THE

TWIN COMANCHE

PILOT'S OPERATING MANUAL

BY

PIPER

This manual is incomplete without a current FAA APPROVED AIRPLANE FLIGHT MA

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.

This Pilot's Operating Manual is not designed, nor can any operating manual serve, as a substitute for adequate and competent flight instruction, or knowledge of the current airworthiness directives, the applicable federal air regulations, and advisory circulars. It is not intended to be a guide of basic flight instruction, nor a training manual for transition from single engine flying to multi-engine flying.

If there is any inconsistency between the Airplane Flight Manual approved by the FAA, and the additional information in this manual the Airplane Flight Manual shall govern.

Additional copies of this manual, Part No. 761 453, may be obtained from your Piper Dealer.

Published by
PUBLICATIONS DEPARTMENT
Piper Aircraft Corporation
761 453
Issued: June 1970

NOTE

Permanent Pilot's Operating Manual Revision Only

This Is Not A Complete Manual

New Sheets Inserted 10-15-73

This Pilot's Operating Manual revision, PR730516, shall be inserted into the current PA-39 Pilot's Operating Manual, 761 453, issued June 1, 1970.

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-39 Pilot's Operating Manual issued June 1970 are as follows:

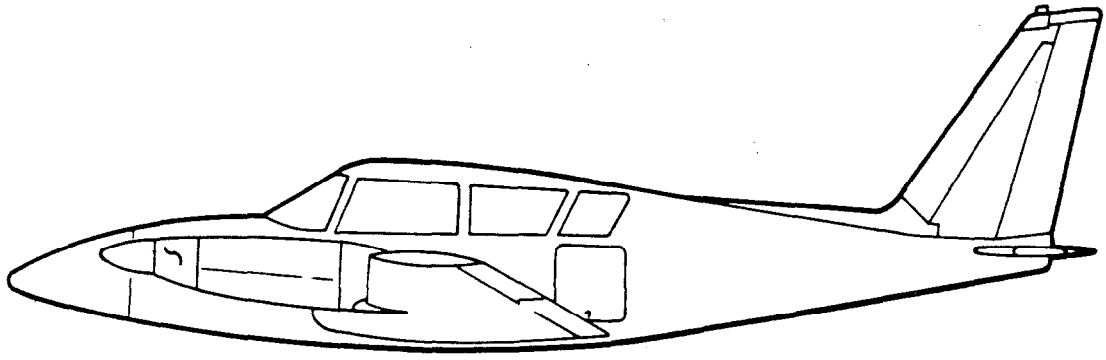
761 453 (PR710317)	Permanent Revision	Dated March 17, 1971
761 453 (PR710827)	Permanent Revision in F/M Added propeller synchrophaser II-10 & added fuel pump revision II-11.	Dated August 27, 1971
761 453 (PR711115)	Permanent Revision	Dated Nov. 15, 1971
761 453 (PR720220)	Permanent Revision	Dated Feb. 20, 1972
761 453 (PR720317)	Permanent Revision	Dated March 17, 1972
761 453 (PR720428)	Misc. Revision to P/O/M; Added nose wheel alternate to Weight & Balance.	Dated April 28, 1972
761 453 (PR730330)	Misc. Revision to P/O/M, F/M, W/B.	Dated March 30, 1973
761 453 (PR730516)	Permanent Revision to F/M (Rev. 10)	Dated May 16, 1973
761 453 (PR730622)	Permanent Revision to W/B	Dated June 22, 1973
761 453 (PR750321)	Permanent Revision to P/O/M, added Rev. 11 to A F/M.	Dated March 21, 1975

FAA APPROVED

AIRPLANE FLIGHT MANUAL

FOR

PIPER "TWIN COMANCHE C/R"



NOTE

THIS MANUAL MUST BE KEPT IN THE AIRPLANE AT ALL TIMES

MANUFACTURER'S MODEL - PA-39

MANUFACTURER'S SERIAL - 39- 25

REGISTRATION - N ~~8870Y~~ 887PM

FAA APPROVED BY: _____

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

DATE OF APPROVAL: NOVEMBER 28, 1969

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

NORMAL CATEGORY ONLY

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761 453 (PR750321)	Permanent Revision to P/O/M, added Rev. 11 to A F/M.	Dated March 21, 1975
761 453 (PR751226)	Permanent Revision to P/O/M	Dated December 26, 1975

SECTION I

LOG OF REVISIONS

Revision	Revised Pages	Description and Revision	FAA Approved Date
	This manual, which was completely revised June 1, 1970, applies to Piper Model PA-39-1 and up.		
1.	I-ii I-19 Page I-32 added Pages I-33 & 34 added II-21 II-24	Under Section V, added Item F. Added Item F. Added information for Supplement F. Added Supplement F. Heated Glass Panel Installation added.	Nov. 2, 1970
2.	I-26 I-28 I-29 II-5 II-6 II-24 II-29	Appropriate was appropriated. Revised Supplement D - Item 2. - d. Added to Supplement D Item 6. - f. C. G. Chart Clarified. Basic weight was basis weight. Added Radair Exhaust Gas Temperature Indicator and Delta Mixture Control Indicator. Added Narco AT5-A Transponder and King Digital ADF KR-85.	March 17, 1971
3.	II-29	Added Bendix ADF-T12D.	April 19, 1971
4.	II-29	Added Marker Beacon Installation MBT-R-12.	June 1, 1971
5.	II-10 II-11	Added Propeller Synchrophaser. Added Piper Dwg. Nos. to Fuel Pumps.	August 13, 1971
6.	I-3 II-9 II-10	Added additional Hartzell Propellers. Added additional Hartzell Propellers. Added additional Hartzell Propellers to Spinners.	Sept. 3, 1971
7.	I-9	Revised instructions for Voltage Regulating System item e. and g.	Nov. 1, 1971

LOG OF REVISIONS (cont)

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8.	i ii 9 10 11 13 19 Pages 35-36-37 38-39-40 added	Revised Section III Item B. Added Supplement G. AltiMatic IIIB-1. Under B. Systems Operation and Checks - Items 1 and 2 combined to 1. a & 1. b, added Ser. Nos. 39-1 thru 39-145. Revised item 2 to Alternator Paralleling information for Ser. Nos. 39-146 and up. Added information from page 9. Added information from page 10. Emergency Procedures for Feathering and Unfeathering revised to include Alternator Paralleling. Added Supplement G. AltiMatic IIIB-1.	Nov. 30, 1971
9.	6	Added Warning Placard information.	Mar. 30, 1973
10.	11	Added item (b) to Cruising under Crossfeed Operation and Single Engine Operation.	May 16, 1973
11.	6	Revised Warning Placard information.	March 21, 1975 Paul E. Everly

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SECTION II

LIMITATIONS

The following limitations must be observed in the operation of this airplane:

A. ENGINES

Lycoming LIO-320-B1A (Right)	One
Lycoming IO-320-B1A (Left)	One

ENGINE LIMITS
For all operation 2700 RPM, 160 HP (See Maneuvers)

B. FUEL
100/130 Octane Aviation Gasoline (Minimum)

C. PROPELLERS

Hartzell HC-E2YL-2B or HC-E2YL-2BF or HC-E2YL-2BS or HC-E2YL-2BSF (Left) — One
Constant Speed
Full Feathering; Blades 7663-4 or F7663-4
Pitch Settings at 30 in. station
Station: High 76° - 77°, Low 12°
Diameter: Not over 72 inches
Not under 70 inches
(No further reduction permitted)

Hartzell HC-E2YL-2BL or HC-E2YL-2BLF or HC-E2YL-2BLS or HC-E2YL-2BLSF (Right) — One
Constant Speed
Full Feathering; Blades J7663-4 or FJ7663-4
Pitch Settings at 30 in. station
Station: High 76° - 77°, Low 12°
Diameter: Not over 72 inches
Not under 70 inches
(No further reduction permitted)

D. COWL FLAPS
Cowl flaps are provided to allow manual control of engine temperatures. The cowl flaps should be open during ground operations and in climbs. In no case should the cylinder head temperatures be allowed to exceed 500° F. and the oil temperatures allowed to exceed 245° F.

E. INSTRUMENT MARKINGS (POWER PLANT)

OIL TEMPERATURE

Green Arc (Normal Operating Range)	120° to 245° F
Yellow Arc (Caution)	60° to 120° F
Red Line (Maximum)	245° F

OIL PRESSURE	
Green Arc (Normal Operating Range)	60 PSI to 90 PSI
Yellow Arc (Caution)	25 PSI to 60 PSI and 90 PSI to 100 PSI
Red Line (Minimum)	25 PSI
Red Line (Maximum)	100 PSI
TACHOMETER	
Green Arc (Normal Operating Range)	500 RPM to 2700 RPM
Red Line (Maximum)	2700 RPM
FUEL FLOW	
Green Arc (Normal Operating Range)	0 GPH to 16 GPH
Red Line (Maximum at Sea Level)	16 GPH (7 PSI)
CYLINDER HEAD TEMPERATURE	
Green Arc (Normal Range)	200° to 500° F
Red Line (Maximum)	500° F

F. AIRSPEED LIMITATIONS AND INDICATOR MARKINGS (Calibrated Airspeed) — Normal Category

NEVER EXCEED SPEED	230 MPH
MAXIMUM STRUCTURAL CRUISING SPEED	194 MPH
DESIGN MANEUVERING SPEEDS	
• Minimum Weight (2825 lbs.)	145 MPH
• Maximum Weight (3600 lbs.)	162 MPH
FLAPS EXTENDED SPEEDS	70 MPH to 125 MPH
MAXIMUM GEAR EXTENDED SPEED	150 MPH
MINIMUM CONTROL SPEED (Single Engine)	80 MPH
STALL SPEED	
Gear and Flaps Up	76 MPH
Gear and Flaps Down	70 MPH
AIRSPEED INDICATOR MARKINGS	
Green Arc (Normal Operating Range)	76 MPH to 194 MPH
Yellow Arc (Caution Range - Smooth Air)	194 MPH to 230 MPH
White Arc (Flaps Extended Range)	70 MPH to 125 MPH
Radial Red Line (Never Exceed - Smooth Air)	230 MPH
Radial Red Line (Minimum Control Speed - Single Engine)	80 MPH
Radial Blue Line (Best R/C Speed Single Engine)	105 MPH

G. FLIGHT LOAD FACTORS

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

H. MAXIMUM WEIGHT

IT IS THE RESPONSIBILITY OF THE AIRPLANE OWNER AND THE PILOT TO ASSURE THAT THE AIRPLANE IS PROPERLY LOADED. MAXIMUM ALLOWABLE GROSS WEIGHT 3600 POUNDS. SEE "WEIGHT AND BALANCE SECTION" FOR PROPER LOADING INSTRUCTIONS.

I. C. G. RANGE

Weight Pounds	Forward Limit Inches Aft of Datum	Aft Limit Inches Aft of Datum
3600	86.5	92
3200	83.0	92
2825	82.0	92

1. Straight line variation between the points given.
2. Datum is 79 inches ahead of the wing leading edge at spanwise Station 97.0 (First leading edge skin lap outboard of engine nacelle).

J. MANEUVERS

All intentional acrobatic maneuvers (including spins) are prohibited. Avoid abrupt maneuvers. When performing power on stalls do not exceed 2100 RPM.

K. WING FLAP SETTINGS

Take-Off 0° to 15°
Landing 27°
The flaps are electrically operated and the deflection is displayed on a flap position indicator. Take-off range indicated by White Arc on flap indicator.

L. UNUSABLE FUEL

The unusable fuel in this aircraft has been determined as 3 gallons in each inboard tank in critical flight attitudes.

M. USABLE FUEL

Inboard tanks – 27 gallons each
Auxiliary tanks (outboard) for use in level flight only – 15 gallons each.

N. PLACARDS

On instrument panel in full view of the pilot:

THIS AIRPLANE MUST BE OPERATED AS A NORMAL CATEGORY AIRPLANE IN COMPLIANCE WITH THE AIRPLANE FLIGHT MANUAL. ACROBATIC MANEUVERS (INCLUDING SPINS) PROHIBITED.

On the baggage compartment door:

EMERGENCY EXIT
HOLD KNOB UP
TURN LATCH CLOCKWISE

On landing gear operating motor access door:

EMERGENCY GEAR EXTENSION. REMOVE COVER. EXTENSION INSTRUCTIONS ON REVERSE SIDE.

On instrument panel:

STALL WARNING

The stall warning system is inoperative when the master switch is off.

At the fuel strainer compartment:

FUEL STRAINERS DRAIN ONLY TANK INDICATED BY FUEL SELECTOR. ALLOW SUFFICIENT DRAIN TIME.

On fuse panel access door:

FUSE PANEL ACCESS DOOR

On right rear window moulding in baggage area:

MAXIMUM BAGGAGE AND/OR PASSENGER WEIGHT 250 LBS. IN BAGGAGE AREA INCLUDING SEATS. SEE WEIGHT AND BALANCE.

On the instrument panel:

MINIMUM SINGLE ENGINE CONTROL SPEED	80 MPH
MANEUVERING SPEED	162 MPH
MAXIMUM GEAR DOWN SPEED	150 MPH

On the instrument 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 1/4 FULL

O. INSTRUMENT MARKINGS
Wing Flap Setting
Take-Off (White Arc) 0° to 15°
Landing (Full) 27°

P. LANDING GEAR DOWN LIGHT
The green gear down light on the instrument panel indicates the landing gear is down and lock GEAR INDICATOR LIGHTS ARE DIMMED WHILE THE INSTRUMENT LIGHTS ARE ON.

BW 98-05

PIPER, THE NEW
AIRWORTHINESS DIRECTIVE
SMALL AIRCRAFT & ROTORCRAFT

98-04-27 THE NEW PIPER AIRCRAFT CORPORATION: Amendment 39-10339; Docket No. 97-CE-61-AD.

Applicability: Models PA-23, PA-23-160, PA-23-235, PA-23-250, PA-E23-250, PA-30, PA-39, PA-40, PA-31, PA-31-300, PA-31-325, PA-31-350, PA-34-200, PA-34-200T, PA-34-220T, PA-42, PA-42-720, PA-42-1000 airplanes (all serial numbers), certificated in any category.

NOTE 1: This AD applies to each airplane identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (d) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, the request should include specific proposed actions to address it.

Compliance: Required as indicated, unless already accomplished.

To minimize the potential hazards associated with operating the airplane in severe icing conditions by providing more clearly defined procedures and limitations associated with such conditions, accomplish the following:

(a) Within 30 days after the effective date of this AD, accomplish the requirements of paragraphs (a)(1) and (a)(2) of this AD.

NOTE 2: Operators should initiate action to notify and ensure that flight crewmembers are apprised of this change.

(1) Revise the FAA-approved Airplane Flight Manual (AFM) by incorporating the following into the Limitations Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"WARNING

Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems, and may seriously degrade the performance and controllability of the airplane.

• During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues. If one or more of these visual cues exists, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions.

- Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.

- Accumulation of ice on the upper surface of the wing, aft of the protected area.

- Accumulation of ice on the engine nacelles and propeller spinners farther aft than normally observed.

• Since the autopilot, when installed and operating, may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in icing conditions.

• All wing icing inspection lights must be operative prior to flight into known or forecast icing conditions at night. [NOTE: This supersedes any relief provided by the Master Minimum Equipment List (MMEL).]"

(2) Revise the FAA-approved AFM by incorporating the following into the Normal Procedures Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"THE FOLLOWING WEATHER CONDITIONS MAY BE CONDUCIVE TO SEVERE IN-FLIGHT ICING:

- Visible rain at temperatures below 0 degrees Celsius ambient air temperature.
- Droplets that splash or splatter on impact at temperatures below 0 degrees Celsius ambient air temperature.

PROCEDURES FOR EXITING THE SEVERE ICING ENVIRONMENT:

These procedures are applicable to all flight phases from takeoff to landing. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as -18 degrees Celsius, increased vigilance is warranted at temperatures around freezing with visible moisture present. If the visual cues specified in the Limitations Section of the AFM for identifying severe icing conditions are observed, accomplish the following:

- Immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.
- Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
- Do not engage the autopilot.
- If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.
- If an unusual roll response or uncommanded roll control movement is observed, reduce the angle-of-attack.
- Do not extend flaps when holding in icing conditions. Operation with flaps extended can result in a reduced wing angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.
- If the flaps are extended, do not retract them until the airframe is clear of ice.
- Report these weather conditions to Air Traffic Control."

(b) Incorporating the AFM revisions, as required by this AD, may be performed by the owner/operator holding at least a private pilot certificate as authorized by section 43.7 of the Federal Aviation Regulations (14 CFR 43.7), and must be entered into the aircraft records showing compliance with this AD in accordance with section 43.9 of the Federal Aviation Regulations (14 CFR 43.9).

(c) Special flight permits may be issued in accordance with sections 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the airplane to a location where the requirements of this AD can be accomplished.

(d) An alternative method of compliance or adjustment of the compliance time that provides an equivalent level of safety may be approved by the Manager, Small Airplane Directorate, FAA, 1201 Walnut, suite 900, Kansas City, Missouri 64106. The request shall be forwarded through an appropriate FAA Maintenance Inspector, who may add comments and then send it to the Manager, Small Airplane Directorate.

NOTE 3: Information concerning the existence of approved alternative methods of compliance with this AD, if any, may be obtained from the Small Airplane Directorate.

(e) All persons affected by this directive may examine information related to this AD at the FAA, Central Region, Office of the Regional Counsel, Room 1558, 601 E. 12th Street, Kansas City, Missouri 64106.

(f) This amendment (39-10339) becomes effective on March 13, 1998.

FOR FURTHER INFORMATION CONTACT:
Mr. John P. Dow, Sr., Aerospace Engineer, Small Airplane Directorate, Aircraft Certification Service, 1201 Walnut, suite 900, Kansas City, Missouri 64106; telephone (816) 426-6932; facsimile (816) 426-2169.

SECTION III

PROCEDURES

A. STANDARD PROCEDURES

1. STOPPING ENGINES

When operating under high ambient temperature conditions engine shut down by mixture alone may not be positive.

Shutting down the engine under these conditions should be as follows:

a. Pull the mixture controls to idle cut-off.
b. Depress button left side of quadrant.
c. Pull back the throttles and hold until engine stops.

2. WARNING

This airplane is certified as a normal category airplane and must be operated in compliance with the Airplane Flight Manual. Acrobatic Maneuvers (including spins) are prohibited. Stalls and slow flight should be performed only in accordance with the Airplane Flight Manual.

Avoid abrupt maneuvers. Maneuvers at speeds and weights in excess of maneuvering speeds and loadings listed under Limitations Section of this Airplane Flight Manual may subject the airplane to load factors beyond which it is certificated.

Maintain at least 5000 feet of terrain clearance when practicing stalls.

3. SPINS

All spins are prohibited, however in the event an unintentional spin is encountered recovery can be accomplished by immediately using the following procedures:

a. Retard both throttles to the idle position.
b. Apply full rudder in the opposite direction to the spin.
c. Push control wheel full forward. While it is not necessary for recovery, the use of ailerons against the turn (i.e. right aileron if spin is to the left) will expedite recovery.
d. Maintain controls in these positions until the spin stops. Then neutralize rudder and ailerons.
e. Recover from dive with smooth back pressure on the control wheel. No abrupt control movement should be used during recovery from the dive, as the maneuvering speed and positive limit maneuvering load factor may be exceeded.

B. SYSTEMS OPERATION AND CHECKS

1. VOLTAGE REGULATING AND ALTERNATOR SYSTEM (FOR AIRCRAFT SER. NOS. 39-1 thru 39-145)

a. Alternator System

Press-to-test switches, in conjunction with the ammeter, are used to determine the output of each alternator. These switches are located directly below the ammeter. In the normal position the ammeter indicates battery charge or discharge current. Depressing an alternator press-to-test switch causes the ammeter to indicate the output current for the corresponding alternator, viz. the left switch checks the left alternator.

A preflight check of the alternators should be made during engine run-up. With both engines operating at approximately 2000 RPM, depress the alternator press-to-test switches individually and check alternator outputs. These should be approximately equal.

b. Voltage Regulating System

In event of 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 battery. To energize the auxiliary regulating system the following procedure shall be followed:

(1) Reduce aircraft electrical load to minimum for continued safe flight.
(2) Switch "VOLTAGE REGULATOR SELECTOR" to "AUXILIARY" position.
(3) Reset tripped breakers but do not reset "MAIN" Voltage Regulator Breaker.
(4) Return to normal required electrical load.

If the electrical system still fails to maintain correct output while using the AUX. VOLTAGE REGULATOR system, an alternator failure has probably occurred. To isolate the faulty component the following procedure should be followed:

(1) Reduce aircraft electrical load to minimum for continued safe flight.
(2) Turn aircraft MASTER SWITCH "OFF."
(3) Place both alternator output circuit breaker switches "OFF."
(4) Reset both MAIN and AUX. Voltage Regulator Circuit Breakers, if tripped. Return Voltage Regulator Selector to "MAIN."
(5) Turn aircraft MASTER SWITCH "ON." Reset Voltage Regulator Circuit Breaker, if tripped.
(6) Close one alternator output circuit breaker switch. Observe if electrical system is operating normally by checking for alternator output current on the ammeter. If not operating properly, open the alternator output circuit breaker; turn aircraft MASTER SWITCH "OFF" for approximately six seconds to reset the overvoltage relay.
(7) Turn aircraft MASTER SWITCH "ON." Reset Voltage Regulator Circuit Breaker, if tripped. Close other alternator output circuit breaker switch and observe if electrical system is operating normally by checking ammeter indication as above.
(8) Check that aircraft electrical load does not exceed the output capability of the operating alternator causing the battery to discharge.

CAUTION

Use of the voltage regulator selector switch and alternator circuit breakers should be limited to the above conditions.

2. ALTERNATOR PARALLELING SYSTEM (FOR AIRCRAFT SER. NOS. 39-146 AND UP)

On aircraft equipped with the subject system, each alternator is controlled independently by its own voltage regulator. These regulators are interconnected electronically so as to provide paralleled outputs from their associated alternators under normal operating engine RPM ranges. An ammeter that can be switched into either alternator output lead is provided for system monitoring, along with alternator "INOP" warning lights that illuminate when their associated alternator is not producing a voltage.

In the event of an alternator "INOP" indication the following steps should be taken:

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

b. Turn OFF one section of the Master Switch (L or R, as appropriate) to open the corresponding alternator field circuit. Reset all circuit breakers which may have tripped.

c. Turn ON the section of the Master Switch which had been previously turned OFF and if "INOP" light goes out - reinstate electrical load.

d. If, after turning ON the section of the Master Switch, the "INOP" light remains lit and/or the alternator circuit breaker switch has tripped, turn the same section of the Master Switch OFF and continue flight with reduced electrical load.

e. In the event that both alternator "INOP" lights come on simultaneously, repeat the above procedure for each alternator individually.

f. If both alternators fail to return to normal operation, turn ON Master Switch and turn OFF both alternator circuit breaker switches. Terminate flight as soon as possible.

CAUTION

The alternator circuit breaker switches should not be opened manually whenever the alternators are functioning normally.

3. CIRCUIT BREAKERS

All circuit breakers are grouped in the lower right corner of instrument panel. To reset the circuit breakers push in on the reset button.

4. FUEL MANAGEMENT

a. Normal Operation
   (1) Take-off and landing
      (a) Fuel valve "ON" main tanks.
      (b) Electric fuel pumps "ON".
   (2) Cruising
      (a) Fuel valves "ON" (Main or Auxiliary).
      (b) Electric fuel pumps "OFF".

b. Crossfeed Operation and Single Engine Operation

A crossfeed is provided to increase the range during single engine emergency operating conditions. Fuel system operation is as follows:

   (1) Cruising
      (a) When using fuel from tanks on the same side as the operating engine, the following will apply:
         (1) Fuel Valve "ON" (main or auxiliary) on Operating engine side.
         (2) Fuel Valve "OFF" on Inoperative engine side.
         (3) Electric fuel pumps "OFF" (except in case of engine driven pump failure, electric fuel pump on operating engine side must be used).

(b) When using fuel from tanks on the opposite side of the operating engine, the following will apply:
(1) Fuel Valve "ON" (main or auxiliary) on Inoperative engine.
(2) Electric fuel pumps "OFF" (except in case of engine driven pump failure, electric fuel pump on operating engine side must be used).
(3) "CROSSFEED ON" on Operative engine side.

WARNING

DO NOT PUT BOTH FUEL SELECTOR VALVES IN THE CROSSFEED POSITION AT THE SAME TIME.

(2) Landing
(a) Fuel Valve "ON" main tank on operating engine side.
(b) Fuel Valve "OFF" on inoperative engine side.
(c) Electric fuel pump "ON" on operating engine side.

5. MANUAL EXTENSION OF LANDING GEAR

Check the following before extending the gear manually:
a. Circuit breakers - check
b. Master switch - ON
c. Alternators - check
d. Instrument lights - OFF (daytime)

To extend the gear, remove the plate covering the emergency disengage control and proceed in these steps as listed on the underside of the cover plate:
a. Reduce power - airspeed not to exceed 100 MPH.
b. Place Landing Gear Selector Switch in "GEAR DOWN LOCKED" position.
c. Disengage motor. Raise motor release arm and push forward thru full travel.
d. Remove gear extension handle from stowage. If left socket is not in clear position, place handle in right socket. Engage slot and twist clockwise to secure handle. Extend handle and rotate forward until left socket is in clear position. Remove handle and place in left socket and secure. Extend handle. Rotate handle FULL forward to extend landing gear and to engage emergency safety lock.
e. Handle locked in full forward position indicates landing gear is down and emergency safety lock engaged. Gear "DOWN LOCKED" indicator light should be "ON".

NOTE

Reducing power and rocking gear extension handle will aid in manually extending the landing gear. DO NOT RETRACT WITH HANDLE IN SOCKET. DO NOT RE-ENGAGE MOTOR IN FLIGHT.

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

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C. EMERGENCY PROCEDURES

1. DETECTING A DEAD ENGINE

a. Loss of Thrust
b. Nose of aircraft will yaw in direction of dead engine (with coordinated controls)

2. FEATHERING PROCEDURE

The propellers can be feathered only while the engine is rotating above 1000 RPM. Loss of centrifugal force due to slowing RPM will actuate a stop pin that keeps the propeller from feathering each time the engine is stopped on the ground. If an engine freezes up, it will be impossible to feather its propeller. Single engine performance will decrease if the propeller of the inoperative engine is not feathered.

a. Minimum Control Speed - 80 MPH
b. Best R/C Speed Single Engine - 105 MPH
c. Maintain Direction and Airspeed above 90 MPH
d. Mixture Controls - forward
e. Propeller Controls - forward
f. Throttle Controls - forward
g. Gear - retract
h. Wing flaps - retracted (check visually)
i. Electric Fuel Pumps - "ON"
j. Magnetos - "ON"
k. Identify inoperative engine
l. Throttle of inoperative engine - retard to verify
m. Propeller on inoperative engine - feather
n. Mixture on inoperative engine - idle cut off
o. Electric Fuel Pump of inoperative engine - "OFF"
p. Magnetos of inoperative engine - off
q. Cowl Flaps - close on inoperative engine, use as required on operative engine
r. Alternator circuit breaker switch of inoperative engine - off
s. Electrical Load - reduce to prevent battery depletion
t. Trim - as required
u. Fuel Management - fuel "OFF" of inoperative engine, consider crossfeed use

3. UNFEATHERING PROCEDURE

a. Fuel valve on inoperative engine side - "ON"
b. Electric fuel pump - "OFF"
c. Throttle - open 1/4 inch
d. Propeller control - forward
e. Mixture - rich
f. Magneto switches - "ON"
g. Starter - engage till prop windmills
h. Propeller - set to cruise RPM
i. Throttle - reduced power till engine is warm
j. Alternator circuit breaker switch - "ON"

4. ENGINE FAILURE DURING TAKE-OFF

a. If there is adequate runway remaining for deceleration - CUT POWER IMMEDIATELY AND STOP STRAIGHT AHEAD.

b. If there is inadequate runway remaining and 95 MPH is not yet attained, the following procedure is recommended:

(1) Throttle controls - closed
(2) Master switch - off
(3) Fuel valves - off
(4) Continue straight ahead, turning to avoid obstacles as necessary

c. If engine failure occurs when airspeed is at or greater than 95 MPH the pilot must decide whether to abort the take-off or attempt a single engine take-off. His decision must be based on his judgment considering the runway remaining, density altitude, loading, obstruction, weather and his own capability.

5. ENGINE FAILURE DURING CLIMB

a. Feather inoperative engine (see feathering procedure)
b. Hold single engine best rate-of-climb speed of 105 MPH
c. Monitor cylinder head temperature - adjust cowl flap as required

6. SINGLE ENGINE LANDING

a. Feather inoperative engine (see feathering procedure)
b. Do not extend landing gear until certain of making field.
c. Do not lower wing flaps until certain of making field.
d. Trim for landing - (rudder)

Maintain additional altitude and speed during approach, keeping in mind that landing should be made right the first time and that a go-around may require the use of full power on the operating engine, making control more difficult.

A final approach speed of 105 miles per hour and the use of half rather than full wing flaps will place the airplane in the best configuration for a go-around should this be necessary, but it should be avoided if at all possible. Under some conditions of loading or density altitude a go-around may be impossible, and in any event the sudden application of power during single engine operation may cause control difficulties.

7. SINGLE ENGINE GO-AROUND

If a single engine go-around cannot be avoided proceed as follows:

a. Throttle - open
b. Propeller - forward
c. Landing Gear - retract
d. Flaps - retract
e. Airspeed - "One Engine Inoperative Best Rate-of-Climp Speed" 105 MPH
f. Trim - set
g. Cowl Flap - as required (operating engine)

NOTE

Aircraft will not climb with gear and flaps extended.

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SECTION IV

PERFORMANCE

The loss of altitude during a power off stall with gear and flaps retracted is 500 feet. Maintain at least 5000 feet of terrain clearance when practicing stalls.

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SECTION V

SUPPLEMENTS

NOTE

A FLIGHT MANUAL SUPPLEMENT IS REQUIRED TO BE IN THE AIRPLANE FLIGHT MANUAL ONLY IF THE EQUIPMENT WHICH IS THE SUBJECT OF THE SUPPLEMENT IS INSTALLED.

A. Oxygen System

B. AutoControl III (Model AK161)

C. Brittain Tip Tanks

D. AltiMatic IIIB

E. Anti-Collision (Strobe) Lights

F. Anti-Icing Equipment

G. AltiMatic IIIB-1 (Including AutoFlite II)

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A. OXYGEN SYSTEM INSTALLATION

1. LIMITATIONS

No smoking while the oxygen system is in use.

2. PROCEDURES

a. Check pressure gauge in rear of cabin for sufficient pressure for anticipated requirements for flight. Full system pressure is approximately 1850 PSIG. If necessary recharge cylinder.

b. When oxygen is desired pull out control cable knob placing regulator in "ON" position.

c. At seating positions where oxygen is to be used plug mask assembly into oxygen outlet, turn clockwise 90° and apply mask to face.

d. The flow indicator located in the mask assembly oxygen line should be checked. When red indicator disappears the oxygen is flowing through the line normally.

e. To stop flow of oxygen push in control cable knob placing regulator in "OFF" position and remove mask from face.

f. Leave mask assembly connected to oxygen outlet for at least 3 minutes to completely bleed down low pressure lines.

3. PLACARDS

a. At each oxygen outlet:

NO SMOKING WITH OXYGEN IN USE

b. At the oxygen control knob:

PULL ON, OXYGEN

4. EMERGENCY

In the event that during operation the red indicator appears in any of the flow indicators, the aircraft should be lowered to a safe altitude immediately.

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B. PIPER AUTOCONTROL III (MODEL AK161) INSTALLATION

1. LIMITATIONS

Disengage during take-off and landing.
Disengage above 225 MPH CAS.

2. OPERATING INSTRUCTIONS

To Engage:

Push Console Heading Lock button (HDG) to "OFF" position. Center ROLL knob. Push ON/OFF button to "ON" position.

To Turn:

Rotate console ROLL knob in desired direction.

For Heading Lock:

Set directional gyro (D.G.) with magnetic compass. Push D.G. HDG knob in, rotate to select desired heading. Push console Heading Lock button (HDG) to "IN" position.

To Disengage:

Push ON/OFF button to "OFF" position.

3. NORMAL OPERATION

a. Be sure airplane is properly trimmed. (Ball Centered)

b. Check vacuum and ascertain that the directional gyro and artifical horizon are functioning properly.

c. Engage AutoControl.

d. (Ground Check Only) Rotate the ROLL knob full right and full left. Determine that the control wheel describes a corresponding right and left turn, then center knob.

e. Set the directional gyro with the magnetic compass. Push D.G. HDG knob in, rotate to select desired heading.

f. Push Console Heading Lock button to "IN" position. The AutoControl is now "locked-in" for directional control.

g. Turns may be accomplished by either of the following methods:
   (1) Push Console Heading Lock button to "OUT" position. Rotate the ROLL knob in desired direction.
   (2) Push Console Heading Lock button to "IN" position. Select new heading by pushing D.G. HDG knob in and rotating.

h. Maximum angle of bank should not exceed 20°.

i. Disengage AutoControl by pushing the ON/OFF button to "OFF" position.

With Piper Radio Coupler Installed:

The AutoPilot is coupled to the VOR NAV receiver in the modes indicated on the function switch.

In the Heading (HDG) mode, the AutoPilot is controlled by the directional gyro.

4. EMERGENCY PROCEDURES

a. In the event of a malfunction in the AutoControl, push the ON/OFF button to "OFF" position. This disengages the AutoControl from the control system.

b. AutoControl may be overpowered manually by exertion of 12(± 3) pounds force on the control wheel.

c. In cruise configuration AutoControl malfunction with a 3 second recovery delay resulted in a 35 degree bank and 30 foot altitude loss.

d. In approach configuration AutoControl malfunction with a 1 second recovery delay resulted in a 25 degree bank and 40 foot altitude loss.

C. BRITTAIN INDUSTRIES, INC. MODEL TT-5 TIP TANKS INSTALLATION

The information in this document is FAA approved material which. together with the appropriate basic CAA-FAA approved Airplane Flight Manual is applicable and must be carried in the airplane when modified by the installation of Brittain Industries, Inc., Model TT-5 Tip Tanks in accordance with S.T.C. SA727WE dated June 25, 1964, revised January 23, 1970.

The information in this document supersedes the basic Airplane Flight Manual only where covered in the items contained in this supplement. For limitations and procedures not contained in this supplement, consult the manual proper.

1. LIMITATIONS

Same as prescribed in appropriate FAA approved Airplane Flight Manual except:

a. Auxiliary wing tip tank fuel to be used in level flight only.

b. When using auxiliary fuel, use wing tip tank fuel first.

c. Maximum allowable gross weight 3725 lbs. Any weight in excess of 3600 lbs. must consist of symmetrically loaded fuel in the tip tanks.

d. Never exceed airspeed limit of 230 MPH (red line).

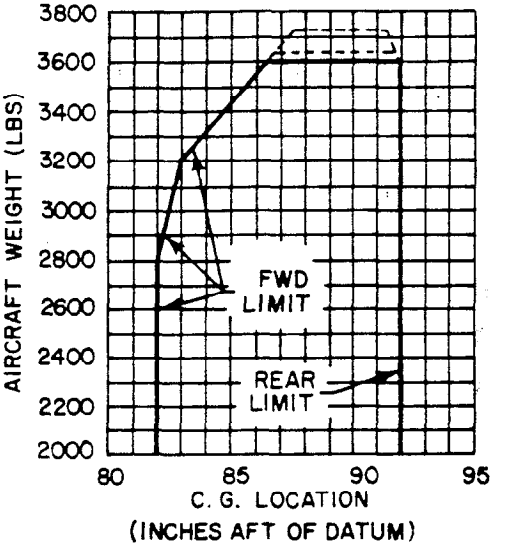
C.G. Range with symmetrical fuel quantity in each tip tank:
87.62" to 91.38" at 3725 lbs.

C.G. Range with 0.3 gals. in each tip tank:
86.72" to 91.87" at 3625 lbs.

C.G. Range with tip tanks empty:
86.5" to 92" at 3600 lbs.

C.G. of wing tip tank fuel is 90.5".

Straight line variation between points given.



2. OPERATING PROCEDURES – NORMAL

Same as prescribed in appropriate FAA approved Airplane Flight Manual except:

a. Select tip tank fuel by positioning Fuel Selector Valve in "AUX" position and TIP/AUX Fuel Selector Switch in "TIP" position.

b. Select auxiliary tank fuel by positioning Fuel Selector Valve in "AUX" position and TIP/AUX Fuel Selector Switch in "AUX" position.

c. Aircraft fuel gauges register fuel quantity of tank selected.

d. TIP/AUX Fuel Selector Switch to be in "AUX" position when using main tank fuel.

e. If the Tip Tanks have been run completely dry in flight, air may be trapped in the line from Tip Tank to solenoid valve when Tip Tanks are subsequently filled. The air pocket in the line may prevent immediate feeding of fuel from Tip Tanks. To avoid this condition, purge air from lines prior to starting aircraft.

(1) Turn fuel selector valve to "AUX" position.

(2) Turn on aircraft master switch and place tip tank fuel selector switch to tip tank position. Ascertain that tip tank solenoid switch, under fuel console, is operating by listening for a slight click when switch is operated.
(3) Lift up appropriate fuel drain valve and allow fuel to drain. Observe for flow in clear plastic tube, followed by interrupted flow of no fuel for a few seconds, further followed by a bubbling flow then full flow. Total drain time should not be less than 30 seconds.
(4) Procedure shall be accomplished for each tip tank separately.
(5) In addition to above procedure, operate the power plant from each wing tip separately until steady fuel flow is assured during ground run-up prior to flight.

3. PERFORMANCE

Same as prescribed in appropriate FAA approved Airplane Flight Manual.

4. EMERGENCY

In the event of malfunction of the tip tank fuel system, place the TIP/AUX Fuel Selector Switch in the "AUX" position.

NOTE

Fuel Solenoid Valve failure automatically switches fuel flow from "TIP" to "AUX" tank.

FAA APPROVED November 28, 1969
REISSUED: June 1, 1970
REVISED: March 17, 1971

D. PIPER ALTIMATIC IIIB INSTALLATION

1. LIMITATIONS

ROLL and PITCH "OFF" during take-off and landing. ROLL, PITCH, and AUTOFLITE "OFF" above 225 MPH. MINIMUM COUPLED APPROACH SPEED (110 MPH).

2. OPERATING INSTRUCTIONS

a. ROLL SECTION

To Engage:

Push console heading lock button (HDG) "OFF". Center ROLL knob. Push ROCKER switch to "ON" position.

To Turn:

Rotate console ROLL knob in desired direction. (Maximum angle of bank should not exceed 30°. Maximum angle will be 20° with heading lock engaged.)

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.

Roll Section Ground Check:

With heading lock button "OFF", 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 (ROLL SECTION must be engaged prior to engaging PITCH SECTION)

To Engage:

Push altitude preselect button (ALT) to "OFF" position. Center the PITCH command disk. Push PITCH button to "ON" position.

To Change Altitude:

Rotate PITCH command disk in desired direction.

Altitude Preselect:

Center PITCH command disk. With airplane in level flight, rotate the altitude selector DN/UP knob until trim UP/DN 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 preslect 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.

Pitch Section Ground Check:

With altitude preselect button "OFF", 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. AUTOFLITE SECTION

The AUTOFLITE SECTION of the AltiMatic IIIB is approved for all attitudes. including take-off and landing. The engagement of the ROLL SECTION of the AltiMatic automatically disengages the AUTOFLITE SECTION.

To Engage:

Place AUTOFLITE rocker switch in "ON" position. Correct minor heading variation by rotating AUTOFLITE "TRIM" knob in desired direction.

To Turn:

Push AUTOPILOT "OFF" button on control wheel. Make turn manually. Release button to re-engage AUTOFLITE on completion of turn.

d. PITCH TRIM SECTION

The airplane can be trimmed (1) manually with the crank or (2) by actuating the pitch trim slide switch on the pilot's control wheel. Push switch forward for nose down trim and rearward for nose up trim. Pitch trim is automatically accomplished when the PITCH SECTION is engaged.

With Pitch Trim Warning Light Installed:

The warning light on the instrument panel will light when the pitch is out of trim for approximately 4 seconds, when the pitch section is engaged.

The press-to-test feature of the indicator light assembly, when held in (with autopilot pitch function engaged) will show the operator that the lamp is good and the length of time that is required for the warning system to actuate.

With Piper Radio Coupler Installed:

The ALTIMATIC is 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.

3. NORMAL FLIGHT OPERATION

a. Be sure airplane is properly trimmed. (Ball Centered)
b. Engage AUTOFLITE SECTION.
c. Check vacuum and ascertain that the directional gyro and artificial horizon are functioning properly.
d. Engage ROLL SECTION.
e. Engage PITCH SECTION.
f. Disengage ROLL and PITCH SECTIONS before landing.

4. WITH GLIDE SLOPE COUPLER INSTALLED (FLIGHT)

a. Set Radio Coupler to localizer normal mode (LOC/NORM).
b. "Engage" altitude hold.
c. Extend landing gear and set flaps 15° maximum.
d. Adjust power to maintain desired approach speed 110 to 120 MPH.

5. EMERGENCY PROCEDURES

a. In the event of a malfunction in the ROLL or PITCH SECTION, push the ROLL ON/OFF button "OFF", or push the A/P "OFF" button on the control wheel.

Either operation above disengages both ROLL and PITCH SECTIONS of the ALTIMATIC from the control system and will disengage the AUTOFLITE SECTION if engaged, as long as button remains depressed.

After the A/P "OFF" button on the control wheel has been pushed due to a malfunction in the ROLL or PITCH SECTION, the ALTIMATIC IIIB can only be re-engaged by the actuation of the ROLL ROCKER switch and PITCH button on the console.

AUTOFLITE SECTION will automatically re-engage upon release of the A/P button.

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

c. The AltiMatic ROLL SECTION and AUTOFLITE SECTION may be overpowered manually by exertion of 12 ± 3 pounds of force on either control wheel. The AltiMatic PITCH SECTION may be overpowered manually by exertion of 15 ± 2 pounds of force on either control wheel.

d. In cruise configuration, AltiMatic malfunction with a 3 second recovery delay results in a 45° bank and 300 foot altitude loss.

e. In approach configuration, AltiMatic malfunction with a 1 second recovery delay results in a 28° bank and 220 foot altitude loss.

f. In cruise configuration, AutoFlite malfunction with a 3 second recovery delay results in a 35° bank and an 80 foot altitude loss.

g. In approach configuration, AutoFlite malfunction with a 1 second recovery delay results in a 25° bank and 40 foot altitude loss.

6. PLACARDS

a. On left control wheel:

DWN ▲ UP ▼

b. On left control wheel:

A/P OFF ▶

c. On instrument panel:

AutoFlite
Trim
L R

d. On instrument panel (when radio coupler is installed):

A/P NAV SEL
ON
OFF
ON

e. On instrument panel (when Glide Slope Coupler is installed):

G/S
ENGAGED

f. On instrument panel (when pitch trim warning is installed):

PITCH
OUT OF TRIM

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E. ANTI-COLLISION (STROBE) LIGHT INSTALLATION

1. OPERATING LIMITATIONS

a. The following shall apply when RED anti-collision (Strobe) lights are installed:

WARNING

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

b. The following shall apply 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 ON FOR ALL NIGHT OPERATIONS.

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F. ANTI-ICING EQUIPMENT INSTALLATION

The following items of equipment must be installed and operable to effectively cope with normally encountered icing conditions:

I. Wiggins Airways Wing and Tail Pump Type Pneumatic Deicing Boots installed per Wiggins Airways S.T.C. No. SA848EA dated October 22, 1970, or FAA approved equivalent.

II. Wiggins Airways Alcohol Propeller Anti-Icing Kit installed per Wiggins Airways S.T.C. No. SA816EA dated May 7, 1970, or FAA approved equivalent.

III. Piper Antennas installed per P.A.C. Dwg. 25043. No special operating instructions required.

IV. Heated Pitot Head installed per P.A.C. Dwg. 26732. No special operating instructions required.

V. Piper Heated Glass Panel on Windshield installed per P.A.C. Dwg. 26711.

1. PLACARDS

a. On circuit breaker panel:

WSHLD
HEAT

b. When heated glass panel only is installed, on instrument panel: "Warning - This aircraft is not fully equipped for flight in icing conditions."

NOTE
WHEN ALL ITEMS OF EQUIPMENT LISTED ABOVE ARE INSTALLED, PLACARD NO. 1.b. IS NOT REQUIRED.

2. OPERATING INSTRUCTIONS

Prior to flight in conditions where the possibility of encountering icing exists, the HEATED PANEL assembly should be attached to the aircraft and the lead wire plug firmly inserted in socket provided.

An operational check should then be accomplished by turning the HEATED PANEL switch ON for a period not exceeding 30 SECONDS.

Proper operation is indicated by the glass section being warm to the touch.

If icing conditions are encountered the HEATED PANEL switch should be turned ON and remain ON until the icing conditions cease.

When icing is not prevalent the unit should be turned OFF. UNDER NO CIRCUMSTANCES SHOULD THE UNIT BE TURNED ON FOR A PERIOD EXCEEDING 30 SECONDS UNLESS:

a. The aircraft is in flight, or
b. Ice exists on the HEATED PANEL.

CAUTION

This equipment cannot be expected to cope with heavy or very prolonged moderate icing conditions. The latter can be expected to tax the equipment beyond its capacity.

Pilots should always strive to avoid heavy icing conditions. If heavy icing is encountered unexpectedly or unavoidably, prompt action must be taken to get into more favorable flying weather conditions.

NOTE

When all items of equipment listed above are installed, the placard "Warning - This aircraft is not fully equipped for flight in icing condition." IS NOT REQUIRED. When the heated panel is removed or any of the above listed installed equipment is inoperable (known before flight) the warning placard must be reinstalled.

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

PERFORMANCE

Performance figures are for standard PA-39 airplanes equipped for cross-country transportation and flown at gross weight under standard conditions at sea level unless otherwise stated. Performance for a specific airplane may vary from published figures depending upon equipment installed, the condition of engines, airplane and equipment, atmospheric conditions and piloting technique.

	Normally Aspirated	Turbo Charged
Take-off Run (short field, ft)	940	990
Take-off Distance Over 50-ft Barrier (short field, ft)	1530	1590
Accelerate - Stop Distance (ft)	2470	2560
Vmc MPH (as determined by the F.A.A.)	80	80
Stalling Speed (gear and flaps down, power off, mph)	70	70
Stalling Speed (gear and flaps up, power off, mph)	76	76
Best Rate of Climb (ft per min)	1460	1290
Best Rate of Climb Speed (mph)	112	112
Best Angle of Climb Speed (mph)	90	90
Single Engine Rate of Climb (ft per min)	260	165
Best Single Engine Rate of Climb Speed (mph)	105	105
Absolute Ceiling (ft)	20,000	25,000+
Service Ceiling (ft)	18,600	25,000+
Single Engine Absolute Ceiling (ft)	7,100	12,600
Single Engine Service Ceiling (ft)	5,800	8,800
Landing Roll (short field, flaps down, ft)	700	725
Landing Over 50-ft Barrier (short field, flaps down, ft)	1,870	1,900

ALTITUDE CRUISING SPEEDS (MPH)

Normally Aspirated

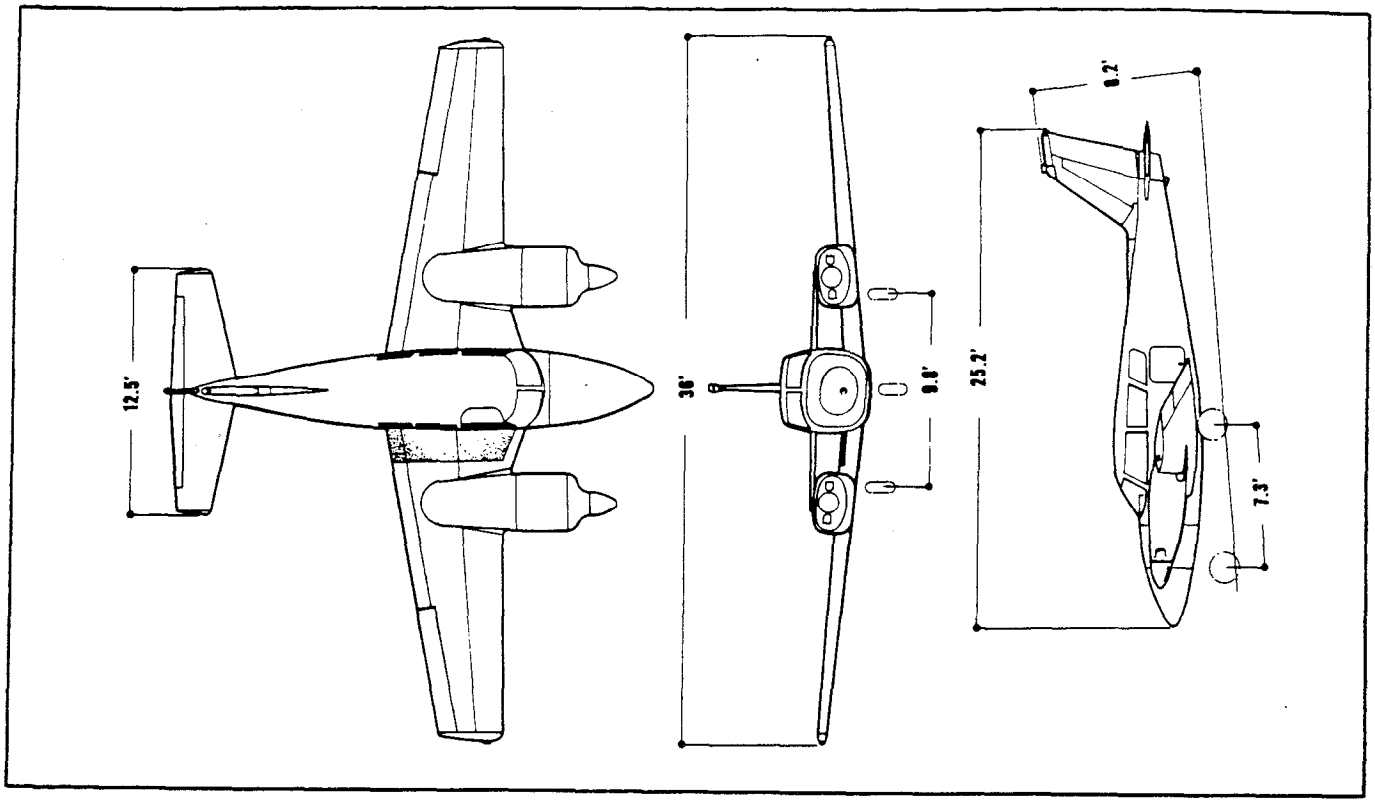
	Power Setting (rpm)	Man. Press. (in.)	Altitude (feet)	Speed (mph)	Range (miles)	Fuel Con. (gph)
Normal	2400	26	4,200	198	830	19.6
Intermediate	2400	24	6,400	196	1030	15.4
Economy	2200	24	6,400	188	1110	13.8
Longe Range	2200	20	11,200	178	1200	11.6

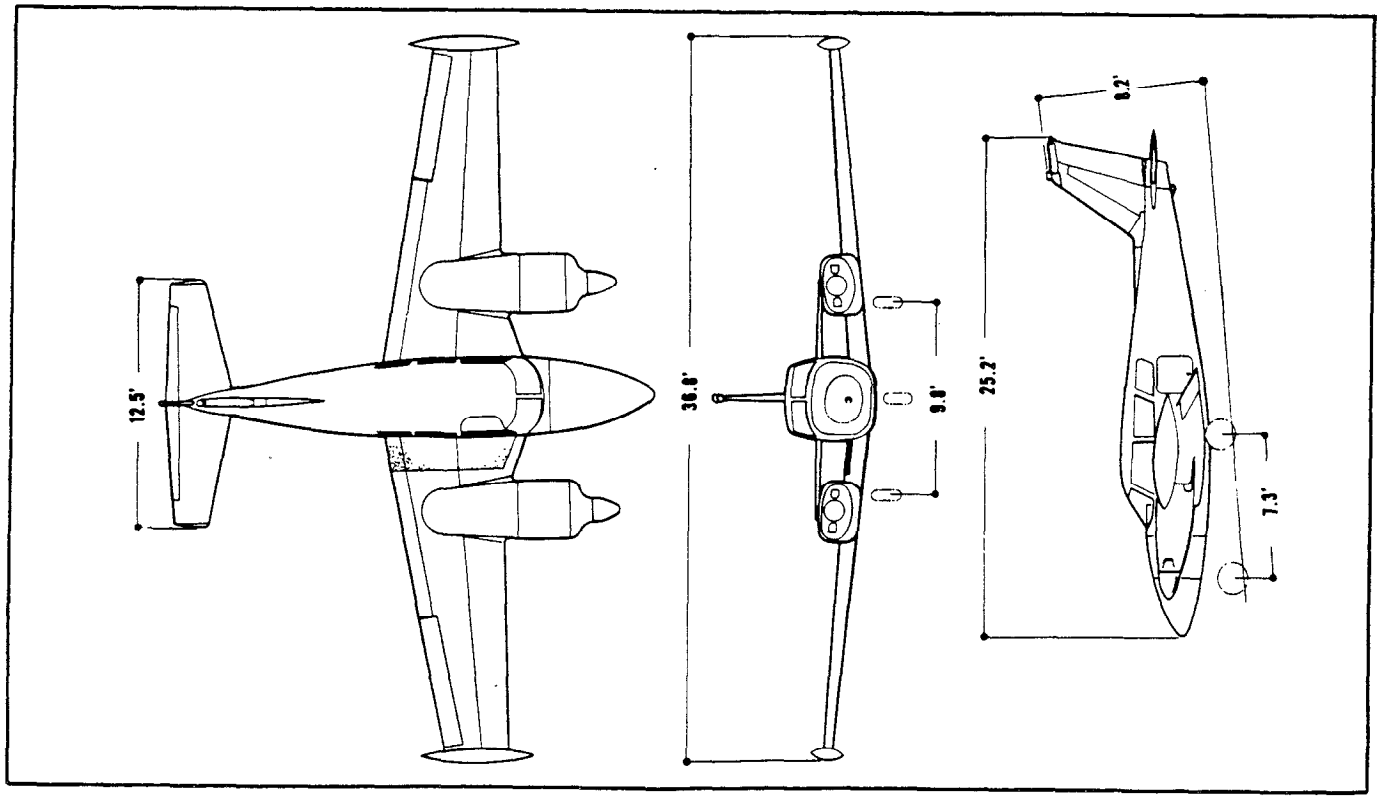
Turbocharged

	Power Setting (rpm)	Man. Press. (in.)	Altitude (feet)	Speed (mph)	Range (miles)	Fuel Con. (gph)
Turbo	2400	28	20,000	234	1210	22.6
Intermediate	2400	26	20,000	222	1475	17.2
Economy	2200	24	20,000	203	1605	14.4
Long Range	2200	22	20,000	191	1650	13.2

	Normally Aspirated	Turbo Charged
WEIGHTS		
Gross Weight (lbs)	3600	3725
Empty Weight (Standard) (lbs)	2270*	2416*
USEFUL LOAD (Standard) (lbs)	1330*	1309*
* These weights are approximate		
POWER PLANT		
Right Engine - Lycoming	L10-320-B1A	L10-320-C1A
Left Engine - Lycoming	10-320-B1A	10-320-C1A
Rated Horsepower	160	160
Rated Speed (rpm)	2700	2700
Bore (in.)	5.125	5.125
Stroke (in.)	3.875	3.875
Displacement (cubic in.)	319.8	319.8
Compression Ratio	8.5:1	8.5:1
Dry Weight (lbs)	295	308
FUEL AND OIL		
Fuel Capacity (U.S. gal)	90	120
Unusable fuel (inboard cells only)	6	6
Fuel, Aviation Grade (minimum octane)	100/130	100/130
Oil Capacity (qts) (each engine)	8	8
BAGGAGE AREA		
Maximum Baggage (lbs)	250	250
Baggage Space (cubic ft)	20	20
Baggage Door Size (in.)	19 x 21	19 x 21
DIMENSIONS		
Wing Span (ft)	36	36.8
Wing Area (sq ft)	178	178
Length (ft)	25.2	25.2
Height (ft)	8.2	8.2
Wing Loading (lbs per sq ft)	20.2	20.9
Power Loading (lbs per hp)	11.3	11.7
Propeller Diameter (in.)	72	72

		Normally Aspirated	Turbo Charged
LANDING GEAR			
Wheel Base (ft)		7.3	7.3
Wheel Tread (ft)		9.8	9.8
Tire Pressure (psi)	Nose	42	42
	Main	42	42
Tire Size	Nose (six-ply rating)	6.00 x 6	6.00 x 6
	Main (six-ply rating)	6.00 x 6	6.00 x 6


12.5'
36'
9.8'
25.2'
9.2'
7.3'


12.5'
36.8'
9.8'
25.2'
9.2'
7.3'

DESCRIPTION
AIRPLANE AND SYSTEMS

DESCRIPTION

AIRPLANE AND SYSTEMS

ENGINE AND PROPELLER

The four cylinder Lycoming fuel injected engines are rated at 160 horsepower at 2700 RPM. The left engine rotates clockwise and the right engine rotates counterclockwise. These engines are equipped with geared starters, fuel injectors shielded ignition systems and special engines are available with optional Rajay Turbochargers.

Engine mounts are of steel tube dynafocal mount construction. Engine cowls are cantilever structures attached at the firewall, with side panels which are quickly removed by means of quick release fasteners.

The exhaust system is a cross-over type with exhaust gases directed overboard at the bottom of the nacelles in the area of the cowl flaps. The cowl flaps are located on the bottom of the engine nacelles and are manually operated by push-pull controls located in the cabin to the right of the power control quadrant.

Oil coolers are mounted on the left rear baffle of each engine. Air passes through the oil coolers before reaching the area of the cowl flaps.

The propellers are Hartzell, constant-speed, controllable, full-feathering units. These are controlled entirely by use of the propeller control levers located in the center of the power control quadrant. Feathering of the propellers is accomplished by moving the controls fully aft through the low RPM detent into the feathering position. Feathering takes place in approximately six seconds. A propeller is unfeathered by moving the prop control ahead and engaging the starter.

THE OPTIONAL RAJAY TURBOCHARGER

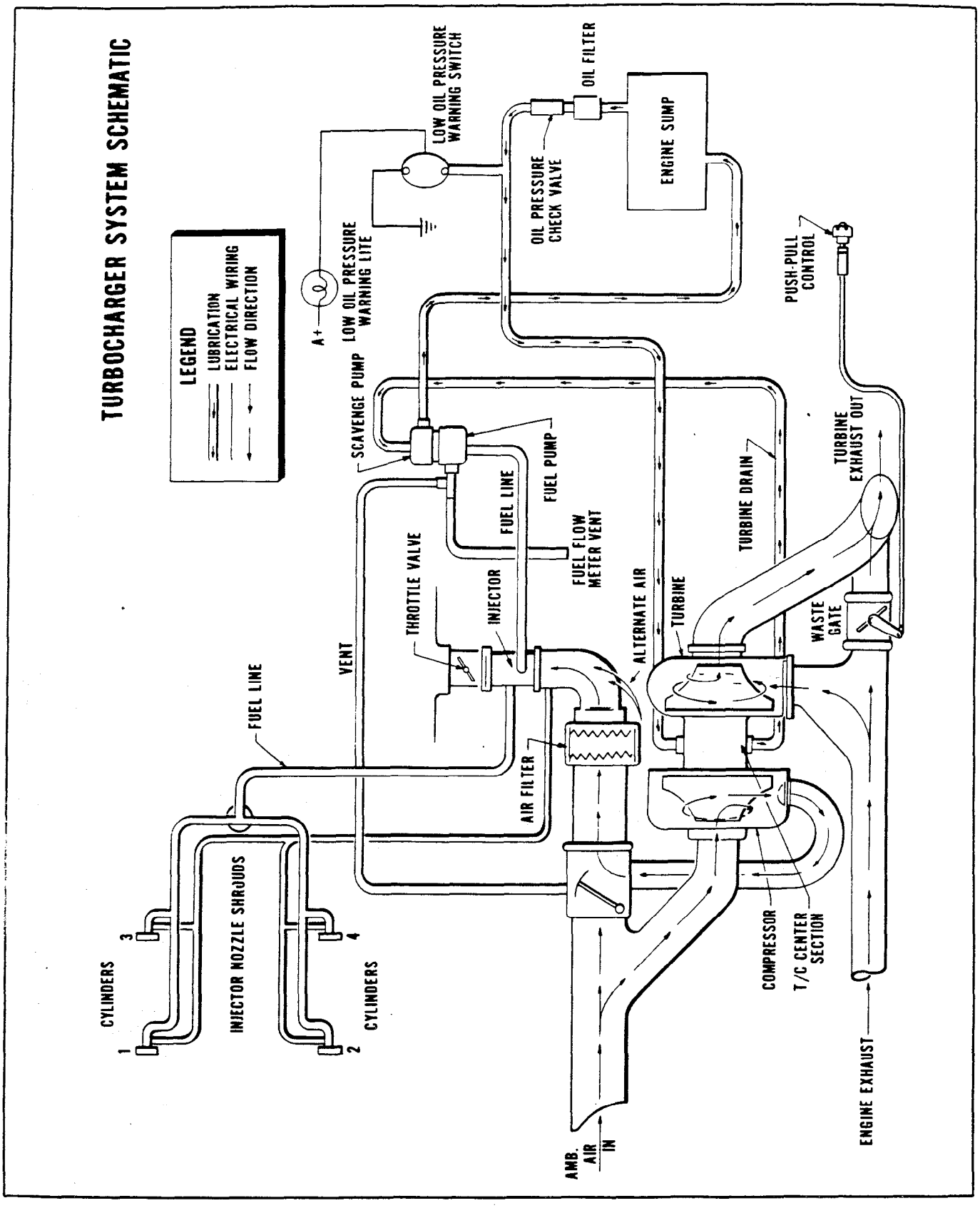
The Rajay Turbocharger consists of a precisely balanced rotating shaft with a radial inflow turbine wheel on one end and a centrifugal compressor impeller on the other. Normally wasted exhaust gases drive the turbine which powers the impeller that supplies air under pressure to the engine air inlet. Since engine horsepower is never used to drive the turbocharger, no additional mechanical load is imposed above those of a naturally aspirated engine. Low altitude power and engine efficiency is thus provided at high altitudes by converting exhaust gas energy to compressed air. Although true airspeeds increase, turbocharging does not increase normal engine speeds, loads, or brake mean effective pressure limits.

The turbocharger bearings are lubricated with engine oil at a pressure of 30-50 psi at normal operating temperatures. Pressure switches within the lubricant supply line will activate a red warning light if the turbocharger oil pressure falls below 27-30 psi. If the light signal is received, the pilot should deactivate the turbocharger.

The primary control in turbocharger operation is the degree of closure of the waste-gate valve. Boost pressure is manually regulated by gradually turning the vernier control knobs to allow matching of manifold pressure in both engines.

The induction system uses the normal throttle and fuel mixture controls that are used in non-turbo operation. The air inlet box is designed to accommodate compressor discharge air without decreasing normally aspirated take-off power. If the turbo compressor fails to deliver boost pressure, a check valve door will open automatically as the engine reverts to normally aspirated operation. This function prevents a prohibitive drop in throttling pressure and the corresponding loss of power that would occur if all the engine air for normal operation were routed through the inoperative compressor.

Alternate air is available automatically if the inlet duct is obstructed during normally aspirated operation.


TURBOCHARGER SYSTEM SCHEMATIC
LEGEND
LUBRICATION
ELECTRICAL WIRING
FLOW DIRECTION
LOW OIL PRESSURE WARNING SWITCH
OIL FILTER
ENGINE SUMP
OIL PRESSURE CHECK VALVE
A+
LOW OIL PRESSURE WARNING LITE
PUSH-PULL CONTROL
SCAVENGE PUMP
FUEL PUMP
FUEL LINE
TURBINE EXHAUST OUT
TURBINE DRAIN
FUEL FLOW METER VENT
THROTTLE VALVE
INJECTOR
VENT
ALTERNATE AIR
TURBINE
WASTE GATE
FUEL LINE
AIR FILTER
CYLINDERS
3
4
1
2
INJECTOR NOZZLE SHROUDS
CYLINDERS
COMPRESSOR
T/C CENTER SECTION
ENGINE EXHAUST
AMB. AIR IN

FUEL INJECTION

The Bendix RSA-5 fuel injection system is based on the principle of measuring engine air consumption by use of a venturi tube and using airflow to control fuel flow to the engines. Fuel distribution to the cylinders in accomplished by a fuel flow divider.

Fuel pressure regulation by means of the servo valve causes a minimal drop in fuel pressure throughout the metering system. Metering pressure is maintained above vapor forming conditions while fuel inlet pressure is low enough to allow the use of a diaphragm pump. Vapor lock and associated problems of difficult starting are thus eliminated.

Incorporated in the servo regulator is the airflow sensing system which contains a throttle valve and venturi. The differential pressure between the entrance and the throat of the yenturi is the measurement of air entering the engine. These pressures are applied across an air diaphragm in the regulator. A change in power changes the airflow to the engine and across the diaphragm in the regulator.

Mounted on top of the engine is the ported fuel flow divider with four nozzle lines routed to the cylinders. The divider contains a spring loaded positive shut-off valve. Within each cylinder are continuous flow air bleed nozzles with provisions to eliminate the adverse effects of low manifold pressure when idling. Since fuel metering is provided by the servo regulator rather than the nozzles, more uniform cylinder head temperatures result and a longer engine life is possible.

Induction air for the engine enters the opening in the nose cowl and is picked up by a large air duct at the right rear baffle. The air is directed through a filter and on to the servo regulator. An alternate air source for the induction system contains a spring loaded door at the throat of the servo regulator. This door operates automatically if primary source is obstructed or manually by the push-pull control on the right side of the power control quadrant. The primary system should always be used for take-off.

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 and exterior surfaces are coated with acrylic lacquer.

The main spars of the wings are joined 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.

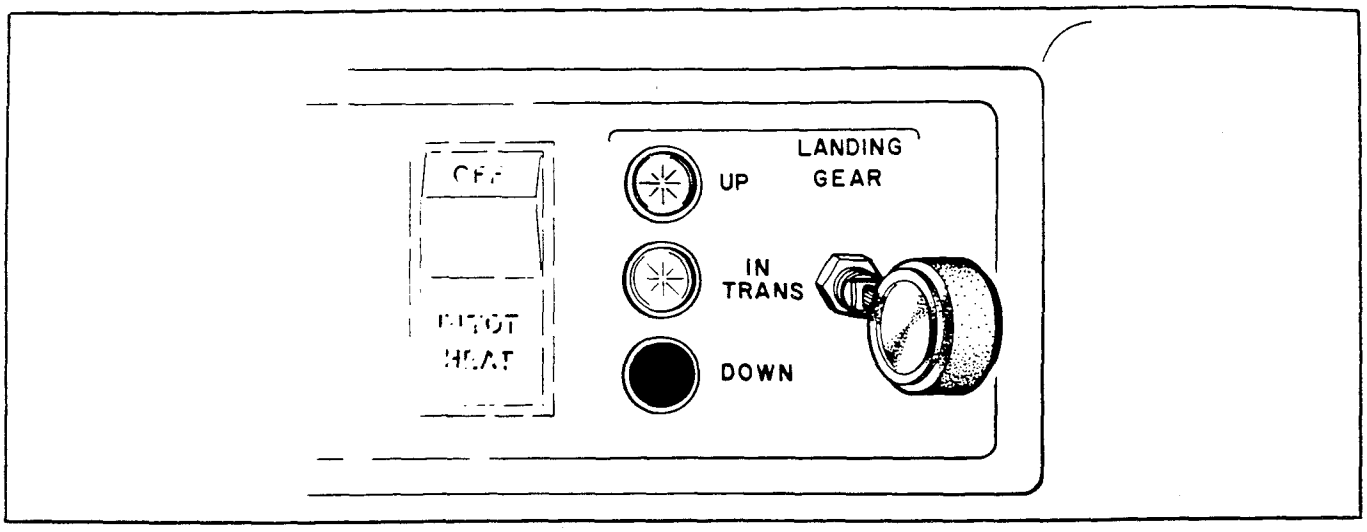
The wing airfoil section is a laminar flow type, with maximum thickness about 40% aft of the leading edge. This permits the main spar, located at the point of maximum thickness, to pass through the cabin under the rear seat, providing unobstructed cabin floor space ahead of the seat.

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.

Retraction of the landing gear is accomplished through the use of an electric motor and gear train, actuating push-pull cables to each of the main gear and a tube to the nose gear. The landing gear motor is beneath the center floor panel and the selector switch on the instrument panel to the left of the power control quadrant.

To guard against inadvertent movement of the landing gear selector on the ground, the handle must also be pulled aft before moving it upward. The gear selector has the shape of a wheel to distinguish it from the electric flap control 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



Landing Gear Selector Switch

with the master switch on and the weight of the airplane on the landing gear. To prevent gear retraction on the ground, an anti-retraction switch is installed on the left main gear. This prevents the completion of the electric circuit to the landing gear motor until the gear strut is within 3/4 inch of full extension.

The gear indicating lights are located conveniently by the gear selector switch. The green indicating light below the selector switch shows that all gear are down and locked. The amber light above the gear selector switch is the gear up indication: it will flash if the power of one engine is reduced below 12 inches of manifold pressure while the gear is up and locked. The white light indicates that the landing gear is in transit. The gear up warning horn will sound when power is reduced (below approximately 12 inches of manifold pressure) on both engines and the gear is not down and locked. The pilots should become familiar with the gear warning horn to distinguish it from the stall warning horn. GEAR INDICATION LIGHTS ARE DIMMED WHILE THE INSTRUMENT LIGHTS ARE ON.

The brakes are actuated by toe brake pedals mounted on the left set of the rudder pedals. Hydraulic brake cylinders above the brake pedals are accessible in the cockpit for servicing. Parking brake valves are incorporated in each cylinder and have two cables attached from the parking brake "T" handle. 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. Toe brakes for the right side are available as optional equipment.

A tow bar is provided with each airplane. When not in use it is stowed next to the main spar. It may be moved by lifting the flap covering the forward side of the spar and removing the bar from its fasteners.

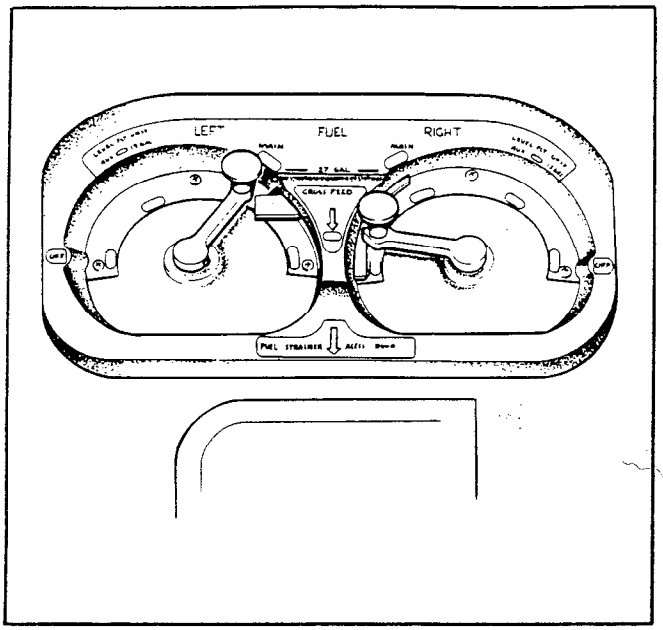
When towing with power equipment, caution should be used not to turn the nose gear beyond its 40 degree arc as this may cause damage to the nose gear and steering mechanism.

CONTROL SYSTEM

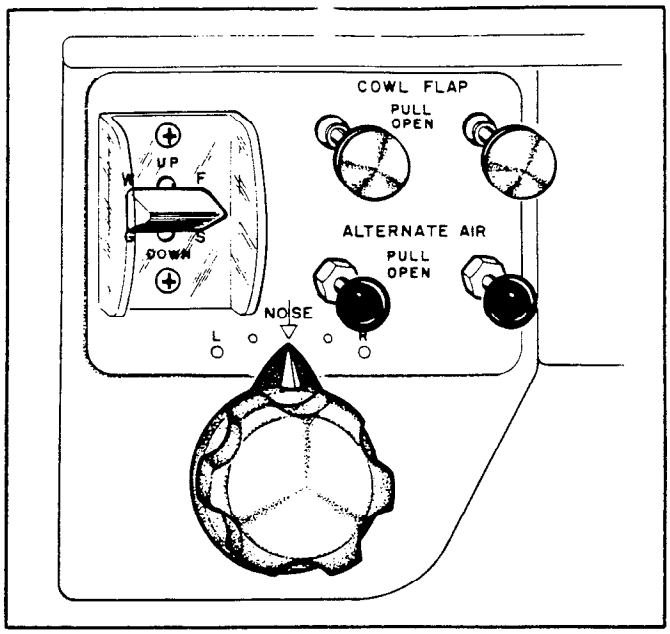
Dual flight controls are provided as standard equipment. Cables connect the movable control surfaces with the rudder pedals and control columns.

Directional and longitudinal trim is provided by an adjustable trim mechansim for the rudder and stabilator. The manual rudder trim control is located to the right of the throttle quadrant.

Max-Lift electrically operated flaps are used on the Twin Comanche C/R. The flaps are operated by an electric motor; they can be lowered and stopped in any desired position. The airfoil shaped flap control is to the right of the power control quadrant. A flap position indicator is located on the instrument panel marked to show the position of the flap relative to the wing. A range for take-off operation is also shown.



Fuel Selector



Rudder Trim And Flap Controls

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.

FUEL SYSTEM

The fuel is carried in four integral fuel cells located in the leading edge sections of the wings. Capacity of the two main fuel cells is 30 gallons each, of which 27 gallons is usable.

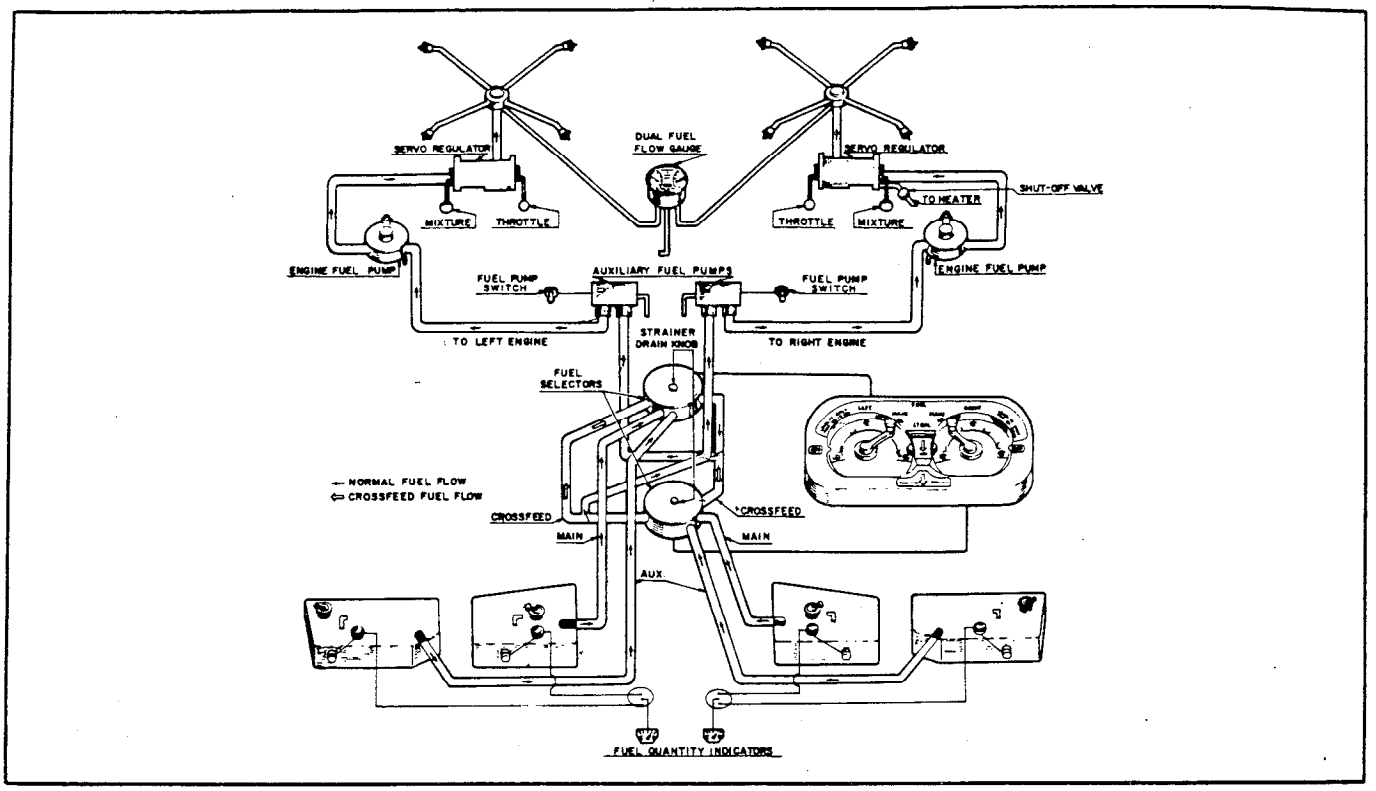
The auxiliary fuel system consists of two 15 gallon cells (all usable) installed in the wings just outboard of the main fuel cells. Wing tip tanks are available as optional equipment on the normally aspirated Twin Comanche C/R and standard equipment on the Turbocharged Twin Comanche C/R. AUXILIARY FUEL AND TIP TANK FUEL IS TO BE USED IN LEVEL FLIGHT ONLY.

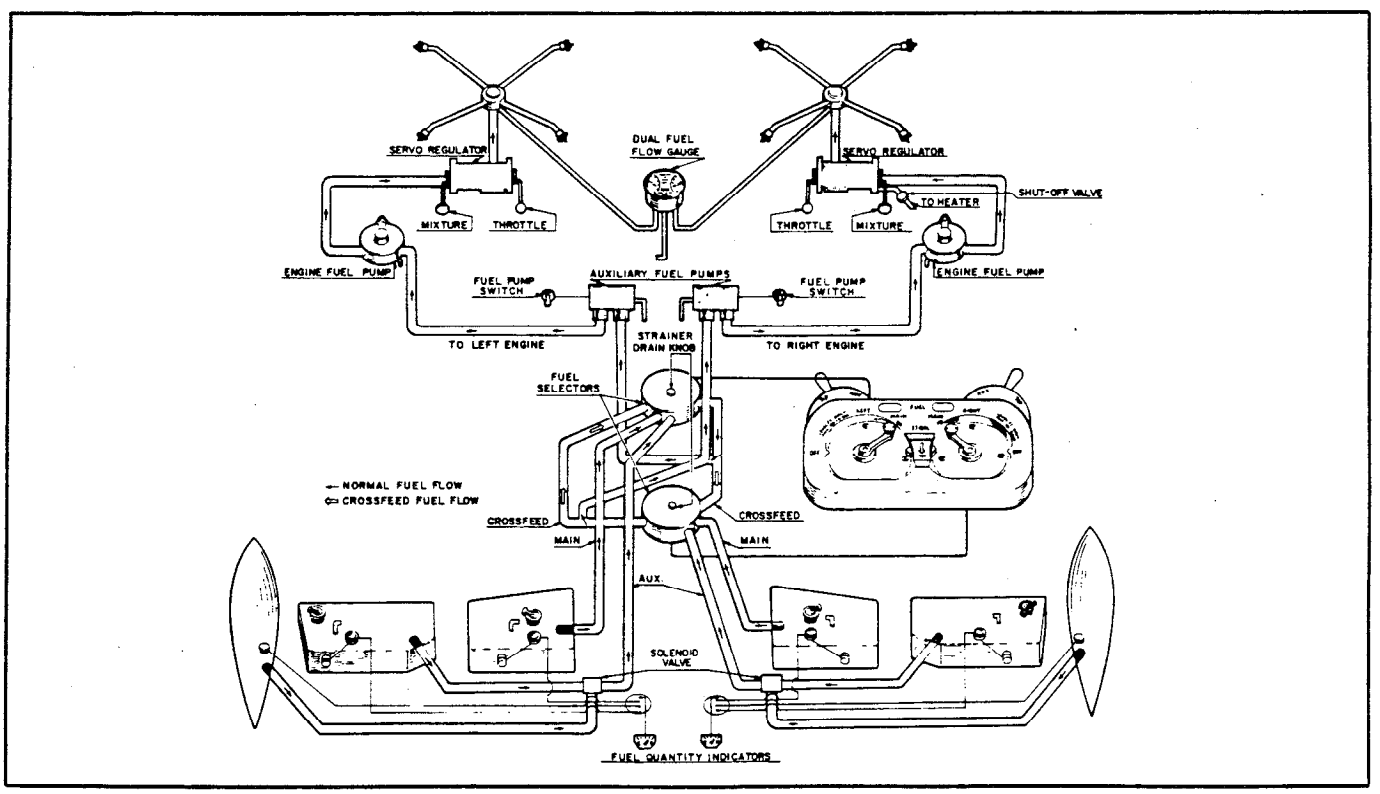
The cells should be kept full of fuel during storage of the airplane to prevent accumulation of moisture and deterioration of the cells. For storage of more than ten days without fuel, the cells should be coated with light engine oil to prevent excessive drying.

During normal operation use the engine driven fuel pump to draw fuel from the cell directly adjacent to that engine. However, fuel can be drawn from any cell to both engines through use of the engine driven fuel pump or the electric auxiliary fuel pump.

For emergency single engine operation a crossfeed is provided to increase the range.

The fuel strainers for the system are located beneath the floor panel in the center section of the fuselage. Daily draining of the strainers may be accomplished in the cockpit by opening the hinged access door located in the floor panel just aft of the fuel selector handles and pulling up on the knob located in the center of the selector valve. The general procedure for draining the fuel system is to open the strainer quick drain for several seconds with the fuel cell selector on the main cell, then to change the selector to the auxiliary cell and repeat the process. To drain tip tanks, if installed, turn the master switch on and follow the procedure for the main and auxiliary cells. Allow enough fuel flow to clear the lines as well as the strainer. Positive fuel flow shut-off can be observed through the clear plastic tube that carries the fuel





Fuel System Schematics

overboard. Located inside the fuel valves is a by-pass valve which will open at 1/2 psi differential pressure if the strainer screen becomes blocked.

Fuel quantity is indicated by two electric gauges located below the instrument cluster. The instruments are connected to a transmitter unit located in each fuel cell. The gauges will indicate the amount of fuel available in the cells that are selected.

ELECTRICAL SYSTEM

Electrical power is supplied by two 12 volt 70 ampere alternators and a 35 ampere-hour battery. The battery is located in the fuselage nose section in a sealed stainless steel battery box. Refer to the Maintenance Section for servicing of the battery.

There are two voltage regulator systems installed in the Twin Comanche aircraft.

On aircraft up to and including serial number 39-145 the alternators are paralleled by using one voltage regulator to control field voltage of both alternators. Also incorporated in the system is an overvoltage 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 overvoltage condition which could damage the electrical equipment.

In the event of a voltage regulating system failure, an auxiliary regulating system may be switched into use. Abnormal system operation may be indicated by zero output on both alternator test positions and a discharge indication for the battery.

NOTE

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

On aircraft with serial number 39-146 and up, the electrical system incorporates an alternator paralleling system. The system has two voltage regulators which control the alternators. The regulators are interconnected electrically to provide parallel outputs from their respective alternators under normal operating engine RPM. Whenever the engines are operating at a high differential RPM, the alternator inoperative light for the slower engine may come on.

A distinctive feature of this alternator paralleling system is the split rocker type master switch and the alternator inoperative lights.

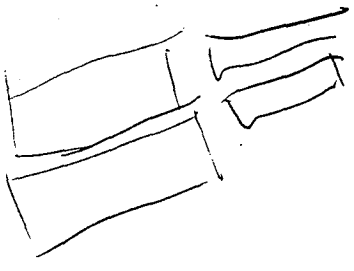
Alternator inoperative lights are located below the ammeter. The lights illuminate when the respective alternator fails to provide voltage. The lights should be checked prior to starting the engines, to see if the bulbs are burned out, by turning on the master switch. If the bulbs do not illuminate the bulbs should be replaced.

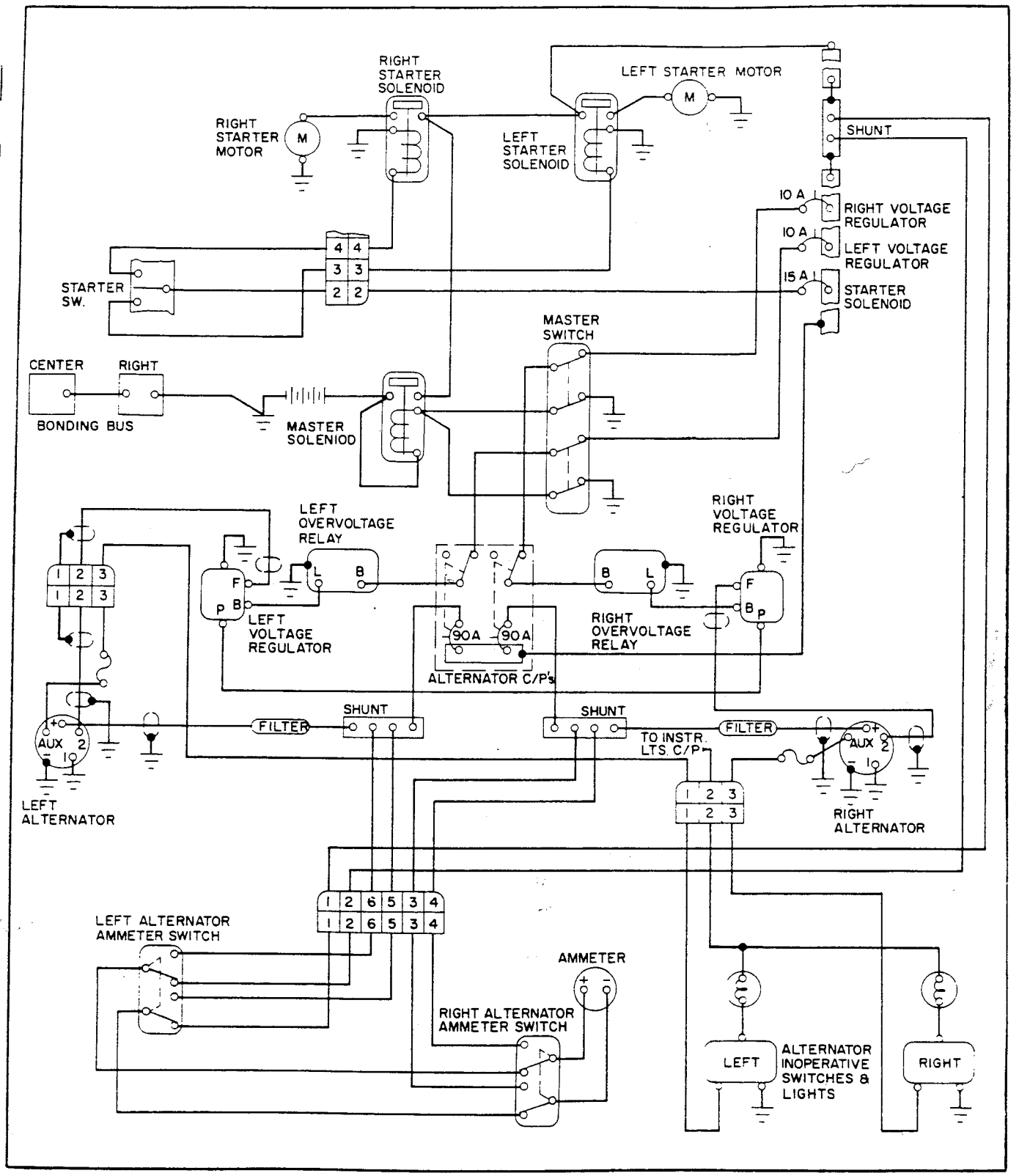
NOTE

Refer to the Airplane Flight Manual Section for corrective action for an alternator failure.

An ammeter, in conjunction with alternator push-to-test switches, is used to check the electrical system output. All of these items are located on the pilot's instrument panel. The ammeter normally indicates battery charge or discharge current. Depressing either of the push-to-test switches will cause the ammeter to indicate the respective alternator output current.

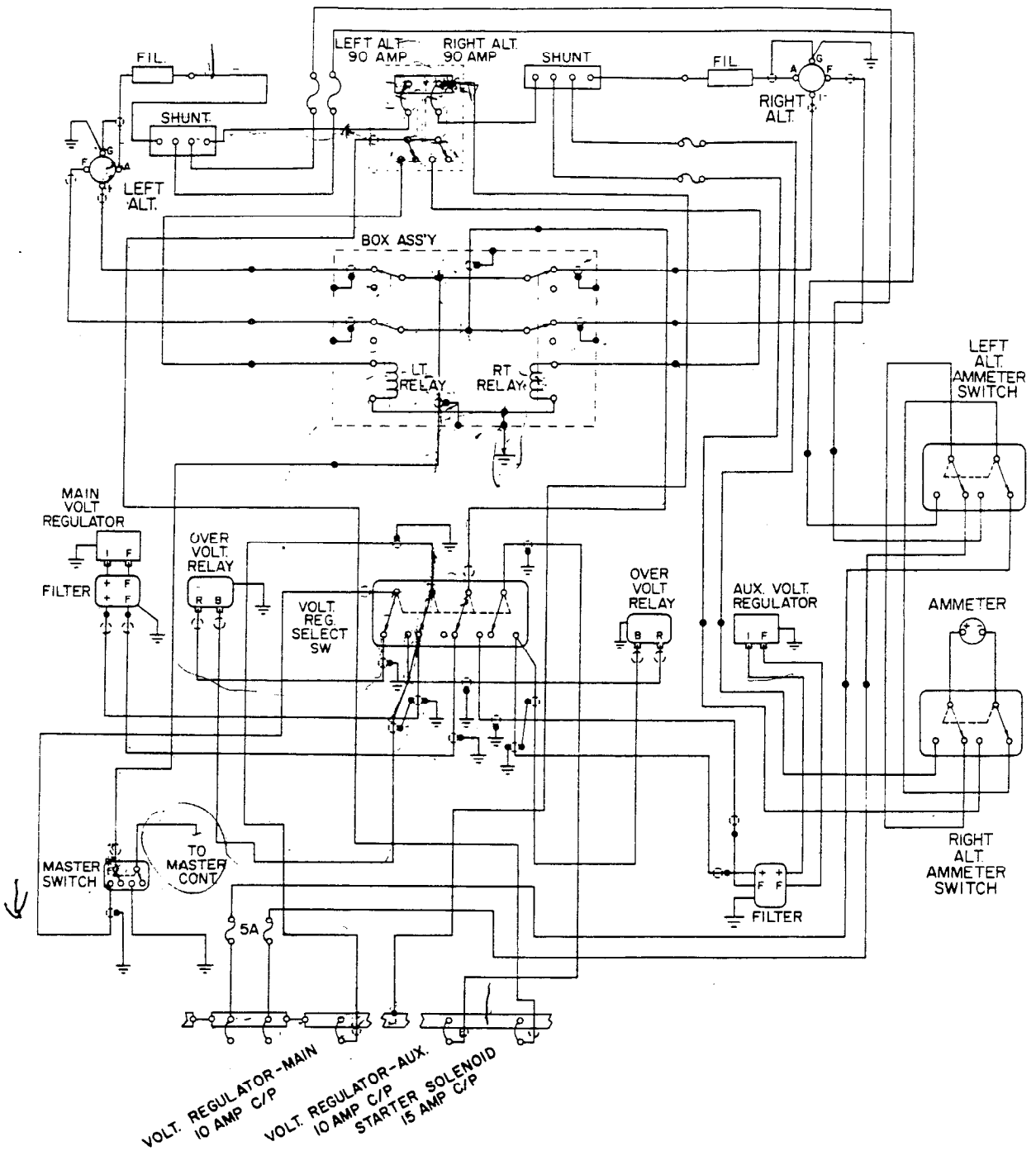
Electrical switches for the various systems are located primarily in the lower left sub-panel. Rheostat switches control the interior lighting: the instrument post light switch is on the left sub-panel just below the parking brake handle. the map light switch is just to the right of the brake handle and the switch for back lighting of the radio selector panel is centrally located at the top of the radio stack. The instrument panel can be illuminated from the cabin ceiling by turning the switch in the center of the overhead light panel. The alternator shunt fuses and spare fuses are located under the floor panel access door aft of the nose wheel well. The circuit breakers are located on the lower right sub-panel and automatically break the electrical circuit if an overload occurs. It may be necessary to allow approximately two minutes for the circuit breakers to cool before resetting them if an overload occurs. Corrective action should be taken in event of continual circuit breaker popping. It is possible to trip the breaker manually by pulling out the reset button. Do not open alternator switches in flight unless an emergency arises. If power loss occurs, reduce electrical load to a minimum and terminate flight as soon as practical.





Electrical System Schematic
Serial Number 39-146 and up

AIRPLANE AND SYSTEMS
ISSUED: June 1, 1970
REVISED: February 20, 1972

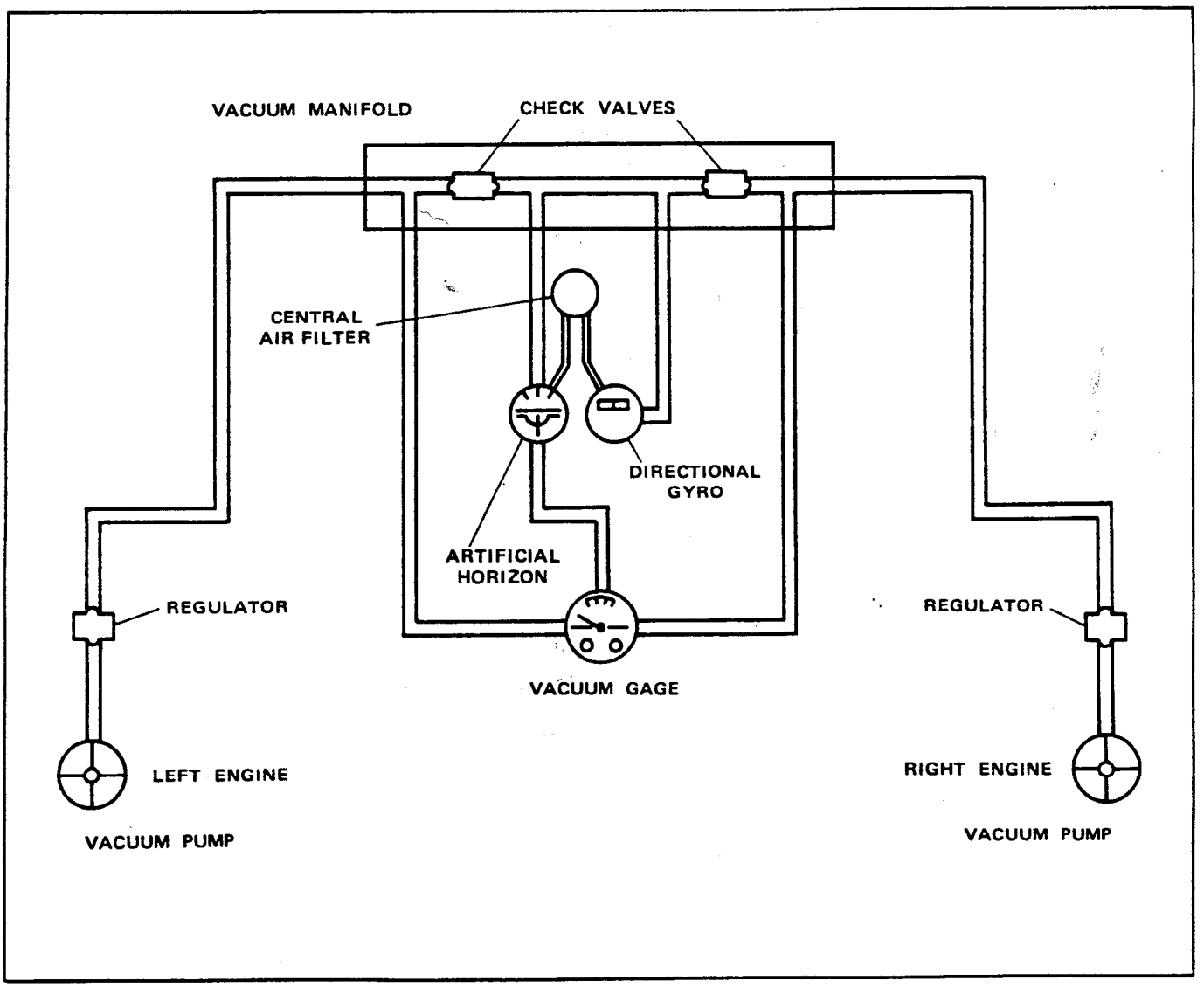


Electrical System Schematic
Up to and including Serial Number 39-145

VACUUM SYSTEM

Suction for the vacuum operated gyro instruments is supplied by two engine driven (dry type) vacuum pumps, interconnected to form a single system. Either vacuum pump has sufficient capacity to operate the gyro instruments. If suction is lost from one or the other side a check valve automatically closes and suction is supplied by the remaining system.

A vacuum gauge is installed in the instrument panel to provide a constant indication of vacuum source. Incorporated in the instrument are two red indicators (right and left systems). During normal operation the indicators are not visible, but if vacuum is lost, for example on the right side, then the right indicator will be visible. Suction is indicated on the gauge in inches of mercury; normal operating range is 4.8 to 5.1 inches. The system is controlled by two adjustable regulators, one located in each engine nacelle. After initial adjustment the regulators require very little attention.



Vacuum System Schematic

INSTRUMENT PANEL

The instrument panel is designed to accommodate the customary advanced flight instruments on the left side in front of the pilot and engine instruments on the right side. The optional instruments such as the gyro instruments of the flight group are shock mounted. The Artificial Horizon and Directional Gyro in this group are operated by an optional vacuum pump on each engine. The vacuum system standby is the optional, electrically operated Rate of Turn Indicator.

INSTRUMENT STATIC PRESSURE SYSTEM

Static air for the airspeed indicator, altimeter and vertical speed indicator is supplied from two static ports, one located on each side of the aft fuselage section.

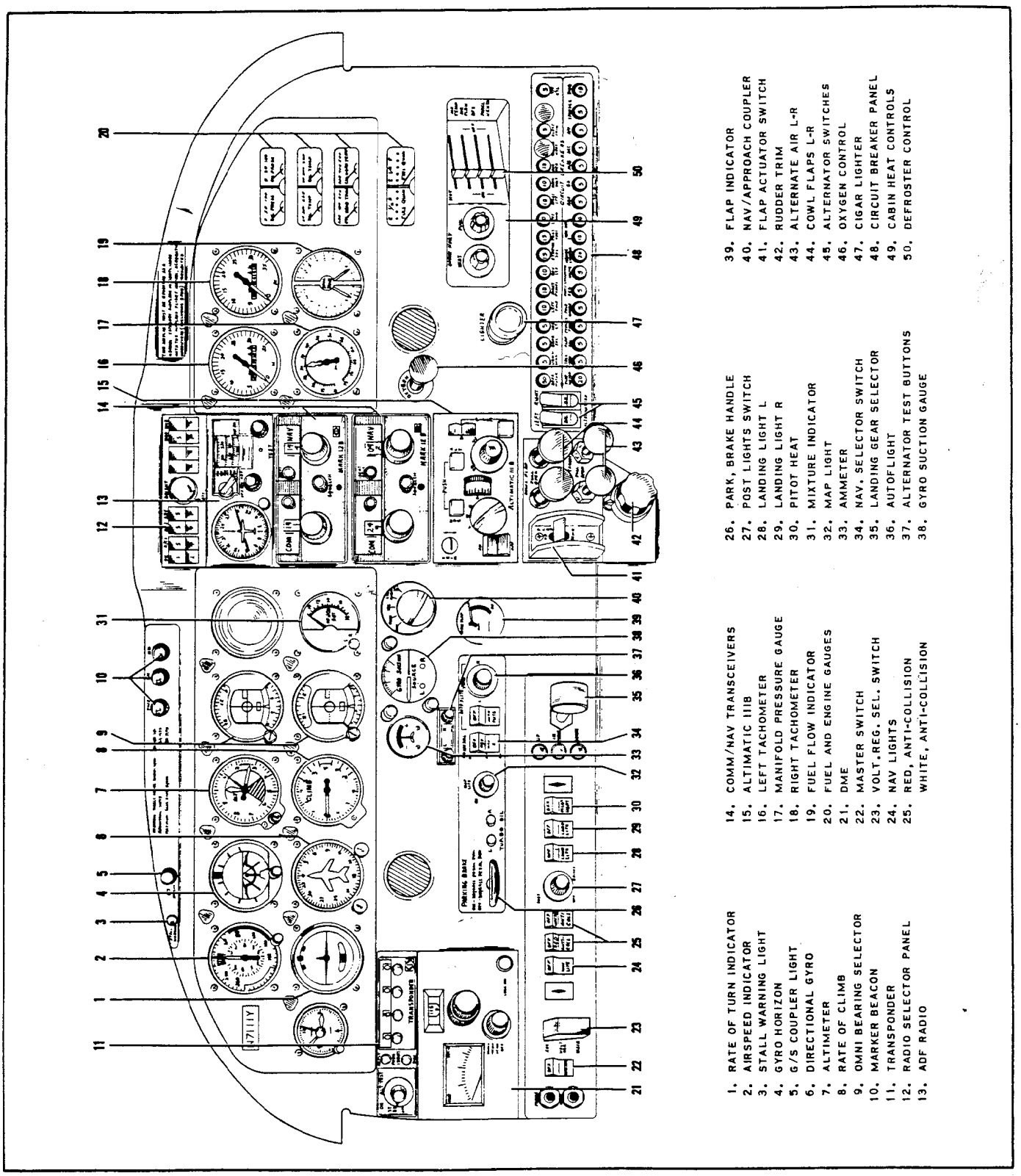
An optional, alternate static source is available to provide continuous operation of the pitot static instruments should the static system ports or lines become obstructed. The alternate static source is located in the cabin on the lower left side of the control quadrant.

If incorrect instrument readings are suspected the alternate static source valve should be opened, venting the static system to cabin pressure. Cabin pressure will vary, however with cabin ventilators open, cabin heater operating and various airspeeds.

Use of the alternate static source may result in the following instrument indications: The altimeter reads higher than normal; indicated airspeed greater than normal; and the vertical velocity indicator momentarily shows a climb.

The following table shows airspeed corrections for the standard static system and the alternate static system:

	Standard Static System	Alternate Static System	Gear and Flaps
IAS MPH	CAS MPH	CAS MPH	
80	82	81	Retracted
88	90	91	
120	121	113	
160	160	148	
200	197	185	
220	216	204	
80	80	81	Extended
91	90	91	
100	98	97	
120	117	113	



Typical Instrument Panel Installation

HEATING AND VENTILATING SYSTEM

The flow of air for heating and defrosting is taken through an inlet located in the nose and regulated by controls located in the lower right side of the instrument panel.

Heated air for the cabin and windshield defrosting is provided by a Janitrol heater installed in the nose section.

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

For heat the manual heater fuel valve must be on and the three position switch 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 levers on the heater control console. The top control regulates a thermostat and provides a wide range of temperature selections. Adjustable heat deflectors are on the cabin wall beneath the instrument panel to provide additional comfort.

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

Windshield defrosting may be regulated by various settings of the defroster lever 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.

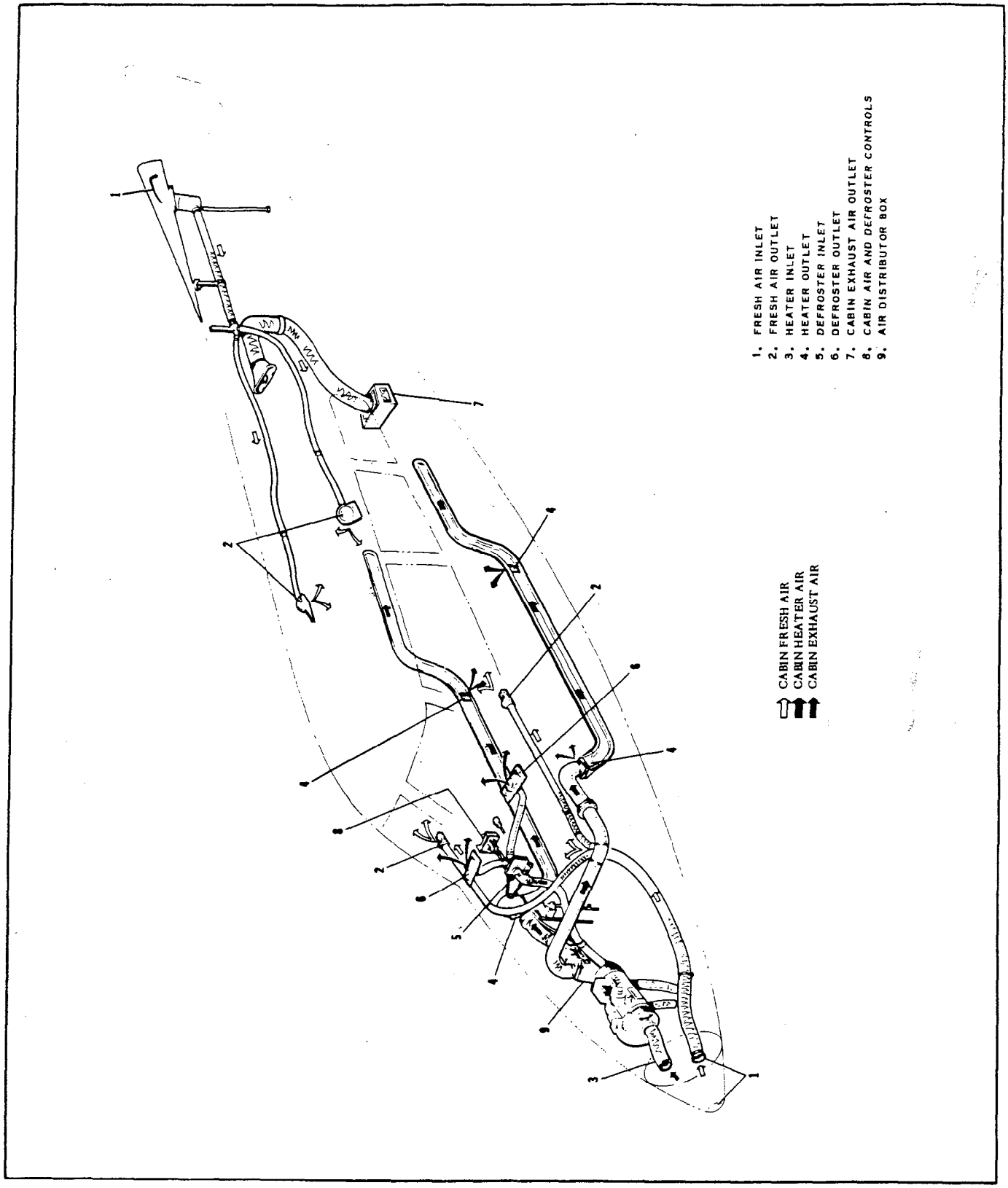
Heat may be supplied to warm the cabin before flight by turning on the master switch, the right auxiliary fuel pump, and starting the heater.

The cabin heater uses gasoline from the fuel injector on the right engine. If the right fuel selector is in the off position the heater is inoperative. In case of right engine failure the heater can be operated by leaving the fuel selector on and closing the mixture control while operating the auxiliary fuel pump. Before the heater is operated under these conditions, determine that no fuel leaks are present between the tank and engine.

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. It is reached only through the nose section to insure that the malfunction causing the overheat condition is corrected prior to future heater operation.

To prevent activation of the overheat control during landing roll or while taxiing, turn the three position switch to FAN during the approach for landing. During ground operation the manual switch should be on FAN for several minutes to cool the heater before turning to the OFF position.

Ventilating air for the cabin interior is obtained from the two ventilators located at each side of the instrument panel. The rear seat area is furnished with air by overhead vents from the dorsal fin scoop. Each individual vent is adjustable for the desired airflow. Located in the aft section of the cabin is an exhaust vent to improve the circulation of air in the cabin interior.



Heating And Ventilating System

SEATS

The front and rear reclining seats are adjustable fore and aft to provide comfort for pilot and passengers. Seat backs may be tipped forward to facilitate ease of entry and exit from the aircraft. They are easily removed by taking out the stops at the end of the mounting tracks and sliding the seats from their tracks.

The optional family seat(s) may be removed to allow more baggage area and access to the rear fuselage panel. Release the snap fasteners that attach the seat backs to the hat shelf and turn the wing fasteners at the back of the seat cushions. Vertically adjustable pilots' seats are offered as optional equipment.

FINISH

All sheet aluminum components are carefully finished inside and outside to assure maximum service life. Both sides of all pieces are alodine treated. External surfaces are coated with durable acrylic lacquer in attractive high gloss colors. The application of primer to interior surfaces prevents corrosion of structural and non-structural parts on the inside of the airplane.

BAGGAGE AREA

Maximum weight in the baggage area, including baggage, passengers and family seats is 250 pounds, with up to 20 cubic feet of available space. Baggage may be placed in the aircraft through a 19 x 21 inch door or through the passenger entrance. Tie-down straps are available for securing baggage when the family seats are not installed.

The baggage door may also be used as an emergency exit. It is opened by holding the inside door knob up while turning the latch clockwise.

STALL WARNING SYSTEM

An approaching stall is indicated by both a stall warning light and horn, activated by a lift detector installed on the left wing outboard of the engine nacelle.

This warning horn is separate and operated by a different system from the gear warning horn previously mentioned under landing gear.

PROPELLER SYNCHROPHASER*

The propeller synchrophaser eliminates manual propeller adjustments to reduce "Beat" effect of the propellers. The synchrophaser automatically maintains selected RPM after the pilot manually sets the desired RPM and selects the "Prop Sync." position on the propeller synchrophaser switch. The synchrophaser will maintain the selected RPM until the pilots readjust RPM's. See Operating Instructions for synchrophaser operation.

*Optional Equipment

WEIGHT AND BALANCE

FLORIDA AIRCRAFT INSTRUMENTS. INC.
8806 AIRPORT BOULEVARD
LEESBURG. FL 34788
PHONE: (904) 787-8566
FAX: (904) 787-3195

DATE: MAY 8. 1992

MAKE: PIPER MODEL: PA-39
SERIAL NO: 39-25 REG NO: N687PM
NAME: MASTRO MOTOR INC ADDRESS: 6402 W HILLSBOROUGH AVE
TAMPA FL 33614

PREPARED BY: JAMES R WILBURTH
see FORM 337 Dated MAY-8-1992.

ITEM	WEIGHT	ARM	MOMENT
PREVIOUS	2478.00	82.71	204968.40
REMOVED			
Flux Detector P/N 254-15A S/N 822	.50	190.00	95.00
Narco HSI100S S/N 10339	4.60	60.00	276.00
Radio Coupler P/N 1C388-3 S/N 1466	1.00	62.00	62.00
	2471.90	82.74	204535.40
ADDED			
Sigma-Tec HSI P/N 1U445 S/N 71406	5.50	60.00	330.00
Radio Coupler P/N 1C388-2 S/N K3938	1.00	62.00	62.00
	2478.40	82.69	204927.40

CATAGORY: NORMAL
NEW E.W.: 2478.40
NEW C.G.: 82.69
NEW U.L.: 1121.60

EMPTY WEIGHT C.G. AS WEIGHED

Empty Weight C.G. Forward Main Wheel Centerline:

A. $\frac{(N)\ 694 \times 87}{(T)\ 2409} =$ 25.1 Inches

Empty Weight C.G. Aft of Wing Leading Edge at Wing Station 97.0:

B. 29.7 - (A) 25.1 = 4.6 inches

Empty Weight C.G. Aft Datum:

C. 79.0 + (B) 4.6 = 83.6 inches

EMPTY WEIGHT AND C.G. WITH UNUSABLE FUEL

Item	Weight	Arm	Moment
Empty Weight as Weighed	2409	83.6	201392
Unusable Fuel (6.0 Gal. Inboard Tanks)	36	90	3240
TOTAL	2445	83.7	204632

BASIC WEIGHT AND C.G.

(With unusable fuel and oil - for use with Visual Plotter, and Weight vs. C.G. Chart.)

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

Item	Weight	Arm	Moment
Empty Weight as Weighed	2409	83.6	201392
Oil (4.0 Gal.)	30	51.0	1530
Unusable Fuel (6.0 Gal. Inboard Tanks)	36	90.0	3240
TOTAL	2475	83.3	206162

Basic Weight and C.G. is 2475 lbs. at 83.3 inches aft datum.

NOTES

(1) The Empty and Basic Weights include 6 gallon of unusable fuel (6.0 lbs. per gal. = 36 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 2 gallons (at 7.5 lbs. per gal. = 30 lbs. total).

WEIGHT AND BALANCE – VISUAL PLOTTER

The chart showing the approved Weight vs. Center of Gravity envelope and the Visual Plotter contained in the following pages will enable the pilot to graphically determine whether or not his proposed loading will fall within the allowable envelope. They will also allow him to easily determine the necessary adjustments to make if his first proposed loading is not within this envelope.

When plotting successive points, the pilot is graphically adding weights and corresponding moments. As the weight increases, through the addition of various items of disposable load, the pilot will see the shift in the center of gravity.

Going clockwise around the envelope, the heavy lines represent allowable weight at the forward C.G. limit (82 in.), the maximum allowable weight as the C.G. shifts rearward, the gross weight (3600 lbs.), and the maximum rearward C.G. limit (92 in.).

The sample problem which follows, will demonstrate the use of the Visual Plotter included with this manual. The pilot is not restricted to adding the items in the same succession as outlined, since the sample problem illustrates only one of many possible loadings. When plotting successive items of disposable load, the items most important to the mission under consideration (range or payload) may be added first.

SAMPLE PROBLEM

Assume (for demonstration purposes only) a Basic Weight and C.G. of 2330 pounds at 83.6 inches. Assume the disposable load to consist of pilot and 3 passengers (170, 170, 180, 160 pounds) 86 pounds baggage and maximum allowable fuel.

(1) On the Weight vs. C.G. Envelope opposite 2330 pounds locate the C.G. at 83.6 inches (Point 1). This point represents the Basic empty airplane with oil and 6 gallons of unusable fuel included.

(2) Lay the transparent Visual Plotter over the envelope (always keep BASE LINES parallel to horizontal or Weight ordinates) and plot along the proper scale the combined weight of the front seat occupants (340 pounds - Point 2).

(3) From Point 2, following the proper scale of the Visual Plotter, plot the combined weights of the rear seat occupants (340 pounds) and mark Point 3.

(4) From Point 3 plot the proper distance (use correct scale of Visual Plotter for each) which represent addition of baggage and finally fuel. (Points 4, 5 and 6.)

(5) When the final step of adding fuel is plotted, the point falls within the envelope at 3600 pounds, and 89.8 inches aft of datum. (The fuel graduations on the plotter run from 0 to 54 gallons, 0 to 30 gallons. The inboard tanks will always contain 6 gallons of unusable fuel, and these three figures total to the listed tank capacity of 90 gallons.)

(6) Fuel of 30 gallons is included for the optional tip tanks on the visual plotter.

NOTE

The dotted portion of the plotter (3600 lbs. to 3725 lbs.) should be used only when tip tanks are installed. Any weight in excess of 3600 lbs. must consist of symmetrically loaded fuel in the tip tanks.

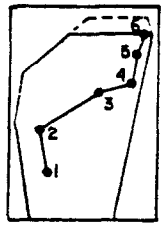
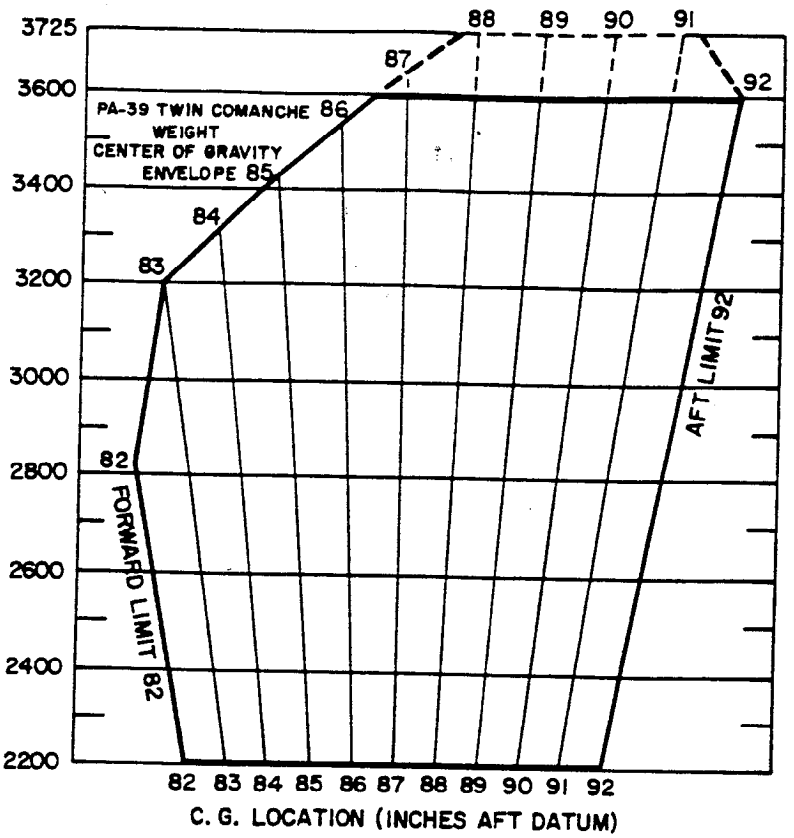


ILLUSTRATION
SAMPLE PROBLEM

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.



Moment change due to retracting Landing Gear = +1266 in.-lbs.

WEIGHT AND BALANCE

SUMMARY OF DISPOSABLE LOAD

ITEM	WEIGHT	ARM AFT DATUM	MOMENT
Oil (4 Gal.)	30	51.0	1530
Fuel - Inboard Tanks (54 Gal.)	324	90.0	29160
Fuel - Outboard Tanks (30 Gal.)	180	95.0	17100
Fuel - Tip Tanks (30 Gal.)	180	90.5	16290
Pilot Seat 1	170	84.8	14416
Co-Pilot Seat 2	170	84.8	14416
Passenger Seat 3	170	120.5	20485
Passenger Seat 4	170	120.5	20485
Passenger Seat 5	235	148.0	34780
Passenger Seat 6			
Baggage *	250	142.0	35500

6 gal. of unusable fuel of inboard tanks plus oil are part of the airplane basic weight.

* Baggage replaces seats 5 & 6.

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REVISED: March 17, 1971

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EQUIPMENT LIST

The following is a list of equipment which may be installed in the PA-39. Items marked with an * are optional equipment. Items marked with an "X" are items installed when the airplane was delivered by the manufacturer.

Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	A. Propellers and Propeller Accessories			
	Two Propellers			
____ ____	Hartzell Model HC-E2YL-2B/ 7663-4 (Left)			
____ ____	Hartzell Model HC-E2YL-2BL/ J7663-4 (Right)	54.5 ea.	23.0	TC P9EA
	or			
____ ____	Hartzell Model HC-E2YL-2BS/ 7663-4 (Left)			
____X____	Hartzell Model HC-E2YL-2BLS/ J7663-4 (Right)	55.5 ea.	23.0	TC P9EA
	or			
____ ____	Hartzell Model HC-E2YL-2BF/ F7663-4 (Left)	54.3 ea.	23.0	TC P9EA
____ ____	Hartzell Model HC-E2YL-2BLF/ FJ7663-4 (Right)	54.3 ea.	23.0	TC P9EA
	or			
____ ____	Hartzell Model HC-E2YL-2BSF/ F7663-4 (Left)	55.5 ea.	23.0	TC P9EA
____ ____	Hartzell Model HC-E2YL-2BLSF/ FJ7663-4 (Right)	55.5 ea.	23.0	TC P9EA

Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	A. Propellers and Propeller Accessories (cont)			
X	Two Spinners, PAC Dwg. 27068, PAC Dwg. 23819 and Bulkhead Adapters PAC Dwg. 23815 (To be used only with Hub Model HC-E2YL-2B or HC-E2YL-2BF or HC-E2YL-2BL or HC-E2YL-2BLF) or Two Spinners, PAC Dwg. 27068, PAC Dwg. 23819-3 and Bulkhead Adapters PAC Dwg. 23815 (To be used only with Hub Model HC-E2HL-2BS or HC-E2YL-2BSF or HC-E2YL-2BLS or HC-E2YL-2BLSF)	4.0 ea.	20.1	TC A1EA
*	Propeller Synchrophaser Inst. Per PAC Dwg. 27243	7.2	59.6	TC A1EA

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REISSUED: June 1, 1970
REVISED: September 3, 1971

Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	B. Engine and Engine Accessories - Fuel and Oil Systems			
X	Two Engines			
X	Lycoming Model IO-320-B1A (L)			
X	Lycoming Model LIO-320-B1A (R)	293.0 ea.	45.8	TC 1E12
	Two Oil Coolers, PAC Dwg. 18622, Harrison Model No. APO7AU06-03			
X	Installed in accordance with PAC Dwg. 24086	2.1 ea.	62.3	TC A1EA
	Two Fuel Pumps - Engine Driven			
X	AC Type JT Model 6440296 (L)			
X	AC Type JT Model GP6440296 (R)	2.0 ea.	58.0	TC 1E12
	Two Fuel Pumps - Elec. - Rotary			
X	Weldon Model No. B8100CC (L) - Per PAC Dwg. 24058-5			
	Weldon Model No. B8100C (R) - Per PAC Dwg. 24058-4	3.0 ea.	90.0	TC A1EA
	or			
	Weldon Model No. 24058-7 (L) - Per PAC Dwg. 24058-7			
	Weldon Model No. 24058-6 (R) - Per PAC Dwg. 24058-6	3.0 ea.	90.0	TC A1EA
	Two Starters - 12V			
X	Prestolite Model MZ-4206 (L)			
X	Prestolite Model MZ-4216 (R)	18.0 ea.	37.0	TC A1EA
	Two Vacuum Pumps			
* X	Airborne Mechanisms Model 200CC (L)			
* X	Airborne Mechanisms Model 200CW (R)	3.5 ea.	58.9	TC A1EA
	Two Hydraulic Governors			
X	Hartzell Model F-6-3A per PAC Dwg. 16564-7 (L)			
X	Hartzell Model F-6-3AL per PAC Dwg. 16564-8 (R)	4.6 ea.	61.8	TC P9EA
X	Two Induction Air Filters Fram Model CA144PL	0.7 ea.	57.0	TC A1EA

Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	B. Engine and Engine Accessories - Fuel and Oil Systems (cont)			
* _____	Brittain Industries Tip Tanks, Model TT-5 – Installed in accordance with Piper Drawing 27019 or Brittain Industries Installation Instructions 12070. Brittain Industries Flight Manual Supplement 11472, Dated July 2, 1964, Revision C Dated February 24, 1970 and Delegation Option Authorization, EA-1 Approved Supplement C to Airplane Flight Manual Piper Report 1605 required.	25	91.2	STC SA727WE
* _____	Two Engines Lycoming Model IO-320-C1A (L) with Rajay Turbocharger, Per STC SA787WE, Dated September 16, 1964, Revised February 6,1970. Installed Per Piper Drawing 26699 or Rajay Dwg. RJ0601. Rajay Flight Manual Supplement Dated Sept. 16, 1964, Revised February 6, 1970 required.	Use Actual Wt. Change		STC SA787WE
* _____	Lycoming Model LIO-320-C1A (R) with Rajay Turbocharger, Per STC SA787WE, Dated September 16, 1964, Revised February 6, 1970. Installed Per Piper Drawing 26699 or Rajay Dwg. RJ0601. Rajay Flight Manual Supplement Dated Sept. 16, 1964, Revised February 6, 1970 required.	Use Actual Wt. Change		STC SA787WE
* X	Two Oil Filters with Adapters Fuel Flow AC Model 6437032 Lycoming Part Nos. 77853 Housing and 77852 Base.	2.5 ea.	60.6	TC 1E12

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ISSUED: November 28, 1969
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Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	C. Landing Gear			
X	Two Main Wheel - Brake Assemblies (With #40-90 Wheel Assemblies #30-23 Brake Assemblies), 6.00-6 Type III, Cleveland Products No. 20-74	10.6 ea.	108.5	FAA TSO C26
X	Two Main 6-Ply Rating Tires 6.00-6 Type III, With Regular Tubes	9.4 ea.	108.5	TC A1EA
X	One Nose Wheel 6.00-6, Type III Cleveland Aircraft Products No. 38501	6.4	21.0	FAA TSO C26
X	One Nose Wheel – 6-Ply Rating Tire 6.00-6 Type III, With Regular Tube	9.4	21.0	TC A1EA

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ISSUED: November 28, 1969
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Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	D. Electrical Equipment			
	One Battery 12 V, 35 Ampere Hour	27.0	16.75	TC A1EA
____	a. Wisco			
X	b. Reading R-35			
____	c. Bowers B-34			
	Two Landing Lights			
____	a. G.E. Model 4509	1.0 ea.	86.0	TC A1EA
X	b. Westinghouse Model 4509	1.0 ea.	86.0	TC A1EA
~~____~~	Rotating Beacon, Whelen Model WRML-12	1.4	275.0	TC A1EA
X	Dual Alternators 12 V, 70 Amp., Prestolite ALX8403 With Regulators, Brackets and Relay	32.0	38.10	TC 1E12
* X	Auxiliary Power Receptacle Installation Per PAC Dwg. 26743 (Includes Power Cable in Baggage Area)	6.5	113.34	TC A1EA
* ____	Red Strobe Anti-Collision Light Installation in accordance with Whelen STC SA615EA and Piper Dwg. 27040. Delegation Option Authorization EA-1 Approved Supplement E to Airplane Flight Manual, Piper Report No. 1605, required.	3.1	175.2	STC SA615EA
* X	White Strobe Anti-Collision Light Installation in accordance with Whelen STC SA615EA and Piper Dwg. 27045. Delegation Option Authorization EA-1 Approved Supplement E to Airplane Flight Manual, Piper Report No. 1605, required.	4.8	134.4	STC SA615EA

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ISSUED: November 28, 1969
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Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	E. Interior Equipment			
___X___	Heater, Janitrol Model 20D35 Per PAC Dwg. 26721	29.0	15.0	FAA TSO C20
* _____	AutoControl III, AutoPilot Inst. Mitchell AK161, in accordance with Piper Dwg. 26733, Delegation Option Authorization, EA-1 Approved Supplement B to Airplane Flight Manual, Piper Report No. 1605, required.	4.0	113.0	TC A1EA
* ___X___	AltiMatic IIIB, AutoPilot Installation in accordance with Piper Dwg. 26884, Delegation Option Authorization EA-1. Approved Supplement D to Airplane Flight Manual, Piper Report No. 1605, required.	19.3	119.0	TC A1EA
* ___X___	Glar Ban Lights Per PAC Dwg. 26871	Neglect Wt. Change		TC A1EA
___X___	Delegation Option Authorization Approved Airplane Flight Manual, Piper Report No. 1605 Dated November 28, 1969, Reissued June 1, 1970 (Serial No. 39-1 and up)			TC A1EA
* _____	Delegation Option Authorization Approved Supplement A, Dated November 28, 1969 to Airplane Flight Manual, Piper Report No. 1605. Required when Oxygen System Installation is installed.			TC A1EA

Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	E. Interior Equipment (cont)			
* _____	Delegation Option Authorization EA-1 Approved Supplement B, Dated November 28, 1969 to Airplane Flight Manual, Piper Report No. 1605. Required when AutoControl III AutoPilot Installation is installed.			TC A1EA
* ___X___	Delegation Option Authorization EA-1 Approved Supplement D, Dated November 28, 1969 to Airplane Flight Manual, Piper Report No. 1605. Required when AltiMatic IIIB AutoPilot Installation is installed.			TC A1EA
* _____	FAA Approved Flight Manual Supplement, Brittain Industries, Inc., No. 11472, Dated January 30, 1969 Revision C Dated February 24, 1970 and Delegation Option Authorization EA-1 Approved Supplement C, Dated November 28, 1969, to Airplane Flight Manual, Piper Report No. 1605. Required when Brittain Industries Model TT-5 Tip Tanks are installed.			STC SA727WE
* _____	FAA Approved Airplane Flight Manual Supplement, Rajay Corp., Dated September 16, 1964, Revised February 6, 1970. Required when Rajay Corp. Turbochargers are installed.			STC SA787WE

Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	E. Interior Equipment (cont)			
* X	Delegation Option Authorization EA-1 Approved Supplement E, Dated November 28, 1969 to Airplane Flight Manual, Piper Report No. 1605. Required when Red Strobe Anti-Collision Lights and/or White Strobe Anti-Collision Lights are installed.			STC SA615EA
*_____	Delegation Option Authorization EA-1 Approved Supplement F, Dated November 2, 1970 to Airplane Flight Manual, Piper Report No. 1605. Required when Heated Glass Panel Installation is installed.			TC A1EA
*_____	AltiMatic IIIB-1, Autopilot including AutoFlite II Installation in accordance with Piper Drawing 27333-3, Delegation Option Authorization EA-1 and EDO-AIRE Mitchell STC SA1342SW Dated 7-20-71. EDO-AIRE Mitchell Flight Manual Supplements Dated 7-20-71 and Delegation Option Authorization EA-1 Approved Supplement G to Airplane Flight Manual, Piper Report 1605, Required.	20.2	94.0	STC SA1342SW STC SA1343SW
*_____	FAA Approved Flight Manual Supplements, EDO-AIRE Mitchell, Dated 7-20-71 and Delegation Option Authorization EA-1 Approved Supplement G, Dated November 30, 1971 to Airplane Flight Manual, Piper Report No. 1605. Required when AltiMatic IIIB-1 Autopilot with AutoFlite II Installation is installed.			STC SA1342SW STC SA1343SW

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Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	F. Miscellaneous Equipment			
* X	Heated Pitot Head - PAC Dwg. 26732	1.0	99.0	TC A1EA
X	Stall Warning Indicator PAC Dwg. 26651	Neglect Wt. Change		TC A1EA
*	Fire Extinguisher and Bracket Type A-30 Spec. MIL-E-5220A Per PAC Dwg. 21731	8.0	84.8	TC A1EA
*	Fire Extinguisher and Bracket Type 2 3/4 DCK-6 (Purch. Walter Kidde) Per PAC Dwg. 21731 or 26950	7.5	84.8	TC A1EA
*	Piper Electric Trim Per PAC Dwg. 26754	4.0	163.0	TC A1EA
* X	Piper Radio Coupler Per PAC Dwg. 26825	.5	66.0	TC A1EA
* X	Alternate Static System Installation PAC Dwg. 26722	Neglect Wt. Change		TC A1EA
*	Dual Brake Installation Per PAC Dwg. 24438 (Copilot only)	5.0	58.0	TC A1EA
*	Oxygen System Installation Per PAC Dwg. 26682, Delegation Option Authorization Approved Supplement A to Airplane Flight Manual, Piper Report No. 1605 required.	41.5	161.2	TC A1EA
* X	Seat Installation - Fifth and Sixth Per PAC Dwg. 26602	7.5 ea.	148.0	TC A1EA
*	Dual Tachometer Installation Per PAC 26897	2.5	64.6	TC A1EA
*	Dual Altimeter Installation Per PAC Dwg. 26730	3.0	64.2	TC A1EA
2-25-97 X	halon 2.5 - 1211 fire ext. & Bracket	5.0	84.0	

Item		Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
		F. Miscellaneous Equipment (cont)			
*	X	Adjustable Seat Installation (2) Front, Per PAC Dwg. 26971 (Leather with Skirt & Map Pan)	21.3 ea.	84.8	TC A1EA
		Shoulder Harness Installation Per PAC Dwg.			
*		Left Front 27006-2	.6	100.0	TC A1EA
*		Right Front 27006-3	.6	100.0	TC A1EA
*		Left Rear 27006-4	.6	133.0	TC A1EA
*		Right Rear 27006-5	.6	133.0	TC A1EA
		Head Rest Installation Per PAC Dwg. 26652			
*	X	Front Seats (1 & 2)	1.0 ea.	95.0	TC A1EA
*	X	Center Seats (3 & 4)	1.0 ea.	130.0	TC A1EA
*	X	Delta Mixture Control Indicator Model 2000 Installation Per PAC DWG. 26738 or Delta Products Instructions. Delegation Optional Authorization EA-1, Approved.	2.5	61.6	TC A1EA

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Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	G. Radio Equipment			
* _____	Narco VOA-4 Omni Head and Converter	3.25	64.0	TC A1EA
* _____	Narco VOA-5 Omni and G.S. Head and Converter	3.25	64.0	TC A1EA
* X	Omni Antenna Narco Type VRP-37	1.0	268.0	TC A1EA
* X	Transmitting Antenna #1 Narco No. VTP-17	1.0	139.5	TC A1EA
* X	Transmitting Antenna #2 Narco No. VTP-17	1.0	187.5	TC A1EA
* X	Piper PM-1 Marker Beacon with Antenna, Cables and Control Panel	2.5	18.7	TC A1EA
* X	Anti-Static Equipment Installation Per PAC Dwg. 25043	2.0	154.0	TC A1EA
* _____	Bendix ADF-T12C with Antenna and Cables	10.8	80.1	TC A1EA
* _____	Narco UDI-4 DME/Ground Speed Indicator with Antenna and Cables	9.0	60.0	TC A1EA
* X	Narco Mark 12B Installation (Less Antennas)	12.1	104.4	TC A1EA
* X	Narco Mark 12B Installation (Less Antennas)	12.1	104.4	TC A1EA
* _____	Narco UGR-2 Glide Slope with Antenna and Cables	5.2	125.2	TC A1EA

Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	G. Radio Equipment (cont)			
* X	Narco UGR-2 Glide Slope with ~~C.C.C. GS-401 Antenna~~ Coupler and Cables	2.4 ~~5.2~~	21.0 ~~125.2~~	TC A1EA
*	Narco UAT-1 Transponder Installation, Per PAC Dwg. 27007-2. (Includes Transponder Control Unit (UTC-2), Antennas, Antenna Cables, and Shock Mounted Base.)	13.8	146.2	TC A1EA
* X	Narco ADF-31A with BFO to include Antenna and Cables	14.2	93.8	TC A1EA
*	Narco VOA-8 Omni Head and Converter	3.25	64.0	TC A1EA
*	Narco VOA-9 Omni and G.S. Head and Converter	3.25	64.0	TC A1EA
*	Piper Glide Slope Coupler Per PAC Dwg. 26729	1.4	58.0	TC A1EA
*	Narco AT6-A Transponder Installation, Per PAC Dwg. 26894. (Includes Transponder Control Unit, Antenna, Antenna Cables, and Power Supply.)	8.4	137.6	TC A1EA
*	Marker Beacon Installation, Piper PM-1 (with Mark 16 Radio Only) Per PAC Dwg. 26801	2.5	30.4	TC A1EA
*	Narco Mark 16 Installation (Less Antennas)	7.2	60.0	TC A1EA
*	Narco Mark 16 Installation (Less Antennas)	7.2	60.0	TC A1EA
* X	Narco VOA-40 Omni Head and Converter (2) Removed (1) 9-13-72	1.6	62.5	TC A1EA

Item	Item	Weight Lbs.	Arm Aft Datum	Cert. Basis
	G. Radio Equipment (cont)			
* X	Narco AT5-A Transponder Installation, Per PAC Dwg. 27215-2 (Includes Transponder Control Unit, Antenna, Antenna Cables and Power Supply.)	REMOVED 24 MAY 1977 ~~8.4~~	~~137.6~~	TC A1EA
* X	Narco VOA-50M Omni and G.S. Head and Converter	1.6	62.5	TC A1EA
* X	Marker Beacon Installation, Piper PM-1 (with Mark 12B, Radio Only), Per PAC Dwg. 26742	2.5	30.4	TC A1EA
* X	Boom Mike Installation Per PAC Dwg. 26933	Neglect Wt. Change		
*	Narco VOA-40M Omni Converter	1.6	62.5	TC A1EA
*	King Digital ADF KR-85 Per PAC Dwg. 27218	8.1	83.5	TC A1EA
*	Bendix ADF-T12D with Antenna and Cables	11.2	80.1	TC A1EA
*	Marker Beacon Installation MBT-R-12 Per PAC Dwg. 27225 or 27226	3.0	41.5	TC A1EA
X	MARTEC ELT	3.0	109.0	
X	NARCO AT-50 TRANSPONDER	3.0	60.0	
X	AEROSONIC ENCODING ALT.	2.2	64.2	
~~X~~	~~KING KN-62 DME~~	~~3.0~~	~~109.0~~	

SEE SUPPLEMENT FOR ADDED EQUIPMENT (FRONT OF WEIGHT & BALANCE SECTION)

OPERATING INSTRUCTIONS

THIS SECTION IS DESIGNED:

1. To help you operate your Twin Comanche C/R 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 Twin Comanche's C/R operation than is permissible to set forth in the Airplane Flight Manual.

OPERATING INSTRUCTIONS

PREFLIGHT

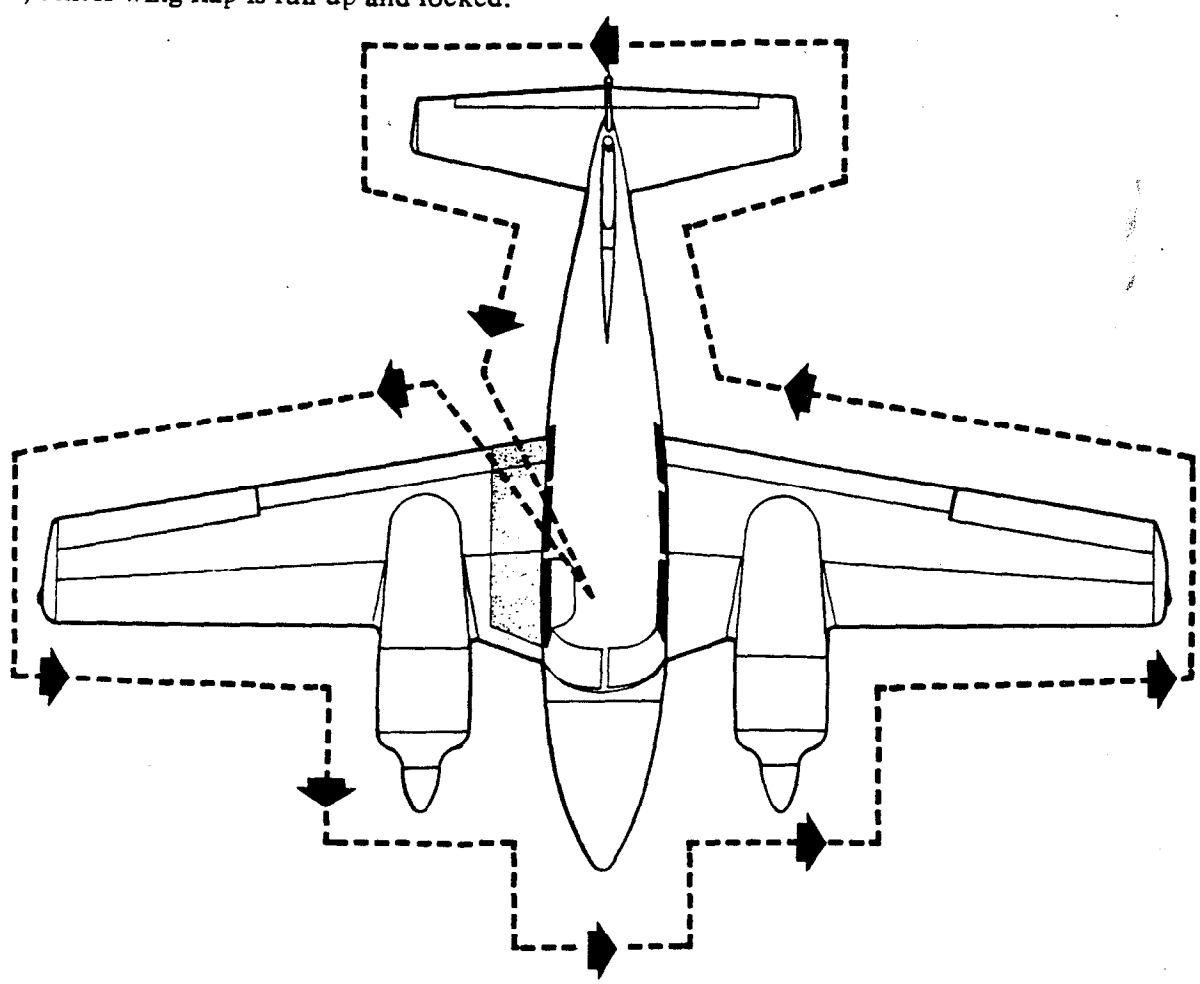
The following safety procedure instructions must become an integral part of the pilot's operational routine and preflight inspection.

Begin the preflight inspection in the cockpit. Check that the landing gear selector switch is in the down position. Turn master switch on and check that the green landing gear indicator light is on. If the green light is not on, make sure that the instrument panel light switch is turned to the OFF position. The landing gear indicator light is automatically dimmed and is difficult to see in the daytime if the instrument lights are on.

Drain about a quarter of a pint of fuel from each tank with the cockpit drains before doing the external preflight check. During the external check, determine that the fuel has stopped draining.

During the external preflight check see that the baggage-emergency door is properly secured. Prior to flight, passengers should be briefed about seat belts and shoulder harness, the use of oxygen when applicable, how to evacuate the airplane, and advised not to smoke during take-off or landing. They should be cautioned against handling or interfering with essential equipment and flight controls, fuel valves, switches, circuit breakers, trim knobs or cranks, radios etc.

The passengers should be cautioned against stepping on wing flap, when entering or leaving the aircraft, unless wing flap is full up and locked.



1. Magneto and master switches - OFF.
2. Fuel strainer sump - drained and not leaking.
3. Fuel selectors on main cells.
4. Control surfaces, wing, fuselage - no damage or operational interference.
5. Control surface - free of obstructions, frost, ice and snow.
6. Fuel supply - adequate.
7. Fuel cell caps - secure.
8. Fuel system vents - open.
9. Landing gear struts - 2-1/4" to 2-3/4" piston exposed under static load.
10. Tires - inflated and not excessively worn.
11. Cowling, landing gear doors, oil and inspection covers - secure.
12. Propellers - check.
13. Oil supply - adequate.
14. Leaks - absent.
15. Windshield - clean and secure.
16. Dorsal fin air scoop - free of obstruction.
17. Control locks - detached.
18. Baggage door - secure.
19. Tow bar - stowed.
20. Cabin controls - operative.
21. Gear selector switch - down.
22. Required papers - in order.
23. Turn master switch on - check stall warning system.
24. Check navigation lights.

BEFORE STARTING ENGINES

1. Baggage - secure.
2. Weight and C. G. - compute.
3. Performance - compute.
4. Aircraft papers - in order.
5. Maps and charts - check.
6. Baggage and main door - locked.
7. Crew seats - adjust.
8. Seat belts - secure.
9. Shoulder harness - secure.
10. Parking brake - set.
11. Altimeter - set.
12. Controls - response.
13. Oxygen press. - check.
14. Fuel valves - on, main.
15. Circuit breakers - check.
16. Switches (Radio etc.) - off.
    Except: Main voltage regulator - on (for airplane serial numbers 39-1 thru 39-145 only).
    Alternator circuit breaker switches - on.
17. Turbochargers - off.

STARTING ENGINES

Be sure that all radio switches, light switches and pitot heat switch are in the off position before starting engines.

1. Master switch - on.
2. Gear lights - check green.
3. Fuel quantity - check gauge reading.
4. Cowl flaps - open.
5. Throttle controls - open 1/2 inch.
6. Propeller controls - forward.
7. Mixture controls - rich.
8. Electric fuel pumps - on until indication on fuel flow gauge, then off.
9. Mixtures - idle cut-off.
10. Magneto switches - on.
11. Propellers - clear.
12. Starters - engage.
13. Mixtures - advance.
14. Oil pressure - check.

FLOODED START

1. Magneto switches - on.
2. Throttles - open.
3. Mixtures - idle cut-off.
4. Electric fuel pumps - off.
5. Starters - engage.
   (When engine fires, retard throttle and advance mixture.)

Cranking periods should be limited to 30 seconds with a two minute interval. Longer cranking periods shorten the life of the starter. Do not engage the starter immediately after releasing it as the starter mechanism may be damaged.

WARM-UP AND GROUND CHECK

Check the oil pressure as soon as the engines start. If no pressure is indicated within thirty seconds, stop the engine and determine the trouble. If cold temperatures exist (10°F or below), a longer period of time will be necessary before an indication is received.

Warm-up the engines at 1000 to 1400 RPM for not more than two minutes in warm weather and four minutes in cold. The engines are warm enough for take-off when no faltering occurs with the throttle opened. Avoid prolonged idling at low RPM to prevent fouled spark plugs. Check the magnetos with the propeller in low pitch and the engine running at 2200 RPM. The maximum drop on each magneto should not exceed 175 RPM while the differential drop between them should not exceed 50 RPM. Operation on one magneto should not exceed 10 seconds.

Move the propeller controls through their complete range to check feathering action, then leave them in the full forward low pitch position. Feathering action can be checked by running the engine between 1000 and 1500 RPM and pulling the prop control rapidly in and out of feathered position to prevent a drop of more than 500 RPM. Excessive manifold pressure will occur if the RPM count falls below 1000 during this check. Propellers should be cycled three times in cold weather.

Cowl flaps permit cooling of the engines by manual control during ground operations or special

conditions of flight. It is recommended that cylinder head temperature not exceed 400° F and the oil temperature should not exceed 245° F.

Turn off the electric fuel pumps after starting to make sure that the engine driven pumps are operating. The electric fuel pump should be on during take-off, landing and when changing fuel selector positions to prevent loss of power at critcial times.

ELECTRICAL POWER

Do not attempt flight with a very low charged battery. If the battery charge is too low, the alternator voltage control may become erratic.

CAUTION

Be sure to have the alternator circuit breaker switches turned on. If the battery charge is low and alternators are not operating, an inadvertent gear-up landing is possible because the warning horn and flashing light will not operate and the landing gear cannot be extended electrically. Manual extension of the landing gear is required under these circumstances.

TAXIING AND PRE-TAKE-OFF

Start to move the airplane forward. During initial taxiing, throttle back and apply brakes to check their operation. Use differential power and nose wheel steering rather than brakes when taxiing. Retard the throttle to the engine on the inside of turn and advance the throttle to the engine on the outside of the turn.

The autopilot should be off before take-off.

On a cold day test defroster and cabin heater before take-off. Do not fly in cold weather when the heater is inoperative, as the windshield may become frosted.

Lock the door before take-off. If this item is neglected and the door comes open after take-off, maintain normal climb and airspeed until sufficient terrain clearance is obtained. (Do not risk loss of control of the airplane to close the door. It is possible to continue safely for extended periods with the door unlatched.) When it is impossible to land straight ahead, the door may sometimes be closed by the following procedure: slow the airplane to 100 miles per hour; lower landing gear and wing flaps; open the small window to the left of the pilot; pull the door shut and lock it.

Check list:

1. Parking brake - on.
2. Engine run-up
   (a) Mixture controls - forward.
   (b) Propeller controls - forward.
   (c) Throttle controls - forward (1500 rpm).
   (d) Propeller controls - exercise.
   (Check feather; 500 rpm maximum decrease.)
   (e) Throttle controls - forward (2200 rpm).
   (f) Magnetos - check.
   Normal drop - 100 rpm
   Maximum drop - 175 rpm
   Differential drop left to right - 50 rpm
3. Engine gauges - check green.
4. Lights - as required.
5. Pitot heat - as required.
6. Transponder ~~- stand-by.~~ MODE C
7. Wing flaps - set (check visually).
8. Trim tabs - set.
9. Gyro pressure - 4.8 to 5.1 in. Hg.
10. Directional Gyro - set.
11. Turn and Bank - operating.
12. Altimeter - set.
13. Clock - wind and set.
14. Alternator output - check.
15. Electric fuel pumps - on.
16. Turbochargers - set or off.
17. Door - locked.

The normally recommended setting for sea level take-off is full throttle at 2700 RPM. The slightly rich mixture for this setting aids in cooling the engine.

TAKE-OFF AND CLIMB

CAUTION

Do not takeoff with ice or frost on the wings, as ice or frost will radically change the flight characteristics of the airplane.

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 and running turning takeoffs are not to be made with the main tanks less than one-quarter full as fuel flow interruption may occur. Only main tanks may be used for takeoff. Auxiliary or tip tanks are for level flight only and may never be used for takeoff.

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 auxiliary and tip tanks are being used or when main tanks are less than one-quarter full.

1. Parking brake - off.
2. Mixture controls - forward.
3. Propeller controls - forward.
4. Throttle controls - forward.
5. Accelerate to - 80 MPH (Prior to climb)
6. Landing gear - retract.
7. Accelerate to - 112 MPH (Best R/C speed)
8. Wing flaps - retracted.
9. Climb power - set. (At approx. 400 AGL)
10. Electric fuel pump - off one at a time.
11. Cowl flaps - set. (Maintain cylinder head temperature at or below maximum.)
12. Oxygen - no smoking - on (10,000 feet and above)

Trim for take-off so that a light back pressure on the control wheel allows the airplane to lift from the runway.

During take-off roll apply light back pressure to the control wheel to avoid porpoising during the take-off run. Accelerate to single engine minimum control speed (Vmc) before applying stronger back pressure for rotation.

When taking off from fields of high elevation use the turbochargers, if installed, to obtain a power setting of 29.5 inches of manifold pressure at 2700 RPM for a maximum for 5 minutes. Turn the turbo control slowly toward ON position to attain correct manifold pressure. Do not exceed 29.5 inches of manifold pressure and use the vernier control for fine adjustment.

During normal conditions, retraction of the landing gear should occur when a gear down landing is no longer possible on the runway. Attain the best rate of climb speed and at least 400 feet above ground level before reducing power.

WING FLAPS

Wing flaps are not necessary for take-off except when operating from a short or soft field. The use of wing flaps during take-off in a lightly loaded airplane may cause the airplane to lift-off the runway before Vmc is attained. An effort to hold the airplane on the runway too long may result in a "wheelbarrowing tendency" with most of the weight on the nose wheel.

Wing flaps are not normally used during a crosswind take-off. After lift-off set up the required crab angle, retract the gear at a safe altitude and continue climb out.

An en route climbing speed of 130 miles per hour is recommended for increased forward visibility during continuous climb.

SHORT AND SOFT FIELD TAKE-OFFS

If it is necessary to get the airplane off the runway in the shortest possible distance, set take-off wing flaps (with the flap position needle at the bottom of the white arc on the flap indicator). With brakes set, run up engines to maximum power and check instruments. If the airplane is off the runway at less than 80 miles per hour, it is essential to fly level a few feet off the runway immediately after lift-off until reaching 80 mph. After airspeed has increased, initiate a climb at the best angle of climb speed (90 mph at sea level) if an obstacle is to be cleared, or at the best rate of climb speed (112 mph at sea level) if a normal climb out is desired. Since the airplane cannot be controlled in flight below Vmc in the event of the sudden power loss in one engine, be ready to reduce power promptly.

NOTE

Take-off at high altitude (density altitude), from a soft, wet, rough or grassy field, or with an uphill gradient or tail wind component results in greatly reduced take-off performance.

During take-off roll, check to be sure the airspeed indicator is operating properly. The needle should indicate zero when the airplane is at rest.

LANDING GEAR RETRACTION

Make sure the aircraft has sufficient altitude and airspeed with no chance of settling back on the runway before retracting the gear. When taking off from a long runway, retract the landing gear when it would no longer be possible to land straight ahead.

DEICER BOOTS

If your Twin Comanche C/R is equipped with deicer boots, they should not be operating during take-off since inflated boots can change the stall characteristics of the airplane.

V_{MC}

Vmc (Velocity minimum control) is the calibrated airspeed, determined by FAA test pilots. below which a twin engine aircraft cannot be controlled in flight with one engine operating at take-off power and the other engine windmilling. The Vmc which the FAA has determined for the Twin Comanche C/R is 80 mph CAS.

Calibrated airspeed is equal to the airspeed indicator reading corrected for position and instrument error. Since calibrated airspeed and density altitude and pilot flight techniques vary, it is best, especially when heavily loaded or on a cold day, to fly the aircraft as though Vmc were slightly higher.

Under no circumstances should the aircraft be flown below the Vmc of the aircraft with one engine operating at maximum power and the other engine windmilling. When operating under single engine flight conditions, either in training or in emergency situations, maintain indicated airspeed above 90 mph.

APPROACH V_{MC} WITH CAUTION

On take-off the aircraft should be kept either on, or near the runway, until reaching Vmc. After Vmc has been reached the aircraft should be accelerated as rapidly as possible to the best rate of climb speed (112 mph) if there are no obstacles ahead. If there are obstacles ahead maintain the best angle of climb speed (90 mph). The applicable speed should be maintained until all obstacles are cleared and the airplane gains sufficient altitude.

STALLS

STALL SPEED TABLE (CAS)

Angle of Bank	Gear & Flaps Up	Gear & Flaps Down
0°	76	70
20°	79	71
40°	87	79
60°	108	98

These figures are at gross weight with power off.

WARNING

When practicing stalls maintain minimum terrain clearance of 5000 feet. Single engine or asymmetric power stalls prohibited. Power on stalls above 2100 RPM prohibited. Do not practice stalls when carrying passengers, when the airplane is heavily loaded or with the center of gravity near the aft limit.

As in any multi-engine airplane, stall recovery in the Twin Comanche C/R should be initiated at the first indication of a pre-stall buffet, warning light or horn. The airplane should not be permitted to develop into a full stall.

CAUTION

Use controls promptly to counteract any rolling or yawing action of the airplane during the approach to and recovery from the stall. The stall warning system is inoperative if the master switch is off.

NOTE

An increase in bank angle increases the stalling speed.

SPINS

All spins are prohibited, however in the event an unintentional spin is encountered recovery can be accomplished by immediately using the following procedures:

a. Retard both throttles to the idle position.

b. Apply full rudder in the opposite direction to the spin.

c. Push control wheel full forward. While it is not necessary for recovery, the use of ailerons against the turn (i.e. right aileron if spin is to the left) will expedite recovery.

d. Maintain controls in these positions until the spin stops. Then neutralize rudder and ailerons.

e. Recover from dive with smooth back pressure on the control wheel. No abrupt control movement should be used during recovery from the dive, as the maneuvering speed and positive limit maneuvering load factor may be exceeded.

NOTE

Altitude loss in a spin may be in excess of 2000 feet. Avoid any maneuver which might result in a spin at low altitude. The more rapidly spin recovery is begun the more prompt the recovery will be.

CRUISING

The cruise power concept now possible with Lycoming engines permits more efficient use of the available horsepower. Simplified power management allows a more constant manifold pressure and eliminates continual reference to power charts.

Refer to Power and Performance charts for power settings. Do not exceed 28 inches of manifold pressure below 2400 RPM.

To INCREASE power, first increase RPM; then increase manifold pressure.

To DECREASE power, first decrease manifold pressure; then decrease RPM.

To obtain the desired cruise, set the manifold pressure and RPM according to the power setting table. For information on leaning procedure see Avco-Lycoming Operator's Manual and current Avco-Lycoming Service Instructions. Also see "Avco-Lycoming Leaning Procedures for Twin Comanche C/R Engine" on Page 9.

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 be accomplished.

1. Electric fuel pumps - off.
   (Unless above 15,000 feet)
2. Power - set.
3. Mixture - lean in accordance with engine manufacturer manual.
4. Cowl flaps - set.
   (Position to maintain allowable cylinder head temperature)
5. Fuel valves (main or auxiliary) - on.
6. Trim - set.
7. Engines gauges - check and monitor.

Since a fuel injected engine such as is used on the Twin Comanche takes an appreciable length of time to start after fuel starvation, it is recommended that you avoid emptying a fuel cell to depletion. If the engine should stop because a fuel cell is depleted of fuel be prepared to wait a while for the engine to start after changing to a fuel cell with fuel in it. If it is necessary to use all the fuel in a fuel cell, carefully monitor the fuel flow meter and quickly change the fuel valve position at the first indication of a decrease in fuel flow. This will enable you to keep the engine operating while using all of the fuel in the fuel cell.

During flight, keep account of time and fuel used in connection with power settings to determine how the fuel flow and fuel quantity gauging systems are operating. If the fuel flow indication is considerably higher than the fuel actually being consumed or an asymmetric flow gauge indication is observed, you may have a clogged fuel nozzle which should be cleaned.

APPROACH AND LANDING

Prior to extending the landing gear for landing, retard both throttle controls to check that the landing gear warning horn is operating. Flying the airplane with the horn inoperative is not permitted. It can lead to a gear up landing as it is easy to forget the landing gear when approaching for a single engine landing when other equipment is inoperative or when attention is drawn to events outside of the cockpit. Therefore it is especially important to check that the landing gear is down when there is any distraction in the landing situation.

Lower the gear at speeds below 150 miles per hour and the flaps at speeds below 125 miles per hour for reduce wing flap operating loads.

CAUTION

Maintain sufficient speed during turns in the traffic pattern. It is a good practice to trim the aircraft to establish a speed of at least 115 miles per hour on the downwind leg and 110 miles an hour on the base leg. Hold 110 miles per hour until the turn onto final approach has been completed. Then reduce to a final approach speed at 95 miles per hour.

Set the propeller at a high cruising RPM of a least 2400 RPM for ample power if a go-around is necessary. Mixture control should be in the full rich position unless density altitude or conditions of high temperature and humidity dictate otherwise.

Avoid steep turns at low airspeeds or at low altitudes, particularly during the turn from base leg to final approach.

Ascertain the landing gear is down and locked on base leg or final approach by checking the green indicator light on the instrument panel and the external mirror to make sure the nose landing gear is extended.

NOTE

When the instrument lights are on, the gear position lights are dimmed for night flight.

The degree of wing flap extension and touch down speed vary with conditions, but under normal conditions full wing flaps (27 degrees) should be used during the final approach and landing to reduce stall speed and to permit contact with the runway at a slower speed.

Contact the ground at the minimum speed consistent with landing conditions.

For short, slow landings under normal conditions use full wing flaps, partial power, and hold the nose up as long as possible before and after contacting the ground with the main wheels.

In high winds and crosswinds, it is desirable to approach a landing at higher than normal speeds with half or no wing flaps. If a go-around is necessary apply full throttle, retract the landing gear, and slowly retract the wing flaps.

During a crosswind approach hold a crabbed angle into the wind until ready to flare out for the landing. Then lower the wing that is into the wind, reduce crabbed angle, and keep the wheels aligned to the runway using rudder.

NOTE

Landings with a crosswind component greater than 20 miles per hour should be avoided.

When extending or retracting wing flaps, do so a few degrees at a time to avoid an asymmetrical flight condition which would result if one wing flap should stick.

Do not side slip with wing flaps extended.

Avoid prolonged side slip with a fuel selector set to a fuel cell with low fuel indication.

Prior to landing and early in the roll out the brakes should be checked for operation. After landing maximum braking is achieved by retracting wing flaps and pulling back on the control wheel as wheel brakes are applied.

CAUTION

It is possible for a pilot to inadvertently reach for the landing gear selector switch instead of the wing flap switch while there is still enough lift on the wings to keep full weight of the airplane off the wheels and thus prevent the actuation of the landing gear safety mechanism, causing retraction during the landing roll. If additional braking is not needed, the wing flaps should be retracted after the airplane has been maneuvered to a stop off the runway. If a landing must be made without wheel brakes the airplane should be flown to contact the ground at a slower speed and landed short on the longest available runway.

The procedure for manually lowering the landing gear should be memorized and understood completely so that it can be accomplished quickly in an emergency situation, such as a single engine landing.

Landing check list:

1. Oxygen (below 10,000 ft) - off.
2. Seat belts - fastened.

NOTE

When the instrument lights are on, the gear position lights are dimmed for night flight.

The degree of wing flap extension and touch down speed vary with conditions, but under normal conditions full wing flaps (27 degrees) should be used during the final approach and landing to reduce stall speed and to permit contact with the runway at a slower speed.

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If a go-around is necessary apply full throttle, retract the landing gear, and retract the wing flaps a few degrees at a time.

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The procedure for manually lowering the landing gear should be memorized and understood completely so that it can be accomplished quickly in an emergency situation, such as a single engine landing.

Landing check list:

1. Oxygen (below 10,000 ft) - off.
2. Seat belts - secure.

3. Shoulder harness - secure.
4. Electric fuel pumps - on.
5. Mixture - rich (unless airport is at high altitude).
6. Fuel valves - on. main.
7. Landing gear (under 150 MPH) - extend, check green.
8. Propellers (2400) - set.
9. Flaps (under 125 MPH) - set.
10. Turbochargers - off.
11. Heater (if used) - fan on.

A gear-up landing may be necessary under the following conditions:

a. If surface is too soft or rough for gear down landing.
b. When the field is too short for a gear down landing.
c. When a water landing is necessary.

During a gear-up landing use a normal flaps-up approach. Unlock the door on the final approach. During flare out close the throttles, shut off the master and magneto switches, turn fuel valves off and contact surface at minimum speed.

POST LANDING

Check list:

1. Wing flaps - retract.
2. Cowl flaps - open.
3. Electric fuel pump - off.
4. Prop controls - forward.

When completely stopped in a parking spot, check the following items for shut down:

1. Radio & elec. equip. - off.
2. Heater (if used) fan - off.
3. Mixture controls - idle cut-off.
4. Magneto switches - off.
5. Master switch - off.
6. Parking brake - on.
7. Main volt. reg. - on (for airplane serial numbers 39-1 thru 39-145 only).
8. Alternator circuit breaker switches - on.

If control locks are not available and the airplane is to be left for more than a few minutes, secure the control wheel with the safety belt strap. Chock the wheels and secure tie downs at appropriate places.

V_{MC} DEMONSTRATION

WARNING

The engine-out minimum control speed demonstration required for the FAA flight test for the multi-engine rating approaches an uncontrolled flight condition with power reduced on one engine. The demonstration should not be performed at an altitude of less than 3500 feet above the ground. APPROACH V_{MC} WITH CAUTION. Initiate recovery during the demonstration by immediately reducing power on the operating engine and promptly lowering the nose of the airplane.

V_{MC} AND STALL SPEED

More power is available on the operating engine at lower altitudes (if the engine is normally aspirated) and hence there can be more asymmetric thrust. The Vmc is highest at low altitudes. The Vmc decreases with altitude and at higher altitudes the airplane will approach a stall speed before reaching Vmc. The most critical situation occurs at the altitude where the stall speed and Vmc speed coincide. Care should be taken to avoid this flight condition because at this point loss of directional control could lead to a spin.

SINGLE ENGINE FLIGHT

During single engine flights be sure that the gear and flaps are fully retracted when climbing at the best single engine climb speed. Speeds above or below the best single engine climb speed will decrease climb performance. Close the cowl flap on the inoperative engine and trim the airplane to reduce drag.

RECOMMENDED PRACTICE

When operating single engine maintain speed above 90 mph. This speed, 90 mph, will not provide optimum single engine climb performance. Optimum single engine climb is obtained at the best single engine rate of climb speed, 105 mph, with the operating engine at full throttle, 2700 rpm and the inoperative engine propeller feathered and cowl flap closed. The gear and wing flaps must be retracted.

LOADING AND WEIGHT AND BALANCE

CAUTION

It is the responsibility of the owner and pilot to determine that the gross weight of the airplane is not exceeded and to determine that the airplane remains within the allowable weight vs center of gravity envelope while in flight. The owner or pilot must determine before each flight that the gross weight is not exceeded and that the center of gravity is within allowable limits. For weight and balance see the Airplane Flight Manual and Weight and Balance form supplied with each airplane.

Weight and balance determination should be accomplished with the Weight and Balance Plotter supplied with the airplane.

The airplane can carry six passengers with less than the full fuel capacity of 90 gallons (without wing tip tanks) and less than the allowable baggage. The two rear family seats, if installed, are designed and placarded to carry not more than 235 lbs. total. With these two rear family seats removed, the area remaining (baggage) will carry up to 250 lbs. depending upon airplane loading. It will carry fewer passengers and baggage with full fuel tanks. As with any airplane, improper loading will cause undesirable flight characteristics if the airplane approaches a critical or marginal flight condition.

Make sure that baggage and/or cargo are secured properly with tie down straps to avoid an accidental in-flight shift of the center of gravity or injury to passengers.

With tip tanks installed, the airplane has an allowable gross weight of 3725 pounds. It is important to remember that any weight in excess of 3600 pounds however, must be in the form of fuel in the tip tanks.

ALTERNATE INDUCTION AIR

When flying in wet, heavy snow or other conditions where the induction air filters may become clogged, monitor the manifold pressure gauge. A decrease in manifold pressure may indicate a clogged filter. If the decrease is followed by a slight increase in manifold pressure, this will then indicate that the automatic alternate induction air system is in operation, and the manifold pressure may then be brought back to the desired level with the throttle control.

A continued drop in manifold pressure would indicate that the automatic induction air system was not working. In this case, actuate the manual alternate air control, which serves as a backup for the automatic system. A partial regain of manifold pressure will indicate that the manual alternate air induction system is operating. Throttle controls may be advanced to gain additional manifold pressure.

The manual alternate air control should not be actuated on the ground with the engines operating, because the engines would then be supplied with unfiltered air.

ROUGH AIR FLIGHT

In conditions of extreme turbulence, reduce power to slow the airplane below the design maneuvering speed of 162 miles per hour.

A further reduction of power will ease the stress to which the airplane is subjected by virtue of turbulence. When flying in extreme turbulence or strong vertical currents, using the autopilot, the altitude-hold mode should not be used.

Secure seat belts and shoulder harness in extreme turbulence.

RADIO OPERATION

Communication and navigational equipment controls are located in the center of the instrument panel. Associated switches are located in a junction box above the radio stack. Circuit breakers for the radios are located on the lower right sub-panel. All sets are turned on by the switch in the control head of each unit. After power is supplied, either one of the transmitters may be operated by moving the selector switch to the desired position.

PROPELLER SYNCHROPHASER OPERATING PROCEDURE

The propeller synchrophaser automatically maintains both propellers at the same RPM and at a preselected phase angle. This eliminates the propeller "Beat" effect and minimizes vibration.

The left engine is established as the master engine. The right engine is equipped with a slave governor which automatically maintains its engine RPM with the left engine RPM.

The propeller synchrophaser switch is located on the lower left side of the instrument panel. It has two positions, "MAN." for manual or stand by and "Prop Sync." for propeller synchrophaser.

For Taxiing:

Set the synchrophaser switch to "MAN."

For Take-off and Landing:

Set the synchrophaser switch to "MAN." "Prop Sync." can be used for or take off with no adverse affect.

For Cruise:

Synchronize the propellers manually so that engine RPM's are within 40 to 50 RPM of each other, then set the synchrophaser switch in the "Prop Sync." position.

NOTE

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

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

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

NOTE

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

NOTE

Each time a propeller RPM differential greater than 50 RPM occurs, it will be necessary to recycle the system to "MAN." for 30 to 40 seconds then to "Prop Sync."

NOTE

Should there be an electrical system failure the slave engine will return to the control selected RPM + approximately 25 RPM.

OPERATING TIPS

OPERATING TIPS

The following Operating Tips are of particular value in the operation of the Twin Comanche C/R:

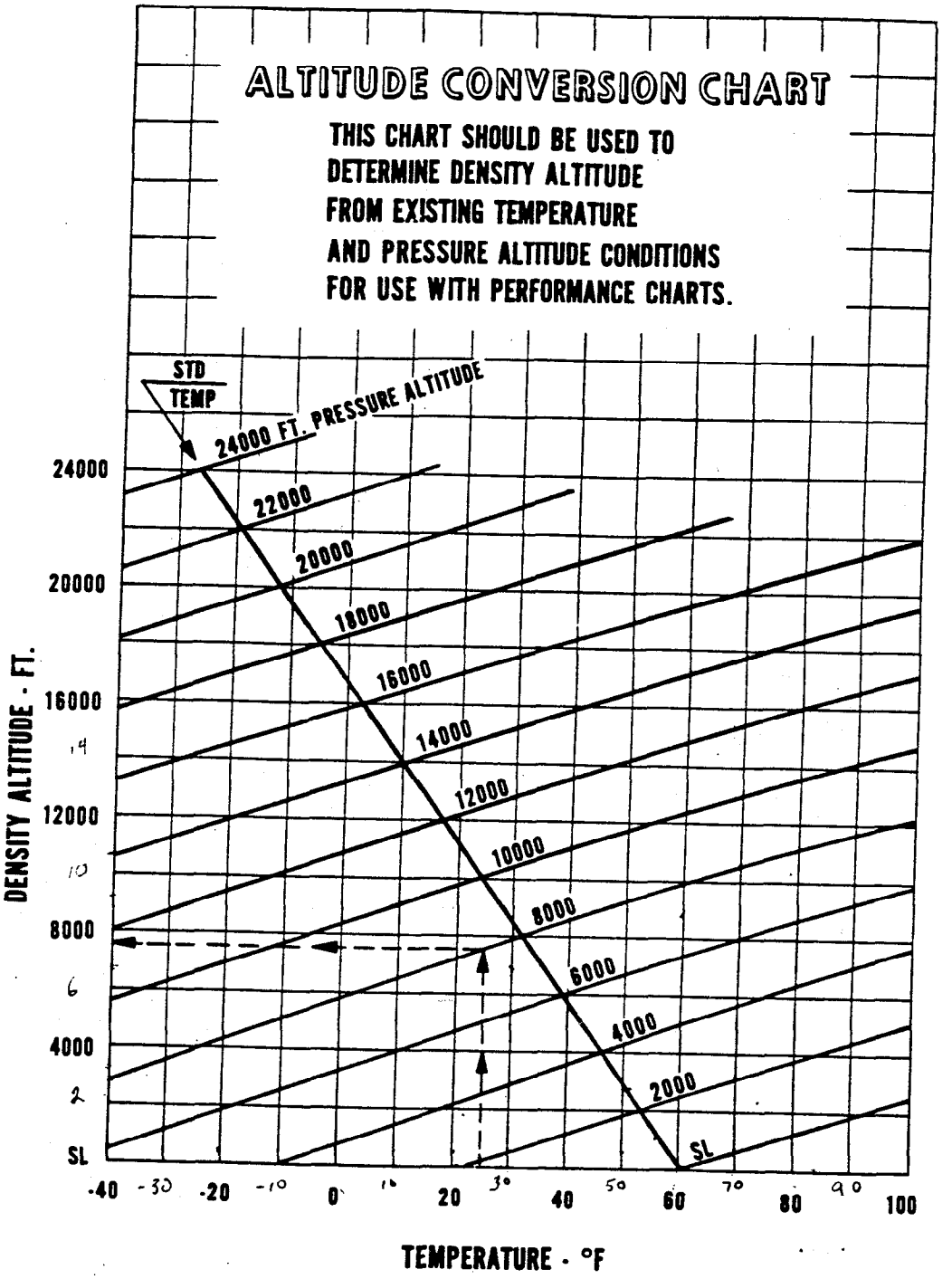
1. Strobe lights should not be operated when flying through heavy haze or clouds, since reflected light can produce spacial disorientation. Show courtesy for other pilots by not operating strobe lights while taxiing in the vicinity of other aircraft.
2. In an effort to avoid accidents, pilots should obtain and study the safety related information made available in FAA publications such as regulations, advisory circulars, Aviation News, AIM, and safety aids.
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. 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 Houson 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:

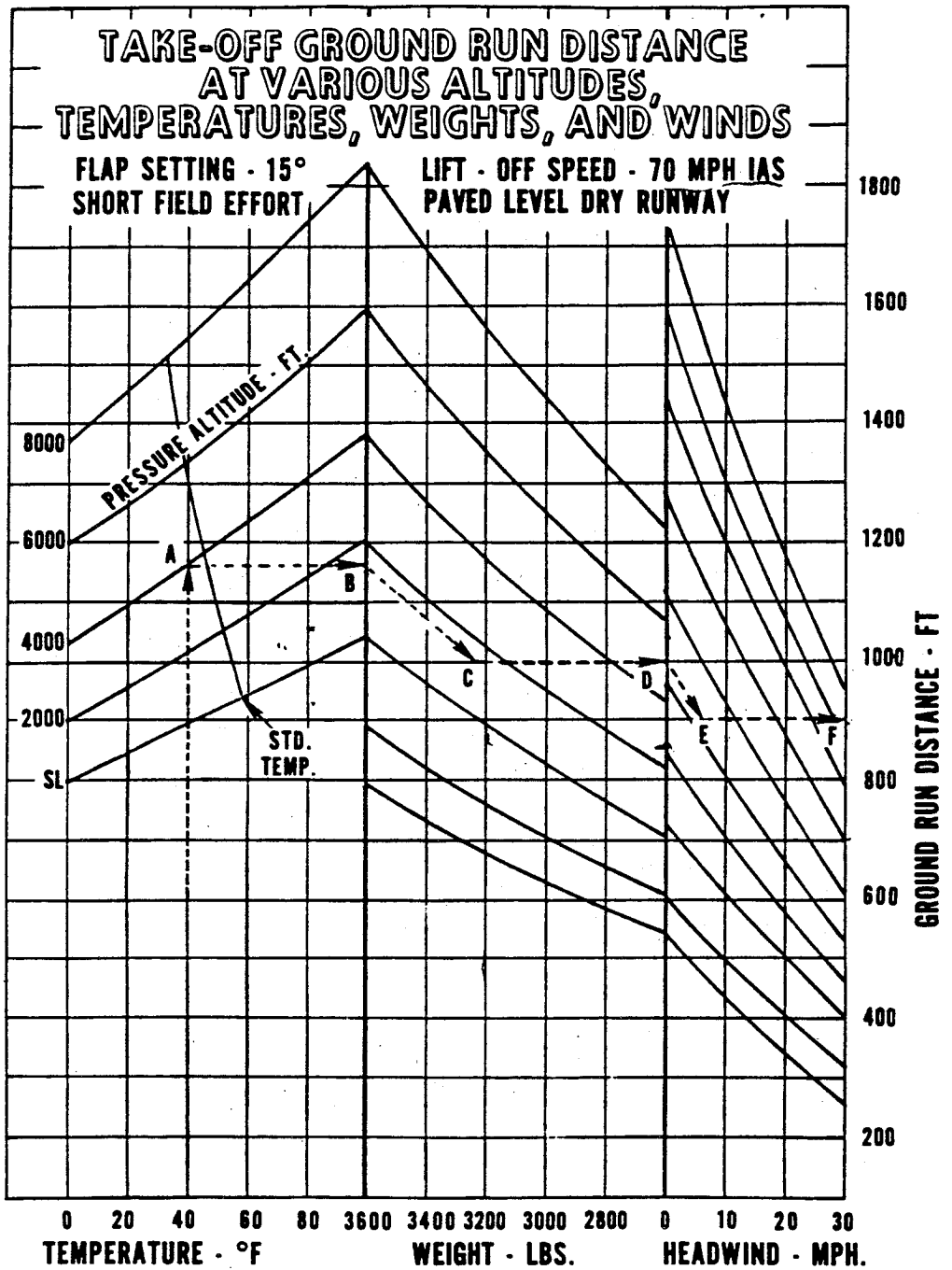
   Chief of Physiological Training, AAC-143
   FAA Aeronautical Center
   P. O. Box 25082
   Oklahoma City, Oklahoma 73125

   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.

PERFORMANCE CHARTS


ALTITUDE CONVERSION CHART
THIS CHART SHOULD BE USED TO
DETERMINE DENSITY ALTITUDE
FROM EXISTING TEMPERATURE
AND PRESSURE ALTITUDE CONDITIONS
FOR USE WITH PERFORMANCE CHARTS.
STD TEMP
24000 FT. PRESSURE ALTITUDE
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
SL
DENSITY ALTITUDE - FT.
24000
20000
16000
12000
8000
4000
SL
-40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100
TEMPERATURE - °F

TWIN COMANCHE C/R



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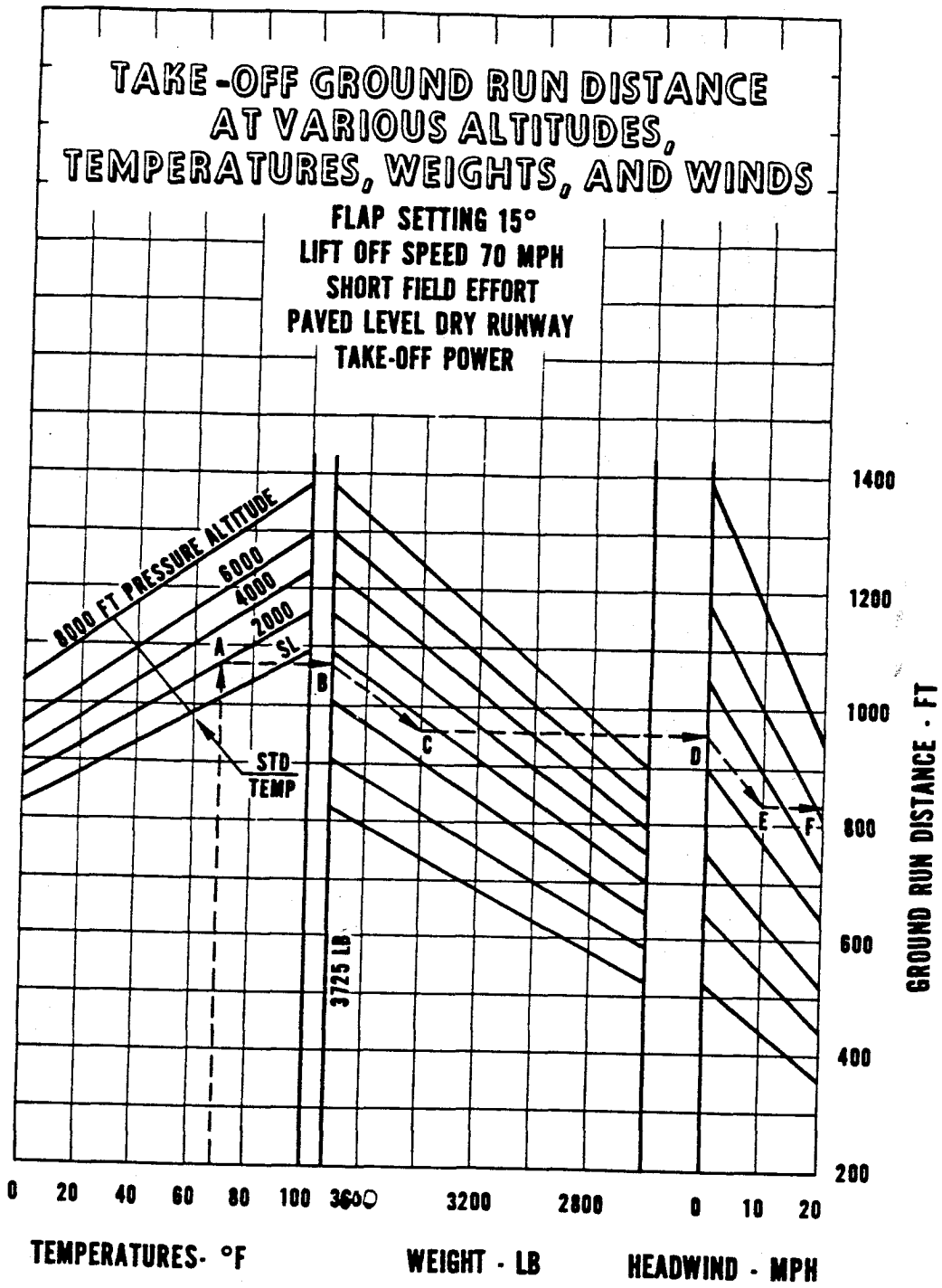
TWIN COMANCHE C/R



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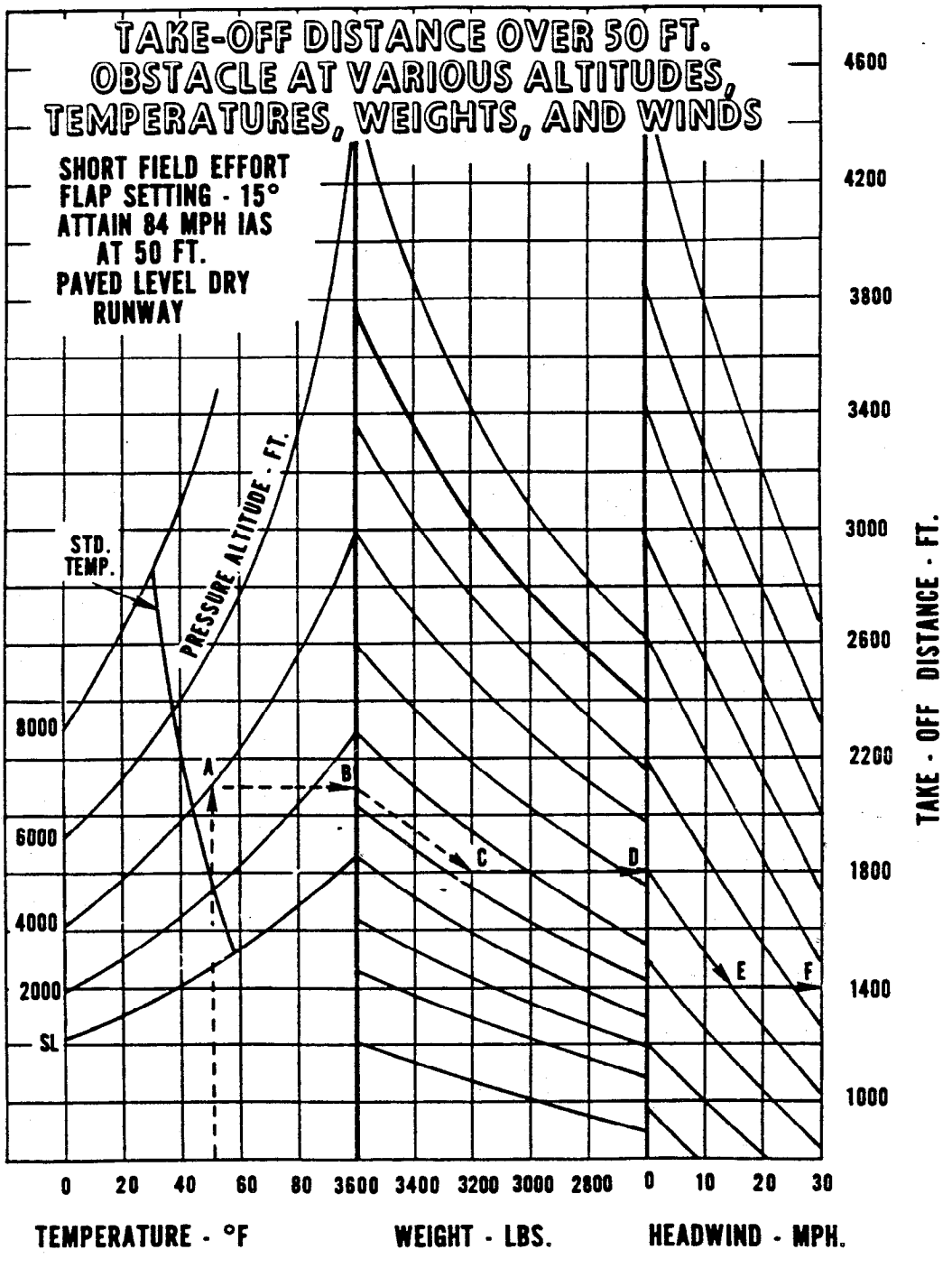

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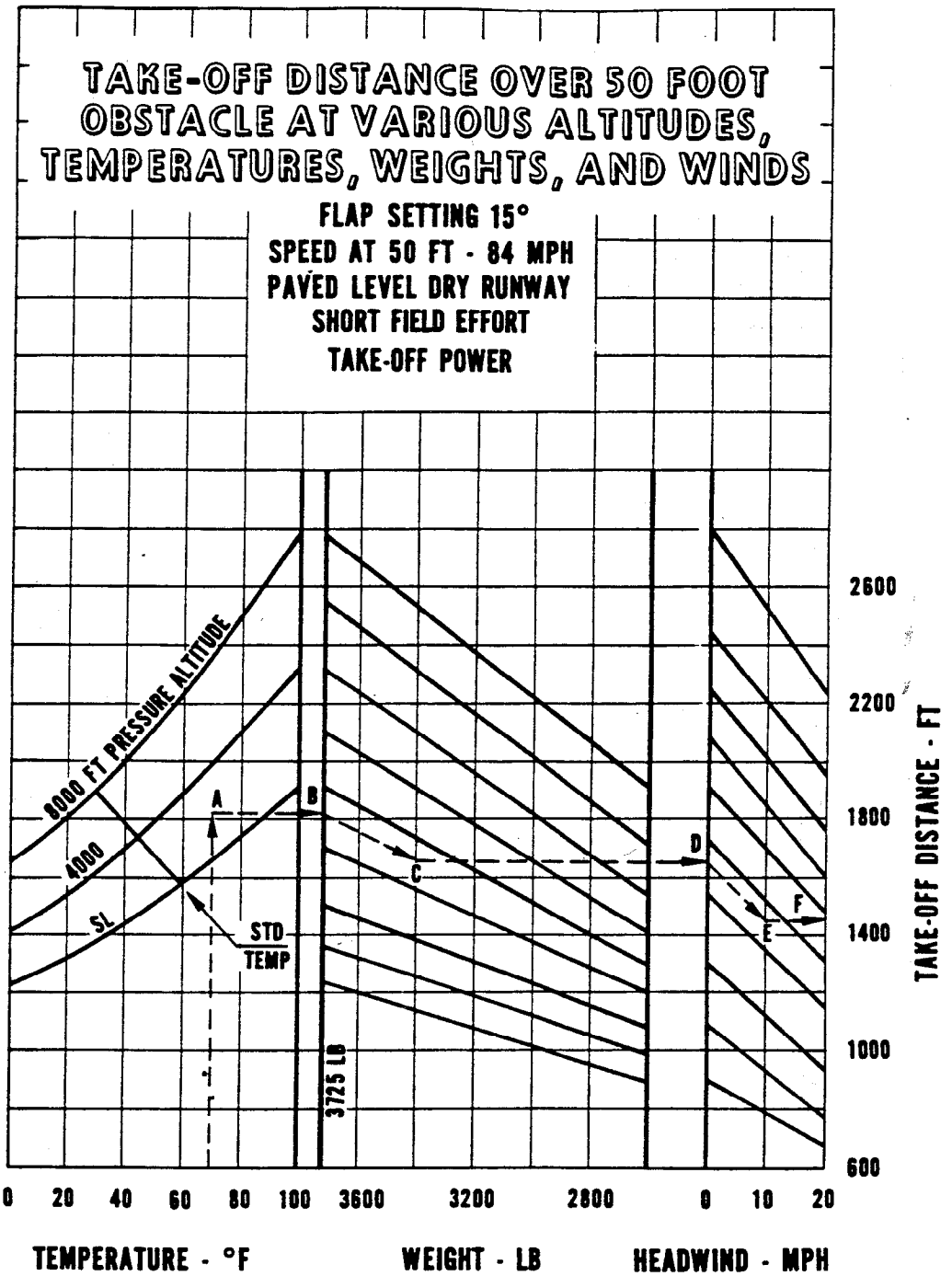

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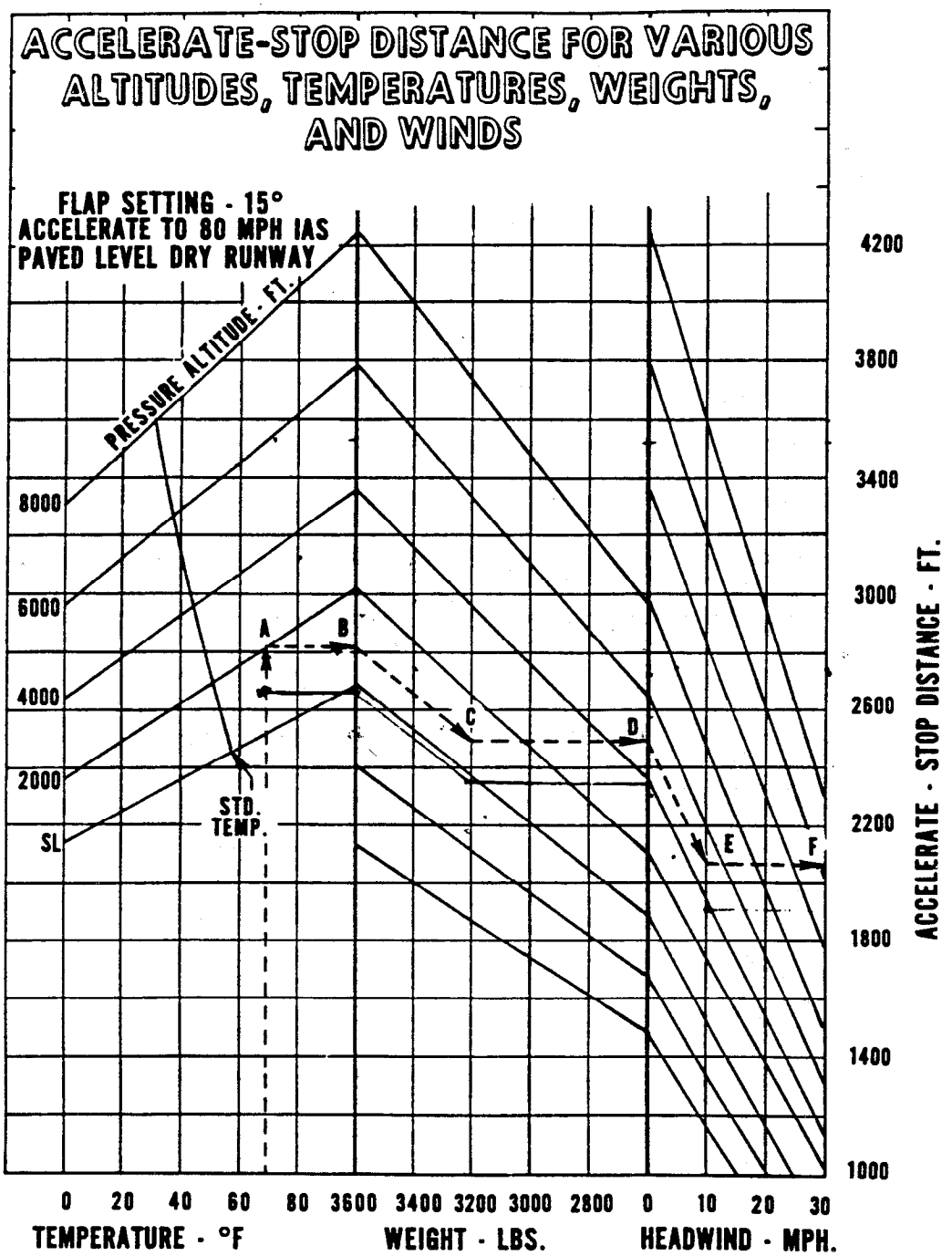

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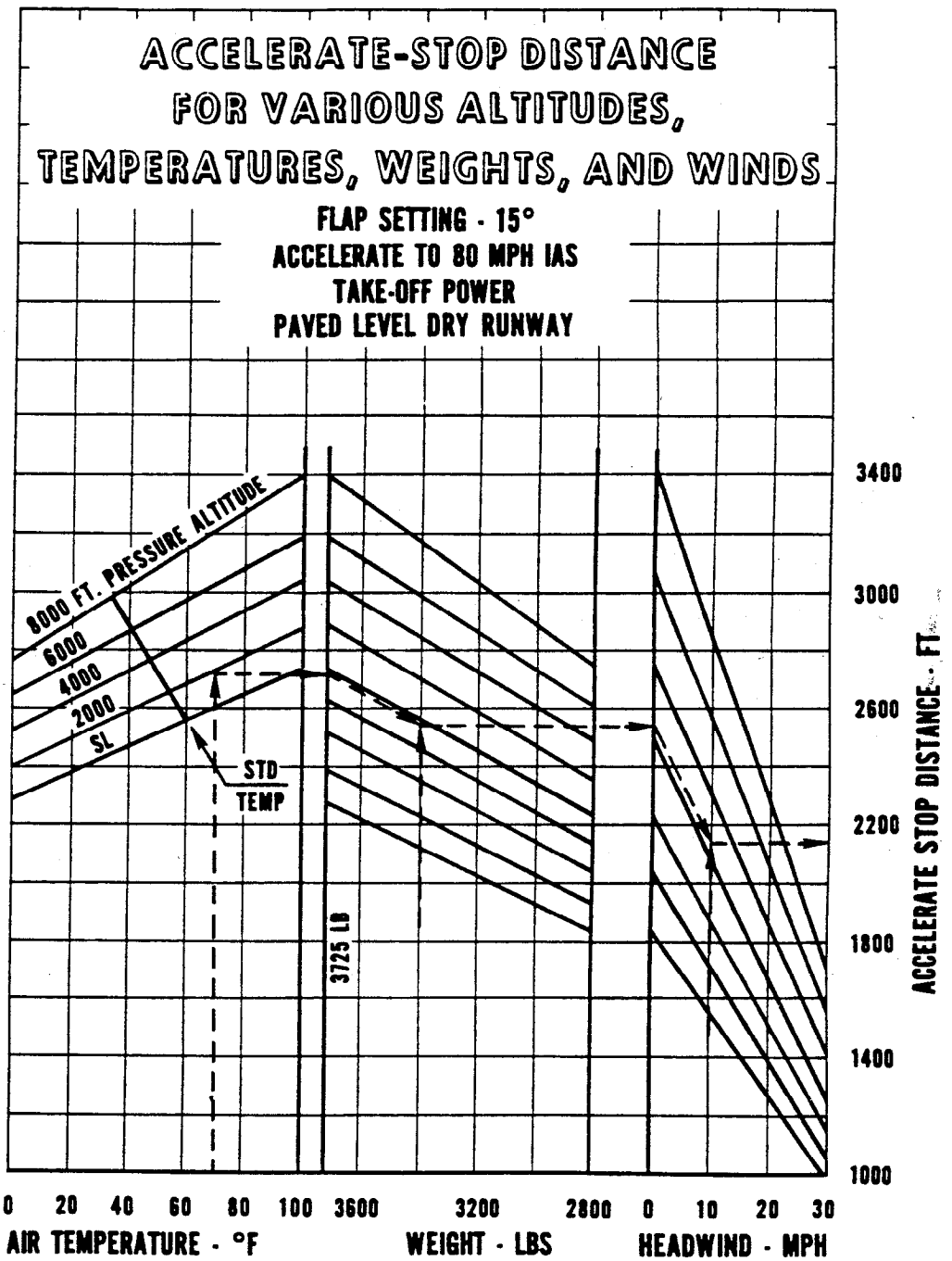

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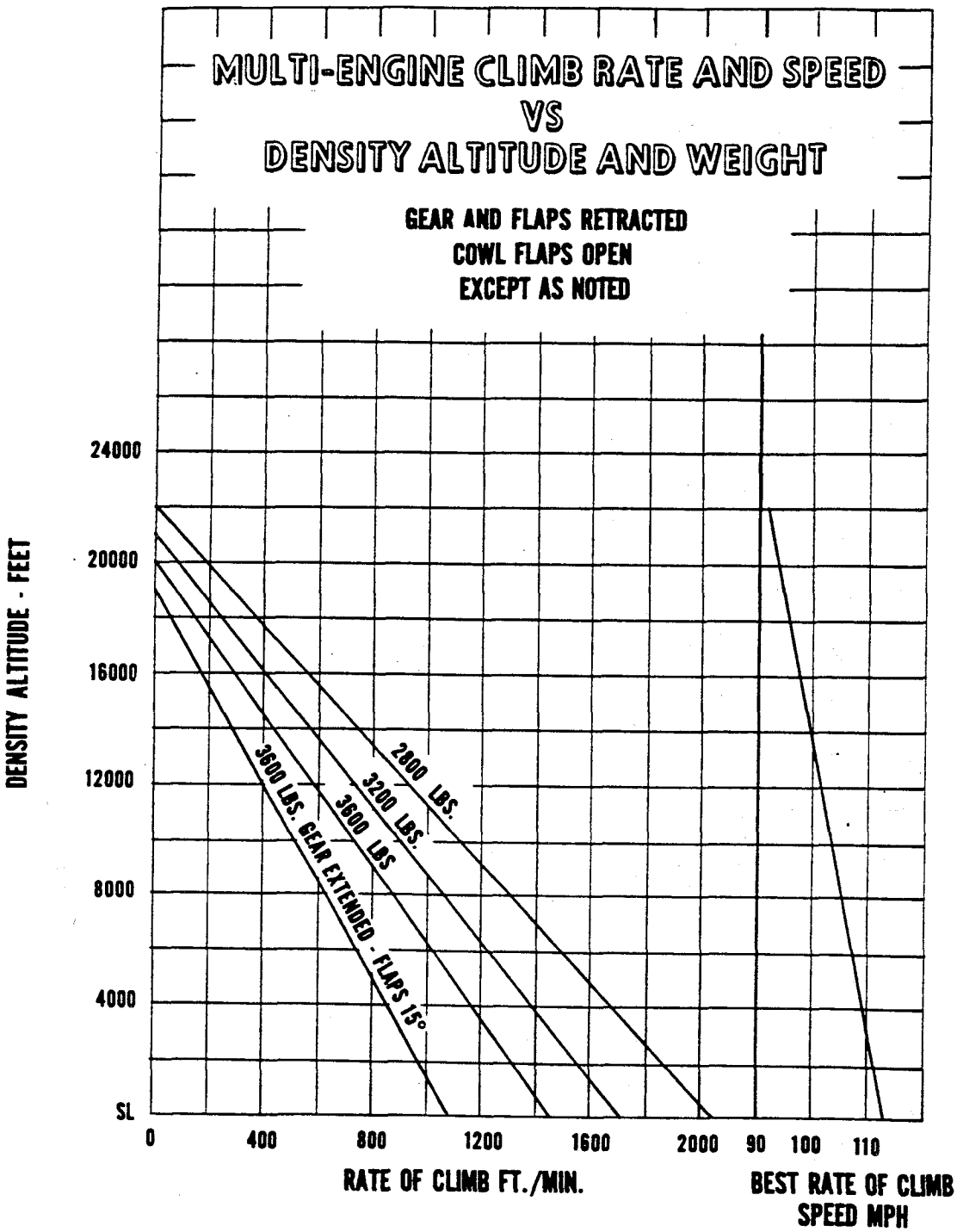

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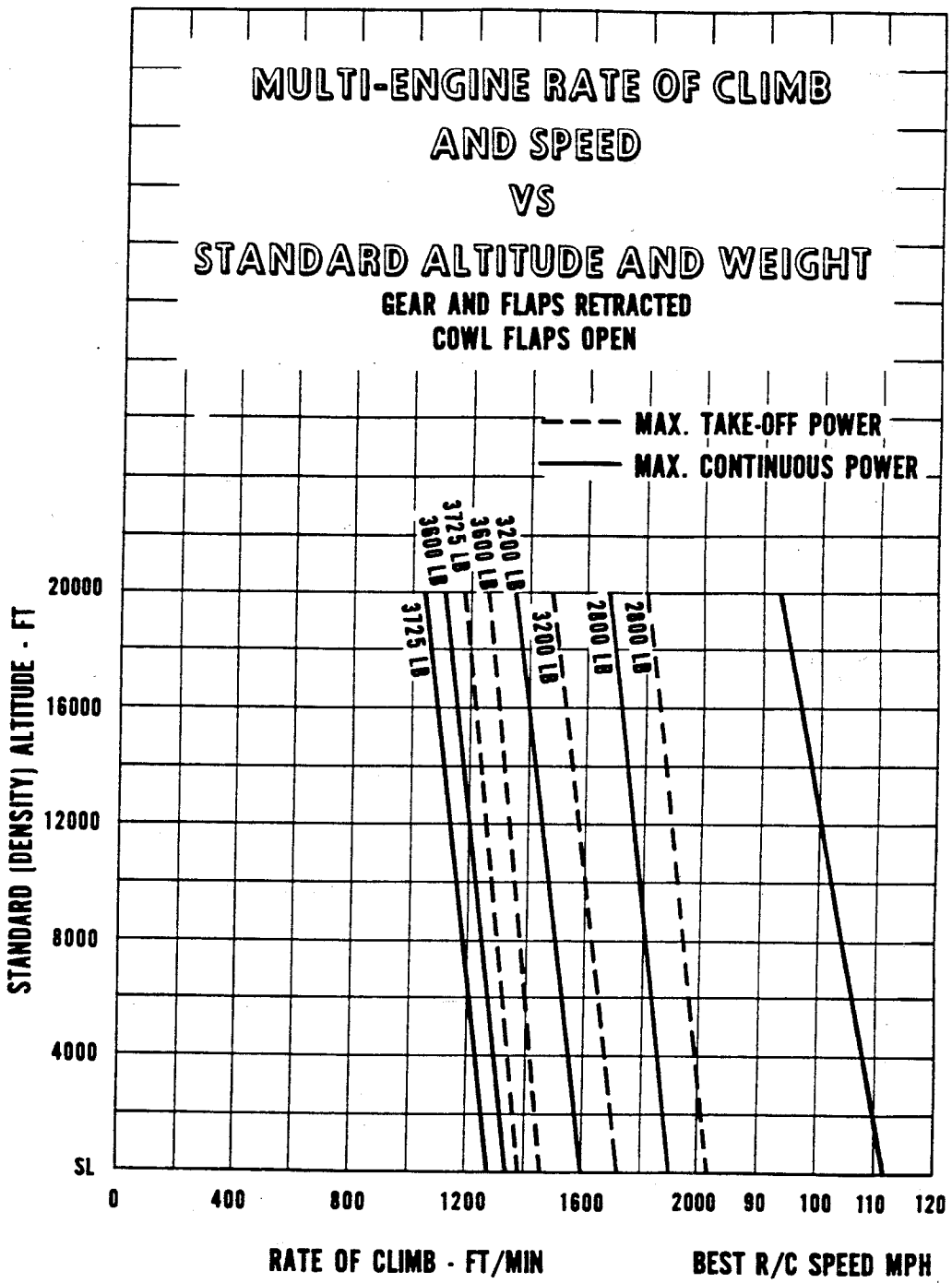

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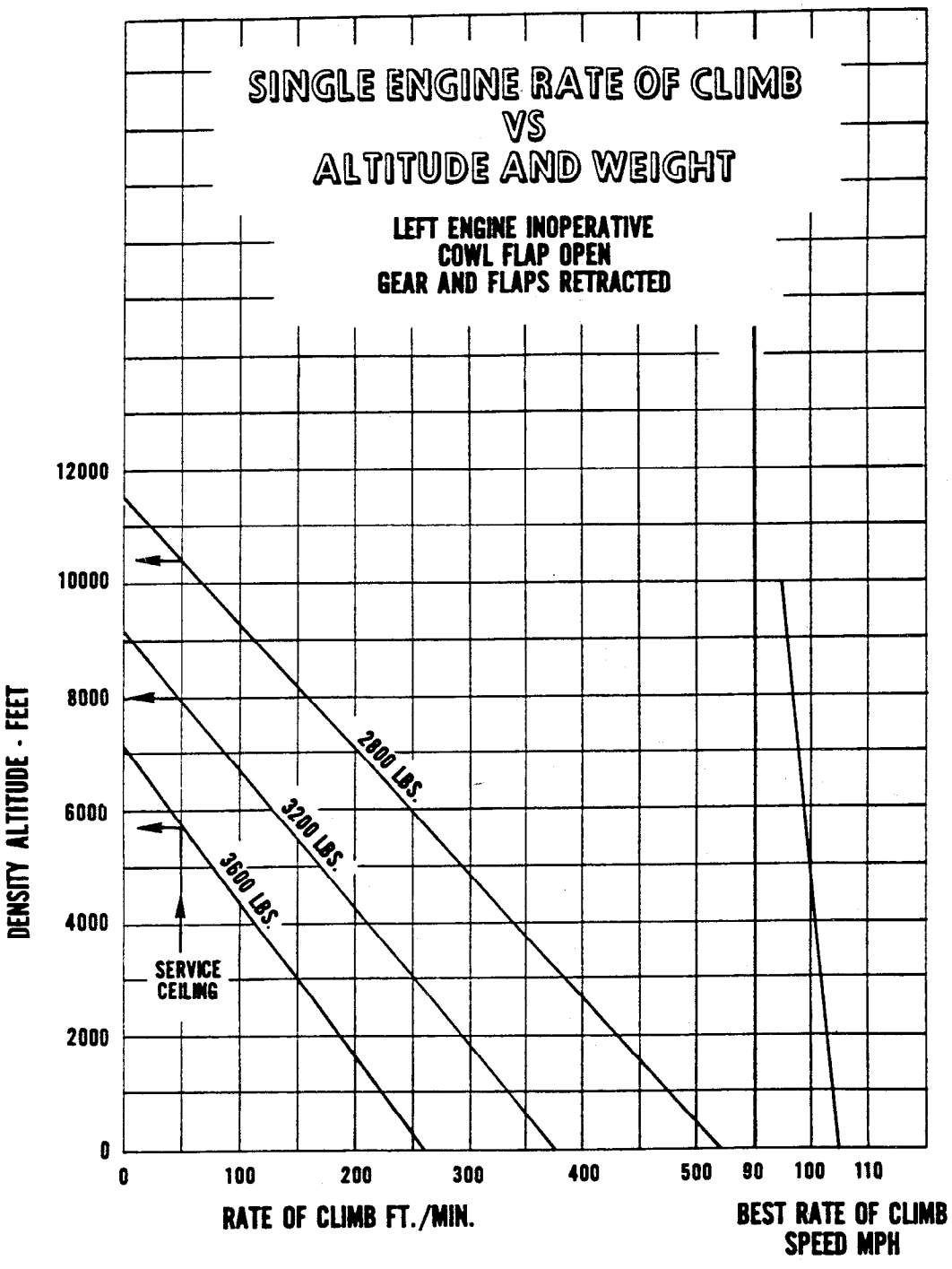

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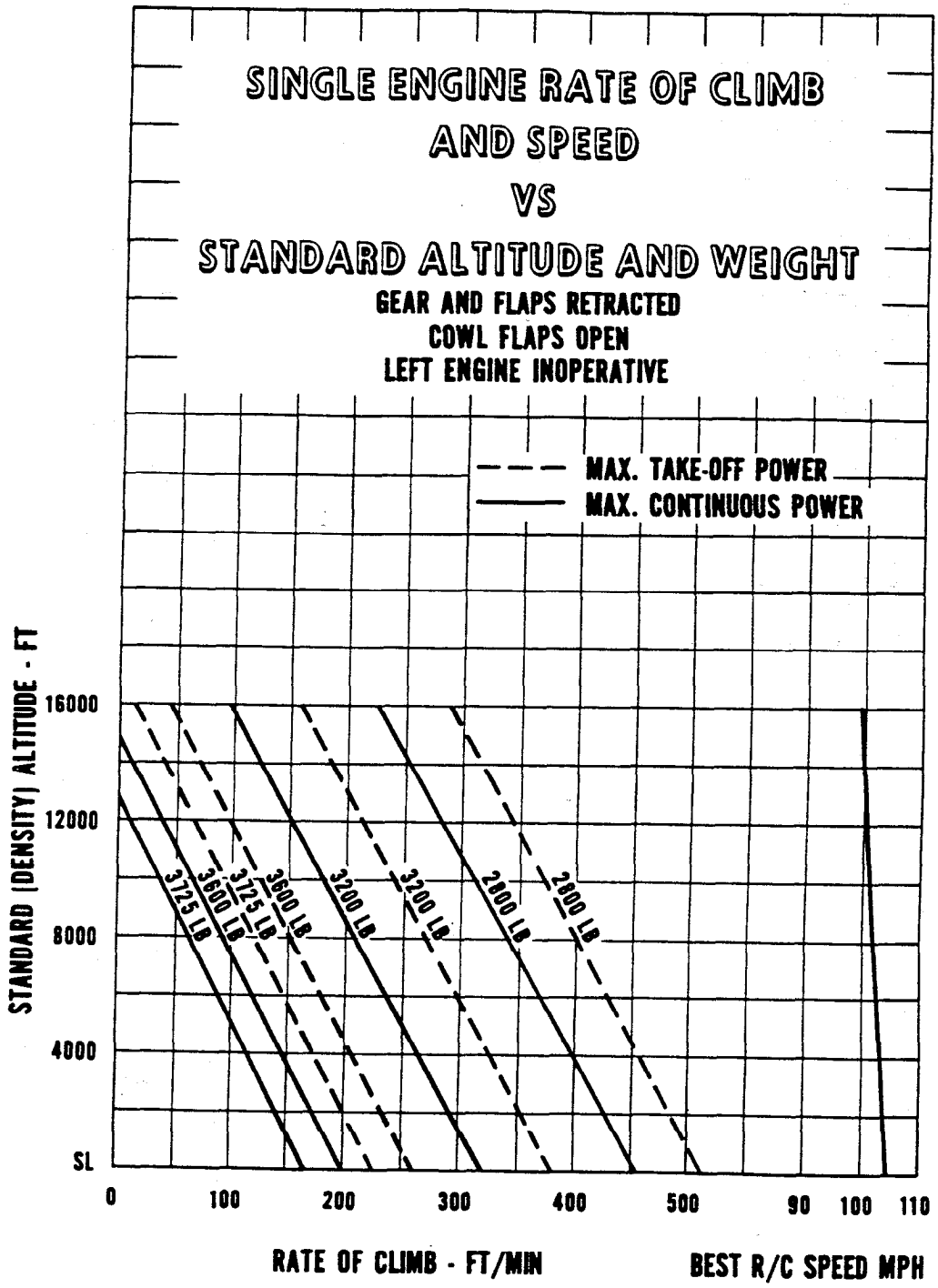

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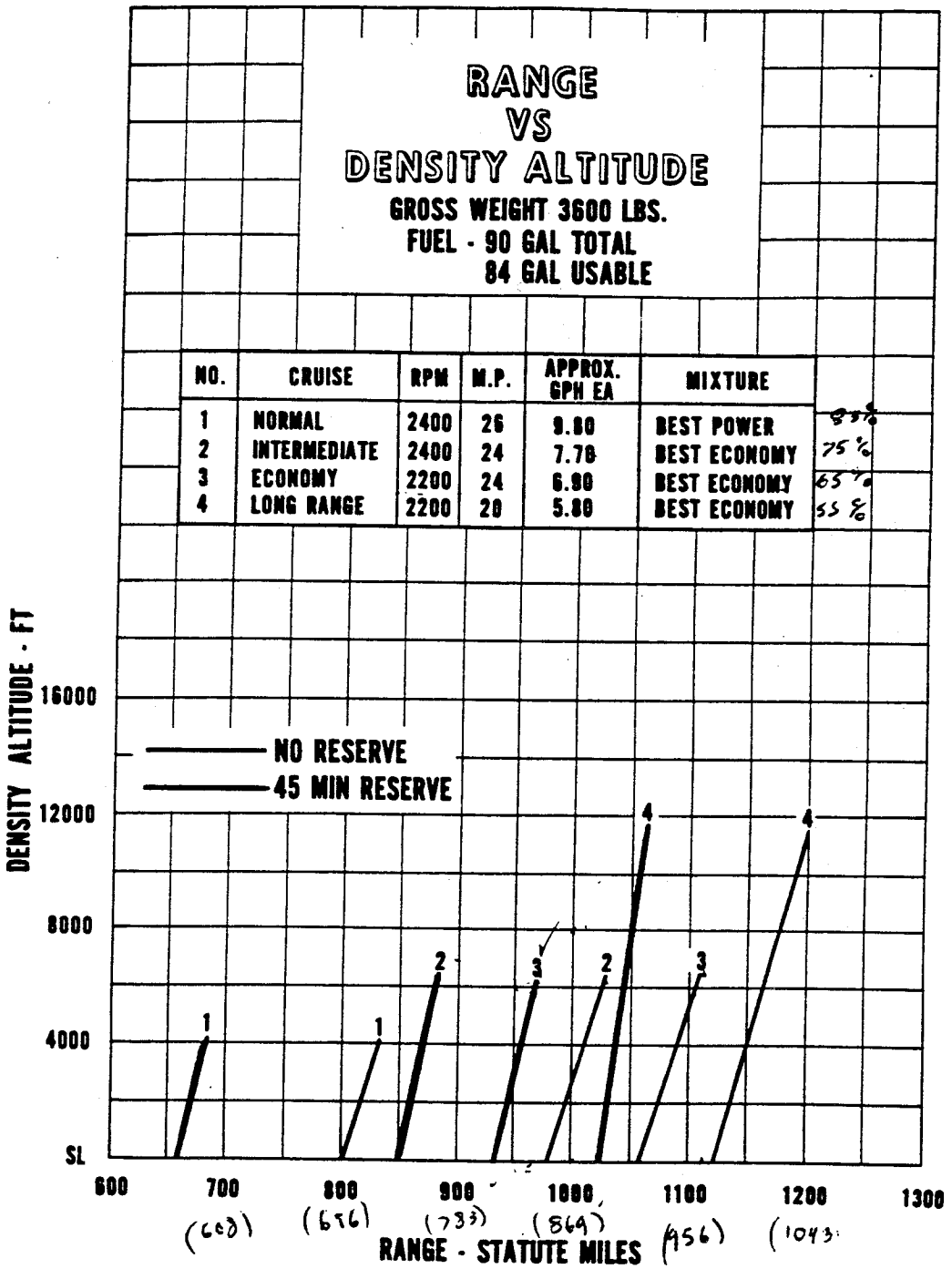

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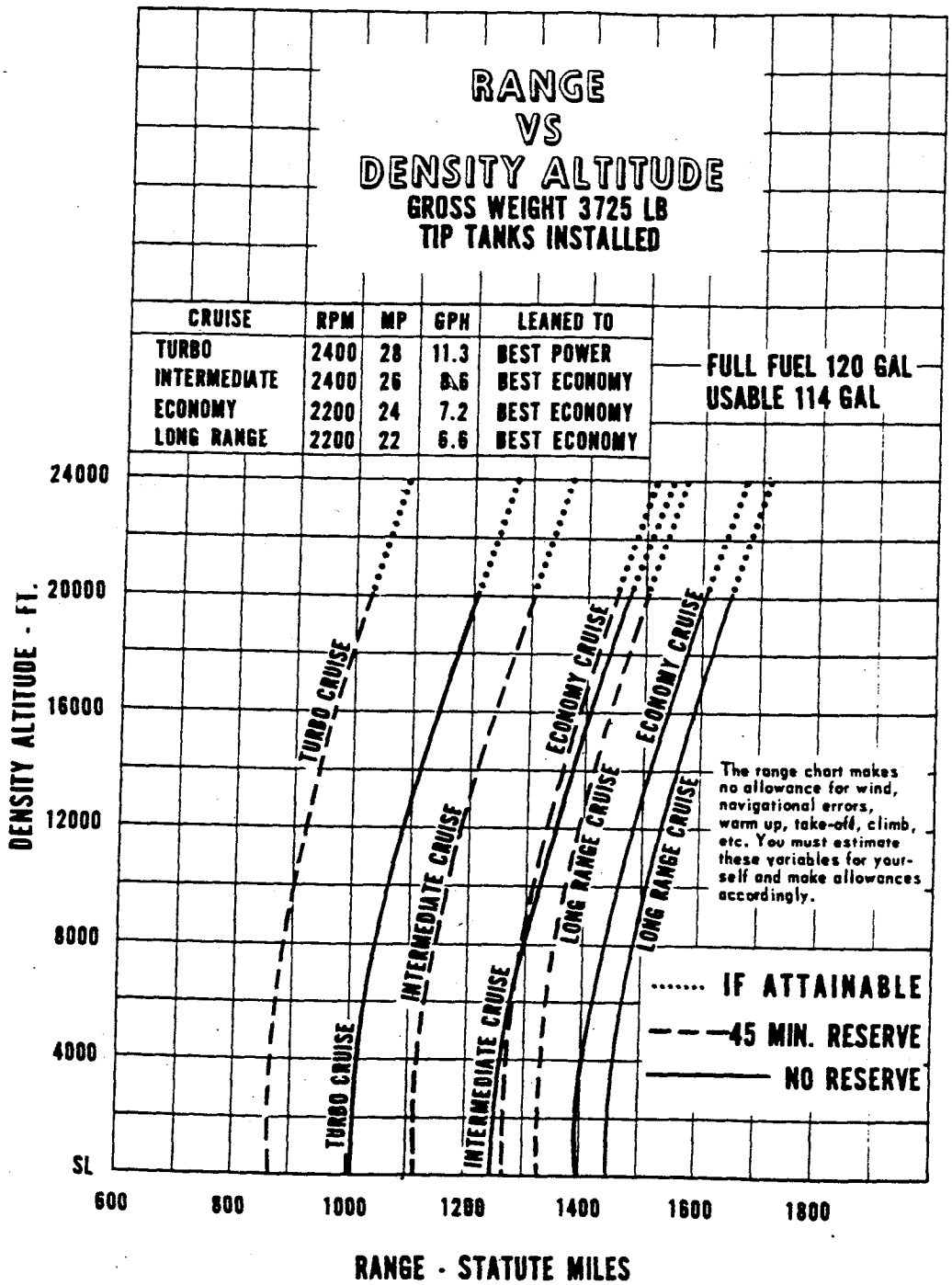

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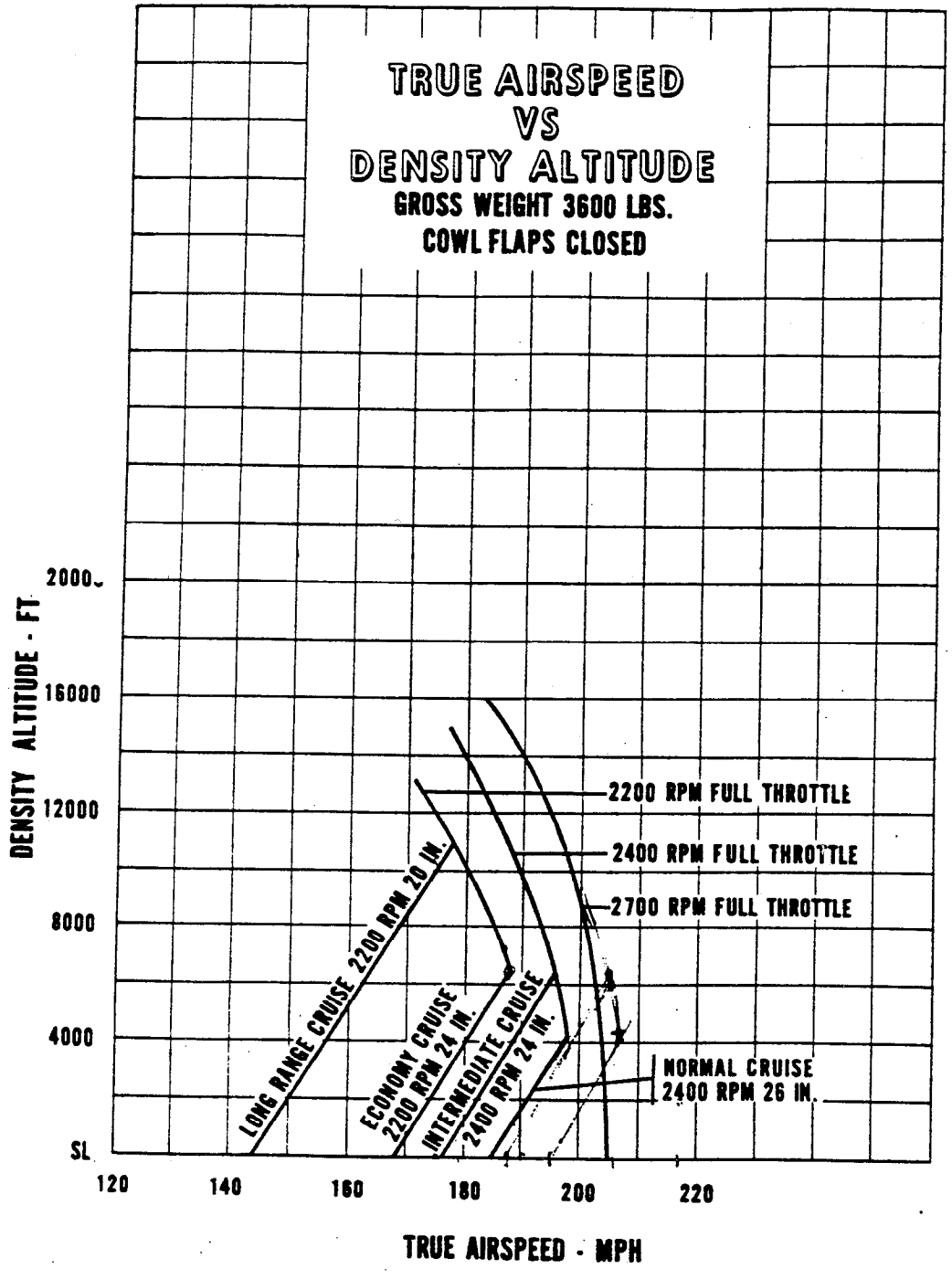

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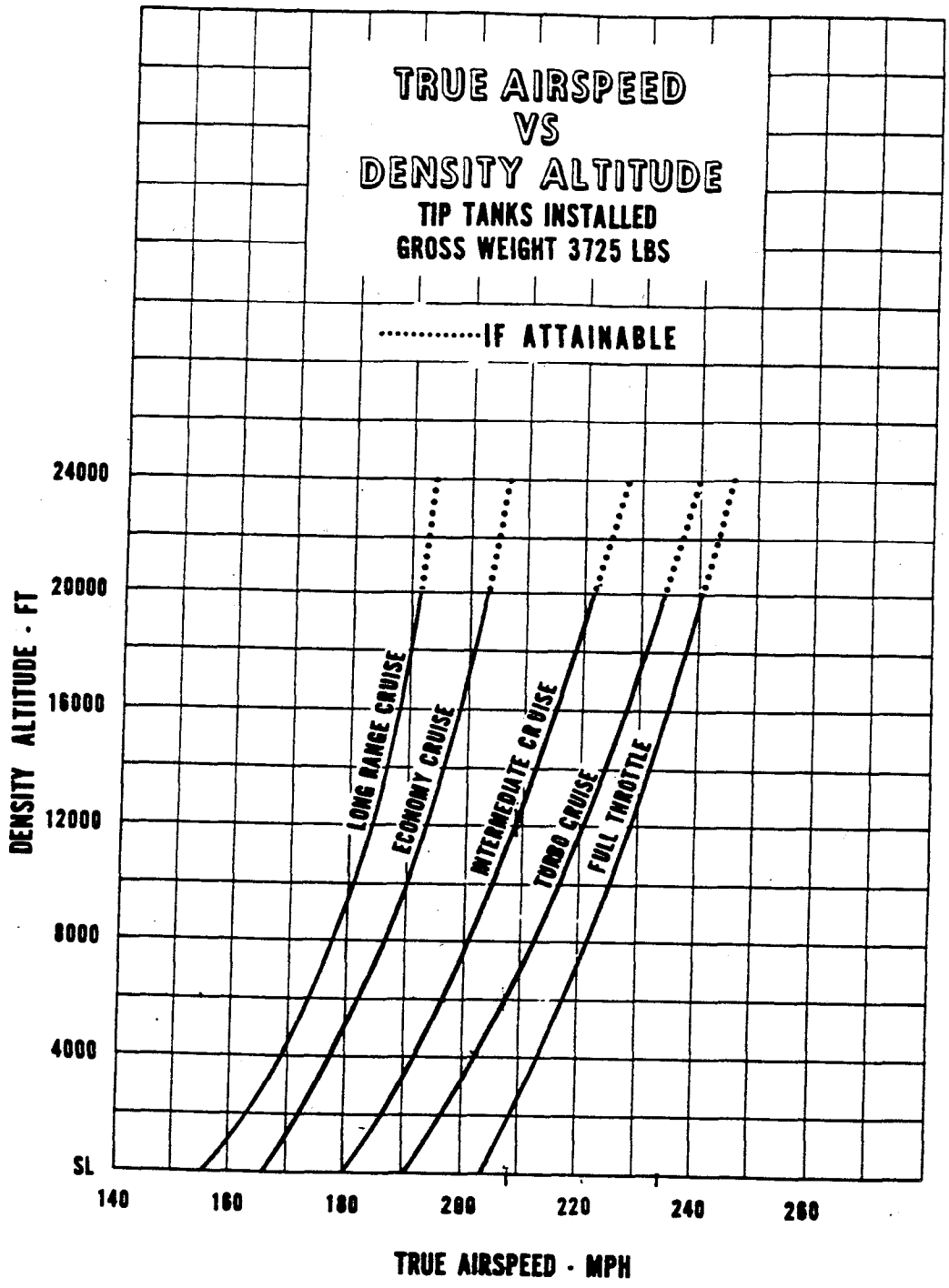

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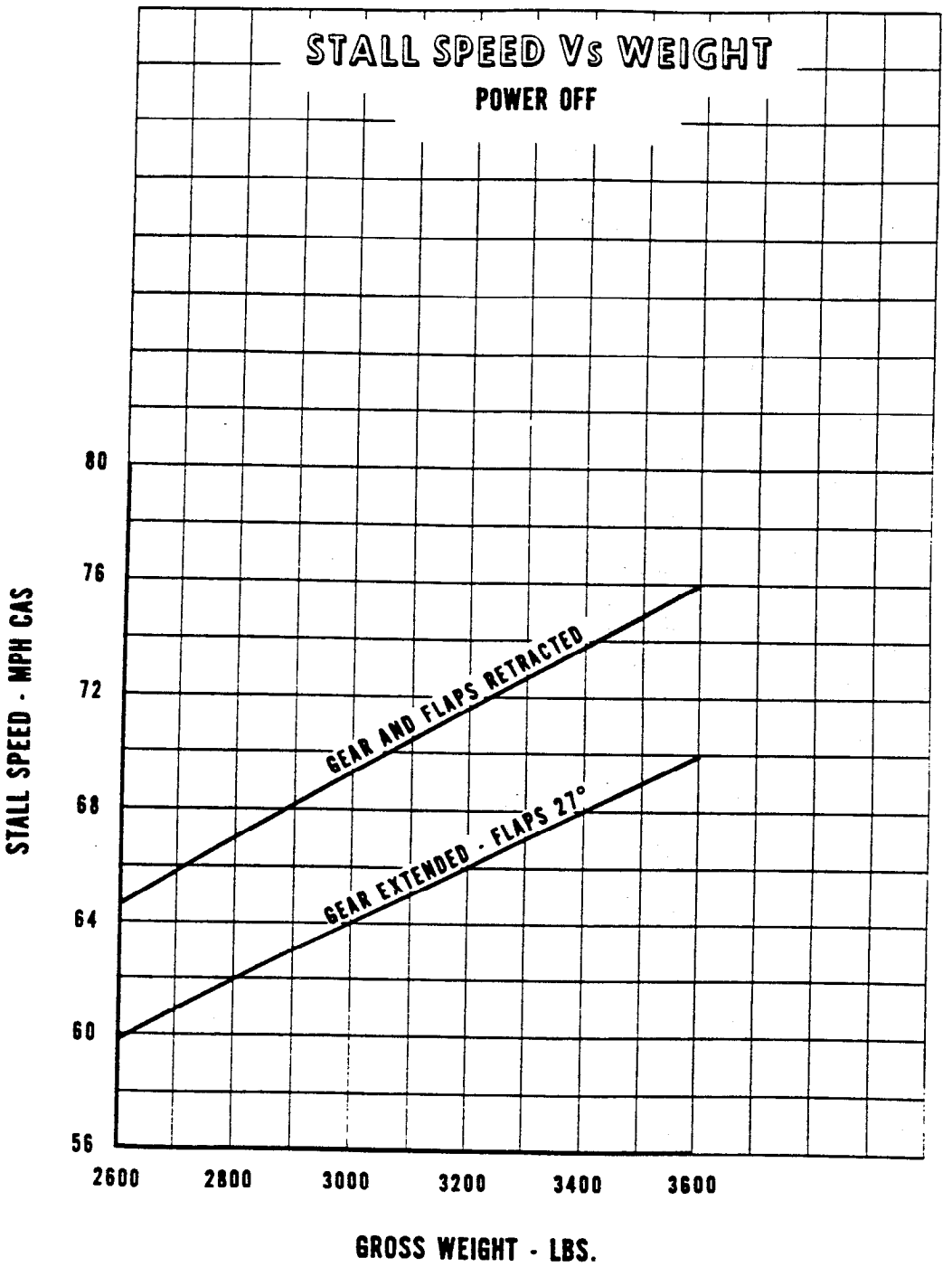

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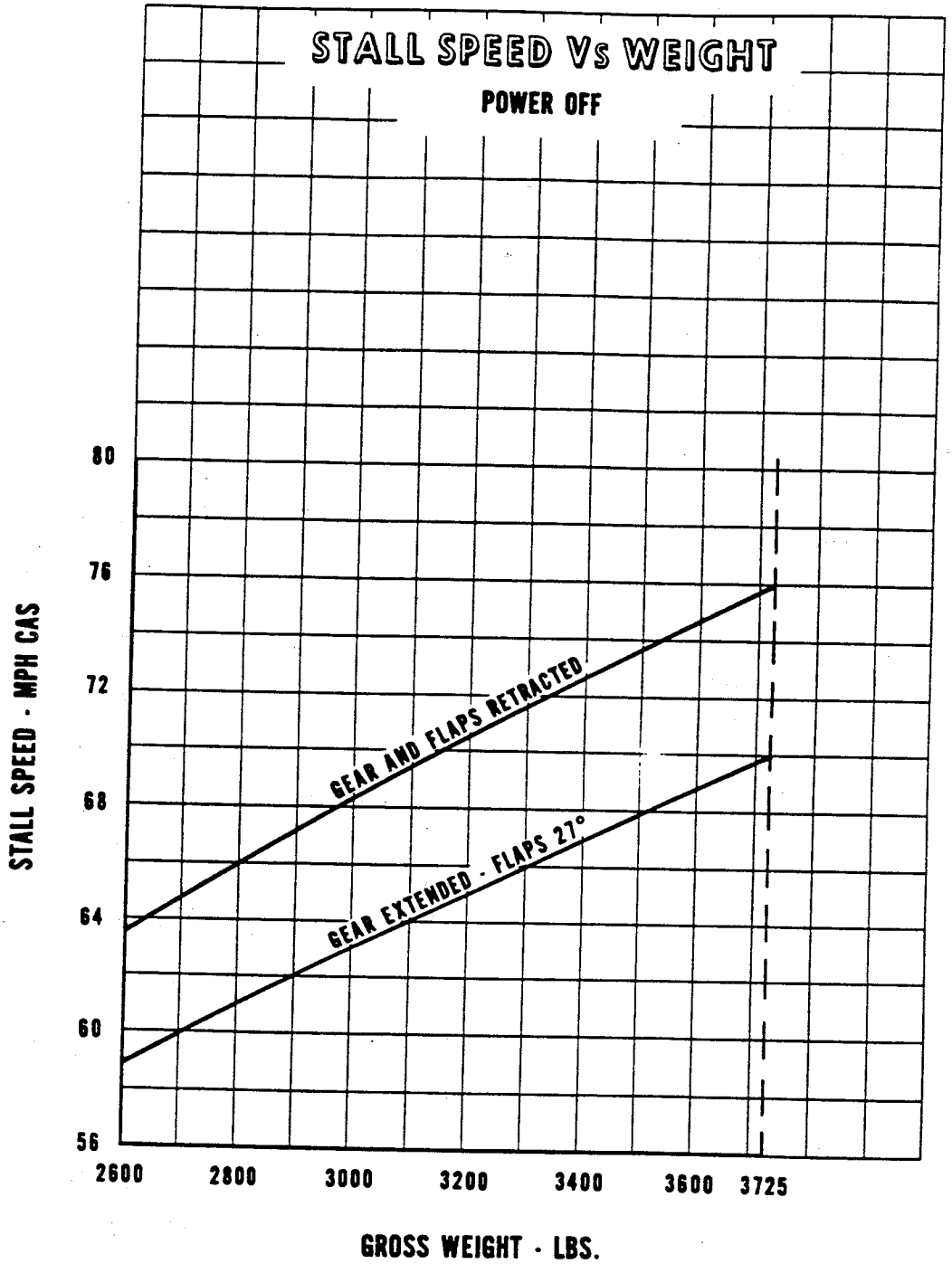

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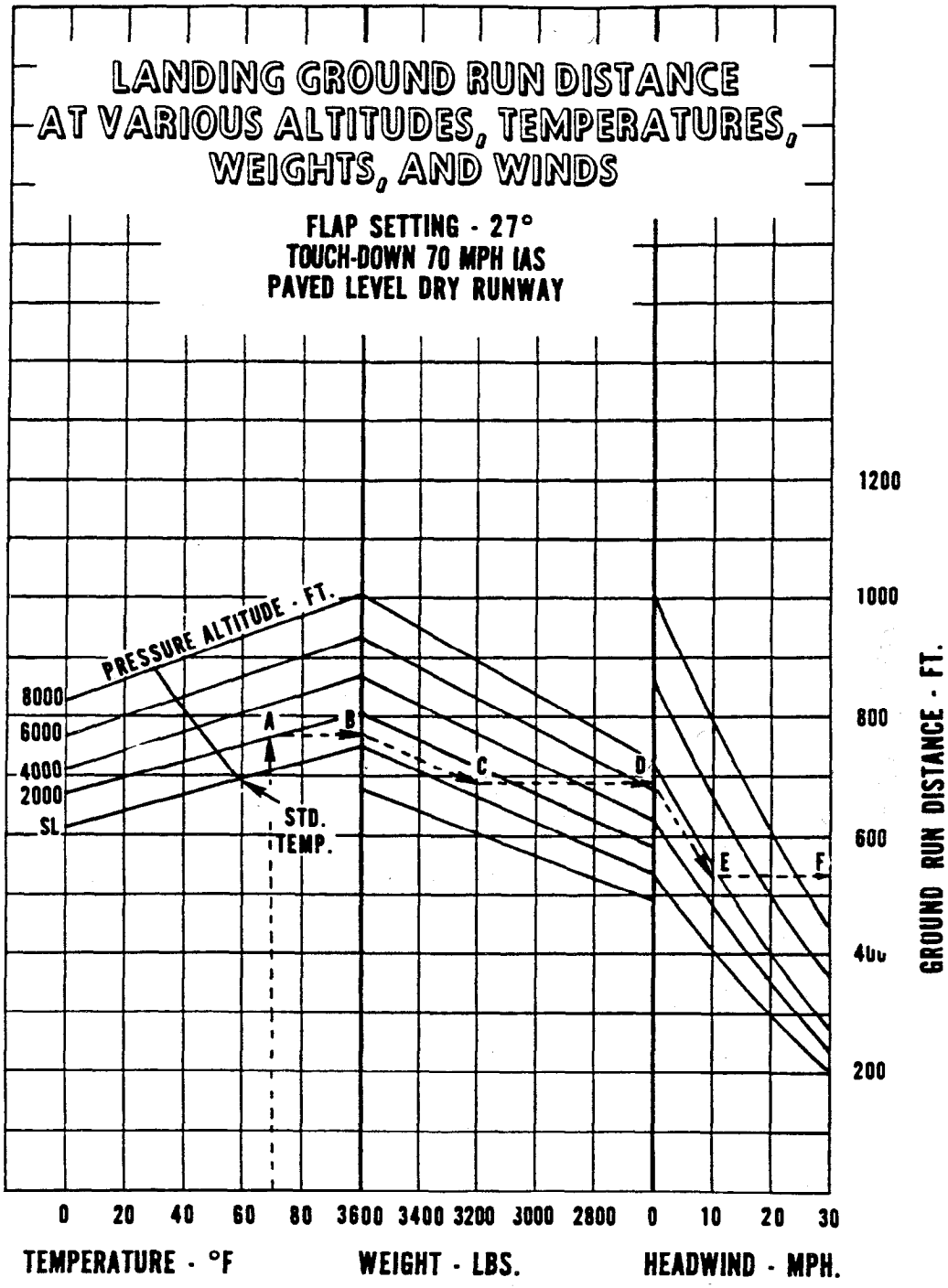

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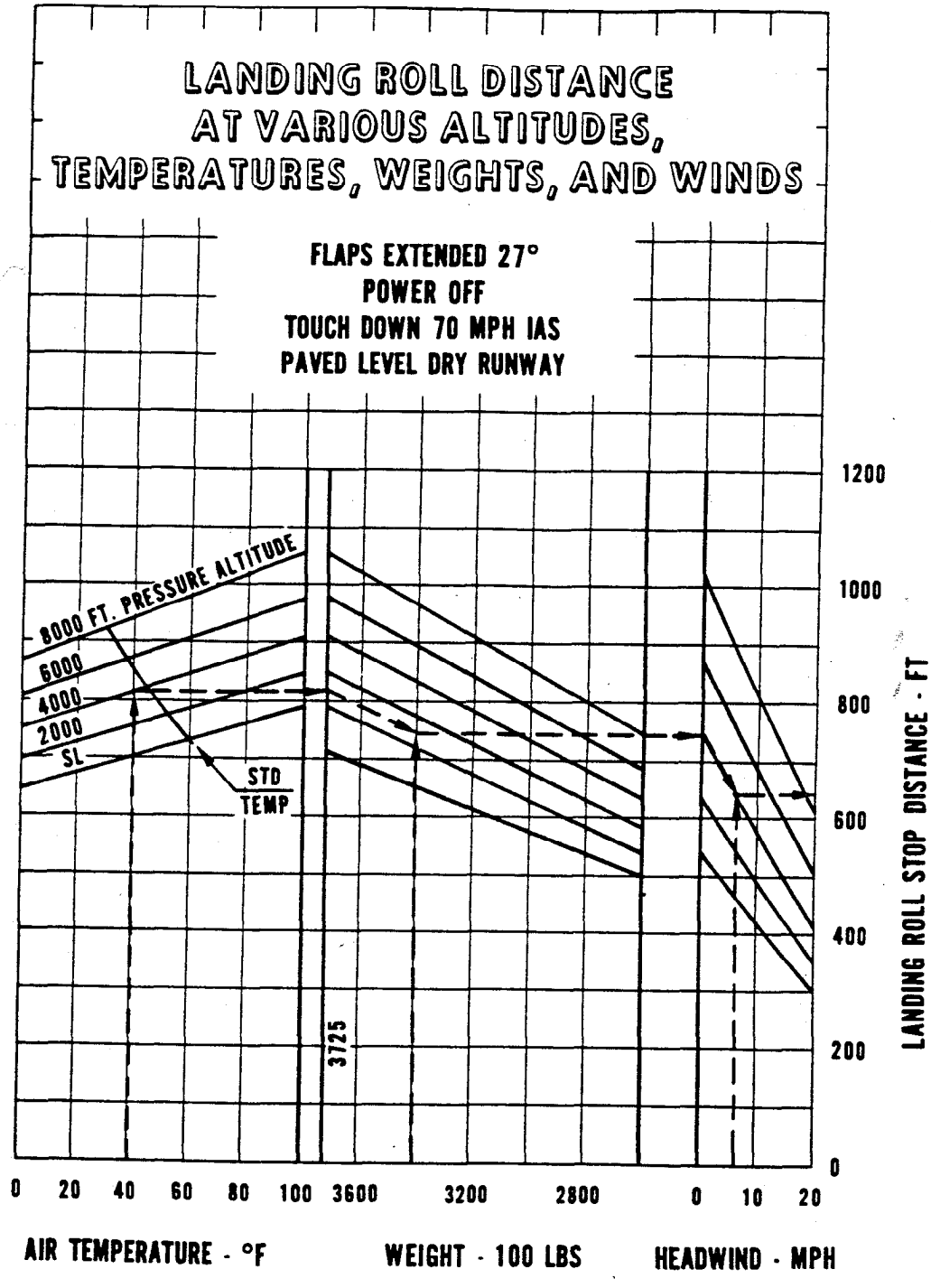

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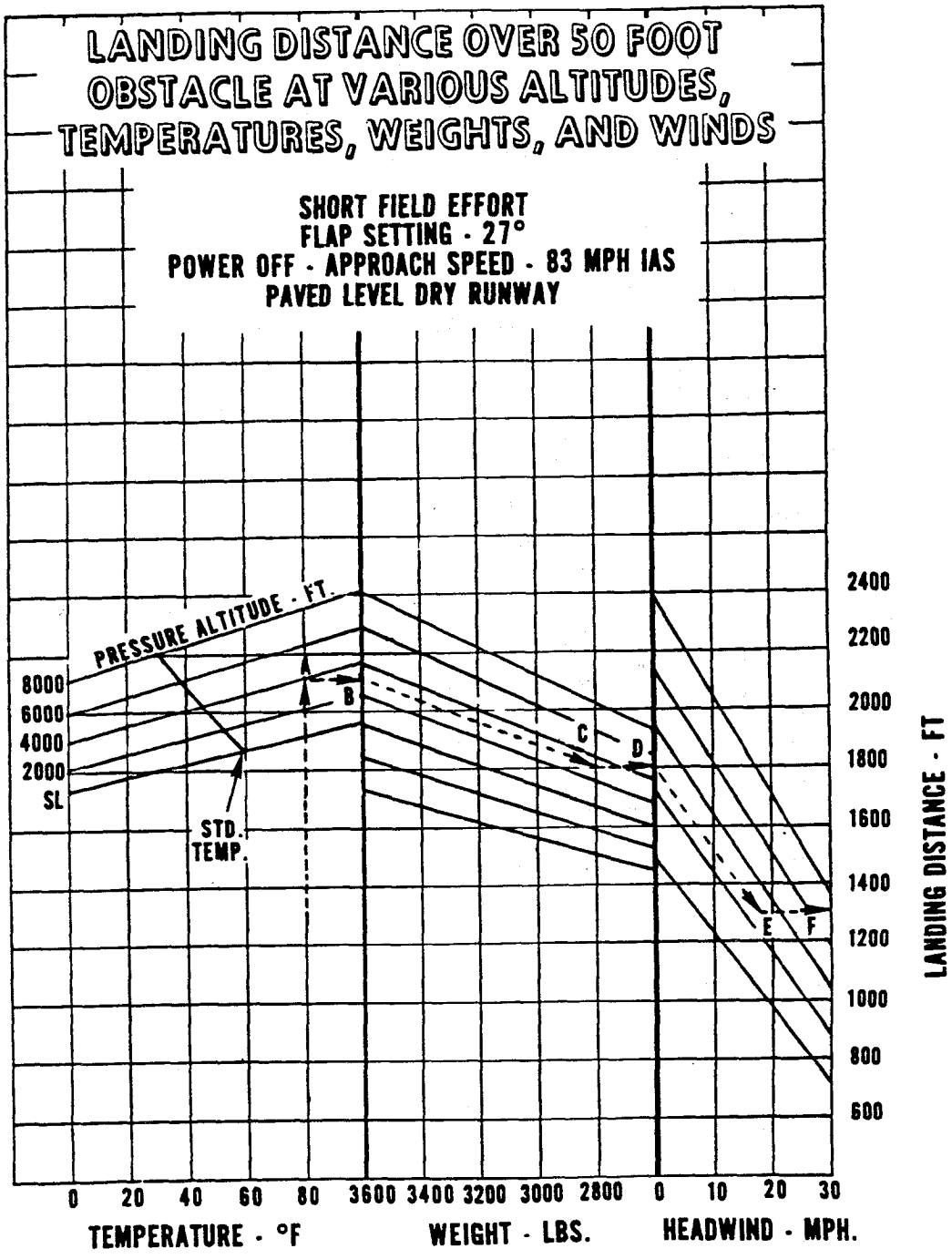

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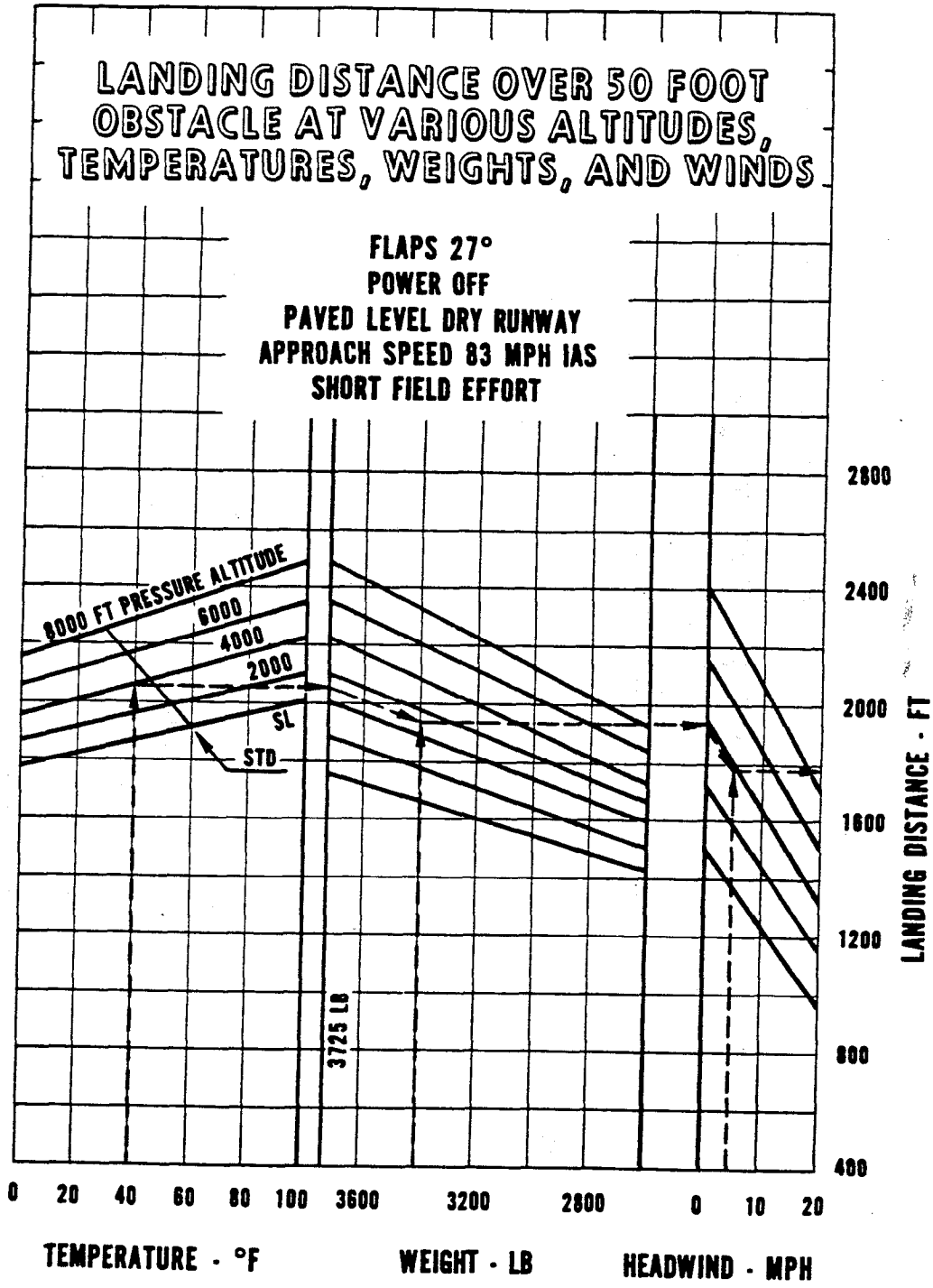

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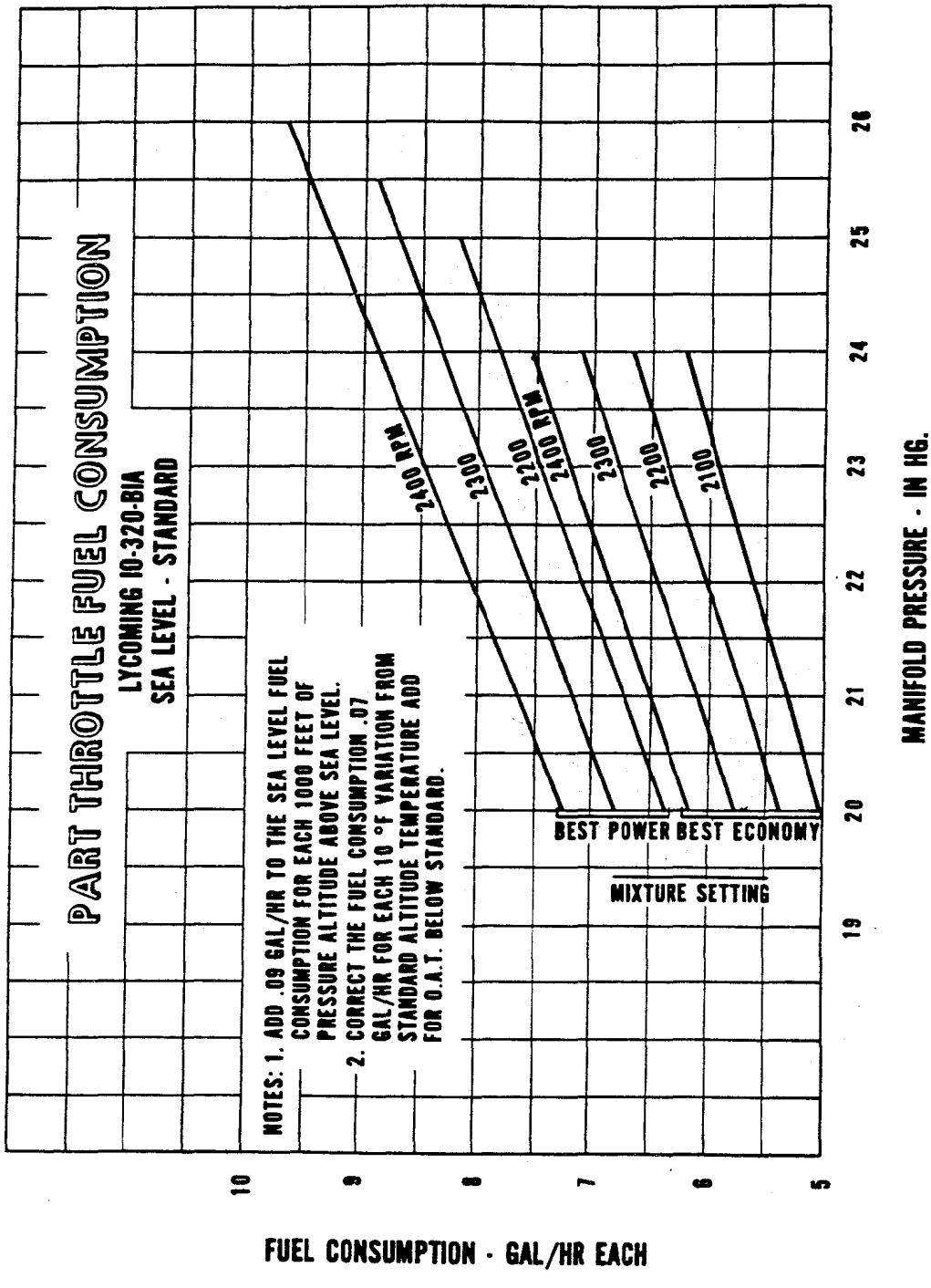

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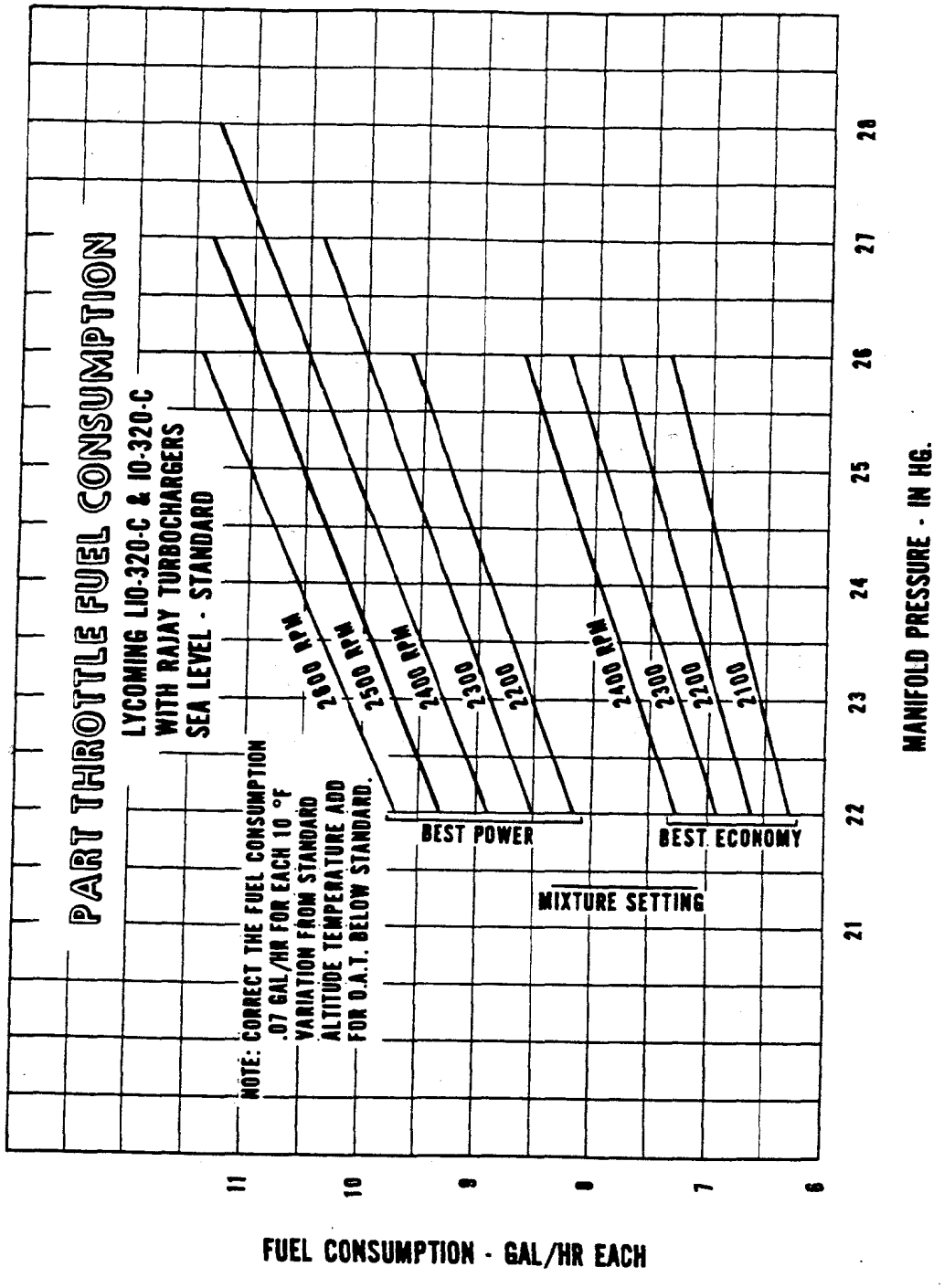


Power Setting Table (Cruise) - Lycoming Model LIO-320-B & IO-320-B Engines

83% Normal Cruise		Intermediate Cruise 75%		Economy Cruise 65%		Long Range Cruise 55%	
RPM	MP	RPM	MP	RPM	MP	RPM	MP
2400	26	2200	25.6	2200	24.0	2100	20.6
		2300	24.7	2300	23.2	2200	20.0
		2400	24.0	2400	22.5	2300	19.3

1. To maintain constant power, correct manifold pressure approximately 0.17" Hg. for each 10° F variation in induction air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard; subtract for temperatures below standard.

2. To determine fuel consumption for these power settings refer to Fuel Consumption Chart.

Power Setting Table (Cruise) - Rajay Turbocharged Lycoming Model LIO-320-C & IO-320-C Engines

Turbo Cruise		Intermediate Cruise		Economy Cruise		Long Range Cruise	
RPM	MP	RPM	MP	RPM	MP	RPM	MP
2400	28.0	2300	26.8	2200	24.0	2100	22.6
2500	27.0	2400	26.0	2300	23.2	2200	22.0
2600	26.0	2500	25.2	2400	22.4	2300	22.4

1. To maintain constant power, correct manifold pressure approximately 0.25" Hg. for each 10° F variation in induction air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard; subtract for temperatures below standard.

2. To determine fuel consumption for these power settings refer to Fuel Consumption Chart.

HANDLING AND SERVICING

HANDLING AND SERVICING

This section contains information on preventive maintenance. Refer to the Twin Comanche Service Manual for further maintenance. Any complex repair or modification should be accomplished by a Piper Certified Service Center.

GROUND HANDLING

TOWING

The airplane may be moved by using the nose wheel steering bar provided, or power equipment that will not damage or cause excess strain to the nose gear assembly. The steering bar is stowed on the forward side of the main spar.

CAUTION

When towing with power equipment, do not turn nose gear more than 20 degrees in either direction as this will result in damage to the nose gear and steering mechanism.

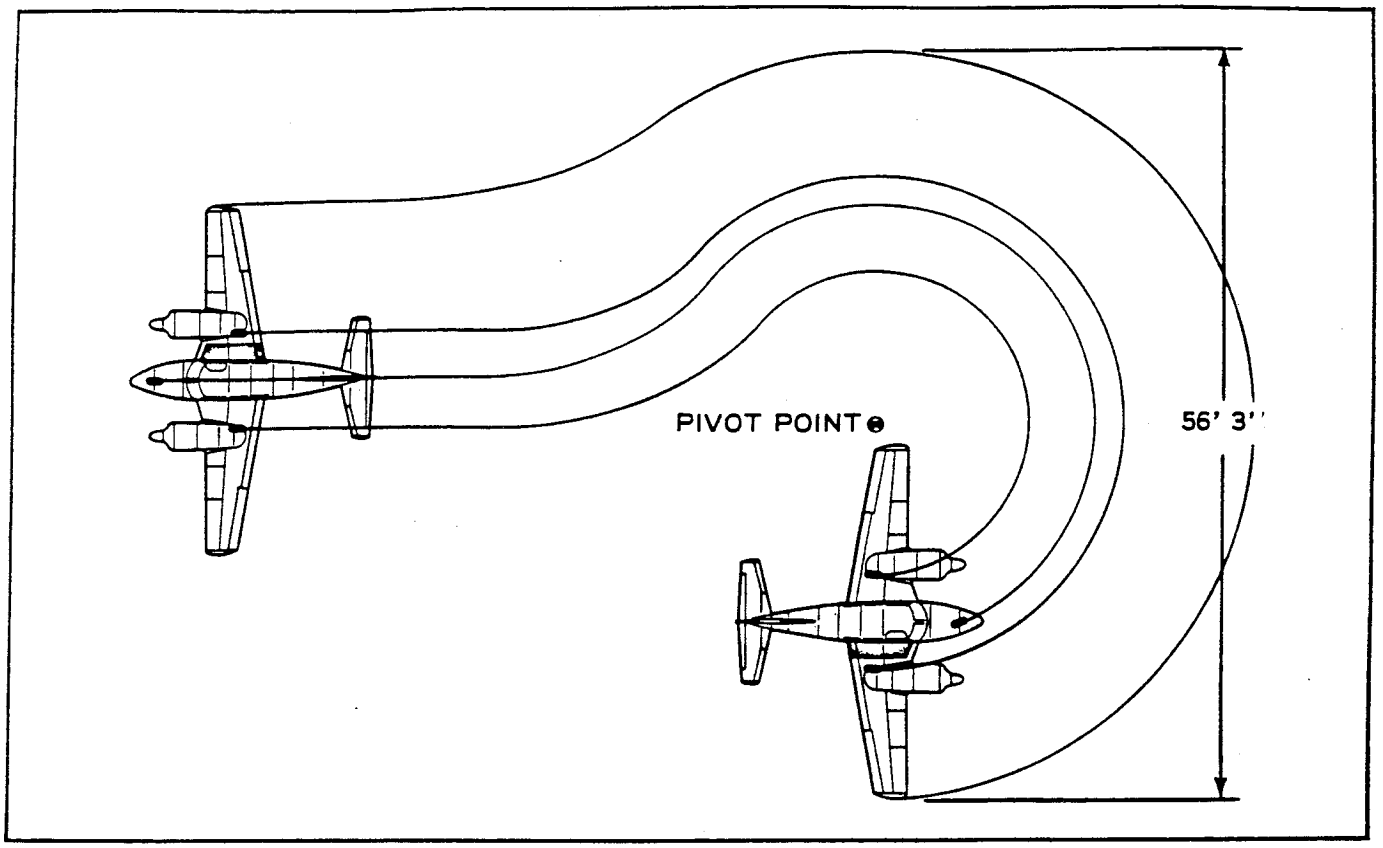
TAXIING

Before attempting to taxi the airplane, ground personnel should be checked out by a qualified pilot or other responsible person. Engine starting and shut-down procedures should be covered as well. When it is ascertained that the propeller back blast and taxi areas are clear, apply power to start the taxi roll and perform the following checks:

a. Taxi forward a few feet and apply brakes to determine their effectiveness.
b. Taxi with propeller set in low pitch, high RPM setting.
c. While taxiing, make slight turns to ascertain the effectiveness of steering.
d. Observe wing clearances when taxiing near buildings or other stationary objects. If possible, station a guide outside the airplane to observe.
e. When taxiing on uneven ground, look for holes and ruts.
f. Do not operate the engine at high RPM when running up or taxiing over ground containing loose stones, gravel or any loose material that may cause damage to the propeller blades.

PARKING

When parking the airplane, insure that it is sufficiently protected against adverse weather conditions and presents no danger to other aircraft. When parking the airplane for any length of time or overnight, it is recommended that it be moored securely.



Minimum Turning Radius

a. To park the airplane, head it into the wind, if possible.

b. Set the parking brake by applying toe pressure against the top of the brake pedals and at the same time pull out on the parking brake handle. To release the parking brake, apply toe pressure on the pedals and push in on the parking brake handle.

NOTE

Care should be taken when setting brakes that are overheated or during cold weather when accumulated moisture may freeze the brake.

MOORING

The airplane should be moored to insure its immovability, protection and security under varying weather conditions. The following procedure gives the instructions for proper mooring of the airplane.

a. Head the airplane into the wind, if possible.

b. Lock the aileron and stabilator controls using the front seat belt, control wheel lock, or control surface blocks.

c. Block the wheels.

d. Secure tie-down ropes to the wing tie-down rings and the tail skid at approximately 45-degree angles to the ground. Leave sufficient slack to avoid damage to the aircraft when the ropes contract due to moisture.

CAUTION

Use square or bowline knots. Do not use slip knots.

NOTE

Additional preparations for high winds include using tie-down ropes from the landing gear forks, and securing the rudder.

e. Install pitot tube cover, if possible.

CLEANING

CLEANING ENGINE COMPARTMENT

Before cleaning the engine compartment, place a strip of tape on the magneto vents to prevent any solvent from entering these units.

a. Place a large pan under the engine to catch waste.

b. With the engine cowling removed, spray or brush the engine with solvent or a mixture of solvent and degreaser, as desired. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.

CAUTION

Do not spray solvent into the generator or alternator, starter and air intakes.

c. Allow the solvent to remain on the engine from five to ten minutes, then rinse the engine clean with additional solvent and allow to dry.

CAUTION

Do not operate engine until excess solvent has evaporated or otherwise been removed.

d. Remove the protective covers from the magnetos.

e. Lubricate controls, bearing surfaces, etc., per Lubrication Chart.

CLEANING LANDING GEAR

Before cleaning the landing gear, place a plastic cover or similar material over the wheel and brake assembly.

a. Place a pan under the gear to catch waste.

b. Spray or brush the gear area with solvent or a mixture of solvent and degreaser, as desired. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.

c. Allow the solvent to remain on the gear from five to ten minutes then rinse the gear with additional solvent and allow to dry.

d. Remove the cover from the wheel and remove the catch pan.
e. Lubricate the gear per Lubrication Chart.

CLEANING EXTERIOR SURFACES

The airplane should be washed with a mild soap and water. Harsh abrasive or alkaline soaps or detergents used on painted or plastic surfaces could make scratches or cause corrosion of metal surfaces. Cover areas where cleaning solution could cause damage. To wash the airplane, the following procedure may be used:

a. Flush away loose dirt with water.
b. Apply cleaning solution with a rag, sponge or soft bristle brush.
c. To remove stubborn oil and grease, use a cloth dampened with naptha.
d. Where exhaust stains exist, allow solution to remain on the surface longer.
e. 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 surfaces will reduce the abrasion problems in these areas.

CLEANING WINDSHIELD AND WINDOWS

a. Remove dirt, mud, etc., from exterior surface with clean water.
b. Wash with mild soap and warm water or an aircraft plastic cleaner. Use a soft cloth or sponge using a straight rubbing motion. Do not harshly rub surfaces.
c. Remove oil and grease with a cloth moistened with kerosene.

NOTE

Do not use gasoline, alcohol, benezene, carbon tetrachloride, thinner, acetone, or window cleaning sprays.

d. After cleaning plastic surfaces, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion.
e. A severe scratch or mar in plastic can be removed by using jeweler's rouge to rub out the scratch. Smooth both sides and apply wax.

CLEANING HEADLINER, SIDE PANELS AND SEATS

a. Clean headliner, side panels and seats with a stiff bristle brush and vacuum where necessary.
b. Soiled upholstery, except leather, may be cleaned by using an approved air type cleaner or foam upholstery cleaner. Carefully follow the manufacturer's instructions. Avoid soaking or harsh rubbing.

CAUTION

Solvent cleaners require adequate ventilation.

c. Leather material should be cleaned with saddle soap or a mild soap and water.

CLEANING CARPETS

Use a small whisk broom or vacuum to remove dirt. For soiled spots, use a non-inflammable dry-cleaning fluid.

POWER PLANT INDUCTION AIR FILTER

The induction air filters must be cleaned at least once every fifty hours. Depending on the type of condition existing, it may be necessary to clean the filters more often.

REMOVAL OF INDUCTION AIR FILTER

a. Remove the right side access panel from the engine nacelle to gain access to the air filter box.
b. Turn the three studs and remove the air filter box cover.
c. Lift the air filter from the filter box.

CLEANING INDUCTION AIR FILTER

a. Tap filter gently to remove dirt particles. Do not use compressed air or cleaning solvents.
b. Inspect filter. If paper element is torn or ruptured or gasket is damaged, the filter should be replaced. The usable life of the filter should be restricted to one year or 500 hours, whichever comes first.

CLEANING INDUCTION AIR FILTER, TURBOCHARGED

a. Clean air filter thoroughly with a dry type solvent or kerosene.
b. Inspect filter. If element is punctured or ruptured or gasket is damaged, the filter should be replaced.
c. Allow filter to dry thoroughly then dip in SAE10 weight oil and allow to drain for four hours.
d. Wipe off excess oil prior to installation.

INSTALLATION OF INDUCTION AIR FILTER

a. Place filter in air box and install cover.
b. Secure cover by turning studs. On turbocharged airplanes, secure air box cover with wing nuts and safety.

BRAKE SERVICE

The brake system is filled with MIL-H-5606 (petroleum base) hydraulic brake fluid. This should be checked at every 100 hour inspection and replenished when necessary. Refill the brake reservoir on the aft bulkhead of the nose section to the indicated level.

No adjustment of brake clearance is necessary. If the brake blocks become worn to 1/64 inch minimum lining, replace them with new brake segments. Remove the four cap bolts that join the brake cylinder housing and lining back plate assemblies, then remove the back plates from between the brake disc and wheel. Slide the brake cylinder housing from the torque plate and slide the pressure plate and lining from the anchor bolts of the cylinder housing. Remove the lining by prying it from the pressure plate and

back plates. With the four cap bolts removed, it is possible to remove the main wheels by taking off the dust cover and axle nut.

LANDING GEAR SERVICE

To raise the aircraft for servicing, use two hydraulic jacks and a tail support. Place about 300 pounds of ballast on the base of the tail support before jacking the aircraft.

Landing gear oleos should be serviced according to instruction on the units. All three oleos should be extended until about two and three-quarter inches of oleo strut extension is exposed in static position.

To add air to the oleo struts, attach a strut pump to the air valve and pump the oleo up to the proper position. To add oil, release the air through the strut valve, and allow the strut to extend fully. Remove the air valve and fill the unit through its opening. Compress the oleo to within one-quarter inch of full compression, allowing air and excess oil to escape. Reinsert the valve core and pump up the strut.

PROPELLER SERVICE

The air charge in the propeller cylinder should be kept at the pressure specified on the placard located in the spinner cap. The pressure in the cylinder will increase about one-third psi for every degree Fahrenheit increase in temperature. This effect should be considered when checking pressure. The charge maintained must be accurate and free of excessive moisture since moisture may freeze the piston during cold weather. Dry nitrogen gas is recommended.

CHAMBER PRESSURE REQUIREMENTS WITH TEMPERATURE

HC-E2YL-2B / HC-E2YL-2BF		and	HC-E2YL-2BL / HC-E2YL-2BLF	
Temp. °F	Press. (psi)		Temp. °F	Press. (psi)
100	188		30	165
90	185		20	162
80	182		10	159
70	178		0	154
60	175		-10	152
50	172		-30	146

HC-E2YL-2BS / HC-E2YL-2BSF	and	HC-E2YL-2BLS / HC-E2YL-2BLSF
Temp. °F		Press. (psi)
100		53
70		50
40		47
10		44
-20		42

NOTE: Do not check pressure or charge with propeller in feather position.

OIL REQIREMENTS

The oil capacity of the Lycoming engines is 8 quarts with a minimum safe quantity of 2 quarts. It is recommended that engine oil be drained and renewed every 50 hours or sooner under unfavorable conditions. 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. The following grades are required for 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 10° F	S.A.E. 20

FUEL SYSTEM

The fuel screens in the strainers require cleaning at fifty hour or ninety day intervals whichever first occurs. The fuel strainers beneath the floor panel are accessible through a plate in the underside center of the fuselage. The fuel injector screen is located in the housing where the fuel inlet line connects to the injector. This screen should be cleaned every fifty hours of operation.

FUEL REQUIREMENTS

A minimum octane of 100/130 Aviation Grade fuel must be used in the Twin Comanche. Since the use of lower grades of fuel can cause serious engine damage in a short period of time, the engine warranty is invalidated by use of lower octanes.

FILLING FUEL CELLS

Observe all required precautions for handling gasoline. Fill the fuel cells to the bottom of the filler neck with the fuel specified on the placard located on the underside of the filler cover or in Table II-I. Each main (inboard) fuel cell holds a maximum of 30 U. S. gallons. The auxiliary (outboard) fuel cells have a maximum capacity of 15 U.S. gallons each which give a total of 90 U. S. gallons of fuel with 84 U. S. gallons usable. In addition, as optional equipment are tip tanks with a capacity of 15 U. S. gallons each. In order to obtain maximum capacity when filling fuel cells, the plane should be approximately level.

DRAINING FUEL VALVES AND LINES

The fuel filter bowls and lines are drained by opening the access door within the fuselage just aft of the fuel selector console, and pulling up on the red knob in the center of each valve. A transparent plastic tube is attached to each filter bowl and extends through a hole in the bottom of the fuselage. Flow of the fuel is observed by means of the transparent tube. The fuel valves, bowls and lines should be drained regularly to check for water or dirt accumulations.

a. The procedure for draining the lines from main and auxiliary cells is to open the drain valve for a

few seconds with the selector handle on the main and then move to the auxiliary cell. Repeat the process for the opposite side.

b. To drain the lines from the tip tanks, move the fuel selector handle to the auxiliary fuel cell position; turn the master switch on; and the electrical selector switch, located on the forward side of the selector panel, to the tip tank position. Open the drain valve to allow the line to drain. Repeat the process for the opposite tank.

DRAINING FUEL SYSTEM

The bulk of the fuel may be drained from the fuel cells and tip tanks by the use of a siphon hose placed in the cell or tank through the filler neck. In addition, the tip tank may be drained by inserting a dowel in the plug at the bottom of the tank and pushing up or by removing the plug itself. The remainder of the fuel may be drained by opening the drain valve in each fuel selector bowl.

TIRE INFLATION

For maximum service from the tires, keep them inflated to the proper pressure of 42 psi. Interchange the tires periodically for even wear. All wheels and tires are balanced before original installation, and the relationship of tire, tube and wheel should be maintained upon reinstallation. In the installation of new components, it may be necessary to rebalance the wheels with the tires mounted. Out of balance wheels can cause extreme vibration in the landing gear.

BATTERY SERVICE

Access to the 12-volt 35 ampere hour battery is gained by removing the top panel of the fuselage nose section. The stainless steel battery container has a plastic drain tube which is normally closed off with a clamp that should be opened every 30 days to drain off any accumulation of fluid.

The battery fluid level must not be brought above the baffle plates. It should be checked every 30 days to determine that the fluid level is proper and the connections are tight and free of corrosion.

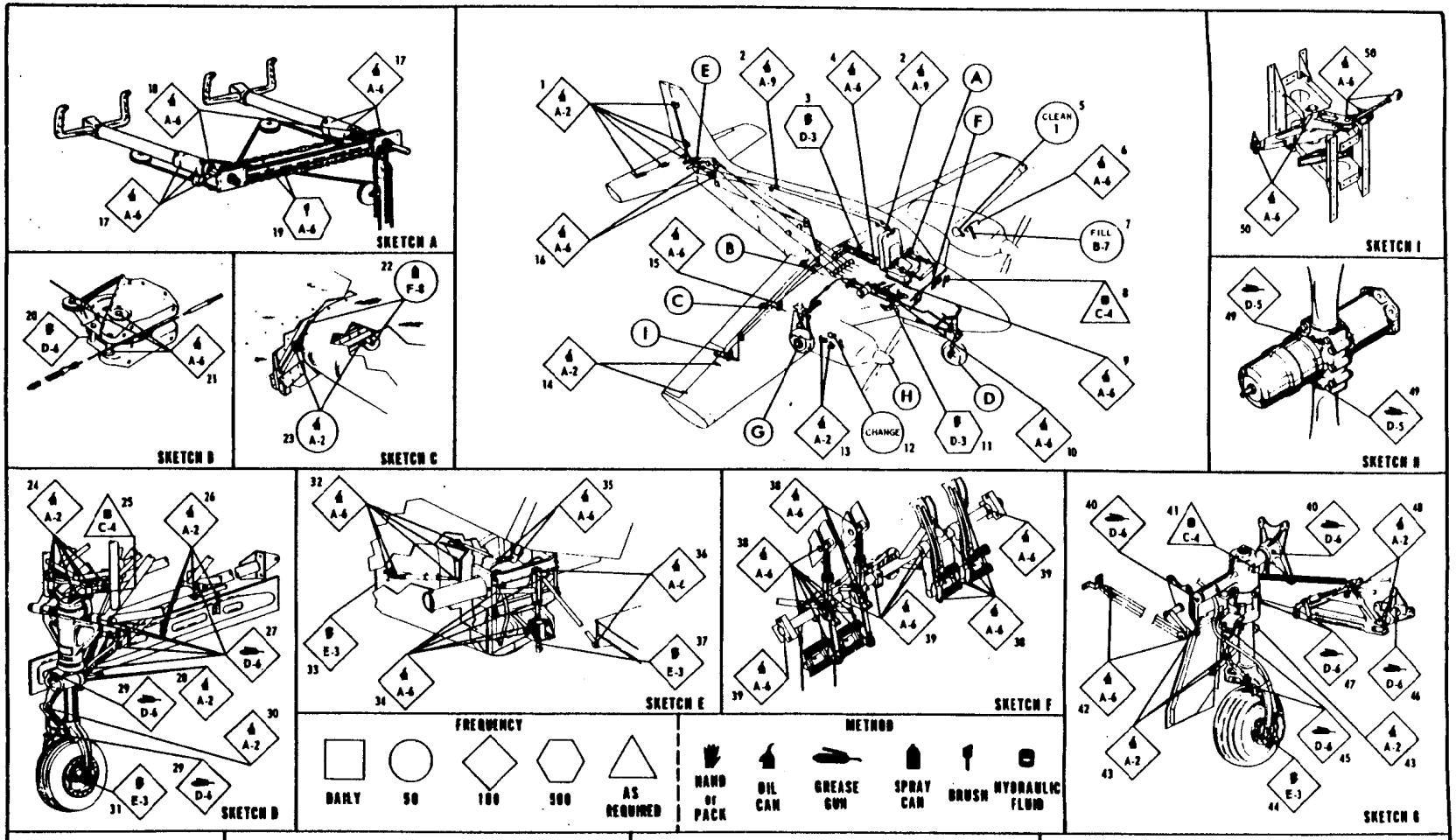
If the battery is not properly charged, recharge it starting with a rate of 4 amperes and finishing with a rate of 2 amperes. Quick charges are not recommended.

The external power receptacle, if installed, is located on the left side of the nose section. Be sure that master switch is off while inserting or removing a plug at this receptacle.

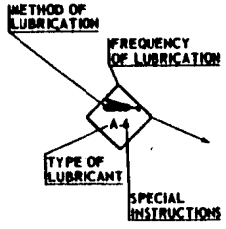
NOTES

PARTS NOMENCLATURE KEY

1. STABILATOR TRIM TAB AND RUDDER HINGES
2. STABILATOR TRIM PULLEYS
3. FLAP TRANSMISSION
4. FLAP CONTROL ARMS AND CABLE ENDS
5. AIR FILTER, RIGHT AND LEFT
6. COWL FLAP CONTROL LINKAGE, RIGHT AND LEFT
7. ENGINE OIL SUMP, RIGHT AND LEFT
8. BRAKE RESERVOIR
9. PILOT AND PASSENGERS SEAT TRACKS
10. LANDING GEAR RETRACTION MECHANISM
11. LANDING GEAR RETRACTION TRANSMISSION
12. OIL FILTER CARTRIDGE, RIGHT AND LEFT
13. GOVERNOR, THROTTLE AND MIXTURE CABLE ENDS
14. AILERON HINGES, RIGHT AND LEFT
15. FLAP CONTROL ROD ENDS, CABLE ENDS AND BELLCRANK BEARINGS
16. STABILATOR CONTROL CABLE ENDS AND TRIM PULLEYS
17. STABILATOR CONTROL TUBE BEARINGS AND SQUARE TUBE MOUNTING BEARINGS
18. CONTROL WHEEL ROLLERS
19. CONTROL WHEEL CHAIN VERTICAL AND HORIZONTAL
20. LOCK PIN, STEP
21. STEP LOCK PULLEYS AND RELEASE ARM PIVOT BEARING
22. FLAP TRACK
23. FLAP TRACK ROLLERS, STEEL
24. STEERING ROD END BEARINGS, STEERING BELLCRANK PIVOT BEARING, STEERING ARM BUSHING, GEAR ALIGNING BUSHING
25. GEAR OLEO STRUT FILLER
26. NOSE GEAR DOOR HINGES, DOOR ACTUATING MECHANISM, NOSE GEAR PUSH-PULL ROD END BEARING
27. STRUT HOUSING ATTACHMENT BUSHINGS, DRAG LINK PIVOT AND ATTACHMENT BUSHINGS
28. SHIMMY DAMPENER ROD END BEARING AND MOUNT
29. UPPER AND LOWER TORQUE LINK BUSHINGS
30. UPPER AND LOWER TORQUE LINK CONNECTING BOLT
31. WHEEL BEARINGS
32. RUDDER TRIM GUIDE, UNIVERSAL JOINT, TRIM TUBE END BEARING, PUSH-PULL TUBE END BEARINGS, BELLCRANK PIVOT BEARING
33. RUDDER TRIM SCREW
34. STABILATOR TRIM MECHANISM
35. RUDDER CONTROL CABLE AND TRIM TUBE END BEARINGS
36. STABILATOR TRIM TAB CONTROL ROD
37. STABILATOR TRIM SCREW
38. RUDDER PEDALS, BRAKE ACTUATING MECHANISM, BRAKE CYLINDER ENDS, CONTROL CABLE ENDS AND STEERING ROD ENDS
39. RUDDER PEDAL TORQUE TUBE AND BLOCK BEARINGS
40. STRUT ATTACHMENT BEARING
41. GEAR OLEO STRUT FILLER
42. BUNGEE CORD ROLLERS
43. GEAR DOOR HINGE, RETRACTION ROD END BEARINGS, TORQUE LINK CONNECTING BOLT
44. WHEEL BEARINGS
45. UPPER AND LOWER TORQUE LINK BUSHINGS
46. SIDE BRACE MOUNT BEARING
47. SIDE BRACE END BEARING AND PIVOT BEARING
48. RETRACTION CABLE END BEARING AND SIDE BRACE ATTACHMENT BUSHING
49. PROPELLER GREASE FITTINGS, RIGHT AND LEFT
50. AILERON PUSH-PULL ROD END BEARINGS, CONTROL CABLE ATTACHMENT POINTS AND BELLCRANK PIVOT BEARINGS



EXAMPLE



LUBRICATION CHART

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. 6411

SPECIAL INSTRUCTIONS

1. AIR FILTER – TO CLEAN FILTER, TAP GENTLY TO REMOVE DIRT PARTICLES. DO NOT BLOW OUT WITH COMPRESSED AIR OR USE SOLVENT. REPLACE FILTER IF PUNCTURED OR DAMAGED. TURBOCHARGED ENGINES – CLEAN FILTER IN SOLVENT AND ALLOW TO DRY. DIP IN SAE 10 OIL AND ALLOW TO DRAIN FOUR HOURS.
2. BEARINGS AND BUSHINGS – CLEAN EXTERIOR WITH A DRY TYPE SOLVENT BEFORE RELUBRICATING.
3. LANDING GEAR AND FLAP TRANSMISSIONS AND SCREWS, TRIM SCREWS AND WHEEL BEARINGS – DISASSEMBLE AND CLEAN WITH A DRY TYPE SOLVENT. WHEN REASSEMBLING TRANSMISSIONS, FILL WITH LUBRICANT AND APPLY A THIN COATING TO SCREW.
4. OLEO STRUTS 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.
8. LUBRICATE FLAP TRACK WITH DUPONT'S ALL PURPOSE SLIP SPRAY #6611. FLAPS REQUIRE CLEANING AND LUBRICATION AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER. FLAPS WITH NYLON ROLLERS WILL NOT REQUIRE LUBRICATION ON EITHER FLAP TRACKS OR ROLLERS.
9. OVERHEAD TRIM PULLEYS – LUBRICATION MAY BE EXTENDED TO 250 HOURS WHEN DUSTY CONDITIONS ARE AT A MINIMUM.

NOTES

1. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
2. SEE LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF DETERGENT OIL.

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.