engine Operating

(1) Autopilot performance has been satisfactorily demonstrated during simulated failure of one engine. In the event that the pilot elects to continue single-engine operation with autopilot, disengage the autopilot; re-trim the aircraft for single-engine operation; and re-engage the autopilot.

(2) Do not initiate single-engine go-around in coupled GA mode. After aircraft is stabilized and trimmed out in single-engine climb, autopilot may be engaged.

(c) Pitch Trim

(1) if trim warning light illuminates in flight, or if electric trim runs at any time without actuating the trim switch, an overpower force up to 20 pounds at the control wheel will be experienced at time of disengagement (3-second delay for recognition time). Turn trim ON-OFF switch OFF, pull the pitch trim circuit breaker, and have system inspected prior to operation.

(2) If the trim circuit breaker releases, or the trim follow-up becomes inoperative during autopilot operation, disengage the autopilot and pull the trim circuit breaker.

SECTION 4 - NORMAL OPERATING PROCEDURES

(a) Manual Electric Trim

Manual electric trim is provided as standard equipment with the autopilot installation. The manual electric trim system is powered through the aircraft master switch, and a trim ON-OFF switch, located on the left side of the pilot's control wheel, both of which must be on for electric trim operation. A circuit breaker, located on the circuit breaker panel, provides circuit protection. Electric trim is obtained by actuating the electric trim switch on the pilot's control wheel in the desired direction.

IN-FLIGHT

NOTE

When engaging the autopilot, the pitch synchronizer will automatically stabilize the aircraft in the pitch attitude existing at the time of engagement.

(a) Engagement

(1) Manually adjust aircraft trim in WINGS-LEVEL attitude prior to engaging autopilot. Press the AP ENGAGE BUTTON which will light upon engagement. To climb, actuate the pitch rocker switch to UP. To descend, actuate the pitch rocker switch to DN.

(2) PITCH SYNC BUTTON - Pressing and holding the PITCH SYNC button, located on the pilot's wheel, disengages the pitch axis to allow the pilot to manually change the aircraft pitch attitude. The pitch trim indicator, when centered, indicates to the pilot that the autopilot has synchronized to the aircraft pitch attitude. While the PITCH SYNC button is depressed, manual electric trim may be actuated without disengaging the autopilot. When the PITCH SYNC button is released, the pitch axis will again engage, synchronized to the new pitch attitude. SYNC will cancel GS, ALT, or GA modes.

(b) Automatic Pitch Trim

Automatic pitch trim is provided whenever the autopilot is engaged. Any attempt to overpower the autopilot pitch axis will cause the pitch trim to oppose the applied force, resulting in an out-of-trim condition.

(c) Manual Electric Trim/AP Disengage

During normal AP operations, actuation of the trim switch in either direction disconnects AP and electric trim is immediately available. The electric trim system design is such that a single fault, other than a stuck switch will not cause a runaway trim. Other faults will be indicated by the trim warning light or by a pre-flight check. Illumination of the trim warning light indicates that a single fault has occurred, but trim will not run away. (See Emergency Pitch Trim Procedures.)

(f) En Route Navigation

NOTE

There are two methods of intercepting a VOR radial.

(1) Variable Intercept Angle - With this method, the pilot may preselect any intercept angle desired.

a. After identifying desired omni station, select desired omni course by rotating the CRS knob on the HSD until the course select pointer aligns with the desired omni course.

b. Position the heading bug to select the desired intercept angle by rotating the HDG knob on the HSD. The number of degrees between the course select pointer and the heading bug is the intercept angle. The pilot should not select an intercept angle less than 20°, or more than 90°.

c. Simultaneously press HDG and NAV buttons on the controller. HDG and NAV buttons will light. The aircraft will turn toward the heading selected until the lateral deviation needle moves approximately one dot away from full deflection. At this time, the HDG button light on the controller will go out and the aircraft will assume a normal 45° intercept angle.

(2) Fixed Intercept Angle

a. After identifying the desired omni station, select desired omni course on the HSD by rotating the CRS knob until the course select pointer aligns with the desired omni course.

b. Press the NAV button. Button light comes on. Aircraft will turn left or right, depending upon the relation of the aircraft heading to that of the selected omni bearing. If the omni bearing selected is less than 120° from the aircraft heading when the NAV mode is selected, the aircraft will turn toward the selected omni course. At angles of 120° or greater, the aircraft will turn away from the selected omni course and continue to turn through the larger angle until a proper intercept angle is established. In either case, the aircraft will assume an intercept course which will be no greater than 45° to the selected omni course.

(3) Glide Slope

a. Automatic Engage

Glide slope is automatically armed and the aircraft will bracket the glide slope and begin a rate of descent commensurate with the glide slope angle (pilot must maintain airspeed with power) providing the following conditions are met:

1. The APPR button is pressed.
2. The aircraft must approach the glide path from below.
3. Aircraft is established on localizer beam at least 20 seconds prior to glide slope interception.
4. The glide slope pointer is centered.

b. Manual Engage

If desired, glide slope may be captured manually by actuating glide slope button when glide slope pointer centers, provided the aircraft is in approach mode.

c. Glide Slope Mode

1. When the aircraft couples to the glide slope signal, the GS PUSH MAN light on the controller will light, and ALT light extinguishes.
2. Glide slope may be disengaged while flying the localizer by pressing ALT, HDG or NAV button on the controller; actuating pitch rocker switch; depressing the GA button; or pitch SYNC button.

d. Back Course Localizer

For a back course localizer approach, select the localizer front course inbound heading. Press REV button on controller. Both APPR and REV button lights will light, indicating to the pilot that he is in both the localizer and reverse modes.

e. Go-Around

Go-around switch may be pressed any time the pilot decides not to continue the approach to landing. Pressing the GA switch will cause the aircraft to automatically assume a pitch attitude of approximately seven degrees nose-up. (Pilot must adjust power settings to maintain airspeed.) Aircraft will continue to track localizer. GA light on controller will light. If a missed approach heading is selected and HDG button pressed, aircraft will turn to the selected heading, and remain in a pitch-up attitude of approximately seven degrees. Movement of the pitch rocker switch, pressing the pitch SYNC button, or ALT button will disengage the GA mode.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 4 FOR FCS-810 AFCS WITHOUT FLIGHT DIRECTOR INSTALLATION

SECTION 1 - GENERAL

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the FCS-810 with the FC 823E Flight Controller is installed per Section 6, Paragraph 6.17 "Equipment List." The information conatined 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.

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ISSUED: SEPTEMBER 18, 1979
REVISED: FEBRUARY 28, 1980

REPORT: LK-1206

(b) Single-Engine Operation

(1) Autopilot performance has been satisfactorily demonstrated during simulated failure of one engine. In the event that the pilot elects to continue single-engine operation with autopilot, disengage the autopilot; re-trim the aircraft for single-engine operation; and re-engage the autopilot.

(2) Do not initiate single-engine go-around in coupled GA mode. After aircraft is stabilized and trimmed out in single-engine climb, autopilot may be engaged.

(c) Pitch Trim

(1) If trim warning light illuminates in flight, or if electric trim runs at any time without actuating the trim switch, an overpower force up to 20 pounds at the control wheel will be experienced at time of disengagement (3-second delay tor recognition time). Turn trim ON-OFF switch OFF, pull the pitch trim circuit breaker, and have system inspected prior to operation.

(2) If the trim circuit breaker releases, or the trim follow-up becomes inoperative during autopilot operation, disengage the autopilot and pull the trim circuit breaker.

SECTION 4 - NORMAL OPERATING PROCEDURES

(a) Manual Electric Trim

Manual electric trim is provided as standard equipment with the autopilot installation. The manual electric trim system is powered through the aircraft master switch, and a trim ON-OFF switch, located on the left side of the pilot's control wheel, both of which must be on for electric trim operation. A circuit breaker, located on the circuit breaker panel, provides circuit protection. Electric trim is obtained by actuating the electric trim switch on the pilot's control wheel in the desired direction.

PRE-FLIGHT

(a) Autopilot

(1) Turn the autopilot master switch to "ON."

(2) Check attitude gyro for proper erection. Set the directional gyro, if manual slaving type.

(3) Depress the Pitch SYNC Button to center trim indicator.

(4) Engage the autopilot; apply a force to the controls (one axis at a time) to determine if the autopilot may be overpowered.

(b) Automatic Pitch Trim
Automatic pitch trim is provided whenever the autopilot is engaged. Any attempt to overpower the autopilot pitch axis will cause the pitch trim to oppose the applied force, resulting in an out-of-trim condition.

(c) Manual Electric Trim/AP Disengage
During normal AP operations, actuation of the trim switch in either direction disconnects AP and electric trim is immediately available. The electric trim system design is such that a single fault, other than a stuck switch will not cause a runaway trim. Other faults will be indicated by the trim warning light or by a pre-flight check. Illumination of the trim warning light indicates that a single fault has occured, but trim will not run away. (See Emergency Pitch Trim Procedures.)

(d) Altitude Hold
The ALT button may be depressed at any time the vertical speed is less than 1500 feet per minute. Aircraft pressure altitude will be held when the autopilot altitude hold is engaged. Momentarily actuating the pitch rocker switch in either direction, engagement of the glide slope or pressing the PITCH SYNC switch disengages the altitude hold function.

NOTE

The altitude controller attempts to maintain the aircraft at the selected altitude by changing the pitch attitude of the aircraft. The human pilot must then maintain power settings to assure a safe airspeed. In level flight, the autopilot should hold altitude within 20 feet of the pre-selected altitude; however, during turns there may be altitude excursions greater than 20 feet, but in no instance should the excursions be greater than 100 feet.

NOTE

If for any reason the selected altitude is deviated from by approximately 300 feet, the altitude controller will recycle to the new altitude.

(2) Fixed Intercept Angle

a. After identifying the desired omni station, select desired omni course on the HSD or NAV indicator by rotating the CRS knob until the course select pointer aligns with the desired omni course.

b. Press the NAV button. Button light comes on. Aircraft will turn left or right, depending upon the relation of the aircraft heading to that of the selected omni bearing. If the omni bearing selected is less than 120° from the aircraft heading when the NAV mode is selected, the aircraft will turn toward the selected omni course. At angles of 120° or greater, the aircraft will turn away from the selected omni course and continue to turn through the larger angle unit a proper intercept angle is established. In either case, the aircraft will assume an intercept course which will be no greater than 45° to the selected omni course.

NOTE

If the NAV indicator is not equipped with a course datum synchro, the heading bug must be set to the same heading as the course select pointer.

(g) Automatic Approach Coupler

NOTE

There are two methods of intercepting the localizer.

(1) Variable Intercept Angle - This method is recommended when being vectored toward the localizer, by approach control, with the HDG and APPR modes engaged.

a. Align course arrow with the published inbound course by rotating the CRS knob on the HSD or NAV indicator.

b. Position the heading bug to select the desired intercept angle by rotating the HDG knob on the HSD or DG.

(3) Glide Slope

a. Automatic Engage

Glide slope is automatically armed and the aircraft will bracket the glide slope and begin a rate of descent commensurate with the glide slope angle (pilot must maintain airspeed with power) providing the following conditions are met:

1. The APPR button is pressed.
2. The aircraft must approach the glide path from below.
3. Aircraft is established on localizer beam at least 20 seconds prior to glide slope interception.
4. The glide slope pointer is centered.

b. Manual Engage

If desired, glide slope may be captured manually by actuating glide slope button when glide slope pointer centers, provided the aircraft is in approach mode.

c. Glide Slope Mode

1. When the aircraft couples to the glide slope signal, the GS PUSH MAN light on the controller will light, and ALT light extinguishes.
2. Glide slope may be disengaged while flying the localizer by pressing ALT, HDG or NAV button on the controller; actuating pitch rocker switch; depressing the GA button; or pitch SYNC button.

d. Back Course Localizer

For a back course localizer approach, select the localizer front course inbound heading. Press REV button on controller. Both APPR and REV button lights will light, indicating to the pilot that he is in both the localizer and reverse modes.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 5 FOR ALTIMATIC IIIC INSTALLATION (INCLUDES ROLL, PITCH AND PITCH TRIM)

SECTION 1 - GENERAL

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Altimatic IIIC is installed per Section 6, Paragraph 6.17 "Equipment List." The information contained herein supple-ments 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.

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(a) In the event of an Autopilot malfunction the Autopilot can be:
(1) Overpowered at either control wheel.

CAUTION

Do not overpower Autopilot pitch axis for periods longer than 3 seconds because the Autotrim System will operate in a direction to oppose the pilot and will, thereby, cause an increase in the pitch overpower forces.

(2) Disconnected by depressing the Master Disc/Inter Switch.
(3) Disconnected by depressing the Trim Switch "A/P OFF" bar.
(4) Disconnected by pushing the Roll rocker switch "OFF."

(b) In the event of a Trim malfunction:
(1) Depress and hold the Master Trim Interrupt Switch.
(2) Trim Master Switch - OFF. Retrim aircraft as necessary using manual trim system.
(3) Release Master Trim Interrupt Switch - be alert for possible trim action.
(4) Trim Circuit Breaker - Pull. Do not operate trim until problem is corrected.

(c) If a trim runaway occurs with the Autopilot operating, the above procedures will disconnect the Autopilot which will immediately result in higher control wheel forces. Be prepared to manually retrim, as necessary, to eliminate undesirable forces.

(d) Altitude Loss During Malfunction:
(1) An Autopilot malfunction during climb or cruise with a 3 second delay in recovery initiation could result in as much as 55° of bank and a 400 foot altitude loss.
(2) Altitude loss - high altitude descent - 3 second delay in recovery could result in a 30° bank and a 800 foot altitude loss.
(3) An Autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 15° of bank and a 100 foot altitude loss. Maximum altitude loss measured in approach configuration gear down and operating either coupled or uncoupled, single or multi-engine.

(4) Reset heading card while observing slaving meter.
(5) Select slaving amplifier #2 (gyro slaving switch is set to No. 2 position).
(6) Reset heading card while checking slaving meter.
(7) Switch to free gyro and periodically set card as unslaved gyro.

SECTION 4 - NORMAL PROCEDURES

PREFLIGHT

(a) Roll Section
(1) Place Radio Coupler in "Heading" mode and place Roll rocker switch in the "ON" position to engage roll section. Rotate Roll Command Knob left and right and observe that control wheel describes a corresponding left and right turn, then center Roll Command Knob.
(2) Set proper D.G. Heading on D.G. and turn Heading Bug to aircraft heading. Engage HDG mode rocker switch and rotate Heading Bug right and left. Aircraft control wheel should turn same direction as Bug. Grasp control wheel and manually override servo, both directions.
(3) Disengage Autopilot by depressing trim switch. Check Aileron operation is free and A/P is disconnected from controls.

(b) Pitch Section
(1) Engage "Roll" rocker switch.
(2) Center pitch command disc and engage "Pitch" rocker switch.
(3) Rotate pitch command disc full DOWN and full UP and check control wheel describes a corresponding fore and aft movement. Check to see that servo can be overridden by hand at control wheel.

NOTE

Autopilot might not be able to raise elevators on ground without assistance from pilot.

(4) Hold control wheel and disengage Autopilot by pressing Master A/P Disconnect/Trim Interrupt switch button. Check Roll and Pitch controls to assure autopilot has disconnected.

(2) Press center bar (A/P OFF) - release - check autopilot disengagement.
(3) Rotate trim wheel to check manual trim operation. Reset to takeoff position prior to takeoff.

IN-FLIGHT

(a) Trim airplane (ball centered).

(b) Check air pressure or vacuum to ascertain that the Directional Gyro and Altitude gyro are receiving sufficient air.

(c) Roll Section
(1) To engage, center Roll Command Knob, push Roll rocker switch to the ON position. To turn, rotate Roll Command Knob in desired direction. (Maximum angle of bank should not exceed 30°.)
(2) For heading mode, set Directional Gyro with Magnetic Compass. Push directional gyro HDG knob in, rotate to select desired heading. Push HDG rocker switch to the "ON" position. (Maximum angle of bank will be 20° with heading lock engaged.)

(d) Pitch Section - (Roll Section must be engaged prior to engaging Pitch Section.)
(1) Center pitch trim indicator with the Pitch Command Disc.
(2) Engage pitch rocker switch. To change attitude, rotate Pitch Command Disc in the desired direction.

(e) Altitude Hold
Upon reaching the desired or cruising altitude, engage ALT Hold Mode rocker switch. As long as ALT Hold Mode rocker switch is engaged, aircraft will maintain selected altitude. For maximum passenger comfort, rate of climb or descent should be reduced to approximately 500 FPM prior to Altitude Hold engagement. For accurate Altitude Holding below 95 KIAS, disengage the autopilot, lower flaps to 15°, retrim and re-engage the autopilot.

NOTE

Prior to disengaging Altitude Hold Mode, rotate Pitch Command Disc to center.

(g) Radio Coupling VOR/ILS with Standard Directional Gyro

NOTE

Radio Coupler operation in conjunction with a standard Directional Gyro and VOR/LOC display differs from operation with an integrated display (H.S.I.) only in one respect. The Heading Bug is used as the radio course datum and therefore must be set to match the desired VOR/ILS course as selected on the O.B.S.

(1) For VOR Intercepts and Tracking: Select the desired VOR course and set the Heading Bug to the same heading. Select OMNI mode on the coupler and engage the HDG mode on the autopilot console.
(2) For ILS Front Course Intercepts and Tracking: Tune the localizer frequency and place the Heading Bug on the inbound, front course heading. Select LOC/NORM mode on the coupler and engage HDG mode on the autopilot console.
(3) For LOC Back Course Intercepts and Tracking: Tune the localizer frequency and place the Heading Bug on the inbound course heading to the airport. Select LOC/REV mode on the coupler and engage HDG mode on the autopilot console.

COUPLED APPROACH OPERATIONS

(a) VOR or LOC
(1) After arrival at the VOR Station, track outbound to the procedure turn area as described in In-Flight item (f) or (g), as appropriate, and slow to 105-120 KIAS. Disengage the autopilot, lower the flaps to 15°, retrim and re-engage the autopilot.
(2) Use HDG mode and Pitch or ALT Hold modes as appropriate during procedure turn.
(3) At the F.A.F. inbound, return to pitch mode for control of descent and lower landing gear.

(5) Monitor localizer and Glide Slope raw data through out approach. Adjust power as necessary to maintain correct final approach airspeed. All power changes should be of small magnitude and smoothly applied for best tracking performance. Do not change aircraft configuration during approach while autopilot is engaged.

(6) Conduct missed approach maneuver as described in Coupled Approach Operations, item (a)(5).

NOTE

Glide Slope Coupler will not automatically decouple from Glide Slope. Decoupling may be accomplished by any of the following means:

a. Disengage ALT Hold mode.
b. Switch Radio Coupler to HDG mode.
c. Disengage Autopilot.

SECTION 5 - PERFORMANCE

Installation of the AltiMatic IIIC does not affect the basic Performance information presented by Section 5 of this handbook.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 6 FOR PIPER YAW DAMPER SYSTEM INSTALLATION

SECTION 1 - GENERAL

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Piper Yaw Damper System is installed per Section 6, Paragraph 6.17 "Equipment List." The information contained herein supplements or supersedes the basic Pilot's Operating Handbook and FAA 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.

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APPROACH/LANDING

(a) During approach operations small magnitude rudder feedback may be expected. For small rudder induced heading changes expect increased rudder forces. Pilot may elect to disengage Yaw Damper during approach if feedback or force increase is objectionable.
(b) Disengage Yaw Damper before landing.

SECTION 5 - PERFORMANCE

Installation of the Piper Yaw Damper System does not affect the basic Performance information presented by Section 5 of this handbook.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 7 FOR PIPER ALTIMATIC X AUTOPILOT MODEL AK 687 OR ALTIMATIC X FLIGHT DIRECTOR AUTOPILOT MODEL AK 687 FD

SECTION 1 - GENERAL

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Piper Altimatic X Autopilot model AK 687 or Altimatic X Flight Director Autopilot model AK 687 FD is installed per Section 6, Paragraph 6.17 "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.

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CAUTION

Do not overpower autopilot pitch axis for periods longer than 3 seconds because the autotrim system will operate in a direction to oppose the pilot and will, thereby, cause an increase in the pitch overpower forces.

(2) Disconnect by depressing the master disconnect/interrupt switch.
(3) Disconnected by depressing the trim switch "AP OFF" bar.
(4) Disconnected by pushing the AP ON-OFF annunciator switch on the autopilot programmer.

(b) ALTITUDE LOSS DURING MALFUNCTION

(1) An autopilot malfunction during cruise with a 3 second delay in recovery initiation could result in as much as 50° of bank and 400 feet of altitude loss.
(2) An autopilot malfunction during a high altitude descent at maximum speed for autopilot operation with a 3 second delay in recovery initiation could result in as much as 30° bank and 800 feet altitude loss.
(3) An autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 15° bank and 100 feet altitude loss. Maximum altitude loss measured in approach configuration gear down and operating either coupled or uncoupled, single or multi-engine.

(c) SINGLE ENGINE OPERATIONS - AUTOPILOT MODE

(1) Engine failure during an autopilot approach operation: Disengage autopilot conduct remainder of approach manually.
(2) Engine failure during go around: Disengage autopilot, retrim aircraft, perform aircraft engine inoperative procedures then re-engage autopilot.
(3) Engine failure during climb, cruise, descent: Retrim aircraft, perform aircraft engine inoperative procedures.
(4) Maintain aircraft yaw trim throughout all single engine operations.

(3) With card disabled VOR/Localizer and Glide Slope displays are still functional; use card set to rotate card to aircraft heading for correct picture.

(4) Slaving Failure - (i.e. failure to self correct for gyro drift):
   a. Check gyro slaving switch is set to No. 1 position. (If equipped with Slave No. 1 - No. 2 switch.)
   b. Check for HDG Flag.
   c. Check compass circuit breaker.
   d. Reset heading card while observing slaving meter.

NOTE

Dead slaving meter needle or a needle displaced fully one direction indicates a slaving system failure.

   e. Select slaving amplifier No. 2 (gyro slaving switch is set to No. 2 position).
   f. Reset heading card while checking slaving meter.
   g. Switch to free gyro mode and periodically set card as with an unslaved gyro.

NOTE

In the localizer mode, the "TO-FROM" arrows may remain out of view, depending upon the design of the NAV converter used in the installation.

(b) Autopilot ON-OFF Switch - Pedestal mounted push ON - push OFF switch to engage or disengage autopilot (servos).

NOTE

Altimatic X systems without the optional Attitude Director Instrument (A.D.I.) will always return to HDG and ATT modes when the autopilot is engaged or disengaged. System with A.D.I. will not change modes during autopilot engage-disengage when flight director display is "ON". When the autopilot is engaged there will be approximately a 1 second lag during synchronization cycle.

(c) HDG (Heading) Mode Selector - provides turn control through use of the heading indice (bug) on the H.S.I. heading instrument.

(d) NAV (Navigation) Mode Selector - provides automatic 45° VOR intercept; tracking and crosswind correction for cross country VOR tracking. Utilizes information from H.S.I. VOR course indicator and left-right needle. (HDG bug is disabled during operation in NAV - APPR - REV modes.) Select desired course on H.S.I. Omni Bearing Selector (O.B.S.) and then select NAV mode.

(e) APPR (Approach) Mode Selector - provides automatic 45° VOR/LOC intercept angle, tracking and crosswind correction for use during instrument approach maneuver. Select desired course on H.S.I. Omni Bearing Selector (OBS) and then select APPR mode.

(f) REV (Reverse) Mode Selector - For use in tracking LOC Front course outbound or LOC Back course inbound to airfield. Always set inbound front course bearing on O.B.S. when using REV mode.

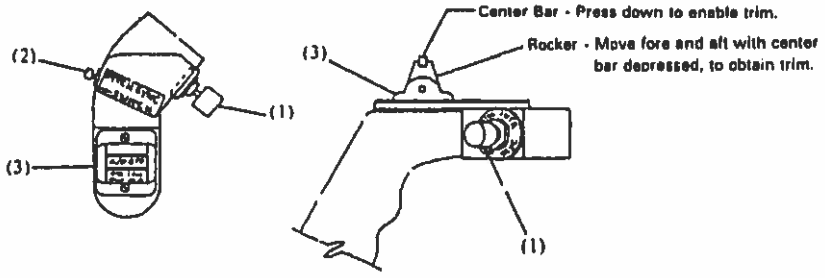
(g) Pitch Command Disc - Controls aircraft climb and dive attitude when operating in ATT mode. System limits maximum angle to 15°, or less. When the autopilot is engaged in ATT mode, automatic pitch synchronization will be provided to match autopilot command position to aircraft attitude.

(l) SPECIAL MODES OR OPERATIONS

(1) Selected angle intercepts may be obtained during VOR or ILS intercept situations, i.e. radar vectors to final approach, by selecting HDG and APPR mode simultaneously when the VOR-LOC needle is displaced 60% full scale or more. In this condition, the system will follow the HDG index (bug) until within 60% of "on course" at which time the system will shift from HDG to APPR automatically. Selected angle intercepts of over 60° are not recommended.

(2) Pitch Synch Mode - The system is provided with a pitch synch switch on the left horn of the pilot's control wheel. When depressed, momentarily, the system will revert to ATT and automatic synchronization will occur before servo re-engagement. When depressed and held, the system will revert to ATT and the roll and pitch servos will be disengaged to allow maneuvering. When released, the servos will re-engage. The lateral (roll) modes will not be disturbed during pitch synch operation.

(m) CONTROL WHEEL SWITCHES



(1) Emergency Interrupt/Disconnect Switch - This switch will disconnect the autopilot and yaw damper when depressed. When depressed and held it will interrupt all electric elevator trim operations.

(2) Pitch Synch Switch - See explanation above.

(3) Command Trim Switch - Split action type trim switch requiring the top bar to be depressed and the switch rocked fore or aft for trim operation. Depressing the top bar will disconnect the autopilot (will not disconnect the yaw damper).

(m) Miniature Airplane (Delta Symbol) - Operate aircraft controls to cause aircraft to pitch or bank as necessary to position  inside steering bars  in order to satisfy computed steering commands.
(n) Miniature airplane elevation knob.
(o) Optional flight director instrument (A.D.I.) providing two-cue steering display.
(p) Vertical steering bar providing roll steering. To satisfy command, maneuver aircraft to keep vertical bar centered.
(q) Horizontal steering bar providing pitch steering. To satisfy command, maneuver aircraft to keep horizontal bar centered.
(r) Miniature aircraft elevation adjust.
(s) Flight director OFF switch to remove steering presentation from view during autopilot operation, if desired.

4.4 PRE-FLIGHT PROCEDURES

NOTE

During system functional check the system must be provided adequate D.C. voltage (24.0 VDC min.) and instrument air (4.2 in. Hg. min.). It is recommended that one engine be operated (minimum) to provide the necessary power and that the aircraft be positioned in a level attitude, during the functional check.

(a) FLIGHT DIRECTOR
(1) Check power - ON.
(2) Programmer lights - press to test.
(3) Flight director switch on A.D.I. - ON. (Two-cue only).
(4) Pitch disc DN - UP - check pitch steering indicator moves appropriately.
(5) HDG index Right - Left - check roll steering indicator moves appropriately.

(b) COMPASS SYSTEM (NSD 360A)
(1) Check slaving switch in slave or slave 1 or 2 position, as appropriate. (Slaving systems with R.M.I. output provide only slave and free gyro positions.)

(d) TRIM SYSTEM

This aircraft is equipped with a command trim system designed to withstand any type of single malfunction, either mechanical or electrical, without uncontrolled operation resulting. The pre-flight check procedure is designed to uncover hidden failures that might otherwise go undetected. Proper operation of the electric elevator trim system is predicated on conducting the following pre-flight check before each flight. If the trim system fails any portion of the procedure pull the trim circuit breaker and leave the circuit breaker out until trim system is repaired. Substitution of any trim system component for another model is not authorized. For emergency interrupt information, refer to EMERGENCY PROCEDURES Section of this supplement.

The command electric trim switch on the left portion of the pilot's control wheel has two functions:

(1) When the top bar (AP OFF) is pressed, it disconnects the autopilot.

(2) When the top bar is pressed AND the rocker is moved forward, nose down trim will occur; when moved aft, nose up trim will occur.

(3) PRE-FLIGHT

Command Trim - Before Each Flight

a. Check trim circuit breaker - IN.
b. Trim master switch - ON.
c. AP OFF - Check normal trim operation - UP. Grasp trim wheel and check override capability. Check nose down operation. Recheck override. With trim operation, depress emergency interrupt/disconnect switch - trim operation should stop.
d. Activate center bar only - Push rocker fore and aft-only. Trim should not operate with either separate action.

Autotrim - Before Each Flight

a. AP ON - Check automatic operation by activating autopilot pitch command disc UP then DN. Observe trim operation follows pitch command direction.

4.7 SPECIAL OPERATIONS AND INFORMATION

ATTITUDE HOLD OPERATION

For best results, reduce rate of climb or descent to 500 FPM before engaging altitude hold mode.

INSTRUMENT APPROACH OPERATIONS

Initial and/or intermediate approach segments should be conducted between 105-120 KIAS with the flaps extended to 15°. Upon intercepting the glide path or when passing the final approach fix (FAF) immediately lower the landing gear and reduce the power for approximately 105-115 KIAS on the final approach segment. Adjust power as necessary during remainder of approach to maintain correct airspeed. Monitor course guidance information(raw data) throughout the approach. All power changes should be of small magnitude and smoothly applied for best tracking performance. Do not change aircraft configuration during approach while autopilot is engaged. For approaches without glide path coupling, adjust pitch command disc in conjunction with power to maintain desired airspeed and descent rate.

NOTES

1. Automatic GS disengagement will occur if a deviation above the GS center line of 80%, or more, occurs after GS capture. Automatic GS disengagement will revert the autopilot to altitude hold mode.
2. Flight director or autopilot will not decouple from the GS or Localizer in the event of radio failure. Monitor course guidance raw data during approach to assure signal quality.

INSTRUMENT APPROACH GO AROUND MANEUVER

At the decision height (DH) or missed approach point (MAP) perform the go-around as follows:

(a) Select GA mode at the programmer or push the remote GA switch, if installed.
(b) Add takeoff power, or power as desired.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 8 FOR KFC 200 AUTOMATIC FLIGHT CONTROL SYSTEM WITH FLIGHT DIRECTOR INSTALLATION

SECTION 1 - GENERAL

This supplement must be attached to the Pilot's operating Handbook and FAA Approved Airplane Flight Manual when the KFC 200 Automatic Flight Control System is installed per Section 6, Paragraph 6.17 "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 _____

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ABBREVIATIONS

ALT	Altitude or Altitude Hold
AP	Autopilot
APPR	Approach
ARM	System Arm for Capture
BC	Back Course
CDI	Course Deviation Indicator or Control
CPLD	Coupled
CWS (SYNC)	Control Wheel Steering or Synchronization
DISC	Disconnect
FCS	Flight Control System
FD	Flight Director
FDI	Flight Director Indicator
GA	Go Around
GS	Glideslope
HDG	Heading Select
LOC	Localizer
NAV	Navigation
PAH	Pitch Attitude Hold
PNI	Pictorial Navigation Indicator

SECTION 2- LIMITATIONS

(a) During autopilot operation, pilot must be seated at the controls with seat belt fastened. Operation is limited to the left-side pilot position.

(b) Maximum speed for autopilot operation is 210 KIAS.

(c) During autopilot operation, the wing flaps must not be extended beyond 15°.

(d) The autopilot must be disengaged during takeoff and landing.

(e) System approved for Category I operation only (APPR mode selected).

(f) Autopilot attitude command limits:

Pitch	±15°
Roll	±25°
Yaw	NA

(g) The maximum altitude for operation of the autopilot has not been determined. The maximum altitude demonstrated during flight test was 24,000 feet.

SECTION 3 - EMERGENCY PROCEDURES

(a) AUTOPILOT/YAW DAMPER DISENGAGEMENT
Disengage the Autopilot/Yaw Damper and/or prevent engagement by:
(1) Pilot's AP DISC switch.
(2) AP engage lever on Mode Controller and Yaw engage switch on Yaw Controller (if so equipped).
(3) Pulling the AUTOPILOT circuit breaker.
(4) Turning master switch OFF.
(5) Turning avionics master switch OFF.

(b) AUTOMATIC AUTOPILOT DISENGAGEMENT
Any of the following will cause the autopilot to automatically disengage:
(1) External power failure.
(2) Actuating manual electric trim.
(3) Internal Flight Control System failure.
(4) With KCS 55A system a loss of compass valid (displaying HDG flag) disengages the AP and FD when a mode using heading information is engaged. With HDG flag present only FD and vertical modes can be selected.
(5) In the event of an autopilot malfunction, the KA 132 Acceleration switch will disconnect the autopilot if the established "G" envelope is exceeded.

(c) MANUAL ELECTRIC PITCH TRIM
Manual electric pitch trim can be disengaged by pressing AP DISC/TRIM INTERRUPT switch and holding down until recovery can be made. Then turn off AVIONICS MASTER switch and manually retrim the airplane using the manual trim control wheel. After the airplane is trimmed out, pull the (PITCH TRIM) breaker and turn the AVIONICS MASTER switch back on.

(d) MAXIMUM ALTITUDE LOSSES DUE TO AUTOPILOT MALFUNCTION

(1) Cruise, Climb, Descent	400 feet
(2) Maneuvering	60 feet
(3) APPR	60 feet
(4) Single Engine APPR	60 feet

SECTION 4 - NORMAL PROCEDURES

(a) The airplane MASTER SWITCH function is unchanged and can be used in an emergency to shut off all electrical power while the problem is isolated.

(b) The AVIONICS MASTER switch supplies power to the avionics bus bar of the radio circuit breakers, AUTOPILOT and PITCH TRIM circuit breakers.

(c) The KFC 200 is controlled by the following circuit breakers.

AUTOPILOT - This supplies power to the FCS KC 295 Computer, KC 290 Mode Controller, KA 285 Annunciator Panel, KI 256 FDI if used, and AP Pitch and Roll Servos. When optional yaw damper system is installed, this breaker also supplies power to the KC 296 Yaw Computer, the Yaw Servo, and the optional KC 291 if so equipped.

AVIONICS MASTER - This in conjunction with the AVIONICS MASTER Switch supplies power to the avionics bus.

COMPASS SYSTEM - This supplies power to the KCS 55A Compass System.

PITCH TRIM - This supplies power to the FCS autotrim and manual electric pitch trim systems.

(d) PILOT'S CONTROL WHEEL SWITCH FUNCTIONS

AP DISC/TRIM INTERRUPT - This emergency disconnect switch will disengage the AP and/or YD and interrupt the power to the electric trim system. To resume AP control, the AP lever on the Mode Controller must be re-engaged. In the event of electric trim or autotrim failure, the switch can be held depressed which removes all power from the trim system to allow the pilot time to turn off the AVIONICS MASTER switch and pull the (PITCH TRIM) circuit breaker.

TRIM - The TRIM warning light, located in the lower right corner of the annunciator panel, will flash and be accompanied by an audible warning whenever autotrim and/or manual electric pitch trim failures occur. The trim servo motor running without a command is monitored on manual electric and autotrim. The trim servo motor not running when commanded to run and the trim servo motor running in the wrong direction are monitored on autotrim only. The TRIM warning light flashes four times and the audible warning sounds when the test switch on the Mode Controller is depressed.

GS - The Glide Slope valid (GS pointer being in view on PNI) has to be present before GS may couple. If, after GS CPLD, the valid is lost, the system will flash the GS Annunciator and revert from GS CPLD to PAH with the FDI pitch steering bar providing pitch attitude steering information. If the GS valid returns, the system will revert back to GS CPLD.

NAV - The NAV or APPR Modes (ARM or CPLD) may be selected and will function with or without a NAV warning flag present. The FDI bank steering will continue to provide steering information with or without a valid NAV signal.

AP DISCONNECT ALERT - The Autopilot Disconnect Alert will sound an audible warning for approximately two seconds whenever the Autopilot engage lever on the KC 290 Mode Controller is disengaged.

(f) BEFORE ENGAGING FLIGHT CONTROL SYSTEM
(1) Verify that all circuit breakers for the system are in.
(2) Allow sufficient time for the gyros to come up to speed and for the system to warm up (3-4 minutes).

(g) PREFLIGHT CHECK (Must be performed prior to each flight)
(1) With no modes engaged and all valid flags retracted, depress the Test Button on the Mode Controller. The Yaw Damp ON light will illuminate and all annunciators will illuminate on the annunciator panel, including the three marker lights. Also, the red TRIM failure light will flash. At least four or more flashes must be observed to indicate proper operation of the autotrim/manual electric pitch trim feature and an audible warning should sound.

CAUTION

Operation of the Autopilot on the ground may cause the Autotrim to run because of back force generated by elevator downsprings or pilot induced forces. Therefore, disengage the AP and check that the airplane manual Pitch Trim is in the Takeoff position prior to takeoff.

CAUTION

If the Autopilot circuit breaker is pulled, the red "TRIM" failure light on the Annunciator panel will be disabled and the audible warning will continuously sound indicating that the failure light is disabled. In this event the "PITCH TRIM" circuit breaker should be pulled and in-flight Trim accomplished by using the manual Pitch Trim Wheel.

(h) IN-FLIGHT OPERATION

(1) Engage Procedure:

After takeoff, clean up airplane and establish climb. Engage the FD mode first, monitor flight controls and engage AP. The pitch attitude will lock on any attitude up to 15° in pitch.

Engaging and holding the CWS switch allows the pilot to momentarily revert to manual control while retaining his previous modes, except GA, and conveniently resuming that profile at his discretion.

NOTE

The "Vertical Trim" switch, located on the Mode Controller, may be used to trim the command pitch attitude at a rate of one degree per second (the pitch attitude degrees legend on the airplane attitude indicator will not serve to indicate accurate FDI pitch steering bar pitch attitudes in degrees).

(4) Altitude Hold Mode (ALT):
When the ALT switch on the Mode Controller is pressed, the FDI will provide commands for maintaining the pressure altitude existing at the time the switch is depressed. For smooth operation, engage the ALT at no greater than 500 feet per minute climb or descent. The ALT will automatically disengage when glideslope couples or the GA switch is depressed. ALT hold may be turned off at any time by depressing the ALT switch. ALT engagement is displayed on the annunciator panel.

NOTE

The "Vertical Trim" switch, located on the Mode Controller, may be used to change or trim the altitude up or down at 500 to 700 FPM without disengaging the mode. The new pressure altitude that exists when the switch is released will then be held.

(5) Heading Mode (HDG):
Set the heading bug to the desired heading on the PNI, depress the HDG switch on the Mode Controller and HDG will be displayed on the annunciator panel. The airplane FDI and/or AP will command a turn to the heading selected and hold. The pilot may then choose any new heading by merely setting the bug on a new heading. The airplane FDI and/or AP will automatically command a turn in the direction of the new setting. To disengage the HDG Mode, depress the HDG switch on the Mode Controller and observe the HDG light go out on the annunciator. The HDG mode will automatically disengage when APPR or NAV CPLD is achieved.

CAUTION

The "APPR" mode of operation will continue to provide airplane commands and/or control without a valid VOR/LOC signal (NAV flag in view).

(8) Back Course Mode (BC):
For BC operation proceed as for normal approach mode, but engage BC after selecting APPR. The BC switch reverses the signals in the computer and cannot be engaged without a LOC frequency selected. BC status is indicated on the annunciator panel. BC mode can be disengaged by depressing either BC, APPR or GA switches, or by selecting other than a LOC frequency on the NAV receiver.

(9) Vertical Mode Switch (Trim Up/Dn):
Operation of the vertical trim switch on the Mode Controller provides a convenient means of adjusting the ALT hold or PAH angle function without disengaging the mode.

(10) Go-Around Mode (GA):
The GA mode may be engaged by depreessing the GA switch on the left engine throttle. GA will illuminate on the annunciator panel indicating mode status. The GA mode commands a fixed pitch up angle. The AP, if engaged, will disengage. GA will cancel all other vertical modes as well as APPR or NAV CPLD.

(11) Yaw Damper Mode (YAW DAMP):
The optional Yaw Damper mode engages automatically when the AP is engaged or may be engaged or disengaged separately by the use of the YAW DAMP switch on the Yaw Controller. The Yaw Damper provides directional damping plus turn coordination as a third axis with AP engaged or as a stand along system with only the YAW DAMP on. The Yaw Damper mode will disengage with AP disengagement if there is no KC 291.

(8) Landing or missed approach.

a. Disengage AP and land.

b. Go-Around by depressing GO AROUND switch on left engine throttle and applying full power. The autopilot, if engaged, will disengage. Manually fly the airplane and retrim as required to establish the GA attitude as displayed on the Flight Director Indicator. After the GA attitude has been established and the airplane has been retrimmed, the autopilot may be re-engaged. APPR may be engaged for a straight away missed approach or HDG may be engaged to turn to the missed approach heading.

CAUTION

At airspeeds below 101 KIAS, rapid power application for Go Around may cause a pronounced pitch-up attitude change.

(k) BACK COURSE PROCEDURE

Same as front course except that BC is engaged after APPR is engaged and the airplane must be set for descent manually by holding the vertical trim switch DN on the MODE CONTROLLER if in ALT HOLD or by establishing the desired Pitch Angle using the CWS or Vertical Trim Switch if in PAH.

SECTION 5 - PERFORMANCE

Installation of the King KFC 200 Flight Control System does not affect the basic performance information presented by Section 5 of this handbook.