DUPLICATE

THE

31-420

NAVAJO

PILOT'S OPERATING MANUAL

BY

PIPER

This manual is incomplete without an APPROPRIATE FAA APPROVED AIRPLANE FLIGHT MANUAL and an APPROPRIATE WEIGHT AND BALANCE REPORT.

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 outlined by the Flight Manual, instrument markings, and placards.

If an inconsistency of information exists between this handbook and the Flight Manual approved by the FAA, the Flight Manual shall be the authority.

This Manual pertains to Turbocharged PA-31 - Navajo's Serial No. 31-1 to 31-659 and Serial No. 31-661 to 31-711 excluding all PA-31-300 Navajo's Serial Nos. 31-228, 31-230, 31-270, 31-279, 31-316, 31-339, 31-415, 31-426, 31-451, 31-455, 31-483 and 31-511.

Additional copies of this manual, Part No. 761 456, may be obtained from your Piper Dealer.

Published by
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Piper Aircraft Corporation
761 456
Issued: September 1970

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REVISIONS

The information compiled in this manual will be kept current by revisions distributed to the airplane owners through their local dealers or distributors.

There are two types of revisions used to keep the Pilot's Operating Manual current; Temporary Revisions and Permanent Revisions. The material compiled in the revisions will consist of information necessary to update the present information or add information to cover added equipment.

I. Temporary Revision

This revision will be distributed at any time it is necessary to forward information to the owners and operators of the airplane. The revision will usually consist of one or two pages which may be inserted in the appropriate section of the manual. This revision will include deletions and/or additions of material pertinent to different paragraphs of the manual.

II. Permanent Revision

This revision will be distributed periodically and will supersede all previous temporary revisions. These revisions will be complete page replacement and shall be inserted in the manual in accordance with the instructions given below.

1. Replace the obsolete pages with revised pages of the same page number.
2. Insert pages with page numbers followed by a small letter in direct sequence with the same common numbered page.

III. Identification of Revised Material

Revised text and illustrations shall be indicated by a black vertical line along the left hand margin of the page, opposite revised, added or deleted material. A line opposite the page number or section title and printing date, will indicate that the text or illustration was unchanged but that material was relocated to a different page or that an entire page was added.

Symbols will indicate only current revisions with changes and additions to or deletions of existing text and illustrations. Changes in capitalization, spelling, punctuation or the physical location of the material on the page will not be identified by symbols.

REVISIONS ISSUED

Current Permanent and Temporary Revisions to the PA-31 Pilot's Operating Manual issued September, 1970 are as follows:

761 456 (PR720901)	Permanent Revision	Dated September 1,1972
761 456 (PR740329)	Permanent Revision to W/B	Dated March 29, 1974
761 456 (PR750321)	Permanent Revision to P/O/M, added Rev. 24 to A F/M.	Dated March 21, 1975
761 456 (PR760109)	Permanent Revision to P/O/M and W/B, added Rev. 25 to A F/M.	Dated January 9, 1976
761 456 (PR760621)	Permanent Revision to P/O/M, added Rev. 26 to A F/M.	Dated June 21, 1976
761 456 (PR770204)	Permanent Revision to P/O/M, added Rev. 27 to A F/M.	Dated February 4, 1977
761 456 (PR770607)	Permanent Revision to P/O/M and W/B, added Rev. 28 to A F/M.	Dated June 7, 1977
761 456 (PR790703)	Permanent Revision to P/O/M, added Rev. 29 to A F/M.	Dated July 3, 1979
761 456 (PR800603)	Permanent Revision to P/O/M added Rev. 30 to A F/M.	Dated June 3, 1980
761 456 (PR810220)	Permanent Revision to P/O/M, added Rev. 31 to A F/M.	Dated February 20, 1981
761 456 (PR820402)	Permanent Revision to P/O/M, added Rev. 32 to A F/M.	Dated April 2, 1982
761 456 (PR970319)	Permanent Revision to P/O/M, added Rev. 33 to A F/M.	Dated March 19, 1997
761 456 (PR020422)	Permanent Revision to P/O/M, added Rev. 34 to A F/M.	Dated April 22, 2002

GENERAL SPECIFICATIONS

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SECTION I

GENERAL SPECIFICATIONS

PERFORMANCE

Published figures are for Standard PA-31 airplanes flown at gross weight under standard conditions at sea level unless otherwise stated.

Take-off Run (ft)	1730
Take-off Distance over 50-ft. barrier (ft)	2280
Minimum Controllable Single Engine Speed (mph)	85
Best Rate of Climb Speed (mph)	110
Best Rate of Climb (ft per min)	1395
Best Angle of Climb Speed (mph)	95
Best Single Engine Rate of Climb Speed (mph)	110
Best Single Engine Rate of Climb (ft per min)	245
Best Single Engine Angle of Climb Speed (mph)	106
Service Ceiling (ft)	26,300
Absolute Ceiling (ft)	27,300
Single Engine Service Ceiling (ft)	15,800
Single Engine Absolute Ceiling (ft)	16,400
Top Speed at 15,500 ft (mph)	260
Cruising Speed (75% power at sea level) (mph)	201
Cruising Speed (75% power at 23,500) (mph)	247
Optimum Cruising Speed (65% power at 24,000) (mph)	231
Stalling Speed (gear and full flaps) (power off) (mph)	73
Stalling Speed (gear and flaps up) (power off) (mph)	80
Fuel Consumption (75% power) (both engines) (gph)	35.6
Fuel Consumption (65% power) (both engines) (gph)	27.8
Cruising Range (75% power at 23,500 ft) (mi)	1300* 1120**
Cruising Range (65% power at 24,000 ft) (mi)	1560* 1390**
Cruising Range (45% power at 24,000 ft) (mi)	1685* 1550**

*190.0 gal usable fuel
**45 min reserve

WEIGHTS

Ramp Weight (lbs)	6536
	a b
Gross Weight (lbs)	6500 6200
Empty Weight (Standard) (six-place) (lbs)	3759
USEFUL LOAD (Standard) (six-place) (lbs)	2741

a - Take-off
b - Landing, maximum (6500 lbs. with kit 763 801 installed)

POWER PLANT

Engine, Lycoming	TIO-540-A
Rated Horsepower	310
Rated Speed (rpm)	2575
Bore (inches)	5.125
Stroke (inches)	4.375
Displacement (cubic inches)	541.5
Compression Ratio	7.3:1
Dry Weight (pounds)	535.00

FUEL AND OIL

Fuel Capacity (U.S. gal) (standard)	192
Usable Fuel (U.S. gal)	186
Fuel, Aviation Grade (minimum octane)	100/130
Oil Capacity (U.S. qts) (each engine)	12

BAGGAGE

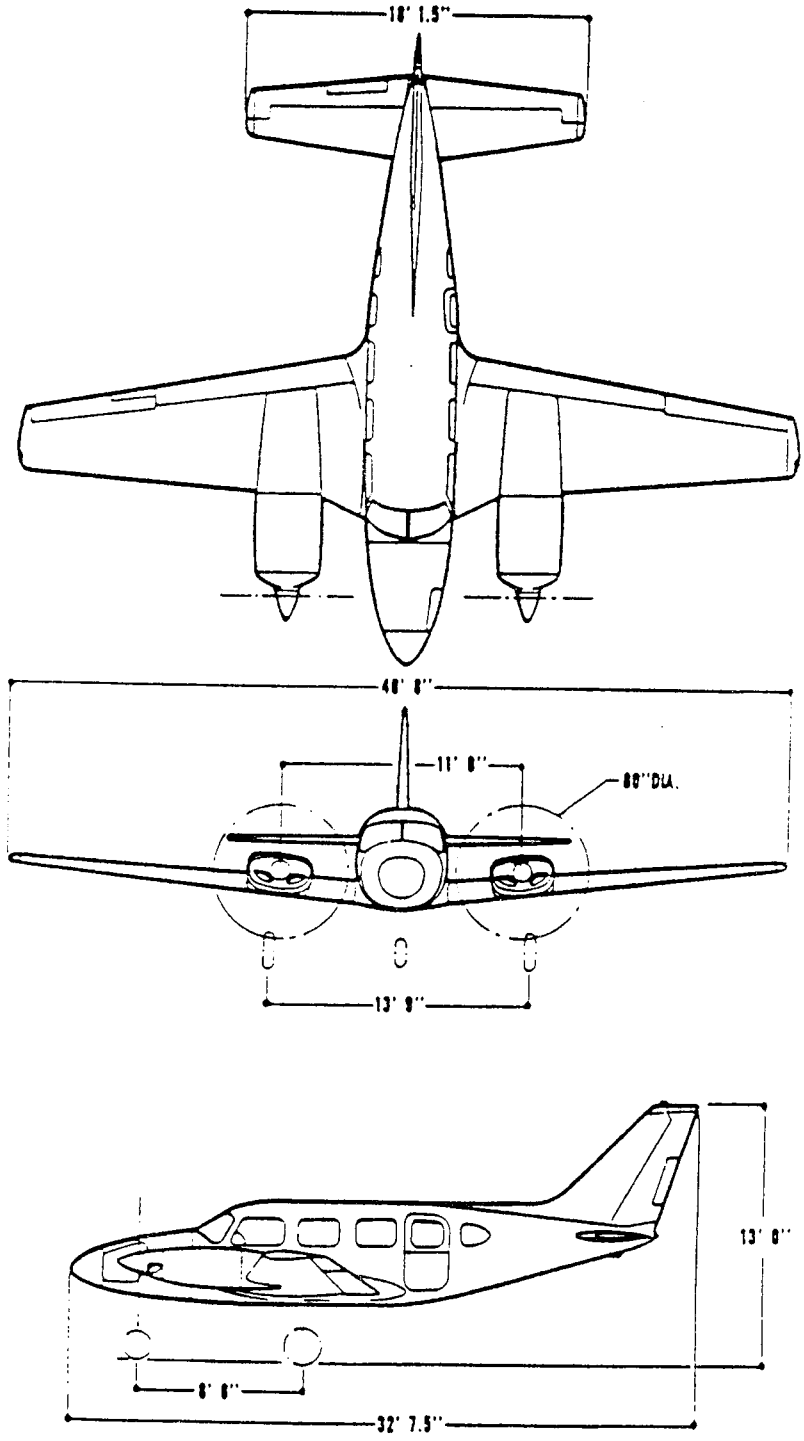
Maximum Baggage (lbs)	
Forward	150
Aft	200
Baggage Space (cubic ft)	36
Baggage Door Size (forward) (in)	25 x 28

DIMENSIONS

Wing Span (ft)	40.67
Wing Area (sq ft)	229
Length (ft)	32.63
Height (ft)	13.00
Wing Loading (lbs per sq ft)	28.4
Power Loading (lbs per HP)	10.5
Propeller Diameter (in)	80
Turning Radius (Nose Wheel) (ft)	28

LANDING GEAR

Wheel Base (ft)		8.67
Wheel Tread (ft)		13.75
Tire Pressure (psi)	Nose	42
	Main	60
Tire Size	Nose (six-ply rating)	6.00 x 6
	Main (eight-ply rating)	6.50 x 10



THREE VIEW

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DESCRIPTION - AIRPLANE AND SYSTEMS

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AIRCRAFT AND STANDARD EQUIPMENT DESIGN AND OPERATION

POWER PLANT

The Navajo is powered by two turbocharged Lycoming TIO-540-A series, six cylinder, fuel injected engines rated at 310 HP at 2575 RPM. The engines are equipped with geared starters, 24 volt 50 or 70 ampere alternators, shielded ignition systems, and dual pneumatic pressure pumps.

The turbocharger 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 a much higher altitude than normally aspirated engines. The power to drive the turbocharger is extracted from energy in the exhaust gas. The exhaust gases are ducted through the turbine and then directed 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 induction air system is provided for each engine. Should the induction air filters become obstructed by ice or other causes, the induction air doors will open automatically to provide air to the engine.

To the right of the control pedestal are two manual alternate air controls which may be used by 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 in the cabin on the bottom of the engine control quadrant. Cowl flaps should be positioned to maintain temperatures at or below maximum temperature. Remote indicating gauges located next to the switches give the pilot a visual indication of cowl flap position.

The engines of the airplane are equipped with doors on the induction housings, and in the event of a turbocharger compressor failure the engine will automatically revert to normally aspirated air. Approximately 75% of normal rated power or 232 HP will be available at sea level.

Engine mounts are of steel tubing construction and incorporate vibration absorbing dynafocal mounts. Engine cowls are cantilever structures, attached at the firewall. The nose cowl and side panel assemblies are quickly removed by means of quick-release fasteners.

Efficient aluminum oil coolers are attached to each of the engine mounts.

PROPELLERS

The propellers on the Navajo are Hartzell constant speed, controllable pitch, full-feathering units, each controlled by a governor mounted on the engine. The governors are controlled by levers located in the center of the control quadrant. Feathering of the propeller is accomplished by moving the control fully aft through the low RPM detent into the feathering position. Feathering takes place in approximately seven seconds. A propeller is unfeathered by moving the propeller control ahead and engaging the starter.

STRUCTURES

The fuselage is an all metal semi-monocoque structure with riveted skin. Windows include a two piece windshield and five windows along each side. The four forward windows are double pane while the aft or triangular shaped window is a single pane. A storm window is located in the forward lower section of each pilot's side window and when the latch at the lower side is released the window will swing in and forward. A 23 by 30 inch emergency exit is an integral part of the second right window and is jettisonable when the release just aft of the exit is pulled. The cabin entrance door is located on the left side of the fuselage just aft of the wing. The door separates at the middle, with the upper half swinging upward and the lower half swinging downward to provide cabin entrance steps.

Each wing panel is an all metal, full cantilever semi-monocoque type construction with a removable fiberglas tip. Two flexible bladder type fuel cells in each wing are used to supply the fuel. The main landing gear is enclosed in wheel wells built into the lower surface of each wing and is enclosed by doors when retracted. The right aileron incorporates a trim tab which is adjustable through a control in the cockpit. The full length I beam type main spars extend into the fuselage and are joined with high strength butt fittings in the center of the fuselage, making in effect a continuous main spar. The main spar is also attached to the side of the fuselage as are the front and rear spars.

The all metal empennage group is a full cantilever design consisting of a vertical stabilizer (fin), rudder, right and left horizontal stabilizer and elevator, all with removable fiberglas tips. The rudder and right elevator have trim tabs attached which are controllable from the cockpit. Both the vertical and horizontal stabilizers incorporate two channel main spars that run the full length of the stabilizer and attach to the aft bulkhead assembly of the fuselage.

All components are completely zinc chromate primed and exterior surfaces are coated with acrylic lacquer.

LANDING GEAR AND BRAKE SYSTEM

The tricycle landing gear system is an air-oil oleo type unit that is hydraulically operated - fully retractable with the nose gear retracting aft into the nose section and the main gear retracting inboard into the wing. Doors completely cover the gear when retracted. The nose and outboard main gear doors operate by mechanical linkage and remain open when the gear is extended. The main gear inboard doors operate hydraulically, opening during gear extension and closing again when the gear has fully extended.

The nose gear is steerable through a 40 degree arc by the use of rudder pedals. As the gear retracts, the steering linkage becomes separated from the gear so that rudder pedal action with the gear retracted is not impeded by the nose gear operation.

To guard against inadvertent retraction of the landing gear on the ground, a solenoid latch, which must be operated before the landing gear control can be moved upward, is positioned just above the control lever. The control knob is in the shape of a wheel to differentiate it from the flap control knob, which has an airfoil shape.

Located on the instrument panel, above and to the right of the gear selector control, are one red and three green indicator lights.

The red light indicates when the gear is in transit between the "up locked" and "down locked" position. The green lights indicate when each gear is down and locked. There is no light indication when the gear is up and locked. A gear unsafe horn will sound if the power in one or both engines is reduced below 12 inches of manifold pressure while the landing gear is not in the "down locked" position. If the gear selector has been forced into the up position with the aircraft on the ground, the warning horn will sound when the master switch is turned on. The selector cannot be in the up position unless the mechanism is out of adjustment.

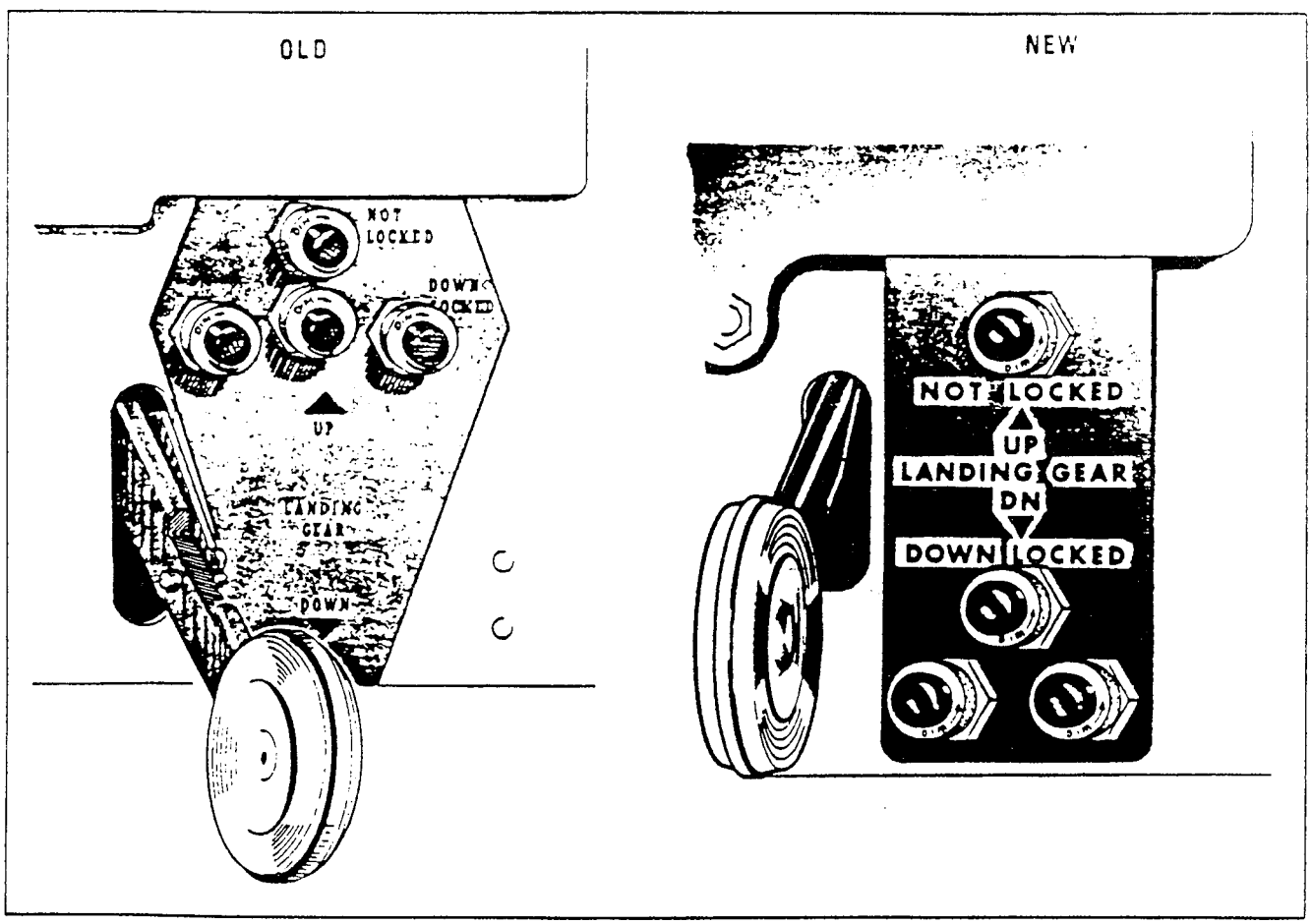
NOTE

With an electrical failure or the master switch OFF, there will be no indication of the down and locked condition of the gear.

The main wheels are 6.50 x 10 Cleveland Aircraft Products units with disc type brakes and 6.50 x 10 tires with eight ply rating. The nose wheel is a Cleveland 6.00 x 6 model fitted with a 6.00 x 6 tire with a six ply rating. All tires have tubes.

The brakes are hydraulically actuated by individual master cylinders mounted on the left (optional on the right) set of rudder pedals. A reservoir, accessible through the nose baggage compartment door,* supplies fluid to each master cylinder. From these cylinders, hydraulic fluid is routed through lines and hoses to a parking brake valve, located on the left aft side of the forward cabin bulkhead, through the cabin and wings to the brake assemblies on each main landing gear. The brakes are self-adjusting, single-disc, single-housing, triple-piston assemblies. The parking brake may be actuated by applying toe pressure and at the same time pulling out on the brake handle located on the left face of the instrument panel. To relieve parking brake pressure, apply toe pressure on the pedals and at the same time push in on the parking brake handle.

*In aircraft with serial numbers 31-300 and up, the reservoir is serviced through an access door atop the nose.



LANDING GEAR CONTROL PANEL

HYDRAULIC SYSTEM

The hydraulic system is used for the extension and retraction of the landing gear. Pressure is supplied to the system by engine driven pumps mounted on each engine. The wheel shaped selector handle, mounted on the left instrument panel, is moved from the center OFF position to effect extension or retraction of the gear.

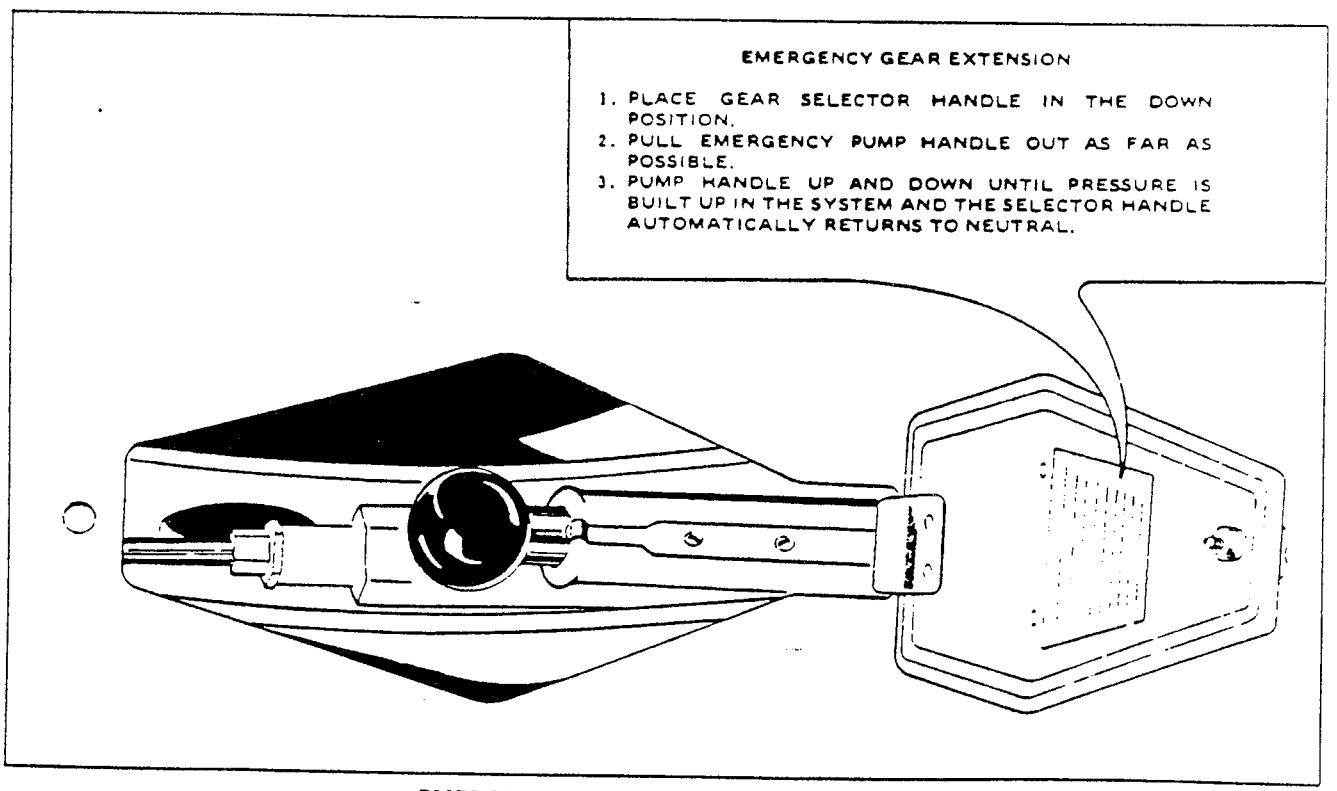
When the desired position of the gear is obtained, the handle is forced back to the center off position by hydraulic pressure in the selector valve, allowing the hydraulic fluid to circulate freely between the pump and control unit. Gear retraction or extension will occur normally in approximately 6 seconds.

NOTE

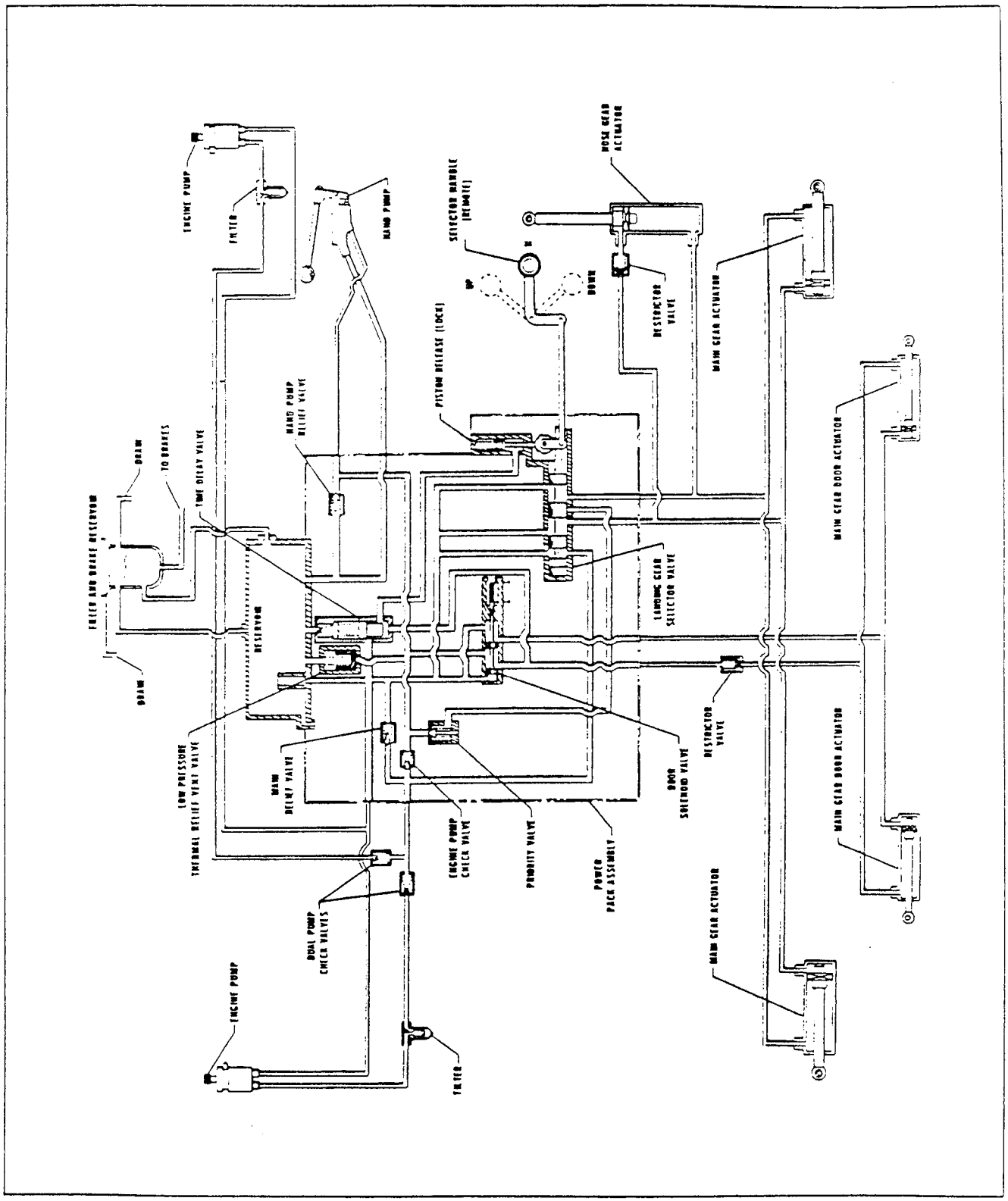
With an electrical failure or the master switch OFF, the selector handle will not return to neutral and the gear doors will not close.

When the selector handle returns to neutral it isolates the activating cylinders and associated lines from the hydraulic fluid supply. This prevents complete loss of fluid in the event of a leak in the lines between the selector valve and the component or at the actuating cylinders. The return of the control handle to the OFF position is also a secondary indication that the components have reached full extension or retraction. The landing gear position lights should be used as primary indications.

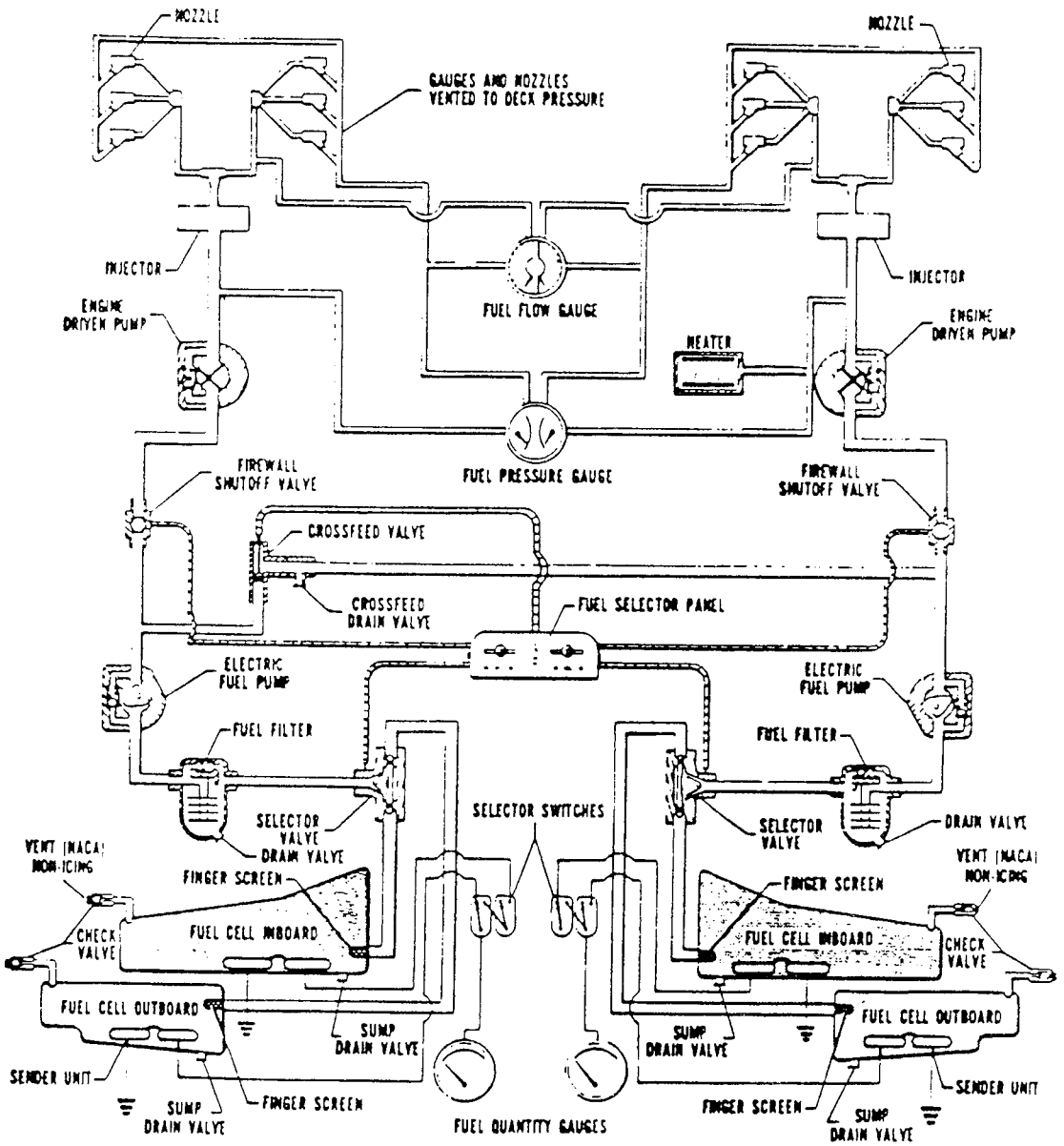
The emergency hydraulic hand pump is used to obtain hydraulic pressure in event of failure of the engine driven hydraulic pumps. This hand pump is located between the pilot's and copilot's seats. An access cover marked Emergency Gear Extension must be lifted to gain access to the pump handle. Follow instructions on the underside of the access plate to lower the gear.



EMERGENCY LANDING GEAR HAND PUMP



HYDRAULIC SYSTEM SCHEMATIC



FUEL SYSTEM SCHEMATIC

CONTROL SYSTEM

The primary flight controls are of the conventional type, operated by dual control wheels and rudder pedals. On the forward end of each control column is a tube and sprocket assembly. A chain is wrapped around the sprockets to connect the right and left controls. Attached to the left set of rudder pedal arms are control cables that lead to the rudder horn. The rudder pedals also control the action of the brakes and nose wheel steering. For coordinated action of the rudder and ailerons, their control cables are interconnected through a cable-spring system.

Aileron, elevator, and rudder trim are operated by knobs or wheels and controlled by cable-wrapped drums located in the control pedestal. With the rotation of the drum, a screw is moved fore or aft to allow for the positioning of the trim tab. To indicate the position of the trim tab, an electric sender unit attached to each screw assembly in the various surfaces will transmit a signal to an indicator in the control pedestal.

The flaps are controlled by a switch shaped like an airfoil located to the right of the pedestal. The switch activates an electric motor under the cabin floorboards about in line with the flap. The motor drives a screw transmission, located at each flap, with a flexible shaft. Micro switches located in the left wing limit the flap up and down travel. Also located in the left wing is a rheostat switch which actuates the flap position indicator located above the flap control switch on the instrument panel. The flaps may be extended to 15° at airspeeds below 175 MPH (152 KT). Full flap extension is limited to airspeeds below 150 MPH (130 KT).

A time delay relay located near the flap motor stops the motor if an asymmetric flap condition occurs. When flaps are selected down and the flaps do not extend together, within one second (approximately 9° right flap travel) after selection, the time delay relay will turn the flap motor off and the flap selector switch will become inoperative. The selector switch will remain inoperative until the time delay relay is reset. Reset by pulling the flap control circuit breaker and then resetting it.

CAUTION

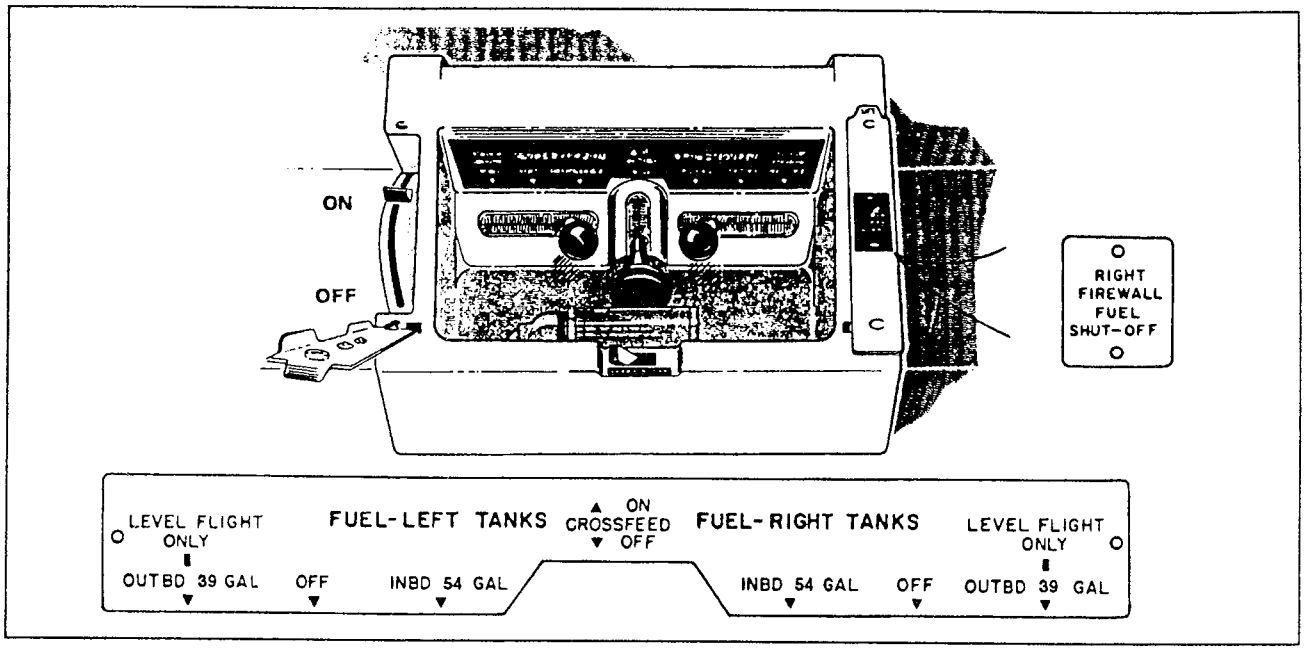
Do not reset the flap time-delay relay system until the aircraft has landed and the problem has been resolved, as resetting the system and activation of the flap selector switch will allow another one second of operation allowing the asymmetric flap differential to become more severe.

The system is not affected by the time delay switch if failure occurs when the left flap is between the up and down limit switches. If failure occurs in either flap system (when flap is not in contact with a limit switch) use the flap selector switch to bring the free flap to a symmetrical configuration with the inoperative flap.

An electrical brake in the flap motor prevents the flaps from coasting when intermediate flap settings are selected.

To preclude the possibility of encountering large asymmetric ("split") flap angles due to a failure in the flap actuating system the following procedures should be followed for flap extensions and retractions:

1. Actuate the flaps only while the airplane is under manual control, not while the autopilot is engaged. The autopilot will mask the high control forces created by an asymmetric flap condition.
2. Extend or retract the flaps in a minimum of five steps of approximately one half second activation each. Do not initiate the successive extension/ retraction step until a symmetric position is verified by a negligible change in aileron/ rudder cockpit control positions to hold straight flight.
3. Do not extend the flaps beyond 15° if the flap motor circuit breaker has a history of popping. A popped circuit breaker is indicative of excessive actuation loads on one or both flaps; such loads are most likely at flap angles in excess of 15°. The airplane should not be flown until the cause of the high loads is determined and repairs effected.



FUEL SYSTEM

Four flexible fuel cells located in the wings provide the fuel storage. The two inboard cells have a capacity of 56 gallons each and the outboard cells have a capacity of 40 gallons each, providing a total fuel capacity of 192 gallons, of which 186 are usable. Fuel can be pumped from any cell to both engines, through use of the engine driven and/or electric fuel pumps.

For normal operation, fuel is pumped by the engine driven pumps from the cells directly to the adjacent fuel injector. The fuel valves can be left on at all times and the crossfeed left in the off position. An electric auxiliary fuel pump, located in each wing fairing, is installed in the fuel line between the cells and the engine driven pumps. The electric pumps are used to provide fuel pressure if the engine driven pumps fail. They are normally turned on to check their operation and for priming engines before starting. Turn the electric pumps off after starting to check engine driven pumps and leave them on during takeoff and landing to preclude the possibility of fuel pressure loss due to engine pump failure at critical times.

If one of the engine driven pumps fails, the electric pump to that engine can be turned on to supply the fuel. For all normal operations fuel should be pumped directly from the cells to their respective engines with the crossfeed off.

The fuel valve controls and crossfeed control are located in the fuel control panel between the front seats. (See illustration.) This panel can be illuminated by a light directly over the controls. Emergency shut-off valve controls are located on their respective side of the fuel control panel. In order to close the cover the emergency shut-off valve must be on. Two electric fuel gauges in the overhead switch panel indicate the fuel quantity in each cell. The electric fuel gauges indicate the fuel quantity in the cell selected by the fuel selector handle located in the fuel control panel. These gauges are illuminated by the rheostat mounted on the left side of the same panel. The electric fuel pump switches are on the right side of the overhead panel.

ELECTRICAL SYSTEM

The electrical system for the Navajo includes a 24 volt 17 ampere hour battery enclosed in a sealed stainless steel battery box. Two 28 volt 50 or 70 ampere alternators are installed as standard equipment. They are paralleled by the use of one voltage regulator to control field voltage of both units. Also incorporated in the system is an over voltage relay. Its function is to open and remove field voltage to the unregulated alternators in the event of a failure of the voltage regulator, thus preventing an over voltage condition which could damage the electrical equipment.

In the event of a failure of the voltage regulating system, an auxiliary regulating system may be switched into the circuit. Abnormal operation may be noted by a discharge indication for the battery and a zero output on both alternator test positions. To energize the auxiliary regulating system, the following procedure will be followed:

1. Reduce electrical load to minimum for continued safe flight.
2. Switch "Voltage Regulator Selector" to "Auxiliary" position. (Located in circuit breaker panel.)
3. Reset any "Tripped" circuit breakers, but DO NOT reset the main voltage regulator or breaker.
4. Return to normal required electrical load.
5. If the alternator malfunction condition persists after switching to the auxiliary position, repeat the above procedure with one alternator at a time. (This can be done by tripping the alternator circuit breaker.)
6. When the offending alternator is located by this method, leave it off the line and continue flight with reduced electrical load.
7. In the event that both alternators are malfunctioning, remove both from the line, reduce loads to the barest minimum and land as soon as possible. Correct the malfunction before flight.

NOTE

Use of the voltage regulator selector switch should be limited to the above conditions unless the Service Manual is consulted.

Press-to-test switches in conjunction with an ammeter, both located on the overhead switch panel, are used to determine the output of each alternator.

NOTE

Use of the alternator circuit breaker should be limited to the above conditions unless the Service Manual is consulted.

ELECTRICAL SYSTEM (cont.)

Electrical switches for the various systems, including the master switch, are located on the circuit breaker panel. The circuit breakers, located below the electrical switches, automatically open the electrical circuit if an overload should occur. To reset the circuit breakers simply push in the reset button. It may be necessary to allow approximately two minutes before resetting the breakers. Corrective action should be taken in the event of continual circuit breaker popping. It is possible to manually trip the breakers by pulling out on the reset button. The alternator circuit breakers, mounted at the bottom of the same panel, are of the switch type.

The starter switch is located on the left side of the overhead switch panel. The switch is a rocker-actuator style and locks in the center off position. To operate, push on the switch and hold until the selected engine is started. After starting, release the switch and it will return to the off position.

Instrument lighting is provided by individual post lamps mounted adjacent to each instrument. These lights are controlled by a rheostat switch located on the upper portion of the circuit breaker panel. The lights are turned on with the first movement of the rheostat knob and the light intensity is increased by further rotation of the knob.

A reading light, with a separate switch incorporated into the light, is mounted over each passenger seat. The rear dome light and a rear exit flood light are controlled by a switch mounted in the circuit breaker panel or by a switch located just inside the cabin door. The forward dome light and switch are in the overhead between the pilots' seats. The dome and rear exit flood lights operate regardless of the master switch position.

The landing/taxi lights, controlled by switches on the circuit breaker panel, are mounted on the upper portion of the nose gear assembly. Being rigidly mounted to the assembly, the lights retract with the nose gear. Retraction of the gear will turn the lights out if the switch is left on by the pilot.

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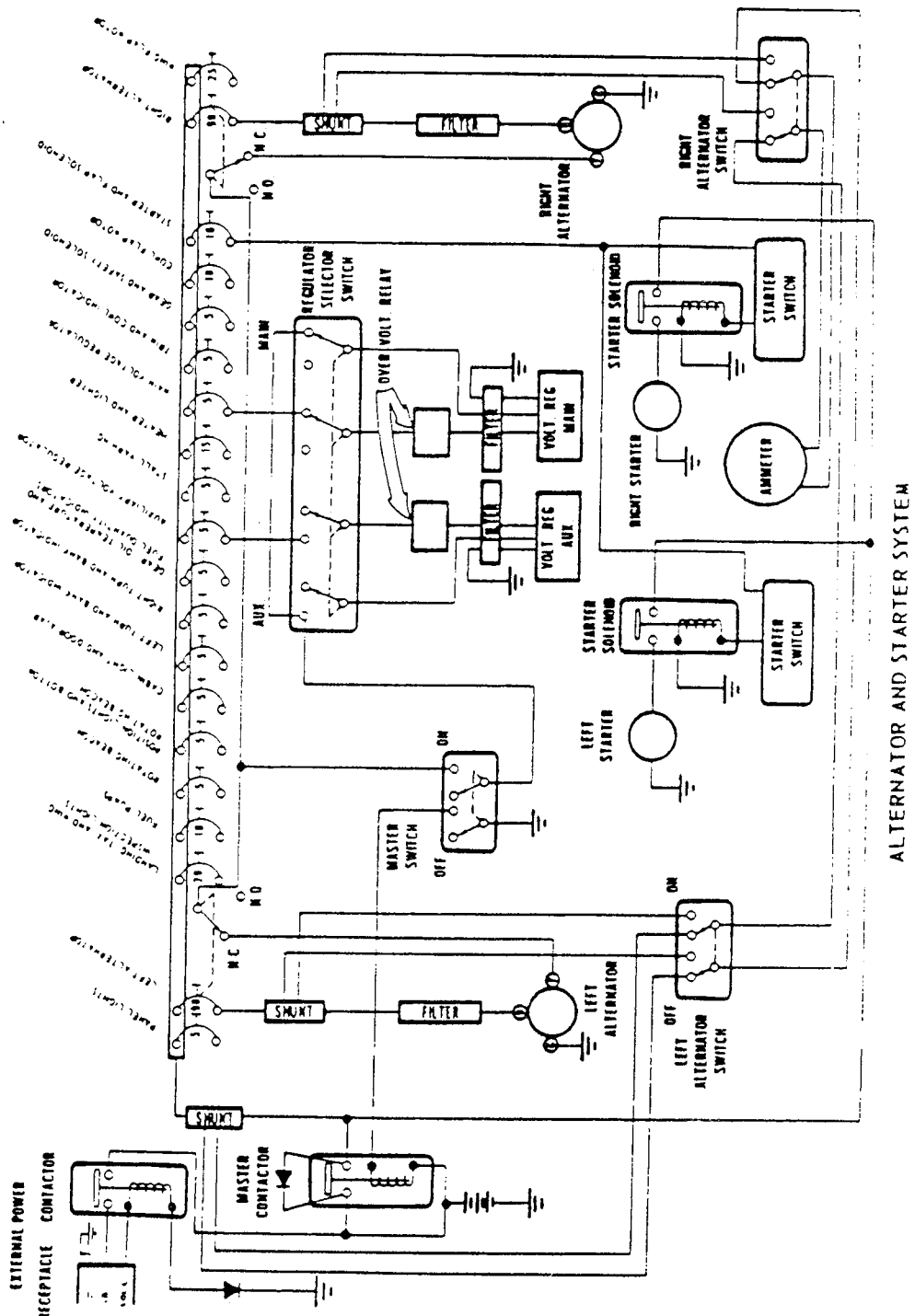
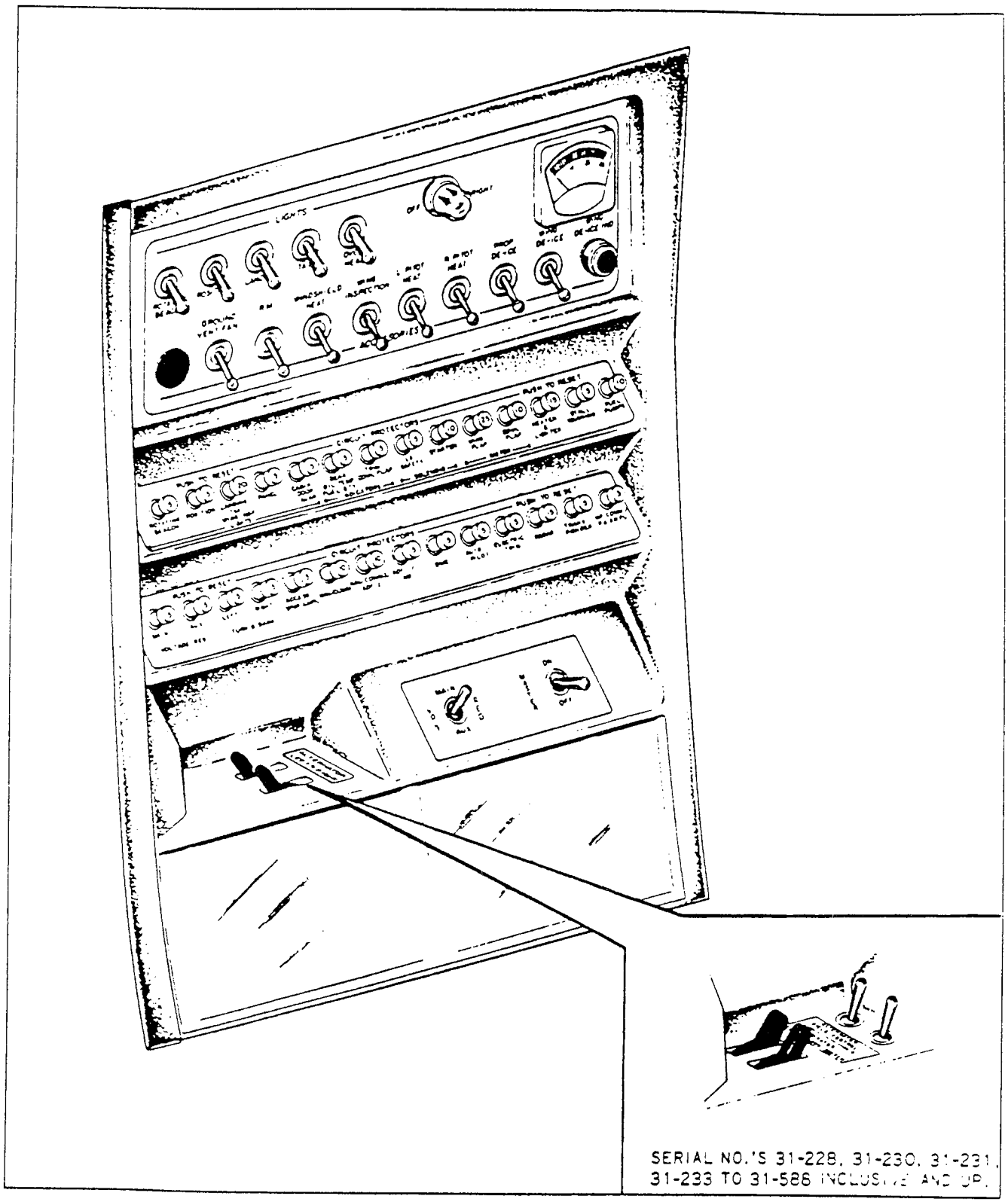
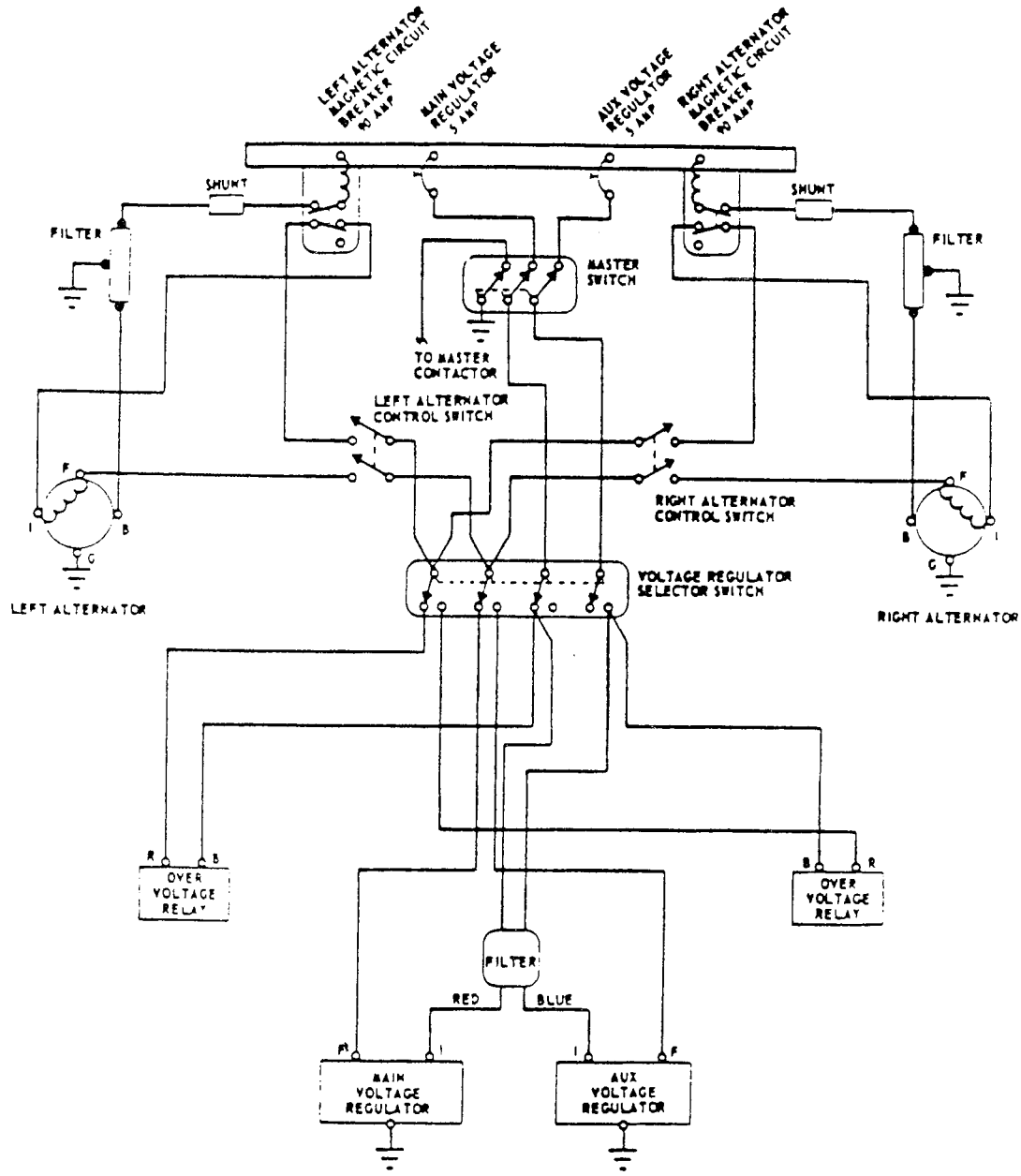


ALTERNATOR AND STARTER SYSTEM



CIRCUIT BREAKER CONTROL PANEL



PRESTOLITE ALTERNATOR INSTALLATIONS, SERIAL NO.'S 31-228, 31-230, 31-231, 31-233 TO 31-588 INCLUSIVE AND UP.

ALTERNATOR SYSTEM

ELECTRICAL SYSTEMS (cont.)

An external power receptacle is installed in the lower left fuselage nose section. This unit allows the utilization of electrical power from such sources as 24 volt generators or battery carts to aid in starting the airplane when the battery is inoperative. Turn the master switch off before inserting or removing a plug at this receptacle.

The battery should be removed for recharging. Starting recharge current should be 2 amperes. Finishing current should be 1 ampere.

ALTERNATOR FAILURE

For alternator failure see Emergency Procedures section of Aircraft Flight Manual.

PNEUMATIC AND PRESSURE GYRO SYSTEM

The two engine driven, dry type, pneumatic pumps supply air pressure to operate the gyro instruments, the optional deicer system and/or the AutoPilot servos. If pressure is lost on either side a check valve closes automatically and pressure is supplied by the remaining side. Pneumatic pressure is also used in conjunction with a venturi to obtain vacuum used in the deicer system to resist the aerodynamic forces and maintain the tubes in a flat or deflated condition. A pneumatic system pressure gauge is installed in the right side of the instrument panel to provide a constant indication of pressure which should be approximately 4.3 to 6.1 inches of mercury. AutoPilot should be turned off if gyro system fails.

HEATING SYSTEM

Cabin air enters the heater system through an inlet in the lower right nose section, and when the heater is not in operation, the inlet can serve as a cool air source if the heater control is selected open.

A 45,000 B.T.U. Janitrol heater installed in the nose section furnishes a source of hot air for cabin heating and windshield defrosting.

Operation of the heater is controlled by a three position switch located on the lower right side of the instrument panel, placarded "FAN", "OFF" and "HEAT". The "FAN" position will operate the vent blower only and may be used for cabin ventilation on the ground or windshield defogging when heat is not desired.

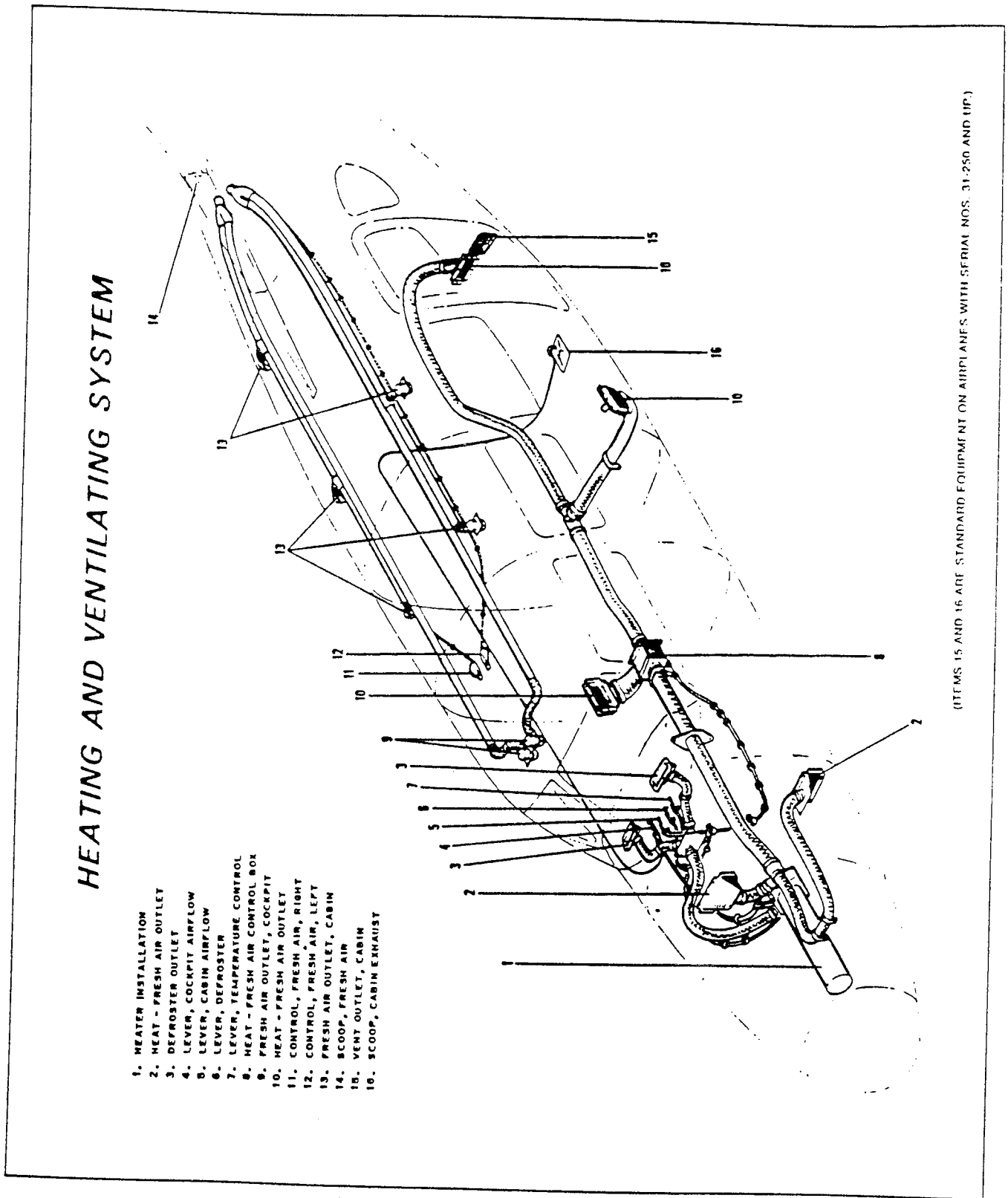
For heat, the three position toggle switch must be turned to "HEAT." This will start fuel flow and ignite the burner simultaneously. With instant starting and no need for priming, heat should be felt within a few seconds.

Regulation of heat, airflow and defroster operation is controlled by the knobs on the instrument panel to the right of the fuel switch. The first knob is connected to an adjustable thermostat which makes it possible to select a desired temperature of heated air through a wide range.

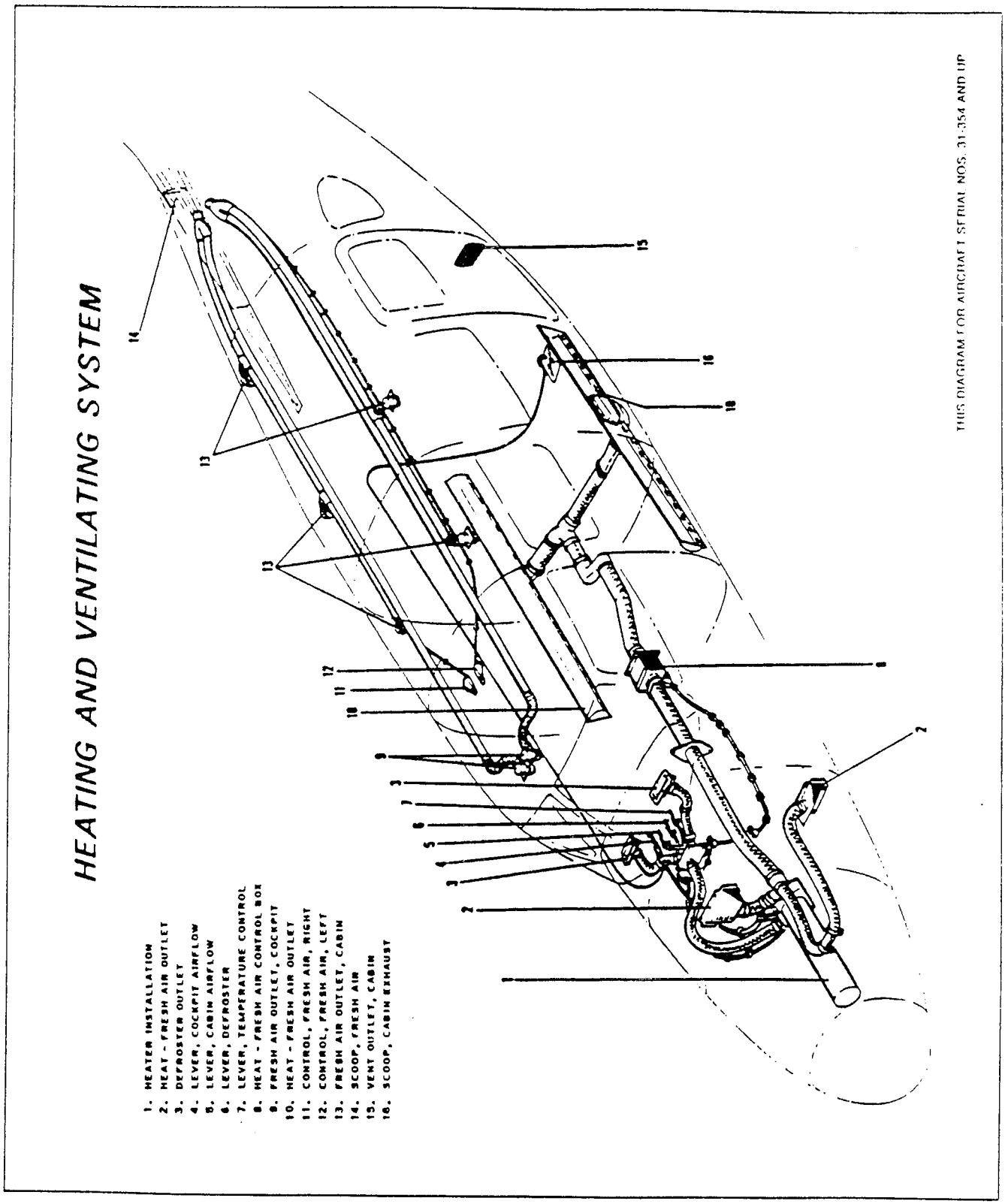
Cabin temperature and air circulation can be maintained by using various combinations of knob settings to suit individual desires. To minimize the feeling of drafts, a low airflow - high heat combination should be used.

Windshield defrosting may be regulated by various settings of the defroster knob, and in severe windshield fogging or icing conditions it may be desirable to restrict the heater air, since this will drive more air through the defrosters.

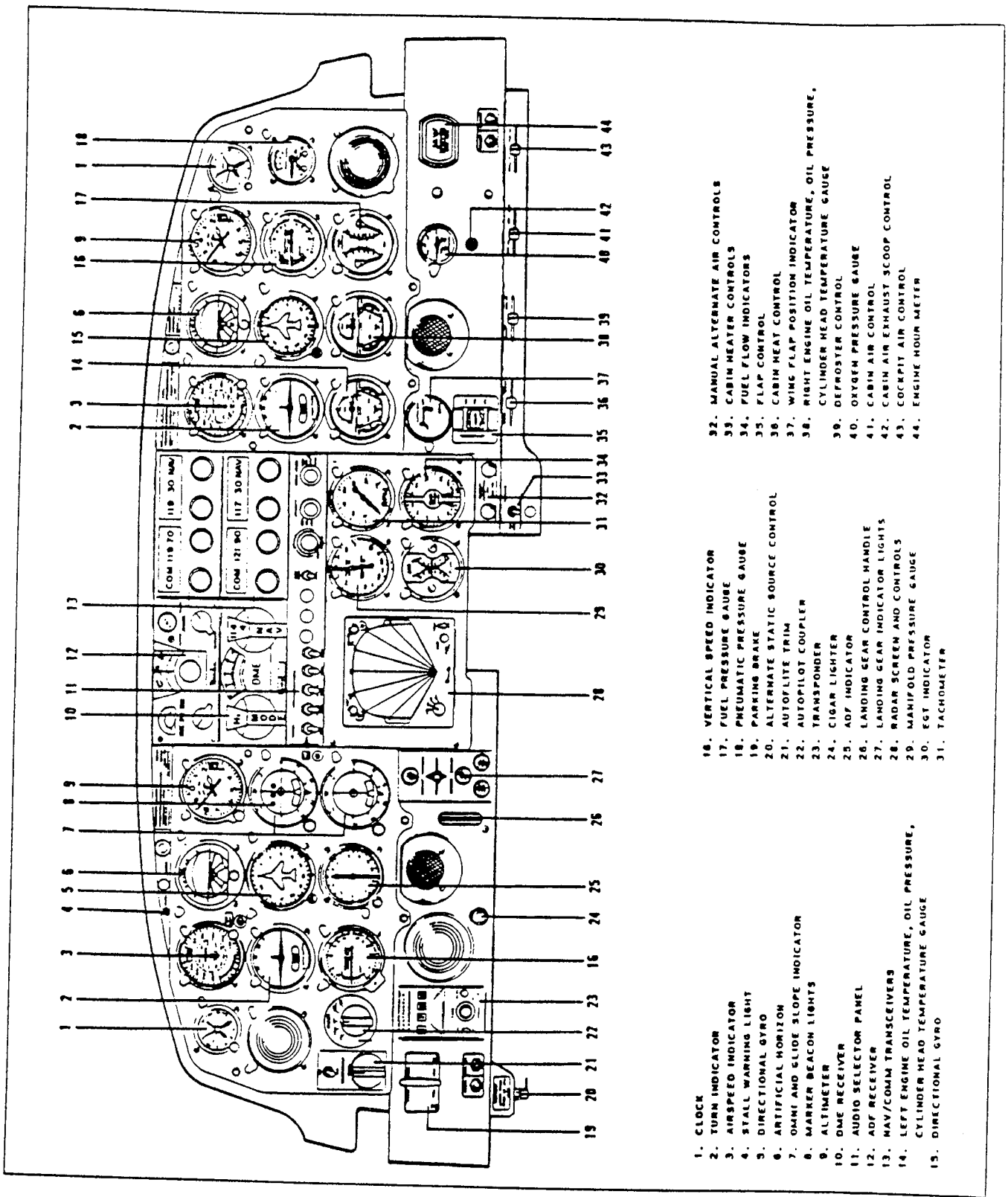
When heat is no longer desired, the three position switch may be turned to the "OFF" position. When the heater has been operating with the airplane on the ground the switch should be turned to "FAN" for several minutes to cool the heater. It may then be turned off.



HEATING AND VENTILATING SYSTEM



HEATING AND VENTILATING SYSTEM



INSTRUMENT PANEL

HEATING SYSTEM (cont.)

Heat may be supplied to warm the cabin before flight by turning on the master switch and the right auxiliary fuel pump and starting the heater. It should not be used in such a way as to deplete the battery.

The cabin heater uses gasoline from either right fuel tank. The heater will not operate with the right engine secured and the right firewall shut-off valve OFF. To operate the heater with the right engine shut down, select a left tank, turn the crossfeed on, left boost pump on, and the fuel off on the right tanks.

Located in the heater is a heat limit switch, which acts as a safety device to render the heater system inoperative if a malfunction should occur causing excessively high temperatures. This control is located in the downstream end of the vent jacket, with the reset button on the heater shroud. The reset button is reached through the access panel on the right side of the nose section.

VENTILATING SYSTEM

The flow of air for cooling the Navajo cabin is controlled by knobs on the air control panel located at the bottom of the right instrument panel.

The right control regulates air flowing to the front seat through the heater system and the second knob from the right controls air flowing to the cabin area via the heater system.

For individual fresh air ventilation, an air scoop is mounted on the tail fin fairing which pushes air into the cabin through overhead vents in the headlining. Left and right master controls for these vents are located in the pilot's speaker-light panel. Each individual vent is adjustable for desired airflow.

A cabin exhaust outlet is located in the raised floor panel in the aft cabin area. The exhaust scoop is controlled by a push-pull knob on the lower right side of the instrument panel and is located in the center of the fuselage underside even with the cabin door. A ventilation fan for this outlet is optional equipment.

INSTRUMENT PANEL

The instrument panel of the Navajo has been designed to accommodate all of the customary advanced flight instruments on the left side in front of the pilot, and all required engine instruments on the right side and lower center section. Provisions for extra instruments have been made in both sections. A complete set of advanced flight instruments can be mounted into the right panel if desired. The flight instrument group is shock mounted in an easily removed sub-panel.

The Artificial Horizon and Directional Gyro in the flight group are pressure operated through the use of pneumatic pumps installed on both engines. The Turn and Bank is an electrically operated instrument and serves as a standby for the Gyros.

An engine hour recorder is installed on the lower right instrument panel. One engine instrumentation at the bottom of the right panel includes the oil pressures, oil temperatures, and cylinder head temperatures. The fuel quantity gauges and ammeter are mounted in the panel over the windshield.

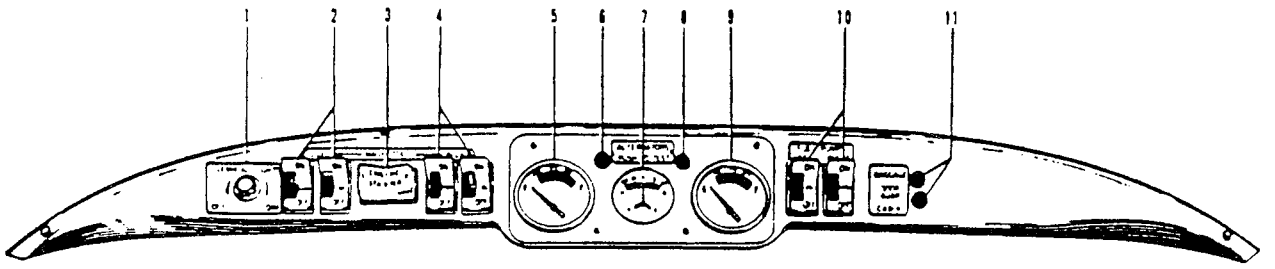
Radio units are installed in the center of the main panel. Radio power supplies are mounted on a shelf located at the rear of the forward baggage compartment.

An emergency static air valve control is located under the instrument panel near the pilot's left knee. When the alternate source is selected the pilot's instruments are vented to cabin air. Correct the airspeed and altimeter indications using the performance charts in the Flight Manual approved by the FAA.

CABIN FEATURES

Arm and headrests for all seats, ash trays, individual reading lights and ventilation controls, and pilot map lights and cigar lighter are all standard. The 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 open the emergency exit, remove the plexiglas cover, pull the red handle, and push out the window.



1. Overhead Lights Rheostat
2. Left Engine Magneto Switches
3. Engine Starter Switch
4. Right Engine Magneto Switches
5. & 9. Fuel Gauges
6. & 8. Alternator Push-to-test Switches
7. Ammeter
10. Electric Fuel Pump Switches
11. Baggage/Cabin Door Ajar Lights

OVERHEAD PANEL

SEATS

The normal seating arrangement is two crew seats and four reclinable executive-type passenger seats, each equipped with easily adjustable headrest and armrests. One or two additional full-size seats can be installed for seven or eight-place seating. The cabin seats are readily removable for cargo area or reversible for a foursome arrangement. (See Aircraft Flight Manual.) All but the seventh and eighth seats are track mounted to allow movement fore and aft.

The pilots seats are adjustable three ways; fore and aft, up and down, and tilting back. The hand lever nearest the floor allows the seat to move fore and aft. The center handle controls the movement up and down. The smaller top handle allows the seat back to be tilted.

BAGGAGE COMPARTMENTS

There are two large baggage compartments provided in the Navajo. The forward compartment provides 14.0 cubic feet of space accessible through a large rectangular door measuring 25 x 28 inches on the left side of the fuselage nose section. This area is placarded for 150 pounds. The rear compartment has a volume of 22.0 cubic feet accessible through the rear cabin door. This area is placarded for 200 pounds, which includes 50 pounds on the shelf or in the cabin. Either the weight and balance computer or curves provided in the weight and balance report should be used to verify safe loading before take-off.

FINISH

All aluminum sheet components of the Navajo are carefully finished inside and outside to assure maximum service life. Both sides of all pieces are alodine treated and are sprayed with zinc chromate primer. External surfaces are coated with durable acrylic lacquer in attractive high gloss colors. Primer is applied to interior surfaces to prevent corrosion of both structural and non-structural parts.

NUMBER PLATES

The manufacturer's name plate is located on the fuselage underside even with the forward edge of the cabin door. A second plate containing only the serial number is located to the left of the tail skid. The serial number should always be used in referring to the airplane in service or warranty matters.

OXYGEN SYSTEM

The Scott oxygen system approved for the Navajo is designed to provide supplementary oxygen for the crew and passengers for more efficient flight at higher altitudes (above 10,000 ft).

Eight oxygen plug-in receptacles are incorporated into the cabin side panels and each one is an ON-OFF valve. An oxygen supply gauge and flow control knob are mounted on the lower right instrument panel. A pressure regulator is mounted directly to the oxygen cylinder.

The 115 cubic foot oxygen cylinder is mounted aft of the forward baggage compartment and, when fully charged, contains oxygen at a pressure of 1850 pounds per square inch.

Before taking off for high altitude flying, determine that the oxygen supply is adequate for the proposed flight (see chart below) and that passengers are briefed.

When oxygen is required, pull the control knob ON, allowing oxygen to flow from the cylinder through the connecting tubing and into the receptacles.

To use oxygen, connect a constant flow mask fitting into a receptacle and don the mask. A flow indicator shows oxygen pressure to the mask by the absence of the red pellet, which is forced toward the mask. The pilot's mask is stowed under the pilot's seat and the copilot's and passengers' masks are stowed in the fuselage side panels beside each seat. The mask for the eighth seat is stowed behind the seat.

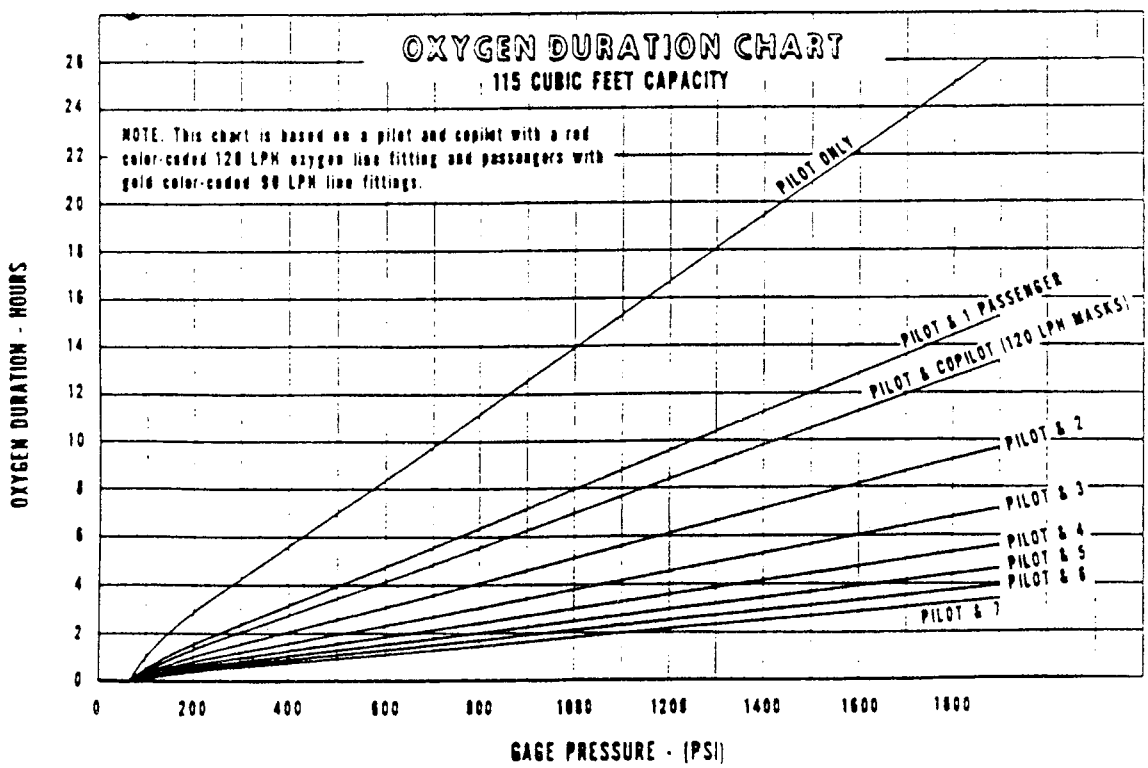
Always remove fitting from receptacle and stow mask when not in use. Oxygen will flow through the mask whenever fitting is in receptacle, with control knob ON. Mask may be damaged if not stowed.

The pilot's mask (identified with a Red band on the supply hose) supplies 120 liters per hour. The passenger masks (identified with a Gold band on the supply hose) supply 90 liters per hour.

Keep oil, grease, hydraulic fluid, paint or other inflammable material away from oxygen equipment.

CAUTION

Positively "NO SMOKING" while oxygen is being used by anyone in the airplane.



PNEUMATIC WING AND TAIL DEICING

The Deicers on the wing and tail surfaces are inflated simultaneously. Timers provide an automatic cycling operation every 3 minutes during timer operation.

The deicing system will normally apply vacuum to the deicers at all times, except when they are being inflated. Deicer inflation is affected by the deicer system control switch. Through actuation of this On-Off switch, the timer energizes the combination overboard-pressure relief control valves for 6 seconds. The energized control valves port pressurized air to the pressure-sensitive shuttle valves which in turn shut off the vacuum and allow the air to inflate all deicers on the plane. The deicer pressure, nominally 18 PSIG, is regulated by the pressure-relief function of the control valves. Upon automatic de-energization of the control valves by the timer, the shuttle valves permit the deicer pressurizing air to return to the control valves and be exhausted overboard. System vacuum is then applied to the deicers to hold them close to the surface skin.

ELECTRIC PROPELLER DEICER

An electrical propeller Deicer system can be installed in the Navajo as optional equipment. The installation consists of four propeller Deicer pads bonded to the leading edges of the propeller blades; modified starter ring gears incorporating slip rings to distribute power to the propeller Deicers; brush assemblies for power distribution to the slip ring; a timer which cycles power to the propeller Deicers; an ammeter, mounted in the circuit protector panel, indicating current through the Deicing system; and a Deicing system ON-OFF switch located on the circuit breaker panel.

When the propeller Deicer switch is placed in the "ON" position, electrical power is supplied to the propeller Deicers from the airplane's electrical power supply. Deicing is accomplished by heating portions of the Deicers in a sequence which is controlled by the timer. The heat reduces the adhesion between the ice and the propeller, so that centrifugal force and the blast of the airstream causes the ice to be thrown off the propeller blades. Cycling of the Deicer heating is as follows:

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

When the system is turned on, heating may begin on any one of the cycles depending upon the initial positioning of the timing switch. Once begun, cycling will proceed in the order of (a), (b), (c) and (d) as indicated above until the system is turned off.

Propeller imbalance may be relieved by varying the RPM: increase RPM briefly and return to desired setting, repeating if necessary. The propeller Deicer ammeter will indicate a reading of from 8 to 12 amps.

ICE DETECTION LIGHT

An ice detection light can be installed on the outboard side of the left engine nacelle for checking icing conditions during night flight.

This light is controlled by a switch mounted in the circuit protector and switch panel.

RADAR

The RDR-100/110 and the AVQ-45/46 Weather Avoidance Radar Systems can be installed in this airplane. Each consists of a transmitter-receiver, an antenna and a cockpit indicator. The function of these systems is the detection and display of high density areas of moisture that are associated with the

turbulence of thunderstorms. With this information outlined on the indicator and interpreted by the pilot, an early decision can be made as to the most desirable avoidance course. Equipment can be chosen with ranges up to 50 or 80 miles to give constant surveillance of enroute weather.

All operating controls for each of these systems are readily accessible to the pilot or copilot.

The function selector knob controls primary power to the radar system, allows the equipment to be placed in a standby condition during the warm-up period and when the system is not in use, and it provides for the selection of operating range. The AVQ-45 differs from the other three systems chiefly in the indicator design as its single range display capability is 50 nautical miles. The AVQ-46 and RDR-100 110 all have range selections of 20 and 80 nautical miles.

The knob on the upper right corner of the indicator is used to control the brilliance of the indicator sweep line and range marks. It is normally adjusted until the sweep is just visible and then backed off slightly until the sweep just disappears.

The gain control knob on the upper left corner of the indicator varies the receiver sensitivity. It should be adjusted for optimum system gain by slowly increasing the control (with intensity control set) until receiver "noise" or "snow" is just visible on the indicator and then slightly decreasing the setting of the knob. This setting should not be changed when making weather observations. However, when using the system for ground mapping, it may be desirable to readjust the gain control for best presentation.

The knob in the lower right corner of the indicator is used to vary the antenna and sweep scanning speed over a range of approximately 0 to 12 looks per second. This allows compensation for various ambient light conditions in the cockpit.

The antenna tilt control adjusts the antenna reflector to move the radar beam as much as 12° up or down from horizontal. This permits the operator flexibility in determining the vertical dimensions of weather systems and enables him to tilt the beam downward for terrain mapping.

The following procedure is suggested for initial adjustment of the system; it is designed to establish an optimum operating condition for the equipment. Ignore references to range selections where they do not apply.

CAUTION

Before attempting to turn on or operate the radar it is important that the airplane be positioned to face away from buildings, large metal structures, or other aircraft in close proximity that are likely to return large amounts of reflected energy to the system. Damage to the radar as well as the possibility of igniting flammable materials is a possibility when operating the radar on the ramp. Avoid operating the radar within 50 feet of other aircraft or objects. Don't operate it closer than 100 feet to refueling operations. Never look directly into the antenna for prolonged periods at close range, with the radar in operation. Serious eye damage may result due to the heating effect of the radar energy on sensitive eye tissue. In general, the minimum safe distance to keep from a radar dome or sweeping antenna is 40 feet.

On the Ramp:

1. Position airplane so that radar beam will be free of all major obstructions.
2. Preset the following controls:
   a. Range selector to standby
   b. Scan Rate - Full counterclockwise (CCW)
   c. Gain - full CCW
   d. Intensity - full CCW
   e. Contour/Normal/Map to Map
   f. Tilt - Up approximately 8°

3. Allow a 3 minute period for filament warm-up of transmitter and indicator tubes. After this period, switch the Range Selector to 20.

4. Adjust the following controls:

a. Advance Intensity CW until the sweep line is just visible.

b. Advance Scan Rate CW until the sweep begins scanning back and forth. This also indicates normal antenna scanning. However, do not leave this control in the extreme CCW position for prolonged periods with the trace visible. Damage to the PPI tube may result.

c. Observe that proper number of range marks (4) appear for both the "20" and "80" position Range Selector switch.

d. Vary the Scan Rate control to determine that high speed scan is possible.

e. Increase Gain Control CW until noise (snow) just begins to appear on scope. Note that it is uniform and not broken up into pie-shaped sectors of varying density.

NOTE

Occasionally, insufficient warm-up time gives the above effect until the tubes heat up enough to come within range of the automatic frequency control circuit. Allow an additional minute for such contingency.

Before continuing with in-flight operational adjustments for the radar system, it should be understood that the radar picture on the pilot's indicator displays only that portion of sky and ground actually being scanned by the radar beam. In some systems the radar antenna is rigidly attached to the airframe and consequently assumes the pitch and roll attitudes dictated by aircraft maneuvers. Therefore, valid weather and terrain mapping data are normally obtained while the airplane is in straight and level flight; observations while the airplane is maneuvering are restricted, depending on the violence of the maneuver, and hence this lack of information must be considered in making an evaluation.

In-Flight:

1. Allow 3 minute warm-up.
2. Turn Range Selector to 80 - Antenna Tilt up 8°.
3. Increase Intensity until trace just appears and back off slightly.
4. Increase Gain until "noise" (snow) is just barely visible.

NOTE

When this position of optimum gain has been determined, a small reference mark may be made on the indicator so that the gain control can be readjusted to this approximate reference setting for all subsequent weather observations.

5. Slowly tilt antenna downward until a maximum density of ground targets is observed. Targets should be displayed well beyond 20 miles, with very prominent targets appearing at 40 miles or more.

6. Switch to 20 mile range and Map function. Readjust Tilt for best display. A uniform ground return should be obtained at low altitudes with some loss of close-in targets at altitudes above 5000 feet.

When satisfactory operation of the radar has been determined by observing terrain targets, the system can be adjusted for weather observations as follows:

1. Move Range Selector to 80.
2. Contour Normal/Map to Normal.
3. Tilt antenna up until all ground targets just disappear from scope.

4. Observe any weather targets within range and note the shift in position on the scope when the range selector is switched to the 20 mile range.

5. By slowly tilting the antenna up and down, storm cells can be scanned vertically and the height of the cell noted.

6. Also observe whether additional cells are evident at the same azimuth but at increased range.

7. When a good weather target is located move the Contour/Normal/Map switch to Contour and note the contoured black hole within the lighted area of the cell.

8. If the cells observed in the above steps can be tracked from 60-80 miles away, a large storm is ahead. If the airplane is within 15 miles of any of these storm cells, turn sufficiently to head away from the storm area.

RIGHT INSTRUMENT PANEL LIGHTING

Instrument lighting for the right instrument panel is provided by individual post lamps mounted adjacent to each instrument. These lights are controlled by a rheostat switch located on the lower right instrument panel. The lights are turned on with the first movement of the rheostat knob and the light intensity is increased by further rotation of the knob.

FIRE EXTINGUISHER (PORTABLE) *

A two and one half pound portable extinguisher is mounted on the wing spar cover directly behind the pilot's seat.

The extinguisher is the dry powder type suitable for liquid or electrical fires. It is operated by aiming the nozzle at the base of the fire and squeezing the trigger grip. Releasing the trigger automatically stops further discharge of the extinguishing powder.

ELECTRIC WINDSHIELD (PILOT SIDE ONLY) *

The electric windshield, used to prevent ice and fogging, is operated with a switch on the switch panel. To check the operation prior to take-off, the engines should be running and the windshield switch turned on. If the windshield feels warm, it is operating properly. Distorted vision or small bubbles in plastic of heated windshield may indicate an overheat condition. Use caution during ground operation to prevent overheat.

WINDSHIELD WIPER *

The electrically operated windshield wiper is available with the heated windshield installation and only on the pilot's side. Caution should be used not to operate it at speeds above 150 MPH or on a dry surface.

ANTI-STATIC WICKS *

The anti-static wicks installed on the trailing edges of the wing panels and tail surfaces are designed for efficiency in clearing the airplane of surface static that disrupts LF reception, loss of ADF indication, or VHF interference.

*Denotes Optional Equipment

ELECTRIC PITOT HEAT

The pitot tubes, located under the nose section ahead of the nose gear doors, are heated by direct current from the electrical system. The controlling switches are located with the deicing equipment switches on the switch - circuit breaker panel.

CABINET AND DISPENSER *

Ahead of the luggage compartment and aft of the seating area a refreshment unit, crafted in walnut, can be installed. Above it, attached to the vertical divider, is a cabinet that accommodates two thermos bottles for hot coffee, water or other noncarbonated beverages. The counter top lifts up for access to ice in an insulated container. Beneath are two large drawers and a cabinet.

WALL DIVIDER *

For privacy, walnut cabin dividers and a curtain door can be installed to separate the cabin from the crew cockpit. A "No Smoking - Fasten Seat Belts" lighted sign is installed on the right divider. A switch on the copilot's side of the divider allows him to control the light.

FOLDING TABLES *

Folding tables can be installed on both sides between the second and third windows. To use the tables, the first seat on each side in the main cabin must be installed facing aft, "conference style". The table pulls up from its wall rack and folds down in position, with two drop leaves then unfolding to increase the surface area. Ash trays and glass holders are an integral part of the installation.

TOILET INSTALLATION *

A self contained toilet unit can be installed on the rear baggage compartment floor. A curtain can be drawn behind the rear seats for complete privacy. A tissue dispenser is designed into the top of the unit, and a plastic bag inside the toilet unit assures sanitary disposal upon reaching your destination. Toilet installation includes a relief tube.

RAMP HAILER *

The ramp hailer is controlled with the Public Address-External Speaker switch located on the audio amplifier control panel. The ramp hailer speaker is located beneath the floor of the nose baggage compartment, and allows communications with attendants or ground personnel on the apron or ramp.

*Denotes Optional Equipment

AFT CABIN HEATER*

A 45,000 B.T.U. Janitrol Heater can be installed in the Aft Cabin Bulkhead. Warm air is expelled through an adjustable deflector mounted in the rear baggage compartment.

Operation of the unit is controlled by a Three Position Switch located below the Forward Heater Control Switch. The "FAN" position can be used for recirculating cabin air. Also, the fan position is used for cooling the heater after ground operation, using the same method as the main cabin heater. To obtain heat select "HEAT" position. This activates the heater fuel pump and ignition occurs instantly. When the heater is "OFF" the fuel is shut off automatically.

The heater has a fuel pump separate from the standard aircraft fuel system. This pump receives fuel from a tee just forward of the fuel system crossfeed valve. Therefore, the only time the heater will not operate is when the right fuel tanks are empty. If the right fuel tanks are empty and you still require heat, select crossfeed "ON" and this will supply fuel to the heater fuel pump.

There is no cabin temperature control, therefore, the pilot has to manually turn the heater "ON" and "OFF" to control cabin temperature.

Except for the above operations the heater operates the same as the forward cabin heater.

*Denotes Optional Equipment

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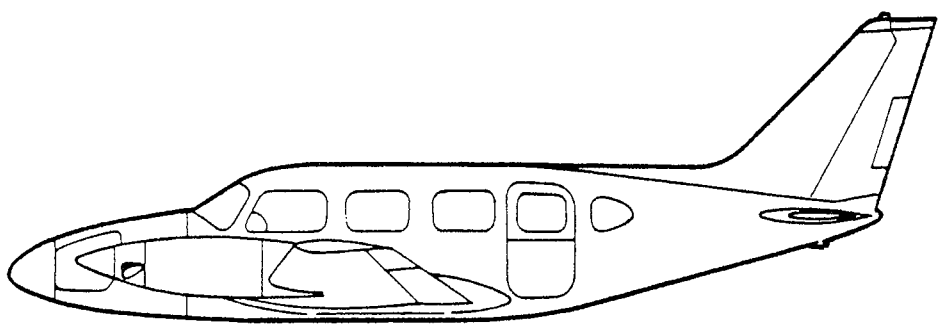
FAA APPROVED

FLIGHT MANUAL

FOR

PIPER "NAVAJO"



NOTE

THIS MANUAL MUST BE KEPT IN THE AIRPLANE AT ALL TIMES

MANUFACTURER'S MODEL · PA-31

MANUFACTURER'S SERIAL · 31-420

REGISTRATION · N

FAA APPROVED BY: _____

J. W. McNARY
PIPER AIRCRAFT CORPORATION
D. O. A. No. EA-1
LOCK HAVEN, PENNSYLVANIA

DATE OF APPROVAL: FEBRUARY 15, 1966

APPROVAL BASIS: CAR 3 AND FAR PART 21, SUBPART J.

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SECTION I

LOG OF REVISIONS

Revision	Revised Pages	Description and Revision	FAA Approved Date
This manual, which was completely revised January 12, 1967, applies to Piper Model PA-31, S/N 31-2 and up.			
1.	38 59	Bank Angles & Alt. Losses Rev. 2nd DADF-1 added RMI-800E added SA-14R Sunair added	Feb. 1, 1967
2.	3 5 15	Minimum Control Speed Wording Revised Delete (15° T.O. Flaps) Flap setting revised	Feb. 15, 1967
3.	43	Item 3. c. removed Item 4. b. (2) reworded	Feb. 24, 1967
4.	49 59 60	Governor model added KNR 660 added Changed heater model number Added Seventh and Eighth seat	March 6, 1967
5.	54 & 55 60 51	Drawing Reference Change Revised Weight and Arm Oil Cooler Part No. Revised	March 21, 1967
6.	58, 59, 60, 61, 62 Pages 63, 64, 65, 66 & 67 added	Dual Mark 12A, VOA-4, ADF-T-12C, Dare ADF added, RCA Radar added, Pilot Comfort Unit deleted.	June 1, 1967
7.	62 65 54	Added 2nd King KFS-590 Channel Selector also King KXP-750 Transponder Added Ground Ventilation Fan Insts. 43524 & 43642 Altimeter changed.	Sept. 1, 1967
8.	ii Pages 38a & 38b added	Addendum to Supplement B added	Sept. 11, 1967

LOG OF REVISIONS (cont)

Revision	Revised Pages	Description and Revision	FAA Approved Date
9.	49	Alternate Spinner, Spinner Caps & Spinner Bulkheads added.	Oct. 3, 1967
10.	ii	Added Item 13	Oct. 13, 1967
	2	Changed to Lyc. TIO-540 Series	
	14	Added note to 8. q.	
	16	Added Note from page 17	
	17	Item 21 rewritten	
	21	Added Item 13	
	51	Added Engine Model	
11.	2	Changed to Lyc. TIO-540-A Series	Dec. 15, 1967
	9	Added Item 8 - "Light to Moderate Icing"	
	19	Revised 3. Unfeathering Procedure	
	38	Revise Roll & Pitch Forces	
	38b	Revise Roll & Pitch Forces	
	51	Revise "Cert. Basis"	
	53	Added 40-102a & 30-68a Wheel & Brake	
	56	Added Gyro Horizon & Voltmeter	
	57	Added 40-0103-25 Anti-Collision Light & 70 Amp Alternator; Revise "Cert. Basis"	
	62	Added KN-60 B DME	
	64	Added AVQ-46 Radar	
	65	Added Shoulder Harnesses	
	66	Added Stall Warning Horn	
	67	Changed Windshield Weight & added Elevator Horn De-Icing Boot	
12.	17	Item 20. Revised	April 22, 1968
	27	Lift Off Speed Revised	
	51	Added Engines; & Air Pumps	
	63	Added New AltiMatic III Inst; & Glide Slope Coupler	
	65	Added Cabin Exhaust Vent Inst.	
13.	2	Added Propeller & Note	May 6, 1968
	49	Added Propeller	
	50	Added Propeller Engine Combination	
14.	ii & iii	Revised Section V	July 1, 1968
	2	Added Propeller	
	7	Revised 1.	
	8	Corrected Spelling	
	38	Revised "Flight" & "Limitations"	
	49	Added Propeller, Spinner, Caps etc.	

LOG OF REVISIONS (cont)

Revision	Revised Pages	Description and Revision	FAA Approved Date
14. (cont)	50	Added Propeller Engine Combination	July 1, 1968
	66	Added Beverage Dispenser	
	67	Added Propeller Anti-Icers	
15.	54	Added Turn & Bank	Sept. 16, 1968
	58	Added VOA-8, VOA-9 ant UAT-1	
16.	iii	Added AltiMatic IIIB to Section V	Nov. 15, 1968
	2	Added Propeller Model	
	44	Added Supplement E - AltiMatic IIIB	
	49	Added Propeller Model & changed Governor Approval	
	50	Added Propeller Model	
	51	Added Hydraulic Pump	
	63	Added AltiMatic IIIB Inst.	
	66	Added Electric Windshield Wiper & Heated Pitot Tube	
	67	Remove Heated Pitot Tube	
17.	43	Par. 4, (c) (2) - D. 2 (a) was VE 2 (a)	March 7, 1969
	51	Changed Weldon Elect. Fuel Pump No.	
	54	Removed callout of Gyro Horizons & added to Pg. 56; changed Part No. Reference for Airspeed, Altimeter, T & B, Rate of Climb (detail no. in lieu of inst.); added Outside Air Temp. Gage & Ammeter (removed from Pg. 55).	
	55	Removed callout of Directional Gyros & added to Pg. 56; Added additional Fuel Flow Gage; Removed Outside Air Temp. Gage & Ammeter; Added Elevator & Aileron Position Indicators, and Combination Gage (removed from Pg. 56).	
	56	Added complete listing of Gyro Horizons & Directional Gyros; Removed Elevator & Aileron Position Indicators, and Combination Gage.	
	58	Added Narco Mark 12B, Mark 16, VOA-40, VOA-50m; Removed installation dwg. ref.	
	59	Removed installation dwg. references.	
	60	Removed installation dwg. references.	
	61	Removed installation dwg. references.	
	62	Added King KA-25 Audio Amplifier; removed installation dwg. references.	
	63	Added AltiMatic IIIB for Glide Slope Coupler, removed installation dwg. references.	

LOG OF REVISIONS (cont)

Revision	Revised Pages	Description and Revision	FAA Approved Date
17. (cont)	64	Added Shure Microphone; Rearranged listings & removed installation dwg. reference.	March 7, 1969
	65	Added Aft Cabin Heater; Removed installation dwg. reference for Fire Extinguisher & added part no.	
	Page 65a added		
	66	Removed installation dwg. reference and added part no. for Heated Pitot.	
	67	Removed installation dwg. references & added part nos. for Heated Pitot, Elect. Prop De-Ice (2 & 3 bld.) & separated callout of Anti-Static Antennas & Anti-Static Wicks.	
18.	ii	Under Section III, B. Emergency Procedures- added Item 14. Alternator Failure.	Oct. 1, 1969
	Pages 21a & 21b added		
		THE FOLLOWING REVISION IS RESULT OF ADDING ADDITIONAL APPROVED EQUIPMENT.	
19.	i	Changed page number for Item N.	Feb. 16, 1970
	ii	Under Section III, A. Normal Operating Procedures, added 27. Anti-Collision Lights	
	6	Added Placards for Anti-Collision Strobe Lights: Removed beginning of N. "Types Of Operation - Equipment Required For Various Conditions Of Flight" added to Page 7	
	7	Added information from Page 6	
	14	Revised instructions for Magneto Check Item 8. j.	
	Pages 18a & 18b added		
	49	Added Prop Synchronizer	
	51	Added additional Hydraulic Pump	
	54	Added additional Altimeters & Electric Turn & Banks	
	56	Added additional Gyro Horizons & Directional Gyros	
	57	Added Anti-Collision Strobes	
	59	Added Bendix RDR-110 Radar	
	62	Added King ADF	
	64	Revised Part No. for Boom Mike	

LOG OF REVISIONS (cont)

Revision	Revised Pages	Description and Revision	FAA Approved Date
19. (cont)	65	Revised "Arm Aft Datum" for Folding Table (Right & Left) & Eighth Seat	Feb. 16, 1970
20.	i Pages 6a & 6b added 9 Pages 9a & 9b added	Changed page number for Item O. Item O. Minimum Crew removed, added to page 9a	Feb. 27, 1970
21.	3 33 & 34 44 45 54	Revised the stall speed (71 to 73) & resulting change to white arc range for airspeed indicator Revised graphs as result of stall speed change Under AltiMatic IIIB, added Par. (d) Pitch Trim Warning Light Added information from page 44. Added additional airspeed indicators	May 25, 1970
22.	21a	Revised instructions for step g. under item 14. Alternator Failure.	Dec. 1, 1971
23.	6a	Warning placard added.	Sept. 1, 1972
24.	6a	Revised Warning placard.	March 21, 1975 P E Everly Paul E. Everly
25.	4	Added Zero Fuel Weight to item J.	Jan. 9, 1976 Paul E. Everly P E Everly
26.	2 49 50	Revised items A. and D. (revised Prop. designations). Revised Prop. designations. Moved material from page 49 to page 50. Revised Prop. designations. Added material from page 49.	June 21, 1976 P E Everly Paul E. Everly

LOG OF REVISIONS (cont)

Revision	Revised Pages	Description and Revision	FAA Approved Date
27.	ii	Added item 15. Asymmetric Flap Extension under Section III B. Emergency Procedures.	Feb. 4, 1977
	9	Added item 15. under DAY VFR requirements.	P Everly
	21a	Added item 15. Asymmetric Flap Extension under Section III B. Emergency Procedures.	Paul E. Everly
28.	4	Revised Max. Landing and Zero Fuel weights.	June 7, 1977
	32	Revised graph as result of increased landing weights.	P E Everly
			Paul E. Everly
29.	4	Added Ramp Weight to Section J.	
	17	Item 22 revised.	July 3, 1979
	21a	Item 15b. revised.	D. H. Trompler
	37	Added note after Pitch Section item 1. (b).	
30.	i, ii	Revised index.	
	3	Removed item G. Flap Indicator Markings. and added new item G. Max. Operating Altitude, removed reference to take-off flaps.	
	7	Revised 25,000 ft. to 24,000 ft.	
	9	Removed Flight above 24,000 ft. MSL info.	
	14	Revised Before Take-off procedures.	
	15	Revised Take-off and Climb procedures. Renumbered items.	
	16, 17, 18, 18a	Renumbered items.	
	18b	Relocated material.	
	19	Revised Engine Failure During Take-off procedure.	
	20	Relocated material.	
	27	Revised Take-off chart	
	28	Revised Accelerate - Stop Distance chart.	
	28a	Added Accelerate - Stop Distance chart. (Heavy Duty Brakes)	
	28b	Add Multi-Engine Climb Performance Chart.	June 3, 1980
	29	Removed Climb Performance with Take-off Flaps chart.	D.H. Trompler
	55	Revised Wing Flap Position Indicator No.	

LOG OF REVISIONS (Cont.)

Revision	Revised Pages	Description of Revision	FAA Approved Date
31.	i	Revised Section III A.	
	ii	Revised Sections III B. and IV C., D.	
	2	Added Pitch Settings to Section II D.	
	14	Revised item 9e.	
	15	Relocated items 13, 14, 15 to pg. 15a; revised item 10.	
	15a	Added pg.; added 13, 14, 15 from pg. 15; added items 15f, g, h, i from pg. 16.	
	15b	Added pg.	
	16	Relocated 15f, g, h, i to pg. 15a.	
	19	Revised item 4; deleted Warning.	
	19a	Added pg.; added new item 5 (Engine Failure During Short Field Takeoff).	
	19b	Added pg.; added new item 5 info. (Engine Failure During Short Field Takeoff).	
	20, 21, 21a	Renumbered items.	
	27	Added Normal to Takeoff Distance Over 50 Feet graph.	
	28	Added Normal to Accelerate/Stop Distance graph.	
	28a	Added Normal to Accelerate/Stop Distance graph (Heavy Duty Brakes).	March 13, 1981
	55	Revised items.	D. H. Trompler
32.	ii	Revised pg. no.	
	6a	Added placard.	
	15a	Revised item 14. f.	
	21a	Revised item 16. Asymmetric Flap Conditions.	
	21b	Added continuation of item 16. from pg. 21a.	
	21c	Added pg. (added continuation of item 16.).	
	21d	Added pg.	
	30	Revised Balked Landing Climb Chart (Flap Condition and format).	
	31	Revised Single Engine Climb Chart (format).	
	32	Revised Landing Distance Chart (Flap Condition, added Power Condition).	
	33	Revised Stall Speed vs Weight Chart (Flap Condition and format).	
	34	Revised Stall Speed vs Angle of Bank Chart (Flap Condition and format).	
	38	Revised item 6. (d), Flap Limits.	May 3, 1982
	39	Revised item 1. (c), Flap Limits.	
	45	Revised item 6. (d), Flap Limits.	D.H. Trompler

LOG OF REVISIONS (cont)

Revision	Revised Pages	Description and Revision	FAA Approved Date
33.	1g	Added page.	
	6	Revised fuel control console placard; relocated information to page 6a.	
	6a	Relocated information from page 6.	
	10	Relocated item a. (Cockpit) from page 11.	
	11	Revised item b. (Left Wing) by adding caution and warning.	March 19, 1997
	12	Revised item d. (Right Wing) by adding caution and warning.	Peter E. Peck
34.	1g	Added Rev. 34 to L of R.	April 22, 2002
	16	Revised para. A.18.	
	20	Revised para. B.10.	Albert J. Mill

SECTION II

LIMITATIONS

A. ENGINE POWER AND SPEED LIMITS

310 HP at 2575 RPM
Full Throttle at all Altitudes

Engine:	Lycoming TIO-540-A Series	Two
Propeller:	Hartzell HC-E2YK-2B/C8475-4 (2 Bld) or HC-E2YR-2B/C8475-4 (2 Bld) or HC-E3YR-2/C8468-6R (3 Bld) or HC-E3YR-2A/C8468-6R (3 Bld)	
	or HC-E2YK-2BT/C8475-4 (2 Bld) or HC-E2YR-2BT/C8475-4 (2 Bld)	
	or HC-E3YR-2T/C8468-6R (3 Bld) or HC-E3YR-2AT/C8468-6R (3 Bld)	Two

(See Page 50 for approved engine-propeller combinations)

B. TEMPERATURE AND MANIFOLD PRESSURE LIMITS

Oil Temperature	(Maximum)	245°F
Cylinder Head Temperature	(Maximum)	475°F
Exhaust Gas Temperature	(Maximum)	1650°F
Manifold Pressure	(Maximum)	43 IN HG

C. FUEL GRADE

100/130 Grade Aviation Gasoline (Minimum)

D. PROPELLER

Hartzell - Constant Speed, Feathering		Two
Hub Model:	HC-E2YK-2B or HC-E2YR-2B (2 Bld) or HC-E2YK-2BT or HC-E2YR-2BT (2 Bld) or HC-E3YR-2 or HC-E3YR-2A (3 Bld) or HC-E3YR-2T or HC-E3YR-2AT (3 Bld)	Two
Blade Model:	C8475-4 (2 Bld) or C8468-6R (3 Bld)	Two
Pitch Settings at 30 Inch Station:	Low Pitch Stop	13.2° ± 0.1°
	High Pitch Stop	82.0° ± 1.0°

E. POWER PLANT DOOR AND FLAP SETTINGS

Cowl flaps will be positioned to maintain temperatures at or below maximum temperatures.

F. INSTRUMENT MARKINGS (POWER PLANT)

Exhaust Gas Temperature	
Green Arc (Normal Operating Range)	750°F to 1650°F
Radial Red Line (Never Exceed)	1650°F
Fuel Pressure	
Green Arc (Normal Operating Range)	25 PSI to 45 PSI
Radial Red Line	
Minimum	25 PSI
Maximum	45 PSI

Manifold Pressure	
Radial Red Line	43 IN HG
Tachometer	
Green Arc (Normal Operating Range)	500 RPM to 2575 RPM
Radial Red Line (Maximum)	2575 RPM
Cylinder Head Temperature	
Green Arc (Normal Operating Range)	100°F to 475°F
Radial Red Line (Never Exceed)	475°F
Oil Pressure	
Green Arc (Normal Operating Range)	60 PSI to 90 PSI
Yellow Arc (Caution Range)	25 PSI to 60 PSI
Yellow Arc (Caution Range)	90 PSI to 100 PSI
Radial Red Line	
Minimum	25 PSI
Maximum	100 PSI
Oil Temperature	
Green Arc (Normal Operating Range)	120°F to 245°F
Yellow Arc (Caution Range)	50°F to 120°F
Radial Red Line (Never Exceed)	245°F

G. MAXIMUM OPERATING ALTITUDE

24,000 feet.

H. AIRSPEED LIMITATIONS AND INDICATOR MARKINGS

Never Exceed Speed	272 MPH (236 KT)
Maximum Structural Cruise Speed	216 MPH (187 KT)
Design Maneuvering Speed	188 MPH (164 KT)
Flaps Extended Speed	150 MPH (130 KT)
Maximum Landing Gear Operation Speed	150 MPH (130 KT)
Maximum Landing Gear Extended Speed	150 MPH (130 KT)
Minimum Control Speed	85 MPH (74 KT)
Stall Speed (Full flaps, gear down, power off, 6500 lbs.) (See Note - Page 4)	73 MPH (63 KT)
(See Performance Section for Stall Speeds at Reduced Weights)	
Demonstrated Crosswind Velocity	23 MPH (20 KT)
Airspeed Indicator Markings	
Green Arc (Normal Operating Range)	80 MPH to 216 MPH (70 KT to 187 KT)
Yellow Arc (Caution Range)	216 MPH to 272 MPH (187 KT to 236 KT)
White Arc (Flaps Extended Range)	73 MPH to 150 MPH (63 KT to 130 KT)
Radial Red Line (Never Exceed-Smooth Air)	272 MPH (236 KT)

Radial Red Line (Minimum Control Speed)	85 MPH (74 KT)
Radial Blue Line (Best Rate of Climb Speed) (Single or Twin Engine)	110 MPH (95 KT)

NOTE

AT REARWARD C.G., GROSS WEIGHT, POWER OFF, GEAR AND FLAPS RETRACTED THE MAXIMUM ALTITUDE LOST DURING A STALL IS 400 FT.

I. FLIGHT LOAD FACTORS (MANEUVERING)

Positive Load Factor (Maximum)	3.8G
Negative Load Factor (Maximum) (No Inverted Maneuvers Approved)	1.52G

J. MAXIMUM WEIGHT

Maximum Ramp Weight	6536 LBS.
Maximum Take-Off Weight	6500 LBS.
Maximum Landing Weight	6200 LBS. (6500 LBS.*)
Zero Fuel Weight	6000 LBS. (6200 LBS.*)

IT IS THE RESPONSIBILITY OF THE AIRPLANE OWNER AND PILOT TO ASSURE THAT THE AIRPLANE IS PROPERLY LOADED. MAXIMUM ALLOWABLE GROSS WEIGHT IS 6500 POUNDS. SEE "WEIGHT AND BALANCE SECTION" FOR LOADING INSTRUCTIONS.

K. C. G. RANGE

Weight Pounds	Forward Limit Inches Aft of Datum	Rearward Limit Inches Aft of Datum
6500	134.0	138
6000	128.5	138
4800 or Less	120	138

1. Straight line variation between points indicated.
2. The Datum Line is located 137 inches forward of the wing main spar centerline.

*Aircraft with kit 763 801 installed.

L. MANEUVERS

This is a Normal Category Airplane. No Acrobatic Maneuvers (Including Spins) Approved.

M. 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 AIRPLANE FLIGHT MANUAL

On top left side of instrument panel:

MINIMUM CONTROL SPEED	85 MPH
MAXIMUM SPEED LANDING GEAR OPERATION	150 MPH
DESIGN MANEUVERING SPEED	188 MPH

SEE AIRPLANE FLIGHT MANUAL FOR ADDITIONAL SPEEDS

On instrument panel adjacent to the stall warning light:

STALL WARNING

On floor between pilot and co-pilot 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 PRESSURE IS BUILT UP IN THE SYSTEM AND SELECTOR HANDLE AUTOMATICALLY 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 under cover:

OFF

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

LEFT FIREWALL
FUEL
SHUT-OFF

(d) On the fuel control console:

LEVEL FLIGHT ONLY	FUEL-LEFT TANKS	ON CROSSFEED OFF	FUEL-RIGHT TANKS	LEVEL FLIGHT ONLY
OUTBD 39 GAL OFF INBD 54 GAL			INBD 54 GAL OFF OUTBD 39 GAL	

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

EMERGENCY EXIT RELEASE
REMOVE COVER
PULL HANDLE DOWN
PUSH EXIT

On forward baggage compartment door:

BAGGAGE CAPACITY
150 LBS MAX
SEE LOADING SCHEDULE

On rear bulkhead in rear baggage compartment:

MAXIMUM BAGGAGE 200 LBS
INCLUDES 50 LBS ON SHELF
SEE LOADING SCHEDULE

On the pilot's side window moulding (when fuselage red strobes are installed):

WARNING

TO AVOID OPTICAL ILLUSION AND SEVERE VERTIGO, TURN ANTI-COLLISION LIGHTS OFF UPON ENTERING CLOUDS, FOG OR HAZE.

On the pilot's window moulding (when supplementary white anti-collision (strobe) lights are installed):

WARNING

TURN OFF STROBE 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.

On window moulding adjacent third and fourth passenger seats:

REQUIREMENTS FOR OCCUPANCY OF AFT FACING SEAT
1. SEAT HEADREST (10" MIN. HT.) INSTALLED.
2. SEAT BACK BOLTED IN UPRIGHT POSITION.
3. SEAT LATCHED AT FORWARD POSITION.
4. FORWARD CABIN DIVIDER PANEL INSTALLED.

On lower left hand corner of left gyro insert panel:

WARNING—UNCOORDINATED MANEUVERS, INCLUDING SIDE SLIPS OF 30 SECONDS OR MORE, FOR ANY REASON, AND FAST TAXI TURNS JUST PRIOR TO TAKE-OFF CAN CAUSE LOSS OF POWER IF FUEL TANKS IN USE ARE LESS THAN 3/4 FULL

On pilot's side window moulding:

FLAP SETTINGS IN EXCESS OF 25° ARE NOT APPROVED.
DISENGAGE THE AIRCRAFT AUTOPILOT PRIOR TO OPERATING FLAPS.
OPERATE FLAP CONTROL IN SMALL INCREMENTS TO ASSURE FLAP SYMMETRY.

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N. TYPES OF OPERATION - EQUIPMENT REQUIRED FOR VARIOUS CONDITIONS OF FLIGHT

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 light to moderate icing.

The certificating regulations of the FAA for this airplane require the manufacturer to specify in the Aircraft Flight Manual the types of operation for which the airplane is equipped.

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

When this airplane was delivered it contained the properly installed equipment listed in the rear of this manual and, therefore, was satisfactory for the types of operation indicated below by an asterisk.

1. a. _____ Day VFR
   b. _____ Night VFR

2. a. _____ Day and night IFR <u>after</u> adequate communication and navigation radio has been installed in an FAA approved manner.

   b. _____ Day and night IFR

3. a. _____ Light to moderate icing <u>after</u> de-icing and icing equipment listed on page for operation in icing conditions has been installed in accordance with Piper drawings or in an FAA approved manner.

   b. _____ Light to moderate icing.

Operators are warned that if any of the equipment listed as having been installed at time of delivery is changed, not operating, or not properly maintained and calibrated the airplane may not be properly equipped for all the conditions noted above. It is the responsibility of the pilot to determine whether the lack of a piece of equipment limits the conditions under which he may fly the airplane.

AIRCRAFT

_____ REGISTRATION NO.

_____ SERIAL NO.

Owners desiring to make changes or additions to the equipment must have these modifications done in an FAA-approved manner. All PA-31's are delivered equipped for day and night VFR flight, and for IFR flight except when there may be insufficient communications or navigation radio.

The performance, handling qualities and structure of the airplane are approved 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.

When the original equipment or FAA-approved equivalent equipment is installed as originally or in an FAA-approved manner, functioning properly, and calibrated in accordance with the Federal Aviation Regulations, and when adequate radio communications and navigation equipment is installed as indicated above, this airplane is approved for day and night VFR and IFR flight.

If the airplane is approved for night IFR, but is not approved for flight in icing conditions when delivered, 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 light to moderate icing conditions. If anti-icing and de-icing 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 known or forecast heavy icing conditions is prohibited, and flight through any icing conditions should be avoided if any of the anti-icing or de-icing equipment is missing or not functioning.

Pilots are also reminded that for flight to high altitude oxygen must be available to passengers and crew and that special electronic equipment is required for flight above specified altitude.

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

In accordance with the FAR's, this airplane is not properly equipped for the condition of flight indicated if any of the equipment listed below is not properly installed, functioning, properly maintained and calibrated according to the FAR's. Pilots are warned that the following lists are based on the FAR's as of January 1, 1966, and that they are responsible for complying with amendments issued after this date.

Day VFR

1. Airspeed indicator
2. Altimeter
3. Magnetic direction indicator
4. Tachometer - each engine
5. Oil pressure gage - each engine
6. Stall warning indicator
7. Oil temperature gage - each engine
8. Manifold pressure gage - each engine
9. Fuel gages

10. Fuel pressure indicator (fuel flow) - each engine
11. Exhaust gas temperature gage - each engine (for PA-31)
12. Landing gear position indicator
13. Seat belts - each occupant
14. Very pistol and flotation gear over water for hire
15. Above 12,500 feet - encoding altimeter

Night VFR

1. All equipment required for Day VFR
2. Position lights
3. Anti-collision lights
4. Alternator - each engine
5. Instrument lights
6. Landing light, if for hire

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

Night IFR

1. All equipment required for day and night VFR
2. All equipment required for Day IFR

Flight in Positive Control Areas

1. Transponder

Light to Moderate Icing

1. All equipment required for night IFR
2. Wing and tail de-icing system
3. Heated windshield
4. Static wicks
5. Shielded antennas
6. Heated pitot tube
7. Propeller de-icing
8. Elevator horn de-icing boot

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, the forward cabin dividers shall be installed, headrests installed (Min. 10" Ht.), seat backs bolted in upright position and seats latched at forward position.

O. 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 co-pilot.

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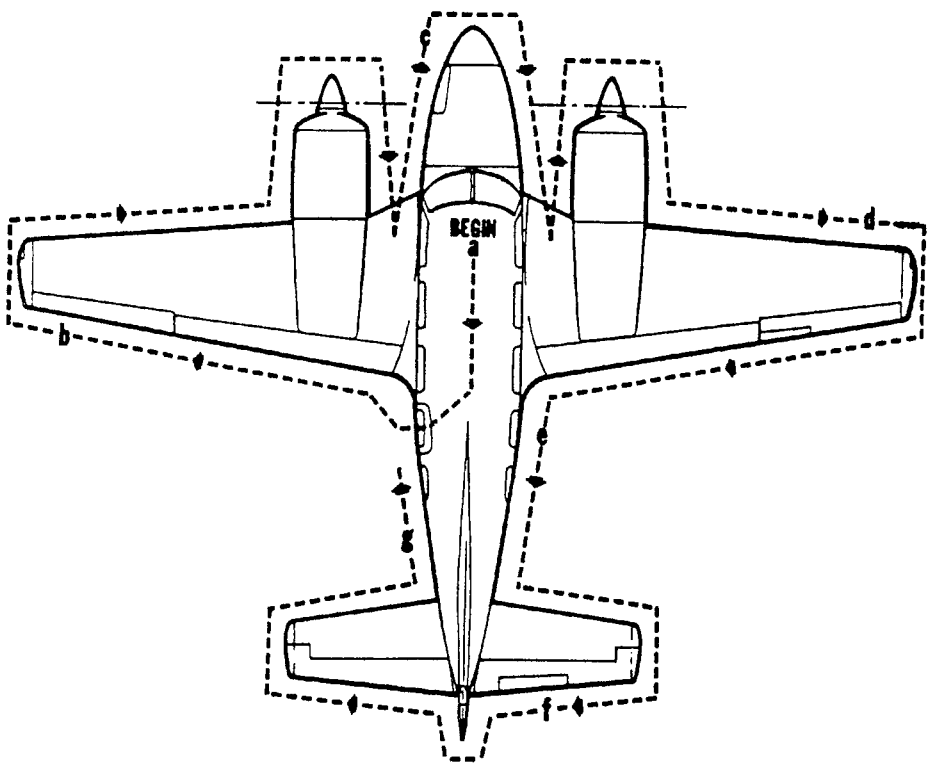
SECTION III

PROCEDURES

A. NORMAL OPERATING PROCEDURES

1. PREFLIGHT
   a. Airplane status - check
   b. Weight and c.g. - compute
   c. Performance - compute

2. WALK-AROUND INSPECTION



   a. Cockpit
      (1) Controls - unlocked
      (2) Magneto switches - off
      (3) All switches - off
      (4) Master switch - on
      (5) Fuel quantity - sufficient
      (6) Trim - neutral
      (7) Master switch - off
      (8) Mixture - idle cut off
      (9) Airplane papers - checked
      (10) Escape hatch - secure
      (11) Fire extinguishers - inspect if installed
      (12) Oxygen pressure - checked and off, masks in place
      (13) Gear handle - down
      (14) Cowl flaps - open

b. Left Wing
   (1) Wing root fillet - check
   (2) Flap - condition and rigging
   (3) Aileron - lock removed, condition, rig, attachment, freedom
   (4) Static wicks - in place, condition
   (5) Wing tip - condition checked, counterbalance checked
   (6) Leading edge - condition checked
   (7) Fuel tank caps - sufficient fuel, secure
   (8) Top and bottom of wing - no tears or fuel stains, no ice
   (9) Fuel tank vents - clear
   (10) Tie down rope - removed
   (11) Outboard fuel drain - check for water, dirt, octane
   (12) Landing gear - condition, strut inflation, micro switches, tires, brakes
   (13) Cowl flaps - open
   (14) Chocks - as desired
   (15) Nacelle - check for condition and security of panels
   (16) Oil - checked
   (17) Propeller - check condition of blades and spinner
   (18) Engine cowl and baffles - inspect

CAUTION

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

WARNING

Failure to insure the presence and security of nose bowl and cowl side fasteners may result in inflight cowl separation and loss of aircraft control.

   (19) Wing root fillet - check
   (20) Inboard fuel tank sump drain - drain and check for dirt, water, octane
   (21) Filter drain - drain and check for dirt, water, octane
   (22) Crossfeed line drain - drain and check for dirt, water, octane

c. Nose Section
   (1) General condition
   (2) Battery vents and drain - clear
   (3) Nose gear - tire, doors, struts - checked
   (4) External power receptacle - as required
   (5) Pitot tube - cover removed, holes clear
   (6) Nose gear - condition, strut inflation, micro switch, tires, light
   (7) Baggage compartment - baggage secure, door locked
   (8) Inspection plates - secure
   (9) Windshield - secure and clean
   (10) Heater inlets and outlets - clear

d. Right Wing
   (1) Inboard fuel tank, sump, crossfeed - drain and check
   (2) Filter drain - drain and check
   (3) Wing root fillet - condition
   (4) Escape hatch secure
   (5) Oil - checked

(6) Engine cowl and baffles

CAUTION

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

WARNING

Failure to insure the presence and security of nose bowl and cowl side fasteners may result in inflight cowl separation and loss of aircraft control.

(7) Propeller - check condition of blades and spinner
(8) Nacelle - check for condition and security of panels
(9) Landing gear - condition, strut inflation, micro switches, tires, brakes
(10) Chocks - as desired
(11) Outboard fuel drain - drain and check
(12) Tie down - removed
(13) Fuel tank vents clear
(14) Top and bottom of wing - no tears, fuel stains, ice
(15) Fuel tank caps - sufficient fuel, secure
(16) Leading edge - checked, stall warning free
(17) Wing tip condition - checked
(18) Static wicks - in place
(19) Aileron and tab - lock removed, condition, rig, attachment, freedom
(20) Flap - condition, rigging
(21) Wing root fillet - check

e. Fuselage - (Right Side)
(1) General condition - check
(2) Antennas - in place and secure
(3) Static vent and openings - clear

f. Empennage
(1) Vertical fin, rudder and fairing - condition checked
(2) Right air scoop - clear
(3) Horizontal surfaces - condition checked
(4) Elevator free and condition
(5) Rudder free and condition
(6) Trim tabs - neutral, good condition
(7) Tie down - removed
(8) Left air scoop - clear

g. Fuselage (Left Side)
(1) General condition - check
(2) Static air vent - clear
(3) Main cabin door attachment - check

3. BEFORE STARTING ENGINES
a. Walk-around inspection - complete
b. Baggage - secure
c. Cabin door - secure, safety chain secure
d. Maps and charts - checked
e. Passenger briefing - complete
f. Pilot's seats and seat belts - adjusted and secure

g. Parking brake - secure
h. Altimeter - set to field elevation
i. Pitot cover - removed
j. Controls - free and proper response
k. Fuel valves - on main tanks
l. Crossfeed - off
m. Firewall fuel shutoff valves - on
n. Alternate air valves - off
o. Circuit breakers - check
p. Electrical switches - off
q. Radio switches - off
r. Transceiver - set to tower or ground control freq.
s. Main voltage regulator - on
t. Alternators - on
u. Alternate static source - normal
v. Master switch - on
w. Fuel quantity - check 4 tanks
x. Trim - set for take off
y. Cowl flaps - open
z. Auxiliary power unit - connect if available
aa. Gear lights - green
ab. Baggage and main door ajar light - out
ac. Seat belt and no smoking sign - on (if installed)

4. STARTING ENGINES (When APU is used it is preferable to start right engine first.)
   a. Throttles - open 1/4 inch
   b. Mixture - rich
   c. Boost pump - on til 6 gph then off
   d. Mixture - idle cut off
   e. Prop controls - forward
   f. Mag. switches - on
   g. Props - clear
   h. Starter - engage
   i. Mixture - advance when engine starts
   j. Oil and fuel pressure - check
   k. Throttles - set 1000 rpm

5. FLOODED START
   a. Mag. switches - on
   b. Throttle - open
   c. Mixture - idle cut off
   d. Starter - engage
      (When engine fires, advance mixture and retard throttle to 1000 rpm.)

6. BEFORE TAXI
   a. APU - removed
   b. Chocks - removed
   c. Radios - tune and check

d. Lights (nav., cockpit, beacon, cabin) - as required and checked
e. Gyros - set
f. Taxi instructions - contact ground control
g. Altimeter and clock - set
h. AutoPilot check - see supplements section
i. Parking brake - off

7. WHILE TAXIING
a. Braking - check
b. Flight instruments - check
c. Fuel valves - check all positions

8. ENGINE RUN-UP
a. Parking brake - on
b. Mixtures - rich
c. Prop controls - forward
d. Cowl flaps - open
e. Engine instruments - checked
f. Crossfeed - Check crossfeed on, selector for left or right engine to "off". After 30 seconds both fuel selectors to "main" and crossfeed "off".
g. Throttles - 1500 rpm
h. Check feathering thru not more than 500 rpm drop
i. Throttle - 2300 rpm
j. Mag. check - 175 rpm drop-off max., 50 rpm drop-off max between mags.
k. Exercise props - for 300 rpm drop
l. Alternators - check at 1200 rpm
m. Throttles - idle position - 600-650 rpm
n. Throttles -1000 rpm
o. Friction - set
p. Directional gyro - reset
q. Instrument pressure - checked, approximately 4.3" Hg. at 1300 rpm
(See "Pneumatic System", Page 17)

9. BEFORE TAKE-OFF
a. Seat belt and no smoking sign - on
b. Fuel selectors - inboard (crossfeed off)
c. Fuel quantity sufficient
d. Mixture and props - forward
e. Flaps - checked and set 0° for normal takeoff, checked and set 15 ° for short field takeoff.
f. Autopilot - off
g. Trim - set
h. Surface deice - off
i. Pitot and prop heat - as required
j. Windshield heat - as required
k. Avionics - as required
l. Direction indicator - set
m. Radar - as desired
n. Transponder - as required
o. Controls - checked
p. Emergency fuel pumps - on
q. Prop sync - off

10. TAKEOFF

NORMAL

a. Brakes - apply and hold
b. Throttles - full forward
c. Manifold pressure - checked
d. Prop speed - 2575 RPM (during takeoff roll)
e. Brakes - released
f. Rotate - 98 MPH min.
g. Gear - retract
h. Accelerate to barrier speed (105 MPH)

SHORT FIELD

a. Brakes - apply and hold
b. Throttles - full forward
c. Manifold pressure - checked
d. Prop speed - 2575 RPM
e. Brakes - release
f. Rotate - 85 MPH
g. Accelerate to barrier speed (100 MPH)

After barrier has been cleared:

h. Gear - retract
i. Flaps - retract
j. Accelerate to best single engine angle of climb speed (106 MPH)

11. CLIMB

a. Climb power - set (when safely clear of obstacles or terrain)
b. Mixture (28 GPH min., 475° CHT max., 1450° EGT max.) - lean
c. Cowl flaps - as required
d. Emergency fuel pumps - off
e. Seat belt and no smoking sign - as required
f. Oxygen - as required

12. CRUISE

a. Fuel boost pumps - off unless above 15,000 ft.
b. Fuel selectors - on (main or auxiliary, see note)
c. Cowl flaps - close (position to maintain temperatures at or below maximum allowable)
d. Throttle - set (desired manifold pressure)
e. Propeller - set (desired rpm)
f. Mixture - lean in accordance with engine manual

NOTE

It is recommended that, with the aircraft loaded to a rearward c.g., fuel be burned from the outboard tanks first. This action will tend to move the c.g. forward with fuel burn-off.

13. DESCENT
    a. Mixture - rich
    b. Oxygen - off below 10,000 ft.
    c. Fuel valves - on main tank

14. BEFORE LANDING
    a. Seat belt no smoking sign - on (if installed)
    b. Fuel boost pumps - on
    c. Gear - extend at less than 150 mph - check 3 green lights
    d. Propellers - set for climb - 2400 rpm
    e. Brakes - check pressure
    f. Wing flaps - as required (in steps) - extend to 15° at less than 175 MPH (152 KTS). 15° to 25° at less than 150 MPH (130 KTS). Maximum extension (full flaps) - 25°.
    g. Landing lights - as required

15. AFTER LANDING
    a. Brakes - test
    b. Flaps - retract
    c. Cowl flaps - open
    d. Heater - off
    e. Booster pumps - off
    f. Prop controls - forward
    g. Trim - set for take-off
    h. Flight plan - close
    i. Unessential radio - off

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16. SHUT DOWN

a. Parking brakes - set
b. Radios - off
c. Lights and electrical equipment - off
d. Throttles - 1000 rpm
e. Alternators - With all load removed, if charge is 25 amp or more charge battery before shutdown.
f. Throttles - full back to idle
g. Magnetos - grounding check
h. Mixtures - idle cut off
i. Magnetos - off
j. Master switch - off

17. ALTERNATOR CHECK

The ammeter indicates battery charging current. When the ammeter pointer indicates to the left of center, the battery is being discharged, when the pointer indicates to the right of center, the battery is being charged. During single-engine operation this feature can be used to determine how much the electrical load should be reduced. Provisions for checking the output of each alternator are also provided. Two test switches are located adjacent to the ammeter, labeled "ALTERNATOR - PUSH TO TEST". The left switch, when depressed, will cause the ammeter to indicate left alternator output. The right switch, when depressed, will cause the ammeter to indicate right alternator output. These switches are the momentary type and must be depressed when reading the ammeter. Preflight check of alternators will be conducted as follows:

Run engines at 1200 RPM, push in either test switch and read output on ammeter - push other test switch and read output. (Alternator outputs should be approximately equal.)

18. VOLTAGE REGULATING SYSTEM

In the event of a failure of the voltage regulating system, an auxiliary regulating system may be switched into the circuit. Abnormal operation may be indicated by zero output on both alternator test positions and a discharge indication for the battery. To energize the auxiliary regulating system the following procedure will be followed:

(a) Reduce electrical load to minimum for continued safe flight.

(b) Switch "Voltage Regulator Selector" to "Auxiliary" position. (Located in circuit breaker panel)

(c) Reset all "Tripped" circuit breakers except DO NOT reset the main voltage regulator breaker.

(d) Return to normal required electrical load.

NOTE

1. Use of the voltage regulator selector switch should be limited to the above conditions unless the Service Manual is consulted.
2. The alternator output circuit breakers should not be opened under any circumstances without consulting the Service Manual.

19. SHUT DOWN CHECK OF BATTERY

During engine shut down with engines turning 1000 rpm and all electrical equipment off, if ammeter shows a battery charging rate in excess of 25 amps the battery has a low charge. In this case do not stop engines until current drops below 25 or there may be insufficient battery current for starting.

20. CIRCUIT BREAKERS

All circuit breakers are located in the cockpit in a single panel. The panel is located to the left of the pilot's knee on the cockpit side panel.

Circuit breakers are "Push to Reset" type.

21. EXTERNAL POWER SUPPLY

The master switch must be "ON" when operating any equipment from external power.

Some aircraft incorporate a current limiting system to the battery. This system is operational when starting the engines by use of external power.

The revised system requires that the master switch and radios be "OFF". Aircraft incorporating the revised system can be identified by placards on the sun visor and external power receptacle, detailing the operation.

Remove battery from aircraft for recharging.

22. PNEUMATIC SYSTEM

The aircraft has a dual pneumatic system. In case of failure of either pneumatic pump, the system will automatically select the operative source. (Inoperative source will be indicated on the gyro pressure gage by red button.)

When the aircraft is equipped with de-icer boots the system should be checked as indicated below prior to each flight:

a. Operate both engines at 2400 RPM.
b. Select de-icer boot operation.
c. Observe pneumatic system pressure gage - normal operation should be as follows:
    1. As boots are selected - a momentary drop of pressure.
    2. A gradual increase of pressure to upper limit of gage.
    3. A momentary drop of pressure to lower end of "Green Arc" or slightly lower.
    4. A gradual increase to approximately 4 in. HG.

The above sequence should be repeated automatically at 3 minute intervals for as long as boots are selected.

Should the pressure continue to drop at step 3 above, the system should be investigated to determine the source of malfunction.

23. ALTERNATE STATIC AIR SOURCE (INSTRUMENT)

Emergency static air valve control is located under instrument panel near pilot's left knee. When the alternate static source is selected the pilot's instruments are vented to cabin air.

Correct the airspeed and altimeter indications using the "Emergency System Correction Graphs" in the Performance Section, when using alternate static air source.

24. COMPRESSOR BY-PASS DOOR (INDUCTION AIR)

The engines of the aircraft are equipped with doors on the induction housings. In the event of a turbocharger compressor failure, the engine will automatically revert to normally aspirated. (Approximately 75% of normal rated power or 232 HP will be available at sea level.)

25. ALTERNATE AIR (INDUCTION)

An automatic alternate induction air system is provided for each engine. Should the induction air filters become obstructed by ice or other causes, the induction air doors will open automatically to provide air to the engine.

To the right of the control pedestals are two manual alternate air controls which may be used if for any reason the automatic feature should not function.

Since alternate air by-passes the air filter, alternate air should never be used for ground operation.

26. ENGINE CHARACTERISTICS

(a) Under full throttle operations (such as take-off and climb) the engines of this aircraft have been adjusted to provide 38.5 inches of manifold pressure at sea level and standard temperature. It is possible to read higher (up to 43 inches of manifold pressure) or lower than 38.5 inches of HG manifold pressure when ambient temperatures are higher or lower than standard.

(b) The engines of this airplane are equipped with dynamic counterweight systems. Therefore, avoid rapid closing or opening of the throttle in order to prevent severe damage which could cause malfunction.

(c) When increasing power, increase engine speed prior to manifold pressure. When decreasing power, decrease manifold pressure before engine speed.

(d) The engines are designed to use 100/130 octane fuel. If not available use next higher grade.

(e) See Lycoming Operator's Manual for leaning procedure.

27. FUEL MANAGEMENT

(a) Main tanks must be used for take-off and landing.

(b) If the airplane is loaded with a rearward c.g., outboard tanks should be used first. This procedure will tend to move the c.g. forward with fuel burn-off.

(c) Fuel quantity gages are selected with the fuel selector valves.

(d) Any time fuel pressure drops below 25 psi the electric fuel pump should be turned on.

(e) Full rich mixture must be used at power settings in excess of 75% power.

(f) Crossfeed Procedure

Crossfeed will normally only be needed for extended single-engine cruise.

(1) Fuel selector valve of inoperative engine - on desired tank.
(2) Crossfeed valve - on
(3) Electric fuel pump of inoperative engine - on
(4) Fuel selector valve of operating engine - off
(5) Electric fuel pump of operating engine - off

To return to operating engine side of fuel system

(1) Fuel selector valve of operating engine side - on
(2) Electric fuel pump of operating engine - on
(3) Electric fuel pump of inoperative engine - off
(4) Crossfeed valve - off
(5) Fuel selector valve of inoperative engine - off

(g) Firewall fuel shutoff valves, which should be on for all normal operations, should be turned off to prevent or eliminate fire in the engine compartment.

28. ANTI-COLLISION LIGHTS

Limitations

To avoid optical illusion and severe vertigo, turn anti-collision lights off upon entering clouds, fog or haze.

Supplementary White Anti-Collision (Strobe) Lights

Turn off strobe lights when taxiing in vicinity of other aircraft or during flight through cloud, fog or haze.

Standard position lights to be on for all night operations.

B. EMERGENCY PROCEDURES

1. DETECTING A DEAD ENGINE
   a. Loss of thrust
   b. Nose of aircraft will point to dead engine

2. FEATHERING PROCEDURE
   a. Maintain direction and airspeed
   b. Mixtures - forward
   c. Props - forward
   d. Throttles - forward
   e. Gear - retract
   f. Flaps - retract
   g. Boost pumps - on
   h. Identify inoperative engine
   i. Throttle on inoperative engine - retard to verify
   j. Prop on inoperative engine - feather
   k. Mixture on inoperative engine - idle cut off
   l. Boost pump on inoperative engine - off
   m. Magnetos on inoperative engine - off
   n. Cowl flaps - close on inoperative engine, as required on good engine
   o. Alternator on inoperative engine - off
   p. Electrical load - reduce, to prevent battery depletion
   q. Trim - as required - retrim for landing
   r. Fuel management - fuel off on inoperative engine, consider crossfeed
   s. Land at first opportunity

3. UNFEATHERING PROCEDURE (INOPERATIVE ENGINE)
   a. Fuel valve - on
   b. Throttle - open 1/4 inch
   c. Propeller - forward to match other control
   d. Mixture - rich (forward)
   e. Magneto switches - on
   f. Starter - engage until windmilling
   g. Fuel pressure - check
   h. Throttle - set for low power until engine is warm
   i. Synchronize propellers

4. ENGINE FAILURE DURING NORMAL TAKEOFF

Below 98 MPH

If sufficient runway remains for a safe stop:

a. Throttles - close immediately
b. Brakes - as required
c. Stop - straight ahead

If insufficient runway remains for a safe stop:

a. Throttles - close immediately
b. Brakes - as required
c. Mixture - idle cutoff
d. Master switch - off
e. Fuel selector - off
f. Magneto switches - off

NOTE

Maintain directional control and maneuver to avoid obstacles. If an engine fails during takeoff at an airspeed of 98 MPH or above, the pilot must decide whether to abort, following the preceding procedures, or to continue the takeoff and climb on a single engine. 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, airplane condition, and the pilot's own proficiency and capability.

98 MPH or above (if decision is to continue takeoff)

a. Directional control - maintain
b. Power (operating engine) - max. continuous
c. Propeller control (inoperative engine) - feather
d. Landing gear (in level or climbing flight) - retract
e. Bank - 5° into operating engine.
f. Airspeed - accelerate to 106 MPH
g. Cowl flaps (inoperative engine) - close
h. Airspeed 110 MPH after all obstacles have been cleared
i. Engine securing procedures - complete
j. Trim - as required

NOTE

Land as soon as practical at the nearest suitable airport.

5. ENGINE FAILURE DURING SHORT FIELD TAKEOFF

100 MPH or Below

If sufficient runway remains for a safe stop:
a. Throttles - immediately close
b. Land (if airborne) - on remaining runway
c. Brakes - as required

If insufficient runway remains for a safe stop:
a. Throttles - immediately close
b. Mixtures - idle cut-off
c. Master switch - off
d. Fuel selectors - off
e. Magneto switches - off
f. Land (if airborne) avoiding obstacles

Above 100 MPH

If sufficient runway remains for a safe stop:
a. Throttles - immediately close
b. Land - on remaining runway
c. Brakes - as required

If insufficient runway remains and the decision is made to abort the takeoff:
a. Throttles - immediately close
b. Landing gear - extend

NOTE

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

c. Flaps - extend
d. Airspeed - 98 MPH min.
e. Mixtures - idle cut-off
f. Master switch - off
g. Fuel selectors - off
h. Magneto switches - off
i. Land avoiding obstacles

If insufficient runway remains, the terrain ahead is unsuitable for a safe landing and the decision is made to continue the takeoff:
a. Directional control - maintain
b. Power (operating engine) - max. continuous
c. Propeller control (inoperative engine) - feather
d. Landing gear (in level or climbing flight) - retract
e. Bank - 5° into operating engine
f. Flaps - retract in increments

g. Airspeed - accelerate to 106 MPH until all obstacles have been cleared then accelerate to 110 MPH
h. Engine Securing Procedures - accomplish

WARNINGS

Negative climb performance may result from an engine failure occurring after lift-off and before the gear and flaps have been retracted, the failed engine propeller has been feathered, the cowl flap on the failed engine is closed and a speed of 110 MPH has been attained. Refer to "Single Engine Climb" Chart, 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.)

6. ENGINE FAILURE DURING CLIMB
   a. Follow feathering procedure.
   b. Hold single engine best rate-of-climb speed of 110 mph.
   c. Watch cylinder head temperature - adjust cowl flaps.

7. SINGLE ENGINE LANDING
   a. Complete feathering procedure.
   b. Before landing checklist.
      (1) Do not drop gear until sure of making field.
      (2) Do not lower flaps until sure of making runway.

8. SINGLE ENGINE GO-AROUND
   a. Throttle - open
   b. Flaps - retract
   c. Landing gear - retract
   d. Airspeed - "One Engine Inoperative Best Rate-of Climb Speed" is 110 mph
   e. Trim - set
   f. Cowl flap - as required (operating engine)

9. POWER PLANT FIRE ON THE GROUND
   a. Firewall shut-off valve - off
   b. Boost pump - off
   c. If engine is running, advance power to use fuel in engine rather than for fire.
   d. If fire is contained within cowling keep engine turning with starter, attempting to start and drawing flame into engine induction system.
   e. In case of a gasoline fire outside the cowling and on the ground, taxi away from fire, if possible.
   f. Call for assistance through tower or ground control.

10. POWER PLANT FIRE IN FLIGHT
    a. Firewall shut-off valve - off
    b. Throttle - close
    c. Propeller control - feather
    d. Mixture - idle cut-off
    e. Inoperative engine - secure
    f. Land as soon as possible

11. ELECTRICAL FIRE
    a. Master switch - off
    b. Circuit breakers - check for popped circuit breaker, pull all
    c. All electrical switches - off
    d. Master switch - on
    e. Circuit breaker and switch for individual units - on, one at a time to locate faulty unit. When faulty unit is located leave it off, turn other units on, one at a time.

12. EMERGENCY LANDING GEAR EXTENSION (HAND OPERATED)
    a. Airspeed - slow to below 150 mph
    b. Gear selector - down
    c. Emergency gear extender cover - lift (instructions on reverse side)
    d. Emergency gear extender handle - extend completely
    e. Pump handle up and down until three green lights indicate gear down (approximately 60 strokes). Master switch must be on for lights.

13. EMERGENCY EXIT
    a. Plexiglass cover - remove
    b. Handle - pull
    c. Window - push out

NOTE

The 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.

14. PNEUMATIC SYSTEM MALFUNCTION

Should malfunction of the pneumatic system occur in flight when the de-icer boots are operated, the following procedure can be used to continue flight to destination:

a. Turn de-icer boots "OFF".

b. Reduce power or RPM to approximately 2200 RPM, pressure will return and be indicated on pneumatic pressure gage.

c. Return power or RPM to original cruise setting.

Boots may continue to be operated provided steps a, b, & c are repeated after each boot cycle.

15. ALTERNATOR FAILURE

If the electrical generating system still fails to maintain correct output while using the auxiliary voltage regulator, an alternator failure has probably occurred.

The following procedure shall be used to determine the faulty alternator and isolate it from the electrical system.

a. Reduce aircraft electrical load to minimum for continued safe flight.
b. Turn master switch "OFF."
c. Turn both alternator field control switches "OFF." (Check that both alternator circuit breaker switches are "ON.")
d. Reset Main and Auxiliary voltage regulator circuit protectors if "tripped." Turn voltage regulator switch to "MAIN."
e. Turn master switch "ON."
f. Turn one of the alternator field control switches to "ON."
g. Check for alternator output current on the ammeter (Refer to Paragraph 16, Normal Operating Procedure section).
   If the generating system is not operating, turn the field control switch to "OFF," and reset voltage regulator circuit protector if "tripped."
h. Turn master switch "OFF" for approximately six seconds to allow for automatic reset of the overvoltage relay and then turn master switch "ON."
i. Turn the opposite field control switch "ON" and again check ammeter for correct alternator output current.
j. After the faulty alternator has been determined and isolated from the system by the field control switch, check that the aircraft electrical load does not exceed the output capabilities of the alternator which will cause the battery to discharge.

16. ASYMMETRIC FLAP CONDITION

CHECKLIST

a. Flap switch - OFF
   (1) Flap switch - OFF
   (2) Aileron - maintain wings level
   (3) Flap switch - UP, in increments (to obtain flap symmetry)
   If flap symmetry cannot be obtained:
   (4) Flap switch - OFF
   (5) Flap control CB - PULL
b. After Flaps Have Been Extended
   (1) Autopilot - disengage
   (2) Aileron - maintain wings level
   (3) Flap switch - UP, in increments (to obtain flap symmetry)
   If flap symmetry cannot be obtained:
   (4) Flap switch - OFF
   (5) Flap control CB - PULL

c. Landing With Asymmetric Flaps
   (1) Approach speed - 115 MPH (100 KTS)
   (2) Power - as required for 500-800 ft/min rate of descent. Slowly reduce during landing flare.

WARNING

Flight with maximum flap asymmetry (0° and 25°) will require an aileron deflection of approximately 85% of the total available travel to maintain wings level. Considering the decreased lateral control maneuvering capability (in the direction of the maximum deflected flap), minimize bank angles and roll rate while maneuvering.

AMPLIFIED PROCEDURE

An asymmetric flap condition occurs when the wing flaps become unsynchronized and each flap assumes a different deflection angle.

Should this condition occur, the aircraft will exhibit a tendency to roll towards the flap with the lesser deflection.

An asymmetric flap condition may occur during flap operation or after the flaps have been positioned. If, while operating the flaps, the aircraft exhibits an uncommanded roll tendency, immediately position the flap switch to the OFF position. Briefly activate the flap switch to the UP and then back to the OFF position (assuring that the switch does not remain in the UP position longer than 0.5 seconds) to determine if the rolling tendency moderates. If the roll tendency moderates, continue the same incremental retraction until symmetry is obtained. Upon achieving symmetry, position the flap switch to the OFF position and pull the flap control circuit breaker.

If the rolling tendency worsens, immediately position the flap control to the OFF position and pull the flap control circuit breaker.

Should the aircraft exhibit an uncommanded rolling tendency after the flaps have been positioned, immediately disengage the autopilot (if engaged) and utilize the aileron control to maintain wings level. If the rolling tendency persists, utilize the previously mentioned incremental retraction technique to obtain flap symmetry. If flap symmetry cannot be obtained, position the flap control to the OFF position and pull the flap control circuit breaker.

Aircraft lateral control with full asymmetric flaps (0° and 25°) can be maintained by utilizing approximately 85% of the total aileron travel in the direction of the flap with the higher deflection angle. Aileron deflection does not vary appreciably with airspeed; however, the aileron force decreases proportionately with airspeed. The affects of power (symmetrical) have a small proportional affect on control deflection and force.

CAUTION

Although flight tests have shown the aircraft to be controllable with symmetrical power, brief application of asymmetric power (increased power on the side of lesser flap deflection) may enhance roll control. Prolonged flight with large power asymmetry is not recommended.

The landing approach should be planned to provide a higher and wider pattern than normal considering the aircraft's reduced lateral control capability. After turning final approach, configure the aircraft for landing. Set the power for a 500-800 ft. rate of descent and establish a final approach airspeed of 115 MPH (100 KTS). During the landing flare, gradually reduce power. Touchdown in a level flight attitude.

WARNING

Considering the aircraft's reduced roll control capability, always select a landing runway which will minimize the crosswind component. Should a landing become necessary in a crosswind condition, maintain a wings level attitude while varying the aircraft's heading for runway alignment until the aircraft has been touched down.

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SECTION IV

PERFORMANCE

AIRSPEED CALIBRATION

ALTIMETER CALIBRATION

TAKE-OFF DATA

ACCELERATE - STOP DISTANCE

CLIMB DATA

LANDING DATA

STALL DATA

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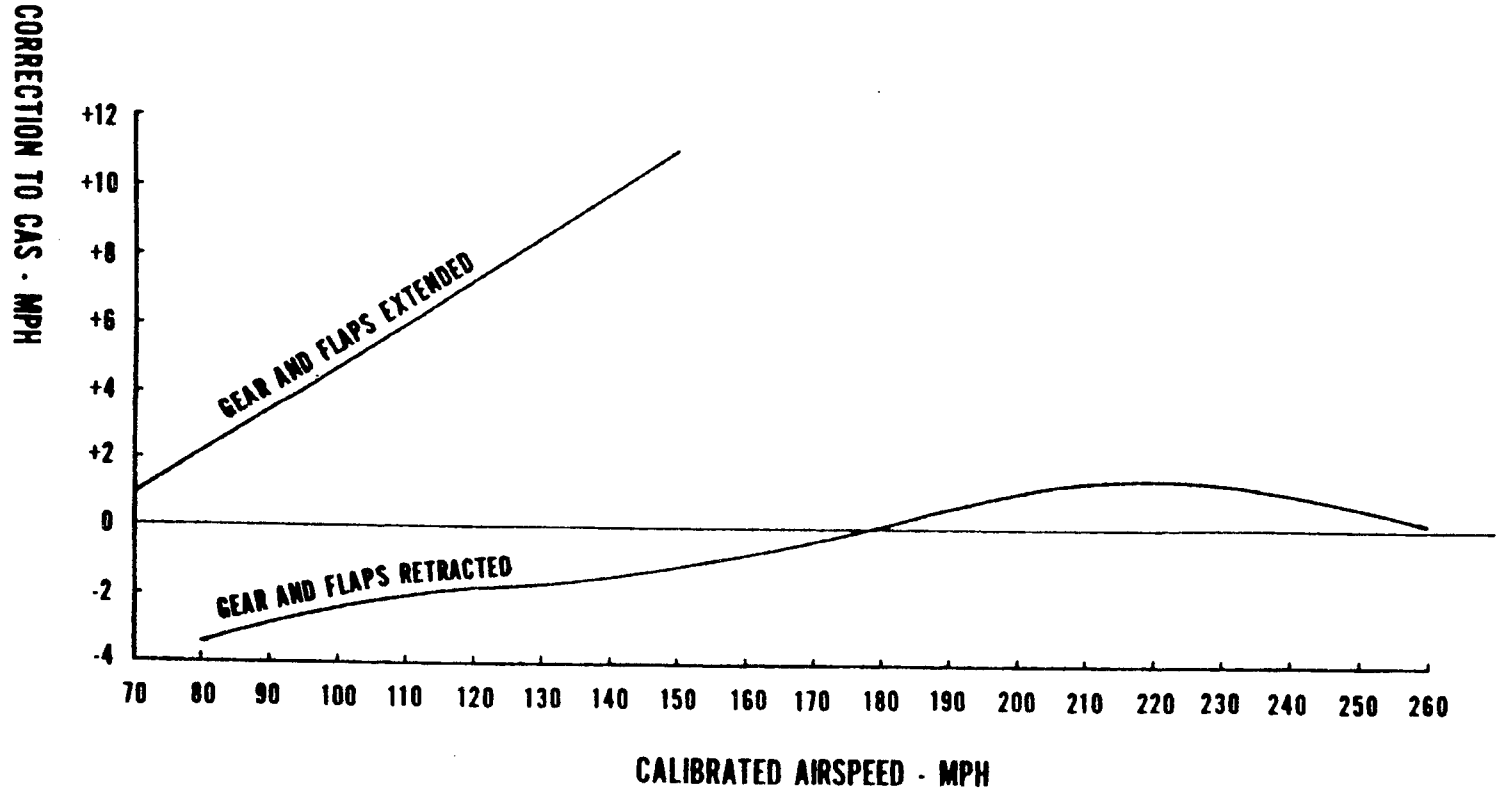
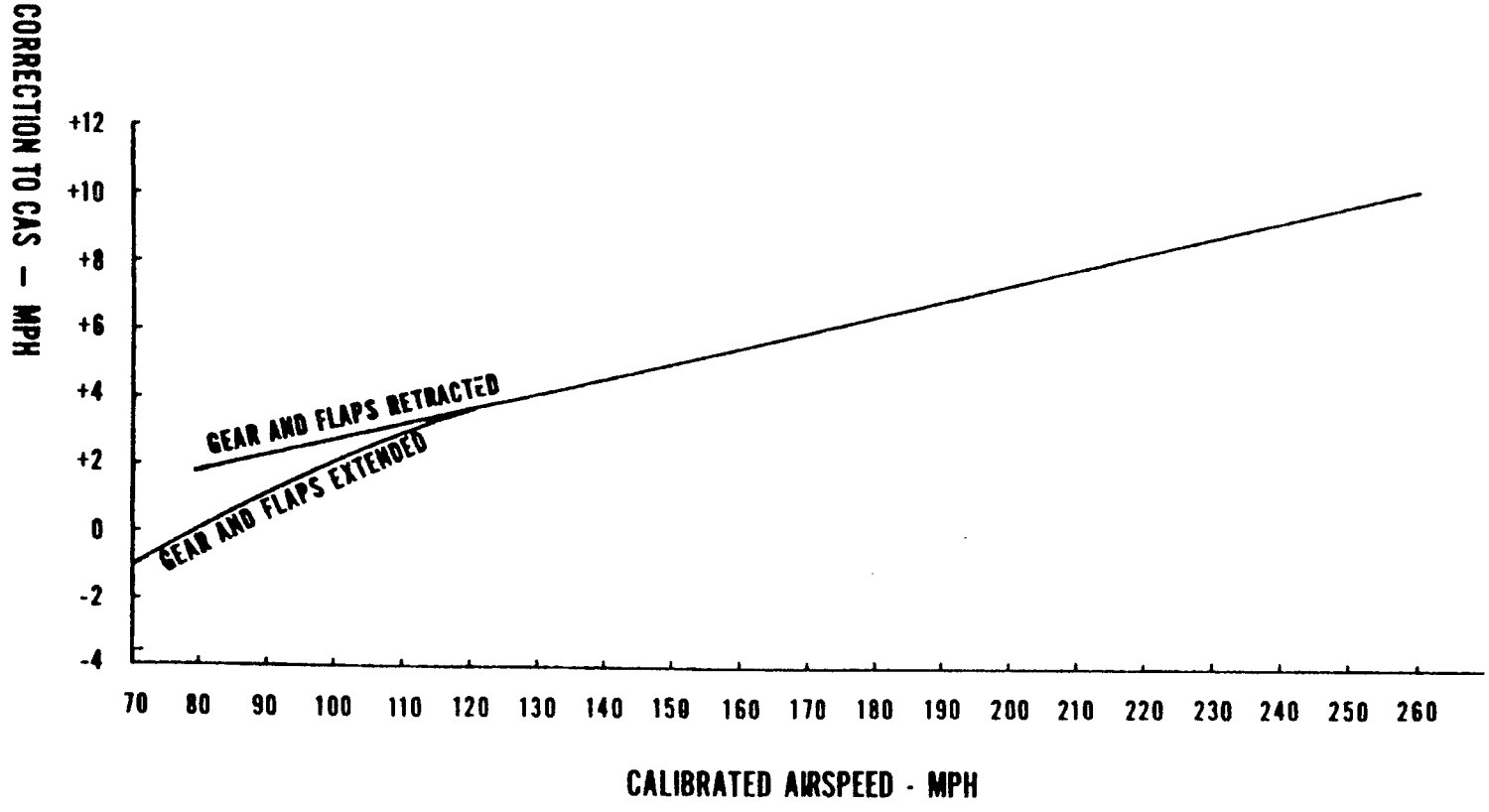
AIRSPEED CALIBRATION - STANDARD STATIC SOURCE

POSITION ERROR CORRECTION TO OBTAIN INDICATED AIRSPEED

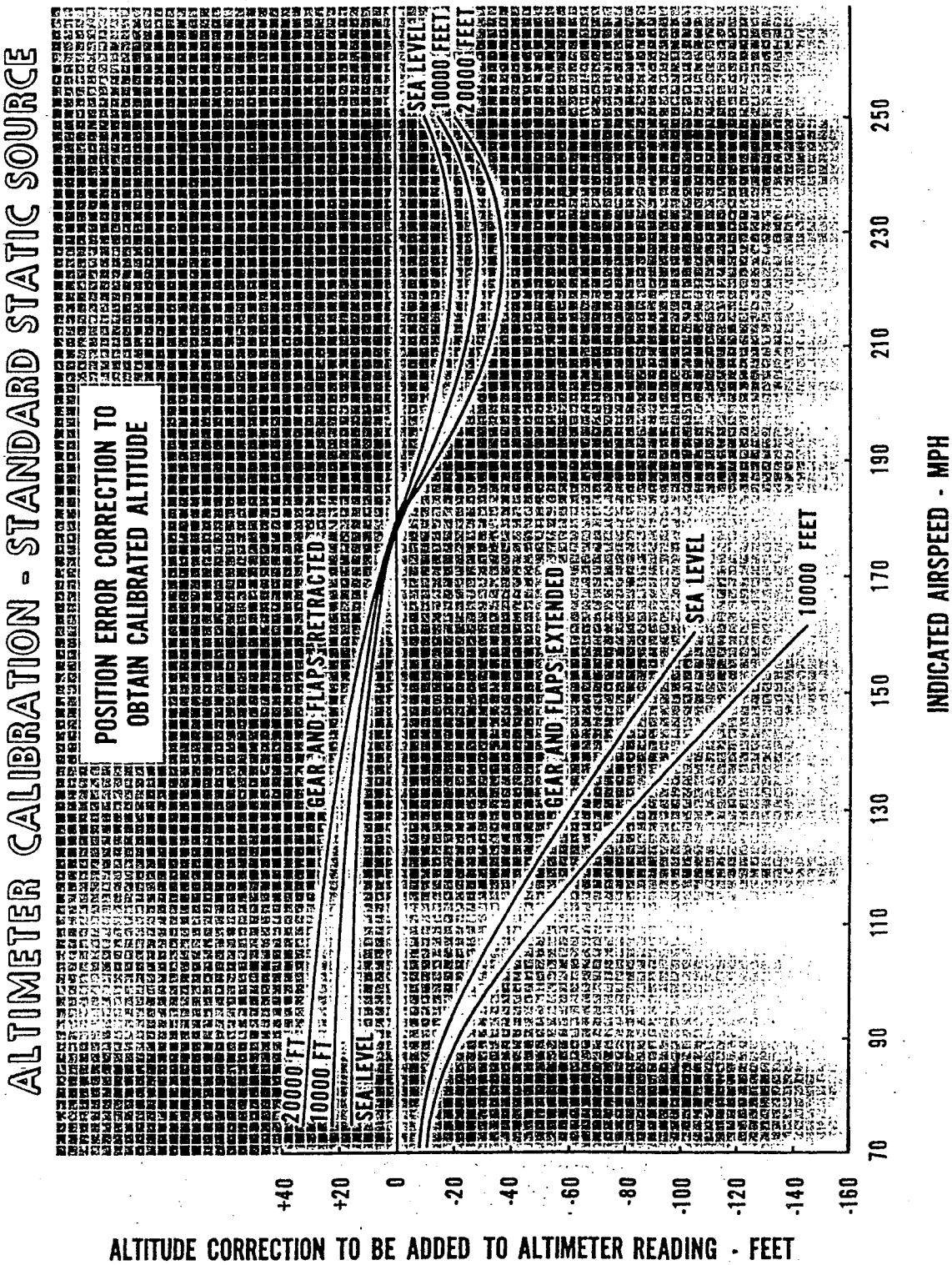


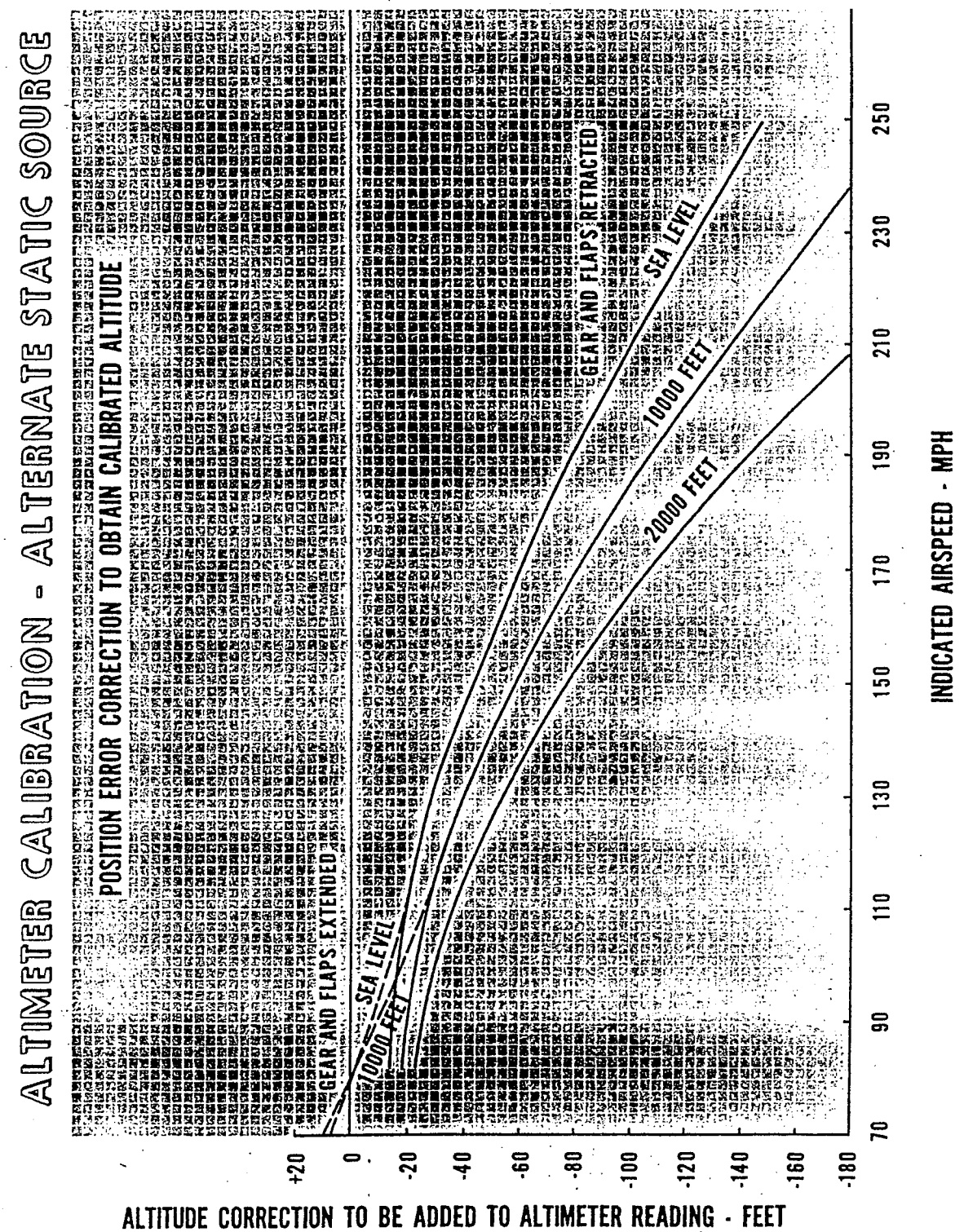
AIRSPEED CALIBRATION - ALTERNATE STATIC SOURCE

POSITION ERROR CORRECTION TO OBTAIN INDICATED AIRSPEED



REVISION FAA APPROVED
January 12, 1967

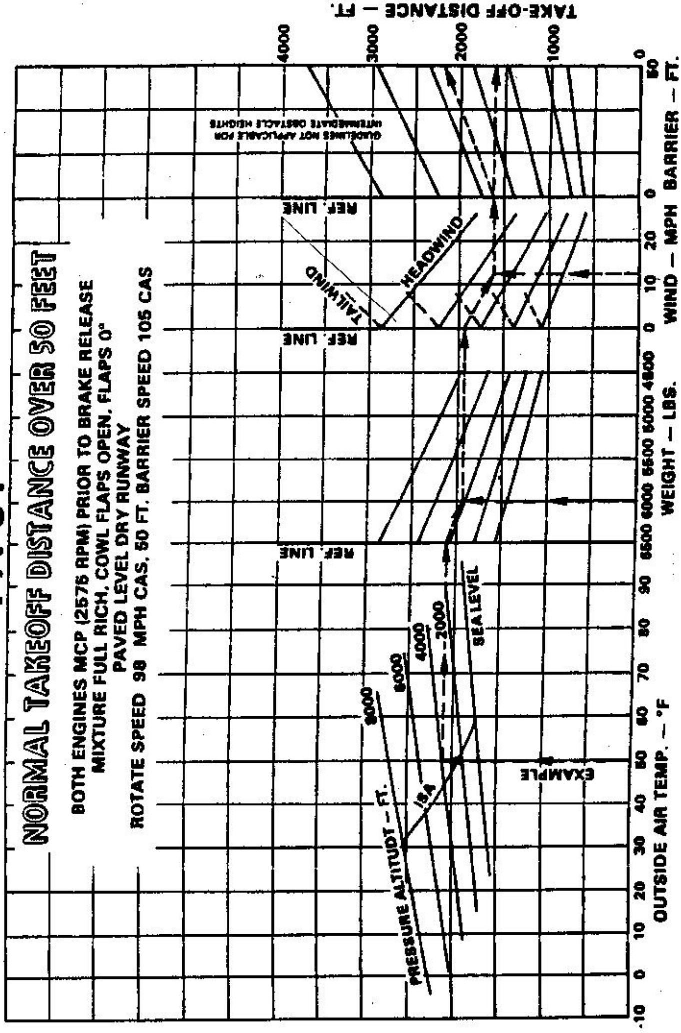

ALTIMETER CALIBRATION - STANDARD STATIC SOURCE
POSITION ERROR CORRECTION TO OBTAIN CALIBRATED ALTITUDE
20000 FT
10000 FT
SEA LEVEL
GEAR AND FLAPS RETRACTED
SEA LEVEL
10000 FEET
20000 FEET
GEAR AND FLAPS EXTENDED
SEA LEVEL
10000 FEET
+40
+20
0
-20
-40
-60
-80
-100
-120
-140
-160
70
90
110
130
150
170
190
210
230
250
INDICATED AIRSPEED - MPH
ALTITUDE CORRECTION TO BE ADDED TO ALTIMETER READING - FEET


ALTIMETER CALIBRATION - ALTERNATE STATIC SOURCE
POSITION ERROR CORRECTION TO OBTAIN CALIBRATED ALTITUDE
GEAR AND FLAPS EXTENDED
GEAR AND FLAPS RETRACTED
SEA LEVEL
10000 FEET
20000 FEET
SEA LEVEL
10000 FEET
+20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
70
90
110
130
150
170
190
210
230
250
ALTITUDE CORRECTION TO BE ADDED TO ALTIMETER READING - FEET
INDICATED AIRSPEED - MPH

PA-31

NORMAL TAKEOFF DISTANCE OVER 50 FEET

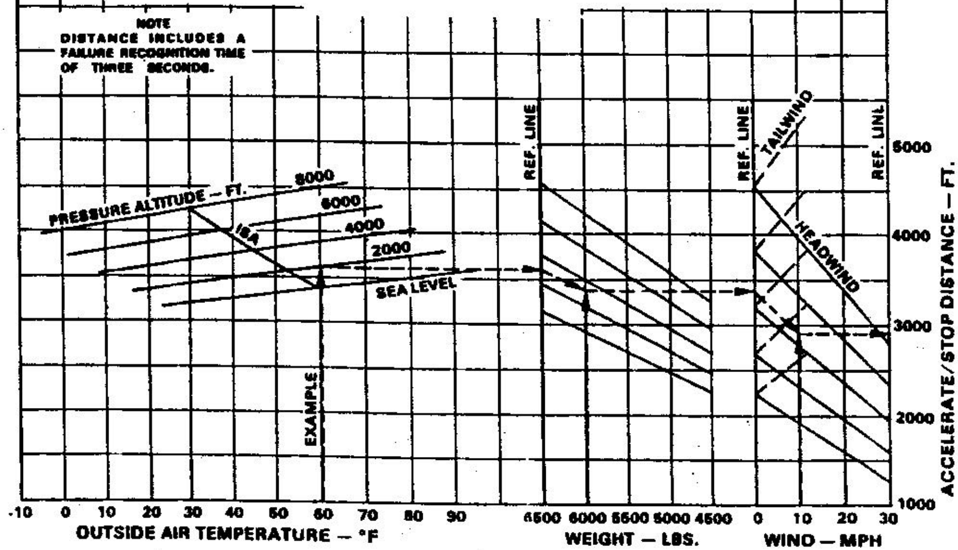
BOTH ENGINES MCP (2575 RPM) PRIOR TO BRAKE RELEASE
MIXTURE FULL RICH, COWL FLAPS OPEN, FLAPS 0°
PAVED LEVEL DRY RUNWAY
ROTATE SPEED 98 MPH CAS, 50 FT. BARRIER SPEED 105 CAS



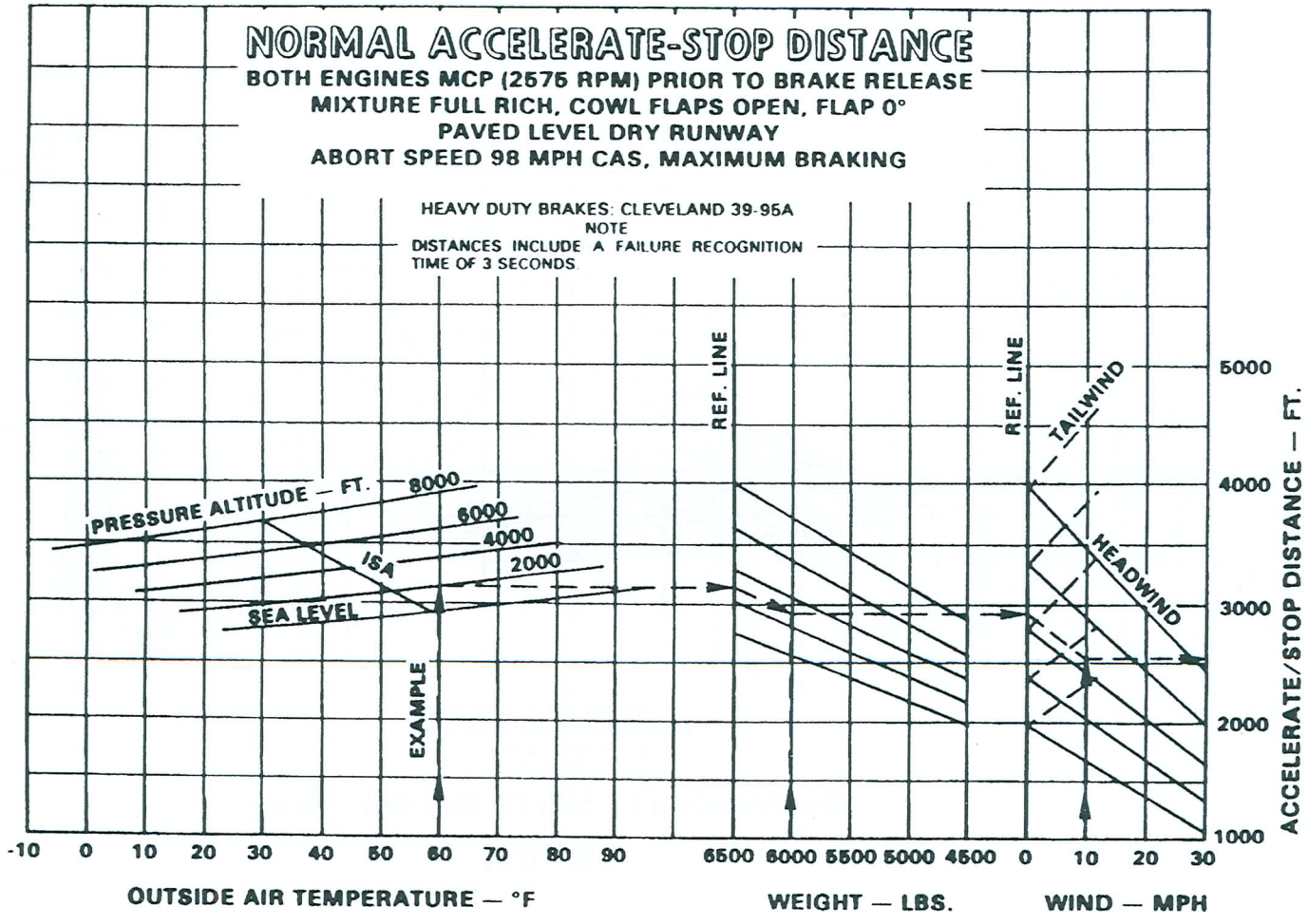
PA-31

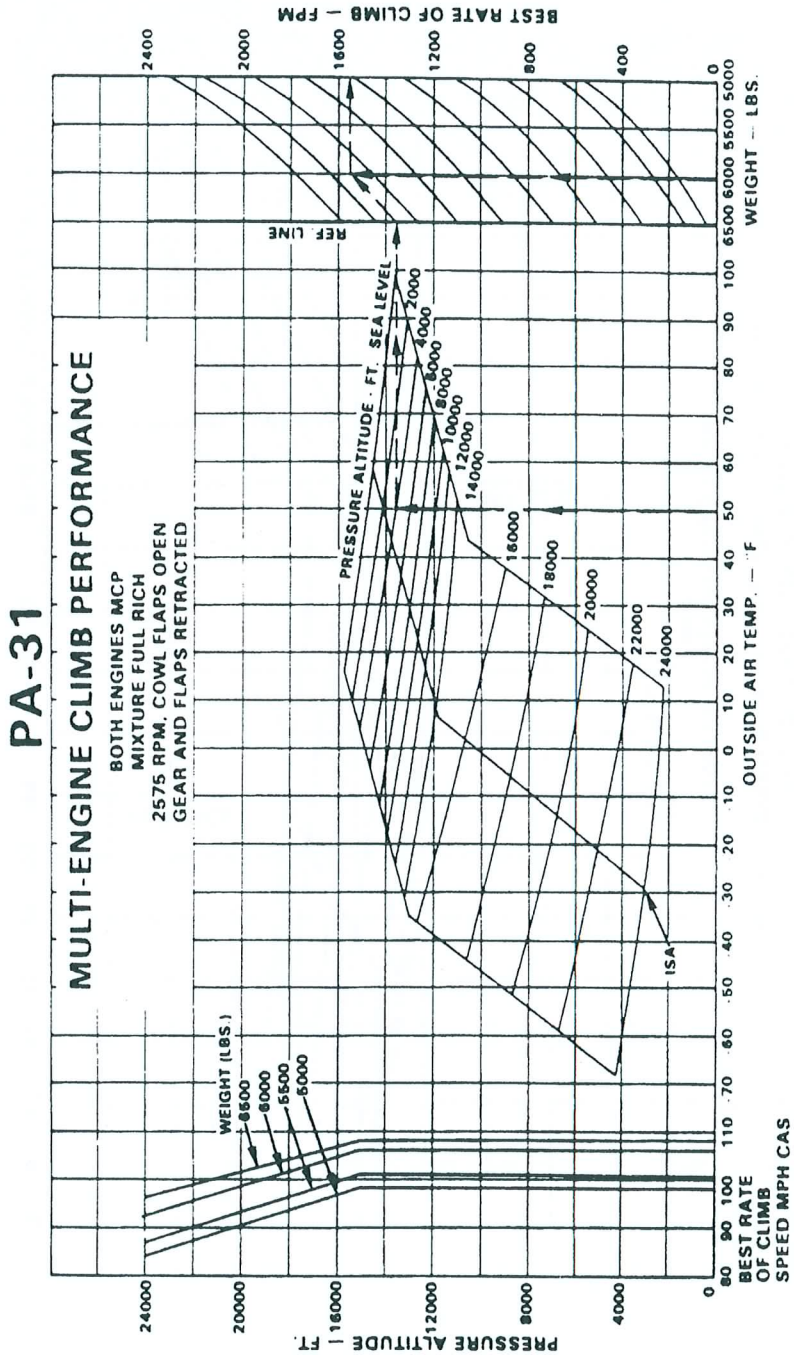
NORMAL ACCELERATE-STOP DISTANCE

BOTH ENGINES MCP (2675 RPM) PRIOR TO BRAKE RELEASE
MIXTURE FULL RICH, COWL FLAPS OPEN, FLAPS 0°
PAVED LEVEL DRY RUNWAY
ABORT SPEED 98 MPH CAS, MAXIMUM BRAKING



PA-31


NORMAL ACCELERATE-STOP DISTANCE
BOTH ENGINES MCP (2575 RPM) PRIOR TO BRAKE RELEASE
MIXTURE FULL RICH, COWL FLAPS OPEN, FLAP 0°
PAVED LEVEL DRY RUNWAY
ABORT SPEED 98 MPH CAS, MAXIMUM BRAKING
HEAVY DUTY BRAKES: CLEVELAND 39-95A
NOTE
DISTANCES INCLUDE A FAILURE RECOGNITION TIME OF 3 SECONDS
PRESSURE ALTITUDE — FT.
8000
6000
4000
2000
SEA LEVEL
ISA
EXAMPLE
REF. LINE
REF. LINE
TAILWIND
HEADWIND
-10 0 10 20 30 40 50 60 70 80 90
6500 6000 5500 5000 4500
0 10 20 30
1000 2000 3000 4000 5000
OUTSIDE AIR TEMPERATURE — °F
WEIGHT — LBS.
WIND — MPH
ACCELERATE/STOP DISTANCE — FT.


PA-31
MULTI-ENGINE CLIMB PERFORMANCE
BOTH ENGINES MCP
MIXTURE FULL RICH
2575 RPM. COWL FLAPS OPEN
GEAR AND FLAPS RETRACTED
BEST RATE OF CLIMB — FPM
REF. LINE
PRESSURE ALTITUDE - FT. SEA LEVEL
WEIGHT (LBS.)
6500
6000
5500
5000
ISA
WEIGHT — LBS.
OUTSIDE AIR TEMP. — °F
PRESSURE ALTITUDE — FT.
BEST RATE OF CLIMB SPEED MPH CAS

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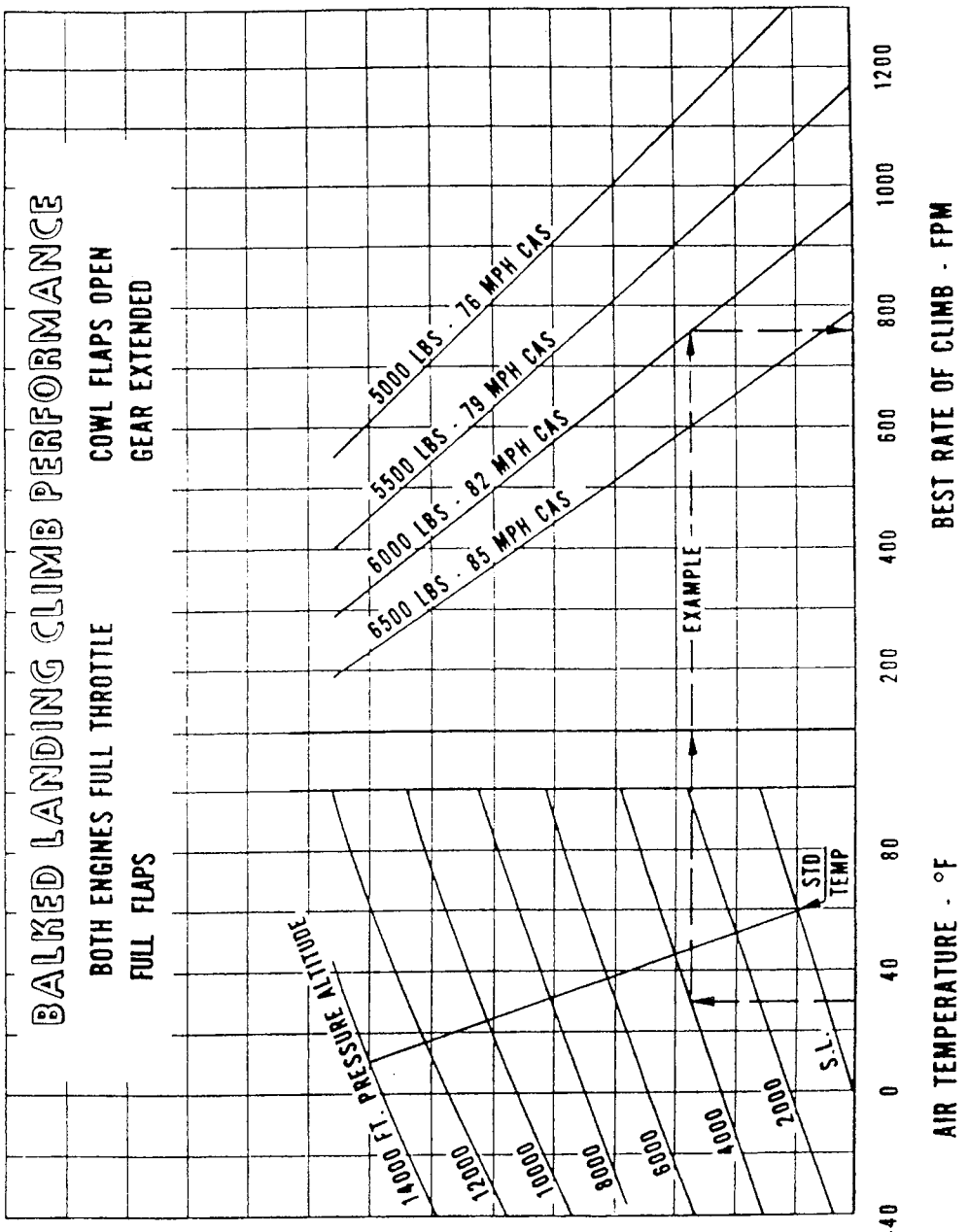
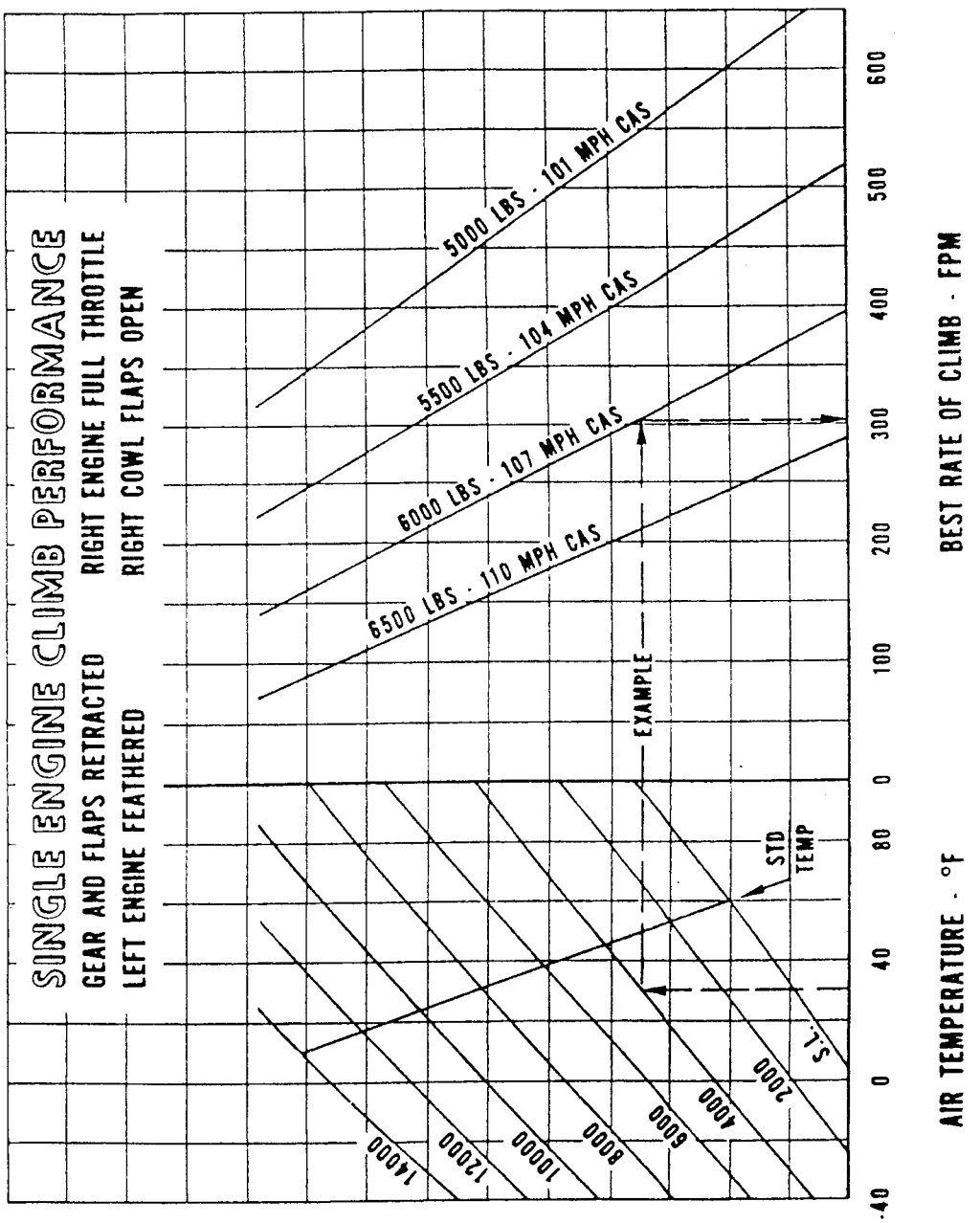
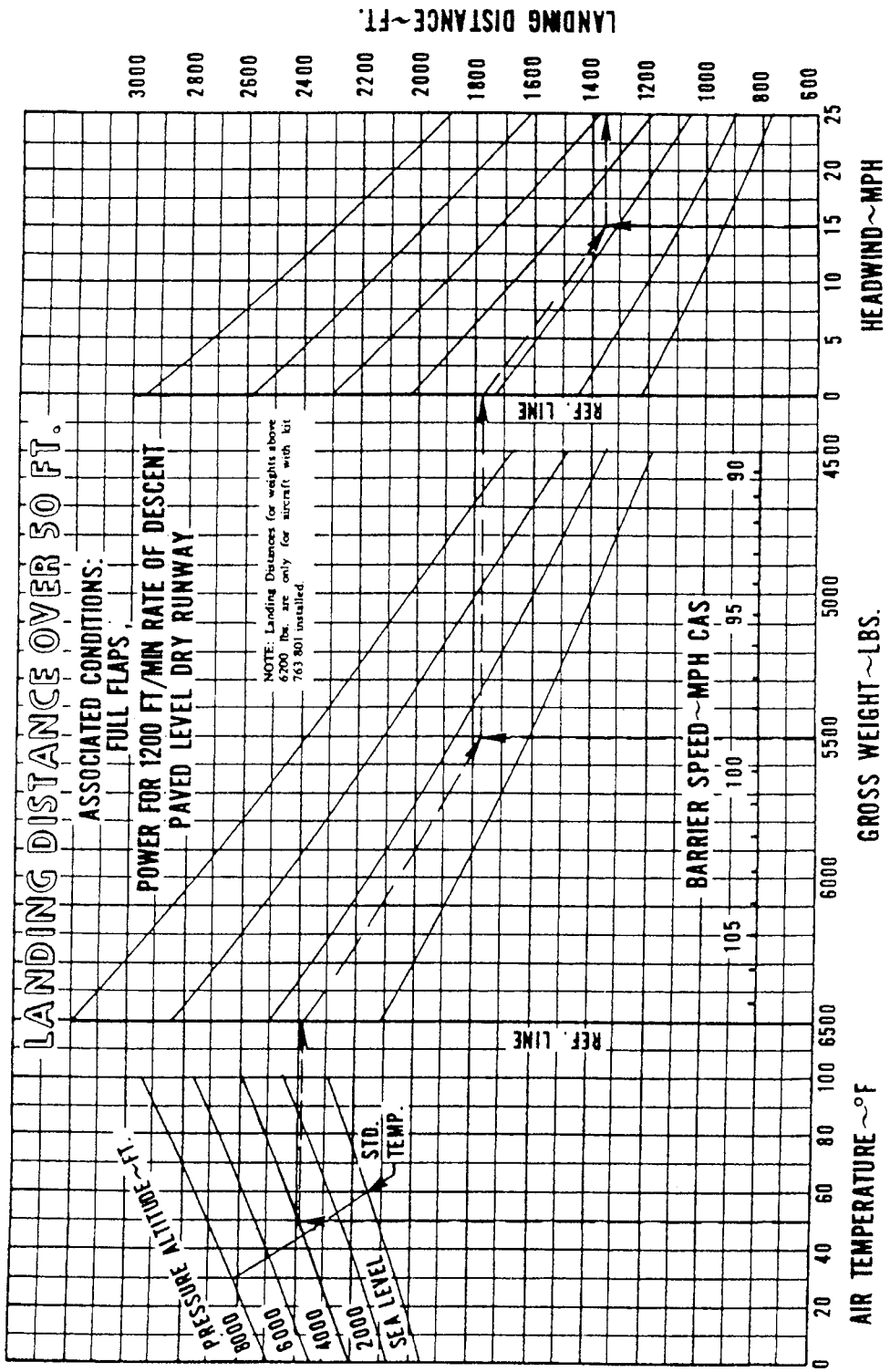
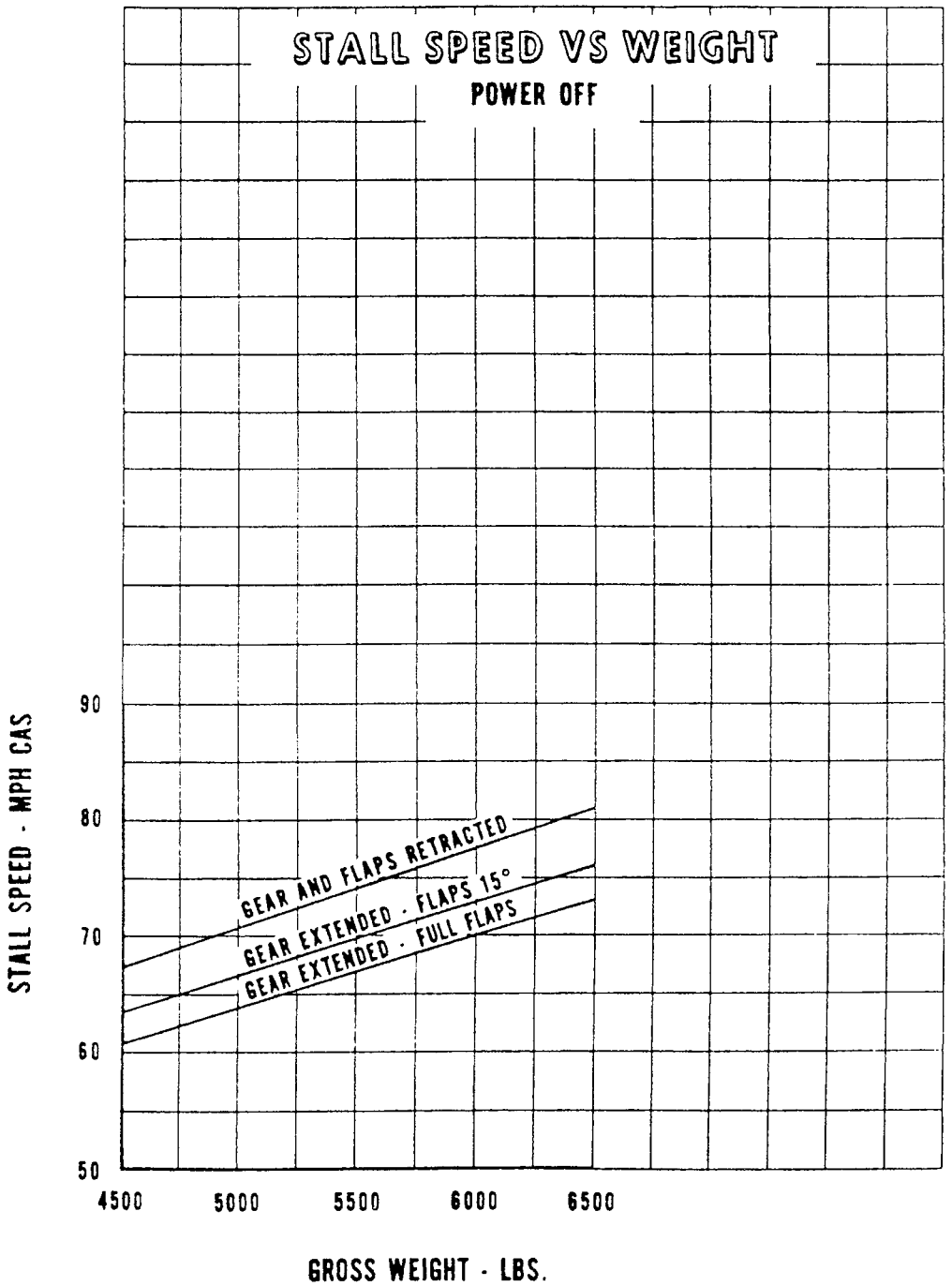
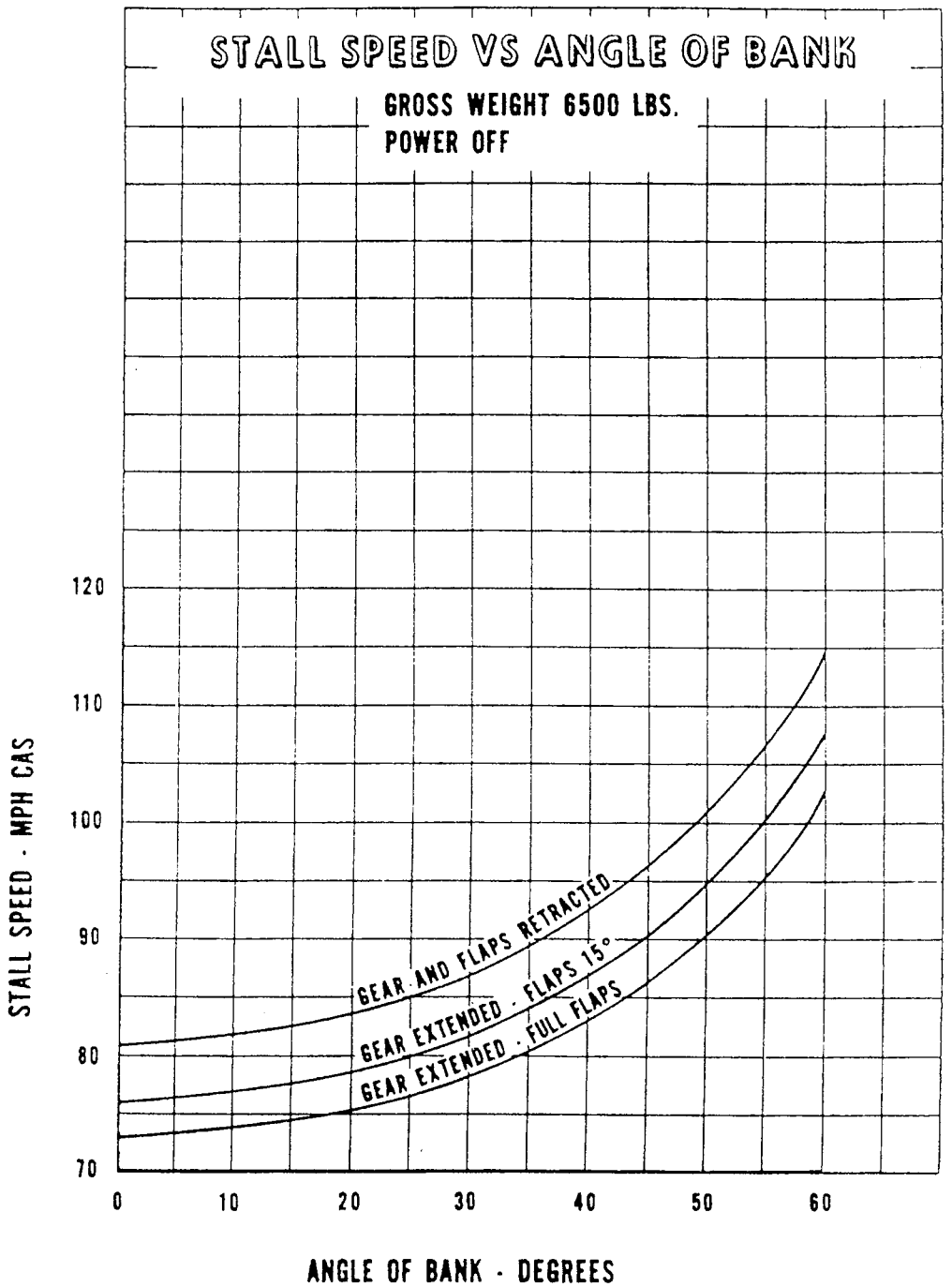

BALKED LANDING CLIMB PERFORMANCE
BOTH ENGINES FULL THROTTLE
FULL FLAPS
COWL FLAPS OPEN
GEAR EXTENDED
5000 LBS - 76 MPH CAS
5500 LBS - 79 MPH CAS
6000 LBS - 82 MPH CAS
6500 LBS - 85 MPH CAS
EXAMPLE
PRESSURE ALTITUDE
14000 FT.
12000
10000
8000
6000
4000
2000
S.L.
STD TEMP
-40
0
40
80
200
400
600
800
1000
1200
AIR TEMPERATURE - °F
BEST RATE OF CLIMB - FPM


SINGLE ENGINE CLIMB PERFORMANCE
GEAR AND FLAPS RETRACTED
LEFT ENGINE FEATHERED
RIGHT ENGINE FULL THROTTLE
RIGHT COWL FLAPS OPEN
5000 LBS - 101 MPH CAS
5500 LBS - 104 MPH CAS
6000 LBS - 107 MPH CAS
6500 LBS - 110 MPH CAS
EXAMPLE
STD TEMP
S.L.
2000
4000
6000
8000
10000
12000
14000
-40
0
40
80
0
100
200
300
400
500
600
AIR TEMPERATURE - °F
BEST RATE OF CLIMB - FPM


LANDING DISTANCE OVER 50 FT.
ASSOCIATED CONDITIONS:
FULL FLAPS,
POWER FOR 1200 FT/MIN RATE OF DESCENT
PAVED LEVEL DRY RUNWAY
NOTE: Landing Distances for weights above 6200 lbs. are only for aircraft with kit 763 801 installed.
PRESSURE ALTITUDE~FT.
8000
6000
4000
2000
SEA LEVEL
STD. TEMP.
REF. LINE
REF. LINE
BARRIER SPEED~MPH CAS
90
95
100
105
LANDING DISTANCE~FT.
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
HEADWIND~MPH
25
20
15
10
5
0
GROSS WEIGHT~LBS.
4500
5000
5500
6000
6500
AIR TEMPERATURE~°F
0
20
40
60
80
100


STALL SPEED VS WEIGHT
POWER OFF
STALL SPEED - MPH CAS
90
80
70
60
50
GEAR AND FLAPS RETRACTED
GEAR EXTENDED - FLAPS 15°
GEAR EXTENDED - FULL FLAPS
4500
5000
5500
6000
6500
GROSS WEIGHT - LBS.


STALL SPEED VS ANGLE OF BANK
GROSS WEIGHT 6500 LBS.
POWER OFF
STALL SPEED - MPH CAS
120
110
100
90
80
70
0
10
20
30
40
50
60
GEAR AND FLAPS RETRACTED
GEAR EXTENDED - FLAPS 15°
GEAR EXTENDED - FULL FLAPS
ANGLE OF BANK - DEGREES

SECTION V

SUPPLEMENTS

A. OXYGEN SYSTEM

1. PREFLIGHT

(a) Pilot's mask is stowed under pilot seat, passenger masks are stowed in fuselage side walls beside each seat. Insure adequate supply of both types of masks.

(b) Check oxygen pressure - 1800 psi when full.

(c) Using pilot's mask, check for operation by momentarily opening control knob and noticing that flow indicator in tube of mask shows flow.

(d) Brief passengers:

(1) Need for oxygen above 10,000 feet

(2) How to determine flow

(3) Recognizing anoxia

(4) No smoking, no oil near oxygen

2. 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

3. NOTES

(a) Always remove fitting from receptacle and stow mask when not in use. Oxygen will flow through mask whenever fitting is in receptacle, with control knob "ON". Mask may be damaged if not stowed.

(b) The pilot's mask (identified with a Red band on the supply hose) supplies 120 liters per hour or a 5000 foot level supply of oxygen to 20,000 feet.

(c) The passenger masks (identified with a Gold band on the supply hose) supply 90 liters per hour or a 10,000 foot level supply of oxygen to 20,000 feet.

(d) If the oxygen tank has a pressure of 1800 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	14.72
1	2	10.30
1	3	7.93
1	4	6.44
1	5	5.42
1	6	4.68
1	7	4.12

With 2 Pilot's Masks		Oxygen Supply Range in Hours
2		12.88
2	1	9.37
2	2	7.36
2	3	6.07
2	4	5.15
2	5	4.48
2	6	3.96

(e) Oxygen mask: should be inspected and cleaned frequently. Defective masks should be replaced.

B. ALTIMATIC III

1. PREFLIGHT

(a) ROLL SECTION

With heading lock button "OFF" and radio coupler in "Heading" mode, engage roll section. Rotate roll knob full right and full left. Determine that the control wheel describes a corresponding right and left turn, then center knob and disengage prior to take-off.

(b) PITCH SECTION

With altitude preselect button "OFF" and "Roll" and "Pitch" buttons pushed in, rotate the pitch command disk full DOWN and full UP. Determine that the control wheel describes a corresponding fore and aft movement, then center the disk and disengage prior to take-off.

NOTE

Autopilot might not be able to raise elevators on ground without assistance from pilot.

(c) PITCH TRIM

Push trim switch forward for nose down trim and aft for nose up trim, check trim position indicator and trim control wheel for proper response. Pitch Trim is automatically accomplished when the Pitch Section is engaged.

2. FLIGHT

(a) Trim airplane (Ball Centered).

(b) Check air pressure to ascertain that the directional gyro and attitude gyro are receiving sufficient air.

(c) ROLL SECTION

To engage, push console heading lock button (HDG) "OFF". Center ROLL knob. Push ROLL button to "ON" position.

To turn, rotate console ROLL knob in desired direction. (Maximum angle of bank should not exceed 30°.)

For heading lock, set directional gyro with magnetic compass. Push directional gyro HDG knob in, rotate to select desired heading. Push console heading lock button (HDG) to "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)

To engage, push Altitude Preselect Button (ALT) to "OFF" position. Center the pitch trim indicator with the pitch command disk. Push PITCH button to "ON" position.

To change altitude, rotate PITCH command disk in desired direction.

To preselect altitude, center PITCH command disk. With airplane in level flight, rotate the altitude selector knob until pitch trim indicator is level. Calibrate the altitude indicator to match altimeter by rotating the knurled altitude indicator dial. Rotate the altitude selector knob to select desired altitude. Push altitude preselect button (ALT) to "ON" position. The altitude preselect button may also be engaged when the aircraft is climbing or descending. Rotate the altitude selector knob until trim indicator indicates UP or DOWN as desired, then engage the altitude preselect button. The selected altitude will be held.

3. FLIGHT (RADIO COUPLER)

The Altimatic may be coupled to the VOR NAV receiver in the modes indicated on the function switch.

In the Heading (HDG) mode, the Altimatic is controlled by the Directional Gyro.

4. FLIGHT (GLIDE SLOPE COUPLER)
   (a) Set Radio Coupler to Localizer Normal Mode (LOC/NORM).
   (b) Engage altitude hold.
   (c) Extend landing gear and set flaps (15° max).
   (d) Adjust power to maintain desired approach speed (120 to 140 MPH).

5. FLIGHT (AUTOFLITE)
   (a) AutoFlite switch "ON".
   (b) Adjust "Trim" knob.
   (c) Press AutoFlite "OFF" button to change heading.
   Engagement of "Roll Section" automatically disengages AutoFlite.

6. LIMITATIONS
   (a) ROLL, PITCH and AUTOFLITE "OFF" during take-off and landing.
   (b) ROLL, PITCH and AUTOFLITE "OFF" above 250 MPH.
   (c) Minimum coupled approach speed 115 MPH.
   (d) Disengage the autopilot prior to operating the flaps.

7. EMERGENCY PROCEDURES

   (a) In the event of a malfunction in the ROLL or PITCH SECTION, push the ROLL ON/OFF button "OFF". This disengages both ROLL and PITCH SECTIONS of the Altimatic from the control system.

   (b) The PITCH TRIM SECTION may be overpowered manually. In the event of a malfunction in the PITCH - TRIM SECTION, pull the Pitch Trim circuit breaker.

   (c) The Altimatic ROLL SECTION may be overpowered manually by exertion of 15 pounds of force on either control wheel. The Altimatic PITCH SECTION may be overpowered manually by exertion of 12 pounds of force on either control wheel.

   (d) In cruise configuration, Altimatic malfunction with a 3-second recovery delay results in a 50° bank and a 350 foot altitude loss.

   (e) In approach configuration, Altimatic malfunction with a 1-second recovery delay results in a 35° bank and a 200 foot altitude loss.

ADDENDUM

ALTIMATIC III (WITH OPTIONAL CONTROL CONSOLE) (MITCHELL 1C404-P)

1. PREFLIGHT

(a) ROLL SECTION

With heading lock switch "OFF" and radio coupler in "Heading" mode, engage roll section. Rotate roll knob full right and full left. Determine that the control wheel describes a corresponding right and left turn, then center knob and disengage prior to take-off.

(b) PITCH SECTION

With altitude switch "OFF" and "Roll" and "Pitch" switches engaged, rotate the pitch command disk full DOWN and full UP. Determine that the control wheel describes a corresponding fore and aft movement, then center the disk and disengage prior to take-off.

(c) PITCH TRIM

Push trim switch forward for nose down trim and aft for nose up trim, check trim position indicator and trim control wheel for proper response. Pitch Trim is automatically accomplished when the Pitch Section is engaged.

2. FLIGHT

(a) Trim airplane (Ball Centered).

(b) Check air pressure to ascertain that the directional gyro and attitude gyro are receiving sufficient air.

(c) ROLL SECTION

To engage, push console heading lock switch (HDG) "OFF". Center ROLL knob. Push ROLL switch to "ON" position.

To turn, rotate console ROLL knob in desired direction. (Maximum angle of bank should not exceed 30°.)

For heading lock, set directional gyro with magnetic compass. Push directional gyro HDG knob in, rotate to select desired heading. Push console heading lock switch (HDG) to "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)

To engage, push Altitude switch (ALT) to "OFF" position. Center the pitch trim indicator with the pitch command disk. Push PITCH switch to "ON" position.

To change altitude, rotate PITCH command disk in desired direction.

To "LOCK ON" an altitude, engage altitude switch (ALT). To change altitude, disengage altitude lock (ALT), rotate pitch command disk in desired direction, reengage altitude lock when desired altitude is reached .

3. FLIGHT (RADIO COUPLER)

The Altimatic may be coupled to the VOR NAV receiver in the modes indicated on the function switch.

In the Heading (HDG) mode, the Altimatic is controlled by the Directional Gyro.

4. LIMITATIONS

(a) ROLL and PITCH "OFF" during take-off and landing.

(b) ROLL and PITCH "OFF" above 250 mph.

5. EMERGENCY PROCEDURES

(a) In the event of a malfunction in the ROLL or PITCH SECTION, disengage the ROLL switch. This disengages both ROLL and PITCH SECTIONS of the Altimatic from the control system, or depress the AutoPilot disengage button on pilot's control wheel.

(b) The PITCH TRIM SECTION may be overpowered manually. In the event of a malfunction in the PITCH - TRIM SECTION, pull the Pitch Trim circuit breaker.

(c) The Altimatic ROLL SECTION may be overpowered manually by exertion of 15 pounds of force on either control wheel. The Altimatic PITCH SECTION may be overpowered manually by exertion of 12 pounds of force on either control wheel.

(d) In cruise configuration, Altimatic malfunction with a 3-second recovery delay results in a 50° bank and a 350 foot altitude loss.

(e) In approach configuration, Altimatic malfunction with a 1-second recovery delay results in a 35 ° bank and a 200 foot altitude loss.

C. H-14 AUTOPILOT

1. OPERATING LIMITATIONS

(a) The maximum speed for Autopilot operation is 245 MPH.

(b) The minimum single engine speed for Autopilot operation is 115 mph.

(c) Disengage the autopilot prior to operating the flaps.

2. PREFLIGHT OPERATION

(a) AutoPilot circuit breaker - push in to reset, if necessary.

(b) Ground Check - Check to see that mode switches (altitude hold, navigation, heading) operate by pressing each in turn and seeing that it stays engaged. However, depressing the heading switch should release the navigation switch and vice-versa. Check gyros for proper erection by noting the horizon bar remaining level and the directional gyro being steady.

(c) Turn off AutoPilot master switch.

3. IN-FLIGHT OPERATION

(a) Engagement - After take-off, manually trim the aircraft, center the pitch trim indicator and turn knob. Press the master switch "ON". The Autopilot is now operating. The rudder may be manually trimmed for ball "center" after the Autopilot is engaged.

(b) Operation - To climb, move the pitch wheel toward "UP"; to descend move the pitch wheel toward "DOWN". The thumb cutout indicates by feel to the pilot whether the pitch wheel is in the descent, level or climb position.

For turns to the left, rotate the Turn Control knob left. Ninety degrees of the knob equals thirty degrees of airplane bank. To turn right, rotate the turn knob to the right. When the turn knob is in the center or detent position, the airplane is automatically on heading control.

Heading is automatically disengaged whenever the Turn Control is moved out of detent. The rudder is coordinated during all turns, and rudder damping is operative any time the system is engaged.

(c) Automatic Pitch Trim - Pneumatic automatic pitch trim is provided whenever the Autopilot is engaged. Any manual mistrim present in the elevator can be observed on the pitch trim meter when the Autopilot is engaged. The automatic pitch trim can be easily overpowered by the pilot.

(d) Altitude Control Operation - Engage the Altitude Control by pressing the ON portion of the ALT switch. It is disengaged automatically whenever a pitch signal is applied through the PITCH command wheel or directly by pressing the OFF portion of the ALT switch.

The aircraft will hold the pressure altitude existing at the time the switch is depressed. For best operation, engage the Altitude Control in level flight. If the ALT switch is pressed to ON during a normal climb or descent, the aircraft will level off slightly beyond the selected altitude. Then when the Altitude Control is disengaged, the aircraft will assume the climb or descent existing at the time the Altitude Control was engaged.

(e) Heading Function

(1) H-14 Heading Select

The Heading Selector enables the pilot to pre-select a heading. Select an aircraft heading by turning the Heading Selector knob until the desired heading is aligned with the index. Push in the Heading Select knob on the lower left hand side of the selector and the airplane will smoothly assume a 22° maximum bank rolling out on the selected heading. Further heading changes may be

made by turning the Heading Selector knob to the new heading. The Heading Selector is disengaged by moving the Turn Control out of detent, by pressing the NAV switch on, or pulling out on the Heading Select knob. When the Heading Select is disengaged, the heading-hold feature as described in 3-b above is still operational.

(f) Automatic Omni Coupling

(1) The Automatic Omni Coupler enables the pilot to intercept and track desired radials to or from omni stations. The addition of this feature does not add any new switch to the AutoPilot. The NAV switch is used for both automatic Omni and automatic ILS.

(2) To intercept a desired radial inbound to a station, the aircraft must be located within 45° sector of the desired inbound radial. To use the Omni Coupler, dial in the desired station on the VHF navigation radio and set the Omni Bearing Selector, and the Heading Selector knob to the desired radial heading. Press the ON portion of the NAV switch and the aircraft will turn to a 45° intercept of the selected inbound or outboard radial.

When the aircraft is within 10° of the selected radial, it will begin an intercept of the radial and track inbound to the station. When passing the station, a smooth bank in each direction will be noted before tracking outbound on the pre-selected radial.

(3) To track outbound within 30° of the inbound radial, dial in the new track with the Heading Selector and Omni Bearing selector.

(4) To track outbound beyond 30° of the inbound radial, turn the aircraft with the Turn Control to the heading of the new radial. Select the desired radial on the Omni Bearing selector and the Heading Selector. Then press the NAV switch ON.

(5) To track inbound to the next station, tune in the station and set the Omni Bearing selector and Heading Selector to the desired radial. The aircraft will track inbound without disengaging the Omni Coupler. Moving the Turn Control out of detent, pressing the OFF portion of the NAV switch, or engaging the Heading Selector will disengage the Automatic Omni Coupler.

(g) Automatic ILS and Glide Slope Coupler

(1) The ILS coupler uses information from the ILS and glide slope receivers to follow the localizer and glide path beams. The proper ILS frequency must be tuned in and the OFF warning flags down before engaging the ILS Coupler. Let-down, orientation, and procedure turn may be performed with the automatic pilot.

NOTE

The recommended approach speed is 120 MPH multi-engine and 130 MPH single-engine with not more than 15° flaps.

(2) Start the procedure turn using the Turn Control or Heading Selector. Then descend to the authorized procedure turn altitude and level off using the Pitch Command Wheel. Press the Altitude Switch ON and complete the procedure turn. Press the "NAV" switch ON with the Turn Control knob in the detent position when the ILS localizer needle is two dots from center circle. The aircraft will then automatically bracket the beam. If "NAV" mode is engaged prior to two dots displacement from the center circle on the localizer indicator a momentary turn toward the back course may be expected.

(3) When the aircraft intercepts the glide path, the Altitude switch will automatically disengage and the glide coupler automatically engage, commanding the proper pitch control to hold the aircraft on the glide path. Adjust the throttles manually to control airspeed during the descent. Disengage the Autopilot at published let-down minimums.

NOTE

NO GLIDE PATH APPROACH - If the glide slope transmitter of the ILS system is inoperative or if a glide slope receiver is not included in the aircraft equipment, fly the let-down with the PITCH command wheel.

(4) The H-14 AutoPilot is equipped with an Automatic Back Course Localizer feature which enables the AutoPilot to fly a back course approach. The localizer needle will still indicate in reverse when the back course feature is being used. To use the back course feature one must engage it by depressing the "Back Course" switch until the internal light turns the switch to blue. This unit should be engaged during the procedure turn or just before intercepting the back course localizer beam during a radar-vectored approach. When the back course feature is being used the glide slope coupler is disengaged. The localizer should be intercepted at 45° or less in order to permit the Autopilot to bracket the localizer before the airport is reached. The descent should be flown by using the pitch command wheel.

4. EMERGENCY PROCEDURES

(a) Disengaging Pilot

(1) The AutoPilot may be disengaged by any of the following:

a. Pressing the disengage button on the pilot's wheel.

b. Pressing the Master switch OFF.

c. Pulling out on the AutoPilot circuit breaker.

(2) The AutoPilot may be overpowered by maximum control forces of:

Rudder	30 lbs.
Aileron	30 lbs.
Elevator	35 lbs.

(b) Single-Engine Procedure

(1) For any single-engine emergency, handle the emergency and then trim the airplane rudder with the Autopilot still engaged. If an engine failure occurs during an ILS coupled approach, observe the 115 MPH minimum speed for single-engine AutoPilot operation and keep the turn and slip indicator ball centered with manual trim. When the AutoPilot is disengaged, there will be a slight tendency of the airplane to bank into the dead engine.

(2) During single-engine operation, the intercept angle to the localizer should be less than 45° with the airplane trimmed for normal single-engine operation.

(c) Maximum altitude loss during malfunction tests was:

(1) Cruise	150 feet
(2) ILS Approach (with ILS coupled)	100 feet
(3) ILS Approach (without ILS coupled)	100 feet
(4) ILS Approach (Single-Engine with coupled)	100 feet
(5) ILS Approach (Single-Engine without coupled)	120 feet

D. ICING EQUIPMENT

The following anti-ice and de-icing equipment is available as optional equipment. (See equipment list for items installed.)

1. Heated pitot tubes
2. Electrically heated windshield
3. Electric propeller anti-icing strip
4. De-icing boots on wing and empennage leading edges
5. Wing ice light

Operation

The above equipment is activated by switches on the circuit breaker panel. Circuit breakers to prevent electric overload are provided.

Some of this equipment draws considerable current. The electrical load should be monitored carefully, especially during single-engine operation.

Limitations on Electrically Heated Equipment

1. Pitot tube heat should not be used for extended periods during ground operation.
2. The electrically heated windshield should not be operated for extended periods during ground operation unless windshield ice is present to prevent overheating.

PNEUMATIC DE-ICING SYSTEM

1. OPERATING PROCEDURES
   - (a) Pre-Flight Check
     - (1) Check Wing De-Ice Indicator (press-to-test).
     - (2) Check source indicator for pump malfunction.
     - (3) At approximately 2000 RPM, check the De-Icer operation. Turn Wing De-Ice Switch ON. In approximately three seconds the indicator light will glow, indicating inflation. Also check the De-Icer boots visually. Return switch to the OFF position.
   - (b) Normal Operation
     - (1) Light Icing - Turn Wing De-Ice switch ON. Boots will inflate once every three minutes. Wing De-Ice Indicator will glow during the six-second inflation period. Most effective de-icing is obtained if a thickness of 1/4 to 1/2" of ice is collected before the De-Icers are operated.
     - (2) Heavier Icing - The Wing De-Ice switch will permit the operator to manually cycle the system in any time interval less than three minutes should icing conditions require. The Wing De-Ice switch resets the timer instantaneously when turned to the OFF position. To allow for proper de-icing action, allow a minimum of 15 seconds per cycle.

2. ALTITUDE LIMITATIONS ON DE-ICER BOOTS

(a) The de-icer boots may not maintain optimum effectiveness above the altitudes listed below for the specified conditions.

No. of Eng.	Engine Speed RPM	Pneumatic AutoPilot - H-14	
		OFF	ON
2	2575	24,000 Ft.	22,000 Ft.
2	2400	24,000 Ft.	21,000 Ft.
1	2575	10,500 Ft.	7,500 Ft.

If the Altimatic III Autopilot is installed in lieu of the H-14 the above altitudes are increased approximately 1000 feet.

3. PLACARDS — CONTROL PANEL MARKINGS

(a) "Wing De-Ice"
Toggle type control switch (Circuit breaker switch)

(b) "Wing De-Ice Ind."
Blue (press-to-test) De-Ice Inflation Indicator

4. EMERGENCY OPERATIONS

(a) De-Icer Electronic Timer Malfunction —
(1) Turn Wing De-Ice switch to OFF position, or switch may have turned OFF automatically .
(2) To activate boots, turn Wing De-Ice switch to ON position.

(b) De-Icer Rapid Cycling Malfunction —
(1) Check "TRIM COWL FLAP" circuit breaker (Press-to-set).
(2) If circuit breaker will not hold, only normal three-minute cycling can be obtained. With the "TRIM COWL FLAP" circuit breaker out, a delay of approximately 3 minutes can be expected before inflation when the Wing De-Ice switch is turned ON.

(c) Single-Engine or Pneumatic Pump Failure —
(1) System will adjust automatically.
(2) Observe altitude limitations given under paragraph D. 2 (a) for optimum effectiveness.

E. ALTIMATIC III B

1. PREFLIGHT

(a) ROLL SECTION

With heading lock button "OFF" and radio coupler in "Heading" mode, engage roll section. Rotate roll knob full right and full left. Determine that the control wheel describes a corresponding right and left turn, then center knob. Check emergency Autopilot Disconnect by depressing the Autopilot "OFF" switch on the pilot's control wheel and observing that the console ROLL switch disengages. Turn control wheel right and left to insure that AutoPilot has been disconnected from control cables. Roll must be disengaged prior to take-off.

(b) PITCH SECTION

With altitude preselect button "OFF" and "Roll" and "Pitch" buttons pushed in, rotate the pitch command disk full DOWN and full UP. Determine that the control wheel describes a corresponding fore and aft movement, then center the disk and disengage prior to take-off.

(c) PITCH TRIM

Push trim switch forward for nose down trim and aft for nose up trim, check trim position indicator and trim control wheel for proper response. Pitch Trim is automatically accomplished when the Pitch Section is engaged.

(d) PITCH TRIM WARNING LIGHT (When Installed)

The pitch trim warning light on the instrument panel will indicate when the pitch has been out of trim for approximately four seconds (Pitch Trim Engaged).

The light has a press-to-test feature (Pitch Trim Engaged) that will indicate to the operator if the bulb is good and that approximately four seconds is required for the warning system to actuate.

2. FLIGHT

(a) Trim airplane (Ball Centered).

(b) Check air pressure to ascertain that the directional gyro and attitude gyro are receiving sufficient air.

(c) ROLL SECTION

To engage, push console heading lock button (HDG) "OFF". Center ROLL knob. Push ROLL button to "ON" position.

To turn, rotate console ROLL knob in desired direction. (Maximum angle of bank should not exceed 30°.)

For heading lock, set directional gyro with magnetic compass. Push directional gyro HDG knob in, rotate to select desired heading. Push console heading lock button (HDG) to "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)

To engage, push Altitude Preselect Button (ALT) to "OFF" position. Center the pitch trim indicator with the pitch command disk. Push PITCH button to "ON" position.

To change altitude, rotate PITCH command disk in desired direction.

To preselect altitude, center PITCH command disk. With airplane in level flight, rotate the altitude selector knob until pitch trim indicator is level. Calibrate the altitude indicator to match altimeter by rotating the knurled altitude indicator dial. Rotate the altitude selector knob to select desired altitude. Push altitude preselect button (ALT) to "ON" position. The altitude preselect button may also be engaged when the aircraft is climbing or descending. Rotate the altitude selector knob until trim indicator indicates UP or DOWN as desired, then engage the altitude preselect button. The selected altitude will be held.

3. FLIGHT (RADIO COUPLER)

The Altimatic may be coupled to the VOR NAV receiver in the modes indicated on the function switch.

In the Heading (HDG) mode, the Altimatic is controlled by the Directional Gyro.

4. FLIGHT (GLIDE SLOPE COUPLER)

(a) Set Radio Coupler to Localizer Normal Mode (LOC/NORM).
(b) Engage altitude hold.
(c) Extend landing gear and set flaps (15° max).
(d) Adjust power to maintain desired approach speed (120 to 140 MPH).

5. FLIGHT (AUTOFLITE)

(a) AutoFlite switch "ON".
(b) Adjust "Trim" knob.
(c) Press AutoPilot "OFF" button to change heading.
Engagement of "Roll Section" automatically disengages AutoFlite.

6. LIMITATIONS

(a) ROLL, PITCH and AUTOFLITE 'OFF" during take-off and landing.
(b) ROLL, PITCH and AUTOFLITE "OFF" above 250 MPH.
(c) Minimum coupled approach speed 115 MPH.
(d) Disengage the autopilot prior to operating the flaps.

7. EMERGENCY PROCEDURES

(a) In the event of a malfunction in the ROLL or PITCH SECTION, push the AUTO-PILOT OFF button on the pilot's control wheel. This disengages both ROLL and PITCH SECTIONS of the Altimatic from the control system.

(b) The PITCH TRIM SECTION may be overpowered manually. In the event of a malfunction in the PITCH - TRIM SECTION, pull the Pitch Trim circuit breaker.

(c) The Altimatic ROLL SECTION may be overpowered manually by exertion of 15 pounds of force on either control wheel. The Altimatic PITCH SECTION may be over-powered manually by exertion of 12 pounds of force on either control wheel.

(d) In cruise configuration, Altimatic malfunction with a 3-second recovery delay results in a 50° bank and a 350 foot altitude loss.

(e) In approach configuration, Altimatic malfunction with a 1-second recovery delay results in a 35° bank and a 200 foot altitude loss.

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SECTION VI

EQUIPMENT LIST

The following is a list of equipment which may be installed in the PA-31. Items marked with a * are required for every flight. The symbol "X" is used to indicate that an item was installed when the airplane was delivered by the manufacturer. For equipment required for various conditions of flight see the "LIMITATIONS" section and the FAR's.

Item		Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	A.	Propeller and Propeller Accessories			
*	_____	Two Propellers, Hartzell Model HC-E2YK-2B/C8475-4 or HC-E2YR-2B/C8475-4, (2 Bld)	66.5 ea.	48.2	TC P9EA
*	_____	Two Propellers, Hartzell Model HC-E2YK-2BT/C8475-4 or HC-E2YR-2BT/C8475-4 (2 Bld)	67.9 ea.	48.2	TC P9EA
*	_____	Two Propellers, Hartzell Model HC-E3YR-2/C8468-6R, or HC-E3YR-2A/C8468-6R (3 Bld)	90.5 ea.	48.2	TC P33EA
*	_____	Two Propellers, Hartzell Model HC-E3YR-2T/C8468-6R or HC-E3YR-2AT/C8468-6R (3 Bld)	91.9 ea.	48.2	TC P33EA
*	_____	Two Hydraulic Propeller Governors, Hartzell Model F-6-11S or F-6-11A Per PAC Dwg. 24622-7	5.5 ea.	64.0	TC A8EA
*	_____	Two Propeller Spinners Per PAC Dwg. 41888 or 43556 (2 Bld)	2.7 ea.	46.2	TC A8EA
*	_____	Two Propeller Spinners Per PAC Dwg. 43940 (3 Bld)	3.1 ea.	46.2	TC A8EA
*	_____	Two Propeller Spinner Caps Per PAC Dwg. 41892 or 23819-2 (2 Bld)	.3 ea.	36.0	TC A8EA
*	_____	Two Propeller Spinner Caps Per PAC Dwg. 43929 (3 Bld)	.6 ea.	36.0	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	A. Propeller and Propeller Accessories (cont)			
* ____	Two Propeller Spinner Bulkheads Per PAC Dwg. 41889 or 43557 (2 Bld)	.7 ea.	49.8	TC A8EA
* ____	Two Propeller Spinner Bulkheads Per PAC Dwg. 43933 (3 Bld)	1.1 ea.	49.8	TC A8EA
____	Propeller Synchronizer Per PAC Dwg. 44343	8.6	96.4	TC A8EA

APPROVED ENGINE - PROPELLER COMBINATIONS

Engines	Propellers
TIO-540-A1A, TIO-540-A1B	HC-E2YK-2B/C8475-4 or HC-E2YK-2BT/C8475-4 (2 Bld)
TIO-540-A1A, TIO-540-A1B TIO-540-A2A, TIO-540-A2B	HC-E2YR-2B/C8475-4 or HC-E2YR-2BT/C8475-4 (2 Bld)
TIO-540-A2A, TIO-540-A2B	HC-E3YR-2/C8468-6R or HC-E3YR-2T/C8468-6R or HC-E3YR-2A/C8468-6R or HC-E3YR-2AT/C8468-6R (3 Bld)

Item		Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	B.	Engine and Engine Accessories - Fuel and Oil Systems			
*	_____	Two Engines, Lycoming Model TIO-540-A1A or TIO-540-A1B or TIO-540-A2A or TIO-540-A2B	541.5 ea.	77.8	TC E14EA
*	_____	Two Oil Coolers, Harrison Model AP16AN08-01, Part No. 8535311, Per PAC Dwg. 41635	4.5 ea.	97.0	TC A8EA
*	_____	Two Fuel Pumps, Engine Driven, Lear-Siegler Model RG9080-J4	1.3 ea.	91.0	TC A8EA
*	_____	Two Fuel Pumps, Electric, Weldon Model A10000D Per PAC Dwg. 42113	2.8 ea.	127.2	TC A8EA
*	_____	Two Starters, 24 Volt, Prestolite MHB-4001	18.0 ea.	65.8	TC A8EA
*	_____	Two Hydraulic Pumps, Eastern Industries Model 1235, Type 263 or 263A or 277A	3.6 ea.	92.0	TC A8EA
*	_____	Two Induction Air Filters, Donaldson Model P10-6590	1.0 ea.	88.0	TC A8EA
*	_____	Two Oil Filters, AC Model 5578770	2.5 ea.	92.0	TC A8EA
*		Two Air Pumps			
	_____	Airborne Manufacturing Model 200CC	4.0 ea.	90.0	TC A8EA
	_____	Airborne Manufacturing Model 423CC	5.7 ea.	90.0	TC A8EA
	_____	Airborne Manufacturing Model 431CC-7	5.7 ea.	90.0	TC A8EA

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Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	C. Landing Gear			
* _____	Two Main Wheel and Brake Assy., Cleveland Aircraft Products, Wheel No. 40-102 or 40-102a, Brake No. 30-68 or 30-68a	18.3 ea.	152.0	FAA TSO C26a
* _____	Two Main Tires, 6.50 x 10, 8-Ply Rating, Type III with Regular Tubes	13.0 ea.	152.0	TC A8EA
* _____	One Nose Wheel Assembly, Cleveland Aircraft Products No. 40-76B	3.8	48.0	FAA TSO C26a
* _____	One Nose Tire, 6.00 x 6, 6-Ply Rating, Type III with Regular Tube	9.3	48.0	TC A8EA

Item		Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	D.	Instruments			
*	_____	Airspeed Indicator Per PAC Dwg. 41507, -3, -7	.6	96	TC A8EA
	_____	Airspeed Indicator Per PAC Dwg. 41507, -3, -7	.6	96	TC A8EA
*	_____	Magnetic Compass Per PAC Dwg. 42580	.7	96	TC A8EA
*	_____	Sensitive Altimeter Per PAC Dwg. 32281-3,-4, -7, -8	1.3	96	TC A8EA
	_____	Sensitive Altimeter Per PAC Dwg. 32281-3, -4, -7, -8	1.3	96	TC A8EA
	_____	Electric Turn & Bank Per PAC Dwg. 32737-3, -5, 43220, 44378	2.3	96	TC A8EA
	_____	Electric Turn & Bank Per PAC Dwg. 32737-3, -5, 43220, 44378	2.3	96	TC A8EA
	_____	Rate of Climb Per PAC Dwg. 41706 or 41706-2	1.0	96	TC A8EA
	_____	Rate of Climb Per PAC Dwg. 41706 or 41706-2	1.0	96	TC A8EA
	_____	Eight-Day Clock - Wakmann W-33-7510ET	.4	96	TC A8EA
	_____	Eight-Day Clock - Wakmann W-33-7510ET	.4	96	TC A8EA
	_____	Eight-Day Clock - Longines ALL-908ET	.4	96	TC A8EA
	_____	Eight-Day Clock - Longines ALL-908ET	.4	96	TC A8EA
	_____	Outside Air Temp Per PAC Dwg. 41707	.3	103	TC A8EA
*	_____	Ammeter Per PAC Dwg. 41505	.2	96	TC A8EA

Item		Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	D.	Instruments (cont)			
*	_____	Dual Manifold Pressure Per PAC Dwg. 19697-4	1.0	96	TC A8EA
	_____	Dual Gyro Pressure Gage Per PAC Dwg. 43158	.5	96	TC A8EA
*	_____	Dual Tachometer Per PAC Dwg. 25700-3	.7	96	TC A8EA
	_____	Engine Hour Recorder Per PAC Dwg. 41502	.3	96	TC A8EA
*	_____	Dual Fuel Pressure Gage Per PAC Dwg. 41503	1.0	96	TC A8EA
*	_____	Two Fuel Quan. Gages Per PAC Dwg. 41503	.4	96	TC A8EA
	_____	Dual Fuel Flow Gage Per PAC Dwg. 41508 or 43938 or 52346-3	1.1	96	TC A8EA
*	_____	Dual Exhaust Gas Temp Gage Per PAC Dwg. 41499	1.2	96	TC A8EA
*	_____	Cowl Flap Position Indicator Per PAC Dwg. 43145	.2	96	TC A8EA
*	_____	Wing Flap Position Indicator Per PAC Dwg. 55567-2, -3 or -4	.2	96	TC A8EA
*	_____	Rudder Trim Position Indicator Per PAC Dwg. 41510	.2	96	TC A8EA
*	_____	Elevator Trim Position Indicator Per PAC Dwg. 42507	.2	96	TC A8EA
*	_____	Aileron Trim Position Indicator Per PAC Dwg. 41510	.2	96	TC A8EA
*	_____	Two Combination Gages Per PAC Dwg. 41506, Oil Pressure, Oil Temperature, Cylinder Head Temperature	2.4	96	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	D. Instruments (cont)			
_____	Voltmeter Per PAC Dwg. 43817	.2	96	TC A8EA
_____	Gyro Horizon Per PAC Dwg. 41563, 99002-2, -3, -4 (Plt/Std.)	2.3	96	TC A8EA
_____	Gyro Horizon Per PAC Dwg. 32173 (Plt./Alt. III)	2.3	96	TC A8EA
_____	Gyro Horizon Per PAC Dwg. 43222 (Plt./H-14)	2.3	96	TC A8EA
_____	Gyro Horizon Per PAC Dwg. 43804 (Plt./ARB)	2.3	96	TC A8EA
_____	Gyro Horizon Per PAC Dwg. 43805 (Plt./ARB/H-14)	2.3	96	TC A8EA
_____	Gyro Horizon Per PAC Dwg. 43806 (Plt./ARB Alt. III)	2.3	96	TC A8EA
_____	Gyro Horizon Per PAC Dwg. 41563, 99002-2, -3, -4 (Co-Plt./Std.)	2.3	96	TC A8EA
_____	Gyro Horizon Per PAC Dwg. 43804 (Co-Plt./ARB)	2.3	96	TC A8EA
_____	Directional Gyro per PAC Dwg. 41564, 99003-2, -3, 4 (Plt./Std.)	3.4	96	TC A8EA
_____	Directional Gyro Per PAC Dwg. 32168 (Plt./Alt. III)	3.4	96	TC A8EA
_____	Directional Gyro Per PAC Dwg. 43223 (Plt./H-14)	3.4	96	TC A8EA
_____	Directional Gyro Per PAC Dwg. 41564, 99003-2, -3, -4 (Co-Plt./Std.)	3.4	96	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	E. Electrical Equipment			
_____	Two Alternators, 50 Amp ea., Delco-Remy No. 1100718	12.6 ea.	62.8	TC A8EA
* _____	One Battery, 24 Volt - 17 Ampere-Hour, Gill No. 12GCAB-9	28.0	22.0	TC A8EA
_____	One Anti-Collision Light, Grimes No. 40-0101-11-24 or 40-0103-25	1.4	375.0	TC A8EA
_____	One Anti-Collision Light, Grimes No. 40-0101-5-24	1.4	207.0	TC A8EA
_____	Two Landing Lights, 28 Volt, 250-Watt GE No. 4596	2.0 ea.	50.5	TC A8EA
_____	Position Lights - Tail Light (White), Grimes #A2064A-1683; Left Wing (Red), Grimes #A1815A-24; Right Wing (Green), Grimes #A1815A-24	1.1	183.0	TC A8EA
_____	Two Alternators, 70 Amp ea., Prestolite No. EO-19807	12.6	62.8	TC A8EA
_____	Two White Anti-Collision Wing Tip Strobes Per PAC Dwg. 44323	4.3	93.7	TC A8EA
_____	Two Red Anti-Collision Strobes Per PAC Dwg. 44325	4.4	223.6	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
F.	Electronic Equipment			
_____	Narco VOA-4 VOR/Loc	3.5	96.0	TC A8EA
_____	Narco VOA-8 VOR/Loc	3.5	96.0	TC A8EA
_____	Narco VOA-40 VOR/Loc	1.6	96.0	TC A8EA
_____	Narco VOA-5 VOR/Loc-ILS	3.5	96.0	TC A8EA
_____	Narco VOA-9 VOR/Loc-ILS	3.5	96.0	TC A8EA
_____	Narco VOA-50M VOR/Loc-ILS - G/S	1.6	96.0	TC A8EA
_____	Narco Mark 12A with Power Supply and Antenna	10.5	85.8	TC A8EA
_____	Narco Mark 12A with Power Supply and Antenna	10.5	85.8	TC A8EA
_____	Narco Mark 12B with Power Supply and Antenna	10.5	85.8	TC A8EA
_____	Narco Mark 12B with Power Supply and Antenna	10.5	85.8	TC A8EA
_____	Narco Mark 16 with Power Supply and Antenna	10.3	92.3	TC A8EA
_____	Narco Mark 16 with Power Supply and Antenna	10.3	92.3	TC A8EA
_____	Narco UGR-2 Glide Slope Receiver and Antenna	5.2	70.0	TC A8EA
_____	Narco UAT-1 Transponder	11.0	80.6	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	F. Electronic Equipment (cont)			
_____	Bendix ADF T-12C (Single)	10.0	126.3	TC A8EA
	2321 E Loop Antenna 551 A Servo Indicator 201 C Receiver 2T006-21 Cable Kit 102B-28V Audio Amplifier			
_____	Bendix ADF T-12C (Dual)	19.0	126.3	TC A8EA
	(2) 2321 E Loop Antennas (2) 551 E Remote Servos (2) 201 C Receivers 551 C Dual Indicator (2) 2T006-21 Cable Kits (2) 102B-28V Audio Amplifiers			
_____	Bendix TPR-600 Transponder with Antenna	8.2	80.1	FAA TSO C74
_____	Bendix RDR-100 Radar	26.3	47.2	TC A8EA
_____	Bendix RDR-110 Radar	25.1	46.5	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
F.	Electronic Equipment (cont)			
_____	Dare DADF-1 ADF (Single)	20.4	76	TC A8EA
	R-DADF-1A Receiver M/DADF-1 Shock Mount C/DADF-1A Control Head DLL-2 Cable (Loop) DGC-2 Cable (Gonio) DL-2 Loop Antenna DGI-1 Indicator			
_____	Dare DADF-1 ADF (Single) with AIM RMI-800 Series	25.4	76	TC A8EA
	DRG-1 Remote Gonio 289-1D Indicator with Alt.III or no AutoPilot 424-2D Indicator when H-14 installed P-10 Power Supply R-DADF-1A Receiver M/DADF-1 Shock Mount C/DADF-1A Control Head DLL-2 Cable (Loop) DGC-2 Cable (Gonio) DL-2 Loop Antenna			
_____	Dare DADF-1 ADF (Dual)	43.0	76	TC A8EA
	(2) R-DADF-1A Receivers (2) M/DADF-1 Shock Mounts (2) C/DADF-1A Control Heads (2) DLL-2 Cables (Loop) (2) DGC-2 Cables (Gonio) (2) DL-2 Loop Antennas (2) DRG-1 Remote Gonios (1) 551-C Dual Indicator (Bendix)			

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
F.	Electronic Equipment (cont)			
_____	Dare DADF-1 ADF (Dual with AIM RMI-800 Series	45.8	76	TC A8EA
(2)	DRG-1 Remote Gonios			
(1)	289-1D Indicator with Alt. III or no Autopilot			
(1)	424-2D Indicator when H-14 installed			
(1)	P-10 Power Supply			
(2)	R-DADF-1A Receivers			
(2)	M DADF-1 Shock Mounts			
(2)	C DADF-1A Control Heads			
(2)	DLL-2 Cables (Loop)			
(2)	DGC-2 Cables (Gonio)			
(2)	DL-2 Loop Antennas			

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
F.	Electronic Equipment (cont)			
_____	King KN-60 DME or KN-60B with Antenna	7.5	95.0	TC A8EA
_____	King KNI-500L Indicator	2.7	96.6	TC A8EA
_____	King KNI-500 Indicator	2.7	96.6	TC A8EA
_____	King KNR-600 Nav Receiver	7.5	75.0	TC A8EA
_____	King KNR-600 Nav Receiver	7.5	75.0	TC A8EA
_____	King KGM-690 G/S & M/B Receivers	4.0	63.0	TC A8EA
_____	King KAA-445 Dual Audio Amplifier	4.3	79.0	TC A8EA
_____	King KTR-900 VHF Transceiver	8.3	77.2	TC A8EA
_____	King KTR-900 VHF Transceiver	8.3	77.2	TC A8EA
_____	King KDM-700 DME	11.8	71.1	TC A8EA
_____	King KNR-660 Nav Receiver	9.6	75.0	TC A8EA
_____	King KFS-590 Channel Selector Head	.8	96.6	TC A8EA
_____	King KFS-590 Channel Selector Head	.8	96.6	TC A8EA
_____	King KXP-750 Transponder	7.8	80.6	TC A8EA
_____	King KA-25 Audio Amplifier	1.3	66.0	TC A8EA
_____	King KDF-800 ADF (Single)	21.2	113.8	TC A8EA
_____	King KDF-800 ADF (Dual)	41.4	115.6	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
F.	Electronic Equipment (cont)			
_____	Sunair SA-14R Transceiver	31.3	71.2	TC A8EA
_____	Piper PM-1 Marker Beacon with Antenna	2.5	151.3	TC A8EA
_____	Piper AltiMatic III Autopilot	19.5	146.2	TC A8EA
_____	Piper AltiMatic H-14 Autopilot	50.9	161.7	TC A8EA
_____	Ramp Hailer University Sound #3623	3.5	71.3	TC A8EA
_____	Piper AltiMatic III & IIIB Glide Slope Coupler	1.4	93.6	TC A8EA
_____	Piper AltiMatic IIIB Autopilot	19.5	146.2	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
F.	Electronic Equipment (cont)			
_____	RCA AVQ-45 or AVQ-46 Radar	27.9	35.7	TC A8EA
_____	Headset Murdock #P-23	.5	99.0	TC A8EA
_____	Microphone Telex #Tel-66C	.5	99.0	TC A8EA
_____	Headset Murdock #P-23	.5	99.0	TC A8EA
_____	Microphone Telex #Tel-66C	.5	99.0	TC A8EA
_____	Boom Mike Pacific Plantronics #MS50/T30-12	1.5	99.0	TC A8EA
_____	Microphone Shure #CM-16TG	.7	99.0	TC A8EA

Item		Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	G.	Interior Equipment			
*	_____	FAA Approved Airplane Flight Manual			TC A8EA
	_____	Cabin Heater. 24 Volt Janitrol No. 39D59	25.5	65.0	FAA TSO C20
	_____	Fire Extinguisher Kidde 2¾ DCK-6	5.1	137.5	TC A8EA
	_____	Oxygen System Installed Per PAC Dwg. 42212	55.2	80.8	TC A8EA
	_____	Cabin Divider Per PAC Dwg. 42579	17.2	140.0	TC A8EA
	_____	Folding Table (Left Side) Per PAC Dwg. 43031	9.2	177.5	TC A8EA
	_____	Folding Table (Right Side) Per PAC Dwg. 43031	9.2	177.5	TC A8EA
	_____	Beverage Unit Per PAC Dwg. 43030	49.4	235.4	TC A8EA
	_____	Lavatory Per PAC Dwg. 41870	16.0	252.0	TC A8EA
	_____	Shoulder Harnesses Per PAC Dwg. 43814	3.0	138.0	TC A8EA
	_____	Seventh Seat Inst. Per PAC Dwg. 42623	26.0	229.0	TC A8EA
	_____	Eighth Seat Inst. Per PAC Dwg. 42718	25.0	242.0	TC A8EA
	_____	Ground Ventilation Fan Per PAC Dwg. 43524	5.0	248.0	TC A8EA
	_____	Ground Ventilation Fan Per PAC Dwg. 43642	6.7	250.0	TC A8EA
	_____	Cabin Exhaust Vent Inst. Per PAC Dwg. 43827	3.0	252.0	TC A8EA
	_____	Aft Cabin Heater 24 Volt Janitrol No. A39D59	29.0	279.0	TC A8EA

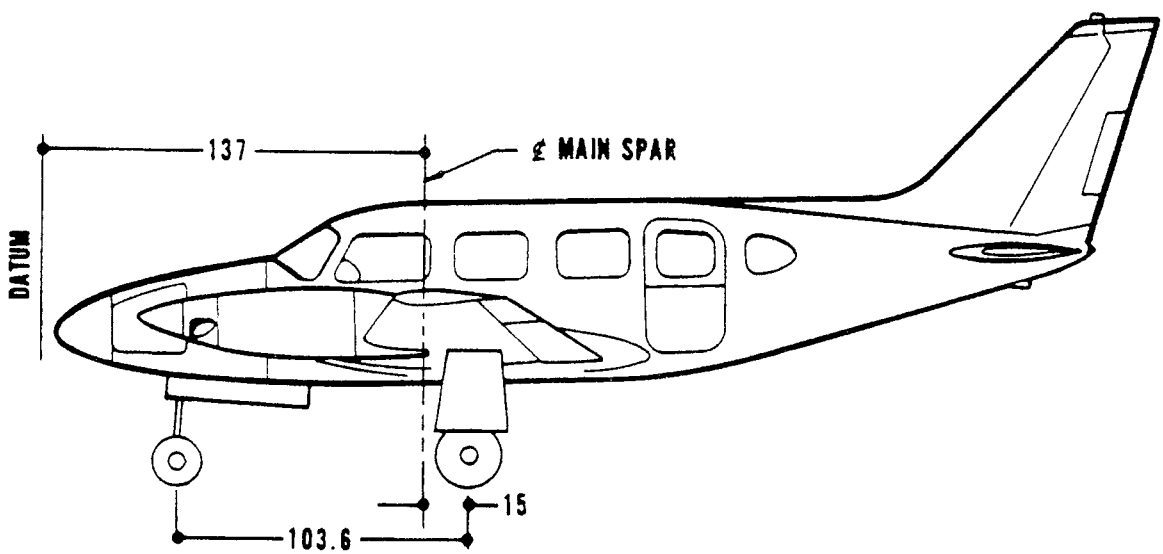
Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	G. Interior Equipment (cont)			
_____	Aft Cabin Divider and Luggage Shelf Per PAC Dwg. 44264	12.0	249.5	TC A8EA

Item		Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	H.	Miscellaneous Equipment			
*	_____	Stall Warning Indicator, Safe Flight Instrument Corp. Lift Detector #C-52207-4	Neglect Weight Change		TC A8EA
	_____	Co-pilot Brake Instl. Per PAC Dwg. 42386	1.8	86.9	TC A8EA
	_____	Stall Warning Horn Per PAC Dwg. 43826	2.0	90.0	TC A8EA
	_____	Beverage Dispenser Per PAC Dwg. 43702	9.2	247.0	TC A8EA
	_____	Electric Windshield Wiper Installation Per PAC Dwg. 44115	5.5	81.1	TC A8EA
*	_____	Heated Pitot Tube AN5812-1 (24 Volt)	1.0	64.3	TC A8EA

Item	Item	Weight Lb.	Arm Aft Datum	Cert. Basis
	I. Icing Equipment			
_____	Second Heated Pitot Tube AN5812-1 (24 Volt)	1.0	64.3	TC A8EA
_____	Electrically Heated Windshield Per PAC Dwg. 42637	13.75	94.0	TC A8EA
_____	Electrical Propeller Anti-Icing Strips B. F. Goodrich Kit 77-240	10.2	64.9	TC A8EA
_____	Deicing Boots (Wing and Empennage Leading Edges) Per PAC Dwg. 42600	38.8	180.9	TC A8EA
_____	Wing Ice Detection Light Per PAC Dwg. 42388	.5	118.5	TC A8EA
_____	Elevator Horn De-Icing Boot Per PAC Dwg. 43757 or 43786	.58	343.5	TC A8EA
_____	Electrical Propeller Anti-Icing Strips B. F. Goodrich Kit 77-340 (3 bld.)	14.0	64.9	TC A8EA
_____	Piper Anti-Static Wicks	Neglect weight change		TC A8EA
_____	Anti-Static Antennas	2.0	177.5	TC A8EA

WEIGHT AND BALANCE DATA

SERIAL NO. 31— REGISTRATION NO.



Empty Weight as Weighed
(Included Items Checked on Equipment List) (See Airplane Flight Manual)

Left Wheel _____

Right Wheel _____

Nose Wheel (N) _____

Total (T)

EMPTY WEIGHT C. G. AS WEIGHED

Empty Weight C.G. Forward Main Wheel C.L. is:

A. $\frac{(N)}{(T)} \times 103.6 =$ inches

Empty Weight C.G. Forward Main Spar C.L. is:

B. (A) - 15 = inches

Empty Weight C.G. Aft Datum is:

C. 137 - (B) = inches

EMPTY WEIGHT AND C.G. WITH UNUSABLE FUEL

Item	Weight	Arm	Moment
Empty Weight As Weighed			
Unusable Fuel (2.7 Gal.)	16	129	2064
TOTAL			

Empty Weight and C.G. are lbs. at inches aft datum

BASIC WEIGHT AND C.G.

The following calculation is performed here for simplicity to aid the pilot in his calculations. This weight will be referred to as "Basic Weight":

Item	Weight	Arm	Moment
Empty Weight			
Oil (6 Gal.)	45	77.3	3478
Unusable Fuel (2.7 Gal.)	16	129	2064
TOTAL			

Basic Weight and C.G. are lbs. at inches aft datum

NOTES

(1) The empty and basic weights include 2.7 gallons of unusable fuel (at 6.0 lbs. per gal. = 16 lbs. total). This fuel should not be considered part of the disposable load which the pilot wishes to add to the airplane. However, any fuel beyond this amount which remains in the tanks from previous flights must be considered part of the disposable load.

(2) Each engine has an oil capacity of 3 gallons (at 7.5 lbs. per gal. = 45 lbs. total).

COMPUTING TOTAL WEIGHT AND CENTER OF GRAVITY

It is the pilot's responsibility to determine that the total weight and center of gravity location of his airplane are within safe limits.

If the airplane is loaded properly for take-off the same distribution of movable load will be safe for landing. However, if the airplane is loaded with a rearward c.g. for take-off fuel from the outboard tanks should be used first during cruise in order to move the c.g. forward as fuel is burned off.

The airplane is approved for a maximum landing weight of 6200 lbs., 300 lbs. less than the maximum for take-off. If an emergency makes it necessary to attempt a landing with an airplane weighing more than 6200 lbs., pilots are advised to make a smooth and gentle landing to avoid overstressing the airframe. The approved maximum landing weight of aircraft with kit 763 801 installed is 6500 lbs.

Using the accompanying charts and work sheet a pilot can quickly compute the total weight and the center of gravity and at the same time determine whether his loading is safe and whether he has a forward or rearward c.g. location. Knowing the latter will enable him to estimate the best longitudinal trim tab setting for take-off.

The increase of moment which results from retracting the landing gear is 860 in. lbs. Therefore, unless the computed c.g. is 138 inches this change may be neglected.

INSTRUCTIONS

The procedure for computing total weight and c.g. location is best explained by an example.

When the airplane is delivered, the manufacturer weighs the airplane and fills in the values of the basic weight, the arm (c.g. location) and basic moment. If the owner adds weight or removes it the mechanic doing the work must compute the revised weight, arm, and moment. This should be recorded in the space provided and used in place of the original basic weight in such cases.

For our example assume a basic weight of 3751 lbs., an arm of 126.8 inches and a basic moment of 475,627 in. lbs. Assume that no changes have been made to the airplane.

Assume the pilots' seats and two front passenger seats are to be occupied by passengers whose weights are as shown on the sample work sheet, and that we plan to carry 100 lbs. in each baggage compartment. We plan to put 100 gallons of fuel in the inboard tanks (50 in each) and 80 gallons in the outboard tanks (40 in each). Oil is included in the basic weight.

Using the weights of the individuals and baggage and going into Figure 1, we determine and record the moments for pilots, passengers and baggage on the work sheet.

The moments for fuel are found by referring to the boxes at the bottom of the work sheet and these values of weight and moment are recorded on the work sheet on page 9.

The weights and moments are then added.

To determine the c.g. location we enter Figure 2 and starting at the bottom of the chart with the total moment (Σ M) we go vertically until we intercept the appropriate total weight line. It may be necessary to draw in or visually imagine a weight line for the total weight. (See example.)

If the interception occurs between the forward-c.g.-limit line and the rearward-c.g.-limit line the airplane is safely loaded. If the interception would occur outside these limits the loading is unsafe. The position of the interception relative to the forward and the rearward limit lines indicates whether the airplane loading tends to be nose heavy or tail heavy and thus how to set the elevator trim tab for take-off.

By projecting horizontally to the left from the interception point, the pilot determines the c.g. location and records it on the work sheet. We note that in our example problem the c.g. is at 131 inches.

In our example the total weight is less than 6500 lbs. and the c.g. is between the forward and rearward limits. Therefore the airplane is safely loaded.

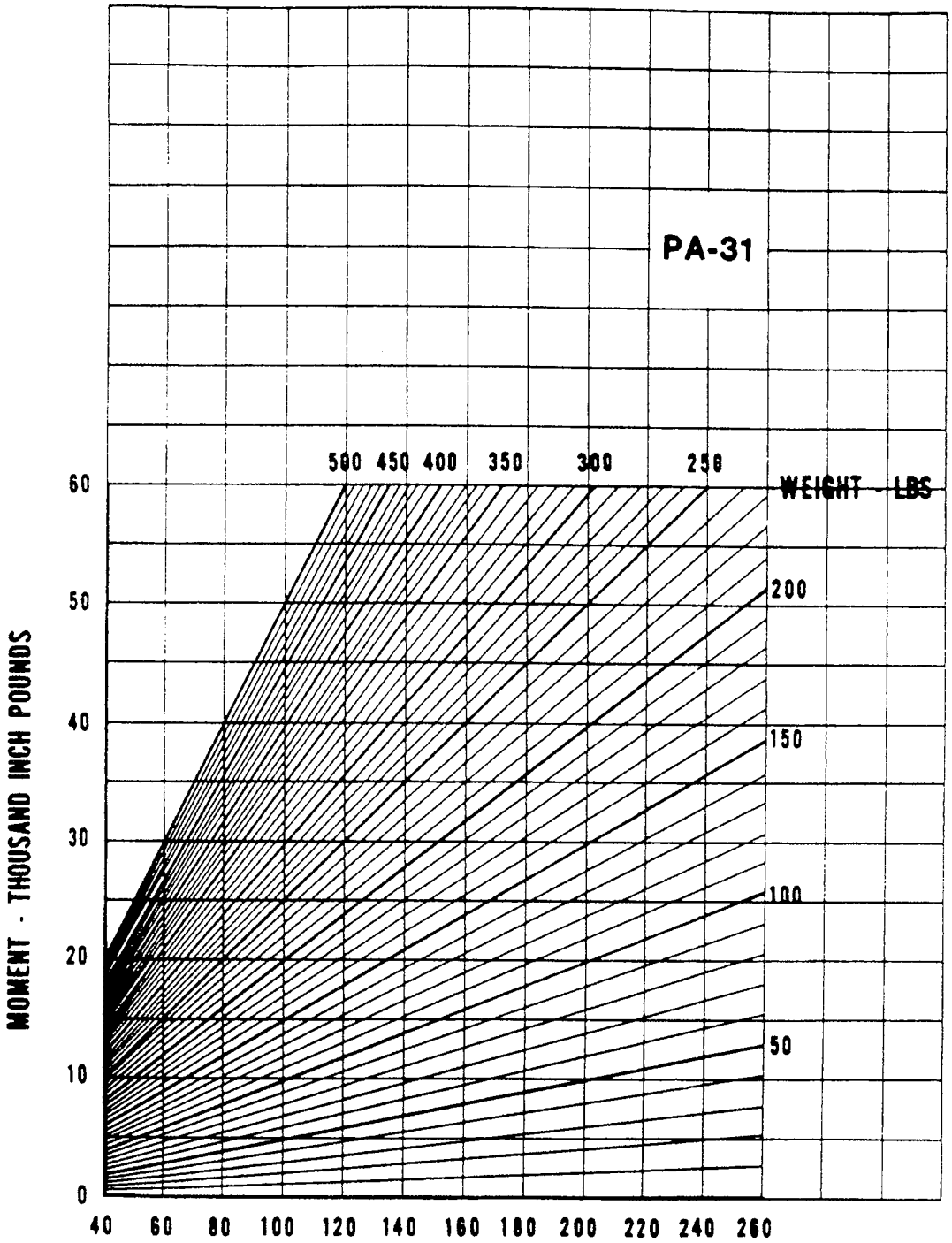

PA-31
500 450 400 350 300 250
WEIGHT - LBS
200
150
100
50
MOMENT - THOUSAND INCH POUNDS
60
50
40
30
20
10
0
40 60 80 100 120 140 160 180 200 220 240 260
ARM INCHES AFT DATUM

Figure 1

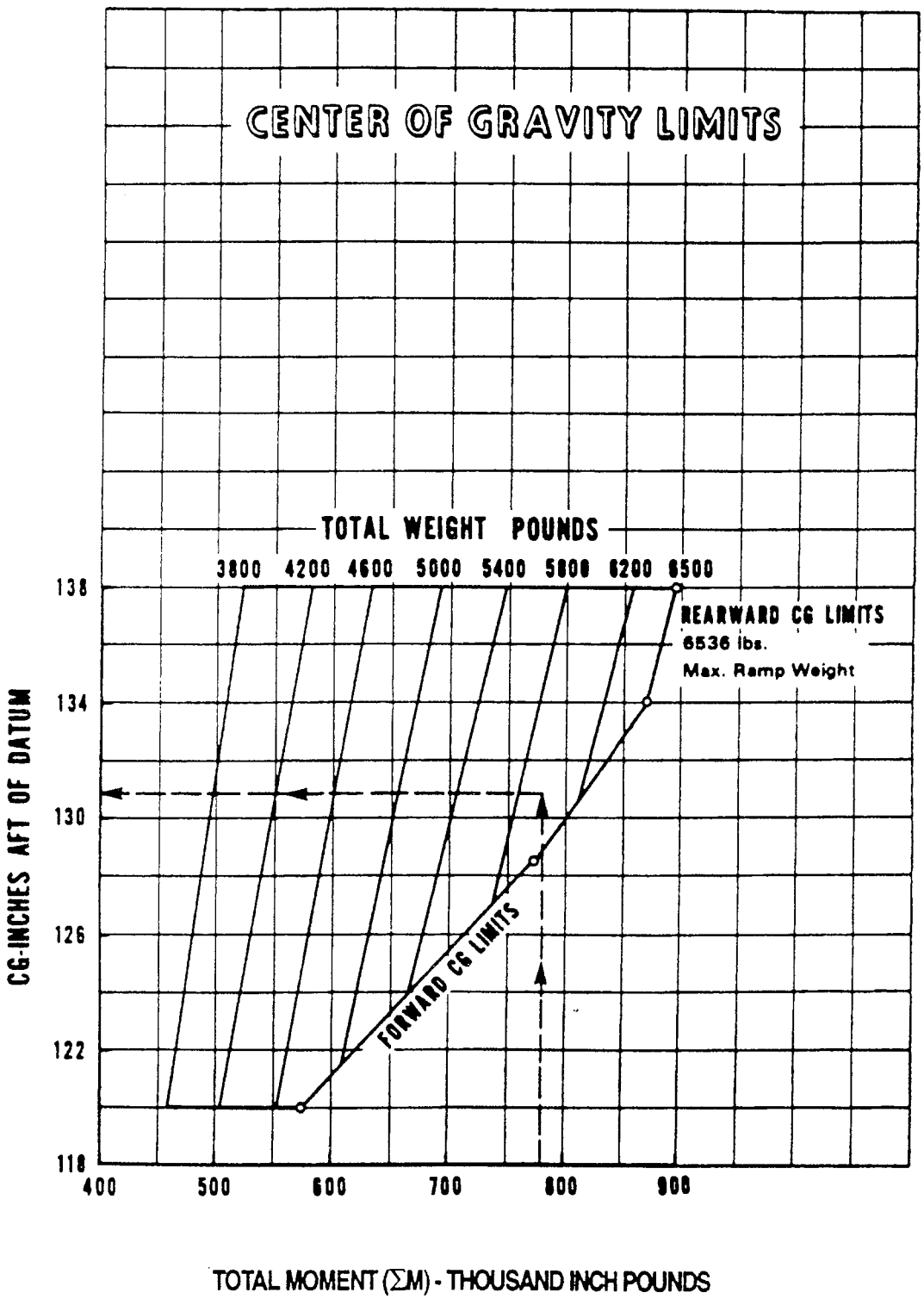

CENTER OF GRAVITY LIMITS
TOTAL WEIGHT POUNDS
3800 4200 4600 5000 5400 5800 6200 6500
REARWARD CG LIMITS
6536 lbs.
Max. Ramp Weight
FORWARD CG LIMITS
CG-INCHES AFT OF DATUM
138
134
130
126
122
118
400 500 600 700 800 900
TOTAL MOMENT (ΣM) - THOUSAND INCH POUNDS

Figure 2

WORK SHEET

ITEM	WT. LBS.	ARM IN.	MOMENT
Basic Airplane			
Revised Airplane			
Pilot's Seat		119.0	
Co-pilot's Seat		119.0	
Seat No. 3		166./159 (Reversed)	
Seat No. 4		166./159 (Reversed)	
Seat No. 5		198.0	
Seat No. 6		198.0	
Seat No. 7		229.0	
Seat No. 8		242.0	
Fwd. Baggage		43.0	
Rwd. Baggage		255.0	
Inb. Fuel		126.8	
Outb. Fuel		148.0	
Other			
Total Wt.		Total Moment	

C.G. Location for Take-off

Fuel

Inboard Tanks			Outboard Tanks		
Gal.	Wt.	Mom.	Gal.	Wt.	Mom.
112	672	85210	80	480	71040
100	600	76080	60	360	53280
80	480	60864	40	240	35520
60	360	45648	20	120	17760
40	240	30432			
20	120	15216			

SAMPLE
WORK SHEET

ITEM	WT. LBS.	ARM IN.	MOMENT
Basic Airplane	3751		475627
Revised Airplane			
Pilot's Seat	175	119.0	20800
Co-pilot's Seat	130	119.0	15500
Seat No. 3	140	166./159 (Reversed)	23500
Seat No. 4	160	166./159 (Reversed)	26500
Seat No. 5		198.0	
Seat No. 6		198.0	
Seat No. 7		229.0	
Seat No. 8		242.0	
Fwd. Baggage	100	43.0	4300
Rwd. Baggage	100	255.0	25500
Inb. Fuel	600	126.8	76080
Outb. Fuel	480	148.0	71040
Other			
Total Wt. 5636		Total Moment	738847

C.G. Location for Take-off

Fuel

Inboard Tanks			Outboard Tanks		
Gal.	Wt.	Mom.	Gal.	Wt.	Mom.
112	672	85210	80	480	71040
100	600	76080	60	360	53280
80	480	60864	40	240	35520
60	360	45648	20	120	17760
40	240	30432			
20	120	15216			

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WEIGHT AND BALANCE

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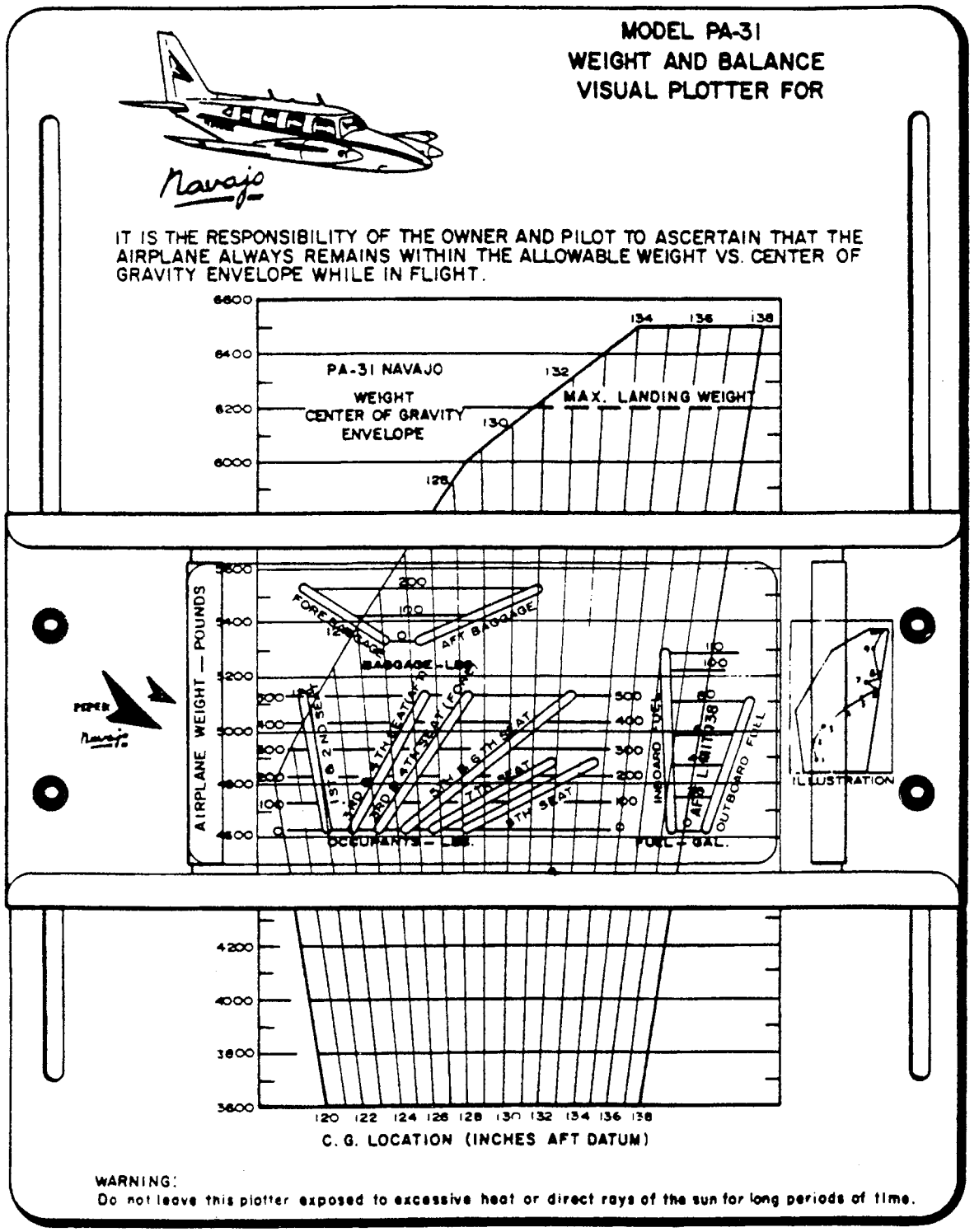
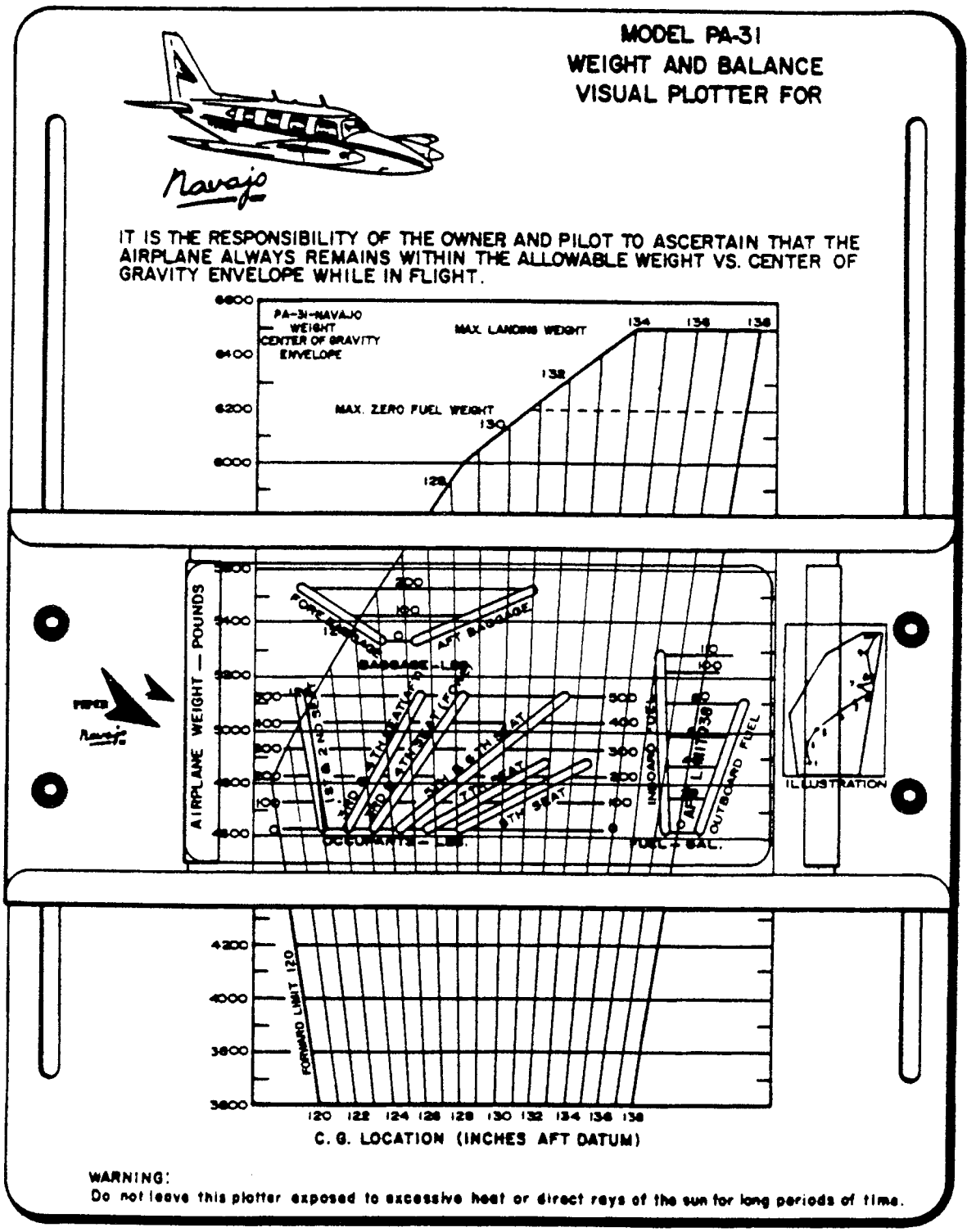
Maximum Ramp Weight 6536
Maximum Take-off Weight 6500



Maximum Ramp Weight 6536
Maximum Take-off Weight 6500



PLOTTER SUPPLIED WITH KIT 763 801

WEIGHT AND BALANCE DATA

WEIGHT AND BALANCE VISUAL PLOTTER

The Weight and Balance Visual Plotter furnished with this airplane is a moment-computing sliding face plotter designed for ease of operation and accuracy.

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 FAA Approved Airplane Flight Manual supplied with each aircraft.

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.

USE OF THE PLOTTER

1. The point corresponding to the "Basic Empty Weight" and "Center of Gravity" location may be located on the face of the plotter in ink as this is the point from which all computations are started.
2. The zero line of the 1st and 2nd seat slot is centered over the starting point. A new point is established up this slot indicating the occupants' weight.
3. The applicable 3rd and 4th seat slot (fore or aft) is next centered over the last point plotted. Again a new point is established up this slot indicating the occupants' weight.
4. Similarly, the 5th and 6th seat, 7th seat, and 8th seat slots are moved over each preceding point and a new point established.
5. The "Front Baggage" slot is used next, centering the zero line over the last "seat" point plotted.
6. The "Rear Baggage", "Inboard Fuel", and "Outboard Fuel" are plotted in that order using the same procedure as before. (See general loading recommendations for baggage and fuel loading.)

NOTE

Should the fuel slot leave the "Center of Gravity Envelope" between 134 and 138 inches, the fuel indicated at the exit point is the maximum allowable. Should the fuel leave the "Center of Gravity 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, up to 6536 lbs. ramp weight.

GENERAL LOADING RECOMMENDATIONS

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

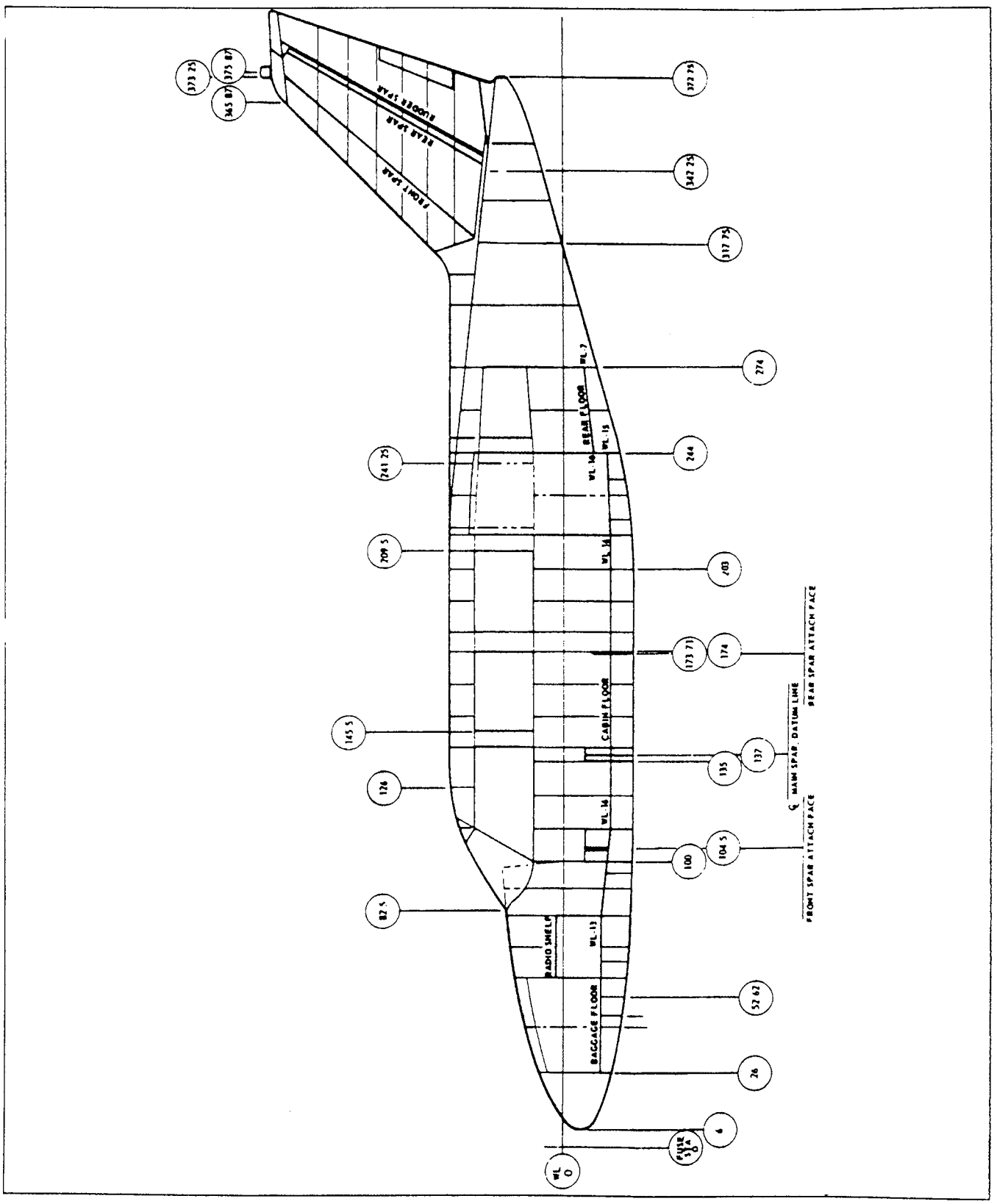
2. When carrying more than 5 occupants, fuel and/or baggage may have to be reduced.
3. When carrying 6 occupants, distribute load between front and rear baggage compartments.
4. When carrying 7 or 8 occupants, load forward baggage compartment first and locate heaviest occupants forward.
5. When carrying 8 occupants, forward baggage may be required to bring the loaded airplane's C.G. within allowable limits.
6. 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 6500 lb.
(+128.5) to (+138.0) at 6000 lb.
(+120.0) to (+138.0) at 4800 lb. or lower
Straight line variation between points given.



STATION REFERENCE - FUSELAGE

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OPERATING INSTRUCTIONS

THIS SECTION IS DESIGNED:

1. To help you operate your Navajo with safety and confidence.
2. To more fully acquaint you with the basic performance and handling characteristics of the airplane.
3. To more fully explain your Navajo operation than is permissible to set forth in the Airplane Flight Manual.

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OPERATING INSTRUCTIONS

EXTERNAL POWER STARTING PROCEDURE

When using a 24 volt battery for external power starting with the aircraft battery nearly depleted, use the following procedure:

1. Turn off all electrical equipment, radios and master switch.
2. Connect external power to the receptacle.
3. Start right and left engines.
4. Remove external power.
5. Turn on master switch and check the ammeter for battery charging current.

NOTE

If the aircraft battery is weak, charging current will be high. Do not take-off until charging current falls below 20 amperes. Do not take-off with a completely discharged battery as three volts are needed to excite the alternator.

If a power cart is not available, a six volt battery may be connected in series with a 24 volt battery to supply 30 volts for starting. Never exceed the maximum of 30 volts from an external source as damage to the electrical system may result.

In aircraft with current limiting systems the master switch should be ON when starting the engine with external power. Placards on the sun visor detail the operation.

NOTE

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

WARM-UP AND GROUND CHECK

As soon as the engines start, the oil pressure should be checked. If no pressure is indicated within thirty seconds, stop the engine and determine the trouble. If a very cold temperature exists (10 F or below) a little longer period of time may be necessary.

The engines should be warmed up at 1000 RPM for two minutes in warm weather and four minutes in cold weather. After the warm-up the fuel valve should be checked in all positions. With mixtures rich and the cowl flaps open, move the crossfeed ON and either right or left fuel valve OFF to determine the operation of the crossfeed.

Feathering is checked with the throttles set at 1500 RPM. No more than 500 RPM drop should be allowed in this check. (Full feathering checks on the ground are not recommended because of the excessive vibration caused in the power plant installation.) The magnetos are checked with the propellers in low pitch and the throttles set at 2300 RPM. The drop should not exceed 125 RPM, and the difference in drop between both magnetos should not exceed 50 RPM.

Hydraulic pump operational check:

With one engine started, warmed up, and running at 1200 RPM, move the gear selector handle to the gear down position. The hydraulic pump should build up pressure and return the selector handle to neutral within three to nine seconds. Push the selector down to check the return time again. Shut down the engine and repeat the procedure for the second engine.

If the selector returns to neutral during the check of one pump and does not return during the check of the other, assume the pump to be faulty and determine the cause of malfunction.

Cold temperatures may cause a delay in return time of the selector handle.

BEFORE TAKEOFF

Before takeoff the following should be checked:

1. Seat belt and no smoking sign - on
2. Fuel selectors - inboard (crossfeed off)
3. Fuel quantity - sufficient
4. Mixture and props - forward
5. Flaps - checked and set 0° for normal takeoff, checked and set 15° for short field takeoff
6. Autopilot - off
7. Trim - set
8. Surface deice - off
9. Pitot and prop heat - as required
10. Windshield heat - as required
11. Avionics - as required
12. Direction indicator - set
13. Radar - as desired
14. Transponder - as required
15. Controls - checked
16. Emergency fuel pumps - on
17. Prop sync - off

NORMAL TAKEOFF

While holding the brakes with the mixture and propeller levers full forward, advance the throttles slowly to a manifold pressure of 30 inches of mercury; then continue to advance the throttles at a normal rate and release the brakes, do not allow manifold pressure to exceed 46 inches. Use smooth, steady throttle movements, and avoid rapid opening and closing. Propeller speed for takeoff should be 2575 RPM.

The engines are adjusted to provide 40 inches Hg. manifold pressure at full throttle in standard temperature at sea level. Depending upon altitude and temperature it is possible to reach higher (up to 46 inches), or lower manifold pressures.

Each engine density controller is set to provide 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 setting should be checked and serviced.

At 98 MPH, CAS, rotate the aircraft and allow it to fly off. Maintain a pitch attitude which will result in acceleration of the aircraft to 105 MPH, CAS, at 50 ft. Before the airspeed exceeds 150 MPH, CAS, retract the landing gear. Continue to accelerate to the desired climb airspeed.

SHORT FIELD TAKEOFF

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 take-off 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 85 MPH, rotate the aircraft to achieve an attitude that will result in an initial climb airspeed of 100 MPH. Maintain 100 MPH until the barrier has been cleared. After the barrier has been cleared, retract the landing gear, the flaps and accelerate to 106 MPH (best single engine angle of climb).

CLIMB

When clearance above obstacles and terrain permits, reduce to climb 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 temperatures within limits.

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

Although the maximum approved operating altitude for this airplane is 24, 000 feet, under standard atmospheric conditions and at maximum gross weight the multi-engine service ceiling and absolute ceiling are 26,300 feet and 27,300 feet, respectively.

STALL WARNING INDICATION

An approaching stall is indicated by both a stall warning light and horn.

NOTE

The factory installation of the horn started with aircraft serial number 31-490 and up.

CRUISING

The cruising speed of the Navajo is determined by many factors including power setting, altitude, temperature, load, and equipment installed on the airplane. The maximum cruising speed of the Navajo at 23,500 feet is 247 MPH. (See Power and Performance Charts for power settings and performance under various conditions.)

The Lycoming engines on the Navajo can be cruised at any percent of power from 75% on down. An engine speed of 2575 RPM is recommended for maximum cruise performance, while a lower engine speed, down to 2200 RPM, is recommended for more economical cruising conditions. Refer to power chart for power settings.

Above the critical altitude (15,500 feet), or when switching tanks, turn boost pumps on. For best economy, lean the mixture to peak exhaust gas temperature then lean further until at least a 25° drop in EGT is observed. Do not lean above 75% power. Cylinder head temperatures in excess of 435 ° in cruise are not recommended. For further information on leaning procedure see Avco-Lycoming Operator's Manual.

NOTE

With the aircraft loaded to a rearward center of gravity, consume fuel from the outboard tanks first to move the center of gravity forward with fuel burn-off.

APPROACH AND LANDING

During the approach, the gear can be lowered at speeds under 150 MPH, preferably on the downwind leg. Extend the wing flaps as required. Flaps should be extended in steps to preclude the possibility of a large asymmetric ("split") flap condition in the event of a failure in the flap actuation system. The maximum speed for 15° flap extension is 175 MPH (152 KTS). The maximum speed for full flap extension is 150 MPH (130 KTS). The amount of flap used during landings and the speed of the airplane at contact should be varied according to the wind, the landing surface, and other factors. Consult Performance Charts and aircraft Flight Manual to determine best approach speed for different landing conditions. It is always best to contact the ground at the minimum practicable speed consistent with landing conditions. Engine speed should be set at 2400 RPM so that climb power will be available in the event a go-around is executed. Cowl flaps should be closed.

1. Seat Belts - Fastened
2. Mixtures- Rich
3. Propellers - 2400 RPM
4. Fuel Boost Pumps - ON
5. Fuel Valves on Main Tanks
6. Brakes - Check Pressure
7. Gear - Down (Dwn)
8. Flaps - (Dwn) - as required
9. Heater - Fan Position - as required

AFTER LANDING

The flaps should be retracted and the cowl flaps opened as soon as the pilot is comfortably on the runway or as soon as he has turned off the runway. The heater is then turned off, the fuel boost pumps turned off, and the propellers set at full low pitch.

After parking, the radios, lights, and all electrical equipment should be turned off. Check magneto switches at idle RPM by flicking both switches off and on to ascertain they are working properly. With the throttles left full aft to avoid engine vibration, the engines are stopped by pulling the mixture controls aft to idle cut-off. Then the magnetos and master switch must be turned off and the parking brake set.

OPERATING TIPS

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OPERATING TIPS

The following Operating Tips are of particular value in the operation of the Navajo.

1. Before starting the engine, check that all radio switches, light switches, and the pitot heat switch are in the off position so as not to create an electrical overload when the starter is engaged.

2. To aid cold weather start use a normal starting procedure but leave the mixture full rich and crank the engine with a fuel flow indication of 6 GPH. Use a preheater if available, to reduce engine wear, at very low temperatures.

3. The rudder pedals are suspended from a torque tube which extends across the fuselage. The pilot should become familiar with the proper positioning of his feet on the rudder pedals so as to avoid interference with the torque tube when moving the rudder pedals or operating the toe brakes.

4. The shape of the wing fuel tanks is such that in certain maneuvers the fuel may move away from the tank outlet. If the outlet is uncovered, the fuel flow will be interrupted and a temporary loss of power may result. Pilots can prevent inadvertent uncovering of the outlet by having adequate fuel in the tank selected and avoiding maneuvers which could result in uncovering the outlet.

   Normal takeoffs are not to be made with inboard tanks less than one-quarter full. Only the inboard tanks may be used for takeoff. Outboard tanks are for level flight only and may never be used for takeoff.

   Running turning takeoffs should be avoided as fuel flow interruption may occur when the inboard tanks are less than three-quarters full.

   Prolonged slips or skids of 30 seconds or more, in any pitch attitude or other unusual or abrupt maneuvers which could cause uncovering of the fuel outlet must be avoided when outboard tanks are being used or when inboard tanks are less than three-quarters full.

   Intentional slips or skids should be avoided when inboard tanks are less than one-quarter full.

5. Always determine landing gear position by checking the gear position lights.

6. Do not use fuel crossfeed to compensate for an inoperative emergency fuel pump.

7. The engines are equipped with a dynamic counterweight system and must be operated accordingly. Use a smooth, steady movement (avoid rapid opening and closing) of the throttle.

8. All fuel pumps should be on for takeoffs and landings.

9. A high indication on the fuel flow indicator is a possible sign of restricted fuel nozzles.

10. When an open circuit breaker is discovered, reset the breaker. If the breaker pops again, allow a two to five minute cooling off period before attempting to reset again.

11. For a smooth comfortable ride for your passengers a 2400 RPM or lower engine speed is recommended for cruise.

12. In extreme turbulence reduce power settings to obtain design maneuvering speed. (See Section II - Limitations for correct speeds.)

13. Strobe lights should not be operated when flying through heavy haze or clouds, since reflected light can produce spacial disorientation. Show courtesy for other pilots by not operating strobe lights while taxiing in the vicinity of other aircraft.

14. Pilots who fly above 10,000 feet should be aware of the need for special physiological training. Appropriate training is available at approximately twenty-three Air Force Bases throughout the United States for a small fee. The training is free at the NASA Center in Houston and at the FAA Aeronautical Center in Oklahoma.

    Forms to be completed (Physiological Training Application and Agreement) for application for the training course may be obtained by writing to the following address:

    Chief of Physiological Training, AAC-143
    FAA Aeronautical Center
    P. O. Box 25082
    Oklahoma City, Oklahoma 73125

    It is recommended that all pilots who plan to fly above 10,000 feet take this training before flying this high and then take refresher training every two or three years.

15. 15° of flaps may be lowered at airspeeds up to 175 MPH, but to reduce flap operating loads, it is desirable to have the airplane at a lower speed before extending the flaps.

16. 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 handle to the neutral position. This test should be performed before entering the traffic pattern so that there will be time to pump the gear down with the hand pump if the hydraulic pump is inoperable.

17. In an effort to avoid accidents, pilots should obtain and study the safety related information made available in FAA publications such as regulations, advisory circulars, Aviation News, AIM, and safety aids.

18. To reduce flap operating loads, it is desirable to have the airplane at a speed lower than the maximum allowable before extending the flaps. The flaps should be extended or retracted in small increments to guard against the possibility of encountering an asymmetric ("split") condition (refer to Section 2, Description of Flight Control System).

19. Experience has shown that the training advantage gained by pulling a mixture control or turning off the fuel to simulate engine failure at low altitude is not worth the risk assumed. Therefore, it is recommended that instead of using either of these procedures to simulate loss of power at low altitude the throttle be retarded slowly to idle position. Fast reduction of power may be harmful to the engine.

PERFORMANCE CHARTS

FOR ADDITIONAL PERFORMANCE CHARTS REFER TO THE FAA APPROVED FLIGHT MANUAL.

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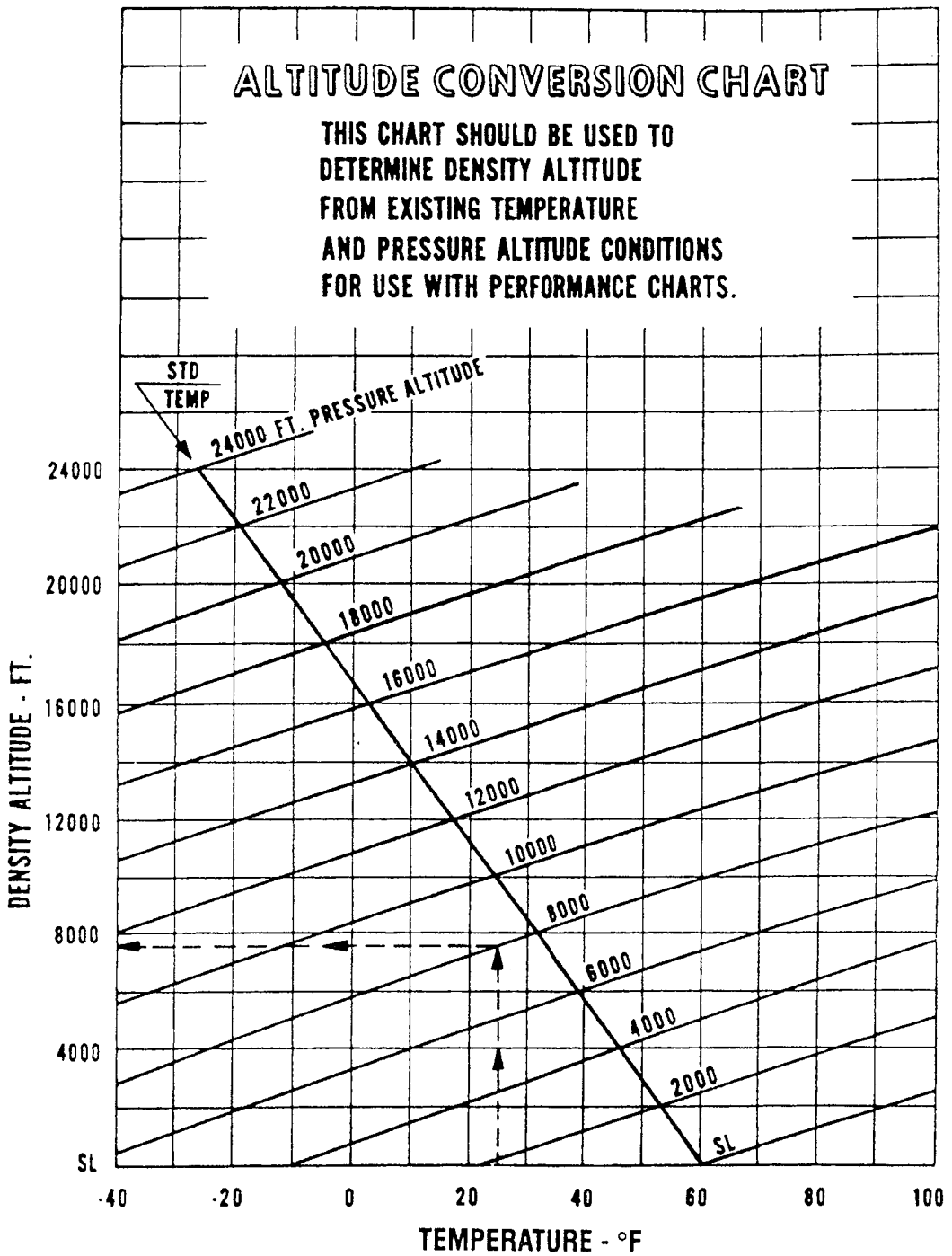
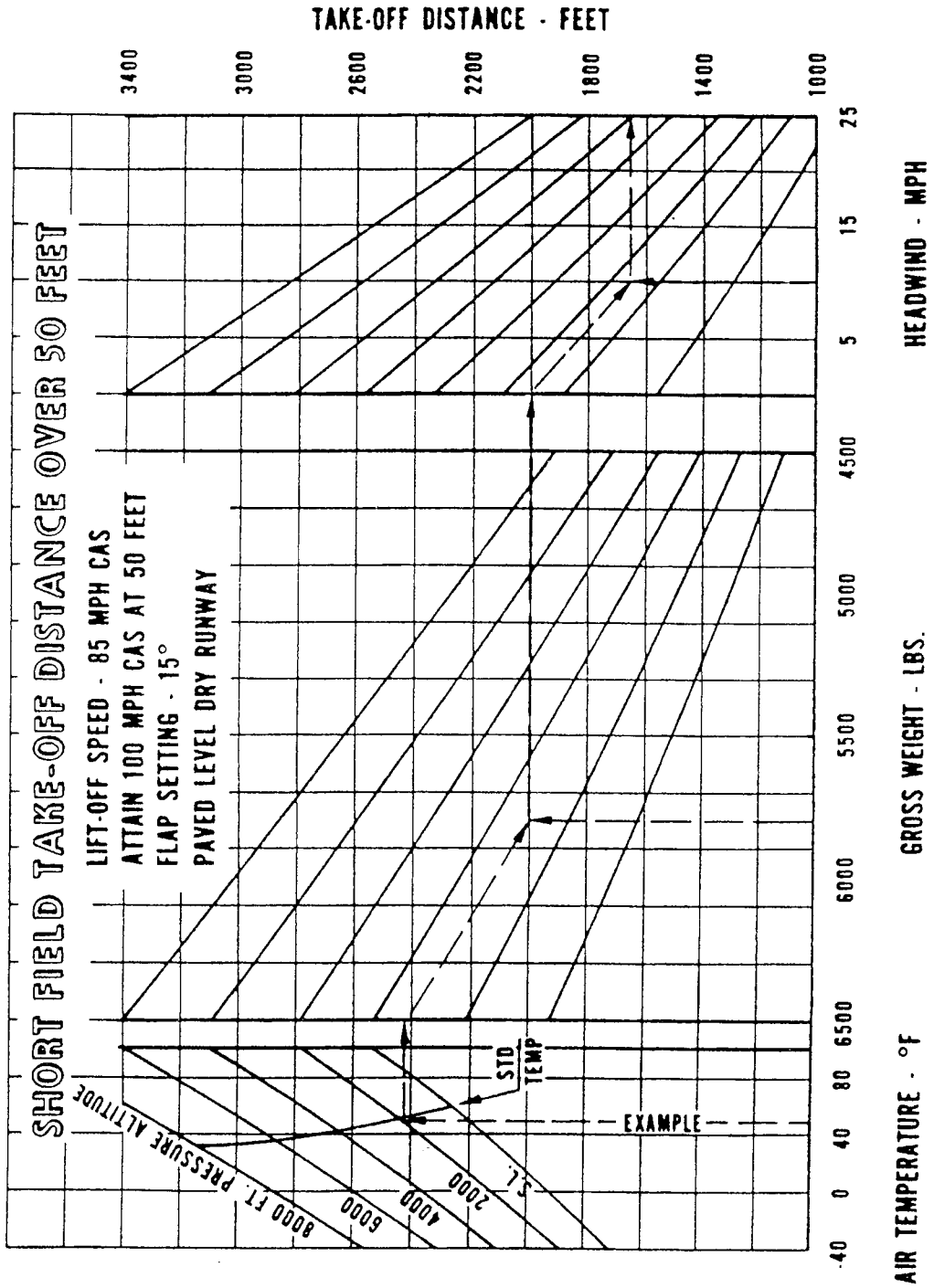
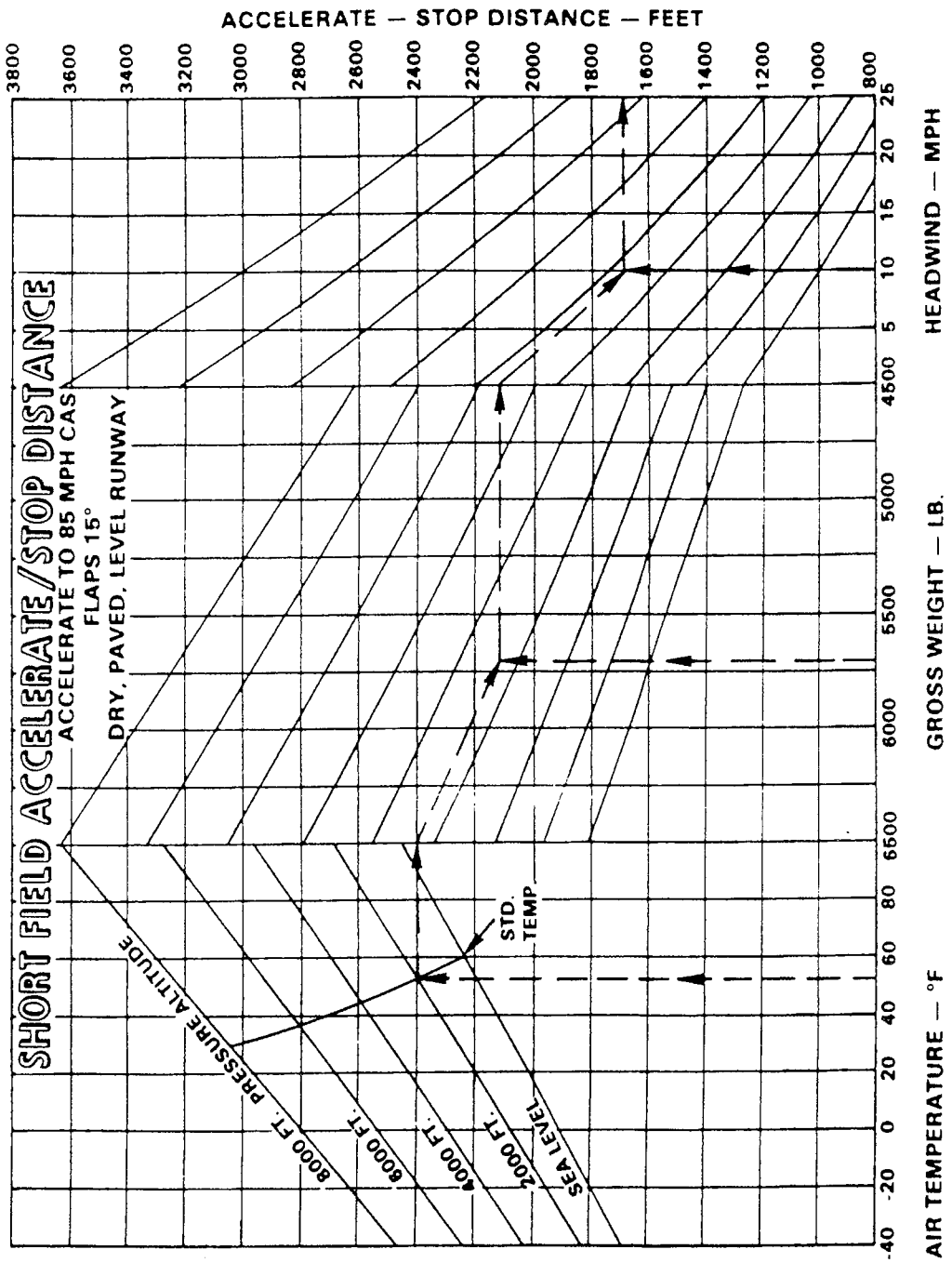
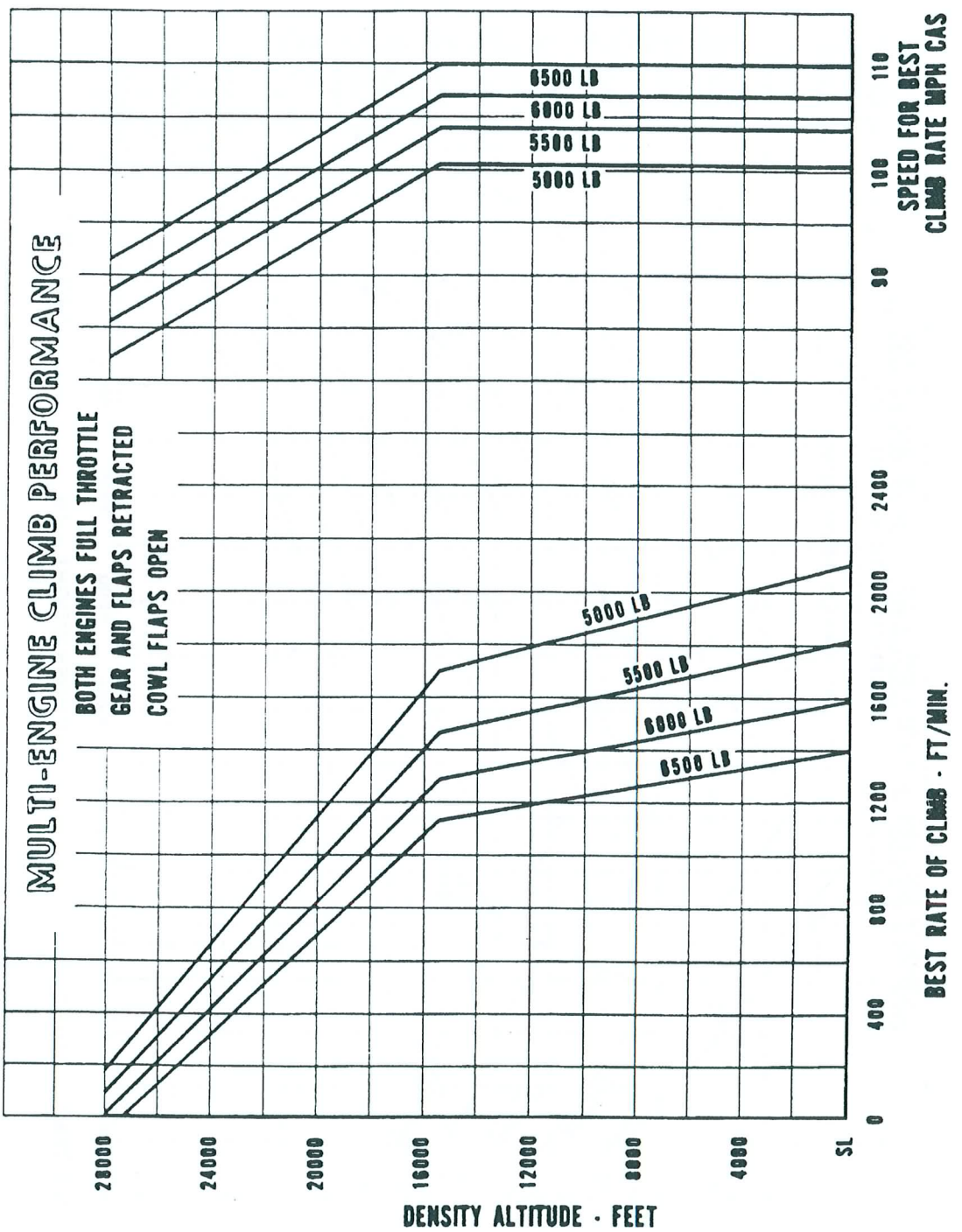


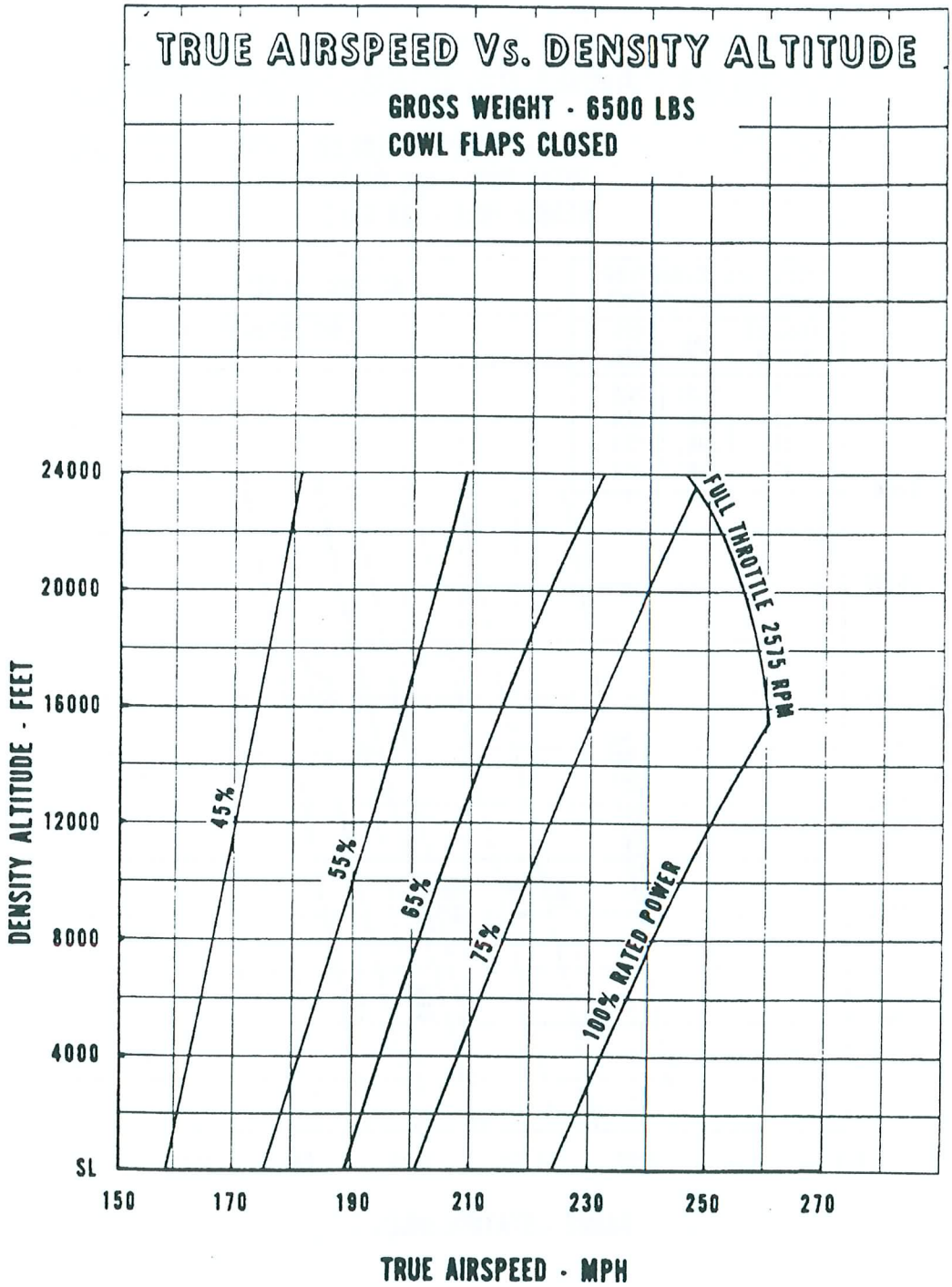
NOTE

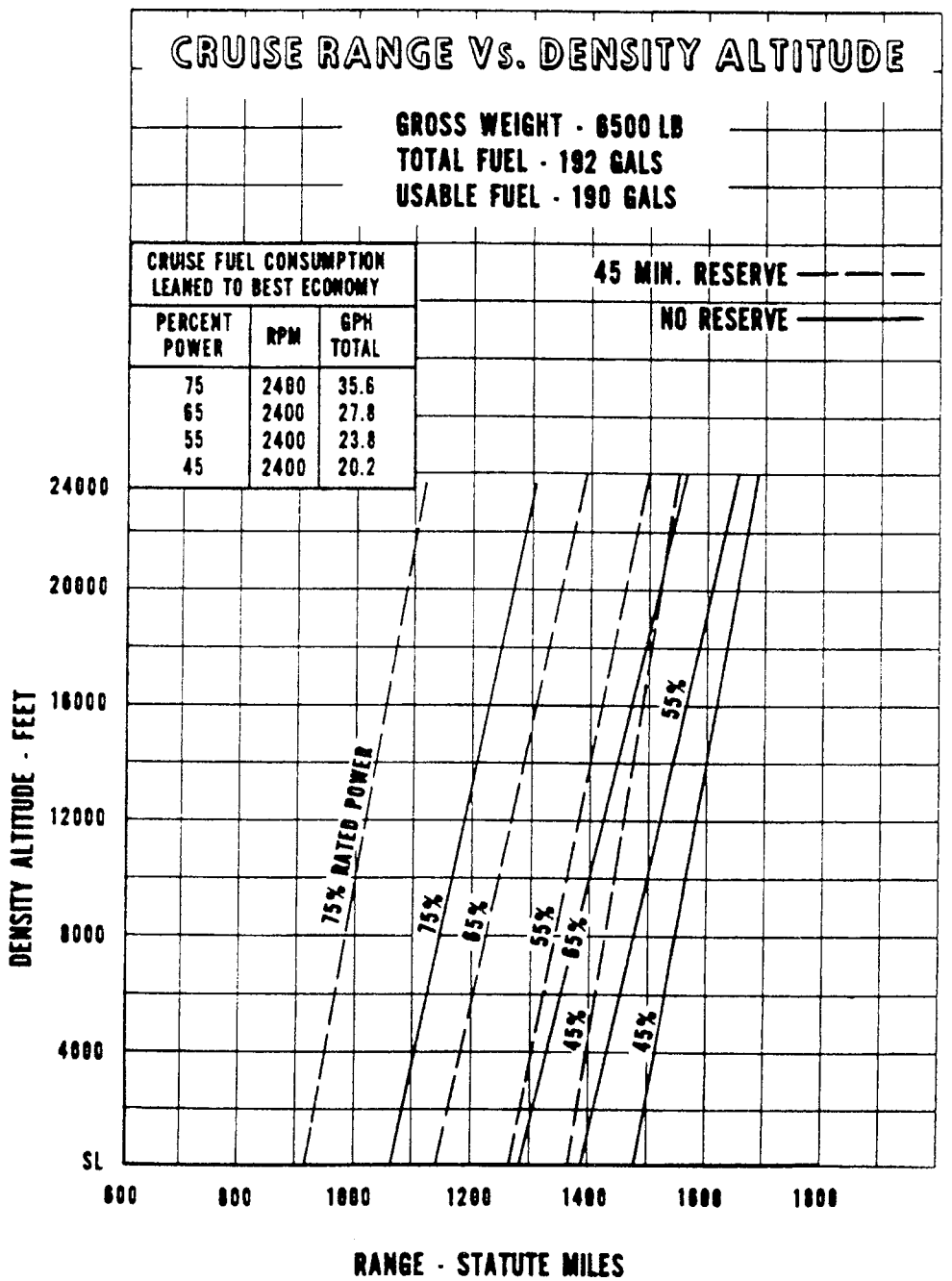
To use this chart simply set the Aircraft AltiMeter to 29.92 (pressure altitude) and read the indicated altitude. Note the outside air temperature in degrees Fahrenheit (°F) and plot these figures on the appropriate grid lines of the chart. The vertex of the figures should then be read directly to the left (Density Altitude - Ft.) which will give the density altitude, for further computation of performance.


SHORT FIELD TAKE-OFF DISTANCE OVER 50 FEET
LIFT-OFF SPEED - 85 MPH CAS
ATTAIN 100 MPH CAS AT 50 FEET
FLAP SETTING - 15°
PAVED LEVEL DRY RUNWAY
TAKE-OFF DISTANCE - FEET
3400
3000
2600
2200
1800
1400
1000
HEADWIND - MPH
25
15
5
GROSS WEIGHT - LBS.
4500
5000
5500
6000
6500
AIR TEMPERATURE - °F
-40
0
40
80
STD TEMP
EXAMPLE
PRESSURE ALTITUDE
SL
2000
4000
6000
8000 FT.


SHORT FIELD ACCELERATE/STOP DISTANCE
ACCELERATE TO 85 MPH CAS
FLAPS 15°
DRY, PAVED, LEVEL RUNWAY
ACCELERATE — STOP DISTANCE — FEET
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
PRESSURE ALTITUDE
8000 FT.
6000 FT.
4000 FT.
2000 FT.
SEA LEVEL
STD. TEMP
AIR TEMPERATURE — °F
-40
-20
0
20
40
60
80
GROSS WEIGHT — LB.
6500
6000
5500
5000
4500
HEADWIND — MPH
25
20
15
10
5


MULTI-ENGINE CLIMB PERFORMANCE
BOTH ENGINES FULL THROTTLE
GEAR AND FLAPS RETRACTED
COWL FLAPS OPEN
8500 LB
8000 LB
5500 LB
5000 LB
5000 LB
5500 LB
8000 LB
8500 LB
SPEED FOR BEST CLIMB RATE MPH CAS
BEST RATE OF CLIMB - FT/MIN.
DENSITY ALTITUDE - FEET
28000
24000
20000
16000
12000
8000
4000
SL
0
400
800
1200
1600
2000
2400
90
100
110


TRUE AIRSPEED Vs. DENSITY ALTITUDE
GROSS WEIGHT - 6500 LBS
COWL FLAPS CLOSED
DENSITY ALTITUDE - FEET
24000
20000
16000
12000
8000
4000
SL
150
170
190
210
230
250
270
TRUE AIRSPEED - MPH
45%
55%
65%
75%
100% RATED POWER
FULL THROTTLE 2575 RPM


CRUISE RANGE Vs. DENSITY ALTITUDE
GROSS WEIGHT - 6500 LB
TOTAL FUEL - 192 GALS
USABLE FUEL - 190 GALS
45 MIN. RESERVE
NO RESERVE
CRUISE FUEL CONSUMPTION
LEANED TO BEST ECONOMY
PERCENT POWER
RPM
GPH TOTAL
75 2480 35.6
65 2400 27.8
55 2400 23.8
45 2400 20.2
DENSITY ALTITUDE - FEET
24000
20000
16000
12000
8000
4000
SL
75% RATED POWER
75%
65%
55%
65%
55%
45%
45%
400
800
1200
1600
2000
2400
RANGE - STATUTE MILES

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Power Setting Table - Lycoming Model TIO-540-A Series, 310 HP Engine

Press. Alt Feet	Std Alt Temp ° F	55% Rated RPM 2200	2400	2575	65% Rated RPM 2200	2400	2575	75% Rated RPM 2200	2400	2575	Press. Alt Feet
SL	59	30.0	27.3	25.5	32.1	30.5	29.0	36.9	34.1	31.7	SL
2,000	52	28.3	25.7	24.1	31.6	29.3	27.4	35.5	33.1	31.0	2,000
4,000	45	27.4	24.9	23.3	30.9	28.0	26.6	34.6	32.1	30.3	4,000
6,000	38	26.7	23.7	22.7	30.4	27.6	26.0	34.3	31.6	29.7	6,000
8,000	31	26.2	23.3	22.3	30.2	27.4	25.6	34.2	31.5	29.5	8,000
10,000	23	26.2	23.2	21.7	30.3	27.2	25.3	34.5	31.6	29.5	10,000
12,000	16	26.4	23.2	21.4	30.8	27.3	25.1	35.0	31.8	29.5	12,000
14,000	9	26.7	23.3	21.3	31.2	27.5	25.0	35.5	32.0	29.6	14,000
16,000	2	27.2	23.4	21.2	31.9	27.6	25.0	36.1	32.4	29.8	16,000
18,000	-5	27.7	23.6	21.1	32.3	27.9	25.0	37.0	33.0	30.1	18,000
20,000	-12	28.3	24.3	21.0	33.1	28.4	25.1	F.T.	33.5	30.3	20,000

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.

680301 230 048

HANDLING AND SERVICING

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GENERAL SERVICING AND MAINTENANCE

GROUND HANDLING

The Navajo should be moved on the ground with the aid of the nose wheel steering or towing bar provided with each airplane and stowed in the forward baggage compartment. This towing bar is designed to attach to the nose gear strut fork forging.

NOTE

When using a towing bar, never exceed the nose wheel turning radius of 20° either side of center, or damage will result to the nose gear and steering mechanism. Do not push or pull on the propeller or the control surfaces when handling the airplane on the ground.

MOORING AND TIE-DOWN

The aileron and elevator controls should be secured by using the control wheel lock or seat belt, and chocks placed fore and aft of both main wheels.

Tie-down ropes for mooring the airplane can be fastened to the wing tie-down rings and to the tail skid at approximately a 45 degree angle to the ground. Allow sufficient slack in the ropes to avoid damage to the airplane when the ropes contract because of moisture.

NOTE

Additional preparations for high winds may be made by using tie-down ropes attached to the main landing gear forks and by securing the rudder.

JACKING

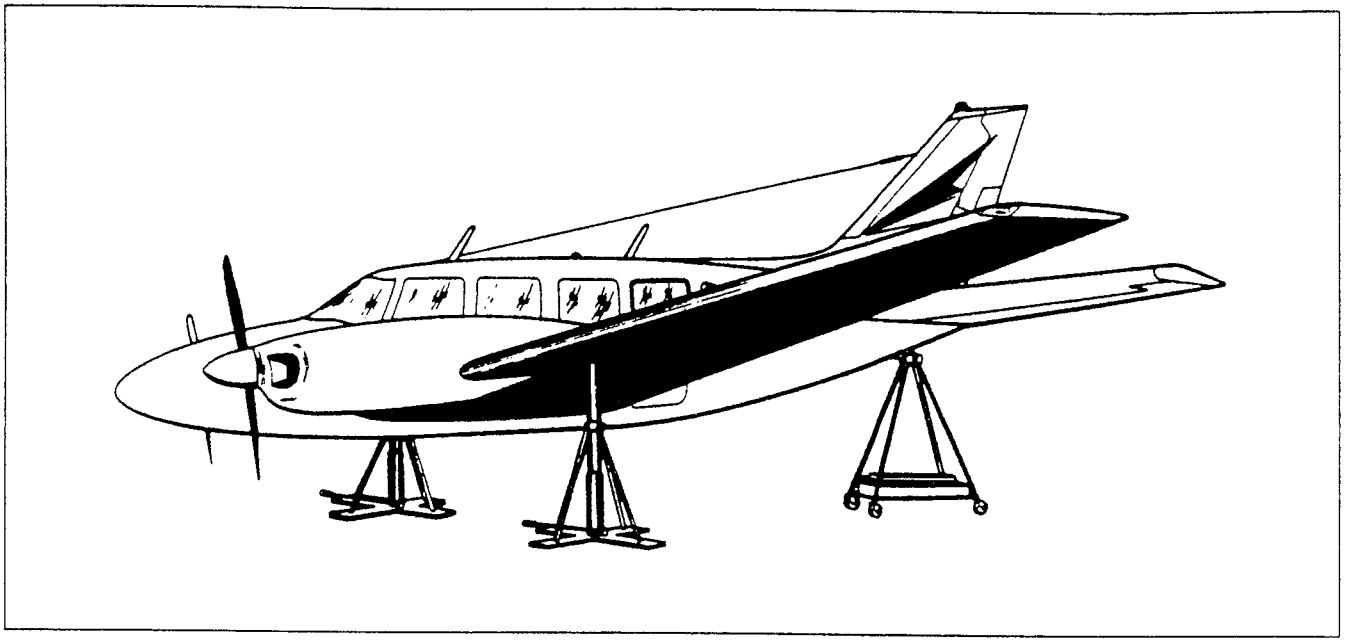
When it is necessary to place the Navajo on jacks for landing gear servicing and other service operations, ascertain that the jack pads, located on the underside of the front wing spars outboard of the engine nacelles, are used. A tail support will be necessary and should be attached to the tail skid and weighted with approximately 500 pounds of ballast.

CAUTION

Be sure to apply sufficient tail support ballast or the airplane will tip forward onto the fuselage nose section.

EXTERIOR CLEANING

The airplane should be washed with a mild soap and water. Loose dirt should be flushed away with clean water. Harsh abrasive or alkaline soaps or detergents could cause corrosion or make scratches.



AIRPLANE ON JACKS

To remove stubborn oil and grease, use a soft cloth dampened with naphtha.

Any good automotive wax may be used to preserve the painted surfaces. Soft cleaning cloths or a chamois should be used to prevent scratches when cleaning or polishing.

A heavier coating of wax on the leading edges of the wings and tail surfaces and on the noise section cone and propeller spinners will reduce the abrasion problems in these areas.

INTERIOR CLEANING

Clean the plastic trim, instrument panel covers, control wheels and control knobs with a damp cloth. Oil and grease on the control knobs can be removed with a cloth moistened with kerosene.

Loose dirt and dust should be vacuumed from the upholstery, headliner, and carpet regularly. Light dirt or dust areas may be removed by rubbing the panel with a draftsman's dry-clean pad (Keuffel and Esser No. 3037 or equivalent). Heavy dirt may be cleaned by using detergent and water, household cleaners such as "Renuzit" or "Carbona", or foam upholstery cleaners. Carefully follow the manufacturer's instructions. Remember that solvent cleaners require adequate ventilation. Avoid soaking or harsh rubbing. For stubborn stains and oil stains, sponge with Carbona, blot with dry cloth, and repeat process if necessary.

All leather material can be cleaned with mild soap and warm water. Do not saturate any padded upholstery.

WINDSHIELD AND WINDOWS

Remove dirt, mud, etc., by flushing with clean water; then wash with mild soap and warm water or Piper Plastic Cleaner. (Do not use plastic cleaners on heated glass windshields.) Use a soft cloth or sponge (DO NOT RUB).

Remove oil and grease with a cloth moistened with kerosene.

NOTE

Do not use gasoline, alcohol, benzene, carbon tetrachloride, lacquer thinner, or window cleaning sprays.

After cleaning plastic surfaces apply a thin coat of hard polishing wax. Rub lightly with a soft cloth.

A severe scratch or mar in plastic can be removed by using jeweler's rouge to rub out the scratch. Smooth on both sides and apply wax.

AIR FILTER

Compressed air may be used to clean the filter if the major contamination on the filter panel is dust.

Direct a jet of air against the clean air side of the filter by moving the jet up and down the pleats. The nozzle pressure must not exceed 100 psi and the nozzle must be kept at least one inch from the filter. Take care that the paper is not ruptured by the nozzle or air jet.

If the filter shows an accumulation of carbon, soot or oil, the filter is cleaned by first cleaning with an air jet as directed above and then washing the filter in a good non-sudsing detergent. Soak the filter for 15 minutes and then move filter back and forth for about two minutes to free dirt deposits. Rinse complete filter with a stream of water (maximum water pressure 40 psi) until rinse water is clear. Dry filter thoroughly before re-using but do not use extreme heat for drying.

Inspection of a cleaned filter is made by holding the filter up to a light bulb and checking for damage or ruptures. The filter should not be oiled after cleaning.

Filters should be rejected for use if the paper filter material is torn or ruptured or the housing is damaged. The filter gasket should have no tears and be securely bonded in place. The usable life of a filter should be restricted to one year or 500 hours, whichever comes first.

TIRE INFLATION

For maximum service, keep the Navajo main wheel tires inflated to 60 psi and the nose wheel tire to 42 psi. When inflating tires, visually inspect them for cracks and breaks. Reverse the tires on the wheels, if necessary, to produce even wear. All tires and wheels are balanced before installation and the relationship of tire, tube and wheel should be maintained upon reinstallation. Out-of-balance wheels can cause extreme vibration in the landing gear during take-off and landing.

BATTERY

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.

LEVELING AND RIGGING

Leveling the Navajo for purposes of reweighting or rigging is accomplished as follows:

1. Partially withdraw the two machine screws which are located on the right side of the fuselage nose section. These screws are leveling points, and the airplane is longitudinally level when a level placed on the head of these screws indicates level.
2. To put the airplane in a longitudinally level position on scales, first block the main gear oleos to full extension, then deflate the nose wheel tire until the proper position is reached. For rigging purposes, place the airplane on jacks.
3. To level the airplane laterally, place a level across the center seat rails.

Rigging: Although the fixed flight surfaces on the Navajo cannot be adjusted in position for rigging purposes, it may be necessary on occasion to check the position of these surfaces. The movable surfaces all have adjustable stops as well as adjustments on their cables or push-pull connections so that their range of movement can be altered. Refer to the PA-31 Service Manual, Section V, for proper rigging instructions.

FUEL AND OIL REQUIREMENTS

Aviation grade 100/130 (minimum) octane should be used in the Navajo. The use of lower grades of fuel can cause serious engine damage in a very short period of time, and is considered of such importance that the engine warranty is invalidated by such use.

The oil capacity of the Lycoming TIO-540-A engine is 12 quarts. It is recommended that the engine oil and oil filter element be changed every 50 hours of flying time. Under unfavorable dusty conditions, the oil and oil filter should be changed more frequently. The minimum safe quantity of oil required is 3 quarts. The following grades are required for the specified temperatures:

Temperatures above 60° F	SAE 50
Temperatures between 30° F and 90° F	SAE 40
Temperatures between 0° F and 70 °F	SAE 30
Temperatures below 10° F	SAE 20

NOTE

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

BRAKE SYSTEM

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

Do not use vegetable base brake fluids (blue) when refilling the system. When it is necessary to add fluid, open the forward baggage compartment door, exposing the brake reservoir. Then add fluid to the reservoir, bringing the fluid to the indicated level. In aircraft with Serial No. 31-300 and up, the reservoir is serviced through an access door atop the nose.

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.

No adjustment of brake clearances is necessary on the Navajo brakes. If, after extended service, braking action requires too much movement of the toe pedal or brakes are spongy, check service manual for corrective action.

LANDING GEAR SYSTEM

The operation of the landing gear oleos is standard for the air-oil type; hydraulic fluid passing through an orifice serves as the major shock absorber, while air compressed statically acts as a taxiing spring. The piston tube has a total travel of 8 inches, and about 3.25 inches of tube should be exposed under normal static loads.

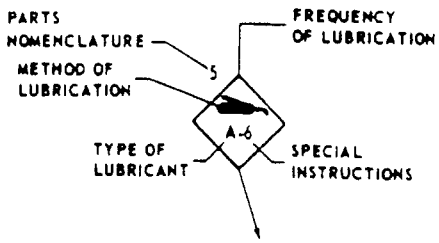
All of the oleos are inflated through readily accessible valves on the tip of the unit. The nose wheel unit is steerable through the rudder pedals, and incorporates a shimmy dampening device at the bottom of the outer housing. All major attachments and actuating bearings are equipped with grease fittings for lubrication of the bearing surfaces, and should be lubricated periodically. (See Lubrication Chart.)

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 oil, first 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 oil to overflow and working out trapped air. Then reinsert the valve core and pump up the strut.

To correct shimmy of the nose wheel, if it should develop, tighten the bolt on the dampening device at the base of the nose wheel forging. The bolt should be tightened just enough to keep the nose wheel from moving freely, but not enough to require excessive pressure to move the wheel by hand. It may be necessary to remove shims from the shimmy dampening collar to permit tightening of the device.

The steering arms from the rudder pedals to the nose wheel steering torque shaft arm are adjusted at the rudder pedals or at the torque shaft rollers by turning in or out the threaded rod end bearings. Adjustment is normally accomplished at the forward end of the rods, and should be done in such a way that the nose wheel is in line with the fore and aft axis of the plane when the rudder pedals and rudder are

EXAMPLE

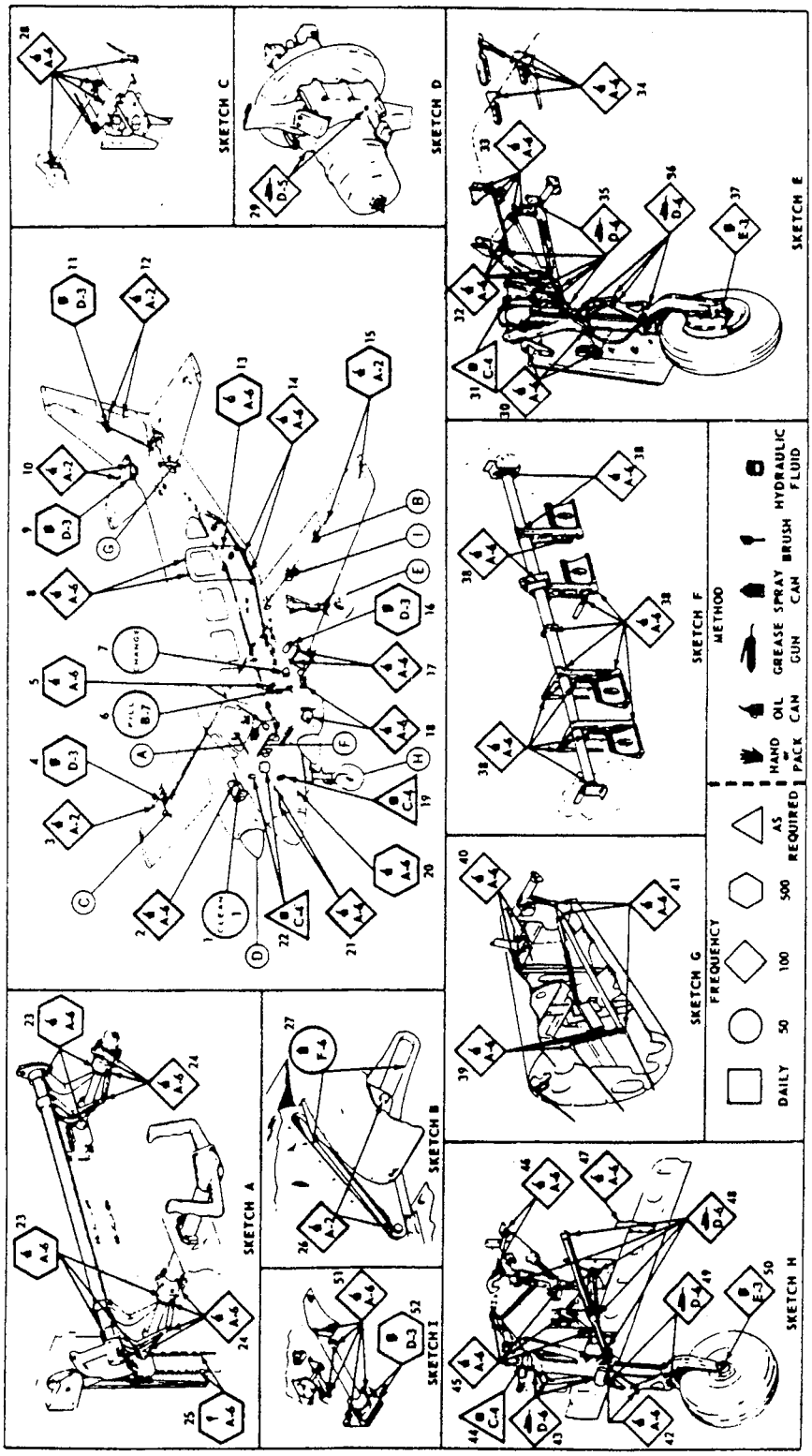


TYPE OF LUBRICANTS

IDENTIFICATION LETTER	SPECIFICATION	LUBRICANT
A	MIL-L-7870	LUBRICATING OIL, GENERAL PURPOSE, LOW TEMPERATURE
B	MIL-L-6082	LUBRICATING OIL, AIRCRAFT RECIPROCATING ENGINE (PISTON) GRADE AS SPECIFIED SAE 50 ABOVE 60°F AIR TEMP. SAE 40 30° TO 90° F AIR TEMP. SAE 30 0° TO 70° F AIR TEMP. SAE 20 BELOW 10° F AIR TEMP.
C	MIL-H-5606	HYDRAULIC FLUID, PETROLEUM BASE
D	MIL-G-23827	GREASE, AIRCRAFT AND INSTRUMENT, GEAR AND ACTUATOR SCREW
E	MIL-G-3545	GREASE, AIRCRAFT, HIGH TEMPERATURE
F	- - -	ALL PURPOSE SLIP SPRAY DUPONT NO. 6611

SPECIAL INSTRUCTIONS

1. AIR FILTER - TO CLEAN FILTER, BLOW OUT WITH COMPRESSED AIR FROM GASKET SIDE OR WASH IN WATER AND MILD DETERGENT, AND DRY. DO NOT USE OIL.
2. BEARINGS AHD BUSHINGS - CLEAN EXTERIOR WITH A DRY SOLVENT BEFORE RE-LUBRICATING.
3. COWL AND FLAP TRANSMISSIONS AND SCREWS, TRIM SCREWS AND WHEEL BEARINGS - DISASSEMBLE AND CLEAN WITH A DRY SOLVENT. WHEN REASSEMBLING TRANSMISIONS, FILL WITH LUBRICANT AND APPLY A THIN COATING TO SCREW.
4. OLEO STRUTS, POWER PACK RESERVOIR AND BRAKE RESERVOIR - FILL PER INSTRUCTIONS ON UNIT OR CONTAINER, OR REFER TO SERVICE MANUAL, SECTION II.
5. PROPELLER - REMOVE ONE OF THE TWO GREASE FITTINGS FOR EACH BLADE. APPLY GREASE THROUGH FITTING UNTIL FRESH GREASE APPEARS AT HOLE OF REMOVED FITTING.
6. LUBRICATION POINTS - WIPE ALL LUBRICATION POINTS CLEAN OF OLD GREASE, OIL, DIRT, ETC. BEFORE RELUBRICATING.
7. LUBRICATING OIL - INTERVALS BETWEEN OIL CHANGES CAN BE INCREASED AS MUCH AS 100% ON ENGINES EQUIPPED WITH FULL FLOW (CARTRIDGE TYPE) OIL FILTERS - PROVIDED THE ELEMENT IS REPLACED EACH 50 HOURS OF OPERATION.


SKETCH A
SKETCH B
SKETCH C
SKETCH D
SKETCH E
SKETCH F
SKETCH G
SKETCH H
SKETCH I
FREQUENCY
DAILY
50
100
500
AS REQUIRED
METHOD
HAND PACK
OIL CAN
GREASE GUN
SPRAY CAN
BRUSH
HYDRAULIC FLUID

PARTS NOMENCLATURE KEY

1. AIR FILTER, RIGHT AND LEFT
2. ALTERNATE AIR MECHANISM, RIGHT AND LEFT
3. AILERON TRIM TAB HINGES AND CONTROL ROD ENDS
4. AILERON TRIM SCREW
5. FUEL PANEL AND CONTROL LEVERS
6. ENGINE OIL SUMP, RIGHT AND LEFT
7. OIL FILTER CARTRIDGE, RIGHT AND LEFT
8. CABIN DOOR HINGES, UPPER
9. ELEVATOR TRIM SCREW
10. ELEVATOR TRIM TAB HINGES AND CONTROL ROD ENDS
11. RUDDER TRIM SCREW
12. RUDDER TRIM TAB HINGES AND CONTROL ROD ENDS
13. CABIN DOOR LATCH AND STEP MECHANISM
14. CABIN DOOR HINGES, LOWER
15. AILERON HINGES, RIGHT AND LEFT
16. COWL FLAP TRANSMISSION AND SCREW, RIGHT AND LEFT
17. COWL FLAP BELLCRANK BEARINGS AND CONTROL RODS, RIGHT AND LEFT
18. GOVERNOR, THROTTLE AND MIXTURE CABLE ENDS
19. BRAKE RESERVIOR, SERIAL NOS. 31-2 TO 31-301 INCLU.
20. BAGGAGE DOOR LATCHING MECHANISM
21. BAGGAGE DOOR HINGES
22. BRAKE POWER PACK RESERVIOR, SERIAL NOS. 31-302 AND UP.
23. CONTROL WHEEL; TORQUE TUBE BEARINGS, SPROCKET BUSHINGS AND ROLLER BEARINGS
24. CONTROL WHEEL; ROLLERS, LINK AND FLEXIBLE JOINT
25. CONTROL WHEEL CHAIN, VERTICAL AND HORIZONTAL
26. FLAP TRACK, RIGHT AND LEFT
27. FLAP TRACK ROLLERS, RIGHT AND LEFT
28. AILERON BELLCRANK CABLE ENDS, PIVOT BEARING AND CONTROL ROD ENDS, RIGHT AND LEFT
29. PROPELLER FITTINGS, RIGHT AND LEFT
30. GEAR DOOR OUTBOARD, HINGES AND CONTROL RODS, LEFT AND RIGHT
31. GEAR OLEO STRUT FILLER, RIGHT AND LEFT
32. GEAR DOWN LOCK HOOK, CONTROL ROD ENDS AND BELLCRANK, RIGHT AND LEFT
33. GEAR UP LOCK HOOK, CONTROL ROD ENDS, CRANK CYLINDER ENDS RIGHT AND LEFT
34. GEAR DOOR, INBOARD, HINGES AND CYLINDER ENDS, RIGHT AND LEFT
35. GEAR SIDE BRACE LINK BUSHING AND HOUSING BUSHING, RIGHT AND LEFT
36. GEAR TORQUE LINK FITTINGS, RIGHT AND LEFT
37. WHEEL BEARINGS, RIGHT AND LEFT
38. RUDDER PEDALS, TORQUE TUBE BEARINGS AND BLOCK, CONTROL CABLE ENDS, BRAKE CYLINDER ENDS, STEERING ROD ENDS AND PEDALS
39. ELEVATOR BELLCRANK, PIVOT BOLT AND CABLE ENDS
40. RUDDER HORN CABLE ENDS
41. ELEVATOR CONTROL ROD ENDS
42. UPPER AND LOWER TORQUE LINK CONNECTING BOLT AND SHIMMY DAMPENER

PARTS NOMENCLATURE KEY(cont)

43. GEAR HOUSING BUSHINGS
44. GEAR OLEO STRUT FILLER
45. STEERING ARM ROLLERS, BELLCRANK RETRACTION ROD ENDS AND STEERING ROD ENDS
46. UP LOCK HOOK AND UP LOCK ROD
47. DOOR HINGES
48. DRAG LINK ASSEMBLY AND IDLER LINK
49. UPPER AND LOWER TORQUE LINK
50. WHEEL BEARINGS
51. FLAP TRANSMISSION PIVOT BOLTS AND SENDER ARM
52. FLAP TRANSMISSION AND SCREW, RIGHT AND LEFT

CAUTIONS

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVER-LUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.

NOTES

1. PILOT AND PASSENGER SEATS - LUBRICATE TRACK ROLLERS AND STOP PINS AS REQUIRED. (TYPE OF LUBRICANT: A .)
2. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
3. SEE LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF DETERGENT OIL.

centered. Alignment of the nose wheel can be checked by pushing the airplane back and forth with the rudder centered to determine that the plane follows a perfectly straight line. 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 is twenty-eight feet.

In adjusting the steering arm stops, care should be taken to see that the nose wheel reaches its full travel just after the rudder hits its stops. This guarantees that the rudder will be allowed to move through its full travel.

Adjustable rod end bearings are present on each hydraulic cylinder that actuates the landing gear struts. These rod ends should be set so that the cylinders move the landing gear retracting links just far enough to engage the spring-loaded down locks and make contact at the stops. Too much extension of the adjusting screws will overload the links, and too little extension will prevent the links from traveling to the required past-center position.

Incorporated with each gear assembly is a micro-switch which closes after full downward movement of the gear. The down switches are connected individually to green indicator lights on the instrument panel. The up switches are in series and make contact after each gear door is closed. The red light will show an indication when the gear is not locked in either the up or down position or when the gear is up and the main gear doors are ajar. Within the control pedestal are two micro switches that operate a warning horn when power from one or both engines is reduced below 12 inches of manifold pressure. Operation of the red gear in transit light is independent of the throttle micro switches.

In the event the oleo strut slowly loses pressure and extension, the most probable source of trouble is the air valve attachment to the leg, or the core of the air valve. These parts should be checked first to determine whether or not air leaks are occurring. If hydraulic fluid is evident on the exposed chrome plated oleo strut, the "O" rings on the piston tube bearing units may need to be replaced.

HYDRAULIC SYSTEM

The fluid level of the hydraulic reservoir should be checked every 50 hours by placing the airplane in a level position and viewing the fluid level through the sight glass located in the forward surface of the reservoir dome. Access to the reservoir is through the forward baggage compartment door. The reservoir is mounted directly aft of the radio shelf.

If the fluid level is not visible, filtered hydraulic fluid MIL-H-5606 can be added through the filler tube to the right of the sight glass. Gravity fill the reservoir until fluid drips from the overflow tube outlet at the left of the nose gear well.

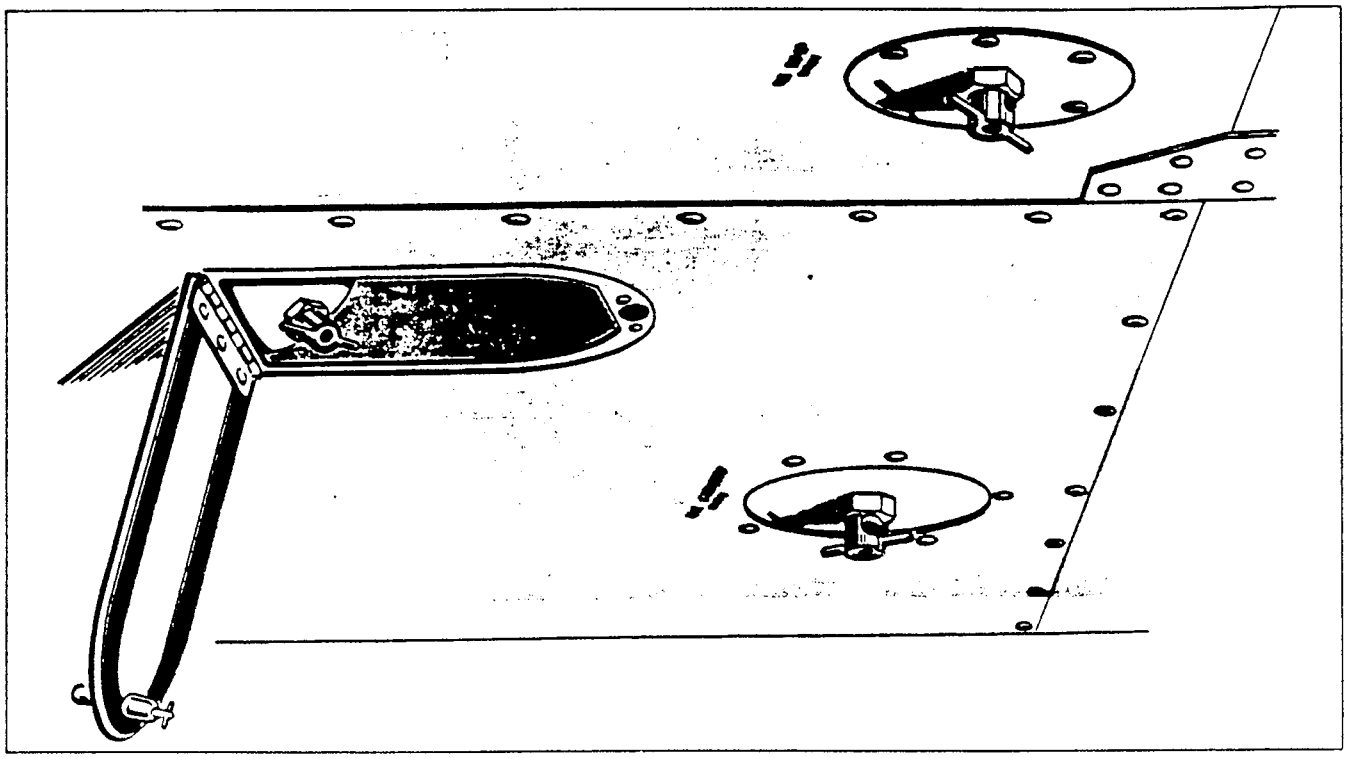
In aircraft with serial numbers 31-300 and up, the reservoir is serviced through an access door atop the nose.

FUEL SYSTEM

The 192 gallon capacity fuel system must be serviced with 100/130 minimum octane fuel. This 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.

When refueling the Navajo, ground the refueling hose before beginning the transfer of fuel. Secure the filler cap immediately after servicing each cell.

Condensed water vapor can be drained from the main or auxiliary cells by the quick-drain fittings on the wing panel lower surface.



FUEL STRAINER AND LINE DRAINING

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.

The fuel strainers and inboard fuel cell fuel line drain valves are located inboard of the main wheel wells, and the outboard fuel cell fuel line drain valves are outboard of the main wheel wells. They are fitted with quick drains and should be drained regularly. In order to check the fuel system for possible moisture content, the inboard fuel cell line quick drain valve should be opened and drained and the quick drain valve on the fuel strainer should be opened and drained. This procedure should be repeated at the quick drain valves located outboard of the main wheel well. Fuel screens are provided at the cell outlets, in the injectors, and in the fuel filter bowls.

A crossfeed line drain valve is located to the rear of the left fuel filter drain valve. This valve should be opened occasionally, with the crossfeed on, the left electric fuel pump on, and then the right electric fuel pump on to allow any water that might accumulate at that point to be drained out.

PRESSURE GYRO SYSTEM

The Navajo 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.

LAMP REPLACEMENT GUIDE

Location	Piper Part No.	Lamp No.
Tail Navigation Light	753 477	1683
Wing Navigation Lights	753 478	A-7512-24
Rotating Beacon(s)	753 440	1939 or (1939-X)
Reading Lights	751 437	305
Rear Exit Light	753 475	307
Dome Lights	472 048	306
Fuel Gauge Lights	453 791	356
Fuel Selector Panel Light	753 476	313
Trim Indicator Lights	472 047	335
Map Lights	472 052	304
Forward Baggage Light	472 755	30-32*
Instrument Panel Lights	472 028	327
Door Ajar Indicators	472 028	327
Stall Warning Light	472 028	327
Gear Indicators	472 028	327
Wing Inspection Light	472 049	4593
Landing and Taxi Lights	472 769	4596
Ammeter	453 792	1828
*Complete Light Replacement		

HEATING SYSTEM

A preflight check should be made of the air inlet scoop, combustion air inlet scoop, exhaust outlet, and fuel drain for possible obstructions. Make sure that all of the openings are clear of any restrictions and that no damage has occurred to the exhaust outlet or combustion air inlet.

An operational check can be performed by moving the airplane master switch to the ON position and the heater control toggle switch to the HEAT position. The ventilating air blower and combustion air blower should operate.

To proceed with the operational check, move the right tank fuel control, right auxiliary fuel pump switch, and the heater fuel control knob to ON. This will start the fuel and ignite the burner simultaneously, and heat should be felt within a few minutes.

PROPELLER

Since propellers will pick up loose pieces of rock or debris from the ramp and runway, the blades should be checked periodically for damage. Minor nicks in the leading edge of blades should be filed out and all edges rounded, since cracks sometimes start from such defects. Use fine emery cloth for finishing the depressions. Refer to FAA Advisory Circular 43.13-1 for blade repair recommendations and repair limitations. Your daily inspection should include examination of blades and spinner for visible damage or cracks and inspection for grease or oil leakage.

Remove spinner cap and check air pressure or, if necessary, charge the cylinder with dry air or nitrogen gas to the prescribed pressure. Refer to the placard in the spinner cap or Table below for an exact pressure for the existing temperature. It is most important that an accurate air charge be maintained.

NOTE

Do not check pressure or charge with propeller in feathered position.

CHAMBER PRESSURE REQUIREMENTS
WITH TEMPERATURE
HC-E2YK-2B, HC-E2YR-2B, HC-E3YR-2 and HC-E3YR-2A HUBS

Temp. °F	Press. (psi)	Temp. °F	Press. (psi)
100	86	30	72
90	84	20	70
80	82	10	68
70	80	0	66
60	78	-10	64
50	76	-20	62
40	74	-30	60

CHAMBER PRESSURE REQUIREMENTS
WITH TEMPERATURE
HC-E2YR-2BT, HC-E2YK-2BT, HC-E3YR-2T and HC-E3YR-2AT HUBS

Temp. °F	Press. (psi)
70 to 100	41 ± 1 lb
40 to 70	38 ± 1 lb
0 to 40	36 ± 1 lb
-30 to 0	33 ± 1 lb

SURFACE DEICING (OPTIONAL)

Clean Deicers when the airplane is washed, using a mild soap and water solution.

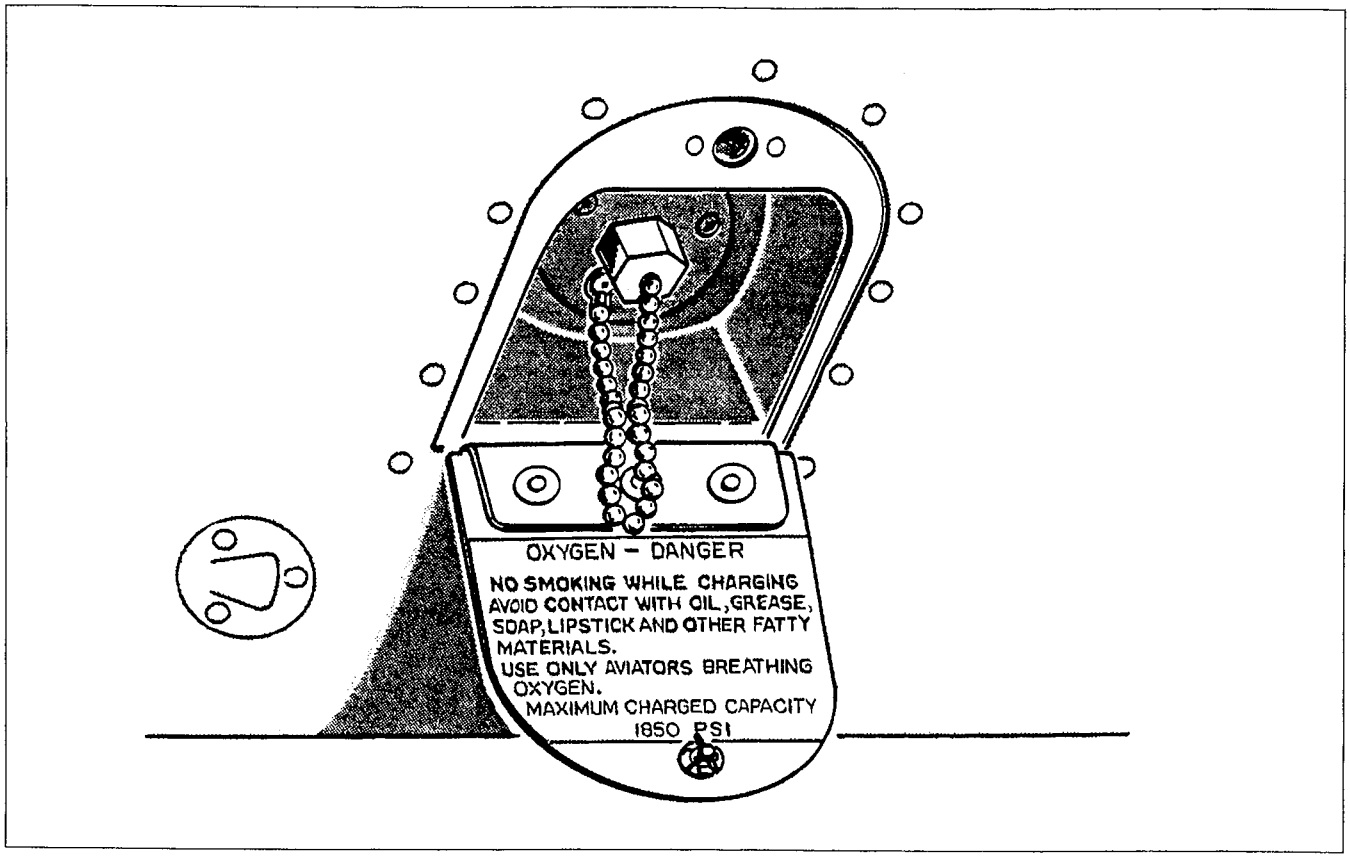
In cold weather, wash the boots with the airplane inside a warm hangar if possible. If the cleaning is to be done outdoors, heat the soap and water solution before taking it out to the airplane. If difficulty is encountered with the water freezing on the boots, direct a blast of warm air along the region being cleaned, using a portable type ground heater.

As alternates, use benzol or non-leaded gasoline. Moisten the cleaning cloth in the solvent, scrub lightly, and then, with a clean, dry cloth, wipe dry so that the cleaner does not have time to soak into the rubber. Petroleum products such as these are injurious to rubber, and therefore should be used sparingly.

PROPELLER DEICING (OPTIONAL)

Lock brakes and operate engines at near take-off power. Turn Deicer system switch ON and observe Deicer ammeter for at least 2 minutes. Ammeter needle must stay within the shaded band except for a "flicker", approximately each 30 seconds, as the step switch of the timer operates.

With engines stopped, turn Deicer switch ON and feel Deicers on propellers for proper sequence of heater operation. The starting point is not important but sequence is vital and must be: RIGHT OUTBOARD, RIGHT INBOARD, LEFT OUTBOARD and LEFT INBOARD heaters, in that order. Temperature rise should be noticeable and each heater should warm for about 30 seconds. Local hot spots indicate surface damage of Deicer heaters.



OXYGEN FILLER VALVE

OXYGEN SYSTEM (OPTIONAL)

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.

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.

Open the cylinder valve on the supply tank and fill the system slowly by adjusting the recharge rate with the pressure regulating valve on the cart. When the pressure gauge on the cylinder reads 1800 to 1850 psi, close the pressure regulating valve and replace the protective cap on the filler valve.