

CESSNA 172RG / PILOT'S OPERATING HANDBOOK

CESSNA MODEL 172RG

PILOT'S OPERATING HANDBOOK



For Flight Training Reference Only

SECTION 1 / GENERAL

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PERFORMANCE - SPECIFICATIONS

SPEED:

Maximum at Sea Level	145 KNOTS
Cruise, 75% Power at 9000 Ft	140 KNOTS

CRUISE: Recommended lean mixture with fuel allowance for engine start, taxi, takeoff, climb and 45 minutes reserve.

75% Power at 9000 Ft	Range	720 NM
62 Gallons Usable Fuel	Time	5.3 HRS
Maximum Range at 10,000 Ft	Range	840 NM
62 Gallons Usable Fuel	Time	7.7 HRS

RATE OF CLIMB AT SEA LEVEL	800 FPM
SERVICE CEILING	16,800 FT

TAKEOFF PERFORMANCE:

Ground Roll	1060 FT
Total Distance Over 50-Ft Obstacle	1775 FT

LANDING PERFORMANCE:

Ground Roll	625 FT
Total Distance Over 50-Ft Obstacle	1340 FT

STALL SPEED (CAS):

Flaps Up, Power Off	54 KNOTS
Flaps Down, Power Off	50 KNOTS

MAXIMUM WEIGHT:

Ramp	2658 LBS
Takeoff or Landing	2650 LBS

STANDARD EMPTY WEIGHT:

Cutlass RG	1558 LBS
Cutlass RG II	1598 LBS

MAXIMUM USEFUL LOAD:

Cutlass RG	1100 LBS
Cutlass RG II	1060 LBS

BAGGAGE ALLOWANCE	200 LBS
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WING LOADING: Pounds/Sq Ft	15.2
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POWER LOADING: Pounds/HP	14.7
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FUEL CAPACITY: Total	66 GAL.
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OIL CAPACITY	9 QTS
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ENGINE: Avco Lycoming	O-360-F1A6
180 BHP at 2700 RPM	

PROPELLER: Constant Speed, Diameter	76.5 IN.
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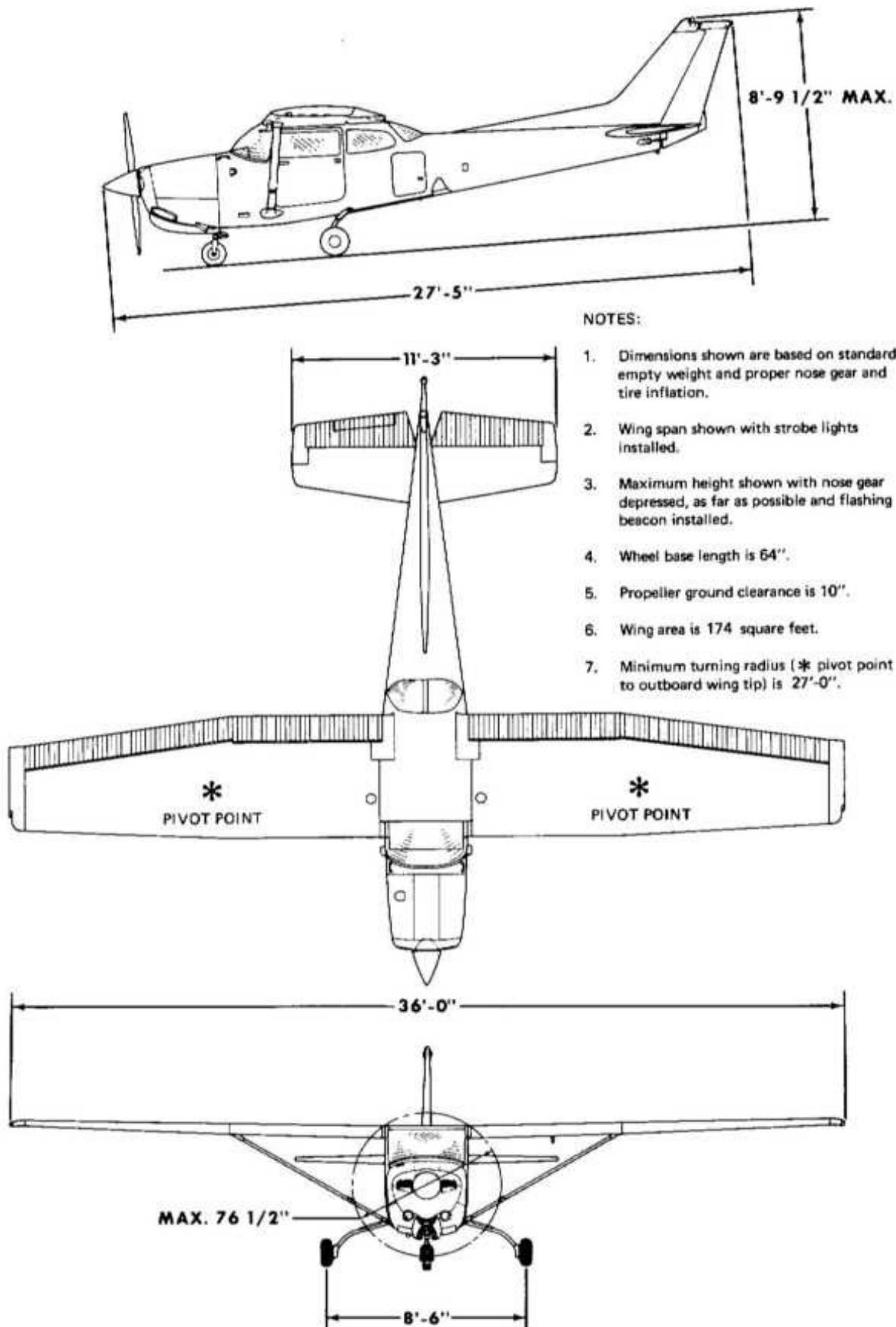


Figure 1-1. Three View

INTRODUCTION

This handbook contains 9 sections, and includes the material required to be furnished to the pilot by CAR Part 3. It also contains supplemental data supplied by Cessna Aircraft Company.

Section 1 provides basic data and information of general interest. It also contains definitions or explanations of symbols, abbreviations, and terminology commonly used.

DESCRIPTIVE DATA

ENGINE

Number of Engines: 1.

Engine Manufacturer: Avco Lycoming.

Engine Model Number: O-360-FIG.

Engine Type: Normally-aspirated, direct-drive, air-cooled, horizontally-opposed, carburetor equipped, four-cylinder engine with 361 cu. in. displacement.

Horsepower Rating and Engine Speed: 180 rated BHP at 2700 RPM.

PROPELLER

Propeller Manufacturer: McCauley Accessory Division.

Propeller Model Number: B2D34C220/SOVHA-3.5

Number of Blades: 2.

Propeller Diameter, Maximum: 76.5 inches.

Minimum: 75.5 inches.

Propeller Type: Constant speed and hydraulically actuated, with a low pitch setting of 12.00 and a high pitch setting of 26.50 (30 inch station).

FUEL

Approved Fuel Grades (and Colors):

IOOLL Grade Aviation Fuel (Blue).

100 (Formerly 100/130) Grade Aviation Fuel (Green).

NOTE

Isopropyl alcohol or ethylene glycol monomethyl ether may be added to the fuel supply. Additive concentrations shall not exceed 1% for isopropyl alcohol or .15% for ethylene glycol monomethyl ether. Refer to Section 8 for additional information.

Total Capacity: 66 gallons.

Total Capacity Each Tank: 33 gallons.

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Total Usable: 52 gallons.

NOTE

To ensure maximum fuel capacity when refueling and minimize cross-feeding when parked on a sloping surface, place the fuel selector valve in either LEFT or RIGHT position.

OIL

Oil Grade (Specification):

MIL-L-6082 Aviation Grade Straight Mineral Oil: Use to replenish supply during first 25 hours and at the first 25-hour oil change. Continue to use until a total of 50 hours has accumulated or oil consumption has stabilized.

MIL-L-22851 Ashless Dispersant Oil: This oil must be used after first 50 hours or oil consumption has stabilized.

Recommended Viscosity For Temperature Range:

MIL-L-6062 Aviation Grade Straight Mineral Oil:

All temperatures use SAE 20W-50 or

Above 16 C (60 F) use SAE 50

-1 C (30⁰F) to 32 C (90⁰F) use SAE 40

-18 C (0⁰F) to 21 C (70 F) use SAE 30

Below -12⁰C (10⁰F) use SAE 20

MIL-L-22851 Ashless Dispersant Oil:

All temperatures use SAE 20W-SO or

Above 1600 (60⁰F) use SAE 40 or SAE 50

-1⁰C (30⁰F) to 3200 (90⁰F) use SAE 40

-18 C (0⁰F) to 2100 (70⁰F) use SAE 40 or SAE 30

Below -12 C (10⁰F) use SAE 30

Oil Capacity:

Sump: 8 Quarts.

Total: 9 Quarts.

MAXIMUM CERTIFICATED WEIGHTS

Ramp: 2658 lbs.

Takeoff: 2650 lbs.

Landing: 2650 lbs.

Weight in Baggage Compartment:

Baggage Area 1 - Station 82 to 108: 200 lbs. See note below. Baggage Area 2 - Station 108 to 124: 50 lbs. See note below.

NOTE

The maximum combined weight capacity for baggage areas 1 and 2 is 200 lbs.

STANDARD AIRPLANE WEIGHTS

Standard Empty Weight, Cutlass RG: 1558 lbs.
Cutlass RG II: 1598 lbs.

Maximum Useful Load, Cutlass RG: 1100 lbs.
Cutlass RG II: 1060 lbs.

CABIN AND ENTRY DIMENSIONS

Detailed dimensions of the cabin interior and entry door openings are illustrated in Section 6.

BAGGAGE SPACE AND ENTRY DIMENSIONS

Dimensions of the baggage area and baggage door opening are illustrated in detail in Section 6.

SPECIFIC LOADINGS

Wing Loading: 15.2 lbs./sq. ft.

Power Loading: 14.7 lbs./hp.

SYMBOLS, ABBREVIATIONS AND TERMINOLOGY

GENERAL AIRSPEED TERMINOLOGY AND SYMBOLS

KCAS Knots Calibrated Airspeed is indicated airspeed corrected for position and instrument error and expressed in knots. Knots calibrated airspeed is equal to KTAS in standard atmosphere at sea level.

KIAS Knots Indicated Airspeed is the speed shown on the airspeed indicator and expressed in knots.

KTAS Knots True Airspeed is the airspeed expressed in knots relative to undisturbed air which is KOAS corrected for altitude and temperature.

V_A Maneuvering Speed is the maximum speed at which you may use abrupt control travel.

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_{NO} Maximum Structural Cruising Speed is the speed that should not be exceeded except in smooth air, then only with caution.

V_{NE} Never Exceed Speed is the speed limit that may not be exceeded at any time.

V_S Stalling Speed or the minimum steady flight speed at which the airplane is controllable.

V_{SO} Stalling Speed or the minimum steady flight speed at which the airplane is controllable in the landing configuration at the most forward center of gravity.

V_X Best Angle-at-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 Y gr6atest gain in altitude in a given time.

METEOROLOGICAL TERMINOLOGY

OAT Outside Air Temperature is the free air static temperature. It is expressed in either degrees Celsius or degrees Fahrenheit.

Standard Temperature is 15 C at sea level pressure altitude and decreases by 2⁰C for each 1000 feet of altitude. ture

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

ENGINE POWER TERMINOLOGY

BHP Brake Horsepower is the power developed by the engine. RPM Revolutions Per Minute is engine speed.

MP Manifold Pressure is a pressure measured in the engine's induction system and is expressed in inches of mercury (Hg).

AIRPLANE PERFORMANCE AND FLIGHT PLANNING TERMINOLOGY

Demonstrated Crosswind Velocity is the velocity of the crosswind component for which adequate control of the airplane during takeoff and landing was actually demonstrated during certification tests. The value shown is not considered to be limiting.

Usable Fuel is the fuel available for flight planning.

Unusable Fuel is the quantity of fuel that can not be safely Fuel used in flight.

GPH Gallons Per Hour is the amount of fuel (in gallons) consumed per hour.

NMPG Nautical Miles Per Gallon is the distance (in nautical miles) which can be expected per gallon of fuel consumed at a specific engine power setting and/or flight configuration.

g is acceleration due to gravity.

WEIGHT AND BALANCE TERMINOLOGY

Reference Datum is an imaginary vertical plane from Datum which all horizontal distances are measured for balance purposes.

Station is a location along the airplane fuselage given in terms of the distance from the reference datum.

Arm is the horizontal distance from the reference datum to the center of gravity (0.0) of an item.

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.)

Center of Gravity (CG) is the point at which an airplane, or equipment, would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.

Center of Gravity Arm is the arm obtained by adding the Arm airplane's individual moments and dividing the sum by the total weight.

Center of Gravity Limits are the extreme center of gravity Limits locations within which the airplane must be operated at a given weight.

Standard Empty Weight is the weight of a standard airplane, including unusable fuel, full operating fluids and full engine oil.

Basic Empty Weight is the standard empty weight plus the Weight weight of optional equipment.

Useful Load is the difference between ramp weight and the basic empty weight.

Maximum Ramp Weight is the maximum weight approved for ground maneuver. (It includes the weight of start, taxi and runup fuel.)

Maximum Takeoff Weight is the maximum weight approved for the start of the takeoff run.

Maximum Landing Weight is the maximum weight approved for the landing touchdown.

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.

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INTRODUCTION

Section 2 includes operating limitations, instrument markings, and basic placards necessary for the safe operation of the airplane, its engine, standard systems and standard equipment. The limitations included in this section and in Section 9 have been approved by the Federal Aviation Administration. Observance of these operating limitations is required by Federal Aviation Regulations.

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.

NOTE

The airspeeds listed in the Airspeed Limitations chart (figure 2-1) and the Airspeed Indicator Markings chart (figure 2-2) are based on Airspeed Calibration data shown in Section 5 with the normal static source, with the exception of the bottom of the green and white arcs on the airspeed indicator. These are based on a power-off air speed calibration. If the alternate static source is being used, refer to the airspeed calibration variations between the normal and alternate static sources as shown in Section 5.

Your Cessna is certificated under FAA Type Certificate No. 3A17 as Cessna Model No. 172RG.

AIRSPPEED LIMITATIONS

Airspeed limitations and their operational significance are shown in figure 2-1.

	SPEED	KCAS	KIAS	REMARKS
V _{NE}	Never Exceed Speed	161	164	Do not exceed this speed in any operation.
V _{NO}	Maximum Structural Cruising Speed	142	145	Do not exceed this speed except in smooth air, and then only with caution.
V _A	Maneuvering Speed: 2650 Pounds 2250 Pounds 1850 Pounds	105 96 87	106 98 89	Do not make full or abrupt control movements above this speed.
V _{FE}	Maximum Flap Extended Speed: To 10° Flaps 10° - 30° Flaps	130 101	130 100	Do not exceed these speeds with the given flap settings.
V _{LO}	Maximum Landing Gear Operating Speed	138	140	Do not extend or retract landing gear above this speed.
V _{LE}	Maximum Landing Gear Extended Speed	161	164	Do not exceed this speed with landing gear extended.
	Maximum Window Open Speed	161	164	Do not exceed this speed with windows open.

Figure 2-1. Airspeed Limitations

AIRSPEED INDICATOR MARKINGS

Airspeed indicator markings and their color code significance are shown in figure 2-2.

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
White Arc	42 - 100	Full Flap Operating Range. Lower limit is maximum weight V_{SO} in landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	50 - 145	Normal Operating Range. Lower limit is maximum weight V_S at most forward C.G. with flaps retracted. Upper limit is maximum structural cruising speed.
Yellow Arc	145 - 164	Operations must be conducted with caution and only in smooth air.
Red Line	164	Maximum speed for all operations.

Figure 2-2. Airspeed Indicator Markings

POWER PLANT LIMITATIONS

Engine Manufacturer: Avco Lycoming.

Engine Model Number: O-360-FIAB.

Engine Operating Limits for Takeoff and Continuous Operations:

Maximum Power: 180 BHP rating.

Maximum Engine Speed: 2700 RPM.

Maximum Cylinder Head Temperature: 500°F (260°C).

Maximum Oil Temperature: 245°F (118°C).

Oil Pressure, Minimum: *25 psi., Maximum: 100 psi.

Fuel Pressure, Minimum: 0.5 psi., Maximum: 8.0 psi.

Propeller Manufacturer: McCauley Accessory Division.

Propeller Model Number: B2D34C220/SOVHA-3.5

Propeller Diameter, Maximum: 76.5 inches. Minimum: 75.5 inches.

Propeller Blade Angle at 30 Inch Station, Low: 12.00., High: 26.5g.

* 20 psi on airplanes modified by Service Kit SK172-85.

POWER PLANT INSTRUMENT MARKINGS

Power plant instrument markings and their color code significance are shown in figure 2-3.

INSTRUMENT	RED LINE	GREEN ARC	RED LINE
	MINIMUM LIMIT	NORMAL OPERATING	MAXIMUM LIMIT
Tachometer: S.L. to 7500 Ft	---	2100 - 2500 (inner arc)	2700 RPM
7500 ft. and above		2100 - 2700 (outer arc)	
Manifold Pressure	---	15 - 25 in. Hg	---
Oil Temperature	---	100 ^o - 245 ^o F	245 ^o F
Cylinder Head Temperature	---	200 ^o - 500 ^o F	500 ^o F
Fuel Pressure	0.5 psi	0.5 - 8.0 psi	8.0 psi
Oil Pressure	*25 psi	*60 - 90 psi	100 psi
Suction	---	4.5 - 5.4 in. Hg	---
Fuel Quantity	E (2 Gal. Unusable Each Tank)	---	---

WEIGHT LIMITS

Maximum Ramp Weight: 2658 lbs.

Maximum Takeoff Weight: 2650 lbs.

Maximum Landing Weight: 2650 lbs.

Maximum Weight in Baggage Compartment:

Baggage Area 1 - Station 82 to 108: 200 lbs. See note below.

Baggage Area 2 - Station 108 to 124: 50 lbs. See note below.

NOTE

The maximum combined weight capacity for baggage areas 1 and 2 is 200 lbs.

CENTER OF GRAVITY LIMITS

Center of Gravity Range:

Forward: 36.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 39.5 inches *aft* of datum at 2650 lbs.

Aft: 46.5 inches aft of datum at all weights.

Moment Change Due To Retracting Landing Gear: +2424 lb-ins. Reference Datum: Front face of firewall.

MANEUVER LIMITS

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

Aerobatic maneuvers, including spins, are not approved.

FLIGHT LOAD FACTOR LIMITS

Flight Load Factors:

*Flaps Up: +3.8 g -1.52g

*Flaps Down: +2.0 g

*The design load factors are 150% of the above, and in all cases, the structure meets or exceeds design loads.

KINDS OF OPERATION LIMITS

The airplane is equipped for day VFR and may be equipped for night VFR and/or IFR operations. FAR Part 91 establishes the minimum required instrumentation and equipment for these operations. The reference to types of flight operations on the operating limitations placard reflects equipment installed at the time of Airworthiness Certificate issuance.

Flight into known icing conditions is prohibited.

FUEL LIMITATIONS

2 Standard Tanks: 33 U.S. gallons each.

Total Fuel: 66 U.S. gallons

Usable Fuel (all flight conditions): 62 U.S. gallons.

Unusable Fuel: 4.0 U.S. gallons.

For Flight Training Reference Only

NOTE

To ensure maximum fuel capacity when refueling and minimize cross-feeding when parked on a sloping surface, place the fuel selector valve in either LEFT or RIGHT position.

Takeoff and land with the fuel selector valve handle in the BOTH position.

Operation on either left or right tank is limited to level flight only.

With 1/4 tank or less, prolonged uncoordinated flight is prohibited when operating on either left or right tank in level flight.

Fuel remaining in the tank after the fuel quantity indicator reads empty (red line) cannot be safely used in flight.

Approved Fuel Grades (and Colors):

100 LL Grade Aviation Fuel (Blue).

100 (Formerly 100/ 130) Grade Aviation Fuel (Green).

OTHER LIMITATIONS

FLAP LIMITATIONS

Approved Takeoff Range:

Above 2550 Pounds Takeoff Weight: 0 deg.

2550 Pounds Takeoff Weight or Less: 0 deg to 10 deg.

Approved Landing Range: 0 deg to 30 deg.

PLACARDS

The following information must be displayed in the form of composite or individual placards.

1. In full view of the pilot; (The "DAY-NIGHT-VFR-IFR" entry, shown on the example below, will vary as the airplane is equipped.)

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 and FAA Approved Airplane Flight Manual.

No acrobatic maneuvers, including spins, approved.

Flight into known icing conditions prohibited.

This airplane is certified for the following flight operations as of date of original airworthiness certificate:

DAY-NIGHT-VFR-IFR

2. Near airspeed indicator:

MAX SPEED - KIAS	
MANEUVER	. . 106
GEAR OPER	. . 140
GEAR DOWN	. . 164

3. On control lock:

CONTROL LOCK - REMOVE BEFORE STARTING ENGINE.

4. On the fuel selector valve:

OFF
LEFT - 30 GAL. LEVEL FLIGHT ONLY
BOTH - 62 GAL. ALL FLIGHT ATTITUDES
BOTH ON FOR TAKEOFF AND LANDING
RIGHT - 30 GAL. LEVEL FLIGHT ONLY

5. On the baggage door:

200 POUNDS MAXIMUM
BAGGAGE
FORWARD OF BAGGAGE DOOR LATCH
50 POUNDS MAXIMUM
BAGGAGE AFT OF BAGGAGE DOOR LATCH
MAXIMUM 200 POUNDS COMBINED
FOR ADDITIONAL LOADING INSTRUCTIONS
SEE WEIGHT AND BALANCE DATA

6. On flap position indicator:

0° to 10°	(Partial flap range with blue color code and 130 kt callout; also, mechanical detent at 10°.)
10° to 30°	White color code and 100 kt callout; also, mechanical detent at 10° and 20°.)

7. Forward of fuel tank filler cap:

FUEL
100LL/100 MIN GRADE AVIATION GASOLINE
CAP. 33.0 U.S. GAL.
CAP. 24.0 U.S. GAL. TO BOTTOM OF FILLER COLLAR

8. Near gear hand pump:

MANUAL
GEAR EXTENSION
1. SELECT GEAR DOWN
2. PULL HANDLE FWD
3. PUMP VERTICALLY

CAUTION
DO NOT PUMP WITH
GEAR UP SELECTED

9. A calibration card is provided to indicate the accuracy of the magnetic compass in 30° increments.

10. On oil filler cap:

OIL
8 QTS

11. Near manifold pressure gage:

WITH LESS THAN 10" MANIFOLD
PRESSURE, AVOID CONTINUOUS
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1750-2050 RPM

SECTION 3
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INTRODUCTION

Section 3 provides checklist and amplified procedures for coping with emergencies that may occur. Emergencies caused by airplane or engine malfunctions are extremely rare if proper preflight inspections and maintenance are practiced. Enroute weather emergencies can be minimized or eliminated by careful flight planning and good judgment when unexpected weather is encountered. However, should an emergency arise, the basic guidelines described in this section should be considered and applied as necessary to correct the problem. Emergency procedures associated with ELT and other optional systems can be found in Section 9.

AIRSPEEDS FOR EMERGENCY OPERATION

Engine Failure After Takeoff:

Wing Flaps Up - - - - - 70 KIAS

Wing Flaps Down - - - - - 65 KIAS

Maneuvering Speed:

2650 Lbs - - - - - 106 KIAS

2250 Lbs - - - - - 98 KIAS

1850 Lbs - - - - - 89 KIAS

Maximum Glide:

2650 Lbs - - - - - 73 KIAS

2250 Lbs - - - - - 67 KIAS

1850 Lbs - - - - - 61 KIAS

Precautionary Landing

With Engine Power - - - - - 65 KIAS

Landing Without Engine Power:

Wing Flaps Up - - - - - 75 KIAS

Wing Flaps Down - - - - - 65 KIAS

OPERATIONAL CHECKLISTS

ENGINE FAILURES

ENGINE FAILURE DURING TAKEOFF RUN

1. Throttle -- IDLE.
2. Brakes -- APPLY.
3. Wing Flaps -- RETRACT.
4. Mixture -- IDLE CUT-OFF.
5. Ignition Switch -- OFF.
6. Master Switch -- OFF.

ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF

1. Airspeed -- 70 KIAS (flaps UP).
65 KIAS (flaps DOWN).
2. Mixture - - IDLE CUT-OFF.
3. Fuel Selector Valve - - OFF.
4. Ignition Switch -- OFF.
5. Wing Flaps - - AS REQUIRED (30 deg recommended).
6. Master Switch - - OFF.

ENGINE FAILURE DURING FLIGHT

1. Airspeed -- 75 KIAS.
2. Carburetor Heat -- ON.
3. Fuel Selector Valve -- BOTH
4. Mixture - - RICH.
5. Ignition Switch -- BOTH (or START if propeller is stopped).
6. Primer -- IN and LOCKED.

FORCED LANDINGS

EMERGENCY LANDING WITHOUT ENGINE POWER

1. Airspeed -- 75 KIAS (flaps UP).
65 KIAS (flaps DOWN).
2. Mixture - - IDLE CUT-OFF.
3. Fuel Selector Valve - - OFF.
4. Ignition Switch - - OFF.
5. Landing Gear -- DOWN (UP if terrain is rough or soft).
6. Wing Flaps -- AS REQUIRED (300 recommended).

For Flight Training Reference Only

7. Doors - - UNLATCH PRIOR TO TOUCHDOWN.
8. Master Switch - - OFF when landing is assured.
9. Touchdown - - SLIGHTLY TAIL LOW.
10. Brakes -- APPLY HEAVILY.

PRECAUTIONARY LANDING WITH ENGINE POWER

1. Wing Flaps 20 deg.
2. Airspeed -- 65 KIAS.
3. Selected Field - - FLY OVER, noting terrain and obstructions, then retract flaps upon reaching a safe altitude and airspeed.
4. Electrical Switches -- OFF.
5. Landing Gear - - DOWN (UP if terrain is rough or soft).
6. Wing Flaps - - 30deg (on final approach).
7. Airspeed -- 65 KIAS.
8. Doors - - UNLATCH PRIOR TO TOUCHDOWN.
9. Avionics Power and Master Switches -- OFF.
10. Touchdown -- SLIGHTLY TAIL LOW.
11. Ignition Switch -- OFF.
12. Brakes - - APPLY HEAVILY.

DITCHING

1. Radio -- TRANSMIT MAYDAY on 121.5 MHz, giving location and intentions and SQUAWK 7700 if transponder is installed.
2. Heavy Objects (in baggage area) -- SECURE OR JETTISON.
3. Landing Gear - - UP.
4. Flaps -- 20 deg - 30 deg.
5. Power -- ESTABLISH 300 FT/MIN DESCENT at 60 KIAS.
6. Approach - - High Winds, Heavy Seas -- INTO THE WIND.
Light Winds, Heavy Swells -- PARALLEL TO SWELLS.

NOTE

If no power is available, approach at 70 KIAS with flaps up or at 65 KIAS with 100 flaps.

7. Cabin Doors -- UNLATCH.
8. Touchdown - - LEVEL ATTITUDE AT ESTABLISHED DESCENT.
9. Face - - CUSHION at touchdown with folded coat.
10. Airplane -- EVACUATE through cabin doors. If necessary, open windows and flood cabin to equalize pressure so doors can be opened.
11. Life Vests and Raft - - INFLATE.

FIRES

DURING START ON GROUND

1. Cranking - - CONTINUE, to get a start which would suck the flames and accumulated fuel through the carburetor and into the engine.

If engine starts:

2. Power -- 1700 RPM for a few minutes.
3. Engine - - SHUTDOWN and inspect for damage.

If engine fails to start:

4. Throttle - - FULL OPEN.
5. Mixture - - IDLE CUT-OFF.
6. Cranking -- CONTINUE.
7. Fire Extinguisher--OBTAIN (have ground attendants obtain if not installed).
8. Engine -- SECURE.
 - a. Master Switch - - OFF.
 - b. Ignition Switch - - OFF.
 - c. Fuel Selector Valve - - OFF.
9. Fire -- EXTINGUISH using fire extinguisher, wool blanket, or dirt.
10. Fire Damage - - INSPECT, repair damage or replace damaged components or wiring before conducting another flight.

ENGINE FIRE IN FLIGHT

1. Mixture - - IDLE CUT-OFF.
2. Fuel Selector Valve - - OFF.
3. Master Switch -- OFF.
4. Cabin Heat and Air - - OFF (except overhead vents).
5. Airspeed - - 105 KIAS (If fire is not extinguished, increase glide speed to find an airspeed which will provide an incombustible mixture).
6. Forced Landing - - EXECUTE (as described in Emergency Landing Without Engine Power).

ELECTRICAL FIRE IN FLIGHT

1. Master Switch -- OFF.
2. Avionics Power Switch - - OFF.
3. All Other Switches (except ignition switch) - - OFF.
4. Vents/Cabin Air/Heat -- CLOSED.
5. Fire Extinguisher - - ACTIVATE (if available).

WARNING

After discharging an extinguisher within a closed cabin, ventilate the cabin.

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

6. Master Switch -- ON.
7. Circuit Breakers -- CHECK for faulty circuit, do not reset.
8. Radio Switches -- OFF.
9. Avionics Power Switch -- ON.
10. Radio/Electrical Switches -- ON one at a time, with delay after each until short circuit is localized.
11. Vents/ Cabin Air/Heat -- OPEN when it is ascertained that fire is completely extinguished.

CABIN FIRE

1. Master Switch -- OFF.
2. Vents/Cabin Air/Heat -- CLOSED (to avoid drafts).
3. Fire Extinguisher - - ACTIVATE (if available).

WARNING

After discharging an extinguisher within a closed cabin, ventilate the cabin.

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

WING FIRE

1. Navigation Light Switch -- OFF.
2. Strobe Light Switch (if installed) - - OFF.
3. Pitot Heat Switch (if installed) -- OFF.

NOTE

Perform a sideslip to keep the flames away from the fuel tank and cabin, and land as soon as possible using flaps only as required for final approach and touchdown.

ICING

INADVERTENT ICING ENCOUNTER

1. Turn pitot heat switch ON (if installed).
2. Turn back or change altitude to obtain an outside air temperature that is less conducive to icing.

3. Pull cabin heat and cabin air controls full out and open defroster valves to obtain maximum defroster airflow.
4. Increase engine speed to minimize ice build-up on propeller blades.
5. Watch for signs of carburetor air filter ice and apply carburetor heat as required. An unexplained loss in manifold pressure could be caused by carburetor ice or air intake filter ice. Lean the mixture if carburetor heat is used continuously.
6. Plan a landing at the nearest airport. With an extremely rapid ice build-up, select a suitable "off airport" landing site.
7. With an ice accumulation of 1/4 inch or more on the wing leading edges, be prepared for significantly higher stall speed.
8. Leave wing flaps retracted. With a severe ice build-up on the horizontal tail, the change in wing wake airflow direction caused by wing flap extension could result in a loss of elevator effectiveness.
9. Open the window and, if practical, scrape ice from a portion of the windshield for visibility in the landing approach.
10. Perform a landing approach using a forward slip, if necessary, for improved visibility.
11. Approach at 80 to 90 KIAS, depending upon the amount of ice accumulation.
12. Perform a landing in level attitude.

STATIC SOURCE BLOCKAGE

(Erroneous Instrument Reading Suspected)

1. Alternate Static Source Valve (if installed) -- PULL ON.
2. Windows -- CLOSED.
3. Airspeed -- Consult appropriate table in Section 5.

LANDING GEAR MALFUNCTION PROCEDURES

LANDING GEAR FAILS TO RETRACT

1. Master Switch -- ON.
2. Landing Gear Lever -- CHECK (lever full up).
3. Landing Gear and Gear Pump Circuit Breakers -- IN.
4. Gear Up Light -- CHECK.
5. Landing Gear Lever -- RECYCLE.
6. Gear Motor -- CHECK operation (ammeter and noise).

LANDING GEAR FAILS TO EXTEND

1. Master Switch -- ON.
2. Landing Gear Lever -- DOWN.
3. Landing Gear and Gear Pump Circuit Breakers -- IN.
4. Emergency Hand Pump--EXTEND HANDLE, and PUMP (perpendicular to handle until resistance becomes heavy -- about 35 cycles).

5. Gear Down Light -- ON.
6. Pump Handle - - STOW.

GEAR UP LANDING

1. Landing Gear Lever -- UP.
2. Landing Gear and Gear Pump Circuit Breakers -- IN.
3. Runway -- SELECT longest hard surface or smooth sod runway available.
4. Wing Flaps - - 300 (on final approach).
5. Airspeed -- 65 KIAS.
6. Doors -- UNLATCH PRIOR TO TOUCHDOWN.
7. Avionics Power and Master Switches -- OFF when landing is assured.
8. Touchdown -- SLIGHTLY TAIL LOW.
9. Mixture -- IDLE CUT-OFF.
10. Ignition Switch -- OFF.
11. Fuel Selector Valve -- OFF.
12. Airplane -- EVACUATE.

LANDING WITHOUT POSITIVE INDICATION OF GEAR LOCKING

1. Before Landing Check -- COMPLETE.
2. Approach -- NORMAL (full flap).
3. Landing Gear and Gear Pump Circuit Breakers -- IN.
4. Landing -- TAIL LOW as smoothly as possible.
5. Braking -- MINIMUM necessary.
6. Taxi -- SLOWLY.
7. Engine -- SHUTDOWN before inspecting gear.

LANDING WITH A DEFECTIVE NOSE GEAR (Or Flat NoseTire)

1. Movable Load -- TRANSFER to baggage area.
 2. Passenger -- MOVE to rear seat.
 3. Before Landing Checklist . - COMPLETE.
 4. Runway -- HARD SURFACE or SMOOTH SOD.
 5. Wing Flaps -- 30 deg
 6. Cabin Doors -- UNLATCH PRIOR TO TOUCHDOWN.
 7. Avionics Power and Master Switches -- OFF when landing is assured.
 8. Land - - SLIGHTLY TAIL LOW.
 9. Mixture -- IDLE CUT-OFF.
 10. Ignition Switch -- OFF.
 11. Fuel Selector Valve -- OFF.
 12. Elevator Control - - HOLD NOSE OFF GROUND as long as possible.
 13. Airplane -- EVACUATE as soon as it stops.

LANDING WITH A FLAT MAIN TIRE

1. Approach -- NORMAL (full flap).
2. Touchdown--GOOD TIRE FIRST, hold airplane off flat tire as long as possible with aileron control.
3. Directional Control -- MAINTAIN using brake on good wheel as required.

ELECTRICAL POWER SUPPLY SYSTEM MALFUNCTIONS

AMMETER SHOWS EXCESSIVE RATE OF CHARGE (Full Scale Deflection)

1. Alternator -- OFF.
2. Alternator Circuit Breaker -- PULL.
3. Nonessential Electrical Equipment -- OFF.
4. Flight -- TERMINATE as soon as practical.

LOW-VOLTAGE LIGHT ILLUMINATES DURING FLIGHT (Ammeter Indicates Discharge)

NOTE

Illumination of the low-voltage light may occur during low RPM conditions with an electrical load on the system such as during a low RPM taxi. Under these conditions, the light will go out at higher RPM. The master switch need not be recycled since an over-voltage condition has not occurred to de-activate the alternator system.

1. Avionics Power Switch -- OFF.
2. Alternator Circuit Breaker -- CHECK IN.
3. Master Switch -- OFF (both sides).
4. Master Switch .- ON.
5. Low-Voltage Light -- CHECK OFF.
6. Avionics Power Switch -- ON.

If low-voltage light illuminates again:

7. Alternator -- OFF.
8. Nonessential Radio and Electrical Equipment -- OFF.
9. Flight -- TERMINATE as soon as practical.

AMPLIFIED PROCEDURES

ENGINE FAILURE

If an engine failure occurs during the takeoff run, the most important thing to do is stop the airplane on the remaining runway. Those extra items on the checklist will provide added safety after a failure of this type.

Prompt lowering of the nose to maintain airspeed and establish a glide attitude is the first response to an engine failure after takeoff. In most cases, the landing should be planned straight ahead with only small changes in direction to avoid obstructions. Altitude and airspeed are seldom sufficient to execute a 180° gliding turn necessary to return to the runway. The checklist procedures assume that adequate time exists to secure the fuel and ignition systems prior to touchdown.

After an engine failure in flight, the best glide speed as shown in figure 3-1 should be established as quickly as possible. While gliding toward a suitable landing area, an effort should be made to identify the cause of the failure. If time permits, an engine restart should be attempted as shown in the checklist. If the engine cannot be restarted, a forced landing without power must be completed.

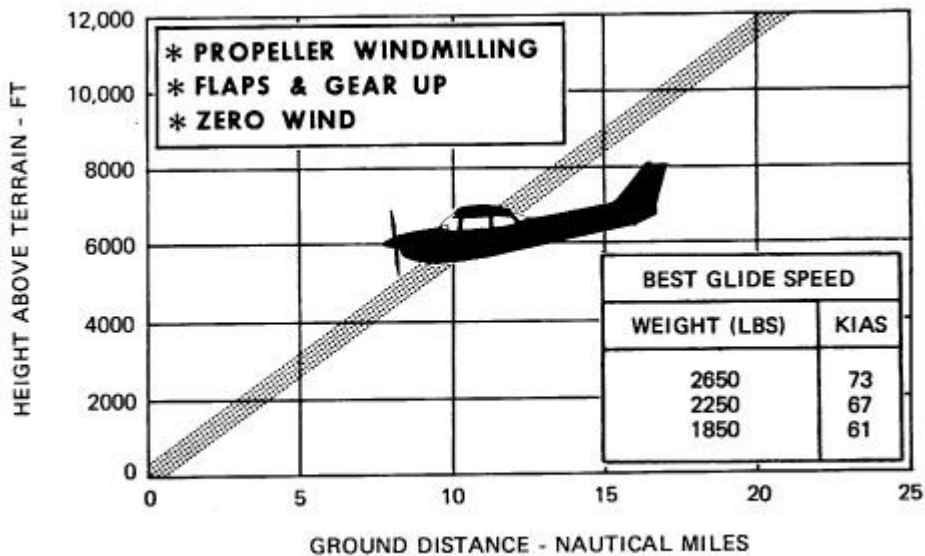


Figure 3-1. Maximum Glide

FORCED LANDINGS

If all attempts to restart the engine fail and a forced landing is imminent, select a suitable field and prepare for the landing as discussed in the checklist for Emergency Landing Without Engine Power.

Before attempting an "off airport" landing with engine power available, one should fly over the landing area at a safe but low altitude to inspect the terrain for obstructions

and surface conditions, proceeding as discussed under the Precautionary Landing With Engine Power checklist.

Prepare for ditching by securing or jettisoning heavy objects located in the baggage area and collect folded coats for protection of occupants' face at touchdown. Transmit Mayday message on 121.5 MHz giving location and intentions and squawk 7700 if a transponder is installed. Avoid a landing flare because of difficulty in judging height over a water surface.

In a forced landing situation, do not turn off the avionics power and master switches until a landing is assured. Premature deactivation of the switches will disable the encoding altimeter and airplane electrical systems.

LANDING WITHOUT ELEVATOR CONTROL

With airspeed below 130 KIAS, simultaneously select gear down and 100 flaps. Trim for horizontal flight with an airspeed of approximately 70 KIAS by using throttle and elevator trim control. Then do not change the elevator trim control setting; control the glide angle by adjusting power exclusively.

At flareout, the nose-down moment resulting from power reduction is an adverse factor and the airplane may hit on the nose wheel. Consequently, at flareout, the elevator trim control should be adjusted toward the nose-up position and the power adjusted so that the airplane will rotate to the horizontal attitude for touchdown. Close the throttle at touchdown.

FIRES

Although engine fires are extremely rare in flight, the steps of the appropriate checklist should be followed if one is encountered. After completion of this procedure, execute a forced landing. Do not attempt to restart the engine. The initial indication of an electrical fire is usually the odor of burning insulation. The checklist for this problem should result in elimination of the fire.

EMERGENCY OPERATION IN CLOUDS (Vacuum System Failure)

In the event of a vacuum system failure during flight, the directional indicator and attitude indicator will be disabled, and the pilot will have to rely on the turn coordinator if he inadvertently flies into clouds. The following instructions assume that only the electrically-powered turn coordinator is operative, and that the pilot is not completely proficient in instrument flying.

EXECUTING A 180 deg TURN IN CLOUDS

Upon inadvertently entering the clouds, an immediate plan should be made to turn back as follows:

1. Note the compass heading.
2. Note the time of the minute hand and observe the position of the sweep second hand on the clock.
3. When the sweep second hand indicates the nearest half-minute, initiate a standard rate left turn, holding the turn coordinator symbolic airplane wing opposite the lower left index mark for 60 seconds. Then roll back to level flight by leveling the miniature airplane.
4. Check accuracy of the turn by observing the compass heading which should be the reciprocal of the original heading.
5. If necessary, adjust heading primarily with skidding motions rather than rolling motions so that the compass will read more accurately.
6. Maintain altitude and airspeed by cautious application of elevator control. Avoid overcontrolling by keeping the hands off the control wheel as much as possible and steering only with rudder.

EMERGENCY DESCENT THROUGH CLOUDS

If conditions preclude reestablishment of VFR flight by a 180degturn, a descent through a cloud deck to VFR conditions may be appropriate. If possible, obtain radio clearance for an emergency descent through clouds. To guard against a spiral dive, choose an easterly or westerly heading to minimize compass card swings due to changing bank angles. In addition, keep hands off the control wheel and steer a straight course with rudder control by monitoring the turn coordinator. Occasionally check the compass heading and make minor corrections to hold an approximate course. Before descending into the clouds, set up a stabilized let-down condition as follows:

1. Extend landing gear.
2. Apply full rich mixture.
3. Apply full carburetor heat.
4. Reduce power to set up a 500 to 800 ft/mm rate of descent.
5. Adjust the elevator and rudder trim control wheels for a stabilized descent at 80 KIAS.
8. Keep hands off control wheel.
7. Monitor turn coordinator and make corrections by rudder alone.
8. Adjust rudder trim to relieve unbalanced rudder force, if present.
9. Check trend of compass card movement and make cautious corrections with rudder to stop turn.
10. Upon breaking out of clouds, resume normal cruising flight.

RECOVERY FROM A SPIRAL DIVE

If a spiral is encountered, proceed as follows:

1. Close the throttle.
2. Stop the turn by using coordinated aileron and rudder control to align the symbolic airplane in the turn coordinator with the horizon reference line.
3. Cautiously apply elevator back pressure to slowly reduce the indicated airspeed to 80 KIAS.
4. Adjust the elevator trim control to maintain an 80 KIAS glide.
5. Keep hands off the control wheel, using rudder control to hold a straight heading. Use rudder trim to relieve unbalanced rudder force, if present.
6. Apply carburetor heat.
7. Clear engine occasionally, but avoid using enough power to disturb the trimmed glide.
8. Upon breaking out of clouds, resume normal cruising flight.

INADVERTENT FLIGHT INTO ICING CONDITIONS

Flight into icing conditions is prohibited. An inadvertent encounter with these conditions can best be handled using the checklist procedures. The best procedure, of course, is to turn back or change altitude to escape icing conditions.

STATIC SOURCE BLOCKED

If erroneous readings of the static source instruments (airspeed, altimeter and vertical speed) are suspected, the alternate static source valve should be pulled on, thereby supplying static pressure to these instruments from the cabin. Cabin pressures will vary with open ventilators or windows and with airspeed. To avoid the possibility of large errors, the windows should not be open when using the alternate static source.

NOTE

In an emergency on airplanes not equipped with an alternate static source, cabin pressure can be supplied to the static pressure instruments by breaking the glass in the face of the vertical speed indicator.

A calibration table is provided in Section S to illustrate the effect of the alternate static source on indicated airspeeds. With the windows closed and the heater and defroster full on, the airspeed indicator may typically read as much as 3 knots slower and the altimeter 35 feet lower in cruise. If the alternate static source must be used for landing, the normal indicated approach speed may be used since the indicated airspeed variations in this configuration are 2 knots or less.

SPINS

Intentional spins are prohibited in this airplane. Should an inadvertent spin occur, the following recovery procedure should be used:

1. RETARD THROTTLE TO IDLE POSITION.
2. PLACE AILERONS IN NEUTRAL POSITION. -
3. APPLY AND **HOLD** FULL RUDDER OPPOSITE TO THE DIRECTION OF ROTATION.
4. JUST **AFTER** THE RUDDER REACHES THE STOP, MOVE THE WHEEL **BRISKLY** FORWARD FAR ENOUGH TO BREAK THE STALL. Full down elevator may be required at aft center of gravity loadings to assure optimum recoveries.
5. **HOLD** THESE CONTROL INPUTS UNTIL ROTATION STOPS
Premature relaxation of the control inputs may extend the recovery.
6. AS ROTATION STOPS, NEUTRALIZE RUDDER, AND MAKE A SMOOTH RECOVERY FROM THE RESULTING DIVE.

NOTE

If disorientation precludes a visual determination of the direction of rotation, the symbolic airplane in the turn coordinator may be referred to for this information.

ROUGH ENGINE OPERATION OR LOSS OF POWER

CARBURETOR ICING

An unexplained drop in manifold pressure and eventual engine roughness may result from the formation of carburetor ice. To clear the ice, apply full throttle and pull the carburetor heat knob full out until the engine runs smoothly: then remove carburetor heat and readjust the throttle. If conditions require the continued use of carburetor heat in cruise flight, use the minimum amount of heat necessary to prevent ice from forming and lean the mixture for smoothest engine operation.

SPARK PLUG FOULING

A slight engine roughness in flight may be caused by one or more spark plugs becoming fouled by carbon or lead deposits. This may be verified by turning the ignition switch momentarily from BOTH to either L or H position. An obvious power loss in single ignition operation is evidence of spark plug or magneto trouble. Assuming that spark plugs are the more likely cause, lean the mixture to the recommended lean setting for cruising flight. If the problem does not clear up in several minutes, determine if a richer mixture setting will produce smoother operation. If not, proceed to the nearest airport for repairs using the BOTH position of the ignition switch unless extreme roughness dictates the use of a single ignition position.

MAGNETO MALFUNCTION

A sudden engine roughness or misfiring is usually evidence of magneto problems. Switching from BOTH to either LB ignition switch position will identify which magneto is malfunctioning. Select different power settings and enrichen the mixture to determine if continued operation on BOTH magnetos is practicable. If not, switch to the good magneto and proceed to the nearest airport for repairs.

ENGINE-DRIVEN FUEL PUMP FAILURE

In the event of an engine-driven fuel pump failure, gravity flow will provide sufficient fuel flow for level or descending flight. However, in a climbing attitude or anytime the fuel pressure drops to 0.5 PSI, the auxiliary fuel pump should be turned on.

LOW OIL PRESSURE

If low oil pressure is accompanied by normal oil temperature, there is a possibility the oil pressure gage or relief valve is malfunctioning. A leak in the line to the gage is not necessarily cause for an immediate precautionary landing because an orifice in this line will prevent a sudden loss of oil from the engine sump. However, a landing at the nearest airport would be advisable to inspect the source of trouble.

If a total loss of oil pressure is accompanied by a rise in oil temperature, there is good reason to suspect an engine failure is imminent. Reduce engine power immediately and select a suitable forced landing field. Use only the minimum power required to reach the desired touchdown spot.

LANDING GEAR MALFUNCTION PROCEDURES

In the event of possible landing gear retraction or extension malfunctions, there are several general checks that should be made prior to initiating the steps outlined in the following paragraphs.

In analyzing a landing gear malfunction, first check that the master switch is ON and the LDG GEAR and GEAR PUMP circuit breakers are in; reset, if necessary. Also, check both landing gear position indicator lights for operation by "pressing-to-test" the light units and rotating them at the same time to check for open dimming shutters. A burned-out bulb can be replaced in flight by using the bulb from the remaining gear position indicator light.

RETRACTION MALFUNCTIONS

If the landing gear fails to retract normally, or an intermittent GEAR UP indicator light is present, check the indicator light for proper operation *and* attempt to recycle the landing gear. Place the landing gear lever in the GEAR DOWN position. When the GEAR DOWN light illuminates, reposition the gear lever in the GEAR UP position for another retraction attempt. If the GEAR UP indicator light still fails to illuminate, the flight may be continued to an airport having maintenance facilities, if practical. If gear motor operation is audible after a period of one minute following gear lever retraction actuation, pull the GEAR PUMP circuit breaker switch to prevent the electric motor from overheating. In this event, remember to re-engage the circuit breaker switch just prior to landing. Intermittent gear motor operation may also be detected by momentary fluctuations of the ammeter needle.

EXTENSION MALFUNCTIONS

Normal landing gear extension time is approximately 5 seconds. If the landing gear will not extend normally, perform the general checks of circuit breakers and master switch and repeat the normal extension procedures at a reduced airspeed of 100 KIAS. The landing gear lever must be in the down position with the detent engaged. If efforts to extend and lock the gear through the normal landing gear system fail, the gear can be manually extended (as long as hydraulic system fluid has not been completely lost) by use of the emergency hand pump. The hand pump is located between the front seats.

A checklist is provided for step-by-step instructions for a manual gear extension.

If gear motor operation is audible after a period of one minute following gear lever extension actuation, pull the GEAR PUMP circuit breaker to prevent the electric motor from overheating. In this event, remember to re-engage the circuit breaker just prior to landing.

GEAR UP LANDINGS

If the landing gear remains retracted or is only partially extended, and all efforts to fully extend it (including manual extension) have failed, plan a wheels-up landing. In preparation for landing, reposition the landing gear lever to GEAR UP and push the LDG GEAR and GEAR PUMP circuit breakers in to allow the landing gear to swing into the gear wells at touchdown. Then proceed in accordance with the checklist.

ELECTRICAL POWER SUPPLY SYSTEM MALFUNCTIONS

Malfunctions in the electrical power supply system can be detected by periodic monitoring of the ammeter and low-voltage warning light; however, the cause of these malfunctions is usually difficult to determine. A broken alternator drive belt or wiring is most likely the cause of alternator failures, although other factors could cause the problem. A damaged or improperly adjusted alternator control unit can also cause malfunctions. Problems of this nature constitute an electrical emergency and should be dealt with immediately. Electrical power malfunctions usually fall into two categories: excessive rate of charge and insufficient rate of charge. The paragraphs below describe the recommended remedy for each situation.

EXCESSIVE RATE OF CHARGE

After engine starting and heavy electrical usage at low engine speeds (such as extended taxiing) the battery condition will be low enough to accept above normal charging during the initial part of a flight. However, after thirty minutes of cruising flight, the ammeter should be indicating less than two needle widths of charging current. If the charging rate were to remain above this value on a long flight, the battery would overheat and evaporate the electrolyte at an excessive rate

Electronic components in the electrical system can be adversely affected by higher than normal voltage. The alternator control unit includes an over-voltage sensor which normally will automatically shut down the alternator if the charge voltage reaches approximately 31.5 volts. If the over-voltage sensor malfunctions or is improperly adjusted, as evidenced by an excessive rate of charge shown on the ammeter, the alternator should be turned off, alternator circuit breaker pulled, nonessential electrical equipment turned off and the flight terminated as soon as practical.

INSUFFICIENT RATE OF CHARGE

NOTE

Illumination of the low-voltage light and ammeter discharge indications may occur during low RPM conditions with an electrical load on the system, such as during a low RPM taxi. Under these conditions, the light will go out at higher RPM. The master switch need not be recycled since an over-voltage condition has not occurred to de-activate the alternator system.

If the over-voltage sensor should shut down the alternator or if the alternator circuit breaker should trip, a discharge rate will be shown on the ammeter followed by illumination of the low-voltage warning light. Since this may be a "nuisance" trip-out, an attempt should be made to reactivate the alternator system. To do this, turn the avionics power switch off, check that the alternator circuit breaker is in, then turn both sides of the master switch off and then on again. If the problem no longer exists, normal alternator charging will resume and the low-voltage light will go off. The

avionics power switch may then be turned back on. If the light illuminates again, a malfunction is confirmed. In this event, the flight should be terminated and/or the current drain on the battery minimized because the battery can supply the electrical system for only a limited period of time. If the emergency occurs at night, power must be conserved for later use of the landing lights and flaps during landing.

SECTION 4

NORMAL PROCEDURES

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INTRODUCTION

Section 4 provides checklist and amplified procedures for the conduct of normal operation. Normal procedures associated with optional systems can be found in Section 9.

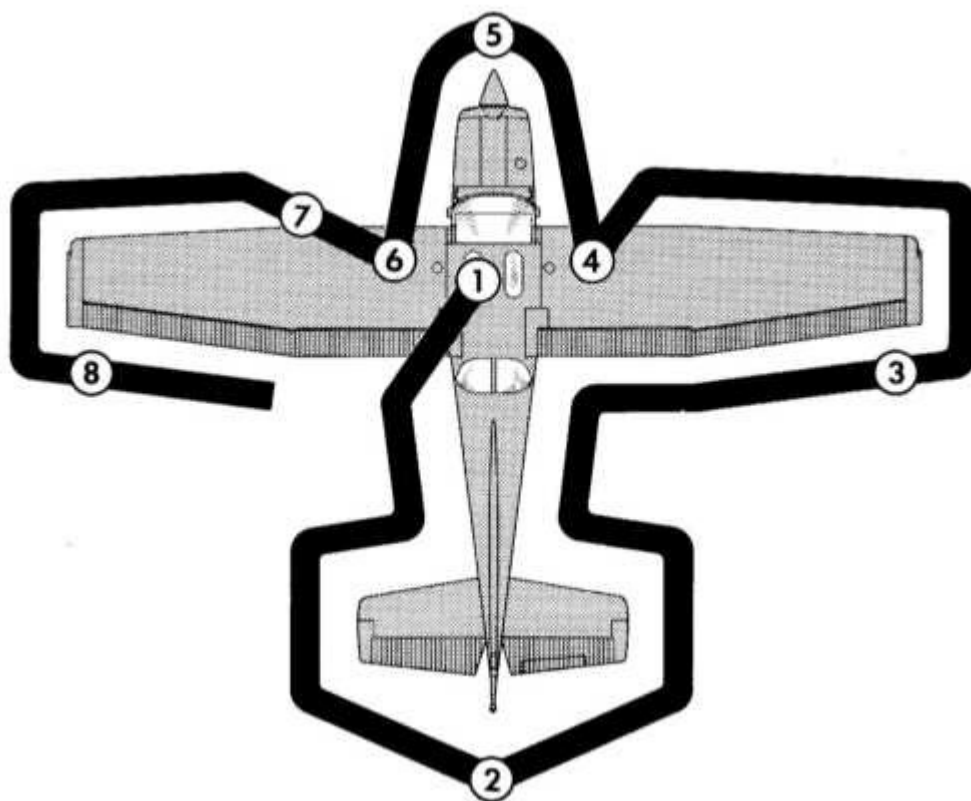
SPEEDS FOR NORMAL OPERATION

Unless otherwise noted, the following speeds are based on a maximum weight of 2650 pounds and may be used for any lesser weight. However, to achieve the performance specified in Section 5 for takeoff distance, the speed appropriate to the particular weight must be used.

Takeoff:

Normal Climb Out	-70-80 KIAS
Short Field Takeoff, Flaps 0 deg, Speed at 50 Feet	63 KIAS
Enroute Climb, Flaps and Gear Up:	
Normal	-85-95 KIAS
Best Rate of Climb, Sea Level	84 KIAS
Best Rate of Climb, 10,000 Feet	77 KIAS
Best Angle of Climb, Sea Level	67 KIAS
Best Angle of Climb, 10,000 Feet	68 KIAS
Landing Approach:	
Normal Approach, Flaps Up	65-75 KIAS
Normal Approach, Flaps 30 deg	60-70 KIAS
Short Field Approach, Flaps 30 deg	63 KIAS
Balked Landing:	
Maximum Power, Flaps 20 deg	55 KIAS
Maximum Recommended Turbulent Air Penetration Speed:	
2650 Lbs	106 KIAS
2250 Lbs	98 KIAS
1850 Lbs	89 KIAS
Maximum Demonstrated Crosswind Velocity:	
Takeoff or Landing	15 KNOTS

PREFLIGHT INSPECTION



NOTE

Visually check airplane for general condition during walk-around inspection. In cold weather, remove even small accumulations of frost, ice or snow from wing, tail and control surfaces. Also, make sure that control surfaces contain no internal accumulations of ice or debris. Prior to flight, check that pitot heater (if installed) is warm to touch within 30 seconds with battery and pitot heat switches on. If a night flight is planned, check operation of all lights, and make sure a flashlight is available.

Figure 4-1. Preflight Inspection

CHECKLIST PROCEDURES

PREFLIGHT INSPECTION

1 CABIN

1. Pilot's Operating Handbook -- AVAILABLE IN THE AIRPLANE.
2. Landing Gear Lever -- DOWN.
3. Control Wheel Lock -- REMOVE.
4. Ignition Switch -- OFF.
5. Avionics Power Switch -- OFF.
6. Master Switch -- ON.

WARNING

When turning on the master switch, using an external power source, or pulling the propeller through by hand, treat the propeller as if the ignition switch were on. Do not stand, nor allow anyone else to stand, within the arc of the propeller, since a loose or broken wire, or a component malfunction, could cause the propeller to rotate.

7. Fuel Quantity Indicators -- CHECK QUANTITY.
8. Landing Gear Position Indicator Light (green) -- ILLUMINATED.
9. Master Switch -- OFF.
10. Fuel Selector Valve -- BOTH.
11. Static Pressure Alternate Source Valve (if installed) -- OFF.
12. Baggage Door -- CHECK for security, lock with key if child's seat is to be occupied.

2 EMPENNAGE

1. Rudder Gust Lock -- REMOVE.
2. Tail Tie-Down -- DISCONNECT.
3. Control Surfaces -- CHECK freedom of movement and security.

3 RIGHT WING Trailing Edge

1. Aileron -- CHECK freedom of movement and security.

4 RIGHT WING

1. Wing Tie-Down -- DISCONNECT.
2. Main Wheel Tire -- CHECK for proper inflation.
3. Before first flight of the day and after each refueling, use sampler cup and drain small quantity of fuel from fuel tank sump quick-drain valve and fuel selector quick-

drain valve (located on bottom of fuselage) to check for water, sediment, and proper fuel grade.

4. Fuel Quantity -- CHECK VISUALLY for desired level.
5. Fuel Filler Cap -- SECURE and vent unobstructed.

5 NOSE

1. Static Source Openings (both sides of fuselage) --CHECK for stoppage.
2. Engine Oil Level -- CHECK. Do not operate with less than five quarts Fill to eight quarts for extended flight.
3. Before first flight of the day and after each refueling, pull out strainer drain knob for about four seconds to clear fuel strainer of possible water and sediment. Check strainer drain closed. If water is observed, the fuel system may contain additional water, and further draining of the system at the strainer, fuel tank sumps, and fuel selector valve will be necessary.
4. Propeller and Spinner -- CHECK for nicks, security and oil leaks.
5. Landing Lights -- CHECK for condition and cleanliness.
6. Nose Gear Doors -- CHECK for security.
7. Nose Wheel Strut and Tire -- CHECK for proper inflation.
8. Nose Tie-Down -- DISCONNECT.

6 LEFT WING

1. Main Wheel Tire -- CHECK for proper inflation.
2. Before first flight of day and after each refueling, use sampler cup and drain small quantity of fuel from fuel tank sump quick-drain valve to check for water, sediment and proper fuel grade.
3. Fuel Quantity -- CHECK VISUALLY for desired level.
4. Fuel Filler Cap -- SECURE.

7 LEFT WING Leading Edge

1. Pitot Tube Cover -- REMOVE and check opening for stoppage.
2. Fuel Tank Vent Opening -- CHECK for stoppage.
3. Stall Warning Vane -- CHECK for freedom of movement while master switch is momentarily turned ON (horn should sound when vane is pushed upward).
4. Wing Tie-Down -- DISCONNECT.

8 LEFT WING Trailing Edge

1. Aileron -- CHECK for freedom of movement and security.

BEFORE STARTING ENGINE

1. Preflight Inspection -- COMPLETE.
2. Seats, Belts, Shoulder Harnesses -- ADJUST and LOOK.
3. Fuel Selector Valve -- BOTH.
4. Avionics Power Switch, Autopilot (if installed), Electrical Equipment -- OFF.

CAUTION

The avionics power switch must be OFF during engine start to prevent possible damage to avionics.

5. Brakes -- TEST and SET.
6. Cowl Flaps -- OPEN (move lever out of locking hole to reposition).
7. Landing Gear Lever -- DOWN
8. Circuit Breakers -- CHECK IN.

STARTING ENGINE

Warm Weather

1. Mixture -- RICH.
2. Propeller -- HIGH RPM.
3. Carburetor Heat -- COLD.
4. Throttle -- PUMP once or twice; leave open 1/4 inch. If engine is hot, turn auxiliary fuel pump ON during start.
5. Propeller Area -- CLEAR.
6. Master Switch -- ON.
7. Ignition Switch -- START (release when engine starts).
8. Oil Pressure -- CHECK.
9. Flashing Beacon and Navigation Lights -- ON as required.
10. Avionics Power Switch -- ON.
11. Radios -- ON.

Cold Weather - With Preheat:

1. With ignition switch OFF and throttle closed, prime the engine two to four strokes as the propeller is being turned over by hand.

NOTE

Use heavy strokes of primer for best atomization of fuel. After priming, push primer all the way in and turn to locked position to avoid possibility of engine drawing fuel through the primer.

2. Propeller Area -- CLEAR.
3. Avionics Power Switch -- OFF.
4. Master Switch -- ON.
5. Mixture -- FULL RICH.
6. Throttle -- OPEN 1/4 INCH.
7. Ignition Switch -- START.

8. Release ignition switch to BOTH when engine starts.
9. Oil Pressure -- CHECK.

Cold Weather - Without Preheat:

1. Prime the engine four to eight strokes while the propeller is being turned by hand with the throttle closed. Leave the primer charged and ready for a stroke.
2. Propeller Area -- CLEAR.
3. Avionics Power Switch -- OFF.
4. Master Switch -- ON.
5. Mixture -- FULL RICH.
6. Pump throttle rapidly to full open twice. Return to 1/4 inch open position.
7. Ignition Switch -- START.
8. Release ignition switch to BOTH when engine starts.
9. Continue to prime engine until it is running smoothly, or alter nately, pump throttle rapidly over first 1/4 of total travel.
10. Oil Pressure -- CHECK.
11. Pull carburetor heat knob full on after engine has started. Leave on until engine is running smoothly.
12. Primer --LOCK.

NOTE

If the engine does not start during the first few attempts, or if engine firing diminishes in strength, it is probable that the spark plugs have been frosted over. Preheat must be used before another start is attempted.

CAUTION

Excessive pumping of the throttle may cause raw fuel to accumulate in the intake manifold, creating a fire hazard in the event of a backfire. If this occurs, maintain a cranking action to suck flames into the engine. An outside attendant with a fire extinguisher is advised for cold starts without preheat.

BEFORE TAKEOFF

1. Parking Brake -- SET.
2. Cabin Doors -- CLOSED and LOCKED.
3. Flight Controls -- FREE and CORRECT.
4. Flight Instruments -- SET.
5. Fuel Selector Valve -- BOTH.
6. Mixture -- RICH (below 3000 feet).
7. Auxilary Fuel Pump -- ON (check for rise in fuel pressure), then OFF

NOTE

In flight, gravity feed will normally supply satisfactory fuel flow if the engine-driven fuel pump should fail. However, if a fuel pump failure causes the fuel pressure to drop below 0.5 PSI, use the auxiliary fuel pump to assure proper engine operation.

8. Elevator and Rudder Trim -- TAKEOFF.
9. Throttle -- 1800 RPM.
 - a. Magnetos -- CHECK (RPM drop should not exceed 150 RPM on either magneto or 50 RPM differential between magnetos).
 - b. Propeller-- CYCLE from high to low RPM; return to high RPM (full in).
 - c. Carburetor Heat -- CHECK (for RPM drop).
 - d. Engine Instruments and Ammeter -- CHECK.
 - e. Suction Gage -- CHECK.
10. Throttle -- 1000 RPM or less.
11. Radios -- SET.
12. Autopilot (if installed) -- OFF.
13. Strobe Lights -- AS DESIRED.
14. Throttle Friction Lock -. ADJUST.
15. Parking Brake -- RELEASE.

TAKEOFF

NORMAL TAKEOFF

1. Wing Flaps -- 0 deg.
2. Carburetor Heat -- COLD.
3. Power -- FULL THROTTLE and 2700 RPM
4. Elevator Control -- LIFT NOSE WHEEL at 55 KIAS.

NOTE

When the nose wheel is lifted, the gear motor may run 1-2 seconds to restore hydraulic pressure.

5. Climb speed -- 70 - 80 KIAS.
6. Brakes -- APPLY momentarily when airborne.
7. Landing Gear -- RETRACT in climb out.

SHORT FIELD TAKEOFF

1. Wing Flaps -- 0deg.
2. Carburetor Heat -- COLD.
3. Brakes -- APPLY.
4. Power -- FULL THROTTLE and 2700 RPM.
5. Brakes -- RELEASE.
6. Elevator Control -- MAINTAIN SLIGHTLY TAIL-LOW ATTITUDE.
7. Climb Speed -- 63 KIAS until all obstacles are cleared.
8. Landing Gear -- RETRACT after obstacles are cleared.

ENROUTE CLIMB

NORMAL CLIMB

1. Airspeed -- 85-95 KIAS.
2. Power -- 25 INCHES Hg and 2500 RPM.
3. Fuel Selector Valve -- BOTH.
4. Mixture - - FULL RICH (mixture may be leaned above 3000 feet).
5. Cowl Flaps -- OPEN as required.

MAXIMUM PERFORMANCE CLIMB

1. Airspeed -- 84 KIAS at sea level to 77 KIAS at 10,000 feet.
2. Power -- FULL THROTTLE and 2700 RPM.
3. Fuel Selector Valve -- BOTH.
4. Mixture -- FULL RICH (mixture may be leaned above 3000 feet).
5. Cowl Flaps -- FULL OPEN.

CRUISE

1. Power -- 15-25 INCHES Hg, 2100-2700 RPM (no more than 75% power).
2. Elevator and Budder Trim - - ADJUST.
3. Mixture -- LEAN.
4. Cowl Flaps -- CLOSED.

DESCENT

1. Fuel Selector Valve -- BOTH.
2. Power -- AS DESIRED.
3. Carburetor Heat -- FULL HEAT AS REQUIRED to prevent carburetor icing.
4. Mixture - - ENRICHEN as required.
5. Cowl Flaps -- CLOSED
6. Wing Flaps--AS DESIRED (0 - 10 deg below 130 KIAS, 10 - 30 deg below 100 KIAS).

NOTE

The landing gear may be extended below 140 KIAS to increase the rate of descent.

BEFORE LANDING

1. Seats, Belts, Shoulder Harnesses -- ADJUST and LOCK.
2. Fuel Selector Valve - - BOTH.
3. Landing Gear -- DOWN (below 140 KIAS).
4. Landing Gear -- CHECK (observe main gear down and green indicator light illuminated).
5. Mixture -- RICH.
6. Carburetor Heat -- ON (apply full heat before closing throttle).
7. Propeller -- HIGH RPM.
- S Autopilot (if installed) -- OFF.

LANDING

NORMAL LANDING

1. Airspeed -- 65-75 KIAS (flaps UP).
2. Wing Flaps --AS DESIRED (0 - 10 deg below 130 KIAS, 10 - 30 deg below 100 KIAS).
3. Airspeed -- 60-70 KIAS (flaps DOWN).
4. Trim -- ADJUST.
5. Touchdown -- MAIN WHEELS FIRST.
6. Landing Roll -- LOWER NOSE WHEEL GENTLY.
7. Braking-- MINIMUM REQUIRED.

SHORT FIELD LANDING

1. Airspeed -- 65-75 KIAS (flaps UP).
2. Wing Flaps -- 30 deg (below 100 KIAS).
3. Airspeed -- MAINTAIN 63 KIAS.
4. Trim -- ADJUST.
5. Power -- REDUCE to idle as obstacle is cleared.
6. Touchdown - - MAIN WHEELS FIRST.
7. Brakes - - APPLY HEAVILY.
8. Wing Flaps - - RETRACT for maximum brake effectiveness.

BALKED LANDING

1. Power -- FULL THROTTLE and 2700 RPM.
2. Carburetor Heat -- COLD.
3. Wing Flaps -- RETRACT to 20 deg.
4. Climb Speed -- 55 KIAS.
5. Wing Flaps - - RETRACT slowly after reaching 65 KIAS.
6. Cowl Flaps -- OPEN.

AFTER LANDING

1. Wing Flaps - - UP.
2. Carburetor Heat -- COLD.
3. Cowl Flaps -- OPEN.

SECURING AIRPLANE

1. Parking Brake -- SET.
2. Throttle -- 1000 RPM.
3. Avionics Power Switch, Electrical Equipment -- OFF.
4. Mixture -- IDLE CUT-OFF (pulled full out).
5. Throttle -- CLOSE as RPM drops.
6. Ignition Switch - - OFF.
7. Master Switch -- OFF.
8. Control Lock - - INSTALL.

AMPLIFIED PROCEDURES

STARTING ENGINE

Ordinarily the engine starts easily with one or two pumps of the throttle in warm temperatures with the mixture full rich. If the engine is hot, turn the auxiliary fuel pump switch ON just prior to and during engine cranking to suppress possible vapor in the fuel line. Turn the auxiliary fuel pump switch OFF after the engine starts. In cooler weather, use of the primer will facilitate engine starting.

NOTE

Additional details concerning cold weather starting and operation may be found under GOLD WEATHER OPERATION paragraphs in this section.

Weak intermittent firing followed by puffs of black smoke from the exhaust stack indicates overpriming or flooding. Excess fuel can be cleared from the combustion chambers by the following procedure: Set the mixture control full lean and the throttle full open; then crank the engine through several revolutions with the starter. Repeat the starting procedure without any additional priming.

If the engine is underprimed (most likely in cold weather with a cold engine) it will not fire at all. Additional priming will be necessary for the next starting attempt.

If prolonged cranking is necessary, allow the starter motor to cool at frequent intervals, since excessive heat may damage the armature.

After starting, if the oil gage does not begin to show pressure within 30 seconds in the summertime and about twice that long in very cold weather, stop engine and investigate. Lack of oil pressure can cause serious engine damage. After starting, avoid the use of carburetor heat unless icing conditions prevail.

TAXIING

When taxiing, it is important that speed and use of brakes be held to a minimum and that all controls be utilized (see Taxiing Diagram figure 4- 2) to maintain directional control and balance.

The carburetor heat control knob should be pushed full in during all ground operations unless heat is absolutely necessary for smooth engine operation. When the knob is pulled out to the heat position, air entering the engine is not filtered.

Taxiing over loose gravel or cinders should be done at low engine speed to avoid abrasion and stone damage to the propeller tips.

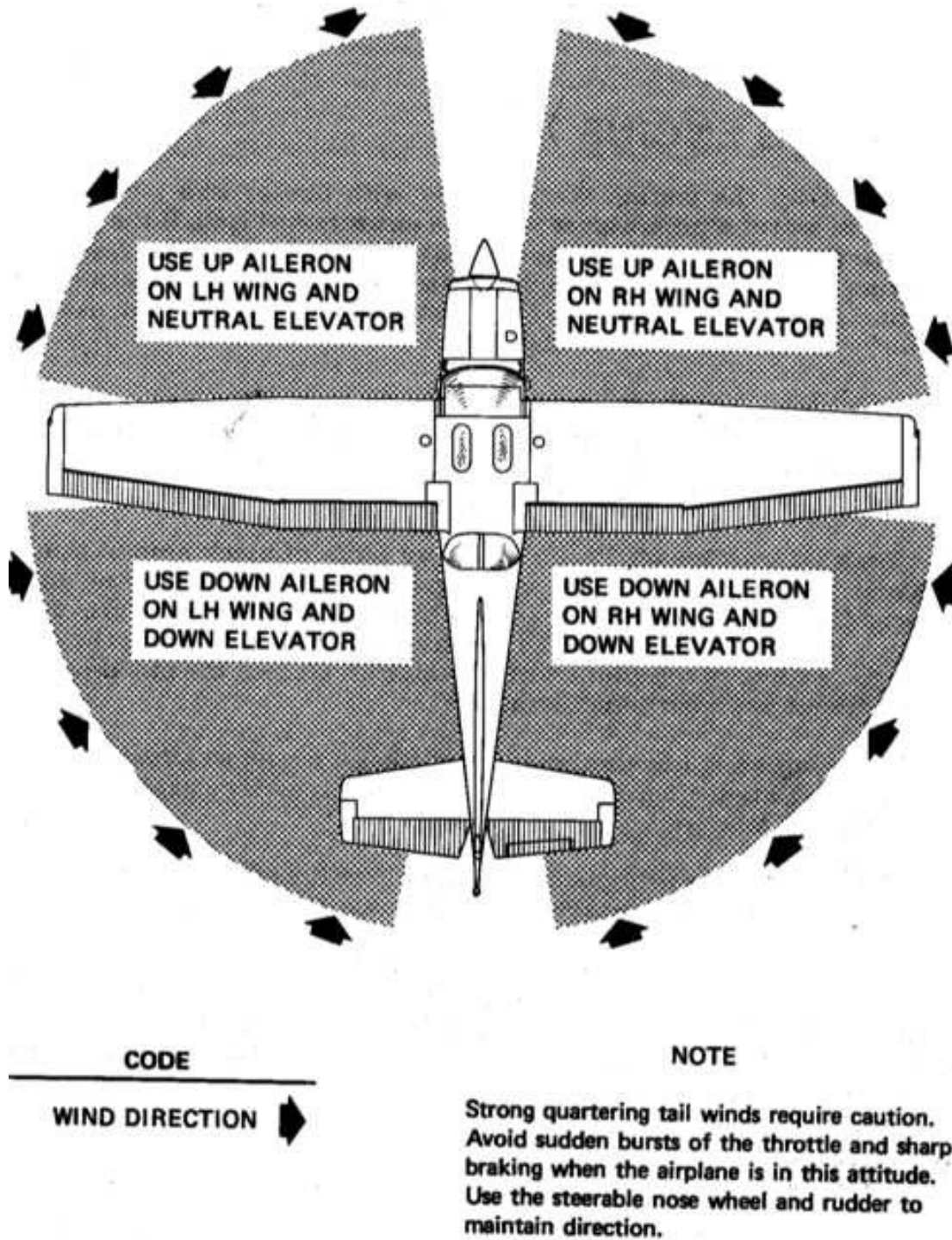


Figure 4-2. Taxiing Diagram

BEFORE TAKEOFF

WARM-UP

Since the engine is closely cowled for efficient in-flight cooling, precautions should be taken to avoid overheating on the ground. Full power checks on the ground are not recommended unless the pilot has good reason to suspect that the engine is not turning up properly.

MAGNETO CHECK

The magneto check should be made at 1800 RPM as follows. Move ignition switch first to L position and note RPM. Next move switch back to BOTH to clear the other set of plugs. Then move switch to the R position, note RPM and return the switch to the BOTH position. RPM drop should not exceed 150 RPM on either magneto or show greater than 50 RPM differential between magnetos. If there is a doubt concerning operation of the ignition system, RPM checks at higher engine speeds will usually confirm whether a deficiency exists.

An absence of RPM drop may be an indication of faulty grounding of one side of the ignition system or should be cause for suspicion that the magneto timing is set in advance of the setting specified.

ALTERNATOR CHECK

Prior to flights where verification of proper alternator and alternator control unit operation is essential (such as night or instrument flights), a positive verification can be made by loading the electrical system momentarily (3 to 5 seconds) with the landing lights during the engine runup (1700 RPM). The ammeter will remain within a needle width of the initial reading if the alternator and alternator control unit are operating properly.

TAKEOFF

POWER CHECK

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

Full power runups over loose gravel are especially harmful to propeller tips. When takeoffs must be made over a gravel surface, 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. When unavoidable small dents appear in the propeller blades they should be corrected immediately as described in Section 8 under Propeller Care.

After full power is applied, adjust the throttle friction lock clockwise to prevent the throttle from creeping from a maximum power position. Similar friction lock adjustment should be made as required in other flight conditions to maintain a fixed throttle setting.

WING FLAP SETTINGS

Normal and short field takeoffs are accomplished with wing flaps 0 deg. To clear an obstacle, an obstacle clearance speed of 63 KIAS should be used.

Soft field takeoffs are performed by lifting the airplane off the ground as soon as practical in a slightly tail-low attitude. If no obstacles are ahead, the airplane should be leveled off immediately to accelerate to a safer climb speed.

At takeoff weights of 2550 pounds or less, 100 flaps may be used if desired for minimum ground runs or takeoffs from soft or rough fields.

CROSSWIND TAKEOFF

Takeoffs into strong crosswinds normally are performed with the minimum flap setting necessary for the field length, to minimize the drift angle immediately after takeoff. With the ailerons partially deflected into the wind, the airplane is accelerated to a speed slightly higher than normal, and then pulled 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.

LANDING GEAR RETRACTION

Landing gear retraction normally is started after reaching the point over the runway where a wheels-down, forced landing on that runway would become impractical. Since the landing gear swings downward approximately two feet as it starts the retraction cycle, damage can result by retracting it before obtaining at least that much ground clearance.

Before retracting the landing gear, the brakes should be applied momentarily to stop wheel rotation. Centrifugal force caused by the rapidly-spinning wheel expands the diameter of the tire. If there is an accumulation of mud or ice in the wheel wells, the rotating wheel may rub as it is retracted into the wheel well.

ENROUTE CLIMB

Normal climbs are performed at 85-95 KIAS with flaps up, 25 In. Hg. or full throttle (whichever is less) and 2500 RPM for the best combination of engine cooling, rate of climb and forward visibility. If it is necessary to climb rapidly to clear mountains or reach favorable winds at high altitudes, the best rate-of-climb speed should be used with maximum power. This speed is 84 KIAS at sea level, decreasing to 77 KIAS at 10,000 feet.

If an obstruction ahead requires a steep climb angle, a best angle-of-climb speed should be used with landing gear and flaps up and maximum power. This speed is 67 KIAS at sea level, increasing to 68 KIAS at 10,000 feet.

The mixture should be full rich during climb at altitudes up to 3000 feet. Above 3000 feet, the mixture may be leaned for increased power and smooth engine operation. With the optional Cessna Economy Mixture Indicator, the mixture may be leaned to maintain the EGT indication corresponding to full rich at 3000 feet. Without an EGT indicator, the mixture may be leaned to momentary engine roughness and then enriched two full turns at the mixture control knob. Each of these procedures result in approximately the same mixture and will significantly improve high altitude climb performance.

CRUISE

Normal cruising is performed between 55% and 75% power. The corresponding power settings and fuel consumption for various altitudes can be determined by using your Cessna Power Computer or the data in Section 5.

NOTE

Cruising should be done at a minimum of 75% power until a total of 25 hours has accumulated or oil consumption has stabilized. Operation at this higher power will ensure proper seating of the rings and is applicable to new engines, and engines in service following cylinder replacement or top overhaul of one or more cylinders. The Cruise Performance Table, figure 4-3, illustrates the true airspeed and nautical miles per gallon during cruise for various altitudes and percent powers. This table should be used as a guide, along with the available winds aloft information, to determine the most favorable altitudes and power setting for a given trip. The selection of cruise altitude on the basis of the most favorable wind conditions and the use of low power settings are significant factors that should be considered on every trip to reduce fuel consumption.

The tachometer is marked with a green arc from 2100 to 2700 RPM with a step at 2500 RPM. The use of 2500 RPM will allow 75% power at altitudes up to 7500 feet on a standard day. For hot day or high altitude conditions, the cruise RPM may be increased to 2700 RPM. Cruise at 2700 RPM permits the use of 75% power at altitudes up to 9000 feet on a standard day. However, for reduced noise levels it is desirable to select the lowest RPM in the green arc range for a given percent power that will provide smooth engine operation.

The cowl flaps should be opened, if necessary, to maintain the cylinder head temperature at approximately two-thirds of the normal operating range (green arc).

Cruise performance data in this handbook and on the power computer is based on a recommended lean mixture setting which may be established as follows:

1. Lean the mixture until the engine becomes rough.
2. Enrichen the mixture to obtain smooth engine operation; then further enrichen an equal amount.

	75% POWER		65% POWER		55% POWER	
ALTITUDE	KTAS	NMPG	KTAS	NMPG	KTAS	NMPG
3000	132	13.2	124	14.2	114	15.0
6000	136	13.6	127	14.6	116	15.3
9000	140	14.0	130	14.9	118	15.6

Standard Conditions Zero Wind

Figure 4-3. Cruise Performance Table

For best fuel economy at 75% power or less, the engine may be operated at the leanest mixture that results in smooth engine operation. This will result in approximately 8% greater range than shown in this handbook accompanied by approximately 3 knots decrease in speed.

Any change in altitude, power or carburetor heat will require a change in the recommended lean mixture setting and a recheck of the EGT setting (if installed).

Carburetor ice, as evidenced by an unexplained drop in manifold pressure, can be removed by application of full carburetor heat. Upon regaining the original manifold pressure indication (with heat off), use the minimum amount of heat (by trial and error) to prevent ice from forming. Since the heated air causes a richer mixture, readjust the mixture setting when carburetor heat is to be used continuously in cruise flight.

LEANING WITH A CESSNA ECONOMY MIXTURE INDICATOR (EGT)

Exhaust gas temperature (EGT) as shown on the optional Cessna Economy Mixture Indicator may be used as an aid for mixture leaning in cruising flight at 75% power or less. To adjust the mixture, using this indicator, lean to establish the peak EGT as a reference point and then enrichen the mixture by a desired increment based on data in figure 4-4.

As noted in the table, operation at peak EGT provides best fuel economy. This results in approximately 8% greater range than shown in this handbook accompanied by approximately 3 knots decrease in speed.

When leaning the mixture under some conditions, engine roughness may occur before peak EGT is reached. In this case, use the EGT corresponding to the onset of roughness as the reference point instead of peak EGT.

MIXTURE DESCRIPTION	EXHAUST GAS TEMPERATURE
RECOMMENDED LEAN (Pilot's Operating Handbook and Power Computer)	50 F Rich of Peak EGT
BEST ECONOMY	Peak EGT

Figure 4-4. EGT Table

STALLS

The stall characteristics are conventional and aural warning is provided by a stall warning horn which sounds between 5 and 10 knots above the stall in all configurations.

Power-off stall speeds at maximum weight for both forward and aft GO. positions are presented in Section 5.

BEFORE LANDING

In view of the relatively low drag of the extended landing gear and the high allowable gear operating speed (140 KIAS), the landing gear should be extended before entering the traffic pattern. This practice will allow more time to confirm that the landing gear is down and locked. As a further precaution, leave the landing gear extended in go-around procedures or traffic patterns for touch-and-go landings.

Landing gear extension can be detected by illumination of the gear down indicator light (green), absence of a gear warning horn with the throttle retarded below 12 inches of manifold pressure and/or the wing flaps extended beyond 200, and visual inspection of the main gear position. Should the gear indicator light fail to illuminate, the light should be checked for a burned-out bulb by pushing to test. A burned-out bulb can be replaced in flight with the landing gear up (amber) indicator light.

LANDING

NORMAL LANDING

Landings should be made on the main wheels first to reduce the landing speed and the subsequent need for braking in the landing roll. The nose wheel is lowered gently to the runway after the speed has diminished to avoid unnecessary nose gear load. This procedure is especially important in rough field landings.

SHORT FIELD LANDING

For a short field landing over an obstacle, make a relatively steep, low power approach at 63 KIAS with 30 deg flaps. As the obstacle is cleared, reduce power to idle, maintain 63 KIAS and flare to land on the main wheels first. Immediately after touchdown, lower the nose gear to the ground and apply heavy braking as required. For maximum brake effectiveness after all three wheels are on the ground, retract the flaps, hold full nose up elevator and apply maximum possible brake pressure without sliding the tires.

CROSSWIND LANDING

When landing in a strong crosswind, use the minimum flap setting required for the field length. Although the crab or combination method of drift correction may be used, the wing-low method gives the best control. After touchdown, hold a straight course with the steerable nose wheel and occasional braking if necessary.

BALKED LANDING

In a bailed landing (go-around) climb, the wing flap setting should be reduced to 200 immediately after full power is applied. After all obstacles are cleared and a safe altitude and airspeed are obtained, the wing flaps should be retracted.

COLD WEATHER OPERATION

STARTING

Prior to starting on cold mornings, it is advisable to pull the propeller through several times by hand to "break loose" or "limber" the oil, thus conserving battery energy.

NOTE

For Flight Training Reference Only

When pulling the propeller through by hand, treat it as if the ignition switch is turned on. A loose or broken ground wire on either magneto could cause the engine to fire.

In extremely cold (-18°C and lower) weather, the use of an external pre heater and an external power source are recommended whenever possible to obtain positive starting and to reduce wear and abuse to the engine and the electrical system. Pre-heat will thaw the oil trapped in the oil cooler, which probably will be congealed prior to starting in extremely cold temperatures. When using an external power source, the position of the master switch is important. Refer to Section 9, Supplements, for Ground Service Plug Receptacle operating details.

Cold weather starting procedures are as follows:

With Preheat:

1. With ignition switch OFF and throttle closed, prime the engine two to four strokes as the propeller is being turned over by hand.

NOTE

Use heavy strokes of primer for best atomization of fuel. After priming, push primer all the way in and turn to locked position to avoid possibility of engine drawing fuel through the primer.

2. Propeller Area -- CLEAR.
3. Avionics Power Switch -- OFF.
4. Master Switch -- ON.
5. Mixture -- FULL RICH.
6. Throttle -- OPEN 1/4 INCH.
7. Ignition Switch -- START.
8. Release ignition switch to BOTH when engine starts.
9. Oil Pressure -- CHECK.

Without Preheat:

1. Prime the engine four to eight strokes while the propeller is being turned by hand with the throttle closed. Leave the primer charged and ready for a stroke.
2. Propeller Area -- CLEAR.
3. Avionics Power Switch -- OFF.
4. Master Switch -- ON.
5. Mixture -- FULL RICH.
6. Pump throttle rapidly to full open twice. Return to 1/4 inch open position.
7. Ignition Switch -- START.
8. Release ignition switch to BOTH when engine starts.
9. Continue to prime engine until it is running smoothly, or alternately, pump throttle rapidly over first 1/4 of total travel.
10. Oil Pressure -- CHECK.
11. Pull carburetor heat knob full on after engine has started. Leave on until engine is running smoothly.
12. Primer --LOCK.

NOTE

For Flight Training Reference Only

If the engine does not start during the first few attempts, or if engine firing diminishes in strength, it is probable that the spark plugs have been frosted over. Preheat must be used before another start is attempted.

CAUTION

Excessive pumping of the throttle may cause raw fuel to accumulate in the intake manifold, creating a fire hazard in the event of a backfire. If this occurs, maintain a cranking action to suck flames into the engine. An outside attendant with a fire extinguisher is advised for cold starts without preheat.

OPERATION

During cold weather operations, no indication will be apparent on the oil temperature gage 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.

Rough engine operation in cold weather can be caused by a combination of an inherently leaner mixture due to the dense air and poor vaporization and distribution of the fuel-air mixture to the cylinders. The effects of these conditions are especially noticeable during operation on one magneto in ground checks where only one spark plug fires in each cylinder.

For optimum operation of the engine in cold weather, the appropriate use of carburetor heat may be necessary. The following procedures are indicated as a guideline:

1. Use the minimum carburetor heat required for smooth operation in takeoff, climb, and cruise.

NOTE

Care should be exercised when using partial carburetor heat to avoid icing. Partial heat may raise the carburetor air temperature to 00 to 2100 range where icing is critical under certain atmospheric conditions.

2. If the airplane is equipped with a carburetor air temperature gage, it can be used as a reference in maintaining carburetor air temperature at or slightly above the top of the yellow arc by application of carburetor heat.

HOT WEATHER OPERATION

The general warm temperature starting information in this section is appropriate. Avoid prolonged engine operation on the ground.

NOISE ABATEMENT

Increased emphasis on improving the quality of our environment requires renewed effort on the part of all pilots to minimize the effect of airplane noise on the public.

We, as pilots, can demonstrate our concern for environmental improvement, by application of the following suggested procedures and thereby tend to build public support for aviation:

1. Pilots operating aircraft under VFR over outdoor assemblies of persons, recreational and park areas, and other noise-sensitive areas should make every effort to fly not less than 2000 feet above the surface, weather permitting, even though flight at a lower level may be consistent with the provisions of government regulations.
2. During departure from or approach to an airport, climb after takeoff and descent for landing should be made so as to avoid prolonged flight at low altitude near noise-sensitive areas.

NOTE

The above recommended procedures do not apply where they would conflict with Air Traffic Control clearances or instructions, or where, in the pilot's judgment, an altitude of less than 2000 feet is necessary for him to adequately exercise his duty to see and avoid other aircraft.

The certificated noise level for the Model 172RG at 2650 pounds maximum weight is 73.9 dB(A). No determination has been made by the Federal Aviation Administration that the noise levels of this airplane are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

SECTION 5

PERFORMANCE

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 Endurance Profile - 62 Gallons Fuel

Figure 5-10, Landing Distance 5-27

INTRODUCTION

Performance data charts on the following pages are presented so that you may know what to expect from the airplane under various conditions, and also, to facilitate the planning of flights in detail and with reasonable accuracy. The data in the charts has been computed from actual flight tests with the airplane and engine in good condition and using average piloting techniques.

It should be noted that the performance information presented in the range and endurance profile charts allows for 45 minutes reserve fuel at the specified cruise power. Fuel flow data for cruise is based on the recommended lean mixture setting. Some indeterminate variables such as mixture leaning technique, fuel metering characteristics, engine and propeller condition, and air turbulence may account for variations of 10% or more in range and endurance. Therefore, it is important to utilize all available information to estimate the fuel required for the particular flight.

USE OF PERFORMANCE CHARTS

Performance data is presented in tabular or graphical form to illustrate the effect of different variables. Sufficiently detailed information is provided in the tables so that conservative values can be selected and used to determine the particular performance figure with reasonable accuracy.

SAMPLE PROBLEM

The following sample flight problem utilizes information from the various charts to determine the predicted performance data for a typical flight. The following information is known:

AIRPLANE CONFIGURATION

Takeoff weight	2600 Pounds
Usable fuel	44 Gallons

TAKEOFF CONDITIONS

Field pressure altitude	1500 Feet
Temperature	28 C (16 C above standard)
Wind component along runway	12 Knot Headwind
Field length	3500 Feet

CRUISE CONDITIONS

Total distance	425 Nautical Miles
Pressure altitude	7500 Feet
Temperature	16 C (16 C above standard)
Expected wind enroute	10 Knot Headwind

LANDING CONDITIONS

Field pressure altitude	2000 Feet
Temperature	25 C
Field length	3000 Feet

TAKEOFF

The takeoff distance chart, figure 5-4, should be consulted, keeping in mind that the distances shown are based on the short field technique. Conservative distances can be established by reading the chart at the next higher value of weight, altitude and temperature. For example, in this particular sample problem, the takeoff distance information presented for a weight of 2650 pounds, pressure altitude of 2000 feet and a temperature of 30 C should be used and results in the following:

Ground roll	1410 Feet
Total distance to clear a 50-foot obstacle	2380 Feet

These distances are well within the available takeoff field length. However, a correction for the effect of wind may be made based on NoteS of the takeoff chart. The correction for a 12 knot headwind is:

$$\frac{12 \text{ Knots}}{9 \text{ Knots}} \times 10\% = 13\% \text{ Decrease}$$

This results in the following distances, corrected for wind:

Ground roll, zero wind	1410
Decrease in ground roll (1410 feet 13%)	- <u>183</u>
Corrected ground roll	1227 Feet

Total distance to clear a 50-foot obstacle, zero wind	2380
Decrease in total distance (2380 feet x 13%)	- <u>309</u>
Corrected total distance to clear 50-foot obstacle	2071 Feet

CRUISE

The cruising altitude should be selected based on a consideration of trip length, winds aloft, and the airplane's performance. A cruising altitude and the expected wind enroute have been given for this sample problem. However, the power setting selection for cruise must be determined based on several considerations. These include the cruise performance characteristics presented in figure 5-7, the range profile chart presented in figure 5-8, and the endurance profile chart presented in figure 5-9.

The relationship between power and range is illustrated by the range profile chart. Considerable fuel savings and longer range result when lower power settings are used. For this sample problem, a cruise power of approximately 65% will be used.

The cruise performance chart for 8000 feet pressure altitude is entered using 20 C above standard temperature. These values most nearly correspond to the planned altitude and expected temperature conditions. The power setting chosen is 2300 RPM and 22 inches of manifold pressure, which results in the following:

Power 65%

True airspeed 132 Knots

Cruise fuel flow 8.8 GPH

The power computer may be used to determine power and fuel consumption more accurately during the flight.

FUEL REQUIRED

The total fuel requirement for the flight may be estimated using the performance information in figures 5-6 and 5-7. For this sample problem, figure 5-6 shows that a normal climb from 2000 feet to 8000 feet requires 2.4 gallons of fuel. The corresponding distance during the climb is 20 nautical miles. These values are for a standard temperature and are sufficiently accurate for most flight planning purposes. However, a further correction for the effect of temperature may be made as noted on the climb chart. The approximate effect of a non-standard temperature is to increase the time, fuel, and distance by 10% for each 10 C above standard temperature, due to the lower rate of climb. In this case, assuming a temperature 16 C above standard, the correction would be:

$$\frac{16 \text{ C}}{10 \text{ C}} \times 10\% = 16\% \text{ Increase}$$

With this factor included, the fuel estimate would be calculated as follows:

Fuel to climb, standard temperature	2.4
Increase due to non-standard temperature (2.4 X 16%)	<u>0.4</u>
Corrected fuel to climb	2.8 Gallons

Using a similar procedure for the distance during climb results in 23 nautical miles.

The resultant cruise distance is:

Total distance	425
Climb distance	<u>-23</u>
Cruise distance	402 Nautical Miles

With an expected 10 knot headwind, the ground speed for cruise is predicted to be:

$$\begin{array}{r} 132 \\ -10 \\ \hline 122 \text{ Knots} \end{array}$$

T

herefore, the time required for the cruise portion of the trip is:

$$\frac{402 \text{ Nautical Miles}}{122 \text{ Knots}} = 3.3 \text{ Hours}$$

The fuel required for cruise is:

$$3.3 \text{ hours} \times 8.8 \text{ gallons/hour} = 29.0 \text{ Gallons}$$

A 45-minute reserve requires:

$$\frac{45}{60} \times 8.8 \text{ gallons per hour} = 6.6 \text{ Gallons}$$

The total estimated fuel required is as follows:

Engine start, taxi, and takeoff	1.4
Climb	2.8
Cruise	29.0
Reserve	<u>6.6</u>
Total fuel required	39.8 Gallons

Once the flight is underway, ground speed checks will provide a more accurate basis for estimating the time enroute and the corresponding fuel required to complete the trip with ample reserve.

LANDING

A procedure similar to takeoff should be used for estimating the landing distance at the destination airport. Figure 5-10 presents landing distance information for the short field technique. The distances corresponding to 2000 feet pressure altitude and a temperature of 30 C are as follows:

Ground roll	705 Feet
Total distance to clear a 50-foot obstacle	1465 Feet

A correction for the effect of wind may be made based on Note 2 of the landing chart using the same procedure as outlined for takeoff.

DEMONSTRATED OPERATING TEMPERATURE

Satisfactory engine cooling has been demonstrated for this airplane with an outside air temperature 23 C above standard. This is not to be considered as an operating limitation. Reference should be made to Section 2 for engine operating limitations.

AIRSPEED CALIBRATION NORMAL STATIC SOURCE

CONDITIONS:
Power required for level flight or maximum power during descent.

FLAPS UP												
KIAS	50	60	70	80	90	100	110	120	130	140	150	160
KCAS	55	63	71	80	89	99	108	118	128	138	147	157
FLAPS 10°												
KIAS	40	50	60	70	80	90	100	110	120	130	---	---
KCAS	50	54	62	71	81	91	100	110	120	130	---	---
FLAPS 30°												
KIAS	40	50	60	70	80	90	100	---	---	---	---	---
KCAS	47	54	62	71	81	90	101	---	---	---	---	---

Figure 5-1. Airspeed Calibration (Sheet 1 of 2)

ALTERNATE STATIC SOURCE

HEATER AND DEFROSTER FULL ON AND WINDOWS CLOSED

FLAPS UP												
NORMAL KIAS	50	60	70	80	90	100	110	120	140	160		
ALTERNATE KIAS	46	58	69	79	88	98	108	117	136	155		
FLAPS 10°												
NORMAL KIAS	50	60	70	80	90	100	110	120	130	---		
ALTERNATE KIAS	45	58	69	80	90	100	109	119	128	---		
FLAPS 30°												
NORMAL KIAS	50	60	70	80	90	100	---	---	---	---		
ALTERNATE KIAS	46	58	68	78	87	96	---	---	---	---		

Figure 5-1. Airspeed Calibration (Sheet 2 of 2)

TEMPERATURE CONVERSION CHART

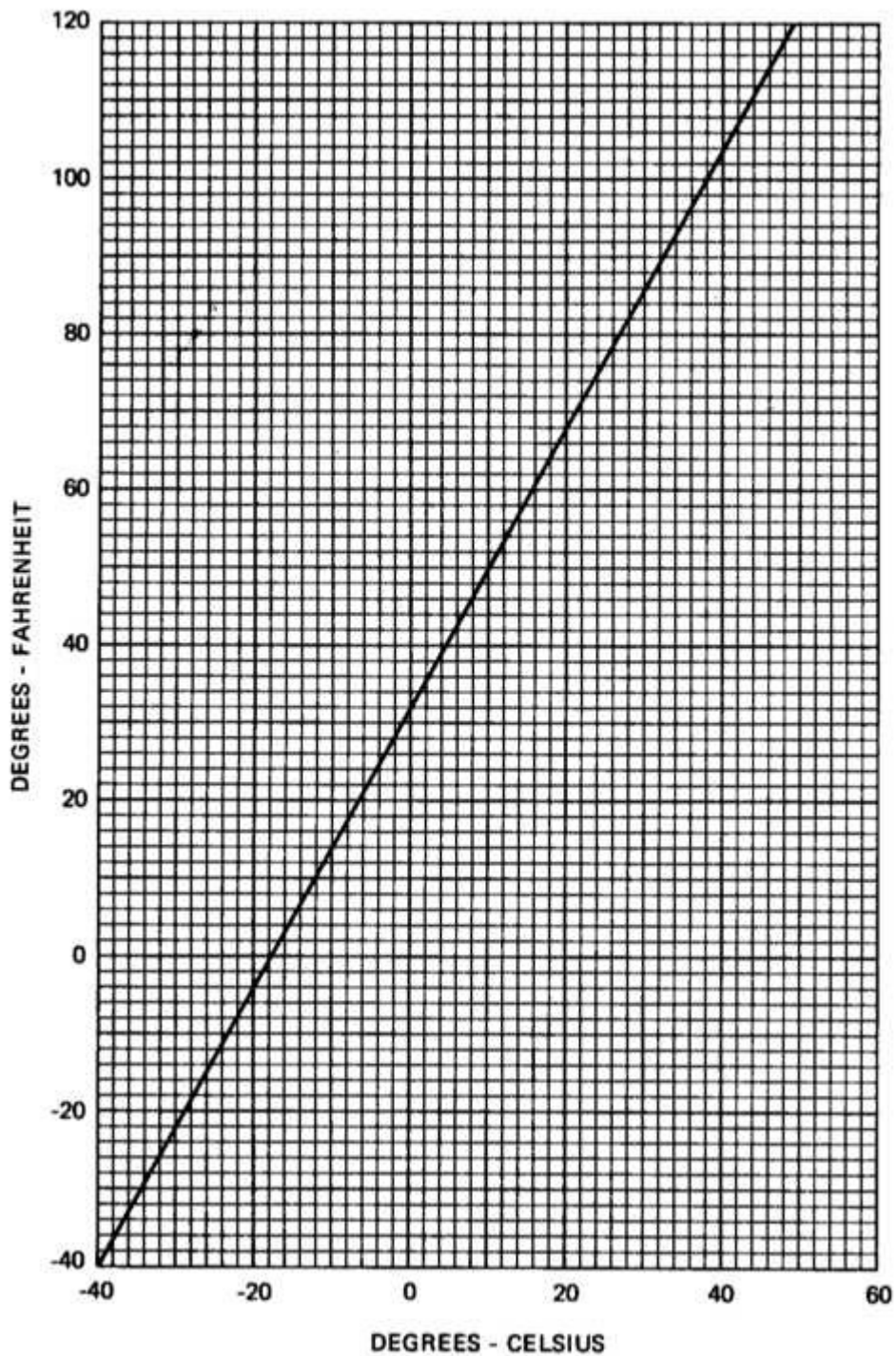


Figure 5-2. Temperature Conversion Chart

STALL SPEEDS

CONDITIONS:

Power Off
Gear Up or Down

NOTES:

1. Maximum altitude loss during a stall recovery may be as much as 230 feet.
2. KIAS values are approximate

MOST REARWARD CENTER OF GRAVITY

WEIGHT LBS	FLAP DEFLECTION	ANGLE OF BANK							
		0°		30°		45°		60°	
		KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
2650	UP	46	54	49	58	55	64	65	76
	10°	42	52	45	56	50	62	59	74
	30°	39	50	42	54	47	59	56	71

MOST FORWARD CENTER OF GRAVITY

WEIGHT LBS	FLAP DEFLECTION	ANGLE OF BANK							
		0°		30°		45°		60°	
		KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
2650	UP	51	57	55	61	61	68	72	81
	10°	46	54	49	58	55	64	65	76
	30°	42	51	45	55	50	61	59	72

Figure 5-3. Stall Speeds

TAKEOFF DISTANCE

MAXIMUM WEIGHT 2650 LBS

CONDITIONS:

Flaps Up
 2700 RPM and Full Throttle Prior to Brake Release
 Cowl Flaps Open
 Paved, Level Dry Runway
 Zero Wind

SHORT FIELD

NOTES:

1. Short field technique as specified in Section 4.
2. Prior to takeoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum power in a full throttle, static runup.
3. Decrease distances 10% for each 9 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2 knots.
4. For operation on a dry, grass runway, increase distances by 15% of the "ground roll" figure.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
2650	58	63	S.L.	955	1605	1025	1715	1100	1835	1175	1965	1260	2100
			1000	1040	1755	1120	1880	1200	2015	1285	2155	1375	2310
			2000	1140	1925	1225	2065	1315	2215	1410	2300	1510	2550
			3000	1250	2120	1340	2280	1440	2450	1545	2630	1655	2830
			4000	1370	2345	1475	2525	1585	2715	1700	2930	1820	3160
			5000	1505	2600	1620	2805	1740	3030	1870	3280	2005	3650
			6000	1660	2905	1785	3145	1920	3405	2065	3700	2215	4025
			7000	1830	3265	1970	3545	2120	3865	2280	4220	2450	4630
			8000	2025	3700	2180	4045	2350	4440	2530	4895	2720	5430

Figure 5-4. Takeoff Distance (Sheet 1 of 2)

TAKEOFF DISTANCE

2500 LBS AND 2300 LBS

SHORT FIELD

REFER TO SHEET 1 FOR APPROPRIATE CONDITIONS AND NOTES.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND	TOTAL	GRND	TOTAL	GRND	TOTAL	GRND	TOTAL	GRND	TOTAL
				ROLL	TO CLEAR 50 FT OBS	ROLL	TO CLEAR 50 FT OBS	ROLL	TO CLEAR 50 FT OBS	ROLL	TO CLEAR 50 FT OBS	ROLL	TO CLEAR 50 FT OBS
2500	56	61	S.L.	835	1400	895	1495	960	1595	1025	1705	1100	1820
			1000	910	1525	975	1635	1045	1745	1120	1865	1200	1995
			2000	995	1670	1070	1790	1145	1915	1225	2050	1315	2195
			3000	1090	1835	1170	1965	1255	2105	1345	2260	1440	2420
			4000	1195	2015	1280	2165	1375	2325	1475	2500	1580	2685
			5000	1310	2230	1410	2400	1515	2580	1625	2780	1740	2990
			6000	1440	2470	1550	2665	1665	2875	1790	3105	1920	3355
			7000	1585	2760	1710	2980	1840	3230	1975	3500	2120	3800
			8000	1755	3095	1890	3360	2035	3655	2185	3980	2350	4350
2300	54	59	S.L.	690	1160	740	1240	790	1320	845	1405	905	1500
			1000	750	1265	805	1350	860	1440	920	1535	985	1635
			2000	820	1380	880	1475	940	1575	1010	1680	1080	1795
			3000	895	1505	960	1610	1030	1725	1105	1845	1180	1970
			4000	980	1650	1050	1770	1130	1895	1210	2025	1295	2170
			5000	1075	1815	1155	1950	1240	2090	1325	2240	1420	2400
			6000	1180	2005	1285	2150	1380	2310	1460	2485	1565	2670
			7000	1295	2220	1395	2385	1500	2570	1610	2765	1725	2980
			8000	1430	2465	1540	2660	1655	2875	1775	3105	1905	3355

Figure 5-4. Takeoff Distance (Sheet 2 of 2)

MAXIMUM RATE OF CLIMB

CONDITIONS:

Flaps Up
 Gear Up
 2700 RPM
 Full Throttle
 Mixture Leaned above 3000 Feet
 Cowl Flaps Open

WEIGHT LBS	PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
			-20°C	0°C	20°C	40°C
2850	S.L.	84	925	855	780	710
	2000	83	825	755	685	620
	4000	81	720	665	590	525
	6000	80	620	560	495	435
	8000	78	525	465	405	340
	10,000	77	430	370	310	---
	12,000	75	330	275	220	---

Figure 5-5. Maximum Rate of Climb

TIME, FUEL, AND DISTANCE TO CLIMB**MAXIMUM RATE OF CLIMB****CONDITIONS:**

Flaps Up
 Gear Up
 2700 RPM
 Full Throttle
 Mixture Leaned above 3000 Feet
 Cowl Flaps Open
 Standard Temperature

NOTES:

1. Add 1.4 gallons of fuel for engine start, taxi, and takeoff allowance.
2. Increase time, fuel and distance by 10% for each 10°C above standard temperature.
3. Distances shown are based on zero wind.

WEIGHT LBS	PRESSURE ALTITUDE FT	TEMP °C	CLIMB SPEED KIAS	RATE OF CLIMB FPM	FROM SEA LEVEL		
					TIME MIN	FUEL USED GALLONS	DISTANCE NM
2650	S.L.	15	84	800	0	0.0	0
	1000	13	83	760	1	0.4	2
	2000	11	83	715	3	0.8	4
	3000	9	82	675	4	1.1	6
	4000	7	81	635	6	1.6	8
	5000	5	81	590	7	2.0	10
	6000	3	80	550	9	2.4	13
	7000	1	79	510	11	2.9	16
	8000	-1	78	465	13	3.3	19
	9000	-3	78	425	15	3.8	22
	10,000	-5	77	385	18	4.3	26
	11,000	-7	76	340	21	4.9	30
12,000	-9	75	300	24	5.5	35	

Figure 5-6. Time, Fuel, and Distance to Climb (Sheet 1 of 2)

TIME, FUEL, AND DISTANCE TO CLIMB

NORMAL CLIMB - 90 KIAS

CONDITIONS:

Flaps Up
 Gear Up
 2500 RPM
 25 Inches Hg or Full Throttle
 Mixture Leaned above 3000 Feet
 Cowl Flaps Open
 Standard Temperature

NOTES:

1. Add 1.4 gallons of fuel for engine start, taxi, and takeoff allowance.
2. Increase time, fuel and distance by 10% for each 10°C above standard temperature.
3. Distances shown are based on zero wind.

WEIGHT LBS	PRESSURE ALTITUDE FT	TEMP °C	RATE OF CLIMB FPM	FROM SEA LEVEL		
				TIME MIN	FUEL USED GALLONS	DISTANCE NM
2650	S.L.	15	530	0	0.0	0
	1000	13	530	2	0.4	3
	2000	11	530	4	0.7	6
	3000	9	530	6	1.1	9
	4000	7	530	8	1.4	12
	5000	5	520	9	1.8	15
	6000	3	475	11	2.2	18
	7000	1	430	14	2.6	22
	8000	-1	385	16	3.1	26

Figure 5-6. Time, Fuel, and Distance to Climb (Sheet 2 of 2)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 2000 FEET

CONDITIONS:
 2650 Pounds
 Recommended Lean Mixture
 Cowl Flaps Closed

NOTE

For best fuel economy, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -9°C			STANDARD TEMPERATURE 11°C			20°C ABOVE STANDARD TEMP 31°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2500	24	77	130	10.3	74	131	9.9	72	132	9.6
	23	72	127	9.7	70	128	9.4	68	128	9.1
	22	68	123	9.1	66	124	8.8	63	124	8.6
	21	63	120	8.6	61	120	8.3	59	120	8.1
2400	25	---	---	---	76	132	10.1	73	133	9.8
	24	74	128	9.9	72	129	9.6	69	130	9.3
	23	70	125	9.3	67	126	9.0	65	126	8.8
	22	65	121	8.8	63	122	8.5	61	122	8.3
2300	25	76	129	10.1	73	130	9.7	71	131	9.4
	24	71	126	9.5	69	127	9.2	67	127	8.9
	23	67	123	9.0	65	123	8.7	63	123	8.5
	22	63	119	8.5	61	119	8.2	59	119	8.0
2200	24	69	124	9.2	66	124	8.9	64	125	8.6
	23	64	121	8.7	62	121	8.4	60	120	8.2
	22	60	117	8.2	58	116	7.9	56	116	7.7
	21	56	112	7.7	54	112	7.5	52	111	7.3
2100	23	62	118	8.3	59	118	8.1	57	118	7.9
	22	57	114	7.9	55	114	7.6	54	113	7.4
	21	53	109	7.4	52	109	7.2	50	108	7.0
	20	49	105	6.9	48	103	6.7	46	101	6.6

Figure 5-7. Cruise Performance (Sheet 1 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 4000 FEET

CONDITIONS:
 2650 Pounds
 Recommended Lean Mixture
 Cowl Flaps Closed

NOTE

For best fuel economy, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -13°C			STANDARD TEMPERATURE 7°C			20°C ABOVE STANDARD TEMP 27°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2500	24	---	---	---	77	135	10.2	74	136	9.9
	23	75	131	10.0	72	132	9.7	70	132	9.4
	22	70	127	9.4	68	128	9.1	66	128	8.8
	21	66	124	8.8	63	124	8.6	61	124	8.3
2400	24	77	132	10.2	74	133	9.9	72	134	9.6
	23	72	129	9.7	70	130	9.3	67	130	9.0
	22	68	126	9.1	65	126	8.8	63	126	8.5
	21	63	122	8.6	61	121	8.3	59	121	8.1
2300	25	---	---	---	76	134	10.1	73	135	9.7
	24	74	130	9.9	71	131	9.5	69	131	9.2
	23	70	127	9.3	67	127	9.0	65	127	8.7
	22	65	123	8.8	63	123	8.5	61	123	8.3
2200	24	71	128	9.5	69	129	9.2	66	129	8.9
	23	67	125	9.0	65	125	8.7	62	125	8.4
	22	63	121	8.5	60	121	8.2	58	120	8.0
	21	58	116	8.0	56	116	7.7	54	115	7.5
2100	23	64	122	8.6	62	122	8.4	60	122	8.1
	22	60	118	8.2	58	118	7.9	56	117	7.7
	21	56	114	7.7	54	113	7.4	52	112	7.2
	20	52	109	7.2	50	108	7.0	48	106	6.8
	19	48	103	6.7	46	101	6.6	44	98	6.4

Figure 5-7. Cruise Performance (Sheet 2 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 6000 FEET

CONDITIONS:

2650 Pounds

Recommended Lean Mixture

Cowl Flaps Closed

NOTE

For best fuel economy, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -17°C			STANDARD TEMPERATURE 3°C			20°C ABOVE STANDARD TEMP 23°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2500	23	---	---	---	75	136	10.0	72	136	9.6
	22	73	132	9.7	70	132	9.4	68	132	9.1
	21	68	128	9.1	66	128	8.8	63	128	8.6
	20	63	123	8.6	61	123	8.3	59	123	8.1
2400	24	---	---	---	77	137	10.2	74	138	9.9
	23	75	133	10.0	72	134	9.6	70	134	9.3
	22	70	130	9.4	68	130	9.1	66	130	8.8
	21	66	126	8.8	63	126	8.6	61	125	8.3
2300	24	77	134	10.2	74	136	9.8	71	136	9.5
	23	72	131	9.6	70	132	9.3	67	132	9.0
	22	68	127	9.1	65	128	8.8	63	127	8.5
	21	63	123	8.5	61	123	8.3	59	123	8.0
2200	24	74	132	9.9	71	133	9.5	69	133	9.2
	23	70	129	9.3	67	129	9.0	65	129	8.7
	22	66	125	8.8	63	125	8.5	61	125	8.2
	21	61	121	8.3	59	120	8.0	57	120	7.9
2100	23	67	126	8.9	64	126	8.7	62	126	8.4
	22	62	122	8.5	60	122	8.2	58	122	7.9
	21	58	118	8.0	56	117	7.7	54	117	7.5
	20	54	113	7.6	52	112	7.3	50	110	7.0
	19	50	108	7.0	48	106	6.8	46	103	6.6

Figure 5-7. Cruise Performance (Sheet 3 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 8000 FEET

CONDITIONS:
 2650 Pounds
 Recommended Lean Mixture
 Cowl Flaps Closed

NOTE

For best fuel economy, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -21°C			STANDARD TEMPERATURE -1°C			20°C ABOVE STANDARD TEMP 19°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2700	22	---	---	---	77	140	10.3	74	141	9.9
	21	75	135	10.0	72	136	9.6	70	136	9.3
2600	22	---	---	---	75	138	10.0	72	139	9.6
	21	73	134	9.7	70	134	9.4	68	134	9.1
	20	68	129	9.1	65	129	8.8	63	129	8.5
2500	22	75	136	10.0	73	136	9.7	70	137	9.4
	21	71	132	9.4	68	132	9.1	66	132	8.8
	20	66	128	8.8	63	127	8.6	61	127	8.3
	19	61	123	8.3	59	122	8.0	57	121	7.8
2400	22	73	134	9.7	70	134	9.4	68	134	9.1
	21	68	130	9.1	66	130	8.8	63	129	8.6
	20	64	125	8.6	61	125	8.3	59	124	8.1
	19	59	120	8.0	57	120	7.8	55	118	7.8
2300	22	70	132	9.4	68	132	9.1	65	132	8.8
	21	66	128	8.8	63	127	8.5	61	127	8.3
	20	61	123	8.3	59	122	8.0	57	121	7.8
	19	57	118	7.8	55	117	7.5	53	115	7.3
2200	22	68	129	9.1	65	129	8.8	63	129	8.5
	21	63	125	8.5	61	125	8.3	59	124	8.0
	20	59	120	8.0	57	120	7.8	55	118	7.6
	19	54	115	7.5	52	114	7.3	51	112	7.1
2100	22	65	127	8.7	63	127	8.5	60	126	8.2
	21	61	122	8.2	59	122	8.0	57	121	7.7
	20	56	117	7.7	54	116	7.5	53	115	7.3
	19	52	112	7.3	50	110	7.0	49	108	6.8
	18	48	105	6.8	46	102	6.6	45	99	6.4

Figure 5-7. Cruise Performance (Sheet 4 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 10,000 FEET

CONDITIONS:
 2650 Pounds
 Recommended Lean Mixture
 Gowl Flaps Closed

NOTE

For best fuel economy, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -25°C			STANDARD TEMPERATURE -5°C			20°C ABOVE STANDARD TEMP 15°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2700	20	72	136	9.7	70	136	9.3	67	136	9.0
	19	67	131	9.0	65	131	8.7	62	130	8.4
2600	20	70	134	9.4	68	134	9.0	65	133	8.8
	19	65	129	8.8	63	128	8.5	61	128	8.2
	18	60	123	8.2	58	123	7.9	56	121	7.7
2500	20	68	132	9.1	66	132	8.8	63	131	8.5
	19	63	127	8.5	61	126	8.3	59	125	8.0
	18	58	121	8.0	56	120	7.7	54	119	7.5
	17	54	115	7.4	52	113	7.2	50	110	7.0
2400	20	66	130	8.9	63	129	8.6	61	129	8.3
	19	61	124	8.3	59	124	8.0	57	123	7.8
	18	56	119	7.7	54	118	7.5	52	115	7.3
	17	52	112	7.2	50	110	7.0	48	107	6.8
2300	20	64	127	8.6	61	127	8.3	59	126	8.0
	19	59	122	8.0	57	121	7.8	55	119	7.6
	18	54	116	7.5	52	114	7.3	51	112	7.1
	17	50	109	7.0	48	106	6.8	46	103	6.6
2200	20	61	125	8.3	59	124	8.0	57	123	7.8
	19	57	119	7.8	55	118	7.5	53	116	7.3
	18	52	113	7.3	50	111	7.0	49	108	6.9
2100	20	59	122	8.0	57	121	7.8	55	119	7.5
	19	55	116	7.5	52	115	7.3	51	112	7.1
	18	50	110	7.0	48	107	6.8	47	104	6.6

Figure 5-7. Cruise Performance (Sheet 5 of 6)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 12,000 FEET

CONDITIONS:
 2650 Pounds
 Recommended Lean Mixture
 Cowl Flaps Closed

NOTE

For best fuel economy, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -29°C			STANDARD TEMPERATURE -9°C			20°C ABOVE STANDARD TEMP 11°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2700	19	69	135	9.3	67	135	9.0	64	134	8.7
	18	64	130	8.7	62	129	8.4	60	128	8.1
2600	19	67	133	9.0	65	133	8.7	63	132	8.5
	18	62	128	8.4	60	127	8.2	58	125	7.9
	17	57	121	7.8	55	120	7.6	53	117	7.4
2500	19	65	131	8.8	63	131	8.5	61	130	8.3
	18	61	126	8.2	58	125	8.0	56	123	7.7
	17	56	119	7.6	54	117	7.4	52	115	7.2
	16	51	112	7.1	49	108	6.9	47	104	6.7
2400	19	63	129	8.6	61	128	8.3	59	127	8.0
	18	59	123	7.8	56	122	7.7	54	120	7.5
	17	54	117	7.4	52	114	7.2	50	111	7.0
	16	49	108	6.9	47	105	6.7	46	100	6.5
2300	19	61	126	8.3	59	125	8.0	57	124	7.8
	18	57	120	7.8	54	119	7.5	53	116	7.3
	17	52	113	7.2	50	111	7.0	48	107	6.8
2200	19	59	124	8.1	57	123	7.8	55	121	7.6
	18	55	118	7.5	53	115	7.3	51	112	7.1
	17	50	110	7.0	48	107	6.8	46	103	6.6
2100	19	57	121	7.8	55	119	7.5	53	117	7.3
	18	52	114	7.3	50	112	7.1	49	108	6.9
	17	48	106	6.8	46	102	6.6	45	98	6.4

Figure 5-7. Cruise Performance (Sheet 6 of 6)

RANGE PROFILE

45 MINUTES RESERVE 44 GALLONS USABLE FUEL

CONDITIONS:

- 2650 Pounds
- Recommended Lean Mixture for Cruise
- Standard Temperature
- Zero Wind

NOTE:

This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the distance during a normal climb up to 8000 feet and maximum climb above 8000 feet.

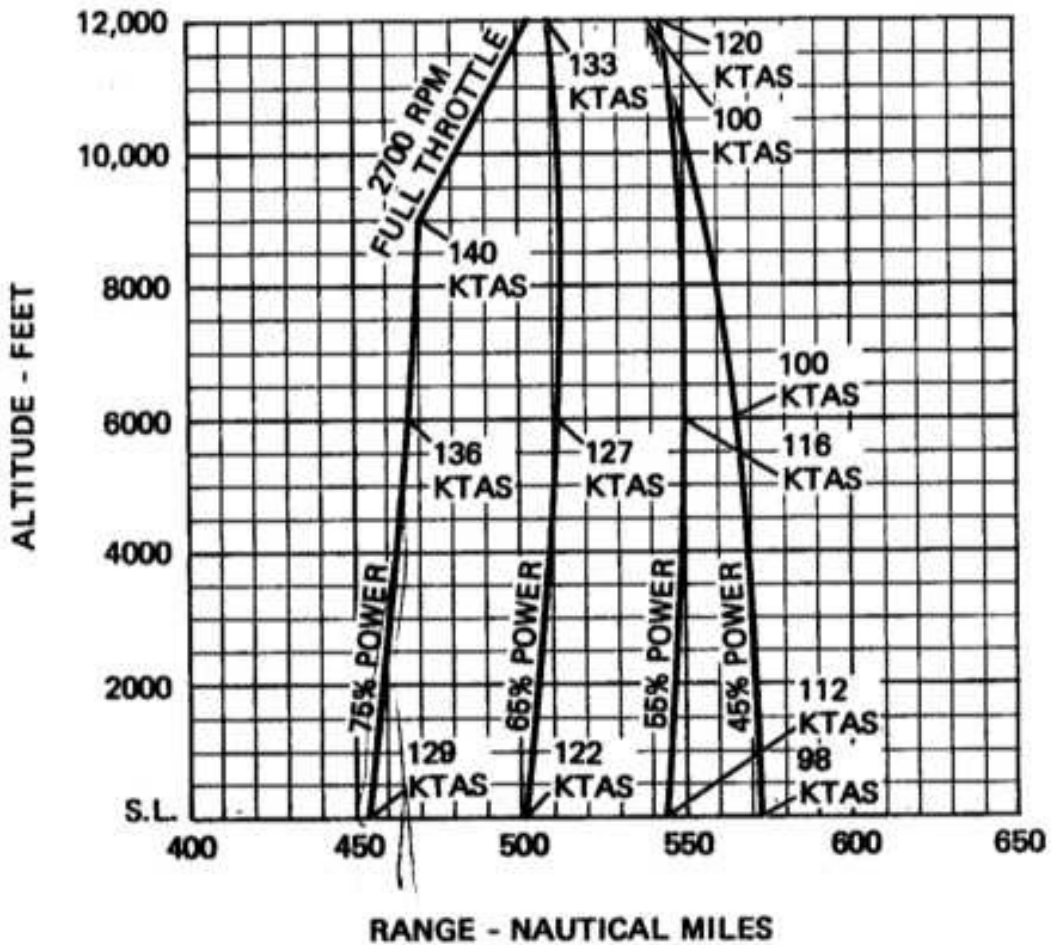


Figure 5-8. Range Profile (Sheet 1 of 2)

RANGE PROFILE

45 MINUTES RESERVE 62 GALLONS USABLE FUEL

CONDITIONS:

2650 Pounds
 Recommended Lean Mixture for Cruise
 Standard Temperature
 Zero Wind:

NOTE:

This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the distance during a normal climb up to 8000 feet and maximum climb above 8000 feet.

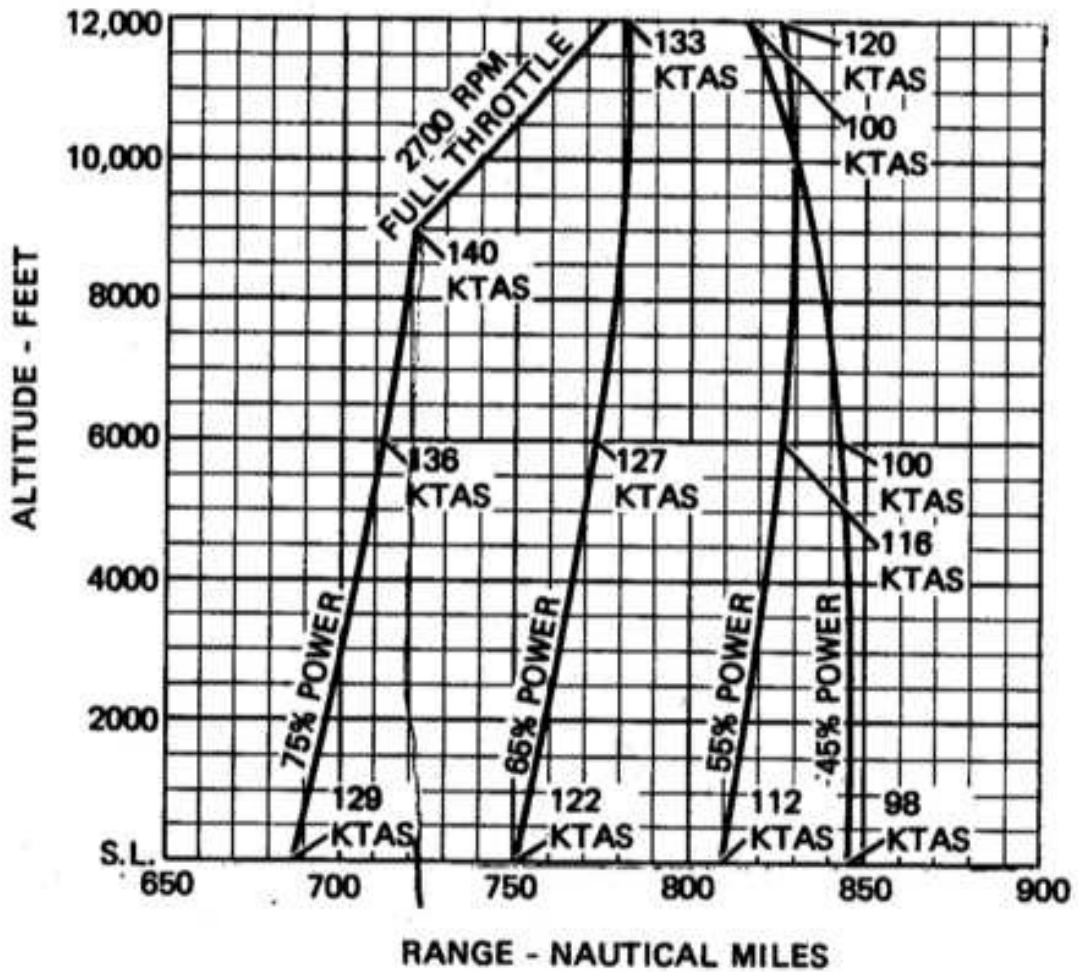


Figure 5-8. Range Profile (Sheet 2 of 2)

For Flight Training Reference Only

ENDURANCE PROFILE

45 MINUTES RESERVE

44 GALLONS USABLE FUEL

CONDITIONS:

2650 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature

NOTE:

This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during a normal climb up to 8000 feet and maximum climb above 8000 feet.

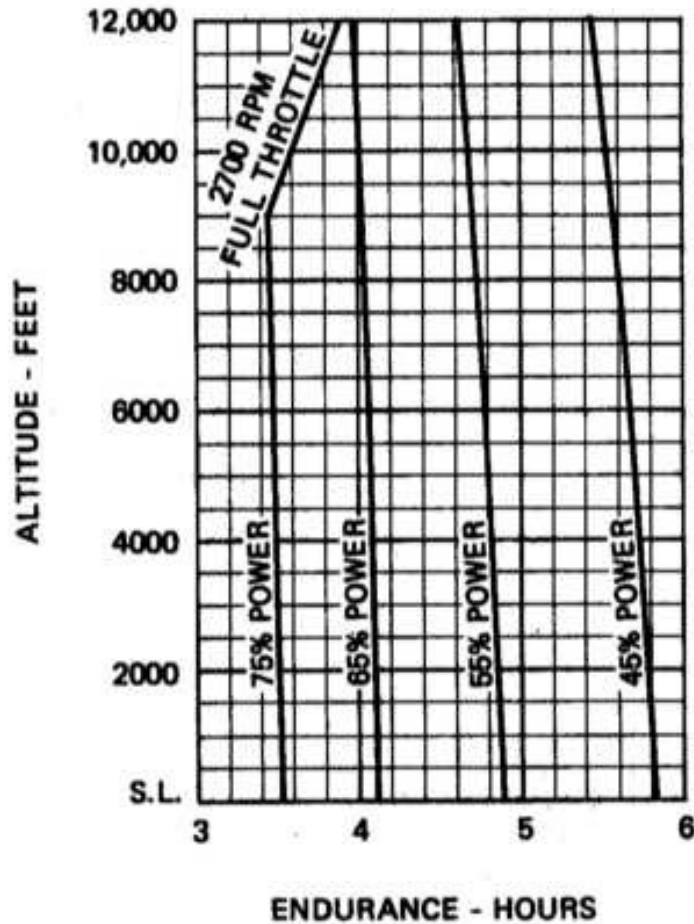


Figure 5-9. Endurance Profile (Sheet 1 of 2)

ENDURANCE PROFILE

45 MINUTES RESERVE
62 GALLONS USABLE FUEL

CONDITIONS:

2650 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature

NOTE:

This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during a normal climb up to 8000 feet and maximum climb above 8000 feet.

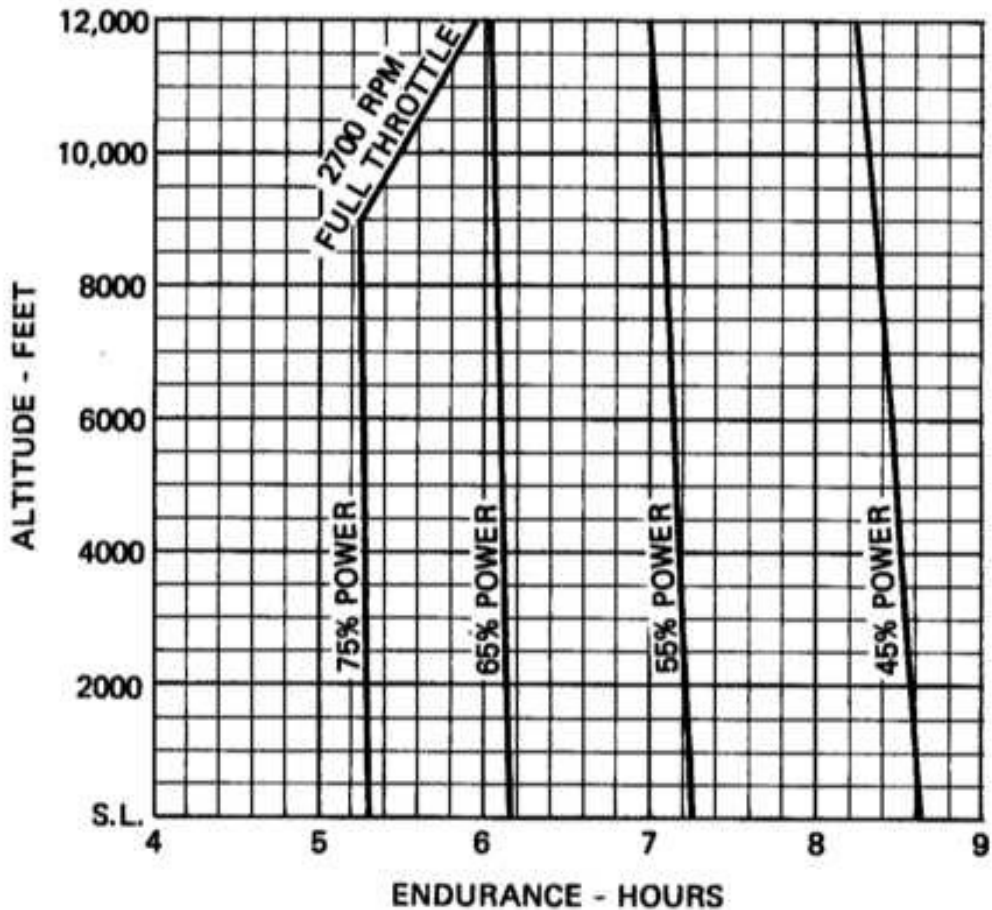


Figure 5-9. Endurance Profile (Sheet 2 of 2)

LANDING DISTANCE**SHORT FIELD****CONDITIONS:**

Flaps 30°
 Power Off
 Maximum Braking
 Paved, Level, Dry Runway
 Zero Wind

NOTES:

1. Short field technique as specified in Section 4.
2. Decrease distances 10% for each 9 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2 knots.
3. For operation on a dry, grass runway, increase distances by 40% of the "ground roll" figure.

WEIGHT LBS	SPEED AT 50 FT KIAS	PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
			GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
2650	63	S.L.	590	1290	615	1325	635	1355	660	1390	680	1425
		1000	615	1325	635	1355	660	1395	680	1425	705	1460
		2000	635	1355	660	1395	685	1430	705	1465	730	1500
		3000	660	1395	685	1430	710	1470	735	1505	760	1545
		4000	685	1430	710	1470	735	1510	760	1545	785	1585
		5000	710	1470	740	1515	765	1550	790	1590	815	1630
		6000	740	1515	765	1555	795	1595	820	1635	850	1680
		7000	770	1560	795	1600	825	1645	850	1685	880	1725
		8000	800	1605	825	1645	855	1690	885	1735	915	1780

Figure 5-10. Landing Distance

SECTION 6
WEIGHT & BALANCE /
EQUIPMENT LIST

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Weight And Balance

 Baggage Tie-Down

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Fig 6-4 Cabin Dimensions / CG Stations

Fig 6-5 Sample Loading Chart

Fig 6-6 Loading Graph

Fig 6-7 CG Moment Envelope

Figure 6-8 CG Limits

INTRODUCTION

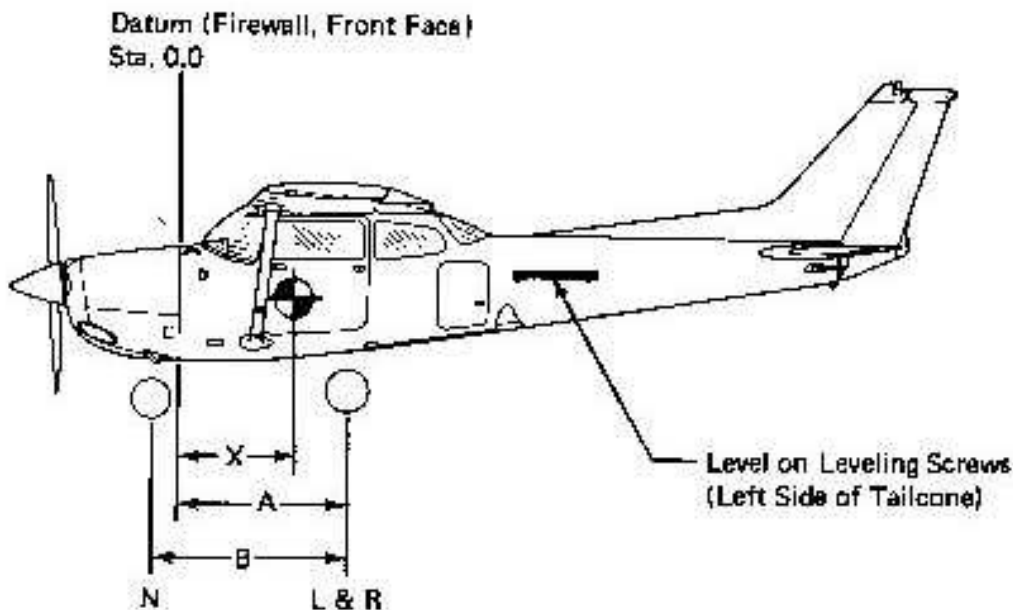
This section describes the procedure for establishing the basic empty weight and moment of the airplane. Sample forms are provided for reference. Procedures for calculating the weight and moment for various operations are also provided. A comprehensive list of all Cessna equipment available for this airplane is included at the back of this section.

It should be noted that specific information regarding the weight, arm, moment and installed equipment list for this airplane can only be found in the appropriate weight and balance records carried in the airplane.

It is the responsibility of the pilot to ensure that the airplane is loaded properly.

AIRPLANE WEIGHING PROCEDURES

1. Preparation:
 - a. Inflate tires to recommended operating pressures.
 - b. Remove the fuel tank sump quick-drain fittings and fuel selector valve quick-drain fitting to drain all fuel.
 - c. Remove oil sump drain plug to drain all oil.
 - d. Move sliding seats to the most forward position.
 - e. Raise flaps to the fully retracted position.
 - f. Place all control surfaces in neutral position.
2. Leveling:
 - a. Place scales under each wheel (minimum scale capacity, 1000 pounds).
 - b. Deflate the nose tire and/or lower or raise the nose strut to properly center the bubble in the level (see figure 6-1).
3. Weighing:
 - a. With the airplane level and brakes released, record the weight shown on each scale. Deduct the tare, if any, from each reading.
4. Measuring:
 - a. Obtain measurement A by measuring horizontally (along the airplane center line) from a line stretched between the main wheel centers to a plumb bob dropped from the firewall.
 - b. Obtain measurement B by measuring horizontally and parallel to the airplane center line, from center of nose wheel axle, left side, to a plumb bob dropped from the line between the main wheel centers. Repeat on right side and average the measurements.
5. Using weights from item 3 and measurements from item 4, the airplane weight and O.G. can be determined.
6. Basic Empty Weight may be determined by completing figure 6-1.



Scale Position	Scale Reading	Tare	Symbol	Net Weight
Left Wheel			L	
Right Wheel			R	
Nose Wheel			N	
Sum of Net Weights (As Weighed)			W	

$$X = \text{ARM} = \frac{(A) - (N) \times (B)}{W}; X = (\quad) - (\quad) \times (\quad) = (\quad) \text{ IN.}$$

Item	Weight (Lbs.)	X C.G. Arm (In.)	Moment/1000 (Lbs.-In.)
Airplane Weight (From Item 5, Page 6-3)			
Add Oil: (9 Qts at 7.5 Lbs/Gal)	16.9	-16.1	-0.3
Add Unusable Fuel: (4 Gal at 6 Lbs/Gal)	24	48.0	1.1
Equipment Changes			
Airplane Basic Empty Weight			

Figure 6-1. Sample Airplane Weighing

the baggage areas as shown on the Loading Arrangements diagram. For loadings which may differ from these, the Sample Loading Problem lists fuselage stations for these items to indicate their forward and aft C.G. range limitations (seat travel and baggage area limitation). Additional moment calculations, based on the actual weight and C.G. arm (fuselage station) of the item being loaded, must be made if the position of the load is different from that shown on the Loading Graph.

Total the weights and moments/ 1000 and plot these values on the Center of Gravity Moment Envelope to determine whether the point falls within the envelope, and if the loading is acceptable.

BAGGAGE TIE-DOWN

A nylon baggage net having six tie-down straps is provided as standard equipment to secure baggage on the cabin floor aft of the rear seat (baggage area 1) and on the top of the wheel well (baggage area 2). Six eyebolts serve as attaching points for the net. Two eyebolts for the forward tie-down straps are mounted on the cabin floor near each sidewall just forward of the baggage door approximately at station 90; two eyebolts are installed near the top of the forward surface of the wheel well slightly inboard of each sidewall approximately at station 108; and two eyebolts are located on the bulkhead below the aft window near each sidewall approximately at station 108.

When the cabin floor (baggage area 1) only is utilized for baggage, the two floor-mounted eyebolts and the two eyebolts on the forward surface of the wheel well (or the two eyebolts below the aft window) may be used, depending on the height of the baggage. When baggage is carried on the wheel well (baggage area 2), the eyebolts on the forward surface of the wheel well and the eyebolts below the aft window should be used. When baggage is loaded in both areas, all six eyebolts should be utilized.

A placard on the baggage door defines the weight limitations in the baggage areas.

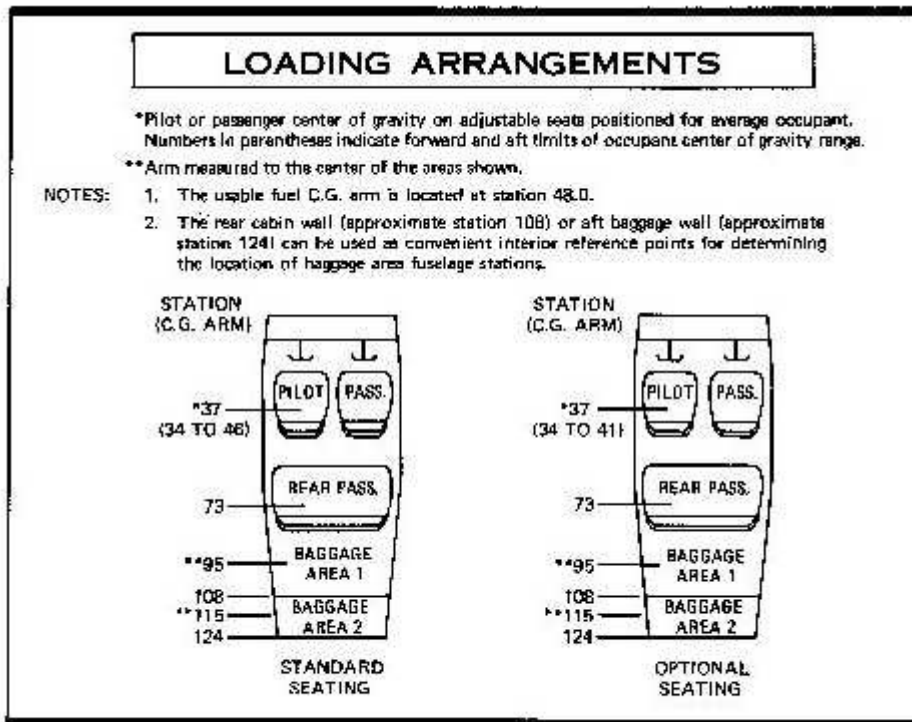
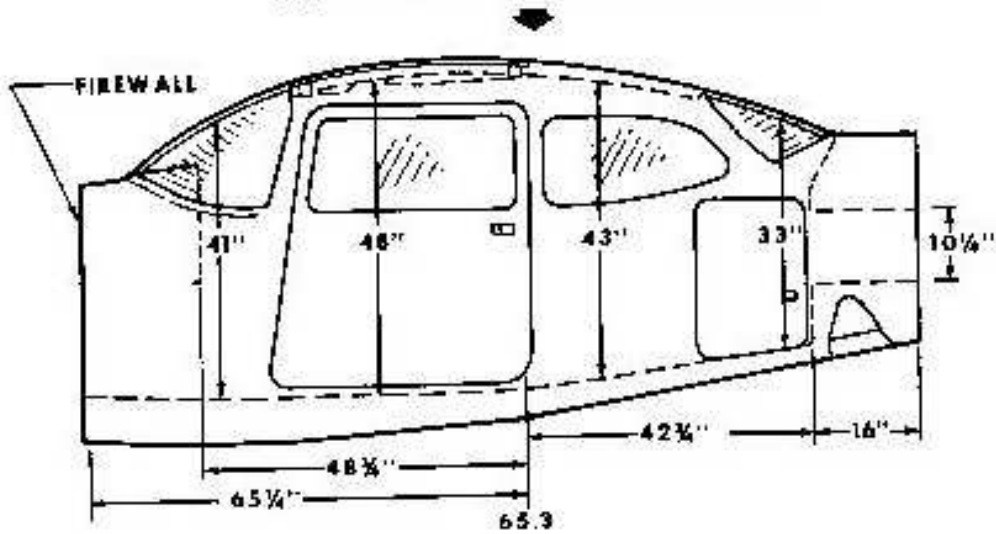


Figure 6-3. Loading Arrangements

CABIN HEIGHT MEASUREMENTS



DOOR OPENING DIMENSIONS

	WIDTH (TOP)	WIDTH (BOTTOM)	HEIGHT (FRONT)	HEIGHT (REAR)
CABIN DOOR	32"	37"	40"	41"
BAGGAGE DOOR	15 1/4"	15 1/4"	22"	21"

——— WIDTH ———
 ● LWR WINDOW LINE
 * CABIN FLOOR

CABIN WIDTH MEASUREMENTS

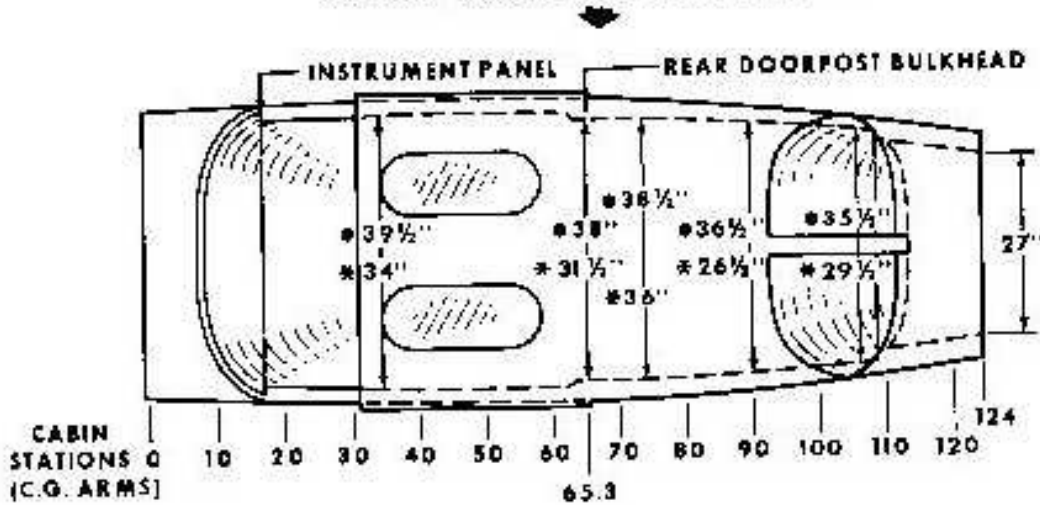
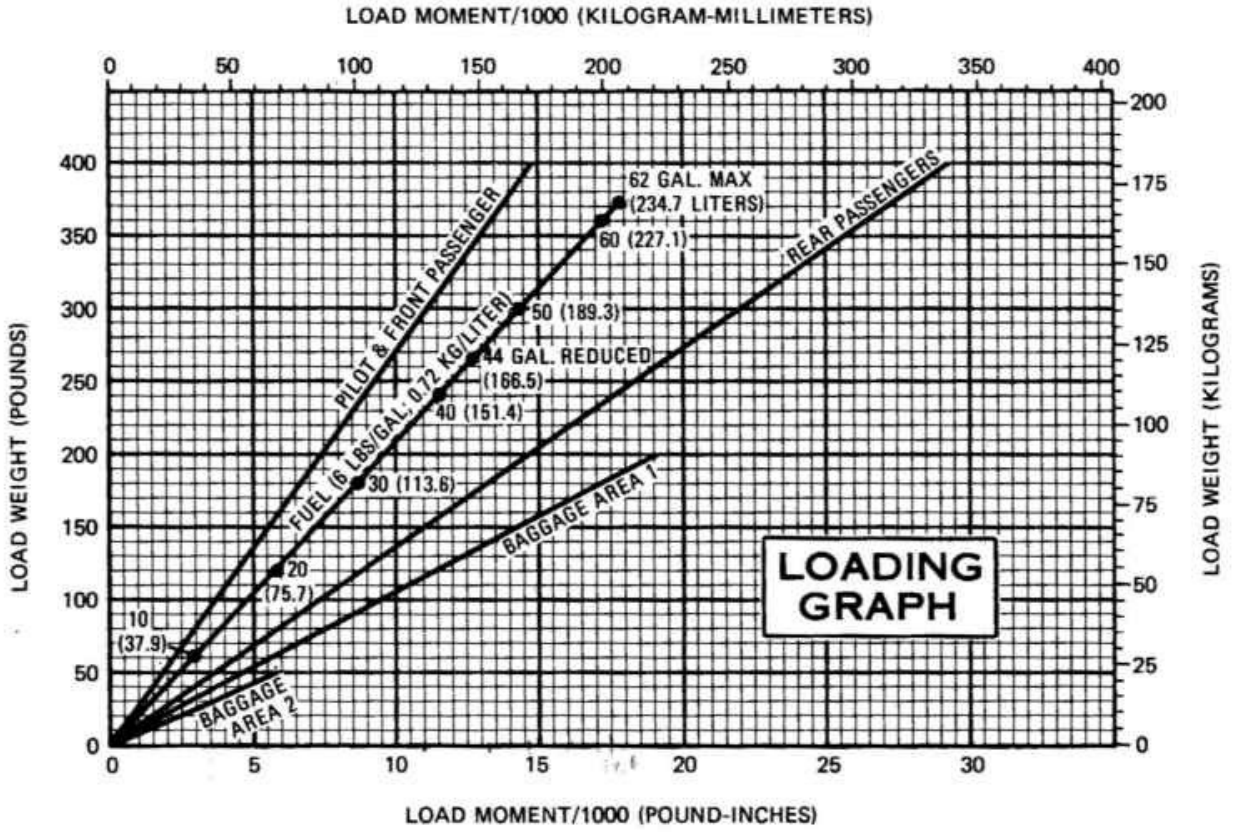


Figure 6-4. Internal Cabin Dimensions

SAMPLE LOADING PROBLEM	SAMPLE AIRPLANE		YOUR AIRPLANE	
	Weight (lbs.)	Moment (lb. - ins. /1000)	Weight (lbs.)	Moment (lb. - ins. /1000)
1. Basic Empty Weight (Use the data pertaining to your airplane as it is presently equipped. Includes unusable fuel and full oil)	1624	61.6		
2. Usable Fuel (At 6 Lbs./Gal.) Standard Tanks (62 Gal. Maximum)				
Reduced Fuel (44 Gal.)	264	12.7		
3. Pilot and Front Passenger (Station 34 to 46)	340	12.6		
4. Rear Passengers	340	24.8		
5. * Baggage Area 1 (Station 82 to 108 - 200 Lbs. Max.)	90	8.6	30	9.8
6. * Baggage Area 2 (Station 108 to 124 - 50 Lbs. Max.)				
7. RAMP WEIGHT AND MOMENT	2658	120.3		
8. Fuel allowance for engine start, taxi, and runup	-8	-.4		
9. TAKEOFF WEIGHT AND MOMENT (Subtract Step 8 from Step 7)	2650	119.9		
10. Locate this point (2650 at 119.9) on the Center of Gravity Moment Envelope, and since this point falls within the envelope, the loading is acceptable. * The maximum allowable combined weight capacity for baggage areas 1 and 2 is 200 lbs.				

Figure 6-5. Sample Loading Problem



NOTES: Line representing adjustable seats shows the pilot or passenger center of gravity on adjustable seats positioned for an average occupant. Refer to the Loading Arrangements diagram for forward and aft limits of occupant C.G. range.

Figure 6-6. Loading Graph

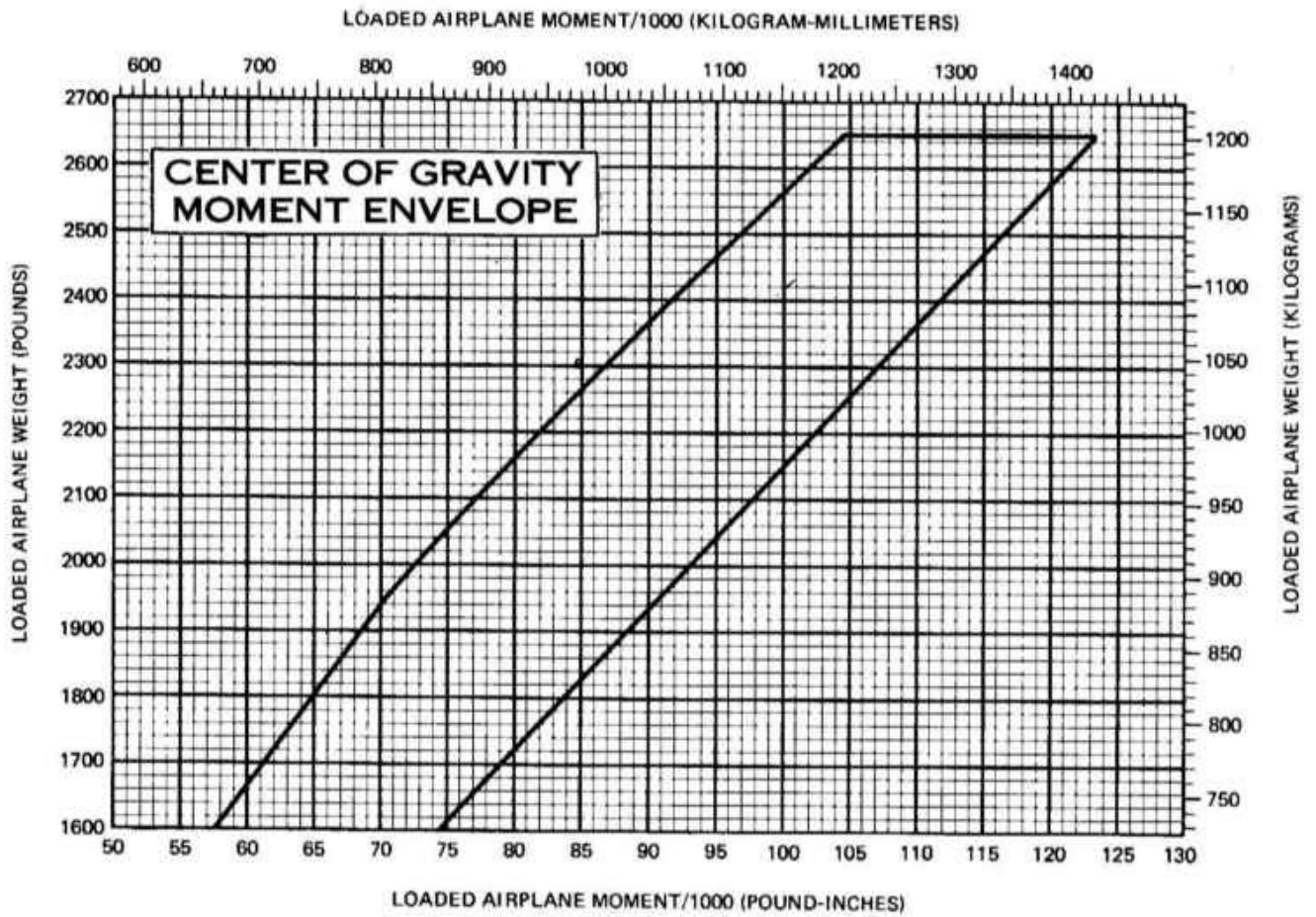


Figure 6-7. Center of Gravity Moment Envelope

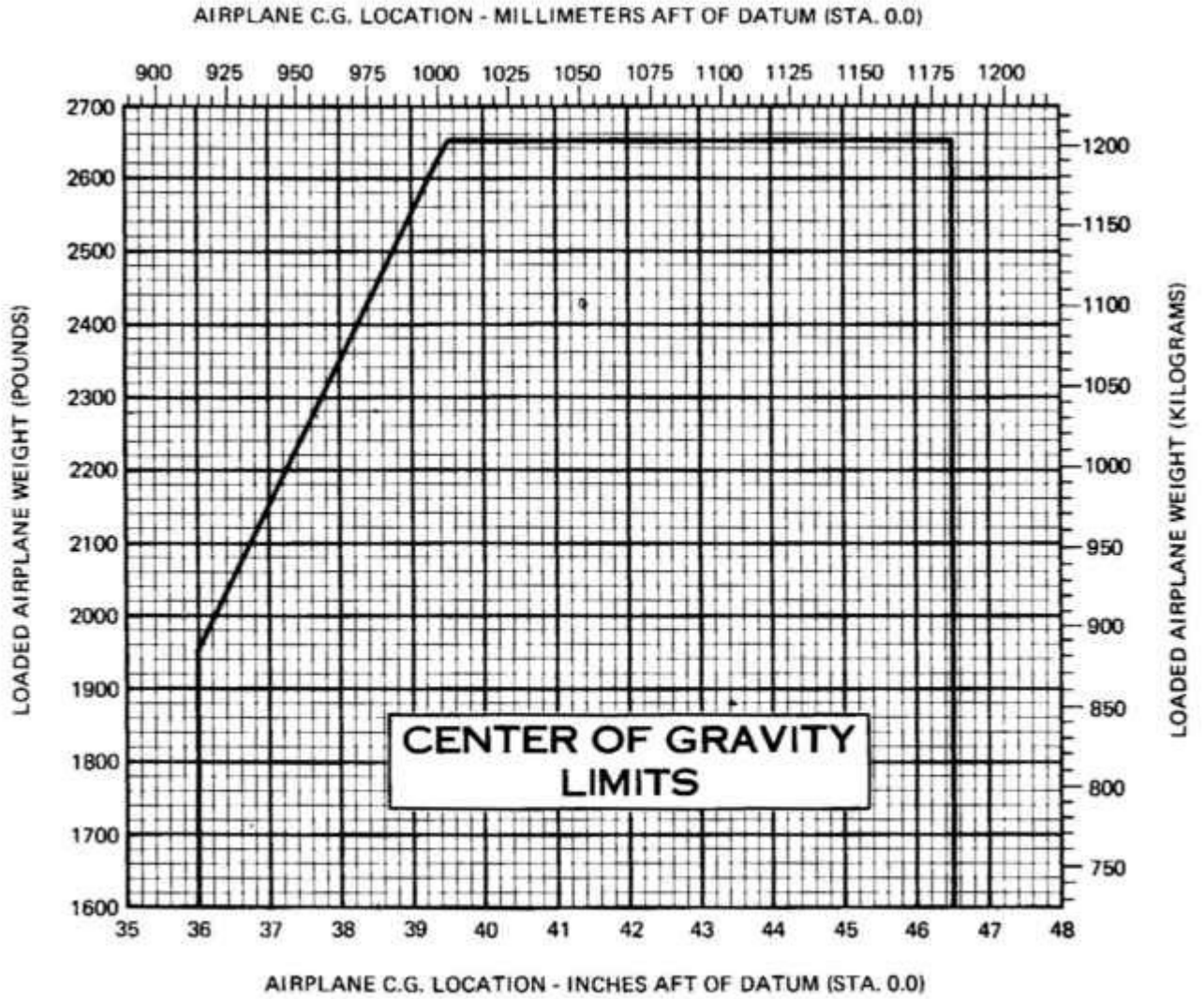


Figure 6-8. Center of Gravity Limits

SECTION 7
AIRPLANE & SYSTEMS
DESCRIPTIONS

- Introduction
- Airframe
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 - Trim Systems
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- Ground Control
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- Vertical Speed Indicator
- Altimeter
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INTRODUCTION

This section provides description and operation of the airplane and its systems. Some equipment described herein is optional and may not be installed in the airplane. Refer to Section 9, Supplements, for details of other optional systems and equipment.

AIRFRAME

The airplane is an all-metal, four-place, high-wing, single-engine airplane equipped with retractable tricycle landing gear and designed for general utility purposes.

The construction of the fuselage is a conventional formed sheet metal bulkhead, stringer, and skin design referred to as semimonocoque. Major items of structure are the front and rear carry-through spars to which the wings are attached, a bulkhead with attaching plates at the base of the forward doorposts for the lower attachment of the wing struts, and the forgings and structure for the retractable main landing gear in the lower aft portion of the fuselage center section. Four engine mount stringers are also attached to the forward doorposts and extend forward to the firewall. A tunnel incorporated into the fuselage structure below the engine, in front of the firewall, is required for the forward retracting nose wheel.

The externally braced wings, containing the fuel tanks, are constructed of a front and rear spar with formed sheet metal ribs, doublers, and stringers. The entire structure is covered with aluminum skin. The front spars are equipped with wing-to-fuselage and wing-to-strut attach fittings. The aft spars are equipped with wing-to-fuselage attach fittings, and are partial-span spars. Conventional hinged ailerons and single-slot type flaps are attached to the trailing edge of the wings. The ailerons are constructed of a forward spar containing balance weights, formed sheet metal ribs and "V" type corrugated aluminum skin joined together at the trailing edge. The flaps are constructed basically the same as the ailerons, with the exception of balance weights and the addition of a formed sheet metal leading edge section.

The empennage (tail assembly) consists of a conventional vertical stabilizer, rudder, horizontal stabilizer, and elevator. The vertical stabilizer consists of a forward and aft spar, formed sheet metal ribs and reinforcements, a wrap-around skin panel, formed leading edge skin, and a dorsal. The rudder is constructed of a formed leading edge skin containing hinge halves, a center wrap-around skin panel, ribs, an aft wrap-around skin panel which is joined at the trailing edge of the rudder by a filler strip, and a ground adjustable trim tab at the base of the trailing edge. The top of the rudder incorporates a leading edge extension which contains a balance weight. The horizontal stabilizer is constructed of a forward and aft spar, ribs and stiffeners, center upper and lower skin panels, left and right upper and lower skins panels, and formed leading edge skins. The horizontal stabilizer also contains the elevator trim tab actuator. Construction of the elevator consists of formed leading edge skins, a forward spar, ribs, torque tube and bellcrank, left upper and lower "V" type corrugated skins, and right upper and lower "V" type corrugated skins incorporating a trailing edge cut-out for the trim tab. The elevator trim tab consists of a spar, rib and upper

and lower "V" type corrugated skins. Both elevator tip leading edge extensions incorporate balance weights.

FLIGHT CONTROLS

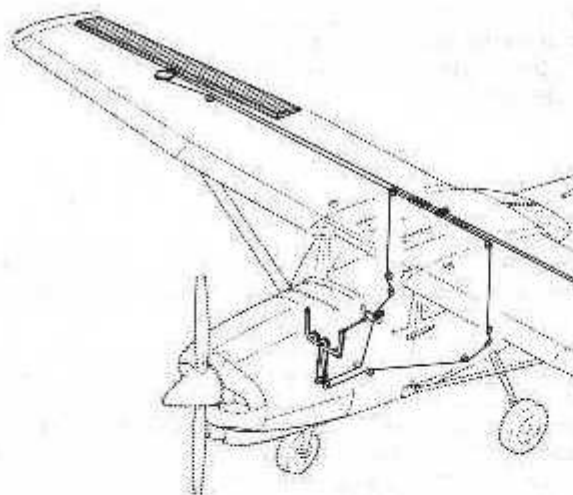
The airplane's flight control system (see figure 7-1) consists of conventional aileron, rudder, and elevator control surfaces. The control surfaces are manually operated through mechanical linkage using a control wheel for the ailerons and elevator, and rudder/brake pedals for the rudder.

Extensions are available for the rudder/brake pedals. They consist of a rudder pedal face, two spacers and two spring clips. To install an extension, place the clip on the bottom of the extension under the bottom of the rudder pedal and snap the top clip over the top of the rudder pedal. Check that the extension is firmly in place. To remove the extensions, reverse the above procedures.

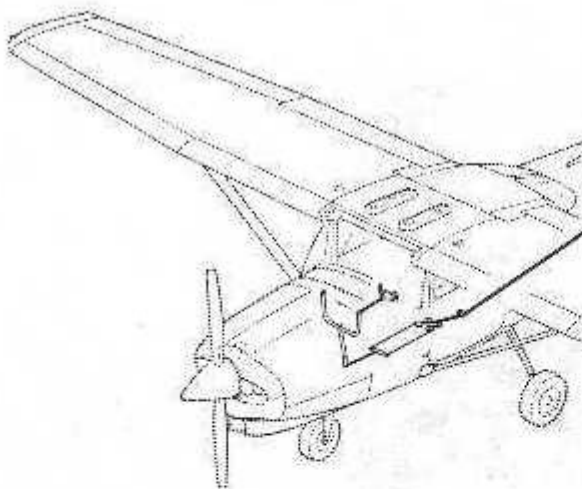
TRIM SYSTEMS

Manually-operated rudder and elevator trim is provided (see figure 7-1). Rudder trimming is accomplished through a bungee connected to the rudder control system and a trim control wheel mounted on the control pedestal. Rudder trimming is accomplished by rotating the horizontally mounted trim control wheel either left or right to the desired trim position. Rotating the trim wheel to the right will trim nose-right; conversely, rotating it to the left will trim nose-left. Elevator trimming is accomplished through the elevator trim tab by utilizing the vertically mounted trim control wheel. Forward rotation of the trim wheel will trim nose-down; conversely, aft rotation will trim nose-up.

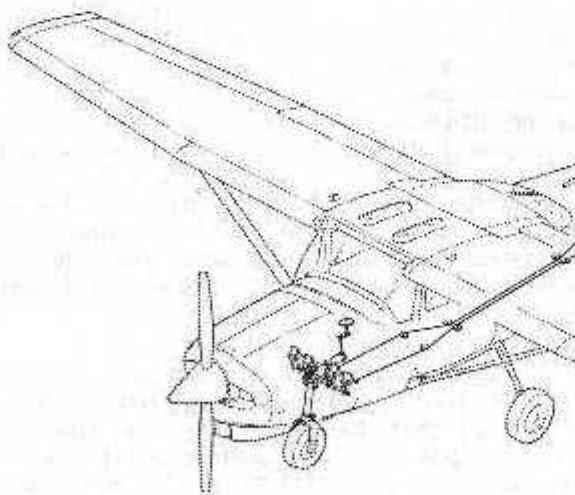
AILERON CONTROL SY



ELEVATOR CONTROL SY



RUDDER AND RUDDER CONTROL SYSTEM



ELEVATOR TRIM CONTROL SYSTEM

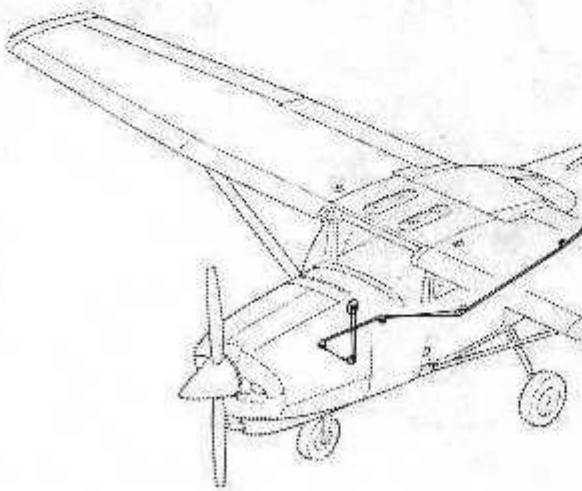


Figure 7-1. Flight Control and Trim Sy

Figure 7-1. Flight Control and Trim Sy

INSTRUMENT PANEL

The instrument panel (see figure 7-2) is designed around the basic "T" configuration. The gyros are located immediately in front of the pilot, and arranged vertically. The airspeed indicator and altimeter are located to the left and right of the gyros, respectively. The remaining flight instruments are located around the basic "T". The fuel pressure gage, clock, fuel quantity indicators, ammeter, oil pressure gage, oil temperature gage, cylinder head temperature gage and low-voltage warning light are located to the left of the flight instruments. Avionics equipment is stacked approximately on the centerline of the panel, with the right side of the panel containing the suction gage, economy mixture indicator (EGT), flight hour recorder, and space for additional instruments and avionics equipment. A switch and control panel, at the lower edge of the instrument panel, contains most of the controls, switches, and circuit breakers necessary to operate the airplane. The left side of the panel contains the auxiliary fuel pump switch, engine primer, master switch, ignition switch, general circuit breakers, electrical switches, landing gear indicator lights and landing gear lever. The center area contains the static pressure alternate source valve, and the carburetor heat, light intensity, throttle, propeller, and mixture controls. The right side of the switch and control panel contains the wing flap switch and position indicator, cabin heat and cabin air controls, cigar lighter, and map compartment. A pedestal extending from the switch and control panel to the floorboard, contains the elevator and rudder trim control wheels, cowl flap control lever, and microphone bracket. The fuel selector valve handle is located at the base of the pedestal. A parking brake handle is mounted below the switch and control panel in front of the pilot. The avionics power switch and avionics circuit breakers are mounted on a small circuit breaker panel located adjacent to the pilot on the left cabin sidewall.

For details concerning the instruments, switches, circuit breakers, and controls on this panel, refer in this section to the description of the systems to which these items are related.

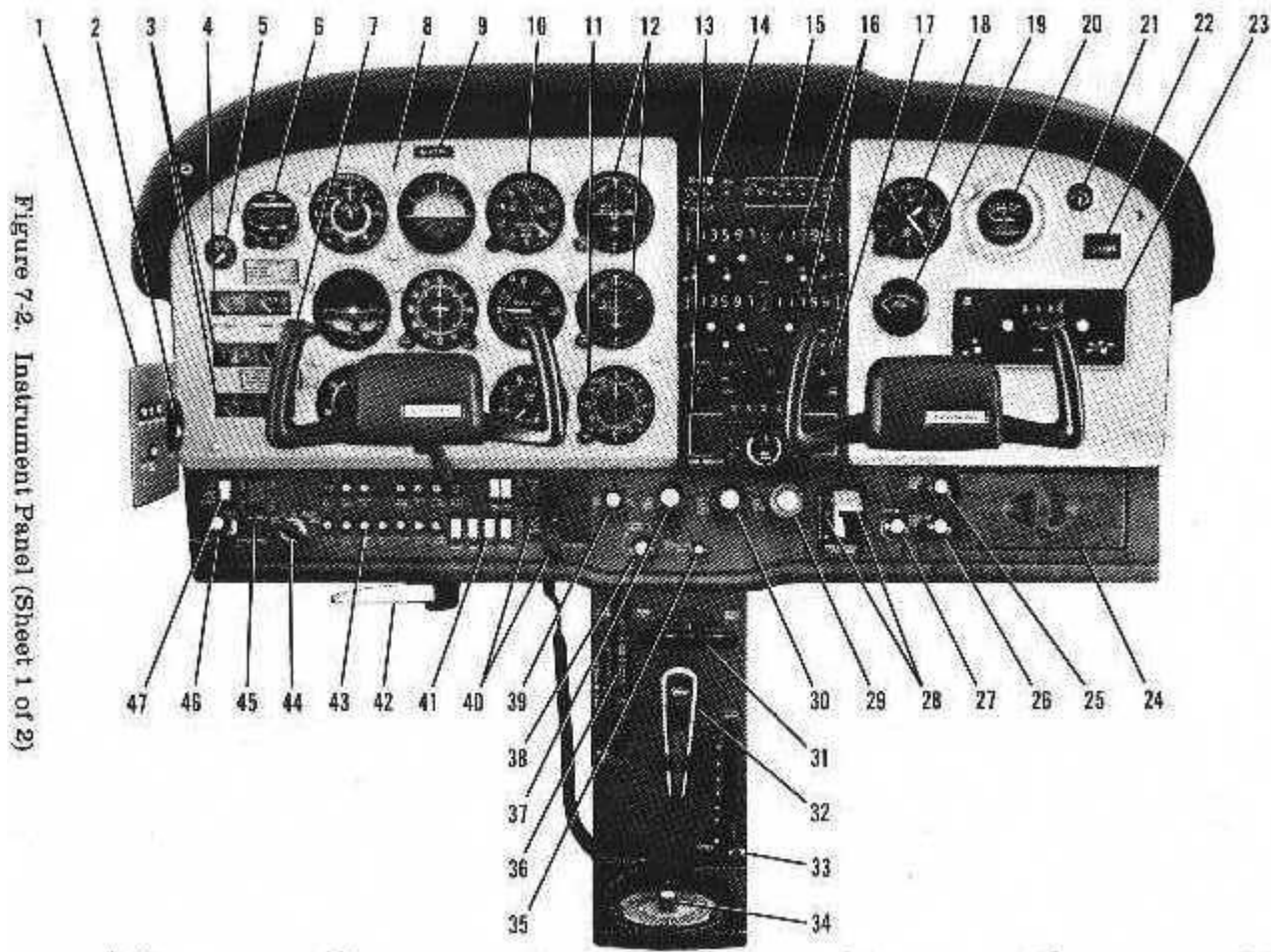


Figure 7-2. Instrument Panel (Sheet 1 of 2)

- | | |
|--|--|
| 1. Sidewall Circuit Breaker Panel | 25. Cabin Heat Control |
| 2. Avionics Power Switch | 26. Cabin Air Control |
| 3. Ammeter, Oil Pressure, Cylinder Head, and Oil Temperature Gages | 27. Cigar Lighter |
| 4. Fuel Quantity Indicators | 28. Wing Flap Switch and Position Indicator |
| 5. Fuel Pressure Gage | 29. Mixture Control |
| 6. Digital Clock | 30. Propeller Control |
| 7. Auxiliary Microphone Switch | 31. Rudder Trim Control Wheel and Position Indicator |
| 8. Flight Instrument Group | 32. Microphone |
| 9. Airplane Registration Number | 33. Cowl Flap Control Lever |
| 10. Encoding Altimeter | 34. Fuel Selector Valve Handle |
| 11. ADE Bearing Indicator | 35. Static Pressure Alternate Source Valve |
| 12. Course Deviation and Glide Slope Indicators | 36. Elevator Trim Control Wheel and Position Indicator |
| 13. Autopilot Control Unit | 37. Throttle (With Friction Lock) |
| 14. Marker Beacon Indicator Lights and Switches | 38. Instrument and Radio Dial Lights Dimming Rheostats |
| 15. Audio Control Panel | 39. Carburetor Heat Control |
| 16. NAV/COM Radios | |

- | | |
|-------------------------------------|-------------------------------------|
| 17. Transponder | 40. Landing Gear Lever and Position |
| 18. Secondary Altimeter | Indicator Lights |
| 19. Economy Mixture Indicator | 41. Electrical Switches |
| 20. Carburetor Air Temperature Gage | 42. Parking Brake Handle |
| 21. Suction Gage | 43. Circuit Breakers |
| 22. Flight Hour Recorder | 44. Ignition Switch |
| 23. ADF Radio | 45. Master Switch |
| 24. Map Compartment | 48. Primer |
| | 47. Auxiliary Fuel Pump Switch |

GROUND CONTROL

Effective ground control while taxiing is accomplished through nose wheel steering by using the rudder pedals: left rudder pedal to steer left and right rudder pedal to steer right. When a rudder pedal is depressed, a spring-loaded steering bungee (which is connected to the nose gear and to the rudder bars) will turn the nose wheel through an arc of approximately 15 deg each side of center. By applying either left or right brake, the degree of turn may be increased up to 30 deg each side of center.

Moving the airplane by hand is most easily accomplished by attaching a tow bar to the nose gear strut. If a tow bar is not available, or pushing is required, use the wing struts as push points. Do not use the vertical or horizontal surfaces to move the airplane. If the airplane is to be towed by vehicle, never turn the nose wheel more than 30 deg either side of center or structural damage to the nose gear could result.

The minimum turning radius of the airplane, using differential braking and nose wheel steering during taxi, is approximately 27 feet. To obtain a minimum radius turn during ground handling, the airplane may be rotated around either main landing gear by pressing down on a tailcone bulkhead just forward of the horizontal stabilizer to raise the nose wheel off the ground.

WING FLAP SYSTEM

The single-slot type wing flaps (see figure 7-3) are extended or retracted by positioning the wing flap switch lever on the right side of the switch and control panel to the desired flap deflection position. The switch lever is moved up or down in a slotted panel that provides mechanical stops at the 10 deg and 20 deg positions. For flap settings greater than 10 deg, move the switch lever to the right to clear the stop and position it as desired. A scale and pointer on the left side of the switch lever indicates flap travel in degrees. The wing flap system circuit is protected by a 15-amp push-to-reset circuit breaker, labeled FLAP, on the left side of the switch and control panel. A gear warning interconnect switch is incorporated in the flap system, and sounds a warning horn when the flaps are extended beyond 200 with the landing gear retracted.

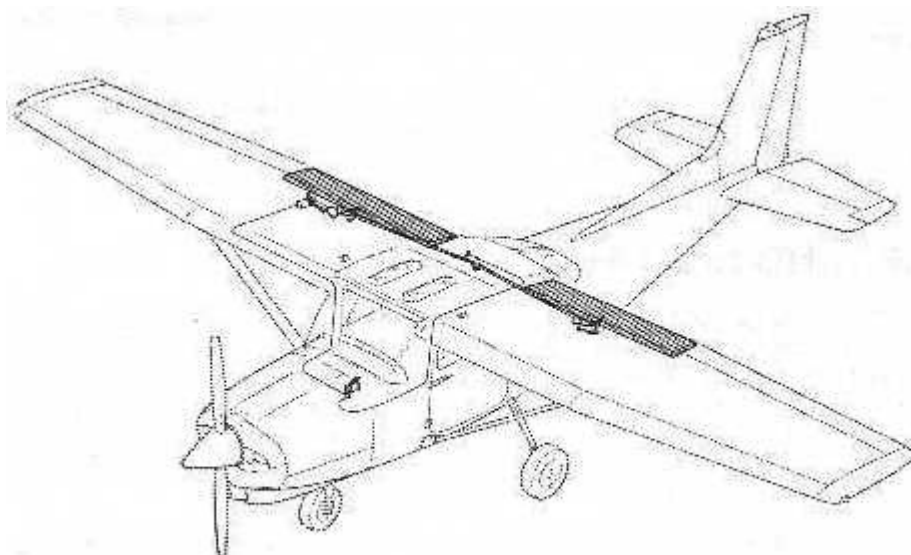


Figure 7-3. Wing Flap System

LANDING GEAR SYSTEM

The landing gear is a retractable, tricycle type with a steerable nose wheel and two main wheels. Shock absorption is provided by the tubular spring-steel main landing gear struts and the air/oil nose gear shock strut. Each main gear wheel is equipped with a hydraulically actuated single-disc brake on the inboard side of each wheel.

The landing gear extension, retraction, and main gear down lock release operation is accomplished by hydraulic actuators powered by an electrically-driven hydraulic power pack (see figure 7-7). The power pack is located aft of the firewall between the pilot's and copilot's rudder pedals. The hydraulic system fluid level may be checked by utilizing the dip stick/filler cap located on the top left side of the power pack adjacent to the motor mounting flange. The system should be checked at 25-hour intervals. If the fluid level is at or below the ADD line on the dipstick, hydraulic fluid (MIL-FI-5606) should be added to bring the level to the top of the dipstick/filler cap opening. A normal operating pressure of 1000 PSI to 1500 PSI is automatically maintained in the landing gear system, and is sufficient to provide a positive up pressure on the landing gear. The nose gear and main gear incorporate positive mechanical down locks. Also, the nose gear has mechanically-actuated wheel well doors. The doors open when the nose gear extends, and close when it retracts.

Power pack operation is started and stopped by a pressure switch, and hydraulic pressure is directed by the landing gear lever. Two position indicator lights are provided to show landing gear position. The landing gear system is also equipped with a nose gear safety (squat) switch, an emergency extension hand pump, and a gear-up warning system.

LANDING GEAR LEVER

The landing gear lever is located on the switch and control panel to the right of the electrical switches. The lever has two positions, labeled GEAR UP and GEAR DOWN, which give a mechanical indication of the gear position selected. From either position, the lever must be pulled out to clear a detent before it can be repositioned; operation of the landing gear system will not begin until the lever has been repositioned. After the lever has been repositioned, it directs hydraulic pressure within the system to actuate the gear to the selected position.

LANDING GEAR POSITION INDICATOR LIGHTS

Two position indicator lights, adjacent to the landing gear control lever, indicate that the gear is either up or down and locked. Both the gear-up (amber) and gear-down (green) lights are the press-to-test type, incorporating dimming shutters for night operation. If an indicator light bulb should burn out, it can be replaced in flight with the bulb from the remaining indicator light.

LANDING GEAR OPERATION

To retract or extend the landing gear, pull out on the gear lever and move it to the desired position. After the lever is positioned, the power pack will create pressure in the system and actuate the landing gear to the selected position. During a normal cycle, the gear retracts fully or extends and locks, limit switches close (GEAR DOWN cycle only), and the indicator light comes on (amber for up and green for down) indicating completion of the cycle. After indicator light illumination, during a GEAR DOWN cycle, the power pack will continue to run until the fluid pressure reaches 1500 PSI, opens the pressure switch, and turns the power pack off. Whenever fluid pressure in the system drops below 1000 PSI, the pressure switch will close and start power pack operation, except when the nose gear safety (squat) switch is open.

The safety (squat) switch, actuated by the nose gear, electrically prevents inadvertent retraction whenever the nose gear strut is compressed by the weight of the airplane. When the nose gear is lifted off the runway during takeoff, the squat switch will close, which may cause the power pack to operate for its 2 seconds and return system pressure to 1500 PSI in the event pressure has dropped below 1000 PSI. A "pull-off" type circuit breaker is also provided in the system as a maintenance safety feature. With the circuit breaker pulled out, landing gear operation by the gear pump motor is prevented. After maintenance is completed, and prior to flight, the circuit breaker should be pushed back in.

EMERGENCY HAND PUMP

A hand-operated hydraulic pump, located between the front seats, is provided for manual extension of the landing gear in the event of a hydraulic system failure. The landing gear cannot be retracted with the hand pump. To utilize the pump, extend the handle forward, and pump vertically. For complete emergency procedures, refer to Section 3.

LANDING GEAR WARNING SYSTEM

The airplane is equipped with a landing gear warning system designed to help prevent the pilot from inadvertently making a wheels-up landing. The system consists of a throttle actuated switch which is electrically connected to a dual warning unit. The warning unit is connected to the airplane speaker.

When the throttle is retarded below approximately 12 inches of manifold pressure at low altitude (master switch on), the throttle linkage will actuate a switch which is electrically connected to the gear warning portion of a dual warning unit. If the landing gear is retracted (or not down and locked), an intermittent tone will be heard on the airplane speaker. An interconnect switch in the wing flap system also sounds the horn when the wing flaps are extended beyond 20 deg with the landing gear retracted.

BAGGAGE COMPARTMENT

The baggage compartment consists of the area from the back of the rear passenger seats to the aft cabin bulkhead. A baggage shelf, above the wheel well, extends aft from the aft cabin bulkhead. Access to the baggage compartment and the shelf is gained through a lockable baggage door on the left side of the airplane, or from within the airplane cabin. A baggage net with six tie-down straps is provided for securing baggage, and is attached by tying the straps to tie-down rings provided in the airplane. For further information on baggage tie-down, refer to Section 6. When loading the airplane, children should not be placed or permitted in the baggage compartment, and any material that may be hazardous to the airplane or occupants should not be placed anywhere in the airplane. For baggage area and door dimensions, refer to Section 6.

SEATS

The seating arrangement consists of two individually adjustable four- way or six-way seats for the pilot and front seat passenger, and a split- backed fixed seat for the rear seat passengers.

The four-way seats may be moved forward or aft, and the seat back angle adjusted to any comfortable angle. To position either seat, lift the tubular handle under the

center of the seat, slide the seat into position, release the handle, and check that the seat is locked in place. The seat back angle is controlled by a cylinder lock release button which is spring-loaded to the locked position. The release button is located on the right side, below the forward corner of the seat cushion. To adjust the angle of the seat back, push up on the release button, position the seat back to the desired angle and release the button. When the seat is not occupied, the seat back will automatically fold forward whenever the release button is pushed up.

The six-way seats may be moved forward or aft, and are infinitely adjustable for height and seat back angle. To position the seat, lift the tubular handle under the center of the seat bottom, slide the seat into position, release the handle, and check that the seat is locked in place. Raise or lower the seat by rotating the large crank under the inboard corner of either seat. The seat back is adjusted by rotating the small crank under the outboard corner of either seat. The seat bottom angle will change as the seat back angle changes, providing proper support. The seat backs will also fold full forward.

The rear passengers' seat consists of a fixed one-piece seat bottom with individually adjustable seat backs. The seat backs are adjusted by cylinder lock release buttons, recessed into skirts located below the seat frame at the outboard ends of the seat. To adjust a seat back, push up on the adjacent cylinder lock release button, which is spring-loaded to the locked position, recline the seat back to the desired position and release the button. When the seat is not occupied, the seat backs will automatically fold forward whenever the cylinder lock release button is pushed up.

Headrests are available for any of the seat configurations. To adjust the headrest, apply enough pressure to it to raise or lower it to the desired level. The headrest may be removed at any time by raising it until it disengages from the top of the seat back.

SEAT BELTS AND SHOULDER HARNESSSES

All seat positions are equipped with seat belts (see figure 7-4). The pilot's and front passenger's seats are also equipped with separate shoulder harnesses; separate shoulder harnesses are also available for the rear seat positions. Integrated seat belt/shoulder harnesses with inertia reels can be furnished for the pilot's and front passenger's seat positions if desired.

SEAT BELTS

The seat belts used with the pilot's and front passenger's seats, are attached to fittings on the floorboard. The buckle half is inboard of each seat and the link half is outboard of each seat. The belts for the rear seat are attached to floorboard fittings and to the seat frame, with the link halves on the left and right sides of the seat bottom, and the buckles at the center of the seat bottom.

To use the seat belts for the front seats, position the seat as desired, and then lengthen the link half of the belt as needed by grasping the sides of the link and pulling against the belt. Insert and lock the belt link into the buckle. Tighten the belt to

a snug fit. Seat belts for the rear seat are used in the same manner as the belts for the front seats. To release the seat belts, grasp the top of the buckle opposite the link and pull upward.

SHOULDER HARNESSSES

Each front seat shoulder harness is attached to a rear doorpost above the window line and is stowed behind a stowage sheath above the cabin door. To stow the harness, fold it and place it behind the sheath. When rear seat shoulder harnesses are furnished, they are attached adjacent to the lower corners of the aft side windows. Each rear seat harness is stowed behind a stowage sheath above an aft side window.

To use a front or rear seat shoulder harness, fasten and adjust the seat belt first. Lengthen the harness as required by pulling on the connecting link on the end of the harness and the narrow release strap. Snap the connecting link firmly onto the retaining stud on the seat belt link half. Then adjust to length. A properly adjusted harness will permit the occupant to lean forward enough to sit completely erect, but prevent excessive forward movement and contact with objects during sudden deceleration. Also, the pilot will want the freedom to reach all controls easily.

Removing the shoulderharness is accomplished by pullingupwardon the narrow release strap, and removing the harness connecting link from the stud on the seat belt link. In an emergency, the shoulder harness may be removed by releasing the seat belt first and allowing the harness, still attached to the link half of the seat belt, to drop to the side of the seat.

INTEGRATED SEAT BELT/SHOULDER HARNESSSES WITH INERTIA REELS

Integrated seat belt! shoulder harnesses with inertia reels are availa ble for the pilot and front seat passenger. The seat belt! shoulder harnesses extend from inertia reels located in the cabin top structure, through slots in the overhead console marked PILOT and COPILOT, to attach points inboard of the two front seats. A separate seat belt half and buckle is located outboard of the seats. Inertia reels allow complete freedom of body movement. However, in the event of a sudden deceleration, they will lock automatically to protect the occupants.

To use the seat belt! shoulder harness, position the adjustable metal link on the harness at about shoulder level, pull the link and harness downward, and insert the link in the seat belt buckle. Adjust belt tension across the lap by pulling upward on the shoulder harness. Removal is accomplished by releasing the seat belt buckle, which will allow the inertia reel to pull the harness inboard of the seat.

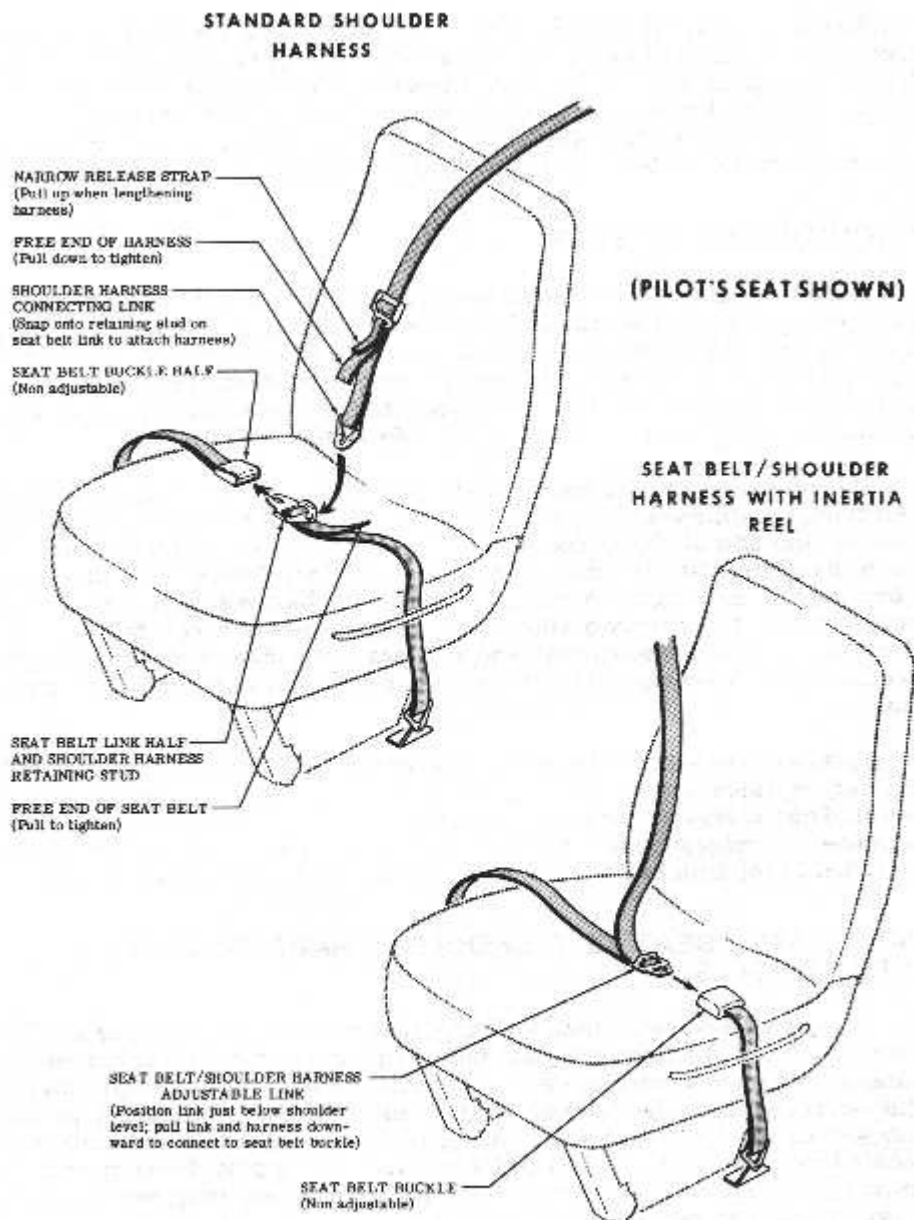


Figure 7-4. Seat Belts and Shoulder Harnesses

ENTRANCE DOORS AND CABIN WINDOWS

Entry to, and exit from the airplane is accomplished through either of two entry doors, one on each side of the cabin at the front seat positions (refer to Section 6 for cabin and cabin door dimensions). The doors incorporate a recessed exterior door handle, a conventional interior door handle, a key-operated door lock (left door only), a door stop mechanism, and an openable window in the left door. An openable right door window is also available.

To open the doors from outside the airplane, utilize the recessed door handle near the aft edge of either door by grasping the forward edge of the handle and pulling outboard. To close or open the doors from inside the airplane, use the combination door handle and arm rest. The inside door handle has three positions and a placard

at its base which reads OPEN, CLOSE, and LOCK. The handle is spring-loaded to the CLOSE (up) position. When the door has been pulled shut and latched, lock it by rotating the door handle forward to the LOCK position (flush with the arm rest). When the handle is rotated to the LOCK position, an over-center action will hold it in that position. Both cabin doors should be locked prior to flight, and should not be opened intentionally during flight.

NOTE

Accidental opening of a cabin door in flight due to improper closing does not constitute a need to land the airplane. The best procedure is to set up the airplane in a trimmed condition at approximately SO KIAS, open a window, momentarily shove the door outward slightly, and forcefully close and lock the door.

Exit from the airplane is accomplished by rotating the door handle from the LOCK position, past the CLOSE position, aft to the OPEN position and pushing the door open. To lock the airplane, lock the right cabin door with the inside handle, close the left cabin door, and using the ignition key, lock the door.

The left cabin door is equipped with an openable window which is held in the closed position by a detent equipped latch on the lower edge of the window frame. To open the window, rotate the latch upward. The window is equipped with a spring-loaded retaining arm which will help rotate the window outward and hold it there. An openable window is also available for the right door, and functions in the same manner as the left window. If required, either window may be opened at any speed up to 164 KIAS. The cabin top windows (if installed), rear side windows, and rear window are of the fixed type and cannot be opened.

CONTROL LOCKS

A control lock is provided to lock the aileron and elevator control surfaces to prevent damage to these systems by wind buffeting while the airplane is parked. The lock consists of a shaped steel rod with a red metal flag attached to it. The flag is labeled CONTROL LOCK, REMOVE BEFORE STARTING ENGINE. To install the control lock, align the hole in the top of the pilot's control wheel shaft with the hole in the top of the shaft collar on the instrument panel and insert the rod into the aligned holes. Installation of the lock will secure the ailerons in a neutral position and the elevators in a slightly trailing edge down position. Proper installation of the lock will place the red flag over the ignition switch. In areas where high or gusty winds occur, a control surface lock should be installed over the vertical stabilizer and rudder. The control lock and any other type of locking device should be removed prior to starting the engine.

ENGINE

The airplane is powered by a horizontally-opposed, four-cylinder, overhead-valve, air-cooled, carbureted engine with a wet sump oil system. The engine is a Lycoming Model O-360-FIG and is rated at 180 horsepower at 2700 RPM. Major accessories

include a starter, belt-driven alternator, and propeller governor on the front of the engine and dual magnetos, fuel pump, vacuum pump, and full-flow oil filter on the rear of the engine.

ENGINE CONTROLS

Engine manifold pressure is controlled by a throttle located on the center area of the switch and control panel. The throttle operates in a conventional manner: in the full forward position, the throttle is open, and in the full aft position, it is closed. A friction lock, which is a round knurled disk, is located at the base of the throttle and is operated by rotating the lock clockwise to increase friction or counterclockwise to decrease it.

The mixture control, mounted near the propeller control, is a red knob with raised points around the circumference and is equipped with a lock button in the end of the knob. The rich position is full forward, and full aft is the idle cut-off position. For small adjustments, the control maybe moved forward by rotating the knob clockwise, and aft by rotating the knob counterclockwise. For rapid or large adjustments, the knob may be moved forward or aft by depressing the lock button in the end of the control, and then positioning the control as desired.

ENGINE INSTRUMENTS

Engine operation is monitored by the following instruments: oil pressure gage, oil temperature gage, cylinder head temperature gage, tachometer, manifold pressure gage and fuel pressure gage. An economy mixture (EGT) indicator and carburetor air temperature gage are also available.

The oil pressure gage, located on the left side of the instrument panel, is operated by oil pressure. A direct pressure oil line from the engine deliv ers oil at engine operating pressure to the oil pressure gage. Gage mark ings indicate that minimum idling pressure is * 25 PSI (red line), the normal operating range is *60 to 90 PSI (green arc), and maximum pressure is 100 PSI (red line).

Oil temperature is indicated by a gage below the oil pressure gage. The gage is operated by an electrical resistance type temperature sensor which receives power from the airplane electrical system. Gage markings indicate the normal operating range (green arc) which is 100 F (38 C) to 245 F (118 C), and the maximum (red line) which is 245 F (118 C).

The cylinder head temperature gage, adjacent to the oil temperature gage, is operated by an electrical-resistance type temperature sensor on the engine which receives power from the airplane electrical system. Gage markings indicate the normal operating range (green arc) which is 200 F (93 C) to 500 F (260 C) and the maximum (red line) which is 500 F (260 C).

The engine-driven mechanical tachometer is located on the lower right side of the pilot's control column. The instrument is calibrated in incre ments of 100 RPM and

indicates both engine and propeller speed. An hour meter below the center of the tachometer dial records elapsed engine time in hours and tenths. Instrument markings include a normal operating range (multiple width green arc) of 2100 to 2700 RPM, and a maximum (red line) of 2700 RPM.

The manifold pressure gage is located on the lower left side of the pilot's control column. The gage is direct reading and indicates induction air manifold pressure in inches of mercury. It has a normal operating range (green arc) of 15 to 25 inches of mercury.

The fuel pressure gage, located on the upper left side of the instrument panel, indicates fuel pressure to the carburetor. Gage markings indicate that minimum pressure is 0.5 PSI (red line), normal operating range is 0.5 to 8 PSI (green arc), and maximum pressure is 8 PSI (red line).

An economy mixture (EGT) indicator is available for the airplane and is located on the right side of the instrument panel. A thermocouple probe in the right exhaust stack assembly measures exhaust gas temperature and transmits it to the indicator. The indicator serves as a visual aid to the pilot in adjusting the mixture during climb or cruise as described in Section 4. Exhaust gas temperature varies with fuel-to-air ratio, power, and RPM. However, the difference between the peak EGT and the EGT at the desired mixture setting is essentially constant and this provides a useful leaning aid. The indicator is equipped with a manually positioned reference pointer which is especially useful for leaning during climb.

A carburetor air temperature gage is available for the airplane. Details of this gage are presented in Section 9, Supplements.

NEW ENGINE BREAK-IN AND OPERATION

The engine underwent a run-in at the factory and is ready for the full range of use. It is, however, suggested that cruising be accomplished at a minimum of 75% power until a total of 25 hours has accumulated or oil consumption has stabilized. This will ensure proper seating of the rings.

ENGINE OIL SYSTEM

Oil for engine lubrication and propeller governor operation is supplied from a sump on the bottom of the engine. The capacity of the engine sump is 8 quarts (one additional quart is required for the full flow oil filter). Oil is drawn from the sump through an oil suction strainer screen 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 bypass the oil cooler and go directly from the pump to the full flow 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 upper right side of the engine. Pressure oil from the cooler returns to the accessory housing where it passes through 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 sump while the balance of the oil is circulated to

various engine parts for lubrication. Residual oil is returned to the sump by gravity flow.

An oil filler cap/oil dipstick is located at the rear of the engine on the right side. The filler cap/dipstick is accessible through an access door in the engine cowling. The engine should not be operated on less than five quarts of oil. To minimize loss of oil through the breather, fill to seven quarts for normal flights of less than three hours. For extended flight, fill to eight quarts (dipstick indication only). For engine oil grade and specifications, refer to Section 8 of this handbook.

An oil quick-drain valve is installed on the bottom of the oil sump, to provide a quick, clean method of draining the engine oil. To drain the oil, slip a hose over the end of the valve and push upward on the end of the valve until it snaps into the open position. Spring clips will hold the valve open. After draining, use a suitable tool to snap the valve into the extended (closed) position and remove the drain hose.

Whenever the oil is drained from the sump, it must also be drained from the oil cooler. This is accomplished by removing the cap at the tee fitting on the oil cooler. Refer to the Service Manual for the correct procedure for refilling the sump to prevent an air lock in the oil cooler.

IGNITION-STARTER SYSTEM

Engine ignition is provided by two engine-driven magnetos, and two spark plugs in each cylinder. The right magneto fires the lower right and upper left spark plugs, and the left magneto fires the lower left and upper right spark plugs. Normal operation is conducted with both magnetos due to the more complete burning of the fuel-air mixture with dual ignition.

Ignition and starter operation is controlled by a rotary type switch located on the left switch and control panel. The switch is labeled clock wise, OFF, B, L, BOTH, and START. The engine should be operated on both magnetos (BOTH position) except for magneto checks. The B and L positions are for checking purposes and emergency use only. When the switch is rotated to the spring-loaded START position (with the master switch in the ON position), the starter contactor is energized and the starter will crank the engine. When the switch is released, it will automatically return to the BOTH position.

AIR INDUCTION SYSTEM

Ram air for the engine induction system is received through the left opening in the nosecap. An induction system air scoop is located in the aft vertical baffle just behind the engine on the left side. This scoop is covered by an air filter which removes dust and other foreign matter from the induction air. After passing through the filter, the induction air enters an airbox which is mounted on the carburetor inlet. From the airbox, the air enters the carburetor and is ducted to the engine cylinders through intake manifold tubes. In the event carburetor ice is encountered or the intake filter

becomes blocked, alternate heated air can be obtained from a shroud around number four cylinder exhaust riser. This heated air is ducted to the airbox and passes through a valve controlled by the carburetor heat control on the instrument panel. Heated air from the shroud is obtained from unfiltered air inside the cowling. Use of full carburetor heat at full throttle will result in a loss of approximately one inch of manifold pressure.

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 heater air.

CARBURETOR AND PRIMING SYSTEM

The engine is equipped with a horizontally-mounted, side-draft, float-type, fixed jet carburetor mounted below the engine adjacent to the firewall. The carburetor is equipped with an enclosed accelerator pump, an idle cut-off mechanism, and a manual mixture control. Fuel is delivered from the fuel system to the carburetor by gravity flow, the engine-driven fuel pump, and/or auxiliary fuel pump. In the carburetor, fuel is atomized, proportionally mixed with intake air, and delivered to the cylinders through intake manifold tubes. The proportion of atomized fuel to air may be controlled, within limits, by the mixture control located on the center area of the switch and control panel.

For easy starting in cold weather, the engine is equipped with a 3-cylinder manual primer. The primer is actually a small pump which draws fuel from the fuel strainer when the plunger knob is pulled out, and injects it into the engine intake ports when the knob is pushed back in. The plunger knob is equipped with a lock and, after being pushed full in, must be rotated either left or right until the knob cannot be pulled out.

COOLING SYSTEM

Ram air for engine cooling enters through two intake openings in the front of the engine cowling. The cooling air is directed around the cylinders and other areas of the engine by baffling, and is then exhausted through cowl flaps on the lower aft edge of the cowling. The cowl flaps are mechanically operated from the cabin by means of a cowl flap lever on the right side of the control pedestal. The pedestal is labeled OPEN, COWL FLAPS, CLOSED. Before starting the engine, and throughout takeoff and high power climb operation, the cowl flap lever should be placed in the OPEN position for maximum cooling. This is accomplished by moving the lever to the right to clear a detent, then moving the lever up to the OPEN position. Anytime the lever is repositioned, it must first be moved to the right. While in cruise flight, cowl flaps should be adjusted to keep the cylinder head temperature at approximately two-thirds of the normal operating range (green arc). During extended let-downs, the cowl flaps should be completely closed by pushing the cowl flap lever down to the CLOSED position.

A winterization kit is available for the airplane. Details of this kit are presented in Section 9, Supplements.

PROPELLER

The airplane has an all-metal, two-bladed, constant-speed, governor-regulated propeller. A setting introduced into the governor with the propeller control establishes the propeller speed, and thus the engine speed to be maintained. The governor then controls flow of engine oil, boosted to high pressure by the governing pump, to or from a piston in the propeller hub. Oil pressure acting on the piston twists the blades toward high pitch (low RPM). When oil pressure to the piston in the propeller hub is relieved, centrifugal force, assisted by an internal spring, twists the blades toward low pitch (high RPM).

A control knob on the center area of the switch and control panel is used to set the propeller and control engine RPM as desired for various flight conditions. The knob is labeled PROP RPM, PUSH INC. When the control knob is pushed in, blade pitch will decrease, giving a higher RPM. When the control knob is pulled out, the blade pitch increases, thereby decreasing RPM. The propeller control knob is equipped with a vernier feature which allows slow or fine RPM adjustments by rotating the knob clockwise to increase RPM, and counterclockwise to decrease it. To make rapid or large adjustments, depress the button on the end of the control knob and reposition the control as desired.

FUEL SYSTEM

The airplane fuel system (see figure 7-5) consists of two vented integral fuel tanks (one in each wing), a four-position selector valve, fuel strainer, manual primer, engine-driven fuel pump, electric auxiliary fuel pump and carburetor. Refer to figure 7-6 for fuel quantity data for the system.

Fuel flows by gravity from the two integral wing tanks to a four-position selector valve, labeled BOTH, RIGHT, LEFT, and OFF. With the selector valve in either the BOTH: RIGHT, or LEFT position, fuel flows through a strainer to the engine-driven fuel pump, and from the pump to the carburetor. When the auxiliary fuel pump is operating, it draws fuel from a tee located between the strainer and the engine-driven fuel pump, and delivers it to the carburetor. From the carburetor, mixed fuel and air flows to the cylinders through intake manifold tubes. The manual primer draws its fuel from the fuel strainer and injects it into the engine intake ports.

The airplane may be serviced to a reduced fuel capacity to permit heavier cabin loadings by filling each fuel tank to the bottom edge of the fuel filler collar, thus giving a reduced fuel load of 24.0 gallons in each tank (22 gallons usable in all flight conditions).

Fuel system venting is essential to system operation. Blockage of the system will result in decreasing fuel flow and eventual engine stoppage. Venting is accomplished by an interconnecting line from the right fuel tank to the left tank. The left fuel tank is

vented overboard through a vent line, equipped with a check valve, which protrudes from the bottom surface of the left wing near the wing strut. The right fuel tank filler cap is also vented.

Fuel quantity is measured by two float-type fuel quantity transmitters (one in each tank) and indicated by two electrically-operated fuel quantity indicators on the left side of the instrument panel. The fuel quantity indicators are calibrated in gallons (lower scale) and pounds (upper scale). An empty tank is indicated by a red line and the letter E. When an indicator shows an empty tank, approximately 2 gallons remain in a tank as unusable fuel. The indicators cannot be relied upon for accurate readings during skids, slips, or unusual attitudes. If both indicator pointers should rapidly move to a zero reading, check the cylinder head temperature gage for operation. If these gages are not indicating, an electrical malfunction has occurred.

The auxiliary fuel pump switch is located on the left side of the switch and control panel and is a rocker-type switch. It is labeled AUX FUEL PUMP. When the pump is operating, it will maintain fuel pressure to the carburetor. It should be used whenever the indicated fuel pressure falls below 0.5 PSI, but is not required when gravity flow and/or the engine-driven fuel pump can maintain indicated pressures above 0.5 PSI.

The fuel selector valve should be in the BOTH position for takeoff, climb, descent, landing, and maneuvers that involve prolonged slips or skids. Operation from either LEFT or RIGHT tank is reserved for level cruising flight only.

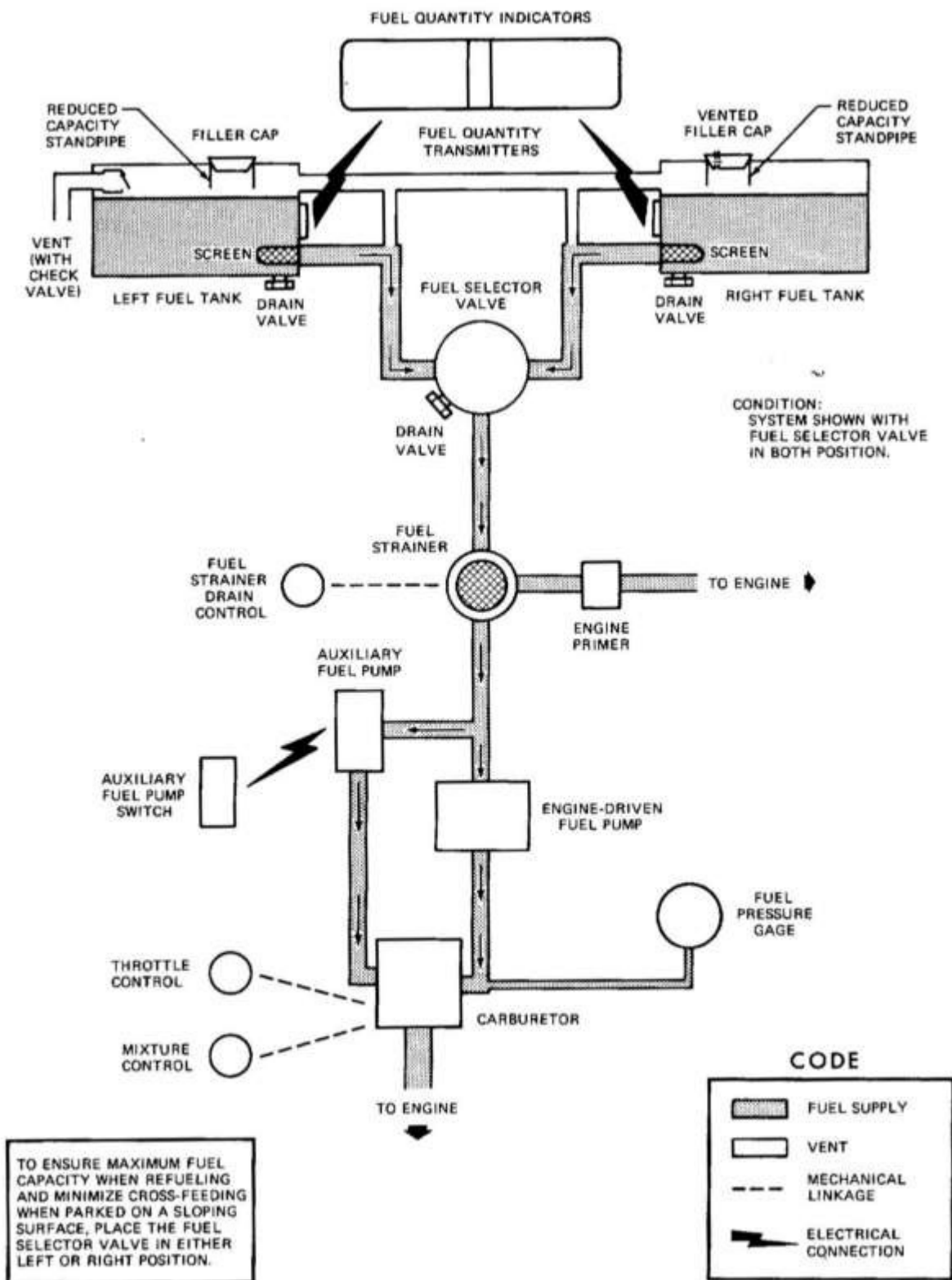


Figure 7-5. Fuel System

FUEL QUANTITY DATA (U. S. GALLONS)

TANKS	TOTAL USABLE FUEL ALL FLIGHT CONDITIONS	TOTAL UNUSABLE FUEL	TOTAL FUEL VOLUME
STANDARD (33 GAL. EACH)	62	4	66
REDUCED FUEL (24 GAL EACH)	44	4	48

Figure 7-6. Fuel Quantity Data

NOTE

Unusable fuel is at a minimum due to the design of the fuel system. However, with 1/4 tank or less, prolonged uncoordinated flight such as slips or skids can uncover the fuel tank outlets, causing fuel starvation and engine stoppage. Therefore, with low fuel reserves, do not allow the airplane to remain in uncoordinated flight for periods in excess of 30 seconds

NOTE

When the fuel selector valve handle is in the BOTH position in cruising flight, unequal fuel flow from each tank may occur if the wings are not maintained exactly level. Resulting wing heaviness can be alleviated gradually by turning the selector valve handle to the tank in the "heavy" wing.

NOTE

It is not practical to measure the time required to consume all of the fuel in one tank, and, after switching to the opposite tank, expect an equal duration from the remaining fuel. The airspace in both fuel tanks is interconnected by a vent line and, therefore, some sloshing of fuel between tanks can be expected when the tanks are nearly full and the wings are not level.

If a fuel tank quantity is completely exhausted in flight, it is recommended that the fuel selector valve be switched back to the BOTH position for the remainder of the flight. This will allow some fuel from the fuller tank to transfer back through the selector valve to the empty tank while in coordinated flight which in turn will prevent fuel starvation when operating in prolonged slips or skids.

The fuel system is equipped with drain valves to provide a means for the examination of fuel in the system for contamination and grade. The system should be examined before the first flight of every day and after each refueling, by using the sampler cup provided to drain fuel from the wing tank sumps and selector valve, and by utilizing the fuel strainer drain under an access panel on the right side of the engine cowling. The fuel tanks should be filled after each flight to prevent condensation.

HYDRAULIC SYSTEM

Hydraulic power (see figure 7-7) is supplied by an electrically-driven hydraulic power pack located behind the firewall between the pilot's and copilot's rudder pedals. The power pack's only function is to supply hydraulic power for operation of the retractable landing gear. This is accomplished by applying hydraulic pressure to actuator cylinders which extend or retract the gear. The hydraulic system normally operates at 1000 PSI to 1500 PSI, and is protected by relief valves which prevent high pressure damage to the pump and other components in the system. The electrical portion of the power pack is protected by a 30-amp push-pull type circuit breaker switch, labeled GEAR PUMP, on the left switch and control panel.

The hydraulic power pack is turned on by a pressure switch on the power pack when the landing gear lever is placed in either the GEAR UP or GEAR DOWN position. When the lever is placed in the GEAR UP or GEAR DOWN position, it mechanically rotates a selector valve which applies hydraulic pressure in the direction selected. As soon as the landing gear reaches the selected position, a series of electrical switches will illuminate one of two indicator lights on the instrument panel to show gear position and completion of the cycle. After indicator light illumination, (GEAR DOWN cycle only), hydraulic pressure will continue to build until the power pack pressure switch turns the power pack off.

The hydraulic system includes an emergency hand pump to permit manual extension of the landing gear in the event of hydraulic power pack failure. The hand pump is located on the cabin floor between the front seats.

During normal operations, the landing gear should require from 5 to 7 seconds to fully extend or retract. For malfunctions of the hydraulic and landing gear systems, refer to Section 3 of this handbook.

BRAKE SYSTEM

The airplane has a single-disc, hydraulically-actuated brake on each main landing gear wheel. Each brake is connected, by a hydraulic line, to a master cylinder attached to each of the pilot's rudder pedals. The brakes are operated by applying pressure to the top of either the left (pilot's) or right (copilot's) set of rudder pedals, which are interconnected. When the airplane is parked, both main wheel brakes may be set by utilizing the parking brake which is operated by a handle below the left side of the switch and control panel. To apply the parking brake, set the brakes with the rudder pedals, pull the handle aft, and rotate it 90° down.

For maximum brake life, keep the brake system properly maintained, and minimize brake usage during taxi operations and landings.

Some of the symptoms of impending brake failure are: gradual decrease in braking action after brake application, noisy or dragging brakes, soft or spongy pedals, and excessive travel and weak braking action. If any of these symptoms appear, the brake system is in need of immediate attention. If, during taxi or landing roll, braking

action decreases, let up on the pedals and then re-apply the brakes with heavy pressure. If the brakes become spongy or pedal travel increases, pumping the pedals should build braking pressure. If one brake becomes weak or fails, use the other brake sparingly while using opposite rudder, as required, to offset the good brake.

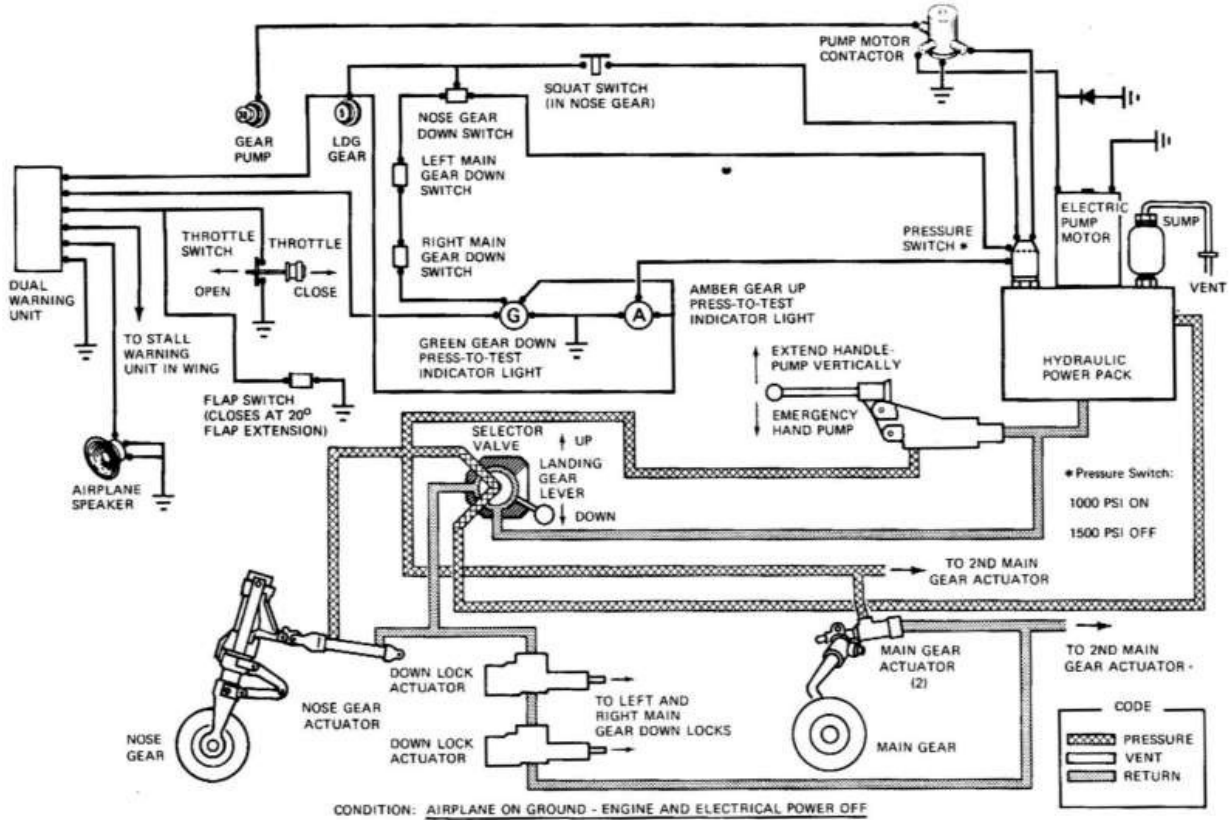


Figure 7-7. Hydraulic System

ELECTRICAL SYSTEM

The airplane is equipped with a 28-volt, direct-current electrical system (see figure 7-8). The system uses a battery, located aft of the rear cabin *wall*, as the source of electrical energy and a belt-driven 60-amp alternator to maintain the battery's state of charge. Power is supplied to most general electrical and all avionics circuits through the primary bus bar and the avionics bus bar, which are interconnected by an avionics power switch. The primary bus bar is on anytime the master switch is turned on, and is not affected by starter or external power usage. Both bus bars are on anytime the master and avionics power switches are on.

CAUTION

Prior to turning the master switch on or off, starting the engine, or applying an external power source, the avionics power switch, labeled AVN PWR, should be turned off to prevent any harmful transient voltage from damaging the avionics equipment.

MASTER SWITCH

The master switch is a split-rocker type switch labeled MASTER, and is ON in the up position and off in the down position. The right half of the switch, labeled BAT, controls all electrical power to the airplane. The left half, labeled ALT, controls the alternator.

Normally, both sides of the master switch should be used simultaneously; however the BAT side of the switch could be turned ON separately to check equipment while on the ground. To check or use avionics equipment or radios while on the ground, the avionics power switch must be turned ON. The ALT side of the switch, when placed in the off position, removes the alternator from the electrical system. With this switch in the off position, the entire electrical load is placed on the battery. Continued operation with the alternator switch in the off position will reduce battery power low enough to open the battery contactor, remove power from the alternator field, and prevent alternator restart.

AVIONICS POWER SWITCH

Electrical power from the airplane primary bus to the avionics bus (see figure 7-8) is controlled by a single-rocker switch/circuit breaker labeled AVN PWR. The switch is located on the left sidewall avionics circuit breaker panel and is ON in the up position and OFF in the down position. With the switch in the OFF position, no electrical power will be applied to the avionics equipment, regardless of the position of the master switch or the individual equipment switches. The avionics power switch also functions as a circuit breaker. If an electrical malfunction should occur and cause the circuit breaker to open, electrical power to the avionics equipment will be interrupted and the switch will automatically move to the OFF position. If this occurs, allow the circuit breaker to cool approximately two minutes before placing the switch in the ON position again. If the circuit breaker opens again, do not reset it. The avionics power switch should be placed in the OFF position prior to turning the master switch ON or

off, starting the engine, or applying an external power source, and may be utilized in place of the individual avionics equipment switches.

AMMETER

The ammeter, located beneath the fuel gages, indicates the amount of current, in amperes, from the alternator to the battery or from the battery to the airplane electrical system. When the engine is operating and the master switch is turned on, the ammeter indicates the charging rate applied to the battery. In the event the alternator is not functioning or the electrical load exceeds the output of the alternator, the ammeter indicates the battery discharge rate.

ALTERNATOR CONTROL UNIT AND LOW-VOLTAGE WARNING LIGHT

The airplane is equipped with a combination alternator regulator high-low voltage control unit mounted on the engine side of the firewall and a red warning light labeled LOW VOLTAGE, on the left side of the instrument panel adjacent to the manifold pressure gage.

In the event an over-voltage condition occurs, the alternator control unit automatically removes alternator field current which shuts down the alternator. The battery will then supply system current as shown by a discharge rate on the ammeter. Under these conditions, depending on electrical system load, the low-voltage warning light will illuminate when system voltage drops below normal. The alternator control unit may be reset by turning the master switch off and back on again. If the warning light does not illuminate, normal alternator charging has resumed; however, if the light does illuminate again, a malfunction has occurred, and the flight should be terminated as soon as practicable.

NOTE

Illumination of the low-voltage light and ammeter discharge indications may occur during low RPM conditions with an electrical load on the system, such as during a low RPM taxi. Under these conditions, the light will go out at higher RPM. The master switch need not be recycled since an over-voltage condition has not occurred to de-activate the alternator system.

The warning light may be tested by turning on the landing lights and momentarily turning off the ALT portion of the master switch while leaving the BAT portion turned on.

CIRCUIT BREAKERS AND FUSES

Most of the electrical circuits in the airplane are protected by "push-to reset" type circuit breakers mounted on the lower left side of the switch and control panel. However, a "pull-off" type circuit breaker protects alternator output and the landing

gear system hydraulic pump motor circuit. In addition to the individual circuit breakers, a single-rocker switch/circuit breaker, labeled AVN PWR on the avionics panel, located on the left cabin sidewall between the forward doorpost and the switch and control panel, also protects the avionics systems. The cigar lighter is protected by a manually-reset type circuit breaker on the back of the lighter, and a fuse behind the instrument panel. The control wheel map light (if installed) is protected by the NAY LIGHTS circuit breaker and a fuse behind the instrument panel. Electrical circuits which are not protected by circuit breakers are the battery contactor closing (external power) circuit, clock circuit, and flight hour recorder circuit. These circuits are protected by fuses mounted adjacent to the battery.

GROUND SERVICE PLUG RECEPTACLE

A ground service plug receptacle may be installed to permit the use of an external power source for cold weather starting and during lengthy maintenance work on the electrical and electronic equipment. Details of the ground service plug receptacle are presented in Section 9, Supplements.

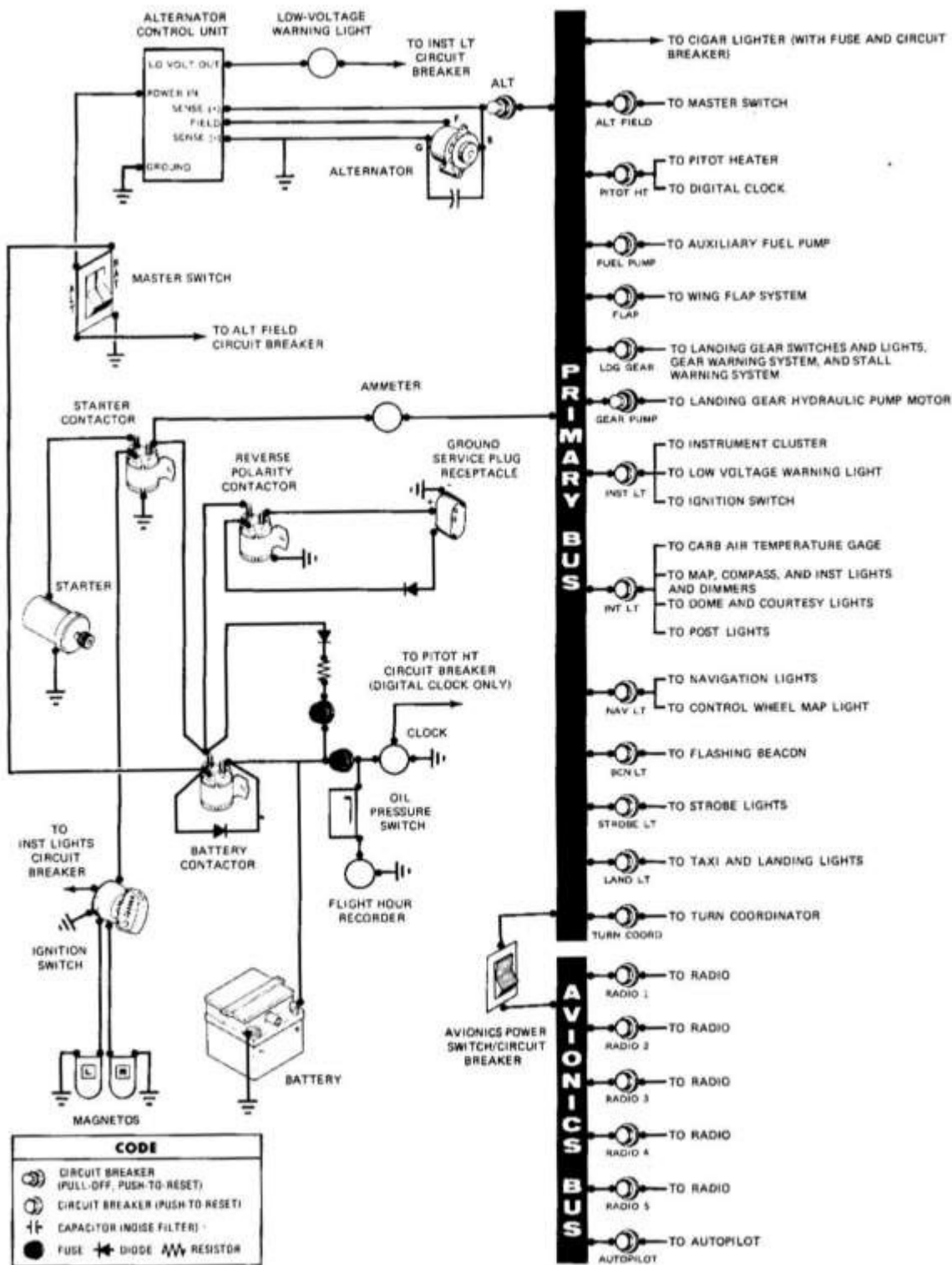


Figure 7-8. Electrical System

LIGHTING SYSTEMS

EXTERIOR LIGHTING

Conventional navigation lights are located on the wing tips and top of the rudder. Dual landing/taxi lights are located in the cowl nose cap. Additional lighting is available and includes a flashing beacon mounted on top of the vertical fin, a strobe light on each wing tip, and a courtesy light recessed into the lower surface of each wing slightly outboard of the cabin doors. Details of the strobe light system are presented in Section 9. Supplements. The courtesy lights are operated by the DOME LIGHTS switch located on the overhead console; push the switch to the right to turn the lights on. The remaining exterior lights are operated by rocker switches located on the left switch and control panel; push the rocker up to the ON position.

The flashing beacon should not be used when flying through clouds or overcast; the flashing light reflected from water droplets or particles in the atmosphere, particularly at night, can produce vertigo and loss of orientation.

INTERIOR LIGHTING

Instrument panel and switch and control panel lighting is provided by flood lighting, integral lighting, and post lighting (if installed). Lighting intensity is controlled by a dual dimming rheostat equipped with an outer knob labeled PANEL LT, and an inner knob labeled RADIO LT, located below the throttle. A slide-type switch (if installed) on the overhead console, labeled PANEL LIGHTS, is used to select flood lighting in the FLOOD position, post lighting in the POST position, or a combination of post and flood lighting in the BOTH position.

Instrument panel and switch and control panel flood lighting consists of a single red flood light in the forward edge of the overhead console. To use flood lighting, move the slide switch in the overhead console, labeled PANEL LIGHTS, to the FLOOD position and rotate the outer knob on the light dimming rheostat, labeled PANEL LT, clockwise to the desired light intensity.

Post lights (if installed) are mounted at the edge of each instrument and provide direct lighting. To use post lighting, move the slide switch in the overhead console, labeled PANEL LIGHTS, to the POST position and rotate the outer knob on the light dimming rheostat, labeled PANEL LT, clockwise to obtain the desired light intensity. When the PANEL LIGHTS switch is placed in the BOTH position, the flood lights and post lights will operate simultaneously.

The engine instrument cluster, radio equipment, digital clock and magnetic compass have integral lighting and operate independently of post or flood lighting. The intensity of instrument cluster, radio, and digital clock lighting is controlled by the inner knob on the light dimming rheostat labeled RADIO LT; compass lighting is controlled by the outer knob labeled PANEL LT. Rotate the knobs clockwise to obtain the desired light intensity. However, for daylight operation, the engine instrument, digital clock and compass lights may be turned off while still maintaining maximum

light intensity for the digital readouts in the radio equipment. This is accomplished by rotating the knobs full counterclockwise. The flood lights/post lights are also turned off for daylight operation by rotating the PANEL LT knob full counterclockwise.

A cabin dome light, in the aft part of the overhead console, is operated by a switch near the light. To turn the light on, move the switch to the right.

A control wheel map light is available and is mounted on the bottom of the pilot's control wheel. The light illuminates the lower portion of the cabin just forward of the pilot and is helpful when checking maps and other flight data during night operations. To operate the light, first turn on the NAV LT switch; then adjust the map light's intensity with the knurled disk type rheostat control located at the bottom of the control wheel.

A doorpost map light is located on the left forward doorpost. It contains both red and white bulbs and may be positioned to illuminate any area desired by the pilot. The light is controlled by a switch, below the light, which is labeled RED, OFF, and WHITE. Placing the switch in the top position will provide a red light. In the bottom position, standard white lighting is provided. In the center position, the map light is turned off. Red light intensity is controlled by the outer knob on the light dimming rheostat labeled PANEL LT.

The most probable cause of a light failure is a burned out bulb; however, in the event any of the lighting systems fail to illuminate when turned on, check the appropriate circuit breaker. If the circuit breaker has opened (white button popped out), and there is no obvious indication of a short circuit (smoke or odor), turn off the light switch of the affected lights, reset the breaker, and turn the switch on again. If the breaker opens again, do not reset it.

CABIN HEATING, VENTILATING AND DEFROSTING SYSTEM

Heated air from a muffler shroud and heater valve and ventilating air from an external ventilating air door are supplied to a manifold just forward of the pilot's and copilot's feet (see figure 7-9). The temperature and volume of airflow to the manifold and then to the cabin is regulated by manipulation of the push-pull CABIN HEAT and CABIN AIR controls. Both controls permit intermediate settings.

Cabin heat and ventilating air from the manifold to the cabin is supplied by two ducts, one extending down each side of the cabin to an outlet at the front door post at floor level. Windshield defrost air is also supplied by dual ducts leading from the cabin manifold to outlets on top of the glare shield. Two knobs on each outlet control sliding valves which permit regulation of defroster airflow.

For cabin ventilation, pull the CABIN AIR knob out, with the CABIN HEAT knob pushed full in. To raise the air temperature, pull the CABIN HEAT knob out until the desired temperature is attained. Additional heat is available by pulling the knob out farther; maximum heat is available with the CABIN HEAT knob pulled out and the CABIN AIR knob pushed full in.

NOTE

For improved partial heating on mild days, pull out the CABIN AIR knob slightly when the CABIN HEAT knob is out. This action increases the airflow through the system, increasing efficiency, and blends cool outside air with the exhaust manifold heated air, thus eliminating the possibility of overheating the system ducting.

Separate adjustable ventilators supply additional ventilation air to the cabin. One near each upper corner of the windshield supplies air for the pilot and copilot, and two ventilators are available for the rear cabin area to supply air to the rear seat passengers. Each rear ventilator outlet can be adjusted in any desired direction by rotating the entire outlet. Rear seat ventilation airflow may be closed off completely, or partially closed, according to the amount of airflow desired, by rotating an adjustment knob protruding from the center of the outlet.

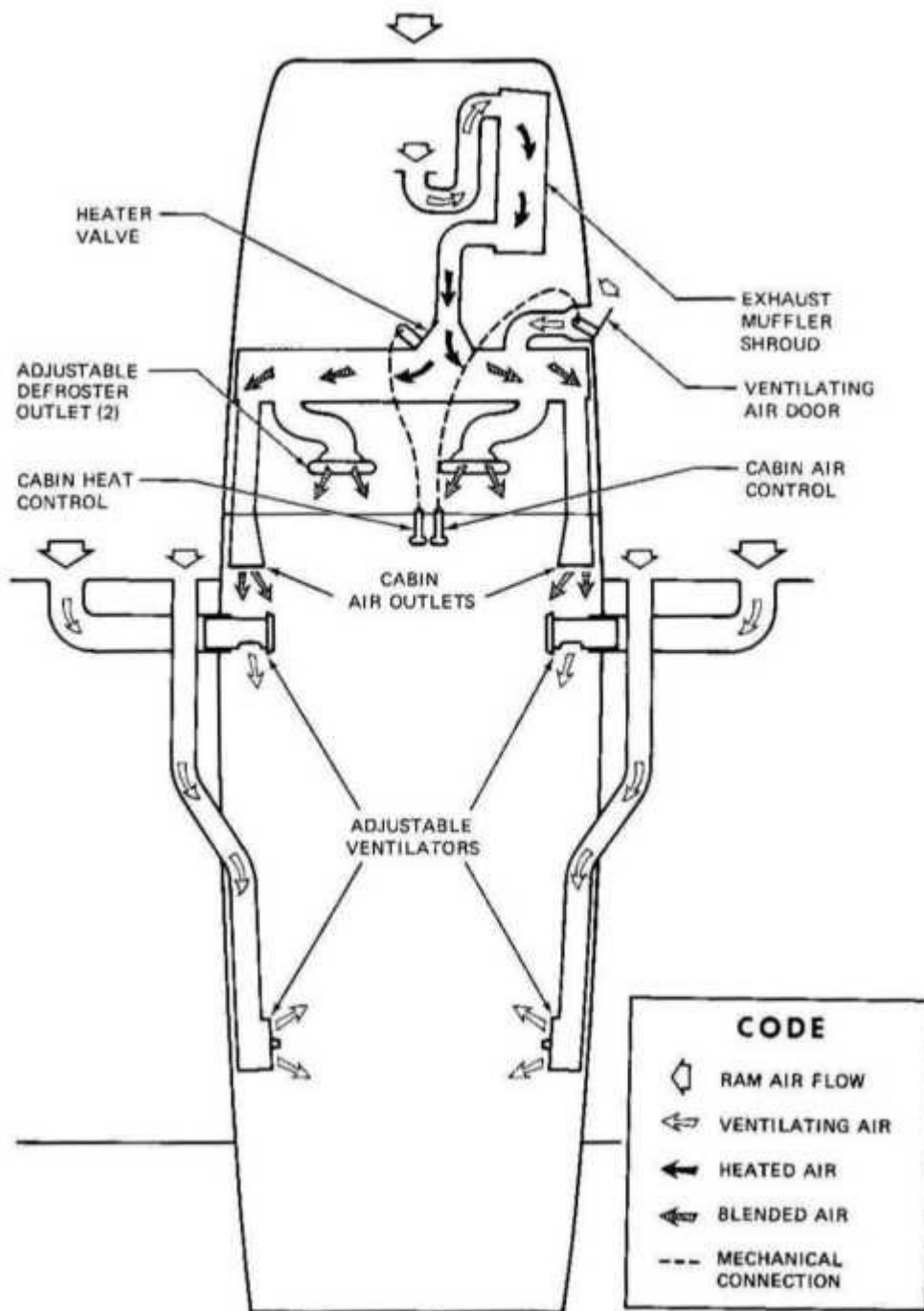


Figure 7-9. Cabin Heating, Ventilating, and Defrosting System

PITOT-STATIC SYSTEM AND INSTRUMENTS

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 either an unheated or heated pitot tube mounted on the lower surface of the left wing, two external static ports on the left and right sides of the forward fuselage, and the associated plumbing necessary to connect the instruments to the sources.

The heated pitot system (if installed) consists of a heating element in the pitot tube, a rocker switch labeled PITOT HT and a 10-amp push-to reset circuit breaker on the left side of the switch and control panel, and associated wiring. When the pitot heat switch is turned on, the element in the pitot tube is heated electrically to maintain proper operation in possible icing conditions. Pitot heat should be used only as required.

A static pressure alternate source valve may be installed beneath the throttle, and can be used if the external static source is malfunctioning. This valve supplies static pressure from inside the cabin instead of the external static ports.

If erroneous instrument readings are suspected due to water or ice in the pressure line going to the standard external static pressure source, the alternate static source valve should be pulled on.

Pressures within the cabin will vary with heater/vents opened or closed and windows open. Refer to Sections 3 and 5 for the effect of varying cabin pressures on airspeed and altimeter readings.

AIRSPEED INDICATOR

The airspeed indicator is calibrated in knots and miles per hour. Limitation and range markings (in KIAS) include the white arc (42 to 100 knots), green arc (50 to 145 knots), yellow arc (145 to 164 knots), and a red line (164 knots).

If a true airspeed indicator is installed, it is equipped with a rotatable ring which works in conjunction with the airspeed indicator dial in a manner similar to the operation of a flight computer. To operate the indicator, first rotate the ring until pressure altitude is aligned with outside air temperature in degrees Fahrenheit. Pressure altitude should not be confused with indicated altitude. To obtain pressure altitude, momentarily set the barometric scale on the altimeter to 29.92 and read pressure altitude on the altimeter. Be sure to return the altimeter barometric scale to the original barometric setting after pressure altitude has been obtained. Having set the ring to correct for altitude and temperature, read the true airspeed shown on the rotatable ring by the indicator pointer. For best accuracy, the indicated airspeed should be corrected to calibrated airspeed by referring to the Airspeed Calibration chart in Section 5. Knowing the calibrated airspeed, read true airspeed on the ring opposite the calibrated airspeed.

VERTICAL SPEED INDICATOR

The vertical speed indicator depicts airplane rate of climb or descent in feet per minute. The pointer is actuated by atmospheric pressure changes resulting from changes of altitude as supplied by the static source.

ALTIMETER

Airplane altitude is depicted by a barometric type altimeter. A knob near the lower left portion of the indicator provides adjustment of the instrument's barometric scale to the current altimeter setting.

VACUUM SYSTEM AND INSTRUMENTS

An engine-driven vacuum system (see figure 7-10) provides the suction necessary to operate the attitude indicator and directional indicator. The system consists of a vacuum pump mounted on the engine, a vacuum relief valve and vacuum system air filter on the aft side of the firewall below the instrument panel, instruments on the left side of the instrument panel and a suction gage on the right side of the panel.

ATTITUDE INDICATOR

An attitude indicator is available and gives a visual indication of flight attitude. Bank attitude is presented by a pointer at the top of the indicator relative to the bank scale which has index marks at 10 deg, 20 deg, 30 deg, 60 deg, and 90 deg either side of the center mark. Pitch and roll attitudes are presented by a miniature airplane superimposed over a symbolic horizon area divided into two sections by a white horizon bar. The upper "blue sky" area and the lower "ground" area have arbitrary pitch reference lines useful for pitch attitude control. A knob at the bottom of the instrument is provided for in-flight adjustment of the miniature airplane to the horizon bar for a more accurate flight attitude indication.

DIRECTIONAL INDICATOR

A directional indicator displays airplane heading on a compass card in relation to a fixed simulated airplane image and index. The directional indicator will precess slightly over a period of time. Therefore, the compass card should be set in accordance with the magnetic compass just prior to takeoff, and occasionally re-adjusted on extended flights. A knob on the lower left edge of the instrument is used to adjust the compass card to correct for any precession.

SUCTION GAGE

The suction gage, located at the upper right corner of the instrument panel, is calibrated in inches of mercury and indicates suction available for operation of the attitude and directional indicators. The desired suction range is 4.5 to 5.4 inches of mercury. A suction reading below this range may indicate a system malfunction or improper adjustment, and in this case, the indicators should not be considered reliable.

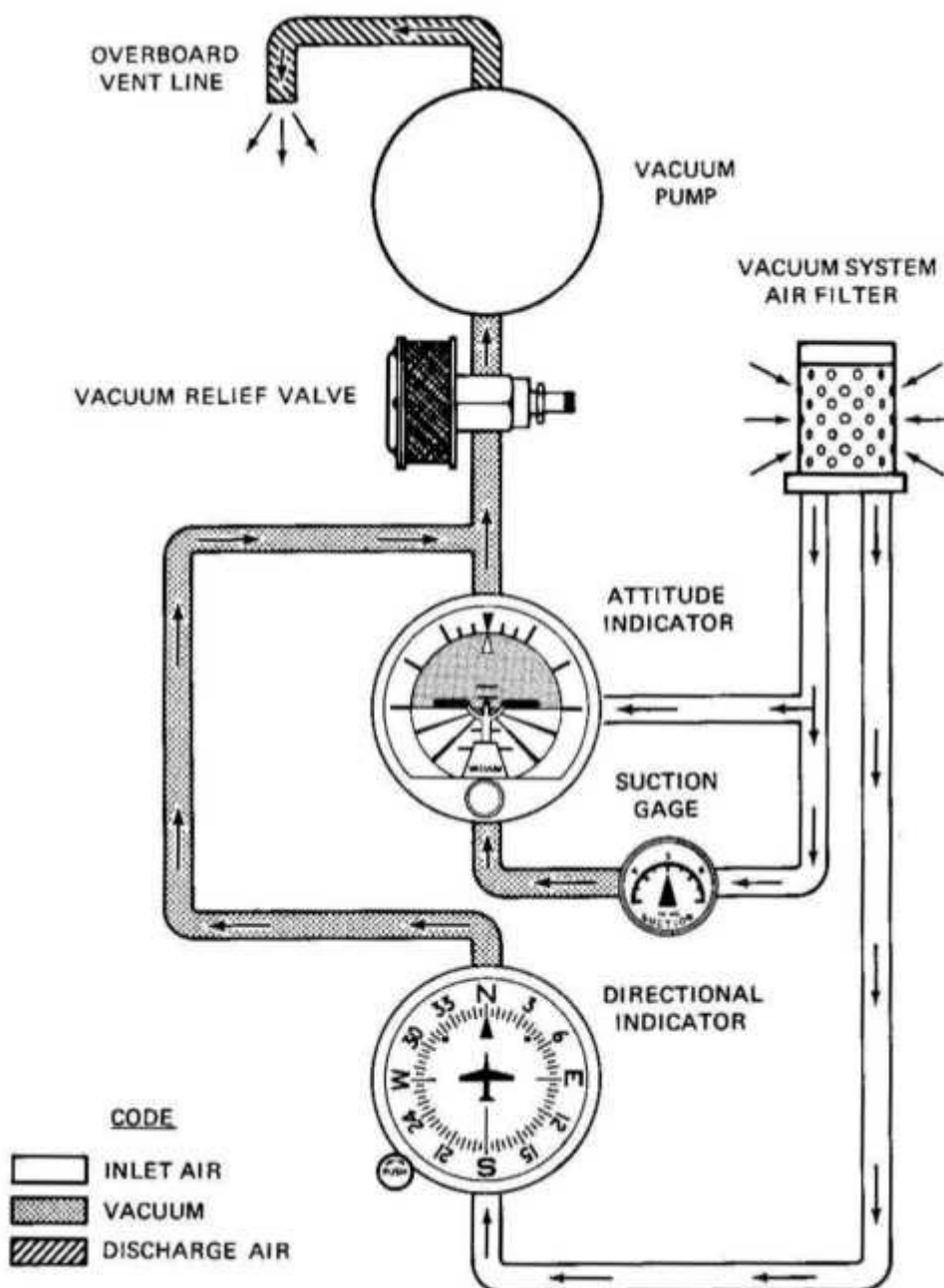


Figure 7-10. Vacuum System

STALL WARNING SYSTEM

The airplane is equipped with a vane-type stall warning unit, in the leading edge of the left wing, which is electrically connected to a dual warning unit located behind the instrument panel. The vane in the wing senses the change in airflow over the wing, and operates the dual warning unit, which produces a continuous tone over the airplane speaker at airspeeds between 5 and 10 knots above the stall in all configurations.

If the airplane has a heated stall warning system, the vane and sensor unit in the wing leading edge is equipped with a heating element. The heated part of the system is operated by the PITOT NT switch, and is protected by the PITOT HT circuit breaker.

The stall warning system should be checked during the pre-flight inspection by momentarily turning on the master switch and actuating the vane in the wing. The system is operational if a continuous tone is heard on the airplane speaker as the vane is pushed upward.

AVIONICS SUPPORT EQUIPMENT

If the airplane is equipped with avionics, various avionics support equipment may also be installed. Equipment available includes two types of audio control panels, microphone-headset installations and control surface static dischargers. The following paragraphs discuss these items. Description and operation of radio equipment is covered in Section 9 of this handbook.

AUDIO CONTROL PANEL

Two types of audio control panels (see figure 7-11) are available for this airplane, depending upon how many transmitters are included. The operational features of both audio control panels are similar and are discussed in the following paragraphs.

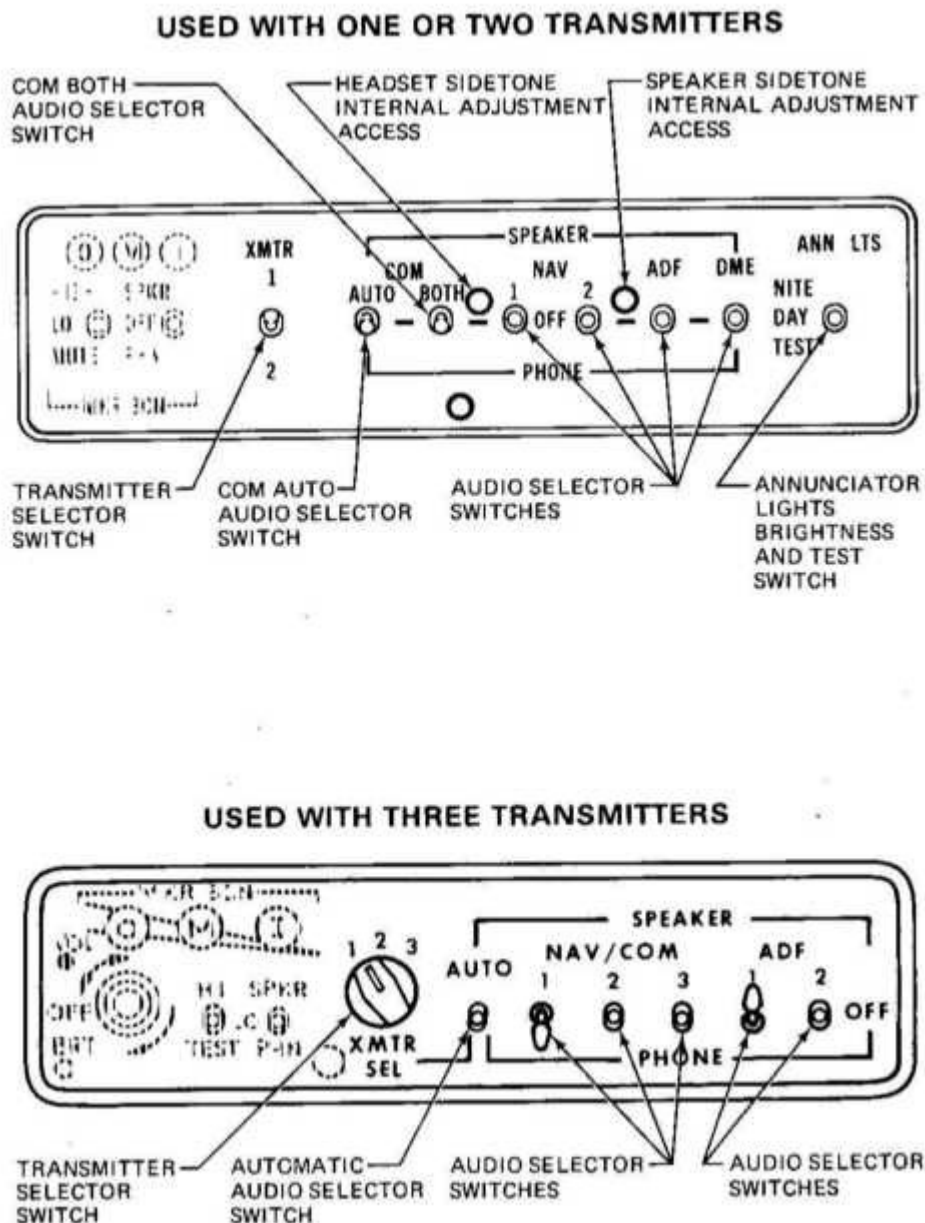


Figure 7-11. Audio Control Panel

TRANSMITTER SELECTOR SWITCH

When the avionics package includes a maximum of two transmitters, a two-position toggle-type switch, labeled XMTR, is provided to switch the microphone to the transmitter the pilot desires to use. If the airplane avionics package includes a third transmitter, the transmitter selector switch is a three-position rotary-type switch, labeled XMTR SEL. The numbers 1, 2, or 1, 2 and 3 adjacent to the selector switches correspond to the first, second and third (from top to bottom) transmitters in the avionics stack. To select a transmitter, place the transmitter selector switch in the position number corresponding to the desired transmitter.

The action of selecting a particular transmitter using the transmitter selector switch simultaneously selects the audio amplifier associated with that transmitter to provide

speaker audio. For example, if the number one transmitter is selected, the audio amplifier in the number one NAV/ COM is also selected and is used for ALL speaker audio. In the event the audio amplifier in use fails, as evidenced by loss of all speaker audio, selecting an alternate transmitter will reestablish speaker audio using the alternate transmitter audio amplifier. Headset audio is not affected by audio amplifier operation.

AUDIO SELECTOR SWITCHES

Both audio control panels (see figure 7-11) incorporate three-position toggle-type audio selector switches for individual control of the audio from systems installed in the airplane. These switches allow receiver audio to be directed to the airplane speaker or to a headset, and heard singly or in combination with other receivers. To hear a particular receiver on the airplane speaker, place that receiver's audio selector switch in the up (SPEAKER) position. To listen to a receiver over a headset, place that receiver's audio selector switch in the down (PHONE) position. The center (OFF) position turns off all audio from the associated receiver.

NOTE

Volume level is adjusted using the individual receiver volume controls on each radio.

A special feature of the audio control panel used when one or two transmitters are installed is separate control of NAV and COM audio from the NAV/COM radios. With this installation, the audio selector switches labeled NAY, 1 and 2 select audio from the navigation receivers of the NAV/COM radios only. Communication receiver audio is selected by the switches labeled COM, AUTO and BOTH. Description and operation of these switches is described in later paragraphs.

When the audio control panel for three transmitters is installed, audio from both NAY and COM frequencies is combined, and is selected by the audio selector switches labeled NAV/COM 1, 2 and 3.

COM AUTO AUDIO SELECTOR SWITCH

The audio control panel used with either one or two transmitters incorporates a three-position toggle switch, labeled COM AUTO, which is provided to automatically match the audio of the appropriate NAV/ COM communications receiver to the transmitter selected by the transmitter selector switch. When the COM AUTO selector switch is placed in the up (SPEAKER) position, audio from the communications receiver selected by the transmitter selector switch will be heard on the airplane speaker. Switching the transmitter selector switch to the other transmitter automatically switches the other communications receiver audio to the speaker. This automatic audio switching feature may also be utilized when listening on a headset by placing the COM AUTO switch in the down (PHONE) position. If automatic audio selection is not desired, the COM AUTO selector switch should be placed in the center (OFF) position.

COM BOTH AUDIO SELECTOR SWITCH

The audio control panel used with either one or two transmitters incorporates a three-position toggle switch, labeled COM BOTH, which is provided to allow both COM receivers to be monitored at the same time. For example, if the COM AUTO switch is in the SPEAKER position, with the transmitter selector switch in the number one transmitter position, number one communications receiver audio will be heard on the airplane speaker. If it is also desired to monitor the number two communications receiver audio without changing the position of the transmitter selector switch, place the COM BOTH selector switch in the up (SPEAKER) position so that the number two communications receiver audio will be heard in addition to the number one communications receiver audio. This feature can also be used when listening on a headset by placing the COM BOTH audio selector switch in the down (PHONE) position.

NOTE

The combination of placing the COM AUTO switch in the SPEAKER position and the COM BOTH switch in the PHONE position (or vice versa) is not normally recommended as it will cause audio from both communications receivers (and any other navigation receiver with its audio selector switch in the PHONE position) to be heard on both the airplane speaker and the headset simultaneously.

AUTO AUDIO SELECTOR SWITCH

The audio control panel used with three transmitters incorporates a three-position toggle switch, labeled AUTO, which is provided to automatically match the audio of the appropriate NAV/ COM receiver to the selected transmitter. To utilize this automatic feature, leave all NAV/ COM audio selector switches in the center (OFF) position, and place the AUTO selector switch in either the SPEAKER or PHONE position, as desired. Once the AUTO selector switch is positioned, the pilot may then select any transmitter and its associated NAV/COM receiver audio simultaneously with the transmitter selector switch. If automatic audio selection is not desired, the AUTO selector switch should be placed in the center (OFF) position.

NOTE

If the NAV/COM audio selector switch corresponding to the selected transmitter is in the PHONE position with the AUTO selector switch in the SPEAKER position, all audio selector switches placed in the PHONE position will automatically be connected to both the airplane speaker and any headsets in use.

ANNUNCIATOR LIGHTS BRIGHTNESS AND TEST SWITCH

The audio control panel used with either one or two transmitters incorporates a three-position toggle-type switch to control the brightness level of the marker beacon indicator lights (and certain other annunciator lights associated with avionics equipment). When the switch is placed in the center (DAY) position, the indicator lights will show full bright. When this switch is placed in the up (NITE) position, the lights are set to a reduced level for typical night operations and can be further adjusted using the RADIO LT dimming rheostat knob. The down (TEST) position illuminates all lamps (except the ARC light in the NAV indicators) which are controlled by the switch to the full bright level to verify lamp operation.

SIDETONE OPERATION

Cessna radios are equipped with sidetone capability (monitoring of the operator's own voice transmission). While adjusting sidetone, be aware that if the sidetone volume level is set too high, audio feedback (squeal) may result when transmitting. When the airplane has one or two transmitters, sidetone is provided in both the speaker and headset anytime the COM AUTO selector switch is utilized. Placing the COM AUTO selector switch in the OFF position will eliminate sidetone. Sidetone internal adjustments are available to the pilot through the front of the audio control panel (see figure 7-11). Adjustment can be made by removing the appropriate plug-button from the audio control panel (left button for headset adjustment and right button for speaker adjustment), inserting a small screwdriver into the adjustment potentiometer and rotating it clockwise to increase the sidetone volume level.

When the airplane has three transmitters, sidetone will be heard on either the speaker or a headset as selected with the AUTO selector switch. Sidetone may be eliminated by placing the AUTO selector switch in the OFF position, and utilizing the individual audio selector switches. Adjustment of speaker and headset sidetone volume can only be accomplished by adjusting the sidetone potentiometers located inside the audio control panel.

NOTE

Sidetone is not available on HF Transceivers (Types PTIO A and ASB-125), when installed.

MICROPHONE-HEADSET INSTALLATIONS

Three types of microphone-headset installations are offered. The standard system provided with avionics equipment includes a hand-held microphone and separate headset. The keying switch for this microphone is on the microphone. Two optional microphone-headset installations are also available; these feature a single-unit microphone-headset combination which permits the pilot to conduct radio communications without interrupting other control operations to handle a hand-held

microphone. One microphone-headset combination is offered without a padded headset and the other version has a padded headset. The microphone-headset combinations utilize a remote keying switch located on the left grip of the pilot's control wheel. The microphone and headset jacks are located on the left side of the instrument panel. Audio to all three headsets is controlled by the individual audio selector switches and adjusted for volume level by using the selected receiver volume controls.

NOTE

When transmitting, the pilot should key the microphone, place the microphone as close as possible to the lips and speak directly into it.

STATIC DISCHARGERS

If frequent IFR flights are planned, installation of wick-type static dischargers is recommended to improve radio communications during flight through dust or various forms of precipitation (rain, snow or ice crystals). Under these conditions, the build-up and discharge of static electricity from the trailing edges of the wings, rudder, elevator, propeller tips, and radio antennas can result in loss of usable radio signals on all communications and navigation radio equipment. Usually the ADF is first to be affected and VHF communication equipment is the last to be affected.

Installation of static dischargers reduces interference from precipitation static, but it is possible to encounter severe precipitation static conditions which might cause the loss of radio signals, even with static dischargers installed. Whenever possible, avoid known severe precipitation areas to prevent loss of dependable radio signals. If avoidance is impractical, minimize airspeed and anticipate temporary loss of radio signals while in these areas.