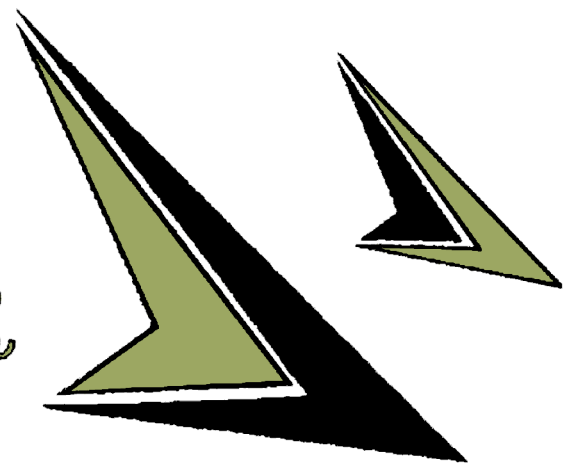
COMANCHE 400



OWNER'S HANDBOOK

the

COMANCHE 400

Owner's Handbook

PIPER

Piper Aircraft Corporation, Lock Haven, Pa.
U. S. A.

Additional copies of this manual may be purchased by writing to the SERVICE DEPARTMENT, PIPER AIRCRAFT CORPORATION, Lock Haven, Pennsylvania, U.S.A.

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N8400P

SECTION I

SPECIFICATION FEATURES

SPECIFICATIONS:

POWER PLANT — PA-24-400

Engine (Lycoming)	IO-720-A1A
Rated Horsepower	400
Rated Speed (rpm)	2650
Bore (inches)	5.125
Stroke (inches)	4.375
Displacement (cubic inches)	722
Compression Ratio	8.7:1
Dry Weight (pounds)	600

PERFORMANCE

Take-off Run (ft.)	980
Take-off Distance over 50ft. obstacle (ft.)	1500
Best Rate of Climb Speed (mph)	120
Rate of Climb (ft. per min.)	1600
Best Angle of Climb Speed (mph)	92
Absolute Ceiling (ft.)	21,000
Service Ceiling (ft.)	19,500
Top Speed (mph)	223
Cruising Speed (75% power at sea level) (mph)	202
Optimum Cruising Speed (75% power at optimum altitude) (mph)	213
Stalling Speed (flaps down) (power off) (mph)	68
Landing Roll (flaps down) (ft.)	1180
Landing Distance over 50 ft. obstacle (flaps down) (ft.)	1820
Fuel Consumption (75% power) (gph)	20.1
Fuel Consumption (65% power) (gph)	17.9
Cruising Range (75% power at 8,000 ft.) (mi) *	1315
Cruising Range (65% power at 12,000 ft.) (mi) *	1425
Cruising Range (55% power at 16,000 ft.) (mi) *	1540

*With reserve fuel

SPECIFICATIONS: (cont)

PERFORMANCE

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

WEIGHTS

Gross Weight (lbs.)	3600
Empty Weight (Standard) (lbs.)	2110
USEFUL LOAD (Standard) (lbs.)	1490

FUEL

Fuel Capacity (gal.) (Standard)	100
Fuel Capacity (gal.) (With reserve)	130
Unuseable Fuel (Inboard tanks only)	6
Fuel Aviation Grade (Min. Octane)	100/130
Oil Capacity (qts)	17

BAGGAGE

Maximum Baggage (lbs.)	200
Baggage Space (cubic ft.)	20
Baggage Door Size (in.)	20 x 20

DIMENSIONS

Wing Span (ft.)	35.98
Wing Area (sq. ft.)	178
Length (ft.)	25.70
Height (ft.)	7.83
Wing Loading (lbs. per sq. ft.)	20.22

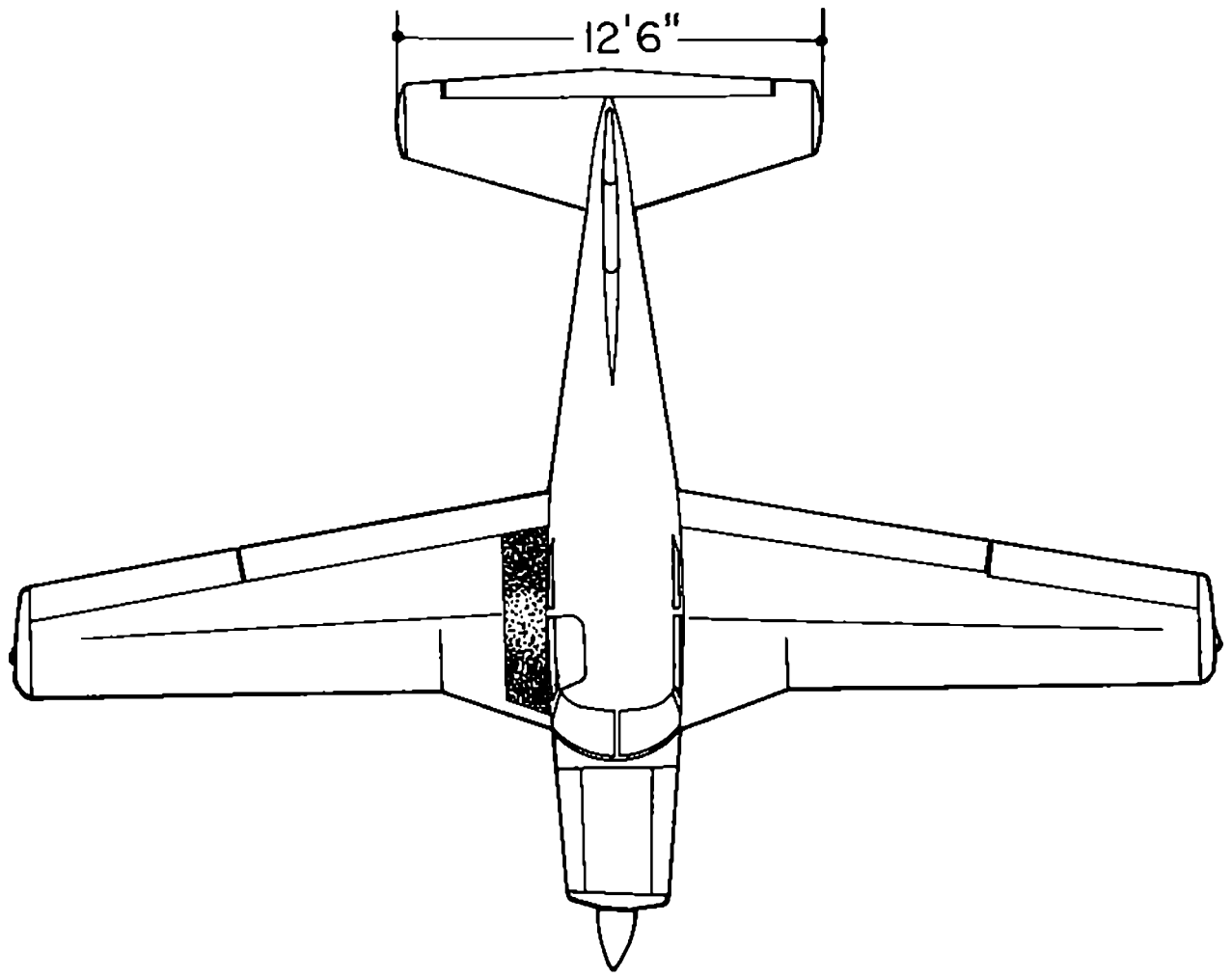
SPECIFICATION: (cont)

DIMENSIONS

Power Loading (lbs. per HP)	9.00
Propeller Diameter (in.)	77.25

LANDING GEAR

Wheel Base (ft.)		6.55
Wheel Tread (ft.)		9.79
Tire Pressure (psi)	Nose	42
	Main	42
Tire Size	Nose (six ply rating)	600 x 6
	Main (six ply rating)	600 x 6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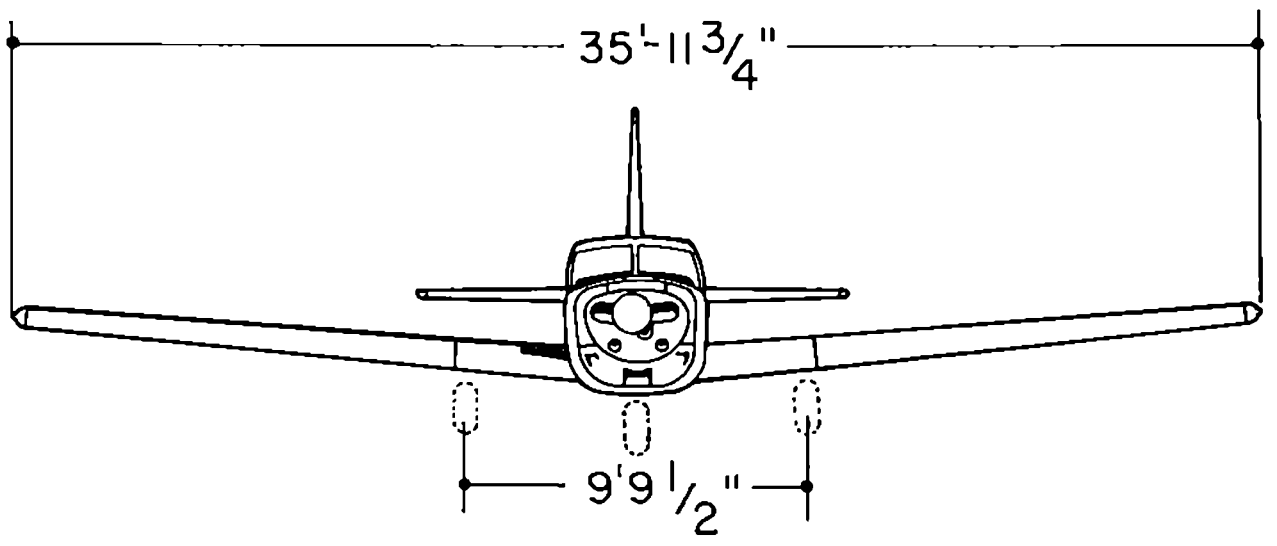
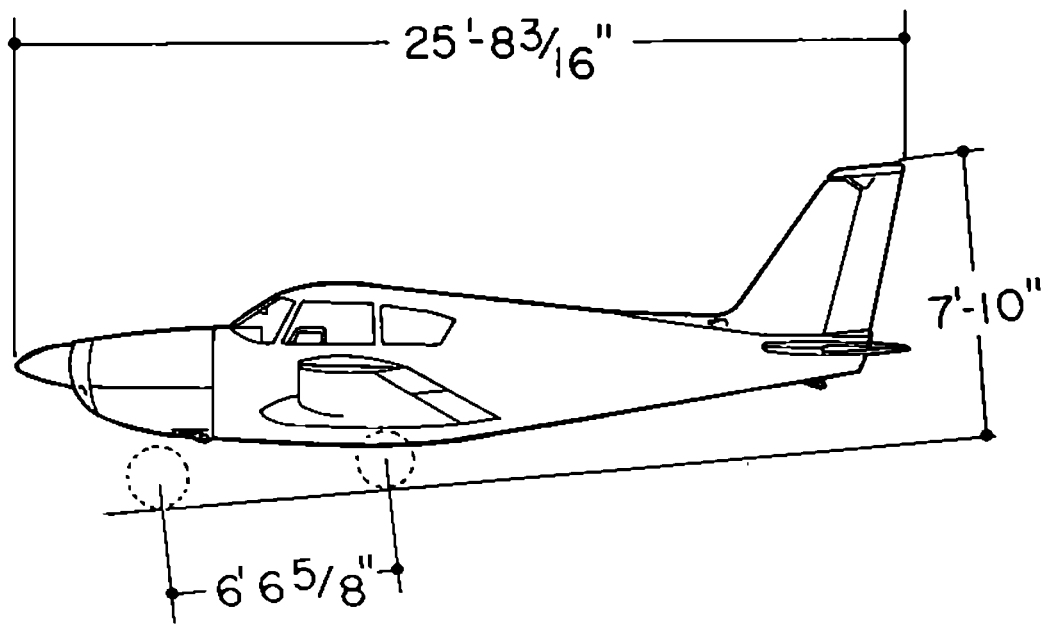

35'-11 3/4"
9'9 1/2"


25'-8 3/16"
7'-10"
6'6 5/8"

SECTION II

DESIGN INFORMATION

SECTION II

DESIGN INFORMATION

ENGINE AND PROPELLER

The Comanche 400 is powered by a Lycoming IO-720-A1A, eight cylinder fuel injection engine rated at 400 HP at 2650 RPM. The engine on the Standard Comanche is equipped with a geared starter, 75 ampere alternator (nominal), fuel injection and shielded ignition system.

Engine mount is of steel tubing construction and incorporated vibration absorbing dynafocal mounts. The aluminum engine cowl with fiberglass nose cowl, is a cantilever structure attached at the firewall. Side panels are hinged for quick access to the engine compartment.

The exhaust system is a dual cross-over type with exhaust gases directed overboard at the bottom rear of the cowling on each side of the nose gear. The cowl flaps, located on each side of the nose gear, are manually operated by a push-pull control located in the cabin on the lower instrument panel.

Efficient aluminum oil coolers are mounted on the left and right rear baffle of the engine. Engine oil drainage is accomplished by a quick drain installed in the left side of engine sump.

The propeller on the Comanche 400 is a three bladed Hartzell HC-A3VK-4/V8433-7 constant-speed, controllable unit. It is controlled entirely by use of the propeller control located in the center of the lower instrument panel.

FUEL INJECTION

The Bendix RSA-10AD1 Type Fuel Injection System installed in the Comanche is based on the principle of measuring

airflow and using the airflow signals to operate a servo valve. The accurately regulated fuel pressure established by the servo valve, when applied across a fuel control (jetting system), makes fuel flow proportional to airflow.

Fuel pressure regulation, by means of a servo valve, necessitates only a minimum fuel pressure drop through the entire metering system. This makes it possible to maintain metering pressure above vapor forming conditions, and at the same time does not require a high inlet fuel pressure. An inherent feature of the Servo System is self-purging, which eliminates any possibility of vapor lock and the associated problem of difficult starting.

The Airflow Sensing System, which is incorporated in the Servo Regulator, consists of the throttle body containing the throttle valve and venturi. The differential pressure between the entrance and the throat of the venturi is a measurement of air entering the engine. These pressures are applied to an air diaphragm in the Servo Regulator to create a force across the diaphragm. A change in power will change the airflow to the engine which in turn will change the force across the air diaphragm in the Servo Regulator.

The air diaphragm in the Servo Regulator converts the airflow measuring signals into an air metering force. Fuel inlet pressure is applied to one side of the fuel diaphragm and the pressure of the fuel, after it passes through the fuel control (metered fuel pressure), is applied to the other side of the diaphragm. This creates a force across the diaphragm which is referred to as fuel metering force. Relatively low airflow signals develop high fuel metering forces by viture of the diaphragm areas selected. The requirement for low airflow signals makes possible the use of a relatively large venturi which keeps engine induction system air losses to a minimum. During idle operation, when air intake is too small to create pressure differential required for operation of the diaphragm, a constant head idle spring is used to operate the diaphragm and supply the required fuel for idle.

The fuel control system, which is also incorporated in the Servo Regulator, consists of an inlet fuel screen, a rotary idle

valve and a rotary mixture control valve. The idle valve is adjustable to obtain good idling characteristics without effecting metering at higher power settings. The mixture control valve gives full rich mixture on one stop and a progressively leaner mixture as it is moved toward the idle cut-off stop. The setting incorporated in the fuel control system is worked out to meet the engine requirement for all power settings without compromise. The full rich stop defines sea level requirements, and the mixture control provides altitude leaning.

The Flow Divider, which is mounted on top of the engine, is provided as a fuel distributor point. Eight individual lines are connected to the flow divider, then routed to the cylinders. The Flow Divider contains a spring loaded positive shut-off valve and is ported to accurately divide fuel flow to the nozzle lines.

Located in each cylinder are the airbleed nozzles. The continuous flow airbleed nozzles incorporate provisions to eliminate the adverse effect of low manifold pressure at idle. Through this, lines can be maintained full of fuel to provide good distribution and acceleration characteristics. Actual fuel metering is provided by the Servo Regulator, not the nozzles, which permits leaner operation for economy and longer engine life due to uniform cylinder head temperatures.

Installed in the instrument panel is a Fuel Flow Indicator. This instrument is connected to the Flow Divider and monitors fuel pressure. The instrument converts fuel pressure to an accurate indication of fuel flow in gallons per hour, percentage of cruise power, and proper leaned mixture for take-off at various altitudes.

> NOTE: An increasing or abnormally high fuel flow indication is a possible symptom of restricted injector lines or nozzles.

Induction air for the engine enters the opening in the nose cowl below the propeller and is picked up by a large air duct. The air is directed through a filter and on to the Servo Regulator. Located in the air box at the throat of the Servo Regulator is a spring loaded door which opens automatically if the filter becomes blocked.

STRUCTURES

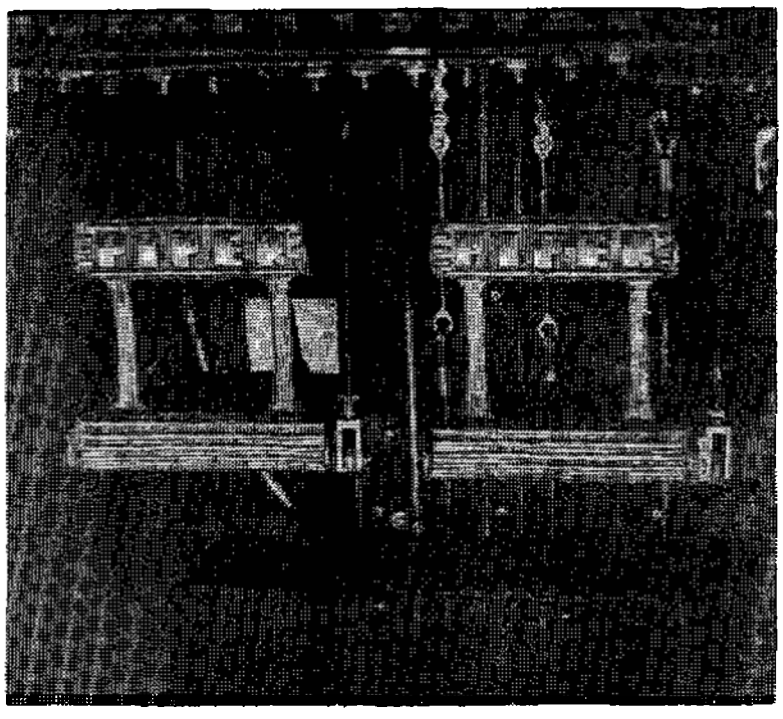
Structures are of sheet aluminum construction and are designed to ultimate load factors well in excess of normal requirements. All components are completely zinc chromate primed; exterior surfaces are coated with acrylic lacquer.

The main spars of the wings are jointed with high strength butt fittings in the center of the fuselage, making in effect a continuous main spar. The spars are attached to the fuselage at the side of the fuselage and in the center of the structure; wings are also attached at the rear spar and at an auxiliary front spar.

The wing airfoil section is a laminar flow type, NACA-64_2A215, with maximum thickness about 40% aft of the leading edge. This permits the main spar, located at the point of maximum thickness, to pass through the cabin under the rear seat, providing unobstructed cabin floor space ahead of the seat.

LANDING GEAR

The nose gear is steerable with the rudder pedals through a 40 degree arc. During retraction of the gear the steering mechanism is disconnected automatically to reduce rudder pedal loads in flight. The nose gear is equipped with a hydraulic shimmy dampener.



Rudder Pedals

Retraction of the landing gear is accomplished through the use of an electric motor and gear train located under the floorboards, actuating push-pull cables to each of the main gears and a tube to the nose gear. The landing gear motor is activated by a selector switch located on the instrument panel.

To guard against inadvertent movement of the land-

ing gear selector on the ground, a mechanical guard is positioned just below the selector handle. The handle must also be pulled aft before moving it upward. The gear selector is in the shape of a wheel to differentiate it from the electric flap control knob, which has an airfoil shape. As an added safety feature, the warning horn is connected to the gear selector switch. The horn will then operate if the selector is moved to the "UP" position with the master switch on and the weight of the airplane is on the landing gear. As a final safety factor to prevent gear retraction on the ground, an antiretraction switch is installed on the left main gear. This prevents the electric circuit to the landing gear motor from being completed until the gear strut is extended. A green light on the instrument panel below the landing gear switch is the indication that all gears are down and locked.

Two indicators (visual and audible) are used on this aircraft to help prevent gear up landings;

1. A warning horn, which will sound if power is reduced below 15" manifold pressure and the gear is not down and locked.

2. A visual indicator, located on top of the instrument panel which will pop-up if the gear is retracted and power is reduced below 15" manifold pressure. This indicator is operated mechanically by the landing gear and throttle and therefore has no connection with the electrical system.

The telescoping emergency gear handle should not be used as the primary indication that the gear is down and locked. An amber light above the switch indicates gears up. THE INDICATION LIGHTS ARE AUTOMATICALLY DIMMED WHEN THE NAVIGATION LIGHTS ARE TURNED ON.

The brakes on the Comanche 400 are actuated by toe brake pedals mounted on the left set of rudder pedals or by a hand lever protruding from under the instrument panel. Hydraulic brake cylinders are located above the left rudder pedals and are accessible in the cockpit for servicing. Parking brake valves are incorporated in each cylinder. Two cables extending from the parking brake "T" handle are attached to the parking brake valves. To prevent inadvertent application of

the parking brake in flight, a safety lock is incorporated in the valves thus eliminating the possibility of pulling out the "T" handle until pressure is applied by use of the toe brakes or the hand lever.

CONTROL SYSTEM

The flight controls on the Comanche 400 are the conventional three control type operated by a control column and rudder pedals. The all movable stabilator, with an anti-servo tab which also acts as a longitudinal trim tab, provides extra stability and controllability with less size, drag and weight.

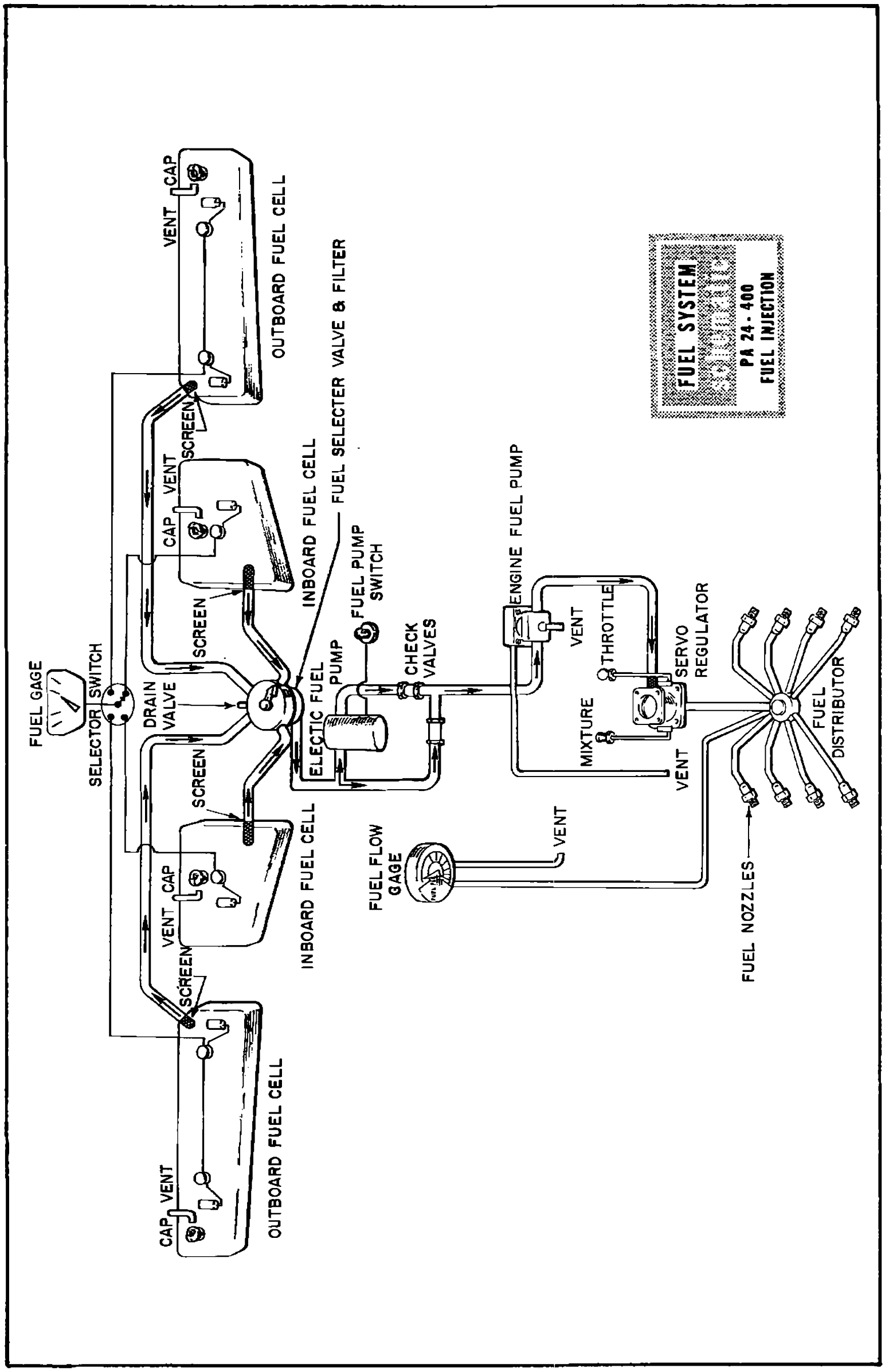
Provision for directional and longitudinal trim is provided by an adjustable trim mechanism for the rudder and stabilator. The trim mechanism for the stabilator is operated by an electric motor, activated by a switch mounted on the control wheel. On a standard airplane the trim switch is located on the left side of the left control wheel. If the airplane is equipped with an Altimatic Pilot a button on top of the left control wheel will activate an automatic electric longitudinal trim.

Max-Lift, electrically operated flaps, are used on the Comanche 400. As the flaps are operated by an electric motor they can be lowered and stopped in any desired position. The flap control switch (airfoil shaped) is located on the wheel well cover. Located on the instrument panel is a flap position indicator marked to show degrees of flap travel. A range for take-off operation is also shown.

Located in the inboard end of the right flap is a lock which holds the flap in the "UP" position so that it can be used as a step for entry or exit. A second lock is incorporated to prevent the flap from going full down in case a step load is applied and the up lock is not fully engaged. The flaps are interconnected to prevent extension or retraction of only one surface.

FUEL SYSTEM

The fuel for the Comanche 400 is carried in four bladder type fuel cells located in the leading edge sections of the wings. Combined capacity of these four fuel cells is 130 gallons. The two inboard cells, which are classified as main cells have a

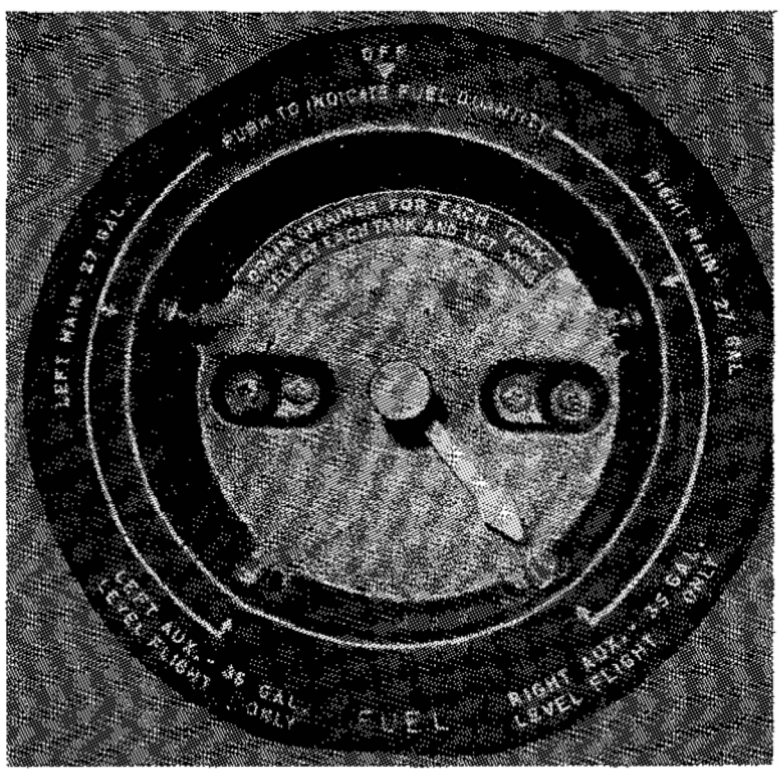

FUEL SYSTEM
PA 24-400
FUEL INJECTION
VENT
CAP
OUTBOARD FUEL CELL
SCREEN
INBOARD FUEL CELL
FUEL SELECTER VALVE & FILTER
FUEL PUMP SWITCH
ENGINE FUEL PUMP
VENT
THROTTLE
SERVO REGULATOR
MIXTURE
VENT
FUEL DISTRIBUTOR
FUEL NOZZLES
FUEL FLOW GAGE
VENT
ELECTIC FUEL PUMP
CHECK VALVES
FUEL GAGE
SELECTOR SWITCH
DRAIN VALVE
SCREEN
INBOARD FUEL CELL
VENT
CAP
SCREEN
OUTBOARD FUEL CELL
VENT
CAP

capacity of 30 gallons each (27 gallons useable) while the two outboards or auxiliary cells have a capacity of 35 gallon each. Auxiliary fuel is to be used in level flight only. Fuel cells are provided with NACA type non-icing vents.

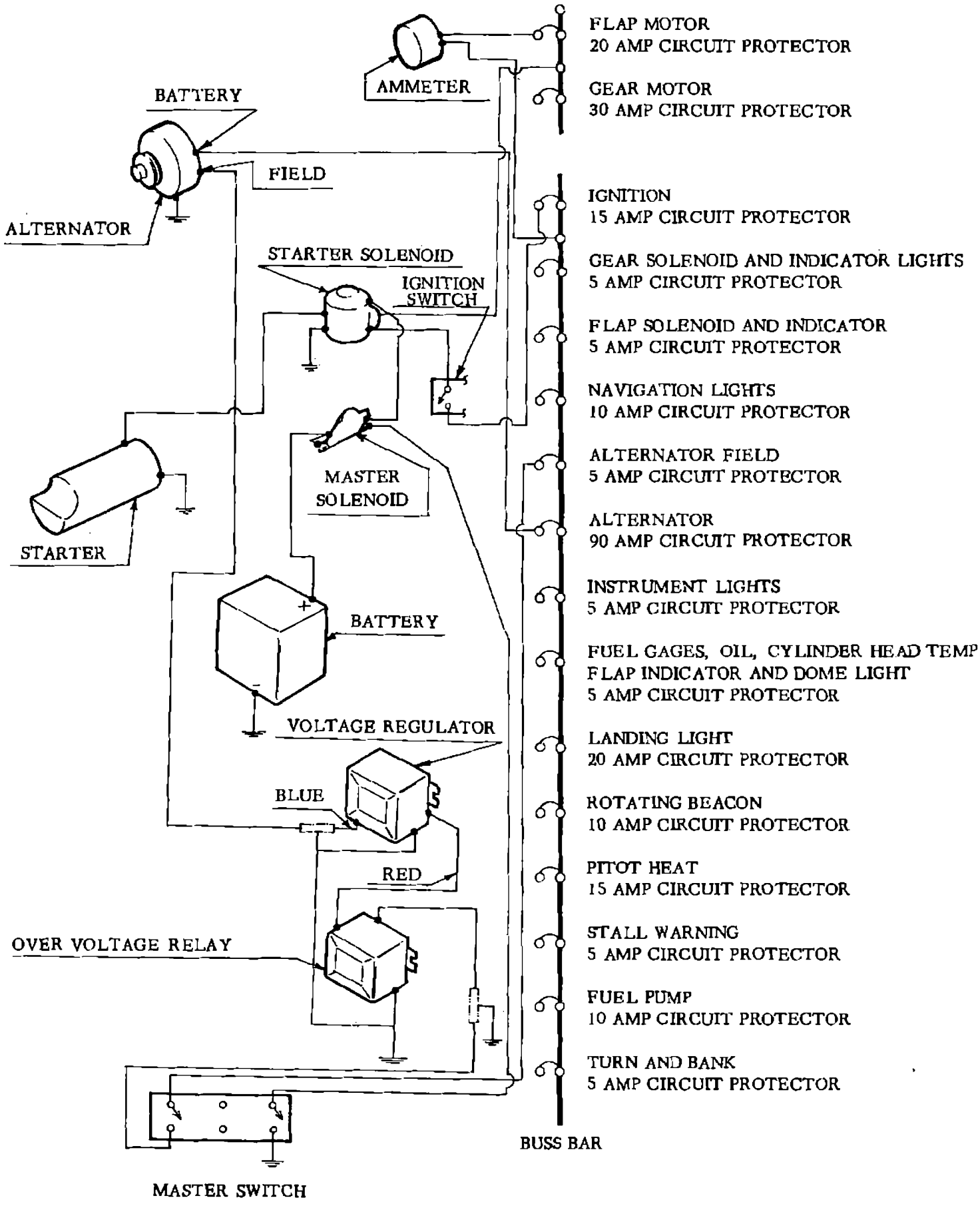
During normal operation the fuel is drawn to the engine from the cell by a mechanically operated fuel pump located on the engine accessory section. In the event the engine driven fuel pump fails an electric auxiliary fuel pump is provided. This pump is operated during starting, take-offs, and landings.

The combination fuel selector and strainer unit for the system is located between the front seats. Daily draining of the strainer is accomplished in the cockpit by lifting up on the red knob located in the center of the selector. The general procedure for draining the fuel system is to lift the strainer quick drain knob for a few seconds with the fuel cell selector on one cell, then change the fuel selector to the opposite cell and repeat the process. The same process applies for the auxiliary fuel cells. Allow enough fuel to flow to clear the lines as well as the strainer. Positive fuel flow shut-off can be observed through the clear plastic tube which carries the fuel overboard.

Fuel quantity is indicated by one electric gauge located in the instrument cluster. This gauge will indicate the amount of fuel in the cell that is selected. An over-ride system is incorporated so that it is possible to check the amount of fuel available in the remaining cells without moving the selector handle to that cell position. This is accomplished by depressing the red button (located on the fuel selector plate) under the desired fuel cell position. The fuel gauge will indicate the amount of fuel available in that cell. When the red button is released the indicating system will return to its normal operation.



ELECTRICAL SYSTEM
PA•24•400



ELECTRICAL SYSTEM

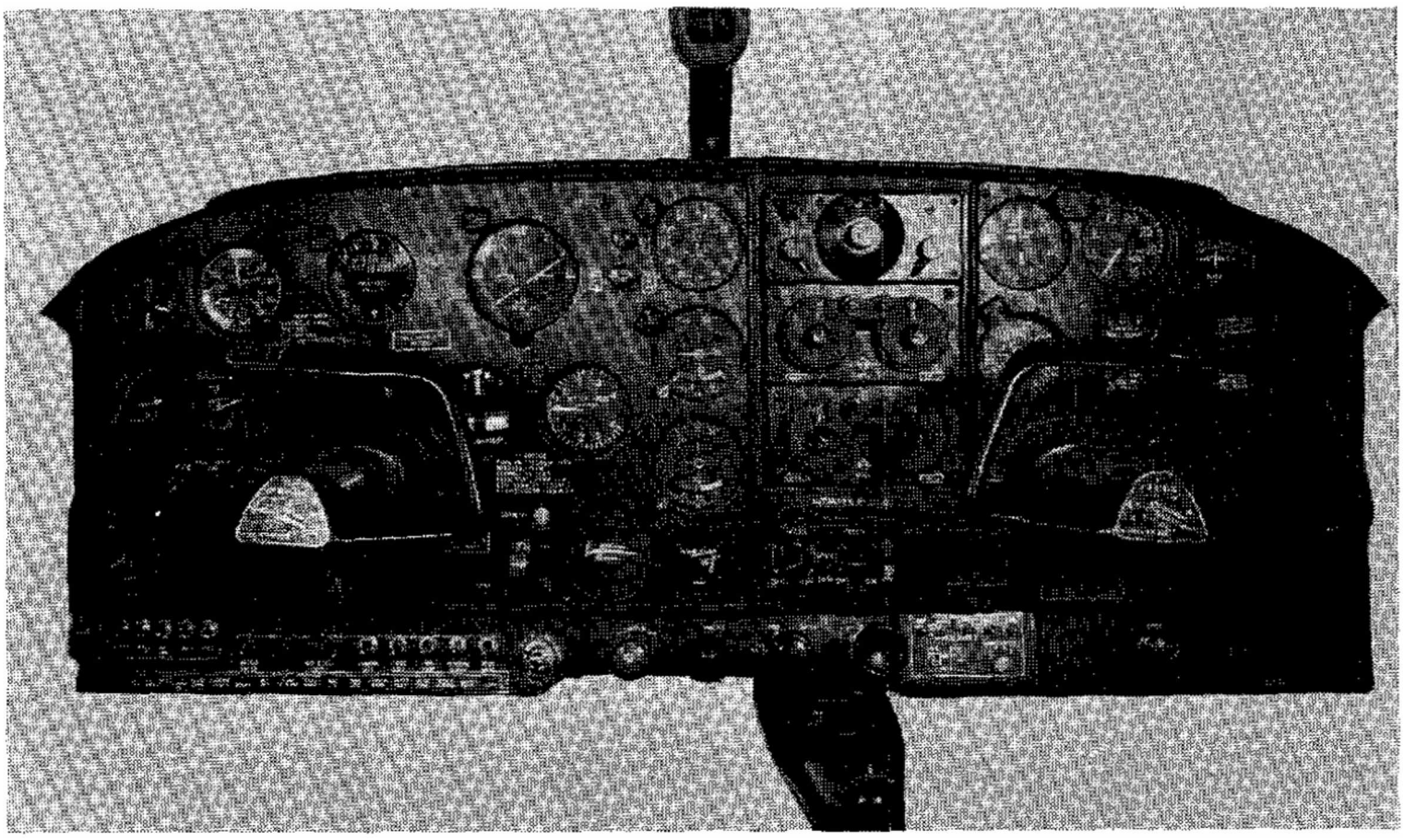
The Comanche 400 electrical system includes 12 volt 75 amp alternator, providing power at all engine speeds, a transistorized voltage regulator, an over voltage relay and a 35 ampere hour battery. This advantage results in improved performance for radio and electrical equipment and longer battery life.

The battery and relays are mounted immediately aft of the baggage compartment. Access for service or inspection is obtained through a removable panel adjacent to the baggage door.

Electrical switches are located on the lower left side of the instrument panel. The circuit breakers, located below the electrical switches, automatically break 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 event of continual circuit breaker popping. It is possible to manually trip the breakers by pulling out on the reset button. The alternator circuit breaker, mounted on the same panel, is of the switch type and should not be turned off while the engine is running.

Standard electrical accessories, in addition to those already listed, include a geared starter, stall warning indicator, cigar lighter, ammeter and anti-collision light. Advanced instrument lighting is offered as optional accessories. Circuit provisions are made to handle optional communications and navigational equipment.

Operation of the alternator system as far as visual indication to the pilot is the same as for a standard generator system. The ammeter, located in the upper right corner of the instrument panel, will give a constant indication of battery charge and/or discharge in case of a malfunction of the system. Should a malfunction of the voltage regulator occur that would cause a high voltage condition the over voltage relay will cut the alternator out of the system. Battery power will still be available to the bus bar.



INSTRUMENT PANEL

The instrument panel in the Comanche is designed to accommodate the customary advanced flight instruments on the left side in front of the pilot and the engine instruments on the right side. The Gyro instruments are shock mounted and are accessible for maintenance by removing the cover located on top of the instrument panel.

The Artificial Horizon and the Directional Gyro in the flight group are vacuum operated through use of a vacuum pump installed on the engine. The Turn and Bank is an electrically operated instrument and serves as a standby in case of vacuum system failure.

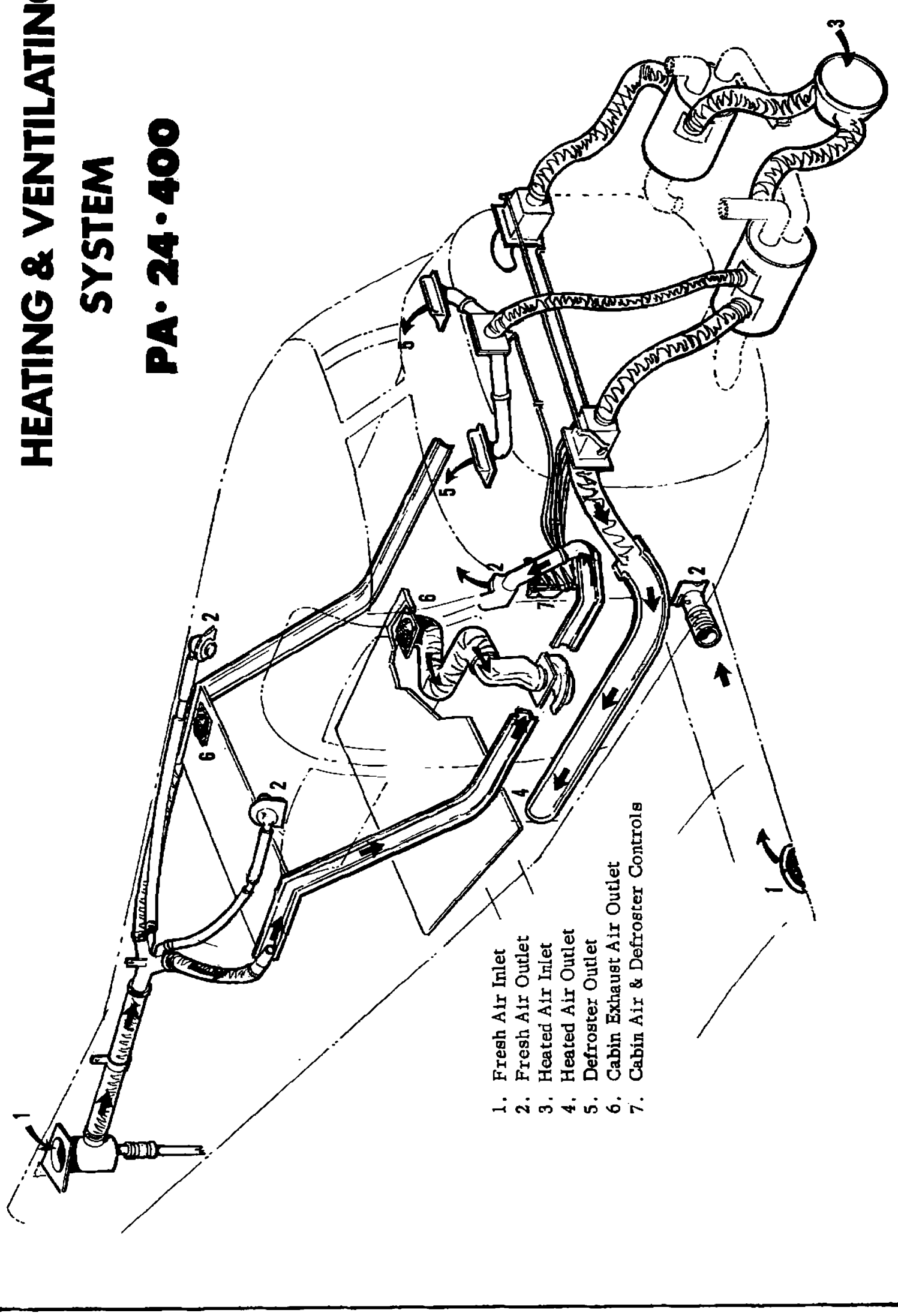
VACUUM SYSTEM

Suction for the vacuum operated Gyro instruments is supplied by an engine driven (dry type) vacuum pump.

A vacuum gauge is installed in the instrument panel to provide a constant indication of vacuum source. Suction is indicated on the gauge in inches of mercury; normal operating range is 4.5 to 5.0 inches. The system is controlled by one adjustable regulator, located under the instrument panel. After initial adjustment the regulator will require very little attention.

HEATING & VENTILATING SYSTEM

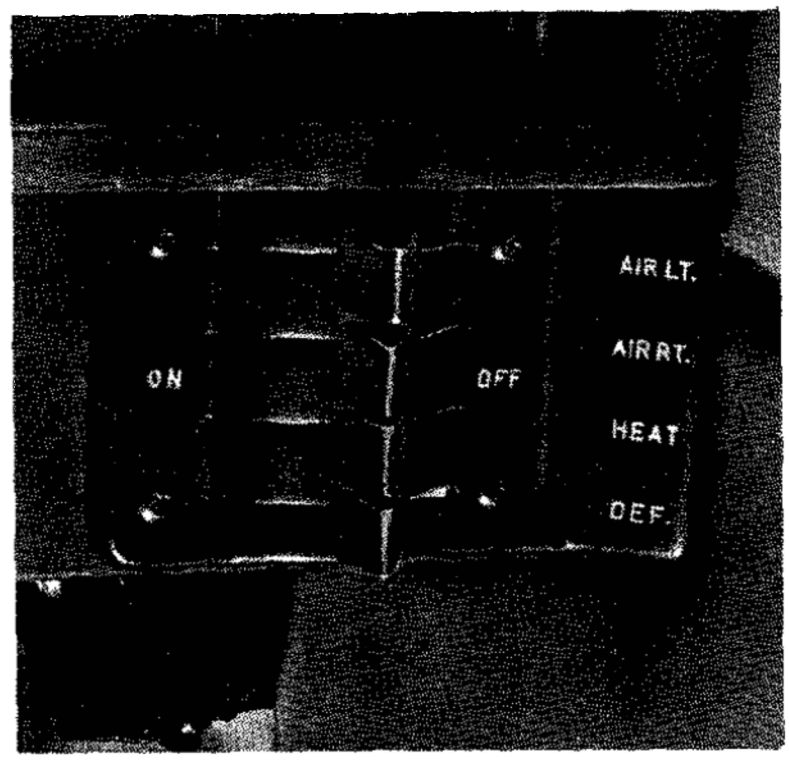
PA·24·400



HEATING AND VENTILATING SYSTEM

There are four individual controls provided for regulating the heating, defrosting and ventilating air. The controls are located on the lower right side of the instrument panel in a console panel.

Heated air for the cabin interior is provided by a heater shroud attached to each exhaust muffler. Fresh air is picked up at the air induction inlet at the front of the cowl and passed through the heater shrouds into a control valve for distribution to the cabin.



Heating Controls

Warm air for the defroster system is obtained directly from the right heater shroud. The amount of air applied to the windshield is regulated with the control in the console. Caution should be used if it is necessary to operate the defroster on the ground as prolonged application of heat to the windshield may cause distortion.

Fresh air for the cabin interior is picked up from two air inlets in the leading edge of each wing. The air passes through the wings to the wing root area and is discharged into the cabin near the floor just forward of the front seats. In addition, two fresh air scoops are located on the dorsal fin. These provide air for two overhead ventilators in the rear seat area and two front seat ventilators located between the windshield posts and the instrument panel.

BAGGAGE COMPARTMENT

Maximum placarded weight of the baggage area is 200 pounds with 20 cubic feet of space available, accessible through a 20 x 20 inch door. Provision for securing cargo is provided by tie-down belts installed in the compartment. Attached to

the top of the baggage compartment are provisions for stowing the tow bar.

SEATS

Front seats are adjustable to provide comfort and facilitate ease of entry and exit from the aircraft for pilot and passengers. They are easily removed by taking out the stops at the end of the mounting tracks and sliding the seats off their tracks.

The back of the rear seat is adjusted to various fore and aft positions by use of the latches at the outboard upper corners. The entire rear seat is removed quickly by disengaging the aft seat bottom tube from its attachment clamps, detaching the latches behind the top of the seat back, removing the center safety belt bolt, then lifting both the seat and the back as one unit from the cockpit.

FINISH

All aluminum sheet components of the Comanche 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. The application of primer to interior surfaces will prevent corrosion of structural and non-structural parts on the inside where there is no access for normal maintenance.

SECTION III

OPERATING INSTRUCTIONS

SECTION III

OPERATING INSTRUCTIONS

PREFLIGHT

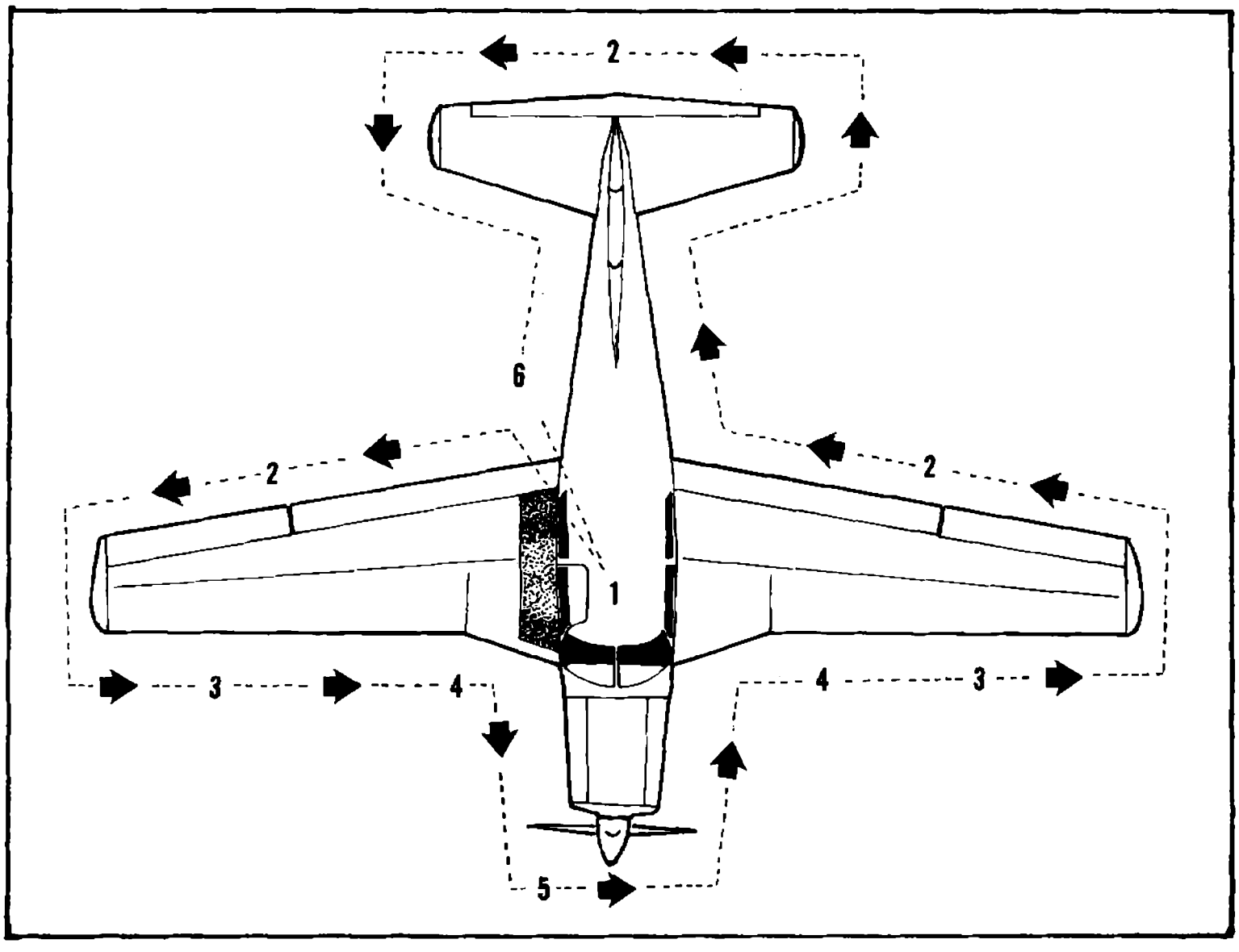
The following safety procedure instructions must become an integral part of the pilot's operational routine and preflight inspection.

Below is an outline for preflighting the Comanche 400:

1. a. Ignition and battery switches are "OFF."

2. a. Check for external damage or operational interference to the control surfaces, wings or fuselage.

b. Check for snow, ice, or frost on the wings or control surfaces.



3. a. Check fuel supply.

b. Check fuel cell caps and covers for security (adjust caps to maintain a tight seal).

c. Fuel system vents open.

4. a. Landing gear shock struts properly inflated (Approxmately 2-1/2" piston exposed).

b. Tires satisfactorily inflated and not excessively worn.

c. Cowling, landing gear doors and inspection covers properly attached and secured.

d. Propeller free of detrimental nicks.

e. No obvious fuel or oil leaks.

f. Engine oil at the proper level. (Insure dip stick is properly seated.)

5. a. Windshield clean and free of defects.

6. a. Tow-bar and control locks detached and properly stowed. Check that baggage door is secured.

7. a. Upon entering the airplane, ascertain that all controls operate normally.

b. Check that the landing gear selector and the other controls are in their proper position.

c. Close and secure the cabin door.

d. Drain the fuel strainer.

e. Check that required papers are in order and in the airplane.

STARTING ENGINES

1. Cowl flaps open.

2. Open throttle approximately 1/2 inch.

3. Turn electric fuel pump on.

4. Move mixture control to full rich until an indication on fuel flow meter is noted. (Engine is primed.)

5. Move mixture control to idle cut-off.

6. Engage starter. When engine fires, move mixture control to full rich. If engine does not fire within 5-10 seconds, disengage starter and reprime.

STARTING ENGINE WHEN FLOODED

1. Move throttle to full open and mixture to idle cut-off.
2. Turn electric fuel pump off.
3. Engage starter. When engine fires advance mixture control and retard throttle.
4. Turn electric fuel pump on.

The starter manufacturer recommends that cranking periods be limited to ten to twelve seconds with a five minute rest between cranking periods. Longer cranking periods will shorten the life of the starter.

WARM-UP AND GROUND CHECK

As soon as the engine starts, 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^{o} F or below) a little longer period of time may be necessary.

Warm-up the engine at 1000 to 1400 RPM for not more than two minutes in warm weather, four minutes in cold weather. Avoid prolonged idling at low RPM as this practice may result in fouled spark plugs. The magnetos should be checked at 2000 RPM with 15" MP and the propeller in high RPM, the drop not to exceed 125 RPM. The engine is warm enough for take-off when the throttle can be opened without the engine faltering.

The propeller control should be moved through its complete range during the warm-up to check for proper operation, then left in the full low pitch positions.

To assure smooth engine operation on the ground the electric fuel pump should be on and turned off only during ground check

or during warm-up to make sure that the engine driven pump is operating. Prior to take-off the electric pump should be turned on again to prevent loss of power during take-off should the engine driven pump fail.

TAKE-OFF

Before take-off the following should be checked:

1. Seat belts fastened.
2. Seats locked in position.
3. Controls free.
4. Fuel on main tank.
5. Cowl flaps open.
6. Electric fuel pump on.
7. Flaps set.
8. Trim set.
9. *Mixture rich.
10. Propeller set.
11. Engine gauges normal.
12. Door locked.

During a normal take-off, with full power at 2650 RPM and full rich mixture, the pointer on the fuel flow meter will stabilize between the sea level mark and the red line. This setting gives a slightly rich mixture to aid in fuel cooling the engine and is recommended for normal take-off at sea level.

*When taking off from a high altitude field, (example 4,000 feet), the mixture should be leaned to obtain maximum power. This is done during the pretake-off check. Apply full throttle, then move mixture control towards the lean position until the fuel flow pointer has stabilized at the 4,000 foot mark, located between the 27 and 28 gallon marks. Leave the mixture in this position and proceed with the take-off. This same procedure can be used at sea level to obtain maximum power except the fuel flow pointer must be stabilized at the sea level mark. Caution should be used when operating at sea level with the mixture leaned so that the engine is not overheated.

After the take-off has proceeded to the point where a landing can no longer be made wheels-down in event of power failure, the gear should be retracted. When the gear is up, the throttle should be brought back to climbing power, 24" MP, and the RPM reduced to 2400.

CLIMB

The best rate of climb is obtained at 120 MPH, but to give a high forward speed as well as a good rate of climb, a cruising climb speed of 138 MPH is recommended.

STALLS

All controls are effective at speeds down through the stalling speed. Stalls are gentle and easily controlled.

STALL SPEED TABLE

Configuration	Power Off
Gear and Flaps Up	78 C.A.S.
Gear and Flaps (Take-off 15°)	75 C.A.S.
Gear and Flaps Down (Full)	68 C.A.S.

These figures are at gross weight of 3600 lbs.

CRUISING

The cruising speed of the Comanche 400 is determined by many factors including power setting, altitude, temperature, weight, and equipment installed.

The normal recommended economy cruising power setting of the Comanche is at 65% power. At 12,000 feet this gives a True Airspeed of 208 MPH. This power setting is obtained under standard conditions at 2400 RPM and full throttle. Fuel consumption is approximately 18 gallons per hour total.

The optimum cruising speed of the Comanche at 8000' is 213 MPH. (See Power and Performance charts for power settings and performance under various conditions.)

The Lycoming engine in the Comanche can be cruised at any percent of power from 75% down. 2400 RPM is recommended for maximum cruise performance and lower RPM's, down to 1800, for more economical cruising conditions.

Ordinarily an RPM setting should be selected which will give maximum smoothness. To avoid undesirable stresses on the propeller, no Manifold Pressure settings over 24" should be used with an RPM of less than 2000.

To obtain the desired power set the manifold pressure and RPM according to the power setting table in this manual. After the desired power settings have been set up, adjust the mixture control for corresponding best power setting as indicated by the fuel flow meter. The low side of the power setting, as shown on the fuel flow meter, indicates best economy for that percent of power while the high side indicates best power.

During climbing operation the servo regulator will sense the change in altitude and will automatically lean the mixture. For better economy manual leaning with the mixture control can also be accomplished if desired.

APPROACH AND LANDING

During the approach, the gear can be lowered at speeds under 150 MPH, preferably on the downwind leg. Flaps should be lowered on final approach at an airspeed under 125 MPH, and the airplane trimmed to a gliding speed of 93 MPH. Normally about 12" MP should be maintained to give a reasonable approach angle. RPM should be left at high cruising RPM or approximately 2400. This propeller setting gives ample power for an emergency go-around and will prevent over-speeding of the engine if the throttle is advanced sharply. The mixture control should be kept in full rich position to insure maximum acceleration if it should be necessary to open the throttle.

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. It is always best to contact the ground at the minimum practicable speed consistent with landing conditions.

Normally, the best technique for short and slow landings is to use full flap and a small amount of power, holding the nose up as long as possible before and after ground contact.

In high wind conditions, particulary in strong crosswinds, it may be desirable to approach the ground at higher than normal speeds with half or no flaps.

Landing check list:

1. Mixture "RICH."
2. Propeller at high cruising RPM.
3. Electric fuel pump "ON."
4. Fuel selector on proper tank.
5. Landing gear "DOWN" (under 150 MPH), check green indicator light on and landing gear warning horn off.
6. Flaps full down or as desired (under 125 MPH).
7. Cowl flaps - open

If, for any reason, it becomes necessary to "go around" apply full throttle, retract the landing gear and slowly retract the flaps.

STOPPING THE ENGINE

During the landing roll, the flaps should be raised and the electric fuel pump turned off. After parking, the radios should be turned off and the engine stopped by pulling the mixture control out to idle cut-off. The throttle should be left full aft to avoid engine vibration while stopping. Then the ignition and master switches must be turned off, mixture control pushed in and the parking brake set.

EMERGENCY PROCEDURES

Manual Gear Extension:

Manual landing gear extension is accomplished with the telescoping lever located directly aft of the nose wheel housing. This control can be used to extend the gear if the electrical actuating system has failed. Do not attempt to retract the gear manually without the use of the electric motor as the mechanism for holding the gear in the "UP" position must be previously disengaged from the gear torque tube to permit the operation of the gear extension lever.

Before proceeding with emergency gear extension, check the following:

1. Master and gear circuit breakers are in.
2. Master switch is on.
3. Navigation lights are off (daytime).

To extend the gear, remove the cover over the emergency disengage control located between the two front seats, and follow the instructions on the back of the cover as follows:

1. Airspeed not over 100 MPH.
2. Landing gear switch in center off position if landing gear switch is a three position and in the gear down locked position if switch is a two position.
3. Disengage electric motor by pushing motor release arm forward through full travel.
4. Extend emergency handle to full length.
5. Push handle forward full travel to extend landing gear.

After the gear has been extended manually, do not perform any unnecessary operation to the gear until the aircraft is placed on jacks.

NOTE

1. Do not pull aft on handle as this will unlock gear.
2. Do not re-engage retraction motor in flight.
3. Reducing power and rocking the gear extension handle will aid in manually extending landing gear.

To return the system to normal electric operation, re-engage the electric motor to the landing gear extension torque tube by following the procedure given:

1. Landing gear switch in center off position if a three position switch is installed and if a two position switch is installed the circuit breaker should be disengaged.
2. Pull landing gear emergency extension handle about half way back, allowing gear to hang partially extended.
3. With landing gear control switch move end of the electric motor drive shaft into position about half way back so

that the slot in the drive shaft is near the mating pin on the torque tube.

4. Using the extension handle move the torque tube pin slightly back and forth until it can be engaged with the drive shaft slot, then push the parts together.

5. Lock the drive shaft to the torque tube by pulling the motor release arm full back to the normal locked position.

Gear-Up Landing:

A gear-up landing should only be made during an emergency (1) when the surface is too soft or rough to permit a gear down landing, (2) when a field is too short for a gear-down landing, which might cause more damage through hitting obstructions than the gear-up landing would cause, (3) when a water landing is necessary.

In the event of a gear-up landing, make a normal approach as with gear-down, leave flaps up (to reduce flap and wing damage), close the throttle and cut the master and ignition switches during the flare out, turn the fuel selector off, and contact the ground at minimum speed.

Engine Failure:

The most common cause of engine failure is mismanagement or malfunction of the fuel system. Therefore, the first step to take after engine failure is to move the fuel selector valve to the tank not being used. This will often keep the engine running even if there is no apparent reason for the engine to stop on the tank being used.

If changing to the opposite fuel tank does not restore the engine:

(1) Check fuel pressure and turn on electric fuel pump, if off.

(2) Push mixture control to full "RICH".

(3) Check ignition switch.

MOORING

The Comanche 400 should be moved on the ground with the

aid of the nose wheel steering bar provided with each plane and stored in the baggage compartment.

Tie down ropes for mooring the airplane can be fastened to the wing tie down rings and at the tail skid.

The aileron and stabilator controls should be secured by means of a safety belt or control locks to prevent control surface damage. The rudder is held in position by its connections with the steerable nose wheel, and does not need to be secured except under unusually high wind conditions.

WEIGHT AND BALANCE

For weight and balance data, see the Weight and Balance Form, which gives the exact weight of the airplane and permissible center of gravity conditions.

OPERATING TIPS

In the operation of the Comanche, as in that of any other type of aircraft, there are a few points of technique and information that apply particularly to this model. The following Operating Tips may be helpful in the operation of the Comanche:

(1) Remember that when the navigation lights are on the gear position lights are very dim.

(2) Learn to trim the airplane for take-off so that only a very light back pressure on the wheel is required to lift the ship off the ground.

(3) On take-off, do not retract the gear prematurely. The aircraft may settle and make contact with the ground because of lack of flying speed, atmospheric conditions or rolling terrain.

(4) The best speed for take-off is at about 80 M.P.H. under normal conditions. Trying to pull the airplane off the ground at too low an airspeed will increase the take-off roll rather than decrease it.

(5) Although it is permissible to extend the landing gear at speeds up to 150 M.P.H., the loads on the landing gear exten-

sion motor and on the gear doors are much lower if slower speeds are used. For this reason, it is recommended that unless there is good reason to lower the gear at a higher speed, it should normally be extended at speeds below 125 M.P.H.

(6) The flaps can be lowered at airspeeds up to 125 M.P.H. To reduce flap operating loads, however, it is desirable to slow the airplane to 100 M.P.H. or less before extending the flaps. At these reduced speeds, the load applied to the flaps is greatly reduced.

(7) During gear operation keep the floor area under the emergency gear lever clear. Restriction to movement of the lever will cause the gear motor circuit breaker to open.

(8) Always ascertain the position of landing gear by the position of the emergency gear lever as well as the gear position lights.

(9) If, under unusual circumstances, the landing gear motor is apparently being overloaded and the circuit breaker opens repeatedly, the electric motor can be assisted by applying light hand pressure to the emergency gear lever.

(10) Before attempting to reset any circuit breaker, allow a two to five minute cooling off period.

(11) When landing and upon making contact with the ground on the main wheels, neutralize the rudder pedals, apply additional back pressure to the control wheel and retract the flaps. This gives best directional control on the ground and provides for full effectiveness of the brakes during the landing roll.

RADIO OPERATION

Communication and navigational equipment controls are located in the center of the instrument panel. Associated auxiliary switches are located on a separate panel below the control column on the lower right side of the instrument panel. Circuit breakers for the radios are located on the main circuit breaker panel.

All sets are turned "ON" by the switch located on the control head of each particular unit, with the exception of the

marker beacon and glide slope power switches which are located on the Audio Selector Switch Panel.

After power is supplied, the pilot may wish to operate one of the two transmitters by moving the transmitter selector switch to the proper position. The switch is located on the selector switch panel.

A separate three position audio selector switch is provided for each receiver. Each receiver audio output may be connected to either the speaker or the headset. In addition they may be placed in the "OFF" or standby position. To receive audio through the speaker from the Marker Beacon and DME UDI-2 the top Mark 12 must be in operation. Power from this radio is not required when the headphones are connected to the Marker Beacon or DME.

Two or more sets may be simultaneously connected to either the headset or speaker position by placing the selector switches in the desired combination. For example, the A.D.F. and the top Mark 12 may be selected to operate on the speaker and the lower Mark 12 may be selected for headset operation. If desired the pilot may listen to the speaker and the co-pilot the headset.

SECTION IV

PERFORMANCE CHARTS

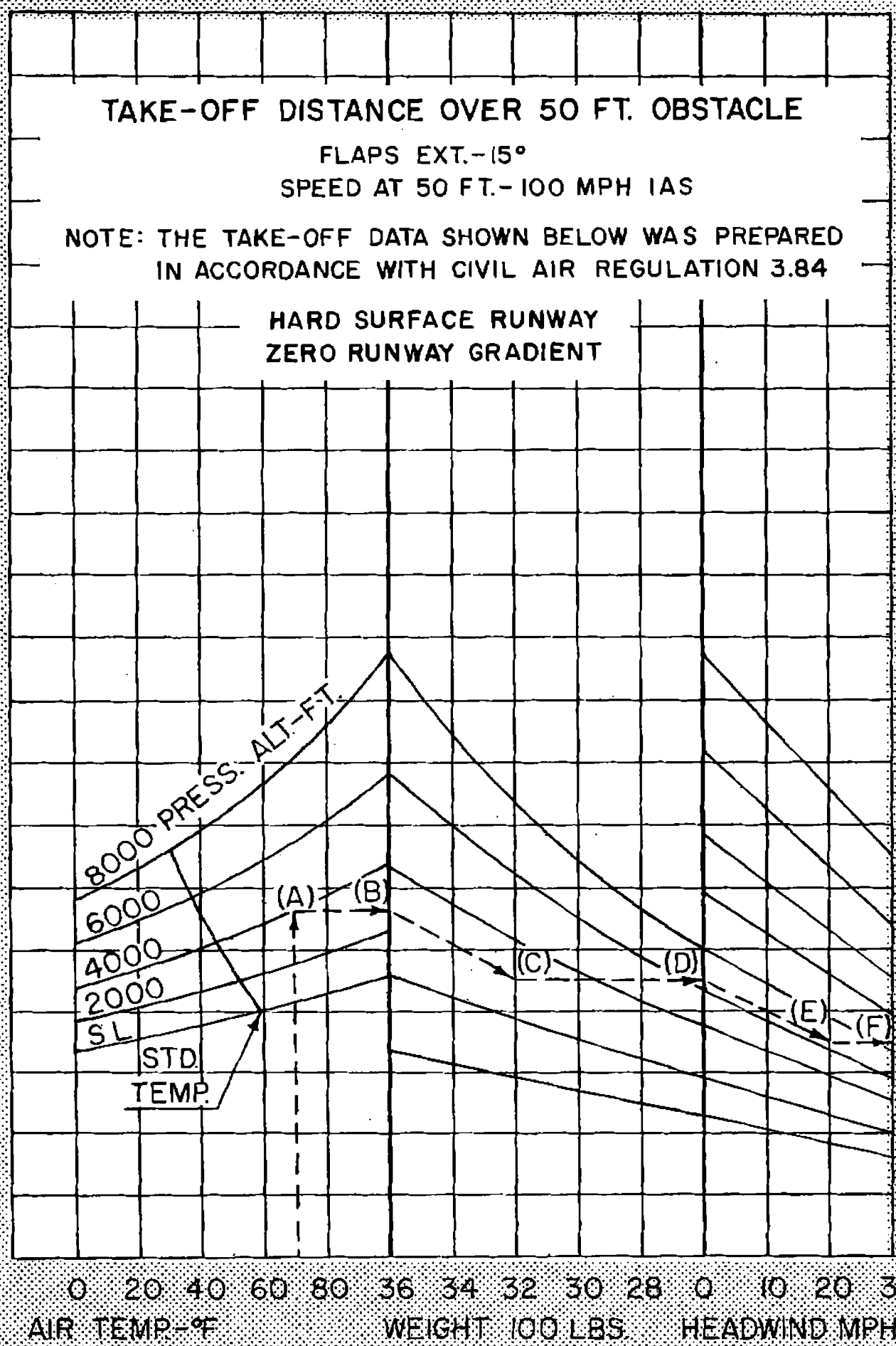
PA-24-400 COMANCHE

TAKE-OFF DISTANCE OVER 50 FT. OBSTACLE

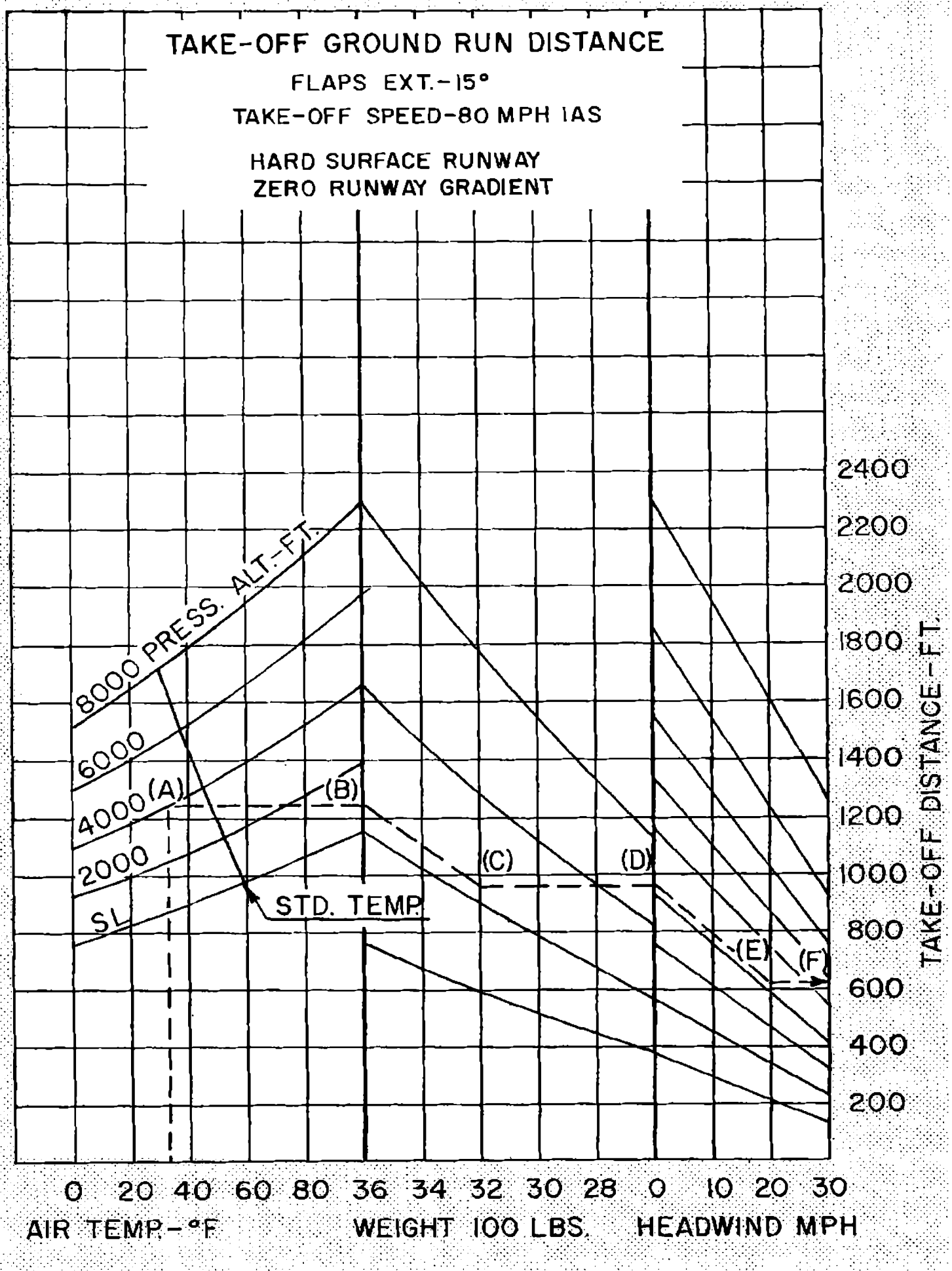
FLAPS EXT.-15°
SPEED AT 50 FT.-100 MPH IAS

NOTE: THE TAKE-OFF DATA SHOWN BELOW WAS PREPARED IN ACCORDANCE WITH CIVIL AIR REGULATION 3.84

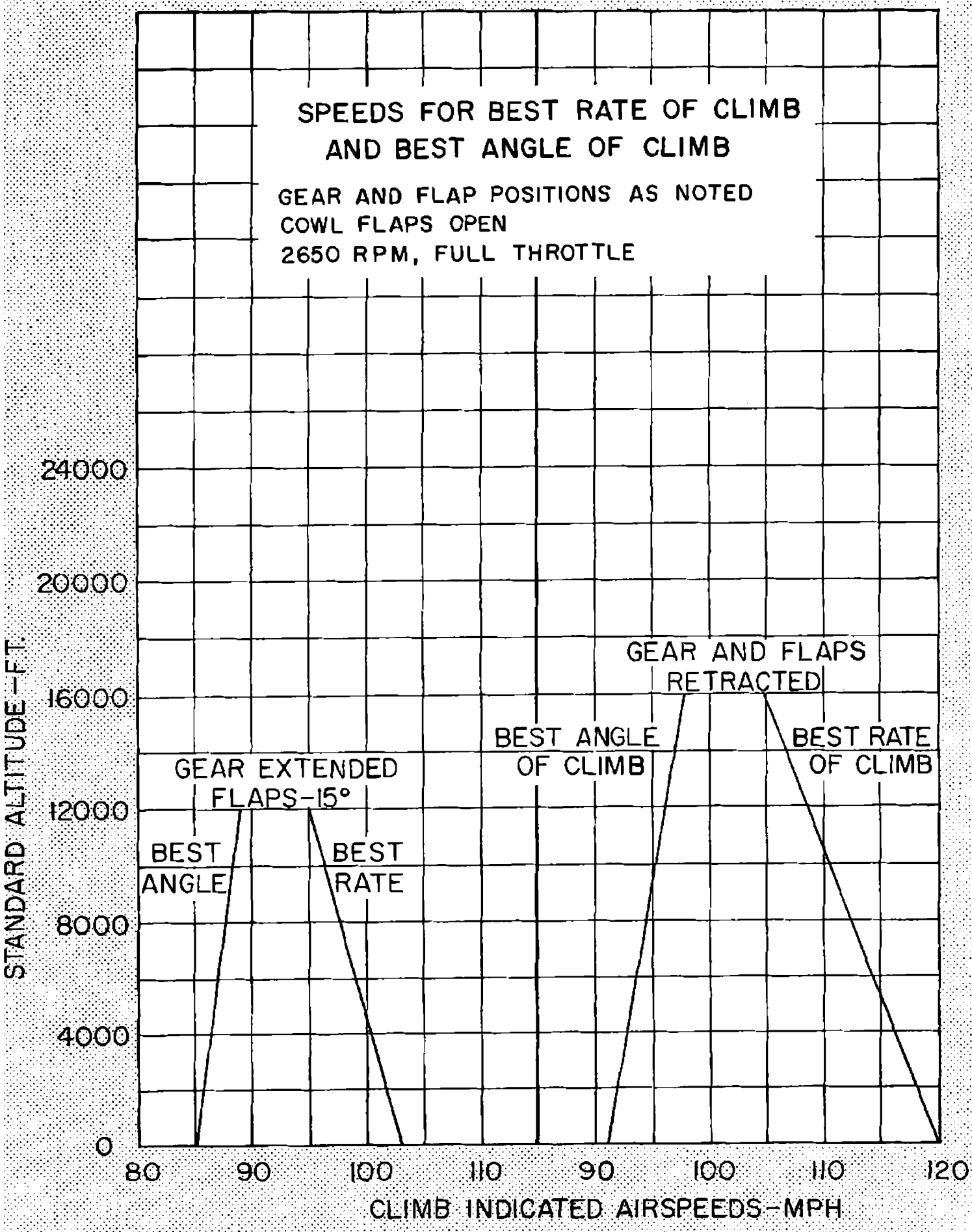
HARD SURFACE RUNWAY
ZERO RUNWAY GRADIENT



PA-24-400 COMANCHE



PA-24-400 COMANCHE



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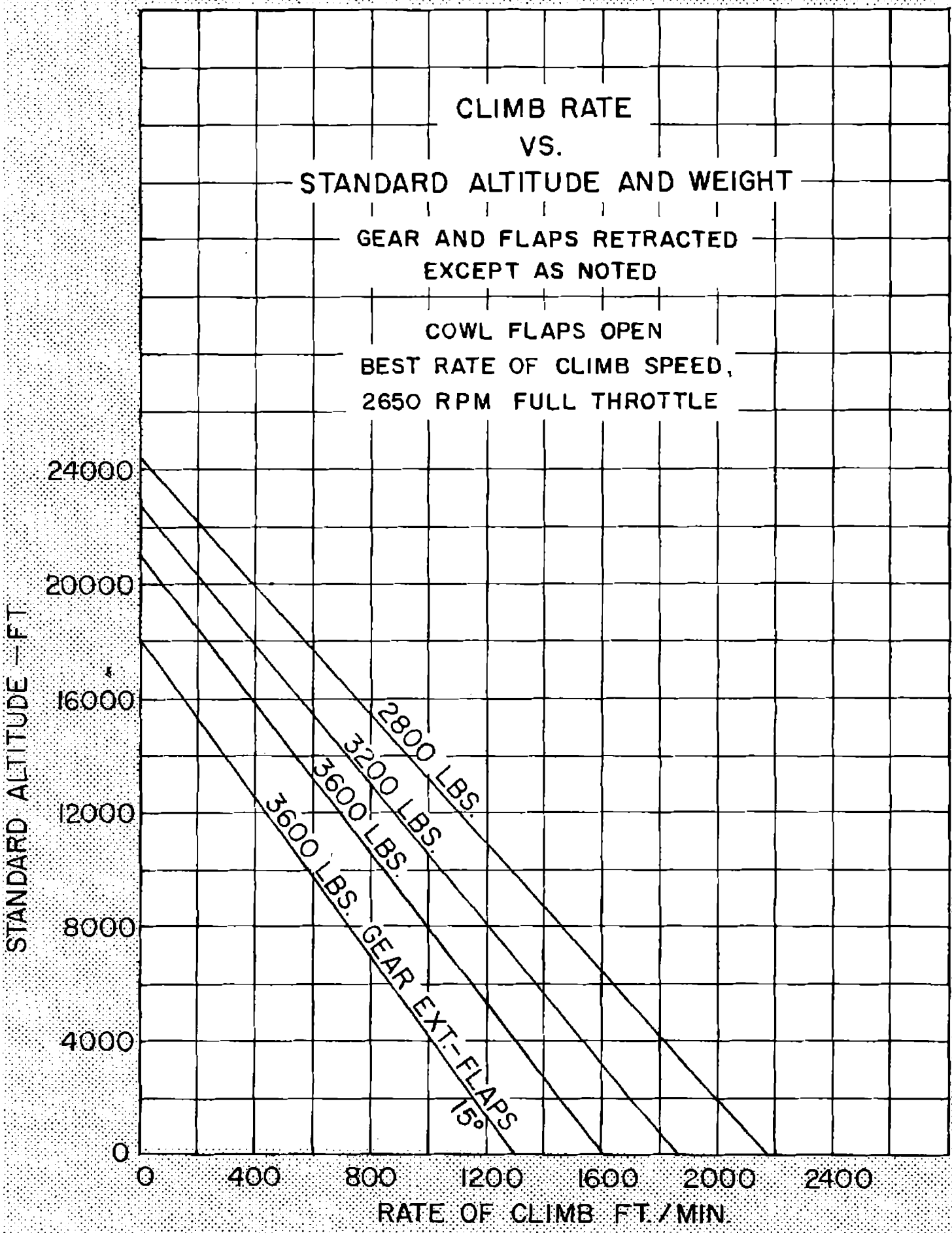

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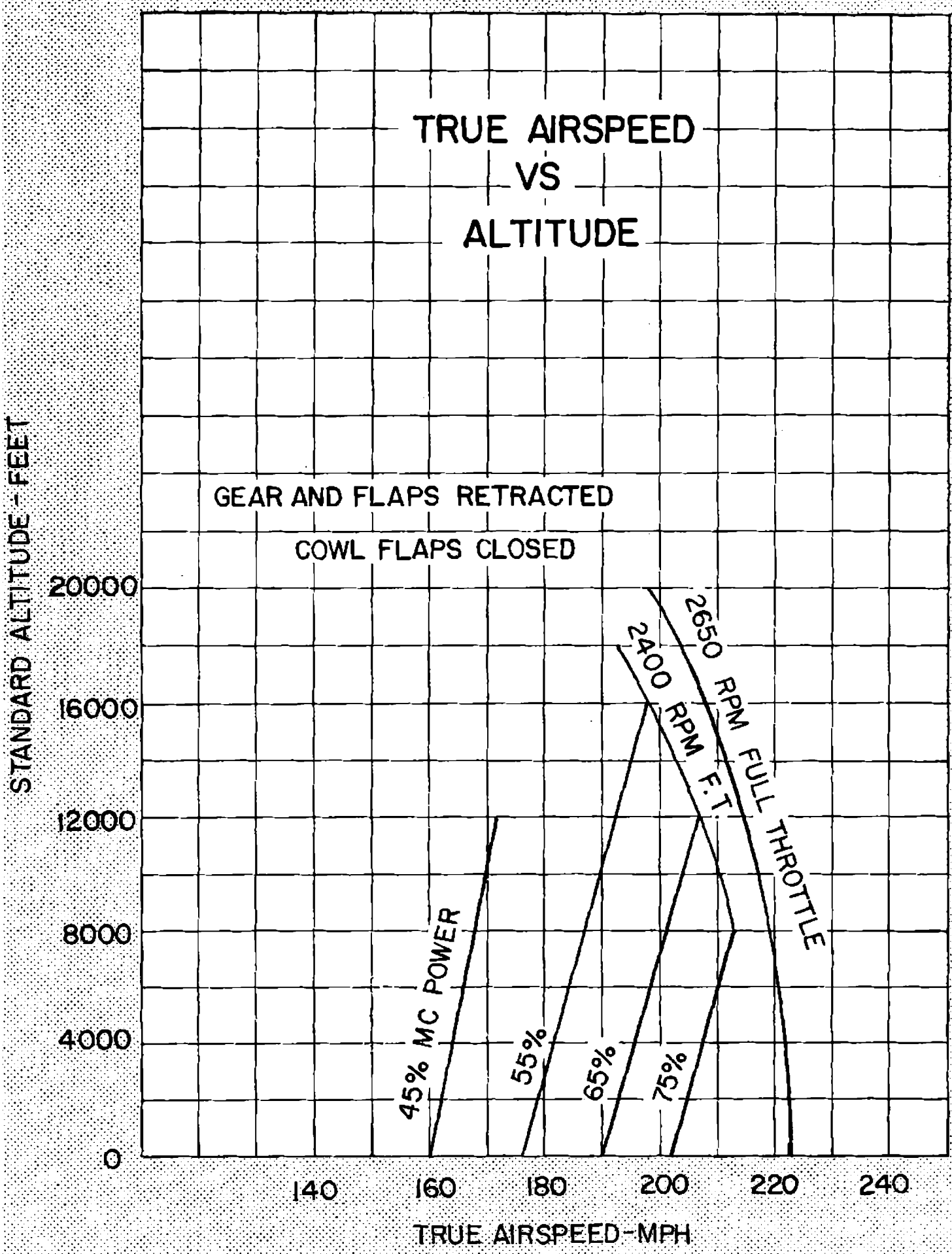
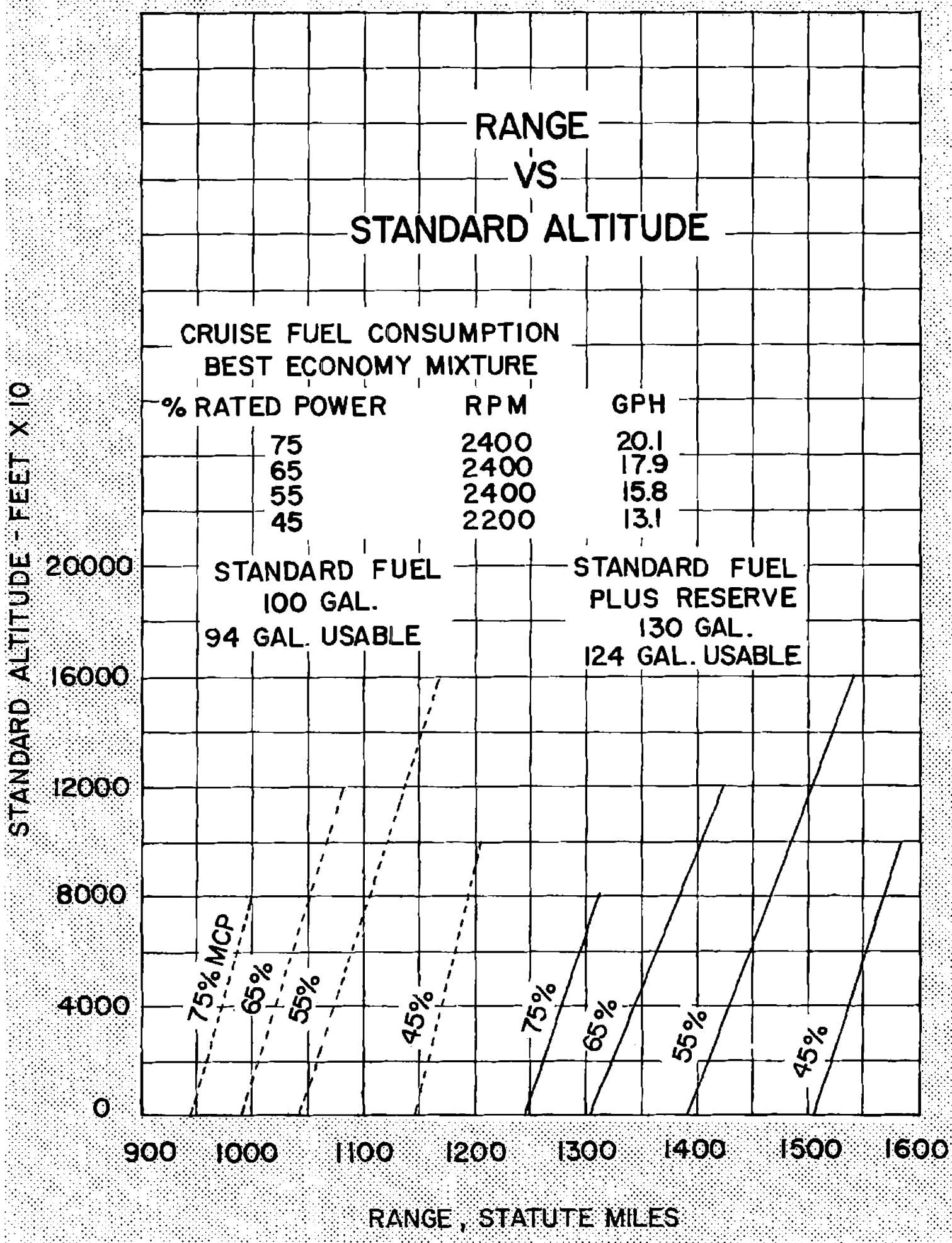


PA-24-400
COMANCHE



PA-24-400 COMANCHE

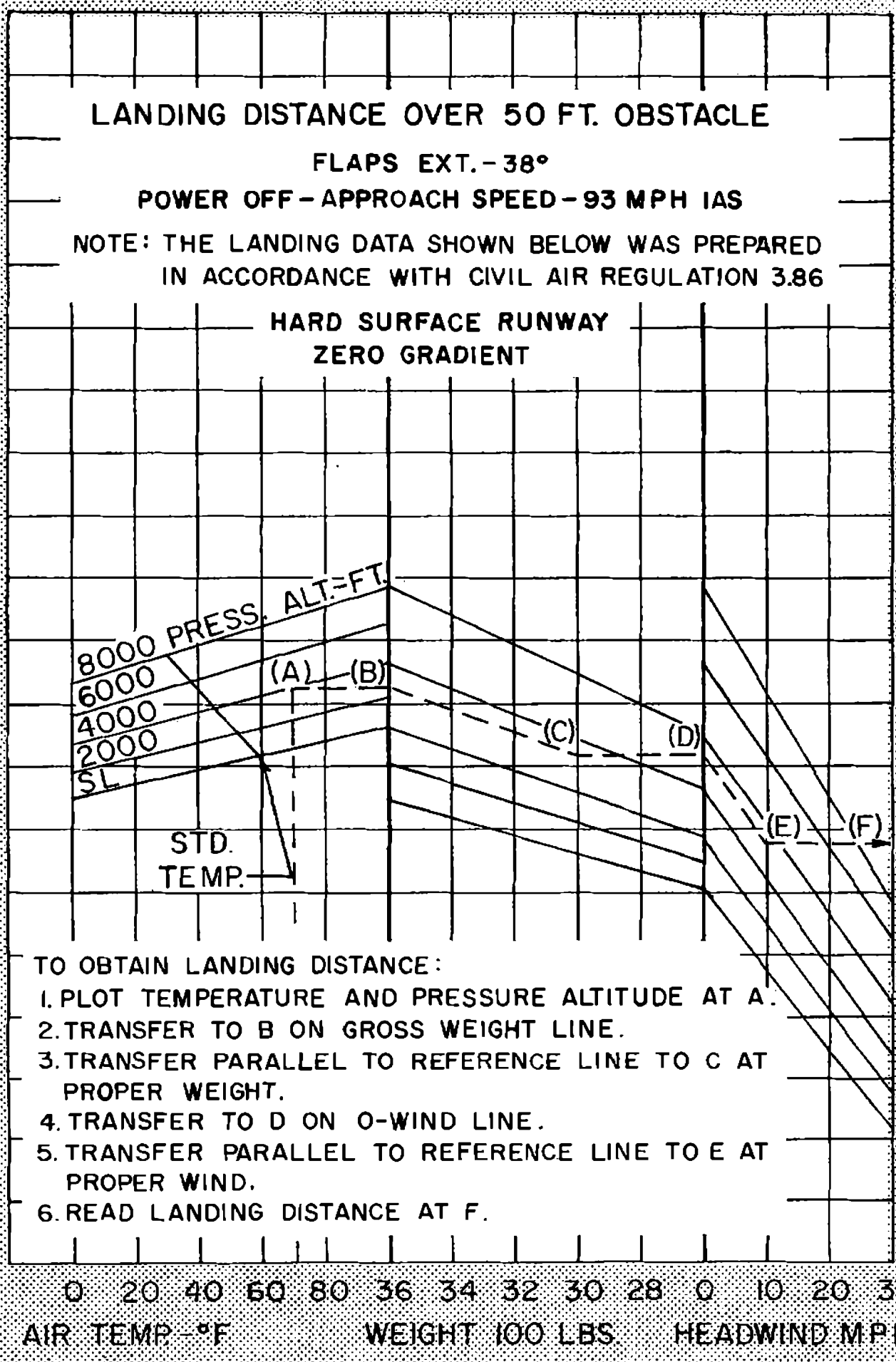
LANDING DISTANCE OVER 50 FT. OBSTACLE

FLAPS EXT. - 38°

POWER OFF - APPROACH SPEED - 93 MPH IAS

NOTE: THE LANDING DATA SHOWN BELOW WAS PREPARED IN ACCORDANCE WITH CIVIL AIR REGULATION 3.86

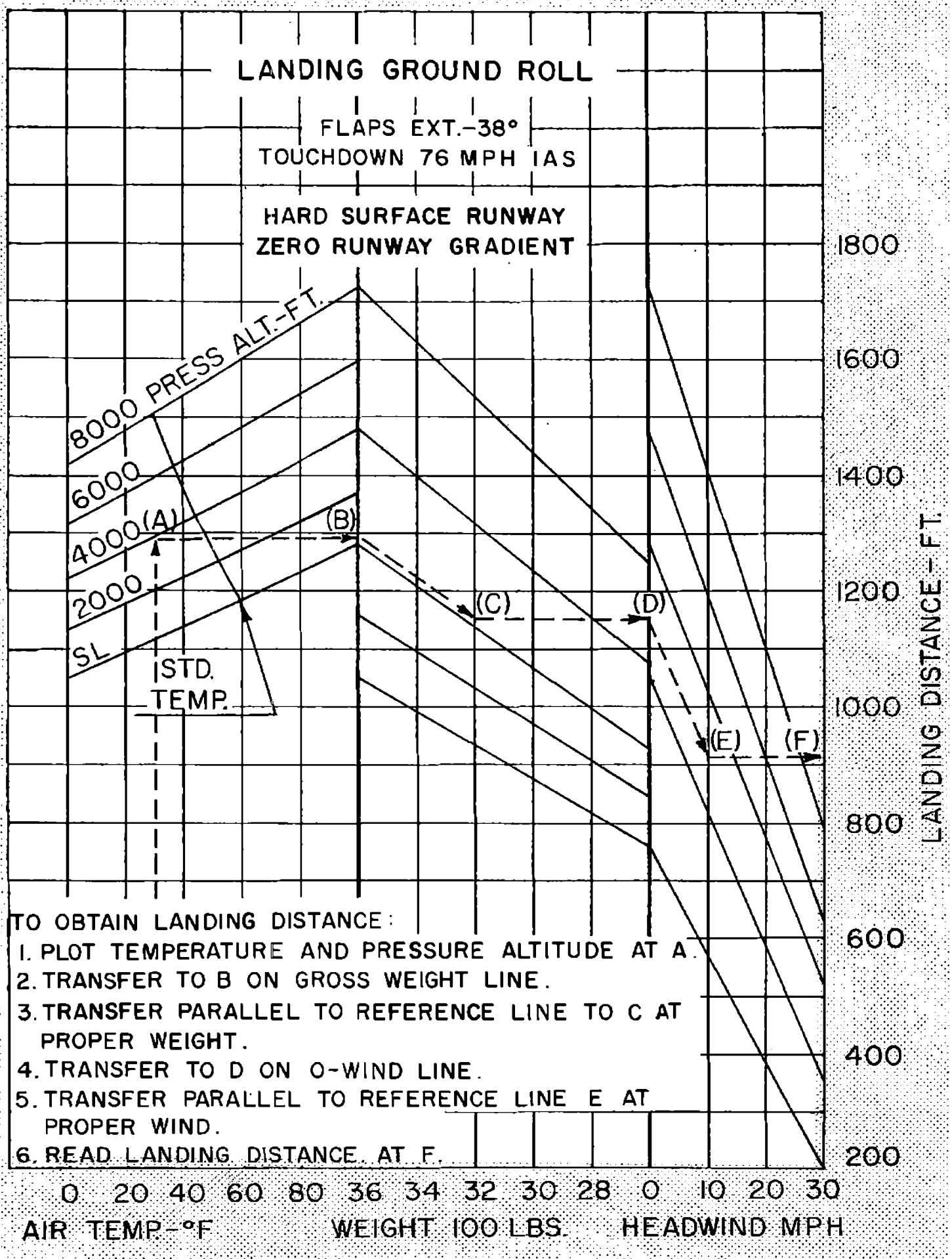
HARD SURFACE RUNWAY
ZERO GRADIENT



TO OBTAIN LANDING DISTANCE:

1. PLOT TEMPERATURE AND PRESSURE ALTITUDE AT A.
2. TRANSFER TO B ON GROSS WEIGHT LINE.
3. TRANSFER PARALLEL TO REFERENCE LINE TO C AT PROPER WEIGHT.
4. TRANSFER TO D ON O-WIND LINE.
5. TRANSFER PARALLEL TO REFERENCE LINE TO E AT PROPER WIND.
6. READ LANDING DISTANCE AT F.

PA-24-400 COMANCHE

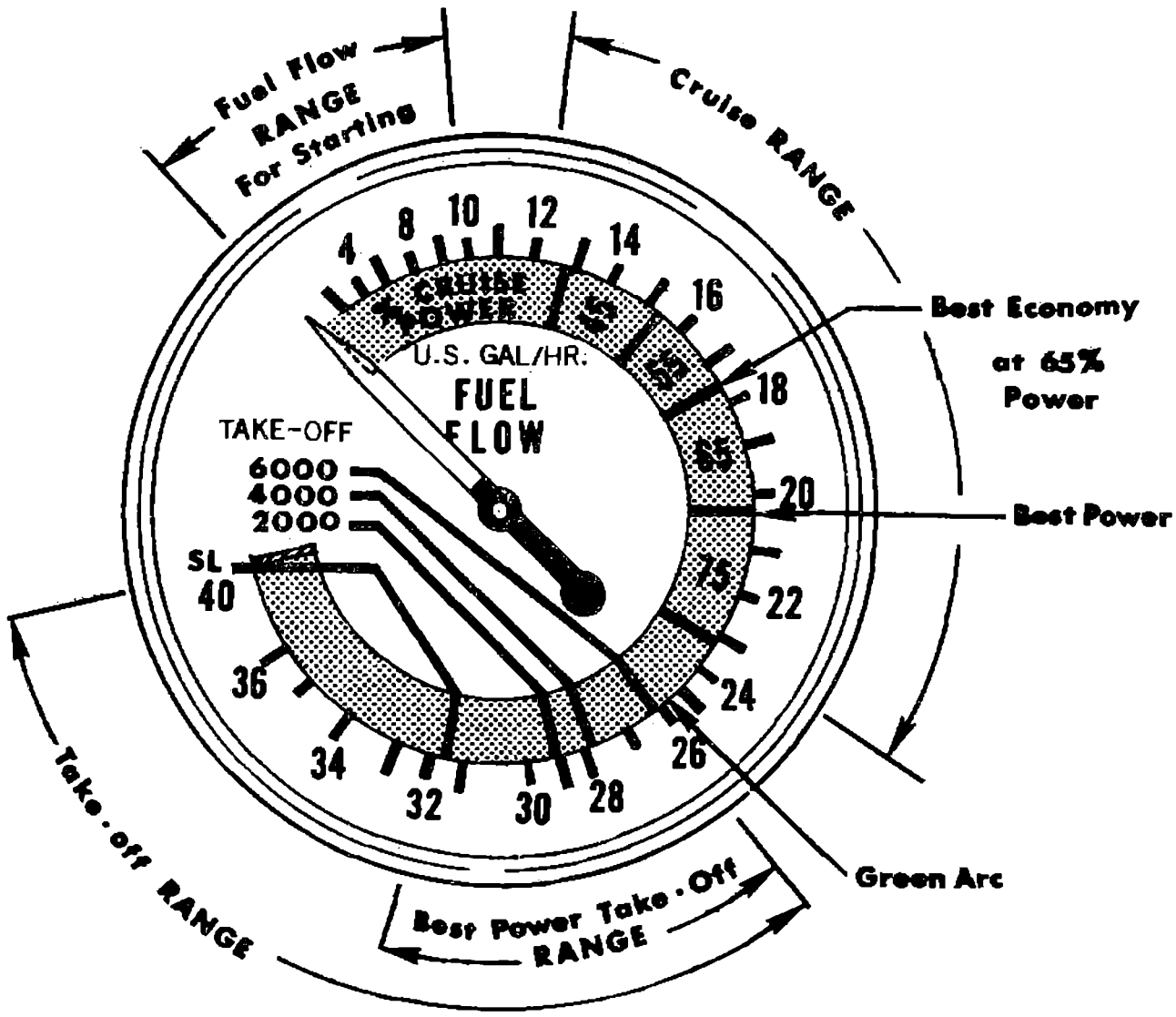


Power Setting Table-Lycoming Model IO-720-A1A, 400 HP Engine

Press. Alt. 1000 Feet	Std. Alt. Temp. °F	220 HP - 55% Rated *Approx. Fuel 15.5 Gal/Hr. RPM AND MAN. PRESS. 2100	2200	2300	2400	260 HP - 65% Rated *Approx. Fuel 18.0 Gal/Hr. RPM AND MAN. PRESS. 2100	2200	2300	2400	300 HP - 75% Rated *Approx. Fuel 20.0 Gal/Hr. RPM AND MAN. PRESS. 2200	2300	2400
SL	59	23.1	22.3	21.3	20.6	25.8	25.1	23.9	22.9	28.0	26.4	25.3
1	55	22.8	22.0	21.0	20.3	25.5	24.8	23.6	22.6	27.6	26.1	24.9
2	52	22.5	21.8	20.8	20.1	25.2	24.5	23.3	22.3	27.2	25.8	24.6
3	48	22.2	21.6	20.6	19.8	24.9	24.1	23.0	22.1	26.9	25.5	24.3
4	45	22.0	21.3	20.3	19.5	24.6	23.8	22.7	21.8	26.6	25.2	24.0
5	41	21.7	21.1	20.1	19.3	24.3	23.5	22.4	21.5	26.3	24.9	23.6
6	38	21.5	20.9	19.8	19.0	24.0	23.2	22.1	21.2	--	24.6	23.3
7	34	21.2	20.6	19.6	18.8	23.7	22.9	21.9	21.0	--	24.3	23.0
8	31	20.9	20.4	19.3	18.5	23.4	22.6	21.6	20.7			22.7
9	27	20.7	20.1	19.1	18.2	--	22.3	21.3	20.4			22.4
10	23	20.4	19.9	18.8	18.0	--	--	21.0	20.1			
11	19	20.1	19.7	18.6	17.7	--	--	20.7	19.8			
12	16	19.8	19.4	18.3	17.4				19.5			
13	12	19.5	19.1	18.1	17.2				19.2			
14	9	19.2	18.8	17.8	16.9							
15	5	--	--	17.5	16.6							

To maintain constant power, correct manifold pressure approximately 0.14" Hg. for each 10°F variation in inlet air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard; subtract for temperatures below standard.

NOTE: Best economy mixture settings used.



READING THE

FUEL FLOW INDICATOR

PA-24-400

SECTION V

GENERAL MAINTENANCE

SECTION V

GENERAL MAINTENANCE

This section of the Comanche 400 Handbook contains information which pertains to minor maintenance of the airplane. Any complex repair or modification should be accomplished by a Piper Certified Service Center or equivalent.

TIRE INFLATION

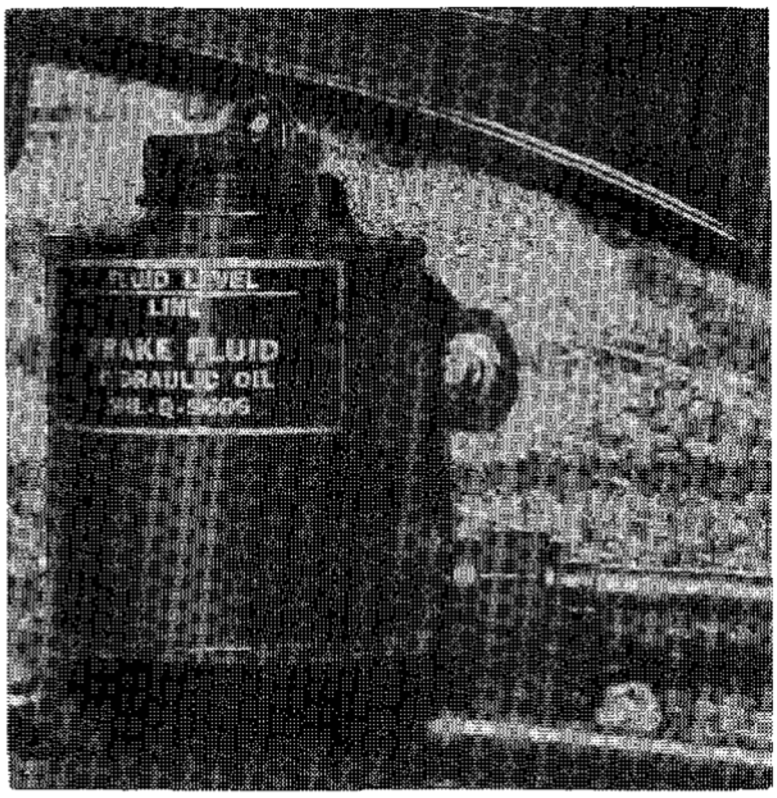
For maximum service from the tires on the Comanche, keep tires inflated to the proper pressure of 42 lbs. Interchange the tires on the wheels if necessary to produce even wear. All wheels and tires are balanced before original installation, and the relationship of tire, tube and wheel should be maintained whenever possible upon reinstallation. Out of balance wheels can cause extreme vibration in the landing gear during take-off. In the installation of new components, it may be necessary to rebalance wheels with the tires mounted.

BATTERY SERVICE

Access to the 12-volt 35-ampere hour battery is through the right rear baggage compartment panel. The stainless steel box has a plastic drain tube which is normally closed off with a clamp and which should be opened occasionally to drain off any accumulation of liquid.

The battery should be checked frequently for proper fluid level, but must not be filled above the baffle plates. All connections must be clean and tight.

If the battery is not up to proper charge, recharge starting with a charging rate of 4 amps and finishing with 2 amps. Quick charges are not recommended.



BRAKE SERVICE

The brake system is filled with Univis No. 40 (petroleum base) hydraulic brake fluid. This should be checked at every 100 hour inspection and replenished when necessary, refilling the brake reservoir on the aft bulkhead of the nose section to the indicated level.

No adjustment of brake clearances is necessary on the Comanche brakes. If after extended service the brake blocks become worn excessively (1/64" minimum lining), they are easily replaced with new brake segments.

Main wheels are easily removed by taking off the axle nut and withdrawing the wheel from the axle. To remove the brake disc and lining, remove the three bolts through the brake housing.

Tires are dismounted from the wheels by deflating the tube, then removing the wheel through-bolts, allowing the wheel halves to be separated.

LANDING GEAR SERVICE

In jacking up the Comanche for landing gear and other service, a jack kit (available through the Piper Aircraft Distributor Service Departments) should be used. This kit includes two hydraulic jacks and a tail support. Approximately 300 lbs. of ballast should be placed on the base of the tail support before jacking up the airplane.

Landing gear oleos on the Comanche should be serviced according to instructions on the units. All three oleos should be extended until about 2-1/2 inches of oleo piston tube is exposed under static load.

To add air to the oleo struts, a strut pump is attached at the air valve and the oleo pumped up to the proper position. To

add oil, first release the air through the valve, allowing the strut to extend fully. Next remove the air valve and fill the unit through this opening. Then compress the oleo to within 1/4 inch of full compression, allowing air and excess oil to escape. Then reinsert the valve core and pump up the strut.

FUEL AND OIL REQUIREMENTS

Aviation Grade 100/130 Octane (minimum) fuel must be used in the Comanche 400. 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 IO-720-A1A is 17 quarts, and the minimum safe quantity is 5 quarts. It is recommended that engine oil be changed every 50 hours or sooner under unfavorable conditions. The following grades are required for the specified temperatures:

Temperatures above 60° F	S.A.E. 50
Temperatures between 30° F and 90° F	S.A.E. 40
Temperatures between 0° F and 70° F	S.A.E. 30
Temperatures below 0° F	S.A.E. 20

LEVELING AND RIGGING

Leveling the Comanche 400 for purposes of reweighing or rigging is accomplished as follows:

(1) Partially withdraw two machine screws located on the side of the fuselage over the baggage door. 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 only, place airplane on jacks.

(3) To level the airplane laterally, place a level across the floorboard at station 136.5 bulkhead (in baggage compartment between rear spar attachment points).

Rigging: Although the fixed flight surfaces on the Comanche obviously 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. The positions and travels of the various surfaces are as follows:

(1) Wings: 5^{o} dihedral, no twist.

(2) Stabilator: No dihedral, travel (leading edge), $4\text{-}1/2^{o} \pm 1^{o}$ up. $15\text{-}1/2^{o}$ down $\pm 1^{o}$.

(3) Stabilator Tab Travel (Stabilator Neutral): $4\text{-}1/2^{o} + 1^{o}$, $- 0^{o}$ up, $9^{o} \pm 1$ down.

(4) Fin: Should be vertical and in line with center of fuselage.

(5) Ailerons: Travel 19^{o} up, 15^{o} down, $\pm 2^{o}$.

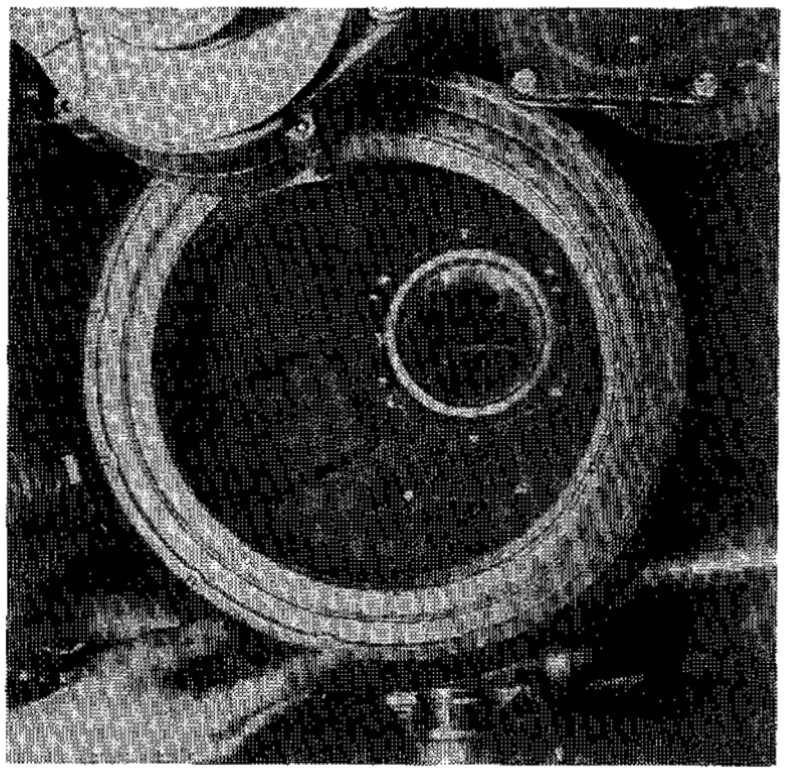
(6) Flaps: 38^{o} down $\pm 1^{o}$.

(7) Rudder: Travel 25^{o} left or right, $\pm 2^{o}$.

For purposes of changing the lateral trim, an adjustable stop screw is provided on the flap. Refer to the Comanche 400 Service Manual.

CARE OF AIR FILTER

The induction air filters must be cleaned at least once every fifty hours and depending on the type of condition existing, it may be necessary to clean the filters daily or every five hours. Extra filters are inexpensive and should be kept on hand and used for rapid replacement.



The following cleaning procedure is recommended by the manufacturer of the filter:

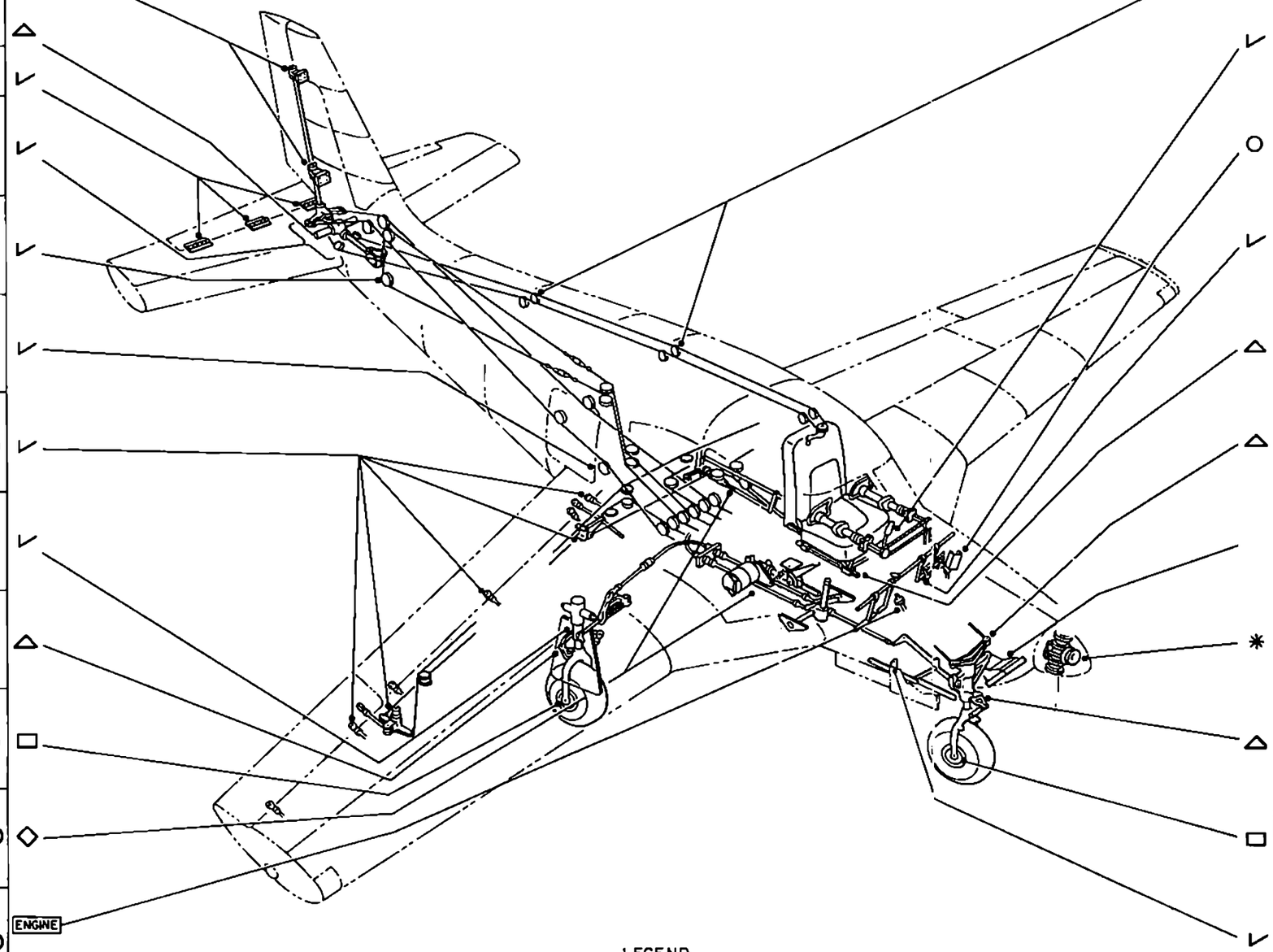
(1) Remove the filter from the engine compartment.

(2) Tap filter gently to remove dirt particles. Do not use compressed air or cleaning solvents.

(3) Reinstall air filter.

LUBRICATION CHART FOR PIPER COMANCHE PA-24

	HOURS	LUBRICANT
RUDDER HINGES AND HORN	100	✓
STABILATOR BEARINGS	100	△
STABILATOR TRIM TAB	100	✓
STABILATOR ADJUSTMENT MECHANISM	100	✓
STABILATOR CONTROL PULLEYS	100	✓
BAGGAGE DOOR AND MAIN DOOR HINGES	100	✓
AILERON AND FLAP HINGES PULLEY, BELL-CRANK RT. & LT.	100	✓
HINGES- MAIN GEAR DOORS 1 EACH	100	✓
MAIN LANDING GEAR GREASE FITTINGS RIGHT AND LEFT-6 EACH	100	△
MAIN WHEEL BEARINGS RIGHT & LEFT	100	□
LANDING GEAR RETRACTION SYSTEM SEE NOTE 2	500	◇
ENGINE OIL TANK DRAIN & REFILL	50	ENGINE



HOURS		LUBRICANT
STABILATOR TRIM 250	PULLEYS	✓
100	CONTROL COLUMN	✓
50	BRAKE RESERVOIR, MAINTAIN FLUID LEVEL INDICATED ON SIDE OF RESERVOIR	○
100	RUDDER ADJUSTMENT MECHANISM	✓
100	FRONT SEAT ADJUSTMENT	△
100	NOSE WHEEL STEERING	△
50	INDUCTION AIR FILTER SEE NOTE 6	
100	PROPELLER GREASE FITTINGS, 4 TOTAL HARTZELL	*
100	NOSE GEAR GREASE FITTINGS-6 TOTAL	△
100	NOSE WHEEL BEARING	□
100	HINGES- NOSE WHEEL DOOR 2 TOTAL	✓

LEGEND

⊕	MIL-G-6032	LUBRICANT
◇	MIL-G-7118	GREASE-GEAR & ACTUATOR
✓	MIL-L-7870	OIL-GENERAL PURPOSE LOW TEMP. LUBRICATION
△	MIL-L-7711	GREASE-LUBRICATION GENERAL PURPOSE AIRCRAFT
□	MIL-L-3545	GREASE-LUBRICATION HIGH TEMPERATURE
*	MIL-G-327B	GREASE-AIRCRAFT AND INSTRUMENTS
○	MIL-H-5606	HYDRAULIC FLUID (RED)
ENGINE	SAE 50	ABOVE 40° AIR TEMP.
	SAE 30	BETWEEN 10° AND 40° AIR TEMP.
	SAE 20	BELOW 10° AIR TEMP.

NOTES

1. FUEL SYSTEM - THE FOLLOWING POINTS REQUIRE REGULAR SERVICING FUEL PUMP STRAINER - CARBURETOR SCREEN - FILTER BOWL - QUICK DRAIN UNIT.
2. LANDING GEAR RETRACTION SYSTEM - WHEN REASSEMBLING TRANSMISSION, FILL TRANSMISSION COVER 1/2 FULL OF "GEAR AND ACTUATOR GREASE" SPECIFICATION MIL-G-7118. APPLY THIN COATING OF "GEAR AND ACTUATOR GREASE" TO RETRACTION SCREW AFTER CLEANING EVERY 500 HOURS.
3. LANDING GEAR STRUTS - FOLLOW INSTRUCTION PLACARD ON OLEO STRUT.
4. MISCELLANEOUS - DURING ROUTINE MAINTENANCE CHECKS, APPLY LUBRICATION TO MISCELLANEOUS LINKAGES.
5. BATTERY - CHECK BATTERY FLUID LEVEL AND BATTERY CONDITION EVERY 25 HOURS.
6. CLEAN FILTER BY TAPPING THE UNIT LIGHTLY AGAINST A HARD SURFACE. DO NOT USE SOLVENT OR COMPRESSED AIR.

CAUTIONS

1. DO NOT USE A HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVER-LUBRICATE PEDESTAL CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.
4. UNDER NO CIRCUMSTANCES SHOULD THE CABLES FROM THE COCKPIT TO THE REAR OF THE FUSELAGE BE LUBRICATED AS THIS MAY CAUSE SLIPPAGE.
5. REMOVE ALL EXCESS GREASE FROM GREASE FITTINGS.

See Lycoming Service Instructions No.1014 for use of DETERGENT OIL.

CARE OF WINDSHIELD AND WINDOWS

A certain amount of care is required to keep the plexiglas windows clean and clear. The following procedure is recommended:

(1) Flush with clean water and dislodge excess dirt, mud, etc., with your hand.

(2) Wash with mild soap and warm water. Use a soft cloth or sponge. (Do not rub.)

(3) Remove oil, grease or sealing compounds with a cloth soaked in kerosene.

(4) After cleaning, apply a thin coat of hard polishing wax. Rub lightly with a soft dry cloth.

(5) A severe scratch or mar can be removed by using jeweler's rouge. After the flaw has been removed apply wax to the area.

SERIAL NUMBER PLATE

The serial number plate is located outside of fuselage to the left of the tail skid. The serial number of the plane should always be used in referring to the airplane in service or warranty matters.

FUEL SYSTEM

The fuel screens in the strainer and the injector will require cleaning at the first 50 hour inspection and every 100 hour inspection thereafter. The screen in the injector is located in the housing where the fuel inlet line connects to the injector. The fuel strainer located under the floorboards are accessible for cleaning through an access plate on the bottom of the fuselage. When reassembling the strainer after cleaning, a small amount of grease applied to the gasket will facilitate assembly.

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PIPER AIRCRAFT CORPORATION
WARRANTY

Piper Aircraft Corporation ("Piper") warrants each new airplane, radio, and part manufactured by it to be free from defects in material and workmanship under normal use and service, Piper's obligation under this warranty being limited to either repairing or replacing any part or parts thereof that shall, within one year after delivery in the case of Piper manufactured radio equipment or within six months after delivery, 150 hours of operation, or 30 days after discovery of the defect, whichever shall first occur, in the case of the airplane or any other part or parts, be returned to Piper at its factory with transportation charges prepaid and that Piper's examination shall disclose to its satisfaction to have been defective. Upon the expiration of the applicable period aforesaid any such obligation or liability shall terminate. This warranty shall not apply to any airplane or part manufactured by Piper that shall have been repaired or altered outside of Piper's factory or that shall have been subject to misuse, negligence or accident.

Piper further warrants to the person purchasing directly from Piper ("the buyer") as to each new airplane and part manufactured by Piper that (a) the title to such article conveyed by Piper is good and its transfer rightful, (b) such article is delivered to the buyer free from any security interest or other lien or encumbrance of which the buyer at the time of purchase has no knowledge or notice and (c) such article is delivered to the buyer free of the rightful claim of any third person by way of infringement or the like. Piper makes no warranty whatever with respect to engines, radios manufactured by others, propellers, ignition apparatus, starting devices, generators, batteries, or other trade accessories, inasmuch as such products are usually warranted separately by their respective manufacturers.

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