PILOT'S OPERATING HANDBOOK
AND FAA APPROVED AIRPLANE FLIGHT MANUAL

Gulfstream American

Model GA-7/COUGAR

FAA APPROVED IN THE NORMAL CATEGORY BASED ON FAR 23. THIS DOCUMENT MUST BE CARRIED IN THE AIRPLANE AT ALL TIMES AND BE KEPT WITHIN REACH OF THE PILOT DURING ALL FLIGHT OPERATIONS.

THIS HANDBOOK INCLUDES THE MATERIAL REQUIRED TO BE FURNISHED TO THE PILOT BY FAR PART 23 AND CONSTITUTES THE FAA APPROVED AIRPLANE FLIGHT MANUAL.

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GULFSTREAM AMERICAN CORPORATION
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LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES: DISPOSE OF SUPERSEDED PAGES.

This handbook will be kept current by Service Letters and Handbook Revisions published by Gulfstream American Corporation. These are distributed to Gulfstream American Dealers and Distributors and to those who subscribe through the Owner's Revision Service. If you are not receiving subscription service, you will want to keep in touch with your Gulfstream American Dealer or Distributor for information concerning the change status of the handbook. Subsequent changes should be examined immediately after receipt; the handbook should not be used for operational purposes until it has been updated to a current status. On a changed page, the portion of the text or illustration affected by the change is indicated by a vertical line in the outer margin of the page.

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THE TOTAL NUMBER OF PAGES IN THIS HANDBOOK IS 212, CONSISTING OF THE FOLLOWING. THIS TOTAL INCLUDES THE SUPPLEMENTS PROVIDED IN SECTION 9.

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Zero in this column indicates original page.
* See Section 9 for Supplements.

PERFORMANCE – SPECIFICATIONS

SPEED:
- Maximum at Sea Level . . . . . 168 Knots
- Cruise, 75% Power at 8500 Ft. . . . . . 160 Knots
- Cruise, 45% Power at 8500 Ft. . . . . . 109 Knots

RANGE AND ENDURANCE:

Range and Endurance figures include allowances for start, takeoff, cruise climb to altitude, cruise, descent, plus fuel sufficient for 45 minutes of holding at 45% power.

Maximum Recommended Cruise Speed:

(118 Gallons Fuel, 75% Power, 8500 Ft.)
- Endurance . . . . . 5.3 hrs.
- Range . . . . . 840 NM

(80 Gallons Fuel, 75% Power, 8500 Ft.)
- Endurance . . . . . 3.3 hrs.
- Range . . . . . 530 NM

Maximum Range:

(118 Gallons Fuel, 45% Power, 8500 Ft.)
- Endurance . . . . . 10.6 hrs.
- Range . . . . . 1170 NM

(80 Gallons Fuel, 45% Power, 8500 Ft.)
- Endurance . . . . . 6.7 hrs.
- Range . . . . . 730 NM

RATE OF CLIMB AT SEA LEVEL:
- Twin Engine . . . . . 1160 fpm
- Single Engine . . . . . 200 fpm

SERVICE CEILING:
- Twin Engine . . . . . 17,400 Ft.
- Single Engine . . . . . 4250 Ft.

TAKEOFF PERFORMANCE: (Max. Gross Weight, Sea Level, 59°F)
- Ground Roll . . . . . 1000 Ft.
- Total Distance to Clear 50 Ft. Obstacle . . . . . 1850 Ft.

LANDING PERFORMANCE: (Max. Gross Weight, Sea Level, 59°F)
- Ground Roll . . . . . 710 Ft.
- Total Distance over 50 Ft. Obstacle . . . . . 1330 Ft.

STALL SPEEDS: (Power OFF)
- Flaps Up . . . . . 71 Knots
- Flaps Down . . . . . 63 Knots

MINIMUM AIR CONTROL SPEED, V_{MCA}: (Single Engine) . . . . . 61 Knots

MAXIMUM GROSS WEIGHT . . . . . 3800 Lbs.

STANDARD EMPTY WEIGHT . . . . . 2569 Lbs.

BAGGAGE ALLOWANCES:
- Forward (Nose) Compartment . . . . . 75 Lbs.
- Aft Cabin Compartment . . . . . 175 Lbs.

WING LOADING: Pounds/Sq. Ft. 20.65

POWER LOADING: Pounds/HP 11.88

FUEL CAPACITY:
- Total . . . . . 118 Gal.
- Useable . . . . . 114 Gal.

OIL CAPACITY: (Each Engine) . . . . . 8 Qts.

ENGINE: (2) Lycoming 0-320-D1D
- 160 BHP, @2700 RPM

PROPELLER: Constant Speed (Full Feathering) (2)
- Diameter . . . . . 73 In.

WELCOME ABOARD!

Your GA-7/Cougar has been designed and constructed to provide you with a responsive four-place airplane to serve your needs for either pleasure or business flying in both comfort and economy.

This handbook has been prepared to help you obtain the maximum pleasure and utility from your airplane. Read it carefully, review it frequently, and keep it with you in the airplane at all times.

With proper operational techniques and good maintenance, your Grumman American Cougar should serve you well. Get to know your Grumman American Dealer. He is equipped to provide any assistance that may be required.

LOG OF REVISIONS

Revision Number and Date	Revised Pages	Description of Revision
Rev. 1 June 15/78	Title Page	Added Revision Date.
	A/(B Blank)	Added Revision 1 and Revised List of Effective Pages.
	C/(D Blank)	Added Revision 1 (Description).
	1-10	Corrected Heading.
	2-4	Corrected Airspeed Indicator Markings.
	5-5	Revised TIME, FUEL and DISTANCE TO CLIMB Data.
	5-6	Revised TIME – FUEL – DISTANCE Data.
	5-13	Revised TAKEOFF DISTANCE (NORMAL TAKEOFF) Chart.
	5-14	Revised TAKEOFF DISTANCE (SHORT FIELD TAKEOFF) Chart.
	5-15	Revised CLIMB – ONE ENGINE INOPERATIVE Chart.
	5-16	Revised ONE ENGINE INOPERATIVE – SERVICE CEILING Chart.
	5-17	Revised CLIMB – TWO ENGINE (CRUISE CLIMB) Chart.
	5-18	Revised CLIMB – TWO ENGINE (MAXIMUM CLIMB) Chart.
	5-19	Revised TIME, FUEL and DISTANCE TO CLIMB (CRUISE CLIMB) Chart.
	5-20	Revised TIME, FUEL and DISTANCE TO CLIMB (MAXIMUM CLIMB) Chart.
	5-32	Revised CLIMB – BALKED LANDING Chart.
	6-5	Corrected Heading.
	6-11	Revised Text.
	6-15	Revised Equipment List.
	7-1	Corrected Heading.
	9-4	Revised Log of Supplements, Added Supplements No. 2, 3 and 4.
Rev. 2 October 15/78	Title Page	Changed Revision Date.
	A	Added Revision 2 and Revised List of Effective Pages.
	B	Revised List of Effective Pages (Continued).
	C	Added Revision 2 (Description).
	D	Added Revision 2 (Continued).
	ii	Revised Rate of Climb and Service Ceiling Data.
	3-6	Revised Engine Failure After Takeoff Procedures.
	3-7	Revised Engine Failure During Flight Procedures.
	3-19	Revised One Engine Inoperative Operation Procedures.
	3-20	Revised Engine Failure During Takeoff (Speed Above 75 KIAS) Procedures.
	3-21	Revised Engine Failure During Flight Procedure.
	4-19	Revised Mixture Leaning Procedures.

LOG OF REVISIONS (Continued)

Revision Number and Date	Revised Pages	Description of Revision
Rev. 2 October 15/78 (Cont)	4-20	Text carried over from Page 4-19.
	5-5	Revised TIME, FUEL and DISTANCE TO CLIMB Data.
	5-6	Revised CRUISE INFORMATION Data.
	5-8	Changed Calibrated Airspeed to KCAS.
	5-13	Revised TAKEOFF DISTANCE (NORMAL TAKEOFF) Chart.
	5-14	Revised TAKEOFF DISTANCE (SHORT FIELD TAKEOFF) Chart.
	5-15	Revised CLIMB – ONE ENGINE INOPERATIVE Charts.
	5-16	Revised ONE ENGINE INOPERATIVE SERVICE CEILING Chart.
	5-17	Revised CLIMB – TWO ENGINE (CRUISE CLIMB) Chart.
	5-18	Revised CLIMB – TWO ENGINE (MAXIMUM CLIMB) Chart.
	5-19	Revised TIME, FUEL and DISTANCE TO CLIMB (CRUISE CLIMB) Chart.
	5-20	Revised TIME, FUEL and DISTANCE TO CLIMB (MAXIMUM CLIMB) Chart.
	5-27	Revised FUEL FLOW (GPH) Chart.
	5-32	Revised CLIMB – BALKED LANDING Chart.
	5-33	Revised LANDING DISTANCE (NORMAL LANDING) Chart.

INTRODUCTION

This handbook contains 10 sections. The sections are arranged in the handbook in an order which increases the in-flight usefulness of the handbook. Information that may be required by the pilot during flight, is located in the front portion of the handbook to provide easy access. Each section of the handbook is marked with a plasticized tab divider. The tab dividers are staggered for ease of reference with section number and title printed on the tab. The "Emergency Procedures" section tab is colored red so that it may be easily located. This handbook also includes the material required to be furnished to the pilot by FAR Part 23. It also contains supplemental data supplied by the airframe manufacturer.

LIST OF SECTIONS

GRUMMAN AMERICAN AVIATION CORPORATION (herein GRUMMAN AMERICAN) warrants each new airplane and part thereof manufactured by it, together with all new airplane equipment and accessories bearing the name "GRUMMAN AMERICAN AVIATION," to be free from defects in material and workmanship under normal use and service, but extends no warranty of any kind, expressed or implied, to any items not manufactured by GRUMMAN AMERICAN, or not so bearing its name, whether incorporated into or installed in the airplane, except that the workmanship involved in installing such items is warranted to be without defect. The obligation of GRUMMAN AMERICAN under this warranty is limited to replacement or repair, at the option of GRUMMAN AMERICAN, of any such airplane, or any part or accessory which shall within twelve (12) months of operation be found defective. Such airplane, part or accessory is to be returned to a GRUMMAN AMERICAN DEALER upon which examination by GRUMMAN AMERICAN, shall disclose to its reasonable satisfaction to have been thus defective. This warranty shall not in any way apply to or cover any products which are in GRUMMAN AMERICAN's opinion damaged as a result of being in any manner altered or repaired outside of the factory of GRUMMAN AMERICAN or that shall have been subject to misuse or negligence.

GRUMMAN AMERICAN makes no warranty whatsoever with respect to engines, radios, propellers, ignition apparatus, starting devices, generators, batteries, or other trade accessories, inasmuch as such products are generally warranted separately by their respective manufacturers.

"THESE WARRANTY PROVISIONS ARE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, STATUTORY OR IMPLIED IN FACT OR BY LAW, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND OF ANY OTHER OBLIGATION OR LIABILITY ON THE PART OF GRUMMAN AMERICAN, EXPRESSED OR IMPLIED, OF ANY NATURE WHATSOEVER. GRUMMAN AMERICAN NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON OR BUSINESS ORGANIZATION TO ASSUME FOR IT ANY OTHER WARRANTY OR LIABILITY IN CONNECTION WITH THE SALE, USE OR OPERATION OF ITS PRODUCTS."

IMMEDIATELY ON COMMENCING FIRST USE OF AN AIRPLANE, A WARRANTY VALIDATION CARD MUST BE FILLED OUT AND MAILED TO THE ATTENTION OF CUSTOMER SERVICE, COMMERCIAL LIGHT AIRCRAFT, P.O. BOX 2206, SAVANNAH, GEORGIA 31402. NO WARRANTY CLAIMS WILL BE HONORED IF THIS CARD IS NOT ON FILE AT THE FACTORY.

SECTION 1
GENERAL

TABLE OF CONTENTS

(1) PROPELLER GROUND CLEARANCE:
WITH NOSE TIRE AND STRUT INFLATED TO RECOMMENDED PRESSURE __ 10 INCHES

WITH NOSE TIRE AND STRUT DEFLATED __ 6 INCHES

(2) WING AREA: 183.81 SQUARE FEET

(3) MINIMUM TURNING RADIUS IS 47 FEET, 8 INCHES.

(SEE FIGURE 7-9 FOR ADDITIONAL INFORMATION

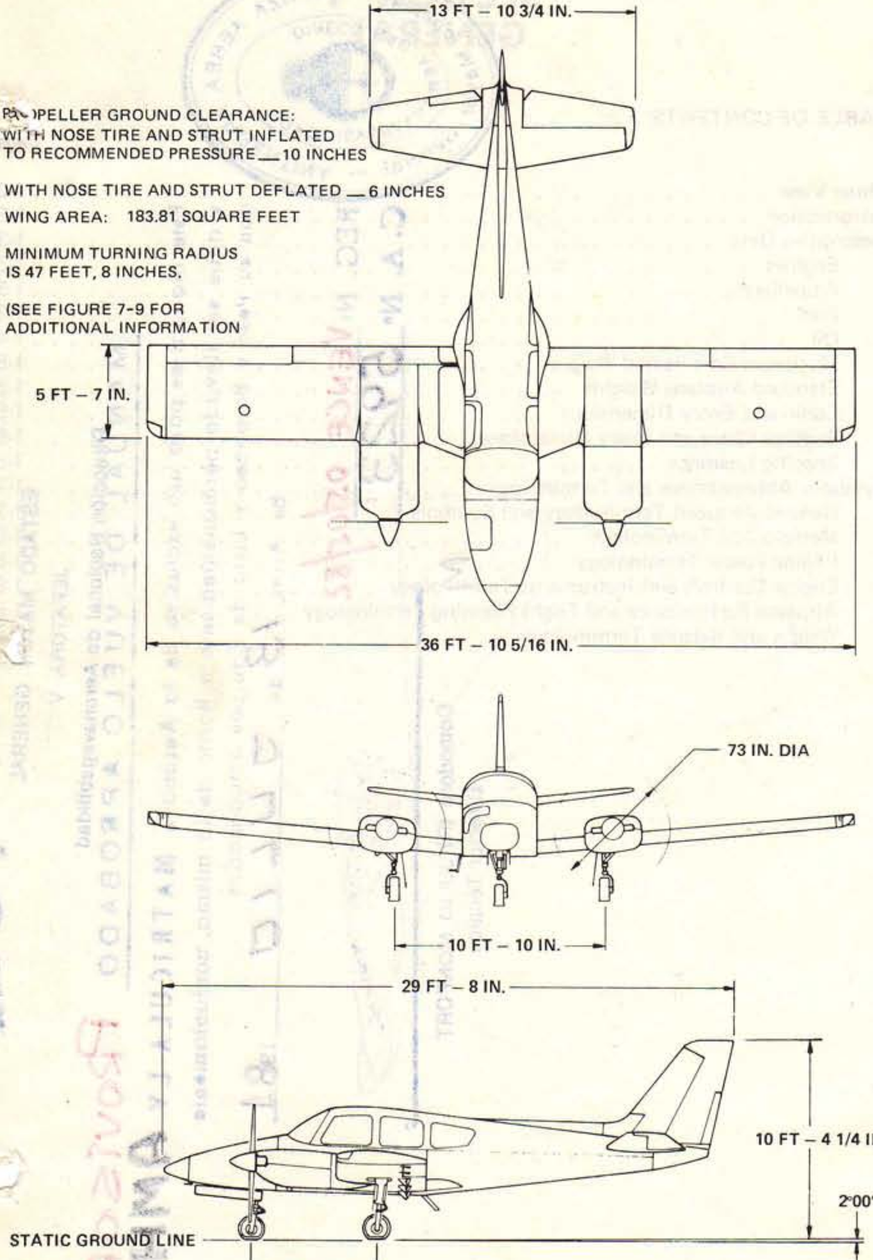

Figure 1-1 Three View

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INTRODUCTION

This section provides basic data and information of general interest to the pilot, to assist him in loading, sheltering, handling, and routine preflight checking of the airplane. Also included in this section are definitions and explanations of the symbols, abbreviations and terminology used in this handbook.

NOTE

Unless otherwise noted, all performance and operational data in this handbook are based on sea level, standard day, and an airplane gross weight of 3800 pounds.

DESCRIPTIVE DATA

ENGINES

Number of Engines: 2
Manufacturer: AVCO Lycoming
Model number: 0-320-D1D
Type: Normally aspirated, direct drive, air-cooled, wet sump, horizontally opposed, four cylinder engine with 319.8 cubic inch displacement.
Horsepower Rating and Engine Speed: 160 HP at 2700 engine RPM

PROPELLERS

Manufacturer: Hartzell
Model Number: HC-F2YL-2UF/FC7663D-3
Diameter: 73 inches
Type: Constant speed, full feathering, governor regulated, two bladed propellers. An unfeathering accumulator is optional.
Blade Angle at 30 Inch Station:
Low Pitch – 11.5° ± 0.1°

FUEL

CAUTION

UNDER NO CIRCUMSTANCES SHOULD FUEL OF A LOWER OCTANE RATING THAN THAT SPECIFIED BELOW, OR AUTOMOTIVE FUEL (REGARDLESS OF OCTANE) BE USED.

Minimum Grade (and color): 100 Minimum Grade Aviation Fuel (green).
100 Low Lead Aviation Fuel (blue) is also approved. Refer to latest revision of Lycoming Service Instruction No. 1070 for further information concerning fuels.

Capacity at an ambient temperature of 70°F (21°C):
- Total 118 U.S. gallons (98.3 Imperial gallons) (446.6 Liters)
- Each Tank: 59 U.S. gallons (49.1 Imperial gallons) (223.3 Liters)
- Total Usable: 114 U.S. gallons (94.9 Imperial gallons) (431.5 Liters)
- Intermediate Loading: 100 U.S. gallons (80 Imperial gallons)(380 Liters) and 80 U.S. gallons (66.6 Imperial gallons) (302.80 Liters)
- Unusable Fuel: 2 U.S. gallons in each wing.

OIL

Grade (Specification):

Aviation Grade Straight Mineral Oil Military Specification MIL-L-6082B (Figure 8-2) shall be used to replenish oil supply during the first 25 hours of operation and at the first 25-hour oil change. Continue to use this grade of oil for the first 50 hours of operation or until oil consumption has stabilized.

Ashless Dispersant Oil, Military Specification MIL-L-22851 (Figure 8-2): This specification oil should be used after the first 50 hours of engine operation.

NOTE

The airplane is delivered from the factory with corrosion preventative airplane engine oil. This oil should be drained after the first 25 hours of engine operation.

***Recommended Viscosity:**

Average Ambient Air Temperature	Mineral Grade	Ashless Dispersant
Above 60°F (16°C)	SAE 50	SAE 40 or SAE 50
30°F (-1°C) to 90°F (32°C)	SAE 40	SAE 40
0°F (-18°C) to 70°F (21°C)	SAE 30	SAE 40 or SAE 20W-30
Below 10°F (-12°C)	SAE 20	SAE 20W-30

*Refer to latest revision of Lycoming Service Instruction No. 1014 and Lycoming Specification No. 301 for further information.

Oil Capacity

Sump: 8 U.S. Quarts (6.66 Imperial Quarts) (7.57 Liters)
Minimum Safe Quantity in Sump: 2 U.S. Quarts (1.67 Imperial Quarts) (1.89 Liters)

CAUTION

EACH DIP STICK IS MARKED WITH BOTH THE LEFT AND RIGHT ENGINE OIL QUANTITIES. ENSURE THAT YOU READ THE QUANTITY FOR THE CORRECT ENGINE.

NOTE

Dip stick indicates the quantity of oil in the engine oil sump but does not account for the one quart of oil in the oil filter. Refer to Section 8 for optional oil filter information.

It is recommended that lubricating oil be changed at least every 50 hours of engine operation. If the engine is equipped with an oil filter, the recommended time is 100 hours of engine operation or 6 months, whichever occurs first.

MAXIMUM CERTIFICATED WEIGHTS

Takeoff: 3800 pounds

Landing: 3800 pounds

Weight in Baggage Compartment 175 pounds in aft compartment, and 75 pounds in nose compartment is maximum allowable if c.g. is within Center of Gravity Envelope (Figure 6-6). Refer to Section 6 for cargo loading instructions.

STANDARD AIRPLANE WEIGHTS

NOTE

Actual weights for each airplane will vary according to installed equipment. Refer to weight and balance data supplied with the particular airplane for specific data for that airplane.

Standard Empty Weight:	2569 pounds
Maximum Useful Load:	1231 pounds

CABIN AND ENTRY DIMENSIONS

(See Figure 1-2 for cabin entry dimensions.)

BAGGAGE SPACE AND ENTRY DIMENSIONS

(See Figure 1-2 for baggage space and entry dimensions.)

SPECIFIC LOADINGS

Wing Loading (Pounds/Sq. Ft.):	20.7
Power Loading (Pounds/B.H.P.):	11.9

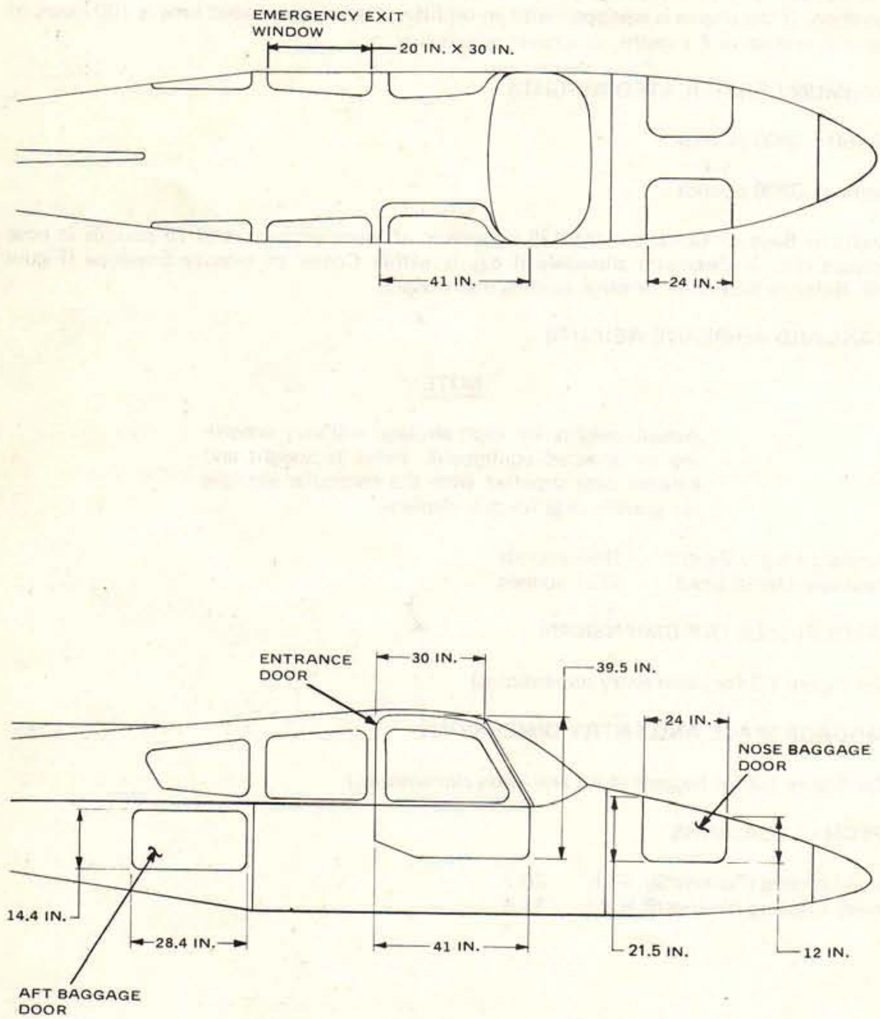

Figure 1-2
Cabin, Baggage and Entrance Dimensions

SYMBOLS, ABBREVIATIONS, AND TERMINOLOGY

GENERAL AIRSPEED TERMINOLOGY AND SYMBOLS

CAS	**Calibrated Airspeed** is the indicated speed corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.
g	g is acceleration due to gravity.
IAS	**Indicated Airspeed** is the speed as shown on the airspeed indicator when corrected for instrument error. IAS values published in this handbook assume zero instrument error.
KCAS	**Knots Calibrated Airspeed.** Calibrated airspeed expressed in knots.
KIAS	**Knots Indicated Airspeed.** Indicated airspeed expressed in knots.
KTAS	**Knots True Airspeed.** True airspeed expressed in knots.
TAS	**True Airspeed** is the airspeed relative to undisturbed air which is the CAS corrected for altitude, temperature and compressibility.
GS	**Ground Speed.** The speed of an aircraft relative to the ground.
V_A	**Maneuvering Speed** is the maximum speed at which application of full available control will not overstress the airplane.
V_{FE}	**Maximum Flap Extended Speed** is the highest speed permissible with wing flaps in a prescribed extended position.
V_{LE}	**Maximum Landing Gear Extended Speed** is the maximum speed at which an airplane can be safely flown with the landing gear extended.
V_{LO}	**Maximum Landing Gear Operating Speed** is the maximum speed at which the landing gear can be safely extended or retracted.
V_{MCA}	**Air Minimum Control Speed** is the minimum flight speed at which the airplane is controllable with a bank of not more than 5° when one engine suddenly becomes inoperative and the remaining engine is operating at takeoff power.
V_{NE}	**Never Exceed Speed** is the speed limit that may not be exceeded at anytime.
V_{NO}	**Maximum Structural Cruising Speed** is the speed that should not be exceeded except in smooth air, then only with caution.
V_S	**Stalling Speed (Clean)** is the minimum steady flight speed at which the airplane is controllable.
V_{S_o}	**Stalling Speed (Landing)** is the minimum steady flight speed at which the airplane is controllable in the landing configuration.

V_X — **Best Angle-of-Climb Speed** is the speed which results in the greatest gain of altitude in a given horizontal distance.

V_Y — **Best Rate-of-Climb Speed** is the speed which results in the greatest gain in altitude in a given time.

METEOROLOGICAL TERMINOLOGY

°C — °C is temperature in degrees Celsius (Centigrade).

°F — °F is temperature in degrees Fahrenheit.

ISA — **International Standard Atmosphere** in which: The air is a dry perfect gas. The temperature at sea level is 15° Celsius (59° Fahrenheit). The pressure at sea level is 29.92 inches Hg. (1013.2 mb). The temperature gradient from sea level to the altitude at which the temperature is -56.5°C (-69.7°F), is -0.00198°C (-0.003566°F) per foot and zero degrees above that altitude.

OAT — **Outside Air Temperature** is the free air static temperature. It is expressed in either degrees Celsius (Centigrade) or degrees Fahrenheit.

Indicated Pressure Altitude — **Indicated Pressure Altitude** is the altitude read from an altimeter when the barometric subscale has been set to 29.92 inches of mercury (1013 mb).

Pressure Altitude — **Pressure Altitude** is altitude measured from standard sea level pressure (29.92 In. Hg.) by a pressure or barometric altimeter. It is the indicated pressure altitude corrected for position and instrument error. In this Handbook, altimeter instrument errors are assumed to be zero. Position errors may be obtained from the altimeter correction chart.

Station Pressure — **Station Pressure** is actual atmospheric pressure at field elevation.

Wind — **The wind** velocities recorded as variables on the charts in this handbook are to be understood as the headwind or tailwind components of the reported winds.

ENGINE POWER TERMINOLOGY

BHP — **Brake Horsepower** is the power developed by the engine.

Critical Altitude — The maximum altitude at which, in standard temperature, it is possible to maintain a specified power.

Maximum Continuous Power	The power developed in a standard atmosphere from sea level to the critical altitude at the maximum RPM and manifold pressure approved for use during periods of unrestricted duration.
RPM	**The revolutions per minute (RPM)** of an engine is the rotational speed of the propeller shaft as indicated on a tachometer.
Manifold Pressure	**Manifold Pressure** is the absolute pressure in the intake manifold of the engine.

ENGINE CONTROLS AND INSTRUMENTS

Throttle Controls	The levers used to control the induction of a fuel-air mixture into the intake passages of an engine.
Mixture Controls	These levers, in the idle cut-off position, stop the flow of fuel and in the intermediate through full rich positions, regulate the fuel-air mixture.
Propeller Controls	These levers request the governor [illegible] maintain rpm at a selected value and in the Maximum decrease rpm posi[illegible], feather the propellers.
Propeller Governors	**The propeller governors** maintain [illegible]ected rpm requested by the propeller control levers.
Manifold Pressure Gauge	**The manifold pressure gauge** me[illegible]s the absolute pressure in the intake manifold of the engine, expresse[illegible]n in[illegible]hes of mercury (In. Hg.).
Tachometers	**Tachometers** indicate the rot[illegible]eed of the propellers (and engines) in revolutions per minute ([illegible]

AIRPLANE PERFORMANCE AND FLIG[illegible]NG TERMINOLOGY

Balked Landing	**A balked landing** is an [illegible]bort[illegible]d landing (i.e., all engines go-around).
Demonstrated Crosswind Velocity	**Demonstrated Crosswind Velocity** is the velocity of the crosswind component for which adequate contr[illegible]l of the airplane during takeoff and landing was actually demonstrated during certification tests.
Climb Gradient	The ratio of the change in height, during a portion of a climb, to the horizontal distance traversed in the same time interval.
MEA	Minimum enroute IFR altitude.
Route Segment	A part of a route. Each end of that part is identified by: (1) a geographical location: or (2) a point at which a definite radio fix can be established.
GPH	**U.S. gallons per hour.**

WEIGHT AND BALANCE TERMINOLOGY

Arm	**Arm** is the horizontal distance from the reference datum to the center of gravity (c.g.) of an item.
Standard Empty Weight	Weight of a standard airplane including unusable fuel, full operating fluids and full oil.
Basic Empty Weight	Standard weight plus optional equipment.
Center of Gravity (c.g.)	**Center of Gravity** is the point at which an airplane would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.
c.g. Arm	**Center of Gravity Arm** is the arm obtained by adding the airplane's individual moments and dividing the sum by the total weight.
c.g. Limits	**Center of Gravit mits** are the extreme center of gravity locations within which the airp can be operated at a given weight.
Gross Weight	**Gross Weight** maximum weight to which the airplane is certificated.
Jack Point	One of the point on the airplane designed to rest on a jack.
Maximum Landing Weight	**Maximum Landin ight** is the maximum weight approved for the landing touchdown.
Maximum Takeoff Weight	**Maximum Takeo** the maximum weight approved for the start of the takeoff run.
Moment	**Moment** is the product of the weight of an item multiplied by its arm. (Moment divided by the constant 1000 is used in this handbook to simplify balance calculations by reducing the number of digits.)
Reference Datum	An imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Station	**Station** is a location along the airplane longitudinal axis given in terms of the distance from the reference datum.
Tare	**Tare** is the weight of chocks, blocks, stands, etc., used when weighing an airplane, and is included in the scale readings. **Tare** is deducted from the scale reading to obtain the actual (net) airplane weight.

Unusable Fuel	**Unusable Fuel** is the quantity of fuel that cannot be used in flight.
Usable Fuel	**Usable Fuel** is the fuel available for flight.
Useful Load	**Useful Load** is the difference between maximum gross weight and the basic empty weight.

SECTION 2
LIMITATIONS

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Page

INTRODUCTION

The limitations included in this section have been approved by the Federal Aviation Administration. This section presents the operation limitations, the operational significance of such limitations, instrument markings, and basic placarding necessary for the safe operation of the airplane, its engine, standard systems and standard equipment. Where the significance of an operating limitation, marking or placard is not obvious, an explanation is presented. Limitations associated with Grumman American designed optional equipment are contained in Section 9.

The Grumman American Model GA-7/COUGAR is certificated under FAA Type Certificate, A17SO.

The airplane is equipped for day VFR (with standard equipment) and may be equipped for night VFR and/or IFR operations. FAR Part 91 establishes the minimum required instruments and equipment for these operations. The reference of types of flight operations on the operating limitations placard reflects equipment installed at the time the Airworthiness Certificate was issued.

THIS AIRPLANE IS NOT APPROVED FOR FLIGHT IN ICING CONDITIONS.

NOTE

Refer to Section 9 of this Pilot's Operating Handbook for amended operating limitations, operating procedures, performance data and other necessary information for airplanes equipped with specific options.

AIRSPEED LIMITATIONS

Airspeed limitations and the operational significance of the limitations are provided in Figure 2-1.

AIRSPEED LIMITATIONS			
Speed	**CAS (Knots)**	**IAS (Knots)**	**Remarks**
Never Exceed Speed (V_{NE})	191	188	Do not exceed this speed under any condition.
Maximum Structural Cruising Speed (V_{NO})	162	160	Do not exceed this speed except in smooth air and then only with caution.
Maneuvering Speed (V_A) Max Weight (3800 lbs) Min Weight (2800 lbs)	 121 105	 120 105	Do not make full or abrupt control movements above this speed.

Speed	CAS (Knots)	IAS (Knots)	Remarks
Maximum Flap Extended Speed (V_{FE}) 10° 11° to Full Down (30°)	 146 110	 145 110	Do not extend flaps or operate with flaps extended above this speed.
Maximum Landing Gear Extended Speed (V_{LE})	146	145	Do not exceed this speed with landing gear extended.
Maximum Landing Gear Operating Speed (V_{LO}) Gear Retraction Gear Extension	 115 146	 115 145	 Max. landing gear retraction speed. Do not extend landing gear above this speed.
Air Minimum Control Speed (V_{MCA})	59	61	This is the lowest speed at which the airplane is controllable after a sudden loss of an engine when the remaining engine is at takeoff power.

Figure 2-1

AIRSPEED INDICATOR MARKINGS

Airspeed indicator markings and the significance of the color coding are provided in Figure 2-2.

*AIRSPEED INDICATOR MARKINGS		
Marking	**IAS (Knots)**	**Significance**
RED RADIAL	61	Minimum Control Speed (V_{MCA})
WHITE ARC	63 – 110	Full Flap Operating Range
BLUE RADIAL	85	Best Rate-of-Climb Speed (one engine inop)
GREEN ARC	71 – 160	Normal Operating Range
YELLOW ARC	160 – 188	Operate with caution, only in smooth air
RED RADIAL	188	Maximum speed for ALL OPERATIONS

*The Airspeed Indicator is marked in IAS values measured in Knots.

Figure 2-2

POWER PLANT LIMITATIONS

Limitations of the power plant are provided in the following data:

Engine Manufacturer: Avco Lycoming
Engine Model Number: 0-320-D1D
Engine Operating Limits for Takeoff and Continuous Operations:
- Maximum Power: 160 BHP
- Maximum Engine Speed: 2700 RPM
- Maximum Cylinder Head Temperature: 500°F (260°C)
- Maximum Oil Temperature: 245°F (118°C)
- Oil Pressure (Normal Operating):
  - Idling: 25 psi
  - Minimum: 60 psi
  - Maximum: 90 psi
- Oil Pressure (Start and Warm-up):
  - Maximum: 100 psi
- Fuel Pressure (Inlet to Carburetor):
  - Minimum: 0.5 psi
  - Maximum: 8.0 psi

Refer to Section 8 for fuel and oil specifications.

PROPELLERS

Number of Propellers: 2
Manufacturer: Hartzell
Model Number: HC-F2YL-2UF/FC7663D-3
Spinner Assembly: 7SCF022
Number of Blades: 2
Diameter: Not over 73 inches
Not under 72 inches (No Further Reduction Permitted)
Blade Range at 30 Inch Station:
- Low Pitch – 11.5° ± 0.1°
- Feather Angle – 81° ± 1°

Operating Limits: 2700 rpm (Maximum Speed)
Constant Speed

POWER PLANT INSTRUMENT MARKINGS

Power plant instrument markings and the significance of their color codes are shown in Figure 2-3.

POWER PLANT INSTRUMENT MARKINGS				
Instrument	Red Radial Minimum Limit	Green Bar Normal Operations	Yellow Bar	Red Radial Maximum Limit
Tachometer		2000 – 2700 rpm		2700 rpm
Cyl. Head Temp.		200 – 500°F		500°F (260°C)
Oil Temperature		75 – 245°F		245°F (118°C)
Fuel Pressure	0.5 psi	0.5 – 8 psi		8 psi
Oil Pressure	25 psi	60 – 90 psi	25 – 60 psi 90 – 100 psi	100 psi

Figure 2-3

FUEL GAUGES – Yellow Arc **40 – 57 Gallons**

CAUTION

FUEL LOADING IN THIS RANGE MAY LIMIT AIRPLANE LOADING. CHECK WEIGHT AND BALANCE.

GYRO PRESSURE GAUGE

The operating range (Green Arc) for the gyro air pressure system is 4.3 to 6.1 inches of mercury for all operations.

WEIGHT LIMITS

NORMAL CATEGORY
Maximum Takeoff Weight: 3800 pounds
Maximum Landing Weight: 3800 pounds
Maximum Baggage Weight:
Nose Bay – 75 pounds
Aft Cabin – 175 pounds

CENTER OF GRAVITY LIMITS (GEAR EXTENDED)

Center of Gravity Range:

Forward: 93.3 inches aft of datum line at 2900 pounds or less, with a straight line variation to 97.8 inches aft of datum line at 3800 pounds.

Aft: 101.6 inches aft of datum line at all weights.

Reference Datum Line: 50 inches forward of front face of fuselage forward bulkhead.

Mean Aerodynamic Chord (MAC): 60.041 inches

Leading Edge of the MAC: 84.784 inches aft of reference datum line. Refer to Weight and Balance, Section 6, for additional information.

MANEUVER LIMITS

NORMAL CATEGORY

This airplane is certificated in the normal category. The normal category is applicable to airplanes intended for non-aerobatic operations. These operations include any maneuvers incidental to normal flying, such as stalls (except whip stalls), lazy eights, chandelles, and steep turns in which the angle of bank is not more than 60 degrees.

Authorized Maneuvers:

1. Any maneuver incidental to normal flying
2. Stalls (except whip stalls)
3. Lazy eights, chandelles and steep turns, in which the angle of bank is not more than 60 degrees.

Unauthorized Maneuvers:

Any acrobatic operation including spins.

Design Maneuvering Speeds (V_A)

Minimum Weight (2800 pounds): 105 KCAS (105 KIAS)
Maximum Weight (3800 pounds): 121 KCAS (120 KIAS)

The important thing to remember in flight maneuvers is that the airplane is clean in aerodynamic design and will build up speed quickly with the nose down. Since proper speed control is essential for execution of a maneuver, care should always be exercised to avoid excessive speed and its resultant heavy airframe loads. In the execution of all maneuvers, avoid abrupt use of controls.

FLIGHT LOAD FACTOR LIMITS (FLAPS UP)

Normal category at maximum takeoff weight of 3800 pounds:
Positive Load Factor (Maximum) 3.8g
Negative Load Factor (Maximum) 1.5g

FLIGHT CREW LIMITS

Minimum flight crew for FAR 91 operations is one pilot.

MAXIMUM PASSENGER SEATING LIMITS

Maximum passenger seating configuration — Three passengers (plus one pilot).

OPERATION LIMITS

The standard airplane is approved for day VFR conditions. With the proper optional equipment installed, the airplane is approved for day and night VFR and/or IFR operations.

FUEL LIMITATIONS

Two Tanks: 59 U.S. gallons each.
Total Capacity: 118 U.S. gallons.

Total Useable: 114 U.S. gallons (57 gallons each wing).
Unusable Fuel: 2.0 gallons in each wing (Total 4.0 gallons).
Approved Minimum Fuel Grades and Color:
    100 Grade Aviation Fuel (Green).
    100 Low Lead Aviation Fuel (Blue).
Fuel Pressure: 0.5 psi minimum, 8.0 psi maximum.

NOISE LEVEL LIMITATIONS

The noise level determined for the GA-7/Cougar, as specified in FAR, Part 36, has been established at 71.99 dBA.

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

REQUIRED PLACARDS:

The following operating information is displayed in the form of composite or individual placards.

On Instrument Panel Over Airspeed Indicator:

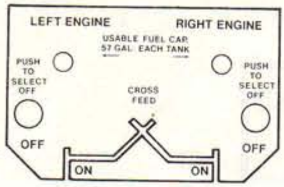
MAX. MANEUVERING SPEED	120 KNOTS IAS
MAX. SPEED - GEAR EXTENSION	145 KNOTS IAS
MAX. SPEED - GEAR RETRACTION	115 KNOTS IAS
MAX. SPEED - GEAR EXTENDED	145KNOTS IAS
LOSS OF ALTITUDE - DURING ONE ENGINE INOP. STALL	300 FT
ANGLE OF PITCH - DURING ONE ENGINE INOP. STALL	20 DEGREES

On Instrument Panel Over Circuit Breaker Panel:

THE MARKINGS AND PLACARDS INSTALLED IN THIS AIRPLANE CONTAIN OPERATING LIMITATIONS WHICH MUST BE COMPLIED WITH WHEN OPERATING THIS AIRPLANE IN THE NORMAL CATEGORY. OTHER OPERATING LIMITATIONS WHICH MUST BE COMPLIED WITH WHEN OPERATING THIS AIRPLANE IN THIS CATEGORY ARE CONTAINED IN THE PILOT'S OPERATING HANDBOOK. THIS AIRPLANE IS APPROVED FOR VFR, IFR, DAY AND NIGHT WHEN EQUIPPED IN ACCORDANCE WITH FAR 91.

THIS AIRPLANE IS NOT APPROVED FOR FLIGHT INTO KNOWN ICING CONDITIONS

On Aft Center Console, Near Each Fuel Selector:



Glare Shield In Front of Pilot:

NO ACROBATIC MANEUVERS (INCLUDING SPINS) APPROVED

Above Strobe Light Switch:

TURN OFF STROBE IN CLOUD, FOG OR HAZE.
TAXI WITH STROBE OFF.

Over Left Rear Seat Window:

EMERGENCY EXIT
OPEN CLOSE
1. INSERT FINGER INTO COVER AND PULL TO REMOVE
2. ROTATE UPPER LEVER TO OPEN
3. PULL LOWER HANDLE IN THEN UP

Near Landing Gear Handle:

LDG GEAR
EMERGENCY
—DOWN—
PULL KNOB ↓

Aft Baggage Compartment on Bulkhead:

BAGGAGE COMPARTMENT CAPACITY
175 LBS MAX

FOR ADDITIONAL LOADING INSTRUCTIONS
SEE WEIGHT & BALANCE DATA

NO HEAVY OBJECTS ON HAT SHELF

Aft Baggage Compartment – Rear Seat Back Folded:

340 LBS MAX CARGO CAPACITY
DISTRIBUTE LOAD EVENLY. MAX DESIGN LOAD 37 LBS/FT^2. NO PASSENGERS. FOR ADDITIONAL LOADING INSTRUCTIONS SEE WEIGHT & BALANCE DATA

In Nose Baggage Compartment:

MAX BAG COMPARTMENT CAPACITY 75 LBS FOR ADDITIONAL LOADING INSTRUCTIONS SEE WEIGHT& BALANCE DATA. NET MUST BE USED TO RESTRAIN BAGGAGE FROM SHIFTING

Above Cabin Door Handle:

TO OPEN DOOR ROTATE OVERHEAD LATCH COUNTERCLOCKWISE PULL LOWER HANDLE OUT AND AFT

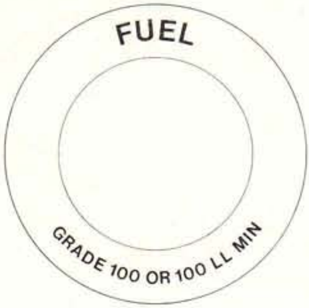
On Cabin Door:

WARNING: TO AVOID DAMAGE LATCH HANDLE MUST BE IN OPEN POSITION BEFORE CLOSING DOOR

Inside External Power Receptacle Cover:

CAUTION: 12 VOLT DC ONLY MASTER SW MUST BE ON PRIOR TO STARTING ENGINE

Around Left and Right Fuel Filler Caps:



Mounted on Aft Bulkhead:

THIS BALLAST MAY NOT BE REMOVED EXCEPT WHEN WARRANTED BY A CHANGE IN LICENSED EMPTY WEIGHT CENTER OF GRAVITY.

NO. OF PLATES [redacted]

ACFT SERIAL NO. [redacted]

DATE [redacted]

7F10038-115

Left Front Side Panel, Adjacent to Instrument Panel:

ALTN. STATIC SOURCE CORR

IN CRUISE FLIGHT SUBTRACT 10 KTS AND 130 FT FROM INDICATED READINGS. NO CORRECTION FOR CLIMBS OR FLIGHT WITH GEAR EXTENDED

SECTION 3
EMERGENCY PROCEDURES

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

AMPLIFIED PROCEDURES

TABLE OF CONTENTS (Continued)

INTRODUCTION

The intent of this section is to provide a checklist of procedures for coping with emergencies that may occur. The checklist is backed up with a corresponding series of amplified procedures to provide a better understanding of the checklist actions and the reasons behind them. A definite plan of action can be formed by the pilot, in advance, for coping with the most probable emergency situations which may be encountered in the operation of the airplane. The first part of the section is the abbreviated checklist. The second part provides amplification of the checklist procedures presented in the same order.

Proper preflight inspections, maintenance practices, and operating procedures will minimize emergencies due to airplane or engine malfunction. Proper flight planning and sound pilot judgement can minimize en route emergencies due to bad weather conditions. In the event that emergencies do develop, the guidelines in this section should be considered, and applied in good judgement as necessary to cope with the problem.

Airspeeds given in this section are specified in terms of Knots Indicated Airspeed (KIAS) and assume zero instrument error. In order to supply one safe speed for each type of emergency situation, the airspeeds were derived using an aircraft weight of 3800 pounds unless otherwise specified.

AIRSPEED FOR EMERGENCY OPERATION

Air Minimum Control Speed (V_{MCA}) . . . . 61 KIAS
One Engine Inoperative Obstacle Clearance (V_{XSE}) . . . . 85 KIAS
One Engine Inoperative Best Rate-of-Climb (V_{YSE}) . . . . 85 KIAS

Maneuvering Speed
3800 pounds . . . . 120 KIAS
3200 pounds . . . . 112 KIAS
2800 pounds . . . . 105 KIAS

Maximum Glide
3800 pounds . . . . 98 KIAS
3200 pounds . . . . 91 KIAS
2800 pounds . . . . 85 KIAS

One Engine Inoperative Approach . . . . 90 KIAS
One Engine Inoperative Go-Around . . . . 85 KIAS
Precautionary Landing with Power, Flaps Down . . . . 75 KIAS

Landing without Engine Power
Wing Flaps Up . . . . 80 KIAS
Wing Flaps Down . . . . 75 KIAS

ABBREVIATED CHECKLISTS

ENGINE FAILURES

ENGINE FAILURE DURING TAKEOFF (SPEED BELOW 75 KIAS)

(1) Throttles – CLOSE IMMEDIATELY. IF AIRBORNE, LAND STRAIGHT AHEAD.
(2) Brakes – As required.

(CHECKLIST CONTINUED NEXT PAGE)

If insufficient runway remains for stopping:

(3) Fuel Selector Valves – OFF.
(4) Master, Alternators, and Magneto Switches – OFF.

ENGINE FAILURE AFTER TAKEOFF (SPEED 75 KIAS OR ABOVE)

If engine failure occurs during takeoff roll, or after lift-off with gear still down and 75 KIAS has been attained:

If adequate runway remains, CLOSE BOTH THROTTLES IMMEDIATELY AND LAND IF AIRBORNE.

If the runway is inadequate for stopping, the pilot must decide whether to abort the takeoff or to continue. The decision must be based on the pilot's judgement, considering loading, density altitude, the weather, and the pilot's competence.

If the decision is made to continue:

(1) Airplane – Maintain control and airspeed.
(2) Landing Gear – RETRACT.
(3) Mixtures – As required for flight ALTITUDE.
(4) Propeller Controls – FULL FORWARD.
(5) Throttles – FULL FORWARD.
(6) Inoperative Engine:
  a. Identify.
  b. Throttle – CLOSE.
  c. Propeller Control – FEATHER.
  d. Mixture – IDLE CUT-OFF.
(7) Airspeed – 85 KIAS.
(8) Inoperative Engine – SECURE. See SECURING INOPERATIVE ENGINE Checklist.
(9) Mixture – Lean to best power on operative engine (see Page 4-19).
(10) Land – As soon as practical.

ENGINE FAILURE DURING FLIGHT

(1) Throttles – FORWARD as required.
(2) Inoperative Engine – Identify. (Dead foot – dead engine. Dead throttle, dead engine.)

Before securing inoperative engine, make the following checks:

(3) Fuel Pressure – CHECK. If deficient, Auxiliary Fuel Pump – ON.
(4) Oil Pressure and Temperatures – CHECK.
(5) Magneto Switches – ON.
(6) Mixture – Adjust until evidence of engine firing. Continue to adjust for smooth operation.
(7) If inoperative engine does not start – SECURE. See SECURING INOPERATIVE ENGINE Checklist.
(8) Operative Engine – ADJUST.
  a. Throttle – As required.

(CHECKLIST CONTINUED NEXT PAGE)

b. Mixture – Lean to best power (see Page 4-19).
c. Fuel Selector – As required to maintain fuel balance.
d. Auxiliary Fuel Pump – ON.
e. Cowl Flap – As required.

(9) Trim Tabs – Adjust for a 5° bank toward operative engine.
(10) Electrical Load – CHECK. Decrease as required.
(11) Land – As soon as practical.

SECURING INOPERATIVE ENGINE

(1) Inoperative Engine – Identify. Check power response to throttle movement.
(2) Throttle – CLOSE. May be advanced enough to silence gear warning horn.
(3) Propeller – FEATHER.
(4) Mixture – IDLE CUT-OFF.
(5) Cowl Flap – CLOSE.
(6) Magneto Switches – OFF.
(7) Alternator Switch – OFF.
(8) Fuel Selector – OFF.
(9) Auxiliary Fuel Pump – OFF.

ONE ENGINE INOPERATIVE OPERATION

ONE ENGINE INOPERATIVE APPROACH

(1) Fuel Selector – Fullest Tank.
(2) Auxiliary Fuel Pump (Selected Tank) – ON.
(3) Carburetor Heat – As required.
(4) Mixture – Lean to best power (see Page 4-19).
(5) Propeller Control – FULL FORWARD.
(6) Approach – 90 KIAS.
(7) Landing Gear – EXTEND when within gliding distance of field.
(8) Wing Flaps – DOWN when landing is ensured.

ONE ENGINE INOPERATIVE GO-AROUND

WARNING

LEVEL FLIGHT MIGHT NOT BE POSSIBLE FOR CERTAIN COMBINATIONS OF WEIGHT, TEMPERATURE, AND ALTITUDE. SEE PAGE 5-15.

(1) Throttle – FULL FORWARD.
(2) Propeller Control – CHECK FULL FORWARD.
(3) Mixture – Lean to best power (see Page 4-19).
(4) Carb Heat – OFF.
(5) Wing Flaps – UP.
(6) Landing Gear – RETRACT.
(7) Cowl Flap – OPEN.
(8) Airspeed – 85 KIAS.

ENGINE RESTARTS IN FLIGHT (AFTER FEATHERING)

(1) Fuel Selector – Desired Tank.

(CHECKLIST CONTINUED NEXT PAGE)

(2) Auxiliary Fuel Pump – ON.
(3) Throttle – Open approximately 1/2 inch.
(4) Mixture Control – FULL RICH.

NOTE

At altitudes above 5000 feet, match mixture control lever position with that of operating engine.

(5) Magneto Switches – ON.

Without unfeathering accumulators:

a. Move propeller control to low pitch (full forward).
b. Engage starter to accomplish unfeathering.
c. If engine does not run, try various other combinations of prime, throttle position, and mixture position until the engine fires and accelerates to normal idle.

With unfeathering accumulators:

a. Move propeller control full forward to accomplish unfeathering. Propeller should windmill automatically at airspeeds above 95 KIAS. Use starter momentarily if necessary to aid unfeathering.
b. If engine does not run, try various other combinations of prime, throttle position, and mixture position until the engine starts and accelerates to normal idle.

(6) When Engine Starts – Adjust throttle, mixture, and propeller controls to maintain operation.
(7) Auxiliary Fuel Pump – OFF.
(8) Alternator Switch – ON.
(9) Oil Pressure – CHECK.
(10) Warm Up Engine – 2000 RPM, 15 in. Hg.
(11) Set Throttle and Trim – As required.

FORCED LANDINGS

DUAL ENGINE FAILURE GLIDE

(1) Propellers – FEATHER.
(2) Flaps – UP.
(3) Landing Gear – UP.
(4) Cowl Flaps – CLOSE.
(5) Airspeed – 98 KIAS

NOTE

The glide ratio in this configuration is approximately 2 nautical miles of gliding distance for each 1000 feet of altitude above the terrain.

(CHECKLIST CONTINUED NEXT PAGE)

EMERGENCY LANDING WITHOUT ENGINE POWER

(1) Airspeed – 98 KIAS at 3800 pounds gross weight.

NOTE

See Figure 3-1, Page 3-23 for best glide speed versus gross weight.

(2) Seat Belts and Shoulder Harnesses – Secure.
(3) Propellers – FEATHER.
(4) Mixtures – IDLE CUT-OFF.
(5) Fuel Selectors – OFF.
(6) All Switches except Master Switch – OFF.
(7) Landing Gear – As required.
(8) Wing Flaps – As required (full down recommended).
(9) Airspeed – 75 KIAS (Flaps Down).
80 KIAS (Flaps Up).
(10) Master Switch – OFF.
(11) Cabin Door – Unlatch prior to flare-out.
(12) Touchdown – Normal. Keep nose wheel off the ground as long as practical.
(13) Brakes – As required.

PRECAUTIONARY "OFF AIRPORT" LANDING WITH ENGINE POWER

(1) Seat Belts and Shoulder Harnesses – SECURE.
(2) Airspeed – 90 KIAS.
(3) Wing Flaps – 10°.
(4) Selected Field – Fly over, noting terrain and obstructions.
(5) All Switches Except Master and Magneto – OFF.
(6) Landing Gear – EXTEND (if surface is smooth and hard).
(7) Wing Flaps – FULL DOWN.
(8) Airspeed – 75 KIAS.
(9) Master Switch – OFF.
(10) Cabin Door – Unlatch prior to flare-out.
(11) Touchdown – Normal, keeping nose wheel off ground as long as possible.
(12) Magneto Switches – OFF.
(13) Brakes – As required.
(14) On soft or rough terrain:
   a. Keep wheels up.
   b. Reduce power to minimum during flare-out.
   c. Magneto Switches – OFF prior to contact.
   d. Land in slightly tail-low attitude.
   e. Get clear of airplane as soon as possible.

NOTE

See also GEAR UP LANDING procedures.

DITCHING

(1) Radio – TRANSMIT MAYDAY on 121.5 MHz, giving location and intentions.
(2) Heavy Objects (in baggage area) – SECURE.

(CHECKLIST CONTINUED NEXT PAGE)

(3) Landing Gear – RETRACT.
(4) Approach – High Winds, Heavy Swells – Into the Wind.
Light Winds, Heavy Swells – Parallel to Swells.
(5) Seat Belts and Shoulder Harnesses – SECURE.
(6) Wing Flaps – FULL DOWN.
(7) Establish 300 ft/Min Descent at 75 KIAS.
(8) Cabin Door – Unlatch prior to flare-out.
(9) Master Switch – OFF.
(10) Face – Cushion at touchdown with folded coat or seat cushion.
(11) Touchdown – Wings level, and slightly tail-low attitude.
(12) Airplane – EVACUATE.
(13) Life Vests and Raft – INFLATE.

EMERGENCY DESCENT PROCEDURES

PREFERRED PROCEDURE

(1) Throttles – IDLE.
(2) Propeller Controls – FULL FORWARD.
(3) Mixtures – Adjust for smooth operation with gradual enrichment as altitude is lost.
(4) Wing Flaps – UP.
(5) Landing Gear – RETRACT.
(6) Moderate Bank – INITIATE.
(7) Airspeed – 188 KIAS (V_{NE}).

IN TURBULENT ATMOSPHERIC CONDITIONS

(1) Throttles – IDLE.
(2) Propeller Controls – FULL FORWARD.
(3) Mixtures – Adjust for smooth operation with gradual enrichment as altitude is lost.
(4) Wing Flaps – 10°.
(5) Landing Gear – EXTEND.
(6) Moderate Bank – INITIATE.
(7) Airspeed – 120 KIAS.

FIRE PROCEDURES

ELECTRICAL FIRE IN FLIGHT

(1) Alternator and Master Switches – OFF.
(2) All Other Switches (except Magneto Switches) – OFF.
(3) Cabin Air – COOL.
(4) Vents – CLOSED.
(5) Fire Extinguisher – ACTIVATE (if available and needed).

WARNING

IF AN OXYGEN SYSTEM IS AVAILABLE AND BREATHING IS DIFFICULT, OCCUPANTS SHOULD USE OXYGEN MASKS UNTIL SMOKE AND DISCHARGED DRY POWDER CLEARS. AFTER DISCHARGING AN EXTINGUISHER WITHIN A CLOSED CABIN, VENTILATE THE CABIN.

(CHECKLIST CONTINUED NEXT PAGE)

If fire appears out and electrical power is necessary for continuance of flight:

(6) Master Switch – ON.
(7) Alternator Switch – ON one at a time, if okay, Both – ON.
(8) Circuit Breakers – Check for faulty circuit; DO NOT RESET.
(9) Radio/Electrical Switches – ON one at a time, with delay after each until short circuit is localized.
(10) Cabin Air/Heat – As desired, when it is ascertained that fire is completely extinguished.

CABIN FIRE

(1) Master Switch – OFF.
(2) Alternator Switches – OFF.
(3) Cabin Air – COOL.
(4) Vents – CLOSED.
(5) Fire Extinguisher – ACTIVATE (If needed).

WARNING

IF AN OXYGEN SYSTEM IS AVAILABLE AND BREATHING IS DIFFICULT, OCCUPANTS SHOULD USE OXYGEN MASKS UNTIL SMOKE AND DISCHARGED DRY POWDER CLEARS. AFTER DISCHARGING AN EXTINGUISHER WITHIN A CLOSED CABIN, VENTILATE THE CABIN.

(6) Land the airplane as soon as practical to inspect for damage.

CABIN VENTILATION PROCEDURE

(1) Fresh Air Vents – OPEN.
(2) Direct Vision Window – OPEN.
(3) Cabin Heat Selectors – COLD.
(4) Floor Heat Shutoffs – OPEN.
(5) Defrosters – ON.

ENGINE INDUCTION FIRE WHILE STARTING

(1) Mixtures – IDLE CUT-OFF.
(2) Continue to crank affected engine with throttle full open in an attempt to pull fire into the engine.
(3) Fuel Selectors – OFF.
(4) Master, Alternator, and Magneto Switches – OFF.
(5) Airplane – EVACUATE.
(6) Extinguish with fire extinguisher.

FIRE ON GROUND (TAXI AND TAKEOFF WITH SUFFICIENT DISTANCE REMAINING TO STOP)

(1) Throttles – CLOSE.
(2) Brakes – As required.

(CHECKLIST CONTINUED NEXT PAGE)

(3) Mixture – IDLE CUT-OFF.
(4) Master, Alternator, and Magneto Switches – OFF.
(5) Fire Extinguisher – OBTAIN (if installed).
(6) Airplane – EVACUATE.
(7) Extinguish Fire.

WING OR ENGINE FIRE IN FLIGHT

(1) Affected Engine Fuel Selector and Boost Pump – OFF.
(2) Affected Engine – SECURE. (See SECURING INOPERATIVE ENGINE Checklist.)
(3) Navigation and Strobe Light Switches – OFF.
(4) Operating Engine:
  a. Power – As required.
  b. Cowl Flaps – As required.
(5) Cabin Heat – COOL. (Affected Engine).
(6) Electrical Load – Reduce as required.
(7) Land as soon as practical.

NOTE

Refer to ONE ENGINE INOPERATIVE OPERATION procedures in this section for additional information.

ICING

INADVERTENT ICING ENCOUNTER

Airframe Icing

(1) Pitot Heat Switch (if installed) – ON.
(2) Cabin Heat – Maximum temperature both sides. Close vents at floor and open defroster vents fully.
(3) Engine RPM – Increase to minimize ice build-up.

NOTE

If excessive vibration is noted, momentarily reduce engine speed to 2000 RPM with the propeller control; then rapidly move the control full forward. Repeating this operation several times should result in a smoother running engine at normal engine operating speeds since flexing of the propeller blades and increased centrifugal force causes ice to shed more readily.

(4) If icing conditions are unavoidable, plan a landing at the nearest suitable airport.
(5) With ice accumulation of 1/4 inch or more on the wing leading edges, be prepared for a significantly higher power requirement, approach speed, stall speed, and a longer landing roll.
(6) Open window and, if practical, scrape ice from a portion of the windshield for visibility in the landing approach.

(CHECKLIST CONTINUED NEXT PAGE)

(7) Set wing flaps at 10° for ice accumulation of 1 inch or less. With heavier ice accumulations, approach with flaps retracted to ensure adequate elevator effectiveness in the approach and landing.
(8) Approach with a higher than normal airspeed, depending on the amount of ice accumulation. If ice accumulation is unusually large, obtain the planned approach speed while in the approach configuration at an altitude high enough to permit recovery in the event of an inadvertent stall.
(9) Land in level attitude using power as required to control rate of descent prior to touchdown.
(10) Missed approaches should be avoided if possible because of severely reduced climb capability. However, if a go-around is mandatory, make the decision much earlier in the approach than normal. Apply maximum power while retracting the wing flaps in small increments. Retract the landing gear after immediate obstacles are cleared.

Carburetor Icing

(1) Carburetor Heat Control – Full ON.
(2) Mixture Control – Lean as necessary for smooth engine operation.
(3) Carburetor Heat Control – OFF, when icing is no longer encountered.
(4) Mixture Control – Adjust as necessary for smooth engine operation.

NOTE

Full carburetor heat will not damage the engine, and is recommended to ensure rapid and complete elimination of carburetor ice. When ice is removed, return the carburetor heat control to the OFF position. Partial carburetor heat may be worse than no heat at all, since it may only partially melt the ice, allowing it to refreeze further down in the intake system.

STATIC SOURCE BLOCKAGE

(Erroneous Instrument Reading Suspected)

NOTE

The altitude hold function of any installed autopilot should be momentarily turned off to avoid abrupt changes in pitch attitude.

(1) Alternate Static Source Valve – PULL ON.

WARNING

WHEN USING THE ALTERNATE STATIC AIR SOURCE, THE FOLLOWING CORRECTIONS APPLY:

DV WINDOW CLOSED: IN CRUISE FLIGHT SUBTRACT 10 KIAS FROM INDICATED AIRSPEED AND 130 FEET FROM INDICATED ALTITUDE. NO CORRECTION FOR CLIMBS OR FLIGHT WITH GEAR EXTENDED.

DV WINDOW OPEN: IN CRUISE FLIGHT SUBTRACT 15 KIAS FROM INDICATED AIRSPEED AND 210 FEET FROM INDICATED ALTITUDE. SUBTRACT 10 KIAS AND 100 FEET FOR CLIMBS AND FLIGHT WITH GEAR EXTENDED.

LANDING GEAR MALFUNCTION PROCEDURES

LANDING GEAR FAILS TO RETRACT

NOTE

Do not exceed 145 KIAS with landing gear extended.

(1) Master Switch – ON.
(2) Landing Gear Control – Check in RETRACT (up) position.
(3) Circuit Breakers – Check, LG breaker IN.
(4) Emergency Gear Extension Handle – FULL IN.
(5) Landing Gear Control – EXTEND (down) position.
(6) Landing Gear Lights – Check green ON.
(7) Airspeed – Reduce to 100 KIAS or less.
(8) Landing Gear Control – Recycle to RETRACT (up) position.

If gear still fails to retract:

(9) Landing Gear Control – EXTEND (down) position. Leave in EXTEND position.

LANDING GEAR FAILS TO EXTEND

(1) Master Switch – ON.
(2) NAV LTS Switch – OFF.
(3) Landing Gear Control – Check in EXTENDED (down) position.
(4) Circuit Breakers – Check LG breaker IN.

If Landing gear still fails to extend:

(4) Circuit Breaker – Pull LG breaker out.
(5) Emergency Gear Extension Handle – Pull.

NOTE

If the airplane is in yawed flight, one main landing gear may not lock down. To position the gear in the down and locked position, return the airplane to coordinated flight or yaw in the opposite direction.

GEAR UP LANDING

If possible, choose firm sod or foamed runway. When assured of reaching landing site:

(1) Seat Belts and Shoulder Harnesses – SECURE.
(2) All Switches (except Master and Magneto) – OFF.
(3) Landing Gear – RETRACT.
(4) Wing Flaps – FULL DOWN. (Gear Warning Horn will sound when flaps exceed 15°.)

(CHECKLIST CONTINUED NEXT PAGE)

(5) Airspeed – 75 KIAS.
(6) Master Switch – OFF.
(7) Cabin Door – UNLATCH prior to flare-out.
(8) Touchdown – Wings level, and slightly tail low.
(9) Airplane – EVACUATE.

NOTE

The gear up landing procedures are based on the best available information. No actual tests have been conducted.

LANDING WITH DEFECTIVE MAIN GEAR

(1) Fuel Selectors – ON.
(2) Wind – Headwind or if crosswind opposite defective gear.
(3) Landing Gear – EXTEND.
(4) Wing Flaps – FULL DOWN.
(5) Approach – Align airplane with the edge of runway opposite the defective landing gear.
(6) Master Switch – OFF.
(7) Land wing low toward operative landing gear. Lower nose wheel immediately for positive steering.
(8) Mixtures – IDLE CUT-OFF.
(9) Use full aileron in landing roll to lighten the load on the defective gear.
(10) Apply brakes only on the operative landing gear to hold desired rate of turn and shorten landing roll.
(11) Fuel Selectors – OFF.
(12) Airplane – EVACUATE.

LANDING WITH FLAT MAIN GEAR TIRE

(1) Landing Gear – EXTEND.
(2) Fuel Selectors – ON.
(3) Wind – HEADWIND or crosswind opposite defective tire.
(4) Wing Flaps – FULL DOWN.
(5) Approach – Align airplane with edge of runway opposite the defective tire, allowing room for a mild turn in the landing roll.
(6) Land slightly wing-low on the side of the inflated tire and lower the nose wheel to the ground immediately for positive steering.
(7) Use full aileron in landing roll to lighten the load on the defective tire.
(8) Apply brakes on the inflated tire as required to minimize landing roll and maintain directional control.
(9) Stop airplane to avoid further damage unless active runway must be cleared for traffic.

LANDING WITH FLAT NOSE GEAR TIRE

(1) Landing Gear – EXTEND.

WARNING

DO NOT EXCEED AFT C.G. LIMIT.

(2) Passengers and Baggage – Move aft.
(3) Approach – 80 KIAS with flaps up.
(4) Landing Attitude – Nose high.
(5) Nose – Hold off during landing roll.
(6) Brakes – Minimum in landing roll.
(7) Throttles – Retard in landing roll.
(8) Control Wheel – Full aft until airplane stops.
(9) Minimize additional taxiing to prevent further damage.

LANDING WITH DEFECTIVE NOSE GEAR

(1) If smooth and hard surface:

WARNING

DO NOT EXCEED AFT C.G. LIMIT.

a. Baggage and Passengers – Move aft.
b. Landing Gear – EXTEND.
c. Approach – 80 KIAS with flaps up.
d. All switches except magnetos – OFF.
e. Landing Attitude – Nose high.
f. Mixtures – IDLE CUT-OFF.
g. Magneto Switches – OFF.
h. Nose – LOWER as speed dissipates.

(2) If Rough or Sod Surface:

a. Landing Gear – RETRACT.
b. Approach – 75 KIAS with full flaps.
c. All Switches Except Magnetos – OFF.
d. Cabin Door – Unlatch prior to flare-out.
e. Landing Attitude – Nose high.
f. Mixtures – IDLE CUT-OFF, after touch-down.
g. Magneto Switches – OFF.
h. Fuel Selectors – OFF.

FUEL SYSTEM EMERGENCY PROCEDURES

ENGINE-DRIVEN FUEL PUMP FAILURE

(1) Auxiliary Fuel Pump – ON.
(2) Fuel Selector – ON.
(3) Land as soon as it is practical.

ELECTRICAL SYSTEM EMERGENCY PROCEDURES

ALTERNATOR FAILURE (SINGLE)

(1) Master Switch – ON.
(2) Electrical Load – REDUCE.
(3) If circuit breaker is tripped:
   a. Turn off affected alternator.
   b. Reset affected alternator circuit breaker.
   c. Turn on affected alternator switch.
   d. If circuit breaker reopens, turn off alternator.
(4) If circuit breaker is not tripped:
   a. Monitor output.
   b. If output is normal and failure light remains on, disregard failure indication and have indicator checked after landing.
   c. If output is insufficient, turn off alternator and reduce electrical load to one alternator capacity.
   d. If complete loss of alternator output occurs, check field circuit breaker and reset if necessary.
   e. If an intermittent light indication accompanied by output fluctuation is observed, turn off affected alternator and reduce load to one alternator capacity.

ALTERNATOR FAILURE (DUAL)

(1) Master Switch – ON.
(2) Electrical Load – Turn off all loads.
(3) If circuit breakers are tripped:
   a. Turn off alternators.
   b. Reset circuit breakers, one at a time.
   c. Turn on left alternator and monitor output.
   d. If there is alternator output, leave it on. Disregard failure light if still illuminated.
   e. If still inoperative, turn off left alternator.
   f. Repeat Steps c through e for right alternator.
   g. If circuit breakers reopen, prepare to terminate flight.
(4) If circuit breakers have not tripped:
   a. Turn off alternators.
   b. Check field circuit breakers and reset if necessary.
   c. Turn on left alternator and monitor output.
   d. If there is alternator output, leave it on. Disregard failure light if still illuminated.
   e. If still inoperative, turn off left alternator.
   f. Repeat Steps c through e for right alternator.
   g. If both still inoperative, turn off alternators.
   h. Repeat Steps c through e for each alternator.
   i. If still inoperative, turn off alternators, nonessential electrical items and prepare to terminate flight.

FLIGHT INSTRUMENTS EMERGENCY PROCEDURES

INSTRUMENT AIR PRESSURE SYSTEM FAILURES

(1) An instrument air pressure system failure will be indicated by a pressure loss on the source gage. In the event of a feathered engine or failure of one pump, a red button annunciator will show on the affected side.

(CHECKLIST CONTINUED NEXT PAGE)

(2) If an instrument air pressure system malfunctions (pressure below 4.3 inches of mercury – red annunciator not showing) and use of the gyro instruments is required:
   a. Increase engine RPM within normal limits as necessary to obtain 4.3 inches of mercury. If possible, descend to an altitude at which 4.3 inches of mercury can be obtained.
   b. Monitor the magnetic compass and electric turn indicator to determine and evaluate DG and attitude indicator performance.

EMERGENCY WINDOW EXIT

(1) Insert finger into cover and PULL to remove.
(2) Upper Lever – Rotate aft to OPEN position.
(3) Lower Handle – Grasp and pull top of window inward to clear top of window frame. Lift window upward to disengage tabs at bottom.

INADVERTENT OPENING OF CABIN DOOR IN FLIGHT

(1) Flight Controls – MANEUVER for return to landing.
(2) Airspeed – Maintain 100 KIAS or less.
(3) Pilot's Vent Window – OPEN to reduce buffet.
(4) Cabin Door – CLOSE, secure main cabin door latch; secure overhead latch.
(5) Landing – If door cannot be properly secured, maintain airspeed at 100 KIAS or less, make normal flaps up approach and landing.

WARNING

WITH THE CABIN DOOR UNSECURED, A NORMAL FLAPS DOWN APPROACH WILL RESULT IN LIGHT TO MODERATE ELEVATOR BUFFETING.

SPINS

(1) Throttles – CLOSE immediately.
(2) Rudder – Full rudder opposite the direction of rotation.
(3) Elevator – Control wheel full forward, simultaneously with rudder application.
(4) Ailerons – Neutral.
(5) Hold the controls in these positions until rotation stops.
(6) When rotation stops, neutralize the rudder and apply smooth steady control wheel back pressure and recover from the resultant dive.
(7) Resume normal flight and power settings.

NOTE

Federal Aviation Administration Regulations do not require spin demonstration of multi-engine airplanes; therefore, no spin tests have been conducted. The recovery technique is based on the best available information.

FUEL MANAGEMENT WITH ONE ENGINE INOPERATIVE

A crossfeed system is provided to increase range during one engine inoperative operation. Fuel system operation is as follows:

(1) To use fuel from tank on same side as operating engine:
   a. Fuel Selector of Operating Engine – ON.
   b. Fuel Selector of Inoperative Engine – OFF.
   c. Auxiliary Fuel Pumps – OFF unless needed. In case of engine-driven fuel pump failure: Auxiliary Fuel Pump (operating engine side) – ON.

(2) To use fuel from side opposite operating engine:
   a. Fuel Selector of Operating Engine – CROSSFEED.
   b. Fuel Selector of Inoperative Engine – OFF.
   c. Auxiliary Fuel Pumps – OFF unless needed. In case of engine-driven fuel pump failure: Auxiliary Fuel Pump (inoperative engine side) – ON.

(3) When landing:
   a. Fuel Selector Operating Engine – FULLEST TANK.
   b. Fuel Selector Inoperative Engine – OFF.
   c. Auxiliary Fuel Pump for Selected Tank – ON.

AMPLIFIED PROCEDURES

ENGINE FAILURES

ONE ENGINE INOPERATIVE OPERATION

Failure of one engine and the resulting loss of power and power symmetry will result in a descending turn and bank in the direction of the failed engine. Order of considerations should be maintaining airspeed and control, avoiding obstacles if at low altitude, and feathering the inoperative engine. Gross weight, altitude, temperature, leaning technique, and other factors determine whether level flight is possible.

A windmilling propeller imposes severe effects on directional control and airspeed. Feather the inoperative engine as soon as practical. A restart attempt is advisable only after cause of failure is known and only at sufficient height above terrain.

Two factors that govern one-engine inoperative operations are airspeed and directional control. Any change in power setting on the operative engine requires a corresponding change in controls. At a given power setting, the airplane can be safely maneuvered or trimmed for hands-off operation and sustained in this configuration AS LONG AS SUFFICIENT AIRSPEED IS MAINTAINED.

DETERMINING INOPERATIVE ENGINE

The inoperative engine must be rapidly and accurately determined, particularly at marginal airspeed and low altitude. A rapidly windmilling propeller may be mistaken for an operative one, and may cause near-normal readings on tachometer and manifold pressure indicators.

Experience indicates that normally increased rudder pedal pressure on the side of the good engine is required in order to maintain directional control. The other foot, or dead foot, is on the side of the dead engine. As a back-up check, move the throttle of the engine believed to be dead. There should be no change in engine sound or control pressures if the throttle for the dead engine has been selected.

ENGINE FAILURE DURING TAKEOFF (SPEED BELOW 75 KIAS)

Airplane performance at less than 75 KIAS is below one-engine inoperative requirements. Close both throttles immediately and apply brakes as required. If inadequate runway remains to stop, turn the fuel selectors OFF, then turn the Master and Magneto Switches OFF.

ENGINE FAILURE DURING TAKEOFF (SPEED ABOVE 75 KIAS)

Gross weight, temperature, mean altitude, climb requirements, and remaining runway are the factors in considering a straight-ahead landing versus a climb-out and go-around. If electing to remain airborne, maintain control and move the landing gear control up. Set the mixture controls as required for altitude, and move all propeller and throttle controls full forward to assure maximum power from the operating engine. Fly straight ahead and maintain altitude unless maneuvering is necessary to avoid obstacles.

Determine the inoperative engine (see above). Pull the inoperative engine throttle to idle, feather the propeller, and move the mixture control to idle cut-off.

The next consideration should be attaining 85 KIAS. Airspeed should increase as the landing gear retracts and the inoperative propeller feathers. Maintain heading and maintain airspeed at 85 KIAS.

On the inoperative engine, close the cowl flap, turn the Magneto and Alternator Switches OFF, and place the fuel selector switch and the auxiliary fuel pump in the OFF position.

After the inoperative engine is secured, lean the operative engine to best power (see Page 4-19).

Attain a safe altitude above terrain before making turns except to avoid obstacles. Land as soon as practical.

ENGINE FAILURE DURING FLIGHT

Adjust power as required to minimize or eliminate altitude loss, keeping airspeed above 85 KIAS. Determine the inoperative engine (see above).

The advisability of an attempted restart depends on mode of engine failure, altitude, rate-of-descent with a windmilling engine, and distance to landing site. Check oil pressure and temperature indications. Check fuel quantity, the positions of the fuel selectors, and the fuel pressure indications.

WARNING

LACK OF FUEL PRESSURE ON A WINDMILLING ENGINE MAY BE CAUSED BY A FUEL LEAK.

To restart, turn the auxiliary fuel pump ON and make sure both Magneto switches are ON. Pull the mixture control through its full range, observing for engine start. Continue to adjust for smooth operation if the engine starts.

If the inoperative engine will not start, secure it. Refer to SECURING INOPERATIVE ENGINE. After the fuel supply and auxiliary fuel pump have been shut off, the throttle of the inoperative engine may be advanced far enough to silence the landing gear warning horn.

Adjust the throttle, propeller and mixture control on the operating engine as required for best power. Set the fuel selector to the fullest tank. Adjust the cowl flaps to compensate for increased power, and monitor the cylinder head and oil temperature.

Adjust the aileron trim for a 5-degree bank toward the operating engine and maintain directional control with the rudder. The airplane can be trimmed for hands-off flight and sustained in this configuration AS LONG AS THE REQUIRED 85 KIAS CAN BE MAINTAINED. Land the airplane as soon as it is practical.

SECURING INOPERATIVE ENGINE

Penalties imposed on airspeed and directional control by a windmilling engine are severe and become critical at low altitudes. Continued flight requires rapid pilot response to maintain lateral and directional control, then to securing the inoperative engine.

Determine the inoperative engine (see above). Once the correct choice has been made, close the throttle, feather the propeller, and set the mixture control to idle cut-off. Close the cowl flap and place the Magneto and Alternator Switches in the OFF positions. Turn the Fuel Selector and Auxiliary Fuel Pump OFF. Advance the inoperative throttle forward as required to silence the landing gear warning horn.

ONE ENGINE INOPERATIVE OPERATION

ONE ENGINE INOPERATIVE APPROACH

In addition to normal approach considerations, other factors must be considered in a one engine approach. Included are reduced power and control capabilities, adverse effects of adding and reducing power, and the fact that level flight may not be possible for certain combinations of weight, temperature, and altitude. Any decision to go around must be made early.

Set the fuel selector of the operating engine to the fullest tank and turn on the auxiliary fuel pump for the selected tank. Set the carburetor heat and mixture control as required, and move the propeller control full forward. Approach at 90 KIAS and put the landing gear down only when within gliding distance of the intended touchdown point. When landing is assured, put the flaps full down.

ONE ENGINE INOPERATIVE GO-AROUND

WARNING

LEVEL FLIGHT MIGHT NOT BE POSSIBLE FOR CERTAIN COMBINATIONS OF WEIGHT, TEMPERATURE, AND ALTITUDE.

When the decision is made to go around, move the propeller and throttle controls full forward, compensating for changes in control forces and altitude. Set the mixture control as required for best power. Raise the flaps, retract the landing gear, and open the cowl flap. Maintain 85 KIAS.

ENGINE RESTARTS IN FLIGHT (AFTER FEATHERING)

Move the fuel selector of the inoperative engine to the desired tank and turn the auxiliary fuel pump ON. Open the throttle about one-half inch. At altitudes below 5000 feet, set the mixture control at full rich. At high altitudes, match the lever position with that of the operating engine. Turn both Magneto Switches of the inoperative engine ON.

Set the propeller control at the HIGH RPM (low pitch) position. In airplanes with unfeathering accumulators installed, the propeller will unfeather and begin to windmill at airspeeds above 95 KIAS. Use the starter as an aid in unfeathering if necessary.

In airplanes not having unfeathering accumulators, use the starter to unfeather the propeller. When the engine starts, adjust throttle, mixture, and propeller controls to maintain operation. If the engine turns over but fails to start, try different combinations of prime, throttle position, and mixture position until engine starts and accelerates to normal idle.

When a normal idle is obtained, turn the auxiliary fuel pump OFF and the alternator on. Check the oil pressure. Warm the engine up at 2000 RPM and 15 in. Hg manifold pressure. When engine is warmed up, set power and trim as required. Continued flight with an unreliable engine is inadvisable. Land at the nearest suitable airport and determine the cause for engine failure.

EMERGENCY LANDING WITHOUT ENGINE POWER

Lower the nose to maintain 98 KIAS and secure seat belts and shoulder harnesses. Move both propeller levers to the FEATHER position simultaneously to minimize required directional control. Move the mixture controls to idle-cut-off and turn both fuel selectors OFF. Turn all switches off except the Master Switch.

Obtaining maximum power-off glide distance is dependent on gross weight versus airspeed, and reduction of drag. Figure 3-1, Page 3-23 should be used to determine the best glide speed.

The landing site will determine the next course of action. If the landing site is smooth and hard, a gear-down landing is indicated. Keep the gear up for a landing on soft or rough terrain. See Gear Up Landing Procedures.

For a gear-down landing, lower the gear when the landing site is assured, and lower the wing flaps as required. Approach airspeed should be 75 KIAS with flaps down or 80 KIAS with flaps up. When landing gear and flaps are in place, turn the Master Switch OFF. Unlatch the cabin door prior to flare-out. Make a normal touchdown, keeping the nose wheel off the ground as long as possible. Use brakes as required.

On soft or rough terrain, keep the wheels up. When the landing site is assured, lower the flaps as required and turn the Master Switch OFF. Approach airspeed should be 75 KIAS with flaps down or 80 KIAS with flaps up. Unlatch the cabin door prior to flare-out. Land in a slightly tail-low attitude. Get out of the airplane as soon as possible after it stops.

PRECAUTIONARY "OFF AIRPORT" LANDING WITH ENGINE POWER

Secure seat belts and shoulder harnesses. Reduce airspeed to 90 KIAS and set the wing flaps at 10 degrees. Fly over the selected landing site, noting terrain and obstacles. Turn off all switches except the Master and Magneto Switches.

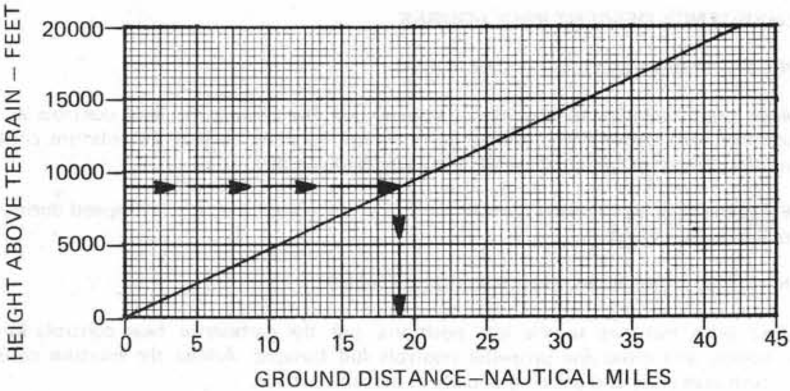
MAXIMUM GLIDE

ASSOCIATED CONDITIONS:

LANDING GEAR	UP
FLAPS	UP
PROPELLERS	FEATHERED
COWL FLAPS	CLOSED
SPEED	IAS AS SCHEDULED
ZERO WIND	

BEST GLIDE SPEED

WEIGHT POUNDS	KIAS
3800	98
3200	91
2800	85



EXAMPLE:

ALTITUDE	9000 FT. ABOVE GROUND LEVEL (AGL)
WEIGHT	3700 LBS
GLIDE DISTANCE	19 NAUTICAL MILES
GLIDE SPEED	97 KIAS

Maximum Glide
Figure 3-1

If the surface is smooth and hard, extend the landing gear. Extend the wing flaps full down and reduce the airspeed to 75 KIAS. Turn the Master Switch OFF and unlatch the cabin door prior to flare-out. Execute a normal touchdown, keeping the nose wheel off the ground as long as possible. Turn the Magneto Switches OFF. Apply brakes as required.

If the surface is soft or rough, leave the landing gear up. Extend the wing flaps full down and reduce the airspeed to 75 KIAS. Turn the Master Switch OFF and unlatch the cabin door prior to flare-out. Reduce power to a minimum during flare-out and turn the Magneto Switches OFF prior to contact. Land in a slightly tail-low attitude. Attempt to keep the tail low through the slide. Evacuate the airplane as soon as possible.

DITCHING

With the radio transmitter tuned to 121.5 MHz, transmit MAYDAY, giving location and intentions. Secure all heavy objects in the baggage area. Retract the landing gear, and secure seat belts and harnesses.

With high winds and heavy swells, make the approach into the wind. With light winds and heavy swells, make the approach parallel to the swells.

Put the flaps full down. (Gear warning will sound when the flaps are extended beyond 15°.) Set the power as required to establish a descent of 300 feet per minute at 75 KIAS. Unlatch the cabin door prior to flare-out and turn the Master Switch OFF. Cushion the face at touchdown with a pillow, folded coat, or seat cushion. Accomplish touchdown with the wings level and the tail slightly low. Evacuate the airplane as soon as possible. Inflate life vests and raft.

EMERGENCY DESCENT PROCEDURES

PREFERRED PROCEDURE (CALM AIR)

Move both throttles to the idle positions, put the carburetor heat controls in the ON positions, and move the propeller controls full forward. Adjust the mixture controls for smooth operation and enrich gradually as descent is made.

With wing flaps and landing gear UP, initiate a moderate bank. Limit airspeed during descent to 188 KIAS (V_{NE}).

IN TURBULENT ATMOSPHERIC CONDITIONS

Move both throttles to the idle positions, put the carburetor heat controls in the ON positions, and move the propeller controls full forward. Adjust the mixture controls for smooth operation and enrich gradually as descent is made.

Set the wing flaps at 10 degrees and extend the landing gear. Initiate a moderate bank. Limit airspeed during descent to 120 KIAS.

FIRE PROCEDURES

ELECTRICAL FIRE IN FLIGHT

In the event of smoke or other evidence of electrical fire during flight, immediately place the Master Switch and both alternator switches in the OFF positions. Once this is done, place all other switches except the Magneto Switches in the OFF positions. Place the left and right cabin air controls in the COOL positions, and close all air vents. Once the source of smoke or fire has been located, if necessary, use a dry chemical fire extinguisher in accordance with the manufacturer's instructions.

If oxygen is available and breathing is difficult, use oxygen masks until smoke and dry powder clears. Open ventilators after discharging an extinguisher within the cabin.

If the fire appears to be out, and electrical power is necessary for continuance of flight, place the Master Switch in the ON position. Turn the Alternators on one at a time, checking for smoke, if okay, both alternators ON. Check the circuit breaker panel for popped circuit breakers, but DO NOT RESET. Turn on radio and other necessary electrical systems one at a time, observing for smoke, overheating, or other malfunction. If the system appears to be operating normally, turn another system on, proceeding in this manner until all essential systems are operating or until the malfunction is localized. Turn the malfunctioning system off.

When certain that the fire is extinguished, cabin air and heat controls may be set as desired.

CABIN FIRE

At the first sign of fire or smoke, turn the Master and alternator switches OFF. Move the cabin air controls to COOL, and close all air vents. Locate the source of smoke or fire and if necessary, use a fire extinguisher in accordance with the manufacturer's instructions.

If oxygen is available and breathing is difficult, use oxygen masks until smoke and dry powder clears. Open ventilators after discharging an extinguisher within a cabin.

Land the airplane as soon as possible to inspect for damage.

CABIN VENTILATION PROCEDURES

To eliminate fumes or smoke, open the fresh air vents and the direct vision window, turn cabin heat selector to cold, open the floor heat shutoffs, and turn the defrosters on.

ENGINE INDUCTION FIRE WHILE STARTING

Induction fires feed on excess raw (unvaporized) fuel in the carburetor throat and intake manifold. The quickest method of controlling this type of fire before it spreads is to shut off fuel and continue cranking the engine in an attempt to pull the fire and fuel into the engine.

In the event of an induction fire, pull the mixture control to the idle cutoff while continuing to crank the engine. Turn both fuel selectors OFF.

If the fire is not extinguished, turn the Master, Alternator, and Magneto Switches OFF. Take the fire extinguisher from its mounting, and evacuate the airplane. Take appropriate measures to extinguish the fire.

FIRE ON GROUND (TAXI AND TAKEOFF WITH SUFFICIENT DISTANCE REMAINING TO STOP)

Close both throttles and apply brakes as required to bring the airplane to a stop. Set both mixture controls to idle cut-off. Turn the Master, Alternator, and Magneto Switches OFF. Take the fire extinguisher from the mounting and evacuate the airplane. Take appropriate measures to extinguish the fire.

WING OR ENGINE FIRE IN FLIGHT

Shut off the affected wing or engine fuel selector and boost pump. Secure the affected engine. (See SECURING INOPERATIVE ENGINE Checklist.) Turn the Navigation and Strobe Lights OFF. Set the power and cowl flaps of the operating engine as required. Move the cabin heat control of the affected engine to the COOL position. Reduce the electrical load as required and land as soon as practical.

NOTE

Refer to ONE ENGINE INOPERATIVE OPERATION procedures for additional information.

INADVERTENT ICING ENCOUNTER

AIRFRAME ICING

If icing is encountered, turn pitot heat on. Set both cabin heat controls for maximum temperature. Make sure the defroster vents on top of the instrument panel are fully open to minimize ice buildup on the windshield. Heated air flow to the windshield can be increased by closing the heat vents at the floor and aft of the center console. Increase engine RPM to minimize ice buildup on the propellers.

Ice buildup on the wings can be monitored visually. Propeller icing is evidenced by excessive vibration. To clear the propellers, momentarily reduce the engine speed to 2000 RPM by pulling the propeller control aft, then rapidly move the control full forward. Repeating this procedure several times should shed ice and result in a smoother running engine.

If further icing cannot be avoided, plan a landing at the nearest suitable airport.

Ice accumulations of 1/4 inch or more on the wing leading edges disrupt air flow over the wing, reducing lift. Be prepared for a higher power requirement. The approach speed should be faster due to increased stall speed. A longer landing roll will be required due to the increased approach speed and possible icing on the ground.

The approach should be planned well ahead. While at sufficient altitude to permit stall recovery, try the planned approach configuration and decelerate to approach speed. Because of severely reduced climb capability and continued ice accumulation, missed approaches should be avoided if at all possible. In a mandatory situation, make the decision much earlier in the approach. Set wing flaps at 10° for ice accumulations of one inch or less. With heavier accumulations, approach with flaps retracted to ensure adequate elevator effectiveness in the approach and landing.

Approach with a higher than normal airspeed, depending on the amount of ice accumulation. If ice accumulation is unusually large, obtain the planned approach speed while in the approach configuration at an altitude high enough to permit recovery in the event of an inadvertent stall.

If required, open the pilot's window and, if possible, scrape ice from a portion of the windshield for visibility in the landing approach.

Maintain a level attitude when landing, using power as required to control rate-of-descent before touchdown. If a go-around is mandatory, apply maximum power while retracting the flaps in small increments. Retract the landing gear after any obstacles have been cleared.

CARBURETOR ICING

The formation of ice in the carburetor throat may result at temperatures well above freezing due to the added cooling caused by evaporation of fuel in the induction system. The formation of carburetor ice causes a gradual loss of engine power, and may result in eventual engine roughness. To clear the ice, pull the carburetor heat control full ON. This may cause additional roughness from the melting ice and the richer fuel mixture. After approximately one minute, return the carburetor heat control to OFF.

If conditions require the continued use of carburetor heat in flight, pull the carburetor heat control full ON and lean the mixture slightly for smoothest engine operation.

Partial carburetor heat may not clear the ice completely, allowing it to refreeze further down in the induction system. Always pull the carburetor heat control full ON when icing is encountered.

STATIC SOURCE BLOCKAGE

(ERRONEOUS INSTRUMENT READING SUSPECTED)

If static source blockage is suspected due to erroneous altimeter, airspeed, or vertical velocity indicator, the alternate static air source should be used.

If an autopilot is in use, turn the altitude hold function OFF momentarily to avoid abrupt climb or descent as the static source is changed. Pull the alternate static air source. When using the alternate static air source, make the following corrections. If the DV window is closed and in cruise flight, subtract 10 KIAS from the indicated airspeed and 130 feet from the indicated altitude. No correction is needed for climbs or flight with landing gear extended. If the DV window is open and in cruise flight, subtract 15 KIAS from the indicated airspeed and 210 feet from the indicated altitude. Subtract 10 KIAS and 100 feet for climbs and flight with landing gear extended. Remember that opening or closing windows and vents will cause changes in pitch if the autopilot is used.

LANDING GEAR MALFUNCTION PROCEDURES

LANDING GEAR FAILS TO RETRACT

If the landing gear will not retract, make sure the Master Switch is in the ON position, and that the landing gear control is in the UP position. Make sure the LG MTR and LG CNTR circuit breakers are in, the emergency gear extension knob is in, and the airspeed is below 115 KIAS.

If the amber NOT SAFE light remains on, move the landing gear control to the down position. All three green lights (NOSE, LEFT, and RT GEAR) should come on.

Reduce airspeed to 100 KIAS or less and move the landing gear control to the up (retract) position. If the landing gear still fails to retract, move the landing gear control to the down position and leave it down. Keep the airspeed below 145 KIAS.

LANDING GEAR FAILS TO EXTEND

If the landing gear fails to extend, make sure the Master switch is ON, the NAV LTS switch is OFF, and the landing gear control is in the extend (down) position. On the circuit breaker panel, make sure the LG circuit breaker is in.

If the landing gear still fails to extend, pull the LG circuit breaker and lower the gear by pulling the emergency gear extension handle.

NOTE

> One main gear may not lock down if the airplane is in yawed flight. Return the airplane to coordinated flight or yaw in the opposite direction in order to position the remaining gear in the down and locked position.

GEAR UP LANDING

NOTE

> The gear up landing procedures given below are based on the best available information. No actual gear up landing tests have been conducted.

If possible, choose firm sod or a foamed runway as a landing site. Turn off all electrical system switches except the Master and Magneto Switches. Close the cowl flaps and place the landing gear control in the retracted (UP) position.

Make approach with the wing flaps full down and airspeed at 75 KIAS. Turn the Master Switch OFF. Unlatch the cabin door prior to flare-out. Accomplish the touchdown with the wings level and the tail slightly low. Evacuate the airplane as soon as possible after it stops.

LANDING WITH DEFECTIVE MAIN GEAR

The landing should be planned to lighten the load on the defective gear as much as possible. A major headwind component and full flaps will reduce ground speed and roll out. A crosswind component opposite the defective gear will allow a wing-low landing toward the operative landing gear. Plan the touchdown near the runway edge opposite the defective gear. Lower wing flaps and turn the Master Switch OFF. Touch down with the wing low on the operative gear side. Lower the nose gear as soon as possible for nose wheel steering capability. Place mixture controls in IDLE CUT-OFF. Turn the control wheel toward the operative landing gear, using full aileron to lighten the load on the defective gear. Maintain directional control as long as possible using nose wheel steering and braking.

Limit the use of brakes to the operative landing gear. Use as required to shorten the landing roll.

Turn both fuel selectors OFF. Evacuate the airplane as soon as possible.

LANDING WITH FLAT MAIN GEAR TIRE

The landing should be planned to lighten the load on the flat tire as much as possible. A mild turn in the direction of the flat tire can be expected. Land into a headwind with full flaps. A crosswind component opposite the flat tire will allow a wing-low landing toward the good tire. Plan the touchdown near the runway edge opposite the flat tire to allow for a mild turn in the landing roll.

Land slightly wing-low toward the inflated tire, lowering the nose wheel immediately to ensure nose wheel steering capability. Turn the control wheel toward the inflated tire, using full aileron to lighten the load on the flat tire.

Apply brakes only on the inflated tire as required to maintain directional control and minimize the landing roll. To avoid further damage, taxi only as required.

LANDING WITH FLAT NOSE GEAR TIRE

Move passengers and baggage as far aft as possible without exceeding the aft C.G. limit. Approach at 80 KIAS with the flaps up to keep the nose high. Plan a long roll-out.

Land in a nose-high attitude, and keep the nose off the ground as long as possible during landing roll. Retard the throttles during the landing roll and keep brake use to a minimum. Once the nose wheel drops, keep the control wheel full aft until the airplane stops. To avoid further damage, taxi only as required.

LANDING WITH DEFECTIVE NOSE GEAR

If planning a landing on a smooth and hard surface, move passengers and baggage as far aft as possible without exceeding the aft C.G. limit. Put the landing gear down and approach at 80 KIAS with the flaps up. Turn all switches except the Magneto Switches OFF.

Land in a nose-high attitude, keeping the nose wheel clear of the ground. Set the mixture controls in the idle cut-off position and turn the Magneto Switches OFF. Lower the nose as the speed dissipates.

If planning a landing on a rough or sod surface, keep the wheels up. Secure seat belts and shoulder harnesses. Turn off all electrical system switches except the Magneto and Master Switches. Close the cowl flaps and place the landing gear control in the retracted (UP) position.

Make the approach with the wing flaps full down and airspeed at 75 KIAS. Turn the Master Switch OFF. Unlatch the cabin door prior to flare-out. Touch down with the wings level and the tail slightly low. Evacuate the airplane as soon as practical.

FUEL SYSTEM EMERGENCY PROCEDURES

ENGINE-DRIVEN FUEL PUMP FAILURE

In the event of an engine-driven fuel pump failure, turn the associated auxiliary fuel pump ON.

Extended flight without a back-up fuel pressure source is not advisable. Land the airplane as soon as practical.

ELECTRICAL SYSTEM EMERGENCY PROCEDURES

ALTERNATOR FAILURE (SINGLE)

In the event an alternator failure light comes on, take immediate steps to reduce the load on the electrical system to within the capability of the remaining alternator by turning off all non-essential loads. Check the alternator circuit breakers. If a circuit breaker is tripped, turn the affected alternator switch OFF and reset the circuit breaker. Turn the alternator switch ON.

If the circuit breaker trips again, turn the alternator switch OFF.

If the circuit breaker does not trip, observe the ammeter for the failed alternator. If the output is within normal limits, but the alternator failure light is on, disregard the light and have the circuit checked after landing. If the alternator output is insufficient, turn the alternator OFF and adjust the electrical load to within the capacity of the remaining alternator. If there is no output from the failed alternator, check the FLD circuit breaker for the alternator and reset if necessary. If an intermittent light indication is observed, coupled with output fluctuation from the alternator, turn the alternator OFF and adjust the electrical load to within the capacity of the remaining alternator.

ALTERNATOR FAILURE (DUAL)

In the event of a dual indication of alternator failure, turn off all electrical loads and turn off the alternators.

If the alternator circuit breakers are tripped, reset them one at a time. Turn on the left alternator and monitor the output. If there is an output, leave the alternator on and disregard the failure light if it is still illuminated. If there is no alternator output, turn the alternator back off. Turn on right alternator and monitor the output. If there is an output, leave the alternator on and disregard the failure light if it is illuminated. If there is no alternator output, turn the alternator back off. Prepare to terminate flight as soon as practical since all electrical power except engine ignition is being supplied by the battery.

If alternator output is regained, turn on essential loads one at a time and monitor output carefully. Terminate flight as soon as practical.

TOTAL ELECTRICAL FAILURE

In the event of a total electrical failure, remove all electrical loads and recycle the Master Switch from ON to OFF and back to ON. Add electrical loads as required.

INSTRUMENT AIR PRESSURE SYSTEM FAILURES

Instrument air pressure is maintained by two engine-driven air pumps. If either pump completely fails or the associated engine is feathered, a red button will show on the corresponding side of the pressure indicator. Normally, pressure to the instruments will be maintained by the operating pump, as evidenced by a pressure reading of at least 4.3 inches of mercury (in. Hg). Air-driven instrument operation will be maintained within normal limits as long as this pressure is maintained by the operating pump.

If some pressure below 4.3 inches of mercury is indicated and gyro instrument use is required, increase engine RPM within normal limits and/or descend to a lower altitude at which 4.3 inches of mercury can be maintained.

The magnetic compass and electric turn indicator can be used to evaluate DG and attitude indicator performance.

EMERGENCY WINDOW EXIT

The emergency window is held in place by two latches at the top and two tabs at the bottom which extend through the bottom sill. To remove the emergency exit window, insert finger into cover over the opening lever and pull to remove. Move the opening lever to the open (aft) position to release the upper latches. Pull handle, located at top of window, in and then up when top of window is clear.

INADVERTENT OPENING OF CABIN DOOR IN FLIGHT

An unsecured cabin door during flight will cause light to moderate elevator buffeting with the flaps down. Secure seat belt or devise other restraint before attempting to close the door.

Open the pilot's window to reduce buffeting and reduce airspeed below 100 KIAS. Close the cabin door, secure the main latch, and secure the overhead latch.

If the door cannot be properly secured, maintain speed at 100 KIAS or less. Land as soon as practical, using a normal flaps-up approach and landing.

WARNING

IF THE CABIN DOOR IS NOT SECURED, LOWERING THE FLAPS WILL CAUSE LIGHT TO MODERATE ELEVATOR BUFFETING.

SPINS

To recover from a spin, close the throttles immediately and apply full rudder in the direction opposite the direction of rotation. Simultaneously move the control wheel full forward. Put the ailerons in the neutral position. Hold these control positions until rotation stops.

As rotation stops, neutralize the rudder. Apply smooth, steady pressure to pull the control wheel back and recover from the resulting dive.

NOTE

As Federal Aviation Administration Regulations do not require spin demonstration of multi-engine airplanes, no spin tests have been conducted. The recovery technique given above is based on the best information available.

FUEL MANAGEMENT WITH ONE ENGINE INOPERATIVE

Extended flight with one engine inoperative places an emphasis on fuel management. Fuel management should be arranged to use fuel from the inoperative engine tank to reduce the out-of-trim condition. If the engine-driven fuel pump on the operative engine is performing satisfactorily, leave the auxiliary fuel pumps turned off until an approach is being made.

If the auxiliary fuel pumps are needed to maintain fuel flow to the engine, it is essential that both pumps be operating when switching from one tank to the other. After the switch is made, the pump for the tank not being used may be turned OFF. The fuel selector valve of the inoperative engine should remain OFF at all times.

To use fuel from the tank on the same side as the operating engine, turn both auxiliary fuel pumps ON if needed. Place the fuel selector valve of the operating engine in the ON position. If ON, turn the auxiliary fuel pump on the inoperative engine side OFF.

To use fuel from the tank on the side opposite the operating engine, turn both auxiliary fuel pumps ON if needed. Place the fuel selector valve of the operating engine in the X-FEED position. If ON, turn the Auxiliary fuel pump on the operating engine side OFF.

When landing, use fuel from the fullest tank. Turn both auxiliary fuel pumps ON and place the fuel selector valve of the operating engine to the fullest tank. The auxiliary fuel pump for the tank not being used may be turned OFF.

CRUISING

To use fuel from the tank on the SAME side as the operating engine:

(1) Fuel selector on SAME side as operating engine – ON.
(2) Fuel selector and auxiliary fuel pump on OPPOSITE side from operating engine – OFF.
(3) Auxiliary fuel pump on SAME side as operating engine – OFF (unless needed to maintain normal pressure).

To use fuel from the tank on the OPPOSITE side from the operating engine:

(1) Fuel selector on SAME side as operating engine – X-FEED.
(2) Fuel selector on OPPOSITE side from operating engine – OFF.
(3) Auxiliary fuel pump on SAME side as operating engine – OFF.
(4) Auxiliary fuel pump on OPPOSITE side from operating engine – OFF (unless needed to maintain normal pressure).

LANDING

(1) Both auxiliary fuel pumps – ON.
(2) Fuel selector operating engine – FULLEST TANK.
(3) Auxiliary fuel pump for the tank not being used may be turned OFF.

SECTION 4
NORMAL PROCEDURES

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AMPLIFIED NORMAL PROCEDURES

INTRODUCTION

This section provides recommended procedures for conducting normal operation of the airplane. Short form checklists are provided in the first part of the section. The checklists were prepared with regard to order of action where sequence is essential to safety. Some of the procedures are amplified in the latter part of the section to provide the pilot with more detailed information and explanation than is suitable for the short form checklists.

NOTE

Refer to Section 9 of this manual for operating procedures for airplanes equipped with specific options, which may not be provided in this section.

AIRSPEEDS FOR SAFE OPERATION

NOTE

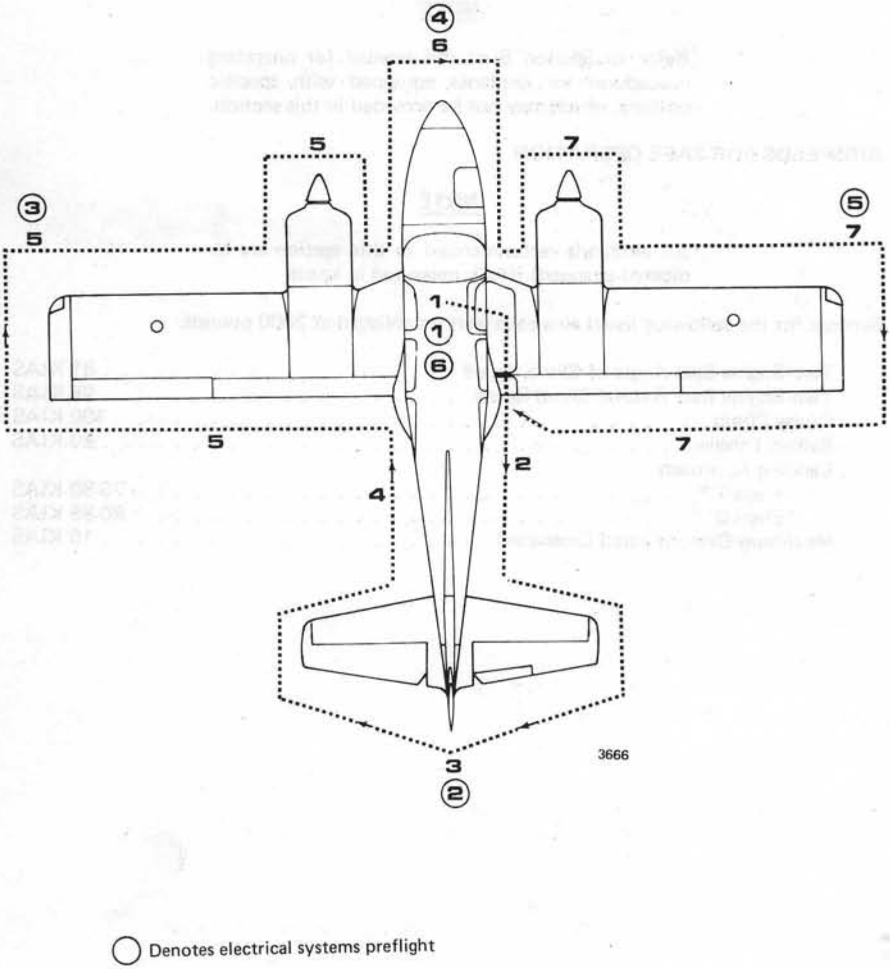
All airspeeds recommended in this section are indicated airspeeds (IAS), measured in knots.

Settings for the following listed airspeeds were established at 3800 pounds.

Two-Engine Best Angle-of-Climb Speed	81 KIAS
Two-Engine Best Rate-of-Climb Speed	95 KIAS
Cruise Climb	100 KIAS
Balked Landing	80 KIAS
Landing Approach	
Flaps 30°	75-80 KIAS
Flaps 0°	80-85 KIAS
Maximum Demonstrated Crosswind	15 KIAS

NOTE

Visually check airplane for general condition during walk-around inspection. During cold weather, remove any accumulation of frost, ice, or snow from wings, tail, and control surfaces.



Preflight Inspection
Figure 4-1

CHECKLIST PROCEDURES

PREFLIGHT INSPECTION

1. **Cockpit**
   (1) Control Locks – REMOVE and STOW.
   (2) Parking Brake – SET.
   (3) Landing Gear Handle – DOWN.
   (4) All Switches – OFF.
   (5) Cowl Flaps – OPEN.
   (6) Trim Tab Controls (3) – NEUTRAL.
   (7) Fuel Selectors (2) – ON.
   (8) Magneto Switches – OFF.
   (9) Master Switch – ON.
   (10) Alternator Warning Lights – ON.
   (11) Landing Gear Position Lights – 3 Green/ON.
   (12) Landing Gear Intransit Light – CHECK.
   (13) Strobe Lights – CHECK, then OFF.
   (14) Fuel Gauges – CHECK.
   (15) Master Switch – OFF.
   (16) Windshield and Windows – CHECK.
   (17) All necessary maps, charts, and spare fuses – ABOARD.

2. **Right Fuselage**
   (1) Baggage Door – SECURE.
   (2) Static Port – CHECK/Unobstructed.
   (3) Fuselage – CHECK/Condition.

3. **Empennage**
   (1) Control Surfaces – CHECK/Freedom of Movement.
   (2) Trim Tabs – NEUTRAL.
   (3) Tailcone – CHECK.
   (4) Tiedown – REMOVE.
   (5) Lights – CHECK.

4. **Left Fuselage**
   (1) Static Port – CHECK/Unobstructed.
   (2) Fuselage – CHECK/Condition.

5. **Left Wing**
   (1) Flap – CHECK.
   (2) Aileron – CHECK.
   (3) Wing Tip/Light – CHECK.
   (4) Tiedown – REMOVE.
   (5) Fuel Tank Vent – CLEAR.
   (6) Fuel – CHECK/Cap Secure.
   (7) Bottom of Wing – Inspection covers secure and check for fuel stains.
   (8) Chocks – REMOVE.
   (9) Fuel Tank Drain – CHECK.
   (10) Main Landing Gear and Wheel Well – CHECK.
   (11) Brake Linings – CHECK/Condition.
   (12) Heater Fresh Air Scoop – CHECK/Unobstructed.
   (13) Engine Cowling – CHECK.

(CHECKLIST CONTINUED NEXT PAGE)

(14) Engine Air Intakes – CHECK.
(15) Propeller & Spinner – CHECK.
(16) Engine Oil – CHECK QUANTITY.
(17) Cowl Flap – CHECK/Unobstructed.
(18) Fuel Sump Drain – CHECK.

6. **Nose Section**
(1) Left Air Inlet – CHECK.
(2) Nose Access Panel – SECURE.
(3) Pitot Tube – CHECK. (Remove Cover.)
(4) Nose Gear and Wheel Well – CHECK.
(5) Nose Baggage Door – SECURE.
(6) Battery Vent – CHECK/Unobstructed.
(7) Right Air Inlet – CHECK.
(8) Chocks – REMOVE.
(9) Landing Light – CHECK.

7. **Right Wing**
(1) Fuel Sump Drain – CHECK.
(2) Propeller & Spinner – CHECK.
(3) Engine Air Intakes – CHECK.
(4) Engine Cowling – CHECK.
(5) Engine Oil – CHECK QUANTITY.
(6) Cowl Flap – CHECK/Unobstructed.
(7) Main Landing Gear and Wheel Well – CHECK.
(8) Brake Linings – CHECK Condition.
(9) Fuel Tank Drain – CHECK.
(10) Chocks – REMOVE.
(11) Heater Fresh Air Scoop – CHECK/Unobstructed.
(12) Fuel – CHECK/Cap Secure.
(13) Bottom of Wing – Inspection covers secure and check for fuel stains.
(14) Fuel Tank Vent – CLEAR.
(15) Stall Warning Vanes (2) – CHECK.
(16) Tiedown – REMOVE.
(17) Wing Tip/Light – CHECK.
(18) Aileron – CHECK.
(19) Flap – CHECK.

ELECTRICAL SYSTEMS PREFLIGHT

NOTE

Complete electrical checks as quickly as possible to decrease drain on battery.

1. **Cockpit**
(1) Master Switch – ON.
(2) Instrument Lights – Check Rheostat, OFF.
(3) Navigation Lights – ON.
(4) Strobe Lights – ON.
(5) Pitot Heat – ON.
(6) Landing Light – ON.

(CHECKLIST CONTINUED NEXT PAGE)

②. **Tailcone**
(1) Navigation Light – ILLUMINATED.
(2) Strobe Light – FLASHING.

③. **Left Wing**
(1) Navigation Light – ILLUMINATED.
(2) Strobe Light – FLASHING.

④. **Nose**
(1) Landing Light – ILLUMINATED.

WARNING

DO NOT TOUCH PITOT TUBE DIRECTLY, IT CAN BE HOT ENOUGH TO BURN SKIN.

(2) Pitot Tube – CHECK (for heat).

⑤. **Right Wing**
(1) Stall Warning Vanes (2) – Lift inboard vane, check that stall warning horn sounds.
(2) Navigation Light – ILLUMINATED.
(3) Strobe Light – FLASHING.

⑥. **Cockpit**
(1) Master Switch – OFF.
(2) Navigation Lights – OFF.
(3) Strobe Lights – OFF.
(4) Pitot Heat – OFF.
(5) Landing Light – OFF.

BEFORE STARTING ENGINES

NOTE

Complete preflight inspection before starting engines.

(1) Cabin Door – AS DESIRED.
(2) Seat, Seat Belt, Shoulder Harness – ADJUSTED.
(3) Auxiliary Fuel Pumps – OFF.
(4) Fuel Selectors – ON.
(5) Cowl Flaps – OPEN.
(6) Carburetor Heat – OFF.
(7) Mixtures – FULL RICH.
(8) Propeller Controls – FULL FORWARD.
(9) Throttles – OPEN Approx. ½ inch.
(10) Landing Gear Handle – DOWN.
(11) Emergency Gear Extend Knob – FULL IN.
(12) Electrical Switches – OFF.

(CHECKLIST CONTINUED NEXT PAGE)

(13) Instrument and Radio Light Rheostats – AS DESIRED.
(14) Cabin Heat – AS DESIRED.
(15) Alternate Static Source – OFF/LATCHED.
(16) Parking Brake – SET.
(17) Master and Alternator Switches – OFF.
(18) Magneto Switches – OFF.
(19) Primer – Spring Loaded to Center.
(20) Flight Instruments – CHECKED.
(21) Engine Instruments – CHECKED.
(22) Radios – AS DESIRED.
(23) Circuit Breakers – CHECKED/IN.

STARTING ENGINES

AIRPLANE POWER

(1) Master Switch – ON.
(2) External Lights – AS REQUIRED.
(3) Auxiliary Fuel Pumps – ON, Check Fuel Pressure, then OFF.
(4) Propellers – "CLEAR".
(5) Magneto – Left ON, Right ON After Start.
(6) Starter Button – PRESS.
(7) Primer – AS NECESSARY.

NOTE

In the event of a balked start or overprimed condition, place the mixture control in idle cut-off and open the throttle. Operate the starter to remove excess fuel. As engine starts, reduce the throttle to idle rpm and place the mixture control in Full Rich.

(8) Throttle – 800 to 1200 rpm for warm-up.
(9) Oil Pressure – 25 psi within 30 seconds.
(10) Alternator Switch – ON.
(11) Engine Instruments – CHECKED.
(12) Gyro Pressure Gauge – CHECKED.
(13) Using the same procedure, start other engine.

EXTERNAL POWER

(1) Master Switch – OFF.
(2) External Power – SET FOR 12 VOLTS, CONNECTED.
(3) Master Switch – ON.
(4) External Lights – AS REQUIRED.
(5) Auxiliary Fuel Pumps – ON, Check Fuel Pressure, then OFF.
(6) Propellers – "CLEAR."
(7) Left Engine Magneto – Left ON, Right ON After Start.
(8) Left Engine Starter Button – PRESS.

(CHECKLIST CONTINUED NEXT PAGE)

NOTE

In the event of a balked start or overprimed condition, place the mixture control in idle cut-off and open the throttle. Operate the starter to remove excess fuel. As engine starts, reduce the throttle to idle rpm and place the mixture control in Full Rich.

(10) Throttle – 800 to 1200 rpm for warm-up.
(11) Oil Pressure – 25 psi within 30 seconds.
(12) Left Alternator Switch – ON.
(13) Left Ammeter – CHECKED.
(14) Engine Instruments – CHECKED.
(15) Gyro Pressure Gauge – CHECKED.
(16) Left Alternator Switch – OFF.
(17) Master Switch – OFF.
(18) External Power – OFF AND DISCONNECTED.
(19) Master Switch – ON.
(20) Left Alternator Switch – ON.

CAUTION

IF THE LEFT ALTERNATOR IS OPERATING PROPERLY AND THE RIGHT ENGINE WILL NOT START USING AIRPLANE POWER, REMOVE THE BATTERY FROM THE AIRPLANE AND SERVICE OR REPLACE BEFORE FURTHER FLIGHT.

(21) Using the AIRPLANE POWER procedure above, start the right engine.

NOTE

Starting one engine with airplane power will ensure that the battery system is charged and operating. If it is necessary due to extreme cold conditions, use EXTERNAL POWER procedure to start both engines. Allow sufficient time for warm-up, then shut down right engine only. Restart right engine using AIRPLANE POWER procedure.

BEFORE TAXIING

(1) Radios/Transponder – ON/STANDBY.
(2) Altimeter/Gyros/Clock – SET.
(3) Autopilot – CHECKED/OFF.
(4) Electric Trim – CHECKED/SET.
(5) Exterior Lights – AS REQUIRED.
(6) Park Brake – RELEASED.

TAXIING

(1) Brakes – CHECKED.
(2) Flight Instruments – CHECKED.

ENGINE RUNUP

(1) Nosewheel – CENTERED.
(2) Parking Brake – SET.
(3) Magneto Groundout – With engines at idle, turn OFF mags, check that engine ceases firing, turn mags ON.
(4) Engine Instruments – CHECKED.

AT 2200 RPM:

(5) Propellers – EXERCISE (Normal rpm drop 150 to 250).

AT 1800 RPM:

(6) Magnetos – CHECK (Maximum rpm drop 175 and 50 rpm differential).
(7) Alternators – CHECK.
(8) Carburetor Heat – ON, Check for rpm drop, then set to OFF.
(9) Instrument Air Pressure Gauge – CHECK, 4.3 to 6.1 in Hg.

AT 1500 RPM:

(10) Propeller Feathering – CHECK (Place propeller levers in feather, then low pitch allowing no more than 500 rpm drop).
(11) Throttles – 800 to 1200 rpm.
(12) Flaps – CHECK.

BEFORE TAKEOFF

(1) Auxiliary Fuel Pumps – ON.
(2) Fuel Selectors – ON.
(3) Trim – SET.
(4) Cowl Flaps – OPEN & LOCKED.
(5) Carburetor Heat – OFF.
(6) Flaps – CHECKED/UP.
(7) Throttle Friction – ADJUST.
(8) Mixture – FULL RICH or as required by field elevation.
(9) Propeller Controls – FORWARD.
(10) Flight Controls – CHECKED.
(11) Instruments – CHECKED/SET.
(12) Radios/Transponder – SET/ON.
(13) Door & Windows – LOCKED.
(14) Lights/Strobe – AS REQUIRED.
(15) Parking Brake – RELEASED.

TAKEOFF

Normal Takeoff

(1) Power – Advance smoothly to full throttle, 2700 rpm.
(2) Brakes – RELEASE.
(3) Engine Instruments – CHECK.

(CHECKLIST CONTINUED NEXT PAGE)

NOTE

Minimum control speed is 61 KIAS.

(4) Elevator Control – Raise nosewheel at 70 KIAS to 75 KIAS.
(5) Landing Gear – Retract (when positive rate of climb is established and a landing can no longer be accomplished).
(6) Airspeed – Establish desired climb speed (when clear of obstacles). Best angle-of-climb speed – 81 KIAS, 3800 lbs, sea level. Best rate-of-climb speed – 95 KIAS, 3800 lbs, sea level. Refer to Section 5 for speeds at altitude and reduced weight.

Maximum Performance Takeoff

(1) Brakes – APPLY.
(2) Power – FULL THROTTLE, 2700 rpm.
(3) Brakes – RELEASE.

WARNING

IF AN ENGINE FAILS, A ONE ENGINE INOPERATIVE STALL WILL OCCUR AT AIRSPEEDS LESS THAN 61 KIAS.

(4) Elevator Control – Lift nose wheel as soon as possible and fly off at approximately 61 KIAS.
(5) Landing Gear – RETRACT (when positive rate-of-climb is established).
(6) Climb Speed – 81 KIAS (at maximum weight) until all obstacles are cleared.

AFTER TAKEOFF

(1) Landing Gear – RETRACT.
(2) Landing Light – OFF (at 1000 ft. AGL).
(3) Auxiliary Fuel Pumps – OFF.

ENROUTE CLIMB

Normal Climb

(1) Airspeed – 95 KIAS at sea level to 86 KIAS at 10,000 ft.
(2) Power – FULL THROTTLE & 2700 rpm.
(3) Mixture – As required for flight altitude.
(4) Cowl Flaps – AS REQUIRED.

Cruise Climb

(1) Airspeed – 100 KIAS
(2) Power – 25 in. Hg (or full throttle) and 2500 rpm.
(3) Mixture – As required for flight altitude.
(4) Cowl Flaps – AS REQUIRED.

CRUISE

(1) Power – Set as desired. Recommend: (Full throttle @ 2700 rpm @ 8500 ft.) (24 in. Hg @ 2500 – rpm @ 5000 ft.)
(2) Cowl Flaps – CLOSED.
(3) Mixtures – LEAN as required. Use EGT gauge if installed. (Best power 100°F on the rich side of peak EGT)
(4) Trim – AS REQUIRED.
(5) Engine Instruments – CHECK.

DESCENT

(1) Power – AS REQUIRED.
(2) Mixtures – Adjust for smoothness.
(3) Cowl Flaps – CLOSED.
(4) Altimeter – SET.

BEFORE LANDING

(1) Seat Belts & Shoulder Harness – FASTENED.
(2) Fuel Selectors – ON.
(3) Auxiliary Fuel Pumps – ON.
(4) Carburetor Heat – CHECK/On if required.
(5) Landing Gear – DOWN below 145 KIAS.
(6) Flaps – 0° to 10° below 145 KIAS. 11° to FULL DOWN below 110 KIAS.
(7) Mixtures – FULL RICH (or as required by Field Elevation).
(8) Propeller Controls – FULL FORWARD.
(9) Airspeed – 80 – 85 KIAS Flaps Up. 75 – 80 KIAS Full Flaps.
(10) Landing Light – AS REQUIRED.
(11) Autopilot – OFF.

BALKED LANDING

(1) Power – FULL THROTTLE and 2700 rpm.
(2) Carburetor Heat – OFF.
(3) Airspeed – 80 KIAS.
(4) Flaps – UP.
(5) Landing Gear – UP.
(6) Cowl Flaps – OPEN.

NORMAL LANDING

(1) Touchdown – Main Wheels First.
(2) Landing Roll – Lower Nose Wheel Gently.
(3) Braking – Minimum Required.

AFTER LANDING

(1) Auxiliary Fuel Pumps – OFF.
(2) Carburetor Heat – OFF.
(3) Cowl Flaps – OPEN.
(4) Flaps – UP.
(5) Avionics – AS REQUIRED.

TAXIING

All taxiing should be done at slow speed, and the controls should be positioned so that the effects of gusty wind are minimized. Taxiing should be done with both engines operating.

A steerable nose wheel, interconnected with the rudder system, provides positive control of nose gear steering through an arc of approximately 18° ± 3° each side of centerline and nose gear swiveling of approximately 35 degrees with differential braking. Normal steering may be aided through the use of differential power and differential braking on the main wheels. These aids are listed in the preferred order of use. Do not use excessive brake on the inboard side to effect a turning radius as decreased tire life will result. If the airplane is parked with the nose wheel castered in either direction, initial taxiing should be done with caution. To straighten the nose wheel, use full opposite rudder and differential power instead of differential braking. After a few feet of forward travel, the nose wheel will steer normally.

At some time early in the taxi run, the brakes should be checked for any unusual reaction, such as uneven braking. The operation of the turn coordinator and directional gyro should also be checked during taxiing. When turning right, the turn coordinator should indicate right wing down while the ball goes left and directional gyro heading increases in numerical value. In a left turn, the converse is true. At this time, the artificial horizon should be up to speed and indicating a level attitude.

Most of the engine warm-up should be done during taxiing, with just enough power to keep the airplane moving. Engine speed should not exceed 1000 rpm while the oil is cold.

Taxiing over loose gravel or cinders should be done at low engine speed to minimize damage to the propeller tips, landing gear, and empennage due to abrasion or stone damage.

BEFORE TAKEOFF

WARM-UP AND GROUND CHECK

Check both oil pressure and oil temperature and ensure mixture controls are set to full rich.

PROPELLER CHECK

Check the propeller control system for proper operation. Advance the throttles to give an engine speed of 2200 rpm. Move the propeller control from high rpm to low rpm and back to high rpm positions. The normal rpm drop is from 150 to 250 rpm. Full feathering check of the propellers on the ground is not recommended, but the feathering action can be checked by running the engine at 1500 rpm, then momentarily pulling the propeller control into the feathering (full aft) position. Do not allow the rpm to drop more than 500 rpm.

MAGNETO CHECK

A proper magneto check is important. Factors other than the ignition system affect magneto drop off. They are load-power output, propeller pitch, and mixture strength. With the propeller at minimum pitch angle, set the engine to 1800 rpm. The mixture control should be in the full rich position.

Switch from both magnetos to one and note drop-off. Return to both until engine regains speed. Switch to the other magneto and note drop-off. Return to both. The drop-off should not exceed 175 rpm or 50 rpm between magnetos. A smooth drop-off past normal is usually a sign of a too lean or too rich mixture. Perform magneto check on both engines.

To minimize plug fouling, do not operate on a single magneto for a long period. A few seconds is usually sufficient to check drop-of.

ELECTRICAL SYSTEM CHECK

NOTE

> When the master switch is OFF, the alternators and the battery are disconnected from the electrical bus. The Master Switch must be ON before either alternator, battery, or external power can power the electrical bus.

To run a functional check of the battery and alternator circuits, use the following procedure:

(1) Set both engines at 1800 rpm with some electrical equipment on.
(2) Turn left alternator switch off.
(3) Right alternator current meter reading will increase and left alternator failure light will illuminate.
(4) Turn left alternator switch on. Turn right alternator switch off.
(5) Left alternator current meter reading will increase and right alternator failure light will illuminate.
(6) Turn right alternator switch on.

Except for the landing gear the circuit breakers cannot be pulled to deactivate electrical circuits. The circuit breakers will automatically open in case of a current overload. The breakers can be reset by pushing in.

A simple last minute recheck of important items should include a quick glance to see that all switches are ON, the mixture and propeller controls are forward, all flight controls have free and correct movement, and the fuel selectors are properly positioned.

A mental review of all single-engine speeds, procedures and field length requirements should be made prior to takeoff.

TAKEOFF

POWER CHECK

It is important to check full-throttle operation early in the takeoff run. Any sign of rough engine operation or sluggish engine acceleration is good cause for discontinuing the takeoff.

Smooth and uniform throttle application should be used to ensure best engine acceleration and to give long engine life. This technique is important under hot weather conditions which may cause a rich mixture that could hinder engine response if the throttle is applied too rapidly.

If sluggish engine performance is indicated, discontinue the takeoff. Perform a thorough full throttle static runup before another takeoff is attempted.

NORMAL TAKEOFF

Before beginning the takeoff roll, align the airplane with the runway. Aligning the nose wheel with the takeoff direction will allow minimum brake usage during the initial ground roll.

Full throttle operation is recommended on takeoff since it is important that a speed well above air minimum control speed (61 KIAS) be obtained as rapidly as possible. Position the throttles to the full forward position.

NOTE

The normal mixture for takeoff is FULL-RICH. During takeoff from a high elevation airport, roughness or loss of power may result from overrichness. Lean the mixture only as required to obtain smooth operation. Observe engine instruments for excessive temperature rise. Rough operation due to over-rich fuel/air mixture is most likely to be encountered at altitudes above 5000 feet.

Accelerate the airplane to 70 to 75 KIAS. Apply a light back pressure on the control wheel to lift the nose wheel. Raising the nose wheel too soon or to an excessive angle may increase takeoff ground distance. After lift off, establish desired climb speed. The best angle-of-climb speed is 81 KIAS at 3800 pounds and best rate-of-climb speed is 95 KIAS at sea level and 3800 pounds. Refer to Section 5 for airspeed at 50 feet and at reduced weight.

NOTE

Normal takeoff distance in Section 5 is based on lift off at 65 KIAS.

Retract the landing gear after a positive rate-of-climb is established. Observe that the landing gear in transit light (Landing Gear Not Safe – Amber) is on as the landing gear retracts and the landing gear down and locked (3 green) lights are out. The in transit light should go out after the landing gear has retracted. The landing light will be automatically turned off by a mercury switch attached to the nose wheel landing gear after the nose wheel has retracted. If landing light switch is on, turn off after 1000 foot AGL is reached.

MAXIMUM PERFORMANCE TAKEOFF

For maximum performance takeoff, the engines should be run up to full power before brake release. For maximum engine power, the mixture should be adjusted for the field elevation.

WARNING

IF AN ENGINE FAILS, A ONE-ENGINE-INOPERATIVE STALL WILL OCCUR AT AIRSPEEDS LESS THAN 61 KIAS.

When full power is reached, release brakes and begin the takeoff roll with elevator neutral. Lift the nose wheel as soon as possible and fly off at approximately 61 KIAS. If obstacles are to be cleared after takeoff, accelerate to the best angle-of-climb speed 81 KIAS (at max. weight) until obstacles are cleared. Retract landing gear after positive rate of climb is established. Refer to Section 5 for airspeed at 50 feet and at reduced weight.

CROSSWIND TAKEOFF

The airplane is accelerated to a speed higher than normal (5 to 10 KIAS), then flown off abruptly to prevent possible settling back to the runway while drifting. When clear of the ground, make a coordinated turn into the wind to correct for drift.

ROUGH FIELD OPERATION

Full-throttle runups over loose gravel are especially harmful to propeller tips. When takeoffs must be made over rough surfaces, it is very important that the throttle be advanced slowly. This allows the airplane to start rolling before high rpm is developed, and the gravel will be blown back of the propeller rather than pulled into it.

ENROUTE CLIMB

Using full throttle and 2700 rpm, a normal climb speed of 95 KIAS at sea level is recommended. Reduce the airspeed one KIAS per 1000 feet of climb to 85 KIAS at 10,000 feet. This speed offers good visibility, excellent over-the-ground speed and rate-of-climb speed. The best rate-of-climb speed is 95 KIAS at sea level and 3800 pounds weight. The best angle-of-climb speed is 81 KIAS at 3800 pounds at sea level. Refer to Section 5 performance charts for additional speeds and weights.

If it is necessary to climb rapidly to clear mountains or reach favorable winds at high altitudes, the best rate-of-climb speed (95 KIAS) should be used with maximum power (full throttle and 2700 rpm). The mixture should be leaned as required for altitude.

If an obstruction ahead requires a steep climb angle, the best angle-of-climb speed (81 KIAS) should be used with flaps up and maximum power.

The recommended cruise climb speed is 100 KIAS with a manifold pressure setting of 25 in. Hg and engine speed of 2500 rpm. The mixture should be leaned as required for altitude.

CRUISE

The maximum recommended cruise power setting is 75 percent of the rated horsepower (full throttle @ 2700 rpm @ 8500 Feet) (24 in. Hg. manifold pressure @ 2500 rpm @ 5000 feet). True airspeeds, which are determined by the particular altitude and power setting chosen, can be obtained from the table in Section 5.

NOTE

On new engines, power should be maintained at 75 percent power or more until a total of 50 hours has accumulated. This is to ensure proper seating of the rings and is applicable to new engines, engines in service following cylinder replacement, or top overhaul of one or more cylinders.

MIXTURE LEANING PROCEDURES

Fuel consumption can be reduced significantly and engine performance improved, especially at high altitudes, by leaning the mixture. The leaning procedure may be monitored by the exhaust gas temperature (EGT) indicator (if installed) or by the engine performance. Never lean the mixture to the point that the maximum (red line) cylinder head temperature is exceeded.

LEANING WITHOUT EGT (EXHAUST GAS TEMPERATURE) SYSTEM

During climb, roughness or loss of power may result from over-richness. In this case, lean the mixture only enough to obtain smooth engine operation, not for economy. Monitor the engine instruments for temperature rise. Rough engine operation due to over-rich fuel/air mixture is most likely to be encountered at altitudes above 5000 feet.

For flight with one engine inoperative, the mixture should be leaned to best power.

BEST POWER

For best engine power, lean the mixture as follows:

(1) Slowly move the mixture control from the FULL RICH position toward the LEAN position.
(2) Continue leaning until engine roughness is noted.
(3) Move mixture control forward approximately 1/2 inch toward the FULL RICH position.

BEST ECONOMY

For optimum fuel consumption at 75% power or less during cruise, lean the mixture and observe engine performance as follows:

(1) Slowly move the mixture control from the FULL RICH position toward the LEAN position.
(2) Continue leaning until engine roughness is noted.
(3) Enrich the mixture slightly until the engine runs smoothly.

The mixture should be adjusted on one engine at a time. Always return the mixture to FULL RICH before increasing the power settings.

In order to maintain smooth engine operation, it may be necessary to enrich the mixture slightly during the descent.

LEANING WITH EGT (EXHAUST GAS TEMPERATURE) SYSTEM

The exhaust gas temperature (EGT) indicator is offered as an optional item on the GA-7/Cougar. The EGT can be used to optimize the mixture setting and reduce the fuel flow. This normally results in more consistent aircraft performance. The following mixture settings are normally used when using the EGT for a reference.

(1) FULL RICH mixture.
(2) Best Power – 100°F on the rich side of peak EGT.
(3) Best Economy – Operate at peak EGT.

During two engine climb, the mixture is normally left at FULL RICH below 5000 feet and adjusted for best power mixture above 5000 feet. If the engine instruments are carefully monitored during the climb, it is also acceptable to operate at best power mixture below 5000 feet.

For flight with one engine inoperative, the mixture should be leaned for best power.

During cruise flight, use of best power mixture is recommended for power settings from maximum power to 65% power. For additional economy, best economy mixture may be used for all power settings of 75% power or below. (Use of best economy mixture will result in a slight decrease in the cruise airspeed). For power settings below 65% power, best economy mixture is recommended.

During descent, the EGT should be monitored and maintained near peak EGT. Mixture must be enriched prior to increasing the engine power.

STALLS

The airplane stall is normally elevator limited. Recovery from practice stalls at normal entry rates should be initiated when the elevator has reached the full aft stick position. Recovery from accelerated entry or turning stalls should be initiated when a nose down pitch occurs or the elevator control reaches the aft stop, whichever occurs first. Onset of light to moderate tail buffet may occur at speeds between stall warning and the stall as described above.

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

The loss of altitude during a power-off stall with gear and flaps retracted may be as much as 200 feet. The loss of altitude with gear down and 30° of flaps may be as much as 200 feet.

The loss of altitude during a power-on stall with gear and flaps retracted may be as much as 160 feet. The loss of altitude with gear down and 30° of flaps may be as much as 150 feet.

The loss of altitude during a one-engine-inoperative stall with gear and flaps retracted may be as much as 300 feet, a pitch-down angle as much as 20° and up to 25° roll. In the approach to a one engine inoperative stall maneuver, it is not necessary to reduce the power on the operating engine in order to maintain lateral and directional control until the stall occurs, except in extreme light weight conditions.

DESCENT

During descent, gradually enrich mixtures to maintain smooth engine operation. Descent should be gradual at approximately 500 fpm at cruise speed, and with enough power to maintain the engine temperatures in the green arc. Prolonged idle settings and low cylinder head temperature should be avoided. The recommended descent speeds are up to 188 KIAS in smooth air, 160 KIAS in rough air, and 120 KIAS in turbulence.

BEFORE LANDING

On landing approach, a final quick check should be made to ensure that mixtures are properly set, propeller controls are full forward, and all necessary switches are on. The landing gear should be extended after airspeed has decreased below 145 KIAS. The landing gear operation can be monitored by the landing gear lights located on the instrument panel. The landing gear NOT SAFE light (amber) should be lit while the landing gear is in transit. The 3 landing gear lights (green) will light after the landing gear is down and locked. If the landing gear is not down and locked, and the manifold pressure is decreased below 13 in. Hg., or the flaps are extended beyond 15°, the pilot will be alerted by an aural warning.

The recommended landing approach speeds are 80 to 85 KIAS with flaps up or 75 to 80 KIAS with full flaps.

LANDING

NORMAL LANDING

Normal landings, on hard and smooth surfaces, are performed with full flaps. Power is reduced during flare-out and cut immediately upon touchdown. Touch down on the main wheels, then gently lower the nose wheel. Brakes are applied as necessary.

SHORT FIELD LANDING

Short field landings are made in a similar manner as the normal, smooth-surface landing except that the main gear is touched down at the slowest safe airspeed with full flaps.

CROSSWIND LANDING

A wing-low drift correction technique with wing flaps fully extended is the preferred method of performing crosswind landings. Landings using this technique are accomplished by banking into the wind to stop the drift while maintaining airplane alignment with the runway by use of the rudder. The maximum demonstrated crosswind velocity is 15 knots.

BALKED LANDING

Should a go-around be required, apply full power immediately, carburetor heat off, establish airspeed of 80 KIAS, retract the flaps, and trim for normal climb. Retract landing gear after positive rate of climb is obtained. Adjust cowl flaps for adequate cooling.

COLD WEATHER OPERATION

STARTING

When starting in extremely cold weather, use of an external preheat and an external power source is recommended to reduce severity of load on the electrical system and engines.

WARNING

WHEN PULLING A PROPELLER THROUGH BY HAND, TREAT IT AS IF THE IGNITION WAS ON. A BROKEN OR LOOSE GROUND WIRE ON EITHER MAGNETO COULD CAUSE THE ENGINE TO FIRE.

Propellers should be pulled through several complete revolutions by hand to loosen oil.

Starting procedures in cold weather are the same as for normal starting except that more priming may be required.

WARM-UP

During cold weather operations, no indication will be apparent on the oil temperature gauge prior to takeoff if outside air temperatures are very cold. After a suitable warm-up period (2 to 5 minutes at 1000 rpm), accelerate the engine several times to higher engine rpm. If the engine accelerates smoothly and the oil pressure remains normal and steady, the airplane is ready for takeoff.

IN FLIGHT

ENGINE ROUGHNESS

Engine roughness is usually due to carburetor icing, and may be accompanied by a slight loss of airspeed or altitude. If too much ice is allowed to accumulate, restoration of full power may not be possible. Prompt action is required.

1. Carburetor Heat – On. Power will decrease slightly and roughness will increase. Wait for a decrease in engine roughness or an increase in power. If no change in approximately one minute, return carburetor heat to OFF. If engine is still rough, try the following steps:
2. Mixture Control – Adjust for a maximum smoothness. Engine will run rough if too rich or too lean.
3. Auxiliary Fuel Pumps – On.
4. Fuel Selector – Change to crossfeed to see if fuel contamination is the problem.
5. Engine Gauges – Check for abnormal readings. If any gauge reading is abnormal, proceed as follows:
   (a) Magneto Switches – Check, one at a time, then both ON. If operation is satisfactory on either magneto, proceed on that magneto at reduced power, with mixture full rich, to a landing at the first available airport.

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

NOISE ABATEMENT

Every practical effort should be made to reduce airplane noise at ground level near recreational, residential, and other noise-sensitive areas. When practical, maintain at least 2000 feet above ground level. Avoid prolonged low-level flight after takeoff and before landing.

NOTE

The above procedures do not apply if they conflict with safety of flight requirements, or Air Traffic Control regulations, clearances, or instructions.

MULTI-ENGINE TRAINING PROCEDURES

SIMULATED ONE ENGINE INOPERATIVE (ZERO THRUST, SIMULATED FEATHER)

When establishing zero thrust operation, use the power setting listed below. By using this power setting to establish zero thrust, you avoid the inherent difficulties of restarting a shut down engine and preserve almost instant power to counter any attendant hazard. To set up a zero thrust condition make the following settings:

(1) Propeller Control – Retard to feather detent (approximately 2000 rpm).
(2) Throttle Control – Set 12 in. Hg. manifold pressure.

NOTE

This setting will approximate zero thrust using recommended one-engine inoperative climb speeds.

MINIMUM CONTROL AIRSPEED (V_{MCA}) TRAINING PROCEDURE (ONE ENGINE INOPERATIVE)

Single engine minimum control airspeed (V_{MCA}) demonstration may be required for multi-engine pilot certification. The demonstration shall be conducted at a safe altitude of at least 5000 feet AGL and in clear air only.

Use the following procedure in the practice of V_{MCA}:

(1) Landing gear – Up.
(2) Flaps – Up.
(3) Airspeed – 85 KIAS.
(4) Propeller levers – Full forward.
(5) Throttle (Simulated inoperative engine) – Idle.
(6) Throttle (Operative engine) – Full throttle.
(7) Airspeed – Reduce approximately 1 knot per second until either V_{MCA} or a stall buffet is obtained.

NOTE

Using the rudder and ailerons to maintain directional and lateral control, a bank of 5° toward the operative engine should be maintained. The recovery should be initiated at the first sign of either V_{MCA} or stall (which may be evidenced by inability to maintain heading, lateral attitude, or aerodynamic stall buffet).

(8) Recovery – Reduce operative engine power to idle, immediately lower the nose to regain airspeed.
(9) Throttles – Add power on both engines to return to normal flight.

SECTION 5
PERFORMANCE

TABLE OF CONTENTS

INTRODUCTION TO PERFORMANCE AND FLIGHT PLANNING

The performance charts and tables presented on the following pages enable the pilot to know what to expect from the GA-7/Cougar airplane under various conditions. These charts also provide the pilot with a valuable aid in accurate flight planning, therefore, they should be consulted prior to each flight.

These charts are a compilation of data obtained through actual flight tests conducted in a GA-7/Cougar airplane with both engines in good condition, and using average pilot techniques. The range and endurances profile charts include allowances for start, taxi, takeoff, climb, descent, and 45 minutes reserve (fuel based on 45% power). The fuel flow was calculated using a full rich mixture above 75% power, best power mixture for power setting between 75% power and 65% power, and economy cruise mixture (peak EGT) below 65% power. Cruise performance does not include allowances for wind and/or navigational errors.

All speeds quoted in this section are indicated airspeeds (IAS) except as noted and assume zero instrument error.

USE OF PERFORMANCE CHARTS

The performance data is presented in tabular or graphical form, depending upon which presentation method best portrays the specific data. Each table or graph contains explanatory material when the use of the table or graph is not obvious. In addition, a sample problem involving typical use of the performance data in this section is presented to illustrate usage of the tables and graphs.

SAMPLE PROBLEM

A sample flight plan has been outlined below to show the use of the performance data presented in this section.

CONDITIONS

ORIGIN – TULSA, OKLAHOMA (TUL)

OUTSIDE AIR TEMPERATURE	29°C (84°F)
FIELD ELEVATION	676 FT.
ALTIMETER SETING	30.05 IN. HG
WIND	180° AT 10 KTS.
RUNWAY 17R LENGTH	5500 FT.
INITIAL WEIGHT	3750 LBS.

DESTINATION – AMARILLO, TEXAS (AMA)

OUTSIDE AIR TEMPERATURE	27°C (81°F)
FIELD ELEVATION	3605 FT.
ALTIMETER SETTING	30.02 IN. HG
WIND	140° AT 20 KTS.
RUNWAY 13 LENGTH	5409 FT.

ROUTE OF TRIP

A cruise altitude of 8500 feet has been selected.

Route Segment	Magnetic Course	Dist N.M.	Wind 8500 Feet Dir/Kts	OAT 8500 Feet °C	Alt Setting In. Hg
TUL-IFI	253°	110	080/30	10°C	30.05
IFI-SYO	242°	84	090/20	10°C	30.05
SYO-AMA	259°	259	128/30	12°C	30.02

ABBREVIATION	AIRPORT/VOR STATION
TUL	Tulsa, Oklahoma
IFI	King Fisher, Oklahoma
SYO	Sayre, Oklahoma
AMA	Amarillo, Texas

To determine pressure altitude at origin and destination airports, add 100 feet to field elevation for each .1 in. Hg below 29.92, and subtract 100 feet from field elevation for each .1 in. Hg above 29.92.

Pressurc altitude at TUL
30.05 – 29-92 = .13
The pressure altitude at TUL is 130 feet below the field elevation.
676 – 130 = 546 feet
Pressure altitude at AMA
30.02 – 29.92 = .1
The pressure altitude at AMA is 100 feet below the field elevation.
3605 – 100 = 3505 feet

NOTE

For flight planning, the differences between cruise altitude and cruise pressure altitude has been ignored.

TAKEOFF

Using the conditions listed at Tulsa, Oklahoma, the takeoff distance required can be found. It should be kept in mind that the distances shown are based on maximum performance techniques. Conservative distances can be established by reading the chart at the next higher value of weight, pressure altitude, and temperature. For this sample problem, 3800 pounds, 2000 feet pressure altitude, and 30°C should be used to determine the takeoff distance from Figure 5-6.

Ground Roll	1237 Ft.
Total distance to clear a 50 foot obstacle	2272 Ft.

A correction for the effect of wind may be based on Note 1 of the takeoff distance chart (Figure 5-6). From Figure 5-5, the headwind component is determined to be 9.8 knots.

$$\frac{9.8 \text{ knots}}{5 \text{ knots}} \times 4\% = 8\% \text{ decrease}$$

This results in the following distance, corrected for wind:

Ground roll, zero wind	1237 ft.
Decrease in ground roll (1237 x 8%)	99 ft.
Corrected ground roll	1138 ft.
Total distance to clear a 50-foot obstacle, zero wind	2272 ft.
Decrease in total distance (2272 x 8%)	182 ft.
Corrected total distance to clear a 50-foot obstacle	2090 ft.

The distance is well within the takeoff distance available of 5500 feet.

TIME, FUEL, AND DISTANCE TO CLIMB

Enter the graph for Time-Fuel-Distance to Climb (Cruise Climb) (Figure 5-12) at the initial altitude (546 feet), OAT (29°C) and weight (3750 pounds). Also enter at the cruise altitude (8500 feet), OAT (10°C) and weight (3750 pounds).

Time to Climb	13.4 - .8 = 12.6 Minutes (.21 Hours)
Fuel to Climb	4.8 - .4 = 4.4 Gallons
Distance to Climb	24 - 1.2 = 22.8 N.M.

TIME,FUEL, AND DISTANCE TO DESCEND

Enter the graph for Time-Fuel-Distance to Descend (Figure 5-18) at the cruise altitude (8500 feet) and at the final altitude (3605 feet).

Time to Descend	17 -7 = 10 minutes (.17 hours)
Fuel to Descend	5.2 -2 = 3.2 gallons
Distance to Descend	46 -19 = 27 N.M.

CRUISE INFORMATION

Based on the distance required, cruise performance tables (Figure 5-14), and the range and endurance profiles (Figures 5-16 and 5-17), a cruise power setting of approximately 65% using 2600 rpm at 8500 feet has been selected.

Entering the cruise performance tables at 8000 feet, 10,000 feet, standard temperature and 20°C above standard temperature, the following table results.

Pressure Altitude Feet	Power Setting RPM/MAN Press	Standard Temperature				20°C Above Standard Temp			
		Temp	%BHP	KTAS	B.P. F/F GPH	Temp	%BHP	KTAS	B.P. F/F GPH
8000	2600/20 in.	-1°C	66	149	17	19°C	64	148	17
10000	2600/20 in.	-5°C	68	153	18	15°C	65	152	17

Interpolating for 8500 feet yields:

Pressure Altitude Feet	Power Setting RPM/MAN Press	Standard Temperature				20°C Above Standard Temp			
		Temp	%BHP	KTAS	B.P. F/F GPH	Temp	%BHP	KTAS	B.P. F/F GPH
8500	2600/20 in.	-2°C	67	150	17	18°C	64	149	17

Interpoloting for the appropriate route segment:

Route Segment	Power Setting RPM/MAN Press	Temp	%BHP	KTAS	B.P. Fuel Flow GPH
TUL-SYO	2600/20 in.	10°C	65	149	17
SYO-AMA	2600/20 in.	12°C	65	149	17

Time and fuel used were calculated as follows:

$$\text{Time} = \frac{\text{Distance}}{\text{Ground Speed}}$$

Fuel Used = (Time) (Fuel Flow)

Route Segment	Distance N.M.	Est. Ground Speed Kts	Time at Cruise Altitude Hrs	Fuel Used for Cruise Gal.
TUL-IFI	87*	179	.49	8.3
IFI-SYO	84	166	.51	8.7
SYO-AMA	232**	170	1.36	23.1

*Distance required to climb has been subtracted from the segment distance.
**Distance required to descend has been subtracted from the segment distance.

Time — Fuel — Distance

Item	Time Hrs Min	Fuel Gal	Distance N.M.
Start, Taxi, and Takeoff	0	2.6	0
Climb	.21	4.4	23
Cruise	2.36	40.1	403
Descent	.17	3.2	27
Total	2.74	50.3	453

Block Speed = 453 N.M. divided by 2.74 hours = 165.3 knots.
The estimated weight is determined by subtracting the fuel required for the trip from the initial takeoff weight.

Initial takeoff weight	3750 lbs.
Estimated fuel used	50.3 Gal. (302 lbs.)
Estimated landing weight	3448 lbs.

LANDING

The landing distance required is determined in a similar manner to the procedure used in determining takeoff distance. Using 3800 pounds, 4000 feet, and 30°C, the distance can be found from Figure 5-21.

Ground roll	836 feet
Total distance to clear a 50-foot obstacle	1573 feet

A correction for the effect of wind may be made based on Note 1 of the landing chart. Using Figure 5-5, headwind component is determined to be 19.7 knots.

$$\frac{19.7}{5\text{ knots}} \times 4\% = 16\%\text{ Decrease}$$

The results is the following distances, corrected for wind:

Ground roll, zero wind	836 feet
Decrease in ground roll (836 x 16%)	132 feet
Corrected ground roll.	704 feet
Total landing distance to clear a 50-foot obstacle, zero wind	1573 feet
Decrease in total distance (1573 x 16%)	252 feet
Corrected total distance to clear a 50-foot obstacle	1321 feet

This distance is well within the landing distance available of 5409 feet.

TEMPERATURE CONVERSION CHART

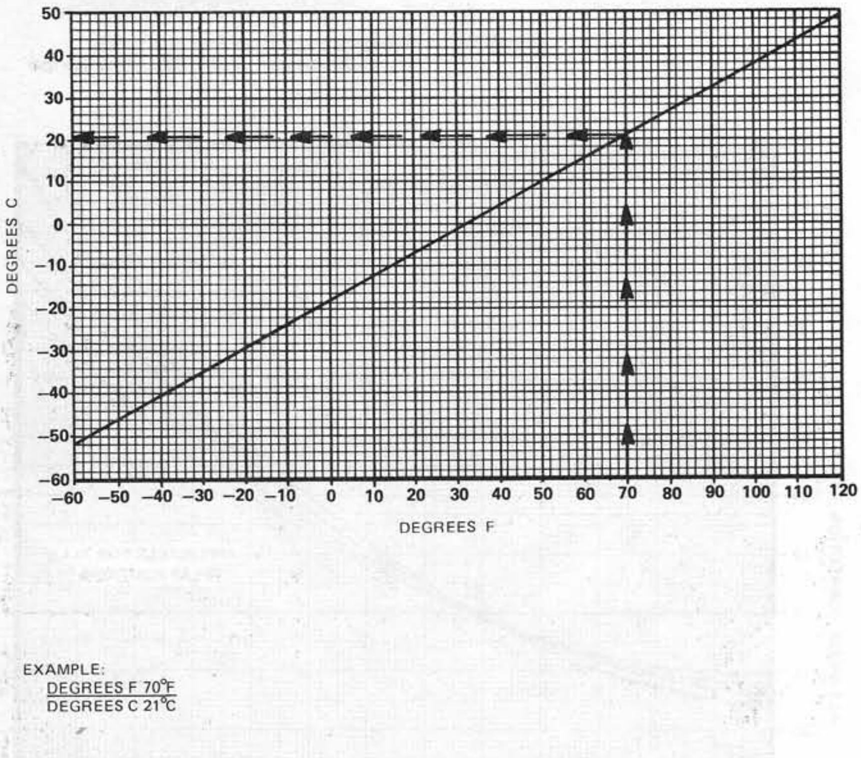


Figure 5-3. Temperature Conversion Chart

STALL SPEEDS

CONDITIONS:
POWER-IDLE

Forward Center of Gravity

Weight Pounds	Configuration		Angle of Bank							
			0°		30°		45°		60°	
	Flaps	Gear	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
3800	0°	Up	71	69	75	74	83	82	98	98
	30°	Down	63	61	68	66	75	73	87	86
3400	0°	Up	67	65	72	70	79	78	93	92
	30°	Down	60	58	64	62	71	69	83	82
3000	0°	Up	63	61	68	66	75	73	88	87
	30°	Down	56	54	60	58	67	64	78	77
2800	0°	Up	61	59	66	64	72	70	85	84
	30°	Down	54	52	58	56	64	62	75	74

EXAMPLE:

WEIGHT	3750 LBS.
LANDING GEAR	DOWN
FLAPS	30°
ANGLE OF BANK	30°
STALL SPEED	68 KIAS 66 KCAS

Figure 5-4. Stall Speeds

CROSSWIND COMPONENT CHART

EXAMPLE:	
WIND SPEED	10 KNOTS
ANGLE BETWEEN WIND DIRECTION AND FLIGHT PATH	10°
HEADWIND COMPONENT	9.8 KNOTS
CROSSWIND COMPONENT	1.8 KNOTS

NOTE:

DEMONSTRATED CROSSWIND COMPONENT IS 15 KNOTS

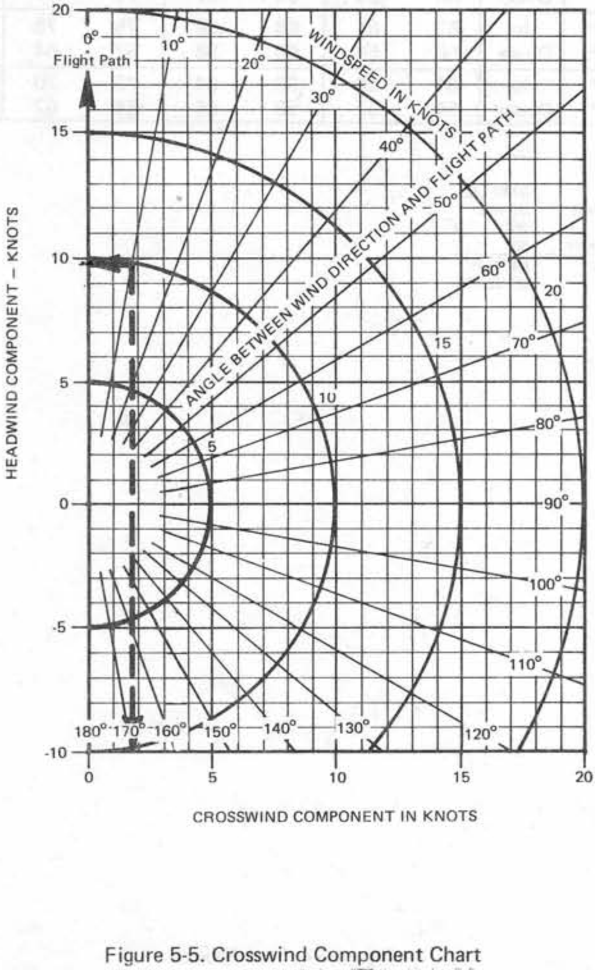


Figure 5-5. Crosswind Component Chart

TAKEOFF DISTANCE (NORMAL TAKEOFF)

ASSOCIATED CONDITIONS:

POWER	FULL THROTTLE AT 2700 RPM
FLAPS	UP
LANDING GEAR	RETRACT AFTER POSITIVE CLIMB ESTABLISHED
COWL FLAPS	OPEN
RUNWAY	HARD SURFACE, LEVEL, AND DRY
ZERO WIND	

NOTES:

1. DECREASE DISTANCES 4% FOR EACH 5 KNOTS HEADWIND. FOR OPERATION WITH TAILWINDS UP TO 10 KNOTS, INCREASE DISTANCES BY 10% FOR EACH 2.5 KNOTS.
2. IF TAKEOFF POWER SET WITHOUT BRAKES APPLIED, THEN DISTANCE APPLY FROM POINT WHERE FULL POWER IS ATTAINED.

Weight Lbs	Takeoff Speed KIAS Lift Off	Takeoff Speed KIAS 50 Ft	Press Alt Ft	0°C (32°F) Ground Roll Feet	0°C (32°F) Total to Clear 50 Ft Obs Feet	10°C (50°F) Ground Roll Feet	10°C (50°F) Total to Clear 50 Ft Obs Feet	20°C (68°F) Ground Roll Feet	20°C (68°F) Total to Clear 50 Ft Obs Feet	30°C (86°F) Ground Roll Feet	30°C (86°F) Total to Clear 50 Ft Obs Feet	40°C (104°F) Ground Roll Feet	40°C (104°F) Total to Clear 50 Ft Obs Feet
3800	65	76	SL	976	1802	992	1834	1008	1866	1023	1897	1038	1928
			2000	1181	2158	1200	2196	1219	2234	1237	2272	1256	2309
			4000	1433	2592	1456	2639	1479	2684	1501	2729	1523	2774
			6000	1744	3125	1772	3181	1800	3236	1828	3290	1854	3343
			8000	2130	3780	2165	3848	2199	3914	2232	3979	2265	4044
3400	61	73	SL	731	1370	743	1395	755	1419	766	1443	777	1466
			2000	884	1641	899	1670	913	1699	927	1728	940	1756
			4000	1073	1971	1090	2006	1107	2041	1124	2075	1141	2109
			6000	1306	2375	1327	2418	1348	2460	1369	2501	1389	2542
			8000	1595	2873	1621	2924	1647	2975	1672	3025	1696	3074
3000	58	68	SL	528	1007	537	1025	545	1043	553	1061	562	1078
			2000	639	1206	649	1228	659	1249	669	1270	679	1291
			4000	775	1448	787	1474	800	1500	812	1525	824	1550
			6000	943	1745	959	1776	974	1807	988	1838	1003	1867
			8000	1152	2110	1171	2148	1189	2185	1207	2222	1225	2258

EXAMPLE:

OAT	29°C (84°F)
PRESSURE ALTITUDE	546 FT.
WEIGHT	3750 LBS.
HEADWIND COMPONENT	9.8 KTS.
GROUND ROLL	964 FT.
TOTAL TO CLEAR 50 FT OBS.	1785 FT.
TAKEOFF SPEED AT LIFT-OFF	65 KIAS
50 FEET	76 KIAS

3. THE TAKEOFF PERFORMANCE PRESENTED IS BASED ON TAKEOFFS FROM HARD SURFACE RUNWAYS. GRASS, SAND, MUD, OR SNOW CAN EASILY DOUBLE THE TAKEOFF DISTANCE.

Figure 5-6. Takeoff Distance (Normal)

TAKEOFF DISTANCE (SHORT FIELD TAKEOFF)

ASSOCIATED CONDITIONS:

POWER	FULL THROTTLE AT 2700 RPM
FLAPS	UP
LANDING GEAR	RETRACT AFTER POSITIVE CLIMB ESTABLISHED
COWL FLAPS	OPEN
RUNWAY	HARD SURFACE, LEVEL, AND DRY
ZERO WIND	

NOTES:

1. DECREASE DISTANCES 4% FOR EACH 5 KNOTS HEADWIND. FOR OPERATION WITH TAILWINDS UP TO 10 KNOTS, INCREASE DISTANCES BY 10% FOR EACH 2.5 KNOTS.
2. IF TAKEOFF POWER SET WITHOUT BRAKES APPLIED, THEN DISTANCE APPLY FROM POINT WHERE FULL POWER IS ATTAINED.

Weight Lbs	Takeoff Speed KIAS Lift Off	Takeoff Speed KIAS 50 Ft	Press Alt Ft	0°C (32°F) Ground Roll Feet	0°C (32°F) Total to Clear 50 Ft Obs Feet	10°C (50°F) Ground Roll Feet	10°C (50°F) Total to Clear 50 Ft Obs Feet	20°C (68°F) Ground Roll Feet	20°C (68°F) Total to Clear 50 Ft Obs Feet	30°C (86°F) Ground Roll Feet	30°C (86°F) Total to Clear 50 Ft Obs Feet	40°C (104°F) Ground Roll Feet	40°C (104°F) Total to Clear 50 Ft Obs Feet
3800	61	70	SL	820	1510	833	1537	847	1563	859	1590	872	1615
			2000	992	1808	1008	1840	1024	1872	1039	1904	1055	1934
			4000	1203	2172	1223	2211	1242	2249	1261	2287	1280	2324
			6000	1465	2618	1489	2665	1512	2711	1535	2757	1557	2801
			8000	1789	3168	1819	3224	1847	3280	1875	3335	1903	3389
3400	58	66	SL	614	1148	624	1169	634	1189	644	1209	653	1229
			2000	743	1375	755	1399	767	1424	778	1447	790	1471
			4000	901	1651	916	1681	930	1710	944	1739	958	1767
			6000	1097	1990	1115	2026	1132	2061	1150	2096	1167	2129
			8000	1340	2407	1362	2450	1383	2493	1404	2534	1425	2575
3000	55	63	SL	444	844	451	859	458	874	465	889	472	903
			2000	536	1010	545	1028	554	1046	562	1064	570	1081
			4000	651	1213	661	1235	672	1257	682	1278	692	1298
			6000	792	1462	805	1488	818	1514	830	1540	843	1565
			8000	968	1768	984	1800	999	1831	1014	1862	1029	1892

EXAMPLE:

OAT	29°C (84°F)
PRESSURE ALTITUDE	546 FT.
WEIGHT	3750 LBS.
HEADWIND COMPONENT	9.8 KTS.
GROUND ROLL	810 FT.
TOTAL TO CLEAR 50 FT OBS.	1495 FT.
TAKEOFF SPEED AT LIFT-OFF	61 KIAS
50 FT.	70 KIAS

3. THE TAKEOFF PERFORMANCE PRESENTED IS BASED ON TAKEOFFS FROM HARD SURFACE RUNWAYS, GRASS, SAND, MUD, OR SNOW CAN EASILY DOUBLE THE TAKEOFF DISTANCE.

Figure 5-7. Takeoff Distance (Short Field)

CLIMB - ONE ENGINE INOPERATIVE

ASSOCIATED CONDITIONS:

POWER	FULL THROTTLE AT 2700 RPM
FLAPS	0°
LANDING GEAR	UP
INOP. PROPELLER	FEATHERED
COWL FLAPS	CLOSED ON INOPERATIVE ENGINE
MIXTURE	BEST POWER

WINGS BANKED 5° TOWARD OPERATIVE ENGINE

WEIGHT POUNDS	CLIMB SPEED KIAS
3800	85
3200	78
2800	73

EXAMPLE:

OAT	29°C (84°F)
PRESSURE ALT.	546 FT
WEIGHT	3750 LBS
RATE-OF-CLIMB	165 FPM

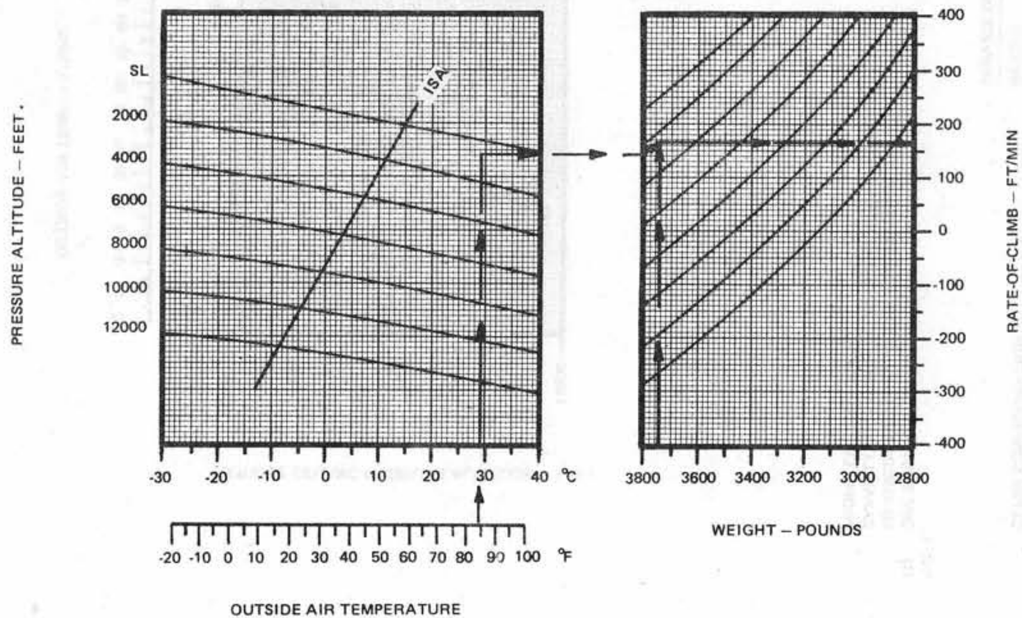


Figure 5-3. Climb- One Engine Inoperative

ONE ENGINE INOPERATIVE SERVICE CEILING

ASSOCIATED CONDITIONS:
ONE ENGINE INOPERATIVE
CLIMB CONFIGURATION

EXAMPLE:

OAT	10°C (50°F)
WEIGHT	3750 LBS
SERVICE CEILING	4600 FT

NOTE:
(1) ONE ENGINE INOPERATIVE SERVICE CEILING IS THE MAXIMUM ALTITUDE WHERE THE AIRPLANE HAS THE CAPABILITY OF CLIMBING 50 FT/MIN WITH INOPERATIVE PROPELLER FEATHERED.

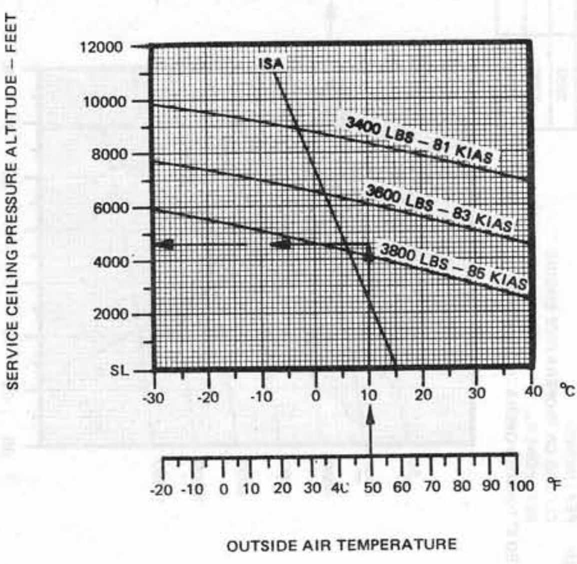


Figure 5-9 One Engine Inoperative Service Ceiling

CLIMB — TWO ENGINE (CRUISE CLIMB)
CLIMB SPEED 100 KIAS

ASSOCIATED CONDITIONS:

POWER	2500 RPM, 25 IN HG (FULL THROTTLE ABOVE 4000 FT)
FLAPS	0°
LANDING GEAR	UP
COWL FLAPS	AS REQUIRED
MIXTURE	RECOMMENDED LEANING PROCEDURE

EXAMPLE:

OAT	10°C (50°F)
PRESSURE ALT	8500 FT
WEIGHT	3750 LBS
RATE-OF-CLIMB	435 FPM

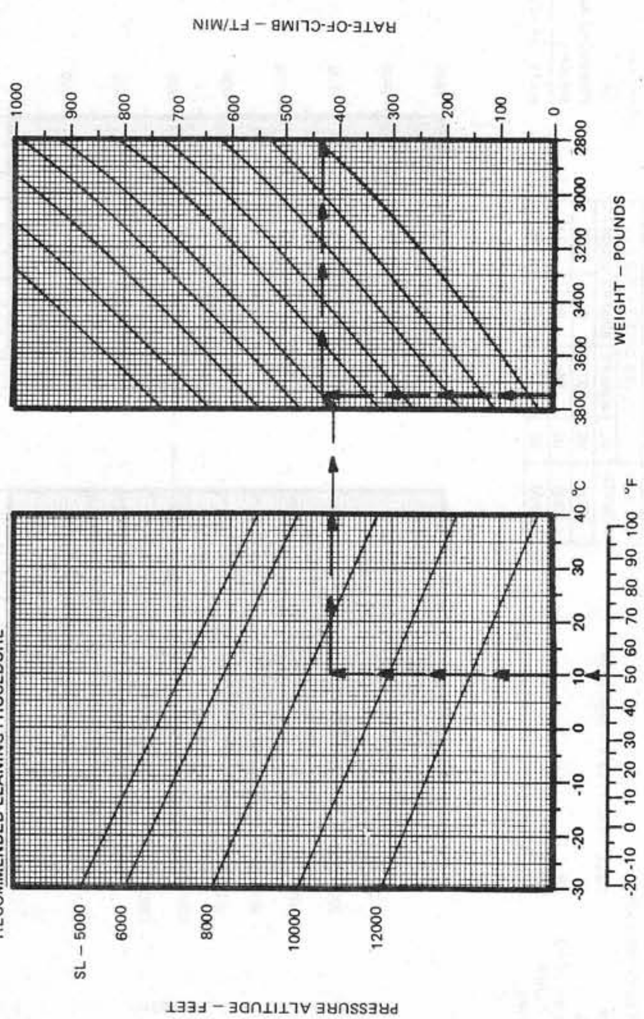


Figure 5-10 Climb — Two Engine (Cruise Climb)

CLIMB–TWO ENGINE (MAXIMUM CLIMB)

ASSOCIATED CONDITIONS:

POWER	FULL THROTTLE AT 2700 RPM
FLAPS	0°
LANDING GEAR	UP
COWL FLAPS	OPEN
MIXTURE	RECOMMENDED LEANING PROCEDURE

WEIGHT POUNDS	CLIMB SPEED – KIAS SL	4000 FT	8000 FT	12000 FT
3800	95	91	87	83
3200	88	84	80	77
2800	82	79	75	72

EXAMPLE:

OAT	10°C (50°F)
PRESSURE ALT	8500 FT
WEIGHT	3500 LBS
RATE–OF–CLIMB	780 FPM

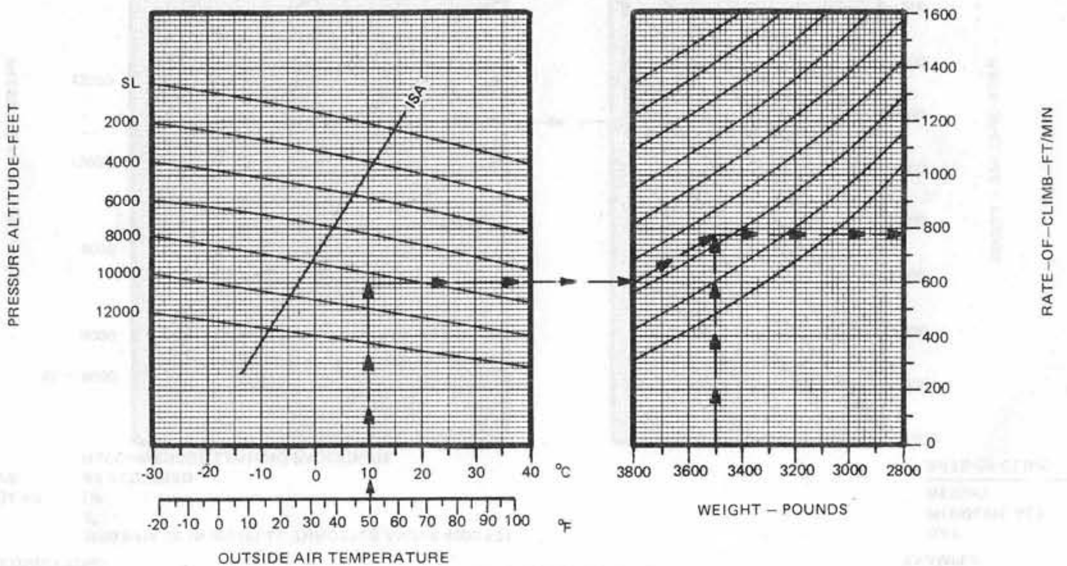


Figure 5-11. Climb – Two Engine (Maximum Climb)

TIME, FUEL AND DISTANCE TO CLIMB (CRUISE CLIMB)
CLIMB SPEED 100 KIAS

ASSOCIATED CONDITIONS

POWER	2500 RPM, 25 IN HG (FULL THROTTLE ABOVE 4000 FT)
FUEL DENSITY	6.0 LBS/GAL
MIXTURE	RECOMMENDED LEANING PROCEDURE
COWL FLAPS	OPEN

NOTE: FOR TOTAL FUEL USED ADD 2.6 GALLONS FOR START, TAXI AND TAKEOFF.

EXAMPLE:

OAT AT TAKE–OFF	29°C (84°F)
OAT AT CRUISE	10°C (50°F)
AIRPORT PRESSURE ALTITUDE	546 FT
CRUISE PRESSURE ALTITUDE	8500 FT
INITIAL CLIMB WEIGHT	3750 LBS
TIME TO CLIMB	13.4-.8=12.6 MIN
FUEL TO CLIMB	4.8-.4=4.4 GAL
DISTANCE TO CLIMB	24-1.2=22.8 NM

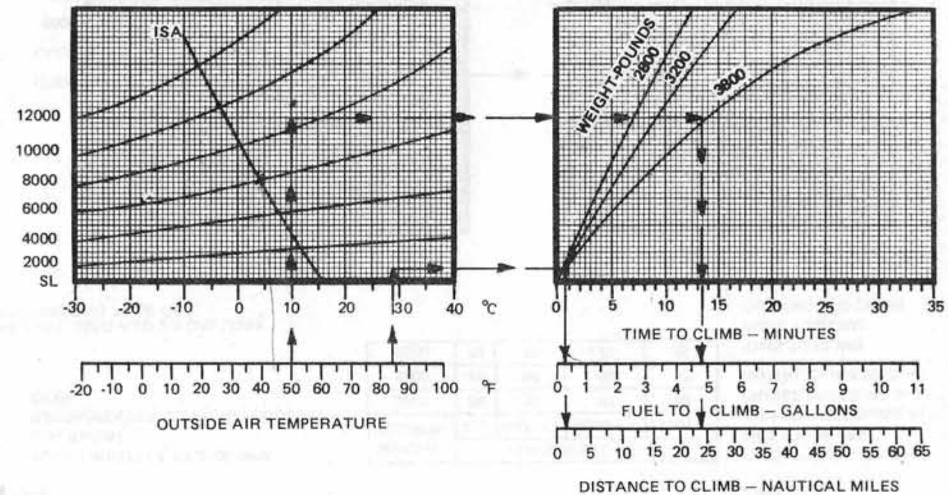


Figure 5-12. Time, Fuel and Distance to Climb (Cruise Climb)

TIME, FUEL AND DISTANCE TO CLIMB (MAXIMUM CLIMB)

ASSOCIATED CONDITIONS:

POWER	FULL THROTTLE AT 2700 RPM
FUEL DENSITY	6.0 LBS/GAL
MIXTURE	RECOMMENDED LEANING PROCEDURE
COWL FLAPS	OPEN

WEIGHT POUNDS	CLIMB SPEED–KIAS			
	S.L.	4000 FT	8000 FT	12000 FT
3800	95	91	87	83
3200	88	84	80	77
2800	82	79	75	72

EXAMPLE:

OAT AT TAKE–OFF	29°C (84°F)
OAT AT CRUISE	10°C (50°F)
AIRPORT PRESSURE ALT.	546 FT
CRUISE PRESSURE ALT.	8500 FT
INITIAL CLIMB WEIGHT	3750 FT
TIME TO CLIMB	10-.5=9.5 MIN
FUEL TO CLIMB	4.1-.25=3.85 GAL
DISTANCE TO CLIMB	16.2-1.0=15.2 NM

NOTE: FOR TOTAL FUEL USED ADD 2.6 GALLONS FOR START, TAXI AND TAKE OFF.

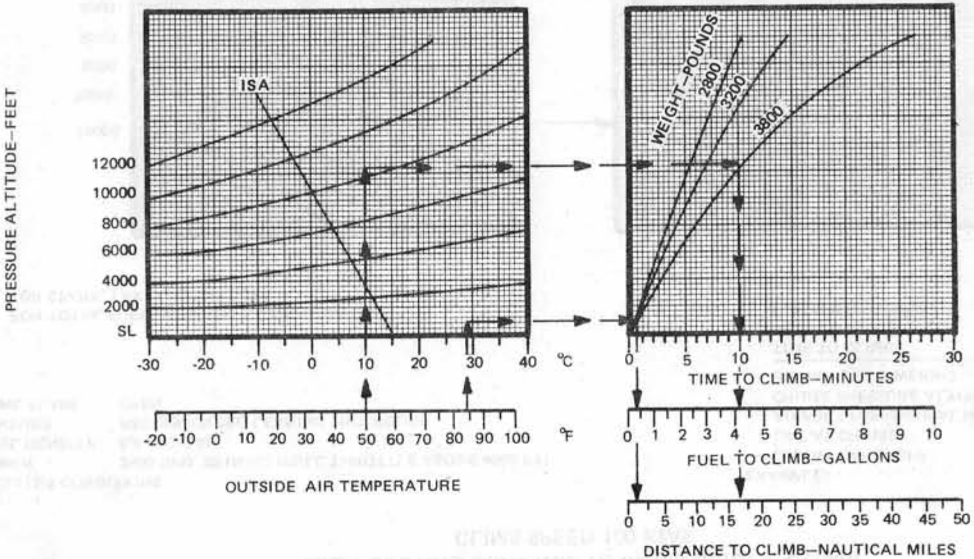


Figure 5-13. Time, Fuel and Distance to Climb (Maximum Climb)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 2000 FEET

CONDITIONS:

3800 POUNDS
RECOMMENDED LEANING PROCEDURE
COWL FLAPS CLOSED

NOTE: WHEN BEST POWER FUEL FLOW IS NOT USED, SPEEDS MAY BE AS MUCH AS 3 KTAS SLOWER THAN THOSE PRESENTED

*FULL RICH FUEL FLOW (GPH)

		20°C Below Standard Temp.				Standard Temperature				20°C Above Standard Temp			
		-9°C (16°F)				11°C (52°F)				31°C (88°F)			
				Total GPH				Total GPH				Total GPH	
RPM	MAP	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ
2700	25	88	157	23	*27	85	159	22	*26	82	159	21	*25
	24	83	154	22	*25	80	155	21	*24	78	156	20	*24
	23	78	150	20	*24	76	151	20	*24	73	152	19	15
	22	73	146	19	15	71	147	19	15	69	148	18	14
	21	69	142	18	14	66	143	17	14	64	143	17	13
2600	25	85	155	22	*26	82	156	21	*25	79	157	21	*24
	24	80	151	21	*24	77	152	20	*24	74	153	19	15
	23	75	147	20	16	73	149	19	15	70	150	18	14
	22	71	144	18	14	68	145	18	14	66	145	17	14
	21	66	140	17	14	64	140	17	13	62	140	16	13
2500	25	81	153	21	*25	79	153	20	*24	76	155	20	*24
	24	77	149	20	*24	74	150	19	15	72	151	19	15
	23	72	145	19	15	70	146	18	14	67	147	18	14
	22	68	141	18	14	65	142	17	13	63	142	17	13
	21	63	137	17	13	61	137	16	13	59	136	15	12
2400	25	78	150	20	*24	75	151	20	16	73	152	19	15
	24	74	146	19	15	71	147	19	15	69	148	18	14
	23	69	143	18	14	67	143	17	14	65	144	17	13
	22	65	139	17	13	62	139	16	13	60	138	16	12
	21	60	134	16	12	58	133	15	12	56	133	15	12
2300	25	75	147	20	15	72	148	19	15	70	149	18	14
	24	70	144	18	14	68	145	18	14	66	145	17	14
	23	66	140	17	14	64	140	17	13	62	140	16	13
	22	62	136	16	13	60	135	16	12	58	135	15	12
	21	58	130	15	12	56	130	15	11	54	128	14	11
2200	25	72	145	19	15	69	146	18	14	67	146	18	14
	24	67	141	18	14	65	142	17	13	63	142	17	13
	23	63	137	17	13	61	137	16	13	59	136	15	12
	22	59	132	15	12	57	132	15	12	55	131	14	11
	21	54	126	14	11	53	125	14	11	51	124	13	11
2100	25	69	142	18	14	66	143	17	14	64	143	17	13
	24	64	138	17	13	62	139	16	13	60	138	16	12
	23	60	134	16	12	58	133	15	12	56	133	15	12
	22	56	129	15	12	54	127	14	11	52	126	14	11
	21	52	122	14	11	51	121	13	10	48	119	13	10
2000	24	62	135	16	13	59	135	16	12	58	134	15	12
	23	57	130	15	12	55	129	15	11	53	128	14	11
	22	53	124	14	11	51	123	13	11	50	122	13	10
	21	49	118	13	10	47	116	12	10	46	114	12	10
	20	45	111	12	9	43	108	11	9	—	—	—	—

Figure 5-14. Cruise Performance (Sheet 1 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 4000 FEET

CONDITIONS:

3800 POUNDS
RECOMMENDED LEANING PROCEDURE
COWL FLAPS CLOSED

NOTE: WHEN BEST POWER FUEL FLOW IS NOT USED, SPEEDS MAY BE AS MUCH AS 3 KTAS SLOWER THAN THOSE PRESENTED

*FULL RICH FUEL FLOW (GPH)

		20°C Below Standard Temp. -13°C (9°F)				Standard Temperature 7°C (45°F)				20°C Above Standard Temp. 27°C (81°F)			
				Total GPH				Total GPH				Total GPH	
RPM	MAP	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ
2700	25	90	162	23	*27	87	163	22	*26	84	164	22	*25
	24	86	159	22	*26	83	159	21	*25	80	161	21	*24
	23	81	155	21	*25	78	156	20	*24	75	157	20	16
	22	76	151	20	*24	73	152	19	15	71	153	18	15
	21	71	147	19	15	68	148	18	14	66	148	17	14
2600	25	87	160	22	*26	84	161	22	*25	81	162	21	*25
	24	83	156	21	*25	80	157	21	*24	77	158	20	*24
	23	78	152	20	*24	75	153	20	15	72	154	19	15
	22	73	148	19	15	70	149	18	14	68	150	18	14
	21	68	144	18	14	66	145	17	14	64	144	17	13
2500	24	79	153	21	*24	81	158	21	*25	74	155	19	15
	23	75	150	19	15	72	151	19	15	70	151	18	14
	22	70	146	18	14	68	147	18	14	65	147	17	13
	21	66	142	17	13	63	142	17	13	61	141	16	13
	20	61	137	16	13	59	136	15	12	57	135	15	12
2400	24	76	151	20	16	73	152	19	15	71	153	19	15
	23	72	147	19	15	69	148	18	14	67	148	17	14
	22	67	143	18	14	65	144	17	13	63	143	16	13
	21	63	139	16	13	61	138	16	12	59	137	15	12
	20	58	133	15	12	63	143	16	12	54	131	14	11
2300	24	73	148	19	15	71	149	18	15	68	150	18	14
	23	69	145	18	14	66	145	17	14	64	145	17	13
	22	64	140	17	13	62	140	16	13	60	140	16	12
	21	60	135	16	12	58	135	15	12	56	133	15	12
	20	56	130	15	12	54	128	14	11	52	127	14	11
2200	24	67	141	18	14	68	147	18	14	66	147	17	13
	23	66	142	17	14	64	142	17	13	62	142	16	13
	22	62	137	16	13	59	137	16	12	58	136	15	12
	21	57	132	15	12	55	131	15	11	53	129	14	11
	20	53	125	14	11	51	124	13	11	49	122	13	10
2100	24	67	144	18	14	65	144	17	13	63	143	16	13
	23	63	139	17	13	61	139	16	13	59	138	15	12
	22	59	134	15	12	57	133	15	12	55	131	14	11
	21	54	128	14	11	53	126	14	11	51	125	13	11
	20	50	121	13	10	49	119	13	10	47	116	12	10
2000	24	65	141	17	13	62	141	16	13	60	140	16	12
	23	60	136	16	12	58	135	15	12	56	134	15	12
	22	56	130	15	12	54	129	14	11	52	127	14	11
	21	52	123	14	11	50	122	13	10	48	120	13	10
	20	48	117	13	10	46	114	12	10	45	109	12	9

Figure 5-14. Cruise Performance (Sheet 2 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 6000 FEET

CONDITIONS:

3800 POUNDS
RECOMMENDED LEANING PROCEDURE
COWL FLAPS CLOSED

NOTE: WHEN BEST POWER FUEL FLOW IS NOT USED, SPEEDS MAY BE AS MUCH AS 3 KTAS SLOWER THAN THOSE PRESENTED

*FULL RICH FUEL FLOW (GPH)

		20°C Below Standard Temp. -17°C (2°F)				Standard Temperature 3°C (38°F)				20°C Above Standard Temp. 23°C (74°F)			
				Total GPH				Total GPH				Total GPH	
RPM	MAP	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ
2700	23	83	159	22	*25	80	160	21	*24	78	162	20	*24
	22	78	155	20	*24	75	156	20	16	73	157	19	15
	21	73	151	19	15	71	152	18	15	68	152	18	14
	20	69	147	18	14	66	147	17	14	64	147	17	13
	19	64	142	17	13	62	141	16	13	60	140	16	12
2600	23	80	157	21	*24	77	158	20	*24	75	159	19	15
	22	75	153	20	16	73	154	19	15	70	154	18	14
	21	71	149	18	15	68	149	18	14	66	149	17	14
	20	66	144	17	14	64	144	17	13	62	143	16	13
	19	61	139	16	13	59	138	16	12	57	137	15	12
2500	23	77	154	20	*24	74	155	19	15	72	156	19	15
	22	72	150	19	15	70	151	18	14	68	151	18	14
	21	68	146	18	14	65	146	17	13	63	146	17	13
	20	63	141	17	13	61	141	16	13	59	140	15	12
	19	59	135	15	12	57	134	15	12	55	133	14	11
2400	23	74	152	19	15	71	153	19	15	69	153	18	14
	22	70	148	18	14	67	148	18	14	65	148	17	13
	21	65	143	17	13	63	143	16	13	61	142	16	13
	20	61	138	16	12	59	137	15	12	57	136	15	12
	19	56	132	15	12	54	130	14	11	52	128	14	11
2300	23	71	149	19	15	69	150	18	14	67	150	17	14
	22	67	145	17	14	65	145	17	13	62	144	16	13
	21	63	140	16	13	60	140	16	12	58	138	15	12
	20	58	134	15	12	56	133	15	12	54	131	14	11
	19	54	127	14	11	52	126	14	11	50	124	13	10
2200	23	69	147	18	14	66	147	17	14	64	147	17	13
	22	64	142	17	13	62	142	16	13	60	141	16	12
	21	60	137	16	12	58	136	15	12	56	134	15	12
	20	56	131	15	11	53	129	14	11	52	127	14	11
	19	51	124	13	11	49	122	13	10	48	118	13	10
2100	23	66	144	17	14	64	144	17	13	61	143	16	13
	22	62	139	16	13	59	138	16	12	57	137	15	12
	21	57	133	15	12	55	132	14	11	53	130	14	11
	20	53	126	14	11	51	125	13	11	49	122	13	10
	19	49	119	13	10	47	116	12	10	45	111	12	9
2000	23	63	141	17	13	61	141	16	13	59	139	15	12
	22	59	136	15	12	57	135	15	12	55	133	14	11
	21	54	129	14	11	53	128	14	11	51	126	13	11
	20	50	122	13	10	49	120	13	10	47	116	12	10
	19	46	114	12	10	45	110	12	9	—	—	—	—

Figure 5-14. Cruise Performance (Sheet 3 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 8000 FEET

CONDITIONS:

3800 POUNDS
RECOMMENDED LEANING PROCEDURE
COWL FLAPS CLOSED

NOTE: WHEN BEST POWER FUEL FLOW IS NOT USED, SPEEDS MAY BE AS MUCH AS 3 KTAS SLOWER THAN THOSE PRESENTED

		20°C Below Standard Temp. -21°C (-6°F)				Standard Temperature -1°C (31°F)				20°C Above Standard Temp. 19°C (67°F)			
				Total GPH				Total GPH				Total GPH	
RPM	MAP	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ
2700	21	75	156	20	16	73	157	19	15	70	157	18	14
	20	71	151	18	15	68	152	18	14	66	151	17	14
	19	66	147	17	14	64	146	17	13	62	145	16	13
	18	61	140	16	13	59	139	15	12	57	138	15	12
	17	57	134	15	12	54	132	14	11	52	130	14	11
2600	21	73	153	19	15	70	154	18	14	68	154	18	14
	20	68	149	18	14	66	149	17	14	64	148	17	13
	19	63	143	17	13	61	143	16	13	59	141	16	12
	18	59	137	15	12	57	136	15	12	55	134	14	11
	17	54	129	14	11	52	128	14	11	50	125	13	10
2500	21	70	151	18	14	68	151	18	14	65	150	17	13
	20	66	146	17	13	63	145	17	13	61	144	16	13
	19	61	140	16	13	59	139	15	12	57	137	15	12
	18	56	133	15	12	54	132	14	11	52	129	14	11
	17	52	126	14	11	50	123	13	10	48	119	13	10
2400	21	67	148	18	14	65	148	17	13	63	147	16	13
	20	63	143	17	13	61	142	16	12	59	140	15	12
	19	59	137	15	12	56	135	15	12	54	133	14	11
	18	54	129	14	11	52	127	14	11	50	124	13	10
	17	49	122	13	10	48	118	13	10	46	111	12	10
2300	21	65	145	17	13	63	144	16	13	60	143	16	12
	20	60	139	16	12	58	138	15	12	56	137	15	12
	19	56	133	15	12	54	131	14	11	52	129	14	11
	18	51	125	13	11	50	123	13	10	48	118	13	10
2200	21	62	142	16	13	60	141	16	12	58	139	15	12
	20	58	136	15	12	56	134	15	12	54	132	14	11
	19	53	129	14	11	52	127	14	11	50	124	13	10
	18	49	121	13	10	47	118	12	10	46	110	12	10
2100	21	60	138	16	12	58	137	15	12	56	136	15	12
	20	56	132	15	11	53	130	14	11	52	128	14	11
	19	51	125	13	11	49	122	13	10	48	117	13	10
2000	21	57	135	15	12	55	133	15	11	53	131	14	11
	20	53	128	14	11	51	126	13	11	49	123	13	10
	19	49	120	13	10	47	116	12	10	45	108	12	9

Figure 5-14. Cruise Performance (Sheet 4 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 10000 FEET

CONDITIONS:

3800 POUNDS
RECOMMENDED LEANING PROCEDURE
COWL FLAPS CLOSED

NOTE: WHEN BEST POWER FUEL FLOW IS NOT USED, SPEEDS MAY BE AS MUCH AS 3 KTAS SLOWER THAN THOSE PRESENTED

		20°C Below Standard Temp. -25°C (-13°F)				Standard Temperature -5°C (23°F)				20°C Above Standard Temp. 15°C (59°F)			
				Total GPH				Total GPH				Total GPH	
RPM	MAP	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ
2700	20	73	156	19	15	70	156	18	14	68	156	18	14
	19	68	151	18	14	66	150	17	13	63	149	17	13
	18	63	145	17	13	61	144	16	13	59	142	15	12
	17	58	138	15	12	56	136	15	12	54	134	14	11
	16	53	130	14	11	52	128	14	11	50	123	13	10
2600	20	70	153	18	14	68	153	18	14	65	152	17	13
	19	66	148	17	13	63	147	17	13	61	146	16	13
	18	61	142	16	13	59	140	15	12	56	139	15	12
	17	56	134	15	12	54	132	14	11	52	129	14	11
	16	51	126	13	11	49	123	13	10	48	116	13	10
2500	20	68	151	18	14	65	150	17	13	63	149	17	13
	19	63	145	17	13	61	144	16	13	59	142	15	12
	18	59	138	15	12	56	137	15	12	54	134	14	11
	17	54	130	14	11	52	128	14	11	50	124	13	10
2400	20	65	147	17	13	63	147	16	13	61	145	16	12
	19	61	141	16	12	58	140	15	12	56	138	15	12
	18	56	134	15	12	54	132	14	11	52	129	14	11
	17	51	126	13	11	50	123	13	10	48	116	13	10
2300	20	63	144	16	13	60	143	16	12	58	141	15	12
	19	58	138	15	12	56	136	15	12	54	133	14	11
	18	54	130	14	11	52	128	14	11	50	123	13	10
	17	49	122	13	10	47	117	12	10	46	104	12	10
2200	20	60	141	16	12	58	139	15	12	56	138	15	12
	19	56	134	15	12	54	132	14	11	52	129	14	11
	18	51	126	13	11	50	123	13	10	48	116	13	10
2100	20	58	137	15	12	56	136	15	12	54	133	14	11
	19	51	125	13	11	51	127	13	11	50	123	13	10
	18	49	122	13	10	49	122	13	10	46	104	12	10
2000	20	58	139	15	12	53	131	14	11	52	128	14	11
	19	51	126	13	11	49	122	13	10	48	115	13	10
	18	47	116	12	10	45	107	12	9	—	—	—	—

Figure 5-14. Cruise Performance (Sheet 5 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 12000 FEET

CONDITIONS:

3800 POUNDS
RECOMMENDED LEANING PROCEDURE
COWL FLAPS CLOSED

NOTE: WHEN BEST POWER FUEL FLOW IS NOT USED, SPEEDS MAY BE AS MUCH AS 3 KTAS SLOWER THAN THOSE PRESENTED

		20°C Below Standard Temp. -29°C (-20°F)				Standard Temperature -9°C (16°F)				20°C Above Standard Temp. 11°C (52°F)			
				Total GPH				Total GPH				Total GPH	
RPM	MAP	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ	% BHP	KTAS	Best Pwr	Econ
2700	18	65	149	17	13	63	148	16	13	61	147	16	12
	17	60	142	16	12	58	141	15	12	56	139	15	12
	16	56	135	15	11	53	132	14	11	51	127	13	11
2600	18	63	146	16	13	60	145	16	12	58	143	15	12
	17	58	139	15	12	56	137	15	12	54	133	14	11
	16	53	131	14	11	51	127	13	11	49	120	13	10
2500	18	60	143	16	12	58	141	15	12	56	139	15	12
	17	56	135	15	12	54	132	14	11	52	128	14	11
	16	51	126	13	11	49	121	13	10	48	109	12	10
2400	18	58	139	15	12	56	137	15	12	54	134	14	11
	17	53	131	14	11	51	128	14	11	50	121	13	10
	16	49	122	13	10	47	113	12	10	—	—	—	—
2300	18	56	135	15	12	54	133	14	11	52	128	14	11
	17	51	127	13	11	49	122	13	10	48	111	13	10
2200	18	53	131	14	11	52	128	14	11	50	121	13	10
	17	49	122	13	10	47	114	12	10	—	—	—	—
2100	18	51	127	13	11	49	122	13	10	48	111	13	10
2000	18	49	122	13	10	47	114	12	10	—	—	—	—

Figure 5-14. Cruise Performance (Sheet 6 of 6)

CRUISE SPEEDS

ASSOCIATED CONDITIONS:
CRUISE WEIGHT 3800 LBS
MIXTURE BEST POWER MIXTURE SETTING
TEMPERATURE STANDARD DAY

EXAMPLE:

PRESSURE ALTITUDE	8500 FT
POWER SETTING	65%
TRUE AIRSPEED	148 KNOTS

NOTE:
WHEN BEST POWER FUEL FLOW IS NOT USED, SPEED MAY BE AS MUCH AS 3 KTAS SLOWER THAN THOSE PRESENTED.

% POWER	FUEL FLOW (GPH)	
	BEST POWER	ECONOMY
75	20	15
65	17	13
55	14	11
45	12	9

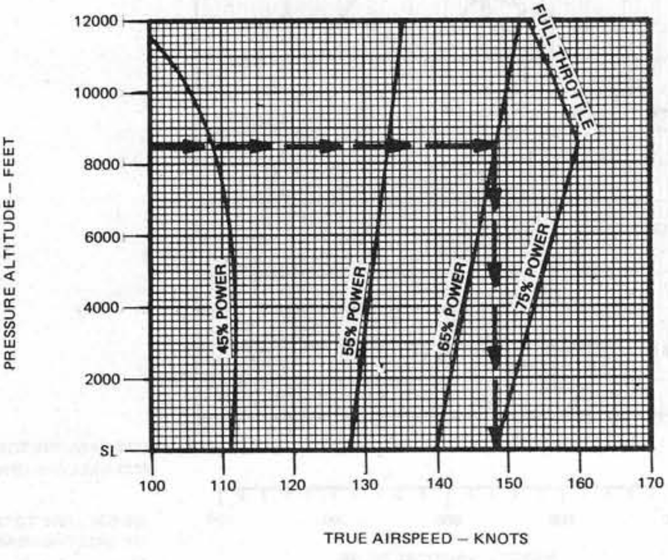


Figure 5-15. Cruise Speeds

RANGE PROFILE

ASSOCIATED CONDITIONS:

WEIGHT	3800 LBS BEFORE ENGINE START
FUEL DENSITY	6.0 LBS/GAL
MIXTURE	RECOMMENDED LEANING PROCEDURE

CRUISE CLIMB TO DESIRED ALTITUDE
STANDARD DAY

EXAMPLE:

PRESSURE ALTITUDE	8500 FEET
POWER SETTING	65% POWER
FUEL LOADING	118 GALLONS TOTAL
RANGE	895 NAUTICAL MILES

NOTE:

(1) RANGE COMPUTATIONS INCLUDE FUEL REQUIRED FOR START, TAXI, TAKEOFF, CRUISE CLIMB TO ALTITUDE, CRUISE, DESCENT, AND 45 MINUTES HOLDING FUEL AT 45% POWER

(2) A BEST POWER FUEL FLOW WAS USED TO CALCULATE FROM 75% TO 65% POWER

(3) AN ECONOMY CRUISE FUEL FLOW WAS USED TO CALCULATE RANGE BELOW 65% POWER

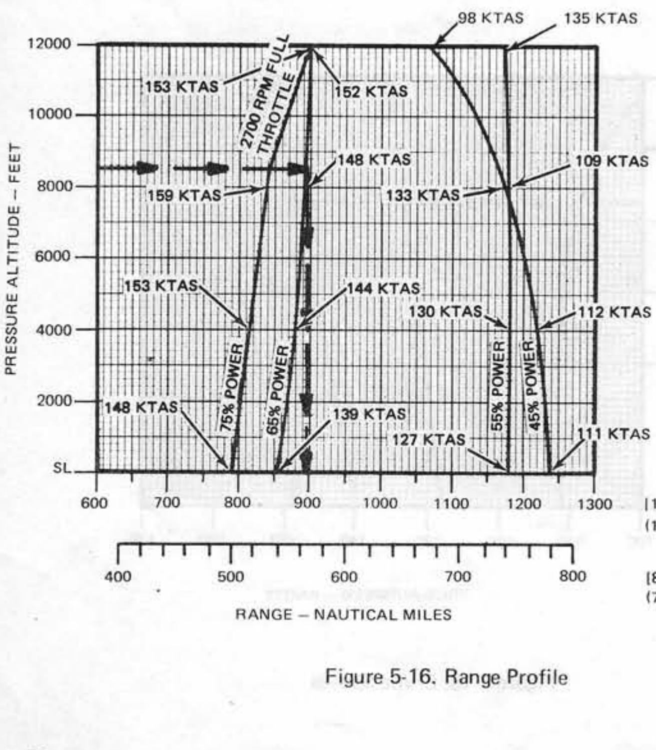


Figure 5-16. Range Profile

ENDURANCE PROFILE

ASSOCIATED CONDITIONS:

WEIGHT	3800 LBS BEFORE ENGINE START
FUEL DENSITY	6.0 LBS/GAL
MIXTURE	RECOMMENDED LEANING PROCEDURE

CRUISE CLIMB TO DESIRED ALTITUDE
STANDARD DAY

EXAMPLE:

PRESSURE ALTITUDE	8500 FEET
POWER SETTING	65% POWER
FUEL LOADING	118 GALLONS TOTAL
ENDURANCE	6.05 HOURS

NOTE:

(1) ENDURANCE COMPUTATIONS INCLUDE FUEL REQUIRED FOR START, TAXI, TAKEOFF, CRUISE CLIMB TO ALTITUDE, CRUISE, DESCENT AND 45 MINUTES HOLDING FUEL AT 45% POWER

(2) A BEST POWER FUEL FLOW WAS USED TO CALCULATE ENDURANCE FROM 75% TO 65% POWER.

(3) AN ECONOMY CRUISE FUEL FLOW WAS USED TO CALCULATE ENDURANCE BELOW 65% POWER.

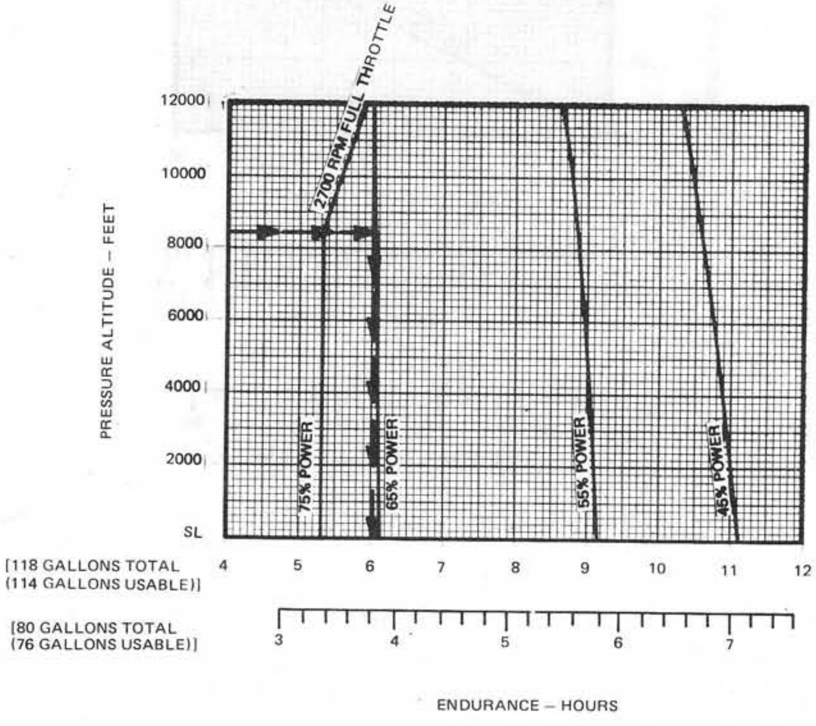


Figure 5-17. Endurance Profile

TIME, FUEL AND DISTANCE TO DESCEND
DESCENT SPEED
150 KNOTS

ASSOCIATED CONDITIONS:

POWER	AS REQUIRED TO MAINTAIN 500 FT/MIN RATE OF DESCENT
LANDING GEAR	UP
FLAPS	0°

EXAMPLE:

INITIAL ALTITUDE	8500 FT
FINAL ALTITUDE	5000 FT
TIME TO DESCEND	17 – 10 = 7 MIN
FUEL TO DESCEND	5.2 – 3 = 2.2 GAL
DISTANCE TO DESCEND	46 – 26 = 20 NM

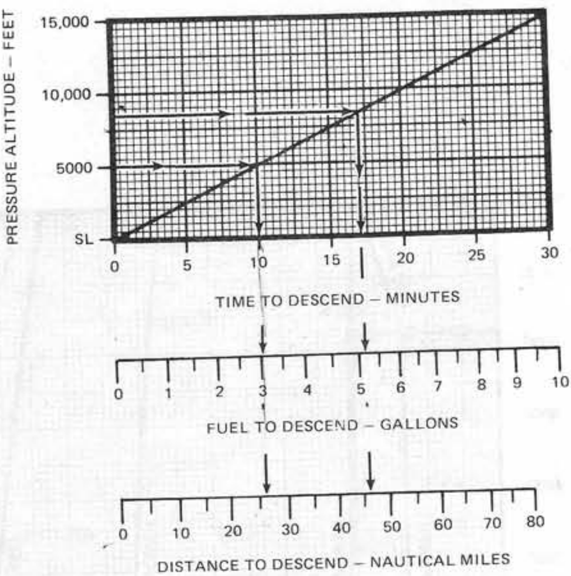


Figure 5-18. Time, Fuel and Distance to Descend

HOLDING TIME

ASSOCIATED CONDITIONS:
POWER 45% POWER *
FUEL DENSITY 6.0 LBS/GAL
MIXTURE RECOMMENDED LEANING PROCEDURE

EXAMPLE:

FUEL AVAILABLE FOR HOLDING	420 LBS (70 GAL)
HOLDING TIME	7 HOURS

*45% POWER AT 2000 RPM CAN BE MAINTAINED WITH THE FOLLOWING MANIFOLD PRESSURE

PRESSURE ALTITUDE	MANIFOLD PRESSURE
SL	21
4000 FT	20
8000 FT	19
12,000 FT	18

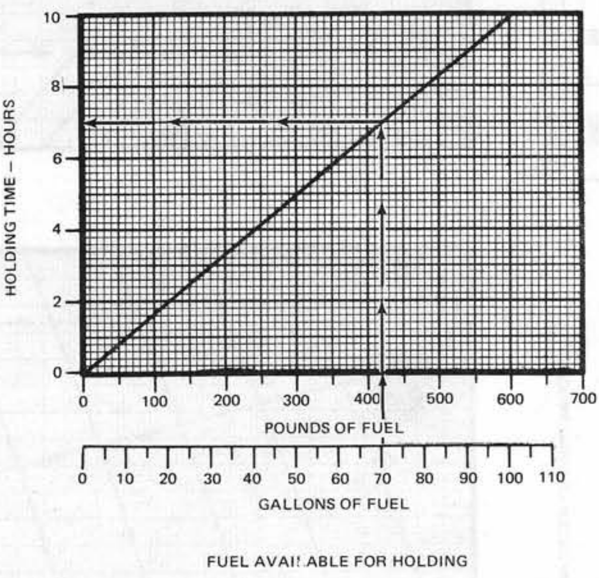


Figure 5-19. Holding Time

CLIMB – BALKED LANDING

ASSOCIATED CONDITIONS

POWER	FULL THROTTLE AT 2700 RPM
FLAPS	30°
LANDING GEAR	DOWN
COWL FLAPS	OPEN
MIXTURE	RECOMMENDED LEANING PROCEDURE

WEIGHT POUNDS	CLIMB SPEED KIAS
3800	80
3200	74
2800	69

EXAMPLE:

OAT	27°C (81°F)
PRESSURE ALTITUDE	3505 FT
WEIGHT	3448 LBS
RATE-OF-CLIMB	495 FPM

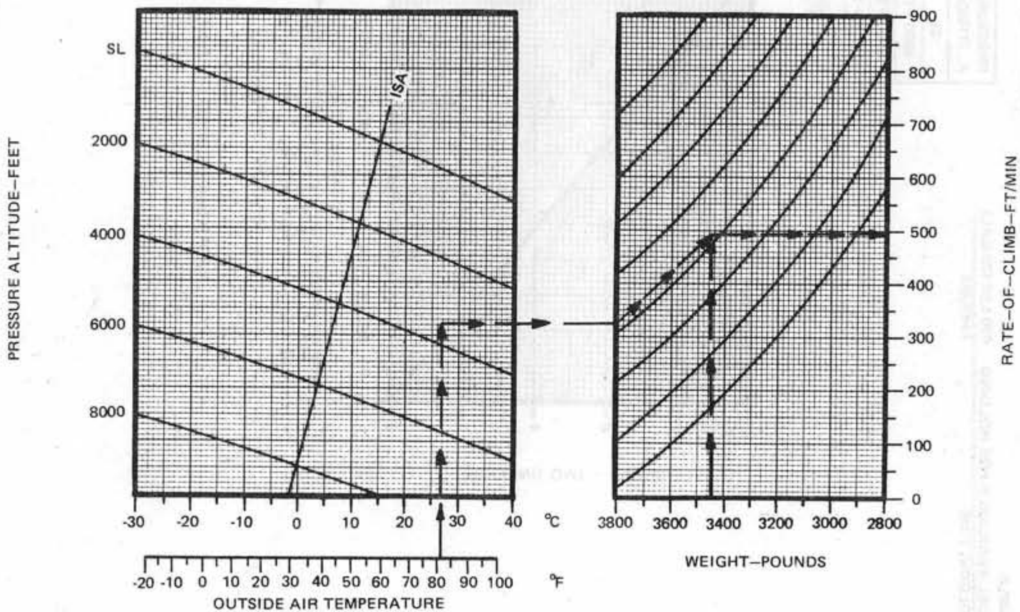


Figure 5-20. Climb-Balked Landing

LANDING DISTANCE (NORMAL LANDING)

ASSOCIATED CONDITIONS:

FLAPS FULL
POWER OFF
BRAKING MAXIMUM
RUNWAY HARD SURFACE LEVEL AND DRY
ZERO WIND

NOTES: 1. DECREASE DISTANCE 4% FOR EACH 5 KNOTS HEADWIND.

2. FOR OPERATIONS WITH TAILWINDS UP TO 10 KNOTS, INCREASE DISTANCES BY 9% FOR EACH 2.5 KNOTS.

Weight Lbs	Speed at 50 Ft IAS	Press Alt Feet	0°C (32°F) Ground Roll Feet	0°C (32°F) Total to Clear 50 Ft Obs Feet	10°C (50°F) Ground Roll Feet	10°C (50°F) Total to Clear 50 Ft Obs Feet	20°C (68°F) Ground Roll Feet	20°C (68°F) Total to Clear 50 Ft Obs Feet	30°C (86°F) Ground Roll Feet	30°C (86°F) Total to Clear 50 Ft Obs Feet	40°C (104°F) Ground Roll Feet	40°C (104°F) Total to Clear 50 Ft Obs Feet
3800	77	SL	681	1275	700	1311	720	1349	739	1386	759	1425
		2000	721	1351	742	1392	763	1433	785	1474	807	1516
		4000	765	1437	789	1481	812	1527	836	1573	860	1619
		6000	815	1532	841	1582	867	1632	893	1682	920	1733
		8000	871	1639	900	1694	928	1748	957	1804	987	1859
3400	73	SL	627	1169	643	1201	660	1233	677	1266	694	1300
		2000	661	1235	679	1271	698	1307	717	1344	736	1381
		4000	700	1310	720	1350	741	1390	762	1430	783	1471
		6000	744	1394	766	1438	789	1482	812	1526	836	1571
		8000	793	1489	818	1537	843	1585	869	1634	894	1683
3000	68	SL	572	1063	586	1090	600	1118	615	1146	630	1175
		2000	601	1120	617	1150	633	1181	649	1213	666	1245
		4000	634	1184	652	1218	670	1252	688	1287	706	1323
		6000	672	1257	691	1294	711	1332	731	1371	752	1410
		8000	714	1338	736	1380	758	1422	780	1464	803	1507

EXAMPLE:

OAT	27°C (81°F)
PRESSURE ALTITUDE	3505 FT.
WEIGHT	3448 LBS.
HEADWIND COMPONENT	19.7 KTS.
GROUND ROLL	634 FT.
TOTAL OVER 50FT OBSTACLE	1190 FT.
APPROACH SPEED	74 KIAS

Figure 5-21. Landing Distance (Normal Landing)

SECTION 6
WEIGHT AND BALANCE/EQUIPMENT LIST

TABLE OF CONTENTS

Page

INTRODUCTION

This section contains procedures for determining the basic empty weight and moment of the GA-7/Cougar airplane. Sample forms and the corresponding procedure for their use are provided to enable a rapid calculation of the weight and moment for various operations. An equipment list, provided at the end of this section, provides weights and arms of all equipment available for the GA-7/Cougar airplane.

AIRPLANE WEIGHING PROCEDURES

NOTE

The airplane may be weighed using electronic scales or platform scales.

PREPARATION

1. Inflate tires to recommended operating pressure.
2. Drain all fuel from tanks and fuel system.
3. Ensure oil and operating fluids are filled to capacity.
4. Adjust seats to normal operating (mid range) position.
5. Raise wing flaps to full up position.
6. Place all controls in their neutral position.
7. Ensure that all objects, not part of the airplane or its accessories, are removed from the airplane.
8. Clean the airplane inside and out.
9. Close all doors and windows.

LEVELING THE AIRPLANE

Airplane on Wheels – Using Platform Scales

1. Place platform scales under each wheel.
2. Place two foot carpenter levels or equivalent against bottom of fuselage as shown in Figure 6-1.
3. Level airplane laterally and longitudinally by deflating tire(s) as required.
4. Remove levels from beneath fuselage.

Airplane on Jack Pads – Using Electronic Scales

1. Check the calibration of the scale.
2. Install the pressure pads (electronic load cells) between the jacks and jack pads on the airplane.

Jack Pad Description	Jack Pad Location (Arm)
Nose	F.S. 49.8
Right and Left Main Gear	F.S. 125.10

3. Place two foot carpenter levels or equivalent against bottom of fuselage as shown in Figure 6-1.

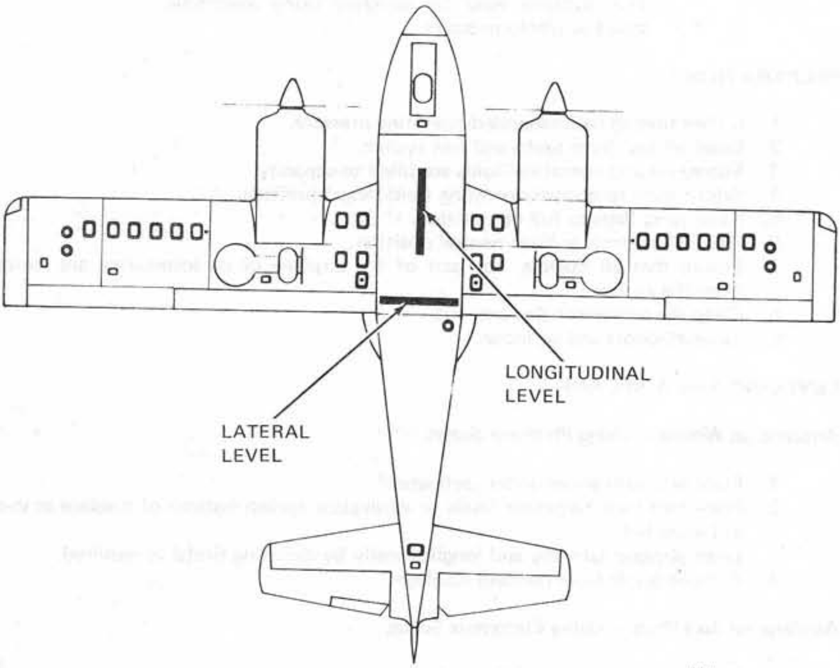


Figure 6-1. Leveling Airplane (Bottom of Fuselage)

4. Level airplane laterally and longitudinally by adjusting jack(s) as required.
5. Remove levels from beneath fuselage.

MEASURING ARM

Airplane on Wheels

1. Obtain measurement A (Figure 6-2) as follows:
   (a) With the airplane level, stretch a string laterally across the airplane from the axle center of one main landing gear to the axle center of the other main landing gear.
   (b) Connect a plumb bob such that it hangs from the forward face of bulkhead (F.S. 50) to the floor.
   (c) Using a tape measure, measure the distance along the centerline of the airplane from the plumb bob to the string stretched between the main landing gears.
   (d) Record measurement A in the Airplane Weighing Form (Figure 6-2).
2. Obtain measurement B (Figure 6-2) as follows:
   (a) Ensure that the nose wheel is set straight along the centerline of the airplane.
   (b) Using a tape measure, measure the distance from the center of nose gear axle to the string stretched between the main landing gears.
   (c) Record measurement B in the Airplane Weighing Form (Figure 6-2).

Airplane Weight on Jack Pads

1. Measurements A and B not needed.
2. See "Sample Airplane Weighing."

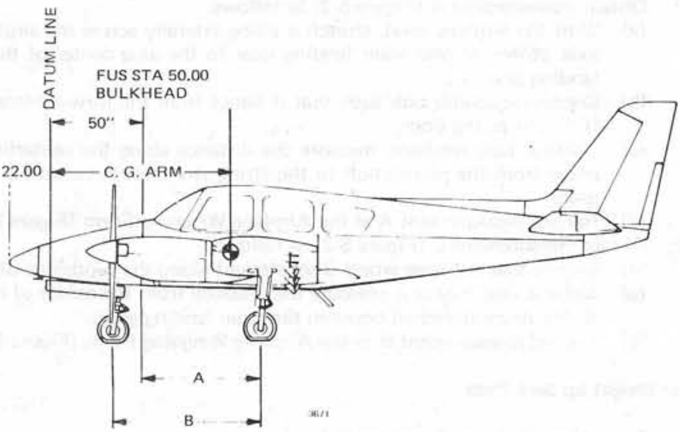
WEIGHING THE AIRPLANE

1. With airplane level and brakes released, record the weight shown on each scale in Figure 6-2.
2. Determine tare weight (chocks, etc.), if any, deduct from the scale readings and record the results in the Airplane Weighing Form (Figure 6-2).

COMPUTING CENTER OF GRAVITY AND AIRPLANE BASIC EMPTY WEIGHT

1. Adding the weights recorded in Figure 6-2, calculate the total Net Weight.
2. Using the weights and measurements recorded in Figure 6-2, calculate the C.G. Arm according to the formula in Figure 6-2.
3. Enter the total Net Weight (W) and C.G. Arm obtained in Steps 1 and 2 in the Airplane Basic Empty Weight Form (Figure 6-3).
4. Obtain Moment by multiplying Weight times C.G. Arm and dividing by 1000. Enter Moment in Moment column (Figure 6-3).
5. Add the entries in the Weight column (Figure 6-3) to obtain the Airplane Basic Empty Weight.
6. Add the entries in the Moment/1000 Lbs. In. column (Figure 6-3) to obtain the Airplane Basic Empty Weight Moment.

AIRPLANE WEIGHING FORM



MEASUREMENT "A" ______________

MEASUREMENT "B" ______________

Scale Position	Scale Reading	Tare	Symbol	Net Weight (Scale Reading – Tare)
Left Wheel			L	
Right Wheel			R	
Nose Wheel			N	
TOTAL NET WEIGHT (L + R + N)			W	

Calculate C. G. Arm of Airplane as weighed:

Airplane on Wheels

$$\text{C.G. Arm} = 50 + \frac{AW - BN}{W}$$

Airplane on Jack Pads

$$\text{C.G. Arm} = 125.1 - \frac{(75.3)(N)}{W}$$

Figure 6-2

AIRPLANE BASIC EMPTY WEIGHT FORM			
Item	Weight	C.G. Arm	Moment/1000 Lbs. In.
Total Net Weight (W) (From Fig. 6-2)			
Unusable Fuel 4 Gal. at 6 Lb./Gal.	24.00	112.00	2.688
Airplane Basic Empty Weight			

Figure 6-3.

WEIGHT AND BALANCE

The following information will enable you to fly your GA-7/Cougar within the prescribed weight and center of gravity limitations. To calculate the Weight and balance for your airplane, use the Sample Loading Problem (Figure 6-4), Loading Graph (Figure 6-5), and Center of Gravity Envelope (Figure 6-6) as follows:

1. Record the Basic Empty Weight and Moment, as calculated in Figure 6-3 or from the Weight and Balance Data Sheet, on the Sample Loading Problem Chart (Figure 6-4).
2. Add all additional weights and their corresponding moments, obtained from the Loading Graph, (Figure 6-5) of items to be carried on the flight. Total the weights and moments.
3. Plot the total weight and moment on the Center of Gravity Envelope chart (Figure 6-6). If the intersection point is within the envelope, the loading is acceptable.
4. Figure 6-7 shows seating and cargo arrangement and center of gravity locations.

SAMPLE LOADING PROBLEMS

	SAMPLE AIRPLANE			YOUR AIRPLANE		
	Weight (Lbs)	Arm (Ins)	Moment (Lb In/1000)	Weight (Lbs)	Arm (Ins)	Moment (Lb In/1000)
Airplane Basic Empty Weight (As calculated in Fig. 6-3 or from Weight and Balance Data Sheet)	2619.00	94.54	247.602			
Fuel (in excess of unusable) Max. Usable 114 Gallons	456.00	112.00	51.072			
Pilot and Copilot	340.00	91.00	30.940			
Rear Seat Passengers	340.00	128.00	43.520			
Baggage (in aft baggage compartment) *Max. Cap. = 175 lbs.	45.00	160.00	7.200			
Baggage (in fwd. baggage compartment) **Max. Cap. = 75 lbs.		26.00				
Cargo Area, Max. Cap. = 340 lbs.		125.40				
TOTAL WEIGHT	3800.00	100.09	380.334***			

Figure 6-4

* Maximum allowable 175 lbs. if C.G. is within center of gravity envelope.

** Maximum allowable 75 lbs. if C.G. is within center of gravity envelope.

*** Locate this point (3800/380.334) on the center of gravity envelope, if the point falls within the envelope, the above loading meets all balance requirements.

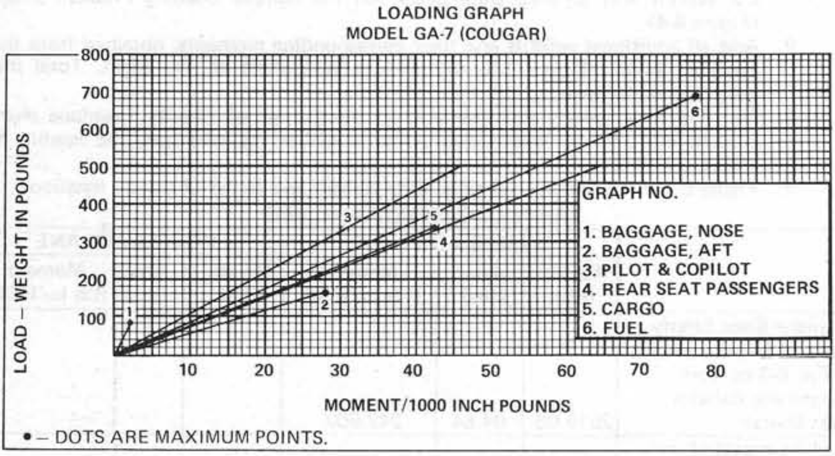


Figure 6-5. Loading Graph

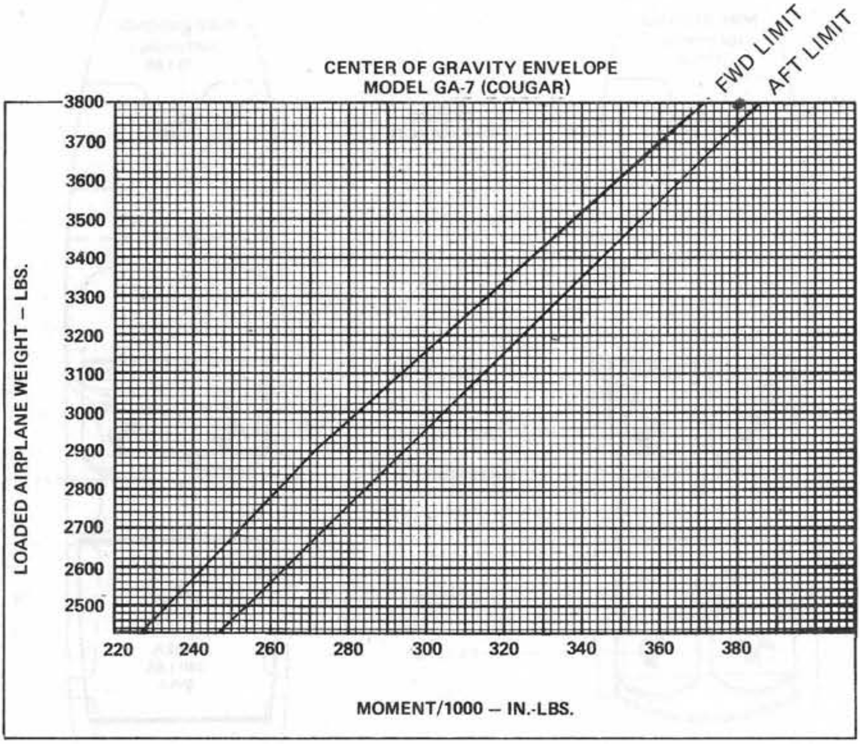


Figure 6-6. Center of Gravity Envelope

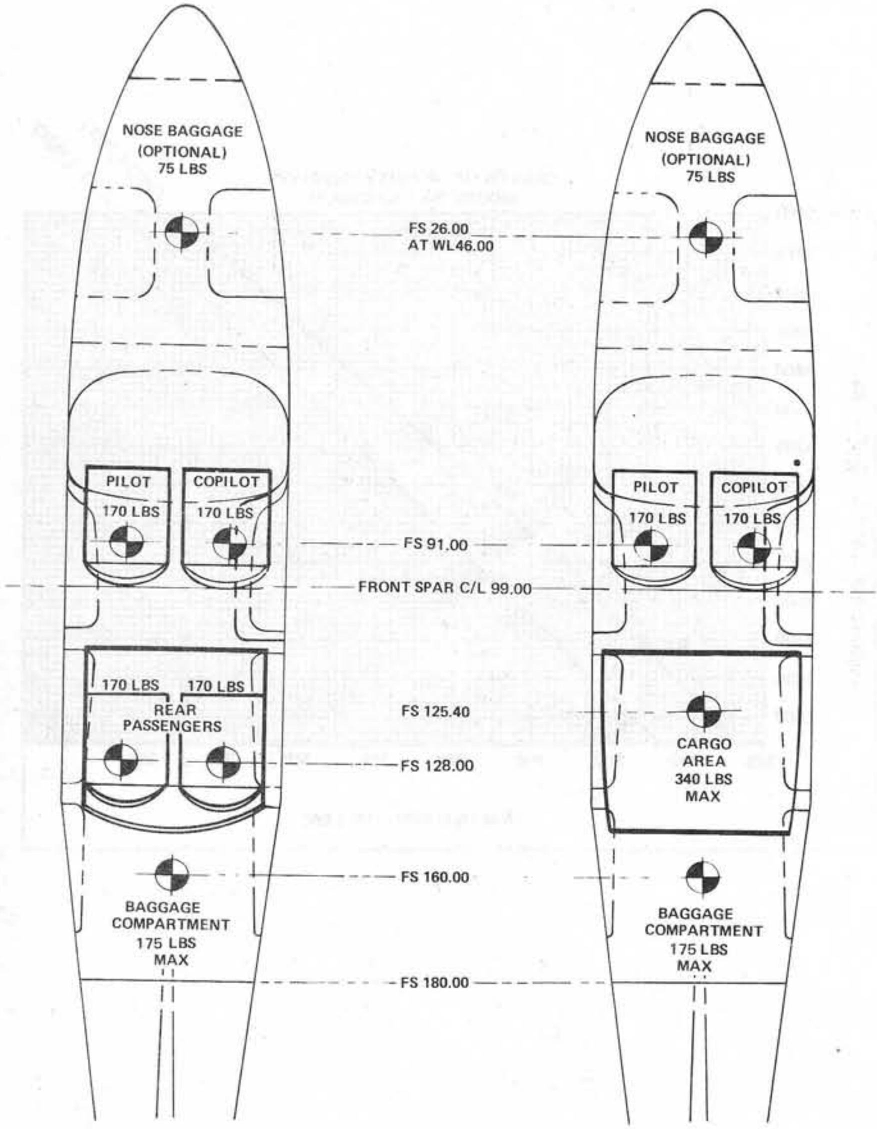


Figure 6-7. Seating – Cargo Arrangement and Center of Gravity Locations

DETERMINING USEFUL LOAD

Gross Weight – Basic Empty Weight = Useful Load
Example: 3800 – 2619 = 1181

EQUIPMENT LIST

The following equipment list contains a list of all equipment available from the manufacturer for the GA-7/Cougar Airplane. A separate equipment list of items installed in your specific airplane is provided with your airplane papers.

NOTE

If additional equipment is to be installed, it must be done in accordance with the reference drawing, service kit instructions, or a separate FAA approval.

Columns showing weight (in pounds) and arm (in inches) provide the weight and center of gravity location for the equipment.

NOTE

Unless otherwise indicated, true values (not net change values) for the weight and arm are shown.

GRUMMAN AMERICAN GA-7/COUGAR EQUIPMENT LIST	
NOTES	
1	Suffix letters to item numbers: –R = required items of equipment for FAA certification –S = standard equipment items –O = optional equipment items replacing required or standard items –A = optional equipment items which are in addition to required or standard items
2	Status of equipment: X = Installed in the airplane at the factory N = Not installed on, or stowed in, the airplane at the factory L = Loose item of equipment which is stowed in the airplane when it left the factory but which is not included in the Optional Equipment Weight and Moment. (Installed ARM is listed.)
3	Unless otherwise indicated, actual value (not net change values) for weight and arm are shown. See Weight and Balance Data sheet for datum location.
4	A separate FAA approval must be obtained if the following items are not installed per applicable Grumman American Aviation Corporation drawings or accessory kit instructions.

ITEM NO ▷1	▷2	DESCRIPTION	STATUS	WT. LBS	ARM INS
001-R		Powerplant Installation includes a 160 HP Lycoming 0-320-D1D Engine, (2) fuel pump, vacuum pump drives, primer system, oil thermostatic bypass valve, carb. air box, filter, carb. heat system (Note: Alternator Excluded)		285.97ea	57.76
002-R		Propeller Installation (Hartzell) (2)		62.00ea	35.00
003-R		Propeller Governor Installation (2)		8.59ea	85.50
004-A		Propeller Defeathering Accumulator (2)		4.35ea	86.25
005-A		Propeller Defeathering Accumulator Installation (2) (includes accumulator)		6.35ea	82.63
006-R		Muffler Assembly (2)		15.25ea	56.48
007-R		Oil Cooler & Lines (2)		2.00ea	66.50
008-R		Propeller Spinner (2)		4.97ea	32.00
009-R		Quick Drain Oil Valve (Exchange) (2)		.20ea	62.50
010-R		Auxiliary Fuel Pump		1.60	160.50
011-R		Fuel Selector Valve		.87	107.75
012-O		Fuel Tank Quick Drains (Exchange)		Negligible	
013-R		Airspeed Indicator		.50	66.25
014-A		True Airspeed Indicator		.50	66.25
015-R		Altimeter — (Sensitive in Ft. & Inches) (Exchange)		.88	66.25
016-R		Magnetic Compass		.67	72.00
017-R		Manifold Pressure Gauge		1.00	68.00
018-R		Dual Tachometer		1.65	67.50
019-A		Gyro Pressure Air Stysem		12.55	57.40
020-A		Outside Air Temperature Indicator		.40	68.00
021-A		Vertical Speed Indicator		.50	68.30
024-A		Instrument Cluster (2) (Oil Pressure, Oil Temp)		1.53ea	69.50
025-S		Flap Position Indicator		.14	69.50
026-A		Hour Meter (Hobbs or Datcon)		.40	69.30
027-A		Clock, Electric		.35	69.30
028-R		Pitot System (Not Heated)		.90	2.00
029-O		Pitot System (Heated) (Exchange)		.90	2.00
030-R		Stall Warning Audible (2)		.66ea	87.75
031-A		NARCO ELT 10 Emergency Locator Beacon		3.62	272.17
032-A		Fire Extinguisher		4.60	82.62
033-S		Inertia Reel & Belt, Front (2)		1.10ea	122.00
034-R		Shoulder Harness, Rear (2)		.50ea	139.00
035-R		Seat Belts, Lap Front (2)		.80ea	97.50
036-R		Seat Belts, Lap Rear (2)		.80ea	141.00
037-A		Baggage Restraint System (Nose)		1.50	28.00
		(Aft)		2.00	161.00
038-A		Head Rests, Front(2)		.86ea	101.50

ITEM NO 1	2	DESCRIPTION	STATUS	WT. LBS	ARM INS
039-A		Head Rests, Rear (2)		.86ea	145.00
040-R		Tie Down Rings, Wing (2)		.10ea	99.00
		Tail (1)		.10	283.00
041-A		Tow Bar		2.68	160.00
042-S		Cabin Step		3.10	149.82
043-R		Control Lock		.08	71.00
044-S		Ash Trays (4)		.39ea	84.00
					122.00
045-S		Instrument Panel Glareshield		1.93	65.00
046-A		Sunvisors (2)		.29ea	63.30
047-R		Seats, Front (2)		14.80	94.00
048-S		Seat, Rear (1)		27.61	134.00
049-A		Nose Baggage Compartment (Optional) (Includes baggage Restraint)		9.70	28.00
050-R		Main Wheel Assembly (2)		12.00ea	117.00
051-R		Nose Wheel Assembly (1)		11.96	37.00
052-R		Brakes, Toe Operated		3.02	57.50
053-R		Parking Brake		.47	57.50
054-R		Battery Assembly (12V)		23.30	29.10
055-R		Alternators (2) 14V, 60A with Mounting Brackets (2)		13.00ea	46.00
056-R		Voltage Regulator (2)		.85ea	29.10
057-R		Over Voltage Protection Relay (2)		.26ea	29.10
058-A		Auxiliary Power Receptacle		2.90	150.00
059-S		Electric Flap Drive		6.01	141.00
060-A		Cigarette Lighter		.25	69.30
061-R		Landing Light		1.67	34.49
062-R		Navigation Lights		1.97	194.74
063-A		Strobe Lights		7.15	232.71
064-R		Instrument Lights including Fwd. Dome Light		.40	102.50
065-R		Cabin Dome Light (Aft)		.15	132.00
066-A		NARCO Com 120/Nav 121		8.15	62.54
067-A		NARCO Com 120/Nav 122		8.65	62.18
068-A		NARCO Com 120/Nav 124		8.80	62.22
069-A		NARCO Com 120		4.82	61.54
070-A		Transponder AT-150		3.40	73.82
071-A		NARCO Nav 122		4.57	61.14
072-A		NARCO CP 135 Audio Switch Panel		1.85	67.78
073-A		NARCO ADF 141		6.65	95.44
074-A		NARCO DME 190		7.05	66.52
075-A		NARCO DME 190 with Remote Tuning		7.05	66.52
076-A		Collins VHF 251 Transmitter, Omni		4.40	62.32
077-A		Collins VIR 351/Ind 350/VHF 251		9.02	63.01
078-A		Collins VHF 251/VIR 351/Ind 351/GLS 350		11.65	61.24
079-A		Collins ADF 650		8.10	98.20

ITEM NO ▷1	▷2	DESCRIPTION	STATUS	WT. LBS	ARM INS
080-A		Collins TDR 950 with Antenna		2.40	68.18
081-A		Collins AMR 350 with Antenna		2.80	114.90
082-A		NARCO MKR-101R Marker Beacon, Installed		1.70	69.00
083-A		Century III Autopilot with Radio Coupler (Exchange)			
		Including Pressure Air System		32.35	84.94
		Excluding Pressure Air System		24.60	95.47
084-A		Century III Autopilot without Radio Coupler (Exchange) Including Pressure Air System		31.25	85.51
		Excluding Pressure Air System		23.50	96.67
085-A		Century IIB Autopilot with Radio Coupler (Exchange)			
		Including Pressure Air System		19.72	72.27
		Excluding Pressure Air System		11.97	85.65
086-A		Century IIB Autopilot without Radio Coupler (Exchange)			
		Including Pressure Air System		18.62	72.47
		Excluding Pressure Air System		10.87	87.33
087-A		King KX 175B/KI-204/KN-75		12.25	87.03
088-A		King KX 175B/KI-203 VOR-LOC Indicator		9.42	71.19
089-A		King KR 85/KI-225/KA 42B		9.90	93.20
090-A		King KMA 20 Audio Marker		3.95	100.58
091-A		King KT 76A Transponder		3.90	67.64
092-S		Paint Scheme		20.00	114.00
093-O		Tinted Windows (Exchange)		------	------
094-A		Dual Controls		7.50	60.80
095-O		Oil Filter (Exchange) (2)		2.50ea	72.00
096-A		Option-1 Avionics (Comm Antenna 7AV10707-2 VOR NAV Antenna 7AV10707-1 Microphone, Headset, Speaker etc.)		5.00	131.62
097-A		Option-2 Avionics (Sense Antenna, 7AV10707-6 ADF Filter)		1.85	143.46
098-A		Option-3 Avionics (Comm. Antenna, 7AV10707-8 Cable Assy. & Triplexer)		0.92	78.74
099-A		Exhaust Gas Temp		1.50	68.00
100-A		KN-75 Glide Slope Receiver (King)		2.90	160.52
101-A		KN 65A/KI-266 DME (King)		10.40	173.70
102-A		Glove Box		0.53	66.00
103-A		Encoding Altimeter (Exchange)			
		5035P2-P30 United Instruments		1.22	66.25
		5035P2-P25 United Instruments		1.22	66.25

ITEM NO 1	2	DESCRIPTION	STATUS	WT. LBS	ARM INS
104-A		Turn Coordinator Instl.			
		4245-8 General Design		2.50	68.00
		TC-100 Britain Industries		3.00	68.00
		4245-10 General Design		2.50	68.00
		TC-100-14V-8° Britain Industries		3.00	68.00
		ANS-50 (8°) Aerosonics Co.		2.50	68.00
105-A		Turn & Bank Indicator		2.10	68.00
106-A		Rear Seat Vents		.36ea	115.00
107-S		Storage Box Assembly		.80	85.00
108-A		Map Light		.25	79.40
109-A		Step Light (includes Wing Walk Light		.20	144.00
110-A		Ballast Weight		Variable	284.00
111-A		Collins DME 451		6.30	152.70
112-O		Altimeter 5934-1 United Instruments (Exchange)		.88	66.25
113-A		Rear Seat Console		4.30	128.50
114-A		Child Seat Installation		9.20	175.30
115-A		Control Wheel Microphone Button Installation		.07	68.00
116-A		Ballast Weight Attachment Hardware		.20	284.00
117-R		Pilot's Handbook (includes AFM)		1.10	85.00
118-A		KING KFC 200/FD Autopilot (Exchange)			
		Including Pressure Air System		59.18	99.25
		Excluding Pressure Air System		46.63	110.51
119-A		KING KFC 200/AP Autopilot (Exchange)			
		Including Pressure Air System		59.98	99.36
		Excluding Pressure Air System		46.43	110.70
120-0		Optional Corrosion Proofing		6-39	114.00

SECTION 7
AIRPLANE & SYSTEMS DESCRIPTIONS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

INTRODUCTION

This section provides description of the airplane and its systems. Some of the equipment described in this section is optional equipment and may not be installed on the airplane. Also, there may be optional equipment on the airplane not discussed in this section. Refer to Section 9, Supplements, for details of Optional Equipment.

AIRFRAME

The Model GA-7/Cougar is an all-metal, low-wing, twin-engine airplane. The airframe, consisting of fuselage, empennage, and wings, employs high-strength adhesive bonding of aluminum sheet metal to bulkheads and ribs. This type of structure provides a smooth aerodynamic surface and eliminates many sources of drag and stress concentrations. The lower cabin section of the fuselage is completely surrounded by aluminum honeycomb, which provides an exceptionally strong, lightweight passenger compartment for maximum safety.

The fuselage is a one piece bonded aluminum assembly using 1/2-inch thick aluminum honeycomb panels around the lower cabin area. The fuselage nose section structure is designed to accept the nose gear. A nose baggage compartment is optional. The forward section of fuselage, aft of the nose section, incorporates the controls installation and instrument panel. The cabin area contains a single pane windshield, six side windows, including an emergency escape window, entrance door and seats for pilot, copilot, and two passengers. A cabin entry step is attached to the right side of the fuselage for easy entry and exit from the airplane. A key operated baggage compartment access door is located on the right hand side of the fuselage. The lower fuselage structure houses the front and rear carry-through spars.

The empennage consists of a stabilizer, elevator, fin, and rudder. The stabilizer consists of reinforced rear spar, center ribs, forward spar, nose ribs, and bonded skins. The elevators consist of a front spar, aft spar, ribs, skins, balance weights, bracketry, and skin stiffeners. The right elevator contains the trim tab. The elevators are actuated through a bellcrank connected to the elevator horns.

The fin assembly consists of a forward spar, rear spar, ribs, and bonded skins. The fin is swept and is faired to the fuselage by a dorsal fin.

The rudder consists of a forward spar, rear spar, ribs, and skins. The rudder is hinged to the fin at three separate points. The rudder control system is a conventional rudder bar-rudder pedal, cable and bellcrank system. Movement of the rudder pedals is transmitted by push-rods, bellcranks, and cables, resulting in a corresponding displacement of the rudder from the neutral position. The rudder pedals are loaded to the neutral position by a spring which is cross-connected between arms on the rudder bars and bellcranks located forward of the rudder pedals. The spring maintains tension in the rudder cable system. Rudder travel is limited in either direction by adjustable stops located at the lower hinge point on the vertical fin assembly. The stops are contacted by the arms of the rudder bellcrank as the limits of travel are reached.

The wing is an all-metal, full cantilever, modified laminar flow, with integral fuel bays in each wing. The basic construction consists of main and rear "I" beam spars, ribs, and bonded wing skin outboard of the engine nacelles. The spars are fabricated of extruded tee section coupled with sheet metal shear webs with vertical stiffening. The inboard ends of the spars are attached to the carry-through spars by splice plates and high shear rivets. The fuel bay areas are located between the main and rear spars. Solid end ribs are used to close off the inboard and outboard ends of the fuel bays. The entire fuel bay is sealed with sealing compound to prevent fuel leaks. Each fuel bay is equipped with a quick drain plug located at the inboard end of the bay.

FLIGHT CONTROLS

The flight controls consist of the ailerons, elevators, rudders, and their respective trim systems. The control surfaces are constructed of spars, ribs, and bonded skins. The control surfaces are ball bearing mounted and operated through push-pull rods and conventional cable systems, terminating in bellcranks.

AILERON CONTROL SYSTEM (Figure 7-1)

The ailerons are driven through a chain and cable drive system. A series of cables and pulleys are routed from the control column through the center console and out into the wing to a bellcrank. The aileron is connected to the bellcrank with a pushrod, using standard rod ends. As a result of the gear ratio provided by the control column and bellcrank arrangement and the static balance on the aileron, the GA-7/Cougar is provided with an extremely smooth, light, and readily responsive aileron control system.

AILERON TRIM SYSTEM

The aileron trim control system provides a means to trim the airplane about the roll axis and compensate for variations in attitude caused by passenger and cargo loading. With the aileron trim control knob positioned so that the pointer is in the neutral (vertical) position, the airplane should be slightly heavy on the left wing when flying solo.

The aileron trim control knob is connected by a system of levers and pushrods to a bungee at the top of the control column (Figure 7-1). With the control knob in the neutral position, spring action in the bungee will return the ailerons to the neutral position each time pressure is released at the control wheel. As the aileron trim control knob is rotated from the neutral position, a corresponding amount of pre-loading is introduced into the bungee, resulting in each aileron being returned to a point slightly away from the neutral position.

ELEVATOR CONTROL SYSTEM (Figure 7-2)

Each elevator is basically a bonded structure composed of ribs, spars, skins, torque tube, and tip cap. The trailing edge of the right elevator contains a hinged trim tab. The elevator is operated by moving the control column forward or aft. As the control column is moved fore and aft, the displacement is transmitted by a pushrod to the elevator control bellcrank located forward of the rudder pedals. The elevator control bellcrank in turn operates the up and down elevator cables which transmit the control wheel displacement to the aft elevator bellcrank located in the aft fuselage. Two pushrods, connected to the aft elevator bellcrank, transmit the motion to a corresponding horn attached to each elevator torque tube. Counter balance for the elevator control system is provided by a bob weight and down spring located in the left side of the nose section, beneath the nose baggage compartment floor.

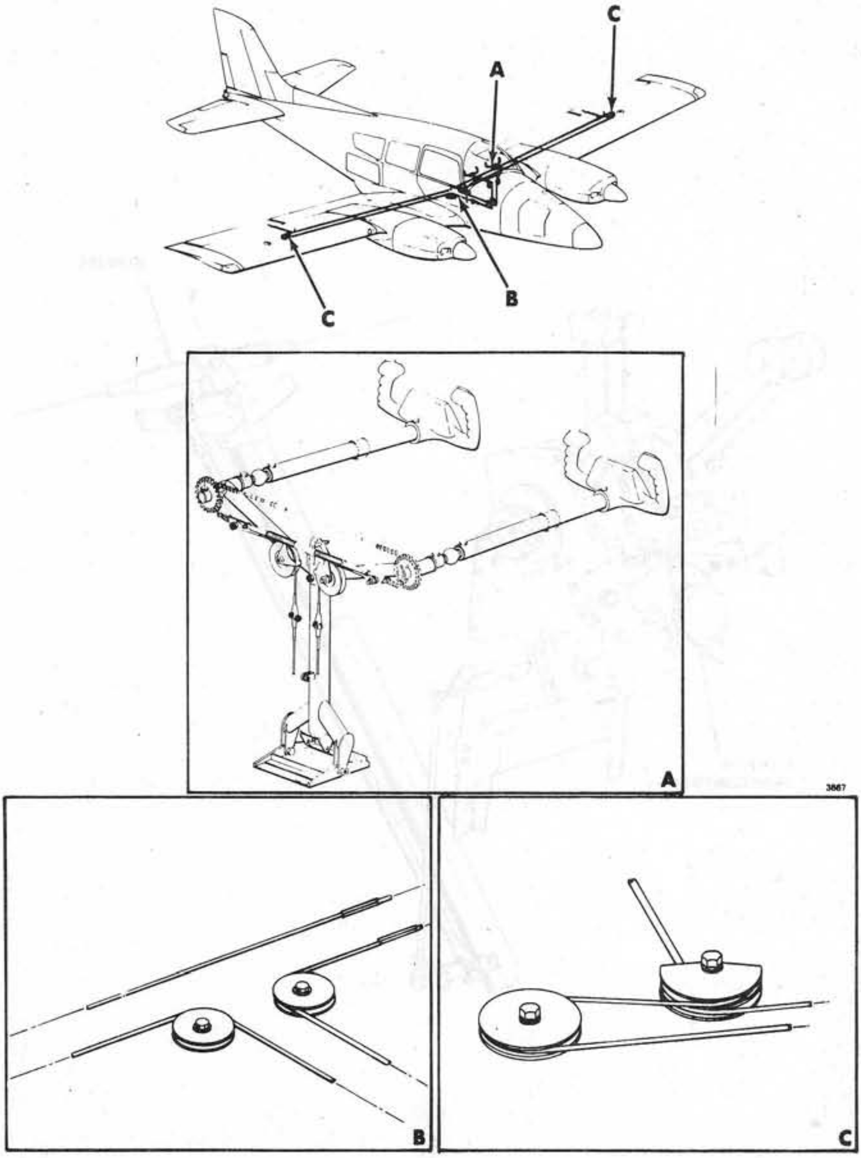


Figure 7-1. Aileron Control System (Sheet 1 of 2)

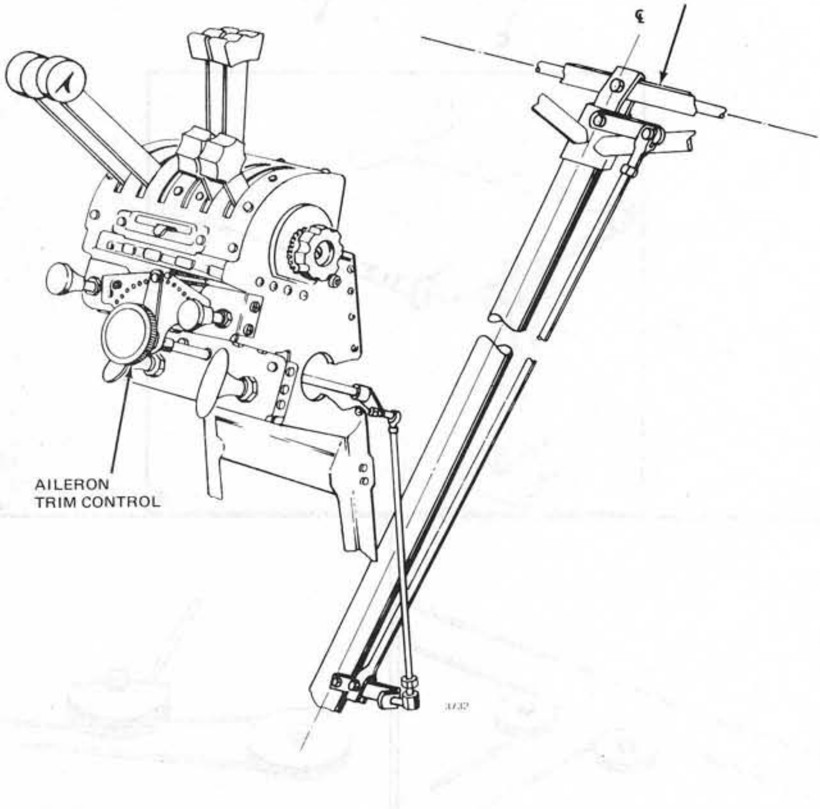


Figure 7-1. Aileron Control System (Sheet 2 of 2)

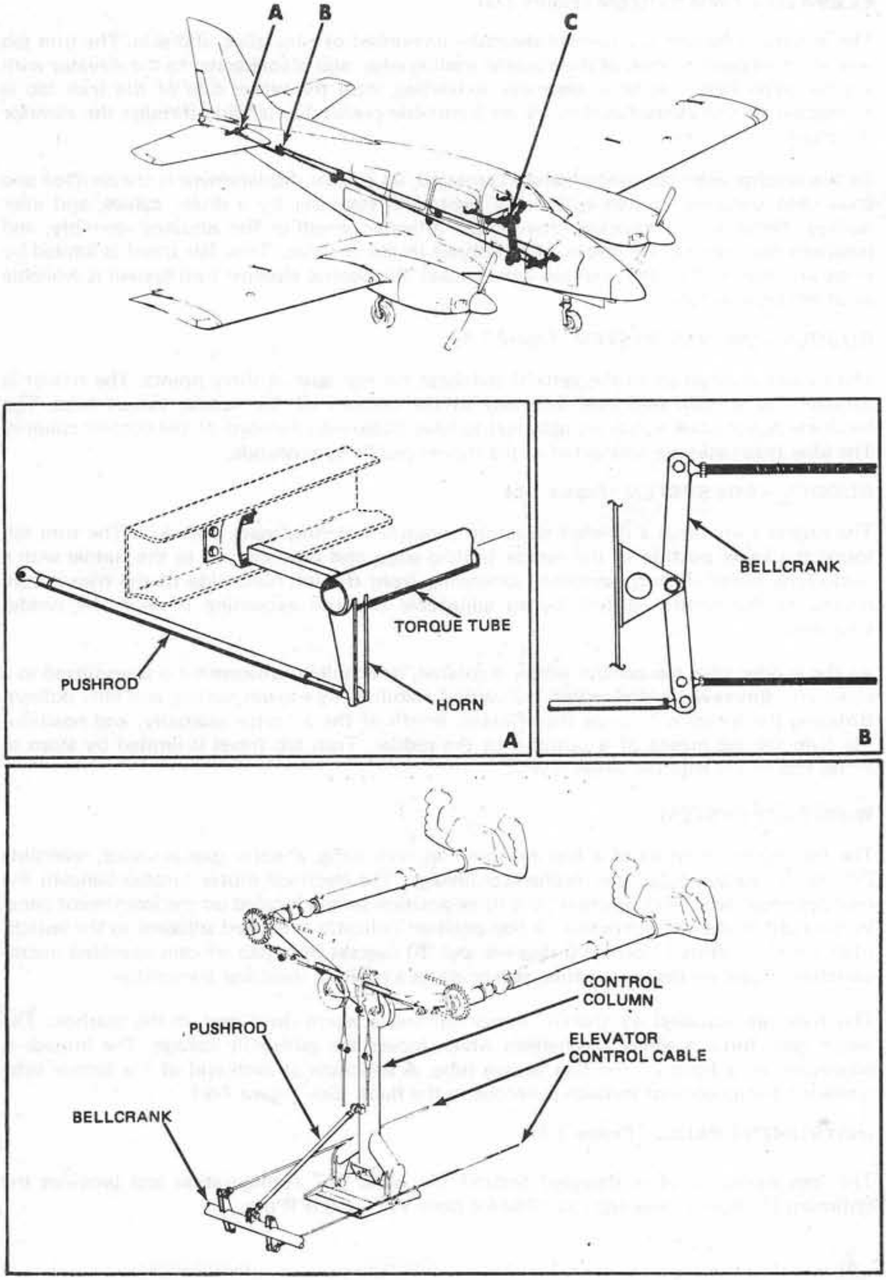


Figure 7-2. Elevator Control System

ELEVATOR TRIM SYSTEM (Figure 7-3)

The elevator trim tab is a bonded structure composed of ribs, spars, and skin. The trim tab forms the inboard portion of the elevator trailing edge, and is connected to the elevator with a piano-type hinge. A horn assembly extending from the under side of the trim tab is connected to the control system by an adjustable pushrod extending through the elevator structure.

As the elevator trim tab control wheel is rotated, its angular displacement is transmitted to a chain and sprocket located within the right-hand stabilizer by a drum, cables, and idler pulleys. Rotating the sprocket changes the effective length of the actuator assembly, and positions the trim tab by means of a pushrod in the elevator. Trim tab travel is limited by stops at either end of the trim tab wheel travel. An electric elevator trim system is available as an optional system.

RUDDER CONTROL SYSTEM (Figure 7-4)

The rudder is attached to the vertical stabilizer fin rear spar at three points. The rudder is actuated by a horn bellcrank attached to the bottom of the rudder torque tube. The bellcrank is actuated by cables attached to idler bellcranks forward of the control column. The idler bellcranks are connected to the rudder pedals by pushrods.

RUDDER TRIM SYSTEM (Figure 7-5)

The rudder trim tab is a bonded structure composed of ribs, spars, and skin. The trim tab forms the lower portion of the rudder trailing edge, and is connected to the rudder with a piano-type hinge. A horn assembly extending from the left-hand side of the trim is connected to the control system by an adjustable pushrod extending through the rudder structure.

As the rudder trim tab control wheel is rotated, its angular displacement is transmitted to a chain and sprocket located within the vertical stabilizer by a drum, cables, and idler pulleys. Rotating the sprocket changes the effective length of the actuator assembly, and positions the trim tab by means of a pushrod in the rudder. Trim tab travel is limited by stops at either end of the trim tab wheel travel.

WING FLAP SYSTEM

The flap system consists of a flap mounted on each wing, a worm gear actuator, reversible DC motor, torque tube, and mechanical linkage. The electrical motor located beneath the rear passenger seat, is controlled by a three-position switch located on the instrument panel to the right of the center console. A flap position indicator is located adjacent to the switch. Flap travel is limited beyond 0 degrees and 30 degrees by a pair of cam operated micro-switches. A cam on the torque tube also operates a position indicator transmitter.

The flaps are actuated by the DC motor turning a worm drive gear in the gearbox. The worm gear turns a screw mechanism which moves the push-pull linkage. The linkage is connected to a horn on the flap torque tube. A bellcrank at each end of the torque tube transmits the movement through pushrods to the flaps. (See Figure 7-6.)

INSTRUMENT PANEL (Figure 7-7)

The instrument panel is designed around the basic "T" configuration and provides the optimum in panel arrangement suitable for both VFR and IFR use.

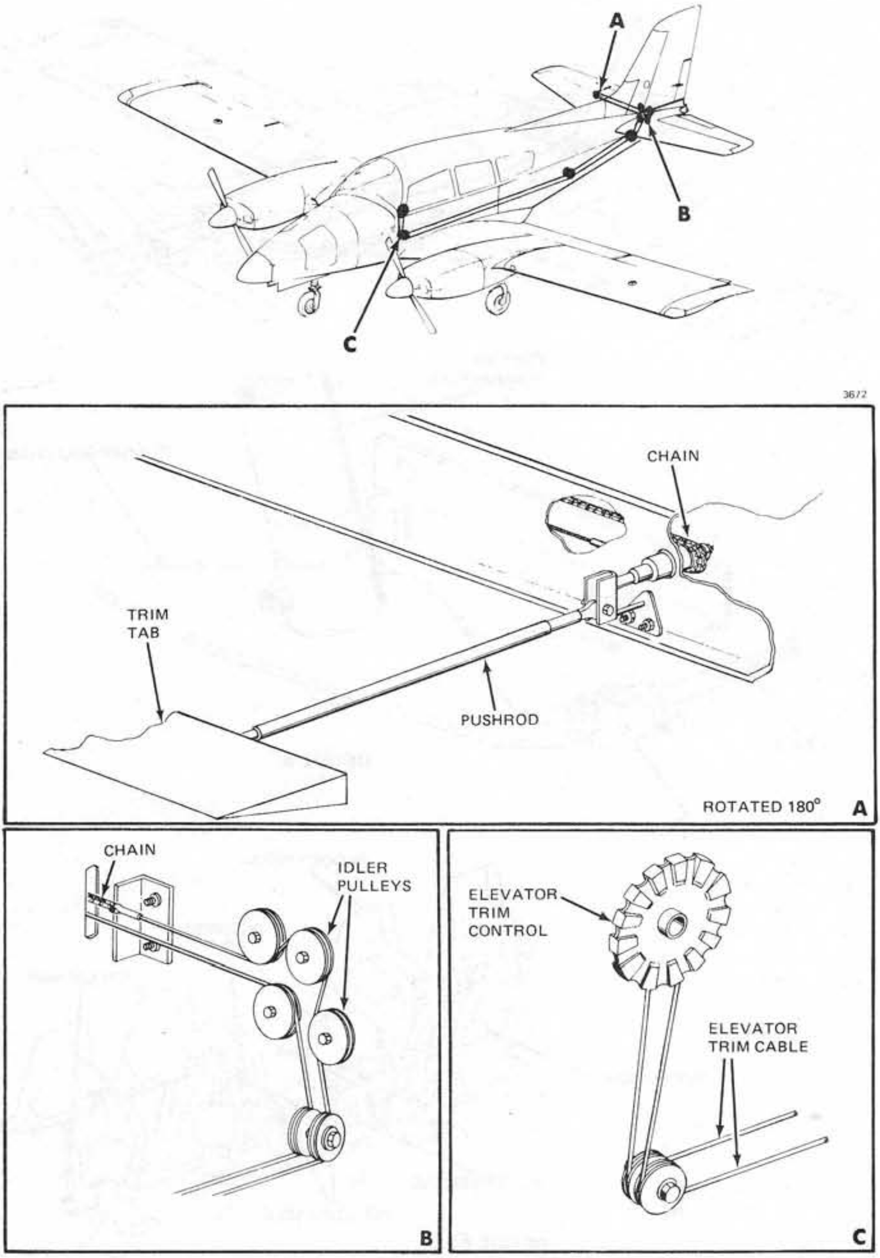


Figure 7-3. Elevator Trim System

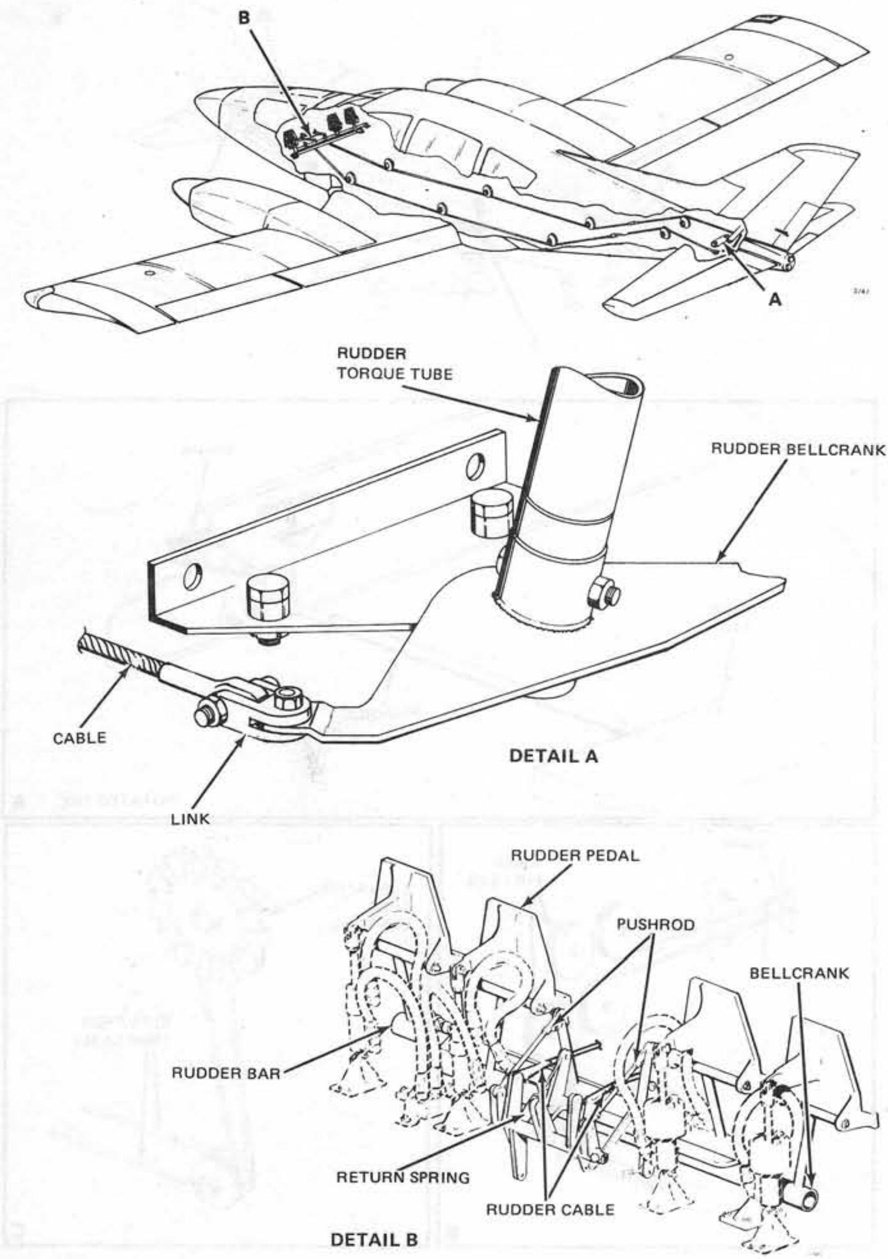
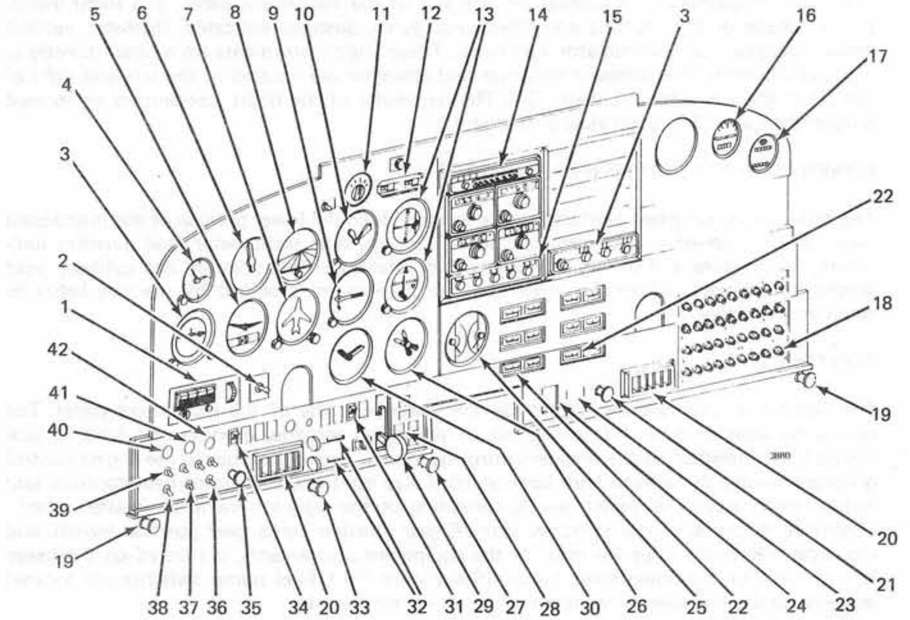


Figure 7-4. Rudder Control System



1. Autopilot Control (Opt.)
2. Electric Trim (Opt.)
3. ADF Indicator/ADF Receiver (Opt.)
4. Clock (Opt.)
5. Turn Coordinator (Opt.)
6. Airspeed Indicator
7. Directional Gyro (Opt.)
8. Attitude Gyro (Opt.)
9. Vertical Speed Indicator (Opt.)
10. Altimeter
11. Radio Coupler (Opt.)
12. DME Indicator (Opt.)
13. VOR Indicator (Opt.)
14. COM/NAV Equipment (Opt.)
15. Transponder (Opt.)
16. Pressure System Indicator (Opt.)
17. Hour Meter
18. Circuit Breakers
19. Fresh Air Vent Controls
20. Fresh Air Vents
21. Cigar Lighter (Opt.)
22. Instrument Cluster
23. Flap Control Switch
24. Flap Position Indicator
25. EGT Indicator (Opt.)
26. Dual Tachometer
27. Emergency Gear Extension Control
28. Landing Gear Lights
29. Landing Gear Control
30. Manifold Pressure Indicator
31. Navigation Lights Switch
32. Cabin Air Controls
33. Parking Brake Control
34. Pitot Heat Switch
35. Alternate Static Air Control
36. Right Alternator Switch
37. Master Switches
38. Left Alternator Switch
39. Magneto Switch
40. Left Starter Switch
41. Primer
42. Right Starter Switch

Figure 7-7. Instrument Panel

FLIGHT INSTRUMENTS (Figure 7-7)

The flight instruments are located on left side of the instrument panel. The flight instruments consist of the attitude and directional gyros, airspeed indicator, altimeter, vertical speed indicator, turn coordinator, and clock. These flight instruments are located directly in front of the pilot. The airspeed indicator and altimeter are located to the left and right of the gyros and complete the basic "T". The remainder of the flight instruments are located around the basic "T" in full view of the pilot.

POWER PLANT INSTRUMENTS (Figure 7-7)

The required power plant instruments are located along the lower portion of the instrument panel and consist of a dual manifold pressure gauge, dual tachometer, fuel quantity indicators, oil pressure and oil temperature gauges, ammeters, fuel pressure and cylinder head temperature gauges. Alternator inoperative indications are provided by warning lights located on the glareshield.

CONTROLS

The cabin heat controls are located on the lower left side of the instrument panel. The engine controls (Figure 7-8) consisting of propeller, throttle, mixture and friction lock controls are installed on the engine control quadrant. A pedestal, below the engine control quadrant houses the aileron trim control, cowl flap controls, carburetor heat controls, and rudder trim control. A switch panel, consisting of the magneto switches, master switch, alternator switches, starter switches, primer, gear position lights, gear position switch, and electrical rocker switches for most of the equipment components, is located on the lower left portion of the instrument panel. (See Figure 7-7.) Fuel pump switches are located adjacent to the fuel selector controls in the aft center console.

All radios are stacked to the right center of the instrument panel. The right hand side of the panel provides space to accommodate optional instruments.

GROUND CONTROL

Spring-loaded linkage from the nose gear to the rudder pedals allows for nosewheel steering. The nose gear spring and linkage provides steering through an arc of approximately 18° ± 3° each side of centerline and is capable of swiveling the nose gear through approximately 35 degrees with differential power and braking. Smooth turning is accomplished by allowing the airplane to roll while depressing the appropriate rudder pedal. The minimum wing tip turning radius, using braking action and differential power is 47 feet, 8 inches. (See Figure 7-9.)

NOTE

Minimum turning radius is accomplished with inboard wheel brake locked, full rudder, and differential power. As large a turning radius as practical should be used to avoid tire wear caused by excessive braking on inboard wheel.

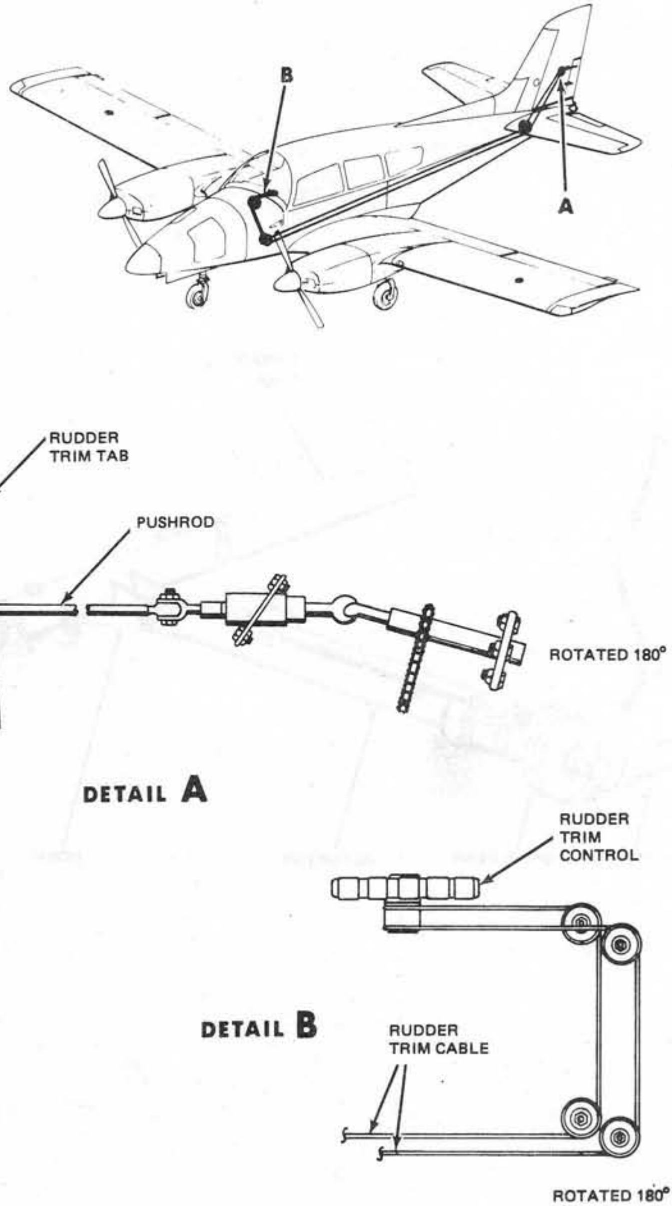


Figure 7-5. Rudder Trim System

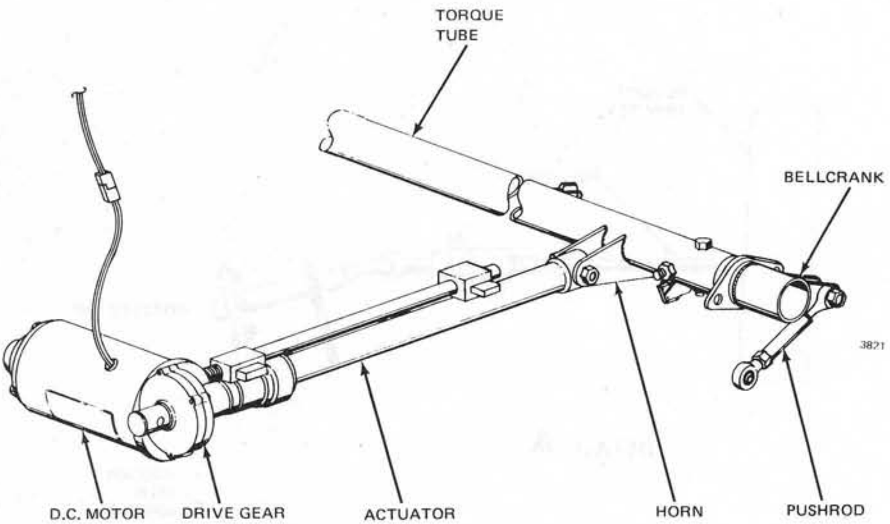


Figure 7-6. Flap Drive Mechanism

LANDING GEAR

The landing gear is a fully retractable tricycle landing gear. The landing gear system consists of the main gear located in each wing, and the nose gear located in the forward fuselage. The landing gear retraction system uses a hydraulic power supply that is self-contained with an electric motor driven pump, reservoir, relief valves, and flow valves. The hydraulic power pack is a 12-volt unit located in the left side of the nose section.

MAIN LANDING GEAR ASSEMBLY

The main landing gear assembly consists of a forged trunion, oleo cylinder, piston and fork assembly, torque links, brace, various seals and seal retainers, tire and wheel assembly and brake assembly. An air valve is located in the top of the assembly to fill the oleo. The brake assemblies are of the conventional design, using a dual piston, and mounts on bushings in a torque plate with two floating pins.

NOSE LANDING GEAR ASSEMBLY

The nose gear construction is similar to the main gear. The nose gear is steerable through a linkage and spring connection with the rudder pedals. Nose gear retraction is same as main gear. The nose gear is completely covered by doors when the gear is retracted.

LANDING GEAR POSITION LIGHTS, WARNING HORN, AND SAFETY SWITCH

There are three gear down and locked indicator lights (green), one for each gear, located on the instrument panel to the right of the gear selector switch. These green, gear down indicator lights are activated by three gear down lock piston switches and three overcenter down switches. As the landing gear extends to the DOWN position, the three gear down lock piston switches and three overcenter down switches are actuated, the hydraulic pump is shut off, and the three green lights are illuminated. The gears are held down by overcenter braces and locked by lock pins engaging the piston of each gear actuator. When the selector is placed in the UP position, hydraulic pressure causes the piston locks to withdraw from the gear actuating cylinders and the gear begins to retract. The three green gear down indicator lights immediately go out and the amber NOT SAFE light comes on. The amber NOT SAFE light, located above the three green lights on the instrument panel, indicates that the gear is in-transit or not down and locked. When all three landing gears have reached the full UP position, the amber NOT SAFE light goes out. The landing gear is held in the full UP position by hydraulic pressure and since no mechanical uplocks are provided, the landing gear will free-fall into the down and locked position in the event of hydraulic pressure loss. A landing gear warning horn is actuated any time power is reduced below approximately 13 in. Hg. of manifold pressure, and the landing gear is not down and locked. The gear warning horn will also actuate when the wing flaps are extended 15 degrees or more and the landing gear is not down and locked.

A safety switch (squat switch) is located on the left main landing gear. In the event the airplane is sitting on the ground and the landing gear control handle is placed in the UP position, the safety switch will prevent the hydraulic pump from actuating.

A shimmy dampener on the nose gear prevents nose gear shimmy. This unit cannot be serviced on the airplane. Refer to the Aircraft Maintenance Manual for servicing procedures.

LANDING GEAR EMERGENCY EXTENSION

The bypassing of hydraulic fluid is accomplished by use of the emergency gear extension valve, located in the nose section. The emergency gear extension control handle is located beneath the instrument panel. Landing gear emergency extension is accomplished by bypassing hydraulic fluid from the up side of the gear actuators, directly to the power pack reservoir. This releases the up pressure on the actuators, allowing the gears to free fall. Down springs aid in placing the gears in full down position. Piston locks mechanically engage to lock the gear down. Should the emergency gear extension handle be inadvertently left OUT, the landing gear will not retract.

FUEL SYSTEM

The GA-7/Cougar has an independent fuel system incorporated into each wing, permitting each engine to operate from its own fuel supply. However, the two fuel systems are interconnected by a crossfeed system, which permits fuel from one tank to be drawn by the engine on the opposite side. The fuel systems consist of two wing tanks, sump tanks, auxiliary fuel pumps (electric), engine driven fuel pumps, selector valves, primer solenoid valves, fuel drains, fuel vents, and associated plumbing. See Figure 7-10 for fuel system schematic.

FUEL TANKS

The fuel bay areas (tanks) are integral parts of the wing, located between the main and rear wing spars. Solid end ribs are used to close off inboard and outboard ends of the bay. Total volume (both tanks) is 118 gallons with 114 gallons useable in all flight attitudes. Each fuel bay is equipped with a quick drain valve.

VENT SYSTEM

The fuel bays are vented overboard through vent lines extending to the bottom of the outer wing. Vent lines from the sump tanks extend to each respective main tank to prevent the sump tanks from becoming airlocked.

SUMP TANKS

A sump tank is provided in each wing, inboard of the engine. Each sump tank is equipped with a quick drain valve.

AUXILIARY FUEL PUMPS

An electric auxiliary fuel pump is located in each wing, immediately forward of the sump tanks. An integral bypass and check valve permits fuel flow through the pump while the pump is inoperative, but prevents reverse flow of fuel. The electric auxiliary pumps are used as a source of fuel pressure in the event of an engine driven pump failure. The auxiliary pumps should be operative during takeoff and landing to provide backup for the engine driven pumps. Two auxiliary fuel pump switches, one for each tank, are located on the fuel selector panel. The switches have two positions, labeled ON and OFF.

LANDING GEAR

The landing gear is a fully retractable tricycle landing gear. The landing gear system consists of the main gear located in each wing, and the nose gear located in the forward fuselage. The landing gear retraction system uses a hydraulic power supply that is self-contained with an electric motor driven pump, reservoir, relief valves, and flow valves. The hydraulic power pack is a 12-volt unit located in the left side of the nose section.

MAIN LANDING GEAR ASSEMBLY

The main landing gear assembly consists of a forged trunion, oleo cylinder, piston and fork assembly, torque links, brace, various seals and seal retainers, tire and wheel assembly and brake assembly. An air valve is located in the top of the assembly to fill the oleo. The brake assemblies are of the conventional design, using a dual piston, and mounts on bushings in a torque plate with two floating pins.

NOSE LANDING GEAR ASSEMBLY

The nose gear construction is similar to the main gear. The nose gear is steerable through a linkage and spring connection with the rudder pedals. Nose gear retraction is same as main gear. The nose gear is completely covered by doors when the gear is retracted.

LANDING GEAR POSITION LIGHTS, WARNING HORN, AND SAFETY SWITCH

There are three gear down and locked indicator lights (green), one for each gear, located on the instrument panel to the right of the gear selector switch. These green, gear down indicator lights are activated by three gear down lock piston switches and three overcenter down switches. As the landing gear extends to the DOWN position, the three gear down lock piston switches and three overcenter down switches are actuated, the hydraulic pump is shut off, and the three green lights are illuminated. The gears are held down by overcenter braces and locked by lock pins engaging the piston of each gear actuator. When the selector is placed in the UP position, hydraulic pressure causes the piston locks to withdraw from the gear actuating cylinders and the gear begins to retract. The three green gear down indicator lights immediately go out and the amber NOT SAFE light comes on. The amber NOT SAFE light, located above the three green lights on the instrument panel, indicates that the gear is in-transit or not down and locked. When all three landing gears have reached the full UP position, the amber NOT SAFE light goes out. The landing gear is held in the full UP position by hydraulic pressure and since no mechanical uplocks are provided, the landing gear will free-fall into the down and locked position in the event of hydraulic pressure loss. A landing gear warning horn is actuated any time power is reduced below approximately 13 in. Hg. of manifold pressure, and the landing gear is not down and locked. The gear warning horn will also actuate when the wing flaps are extended 15 degrees or more and the landing gear is not down and locked.

A safety switch (squat switch) is located on the left main landing gear. In the event the airplane is sitting on the ground and the landing gear control handle is placed in the UP position, the safety switch will prevent the hydraulic pump from actuating.

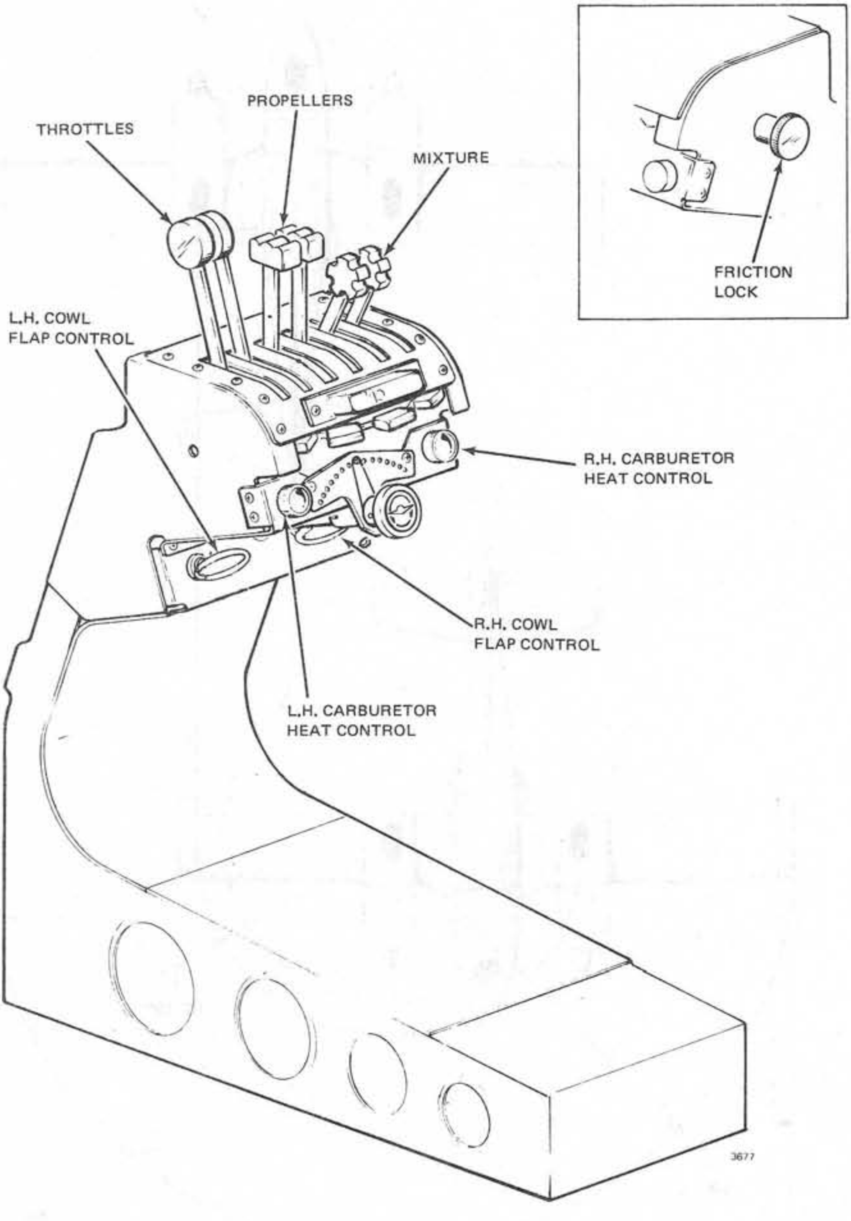


Figure 7-8. Engine Controls

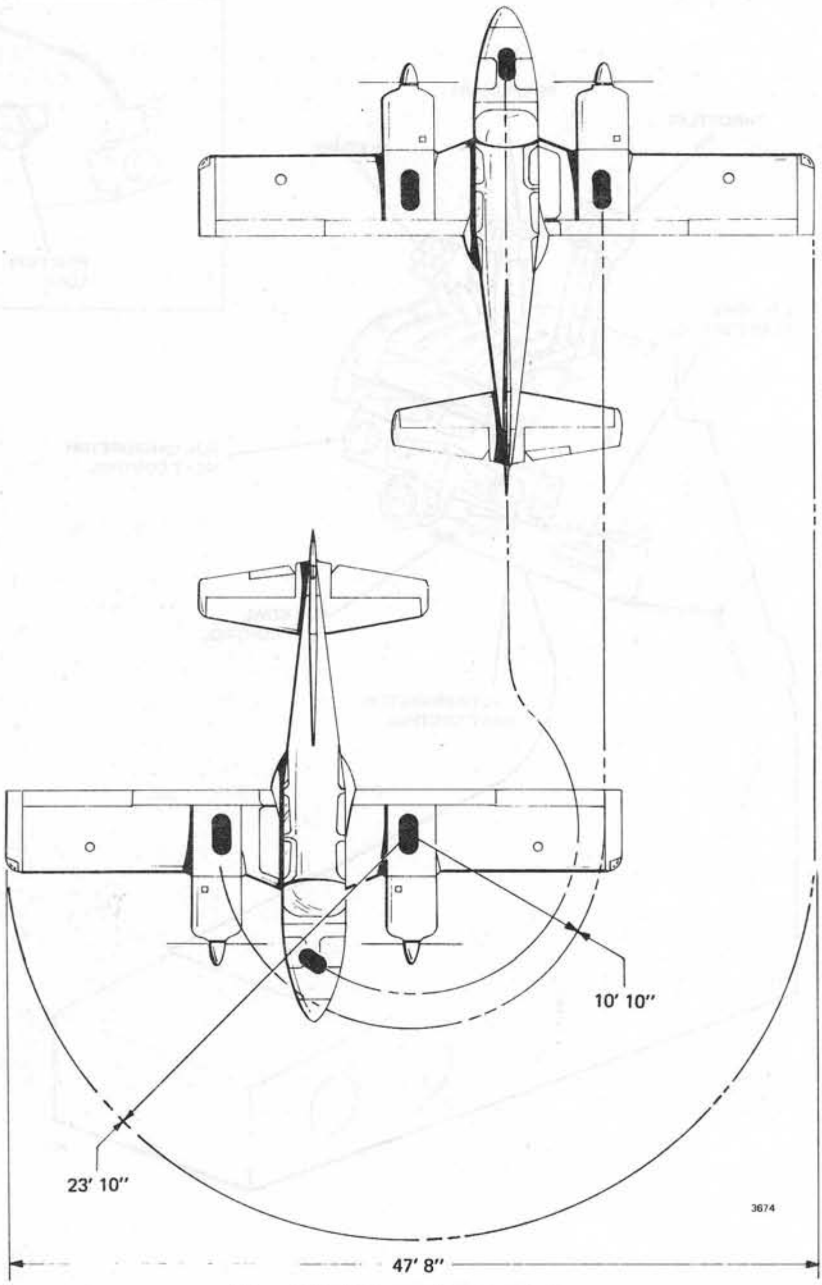


Figure 7-9. Minimum Turning Radius

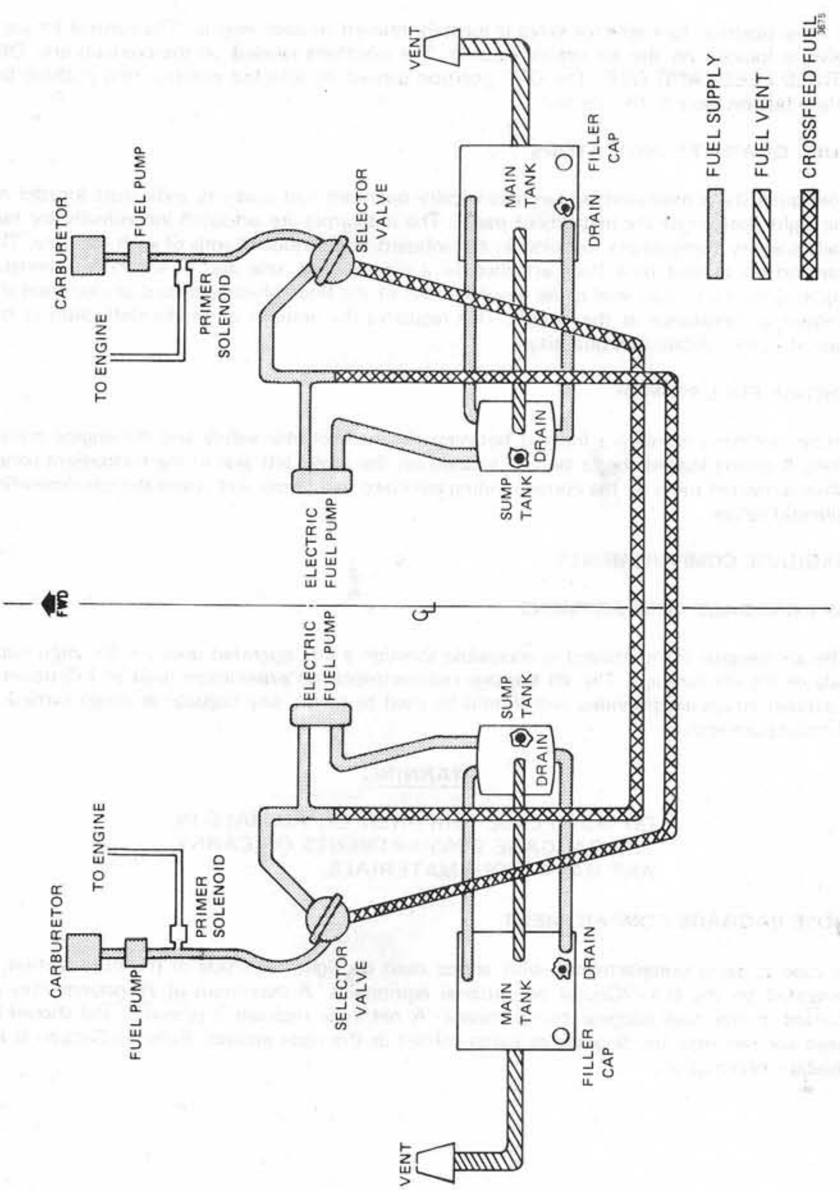


Figure 7-10. GA-7/Cougar Fuel System Schematic

FUEL SELECTOR VALVES

A three position fuel selector valve is located inboard of each engine. The control for each valve is located on the aft center console. The positions labeled on the controls are: ON, CROSS FEED, AND OFF. The OFF position cannot be selected without first pushing the safety button next to the control.

FUEL QUANTITY INDICATORS

Fuel quantity is measured by two electrically operated fuel quantity indicators located on the right portion of the instrument panel. The indicators are actuated individually by two fuel quantity transmitters installed in the inboard and outboard ends of each fuel bay. The transmitters consist of a float attached to a pivoted rod, one end of which is a rheostat wiper. Changes in fuel level cause angular travel of the float which increases or decreases the amount of resistance in the circuit. This regulates the amount of needle deflection at the indicator, to indicate fuel quantity.

ENGINE FUEL PRIMER

Primer solenoid valves are located between the fuel selector valves and the engine primer lines. A spring loaded toggle switch, located on the lower left side of the instrument panel, when activated turns on the corresponding auxiliary fuel pump and opens the corresponding solenoid valves.

BAGGAGE COMPARTMENTS

AFT BAGGAGE COMPARTMENT

The aft baggage compartment is accessible through a key operated door on the right hand side of the aft fuselage. The aft baggage compartment has a maximum limit of 175 pounds. Tiedown straps are provided and should be used to secure any baggage or cargo carried in the compartment.

WARNING

DO NOT PLACE CHILDREN OR ANIMALS IN THE BAGGAGE COMPARTMENTS OR CARRY ANY HAZARDOUS MATERIALS.

NOSE BAGGAGE COMPARTMENT

A nose baggage compartment, with access door on right hand side of the nose section, is provided on the GA-7/Cougar as optional equipment. A maximum of 75 pounds may be carried in the nose baggage compartment. A net type tiedown is provided and should be used for securing any baggage or cargo carried in the nose section. Refer to Section 6 for loading information.

SEATS AND BELTS

Contoured front seats are individually adjustable fore and aft using the adjustment levers located on the front (center) of each seat. The front seat backs fold forward for easy access to the rear seat. Each seat is provided with a seat belt and a shoulder harness. The shoulder harness is attached to the outboard seat belt, allowing both belts to be removed or fastened in one operation. All belts are adjustable. The seat belts should be adjusted to lie low on the hips without any slack. Shoulder harness should lie over the outer shoulder and across the chest with just enough slack to reach all controls comfortably.

ENGINES

The GA-7/Cougar is equipped with two Lycoming 0-320-D1D, four cylinder, direct drive, horizontally opposed, air cooled engines. Each engine has a rated horsepower of 160 at 2700 rpm. Standard equipment provided on each engine includes an oil pump, fuel pump, propeller governor, starter, and alternator. The compression ratio is 8.5:1 and propeller drive ratio is 1:1. Propeller drive rotation is clockwise.

ENGINE CONTROLS (Figure 7-8)

The engine controls, consisting of propeller, throttle, cowl flaps, mixture and carburetor heat controls, are located on the engine control quadrant below the instrument panel. A quadrant friction lock is provided to keep the engine primary controls (throttle, mixture, and propeller) from creeping, once they have been set.

ENGINE INSTRUMENTS

The engine instruments are discussed under INSTRUMENT PANEL paragraph in this section. (See Figure 7-7.)

ENGINE LUBRICATING SYSTEM

Oil for engine lubrication is supplied from a sump on the bottom of the engine. The capacity of the engine sump is eight quarts. Oil is drawn from the sump through an oil suction strainer into the engine-driven oil pump. From the pump, oil is routed to a bypass valve. If the oil is cold, the bypass valve allows the oil to go directly from the pump to the oil filter. If the oil is hot, the bypass valve routes the oil out of the accessory housing and into a flexible hose leading to the oil cooler on the left rear of the engine. Oil from the cooler returns to the accessory housing where it enters the oil filter. The filtered oil then enters a pressure relief valve which regulates engine oil pressure by allowing excessive oil to return to the pump, while the balance of the oil is circulated to various engine parts for lubrication. Residual oil is returned to the sump by gravity flow.

NOTE

Constant use of correct grades of fuel and oil contributes more to satisfactory performance and long life of an engine than any other item of engine operation and maintenance. Also, correct engine timing and flying the airplane at all times within the speed and power range specified for the engine, attributes to good performance and long life of the engine. Although the engines have been carefully run-in by Avco Lycoming, and no further break-in is required, new or newly overhauled engines should be operated on straight mineral oil for a minimum of 50 hours or until oil consumption has stabilized.

IGNITION SYSTEM

The ignition system is a dual system. Each system is independent of the other and a failure of one system will not effect the other system. An ignition system consists of magneto, ignition harness and spark plugs. The left magneto fires the lower right and upper left spark plugs. The right magneto fires the upper right and lower left spark plugs. Placing the magneto switch in OFF position electrically grounds the magneto primary circuit and the magneto will not produce a spark.

AIR INDUCTION SYSTEM

The engine air induction system receives ram air through the engine air intake inside the engine cowling. The ram air passes through a duct to the air filter located directly behind the carburetor where the air is filtered prior to entry into the carburetor. When carburetor heat is being applied, a flapper valve in the intake to the air filter is closed off and the carburetor draws unfiltered heated air from a shroud around the engine exhaust muffler.

EXHAUST SYSTEM

Exhaust gas from each cylinder passes through riser assemblies to a muffler and tailpipe. The muffler is constructed with a shroud around the outside, which forms a heating chamber for cabin and carburetor heat.

ENGINE COOLING

Ram air for engine cooling enters through the air intake openings in the engine cowl. The air is directed around the cylinders and other engine areas by baffling, and then exhausted through an exit duct in the bottom of the engine cowling.

COWL FLAPS

Each engine has a cowl flap located in the lower cowling. The cowl flaps control engine heat and are controlled by manual control knobs located on the bottom of the control quadrant (Figure 7-8). Pulling the knobs out closes the cowl flaps and the flaps are opened by pushing the knobs in. The cowl flaps can be set at any desired position from closed to full open and can be locked in a position by turning the control knob to the right.

ENGINE MOUNTS

Each engine is mounted to the nacelle engine support structure at four mount points. Each of these mounts contains rubber isolators capable of sustaining operational loads and providing absorption for engine vibration.

PROPELLERS

The airplane is equipped with Hartzell all metal, two bladed, constant speed, full feathering, governor regulated propellers. The propellers are operated by oil pressure from the engine oil system. The oil pressure is boosted by the propeller governor gear pump. Oil pressure from the governor drives the blades toward low pitch (increasing rpm) and springs, along with air pressure in the hub, and counterweights drive the blades toward high pitch (decreasing rpm).

HYDRAULIC SYSTEM (Figure 7-11)

A hydraulic system is provided for retraction and extension of the landing gears. The system consists of a power pack assembly, lines, landing gear actuators, hydraulic pressure switch, relief valve, and manually operated selector valve. The normal operating pressure for the system is 1500 psi. Actuation of the system is initiated by a selector valve control handle located on the lower, left center portion of the instrument panel, adjacent to the gear indicator lights.

HYDRAULIC POWER PACK

The hydraulic power pack consists of a reservoir, a DC electric motor driven pump and pressure control and relief valves. The power pack is a 12-volt unit located in the left side of the nose section.

BRAKE SYSTEM

An independent hydraulically actuated brake system is provided for each main wheel. Hydraulic master cylinders are connected to each rudder pedal. The master cylinders are connected to wheel cylinders through lines and hose assemblies. The brakes are operated from the pilot's rudder pedals. Brakes for the copilot's side are available as optional equipment. The brakes are operated by applying toe pressure to the top of the rudder pedals. The parking brake system consists of a manually operated knob connected to a parking brake valve located in the brake lines. When pressure is applied to the brake system and the parking brake handle is pulled, pressure is locked on the wheel cylinders by the parking brake valve. Pressure at the wheel cylinders is released by pushing the parking brake knob in.

The brake linings and brake disc should be inspected during the preflight inspection. If the linings are less than 1/10 inch (0.100) thickness or the disc less than 11/32 inch (0.345 thickness, they should be replaced as soon as possible.

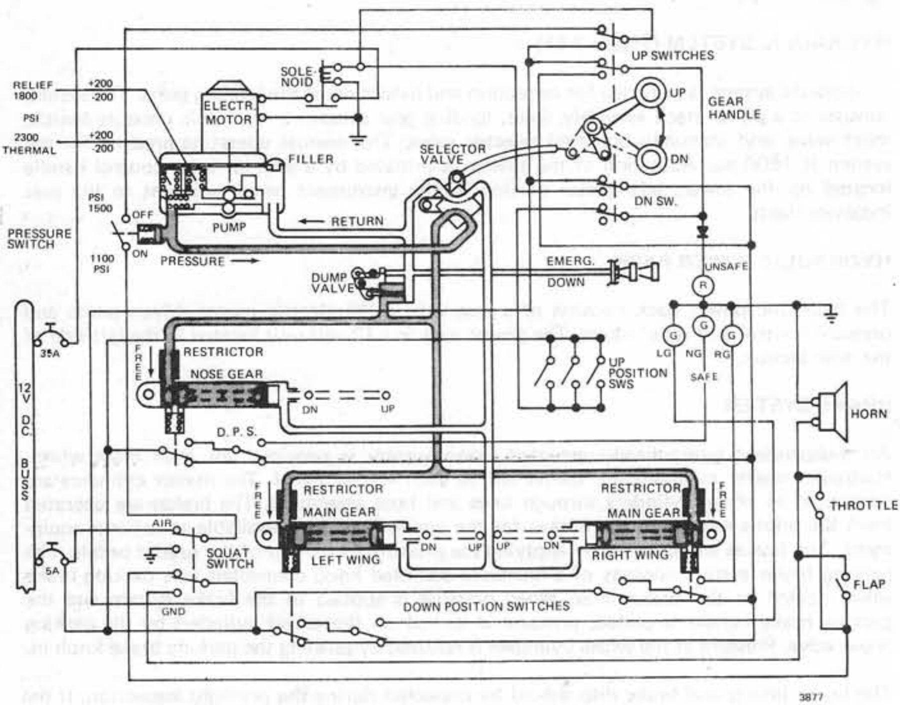


Figure 7-11. Hydraulic System Schematic (Gear Retracted)

NOTE

> The parking brake should be left off and wheel chocks installed if the airplane is to be left unattended. Changes in ambient temperature can cause the brakes to release or to exert excessive pressures.

ELECTRICAL SYSTEM (Figure 7-12)

Electrical power is supplied by a 14-volt, direct current, negative ground electrical system. A 12-volt, 25 ampere hour battery is incorporated in the system to furnish power for starting and as a reserve power source in case of alternator failure. The battery is located in the nose section of the airplane on the right side below the baggage compartment floor. The electrical generating system consists of two engine driven, (self exciting) 60 ampere alternators. Two solid state regulators maintain effective alternator load sharing while regulating the system bus voltage at 14.0 volts. Also, incorporated in the system are overvoltage relays, one for each alternator circuit, which prevents damage to electrical and avionic equipment in case of regulator malfunction. A warning light on the instrument panel will illuminate if either alternator fails to produce current, accompanied by a zero indication on the individual ammeter. The loads from the electrical bus system are protected by manual reset type circuit breakers, mounted on the lower right-hand portion of the instrument panel. An external power receptacle is available as optional equipment, to supplement the battery system for starting the engines and for ground operation. Operation of the battery is controlled by a master switch, located on the lower left-hand section of the instrument panel. The master switch also connects the bus bar to the alternator field circuit switches on the instrument panel.

LIGHTING SYSTEM

EXTERIOR LIGHTING

Navigation lights are standard equipment on the airplane with a light located on each wing tip and one in the aft end of the tailcone. The navigation lights are controlled by a single switch on the lower left section of the instrument panel. Other external lights available as optional equipment consist of three anticollision strobe lights (one in each wing tip and one in the aft end of the tail), a courtesy entrance step and walkway light, and a landing light. The strobe lights are vibration resistant and produce an extremely high intensity flash. The strobe light switch is located on the lower left section of the instrument panel. Courtesy lights, one for the entrance step and one for the walkway are available as optional equipment. The step light is located above the step, beneath the inboard wing. The walkway light is located above the walkway on the side of the fuselage with a switch adjacent to the light. Another switch is located inside the cabin, on the left-hand side of the fuselage.

INTERIOR LIGHTING

Interior lighting consists of the instrument lights, compass and radio dial lights, cabin lights, map light (optional), and baggage compartment lights. The instrument panel lighting is provided by lights located in the instrument panel, glareshield, and overhead. The intensity of the instrument panel lighting is controlled by a dimming rheostat on the left side of the instrument panel. The radio dial lights are controlled by a separate dimming rheostat. A map light, mounted on the left side of the cabin, is available as optional equipment. Also available as optional equipment are lights in the baggage compartments and two overhead cabin lights with individual switches for the passenger compartment.

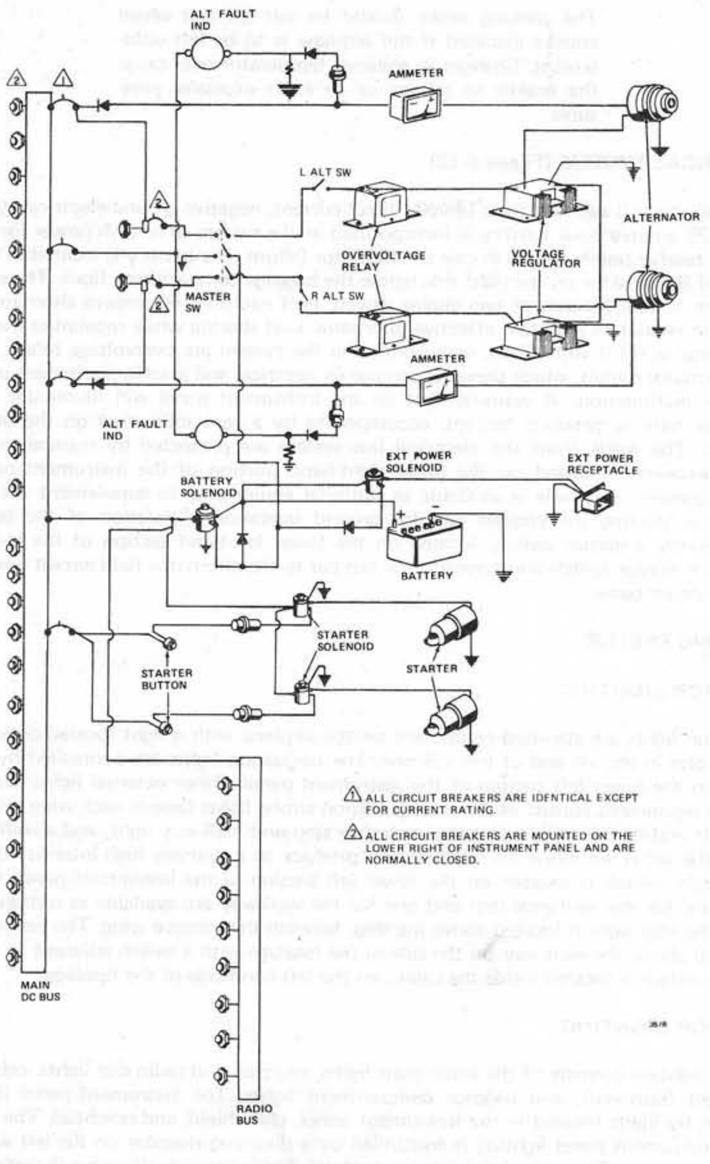


Figure 7-12. Electrical System Schematic

INSTRUMENT PRESSURE SYSTEM (Figure 7-13)

An Instrument pressure system is used on the GA-7/Cougar to provide pressure for operation of the gyro instruments. The pressure system consists of two inlet air filters, two engine driven dry air pumps, two regulators, a pressure manifold, an inline filter, directional gyro, horizon gyro, differential pressure gauge with source indicator, and necessary tubing and fittings. The two pumps are interconnected at the manifold to form a single system. If either pump fails, a valve automatically closes in the manifold and the remaining pump continues to operate all gyro instruments.

The two source indicators in the pressure gauge are red "Bull's Eye" type indicators which retract out of sight in the gauge face when the pumps are operating normally. The normal operating system pressure should be between 4.3 to 6.1 psi at engine normal operating speed. Should an air pump malfunction occur, the "Bull's Eye" for that pump will appear in the dial face.

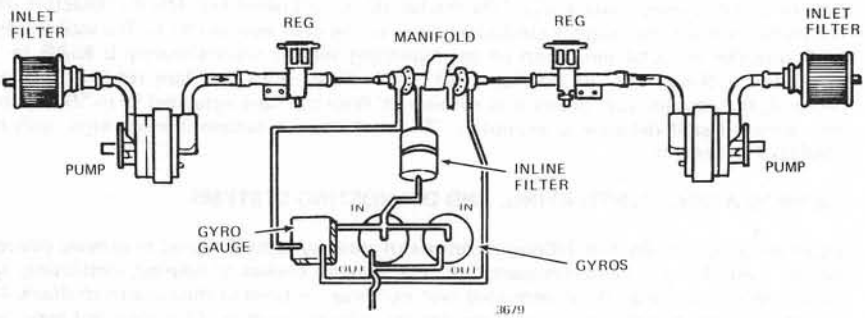


Figure 7-13. Pressure System Schematic

PITOT-STATIC SYSTEM

The pitot-static system supplies ram air pressure to the airspeed indicator and static pressure to the airspeed indicator, vertical speed indicator and altimeter. The system is composed of a pitot tube mounted on the lower surface of the nose section, two external static ports, one on each side of the aft fuselage, and the associated plumbing necessary to connect the instruments to the pressure sources. An alternate internal static pressure system is provided to supply an alternate static source to the pilot's instruments should the external static pressure source malfunction. The control for the alternate static air is located adjacent to pilot's air vent on the instrument panel.

The airplane is equipped with a pitot heat system. The system consists of a heating element in the pitot tube, a pitot heat switch located on the lower left side of the instrument panel, a 14-ampere circuit breaker on the lower right side of the instrument panel and associated wiring. When the pitot heat is turned on, the heating element in the pitot tube is heated to maintain proper operation in possible icing conditions.

STALL WARNING SYSTEM

The GA-7/Cougar airplane is equipped with an electrically operated stall warning system. The system consists of two stall sensor switches located in the right wing leading edge, a warning horn located behind the instrument panel, a cam actuated flap position detector microswitch, a 5-ampere circuit protector, and necessary wiring.

The stall sensor switches actuate the stall warning system. As the airspeed and angle of attack of the wing change to the extent that a stall condition is imminent, a portion of the airflow over the wing leading edge lifts the tab on the lift detectors. The lift detectors then complete a circuit that applies electrical power to the stall warning horn. The stall warning horn provides an aural indication of an impending stall at approximately 5 KIAS to 10 KIAS above the power off stall speed of the airplane. With the flaps retracted (0 to 5 degrees), the inboard stall detector is monitored. With the flaps extended (5 to 30 degrees), the outboard stall detector is monitored. The stall warning system is inoperative with the MASTER switch off.

CABIN HEATING, VENTILATING, AND DEFROSTING SYSTEMS

Cabin air supply in the GA-7/Cougar consists of three systems designed to provide environmental control in the cabin compartment. The systems consist of heating, ventilating, and defrosting systems with their associated heat exchange sections of the exhaust mufflers, hot and cold air valves with interconnecting linkage, valve controls on the instrument panel and adjustable outlets and ducting connecting the system.

A means of exhaust for air brought into the cabin by the three systems is provided by a cabin air exit scoop assembly located in the aft fuselage access cover beneath the fuselage at the aft fuselage bulkhead.

HEATING SYSTEM

Cabin heat is provided by a dual system with separate heat sources and controls for the left and right side of the cabin. Ram air is ducted through each engine baffle inlet and the heat exchange section of the muffler, and to the hot air valve located on the forward side of the engine firewall. Ram air is also ducted from the wing lower leading edge to the cold air valve located on the aft side of the engine firewall. Left and right cabin air controls located on the instrument panel control the respective systems. Depending on the position of the control, various amounts of hot and cold air are mixed for delivery to the cabin.

VENTILATING SYSTEM

Fresh air ventilation is provided by directional vents located on the instrument panel, with the air supply being ducted in from inlets in the fuselage. The quantity of air through each is controlled by a swiveling valve which can be adjusted to increase or decrease volume.

Fresh air ventilation for the rear cabin area is offered as optional equipment. Air is provided by adjustable vents. They are operated by a twisting motion and air may be directed by positioning the vent in the desired direction.

DEFROSTING SYSTEM

The defrosting system consists of a duct from each front outlet box, two defroster outlets which are mounted in the sides of the cowl deck immediately aft of the windshield and a control on each instrument panel outlet. Temperature and volume of this air are regulated by the cabin air control.

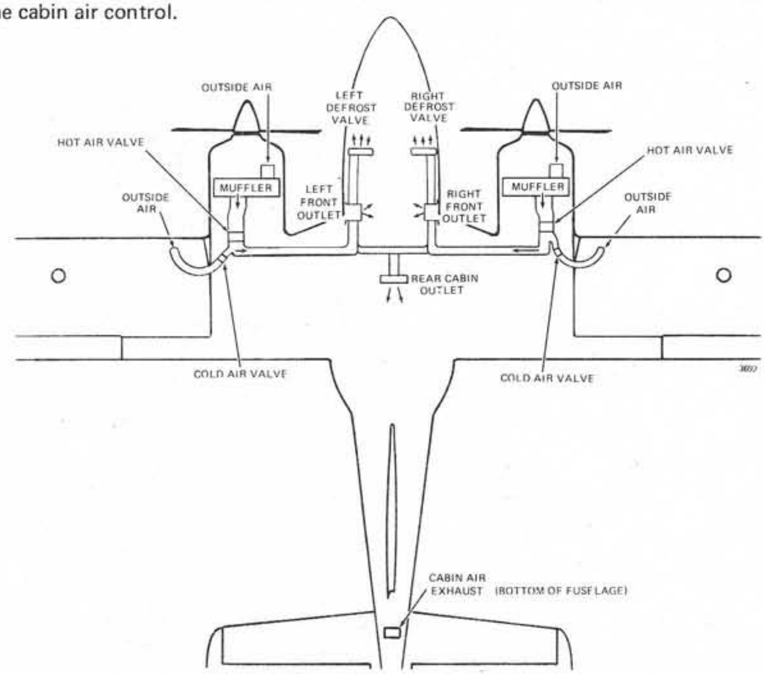


Figure 7-14. Heating and Defrosting Systems

SECTION 8
HANDLING, SERVICE & MAINTENANCE

TABLE OF CONTENTS

INTRODUCTION

The purpose of this section is to provide the procedures recommended by Grumman American for proper ground handling, routine care and servicing, inspection, and maintenance requirements to retain a new plane performance and reliability standard. It is recommended that a planned schedule of lubrication and preventive maintenance be followed, and that this schedule be tailored to the climatic or flying conditions to which the airplane is subjected.

Much valuable knowledge and experience are available to you through your Grumman American dealer. It is suggested that you take advantage of the services he offers, since he is an expert on your airplane and its maintenance.

IDENTIFICATION PLATE

All correspondence regarding your airplane should include its serial number. This number, together with the model number, type certificate number, and production certificate number, is stamped on the identification plate attached to the left side of the aft fuselage, beneath the horizontal stabilizer. On the aft wall of the forward baggage compartment is a plate giving the finish and trim code number of the airplane. This code number describes the interior color scheme and exterior paint combination of the airplane. This code number should be included in any correspondence regarding items requiring identification of color or trim.

PUBLICATIONS

When the airplane is delivered from the factory it is supplied with a Pilot's Operating Handbook and supplemental data covering optional equipment installed in the airplane. In addition, the owner may purchase, through a Grumman American parts and service outlet, the following manuals:

Maintenance Manual
Illustrated Parts Catalog
Service Instructions

AIRPLANE FILE

Numerous data, information, and licenses are required by Federal Aviation Regulations and by the Federal Communications Commission as parts of the airplane file. This file shall be maintained as a permanent record of the airplane. The applicable FAA regulations should be checked periodically by the owner to ensure that the file is current. The following checklist contains a listing of required documents:

(1) To be displayed in the airplane at all times:
  1. Aircraft Airworthiness Certificate (FAA Form 8100-2)
  2. Aircraft Registration Certificate (FAA Form 8050-3)
  3. Aircraft Radio Station License, if a transmitter is installed (FCC Form 556)
  4. All operating limitations placards.

(2) To be carried in the airplane at all times:
  1. Weight and Balance, and associated papers.
  2. Equipment list.
  3. Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

(3) To be available upon request:
1. Airplane Log Book
2. Engine Log Book

The items listed are required by the United States Federal Aviation Regulations and by the Federal Communications Commission (if a transmitter is installed). Regulations of other nations may require other documents or data, therefore, owners of airplanes not registered in the United States should check with their own aviation officials to determine the requirements of the nation in which the airplane is to be flown.

AIRPLANE INSPECTION PERIODS

As required by Federal Aviation Regulations, all civil airplanes of U.S. registry must undergo a complete inspection (annual) each twelve (12) calendar months. In addition to the required annual inspection, airplanes operated commercially (for hire) must have a complete inspection every 100 hours of operation.

The FAA may require other inspections by issuance of airworthiness directives applicable to the airplane, engine, propeller, and components. It is the responsibility of the owner/operator to ensure compliance with all applicable airworthiness directives and, when the inspections are repetitive, to take appropriate steps to prevent inadvertent noncompliance.

PILOT CONDUCTED PREVENTIVE MAINTENANCE

A certificated pilot who owns or operates an airplane not used as an air carrier is authorized by FAR Part 43 to perform limited maintenance on his airplane. Refer to FAR Part 43 for a list of the specific maintenance operations which are allowed.

NOTE

Pilots operating airplanes of other than U.S. registry should refer to the regulations of the country of registry for information on preventive maintenance that may be performed by pilots.

A maintenance manual should be obtained prior to performing any preventive maintenance to ensure that proper procedures are followed. Your Grumman American Dealer should be contacted for further information or for required maintenance which must be accomplished by appropriately licensed personnel.

ALTERATIONS OR REPAIRS TO AIRPLANE

It is essential that the FAA be contacted prior to any alterations on the airplane to ensure that airworthiness of the airplane is not violated. Alterations or repairs to the airplane must be accomplished by licensed personnel.

GROUND HANDLING

STEERING

Steering of the airplane should be accomplished by use of the nose gear towbar. Ensure rudder lock is removed prior to steering the airplane with the towbar. Never exceed the steering limit placards on nose wheel doors and towbar.

CAUTION

USING THE PROPELLERS FOR GROUND HANDLING COULD RESULT IN SERIOUS DAMAGE, ESPECIALLY IF PRESSURE IS EXERTED ON THE OUTER ENDS. DO NOT ATTEMPT TO PUSH THE AIRPLANE BACKWARD OR FORWARD WITHOUT THE AID OF A TOW BAR.

PARKING

When parking, head the airplane into the wind. Do not set the parking brakes during cold weather when accumulated moisture may freeze the brakes, or when the brakes are overheated.

If the airplane is to be parked for an extended period of time, release the parking brake. A rise in temperature could cause the hydraulic fluid to expand and build up excessive pressure in the hydraulic system. A decrease in temperature could cause the brakes to release.

Install the control wheel and rudder locks and chock the wheels. In severe weather and high wind conditions, tie the airplane down as outlined in the following paragraph.

TIEDOWN

Proper tiedown procedure is the best precaution against damage to the parked airplane by gusty or strong winds. To tiedown the airplane securely, proceed as follows:

(1) Chock all wheels and install the control wheel lock.
(2) Tie sufficiently strong ropes or chains (3000 pounds tensile strength) to the wing and tail tiedown fittings and secure each rope to a ramp tiedown.
(3) Tie a rope (no chains or cables) to the nose gear and secure to a ramp tiedown.
(4) Install a pitot tube cover.
(5) Ensure that the passenger door is closed and latched.

NOTE

FAA Advisory Circular No. 20-35 provides additional tiedown information.

JACKING

When it is necessary to jack the entire airplane off the ground, or when jack points are used in the jacking operation, refer to the maintenance manual for specific procedures and equipment required.

LEVELING

Level the airplane as described in Section 6.

FLYABLE STORAGE

Airplanes placed in storage for a maximum of 30 days or those which receive only intermittent use for the first 25 hours are considered in flyable storage. Every seventh day during these periods, the propellers should be rotated by hand through several revolutions. This action "limbers" the oil and prevents any accumulation of corrosion on engine cylinder walls.

WARNING

CHECK THAT THE IGNITION SWITCHES ARE OFF, THROTTLES CLOSED, MIXTURE CONTROLS ARE IN THE IDLE CUT-OFF POSITION, AND THE AIRPLANE IS SECURED BEFORE ROTATING THE PROPELLERS BY HAND. DO NOT STAND WITHIN THE ARC OF THE PROPELLERS WHILE TURNING THE PROPELLERS.

After 30 days in storage, the airplane should be flown for 30 minutes, or a ground runup should be made just long enough to produce an oil temperature within the lower green arc range. Excessive ground runup should be avoided.

Engine runup helps to eliminate excessive accumulations of water in the fuel system and other air spaces in the engine. Keep fuel tanks full to minimize condensation in the tanks. Keep the battery fully charged to prevent the electrolyte from freezing in cold weather.

SERVICING (See Figure 8-1.)

In addition to the preflight inspection in Section 4, servicing, inspection, and test requirements for your airplane are detailed in the maintenance manual. The maintenance manual outlines all items which require attention at 50, 100, and 1000 hour intervals plus those items which require servicing, inspection, and/or testing at special intervals.

Depending on various flight operations, your local Government Aviation Agency may require additional service, inspections, or tests. For these regulatory requirements, owners should check with local aviation officials where the airplane is being serviced.

For quick and ready reference, quantities, materials, and specifications for frequently used service items are as follows:

ENGINE OIL

GRADE – Aviation Grade SAE 50 Above 60°F (16°C).
Aviation Grade SAE 10W30 or SAE 30 Between 0°F (-18°C) and 70°F (21°C).
Aviation Grade SAE 10W30 or SAE 20 Below 10°F (-12°C).

Multi-viscosity oil with a range of SAE 10W30 is recommended for improved starting in cold weather. Ashless dispersant oil, conforming to Specification No. MIL-L-22851, must be used. (See Figure 8-2.)

NOTE

Your GA-7/Cougar was delivered from the factory with a corrosion preventive aircraft engine oil. If oil must be added during the first 25 hours of engine operation, use only aviation grade straight mineral oil (Gulf-40 or equivalent) conforming to Specification No. MIL-L-6082B. (See Figure 8-2.)

CAPACITY OF ENGINE SUMP

The capacity of the engine sump is eight (8) quarts. Do not operate on less than 2 quarts. To minimize loss of oil through the breather, fill to 7 quart level for normal flights of less than 3 hours. For extended flight, fill to 8 quarts. These quantities refer to oil dipstick level readings.

OIL CHANGE

After the first 25 hours of operation, drain engine oil sumps and clean the oil suction strainers. Refill sumps with straight mineral oil and use until a total of 50 hours has accumulated or oil consumption has stabilized; then change to dispersant oil. Drain the engine oil sumps and oil coolers, and clean oil suction strainers, each 50 hours thereafter. Change engine oil at least every 6 months even though less than the recommended hours have accumulated. Reduce intervals for prolonged operation in dusty areas, cold climates, or when short flights and long idle periods result in sludging conditions.

A full-flow oil filter is available as optional equipment. The filter can increase the oil change interval by 25 to 100 percent, depending on environmental conditions, and provided the filter is replaced after each 50 hours of engine operation. The full-flow oil filter, if installed, is located at the rear of the engine.

FUEL

Minimum Grade (and Color) — 100 Grade Aviation Fuel (green). 100 low lead aviation fuel (blue) with a lead content limited to 2ml of TEL per U.S. gallon is also approved. The capacity of each tank is 59 gallons.

TIRE SERVICE

All tires and wheels are balanced at the factory prior to original installation. A similar relationship of the tire, tube, and wheel should be maintained. If vibration is encountered, it may be due to out-of-round or out-of-balance conditions. When wheel, tire, or tube is replaced due to wear, it is recommended that they be re-balanced.

NOSE WHEEL TIRE PRESSURE — 40 PSI ± 2 PSI on 15 X 6.00-6, 4-Ply Rated Tire.

MAIN WHEEL TIRE PRESSURE — 40 PSI ± 2 PSI on 6.00-6, 6-Ply Rated Tires.

BRAKE SERVICE

The hydraulic brake system reservoirs, located on the brake master cylinders, should be filled to within 1/4 inch of the reservoir top with hydraulic fluid conforming to MIL-H-5606.

The brake linings and brake disc should be inspected during the preflight inspection. If the linings are less than 1/10 inch (0.100) thickness or the disc less than 11/32 inch (0.345) thickness, they should be replaced as soon as possible.

HYDRAULIC RESERVOIR SERVICE

The hydraulic reservoir should be checked at each 50-hour inspection and whenever fluid level is suspected of being low. Gain access to the hydraulic reservoir by removing access door on upper left side of nose section and removing access panel on nose baggage compartment floor. Remove filler plug on top of reservoir and fill to bottom of casting in filler hole with MIL-H-5606 hydraulic fluid. (See Figure 8-1.)

BATTERY SERVICE

The battery is accessible by opening the forward baggage compartment door and removing baggage compartment floor panels. The battery is rated at 12 volts, 25 ampere-hours. It should be inspected periodically for proper fluid level. If the fluid level is found to be low, fill as recommended by the battery manufacturer. DO NOT fill above the visible battery baffle plates.

CLEANING AND CARE

EXTERIOR CARE

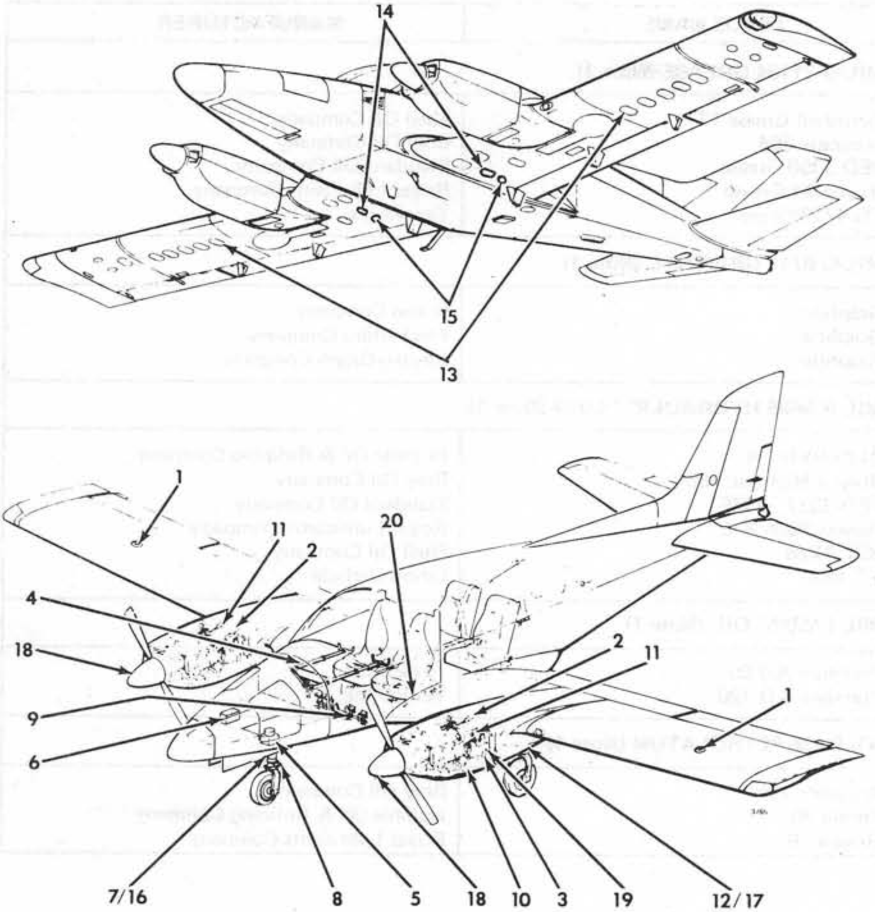
The painted surfaces of the airplane have a long-lasting, all-weather finish and should require no buffing or rubbing out in normal conditions. However, it is desirable to wax and polish it to preserve the outstanding exterior finish.

The paint can be kept bright simply by washing with water and mild soap. Avoid abrasive or harsh detergents. Rinse with clear water and dry with terry cloth towels or chamois. Oil and grease spots may be removed with kerosene or mineral spirits.

NOTE

> No commercial paint removers are to be used on any airframe component unless specific prior approval has been received from the factory. (See Maintenance Manual.)

If you choose to wax your airplane, use a good automotive-type wax applied as directed. The use of wax in areas subject to high abrasion, such as leading edges of wings and tail surfaces, propeller spinner, and blades, is recommended.



1. Fuel Fillers
2. Pressure System Pump Inlet Filter
3. Carburetor Air Filter
4. Pressure System Inline Filter
5. Hydraulic Reservoir (Landing Gear)
6. Battery
7. Hydraulic Reservoir (Nose Oleo)
8. Shimmy Dampener
9. Hydraulic Reservoir (Brake) (2)
10. Carburetor Fuel Filter
11. Oil Filler
12. Hydraulic Reservoir (Main Gear Oleo)
13. Fuel Tank Drain
14. Aux. Fuel Pump Filter
15. Fuel Sump Drain
16. Air Valve
17. Air Valve
18. Prop Air Servicing Valve
19. Engine Oil Filter
20. Pitot Static Drain (Located on left side of Airplane at F.S. 61.25)

Figure 8-1. Servicing Points

RECOMMENDED LUBRICANTS

TRADE NAME	MANUFACTURER
MIL-G-21164 GREASE (Note 1)	
Aeroshell Grease 17 Braycote 664 PED 3350 Grease Royco 64 Grease TG-4727 Grease	Shell Oil Company Bray Oil Company Standard Oil Company Royal Lubricants Company Texaco Inc.
MIL-G-6711 GRAPHITE (Note 1)	
Graphite Graphite Graphite	Dixon Company Electrofilm Company Electro-Graph Company
MIL-H-5606 HYDRAULIC FLUID (Note 1)	
3125 HVD Oil Brayco Micronic 756C PED-3337, -3335 Royco 756A & B XSL 7828 YT-283	Humble Oil & Refining Company Bray Oil Company Standard Oil Company Royal Lubricants Company Shell Oil Company Union Carbide
MIL-L-22851 OIL (Note 1)	
Premium AD 80 Premium AD 120	Texaco Inc. Texaco Inc.
VV-P-236 PETROLATUM (Note 1)	
Braycote 236 Permo 70 Royco 1R	Bray Oil Company Humble Oil & Refining Company Royal Lubricants Company

Figure 8-2 (Sheet 1 of 3)

WINDSHIELD AND WINDOW CARE

It is recommended that you keep the Plexiglas in the windshield and cabin windows clean and unscratched. The following procedures are recommended:

1. If large deposits of mud and/or dirt have accumulated on the Plexiglas, flush with clean water. Rubbing with your hand is recommended to dislodge excess dirt and mud without scratching the Plexiglas.
2. Wash with soap and water. Use a sponge or heavy wadding of a soft cloth. DO NOT rub, as the abrasive action in the dirt and mud residue will cause fine scratches in the surface.
3. Grease and oil spots may be removed with a soft cloth soaked in kerosene.
4. After cleaning, wax the Plexiglas surface with a thin coat of hard polish or wax.
5. If a severe scratch or marring occurs, jeweler's rouge is recommended. Follow directions, rub out scratch, smooth, apply wax and buff.

CAUTION

NEVER USE GASOLINE, BENZINE, ALCOHOL, ACETONE, CARBON TETRACHLORIDE, FIRE EXTINGUISHER FLUID, ANTI-ICE FLUID, LACQUER THINNER OR GLASS CLEANER TO CLEAN PLASTIC. THESE MATERIALS WILL DAMAGE THE PLASTIC AND MAY CAUSE SEVERE CRAZING.

PROPELLER CARE

Damage from foreign objects, sometimes referred to as "nicks", may appear in the leading edges of the propellers from time to time. It is vital that these nicks be inspected by qualified maintenance personnel and corrected as quickly as possible. Such minor damage may cause stress concentrations and result in cracks forming in the propeller. Keep the blades clean and free of dirt or grass buildup. This type of foreign material on the propeller may cause an imbalance and accompanying vibration. We recommend cleaning agents such as Stoddard solvent or equivalent followed by waxing or coating with a light film of oil.

ENGINE CLEANING

Clean the engine with neutral solvent or any standard engine cleaning solvent. Spray or brush the solvent over the engine, then wash off the solvent with water and allow to dry. Solutions which may attack rubber or plastics should not be used.

INTERIOR CARE

Clean the interior regularly with a vacuum cleaner to remove dust and loose dirt from the upholstery and carpet.

If liquid (coffee, etc.) is spilled on the upholstery or carpet, blot it up promptly with cleansing tissue or rags. Continue blotting until no more liquid is taken up. Sticky materials may be scraped up with a dull knife, then cleaned up with a spot remover.

Oily spots may be cleaned with household spot removers, used sparingly. Before using any solvent, read the instructions on the container and test it on an obscure place on the fabric to be cleaned. Never saturate the fabric with a volatile solvent; it may damage the padding and backing materials.

Soiled upholstery and carpet may be cleaned with foam-type detergent, used according to the manufacturer's instructions. To minimize wetting the fabric, keep the foam as dry as possible and remove it with a vacuum cleaner.

The plastic trim, headliner, instrument panel, and control knobs need only be wiped off with a damp cloth. Oil and grease on the control wheel and control knobs can be removed with a cloth moistened with Stoddard solvent. Volatile solvents, such as mentioned in paragraphs on care of the windshield, must never be used since they soften and craze the plastic.

RECOMMENDED LUBRICANTS

TRADE NAME	MANUFACTURER
MIL-L-7870 OIL (Note 1)	
Brayco 363	Bray Oil Company
Cosmolube 263	E. F. Houghton Company
Enco Instrument Oil	Humble Oil & Refining Company
Low Temperature Oil 1692	Texaco Inc.
Royco 363	Royal Lubricants Company
MIL-G-25760 GREASE (Note 1)	
Aeroshell Grease 16	Shell Oil Company
Braycote 6605	Bray Oil Company
Royco 60R	Royal Lubricants Company
Supermil ASU No. 06752	American Oil Company
TG-4971 Grease	Texaco Inc.
MIL-G-7711 GREASE (Note 1)	
Aeroshell No. 6	Shell Oil Company
Regal AFB 2	Texaco Inc.
MIL-L-6082B ENGINE OIL (Notes 1 and 2)	
Aeroshell W 120*	Shell Oil Company
Aeroshell W80*	Shell Oil Company
Aeroshell Oil 65**	Shell Oil Company
Aeroshell Oil 100**	Shell Oil Company
Chevron Aero Oil Grade 120*	Standard Oil Company
Chevron Aviation Oil 65**	Chevron Oil Company
Grade 1100**	Chevron Oil Company
RT-451*	Mobil Oil Company
RM-173E*	Mobil Oil Company
RM-180E*	Mobil Oil Company
Avrex 101/1065**	Mobil Oil Company
Avrex 101/1100**	Mobil Oil Company
TX-6309*	Texaco Inc.
Premium AD 120*	Texaco Inc.
Premium AD 80*	Texaco Inc.
Conoco Aero Oil 1065**	Continental Oil Company

Figure 8-2 (Sheet 2 of 3)

RECOMMENDED LUBRICANTS

TRADE NAME	MANUFACTURER
MIL-L-6082B ENGINE OIL (Notes 1 and 2) (Continued)	
Conoco Aero Oil 1100**	Continental Oil Company
Chevron Aero Oil Grade 120*	Standard Oil Company
Oil E-120*	Exxon Company
Oil A-100*	Exxon Company
Oil E-80*	Exxon Company
Grade 1065**	Champlin Oil & Refining Company
Grade 1100**	Champlin Oil & Refining Company

*Ashless Dispersant Oils with additives conforming to MIL-L-22851.
**Straight Mineral Oils.

Note 1: The vendor products listed in this chart have been selected as representative of the specification under which they appear. Other equivalent products conforming to the same specifications may be used.

Note 2: Oils conforming to the latest revision of Lycoming Service Instruction No. 1014 may be used.

Figure 8-2 (Sheet 3 of 3)

SECTION 9
SUPPLEMENTS

TABLE OF CONTENTS

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT NO. 1

SECTION 1

GENERAL

This supplement must be included in the applicable Pilot's Operating Handbook and FAA Approved Airplane Flight Manual, dated 4-10-78, when Edo-Aire Mitchell, Century IIB Autopilot Model AK636 is installed in accordance with Grumman American Drawing 7AV10980. The information contained herein supplements the information of the basic Pilot's Operating Handbook and Airplane Flight Manual.

SECTION 2

LIMITATIONS

1. Autopilot operation is prohibited above 175 KIAS.
2. Autopilot OFF for takeoff and landing.

SECTION 3

EMERGENCY PROCEDURES

1. In the event of an autopilot malfunction, the autopilot can be disconnected by pushing the roll ON – OFF switch to OFF.
2. The autopilot can be overpowered at either control wheel.
3. An autopilot runaway in climb, cruise or descent with a 3 second delay in recovery initiation, could result in a 58° bank and/or a 150 ft. altitude loss. Maximum altitude loss measured at 175 KIAS.
4. An autopilot runaway during an approach operation with a 1 second delay in recovery initiation, single or multi-engine, could result in 22° bank and/or 20 ft. altitude loss, either coupled or uncoupled.

SECTION 4

NORMAL PROCEDURES

1. Navigation receiver selector switch (NAV 1/NAV 2 TRACKER) allows selection of NAV 1 or NAV 2 for autopilot operation.
2. Refer to Edo-Aire Mitchell Pilot's Operating Manual No. 68S75, dated 6-1-72, revised 8-1-73.
3. Refer to Drawing 360A and NSD 360A, Pilot's Handbook No. 68S85, dated 4-1-74, revised 5-1-76 (if applicable).

SECTION 5

PERFORMANCE

There is no change to the performance of the airplane due to the autopilot's installation.

John R James
FAA APPROVED
ACTING CHIEF, ENGINEERING
AND MANUFACTURING BRANCH
SOUTHERN REGION FAA
DATE: May 25, 1978

INTRODUCTION

This section consists of a series of supplements. Each supplement contains a brief description, and when applicable, operating limitations, emergency and normal procedures, and performance. Routinely installed items of optional equipment, whose function and operational procedures do not require detailed instructions, are discussed in Section 7.

PILOT'S OPERATING HANDBOOK
and
FAA APPROVED AIRPLANE FLIGHT MANUAL

LOG OF SUPPLEMENTS

FAA Supplements must be in the airplane for flight operation when subject equipment is installed.

Supplement No.	Part No.	Subject	Rev. No.	Date
1	68S411-1S	Century IIB Autopilot		5-25-78
2	68S410-1S	Century III Autopilot		5-25-78
3		United Kingdom		4-10-78
		Supplement to POH and AFM	1	6-15-78
4		Pressure Conversion - Inches of Mercury to Millibars		6-15-78

Revised: June 15, 1978

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT NO. 2

SECTION 1

GENERAL

This supplement must be included in the applicable Pilot's Operating Handbook and FAA Approved Airplane Flight Manual, dated 4-10-78, when Edo-Aire Mitchell Century III Autopilot, Model AK635 is installed in accordance with Grumman American Drawing 7AV10981, (7AV10982 when optional glide slope coupling is installed). The information contained herein supplements the information of the basic Pilot's Operating Handbook and Airplane Flight Manual.

SECTION 2

LIMITATIONS

1. Autopilot use is prohibited above 175 KIAS.
2. Autopilot OFF for takeoff and landing.
3. Placard stating: "Conduct trim check prior to flight (See P.O.H.)" to be installed in clear view of pilot.

SECTION 3

EMERGENCY PROCEDURES

This airplane is equipped with a master disconnect/interrupt switch on the pilot's control wheel. When the switch button is depressed it will disconnect the autopilot. When depressed and held, it will interrupt all electric elevator trim operations. Trim operations will be restored when the switch is released. If an autopilot or trim emergency is encountered, do not attempt to determine which system is at fault. Immediately depress and hold the master disconnect/interrupt button. Turn off autopilot and trim master switch and retrim airplane, then release the interrupt switch.

NOTE

During examination of this supplement, the pilot is advised to locate and identify the autopilot controls and the trim master switch.

John E. James

FAA APPROVED
ACTING CHIEF, ENGINEERING
AND MANUFACTURING BRANCH
SOUTHERN REGION FAA
DATE: May 25, 1978

AUTOPILOT

1. In the event of an autopilot malfunction the autopilot can be:
   a. Disconnected by depressing the master disconnect/interrupt switch (Electric Trim ON).
   b. Disconnected by depressing the trim switch autopilot OFF bar.
   c. Disconnected by pushing the roll rocker switch OFF.
   d. Overpowered at either control wheel.

CAUTION

Do not overpower pitch axis for more than 3 seconds because electric trim action will increase overpower force.

2. Altitude Loss During Malfunction:
   a. An autopilot malfunction during climb, cruise or descent with a 3 second delay in recovery initiation could result in as much as 58° bank and 420 ft. altitude loss. Maximum altitude loss was recorded at 175 KIAS during descent.
   b. An autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 22° bank and 50 ft. altitude loss. Maximum altitude loss measured in approach configuration 20° flaps and operating either coupled or uncoupled, single or multi-engine.
3. Single Engine Operations
   a. Engine failure during an autopilot approach operation: Disengage autopilot, conduct remainder of approach manually.
   b. Engine failure during go-around: Disengage autopilot, retrim airplane, perform normal airplane engine out procedures then re-engage autopilot.
   c. Engine failure during normal climb, cruise, descent: Retrim airplane, perform normal airplane engine out procedures.
   d. Maintain airplane yaw trim throughout all single engine operations.

TRIM SYSTEM

1. In the event of a trim malfunction:
   a. Depress and hold master autopilot disc/trim interrupt switch.
   b. Trim master switch – OFF. Retrim airplane as necessary.
   c. Release master interrupt switch – be alert for possible trim action.
2. If a trim runaway occurs with the autopilot operating, the above procedures will disconnect the autopilot which will immediately result in higher control wheel forces. Be prepared to manually retrim, as necessary, to eliminate undesirable forces.

NSD 360A (HSI)

1. Appearance of HDG Flag:
   a. Check air supply gauge (vacuum or pressure) for adequate air supply (4.3 in. Hg. Min.).
   b. Check compass circuit breaker.
   c. Observe display for proper operation.
2. To disable heading card – pull circuit breaker and use magnetic compass for directional data.

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NOTE

If heading card is not operational, autopilot should not be used.

3. With card disabled VOR/Localizer and Glide Slope displays are still functional; use card set to rotate card to airplane heading for correct picture.
4. Slaving Failure – (i.e. failure to self correct for gyro drift):
   a. Check gyro slaving switch is set to No. 1 position (if equipped with Slave No. 1 – No. 2 switch) or "SLAVED" position when equipped with slaved and free gyro mode switch.
   b. Check for HDG Flag.
   c. Check compass circuit breaker.
   d. Reset heading card while observing slaving meter.

NOTE

Dead slaving meter needle or a needle displaced fully one direction indicates a slaving system failure.

   e. Select slaving amplifier No. 2, if equipped. If not equipped, proceed with Item g, below.
   f. Reset heading card while checking slaving meter. If proper slaving indication is not obtained.
   g. Switch to free gyro mode and periodically set card as an unslaved gyro.

NOTE

In the localizer mode, the "TO-FROM" arrows may remain out of view, depending upon the design of the NAV converter used in the installation.

SECTION 4

NORMAL PROCEDURES

AUTOPILOT

1. Navigation receiver selector switch (NAV 1/NAV 2 Tracker) allows selection of NAV 1 or NAV 2 for autopilot operation.
2. Refer to Edo-Aire Mitchell Pilot's Operating Manual, P/N 68S25, dated 2-71 for autopilot preflight and normal inflight procedures, and DG 360A – NSD 360A Operator's Manual, P/N 68S85, dated 4-1-74, revised 5-1-76.

TRIM SYSTEM

GENERAL

This airplane is equipped with an electric elevator trim system that has two operating modes:

1. Manual command trim
2. Auto trim follow-up mode when the autopilot is engaged

The electric trim system is designed to withstand any type of single malfunction, either mechanical or electrical, without uncontrolled operation resulting. The preflight check procedure is designed to uncover hidden failures that might otherwise go undetected. Proper operation of the electric elevator trim system is predicated on conducting the following preflight check before each flight. If the trim system fails any portion of the procedure, turn the trim circuit breaker OFF and leave the system OFF until trim system is repaired. Substitution of any trim system component for another model is not authorized. For emergency interrupt information, refer to EMERGENCY PROCEDURES Section of this supplement.

The command electric trim switch on the left hand portion of the pilot's control wheel has two functions:

1. When the top bar (autopilot OFF) is pressed, it disconnects the autopilot.
2. When the top bar is pressed and the rocker is moved forward, nose down trim will occur – when moved aft, nose up trim will occur.

PREFLIGHT COMMAND TRIM – BEFORE EACH FLIGHT

1. Trim master switch – ON (switch circuit breaker).
2. Autopilot OFF – Check normal trim operation – UP. Grasp trim control and check override capability. Check nose down operation. Recheck override.
3. With trim operating – depress master trim interrupt switch – trim should stop – release interrupt switch – trim operation should resume.
4. Activate center bar only – push rocker fore and aft – only. Trim should not operate with either separate action.

AUTOTRIM – BEFORE EACH FLIGHT

1. Autopilot ON – (Roll and Pitch Sections) – Check automatic operation by activating autopilot pitch command disc UP then DN. Observe trim operation follows pitch command direction.

<u>NOTE</u>

In autopilot mode, there will be approximately a 3 second delay between operation of pitch command and operation of trim.

2. Press center bar (autopilot OFF) – release – check autopilot disengagement.
3. Rotate trim control to check manual trim operation.
4. Recheck airplane pitch trim to correct takeoff position after autopilot and trim system check.

SPECIAL OPERATIONS AND INFORMATION

1. Initial and/or intermediate approach segments should be conducted at approximately 90 to 100 KIAS with the flaps extended up to 20° and the gear down. Upon intercepting the glide path or when passing the final approach fix (FAF) immediately reduce the power as necessary to hold 80 to 90 KIAS on the final approach to maintain correct airspeed. All power changes should be of small magnitude and smoothly applied for best tracking performance. Do not change airplane configuration during approach while autopilot is engaged. For approaches without glide path coupling, adjust pitch command disc in conjunction with power to maintain desired airspeed and descent rate.
2. Altitude Hold Operation – For best results reduce rate of climb or descent to 500 FPM or less before engaging altitude hold mode. For precise altitude control in altitude hold mode below approximately 90 KIAS lower up to 20° flaps.
3. Instrument Approach Go-Around Maneuver – At the decision height (DH) or missed approach point (MAP) perform the go-around as follows:
   a. Select pitch mode and adjust for desired attitude.

   NOTE

   During glide slope coupled approach the pitch command disc can be preset to the desired attitude. At the decision height, disengage the altitude hold to initiate the go-around attitude.

   b. Add takeoff power or power as desired.
   c. After positive rate of climb is established, raise landing gear and flaps.
   d. Select HDG mode at coupler for turn from the approach course and set the desired heading on the DG.

SECTION 5

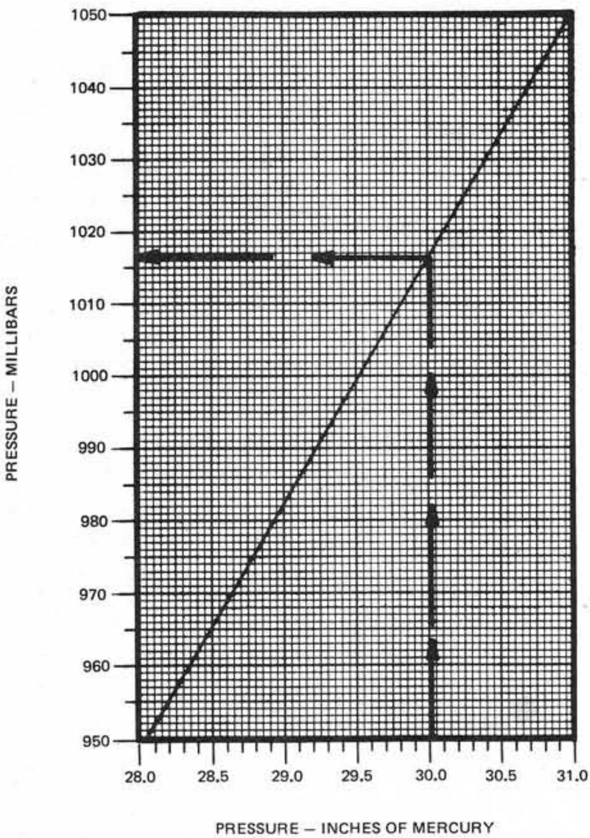
PERFORMANCE

There is no change to the performance of the airplane due to the autopilot's installation.

PILOT'S OPERATING HANDBOOK AND
FAA APPROVED
AIRPLANE FLIGHT MANUAL SUPPLEMENT NO. 4

EXAMPLE:	
PRESSURE (IN HG)	30.02
PRESSURE (MILLIBARS)	1016.6

PRESSURE CONVERSION
INCHES OF MERCURY TO MILLIBARS



SECTION 10
SAFETY INFORMATION

TABLE OF CONTENTS

INTRODUCTION

Your Grumman American airplane is a responsive, high-performance vehicle, designed to provide you with safe and efficient transportation. Like any other airplane, your Grumman American airplane operates most efficiently and safely in the hands of a skilled pilot.

We urge you to be thoroughly familiar with the contents of this handbook, placards, and checklists to ensure maximum utilization of your airplane. When the airplane was delivered, it was equipped with a pilot's operating handbook, checklist, weight and balance information, and placards. If the airplane has changed ownership, some of these may have been misplaced. If any are missing, replacement should be obtained as soon as possible.

We have added this special section of safety information to refresh owners' and pilots' knowledge of a number of safety subjects. We strongly recommend these subjects be reviewed periodically, along with other documents required for operation of the airplane.

Topics in this publication are mostly excerpts from FAA Documents and other articles pertaining to the subject of safe flying. They are not limited to any particular make or model airplane and do not replace instructions for particular types of airplanes.

Your Grumman American airplane is built to provide you with many years of safe and efficient transportation. By maintaining it properly and flying it prudently, you will realize its full potential.

GENERAL

Flying can be one of the safest modes of travel. Remarkable safety records are being established each year. As a pilot you are responsible to yourself, your relatives, to those who travel with you, to other pilots, and to ground personnel to fly wisely and safely.

The following material in this Safety section covers several subjects in limited detail. Here are some condensed Do's and Dont's.

DO'S

Be thoroughly familiar with your airplane. If you are not current in your airplane, get a check ride.

Pre-plan all aspects of your flight. Include in your pre-planning a complete weather briefing.

Use all services available when needed (FSS, Weather Bureau,etc.)

Prior to takeoff, ensure that a complete pre-flight inspection has been performed.

Use your checklists.

Prior to takeoff, ensure that you have enough fuel aboard the airplane to make the intended trip and arrive at your destination with an adequate reserve.

Prior to takeoff, ensure that the airplane weight and C.G. are within limits for the type of flying intended.

Be sure that articles and baggage are secured.

Check freedom of all controls.

Maintain an appropriate airspeed in takeoff, climb, descent, and landing.

Avoid big airplane wake turbulence.

Keep your airplane in good mechanical condition.

Stay informed and alert, fly in a sensible manner.

DON'TS

Don't take off with frost, ice, or snow on the airplane surfaces.

Don't takeoff with less than minimum recommended fuel, plus reserves.

Don't fly in a reckless, show off, or careless manner.

Don't fly into thunderstorms or severe weather.

Don't fly into possible icing conditions.

Don't fly close to mountainous terrain.

Don't apply controls abruptly or with high forces that could exceed design loads of the airplane.

Don't fly when physically or mentally under par.

Don't trust to luck.

GENERAL SOURCES OF INFORMATION

The FAA and various aviation service agencies provide the pilot with a wealth of information. This information is provided for the sole purpose of making your flying easier, faster, and safer. Take advantage of this knowledge and be prepared for an emergency in the event that one should occur. Your responsibilities as a pilot are clearly defined by government regulations. Since these regulations are designed for your own protection, compliance with them is not only mandatory, but beneficial to you.

RULES AND REGULATIONS

Federal Aviation Regulations, Part 91, General Operating and Flight Rules, is a document of law governing operation of aircraft and the owner's and pilot's responsibilities.

This document covers such subjects as:

- Responsibilities and authority of the pilot in command
- Certificates required
- Liquor and drug usage
- Flight plans
- Pre-flight action
- Fuel requirements
- Flight rules
- Maintenance, preventative maintenance, alterations, inspections, and maintenance records.

These are only some of the topics covered. It is the owner's and pilot's responsibility to be thoroughly familiar with all regulations in FAR Part 91 and to follow them.

FEDERAL AVIATION REGULATIONS, PART 39, AIRWORTHINESS DIRECTIVES

This document specifies that no person may operate an aircraft to which an airworthiness directive (issued by the FAA) applies, except in accordance with the requirements of that airworthiness directive. It is the responsibility of the owner or pilot to ensure that the airplane he intends to fly is in compliance with all applicable airworthiness directives before the airplane is operated.

AIRMAN INFORMATION, ADVISORIES, AND NOTICES – FAA AIRMAN'S INFORMATION MANUAL

This document contains a wealth of pilot information for nearly all realms of flight, including navigation, ground procedures, and medical information. Among the subjects discussed are:

- Controlled Air Space
- Services Available to Pilots
- Radio Phraseology and Technique
- Airport Operations
- Clearances and Separations
- Pre-flight
- Departures – IFR
- Enroute – IFR
- Arrival – IFR
- Emergency Procedures
- Weather
- Wake Turbulence
- Medical Facts for Pilots
- Bird Hazards
- Good Operating Practices
- Airport Location Directory

We urge all pilots to be thoroughly familiar with and use the information in this handbook.

ADVISORY INFORMATION

Airmen can subscribe to services that provide FAA NOTAMS and Airman Advisories. These documents are also available at most FAA Flight Service Stations, and at many Fixed Base Operations. When using these documents, ensure that they are current prior to using the information in them for flight planning.

NOTAMS are documents that provide information of a time-critical nature affecting a pilot's decision to make an intended flight. For example, closed airports, terminal radar out of service, enroute navigational aids out of service, etc.

GENERAL INFORMATION ON SPECIFIC TOPICS

FLIGHT PLANNING

FAR, Part 91 requires that each pilot in command, before beginning a flight, familiarize himself with all available information concerning that flight.

All pilots are urged to obtain a complete pre-flight briefing, preferably from an expert such as an FSS briefer. The pre-flight briefing should consider such items as local, enroute, and destination weather; alternate airports; enroute navaids; airport runways in use; length of runways; takeoff and landing performance of the airplane under expected conditions; etc.

The prudent pilot will review his planned enroute track and stations and make a list for quick reference. It is strongly recommended that a flight plan be filed with Flight Service Station even though the flight may be VFR. Also, advise Flight Service Stations of changes or delays of one hour or more in flight plans and remember to close the flight plan at your destination.

The pilot must be completely familiar with the performance of his airplane including performance data in the airplane manuals and placards. The resultant effect of temperature and pressure altitude must be taken into account in determining performance if not accounted for on the charts. Applicable FAA manuals including the weight and balance forms and equipment lists must be aboard the airplane at all times.

The airplane must be loaded so that its maximum weight and center of gravity (C.G.) limitations are not exceeded. Also, enough fuel must be aboard to ensure that the intended trip can be made with sufficient reserve fuel remaining. The engine oil level should be checked and brought to the proper level prior to flight.

INSPECTIONS . MAINTENANCE

In addition to maintenance inspections and pre-flight information required by FAR, Part 91, a complete pre-flight inspection is imperative. It is the responsibility of the owner and operator to ensure that the airplane is maintained in an airworthy condition and proper maintenance records are kept.

While the following items cannot substitute for the pre-flight specified for each type of airplane, they will serve as reminders of general items that should be checked.

SPECIAL CONDITIONS AND PRECAUTIONS

NOTE

> Airplanes operated in humid tropics or cold and damp climates, etc., may need more frequent inspections for wear, corrosion, and/or lack of lubrication. In these areas periodic inspections should be performed until the operator can set his own inspection periods based on experience. The required periods do not constitute a guarantee that the item will reach the period without malfunctions, as the above factors cannot be controlled by the manufacturer.

Corrosion, and its effects, must be treated at the earliest possible opportunity. A clean dry surface is virtually immune to corrosion. Make sure that all drain holes remain unobstructed. Protective films and sealants help to keep corrosive agents from contacting metallic surfaces. Corrosion inspections should be made most frequently under high-corrosion-risk operating conditions, such as in areas of high airborne salt concentrations (e.g., near the sea) and high-humidity areas (e.g., tropical regions).

WALK-AROUND INSPECTIONS

All airplane surfaces free of ice, frost, or snow.
Tires properly inflated.
All external locks, covers, and tiedowns removed.
Fuel sumps drained; fuel checked for proper color, absence of water, or sediment.
Fuel quantity, adequate for trip, plus reserve, visually checked.
Oil quantity checked and access doors secured.
General condition of airplane, engine, propeller, exhaust stack, etc., checked.
All external doors secured.

COCKPIT CHECKS

Flashlight available.
Required documents on board.
Use the checklist.
All internal control locks removed.
Freedom of controls checked.
Entrance door properly closed and latched.
Seat belts and shoulder harnesses fastened.
Passengers briefed.
Engines operating satisfactorily.
All engine gauges checked for proper readings.
Fuel selector in proper position.
Fuel quantity checked by gauges.
Altimeter setting checked.
Carburetor heat control checked
Propeller control checked.

FLIGHT OPERATIONS

GENERAL

The pilot should be thoroughly familiar with all information published by the manufacturer concerning the airplane. He is required by FAA regulations to operate in accordance with the placards installed.

ENGINE OPERATION IN FLIGHT

Aviation grade 100 fuels (100 LL) in which the lead content is limited to 2cc per gallon are approved for continuous use in all Avco Lycoming engines installed in Grumman American Aviation Corporation airplanes. Several procedures may be observed to limit spark plug lead fouling; however, the single most important item is proper fuel mixture leaning. At 75% power or less, lean the mixture as indicated in the operating procedures section of this manual.

In addition to leaning, the following techniques should be considered to minimize spark plug lead fouling:

1. Swap top spark plugs with bottom spark plugs between regular plug servicing periods (50 hours).

2. Avoid closed throttle idle operation on the ground whenever possible. Try to idle engine in the 1000 to 1200 RPM range whenever conditions permit.

3. Ensure that the idle mixtures have been properly adjusted to avoid a rich condition.

4. Rather than completely closing the throttles, use other means to lower airspeed and altitude. Power landings prevent rapid temperature drop, retaining the advantage of proper operating temperatures.

5. Use the correct heat range spark plugs.

TURBULENT WEATHER

A complete weather briefing prior to beginning a flight is an essential element of a safe trip.

Updating of weather information enroute is another safety aid. However, the wise pilot also knows weather conditions change quickly at times and treats weather forecasting as professional advice rather than an absolute fact. He obtains all the advice he can, but still stays alert by using his knowledge of weather conditions.

Plan the flight to avoid areas of severe turbulence and thunderstorms. It is not always possible to detect individual storm areas or find the in-between clear areas.

Thunderstorms, squall lines, and violent turbulence should be regarded as extremely dangerous and should be avoided. The hail and tornadic wind velocities encountered in thunderstorms can destroy any airplane, just as tornados destroy nearly everything in their path on the ground.

A roll cloud ahead of a squall line or thunderstorm is visible evidence of violent turbulence. However, the absence of a roll cloud should not be interpreted as denoting the lack of turbulence.

FLIGHT IN TURBULENT AIR

Even though flight in severe turbulence is to be avoided, flight in turbulent air may be encountered under certain conditions.

Flying through turbulent air presents two basic problems, to both of which the answer is proper airspeed. If you maintain an excessive airspeed, you run the risk of structural damage or failure. If your airspeed is too low, you run the risk of stalling.

If turbulence encountered in cruise or descent becomes uncomfortable to the pilot or passengers, the best procedure is to reduce speed to the maneuvering speed listed in the limitations section of this handbook.

This speed gives the best assurance of avoiding excessive stress loads, and at the same time provides a margin of airspeed to prevent inadvertent stalls due to gusts.

Beware of overcontrolling in attempting to correct for changes in altitude; applying control pressure abruptly will build up g-forces rapidly and could cause damaging structural stress loads. You should watch particularly your angle of bank, making turns as wide and shallow as possible, and be equally cautious in applying forward or back pressure to keep the nose level. Maintain straight and level attitude in either up or down drafts. Use trim sparingly to avoid being grossly mistrimmed as the vertical air columns change velocity and direction.

FLIGHT IN ICING CONDITIONS

An airplane which does not have all critical areas protected in a proper manner must not be exposed to icing encounters – the pilot should make an immediate 180 degree turn when icing conditions are encountered.

MOUNTAIN FLYING

Avoid flight at low altitudes over mountainous terrain, particularly near the lee slopes. If the wind velocity near the level of the ridge is in excess of 25 knots and approximately perpendicular to the ridge, mountain wave conditions are likely over and near the lee slopes. If the wind velocity at the level of the ridge exceeds 50 knots, a strong mountain wave is probable with strong up and down drafts and severe or extreme turbulence. The worst turbulence will be encountered in and below the rotor zone which is usually 8 to 10 miles downwind from the ridge. This zone is characterized by the presence of "roll clouds" if sufficient moisture is available; altocumulus standing lenticular clouds are also visible signs that a mountain wave exists, but their presence is likewise dependent upon moisture. Mountain wave turbulence can, of course, occur in dry air and the absence of such clouds should not be taken as any assurance that mountain wave turbulence will not be encountered. A mountain wave downdraft may exceed the climb capability of your airplane. Avoid mountain wave downdrafts.

VFR – LOW CEILINGS

If you are not instrument rated, avoid "VFR On Top" and "Special VFR." Being caught above an undercast when an emergency descent is required (or at destination) is an extremely hazardous position for the VFR pilot. Accepting a clearance out of certain airport control zones with no minimum ceiling and 1-mile visibility as permitted with "Special VFR" is not a recommended practice for a VFR pilot.

Avoid areas of low ceilings and restricted visibility unless you are instrument proficient and have an instrument equipped airplane, then proceed with caution and have planned alternates.

VFR AT NIGHT

When flying VFR at night, in addition to the altitude appropriate for the direction of flight, pilots should maintain a safe minimum altitude as dictated by terrain, obstacles such as TV towers, or communities in the area flown. This is especially true in mountainous terrain, where there is usually very little ground reference and absolute minimum clearance is 2,000 feet. Don't depend on your being able to see obstacles in time to miss them.

VERTIGO – DISORIENTATION

Disorientation can occur in a variety of ways. During flight, inner ear balancing mechanisms are subjected to varied forces not normally experienced on the ground. This, combined with loss of outside visual reference, can cause vertigo. False interpretations (illusions) result and may confuse the pilot's conception of the attitude and position of his airplane.

Under VFR conditions the visual sense, using the horizon as a reference, can override the illusions. Under low visibility conditions (night, fog, clouds, haze, etc.) the illusions predominate. Only through awareness of these illusions, and proficiency in instrument flight procedures, can an airplane be operated safely in a low visibility environment.

Flying in fog, dense haze or dust, cloud banks, or very low visibility, with strobe lights, and particularly rotating beacons turned on, frequently causes vertigo. They should be turned off in these conditions, particularly at night.

All pilots should check the weather and use good judgment in planning flights. The VFR pilot should use extra caution in avoiding low visibility conditions.

Motion sickness often precedes or accompanies disorientation and may further jeopardize the flight.

STALLS, SLOW FLIGHT, AND V_{MCA} DEMONSTRATION

Stalls and slow flight should be practiced at safe altitudes to allow for recovery. Either of these maneuvers should be performed at an altitude in excess of 5,000 feet above ground level.

Spins may be dangerous and should be avoided in this airplane. Since spins are preceded by stalls, a prompt and decisive stall recovery protects against inadvertent spins.

STANDARD PROCEDURE FOR SPIN RECOVERY – GRUMMAN AMERICAN AIRPLANES

In case of an inadvertent spin, recovery is effected by applying full rudder opposite to the spin rotation and neutralizing the aileron, then applying full down elevator. The controls should be applied briskly. As the rotation stops, neutralize the anti-spin rudder and elevator, then apply smooth elevator back pressure to bring the nose up to level flight.

VORTICES – WAKE TURBULENCE

Every airplane generates wakes of turbulence while in flight. Part of this is from the propeller or jet engine and part from the wing tip vortices. The larger and heavier the airplane the more pronounced and turbulent the wakes will be. Wing tip vortices from large heavy airplanes are very severe at close range, degenerating with time, wind, and space. These are rolling in nature from each wing tip. In test, vortex velocities of 133 knots have been recorded. Exhaust velocities from large airplanes at takeoff have been measured at 25 MPH, 2100 feet behind medium large airplanes.

Encountering the rolling effect of wing tip vortices within 2 minutes or less after passage of large airplanes is the most hazardous to the light airplanes. This roll effect can exceed the maximum counter roll obtainable in an airplane.

The turbulent areas may remain for as long as 3 minutes or more, depending on wind conditions, and may extend several miles behind the airplane. Plan to fly slightly above or to the side of the other airplanes.

Because of the wide variety of conditions that can be encountered, there is no set rule to follow to avoid wake turbulence in all situations; however, the Airman's Flight Information Manual goes into considerable detail for a number of vortex avoidance procedures. Use prudent judgment and allow ample clearance time and space following or crossing the wake of large airplanes and in all takeoff, climb out, approach, and landing operations.

TAKEOFF AND LANDING CONDITIONS

Use caution when landing on runways that are covered by water or slush which cause hydroplaning (aquaplaning), a phenomenon that renders braking and steering ineffective because of the lack of sufficient surface friction. Snow and ice covered runways are also hazardous. The pilot should also be alert to the possibility of the brakes freezing.

Use caution when taking off and landing during gusty wind conditions. Also be aware of the special wind conditions caused by buildings or other obstructions located near the runway in a crosswind pattern.

MEDICAL FACTS FOR PILOTS

GENERAL

Modern industry's record in providing reliable equipment is very good. When the pilot enters the airplane, he becomes an integral part of the man-machine system. He is just as essential to a successful flight as the control surfaces. To ignore the pilot in pre-flight planning would be as senseless as failing to inspect the integrity of the control surfaces or any other vital part of the machine. The pilot himself has the responsibility for determining his reliability prior to entering the airplane for flight.

When piloting an airplane, an individual should be free of conditions which are harmful to alertness, ability to make correct decisions, and rapid reaction time.

FATIGUE

Fatigue generally slows reaction times and causes foolish errors due to inattention. In addition to the most common cause of fatigue, insufficient rest and loss of sleep, the pressures of business, financial worries, and family problems can be important contributing factors. If your fatigue is marked prior to a given flight, don't fly. To prevent fatigue effects during long flights, keep mentally active by making ground checks and radio-navigation position plots.

HYPOXIA

Hypoxia in simple terms is a lack of sufficient oxygen to keep the brain and other body tissues functioning properly. Wide individual variation occurs with respect to susceptibility to hypoxia. In addition to progressively insufficient oxygen at higher altitudes, anything interfering with the blood's ability to carry oxygen can contribute to hypoxia (anemias, carbon monoxide, and certain drugs). Also, alcohol and various drugs decrease the brain's tolerance to hypoxia.

Your body has no built–in alarm system to let you know when you are not getting enough oxygen. It is impossible to predict when or where hypoxia will occur during a given flight, or how it will manifest itself. A major early symptom of hypoxia is an increased sense of well-being (referred to as euphoria).

This progresses to slow reactions, impaired thinking ability, unusual fatigue, and dull headache feeling.

The symptoms are slow but progressive, insidious in onset, and are most marked at altitudes starting above 10,000 feet. Night vision, however, can be impaired starting at altitudes lower than 10,000 feet. Heavy smokers may experience early symptoms of hypoxia at altitudes lower than is so with non-smokers.

HYPERVENTILATION

Hyperventilation or overbreathing, is a disturbance of respiration that may occur in individuals as a result of emotional tension or anxiety. Under conditions of emotional stress, fright, or pain, breathing rate may increase, causing increased lung ventilation, although the carbon dioxide output of the body cells does not increase. As a result, carbon dioxide is "washed out" of the blood. The most common symptoms of hyperventilation are: dizziness; hot and cold sensations; tingling of the hands, legs, and feet; nausea; sleepiness; and finally unconsciousness.

Should symptoms occur, consciously slow your breathing rate until symptoms clear and then resume normal breathing rate. Breathing can be slowed by breathing into a bag, or talking loud.

ALCOHOL

Common sense and scientific evidence dictate that you not fly as a crew member while under the influence of alcohol. Even small amounts of alcohol in the human system can adversely affect judgment and decision making abilities. FAR 91.11 states "(a) No person may act as a crew member – (1) within 8 hours after the consumption of any alcoholic beverage."

Tests indicate that as a general rule, 2 ounces of alcohol at 15,000 feet produces the same adverse effects as 6 ounces at sea level. In other words, the higher you get, "the higher you get."

DRUGS

Self-medication or taking medicine in any form when you are flying can be extremely hazardous. Even simple home or over-the-counter remedies and drugs such as aspirin, antihistamines, cold tablets, cough mixtures, laxatives, tranquilizers, and appetite suppressors may seriously impair the judgment and coordination needed while flying. The safest rule is to take no medicine before or while flying, except on the advice of your Aviation Medical Examiner.

SCUBA DIVING

Flying shortly after any prolonged scuba diving could be dangerous. Under the increased pressure of the water, excess nitrogen is absorbed into your system. If sufficient time has not elapsed prior to takeoff for your system to rid itself of this excess gas, you may experience the bends at altitudes under 10,000 feet, where most light planes fly.

ADDITIONAL INFORMATION

In addition to the coverage of subjects in this section, the National Transportation Safety Board and the Federal Aviation Administration periodically issue general aviation pamphlets concerning aviation safety, and in greater detail. These can be obtained at FAA Offices, Weather Stations, Flight Service Stations, or Airport Facilities. These are very good sources of information and are highly recommended for study. Some of these are titled:

Airman's Information Manual
12 Golden Rules for Pilots
Weather or Not

Disorientation
Plane Sense
Weather Info Guide for Pilots
Wake Turbulence
Don't Trust to Luck, Trust to Safety
Thunderstorm – TRW
IFR VFR Either Way Disorientation Can be Fatal