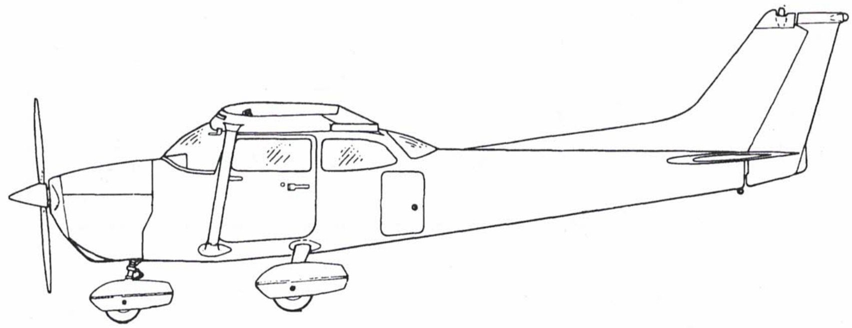
Pilot's Operating Handbook
and
FAA Approved Airplane Flight Manual



Cessna Aircraft Company

THIS DOCUMENT MUST BE CARRIED IN THE AIRPLANE AT ALL TIMES.

1983 Model 172Q

Serial No. ____________

Registration No. ____________

THIS HANDBOOK INCLUDES THE MATERIAL REQUIRED TO BE FURNISHED TO THE PILOT BY CAR PART 3 AND CONSTITUTES THE FAA APPROVED AIRPLANE FLIGHT MANUAL.

Cessna Aircraft Company
Wichita, Kansas USA

Member of GAMA

Original Issue - 29 October 1982

THIS MANUAL WAS PROVIDED FOR THE AIRPLANE IDENTIFIED ON THE TITLE PAGE ON ______________ . SUBSEQUENT REVISIONS SUPPLIED BY CESSNA AIRCRAFT COMPANY MUST BE PROPERLY INSERTED.

____

Cessna Aircraft Company, Pawnee Aircraft Division

CONGRATULATIONS ....

Welcome to the ranks of Cessna owners! Your Cessna has been designed and constructed to give you the most in performance, economy, and comfort. It is our desire that you will find flying it, either for business or pleasure, a pleasant and profitable experience.

This Pilot's Operating Handbook has been prepared as a guide to help you get the most pleasure and utility from your airplane. It contains information about your Cessna's equipment, operating procedures, and performance; and suggestions for its servicing and care. We urge you to read it from cover to cover, and to refer to it frequently.

Our interest in your flying pleasure has not ceased with your purchase of a Cessna. Worldwide, the Cessna Dealer Organization backed by the Cessna Customer Services Department stands ready to serve you. The following services are offered by most Cessna Dealers:

- THE CESSNA WARRANTY, which provides coverage for parts and labor, is available at Cessna Dealers worldwide. Specific benefits and provisions of warranty, plus other important benefits for you, are contained in your Customer Care Program book, supplied with your airplane. Warranty service is available to you at authorized Cessna Dealers throughout the world upon presentation of your Customer Care Card which establishes your eligibility under the warranty.
- FACTORY-TRAINED PERSONNEL to provide you with courteous expert service.
- FACTORY-APPROVED SERVICE EQUIPMENT to provide you efficient and accurate workmanship.
- A STOCK OF GENUINE CESSNA SERVICE PARTS on hand when you need them.
- THE LATEST AUTHORITATIVE INFORMATION FOR SERVICING CESSNA AIRPLANES, since Cessna Dealers have all of the Service Manuals and Parts Catalogs, kept current by Customer Care Service Information Letters and Customer Care News Letters, published by Cessna Aircraft Company.

We urge all Cessna owners to use the Cessna Dealer Organization to the fullest.

A current Worldwide Customer Care Directory accompanies your new airplane. The Directory is revised frequently, and a current copy can be obtained from your Cessna Dealer. Make your Directory one of your cross-country flight planning aids; a warm welcome awaits you at every Cessna Dealer.

PERFORMANCE - SPECIFICATIONS

SPEED:		
Maximum at Sea Level		124 KNOTS
Cruise, 75% Power at 8500 Ft		122 KNOTS
CRUISE: Recommended lean mixture with fuel allowance for engine start, taxi, takeoff, climb and 45 minutes reserve.		
75% Power at 8500 Ft	Range	475 NM
50 Gallons Usable Fuel	Time	4.0 HRS
75% Power at 8500 Ft	Range	620 NM
62 Gallons Usable Fuel	Time	5.2 HRS
Maximum Range at 10,000 Ft	Range	600 NM
50 Gallons Usable Fuel	Time	6.4 HRS
Maximum Range at 10,000 Ft	Range	775 NM
62 Gallons Usable Fuel	Time	8.2 HRS
RATE OF CLIMB AT SEA LEVEL		680 FPM
SERVICE CEILING		17,000 FT
TAKEOFF PERFORMANCE:		
Ground Roll		960 FT
Total Distance Over 50-Ft Obstacle		1690 FT
LANDING PERFORMANCE:		
Ground Roll		575 FT
Total Distance Over 50-Ft Obstacle		1335 FT
STALL SPEED (KCAS):		
Flaps Up, Power Off		53 KNOTS
Flaps Down, Power Off		48 KNOTS
MAXIMUM WEIGHT:		
Ramp		2558 LBS
Takeoff or Landing		2550 LBS
STANDARD EMPTY WEIGHT:		
Cutlass		1486 LBS
Cutlass II		1513 LBS
MAXIMUM USEFUL LOAD:		
Cutlass		1072 LBS
Cutlass II		1045 LBS
BAGGAGE ALLOWANCE		120 LBS
WING LOADING: Pounds/Sq Ft		14.7
POWER LOADING: Pounds/HP		14.2
FUEL CAPACITY: Total		
Standard Tanks		54 GAL.
Long Range Tanks		68 GAL.
OIL CAPACITY		9 QTS
ENGINE: Avco Lycoming		O-360-A4N
180 BHP at 2700 RPM		
PROPELLER: Fixed Pitch, Diameter		76 IN.

The above performance figures are based on the indicated weights, standard atmospheric conditions, level hard-surface dry runways, and no wind. They are calculated values derived from flight tests conducted by the Cessna Aircraft Company under carefully documented conditions and will vary with individual airplanes and numerous factors affecting flight performance.

COVERAGE

The Pilot's Operating Handbook in the airplane at the time of delivery from Cessna Aircraft Company contains information applicable to the 1983 Model 172Q airplane designated by the serial number and registration number shown on the Title Page of this handbook. This information is based on data available at the time of publication.

REVISIONS

Changes and/or additions to this handbook will be covered by revisions published by Cessna Aircraft Company. These revisions are distributed to owners of U.S. Registered aircraft according to FAA records at the time of revision issuance, and to Internationally Registered aircraft according to Cessna Owner Advisory records at the time of issuance.

Revisions should be examined immediately upon receipt and incorporated in this handbook.

NOTE

It is the responsibility of the owner to maintain this handbook in a current status when it is being used for operational purposes.

Owners should contact their Cessna Service Station whenever the revision status of their handbook is in question.

A revision bar will extend the full length of new or revised text and/or illustrations added on new or presently existing pages. This bar will be located adjacent to the applicable revised area on the outer margin of the page.

All revised pages will carry the revision number and date on the applicable page.

The following Log of Effective Pages provides the dates of issue for original and revised pages, and a listing of all pages in the handbook. Pages affected by the current revision are indicated by an asterisk (*) preceding the pages listed.

LOG OF EFFECTIVE PAGES

Dates of issue for original and revised pages:

Original	29 October 1982
Revision 1	1 December 1983
Revision 2	1 October 1994

Page	Date
Title	29 October 1982
Assignment Record	29 October 1982
i thru ii	29 October 1982
* iii thru iv	1 October 1994
v	29 October 1982
vi Blank	29 October 1982
1-1 thru 1-9	29 October 1982
1-10 Blank	29 October 1982
2-1	29 October 1982
2-2 Blank	29 October 1982
2-3 thru 2-4	29 October 1982
* 2-5 thru 2-6	1 October 1994
2-7 thru 2-12	29 October 1982
3-1 thru 3-9	29 October 1982
3-10 Blank	29 October 1982
3-11 thru 3-18	29 October 1982
4-1 thru 4-11	29 October 1982
4-12 Blank	29 October 1982
4-13 thru 4-25	29 October 1982
4-26 Blank	29 October 1982
5-1	29 October 1982
5-2 Blank	29 October 1982
5-3 thru 5-7	29 October 1982
5-8 Blank	29 October 1982
5-9 thru 5-23	29 October 1982
5-24 Blank	29 October 1982
6-1	29 October 1982
6-2 Blank	29 October 1982
6-3 thru 6-18	29 October 1982
* 6-19	1 October 1994
6-20 thru 6-27	29 October 1982
6-28 Blank	29 October 1982
7-1 thru 7-16	29 October 1982
* 7-17	1 October 1994
7-18 thru 7-37	29 October 1982
7-38 Blank	29 October 1982

LOG OF EFFECTIVE PAGES (Continued)

Page	Date
8-1	29 October 1982
8-2 Blank	29 October 1982
8-3 thru 8-19	29 October 1982
8-20 Blank	29 October 1982
9-1 thru 9-3	29 October 1982
9-4 Blank	29 October 1982

NOTE

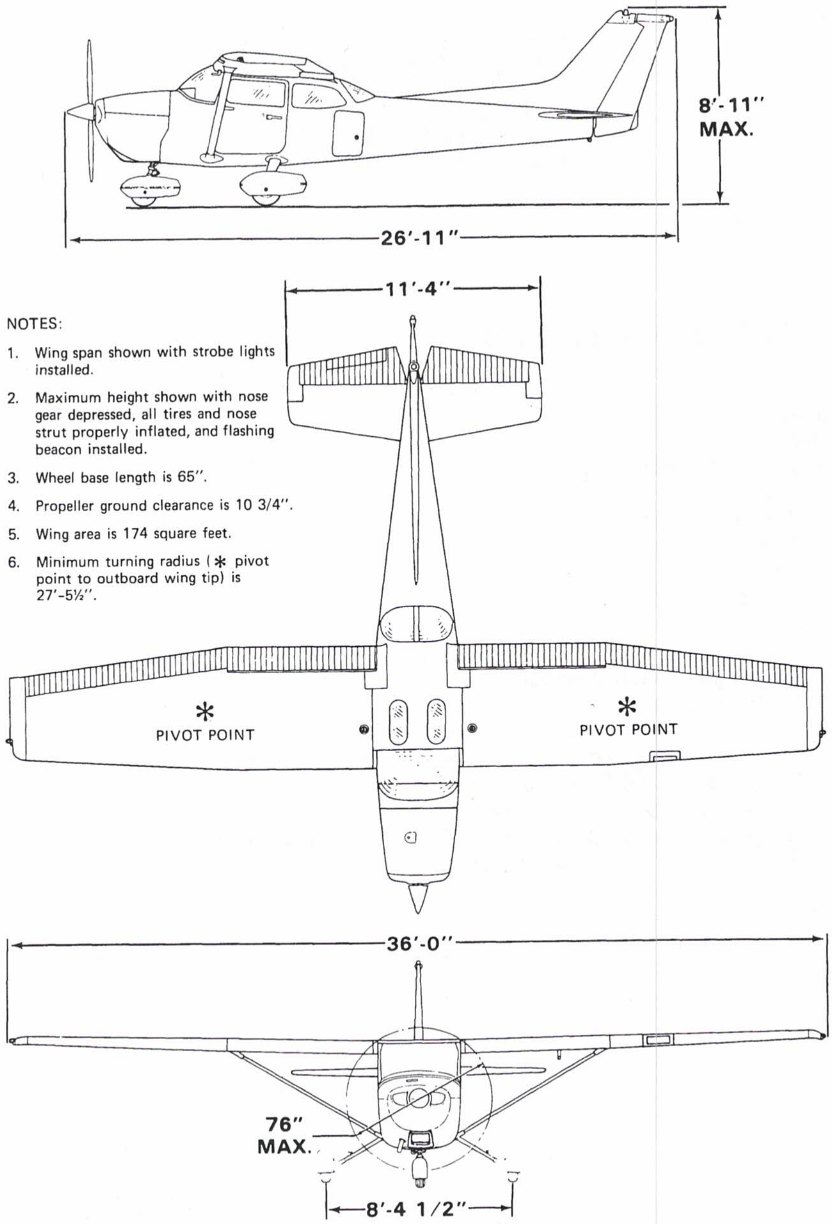
Refer to Section 9 Table of Contents for supplements applcable to optional systems.

TABLE OF CONTENTS

SECTION 1
GENERAL

TABLE OF CONTENTS

Page



NOTES:

1. Wing span shown with strobe lights installed.
2. Maximum height shown with nose gear depressed, all tires and nose strut properly inflated, and flashing beacon installed.
3. Wheel base length is 65".
4. Propeller ground clearance is 10 3/4".
5. Wing area is 174 square feet.
6. Minimum turning radius (✱ pivot point to outboard wing tip) is 27'-5½".

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-A4N.
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: 1A170E/JFA7658.
Number of Blades: 2.
Propeller Diameter, Maximum: 76 inches.
Minimum: 74.5 inches.
Propeller Type: Fixed pitch.

FUEL

Approved Fuel Grades (and Colors):
100LL 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.

Fuel Capacity:
- Standard Tanks:
  - Total Capacity: 54 gallons.
  - Total Capacity Each Tank: 27 gallons.
  - Total Usable: 50 gallons.
- Long Range Tanks:
  - Total Capacity: 68 gallons.
  - Total Capacity Each Tank: 34 gallons.
  - Total Usable: 62 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 Specification:

MIL-L-6082 Aviation Grade Straight Mineral Oil: Used when the airplane was delivered from the factory and should be used to replenish the supply during the first 25 hours. This oil should be drained after the first 25 hours of operation. Refill the engine and continue to use until a total of 50 hours has accumulated or oil consumption has stabilized.

MIL-L-22851 Aviation Grade Ashless Dispersant Oil: Oil conforming to Avco Lycoming Service Instruction No. 1014, and all revisions and supplements thereto, **must be used** after first 50 hours or oil consumption has stabilized.

Recommended Viscosity for Temperature Range:
- All temperatures, use multi-viscosity oil or
- Above 16° C (60° F), use SAE 50
- -1° C (30° F) to 32° C (90° F), use SAE 40
- -18° C (0° F) to 21° C (70° F), use SAE 30

NOTE

When operating temperatures overlap, use the lighter grade of oil.

Oil Capacity:
- Sump: 8 Quarts.
- Total: 9 Quarts.

MAXIMUM CERTIFICATED WEIGHTS

Ramp: 2558 lbs.
Takeoff: 2550 lbs.
Landing: 2550 lbs.
Weight in Baggage Compartment:
- Baggage Area 1 (or passenger on child's seat) - Station 82 to 108; 120 lbs. See note below.
- Baggage Area 2 - Station 108 to 142: 50 lbs. See note below.

NOTE

The maximum combined weight capacity for baggage areas 1 and 2 is 120 lbs.

STANDARD AIRPLANE WEIGHTS

Standard Empty Weight, Cutlass: 1486 lbs.
Cutlass II: 1513 lbs.
Maximum Useful Load, Cutlass: 1072 lbs.
Cutlass II: 1045 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: 14.7 lbs./sq. ft.
Power Loading: 14.2 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 KCAS corrected for altitude and temperature.
V_A	**Maneuvering Speed** is the maximum speed at which full or abrupt control movements may be used.
V_{FE}	**Maximum Flap Extended Speed** is the highest speed permissible with wing flaps in a prescribed extended position.
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_{S_o}	**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-of-Climb Speed** is the speed which results in the greatest gain of altitude in a given horizontal distance.
V_Y	**Best Rate-of-Climb Speed** is the speed which results in the greatest gain in altitude in a given time.

METEOROLOGICAL TERMINOLOGY

OAT	**Outside Air Temperature** is the free air static temperature.

	It is expressed in either degrees Celsius or degrees Fahrenheit.
Standard Temperature	**Standard Temperature** is 15°C at sea level pressure altitude and decreases by 2°C for each 1000 feet of altitude.
Pressure Altitude	**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.
Static RPM	**Static RPM** is engine speed attained during a full-throttle engine runup when the airplane is on the ground and stationary.

AIRPLANE PERFORMANCE AND FLIGHT PLANNING TERMINOLOGY

Demonstrated Crosswind Velocity	**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	**Usable Fuel** is the fuel available for flight planning.
Unusable Fuel	**Unusable Fuel** is the quantity of fuel that can not be safely used in flight.
GPH	**Gallons Per Hour** is the amount of fuel consumed per hour.
NMPG	**Nautical Miles Per Gallon** is the distance which can be expected per gallon of fuel consumed at a specific engine power setting and/or flight configuration.
g	**g** is acceleration due to gravity.

WEIGHT AND BALANCE TERMINOLOGY

Reference Datum	**Reference Datum** is an imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Station	**Station** is a location along the airplane fuselage given in terms of the distance from the reference datum.
Arm	**Arm** is the horizontal distance from the reference datum to the center of gravity (C.G.) of an item.
Moment	**Moment** is the product of the weight of an item multiplied by its arm. (Moment divided by the constant 1000 is used in this handbook to simplify balance calculations by reducing the number of digits.)
Center of Gravity (C.G.)	**Center of Gravity** 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.
C.G. Arm	**Center of Gravity Arm** is the arm obtained by adding the airplane's individual moments and dividing the sum by the total weight.
C.G. Limits	**Center of Gravity Limits** are the extreme center of gravity locations within which the airplane must be operated at a given weight.
Standard Empty Weight	**Standard Empty Weight** is the weight of a standard airplane, including unusable fuel, full operating fluids and full engine oil.
Basic Empty Weight	**Basic Empty Weight** is the standard empty weight plus the weight of optional equipment.
Useful Load	**Useful Load** is the difference between ramp weight and the basic empty weight.
Maximum Ramp 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	**Maximum Takeoff Weight** is the maximum weight approved for the start of the takeoff roll.

Maximum Landing Weight

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

Tare

Tare is the weight of chocks, blocks, stands, etc. used when weighing an airplane, and is included in the scale readings. Tare is deducted from the scale reading to obtain the actual (net) airplane weight.

SECTION 2
LIMITATIONS

TABLE OF CONTENTS

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. If the alternate static source is being used, ample margins should be observed to allow for 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. 3A12 as Cessna Model No. 172Q.

AIRSPEED LIMITATIONS

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

	SPEED	KCAS	KIAS	REMARKS
V_{NE}	Never Exceed Speed	151	158	Do not exceed this speed in any operation.
V_{NO}	Maximum Structural Cruising Speed	123	127	Do not exceed this speed except in smooth air, and then only with caution.
V_A	Maneuvering Speed: 2550 Pounds 2150 Pounds 1750 Pounds	 102 94 85	 105 95 85	Do not make full or abrupt control movements above this speed.
V_{FE}	Maximum Flap Extended Speed: 10° Flaps 10° - 30° Flaps	 107 85	 110 85	Do not exceed this speed with flaps down.
	Maximum Window Open Speed	151	158	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	40 - 85	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 -127	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	127 - 158	Operations must be conducted with caution and only in smooth air.
Red Line	158	Maximum speed for all operations.

Figure 2-2. Airspeed Indicator Markings

POWERPLANT LIMITATIONS

Engine Manufacturer: Avco Lycoming.
Engine Model Number: O-360-A4N.
Maximum Power: 180 BHP rating.
Engine Operating Limits for Takeoff and Continuous Operations:
    Maximum Engine Speed: 2700 RPM.

NOTE

The static RPM range at full throttle (carburetor heat off and mixture leaned to maximum RPM) is 2350 to 2450 RPM.

Maximum Oil Temperature: 245°F (118°C).
Oil Pressure, Minimum: *25 psi.
    Maximum: 115 psi.
Fuel Grade: See Fuel Limitations.
Oil Grade (Specification):
    MIL-L-6082 Aviation Grade Straight Mineral Oil or MIL-L-22851 Ashless Dispersant Oil.
Propeller Manufacturer: McCauley Accessory Division.
Propeller Model Number: 1A170E/JFA7658.
Propeller Diameter, Maximum: 76 inches.
    Minimum: 74.5 inches.

*** 20 psi on airplanes modified by Service Kit SK172-83, SK172-84 or SK172-123A.**

POWERPLANT INSTRUMENT MARKINGS

Powerplant instrument markings and their color code significance are shown in Figure 2-3.

INSTRUMENT	RED LINE MINIMUM LIMIT	GREEN ARC NORMAL OPERATING	RED LINE MAXIMUM LIMIT
Tachometer: Sea Level 5000 Feet 10000 Feet	---	2100 - 2500 RPM 2100 - 2600 RPM 2100 - 2700 RPM	2700 RPM
Oil Temperature	---	100° - 245°F	245°F
Oil Pressure	* 25 psi	* 60 - 90 psi	115 psi
Fuel Quantity (Standard Tanks)	E (2.0 Gal. Unusable Each Tank)	---	---
Fuel Quantity (Long Range Tanks)	E (3.0 Gal. Unusable Each Tank)	---	---
Fuel Pressure	0.5 psi	0.5 - 8.0 psi	8.0 psi
Suction	---	4.5 - 5.4 in. Hg	---

Figure 2-3. Powerplant Instrument Markings

WEIGHT LIMITS

NORMAL CATEGORY

Maximum Ramp Weight: 2558 lbs.
Maximum Takeoff Weight: 2550 lbs.
Maximum Landing Weight: 2550 lbs.
Maximum Weight in Baggage Compartment:

Baggage Area 1 (or passenger on child's seat) - Station 82 to 108: 120 lbs. See following note.

Baggage Area 2 - Station 108 to 142: 50 lbs. See following note.

*** 20 psi (red line) and 50-90 psi (green arc) on airplanes modified by Service Kit SK172-83, SK172-84 or SK172-123A.**

NOTE

The maximum combined weight capacity for baggage areas 1 and 2 is 120 lbs.

CENTER OF GRAVITY LIMITS

Center of Gravity Range:
Forward: 35.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 41.0 inches aft of datum at 2550 lbs.
Aft: 47.3 inches aft of datum at all weights.
Reference Datum: Lower portion of 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 turns in which the angle of bank is not more than 60°.

Aerobatic maneuvers, including spins, are not approved.

FLIGHT LOAD FACTOR LIMITS

Flight Load Factors (Maximum Takeoff Weight - 2550 lbs.):
*Flaps Up . . . . +3.8g, -1.52g
*Flaps Down . . . . +3.0g

*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: 27 U.S. gallons each.
Total Fuel: 54 U.S. gallons.
Usable Fuel (all flight conditions): 50 U.S. gallons.
Unusable Fuel: 4 U.S. gallons.
2 Long Range Tanks: 34 U.S. gallons each.
Total Fuel: 68 U.S. gallons.
Usable Fuel (all flight conditions): 62 U.S. gallons.
Unusable Fuel: 6 U.S. 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.

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

Maximum slip or skid duration with one tank dry: 30 seconds.

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

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):
100LL Grade Aviation Fuel (Blue).
100 (Formerly 100/130) Grade Aviation Fuel (Green).

OTHER LIMITATIONS

FLAP LIMITATIONS

Approved Takeoff Range: 0° to 10°.
Approved Landing Range: 0° to 30°.

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.
>
> Normal Category - 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. On the fuel selector valve (standard tanks):

TAKEOFF LANDING	BOTH 50.0 GAL.	ALL FLIGHT ATTITUDES
LEFT 25.0 GAL. LEVEL FLIGHT ONLY		RIGHT 25.0 GAL. LEVEL FLIGHT ONLY
		FUEL SELECTOR
	OFF OFF	

On the fuel selector valve (long range tanks):

TAKEOFF LANDING	BOTH 62.0 GAL.	ALL FLIGHT ATTITUDES
LEFT 31.0 GAL. LEVEL FLIGHT ONLY		RIGHT 31.0 GAL. LEVEL FLIGHT ONLY
		FUEL SELECTOR
	OFF OFF	

3. Near fuel tank filler cap (standard tanks):

FUEL 100LL/100 MIN. GRADE AVIATION GASOLINE CAP. 27 U.S. GAL.

Near fuel tank filler cap (long range tanks):

FUEL 100LL/100 MIN. GRADE AVIATION GASOLINE CAP. 34 U.S. GAL. CAP. 24.0 U.S. GAL. TO BOTTOM OF FILLER COLLAR

4. Near wing flap switch:

AVOID SLIPS WITH FLAPS EXTENDED

5. On flap control indicator:

0° to 10°	110 KIAS	(Partial flap range with blue color code; also, mechanical detent at 10°.)
10° to 30°	85 KIAS	(White color code; also, mechanical detent at 20°.)

6. In baggage compartment:

120 POUNDS MAXIMUM
BAGGAGE AND/OR AUXILIARY PASSENGER
FORWARD OF BAGGAGE DOOR LATCH

50 POUNDS MAXIMUM
BAGGAGE AFT OF BAGGAGE DOOR LATCH

MAXIMUM 120 POUNDS COMBINED

FOR ADDITIONAL LOADING INSTRUCTIONS
SEE WEIGHT AND BALANCE DATA

7. A calibration card must be provided to indicate the accuracy of the magnetic compass in 30° increments.

8. On oil filler cap:

OIL
8 QTS

9. On control lock:

CAUTION!
CONTROL LOCK
REMOVE BEFORE STARTING ENGINE

10. Near airspeed indicator:

MANEUVER SPEED - 105 KIAS

11. On forward face of firewall adjacent to the battery:

CAUTION 24 VOLTS D.C. This aircraft is equipped with alternator and a negative ground system. OBSERVE PROPER POLARITY Reverse polarity will damage electrical components.

SECTION 3
EMERGENCY PROCEDURES

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

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:	
2550 Lbs	105 KIAS
2150 Lbs	95 KIAS
1750 Lbs	85 KIAS
Maximum Glide:	
2550 Lbs	68 KIAS
2150 Lbs	62 KIAS
1750 Lbs	56 KIAS
Precautionary Landing With Engine Power	65 KIAS
Landing Without Engine Power:	
Wing Flaps Up	70 KIAS
Wing Flaps Down	65 KIAS

OPERATIONAL CHECKLISTS

Procedures in the Operational Checklists portion of this section shown in **bold-faced** type are immediate-action items which should be committed to memory.

ENGINE FAILURES

ENGINE FAILURE DURING TAKEOFF ROLL

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.
6. Master Switch -- OFF.

ENGINE FAILURE DURING FLIGHT (RESTART PROCEDURES)

1. **Airspeed -- 75 KIAS.**
2. **Carburetor Heat -- ON.**
3. **Fuel Selector Valve -- BOTH.**
4. Mixture -- RICH.
5. Auxiliary Fuel Pump -- ON if fuel pressure is below 0.5 psi.
6. Ignition Switch -- BOTH (or START if propeller is stopped).
7. Primer -- IN and LOCKED.

FORCED LANDINGS

EMERGENCY LANDING WITHOUT ENGINE POWER

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° recommended).
6. Master Switch -- OFF.
7. Doors -- UNLATCH PRIOR TO TOUCHDOWN.
8. Touchdown -- SLIGHTLY TAIL LOW.
9. Brakes -- APPLY HEAVILY.

PRECAUTIONARY LANDING WITH ENGINE POWER

1. Wing Flaps -- 20°.
2. Airspeed -- 65 KIAS.
3. Selected Field -- FLY OVER, noting terrain and obstructions, then retract flaps upon reaching a safe altitude and airspeed.

4. Avionics Power Switch and Electrical Switches -- OFF.
5. Wing Flaps -- 30° (on final approach).
6. Airspeed -- 65 KIAS.
7. Master Switch -- OFF.
8. Doors -- UNLATCH PRIOR TO TOUCHDOWN.
9. Touchdown -- SLIGHTLY TAIL LOW.
10. Ignition Switch -- OFF.
11. 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. Approach -- High Winds, Heavy Seas -- INTO THE WIND.
   Light Winds, Heavy Swells -- PARALLEL TO SWELLS.
4. Wing Flaps -- 20° - 30°.
5. Power -- ESTABLISH 300 FT/MIN DESCENT AT 55 KIAS.

NOTE

If no power is available, approach at 70 KIAS with flaps up or at 65 KIAS with 10° flaps.

6. Cabin Doors -- UNLATCH.
7. Touchdown -- LEVEL ATTITUDE AT ESTABLISHED RATE OF DESCENT.
8. Face -- CUSHION at touchdown with folded coat.
9. Airplane -- EVACUATE through cabin doors. If necessary, open window and flood cabin to equalize pressure so doors can be opened.
10. 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 -- 100 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. **Vents/Cabin Air/Heat -- CLOSED.**
3. **Fire Extinguisher -- ACTIVATE** (if available).

WARNING

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

4. Avionics Power Switch -- OFF.
5. All Other Switches (except ignition switch) -- OFF.

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. **Landing/Taxi Light Switches -- OFF.**
2. **Pitot Heat Switch (if installed) -- OFF.**
3. **Navigation Light Switch -- OFF.**
4. **Strobe Light 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 control full out and open defroster outlets** to obtain maximum windshield defroster airflow. Adjust cabin air control to get maximum defroster heat and airflow.

4. Open the throttle to increase engine speed and 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 engine speed could be caused by carburetor ice or air intake filter ice. Lean the mixture for maximum RPM, 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 left 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 the accumulation.
12. Perform a landing in level attitude.

STATIC SOURCE BLOCKAGE
(Erroneous Instrument Reading Suspected)

1. **Static Pressure Alternate Source Valve (if installed) -- PULL ON.**

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.

2. Airspeed -- Consult appropriate calibration tables in Section 5.

LANDING WITH A FLAT MAIN TIRE

1. Approach -- NORMAL.
2. Touchdown -- GOOD TIRE FIRST, hold airplane off flat tire as long as possible.

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

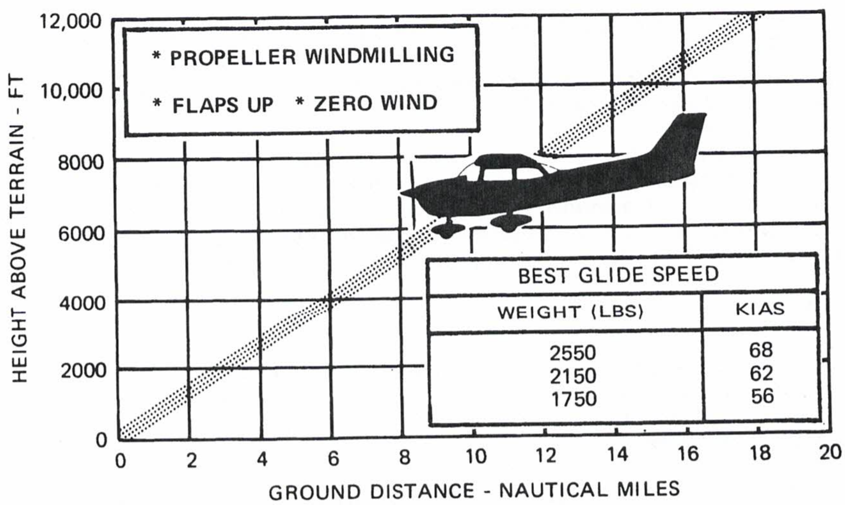
The following Amplified Procedures elaborate upon information contained in the Operational Checklists portion of this section. These procedures also include information not readily adaptable to a checklist format, and material to which a pilot could not be expected to refer in resolution of a specific emergency.

ENGINE FAILURE

If an engine failure occurs during the takeoff roll, 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



BEST GLIDE SPEED	
WEIGHT (LBS)	KIAS
2550	68
2150	62
1750	56

Figure 3-1. Maximum Glide

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.

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 under the Emergency Landing Without Engine Power checklist.

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.

LANDING WITHOUT ELEVATOR CONTROL

Trim for horizontal flight (with an airspeed of approximately 65 KIAS and flaps set to 20°) by using throttle and elevator trim controls. 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 full 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 complete 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. If an autopilot is installed, it too can be affected and should be turned off. Refer to Section 9, Supplements, for additional details concerning autopilot operation. 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° 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 180° turn, 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. Apply full rich mixture.
2. Use full carburetor heat.
3. Reduce power to set up a 500 to 800 ft/min rate of descent.
4. Adjust the elevator trim and rudder trim (if installed) for a stabilized descent at 70-80 KIAS.
5. Keep hands off the control wheel.
6. Monitor turn coordinator and make corrections by rudder alone.
7. Check trend of compass card movement and make cautious corrections with rudder to stop the turn.
8. 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 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. Adjust rudder trim (if installed) to relieve unbalanced rudder force.
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 static pressure alternate source valve should be pulled on, thereby supplying static pressure to these instruments from the cabin.

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.

With the alternate static source on, adjust indicated airspeed slightly during climb or approach according to the alternate static source airspeed calibration table in Section 5, appropriate to vent/window(s) configuration, causing the airplane to be flown at the normal operating speeds.

Maximum airspeed and altimeter variation from normal is 4 knots and 30 feet over the normal operating range with the window(s) closed. With window(s) open, larger variations occur near stall speed. However, maximum altimeter variation remains within 50 feet of normal.

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 CONTROL 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

A gradual loss of RPM 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 R 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 L or R 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.

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 defective 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 following paragraphs 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, 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 output is low, 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. Battery power must be conserved for later operation of the wing flaps and, if the emergency occurs at night, for possible use of the landing lights during landing.

OTHER EMERGENCIES

WINDSHIELD DAMAGE

If a bird strike or other incident should damage the windshield in flight to the point of creating an opening, a significant loss in performance may be expected. This loss **may** be minimized **in some cases** (depending on amount of damage, altitude, etc.) by opening the side windows while the airplane is maneuvered for a landing at the nearest airport.

If airplane performance or other adverse conditions preclude landing at an airport, prepare for an "off airport" landing in accordance with the Precautionary Landing With Engine Power or Ditching checklists.

SECTION 4
NORMAL PROCEDURES

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

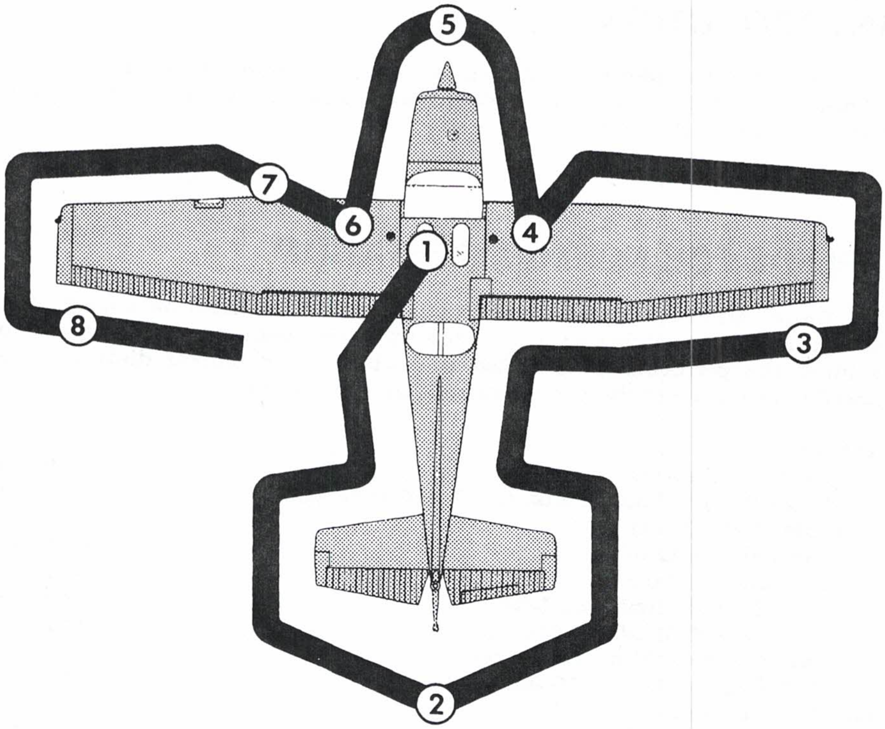
INTRODUCTION

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 2550 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	75-85 KIAS
Short Field Takeoff, Flaps 10°, Speed at 50 Feet	57 KIAS
Enroute Climb, Flaps Up:	
Normal, Sea Level	75-85 KIAS
Normal, 10,000 Feet	70-80 KIAS
Best Rate of Climb, Sea Level	73 KIAS
Best Rate of Climb, 10,000 Feet	72 KIAS
Best Angle of Climb, Sea Level	62 KIAS
Best Angle of Climb, 10,000 Feet	67 KIAS
Landing Approach:	
Normal Approach, Flaps Up	65-75 KIAS
Normal Approach, Flaps 30°	60-70 KIAS
Short Field Approach, Flaps 30°	62 KIAS
Balked Landing:	
Maximum Power, Flaps 20°	60 KIAS
Maximum Recommended Turbulent Air Penetration Speed:	
2550 Lbs	105 KIAS
2150 Lbs	95 KIAS
1750 Lbs	85 KIAS
Maximum Demonstrated Crosswind Velocity:	
Takeoff or Landing	15 KNOTS



NOTE

Visually check airplane for general condition during walk-around inspection. Use of the refueling steps and assist handles (if installed) will simplify access to the upper wing surfaces for visual checks and refueling operations. 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. Parking Brake -- SET.
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. Low-Vacuum Warning Light -- CHECK ON.
9. Avionics Cooling Fan -- CHECK AUDIBLY FOR OPERATION.
10. Master Switch -- OFF.
11. Static Pressure Alternate Source Valve (if installed) -- OFF.
12. Fuel Selector Valve -- BOTH.
13. Baggage Door -- CHECK, 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. Fuel Tank Sump Quick-Drain Valve -- DRAIN fuel (using sampler cup) to check for water, sediment, and proper fuel grade before first flight of day and after each refueling. If water is observed, take further samples until there is no evidence of water contamination.
4. Fuel Selector Quick-Drain Valve (located on bottom of fuselage) -- DRAIN fuel (using sampler cup) to check for water, sediment, and proper fuel grade before first flight of day and after each refueling. If water is observed, take further samples until there is no evidence of water contamination.
5. Fuel Quantity -- CHECK VISUALLY for desired level.
6. Fuel Filler Cap -- SECURE.

⑤ NOSE

1. Engine Oil Dipstick/Filler Cap -- CHECK oil level, then check dipstick/filler cap SECURE. Do not operate with less than five quarts. Fill to eight quarts for extended flight.
2. Fuel Strainer Drain Knob -- PULL OUT for about four seconds to clear strainer of possible water and sediment before first flight of day and after each refueling. Return drain knob full in and 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 quick-drain valve must be accomplished.
3. Propeller and Spinner -- CHECK for nicks and security.
4. Engine Cooling Air Inlets -- CLEAR of obstructions.
5. Carburetor Air Filter -- CHECK for restrictions by dust or other foreign matter.
6. Nose Wheel Strut and Tire -- CHECK for proper inflation.
7. Nose Tie-Down -- DISCONNECT.
8. Static Source Opening (left side of fuselage) -- CHECK for stoppage.

⑥ LEFT WING

1. Fuel Quantity -- CHECK VISUALLY for desired level.
2. Fuel Filler Cap -- SECURE.
3. Fuel Tank Sump Quick-Drain Valve -- DRAIN fuel (using sampler cup) to check for water, sediment, and proper fuel grade before first flight of day and after each refueling. If water is observed, take further samples until there is no evidence of water contamination.
4. Main Wheel Tire -- CHECK for proper inflation.

(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 Opening -- CHECK for stoppage. To check the system, place a clean handkerchief over the vent opening and apply suction; a sound from the warning horn will confirm system operation.
4. Wing Tie-Down -- DISCONNECT.
5. Landing Lights -- CHECK for condition and cleanliness of cover.

(8) LEFT WING Trailing Edge

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

BEFORE STARTING ENGINE

1. Preflight Inspection -- COMPLETE.
2. Passenger Briefing -- COMPLETE.
3. Seats, Seat Belts, Shoulder Harnesses -- ADJUST and LOCK.
4. Brakes -- TEST and SET.
5. Avionics Power Switch -- OFF.

CAUTION

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

6. Circuit Breakers -- CHECK IN.
7. Electrical Equipment, Autopilot (if installed) -- OFF.
8. Fuel Selector Valve -- BOTH.

STARTING ENGINE

1. Carburetor Heat -- COLD.
2. Mixture -- RICH.
3. Propeller Area -- CLEAR.
4. Master Switch -- ON.
5. Throttle -- PUMP once or twice; leave open 1/4 inch. If engine is HOT, turn auxiliary fuel pump on during start.
6. Ignition Switch -- START (release when engine starts).
7. Oil Pressure -- CHECK.
8. Starter -- CHECK DISENGAGED (if starter were to remain engaged, ammeter would indicate full scale charge with engine running at 1000 RPM).

9. Avionics Power Switch -- ON.
10. Navigation Lights and Flashing Beacon -- ON as required.
11. Radios -- ON.

BEFORE TAKEOFF

1. Parking Brake -- SET.
2. Seats, Seat Belts, Shoulder Harnesses -- CHECK SECURE.
3. Cabin Doors -- CLOSED and LOCKED.
4. Flight Controls -- FREE and CORRECT.
5. Flight Instruments -- CHECK and SET.
6. Fuel Quantity -- CHECK.
7. Auxiliary 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. Mixture -- RICH.
9. Fuel Selector Valve -- RECHECK BOTH.
10. Elevator Trim and Rudder Trim (if installed) -- SET for takeoff.
11. Throttle -- 1700 RPM.
    a. Magnetos -- CHECK (RPM drop should not exceed 125 RPM on either magneto or 50 RPM differential between magnetos).
    b. Carburetor Heat -- CHECK (for RPM drop).
    c. Suction Gage -- CHECK.
    d. Engine Instruments and Ammeter -- CHECK.
12. Throttle -- 1000 RPM or LESS.
13. Throttle Friction Lock -- ADJUST.
14. Strobe Lights (if installed) -- AS DESIRED.
15. Radios and Avionics -- SET.
16. Autopilot (if installed) -- OFF.
17. Air Conditioner (if installed) -- OFF.
18. Wing Flaps -- SET for takeoff (see Takeoff checklists).
19. Brakes -- RELEASE.

TAKEOFF

NORMAL TAKEOFF

1. Wing Flaps -- 0° - 10°.

2. Carburetor Heat -- COLD.
3. Throttle -- FULL OPEN.
4. Mixture -- RICH (mixture may be leaned above 3000 feet to obtain maximum power).
5. Elevator Control -- LIFT NOSE WHEEL (at 55 KIAS).
6. Climb Speed -- 70-80 KIAS.

SHORT FIELD TAKEOFF

1. Wing Flaps -- 10°.
2. Carburetor Heat -- COLD.
3. Brakes -- APPLY.
4. Throttle -- FULL OPEN.
5. Mixture -- RICH (above 3000 feet, LEAN to obtain maximum RPM).
6. Brakes -- RELEASE.
7. Elevator Control -- SLIGHTLY TAIL LOW.
8. Climb Speed -- 57 KIAS (until all obstacles are cleared).

ENROUTE CLIMB

1. Airspeed -- 75-85 KIAS.

NOTE

If a maximum performance climb is necessary, use speeds shown in the Rate Of Climb chart in Section 5.

2. Throttle -- FULL OPEN.
3. Fuel Selector Valve -- BOTH.
4. Mixture -- RICH (above 3000 feet, LEAN to obtain maximum RPM).

CRUISE

1. Power -- 2100-2700 RPM (no more than 75% is recommended).
2. Elevator and Rudder Trim (if installed) -- ADJUST.
3. Mixture -- LEAN.

DESCENT

1. Fuel Selector Valve -- BOTH.

2. Power -- AS DESIRED.
3. Mixture -- ADJUST for smooth operation.
4. Carburetor Heat -- FULL HEAT AS REQUIRED (to prevent carburetor icing).

BEFORE LANDING

1. Seats, Seat Belts, Shoulder Harnesses -- SECURE.
2. Fuel Selector Valve -- BOTH.
3. Mixture -- RICH.
4. Carburetor Heat -- ON (apply full heat before closing throttle).
5. Autopilot (if installed) -- OFF.
6. Air Conditioner (if installed) -- OFF.

LANDING

NORMAL LANDING

1. Airspeed -- 65-75 KIAS (flaps UP).
2. Wing Flaps -- AS DESIRED (0°-10° below 110 KIAS, 10°-30° below 85 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 -- FULL DOWN (30°).
3. Airspeed -- 62 KIAS (until flare).
4. Trim -- ADJUST.
5. Power -- REDUCE to idle after clearing obstacle.
6. Touchdown -- MAIN WHEELS FIRST.
7. Brakes -- APPLY HEAVILY.
8. Wing Flaps -- RETRACT.

BALKED LANDING

1. Throttle -- FULL OPEN.
2. Carburetor Heat -- COLD.
3. Wing Flaps -- RETRACT TO 20° (immediately).

4. Climb Speed -- 60 KIAS.
5. Wing Flaps -- 10° (until obstacles are cleared).
RETRACT SLOWLY after reaching a safe altitude and 65 KIAS.

AFTER LANDING

1. Carburetor Heat -- COLD.
2. Wing Flaps -- UP.

SECURING AIRPLANE

1. Parking Brake -- SET.
2. Throttle -- 1000 RPM.
3. Avionics Power Switch, Electrical Equipment, Autopilot/Air Conditioner (if installed) -- 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

PREFLIGHT INSPECTION

The Preflight Inspection, described in figure 4-1 and adjacent checklist, is recommended for the first flight of the day. Inspection procedures for subsequent flights are normally limited to brief checks of control surface hinges, fuel and oil quantity, and security of fuel and oil filler caps and draining of the fuel strainer, fuel tank sumps and fuel selector valve. If the airplane has been in extended storage, has had recent major maintenance, or has been operated from marginal airports, a more extensive exterior inspection is recommended.

After major maintenance has been performed, the flight and trim tab controls should be double-checked for free and correct movement and security. The security of all inspection plates on the airplane should be checked following periodic inspections. If the airplane has been waxed or polished, check the external static pressure source hole for stoppage.

If the airplane has been exposed to much ground handling in a crowded hangar, it should be checked for dents and scratches on wings, fuselage, and tail surfaces, as well as damage to navigation and anti-collision lights, and avionics antennas.

Outside storage for long periods may result in dust and dirt accumulation on the induction air filter, obstructions in airspeed system lines, and condensation in fuel tanks. If any water is detected in the fuel system, the fuel tank sump quick-drain valves, fuel selector quick-drain valve, and fuel strainer drain should all be thoroughly drained until there is no evidence of water or sediment contamination. Outside storage in windy or gusty areas, or tie-down adjacent to taxiing airplanes, calls for special attention to control surface stops, hinges, and brackets to detect the presence of wind damage.

If the airplane has been operated from muddy fields or in snow or slush, check the main and nose gear wheel fairings for obstructions and cleanliness. Operation from a gravel or cinder field will require extra attention to propeller tips and abrasion on leading edges of the horizontal tail. Stone damage to the propeller can seriously reduce the fatigue life of the blades.

Airplanes that are operated from rough fields, especially at high altitudes, are subjected to abnormal landing gear abuse. Frequently check all components of the landing gear, shock strut, tires, and brakes. If the shock strut is insufficiently extended, undue landing and taxi loads will be subjected on the airplane structure.

To prevent loss of fuel in flight, make sure the fuel tank filler caps are tightly sealed after any fuel system check or servicing. Fuel system vents should also be inspected for obstructions, ice or water, especially after exposure to cold, wet weather.

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 COLD WEATHER OPERATION paragraphs in this section.

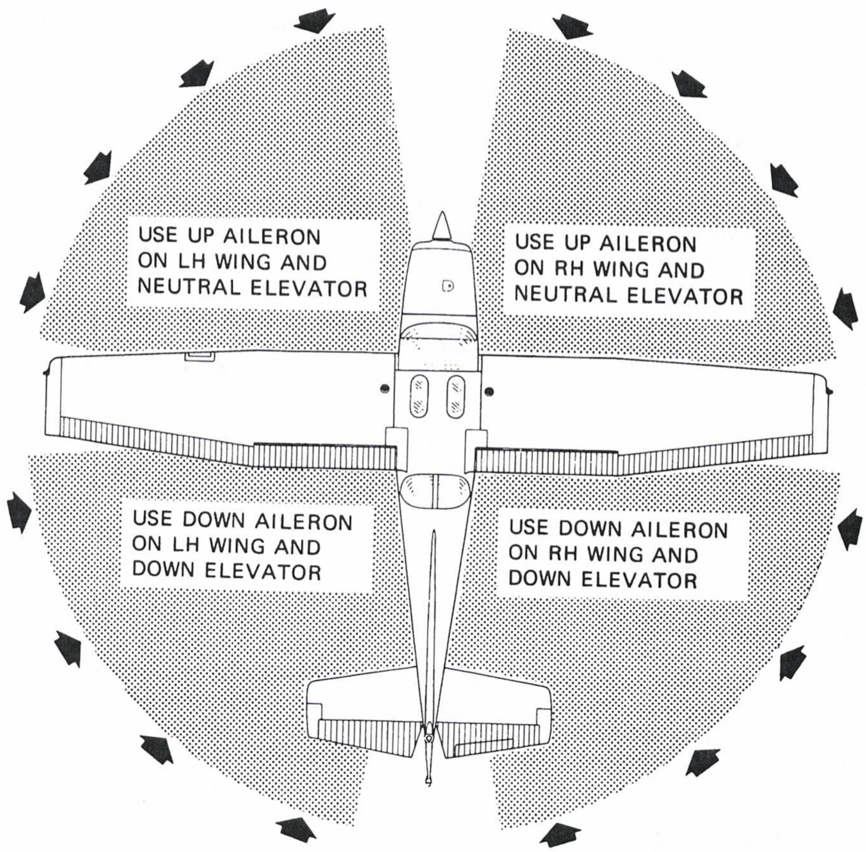
Weak intermittent firing followed by puffs of black smoke from the exhaust stack indicates overpriming or flooding. Excess fuel can be cleared from the combustion chambers by the following procedure: set the mixture control full lean and the throttle full open; then crank the engine through several revolutions 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, and additional priming will be necessary. As soon as the cylinders begin to fire, open the throttle slightly to keep it running.

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.

After the completion of normal engine starting procedures, it is a good practice to verify that the engine starter has disengaged. If the starter contactor were to stick closed, causing the starter to remain engaged, an excessively high charge indication (full scale at 1000 RPM) would be evident



CODE

WIND DIRECTION ➡

NOTE

Strong quartering tail winds require caution. Avoid sudden bursts of the throttle and sharp braking when the airplane is in this attitude. Use the steerable nose wheel and rudder to maintain direction.

Figure 4-2. Taxiing Diagram

on the ammeter. In this event, immediately shut down the engine and take corrective action prior to flight.

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.

BEFORE TAKEOFF

WARM-UP

If the engine accelerates smoothly, the airplane is ready for takeoff. Since the engine is closely cowled for efficient in-flight engine cooling, precautions should be taken to avoid overheating during prolonged engine operation on the ground. Also, long periods of idling may cause fouled spark plugs.

MAGNETO CHECK

The magneto check should be made at 1700 RPM as follows. Move ignition switch first to R position and note RPM. Next move switch back to BOTH to clear the other set of plugs. Then move switch to the L position, note RPM and return the switch to the BOTH position. RPM drop should not exceed 125 RPM on either magneto or show greater than 50 RPM differential between magnetos. If RPM drop is excessive, lean to smooth operation and recheck. Return mixture control to full rich position before takeoff from field elevations of less than 3000 feet. 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 light or by operating the wing flaps during the engine runup (1700 RPM). The ammeter will remain within a needle width of its initial reading if the alternator and alternator control unit are operating properly.

TAKEOFF

POWER CHECK

It is important to check full-throttle engine operation early in the takeoff roll. Any sign of rough engine operation or sluggish engine acceleration is good cause for discontinuing the takeoff. If this occurs, you are justified in making a thorough full-throttle static runup before another takeoff is attempted. The engine should run smoothly and turn approximately 2350 to 2450 RPM with carburetor heat off and mixture leaned to maximum RPM.

NOTE

Carburetor heat should not be used during takeoff unless it is absolutely necessary for obtaining smooth engine acceleration.

Full-throttle 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 immediately corrected as described in Section 8 under Propeller Care.

Prior to takeoff from fields above 3000 feet elevation, the mixture should be leaned to give maximum RPM in a full-throttle, static runup.

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

WING FLAP SETTINGS

Normal takeoffs are accomplished with wing flaps 0° - 10°. Using 10°

wing flaps reduces the ground roll and total distance over an obstacle by approximately 10 percent. Flap deflections greater than 10° are not approved for takeoff. If 10° wing flaps are used for takeoff, they should be left down until all obstacles are cleared and a safe flap retraction speed of 65 KIAS is reached. On a short field, 10° wing flaps and an obstacle clearance speed of 57 KIAS should be used.

Soft or rough field takeoffs are performed with 10° flaps 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 higher climb speed. When departing a soft field with an aft C.G. loading, the elevator trim should be adjusted towards the nose down direction to give comfortable control wheel forces during the initial climb.

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, 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.

ENROUTE CLIMB

Normal climbs are performed with flaps up and full throttle and at speeds 5 to 10 knots higher than best rate-of-climb speeds for the best combination of performance, visibility and engine cooling. The mixture should be full rich below 3000 feet and may be leaned above 3000 feet for smoother operation or to obtain maximum RPM. For maximum rate of climb, use the best rate-of-climb speeds shown in the Rate-of-Climb chart in Section 5. If an obstruction dictates the use of a steep climb angle, the best angle-of-climb speed should be used with flaps up and maximum power. Climbs at speeds lower than the best rate-of-climb speed should be of short duration to improve engine cooling.

CRUISE

Normal cruising is performed between 55% and 75% power. The engine RPM and corresponding fuel consumption for various altitudes can be determined by using the data in Section 5.

NOTE

Cruising should be done at 75% power as much as practicable until a total of 50 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 altitude 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.

To achieve the recommended lean mixture fuel consumption figures shown in Section 5, the mixture should be leaned until engine RPM peaks and then leaned further until it drops 25-50 RPM. At lower powers it may be necessary to enrichen the mixture slightly to obtain smooth operation.

The tachometer is marked with a green arc from 2100 to 2700 RPM with steps at 2500 and 2600 RPM. The use of 2500 RPM provides approximately 75% power at sea level on a standard day. Using 2600 RPM provides approximately 75% power at 5000 feet altitude on a standard day. For a hot day or high altitude conditions, the cruise RPM may be increased to 2700 RPM. Cruise at 2700 RPM permits the use of approximately 75% power at 8500 feet on a standard day.

	75% POWER		65% POWER		55% POWER	
ALTITUDE	KTAS	NMPG	KTAS	NMPG	KTAS	NMPG
2500 Feet	116	11.6	109	12.4	101	13.3
5500 Feet	119	11.9	112	12.7	103	13.6
8500 Feet	122	12.2	114	13.0	105	13.9
Standard Conditions						Zero Wind

Figure 4-3. Cruise Performance Table

MIXTURE DESCRIPTION	EXHAUST GAS TEMPERATURE
RECOMMENDED LEAN	50°F Rich of Peak EGT
BEST ECONOMY	Peak EGT

Figure 4-4. EGT Table

Carburetor ice, as evidenced by an unexplained drop in RPM, can be removed by application of full carburetor heat. Upon regaining the original RPM (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 the desired increment based on figure 4-4.

As noted in this table, operation at peak EGT provides the best fuel economy. This results in approximately 4% greater range than shown in this handbook accompanied by approximately a 3 knot decrease in speed.

Under some conditions, engine roughness may occur while operating at peak EGT. In this case, operate at the Recommended Lean mixture. Any change in altitude or throttle position will require a recheck of EGT indication.

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 C.G. positions are presented in Section 5.

SECTION 5
PERFORMANCE

TABLE OF CONTENTS

Page

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 power setting. 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	2500 Pounds
Usable fuel	50 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	360 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 5-5, 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 2550 pounds, pressure altitude of 2000 feet and a temperature of 30°C should be used and results in the following:

Ground roll	1290 Feet
Total distance to clear a 50-foot obstacle	2285 Feet

These distances are well within the available takeoff field length. However, a correction for the effect of wind may be made based on Note 3 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	1290
Decrease in ground roll (1290 feet × 13%)	168
Corrected ground roll	1122 Feet
Total distance to clear a 50-foot obstacle, zero wind	2285
Decrease in total distance (2285 feet × 13%)	297
Corrected total distance to clear 50-foot obstacle	1988 Feet

CRUISE

The cruising altitude should be selected based on a consideration of trip length, winds aloft, and the airplane's performance. A typical 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 5-8, the range profile charts presented in figure 5-9, and the endurance profile charts presented in figure 5-10.

The relationship between power and range is illustrated by the range profile charts. 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, figure 5-8, is entered at 8000 feet altitude and 20°C above standard temperature. These values most nearly correspond to the planned altitude and expected temperature conditions. The engine speed chosen is 2600 RPM, which results in the following:

Power	65%
True airspeed	116 Knots
Cruise fuel flow	8.7 GPH

FUEL REQUIRED

The total fuel requirement for the flight may be estimated using the performance information in figures 5-7 and 5-8. For this sample problem, figure 5-7 shows that a climb from 2000 feet to 8000 feet requires 2.8 gallons of fuel. The corresponding distance during the climb is 16 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:

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

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

Fuel to climb, standard temperature	2.8
Increase due to non-standard temperature (2.8 × 16%)	0.4
Corrected fuel to climb	3.2 Gallons

Using a similar procedure for the distance to climb results in 19 nautical miles.

The resultant cruise distance is:

Total distance	360
Climb distance	-19
Cruise distance	341 Nautical Miles

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

116
-10
106 Knots

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

$$\frac{341 \text{ Nautical Miles}}{106 \text{ Knots}} = 3.2 \text{ Hours}$$

The fuel required for cruise is:

3.2 hours × 8.7 gallons/hour = 27.8 Gallons

A 45-minute reserve requires:

$$\frac{45}{60} \times 8.7 \text{ gallons/hour} = 6.5 \text{ Gallons}$$

The total estimated fuel required is as follows:

Engine start, taxi, and takeoff	1.4
Climb	3.2
Cruise	27.8
Reserve	6.5
Total fuel required	38.9 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 5-11 presents landing distance information for the short field technique. The distances corresponding to 2000 feet and 30°C are as follows:

Ground roll	650 Feet
Total distance to clear a 50-foot obstacle	1455 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

CONDITION:
Power required for level flight or maximum rated RPM dive.

FLAPS UP												
KIAS	50	60	70	80	90	100	110	120	130	140	150	160
KCAS	59	64	72	81	89	98	107	116	126	135	144	153
FLAPS 10°												
KIAS	40	50	60	70	80	90	100	110	---	---	---	---
KCAS	55	58	64	72	81	90	99	107	---	---	---	---
FLAPS 30°												
KIAS	40	50	60	70	80	85	---	---	---	---	---	---
KCAS	54	57	62	71	80	85	---	---	---	---	---	---

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

AIRSPEED CALIBRATION
ALTERNATE STATIC SOURCE

HEATER/VENTS AND WINDOWS CLOSED

FLAPS UP											
NORMAL KIAS	50	60	70	80	90	100	110	120	130	140	---
ALTERNATE KIAS	51	61	71	82	91	101	111	121	131	141	---
FLAPS 10°											
NORMAL KIAS	40	50	60	70	80	90	100	110	---	---	---
ALTERNATE KIAS	40	51	61	71	81	90	99	108	---	---	---
FLAPS 30°											
NORMAL KIAS	40	50	60	70	80	85	---	---	---	---	---
ALTERNATE KIAS	38	50	60	70	79	83	---	---	---	---	---

HEATER/VENTS OPEN AND WINDOWS CLOSED

FLAPS UP											
NORMAL KIAS	40	50	60	70	80	90	100	110	120	130	140
ALTERNATE KIAS	36	48	59	70	80	89	99	108	118	128	139
FLAPS 10°											
NORMAL KIAS	40	50	60	70	80	90	100	110	---	---	---
ALTERNATE KIAS	38	49	59	69	79	88	97	106	---	---	---
FLAPS 30°											
NORMAL KIAS	40	50	60	70	80	85	---	---	---	---	---
ALTERNATE KIAS	34	47	57	67	77	81	---	---	---	---	---

WINDOWS OPEN

FLAPS UP											
NORMAL KIAS	40	50	60	70	80	90	100	110	120	130	140
ALTERNATE KIAS	26	43	57	70	82	93	103	113	123	133	143
FLAPS 10°											
NORMAL KIAS	40	50	60	70	80	90	100	110	---	---	---
ALTERNATE KIAS	25	43	57	69	80	91	101	111	---	---	---
FLAPS 30°											
NORMAL KIAS	40	50	60	70	80	85	---	---	---	---	---
ALTERNATE KIAS	25	41	54	67	78	84	---	---	---	---	---

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

TEMPERATURE CONVERSION CHART

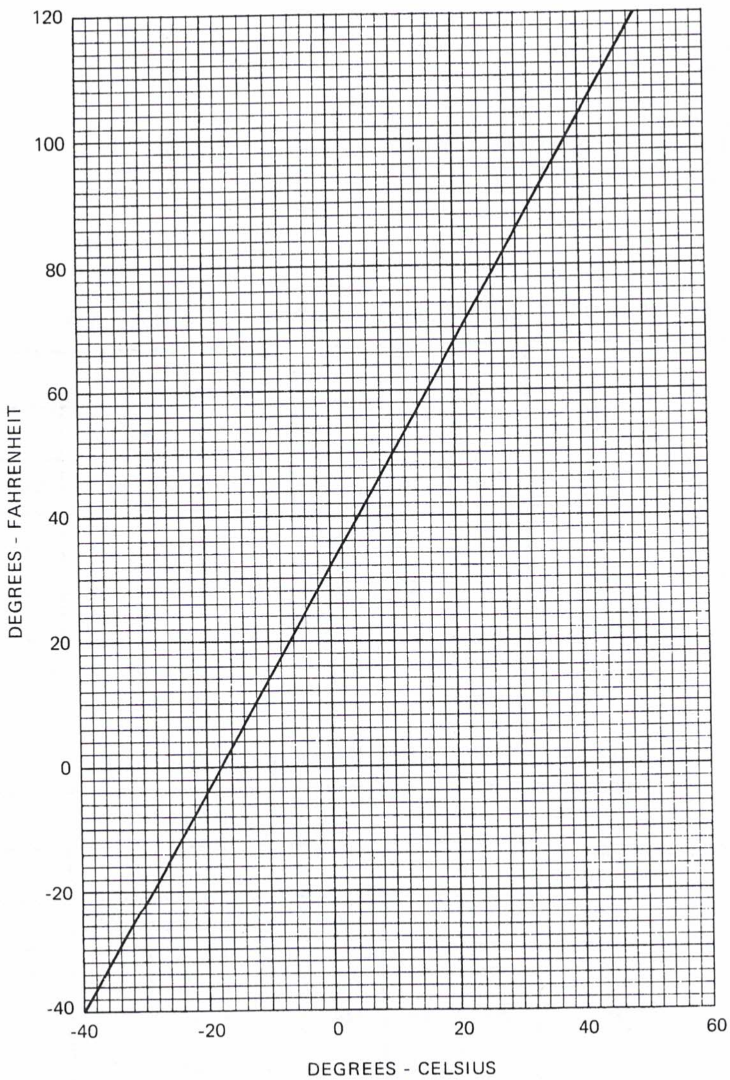


Figure 5-2. Temperature Conversion Chart

STALL SPEEDS

CONDITIONS:
Power Off

NOTES:
1. 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
2550	UP	50	53	54	57	59	63	71	75
	10°	42	50	45	54	50	59	59	71
	30°	40	48	43	52	48	57	57	68

MOST FORWARD CENTER OF GRAVITY

WEIGHT LBS	FLAP DEFLECTION	ANGLE OF BANK							
		0°		30°		45°		60°	
		KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
2550	UP	50	53	54	57	59	63	71	75
	10°	43	51	46	55	51	61	61	72
	30°	40	48	43	52	48	57	57	68

Figure 5-3. Stall Speeds

WIND COMPONENTS

NOTE:
Maximum demonstrated crosswind velocity is 15 knots (not a limitation).

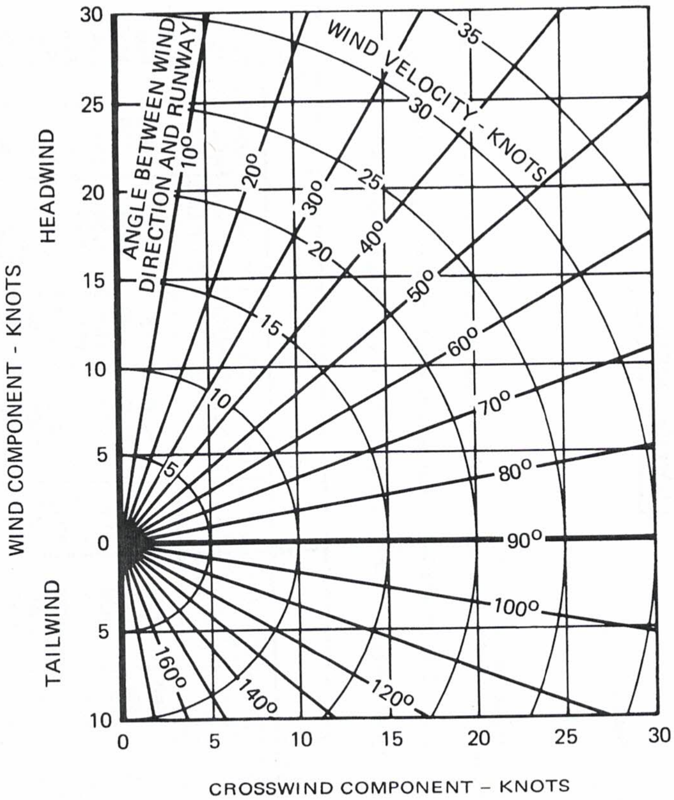


Figure 5-4. Wind Components

TAKEOFF DISTANCE

MAXIMUM WEIGHT 2550 LBS

SHORT FIELD

CONDITIONS:
Flaps 10°
Full Throttle Prior to Brake Release
Paved, Level, Dry Runway
Zero Wind

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 RPM 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 FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS
2550	48	57	S.L.	860	1520	925	1630	995	1750	1070	1880	1150	2015
			1000	940	1665	1015	1790	1090	1925	1175	2070	1260	2225
			2000	1030	1830	1110	1970	1195	2125	1290	2285	1385	2460
			3000	1130	2015	1220	2175	1315	2350	1415	2535	1520	2740
			4000	1245	2230	1345	2415	1450	2615	1560	2830	1675	3060
			5000	1370	2480	1480	2690	1595	2920	1720	3170	1850	3450
			6000	1510	2770	1635	3015	1765	3290	1900	3585	2050	3925
			7000	1670	3120	1805	3410	1950	3735	2105	4100	2270	4520
			8000	1850	3535	2000	3890	2165	4295	2340	4760	2525	5315

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

TAKEOFF DISTANCE

2400 LBS AND 2200 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 ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS
2400	47	55	S.L.	745	1320	805	1415	865	1520	925	1625	995	1745
			1000	815	1445	880	1550	945	1665	1015	1785	1090	1915
			2000	895	1585	965	1705	1035	1830	1115	1965	1195	2110
			3000	980	1740	1055	1875	1135	2020	1225	2170	1315	2335
			4000	1075	1920	1160	2070	1250	2235	1345	2405	1445	2595
			5000	1185	2125	1275	2295	1375	2480	1485	2680	1595	2900
			6000	1305	2360	1410	2555	1520	2770	1635	3005	1760	3260
			7000	1440	2635	1555	2860	1680	3115	1810	3390	1950	3700
			8000	1590	2960	1720	3230	1860	3530	2005	3865	2165	4245
2200	45	53	S.L.	610	1090	660	1165	705	1245	760	1335	815	1425
			1000	670	1190	720	1270	775	1360	830	1460	890	1560
			2000	730	1295	785	1390	845	1490	910	1600	975	1710
			3000	800	1420	860	1525	930	1635	995	1755	1070	1885
			4000	875	1560	945	1675	1020	1800	1095	1935	1175	2080
			5000	965	1715	1040	1850	1120	1990	1205	2140	1295	2305
			6000	1060	1895	1145	2045	1235	2205	1325	2380	1425	2565
			7000	1170	2100	1260	2270	1360	2455	1465	2655	1575	2870
			8000	1290	2335	1395	2535	1505	2745	1620	2980	1745	3235

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

MAXIMUM RATE OF CLIMB

CONDITIONS:
Flaps Up
Full Throttle

NOTE:
Mixture leaned above 3000 feet for maximum RPM.

WEIGHT LBS	PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
			-20°C	0°C	20°C	40°C
2550	S.L.	73	795	730	665	600
	2000	73	705	645	585	525
	4000	73	625	565	510	450
	6000	72	540	485	430	370
	8000	72	460	405	350	295
	10,000	72	380	325	275	- - -
	12,000	72	300	250	- - -	- - -

Figure 5-6. Maximum Rate of Climb

TIME, FUEL, AND DISTANCE TO CLIMB

MAXIMUM RATE OF CLIMB

CONDITIONS:
Flaps Up
Full Throttle
Standard Temperature

NOTES:
1. Add 1.4 gallons of fuel for engine start, taxi and takeoff allowance.
2. Mixture leaned above 3000 feet for maximum RPM.
3. Increase time, fuel and distance by 10% for each 10°C above standard temperature.
4. 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
2550	S.L.	15	73	680	0	0.0	0
	1000	13	73	645	2	0.4	2
	2000	11	73	615	3	0.8	4
	3000	9	73	580	5	1.3	6
	4000	7	73	545	7	1.7	8
	5000	5	73	510	9	2.2	11
	6000	3	72	475	11	2.7	14
	7000	1	72	440	13	3.1	17
	8000	-1	72	410	15	3.6	20
	9000	-3	72	375	18	4.2	24
	10,000	-5	72	340	21	4.7	28
	11,000	-7	72	305	24	5.3	32
	12,000	-9	72	270	27	5.9	37

Figure 5-7. Time, Fuel, and Distance to Climb

CRUISE PERFORMANCE

CONDITIONS:
2550 Pounds
Recommended Lean Mixture (See Section 4, Cruise)

PRESSURE ALTITUDE FT	RPM	20°C BELOW STANDARD TEMP			STANDARD TEMPERATURE			20°C ABOVE STANDARD TEMP		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2000	2550	- - -	- - -	- - -	76	116	10.2	72	115	9.6
	2500	77	114	10.3	72	113	9.6	68	113	9.1
	2400	69	109	9.2	64	108	8.7	61	107	8.3
	2300	61	103	8.3	58	103	7.9	55	102	7.6
	2200	55	98	7.5	52	97	7.2	49	96	6.9
	2100	49	92	6.8	46	91	6.6	43	89	6.3
4000	2600	- - -	- - -	- - -	76	118	10.2	72	117	9.6
	2500	73	113	9.7	68	113	9.2	65	112	8.7
	2400	65	108	8.8	62	107	8.3	58	107	8.0
	2300	58	103	8.0	55	102	7.6	52	101	7.3
	2200	52	97	7.3	49	96	6.9	47	94	6.6
	2100	46	91	6.6	44	89	6.3	41	87	6.1
6000	2650	- - -	- - -	- - -	76	120	10.1	72	119	9.6
	2600	77	118	10.3	72	117	9.6	68	117	9.1
	2500	69	113	9.3	65	112	8.8	62	111	8.4
	2400	62	108	8.4	59	107	8.0	56	106	7.6
	2300	56	102	7.7	53	101	7.3	50	99	7.0
	2200	50	96	7.0	47	95	6.7	44	93	6.4
8000	2700	- - -	- - -	- - -	76	122	10.1	71	121	9.5
	2600	73	117	9.8	69	117	9.2	65	116	8.7
	2500	66	112	8.8	62	111	8.4	59	110	8.0
	2400	59	107	8.1	56	106	7.7	53	104	7.3
	2300	53	101	7.4	50	100	7.0	47	98	6.7
	2200	47	95	6.7	45	93	6.4	42	90	6.1
10,000	2700	77	122	10.2	72	121	9.6	68	121	9.1
	2600	69	117	9.3	65	116	8.8	62	115	8.4
	2500	63	112	8.5	59	110	8.1	56	109	7.7
	2400	57	106	7.8	53	104	7.4	50	103	7.0
	2300	51	100	7.1	48	98	6.8	45	96	6.5
12,000	2650	69	119	9.3	65	118	8.8	62	117	8.4
	2600	66	116	8.9	62	115	8.4	59	114	8.0
	2500	60	111	8.2	56	109	7.7	53	107	7.4
	2400	54	105	7.5	51	103	7.1	48	100	6.7
	2300	48	98	6.8	45	96	6.5	42	93	6.2

Figure 5-8. Cruise Performance

RANGE PROFILE
45 MINUTES RESERVE
50 GALLONS USABLE FUEL

CONDITIONS:
2550 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 climb.

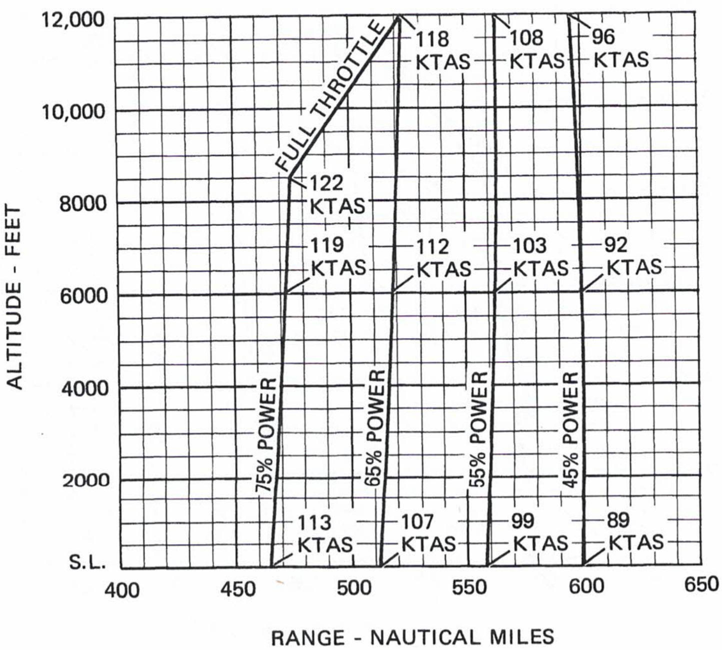


Figure 5-9. Range Profile (Sheet 1 of 2)

RANGE PROFILE
45 MINUTES RESERVE
62 GALLONS USABLE FUEL

CONDITIONS:
2550 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 climb.

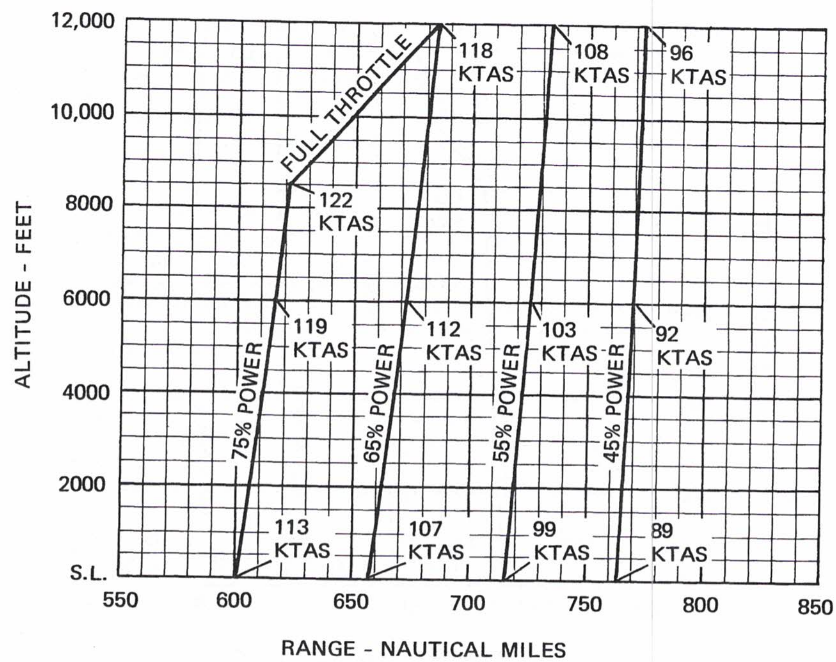


Figure 5-9. Range Profile (Sheet 2 of 2)

ENDURANCE PROFILE
45 MINUTES RESERVE
50 GALLONS USABLE FUEL

CONDITIONS:
2550 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 climb.

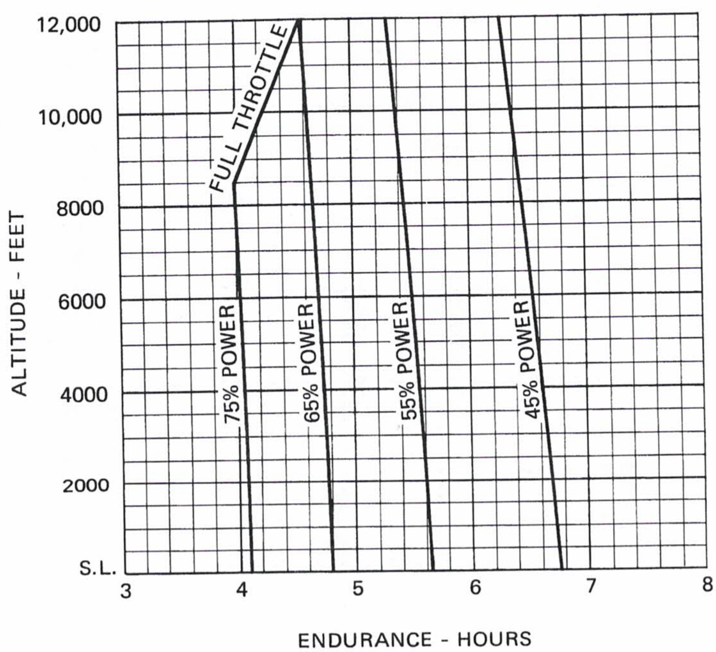


Figure 5-10. Endurance Profile (Sheet 1 of 2)

ENDURANCE PROFILE
45 MINUTES RESERVE
62 GALLONS USABLE FUEL

CONDITIONS:
2550 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 climb.

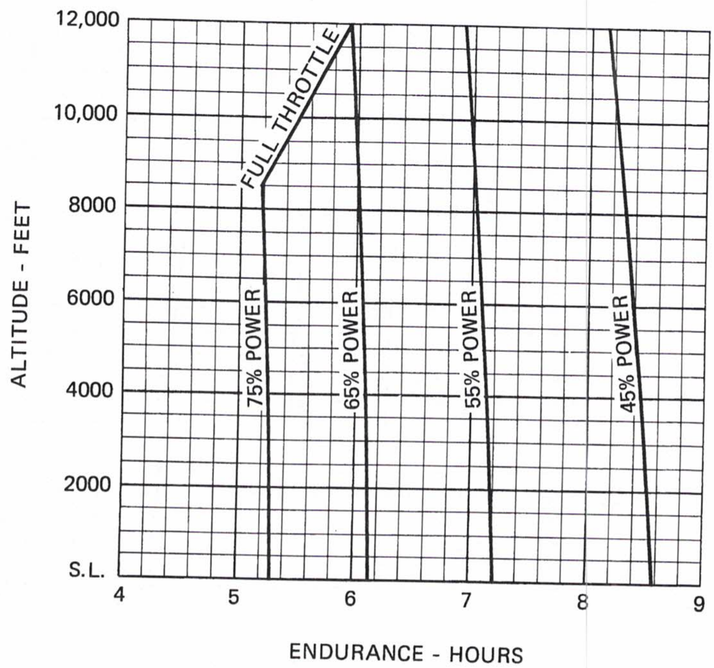


Figure 5-10. Endurance Profile (Sheet 2 of 2)

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 45% of the "ground roll" figure.
4. If a landing with flaps up is necessary, increase the approach speed by 9 KIAS and allow for 35% longer distances.

WEIGHT LBS	SPEED AT 50 FT KIAS	PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
			GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS	GRND ROLL FT	TOTAL FT TO CLEAR 50 FT OBS
2550	62	S.L.	545	1290	565	1320	585	1350	605	1380	625	1415
		1000	565	1320	585	1350	605	1385	625	1420	650	1450
		2000	585	1355	610	1385	630	1420	650	1455	670	1490
		3000	610	1385	630	1425	655	1460	675	1495	695	1530
		4000	630	1425	655	1460	675	1495	700	1535	725	1570
		5000	655	1460	680	1500	705	1535	725	1575	750	1615
		6000	680	1500	705	1540	730	1580	755	1620	780	1660
		7000	705	1545	730	1585	760	1625	785	1665	810	1705
		8000	735	1585	760	1630	790	1670	815	1715	840	1755

Figure 5-11. Landing Distance

SECTION 6
WEIGHT & BALANCE/
EQUIPMENT LIST

TABLE OF CONTENTS

INTRODUCTION

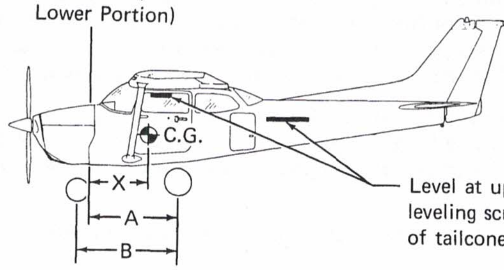
This section describes the procedure for establishing the basic empty weight and moment of the airplane. Sample forms are provided for reference. Procedures for calculating the weight and moment for various operations are also provided. A comprehensive list of all Cessna equipment available for this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

It should be noted that specific information regarding the weight, arm, moment and installed equipment for this airplane as delivered from the factory can only be found in the plastic envelope carried in the back of this handbook.

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 fuel tank sump quick-drain fittings and use sampler cup at quick-drain in fuel selector valve to drain all fuel.
   c. Service engine oil as required to obtain a normal full indication (8 quarts on dipstick).
   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, 500 pounds nose, 1000 pounds each main).
   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 C.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	

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

Item	Weight (Lbs.)	X C.G. Arm (In.) =	Moment/1000 (Lbs.-In.)
Airplane Weight (From Item 5, page 6-3)			
Add Unusable Fuel: Std. Tanks (4 Gal at 6 Lbs/Gal)		46.0	
L.R. Tanks (6 Gal at 6 Lbs/Gal)		46.0	
Equipment Changes			
Airplane Basic Empty Weight			

Figure 6-1. Sample Airplane Weighing

SAMPLE WEIGHT AND BALANCE RECORD

(Continuous History of Changes in Structure or Equipment Affecting Weight and Balance)

AIRPLANE MODEL				SERIAL NUMBER						PAGE NUMBER	
DATE	ITEM NO.		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						RUNNING BASIC EMPTY WEIGHT	
				ADDED (+)			REMOVED (-)				
	In	Out		Wt. (lb.)	Arm (In.)	Moment /1000	Wt. (lb.)	Arm (In.)	Moment /1000	Wt. (lb.)	Moment /1000
			As delivered								

Figure 6-2. Sample Weight and Balance Record

WEIGHT AND BALANCE

The following information will enable you to operate your Cessna within the prescribed weight and center of gravity limitations. To figure weight and balance, use the Sample Problem, Loading Graph, and Center of Gravity Moment Envelope as follows:

Take the basic empty weight and moment from appropriate weight and balance records carried in your airplane, and enter them in the column titled YOUR AIRPLANE on the Sample Loading Problem.

NOTE

In addition to the basic empty weight and moment noted on these records, the C.G. arm (fuselage station) is also shown, but need not be used on the Sample Loading Problem. The moment which is shown must be divided by 1000 and this value used as the moment/1000 on the loading problem.

Use the Loading Graph to determine the moment/1000 for each additional item to be carried; then list these on the loading problem.

NOTE

Loading Graph information for the pilot, passengers and baggage is based on seats positioned for average occupants and baggage loaded in the center of 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 tie-down straps is provided as standard equipment to secure baggage on the cabin floor aft of the rear seat (baggage area 1) and in the aft baggage area (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 on the cabin floor slightly inboard of each sidewall approximately at station 107; and two eyebolts are located below the aft window near each sidewall approximately at station 107.

When the cabin floor (baggage area 1) only is utilized for baggage, the two forward floor-mounted eyebolts and the two aft floor-mounted eyebolts (or the two eyebolts below the aft window) may be used, depending on the height of the baggage. When baggage is carried in the aft baggage area (baggage area 2), the aft floor-mounted eyebolts 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.

LOADING ARRANGEMENTS

*Pilot or passenger center of gravity on adjustable seats positioned for average occupant. Numbers in parentheses indicate forward and aft limits of occupant center of gravity range.

**Arm measured to the center of the areas shown.

NOTES:
1. The usable fuel C.G. arm for standard and long range tanks is located at station 48.0.
2. The rear cabin wall (approximate station 108) or aft baggage wall (approximate station 142) can be used as convenient interior reference points for determining the location of baggage area fuselage stations.

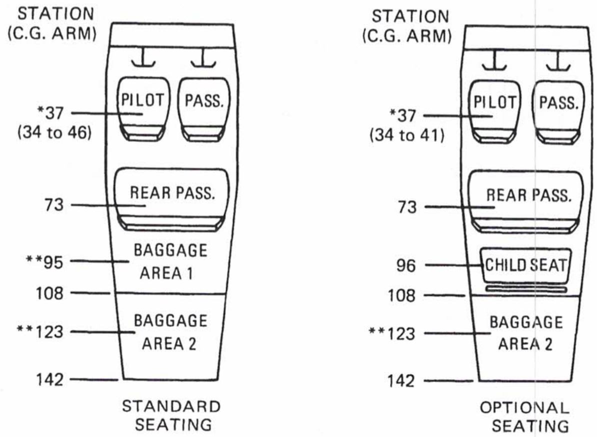
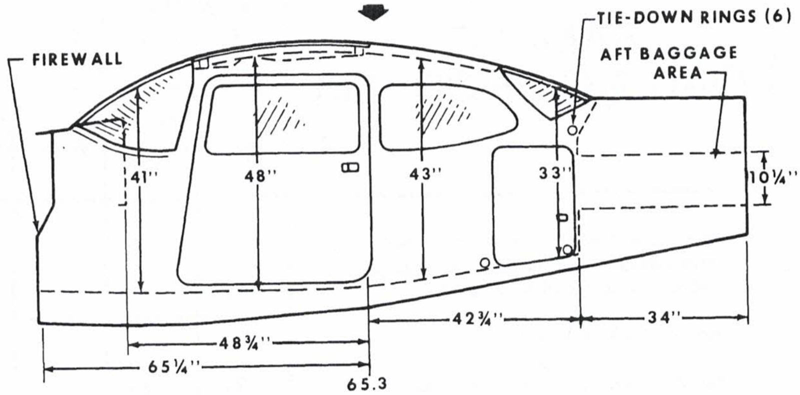


Figure 6-3. Loading Arrangements

CABIN HEIGHT MEASUREMENTS



DOOR OPENING DIMENSIONS

	WIDTH (TOP)	WIDTH (BOTTOM)	HEIGHT (FRONT)	HEIGHT (REAR)
CABIN DOOR	32"	37"	40½"	39"
BAGGAGE DOOR	15¼"	15¼"	22"	21"

WIDTH
● LWR WINDOW LINE
* CABIN FLOOR

CABIN WIDTH MEASUREMENTS

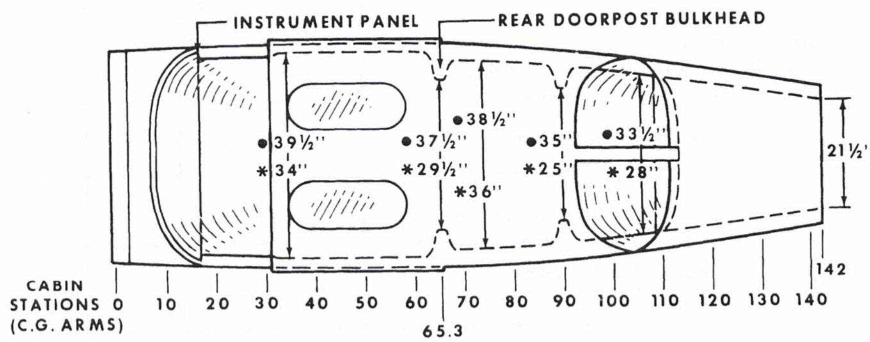


Figure 6-4. Internal Cabin Dimensions

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)	1513	57.9		
2. Usable Fuel (At 6 Lbs./Gal.)				
Standard Tanks (50 Gal. Maximum) . . .	300	14.4		
Long Range Tanks (62 Gal. Maximum) . .				
Long Range Reduced Fuel (42 Gal.) . . .				
3. Pilot and Front Passenger (Station 34 to 46)	340	12.6		
4. Rear Passengers	340	24.8		
5. * Baggage Area 1 or Passenger on Child's Seat (Station 82 to 108, 120 Lbs. Max.) . . .	65	6.2		
6. * Baggage Area 2 (Station 108 to 142, 50 Lbs. Max.) . . .				
7. RAMP WEIGHT AND MOMENT	2558	115.9		
8. Fuel allowance for engine start, taxi, and runup	-8	-.4		
9. TAKEOFF WEIGHT AND MOMENT (Subtract Step 8 from Step 7)	2550	115.5		

10. Locate this point (2550 at 115.5) on the Center of Gravity Moment Envelope, and since this point falls within the envelope, the loading is acceptable.

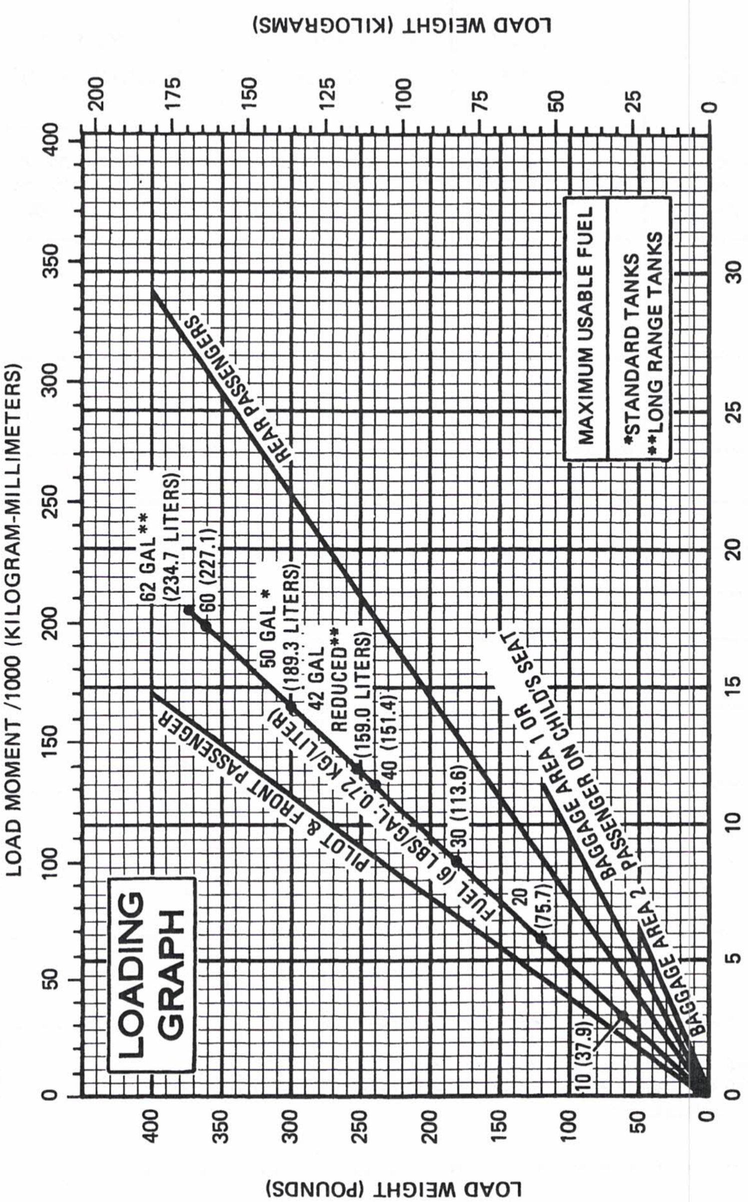
* The maximum allowable combined weight capacity for baggage areas 1 and 2 is 120 pounds.

Figure 6-5. Sample Loading Problem (Sheet 1 of 2)

YOUR AIRPLANE		YOUR AIRPLANE		YOUR AIRPLANE		YOUR AIRPLANE	
Weight (lbs.)	Moment (lb.-ins. /1000)	Weight (lbs.)	Moment (lb.-ins. /1000)	Weight (lbs.)	Moment (lb.-ins. /1000)	Weight (lbs.)	Moment (lb.-ins. /1000)

When several loading configurations are representative of your operations, it may be useful to fill out one or more of the above columns so that specific loadings are available at a glance.

Figure 6-5. Sample Loading Problem (Sheet 2 of 2)



NOTE: 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

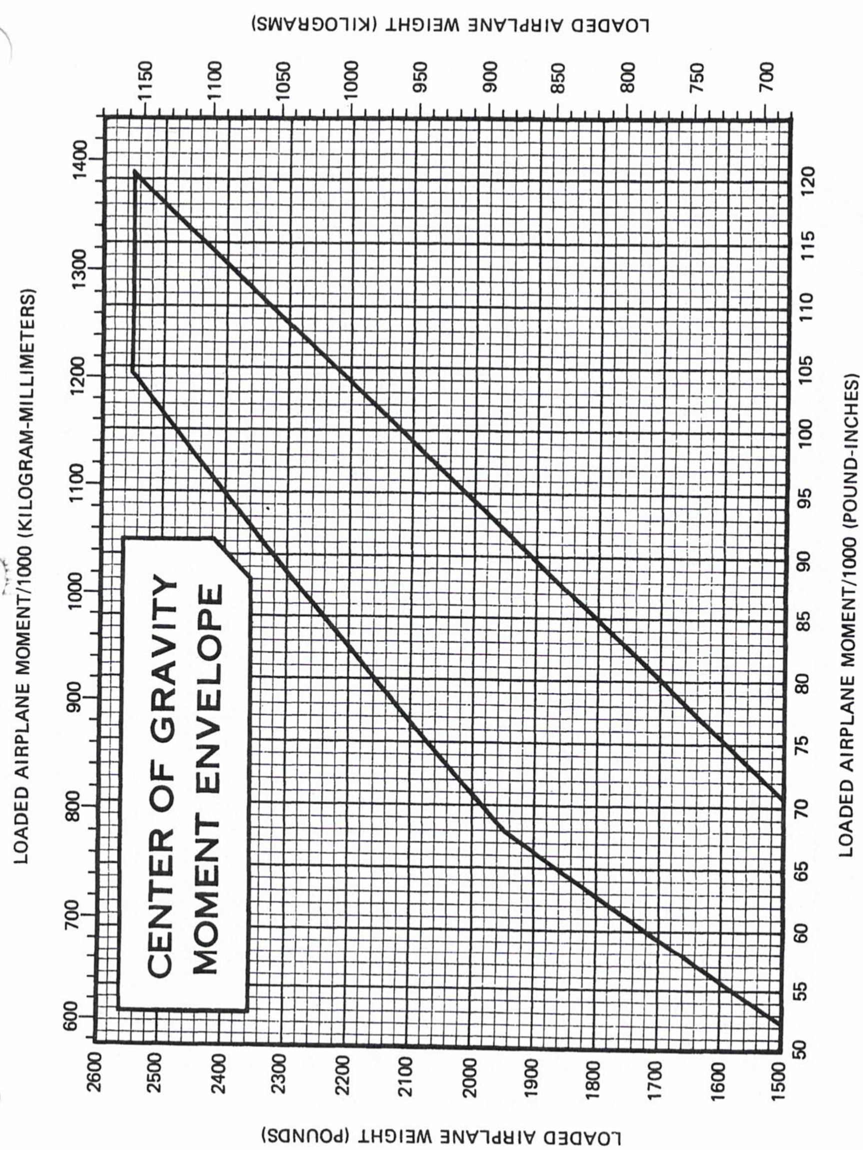


Figure 6-7. Center of Gravity Moment Envelope

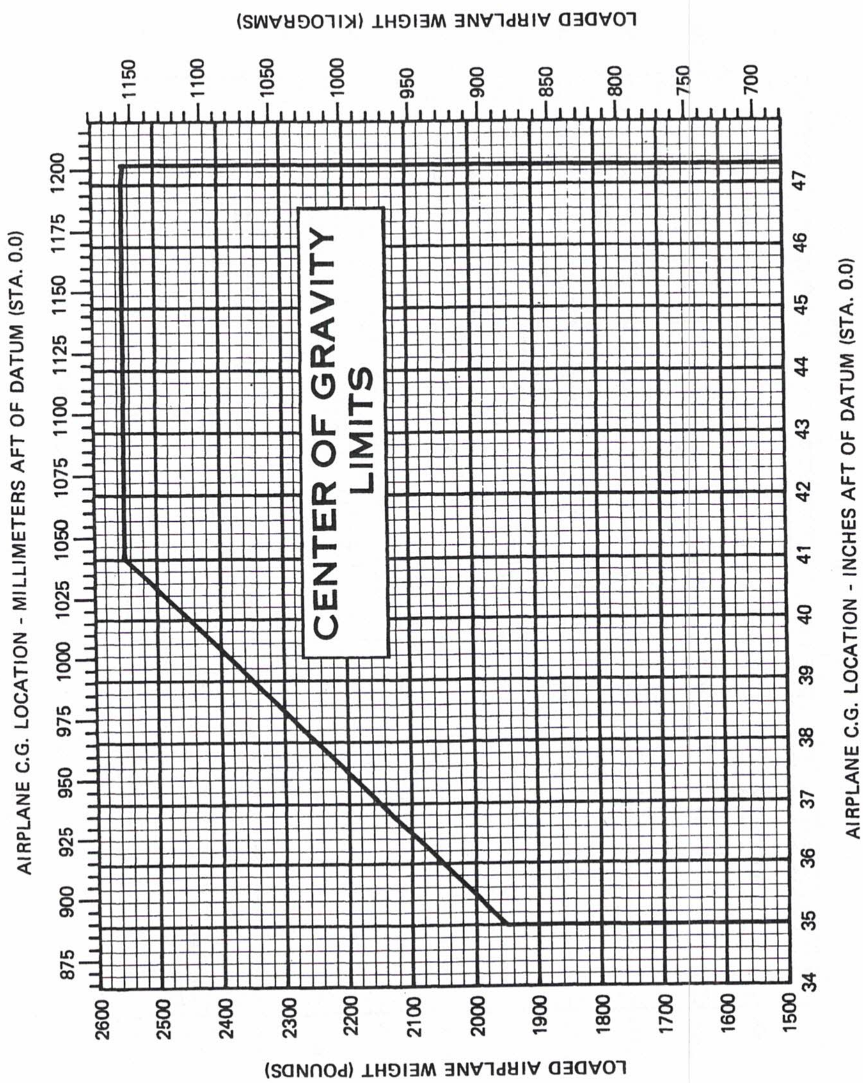


Figure 6-8. Center of Gravity Limits

EQUIPMENT LIST

The following equipment list is a comprehensive list of all Cessna equipment available for this airplane. A separate equipment list of items installed in your specific airplane is provided in your aircraft file. The following list and the specific list for your airplane have a similar order of listing.

This equipment list provides the following information:

An **item number** gives the identification number for the item. Each number is prefixed with a letter which identifies the **descriptive** grouping (example: A. Powerplant & Accessories) under which it is listed. Suffix letters identify the equipment as a required item, a standard item or an optional item. Suffix letters are as follows:

- -R = required items of equipment for FAA certification
- -S = standard equipment items
- -O = optional equipment items replacing required or standard items
- -A = optional equipment items which are in addition to required or standard items

A **reference drawing** column provides the drawing number for the item.

NOTE

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

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

NOTE

Unless otherwise indicated, true values (not net change values) for the weight and arm are shown. Positive arms are distances aft of the airplane datum; negative arms are distances forward of the datum.

NOTE

Asterisks (*) after the item weight and arm indicate complete assembly installations. Some major components of the assembly are listed on the lines immediately following. The summation of these major components does not necessarily equal the complete assembly installation.

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	A. POWERPLANT & ACCESSORIES			
A01-R	ENGINE, LYCOMING O-360-A4N (INCLUDES ELECTRIC STARTER, VACUUM PAD, SPARK-PLUGS, TWO MAGNETOS AND OIL FILTER)	0509086	292.0	-19.6
A05-R	FILTER, CARBURETOR AIR	BA8110-1	1.0	-26.0
A09-R	ALTERNATOR, 28 VOLT, 60 AMP	C611503-0102	10.7	-29.0
A17-R	OIL COOLER INSTALLATION	0509086	3.3*	-10.2*
	-OIL COOLER	8406R	2.3	-11.7
A33-R	PROPELLER ASSY. (FIXED PITCH)	0509077	38.6*	-38.3*
	-PROPELLER (MCCAULEY)	1A170E/JFA7658	34.1	-38.7
	-PROP SPACER ADAPTOR (C4516 OR C4592)	- -	3.6	-35.5
A41-R	SPINNER INSTALLATION, PROPELLER	0509077-1	2.0*	-41.4*
	-SPINNER DOME ASSY.	0550236-8	1.2	-43.1
	-FWD SPINNER BULKHEAD	0550321-4	0.3	-40.8
	-AFT SPINNER BULKHEAD	0550321-10	0.4	-37.3
A61-S	VACUUM PUMP INSTALLATION	0501054	3.0*	-2.7*
	-VACUUM PUMP	C431003-0101	1.8	-6.3
	-FILTER INSTL	1201075-2	0.2	5.4
	-VACUUM GAUGE	C668509-0101	0.1	16.7
	-RELIEF VALVE	C482001-0401	0.4	5.0
	-LOW WARNING LIGHT	S-2571	0.1	17.5
A70-S	PRIMER SYSTEM, ENGINE THREE CYLINDER	0509086-2	0.5	-11.7
A73-A	OIL QUICK DRAIN VALVE (NET CHANGE)	1701015-2	NEGL	-.-
	B. LANDING GEAR & ACCESSORIES			
B01-R	WHEEL, BRAKE & TIRE ASSY, 6.00X6 MAIN (2)	C163019-0202	39.8*	57.8*
	-WHEEL ASSY., MCCAULEY (EACH)	C163006-0101	7.6	58.2

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	-BRAKE ASSY., MCCAULEY (LEFT)	C163033-0102	1.8	54.5
	-BRAKE ASSY., MCCAULEY (RIGHT)	C163033-0102	1.8	54.5
	-TIRE, 6 PLY BLACKWALL (EACH)	C262003-0204	8.4	58.2
	-TUBE (EACH)	C262023-0102	2.1	58.2
B04-R	WHEEL & TIRE ASSY., 5.00X5 NOSE	C163018-0104	10.4*	-6.8*
	-WHEEL ASSY., MCCAULEY	C163005-0201	3.8	-6.8
	-TIRE, 6 PLY BLACKWALL	C262003-0202	5.2	-6.8
	-TUBE	C262023-0101	1.4	-6.8
B10-S	FAIRING INSTALLATION	0541225-1	16.5*	44.3*
	-NOSE WHEEL FAIRING	0543088-2	3.9	-4.9
	-MAIN WHEEL FAIRING (2)	0541229	10.4	60.3
	-BRAKE FAIRINGS (2)	0541224	1.1	55.0
	-MOUNTING PLATE (2) & HARDWARE	0541220	1.1	55.0
	C. ELECTRICAL SYSTEMS			
C01-R	BATTERY, 24 VOLT, STANDARD DUTY	C614002-0101	23.2	-5.0
C01-D	BATTERY, 24 VOLT, HEAVY DUTY	C614002-0102	25.2	-5.0
C04-R	ALTERNATOR CONTROL UNIT, 28 VOLT W/HIGH PROTECTION & LOW SENSING	C611005-0101	0.4	3.5
C07-A	GROUND SERVICE PLUG RECEPTACLE	0501104-1	3.1	-2.6
C16-D	HEATING SYSTEM, PITOT (NET CHANGE)	0422355-8	0.6	24.4
C22-A	LIGHTS, INSTRUMENT POST (REQUIRES E34-0-1 DELUXE GLARE SHIELD)	0513556-1	0.5	16.5
C25-A	MAP LIGHT INSTL., CONTROL WHEEL MOUNTED (REQUIRED W/E89-C ONLY)	0570453-2	0.2	21.5
C28-S	LIGHT INSTL., MAP & INSTRUMENT PANEL FLOOD (DOORPOST MOUNTED)	0700149-13	0.3	32.0
C31-A	LIGHTS, COURTESY ENTRANCE (SET OF 2)	0521101-1	0.5	61.0

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
C34-R	FUEL PUMP, AUXILLARY (ELECTRIC)	C291504-0204	1.9	12.5
C40-A	DETECTORS, NAVIGATION LIGHT (SET OF 2)	0701013-1, -2	NEGL	-.-
C43-A	LIGHT INSTALLATION, OMNIFLASH BEACON	0506003-5	1.4*	204.7*
	-BEACON LIGHT ON FIN TIP	C621001-0102	0.4	242.5
	-FLASHER POWER SUPPLY	C594502-0102	0.6	205.1
	-RESISTOR (MEMCOR)	OR95-6	0.2	208.3
	-MISC. HARDWARE		0.2	124.3
C46-A	LIGHT INSTALLATION, WING TIP STROBE	0501027-4	3.4*	43.3*
	-POWER SUPPLY (SET OF 2)	C622008-0102	2.3	47.0
	-STROBE LIGHTS (SET OF 2)	C622006-0107	0.2	43.5
	-WIRING & MISC. HARDWARE		0.9	33.0
C49-S	LANDING & TAXI LIGHT INSTL., WING MOUNTED		2.2*	25.3*
	-LAMP 250 WATT (G.E.) LANDING	4596	0.5	29.0
	-LAMP 250 WATT (G.E.) TAXI	4587	0.5	29.0
	-WIRING & HARDWARE		1.2	22.2
	D. INSTRUMENTS			
D01-R	INDICATOR, AIRSPEED	C661064-0112	0.6	16.2
D01-O	INDICATOR, TRUE AIRSPEED	513279-7	0.7	16.3
D04-A	STATIC AIR ALTERNATE SOURCE	0501017-1	0.2	15.5
D07-R	ALTIMETER (SENSITIVE)	C661071-0101	0.9	14.0
D07-O-1	ALTIMETER (FEET AND MILLIBARS) (SENSITIVE WITH 50 FT MARKINGS)	C661071-0102	0.8	14.0
D07-O-2	ALTIMETER, (FEET AND MILLIBARS) (SENSITIVE WITH 20 FT MARKINGS)	C661025-0102	0.7	14.0
D10-A	DUAL ALTIMETER, 2ND UNIT	2001015	0.8	14.5

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
D16-A-1	ENCODING ALTIMETER (REQUIRES RELOCATION OF REGULAR ALTIMETER)	0501049	3.0	14.0
D16-A-2	ENCODING ALTIMETER, (FEET & MILLIBARS) (REQUIRES RELOCATION OF REGULAR ALTIMETER)	0501049	3.0	14.0
D16-A-3	ALTITUDE ENCODER (BLIND, DOES NOT REQUIRE INSTRUMENT PANEL MOUNTING)	0511085	1.5	14.4
D19-R	AMMETER	S-1320-5	0.3	16.5
D22-A	GAGE, CARBURETOR AIR TEMPERATURE	0513339-4	1.0	14.0
D25-S	CLOCK, ELECTRIC	C664508-0102	0.3	16.3
D25-O	CLOCK, DIGITAL READOUT	C664511-0101	0.3	16.3
D28-R	COMPASS, MAGNETIC-INSTALLATION	0513262-1	0.5	14.0
D38-R	INSTRUMENT CLUSTER, LH & RH FUEL QUANTITY	C669537-0101	0.4	16.5
D41-R	INSTRUMENT CLUSTER, OIL PRESSURE & TEMP.	** C669535-0101	0.4	16.5
D49-A	INDICATOR, ECONOMY MIXTURE (EGT)	0501043-2	0.6	7.8
D64-S	GYRO INSTALLATION, NON NAV-O-MATIC	0501054-1	5.7 *	12.4 *
	-DIRECTIONAL INDICATOR	C661075-0104	2.5	13.5
	-ATTITUDE INDICATOR	C661076-0101	1.9	14.5
	-HOSES & HARDWARE		1.4	7.7
D64-O	GYRO INSTALLATION FOR 300 NAV-O-MATIC	0501054-2	6.0 *	12.5 *
	-DIRECTIONAL INDICATOR	40760-0114	2.7	13.5
	-ATTITUDE INDICATOR	C661076-0101	1.9	14.5
	-HOSES & HARDWARE		1.4	7.7
D67-A	RECORDER INSTALLATION, FLIGHT HOUR	0501052-3	0.5	6.3
D82-S	GAGE, OUTSIDE AIR TEMPERATURE	C668507-0101	0.1	28.6
D85-R	TACHOMETER INSTALLATION, ENGINE	0509065	1.0*	12.1*

** C669535-0102 on airplanes modified by Service Kit SK172-83; C669564-0102 on airplanes modified by Service Kit SK172-84; 6247-00390 on airplanes modified by Service Kit SK172-123A.

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	-RECORDING TACH. INDICATOR	C668020-0225	0.7	16.0
D88-S-1	INDICATOR, TURN COORDINATOR, 28 VOLT ONLY	C661003-0507	1.8	15.8
D88-S-2	INDICATOR, TURN COORDINATOR, 10-30 VOLT	C661003-0506	1.0	15.8
D88-O	INDICATOR, TURN COORDINATOR (USED W/ 200A & 300A N-O-M)	42320-0028	1.2	14.6
D91-S	INDICATOR, VERTICAL SPEED	C661080-0101	0.8	14.9
	E. CABIN ACCOMMODATIONS			
E05-R	SEAT, ADJUSTABLE FORE & AFT PILOT	0514203	16.0	44.0
E05-O	SEAT, INFINITE ADJUSTABLE - PILOT	0514204-1	23.0	41.5
E07-S	SEAT, ADJUSTABLE FORE & AFT - CO-PILOT	0514203	16.0	44.0
E07-O	SEAT, INFINITE ADJUSTABLE - CO-PILOT	0514204-2	23.0	41.5
E09-S	SEAT, REAR (ONE PIECE BACK CUSHION)	0514201	23.0	79.5
E09-O	SEAT, REAR (TWO PIECE BACK CUSHION)	0501076	26.5	79.5
E15-R	PILOT LAP BELT ASSEMBLY	S-2275-103	1.0	37.0
E15-S	SHOULDER HARNESS ASSY - PILOT	S-2275-201	0.6	37.0
E19-O	SHOULDER HARNESS INERTIA REEL INSTL.. PILOT & COPILOT, REPLACES STD. BELTS AND SHOULDER HARNESS, (WT. NET CHANGE)	S-2577	2.0	82.0
E23-S	BELT & SHOULDER ASSY - CO-PILOT	S-2275-3	1.6	37.0
E27-S	BELT ASSY, 2ND ROW (SET OF 2)	S-1746-39	2.0	70.0
E27-O	BELT & SHOULDER ASSEMBLY (USE S FOR 2ND ROW SEATING)	S-2275-8	3.2	70.0

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
E34-0-1	DELUXE GLARESHIELD (NET CHANGE)	0515034	1.0	21.0
E34-0-2	SIDE PANEL COVERING, LEATHER (NET CHG)		1.0	63.0
E35-A-1	LEATHER SEAT COVERING (NET CHG)	CES-1151	2.0	62.0
E35-A-2	LEATHER & VINYL OR FABRIC COVER (NET CHG)	CES-1151	1.5	62.0
E36-A	FLOORMATS, REMOVABLE (SET OF 2)	0501120-1	3.8	21.0
E37-0	WINDOW, HINGED, RIGHT HAND DOOR (NET CHG)	0501107-3	2.3	47.0
E39-A	WINDOWS, OVERHEAD CABIN TOP (NET CHANGE)	0511800-10	0.9	47.9
E43-A	VENTILATION SYSTEM INSTL., REAR SEAT (NOT COMPATIBLE WITH E88-A)	0700322-14	1.7	60.0
E49-A	BEVERAGE CUP HOLDER	0501023-3	0.1	15.0
E50-A	HEADREST, 1ST ROW (SET OF 2)	1215073-11	1.5	47.0
E51-A	HEADREST, 2ND ROW (SET OF 2)	1215073-11	1.5	86.0
E55-S	SUN VISOR INSTL., (SET OF 2)	0514166	0.9	32.8
E57-A	CABIN WINDOWS, TINTED (NET CHANGE)	0500267-4	NEGL	-.-
E59-A	APPROACH PLATE HOLDER INSTALLATION	0415044-2	0.1	20.5
E65-S	BAGGAGE NET	2015009-7	0.5	95.0
E71-A	RINGS, CARGO TIE DOWN (STOWED) (USE ARM AS INSTALLED W/CARGO)	0500042-1	1.0	-.-
E75-A	STRETCHER INSTALLATION, (BOX, STOWED, NOT FACTORY INSTALLED)	0700164-4	9.8	-.-
E85-A	CONTROL INSTALLATION, DUAL	0513335-6	5.5	12.4
E87-A	RUDDER TRIM SYSTEM INSTAL.	0513290-1	1.9	9.4

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
E88-A	CABIN AIR CONDITIONING SYSTEM, CHILLED AIR -COMPRESSOR ASSY. AND CLUTCH -EVAPORATOR INSTALLATION -CONDENSOR (UNDER FUSELAGE) -HOSES & MISC. ITEMS	0501066 C413001-0115 0501116 0519600	58.8* 18.0 23.0 5.3 12.5	52.7* -28.9 126.0 93.5 18.0
E89-O	CONTROL WHEEL, ALL PURPOSE, PILOT (INCLUDED MIKE SW. & PANEL MOUNTED AUXILIARY MIKE JACK) (NET CHANGE)	0570087-1	NEGL	-.-
E93-R	HEATING SYSTEM, CABIN & CARBURETOR AIR -EXHAUST SYSTEM, INCLUDED	0509086 - -	17.5	-21.0
	NOTE--HEATING SYSTEM, W/CARBURETOR IS REQ. BUT CABIN IS STANDARD ITEM			
	F. PLACARDS, WARNINGS & MANUALS			
F01-R	PLACARD, OPERATIONAL LIMITATIONS-DAY VFR	0505087	NEGL	-.-
F01-O-1	PLACARD, OPERATIONAL LIMITATIONS-DAY NIGHT VFR	0505087	NEGL	-.-
F01-O-2	PLACARD, OPERATIONAL LIMITATIONS-DAY NIGHT VFR & IFR	0505087	NEGL	-.-
F04-R	INDICATOR, AUDIBLE PNEUMATIC STALL WARNING	0523112-2	0.2	28.5
F10-S	PILOT'S CHECKLIST (STOWED) (LOCATED IN GLOVE BOX)	D6122	0.3	15.0
F13-S	LOW VOLTAGE WARNING LIGHT, ALTERNATOR		NEGL	-.-
F16-R	PILOT'S OPERATING HANDBOOK & FAA APPROVED AIRPLANE FLIGHT MANUAL (AT BACK POCKET OF PILOT SEAT)	D1247-13PH	1.2	50.0
	G. AUXILIARY EQUIPMENT			

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
G07-A	RINGS, AIRPLANE HOISTING (CABIN TOP)	0541115-10	1.1	49.1
G13-A	CORROSION PROOFING, INTERNAL	0501108-1	12.9	77.0
G16-A	STATIC DISCHARGERS (SET OF 10)	0501048-1	0.4	143.2
G19-A	ABRASION BOOTS, STABILIZER	0500041-3	2.7	206.0
G22-A	TOW BAR, AIRPLANE (STOWED)	0501019-1	1.7	124.0
G25-S	PAINT, OVERALL EXTERIOR	0504046	12.7*	91.6*
	-OVERALL WHITE BASE		12.0	90.5
	-STRIPE COLOR SCHEME		0.7	111.0
G31-A	CABLES, CORROSION RESISTANT (NET CHG)	-.-	NEGL	-.-
G55-A	FIRE EXTINGUISHER INSTALLATION	0501011-2	5.3*	43.8*
	-FIRE EXTINGUISHER (GENERAL CORP)	C421001-0201	4.8	44.0
	-FIRE EXTINGUISHER MOUNTING CLAMP	C421001-0202	0.5	42.2
G58-A	STEPS & HANDLES, REFUELING ASSISTING	0513415-2	1.7	16.3
G67-A	RUDDER PEDAL EXTENSIONS, REMOVABLE (STOWABLE - INSTALLED ARM SHOWN) AVAILABLE FROM DEALERS, SET OF 2	0501082-1	2.8	8.0
G88-A	WINTERIZATION KIT INSTALLATION, ENGINE	0501008-3	0.8*	-22.7*
	-BREATHER TUBE INSULATION	0552011	0.4	-13.8
	-COWL INLET COVERS (INSTALLED)	0553243-5,-6	0.3	-32.0
	-COWL INLET COVERS (STOWED)	0552132-5,-6	0.3	95.0
	-OIL COOLER COVER PLATE	0552220-1	0.1	-10.2
G92-O	FUEL SYSTEM, EXTENDED RANGE WET WINGS EXCHANGED W/STD WINGS (WT NET CHANGE)	0501094-2	-15.2	48.0
	H. AVIONICS & AUTOPILOTS			
H01-A	CESSNA 300 ADF INSTALLATION, W/BFO	3910159-2	6.9*	23.2*

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	-RECEIVER, R-546E	41240-0001	3.3	13.1
	-INDICATOR, IN-346A	40980-1001	0.9	14.1
	-SENSE ANT. INSTAL.	0570400-632	0.2	101.8
	-LOOP ANT. INSTAL.	3960104-1	1.4	58.2
	-WIRING & HARDWARE	3950122-31	1.1	20.8
H04-A	COLLINS DME-450C INSTALLATION	3910213-1	7.6*	54.0*
	-INDICATOR, IND-450C	622-5588-001	0.9	14.5
	-TRANSCEIVER, TCR-451	622-3670-001	5.3	116.0
	-ANTENNA, ANT-451	622-4011-001	0.2	86.3
	-WIRING & MISC. ITEMS		1.2	47.2
H05-A	COLLINS ANS-351C R-NAV INSTALLATION	3910214-1	3.7*	26.0*
	-INDICATOR, IN-442AR, ADDED	43910-1000	1.0	14.7
	-INDICATOR, IN-380A DELETED	50570-1000	-1.8	14.7
	-COMPUTER R-NAV., ANS-351C	622-5579-001	3.3	14.5
	-COOLING, WIRING & HARDWARE	3930252-5	1.1	47.8
H07-A	CESSNA 400 GLIDESLOPE (INCLUDES VOR/ILS INDICATOR--NET CHANGE FOR VOR/LOC INC.)	3910157-2	4.7*	80.4*
	-400 GLIDESLOPE RECEIVER, R-443B	42100-0000	2.1	117.2
	-ANTENNA COUPLER, (NET CHANGE)	S2473-1	NEGL	-.-
	-VOR/ILS INDICATOR, IN-381A ADDED	50570-2000	1.9	14.7
	-VOR/LOC INDICATOR, IN-380A DELETED	50570-1000	-1.8	14.7
	-WIRING, MOUNTING & MISC. HARDWARE	3950122	2.5	53.1
H08-A-1	AUTO RADIAL CENTERING INDICATOR (ARC/LOC) EXCHANGE FOR VOR/LOC IND (300 SERIES) NAV-COM 720 CH COM 1ST & 2ND UNIT (WT NET CHG)	3910196-3	NEGL	-.-
	-ARC/LOC INDICATOR, IN-380AC ADDED	50570-1200	1.8	14.7
	-VOR/LOC INDICATOR, IN-380A DELETED	50570-1000	-1.8	14.7
H08-A-2	AUTO RADIAL CENTERING INDICATOR (ARC/ILS) EXCHANGE FOR VOR/ILS INDICATOR USED WITH ITEM H07-A 400 GLIDESLOPE (WT NET CHANGE)	3910196-4	NEGL	-.-
	-ARC/ILS INDICATOR, IN-381AC ADDED	50570-2200	1.9	14.7
	-VOR/ILS INDICATOR, IN-381A DELETED	50570-2000	-1.9	14.7
H11-A	SUNAIR ASB-125 HF TRANSCEIVER, 2ND UNIT	3910158-1	20.8*	86.7*
	-ANTENNA LOAD BOX, CU-1000A	99816	4.9	108.0
	-POWER SUPPLY & SHOCK RACK	99391	8.5	114.3
	-TRANSCEIVER, PANEL MOUNTED	99681	5.3	13.1

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	-ANTENNA INSTL. 351 IN LONG	3960117-3	0.3	163.1
	-WIRING AND MISC. HARDWARE	3950122-12	1.8	94.3
H13-A	CESSNA 400 MARKER BEACON INSTALLATION	3910164-19	2.2*	60.3*
	-RECEIVER, R-402B	51170-0000	0.6	8.2
	-ANTENNA, L. ROD	0770681-1	0.7	140.0
	-WIRING & HARDWARE	3950122	0.9	33.0
H16-A-1	CESSNA 300 TRANSPONDER INSTALLATION	3910127-17	4.1*	26.6*
	-TRANSCEIVER, RT-359A	41420-0028	2.7	14.2
	-TRANSPONDER ANTENNA	42940-0000	0.2	127.0
	-RADIO COOLING	3930252-4	0.1	7.7
	-WIRING AND HARDWARE	3950122	1.1	38.7
H16-A-2	CESSNA 400 TRANSPONDER (USED FOR EXPORT)	3910128-21	4.2*	25.8*
	-TRANSCEIVER, RT-459A	41470-1028	2.8	14.2
	-TRANSPONDER ANTENNA	42940-0000	0.2	127.0
	-WIRING AND HARDWARE	3950122	1.1	38.7
	-RADIO COOLING	3930252-4	0.1	7.7
H22-A	CESSNA 300 NAV/COM 720 CH COM INSTALLATION	3910183-4	7.9*	13.3*
	REQUIRES--H34-A TO BE OPERATIONAL 1ST UNIT			
	H37-A TO BE OPERATIONAL 2ND UNIT			
	-RECEIVER-TRANSCEIVER, RT-385A	46660-1000	5.5	13.5
	-VOR/LOC INDICATOR, IN-380A	50570-1000	1.8	14.5
	-MOUNT, WIRING & MISC. HARDWARE	3950122-26	0.6	12.5
H28-A	EMERGENCY LOCATOR TRANSMITTER INSTL.	0470435	3.0*	116.7*
	-TRANSMITTER	C589512-0103	2.7	116.4
	-ANTENNA KIT	C589512-0106	0.2	122.0
	-HARDWARE		0.1	114.3
H31-A-1	NAV-O-MATIC 200A INSTALLATION (AF-295A)	3910162-1	8.3*	46.5*
	-CONTROLLER-AMPLIFIER, CA-295B	43610-1202	1.1	13.5
	-TURN COORDINATOR (NET CHANGE)	42320-0028	0.2	15.8
	-AILERON ROLL ACTUATOR PA-495A	42730-3908	3.8	61.1
	-A/P RELAY INSTALLATION KIT	2470016-4	0.4	4.0
	-WIRING AND MISC. HARDWARE	-.-	2.8	48.2
H31-A-2	NAV-O-MATIC 300A INSTALLATION (AF-395A)	3910163-1	8.9*	44.0*
	-CONTROLLER-AMPLIFIER, CA-395A	42660-1202	1.4	13.5
	-D64-O GYRO INSTL. (NET CHANGE)	0501054-2	0.3	12.5

ITEM NO.	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	-D88-O TURN COORD. (NET CHANGE)	42320-0028	0.2	15.8
	-AILERON ROLL ACTUATOR, PA-459A	42730-3908	3.8	61.1
	-A/P RELAY INSTALLATION KIT	2470016-4	0.4	4.0
	-WIRING AND MISC. HARDWARE	-.-	2.8	51.2
H33-A	INTERCOM SYSTEM INSTALLATION	3910210-3	2.9*	15.0*
	REQUIRES--E89-O ALL PURPOSE CONTROL WHEEL			
	E85-A DUAL CONTROL WHEEL INSTL.			
	-JACK INSTL. FOR INTERPHONE, R.H.	3970150-2	0.3	18.0
	-H56-A HEADPHONE & MIKE (SET OF 2)	C596531-0101	2.2	13.0
	-INTERCOM, P/C BOARD ASSEMBLY	3970149-1	0.2	14.0
	-R.H. CONTROL WHEEL INSTALLATION	3970153-3	0.3	19.0
H34-A	BASIC AVIONICS KIT INSTALLATION	3910186-2	7.0*	50.1*
	REQUIRED WITH 1ST NAV/COM INSTALLATION &			
	CONSISTS OF			
	-BLOWER & COOLING INSTALLATION	3930252-1,-2	1.0	2.8
	-NOISE FILTER-AUDIO (ON ALT.)	3940146-2	0.1	-26.1
	-L.H. COM ANTENNA CABLE INSTL.	3950122-36	0.4	27.8
	-NAV ANTENNA CABLE INSTALLATION	3950122-4	0.6	116.0
	-COMANT ANTI-P-STATIC NAV. ANT.	3960142-1	0.5	220.8
	-L.H. VHF COM ANT. INSTALLATION	3960113-1	0.4	62.4
	-CABIN SPEAKER INSTAL. & WIRING	3970123-5	1.2	37.9
	-MICROPHONE & MIC JACK HANDHELD	3970124-1	0.3	17.2
	-HEADPHONE & JACK INSTALLATION	3970125-4	0.2	14.2
	-AUDIO CONTROL PNL INSTALLATION	3970152-1	1.8	12.5
	-1ST N/C TRANSCEIVER KIT INSTL.	3930186-2	0.1	16.5
	-STATIC WICKS (SET OF 10)	0501048-1	0.4	143.2
H37-A	ANTENNA & COUPLER KIT INSTALLATION	3910185-2	1.2*	33.7*
	REQUIRED W/2ND NAV/COM, CONSISTS OF--			
	-2ND N/C TRANSCEIVER KIT INSTL.	3930186-4	0.1	16.5
	-COM ANTENNA CABLE INSTL., R.H.	3950122-35	0.4	27.8
	-300 NAV/COM ANT. COUPLER INSTL	3960111-25	0.2	10.0
	-VHF ANTENNA INSTALLATION, R.H.	3960113-2	0.4	62.4
	-RADIO COOLING	3930252-3	0.1	7.1
H43-A	AVIONICS OPTION D NAV-O-MATIC WING PROV.	0522632-6	1.7	68.2
H55-A	MIKE - HEADSET (STOWED) COMBINATION (REQUIRES E89-O ALL PURPOSE CONTROL)	C596533-0101	0.3	13.0

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
H56-A	MICROPHONE & HEADSET PADDED (STOWED) (REQUIRES E89-0 ALL PURPOSE CONTROL)	C596531-0101	1.1	13.0
	J. SPECIAL OPTION PACKAGES			
J01-A	CUTLASS II EQUIPMENT CONSISTS OF ITEMS	0500510	26.2*	46.1*
	-C16-0 HEATED PITOT SYSTEM INSTL.	0422355-8	0.6	24.4
	-C31-A COURTESY LIGHTS INSTL. (2)	0521101-1	0.5	61.0
	-C40-A NAV LIGHT DETECTOR INSTL.	0701013-1,-2	NEGL	-.-
	-C43-A LIGHT INSTL. FLASH BEACON	0506003-5	1.4	204.7
	-D01-0 AIRSPEED IND., (NET CHG.)	0513279-7	0.1	16.3
	-D04-A STATIC, ALTERNATE SOURCE	0501017-1	0.2	15.5
	-E85-A DUAL CONTROL INSTALLATION	0513335-6	5.5	12.4
	-H22-A NAV/COM, IN-380A 1ST UNIT	3910183-4	7.9	13.3
	-H28-A EMERGENCY LOC TRANSMITTER	0470435	3.0	116.7
	-H34-A BASIC AVIONICS KIT INSTL.	3910186-2	7.0	50.1
J04-A	NAV-PAC INSTALLATION (CUTLASS II ONLY)		20.1*	20.6*
	-H01-A 300 ADF INSTL., R-546E	3910159-2	6.9	23.2
	-H16-A-1 300 TRANSPONDER, RT-359A	3910127-17	4.1	26.6
	-H22-A NAV/COM, IN-380A 2ND UNIT	3910183-4	7.9	13.3
	-H37-A ANT. & COUPLER KIT INSTL	3910185-2	1.2	33.7

SECTION 7
AIRPLANE & SYSTEMS DESCRIPTIONS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

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.

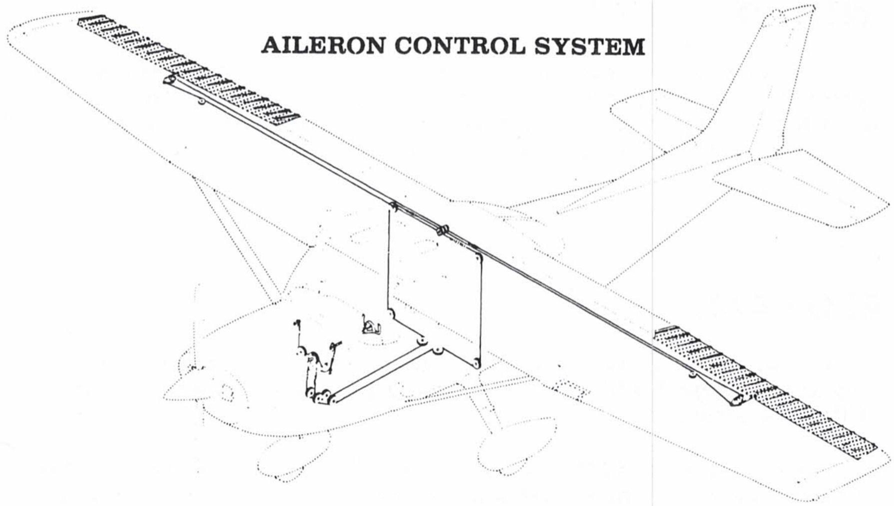
AIRFRAME

The airplane is an all-metal, four-place, high-wing, single-engine airplane equipped with 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 and forgings for main landing gear attachment at the base of the rear door posts, and a bulkhead with attach fittings at the base of the forward door posts for the lower attachment of the wing struts. Four engine mount stringers are also attached to the forward door posts and extend forward to the firewall.

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 the 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 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 and spar with attached hinge brackets and ribs, a center spar, a wrap-around skin, 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.



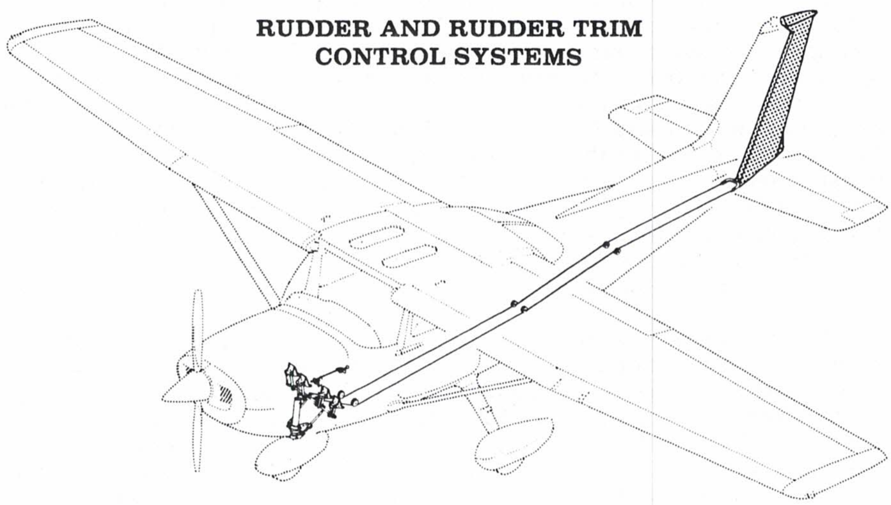
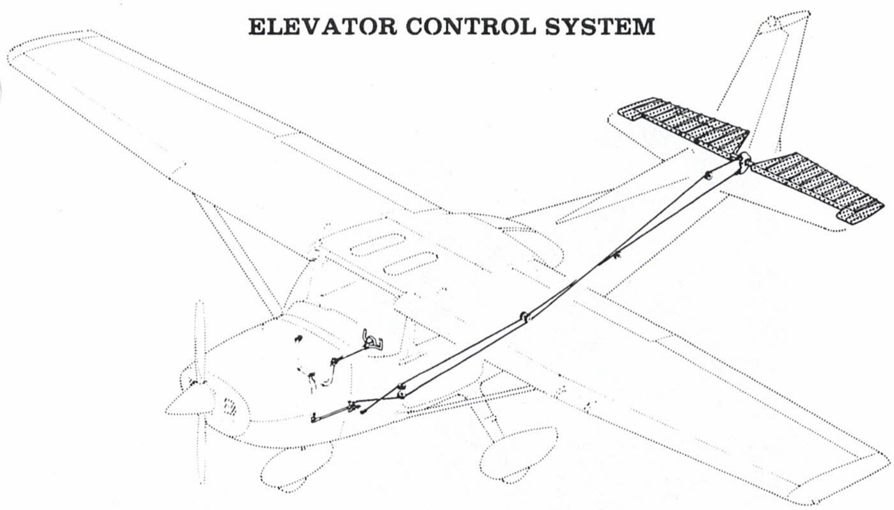


Figure 7-1. Flight Control and Trim Systems (Sheet 1 of 2)



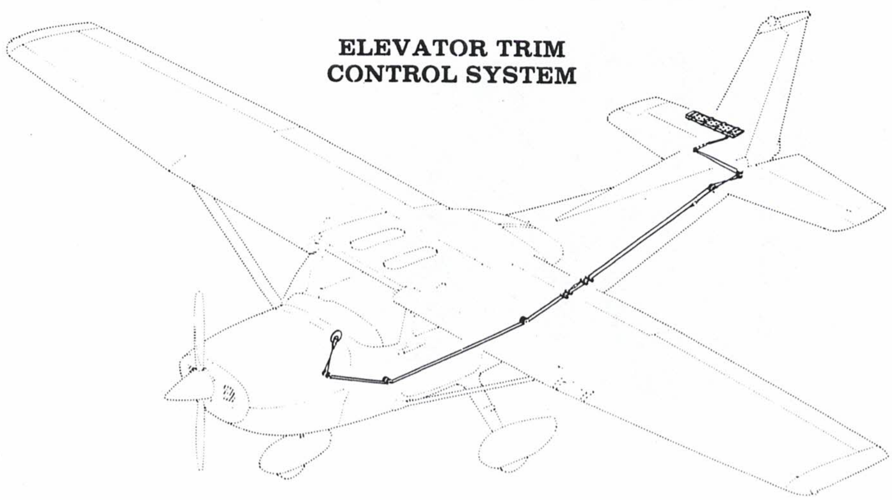


Figure 7-1. Flight Control and Trim Systems (Sheet 2 of 2)

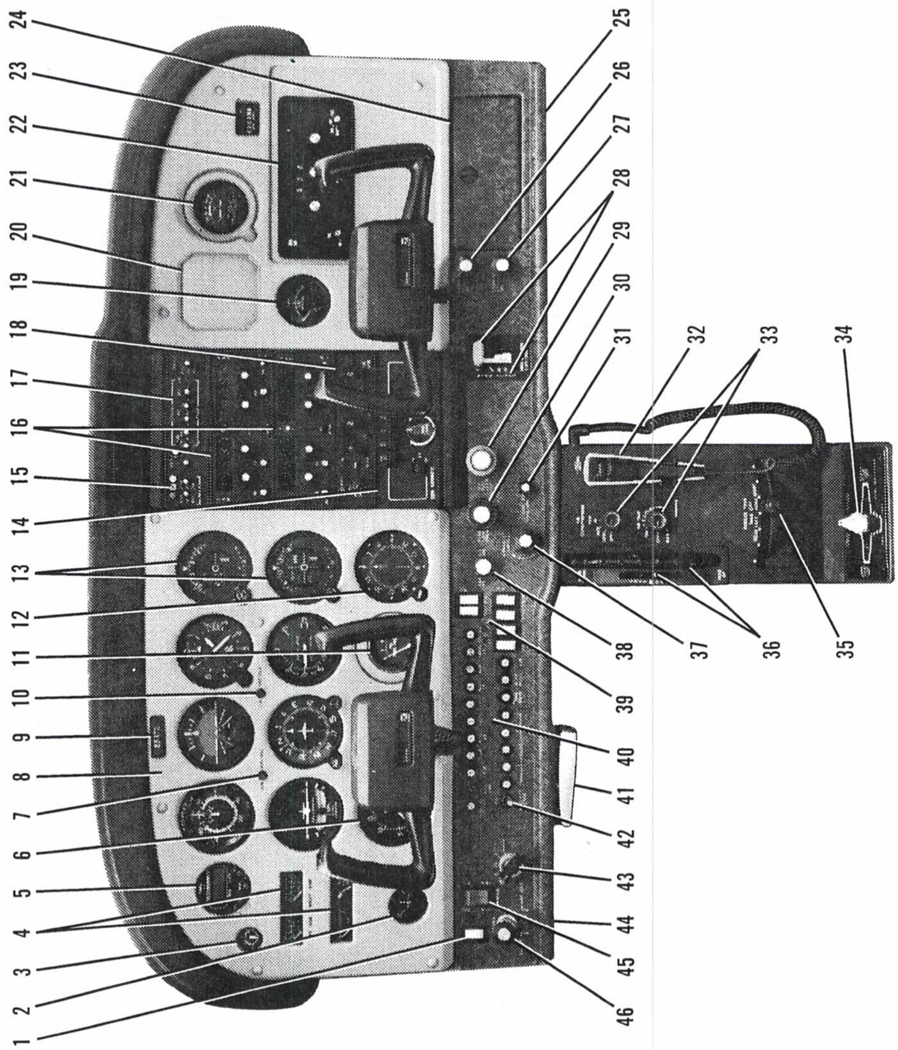


Figure 7-2. Instrument Panel (Sheet 1 of 2)

SECTION 8
AIRPLANE HANDLING, SERVICE & MAINTENANCE

TABLE OF CONTENTS

INTRODUCTION

This section contains factory-recommended procedures for proper ground handling and routine care and servicing of your Cessna. It also identifies certain inspection and maintenance requirements which must be followed if your airplane is to retain that new-plane performance and dependability. It is wise to follow a planned schedule of lubrication and preventive maintenance based on climatic and flying conditions encountered in your locality.

Keep in touch with your Cessna Dealer and take advantage of his knowledge and experience. He knows your airplane and how to maintain it. He will remind you when lubrications and oil changes are necessary, and about other seasonal and periodic services.

IDENTIFICATION PLATE

All correspondence regarding your airplane should include the SERIAL NUMBER. The Serial Number, Model Number, Production Certificate Number (PC) and Type Certificate Number (TC) can be found on the Identification Plate, located on the lower part of the left forward doorpost. Located adjacent to the Identification Plate is a Finish and Trim Plate which contains a code describing the interior color scheme and exterior paint combination of the airplane. The code may be used in conjunction with an applicable Parts Catalog if finish and trim information is needed.

OWNER NOTIFICATION SYSTEM

As the owner of a Cessna, you will receive applicable Cessna Owner Advisories at no charge. These Owner Advisories will be mailed to owners of record. A subscription service for Service Information Letters is available directly from the Cessna Customer Services Department. Your Cessna Dealer will be glad to supply you with details concerning this subscription program, and stands ready, through his Service Department, to supply you with fast, efficient, low-cost service.

PUBLICATIONS

Various publications and flight operation aids are furnished in the airplane when delivered from the factory. These items are listed below.

- CUSTOMER CARE PROGRAM BOOK
- PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL
- PILOT'S CHECKLISTS
- WORLDWIDE CUSTOMER CARE DIRECTORY

The following additional publications, plus many other supplies that are applicable to your airplane, are available from your Cessna Dealer.

- INFORMATION MANUAL (Contains Pilot's Operating Handbook Information)
- SERVICE MANUALS AND PARTS CATALOGS FOR YOUR:
  - AIRPLANE
  - ENGINE AND ACCESSORIES
  - AVIONICS AND AUTOPILOT

Your Cessna Dealer has a Customer Care Supplies Catalog covering all available items, many of which he keeps on hand. He will be happy to place an order for any item which is not in stock.

NOTE

A Pilot's Operating Handbook and FAA Approved Airplane Flight Manual which is lost or destroyed may be replaced by contacting your Cessna Dealer. An affidavit containing the owner's name, airplane serial number and registration number must be included in replacement requests since the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual is identified for specific airplanes only.

AIRPLANE FILE

There are miscellaneous data, information and licenses that are a part of the airplane file. The following is a checklist for that file. In addition, a periodic check should be made of the latest Federal Aviation Regulations to ensure that all data requirements are met.

A. To be displayed in the airplane at all times:
   1. Aircraft Airworthiness Certificate (FAA Form 8100-2).
   2. Aircraft Registration Certificate (FAA Form 8050-3).
   3. Aircraft Radio Station License, if transmitter installed (FCC Form 556).
B. To be carried in the airplane at all times:
   1. Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.
   2. Weight and Balance, and associated papers (latest copy of the Repair and Alteration Form, FAA Form 337, if applicable).
   3. Equipment List.
C. To be made available upon request:
   1. Airplane Log Book.
   2. Engine Log Book.

Most of the items listed are required by the United States Federal Aviation Regulations. Since the Regulations of other nations may require other documents and data, owners of airplanes not registered in the United States should check with their own aviation officials to determine their individual requirements.

Cessna recommends that these items, plus the Pilot's Checklists, Customer Care Program book and Customer Care Card, be carried in the airplane at all times.

AIRPLANE INSPECTION PERIODS

FAA REQUIRED INSPECTIONS

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

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

In lieu of the 100 HOUR and ANNUAL inspection requirements, an airplane may be inspected in accordance with a progressive inspection schedule, which allows the work load to be divided into smaller operations that can be accomplished in shorter time periods.

The CESSNA PROGRESSIVE CARE PROGRAM has been developed to provide a modern progressive inspection schedule that satisfies the complete airplane inspection requirements of both the 100 HOUR and ANNUAL inspections as applicable to Cessna airplanes. The program assists the owner in his responsibility to comply with all FAA inspection requirements, while ensuring timely replacement of life-limited parts and adherence to factory-recommended inspection intervals and maintenance procedures.

CESSNA PROGRESSIVE CARE

The Cessna Progressive Care Program has been designed to help you realize maximum utilization of your airplane at a minimum cost and downtime. Under this program, your airplane is inspected and maintained in four operations. The four operations are recycled each 200 hours and are recorded in a specially provided Aircraft Inspection Log as each operation is conducted.

The Cessna Aircraft Company recommends Progressive Care for airplanes that are being flown 200 hours or more per year, and the 100-hour inspection for all other airplanes. The procedures for the Progressive Care Program and the 100-hour inspection have been carefully worked out by the factory and are followed by the Cessna Dealer Organization. The complete familiarity of Cessna Dealers with Cessna equipment and factory-approved procedures provides the highest level of service possible at lower cost to Cessna owners.

Regardless of the inspection method selected by the owner, he should keep in mind that FAR Part 43 and FAR Part 91 establishes the requirement that properly certified agencies or personnel accomplish all required FAA inspections and most of the manufacturer recommended inspections.

CESSNA CUSTOMER CARE PROGRAM

Specific benefits and provisions of the CESSNA WARRANTY plus other important benefits for you are contained in your CUSTOMER CARE PROGRAM book supplied with your airplane. You will want to thoroughly review your Customer Care Program book and keep it in your airplane at all times.

An initial inspection and either a Progressive Care Operation No. 1 or the first 100-hour inspection will be performed within the first 6 months of ownership at no charge to you. If you take delivery from your Dealer, the initial inspection will have been performed before delivery of the airplane to you. If you pick up your airplane at the factory, plan to take it to your Dealer within 30 days after you take delivery, so the initial inspection may be performed allowing the Dealer to make any minor adjustments which may be necessary.

You will also want to return to your Dealer either at 50 hours for your first Progressive Care Operation, or at 100 hours for your first 100-hour inspection depending on which program you choose to establish for your airplane. While these important inspections will be performed for you by any Cessna Dealer, in most cases you will prefer to have the Dealer from whom you purchased the airplane accomplish this work.

PILOT CONDUCTED PREVENTIVE MAINTENANCE

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

NOTE

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

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

ALTERATIONS OR REPAIRS

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

GROUND HANDLING

TOWING

The airplane is most easily and safely maneuvered by hand with the tow-bar attached to the nose wheel (the tow bar is stowed on the floor in

SECTION 9
SUPPLEMENTS
(Optional Systems Description & Operating Procedures)

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

INTRODUCTION

This section consists of a series of supplements, each covering a single optional system which may be installed in the airplane. Each supplement contains a brief description, and when applicable, operating limitations, emergency and normal procedures, and performance. As listed in the Table of Contents, the supplements are classified under the headings of General and Avionics, and have been provided with reference numbers. Also, the supplements are arranged alphabetically and numerically to make it easier to locate a particular supplement. Other routinely installed items of optional equipment, whose function and operational procedures do not require detailed instructions, are discussed in Section 7.

Limitations contained in the following supplements are FAA approved. Observance of these operating limitations is required by Federal Aviation Regulations.

SUPPLEMENT AIR CONDITIONING SYSTEM

SECTION 1
GENERAL

The air conditioning system provides comfortable cabin temperatures during hot weather operations, both on the ground or in flight. Controls for the air conditioning system include two rotary switches on the control pedestal, and a push-pull lever, labeled OVERHEAD AIR SELECTOR, located in the overhead console above the front seats. Rotating the lower rotary switch, labeled AIR TEMP, to the ON position starts the system compressor.

NOTE

The compressor will not operate unless the AIR CONDITIONING FAN switch is in the LOW, MED or HI position.

With continued clockwise rotation from ON, progressively cooler cabin temperature is obtained by longer cycles of compressor operation. When the switch is rotated fully clockwise, the compressor runs continuously to provide the coolest cabin temperature. Airflow is controlled by the switch, labeled AIR CONDITIONING FAN, which rotates clockwise from OFF through three positions, labeled LOW, MED and HI, to provide three blower speeds. Positioning the overhead air selector lever to its forward position, labeled FRESH AIR, supplies outside air from inlets located in both wings to the air conditioning system. When moved to the aft position, labeled CABIN AIR, air inside the cabin is circulated through the air conditioning system. System electrical protection is provided by a 15-amp circuit breaker, labeled AIR COND, on the left side of the switch and control panel. Cooling air is vented to the cabin through four fully adjustable outlets in the overhead console. The two forward outlets are located on each side of the radio speaker; the aft outlets are between the front and rear seats.

In this system (see figure 1), a belt-driven compressor is located on the left front side of the engine. Twin evaporator coils with blowers, located above the headliner in the cabin top, direct cold air to four adjustable outlets in the overhead console. Refrigerant lines in the external tunnel and in the cabin top interconnect the compressor, evaporators and the condenser, located within an air scoop on the bottom of the tailcone.

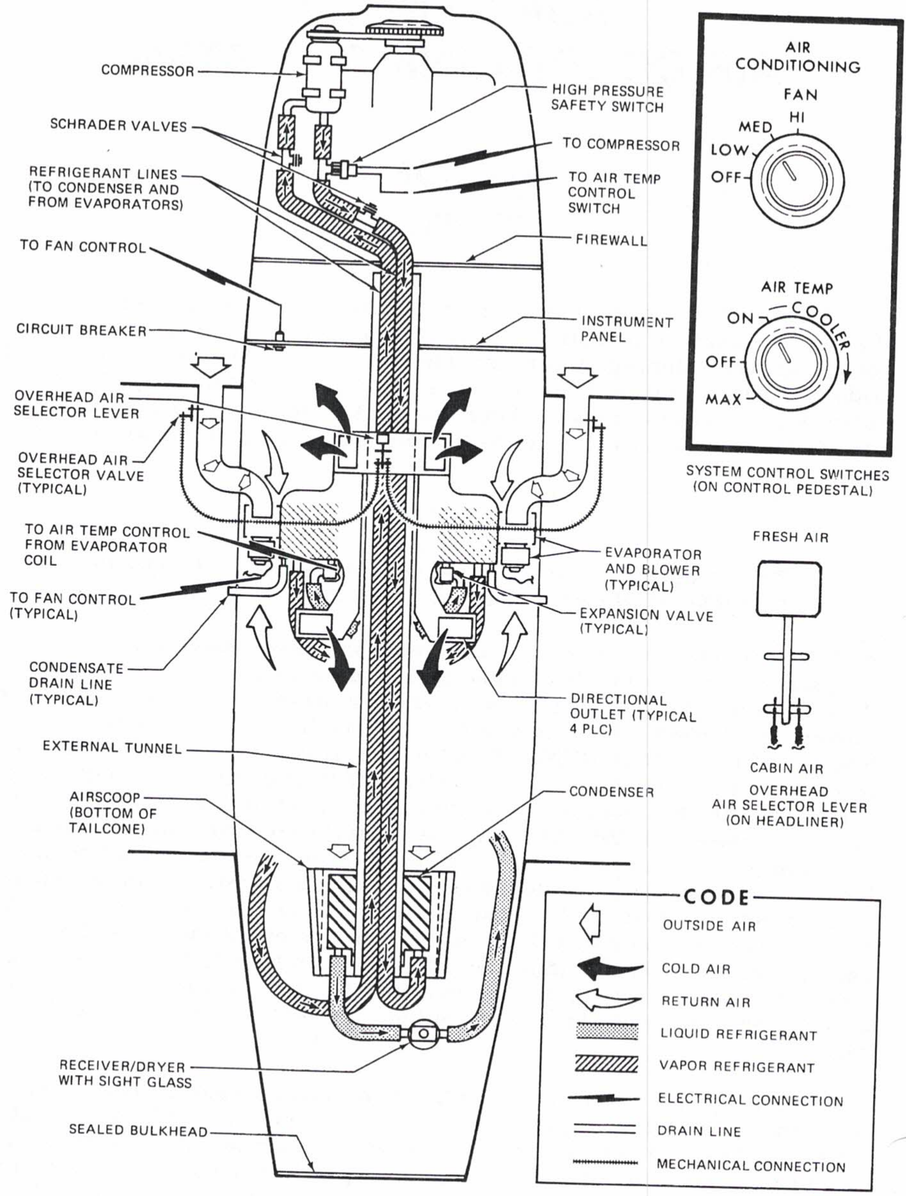


Figure 1. Air Conditioning System

Access for servicing the system is provided through the aft baggage compartment floor to the receiver/dryer sight glass, and the Schrader valves may be serviced by removing the upper engine cowl.

Refer to the Air Conditioner Service/Parts Manual for specific testing, servicing procedures, and instructions for removing and replacing system components.

SECTION 2
LIMITATIONS

The air conditioning system must not be operated during takeoff and landing.

The following information must be presented in the form of a placard, located near the engine instrument cluster.

TURN OFF AIR CONDITIONER FOR TAKEOFF AND LANDING

SECTION 3
EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when the air conditioning system is installed.

SECTION 4
NORMAL PROCEDURES

PREFLIGHT INSPECTION

During the preflight (walk-around) inspection, open both cabin doors to aid in cool-down of the cabin before flight. Air conditioning system components should be inspected as follows:

1. Check compressor drive belt for tightness, and compressor for condition.
2. Check tunnel from firewall to condenser air scoop for damage, looseness and evidence of line leakage.
3. Check condenser air scoop for blockage, condition, and evidence of system leakage.
4. Check left and right condensate drains, located on lower fuselage, for damage or blockage.

OPERATION ON GROUND

After preflight inspection and engine start, use the following procedures for quickest reduction of hot cabin temperatures prior to takeoff:

1. Cabin Doors and Windows -- CLOSED.
2. Cabin Air Control Knob -- PUSHED IN.
3. Wing Root Ventilators -- CLOSED.
4. Overhead Air Selector --CABIN AIR.
5. AIR TEMP Switch -- MAX.
6. AIR CONDITIONING FAN Switch -- HI.

NOTE

If the temperature of the air coming from the outlets does not start to cool within a minute or two, the system may be malfunctioning and should be turned off.

7. After Initial Cooldown -- REPOSITION AIR TEMP and AIR CONDITIONING FAN switches as required to maintain desired temperature.

BEFORE TAKEOFF

1. AIR TEMP Switch -- OFF.
2. AIR CONDITIONING FAN Switch -- AS DESIRED.

OPERATION IN FLIGHT

Initially, it may be desirable to operate the system at its coldest setting and highest blower speed for fast cool-down. Later in the flight, adjustment of the controls to reduced settings and selection of fresh air may be more comfortable.

During extended flight when temperature and humidity are extremely high, the evaporator coils may frost over. Normally, the compressor cycles off when temperatures in the evaporators near 32° F (0° C). However, when the AIR TEMP switch is at its coldest setting, the compressor runs continuously. Therefore, if frost does form as evidenced by reduced cooling airflow, move the temperature control counterclockwise slightly toward the OFF position and select the HI position of the AIR CONDITIONING FAN switch. This should increase evaporator discharge temperature sufficiently to clear the frost.

NOTE

A high pressure safety switch in the air conditioning system disengages the compressor clutch and stops system operation in the event the system becomes overloaded. The system will cycle on again when the pressure reduces. However, if cooling ability cannot be restored within a reasonable amount of time, the system may be malfunctioning and should be turned off.

The blower portion of the system may be used anytime air circulation (outside or cabin air) is desired. This is accomplished by leaving the AIR TEMP switch in the OFF position and placing the AIR CONDITIONING FAN switch in the LOW, MED, or HI positions as desired.

BEFORE LANDING

1. AIR TEMP Switch -- OFF.
2. AIR CONDITIONING FAN Switch -- AS DESIRED.

AFTER LANDING

The AIR TEMP switch may be rotated from OFF to a position that will maintain the cabin temperature at a comfortable level while operating on the ground.

SECTION 5
PERFORMANCE

To obtain takeoff performance of the airplane with the air conditioning system installed, increase the distances shown in Section 5 of the basic handbook by 5%.

The reduction in climb performance with the air conditioning system installed is 75 FPM with the compressor on and 50 FPM with the compressor off.

Cruise speeds with the air conditioning system installed are 5 knots below those shown in Section 5 of the basic handbook for any particular RPM. Also, an allowance should be made for cruise fuel consumption which is up to 0.5 GPH higher than shown in Section 5 of the basic handbook for any particular RPM.

A condenser air scoop fairing, provided with the system, will change the performance decrements to 2 knots for cruise speed and 25 FPM for rate of climb. The fairing is intended for use during off-season operations. Do not operate the air conditioning system with the fairing installed.

DEMONSTRATED OPERATING TEMPERATURE

Satisfactory engine cooling has been demonstrated for the airplane with this equipment installed 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 of the basic handbook for engine operating limitations.

SUPPLEMENT

CARBURETOR AIR TEMPERATURE GAGE

SECTION 1
GENERAL

The carburetor air temperature gage provides a means of detecting carburetor icing conditions. The gage is located on the right side of the instrument panel. It is marked in 5° increments from -30°C to +30°C, and has a yellow arc between -15°C and +5°C which indicates the temperature range most conducive to carburetor icing.

SECTION 2
LIMITATIONS

There is no change to the airplane limitations when the carburetor air temperature gage is installed.

SECTION 3
EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when the carburetor air temperature gage is installed.

SECTION 4
NORMAL PROCEDURES

There is no change to the airplane normal procedures when the carburetor air temperature gage is installed. It is good practice to monitor the gage periodically and keep the needle out of the yellow arc during possible carburetor icing conditions. Refer to Section 4 of the basic handbook for procedures used when operating with carburetor heat applied.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when the carburetor air temperature gage is installed. However, if it is necessary to operate with carburetor heat applied, a small performance loss may be expected at any given power setting due to the warmer induction air temperature.

SUPPLEMENT

DIGITAL CLOCK

SECTION 1
GENERAL

The Astro Tech LC-2 Quartz Chronometer (see figure 1) is a precision, solid state time keeping device which will display to the pilot the time-of-day, the calendar date, and the elapsed time interval between a series of selected events, such as in-flight check points or legs of a cross-country flight, etc. These three modes of operation function independently and can be alternately selected for viewing on the four digit liquid crystal display (LCD) on the front face of the instrument. Three push button type switches directly below the display control all time keeping functions. These control functions are summarized in figures 2 and 3.

The digital display features an internal light (back light) to ensure good visibility under low cabin lighting conditions or at night. The intensity of the back light is controlled by the RADIO LT rheostat. In addition, the display incorporates a test function (see figure 1) which allows checking that all elements of the display are operating. To activate the test function, press the LH and RH buttons at the same time.

SECTION 2
LIMITATIONS

There is no change to the airplane limitations when the digital clock is installed.

SECTION 3
EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when the digital clock is installed.

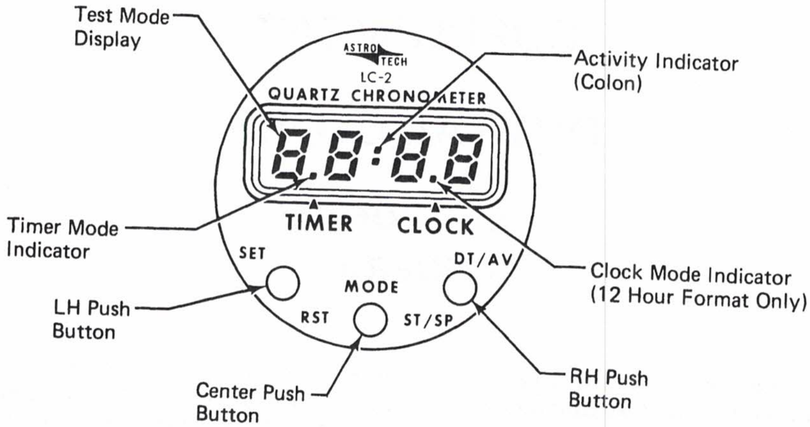


Figure 1. Digital Clock

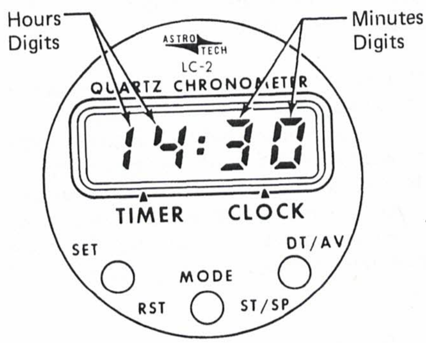
SECTION 4
NORMAL PROCEDURES

CLOCK AND DATE OPERATION

When operating in the clock mode (see figure 2), the display shows the time of day in hours and minutes while the activity indicator (colon) will blink off for one second each ten seconds to indicate proper functioning. If the RH push button is pressed momentarily, while in the clock mode, the calendar date appears numerically on the display with month of year to the left of the colon and day of the month shown to the right of the colon. The display automatically returns to the clock mode after approximately 1.5 seconds. However, if the RH button is pressed continuously longer than approximately two seconds, the display will return from the date to the clock mode with the activity indicator (colon) blinking altered to show continuously or be blanked completely from the display. Should this occur, simply press the RH button again for two seconds or longer, and correct colon blinking will be restored.

NOTE

The clock mode is set at the factory to operate in the 24-hour format. However, 12-hour format operation may be

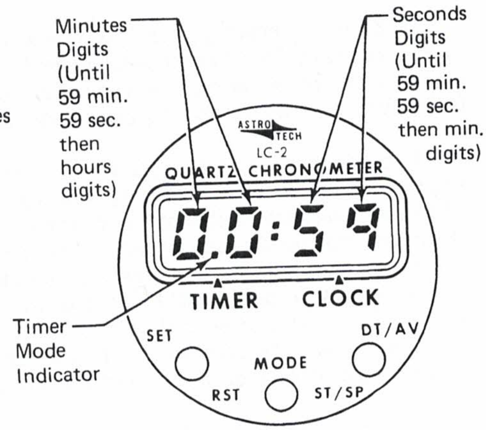


LH Button: Sets date and time of day (when used with RH button).

Center Button: Alternately displays clock or timer status

RH Button: Shows calendar date momentarily; display returns to clock mode after 1.5 seconds.

Figure 2. Clock Mode



LH Button: Resets timer to "zero".

Center Button: Alternately displays clock or timer status

RH Button: Alternately starts and stops timer; timer starts from any previously accumulated total.

Figure 3. Timer Mode

selected by changing the position of an internal slide switch accessible through a small hole on the bottom of the instrument case. Notice that in the 24-hour format, the clock mode indicator does not appear.

SETTING CORRECT DATE AND TIME

The correct date and time are set while in the clock mode using the LH and RH push buttons as follows: press the LH button once to cause the date to appear with the month flashing. Press the RH button to cause the month to advance at one per second (holding button), or one per push until the correct month appears. Push the LH button again to cause the day of month to appear flashing, then advance as before using RH button until correct day of month appears.

Once set correctly, the date advances automatically at midnight each day. February 29 of each leap year is not programmed into the calendar mode, and the date will advance to March 1. This may be corrected the following day by resetting the mode back to March 1.

Pressing the LH button two additional times will cause the time to appear with the hours digits flashing. Using the RH button as before, advance the hour digits to the correct hour as referenced to a known time standard. Another push of the LH button will now cause the minutes digits to flash. Advance the minutes digits to the next whole minute to be reached by the time standard and "hold" the display by pressing the LH button once more. At the exact instant the time standard reaches the value "held" by the display, press the RH button to restart normal clock timing, which will now be synchronized to the time standard.

In some instances, however, it may not be necessary to advance the minutes digits of the clock; for example when changing time zones. In such a case, do not advance the minutes digits while they are flashing. Instead, press the LH button again, and the clock returns to the normal time keeping mode without altering the minutes timing.

TIMER OPERATION

The completely independent 24-hour elapsed timer (see figure 3) is operated as follows: press the center (MODE) push button until the timer mode indicator appears. Reset the display to "zero" by pressing the LH button. Begin timing an event by pressing the RH button. The timer will begin counting in minutes and seconds and the colon (activity indicator) will blink off for 1/10 second each second. When 59 minutes 59 seconds have accumulated, the timer changes to count in hours and minutes up to a maximum of 23 hours, 59 minutes. During the count in hours and minutes, the colon blinks off for one second each ten seconds. To stop timing the event, press the RH button once again and the time shown by the display is "frozen". Successive pushes of the RH button will alternately restart the count from the "held" total or stop the count at a new total. The hold status of the timer can be recognized by lack of colon activity, either continuously on or continuously off. The timer can be reset to "zero" at anytime using the LH button.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when the digital clock is installed.

SUPPLEMENT

GROUND SERVICE PLUG RECEPTACLE

SECTION 1
GENERAL

The ground service plug receptacle permits the use of an external power source for cold weather starting and during lengthy maintenance work on electrical and avionics equipment. The receptacle is located behind a door adjacent to the firewall on the left side of the lower cowl.

NOTE

If no avionics equipment is to be used or worked on, the avionics power switch should be turned off. If maintenance is required on the avionics equipment, it is advisable to utilize a battery cart external power source to prevent damage to the avionics equipment by transient voltage. Do not crank or start the engine with the avionics power switch turned on.

A special fused circuit is included with the ground service plug receptacle which will close the battery contactor when external power is applied with the master switch turned on. This circuit is intended as a servicing aid when battery power is too low to close the contactor, and should not be used to avoid performing proper maintenance procedures on a low battery.

NOTE

Use of the ground service plug receptacle for starting an airplane with a "dead" battery or charging a "dead" battery in the airplane is not recommended. The battery should be removed from the airplane and serviced in accordance with Service Manual procedures. Failure to observe this precaution could result in loss of electrical power during flight.

SUPPLEMENT

CESSNA 300 NAV/COM
(720-Channel - Type RT-385A)

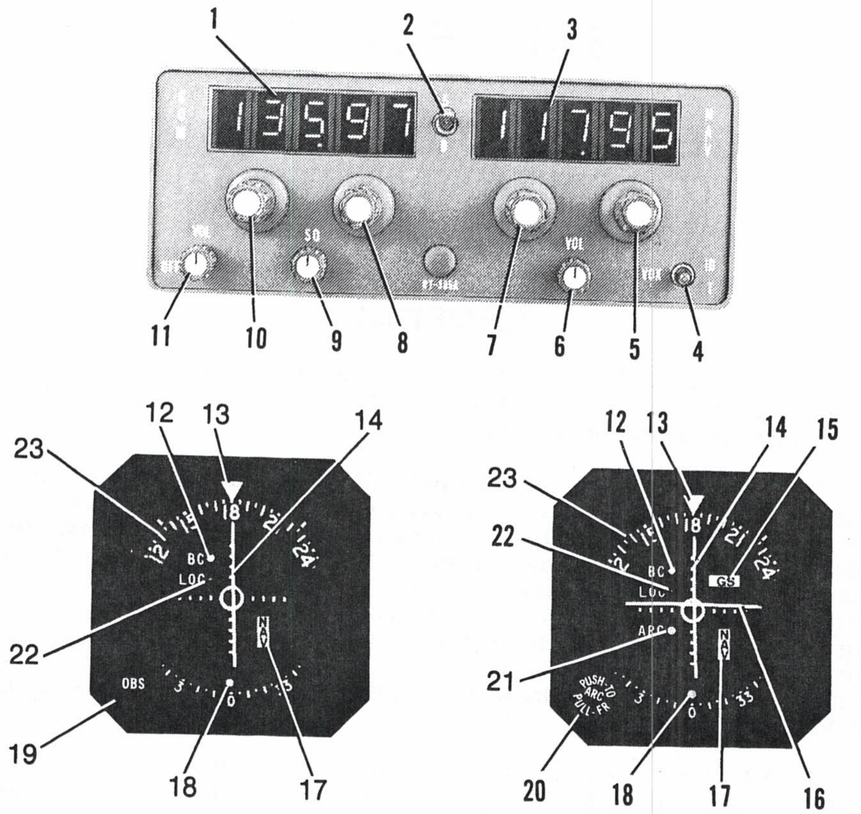
SECTION 1
GENERAL

The Cessna 300 Nav/Com (Type RT-385A), shown in figure 1, consists of a panel-mounted receiver-transmitter and a single or dual-pointer remote course deviation indicator.

The set includes a 720-channel VHF communications receiver-transmitter and a 200-channel VHF navigation receiver, both of which may be operated simultaneously. The communications receiver-transmitter receives and transmits signals between 118.000 and 135.975 MHz in 25-kHz steps. The navigation receiver receives omni and localizer signals between 108.00 and 117.95 MHz in 50-kHz steps. The circuits required to interpret the omni and localizer signals are located in the course deviation indicator. Both the communications and navigation operating frequencies are digitally displayed by incandescent readouts on the front panel of the Nav/Com.

A DME receiver-transmitter or a glide slope receiver, or both, may be interconnected with the Nav/Com set for automatic selection of the associated DME or glide slope frequency. When a VOR frequency is selected on the Nav/Com, associated VORTAC or VOR-DME station frequency will also be selected automatically; likewise, if a localizer frequency is selected, the associated glide slope will be selected automatically.

The course deviation indicator includes either a rectilinear single-pointer and related NAV flag for VOR/LOC indication only, or rectilinear dual pointers and related NAV and GS flags for both VOR/LOC and glide slope indications. Both types of course deviation indicators incorporate an amber back-course lamp (BC) which lights when optional back course (reversed sense) operation is selected and a green localizer lamp (LOC) which illuminates when a localizer frequency is selected on the associated Navigation Receiver. Both types may be provided with Automatic Radial Centering which, depending on how it is selected, will automatically indicate the bearing TO or FROM the VOR station. The ARC feature includes an amber annunciator light that illuminates when ARC is in use.



1. COMMUNICATION OPERATING FREQUENCY READOUT (Third-decimal-place is shown by the position of the "5-0" switch).

2. 5-0 SWITCH - Part of Com Receiver-Transmitter Fractional MHz Frequency Selector. In "5" position, enables Com frequency readout to display and Com Fractional MHz Selector to select frequency in .05-MHz steps between .025 and .975 MHz. In "0" position, enables COM frequency readout to display and Com Fractional MHz Selector to select frequency in .05-MHz steps between .000 and .950 MHz.

NOTE

The "5" or "0" may be read as the third decimal digit, which is not displayed in the Com fractional frequency display.

Figure 1. Cessna 300 Nav/Com (Type RT-385A), Operating Controls and Indicators (Sheet 1 of 3)

3. NAVIGATION OPERATING FREQUENCY READOUT.

4. ID-VOX-T SWITCH - With VOR or LOC station selected, in ID position, station identifier signal is audible; in VOX (Voice) position, identifier signal is suppressed; in T (Momentary On) position, the VOR navigational self-test function is selected.

5. NAVIGATION RECEIVER FRACTIONAL MEGAHERTZ SELECTOR - Selects Nav frequency in .05-MHz steps between .00 and .95 MHz; simultaneously selects paired glide slope frequency and DME channel.

6. NAV VOL CONTROL - Adjusts volume of navigation receiver audio.

7. NAVIGATION RECEIVER MEGAHERTZ SELECTOR - Selects NAV frequency in 1-MHz steps between 108 and 117 MHz; simultaneously selects paired glide slope frequency and DME channel.

8. COMMUNICATION RECEIVER-TRANSMITTER FRACTIONAL MEGAHERTZ SELECTOR - Depending on position of 5-0 switch, selects COM frequency in .05-MHz steps between .000 and .975 MHz. The 5-0 switch identifies the last digit as either 5 or 0.

9. SQUELCH CONTROL - Used to adjust signal threshold necessary to activate COM receiver audio. Clockwise rotation increases background noise (decreases squelch action); counterclockwise rotation decreases background noise.

10. COMMUNICATION RECEIVER-TRANSMITTER MEGAHERTZ SELECTOR - Selects COM frequency in 1-MHz steps between 118 and 135 MHz.

11. COM OFF-VOL CONTROL - Combination on/off switch and volume control; turns on NAV/COM set and controls volume of communications receiver audio.

12. BC LAMP - Amber light illuminates when an autopilot's back-course (reverse sense) function is engaged; indicates course deviation pointer is reversed on selected receiver when tuned to a localizer frequency. Light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.

13. COURSE INDEX - Indicates selected VOR course.

14. COURSE DEVIATION POINTER - The rectilinear vertical pointer indicates course deviation from selected omni course or localizer centerline. When power is removed or the received signal applied to the indicator is not usable, the vertical pointer is stored out of view to the right of the indicator.

15. GLIDE SLOPE "GS" FLAG - When visible, red GS flag indicates unreliable glide slope signal or improperly operating equipment. Flag disappears when a reliable glide slope signal is being received.

16. GLIDE SLOPE DEVIATION POINTER - The rectilinear horizontal pointer indicates deviation from ILS glide slope. When power is removed or the received signal applied to the indicator is not usable, the horizontal pointer is stored out of view to the top of the indicator.

Figure 1. Cessna 300 Nav/Com (Type RT-385A), Operating Controls and Indicators (Sheet 2 of 3)

17. NAV/TO-FROM INDICATOR - Operates only with a VOR or localizer signal. Red NAV position (Flag) indicates unusable signal. With usable VOR signal, indicates whether selected course is TO or FROM station. With usable localizer signal, shows TO.

18. RECIPROCAL COURSE INDEX - Indicates reciprocal of selected VOR course.

19. OMNI BEARING SELECTOR (OBS) - Rotates OBS course card to select desired course.

20. AUTOMATIC RADIAL CENTERING (ARC-PUSH-TO/PULL-FR) SELECTOR - In center detent, functions as conventional OBS. Pushed to inner (Momentary On) position, turns OBS course card to center course deviation pointer with a TO flag, then returns to conventional OBS selection. Pulled to outer detent, continuously drives OBS course card to indicate bearing from VOR station, keeping course deviation pointer centered, with a FROM flag. ARC function will not operate on localizer frequencies.

21. AUTOMATIC RADIAL CENTERING (ARC) LAMP - Amber light illuminates when Automatic Radial Centering is in use.Light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.

22. LOCALIZER (LOC) LAMP - Green light illuminates when a localizer frequency is selected on the associated Navigation Receiver. Light dimming is only available when installed with an audio control panel incorporating the annunciator light DAY/NITE selector switch.

23. OBS COURSE CARD - Indicates selected VOR course under course index.

Figure 1. Cessna 300 Nav/Com (Type RT-385A), Operating Controls and Indicators (Sheet 3 of 3)

The Cessna 300 Nav/Com incorporates a variable threshold automatic squelch. With this squelch system, you set the threshold level for automatic operation - the further clockwise the lower the threshold - or the more sensitive the set. When the signal is above this level, it is heard even if the noise is very close to the signal. Below this level, the squelch is fully automatic so when the background noise is very low, very weak signals (that are above the noise) are let through. For normal operation of the squelch circuit, just turn the squelch clockwise until noise is heard - then back off slightly until it is quiet, and you will have automatic squelch with the lowest practical threshold. This adjustment should be rechecked periodically during each flight to assure optimum reception.

All controls for the Nav/Com, except the standard omni bearing selector (OBS) knob or the optional automatic radial centering (ARC) knob located on the course deviation indicator, are mounted on the front panel of the receiver-transmitter. Operation and description of the audio control panels used in conjunction with this radio are shown and described in another supplement in this section.

SECTION 2
LIMITATIONS

There is no change to the airplane limitations when this avionic equipment is installed.

SECTION 3
EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when this avionic equipment is installed. However, if the frequency readouts fail, the radio will remain operational on the last frequency selected. The frequency control should not be moved due to the difficulty of obtaining a known frequency under this condition.

SECTION 4
NORMAL PROCEDURES

COMMUNICATION RECEIVER-TRANSMITTER OPERATION:

1. COM OFF/VOL Control -- TURN ON; adjust to desired audio level.
2. XMTR SEL Switch (on audio control panel) -- SET to desired Nav/Com Radio.
3. SPEAKER/PHONE Selector Switches (on audio control panel) -- SET to desired mode.
4. 5-0 Fractional MHz Selector Switch -- SELECT desired operating frequency (does not affect navigation frequencies).
5. COM Frequency Selector Switch -- SELECT desired operating frequency.
6. SQ Control -- ROTATE counterclockwise to just eliminate background noise. Adjustment should be checked periodically to assure optimum reception.
7. Mike Button:
   a. To Transmit -- DEPRESS and SPEAK into microphone.

NOTE

Sidetone may be selected by placing the AUTO selector switch (on audio control panel) in either the SPEAKER or PHONE position. Sidetone may be eliminated by placing the AUTO selector switch in the OFF position. Adjustment of sidetone on audio control panels supplied with three transmitters cannot be accomplished externally. However, audio control panels supplied with one or two transmitters have sidetone adjustment pots that are accessible through the front of the audio control panel with a small screwdriver.

   b. To Receive -- RELEASE mike button.

NAVIGATION OPERATION:

NOTE

The pilot should be aware that on Cessna airplanes equipped with the vertical fin mounted combination glide slope and omni antenna, pilots should avoid use of 2700 ± 100 RPM on airplanes equipped with a two-bladed propeller or 1800 ± 100 RPM on airplanes equipped with a three-bladed propeller during ILS approaches to avoid any possibility of oscillations of the glide slope deviation pointer caused by propeller interference.

1. COM OFF/VOL Control -- TURN ON.
2. SPEAKER/PHONE Selector Switches (on audio control panel) -- SET to desired mode.
3. NAV Frequency Selector Knobs -- SELECT desired operating frequency.

NOTE

If a localizer frequency was selected, the LOC lamp will illuminate green.

4. NAV VOL -- ADJUST to desired audio level.
5. ID-VOX-T Switch:
   a. To Identify Station -- SET to ID to hear navigation station identifier signal.
   b. To Filter Out Station Identifier Signal -- SET to VOX to include filter in audio circuit.
6. Course Deviation Indicator -- CHECK that it reads TO or FROM with the usable VOR navigation signal and that the vertical pointer is indicating the bearing to the VOR station.
7. ARC PUSH-TO/PULL-FROM Knob (If Applicable):
   a. To Use As Conventional OBS -- PLACE in center detent and select desired course.
   b. To Obtain Bearing TO VOR Station -- PUSH (ARC/PUSH-TO) knob to inner (momentary on) position.

NOTE

ARC lamp will illuminate amber while the OBS course card is moving to center with the course deviation pointer. After alignment has been achieved to reflect bearing to VOR, automatic radial centering will automatically shut down, causing the ARC lamp to go out.

   c. To Obtain Continuous Bearing FROM VOR Station -- PULL (ARC/PULL-FR) knob to outer detent.

NOTE

ARC lamp will illuminate amber, OBS course card will turn to center the course deviation pointer with a FROM flag to indicate bearing from VOR station.

8. OBS Knob (If Applicable) -- SELECT desired course.

VOR SELF-TEST OPERATION:

1. COM OFF/VOL Control -- TURN ON.
2. NAV Frequency Selector Switches -- SELECT usable VOR station signal.
3. OBS Knob -- SET for 0° course at course index; course deviation pointer centers or deflects left or right, depending on bearing of signal; NAV/TO-FROM indicator shows TO or FROM.
4. ID/VOX/T Switch -- PRESS to T and HOLD at T; course deviation pointer centers and NAV/TO-FROM indicator shows FROM.
5. OBS Knob -- TURN to displace course approximately 10° to either side of 0° (while holding ID/VOX/T to T). Course deviation pointer deflects full scale in direction corresponding to course displacement. NAV/TO-FROM indicator shows FROM.

NOTE

When the 300 NAV/COM is coupled to the ANS-351C RNAV system the TEST operation is non-functional. Refer to the "Ground Check Procedures" in the Area Navigation System (Type ANS-351C) Supplement in this section to verify VOR operation of the CDI.

6. ID/VOX/T Switch -- RELEASE for normal operation.

NOTE

This test does not fulfill the requirements of FAR 91.25.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when this avionic equipment is installed. However, the installation of an externally mounted antenna or several related external antennas, will result in a minor reduction in cruise performance.

SUPPLEMENT

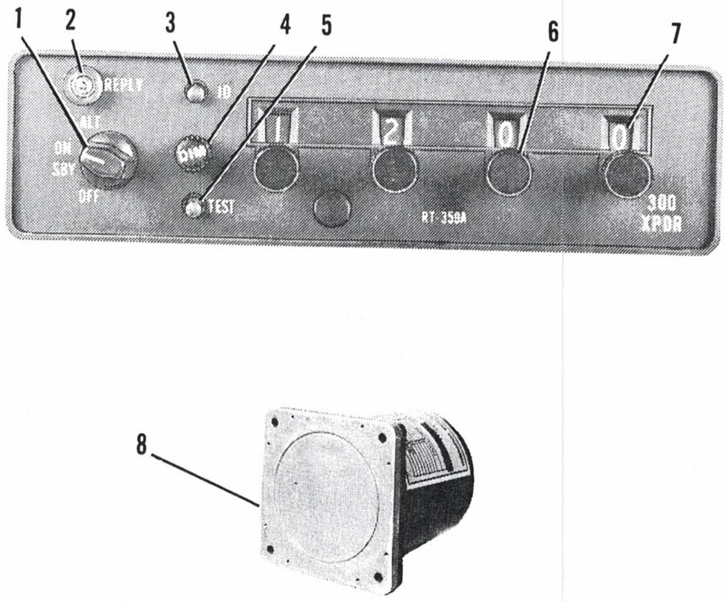
CESSNA 300 TRANSPONDER (Type RT-359A) AND OPTIONAL ALTITUDE ENCODER (BLIND)

SECTION 1
GENERAL

The Cessna 300 Transponder (Type RT-359A), shown in Figure 1, is the airborne component of an Air Traffic Control Radar Beacon System (ATCRBS). The transponder enables the ATC ground controller to "see" and identify the aircraft, while in flight, on the control center's radarscope more readily.

The Cessna 300 Transponder system consists of a panel-mounted unit and an externally-mounted antenna. The transponder receives interrogating pulse signals on 1030 MHz and transmits pulse-train reply signals on 1090 MHz. The transponder is capable of replying to Mode A (aircraft identification) and also to Mode C (altitude reporting) when coupled to an optional altitude encoder system. The transponder is capable of replying on both modes of interrogation on a selective reply basis on any of 4096 information code selections. The optional altitude encoder system (not part of a standard 300 Transponder system) required for Mode C (altitude reporting) operation consists of a completely independent remote-mounted digitizer that is connected to the static system and supplies encoded altitude information to the transponder. When the altitude encoder system is coupled to the 300 Transponder system, altitude reporting information is available in 100-foot increments.

All Cessna 300 Transponder operating controls are located on the front panel of the unit. Functions of the operating controls are described in Figure 1.



1. FUNCTION SELECTOR SWITCH - Controls application of power and selects transponder operating mode as follows:

   OFF - Turns set off.
   SBY - Turns set on for equipment warm-up or standby power.
   ON - Turns set on and enables transponder to transmit Mode A (aircraft identification) reply pulses.
   ALT - Turns set on and enables transponder to transmit both Mode A (aircraft identification) reply pulses and Mode C (altitude reporting) pulses selected automatically by the interrogating signal.

2. REPLY LAMP - Lamp flashes to indicate transmission of reply pulses; glows steadily to indicate transmission of IDENT pulse or satisfactory self-test operation. (Reply lamp will also glow steadily during initial warm-up period.)

Figure 1. Cessna 300 Transponder and Altitude Encoder (Blind) (Sheet 1 of 2)

3. IDENT (ID) SWITCH - When depressed, selects special pulse identifier to be transmitted with transponder reply to effect immediate identification of aircraft on ground controller's display. (Reply lamp will glow steadily during duration of IDENT pulse transmission.)

4. DIMMER (DIM) CONTROL - Allows pilot to control brilliance of reply lamp.

5. SELF-TEST (TST) SWITCH - When depressed, causes transponder to generate a self-interrogating signal to provide a check of transponder operation. (Reply lamp will glow steadily to verify self-test operation.)

6. REPLY-CODE SELECTOR KNOBS (4) - Select assigned Mode A reply code.

7. REPLY-CODE INDICATORS (4) - Display selected Mode A reply code.

8. REMOTE-MOUNTED DIGITIZER - Provides an altitude reporting code range from -1000 feet up to the airplane's maximum service ceiling.

Figure 1. Cessna 300 Transponder and Altitude Encoder (Blind) (Sheet 2 of 2)

SECTION 2
LIMITATIONS

There is no change to the airplane limitations when this avionic equipment is installed. However, the following information must be displayed in the form of a placard located near the altimeter.

ALTITUDE ENCODER EQUIPPED

SECTION 3
EMERGENCY PROCEDURES

TO TRANSMIT AN EMERGENCY SIGNAL:

1. Function Selector Switch -- ON.
2. Reply-Code Selector Knobs -- SELECT 7700 operating code.

TO TRANSMIT A SIGNAL REPRESENTING LOSS OF ALL COMMUNICATIONS (WHEN IN A CONTROLLED ENVIRONMENT):

1. Function Selector Switch -- ON.
2. Reply-Code Selector Knobs -- SELECT 7700 operating code for 1 minute; then SELECT 7600 operating code for 15 minutes and then REPEAT this procedure at same intervals for remainder of flight.

SECTION 4
NORMAL PROCEDURES

BEFORE TAKEOFF:

1. Function Selector Switch -- SBY.

TO TRANSMIT MODE A (AIRCRAFT IDENTIFICATION) CODES IN FLIGHT:

1. Reply-Code Selector Knobs -- SELECT assigned code.

2. Function Selector Switch -- ON.
3. DIM Control -- ADJUST light brilliance of reply lamp.

NOTE

During normal operation with function selector switch in ON position, reply lamp flashes indicating transponder replies to interrogations.

4. ID Button -- DEPRESS momentarily when instructed by ground controller to "squawk IDENT" (reply lamp will glow steadily, indicating IDENT operation).

TO TRANSMIT MODE C (ALTITUDE REPORTING) CODES IN FLIGHT:

1. Reply-Code Selector Knobs -- SELECT assigned code.
2. Function Selector Switch -- ALT.

NOTE

When directed by ground controller to "stop altitude squawk", turn Function Selector Switch to ON for Mode A operation only.

NOTE

Pressure altitude is transmitted by the transponder for altitude squawk and conversion to indicated altitude is done in ATC computers. Altitude squawked will only agree with indicated altitude when the local altimeter setting in use by the ground controller is set in the aircraft altimeter.

3. DIM Control -- ADJUST light brilliance of reply lamp.

TO SELF-TEST TRANSPONDER OPERATION:

1. Function Selector Switch -- SBY and wait 30 seconds for equipment to warm-up.
2. Function Selector Switch -- ON or ALT.
3. TST Button -- DEPRESS (reply lamp should light brightly regardless of DIM control setting).
4. TST Button -- RELEASE for normal operation.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when this avionic equipment is installed. However, the installation of an externally mounted antenna or several related external antennas, will result in a minor reduction in cruise performance.

SUPPLEMENT

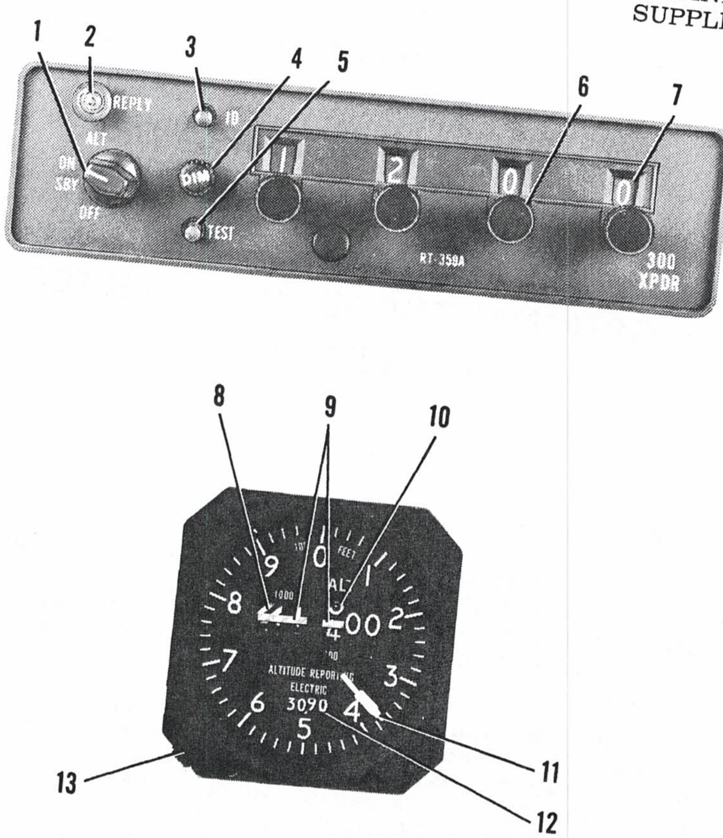
CESSNA 300 TRANSPONDER (Type RT-359A) AND OPTIONAL ENCODING ALTIMETER (Type EA-401A)

SECTION 1
GENERAL

The Cessna 300 Transponder (Type RT-359A), shown in Figure 1, is the airborne component of an Air Traffic Control Radar Beacon System (ATCRBS). The transponder enables the ATC ground controller to "see" and identify the aircraft, while in flight, on the control center's radarscope more readily.

The Cessna 300 Transponder system consists of a panel-mounted unit and an externally-mounted antenna. The transponder receives interrogating pulse signals on 1030 MHz and transmits coded pulse-train reply signals on 1090 MHz. It is capable of replying to Mode A (aircraft identification) and Mode C (altitude reporting) interrogations on a selective reply basis on any of 4096 information code selections. When an optional panel-mounted EA-401A Encoding Altimeter (not part of a standard 300 Transponder system) is included in the avionic configuration, altitude reporting information is available in 100 foot increments.

All Cessna 300 Transponder operating controls, with the exception of the optional altitude encoder's altimeter setting knob, are located on the front panel of the unit. The altimeter setting knob is located on the encoding altimeter. Functions of the operating controls are described in Figure 1.



1. FUNCTION SELECTOR SWITCH - Controls application of power and selects transponder operating mode as follows:

   OFF - Turns set off.
   SBY - Turns set on for equipment warm-up.
   ON - Turns set on and enables transponder to transmit Mode A (aircraft identification) reply pulses.
   ALT - Turns set on and enables transponder to transmit both Mode A (aircraft identification) reply pulses and Mode C (altitude reporting) pulses selected automatically by the interrogating signal.

2. REPLY LAMP - Lamp flashes to indicate transmission of reply pulses; glows steadily to indicate transmission of IDENT pulse or satisfactory self-test operation. (Reply Lamp will also glow steadily during initial warm-up period.)

Figure 1. Cessna 300 Transponder and Encoding Altimeter (Sheet 1 of 2)

3. IDENT (ID) SWITCH - When depressed, selects special pulse identifier to be transmitted with transponder reply to effect immediate identification of aircraft on ground controller's display. (Reply Lamp will glow steadily during duration of IDENT pulse transmission.)
4. DIMMER (DIM) CONTROL - Allows pilot to control brilliance of reply lamp.
5. SELF-TEST (TST) SWITCH - When depressed, causes transponder to generate a self-interrogating signal to provide a check of transponder operation. (Reply Lamp will glow steadily to verify self test operation.)
6. REPLY-CODE SELECTOR KNOBS (4) - Select assigned Mode A reply code.
7. REPLY-CODE INDICATORS (4) - Display selected Mode A reply code.
8. 1000-FOOT DRUM TYPE INDICATOR - Provides digital altitude readout in 1000-foot increments between -1000 feet and +35,000 feet. When altitude is below 10,000 feet, a diagonally striped flag appears in the 10,000 foot window.
9. OFF INDICATOR WARNING FLAG - Flag appears across altitude readout when power is removed from the altimeter to indicate that readout is not reliable.
10. 100-FOOT DRUM TYPE INDICATOR - Provides digital altitude readout in 100-foot increments between 0 feet and 1000 feet.
11. 20-FOOT INDICATOR NEEDLE - Indicates altitude in 20-foot increments between 0 feet and 1000 feet.
12. ALTIMETER SETTING SCALE - DRUM TYPE - Indicates selected altimeter setting in the range of 27.9 to 31.0 inches of mercury on the standard altimeter or 950 to 1050 millibars on the optional altimeter.
13. ALTIMETER SETTING KNOB - Dials in desired altimeter setting in the range of 27.9 to 31.0 inches of mercury on the standard altimeter or 950 to 1050 millibars on the optional altimeter.

SECTION 2
LIMITATIONS

There is no change to the airplane performance when this avionic equipment is installed. However, the encoding altimeter used in this installation does have a limitation that requires a standard barometric altimeter to be installed as a back-up altimeter.

Figure 1. Cessna 300 Transponder and Encoding Altimeter (Sheet 2 of 2)

SECTION 3
EMERGENCY PROCEDURES

TO TRANSMIT AN EMERGENCY SIGNAL:

1. Function Selector Switch -- ON.
2. Reply-Code Selector Knobs -- SELECT 7700 operating code.

TO TRANSMIT A SIGNAL REPRESENTING LOSS OF ALL COMMUNICATIONS (WHEN IN A CONTROLLED ENVIRONMENT):

1. Function Selector Switch -- ON.
2. Reply-Code Selector Knobs -- SELECT 7700 operating code for 1 minute; then SELECT 7600 operating code for 15 minutes and then REPEAT this procedure at same intervals for remainder of flight.

SECTION 4
NORMAL PROCEDURES

BEFORE TAKEOFF:

1. Function Selector Switch -- SBY.

TO TRANSMIT MODE A (AIRCRAFT IDENTIFICATION) CODES IN FLIGHT:

1. Reply-Code Selector Knobs -- SELECT assigned code.
2. Function Selector Switch -- ON.
3. DIM Control -- ADJUST light brilliance of reply lamp.

NOTE

During normal operation with function selector switch in ON position, reply lamp flashes indicating transponder replies to interrogations.

4. ID Button -- DEPRESS momentarily when instructed by ground controller to "squawk IDENT" (reply lamp will glow steadily, indicating IDENT operation).

TO TRANSMIT MODE C (ALTITUDE REPORTING) CODES IN FLIGHT:

1. Off Indicator Warning Flag -- VERIFY that flag is out of view on encoding altimeter.
2. Altitude Encoder Altimeter Setting Knob -- SET IN assigned local altimeter setting.
3. Reply-Code Selector Knobs -- SELECT assigned code.
4. Function Selector Switch -- ALT.

NOTE

When directed by ground controller to "stop altitude squawk", turn Function Selector Switch to ON for Mode A operation only.

NOTE

Pressure altitude is transmitted by the transponder for altitude squawk and conversion to indicated altitude is done in ATC computers. Altitude squawked will only agree with indicated altitude when the local altimeter setting in use by the ground controller is set in the encoding altimeter.

5. DIM Control -- ADJUST light brilliance of reply lamp.

TO SELF-TEST TRANSPONDER OPERATION:

1. Function Selector Switch -- SBY and wait 30 seconds for equipment to warm-up.
2. Function Selector Switch -- ON or ALT.
3. TST Button -- DEPRESS and HOLD (reply lamp should light with full brilliance regardless of DIM control setting).
4. TST Button -- RELEASE for normal operation.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when this avionic equipment is installed. However, the installation of an externally mounted antenna or several related external antennas, will result in a minor reduction in cruise performance.

SUPPLEMENT

CESSNA NAVOMATIC 300A AUTOPILOT (Type AF-395A)

SECTION 1
GENERAL

The Cessna 300A Navomatic is an all electric, single-axis (aileron control) autopilot system that provides added lateral and directional stability. Components are a computer-amplifier, a turn coordinator, a directional gyro, an aileron actuator and a course deviation indicator(s) incorporating a localizer reversed (BC) indicator light.

Roll and yaw motions of the airplane are sensed by the turn coordinator gyro. Deviations from the selected heading are sensed by the directional gyro. The computer-amplifier electronically computes the necessary correction and signals the actuator to move the ailerons to maintain the airplane in the commanded lateral attitude or heading.

The actuator includes a thermostatic switch which monitors the operating temperature of the motor. If the temperature becomes abnormal, the thermostatic switch opens and disengages the autopilot to remove power from the actuator. After approximately 10 minutes, the switch will automatically close to reapply power to the actuator and autopilot system.

The 300A Navomatic will also intercept and track a VOR or localizer course using signals from a VHF navigation receiver.

The operating controls for the Cessna 300A Navomatic are located on the front panel of the computer-amplifier and on the directional gyro, shown in Figure 1. The primary function pushbuttons (HDG SEL, NAV INT, and NAV TRK), are interlocked so that only one function can be selected at a time. The HI SENS and BACK CRS pushbuttons are not interlocked so that either or both of these functions can be selected at any time.

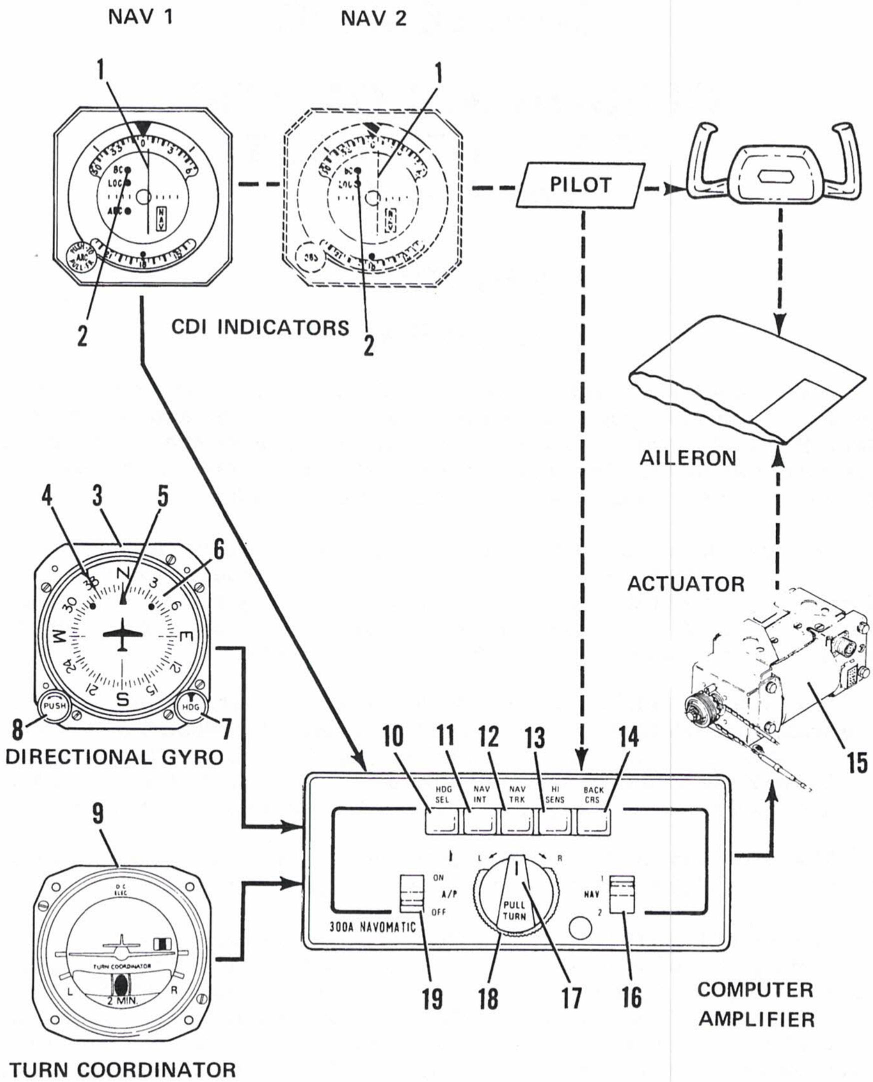


Figure 1. Cessna 300A Autopilot, Operating Controls and Indicators (Sheet 1 of 3)

1. COURSE DEVIATION INDICATOR - Provides VOR/LOC navigation inputs to autopilot for intercept and tracking modes.

2. LOCALIZER REVERSED INDICATOR LIGHT - Amber light, labeled BC, illuminates when BACK CRS button is pushed in (engaged) and LOC frequency selected. BC light indicates course indicator needle is reversed on selected receiver (when tuned to a localizer frequency). This light is located within the CDI indicator.

3. NON-SLAVED DIRECTIONAL GYRO - Provides a stable visual indication of aircraft heading to the pilot and provides heading information to the autopilot for heading intercept and hold.

4. HEADING BUG - Moved by HDG knob to select desired heading.

5. LUBBER LINE - Indicates aircraft heading on compass card (6).

6. COMPASS CARD - Rotates to display heading of airplane with reference to lubber line (5).

7. HEADING SELECTOR KNOB (HDG) - When pushed in, the heading bug (4) may be positioned to the desired magnetic heading by rotating the HDG selector knob. Also used to select VOR or LOC course.

8. GYRO ADJUSTMENT KNOB (PUSH) - When pushed in, allows the pilot to manually rotate the compass card (6) to correspond with the magnetic heading indicated by the compass. The compass card must be manually reset periodically to compensate for precessional errors in the gyro.

9. TURN COORDINATOR - Senses roll and yaw for wings leveling and command turn functions.

10. HDG SEL PUSHBUTTON - Aircraft will turn to and hold heading selected by the heading "bug" on the directional gyro.

11. NAV INT PUSHBUTTON - When heading "bug" on DG is set to selected course, aircraft will turn to and intercept selected VOR or LOC course.

12. NAV TRK PUSHBUTTON - When heading "bug" on DG is set to selected course, aircraft will track selected VOR or LOC course.

13. HI SENS PUSHBUTTON - During NAV INT or NAV TRK operation, this high sensitivity setting increases autopilot response to NAV signal to provide more precise operation during localizer approach. In low-sensitivity position (pushbutton out), response to NAV signal is dampened for smoother tracking of enroute VOR radials; it also smooths out effect of course scalloping during NAV operation.

14. BACK CRS PUSHBUTTON - Used with LOC operation only. With A/P switch OFF or ON, and when navigation receiver selected by NAV switch is set to a localizer frequency, it reverses normal localizer needle indication (CDI) and causes localizer reversed (BC) light to illuminate. With A/P switch ON, reverses localizer signal to autopilot.

Figure 1. Cessna 300A Autopilot, Operating Controls and Indicators (Sheet 2 of 3)

15. ACTUATOR - The torque motor in the actuator causes the ailerons to move in the commanded direction.
16. NAV SWITCH - Selects NAV 1 or NAV 2 navigation receiver.
17. PULL TURN KNOB - When pulled out and centered in detent, airplane will fly wings-level; when turned to the right (R), the airplane will execute a right, standard rate turn; when turned to the left (L), the airplane will execute a left, standard rate turn. When centered in detent and pushed in, the operating mode selected by a pushbutton is engaged.
18. TRIM - Used to trim autopilot to compensate for minor variations in aircraft trim or lateral weight distribution. (For proper operation, the aircraft's rudder trim, if so equipped, must be manually trimmed before the autopilot is engaged.)
19. A/P SWITCH - Turns autopilot ON or OFF.

Figure 1. Cessna 300A Autopilot, Operating Controls and Indicators (Sheet 3 of 3)

SECTION 2
LIMITATIONS

The following autopilot limitation must be adhered to:

BEFORE TAKE-OFF AND LANDING:

1. A/P ON-OFF Switch -- OFF.

SECTION 3
EMERGENCY PROCEDURES

TO OVERRIDE THE AUTOPILOT:

1. Airplane Control Wheel -- ROTATE as required to override autopilot.

NOTE

The servo may be overpowered at any time without damage.

TO TURN OFF AUTOPILOT:

1. A/P ON-OFF Switch -- OFF.

VACUUM SYSTEM FAILURE:

1. Pull Turn Knob -- PULL OUT AND CENTER.

NOTE

The autopilot may continue to be used as a wings leveller, but all heading and nav modes will be inoperative.

TURN COORDINATOR FAILURE:

1. A/P ON-OFF Switch -- OFF.

SECTION 4
NORMAL PROCEDURES

NOTE

If autopilot is to be turned on while airplane is on the ground, the control wheel should be held to prevent ailerons from banging stops and possibly damaging, or shearing, actuator shear pins.

BEFORE TAKE-OFF AND LANDING:

1. A/P ON-OFF Switch -- OFF.
2. BACK CRS Button -- OFF (see Caution note under Nav Intercept).

NOTE

Periodically verify operation of amber warning light(s), labeled BC on CDI(s), by engaging BACK CRS button with a LOC frequency selected.

INFLIGHT WINGS LEVELING:

1. Airplane Rudder Trim -- ADJUST for zero slip ("Ball" centered on Turn Coordinator).
2. PULL-TURN Knob -- PULL out and CENTER.
3. A/P ON-OFF Switch -- ON.
4. Autopilot TRIM Control -- ADJUST for zero turn rate (wings level indication on Turn Coordinator).

NOTE

For optimum performance in airplanes equipped as float-planes, use autopilot only in cruise flight or in approach configuration with flaps down no more than 10° and airspeed no lower than 75 KIAS on 172 and R172 Series Models or 90 KIAS on 180, 185, U206 and TU206 Series Models.

COMMAND TURNS:

1. PULL-TURN Knob -- PULL out and ROTATE.

HEADING SELECT:

1. Directional Gyro -- SET to airplane magnetic heading.
2. Heading Selector Knob -- ROTATE bug to desired heading.
3. Heading Select Button -- PUSH.
4. PULL-TURN Knob -- CENTER and PUSH.

NOTE

Airplane will turn automatically to selected heading. If airplane fails to hold the precise heading, readjust autopilot TRIM control as required or disengage autopilot and reset manual rudder trim (if installed).

NAV INTERCEPT (VOR/LOC):

1. PULL-TURN Knob -- PULL out and CENTER.
2. NAV 1-2 Selector Switch -- SELECT desired receiver.
3. Nav Receiver OBS or ARC Knob -- SET desired VOR course (if tracking omni).

NOTE

Optional ARC knob should be in center position and ARC warning light should be off.

4. Heading Selector Knob -- ROTATE bug to selected course (VOR or localizer - inbound or outbound as appropriate).
5. Directional Gyro --SET for magnetic heading.
6. NAV INT Button -- PUSH.
7. HI SENS Button -- PUSH for localizer and "close-in" omni intercepts.
8. BACK CRS Button -- PUSH only if intercepting localizer front course outbound or back course inbound.

CAUTION

With BACK CRS button pushed in and localizer frequency selected, the CDI on selected nav radio will be reversed even when the autopilot switch is OFF.

9. PULL-TURN Knob -- PUSH.

NOTE

Airplane will automatically turn to a 45° intercept angle.

NAV TRACKING (VOR/LOC):

1. NAV TRK Button -- PUSH when CDI centers (within one dot) and airplane is within ± 10° of course heading.
2. HI SENS Button -- Disengage for enroute omni tracking (leave engaged for localizer).

NOTE

Optional ARC function, if installed, should not be used for autopilot operation. If airplane should deviate off course, pull out PULL TURN knob and readjust airplane rudder trim for straight flight on the turn coordinator. Push in PULL TURN knob to reintercept course. If deviation persists, progressively make slight adjustments of autopilot TRIM control or heading bug on the directional gyro, towards the course as required to maintain track.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when this avionic equipment is installed.

SUPPLEMENT

CESSNA 400 GLIDE SLOPE

(Type R-443B)

SECTION 1
GENERAL

The Cessna 400 Glide Slope is an airborne navigation receiver which receives and interprets glide slope signals from a ground-based Instrument Landing System (ILS). It is used with the localizer function of a VHF navigation system when making instrument approaches to an airport. The glide slope provides vertical path guidance while the localizer provides horizontal track guidance.

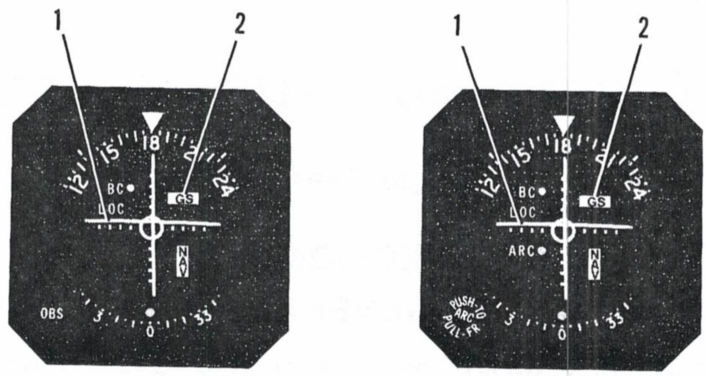
The Cessna 400 Glide Slope system consists of a remote-mounted receiver coupled to an existing navigation system, a panel-mounted indicator and an externally mounted antenna. The glide slope receiver is designed to receive ILS glide slope signals on any of 40 channels. The channels are spaced 150 kHz apart and cover a frequency range of 329.15 MHz through 335.0 MHz. When a localizer frequency is selected on the NAV receiver, the associated glide slope frequency is selected automatically.

Operation of the Cessna 400 Glide Slope system is controlled by the associated navigation system. The functions and indications of typical 300 and 400 series glide slope indicators are pictured and described in Figure 1. The glide slope indicators shown in Figure 1 depict typical indications for Cessna-crafted glide slope indicators. However, refer to the RNAV or HSI write-ups if they are listed in this section as options for additional glide slope indicators.

SECTION 2
LIMITATIONS

There is no change to the airplane limitations when this avionic equipment is installed.

TYPICAL 300 & 400 SERIES GLIDE SLOPE INDICATORS



1. GLIDE SLOPE DEVIATION POINTER - Indicates deviation from normal glide slope. The rectilinear, horizontal pointer stows to top of indicator (out of view) when power is removed or Navigation System is set to a VOR frequency.
2. GLIDE SLOPE "OFF" OR "GS" FLAG - When visible, indicates unreliable glide slope signal or improperly operating equipment. The flag disappears when a reliable glide slope signal is being received.

CAUTION

Spurious glide slope signals may exist in the area of the localizer back course approach which can cause the glide slope "OFF" or "GS" flag to disappear and present unreliable glide slope information. Disregard all glide slope signal indications when making a localizer back course approach unless a glide slope (ILS BC) is specified on the approach and landing chart.

Figure 1. Typical 300 Series VOR/LOC/ILS Indicator

SECTION 3
EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when this avionic equipment is installed.

SECTION 4
NORMAL PROCEDURES

TO RECEIVE GLIDE SLOPE SIGNALS:

NOTE

The pilot should be aware that on Cessna airplanes equipped with the vertical fin mounted glide slope antenna, pilots should avoid use of 2700 ±100 RPM on airplanes equipped with a two-bladed propeller or 1800 ±100 RPM on airplanes equipped with a three-bladed propeller during ILS approaches to avoid any possibility of oscillations of the glide slope deviation pointer caused by propeller interference.

1. NAV Frequency Select Knobs -- SELECT desired localizer frequency (glide slope frequency is automatically selected).
2. NAV/COM VOX-ID-T Switch -- SELECT ID position to disconnect filter from audio circuit.
3. NAV VOL Control -- ADJUST to desired listening level to confirm proper localizer station.

CAUTION

When glide slope "OFF" or "GS" flag is visible, glide slope indications are unusable.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when this avionic equipment is installed.

SUPPLEMENT

CESSNA 400 MARKER BEACON
(Type R-402)

SECTION 1
GENERAL

The system consists of a remote mounted 75 MHz marker beacon receiver, an antenna which is either flush mounted or externally mounted on the under side of the aircraft and operating controls and annunciator lights which are mounted on the front of the audio control panel.

Operating controls for the marker beacon system are supplied on the front of the two types of audio control panels used in this Cessna aircraft. The operating controls for the marker beacon are different on the two audio control panels. One type of audio control panel is supplied with one or two transmitters and the other is supplied with three transmitters.

The marker beacon operating controls and annunciator lights used on the audio control panel supplied with two or less transmitters are shown and described in Figure 1. The operating controls consist of three, three-position toggle switches. One switch is labeled "HIGH/LO/MUTE" and provides the pilot with HIGH-LO sensitivity selection and marker beacon audio muting, for approximately 30 seconds, to enable voice communication to be heard without interference of marker beacon signals. The marker beacon audible tone is automatically restored at the end of the 30 second muting period to continue marker audio for passage over the next marker. Another switch is labeled "SPKR/OFF/PHN" and is used to turn the set on and select the desired speaker or phone position for marker beacon signals. The third toggle switch labeled, "ANN LT", is provided to enable the pilot to select the desired DAY or NITE lighting position for annunciator lights, and also a "TEST" position to verify operation of marker beacon annunciator lights.

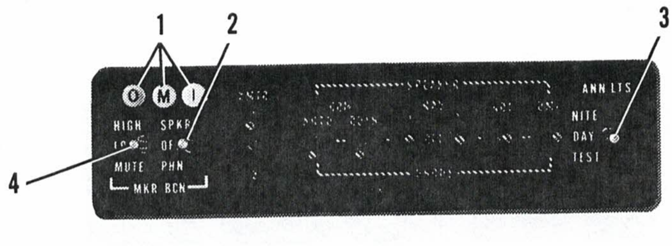
The marker beacon operating controls and annunciator lights used on the audio control panel supplied with three transmitters are shown and described in Figure 2. The operating controls consist of two, three-position toggle switches, and two concentric control knobs. One switch is labeled "SPKR/PHN" and is used to select the desired speaker or phone position for marker beacon signals. The other switch is labeled "HI/LO/TEST" and provides the pilot with HI-LO sensitivity selection and a TEST position to verify operation of all annunciator lights. The small, inner control knob labeled OFF/VOL, turns the set on or off and adjusts the audio listening level. The large, outer control knob labeled BRT, provides light dimming for the marker beacon lights.

When the Cessna 400 Marker Beacon controls are incorporated in an audio control panel incorporated with two or less transmitters a marker Beacon audio level adjustment potentiometer and an annunciator lights minimum dimming potentiometer are mounted on the audio control panel circuit board. Potentiometer adjustments cannot be accomplished externally. However, if readjustments are desired, adjustments can be made in accordance with instructions found in the Avionics Installations Service/Parts Manual for this aircraft.

MARKER FACILITIES

MARKER	IDENTIFYING TONE	LIGHT*
Inner & Fan	Continuous 6 dots/sec (3000 Hz)	White
Back Course	72-95 two dot combinations per minute (3000 Hz)	White
Middle	Alternate dots and dashes (1300 Hz)	Amber
Outer	2 dashes/sec (400 Hz)	Blue

* When the identifying tone is keyed, the respective indicating light will blink accordingly.



AUDIO CONTROL PANEL FOR USE WITH ONE OR TWO TRANSMITTERS

1. MARKER BEACON ANNUNCIATOR LIGHTS:

   OUTER - Light illuminates blue to indicate passage of outer marker beacon.
   MIDDLE - Light illuminates amber to indicate passage of middle marker beacon.
   INNER - Light illuminates white to indicate passage of inner, fan, or back course marker beacons.

2. SPEAKER/OFF/PHONE SELECTOR SWITCH:

   SPEAKER POSITION - Turns set on and selects speaker for aural reception.
   OFF POSITION - Turns set off.
   PHONE POSITION - Turns set on and selects phone for aural reception.

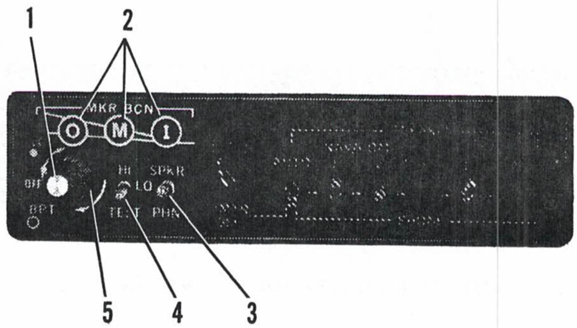
3. ANNUNCIATOR LIGHTS SWITCH:

   NITE POSITION - Places the annunciator lights in a dim lighting mode for night flying operations. Light intensity of the NITE position is controlled by the RADIO LT dimming rheostat.
   DAY POSITION - Places the annunciator lights in the full bright position for daylight flying operations.
   TEST POSITION - Illuminates all marker beacon annunciator lights in the full bright position to verify operation of marker beacon lights.

4. HIGH/LO/MUTE SELECTOR SWITCH:

   HIGH POSITION - Receiver sensitivity is positioned for airway flying.
   LO POSITION - Receiver sensitivity is positioned for ILS approaches.
   MUTE POSITION - The marker beacon audio signals are temporarily blanked out (for approximately 30 seconds) and then automatically restored, over the speaker or headset in order to provide voice communications without interference of marker beacon signals.

Figure 1. Cessna 400 Marker Beacon Operating Controls and Indicator Lights Supplied with Two or Less Transmitters



AUDIO CONTROL PANEL FOR USE WITH THREE TRANSMITTERS

1. OFF/VOLUME CONTROL:

   OFF/VOL - Turns the set on or off and adjusts the audio listening level. Clockwise rotation of the smaller knob turns the set on and increases the audio level.

2. MARKER BEACON ANNUNCIATOR LIGHTS:

   OUTER - Light illuminates blue to indicate passage of outer marker beacon.
   MIDDLE - Light illuminates amber to indicate passage of middle marker beacon.
   INNER - Light illuminates white to indicate passage of inner, fan, or back course marker beacons.

3. SPEAKER/PHONE SELECTOR SWITCH:

   SPEAKER POSITION - Selects speaker for aural reception.
   PHONE POSITION - Selects headphone for aural reception.

4. HI/LO/TEST SELECTOR SWITCH:

   HI POSITION - Receiver sensitivity is positioned for airway flying.
   LO POSITION - Receiver sensitivity is positioned for ILS approaches.
   TEST POSITION - Illuminates marker beacon annunciator lights in the full bright position to verify operation of marker beacon lights.

5. LIGHT DIMMING CONTROL:

   BRT - Provides light dimming for the annunciator lights. Clockwise rotation of the larger knob increases light intensity.

Figure 2. Cessna 400 Marker Beacon Operating Controls and Indicator Lights Supplied With Three Transmitters.

SECTION 2
LIMITATIONS

There is no change to the airplane limitations when this avionic equipment is installed.

SECTION 3
EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when this avionic equipment is installed.

SECTION 4
NORMAL PROCEDURES

MARKER BEACON OPERATING PROCEDURES FOR USE WITH AUDIO CONTROL PANELS PROVIDED WITH ONE OR TWO TRANSMITTERS (REF. FIG. 1)

1. SPKR/OFF/PHN Selector Switch -- SELECT desired speaker or phone audio. Either selected position will turn set on.
2. NITE/DAY/TEST Selector Switch -- PRESS to TEST position and verify that all marker beacon annunciator lights illuminate full bright to indicate lights are operational.
3. NITE/DAY/TEST Selector Switch -- SELECT desired position for NITE or DAY lighting.
4. HIGH/LO/MUTE Selector Switch - - SELECT HI position for airway flying or LO position for ILS approaches.

NOTE

Press MUTE switch to provide an approximate 30 seconds temporary blanking out of Marker Beacon audio tone. The marker beacon audio tone identifier is automatically restored at the end of the muting period.

NOTE

Due to the short distance typical between the middle marker and inner marker, audio identification of an inner marker may not be possible if muting is activated over the middle marker.

MARKER BEACON OPERATING PROCEDURES FOR USE WITH AUDIO CONTROL PANELS PROVIDED WITH THREE TRANSMITTERS. (REF. FIG. 2)

1. OFF/VOL Control -- TURN to VOL position and adjust to desired listening level. Clockwise rotation increases audio level.
2. HI/LO Sen Switch -- SELECT HI position for airway flying or LO position for ILS approaches.
3. SPKR/PHN Switch -- SELECT speaker or phone audio.
4. BRT Control -- SELECT BRT (full clockwise). ADJUST as desired when illuminated over marker beacon.
5. TEST Switch -- PRESS to TEST position and verify that all marker beacon annunciator lights will illuminate full bright to indicate lights are operational.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when this avionic equipment is installed. However, the installation of an externally mounted antenna or several related external antennas, will result in a minor reduction in cruise performance.

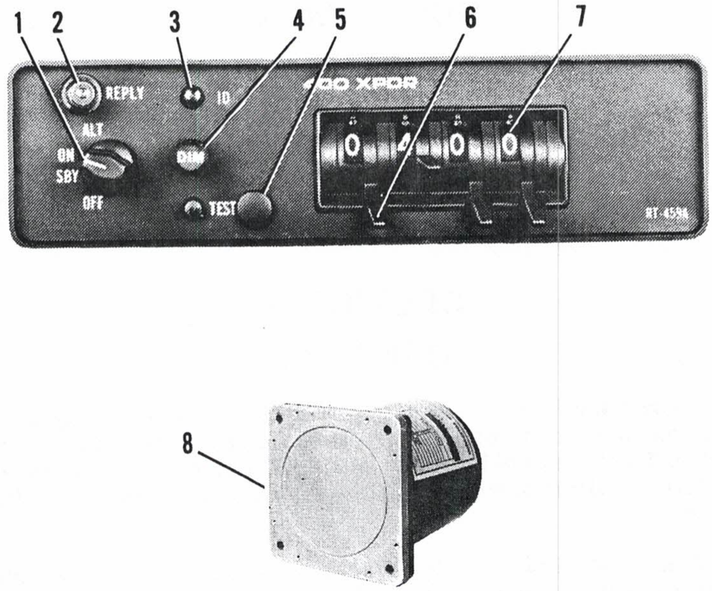
SUPPLEMENT
CESSNA 400 TRANSPONDER (Type RT-459A) AND OPTIONAL ALTITUDE ENCODER (BLIND)

SECTION 1
GENERAL

The Cessna 400 Transponder (Type RT-459A), shown in Figure 1, is the airborne component of an Air Traffic Control Radar Beacon System (ATCRBS). The transponder enables the ATC ground controller to "see" and identify the aircraft, while in flight, on the control center's radarscope more readily.

The Cessna 400 Transponder system consists of a panel-mounted unit and an externally mounted antenna. The transponder receives interrogating pulse signals on 1030 MHz and transmits pulse-train reply signals on 1090 MHz. The transponder is capable of replying to Mode A (aircraft identification) and also to Mode C (altitude reporting) when coupled to an optional altitude encoder system. The transponder is capable of replying on both modes of interrogation on a selective reply basis on any of 4,096 information code selections. The optional altitude encoder system (not part of a standard 400 Transponder system) required for Mode C (altitude reporting) operation, consists of a completely independent remote-mounted digitizer that is connected to the static system and supplies encoded altitude information to the transponder. When the altitude encoder system is coupled to the 400 Transponder system, altitude reporting capabilities are available in 100-foot increments between -1000 feet and the airplane's maximum service ceiling.

All Cessna 400 Transponder operating controls are located on the front panel of the unit. Functions of the operating controls are described in Figure 1.



1. FUNCTION SELECTOR SWITCH - Controls application of power and selects transponder operating mode as follows:

   OFF - Turns set off.
   SBY - Turns set on for equipment warm-up or standby power.
   ON - Turns set on and enables transponder to transmit Mode A (aircraft identification) reply pulses.
   ALT - Turns set on and enables transponder to transmit both Mode A (aircraft identification) reply pulses and Mode C (altitude reporting) pulses selected automatically by the interrogating signal.

2. REPLY LAMP - Lamp flashes to indicate transmission of reply pulses; glows steadily to indicate transmission of IDENT pulse or satisfactory self-test operation. (Reply lamp will also glow steadily during initial warm-up period.)

Figure 1. Cessna 400 Transponder and Altitude Encoder (Blind) (Sheet 1 of 2)

3. IDENT (ID) SWITCH - When depressed, selects special pulse identifier to be transmitted with transponder reply to effect immediate identification of aircraft on ground controller's display. (Reply lamp will glow steadily during duration of IDENT pulse transmission.)

4. DIMMER (DIM) CONTROL - Allows pilot to control brilliance of reply lamp.

5. SELF-TEST (TEST) SWITCH - When depressed, causes transponder to generate a self-interrogating signal to provide a check of transponder operation. (Reply lamp will glow steadily to verify self-test operation.)

6. REPLY-CODE SELECTOR SWITCHES (4) - Select assigned Mode A reply code.

7. REPLY-CODE INDICATORS (4) - Display selected Mode A reply code.

8. REMOTE-MOUNTED DIGITIZER - Provides an altitude reporting code range from -1000 feet up to the airplane's maximum service ceiling.

Figure 1. Cessna 400 Transponder and Altitude Encoder (Blind) (Sheet 2 of 2)

SECTION 2
LIMITATIONS

There is no change to the airplane limitations when this avionic equipment is installed. However, the following information must be displayed in the form of a placard located near the altimeter.

ALTITUDE ENCODER EQUIPPED

SECTION 3
EMERGENCY PROCEDURES

TO TRANSMIT AN EMERGENCY SIGNAL:

1. Function Selector Switch -- ON.
2. Reply-Code Selector Switches -- SELECT 7700 operating code.

TO TRANSMIT A SIGNAL REPRESENTING LOSS OF ALL COMMUNICATIONS (WHEN IN A CONTROLLED ENVIRONMENT):

1. Function Selector Switch -- ON.
2. Reply-Code Selector Switches -- SELECT 7700 operating code for 1 minute; then SELECT 7600 operating code for 15 minutes and then REPEAT this procedure at same intervals for remainder of flight.

SECTION 4
NORMAL PROCEDURES

BEFORE TAKEOFF:

1. Function Selector Switch -- SBY.

TO TRANSMIT MODE A (AIRCRAFT IDENTIFICATION) CODES IN FLIGHT:

1. Reply-Code Selector Switches -- SELECT assigned code.

2. Function Selector Switch -- ON.
3. DIM Control -- ADJUST light brilliance of reply lamp.

NOTE

During normal operation with function switch in ON position, reply lamp flashes indicating transponder replies to interrogations.

4. ID or XPDR IDENT Button -- DEPRESS momentarily when instructed by ground controller to "squawk IDENT" (reply lamp will glow steadily, indicating IDENT operation).

TO TRANSMIT MODE C (ALTITUDE REPORTING) CODES IN FLIGHT:

1. Reply-Code Selector Switches -- SELECT assigned code.
2. Function Selector Switch -- ALT.

NOTE

When directed by ground controller to "stop altitude squawk", turn Function Selector Switch to ON for Mode A operation only.

NOTE

Pressure altitude is transmitted by the transponder for altitude squawk and conversion to indicated altitude is done in ATC computers. Altitude squawked will only agree with indicated altitude when the local altimeter setting in use by the ground controller is set in the aircraft altimeter.

3. DIM Control -- ADJUST light brilliance of reply lamp.

TO SELF-TEST TRANSPONDER OPERATION:

1. Function Selector Switch -- SBY and wait 30 seconds for equipment to warm-up.
2. Function Selector Switch -- ON.
3. TEST Button -- DEPRESS (reply lamp should light brightly regardless of DIM control setting).
4. TEST Button -- RELEASE for normal operation.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when this avionic equipment is installed. However, the installation of an externally mounted antenna or several related external antennas, will result in a minor reduction in cruise performance.

SUPPLEMENT

CESSNA 400 TRANSPONDER (Type RT-459A) AND OPTIONAL ENCODING ALTIMETER (Type EA-401A)

SECTION 1
GENERAL

The Cessna 400 Transponder (Type RT-459A), shown in Figure 1, is the airborne component of an Air Traffic Control Radar Beacon System (ATCRBS). The transponder enables the ATC ground controller to "see" and identify the aircraft, while in flight, on the control center's radarscope more readily.

The 400 Transponder consists of a panel-mounted unit and an externally mounted antenna. The transponder receives interrogating pulse signals on 1030 MHz and transmits coded pulse-train reply signals on 1090 MHz. It is capable of replying to Mode A (aircraft identification) and Mode C (altitude reporting) interrogations on a selective reply basis on any of 4,096 information code selections. When an optional panel mounted EA-401A Encoding Altimeter (not part of 400 Transponder System) is included in the avionic configuration, the transponder can provide altitude reporting in 100-foot increments between -1000 and +35,000 feet.

All Cessna 400 Transponder operating controls, with the exception of the optional altitude encoder's altimeter setting knob, are located on the front panel of the unit. The altimeter setting knob is located on the encoding altimeter. Functions of the operating controls are described in Figure 1.

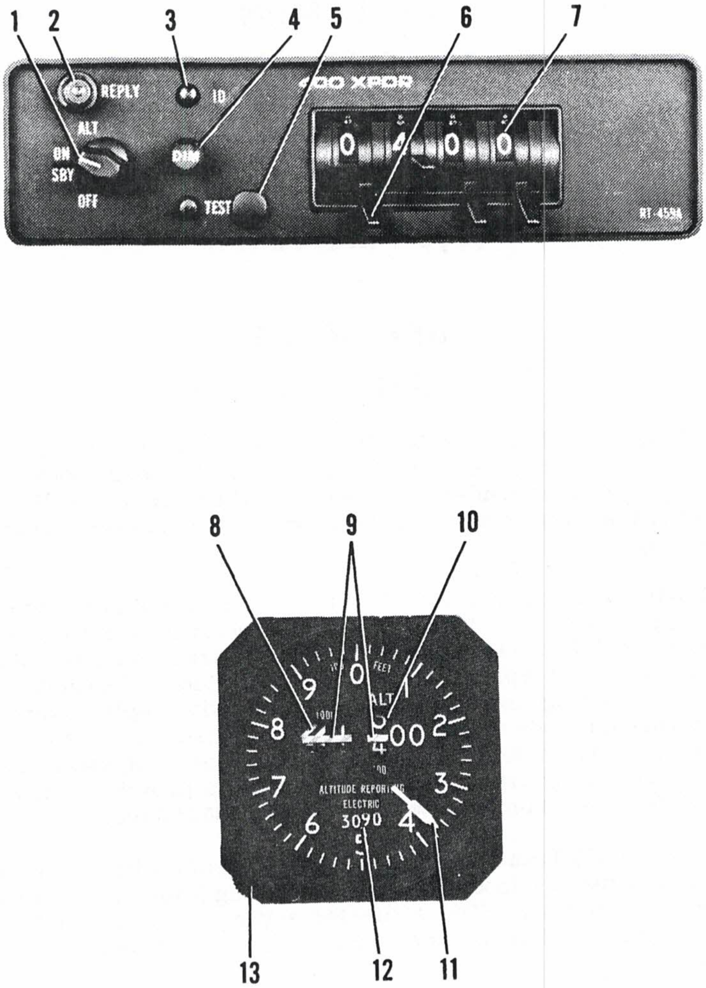


Figure 1. Cessna 400 Transponder and Encoding Altimeter Operating Controls (Sheet 1 of 2)

1. FUNCTION SELECTOR SWITCH - Controls application of power and selects transponder operating mode as follows:

   OFF - Turns set off.
   SBY - Turns set on for equipment warm-up or standby power.
   ON - Turns set on and enables transponder to transmit Mode A (aircraft identification) reply pulses.
   ALT - Turns set on and enables transponder to transmit both Mode A (aircraft identification) reply pulses and Mode C (altitude reporting) pulses selected automatically by the interrogating signal.

2. REPLY LAMP - Lamp flashes to indicate transmission of reply pulses; glows steadily to indicate transmission of IDENT pulse or satisfactory self-test operation. (Reply Lamp will also glow steadily during initial warm-up period.)

3. IDENT (ID) SWITCH - When depressed, selects special pulse identifier to be transmitted with transponder reply to effect immediate identification of aircraft on ground controller's display. (Reply Lamp will glow steadily during duration of IDENT pulse transmission.)

4. DIMMER (DIM) CONTROL - Allows pilot to control brilliance of Reply Lamp.

5. SELF-TEST (TEST) SWITCH - When depressed, causes transponder to generate a self-interrogating signal to provide a check of transponder operation. (Reply Lamp will glow steadily to verify self test operation.)

6. REPLY-CODE SELECTOR SWITCHES (4) - Select assigned Mode A Reply Code.

7. REPLY-CODE INDICATORS (4) - Display selected Mode A Reply Code.

8. 1000-FOOT DRUM TYPE INDICATOR - Provides digital altitude readout in 1000-foot increments between -1000 and +35,000 feet. When altitude is below 10,000 feet, a diagonally striped flag appears in the 10,000-foot window.

9. OFF INDICATOR WARNING FLAG - Flag appears across altitude readout when power is removed from altimeter to indicate that readout is not reliable.

10. 100-FOOT DRUM TYPE INDICATOR - Provides digital altitude readout in 100-foot increments between 0 feet and 1000 feet.

11. 20-FOOT INDICATOR NEEDLE - Indicates altitude in 20-foot increments between 0 feet and 1000 feet.

12. ALTIMETER SETTING SCALE - DRUM TYPE - Indicates selected altimeter setting in the range of 27.9 to 31.0 inches of mercury on the standard altimeter or 950 to 1050 millibars on the optional altimeter.

13. ALTIMETER SETTING KNOB - Dials in desired altimeter setting in the range of 27.9 to 31.0 inches of mercury on standard altimeter or 950 to 1050 millibars on the optional altimeter.

Figure 1. Cessna 400 Transponder and Encoding Altimeter Operating Controls (Sheet 2 of 2)

SECTION 2
LIMITATIONS

There is no change to the airplane performance when this avionic equipment is installed. However, the encoding altimeter used in this installation does have a limitation that requires a standard barometric altimeter be installed as a back-up altimeter.

SECTION 3
EMERGENCY PROCEDURES

TO TRANSMIT AN EMERGENCY SIGNAL:

1. Function Selector Switch -- ON.
2. Reply-Code Selector Switches -- SELECT 7700 operating code.

TO TRANSMIT A SIGNAL REPRESENTING LOSS OF ALL COMMUNICATIONS (WHEN IN A CONTROLLED ENVIRONMENT):

1. Function Selector Switch -- ON.
2. Reply-Code Selector Switches -- SELECT 7700 operating code for 1 minute; then SELECT 7600 operating code for 15 minutes and then REPEAT this procedure at same intervals for remainder of flight.

SECTION 4
NORMAL PROCEDURES

BEFORE TAKEOFF:

1. Function Selector Switch -- SBY.

TO TRANSMIT MODE A (AIRCRAFT IDENTIFICATION) CODES IN FLIGHT:

1. Reply-Code Selector Switches -- SELECT assigned code.

2. Function Selector Switch -- ON.
3. DIM Control -- ADJUST light brilliance of reply lamp.

NOTE

During normal operation with function switch in ON position, REPLY lamp flashes indicating transponder replies to interrogations.

4. ID or XPDR IDENT Button -- DEPRESS momentarily when instructed by ground controller to "squawk IDENT" (REPLY lamp will glow steadily, indicating IDENT operation).

TO TRANSMIT MODE C (ALTITUDE REPORTING) CODES IN FLIGHT:

1. Off Indicator Warning Flag -- VERIFY that flag is out of view on encoding altimeter.
2. Altitude Encoder Altimeter Setting Knob -- SET IN assigned local altimeter setting.
3. Reply-Code Selector Switches -- SELECT assigned code.
4. Function Selector Switch -- ALT.

NOTE

When directed by ground controller to "stop altitude squawk", turn Function Selector Switch to ON for Mode A operation only.

NOTE

Pressure altitude is transmitted by the transponder for altitude squawk and conversion to indicated altitude is done in ATC computers. Altitude squawked will only agree with indicated altitude when the local altimeter setting in use by the ground controller is set in the encoding altimeter.

5. DIM Control -- ADJUST light brilliance of reply lamp.

TO SELF-TEST TRANSPONDER OPERATION:

1. Function Selector Switch -- SBY and wait 30 seconds for equipment to warm-up.
2. Function Selector Switch -- ON or ALT.
3. TEST Button -- DEPRESS and HOLD (reply lamp should light with full brilliance regardless of DIM control setting).
4. TST Button -- RELEASE for normal operation.

SECTION 5
PERFORMANCE

There is no change to the airplane performance when this avionic equipment is installed. However, the installation of an externally mounted antenna or several related external antennas, will result in a minor reduction in cruise performance.

Cessna

TEXTRON AVIATION

Pilot Safety and Warning Supplements

The information contained in this document is not intended to supersede the Owner's Manual or Pilot's Operating Handbook applicable to a specific airplane. If there is a conflict between this Pilot Safety and Warning Supplement and either the Owner's Manual or Pilot's Operating Handbook to a specific airplane, the Owner's Manual or Pilot's Operating Handbook shall take precedence. This publication replaces the original issue D5099-13 and the D5139-13 1 June 1998 Reissue in their entirety.

Member of GAMA

D5139-1-13

Original Issue - 2 October 1985
Reissue - 1 June 1998
Reissue 2 - 28 September 2018

CONTENTS

Supplement

INTRODUCTION

INTRODUCTION

Pilots should know the information contained in the airplane's operating handbook, placards and checklists, and be familiar with service/maintenance publications, including service letters and bulletins, to ensure maximum safe utilization of the airplane. When the airplane was manufactured, it was equipped with a Pilot's Operating Handbook, Flight Manual, and/or Owner's Manual. If a handbook or manual is missing, a replacement should be obtained by contacting a Cessna Authorized Service Station.

In an effort to re-emphasize subjects that are generally known to most pilots, safety and operational information has been provided in the following Pilot Safety and Warning Supplements. As outlined in the table of contents, the Supplements are arranged numerically to make it easier to locate a particular Supplement. Supplement coverage is classified in three (3) categories: Flight Considerations, System Operational Considerations, and Maintenance Considerations. Most of the information relates to all Cessna airplanes, although a few Supplements are directed at operation of specific configurations such as multi-engine airplanes, pressurized airplanes, or airplanes certified for flight into known icing conditions.

Day-to-day safety practices play a key role in achieving maximum utilization of any piece of equipment.

WARNING

IT IS THE RESPONSIBILITY OF THE PILOT TO ENSURE THAT ALL ASPECTS OF PREFLIGHT PREPARATION ARE CONSIDERED BEFORE A FLIGHT IS INITIATED. ITEMS WHICH MUST BE CONSIDERED INCLUDE, BUT ARE NOT NECESSARILY LIMITED TO, THE FOLLOWING:

- **PILOT PHYSICAL CONDITION AND PROFICIENCY**
- **AIRPLANE AIRWORTHINESS**
- **AIRPLANE EQUIPMENT APPROPRIATE FOR THE FLIGHT**
- **AIRPLANE LOADING AND WEIGHT AND BALANCE**
- **ROUTE OF THE FLIGHT**
- **WEATHER DURING THE FLIGHT**
- **FUEL QUANTITY REQUIRED FOR THE FLIGHT, INCLUDING ADEQUATE RESERVES**

(Continued Next Page)

WARNING (CONTINUED)

- **AIR TRAFFIC CONTROL AND EN-ROUTE NAVIGATION FACILITIES**
- **FACILITIES AT AIRPORTS OF INTENDED USE**
- **ADEQUACY OF AIRPORT (RUNWAY LENGTH, SLOPE, CONDITION, ETC.)**
- **LOCAL NOTICES, AND PUBLISHED NOTAMS**

FAILURE TO CONSIDER THESE ITEMS COULD RESULT IN AN ACCIDENT CAUSING EXTENSIVE PROPERTY DAMAGE AND SERIOUS OR EVEN FATAL INJURIES TO THE PILOT, PASSENGERS, AND OTHER PEOPLE ON THE GROUND.

The following Pilot Safety and Warning Supplements discuss in detail many of the subjects which must be considered by a pilot before embarking on any flight. Knowledge of this information is considered essential for safe, efficient operation of an airplane.

Proper flight safety begins long before the takeoff. A pilot's attitude toward safety and safe operation determines the thoroughness of the preflight preparation, including the assessment of the weather and airplane conditions and limitations. The pilot's physical and mental condition and proficiency are also major contributing factors. The use of current navigation charts, the Aeronautical Information Manual, NOTAMs, airport data, weather information, Advisory Circulars and training information, etc., is important. Individuals often develop their own personal methods for performing certain flight operations; however, it is required that these do not conflict with the limitations or recommended operating procedures for a specific airplane.

The pilot should know the Emergency Procedures for the airplane, since there may not be time to review the checklist in an emergency situation. It is essential that the pilot review the entire operating handbook to retain familiarity. He or she should maintain a working knowledge of the limitations of his or her airplane. When the pilot deliberately or inadvertently operates the airplane outside the limitations, he or she is violating Federal Aviation Regulations and may be subject to disciplinary actions.

Cessna does not support modifications to Cessna airplanes, whether by Supplemental Type Certificate or otherwise, unless these certificates are approved by Cessna. Such modifications, although approved by the FAA, may void any and all Cessna warranties on the airplane since Cessna may not know the full effects on the overall airplane. Cessna does not and has not tested and approved all such modifications by other companies. Maintenance and operating procedures and performance data provided by Cessna may no longer be accurate for the modified airplane.

Airplanes require maintenance on a regular basis. As a result, it is essential that the airplane be regularly inspected and repaired when parts are worn or damaged in order to maintain flight safety. Information for the proper maintenance of the airplane is found in the airplane Service/Maintenance Manual, Illustrated Parts Catalog, and in company-issued Service Information Letters or Service Bulletins, etc. Pilots should assure themselves that all recommendations for product changes or modifications called for by Service Bulletins, etc., are accomplished and that the airplane receives repetitive and required inspections.

Much of the subject matter discussed in the following Supplements has been derived from various publications of the U.S. Government. Since these documents contain considerably more information and detail than is contained here, it is highly recommended that the pilot also read them in order to gain an even greater understanding of the subjects related to flight safety. These publications include the following:

AERONAUTICAL INFORMATION MANUAL (AIM)

This Federal Aviation Administration (FAA) manual is designed to provide airmen with basic flight information and Air Traffic Control (ATC) procedures for use in the National Airspace System (NAS). It also contains items of interest to pilots concerning health and medical facts, factors affecting flight safety, a pilot/controller glossary of terms used in the Air Traffic Control System, and information on safety, accident and hazard reporting. This manual can be purchased at retail dealers, or on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

NOTICES TO AIRMEN (Class II)

This is a publication containing current Notices to Airmen (NOTAMs) which are considered essential to the safety of flight as well as supplemental data affecting the other operational publications listed here. It also includes current Flight Data Center (FDC) NOTAMs, which are regulatory in nature, issued to establish restrictions to flight or amend charts or published Instrument Approach Procedures. This publication is issued every 14 days and is available by subscription from the Superintendent of Documents.

AIRPORT FACILITY DIRECTORY, ALASKA and PACIFIC CHART SUPPLEMENTS

These publications contain information on airports, communications, navigation aids, instrument landing systems, VOR receiver checks, preferred routes, FSS/Weather Service telephone numbers, Air Route Traffic Control Center (ARTCC) frequencies, and various other pertinent special notices essential to air navigation. These publications are available by subscription from the National Ocean Service (NOS), NOAA N/ACC3 Distribution Division, Riverdale, Maryland 20737, telephone 1-800-638-8972 FAX (301) 436-6829.

FEDERAL AVIATION REGULATIONS (FARs)

The FAA publishes the FARs to make readily available to the aviation community the regulatory requirements placed upon them. These regulations are sold as individual parts by the Superintendent of Documents. The more frequently amended parts are sold by subscription service with subscribers receiving changes automatically as they are issued. Less active parts are sold on a single-sale basis. Changes to single-sale parts will be sold separately as issued. Information concerning these changes will be furnished by the FAA through its Status of Federal Aviation Regulations, AC 00-44II.

ADVISORY CIRCULARS (ACs)

The FAA issues ACs to inform the aviation public of non regulatory material of interest. Advisory Circulars are issued in a numbered subject system corresponding to the subject areas of the Federal Aviation Regulations. AC 00-2.11, Advisory Circular Checklist contains a listing of ACs covering a wide range of subjects and how to order them, many of which are distributed free-of-charge.

AC 00-2.11 is issued every four months and is available at no cost from: U.S. Department of Transportation, Distribution requirements Section, SVC 121.21, Washington, DC 20590. The checklist is also available via the Internet at http://www.faa.gov/abc/ac-chklist/actoc.htm.

PHYSIOLOGICAL

FATIGUE

Fatigue continues to be one of the most treacherous hazards to flight safety. It generally slows reaction times and causes errors due to inattention, and it may not be apparent to a pilot until serious errors are made. Fatigue is best described as either acute (short-term) or chronic (long-term). As a normal occurrence of everyday living, acute fatigue is the tiredness felt after long periods of physical and/or mental strain, including strenuous muscular effort, immobility, heavy mental workload, strong emotional pressure, monotony, and lack of sleep. In addition to these common causes, the pressures of business, financial worries, and unique family problems can be important contributing factors. Consequently, coordination and alertness, which are vital to safe pilot performance, can be reduced. Acute fatigue can be prevented by adequate rest and sleep, as well as regular exercise and proper nutrition.

Chronic fatigue occurs when there is insufficient time for full recovery between periods of acute fatigue. Performance continues to degrade and judgment becomes impaired so that unwarranted risks may be taken. Recovery from chronic fatigue requires a prolonged period of rest. If a pilot is markedly fatigued prior to a given flight, he or she should not fly. To prevent cumulative fatigue effects during long flights, pilots should conscientiously make efforts to remain mentally active by making frequent visual and radio navigation position checks, estimates of time of arrival at the next check point, etc.

STRESS

Stress from the pressures of everyday living can impair pilot performance, often in very subtle ways. Difficulties can occupy thought processes enough to markedly decrease alertness. Distractions can also interfere with judgment to the point that unwarranted risks are taken, such as flying into deteriorating weather conditions to keep on schedule. Stress and fatigue can be an extremely hazardous combination.

It is virtually impossible to leave stress on the ground. Therefore, when more than usual difficulties are being experienced, a pilot should consider delaying flight until these difficulties are satisfactorily resolved.

EMOTION

Certain emotionally upsetting events, including a serious argument, death of a family member, separation or divorce, loss of job, or financial catastrophe can seriously impair a pilot's ability to fly an airplane safely. The emotions of anger, depression, and anxiety from such events not only decrease alertness but may also lead to taking unnecessary risks. Any pilot who experiences an emotionally upsetting event should not fly until satisfactorily recovered from the event.

ILLNESS

A pilot should not fly with a known medical condition or a change of a known medical condition that would make the pilot unable to meet medical certificate standards. Even a minor illness suffered in day-to-day living can seriously degrade performance of many piloting skills vital to safe flight. An illness may produce a fever and other distracting symptoms that can impair judgment, memory, alertness, and the ability to make decisions. Even if the symptoms of an illness are under adequate control with a medication, the medication may adversely affect pilot performance, and invalidate his or her medical certificate.

The safest approach is not to fly while suffering from any illness. If there is doubt about a particular illness, the pilot should contact an Aviation Medical Examiner for advice.

MEDICATION

Pilot performance can be seriously degraded by both prescribed and over-the-counter medications. Many medications, such as tranquilizers, sedatives, strong pain relievers, and cough suppressant preparations, have primary effects that may impair judgment, memory, alertness, coordination, vision, and ability to make decisions. Other medications, such as antihistamines, blood pressure drugs, muscle relaxants, and agents to control diarrhea and motion sickness, have side effects that may impair the body's critical functions. Any medications that depress the nervous system, such as a sedative, tranquilizer or antihistamine, can make a pilot more susceptible to hypoxia.

FARs prohibit pilots from flying while using any medication that affects their faculties in any way contrary to safety. The safest advice is to not fly while taking medications, unless approved to do so by an Aviation Medical Examiner. The condition for which the drug is required may itself be very hazardous to flying, even when the symptoms are suppressed by the drug. A combination of medications may cause adverse effects that do not result from a single medication.

ALCOHOL

Do not fly while under the influence of alcohol. Flying and alcohol are definitely a lethal combination. FARs prohibit pilots from flying within 8 hours after consuming any alcoholic beverage or while under the influence of alcohol. A pilot may still be under the influence 8 hours after drinking a moderate amount of alcohol. Therefore, an excellent practice is to allow at least 24 hours between "bottle and throttle," depending on the amount of alcoholic beverage consumed.

Extensive research has provided a number of facts about the hazards of alcohol consumption and flying. As little as one ounce of liquor, one bottle of beer, or four ounces of wine can impair flying skills, with the alcohol consumed in these drinks being detectable in the breath and blood for at least three hours. Alcohol also renders a pilot much more susceptible to disorientation and hypoxia. In addition, the after effects of alcohol increase the level of fatigue significantly.

There is simply no way of alleviating a hangover. Remember that the human body metabolizes alcohol at a fixed rate, and no amount of coffee or medications will alter this rate. Do not fly with a hangover, or a "masked hangover" (symptoms suppressed by aspirin or other medication). A pilot can be severely impaired for many hours by hangover.

DRINKING THE RIGHT FLUIDS

One of the main sources of pilot and passenger complaints stems from the relatively lowered humidity during air travel encountered at altitude particularly on extended flights. Even though an individual may not be physically active, body water is continuously expired from the lungs and through the skin. This physiological phenomenon is called insensible perspiration or insensible loss of water.

The loss of water through the skin, lungs, and kidneys never ceases. Water loss is increased with exercise, fever, and in some disease conditions such as hyperthyroidism. Combating the effects of insensible water loss during flight requires frequent water intake. Unless this is done, dehydration will occur and this causes interference with blood circulation, tissue metabolism, and excretion of the kidneys. Water is vital for the normal chemical reaction of human tissue. It is also necessary for the regulation of body temperature and as an excretory medium.

Beginning a flight in a rested, healthy condition is of prime importance. Proper water balance through frequent fluid intake relieves the adverse effects produced by insensible water loss in an atmosphere of lowered humidity. Typical dehydration conditions are: dryness of the tissues and resulting irritation of the eyes, nose, and throat as well as other conditions previously mentioned plus the associated fatigue relating to the state of acidosis (reduced alkalinity of the blood and the body tissues). A person reporting for a flight in a dehydrated state will more readily notice these symptoms until fluids are adequately replaced. Consumption of coffee, tea, cola, and cocoa should be minimized since these drinks contain caffeine. In addition, tea contains a related drug, theophylline, while cocoa (and chocolate) contain theobromine, of the same drug group. These drugs, besides having a diuretic effect, have a marked stimulating effect and can cause an increase in pulse rate, elevation of blood pressure, stimulation of digestive fluid formation, and irritability of the gastrointestinal tract.

HYPOXIA

Hypoxia, in simple terms, is a lack of sufficient oxygen to keep the brain and other body tissues functioning properly. Wide individual variation occurs with respect to susceptibility to and symptoms of hypoxia. In addition to progressively insufficient oxygen at higher altitudes, anything interfering with the blood's ability to carry oxygen can contribute to hypoxia (e.g., anemias, carbon monoxide, and certain drugs). Also, alcohol and various other drugs decrease the brain's tolerance to hypoxia. A human body has no built-in alarm system to let the pilot know when he is not getting enough oxygen. It is difficult to predict when or where hypoxia will occur during a given flight, or how it will manifest itself.

Although a deterioration in night vision occurs at a cabin pressure altitude as low as 5000 feet, other significant effects of altitude hypoxia usually do not occur in a normal healthy pilot below 12,000 feet. From 12,000 to 15,000 feet of altitude, judgment, memory, alertness, coordination, and ability to make decisions are impaired, and headache, drowsiness, dizziness, and either a sense of well-being (euphoria) or belligerence occurs. The effects appear following increasingly shorter periods of exposure to increasing altitude. In fact, a pilot's performance can seriously deteriorate within 15 minutes at 15,000 feet. At cabin pressures above 15,000 feet, the periphery of the visual field grays out to a point where only central vision remains (tunnel vision). A blue coloration (cyanosis) of the fingernails and lips develops and the ability to take corrective and protective action is lost in 20 to 30 minutes at 18,000 feet and 5 to 12 minutes at 20,000 feet, followed soon thereafter by unconsciousness.

The altitude at which significant effects of hypoxia occur can be lowered by a number of factors. Carbon monoxide inhaled in smoking or from exhaust fumes, lowered hemoglobin (anemia), and certain medications can reduce the oxygen-carrying capacity of the blood to the degree that the amount of oxygen provided to body tissues will already be equivalent to the oxygen provided to the tissues when exposed to a cabin pressure altitude of several thousand feet. Small amounts of alcohol and low doses of certain drugs, such as antihistamines, tranquilizers, sedatives, and analgesics can, through their depressant action, render the brain much more susceptible to hypoxia. Extreme heat and cold, fever, and anxiety increase the body's demand for oxygen, and hence, its susceptibility to hypoxia.

Current regulations require that pilots use supplemental oxygen after 30 minutes of exposure to cabin pressure altitudes between 12,500 and 14,000 feet and immediately upon exposure to cabin pressure altitudes above 14,000 feet. Every occupant of the airplane must be provided with supplemental oxygen at cabin pressure altitudes above 15,000 feet.

Hypoxia can be prevented by avoiding factors that reduce tolerance to altitude, by enriching the air with oxygen from an appropriate oxygen system, and by maintaining a comfortable, safe cabin pressure altitude. For optimum protection, pilots are encouraged to use supplemental oxygen above 10,000 feet during the day, and above 5000 feet at night.

NOTE

When using oxygen systems that do not supply “pressure breathing”, 100% oxygen cannot maintain proper blood oxygen level above 25,000 feet altitude. Pilot's must be familiar with limitations of the airplane oxygen system.

Pilots are encouraged to attend physiological training and susceptibility testing in a high-altitude chamber to experience and make note of their own personal reactions to the effects of hypoxia. These chambers are located at the FAA Civil Aeromedical Institute and many governmental and military facilities. Knowing before hand what your own early symptoms of hypoxia are will allow a greater time margin for taking corrective action. The corrective action, should symptoms be noticed, is to use supplemental oxygen and/or decrease cabin altitude. These actions must not be delayed.

SMOKING

Smokers are slightly resistant to the initial symptoms of hypoxia. Because of this, smokers risk the possibility of delayed detection of hypoxia. Pilots should avoid any detrimental factors, such as second hand smoke, which can cause such insensitivity. The small merit of hypoxic tolerance in smokers will do more harm than good by rendering them insensitive and unaware of the hypoxic symptoms.

Smoking in the cabin of the airplane exposes other passengers to high concentrations of noxious gas and residue. Furthermore, many of the systems of the airplane are contaminated and deteriorated by long-term exposure to smoking residue. Due to the large number of known dangers and hazards, as well as those which are still the subject of research, it is strongly recommended that smoking not take place in flight.

WARNING

SMOKING WHILE OXYGEN SYSTEMS ARE IN USE CREATES AN EXTREME FIRE HAZARD.

HYPERVENTILATION

Hyperventilation, or an abnormal increase in the volume of air breathed in and out of the lungs, can occur subconsciously when a stressful situation is encountered in flight. As hyperventilation expels excessive carbon dioxide from the body, a pilot can experience symptoms of light headedness, suffocation, drowsiness, tingling in the extremities, and coolness -- and react to them with even greater hyperventilation. Incapacitation can eventually result. Uncoordination, disorientation, painful muscle spasms, and finally, unconsciousness may ultimately occur.

The symptoms of hyperventilation will subside within a few minutes if the rate and depth of breathing are consciously brought back under control. The restoration of normal carbon dioxide levels in the body can be hastened by controlled breathing in and out of a paper bag held over the nose and mouth.

Early symptoms of hyperventilation and hypoxia are similar. Moreover, hyperventilation and hypoxia can occur at the same time. Therefore, if a pilot is using oxygen when symptoms are experienced, the oxygen system should be checked to assure that it has been functioning effectively before giving attention to rate and depth of breathing.

EAR BLOCK

As an airplane climbs and the cabin pressure decreases, trapped air in the middle ear expands and escapes through the eustachian tube to the nasal passages, thus equalizing with the pressure in the cabin. During descent, cabin pressure increases and some air must return to the middle ear through the eustachian tube to maintain equal pressure. However, this process does not always occur without effort. In most cases it can be accomplished by swallowing, yawning, tensing the muscles in the throat or, if these do not work, by the combination of closing the mouth, pinching the nose closed, and attempting to blow gently through the nostrils (Valsalva maneuver).

Either an upper respiratory infection, such as a cold or sore throat, or a nasal allergic condition can produce enough congestion around the eustachian tube to make equalization difficult. Consequently, the difference in pressure between the middle ear and the airplane cabin can build up to a level that will hold the eustachian tube closed, making equalization difficult, if not impossible. This situation is commonly referred to as an "ear block." An ear block produces severe pain and loss of hearing that can last from several hours to several days. Rupture of the ear drum can occur in flight or after landing. Fluid can accumulate in the middle ear and become infected. If an ear block is experienced and does not clear shortly after landing, a physician should be consulted. Decongestant sprays or drops to reduce congestion usually do not provide adequate protection around the eustachian tubes. Oral decongestants have side effects that can significantly impair pilot performance. An ear block can be prevented by not flying with an upper respiratory infection or nasal allergic condition.

SINUS BLOCK

During climb and descent, air pressure in the sinuses equalizes with the airplane cabin pressure through small openings that connect the sinuses to the nasal passages. Either an upper respiratory infection, such as a cold or sinusitis, or a nasal allergic condition can produce enough congestion around the openings to slow equalization, and as the difference in pressure between the sinus and cabin increases, eventually the openings plug. This "sinus block" occurs most frequently during descent.

A sinus block can occur in the frontal sinuses, located above each eyebrow, or in the maxillary sinuses, located in each upper cheek. It will usually produce excruciating pain over the sinus area. A maxillary sinus block can also make the upper teeth ache. Bloody mucus may discharge from nasal passages. A sinus block can be prevented by not flying with an upper respiratory infection or nasal allergic condition. If a sinus block does occur and does not clear shortly after landing, a physician should be consulted.

VISION IN FLIGHT

Of all the pilot's senses, vision is the most critical to safe flight. The level of illumination is the major factor to adequate in-flight vision. Details on flight instruments or aeronautical charts become difficult to discern under dimly lit conditions. Likewise, the detection of other aircraft is much more difficult under such conditions.

In darkness, vision becomes more sensitive to light, a process called dark adaptation. Although exposure to total darkness for at least 30 minutes is required for complete dark adaptation, a pilot can achieve a moderate degree of dark adaptation within 20 minutes under dim red lighting. Since red light severely distorts colors, especially on aeronautical charts, and can cause serious difficulty in focusing the eyes on objects inside the cabin, its use is advisable only where optimum outside night vision is necessary. Even so, white flight station lighting must be available when needed for map and instrument reading, especially while under IFR conditions. Dark adaptation is impaired by exposure to cabin pressure altitudes above 5000 feet, carbon monoxide inhaled in smoking and from exhaust fumes, deficiency of vitamin A in the diet, and by prolonged exposure to bright sunlight. Since any degree of dark adaptation is lost within a few seconds of viewing a bright light, pilots should close one eye when using a light to preserve some degree of night vision. In addition, use of sunglasses during the day will help speed the process of dark adaptation during night flight.

SCUBA DIVING

A pilot or passenger who flies shortly after prolonged scuba diving could be in serious danger. Anyone who intends to fly after scuba diving should allow the body sufficient time to rid itself of excess nitrogen absorbed during diving. If not, decompression sickness (commonly referred to as the "bends"), due to dissolved gas, can occur even at low altitude and create a serious in-flight emergency. The recommended waiting time before flight to cabin altitudes of 8000 feet or less is at least 12 hours after diving which has not required controlled ascent (non-decompression diving), and at least 24 hours after diving which has required a controlled ascent (decompression diving). The waiting time before flight to cabin pressure altitudes above 8000 feet should be at least 24 hours after any scuba diving.

AEROBATIC FLIGHT

Pilots planning to engage in aerobatic maneuvers should be aware of the physiological stresses associated with accelerative forces during such maneuvers. Forces experienced with a rapid push-over maneuver will result in the blood and body organs being displaced toward the head. Depending on the forces involved and the individual tolerance, the pilot may experience discomfort, headache, "red-out", and even unconsciousness. Forces experienced with a rapid pull-up maneuver result in the blood and body organs being displaced toward the lower part of the body away from the head. Since the brain requires continuous blood circulation for an adequate oxygen supply, there is a physiological limit to the time the pilot can tolerate higher forces before losing consciousness. As the blood circulation to the brain decreases as a result of the forces involved, the pilot will experience "narrowing" of visual fields, "gray-out", "black-out", and unconsciousness.

Physiologically, humans progressively adapt to imposed strains and stresses, and with practice, any maneuver will have a decreasing effect. Tolerance to "G" forces is dependent on human physiology and the individual pilot. These factors include the skeletal anatomy, the cardiovascular architecture, the nervous system, blood make-up, the general physical state, and experience and recency of exposure. A pilot should consult an Aviation Medical Examiner prior to aerobatic training and be aware that poor physical condition can reduce tolerance to accelerative forces.

CHECKLISTS

CONSISTENT USE

Airplane checklists are available for those persons who do not wish to use the operating handbook on every flight. These checklists contain excerpts from the operating handbook written for that particular airplane and are designed to remind pilots of the minimum items to check for safe operation of the airplane, without providing details concerning the operation of any particular system. Checklists should be used by the pilot and not placed in the seat pocket and forgotten. Even pilots who consistently carry the checklists tend to memorize certain areas and intentionally overlook these procedural references. Consequently, in time, these individuals find that operating something as complex as an airplane on memory alone is practically impossible, and eventually, could find themselves in trouble because one or more important items are overlooked or completely forgotten. The consistent use of all checklists is required for the safe operation of an airplane.

NOTE

Abbreviated checklists can be used in place of the airplane operating manual. However, they should be used only after the pilot becomes familiar with the airplane operating manual, and thoroughly understands the required procedures for airplane operation.

CONTRIBUTIONS TO SAFETY

Most large airplanes in the transport category are flown by consistent use of all checklists. Experience has shown that pilots who consistently use checklists on every flight maintain higher overall proficiency, and have better safety records. The pilot should not become preoccupied inside the cockpit and fail to remain alert for situations outside the airplane.

CHECKLIST ARRANGEMENT (ORGANIZATION OF ITEMS)

Abbreviated checklists are written in a concise form to provide pilots with a means of complying with established requirements for the safe operation of their airplane. The checklists are usually arranged by "Item" and "Condition" headings. The item to be checked is listed with the desired condition stated. Key words or switch and lever positions are usually emphasized by capitalization in the "Condition" column. The checklist may also contain supplemental information pertinent to the operation of the airplane, such as performance data, optional equipment operation, etc., that the pilot might routinely use.

EMERGENCY CHECKLISTS

Emergency checklists are provided for emergency situations peculiar to a particular airplane design, operating or handling characteristic. Pilots should periodically review the airplane operating handbook to be completely familiar with information published by the manufacturer concerning the airplane. Emergency situations are never planned and may occur at the worst possible time. During most emergency conditions, there will not be sufficient time to refer to an emergency checklist; therefore, it is essential that the pilot commit to memory those emergency procedures that may be shown in **bold-face** type or outlined with a black border, within the emergency procedures section in operating handbooks or equivalent hand-held checklists. These items are essential for continued safe flight. After the emergency situation is under control, the pilot should complete the checklist in its entirety, in the proper sequence, and confirm that all items have been accomplished. It is essential that the pilot review and know published emergency checklists and any other emergency procedures. Familiarity with the airplane and its systems and a high degree of pilot proficiency are valuable assets if an emergency should arise.

AIRPLANE LOADING

AIRPLANE CENTER-OF-GRAVITY RANGE

Pilots should never become complacent about the weight and balance limitations of an airplane, and the reasons for these limitations. Since weight and balance are vital to safe airplane operation, every pilot should have a thorough understanding of airplane loading, with its limitations, and the principles of airplane balance. Airplane balance is maintained by controlling the position of the center-of-gravity. Overloading, or misloading, may not result in obvious structural damage, but could do harm to hidden structure or produce a dangerous situation in the event of an emergency under those conditions. Overloading, or misloading may also produce hazardous airplane handling characteristics.

There are several different weights to be considered when dealing with airplane weight and balance. These are defined in another paragraph in this supplement. Airplanes are designed with predetermined structural limitations to meet certain performance and flight characteristics and standards. Their balance is determined by the relationship of the center-of-gravity (C.G.) to the center of lift. Normally, the C.G. of an airplane is located slightly forward of the center of lift. The pilot can safely use the airplane flight controls to maintain stabilized balance of the airplane as long as the C.G. is located within specified forward and aft limits. The allowable variation of the C.G. location is called the center-of-gravity range. The exact location of the allowable C.G. range is specified in the operating handbook for that particular airplane.

LOCATING THE LOAD

It is the responsibility of the pilot to ensure that the airplane is loaded properly. Operation outside of prescribed weight and balance limitations could result in an accident and serious or fatal injury.

To determine the center-of-gravity (C.G.) of an airplane, a pilot must have an understanding of the three terms used in weight and balance calculations. These terms are weight, moment, and arm. The principles associated with these terms are applied to each occupant, piece of cargo or baggage, the airplane itself, and all the fuel to determine the overall C.G. of the airplane.

The weight of an object should be carefully determined or calculated. All weights must be measured in the same units as the aircraft empty weight. The arm is the distance that the weight of a particular item is located from the reference datum line or the imaginary vertical line from which all horizontal distances are measured for balance purposes (refer to examples in Figure 1).

The word "moment", as used in airplane loading procedures, is the product of the weight of the object multiplied by the arm.

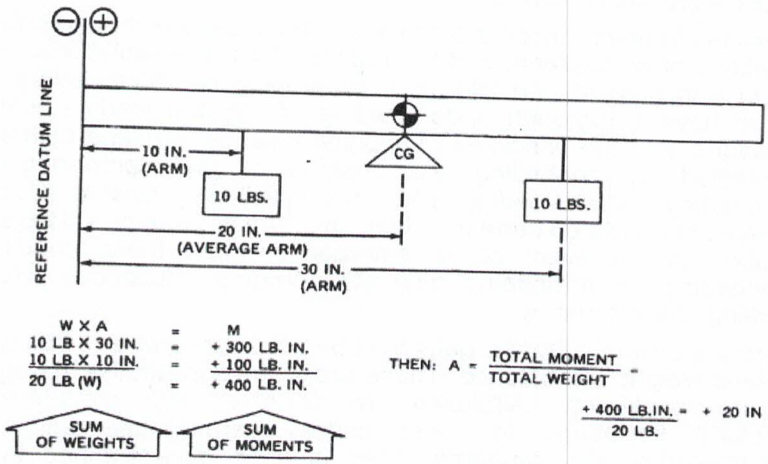
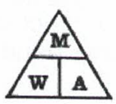


Figure 1. Computing the Center-of-Gravity

Pilots can remember and use the relationship of these terms most easily by arranging them in a mathematical triangle:



weight × arm = moment
moment ÷ weight = arm
moment ÷ arm = weight

The relative position of any two terms indicates the mathematical process (multiplication or division) required to compute the third term.

A loading graph or loading tables, a center-of-gravity limits chart and/or a center-of-gravity moment envelope chart, as well as a sample loading problem are provided in most airplane operating handbooks. By following the narrative directions, the pilot can determine the correct airplane C.G. for any configuration of the airplane. If the position of the load is different from that shown on the loading graph or in the loading tables, additional moment calculations, based on the actual weight and C.G. arm (fuselage station) of the item being loaded, must be performed.

LOAD SECURITY

In addition to the security of passengers, it is the pilot's responsibility to determine that all cargo and/or baggage is secured before flight. When required, the airplane may be equipped with tie-down rings or fittings for the purpose of securing cargo or baggage in the baggage compartment or cabin area. The maximum allowable cargo loads to be carried are determined by cargo weight limitations, the type and number of tie-downs used, as well as by the airplane weight and C.G. limitations. Always carefully observe all precautions listed in the operating handbook concerning cargo tie-down.

Pilots should assist in ensuring seat security and proper restraint for all passengers. Pilots should also advise passengers not to put heavy or sharp items under occupied seats since these items may interfere with the seats' energy absorption characteristics in the event of a crash.

Optional equipment installed in the airplane can affect loading, and the airplane center-of-gravity. Under certain loading conditions in tricycle gear airplanes, it is possible to exceed the aft C.G. limit, which could cause the airplane to tip and allow the fuselage tailcone to strike the ground while loading the airplane. The force of a tail ground strike could damage internal structure, resulting in possible interference with elevator control system operation.

EFFECTS OF LOADING ON THE FLIGHT

Weight and balance limits are placed on airplanes for three principal reasons: first, the effect of the weight on the primary and secondary structures; second, the effect on airplane performance; and third, the effect on flight controllability, particularly in stall and spin recovery.

A knowledge of load factors in flight maneuvers and gusts is important for understanding how an increase in maximum weight affects the characteristics of an airplane. The structure of an airplane subjected to a load factor of 3 Gs, must be capable of withstanding an added load of three hundred pounds for each hundred pound increase in weight. All Cessna airplanes are analyzed and tested for flight at the maximum authorized weight, and within the speeds posted for the type of flight to be performed. Flight at weights in excess of this amount may be possible, but loads for which the airplane was not designed may be imposed on all or some part of the structure.

An airplane loaded to the rear limit of its permissible center-of-gravity range will respond differently than when it is loaded near the forward limit. The stall characteristics of an airplane change as the airplane load changes, and stall characteristics become progressively better as center-of-gravity moves forward. Distribution of weight can also have a significant effect on spin characteristics. Forward location of the C.G. will usually make it more difficult to obtain a spin. Conversely, extremely aft C.G. locations will tend to promote lengthened recoveries since a more complete stall can be achieved. Changes in airplane weight as well as its distribution can have an effect on spin characteristics since increases in weight will increase inertia. Higher weights may delay recoveries.

An airplane loaded beyond the forward C.G. limit will be nose heavy, and can be difficult to rotate for takeoff or flare for landing. Airplanes with tail wheels can be nosed over more easily.

LOAD AND LATERAL TRIM

Some airplanes have a maximum limit for wing fuel lateral imbalance and/or a maximum wing locker load limitation. These limitations are required for one or both of two primary reasons. The first is to ensure that the airplane will maintain certain roll responses mandated by its certification. The other is to prevent overheating and interruption of lateral trim on certain types of autopilots caused by the excessive work required to maintain a wings level attitude while one wing is heavier than the other. Pilots should carefully observe such limitations and keep the fuel balance within the limits set forth in the respective operating handbook.

WEIGHT AND BALANCE TERMINOLOGY

The following list is provided in order to familiarize pilots and owners with the terminology used in calculating the weight and balance of Cessna airplanes. (Some terminology listed herein is defined and used in Pilot's Operating Handbooks only.)

Arm	The horizontal distance from the reference datum to the center-of-gravity (C.G.) of an item.
Basic Empty Weight	The standard empty weight plus the weight of installed optional equipment.
C.G. Arm	The arm obtained by adding the airplane's individual moments and dividing the sum by the total weight.
C.G. Limits	The extreme center-of-gravity locations within which the airplane must be operated at a given weight.

Center-of-Gravity (C.G.)	The point at which an airplane or item of 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 or item of equipment.
MAC	The mean aerodynamic chord of a wing is the chord of an imaginary airfoil which throughout the flight range will have the same force vectors as those of the wing.
Maximum Landing Weight	The maximum weight approved for the landing touchdown.
Maximum Ramp Weight	The maximum weight approved for ground maneuvers. It includes the weight of start, taxi and run up fuel.
Maximum Takeoff Weight	The maximum weight approved for the start of the takeoff roll.
Maximum Zero Fuel Weight	The maximum weight exclusive of usable fuel.
Moment	The product of the weight of an item multiplied by its arm. (Moment divided by a constant is used to simplify balance calculations by reducing the number of digits.)
Payload	The weight of occupants, cargo, and baggage.
Reference Datum	An imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Standard Empty Weight	The weight of a standard airplane, including unusable fuel, full operating fluids and full engine oil. In those manuals which refer to this weight as Licensed Empty Weight, the weight of engine oil is not included and must be added separately in weight and balance calculations.
Station	A location along the airplane fuselage given in terms of the distance from the reference datum.

Tare	The weight of chocks, blocks, stands, etc., used when weighing an airplane, and is included in the scale readings. Tare is deducted from the scale reading to obtain the actual (net) airplane weight.
Unusable Fuel	The quantity of fuel that cannot be safely used in flight.
Usable Fuel	The fuel available for flight planning.
Useful Load	The difference between ramp weight and the basic empty weight.

SINGLE ENGINE FLIGHT INFORMATION (MULTI-ENGINE AIRPLANES)

INTRODUCTION

The following discussion is intended primarily for pilots of propeller-driven, light twin-engine airplanes, powered by reciprocating engines and certified under CAR Part 3 or FAR Part 23. This discussion is not intended to apply to specific models, but is intended, instead, to give general guidelines or recommendations for operations in the event of an engine failure during flight.

SINGLE ENGINE TAKEOFF AND CLIMB

Each time a pilot considers a takeoff in a twin-engine airplane, knowledge is required of the Minimum Control Speed (V_{MC}) for that particular airplane. Knowledge of this speed, is essential to ensure safe operation of the airplane in the event an engine power loss occurs during the most critical phases of flight, the takeoff and initial climb.

V_{MC} is the minimum flight speed at which the airplane is directionally and laterally controllable as determined in accordance with Federal Aviation Regulations. Airplane certification conditions include: one engine becoming inoperative and windmilling; not more than a 5-degree bank toward the operative engine; takeoff power on the operative engine; landing gear retracted; flaps in the takeoff position; and the most critical C.G. (center of gravity). A multi-engine airplane must reach the minimum control speed before full control deflections can counteract the adverse rolling and/or yawing tendencies associated with one engine inoperative and full power operation on the other engine. The most critical time for an engine failure is during a two or three second period, late in the takeoff, while the airplane is accelerating to a safe speed.

Should an engine failure be experienced before liftoff speed is reached, the takeoff must be aborted. If an engine failure occurs immediately after liftoff, but before the landing gear is retracted, continue takeoff while retracting gear. Abort takeoff only if sufficient runway is available. This decision should be made before the takeoff is initiated.

The pilot of a twin-engine airplane must exercise good judgment and take prompt action in the decision whether or not to abort a takeoff attempt following an engine failure, since many factors will influence the decision.

Some of these factors include: runway length, grade and surface condition (i.e., slippery, dry, etc.), field elevation, temperature, wind speed and direction, terrain or obstructions in the vicinity of the runway, airplane weight and single engine climb capability under the prevailing conditions, among others. The pilot should abort the takeoff, following an engine-out, even if the airplane has lifted off the runway, if runway conditions permit. However, under limited circumstances (i.e., short runway with obstructions) the pilot may have to continue the takeoff following a liftoff and an engine-out.

While it may be possible to continue the takeoff at light weights and with favorable atmospheric conditions following an engine failure just after liftoff, long distances are required to clear even small obstacles. Distances required to clear an obstacle are reduced under more favorable combinations of weight, headwind component, or obstacle height.

The pilot's decision to continue the takeoff after an engine failure should be based on consideration of either the single engine best angle-of-climb speed (V_{XSE}) if an obstacle is ahead, or the single engine best rate-of-climb speed (V_{YSE}) when no obstacles are present in the climb area. Once the single engine best angle-of-climb speed is reached, altitude becomes more important than airspeed until the obstacle is cleared. On the other hand, the single engine best rate-of-climb speed becomes more important when there are no obstacles ahead. Refer to the Owners Manual, Flight Manual or Pilot's Operating Handbook for the proper airspeeds and procedures to be used in the event of an engine failure during takeoff. Refer to the warning placard "To Continue Flight With An Inoperative Engine" in the airplane's operating handbook and/or on the instrument panel for additional information.

Should an engine failure occur at or above these prescribed airspeeds, the airplane, within the limitations of its single engine climb performance, should be maneuvered to a landing. After the airplane has been "cleaned up" following an engine failure (landing gear and wing flaps retracted and the propeller feathered on the inoperative engine), it may be accelerated to its single engine best rate-of-climb speed. If immediate obstructions so dictate, the single engine best angle-of-climb speed may be maintained until the obstacles are cleared. In no case should the speed be allowed to drop below single engine best angle-of-climb speed unless an immediate landing is planned, since airplane performance capabilities will deteriorate rapidly as the airspeed decreases. After clearing all immediate obstacles, the airplane should be accelerated slowly to its single engine best rate-of-climb speed and the climb continued to a safe altitude which will allow maneuvering for a return to the airport for landing.

To obtain single engine best climb performance with one engine inoperative, the airplane must be flown in a 3 to 5 degree bank toward the operating engine. The rudder is used to maintain straight flight, compensating for the asymmetrical engine power. The ball of the turn-and-bank indicator should not be centered, but should be displaced about 1/2 ball width toward the operating engine.

The propeller on the inoperative engine must be feathered, the landing gear retracted, and the wing flaps retracted for continued safe flight. Climb performance of an airplane with a propeller windmilling usually is nonexistent. Once the decision to feather a propeller has been made, the pilot should ensure that the propeller feathers properly and remains feathered. The landing gear and wing flaps also cause a severe reduction in climb performance and both should be retracted as soon as possible (in accordance with the operating handbook limitations).

The following general facts should be used as a guide if an engine failure occurs during or immediately after takeoff:

1. Discontinuing a takeoff upon encountering an engine failure is advisable under most circumstances. Continuing the takeoff, if an engine failure occurs prior to reaching single engine best angle-of-climb speed and landing gear retraction, is not advisable.
2. Altitude is more valuable to safety immediately after takeoff than is airspeed in excess of the single engine best angle-of-climb speed.
3. A windmilling propeller and extended landing gear cause a severe drag penalty and, therefore, climb or continued level flight is improbable, depending on weight, altitude and temperature. Prompt retraction of the landing gear (except Model 337 series), identification of the inoperative engine, and feathering of the propeller is of utmost importance if the takeoff is to be continued.
4. Unless touchdown is imminent, in no case should airspeed be allowed to fall below single engine best angle-of-climb speed even though altitude is lost, since any lesser speed will result in significantly reduced climb performance.
5. If the requirement for an immediate climb is not present, allow the airplane to accelerate to the single engine best rate-of-climb speed since this speed will always provide the best chance of climb or least altitude loss.

SINGLE ENGINE CRUISE

Losing one engine during cruise on a multi-engine airplane causes little immediate problem for a proficient, properly trained pilot. After advancing power on the operating engine and retrimming the airplane to maintain altitude, if possible the pilot should attempt to determine if the cause of the engine failure can be corrected in flight prior to feathering the propeller. The magneto/ignition switches should be checked to see if they are on, and the fuel flow and fuel quantity for the affected engine should also be verified. If the engine failure was apparently caused by fuel starvation, switching to another fuel tank and/or turning on the auxiliary fuel pump (if equipped) or adjusting the mixture control may alleviate the condition. It must be emphasized that these procedures are not designed to replace the procedural steps listed in the emergency procedures section of the airplane operating handbook, but are presented as a guide to be used by the pilot if, in his or her judgment, corrective action should be attempted prior to shutting down a failing or malfunctioning engine. Altitude, terrain, weather conditions, weight, and accessibility of suitable landing areas must all be considered before attempting to determine and/or correct the cause of an engine failure. In any event, if an engine fails in cruise and cannot be restarted, a landing at the nearest suitable airport is recommended.

SINGLE ENGINE APPROACH AND LANDING OR GO-AROUND

An approach and landing with one engine inoperative on a multi-engine airplane can easily be completed by a proficient, properly trained pilot. However, the pilot must plan and prepare the airplane much earlier than normal to ensure success. While preparing, fuel should be scheduled so that an adequate amount is available for use by the operative engine. All cross feeding should be completed during level flight above a minimum altitude of 1000 feet AGL.

During final approach, the pilot should maintain the single engine best rate-of-climb speed or higher, until the landing is assured. An attempt should be made to keep the approach as normal as possible, considering the situation. Landing gear should be extended on downwind leg or over the final approach fix, as applicable. Flaps should be used to control the descent through the approach.

Consideration should be given to a loss of the other engine or the necessity to make an engine inoperative go-around. Under certain combinations of weight, temperature and altitude, neither level flight nor a single engine go-around may be possible. Do not attempt an engine inoperative go-around after the wing flaps have been extended beyond the normal approach or the published approach flap setting, unless enough altitude is available to allow the wing flaps to be retracted to the normal approach or the published approach flap setting, or less.

PILOT PROFICIENCY

AIRSPEED CONTROL

Flying other than published airspeeds could put the pilot and airplane in an unsafe situation. The airspeeds published in the airplane's operating handbook have been tested and proven to help prevent unusual situations. For example, proper liftoff speed puts the airplane in the best position for a smooth transition to a climb attitude. However, if liftoff is too early, drag increases and consequently increases the takeoff ground run. This procedure also degrades controllability of multi-engine airplanes in the event an engine failure occurs after takeoff. In addition, early liftoff increases the time required to accelerate from liftoff to either the single-engine best rate-of-climb speed (V_{YSE}) or the single-engine best angle-of-climb speed (V_{XSE}) if an obstacle is ahead. On the other hand, if liftoff is late, the airplane will tend to "leap" into the climb. Pilots should adhere to the published liftoff or takeoff speed for their particular airplane.

The pilot should be familiar with the stall characteristics of the airplane when stalled from a normal 1 G stall. Any airplane can be stalled at any speed. The absolute maximum speed at which full aerodynamic control can be safely applied is listed in the airplane's operating handbook as the maneuvering speed. Do not make full or abrupt control movements above this speed. To do so could induce structural damage to the airplane.

TRAFFIC PATTERN MANEUVERS

There have been incidents in the vicinity of controlled airports that were caused primarily by pilots executing unexpected maneuvers. Air Traffic Control (ATC) service is based upon observed or known traffic and airport conditions. Air Traffic Controllers establish the sequence of arriving and departing airplanes by advising them to adjust their flight as necessary to achieve proper spacing. These adjustments can only be based on observed traffic, accurate pilot radio reports, and anticipated airplane maneuvers. Pilots are expected to cooperate so as to preclude disruption of the traffic flow or the creation of conflicting traffic patterns. The pilot in command of an airplane is directly responsible for and is the final authority as to the operation of his or her airplane. On occasion, it may be necessary for a pilot to maneuver an airplane to maintain spacing with the traffic he or she has been sequenced to follow. The controller can anticipate minor maneuvering such as shallow "S" turns. The controller cannot, however, anticipate a major maneuver such as a 360-degree turn. This can result in a gap in the landing interval and more importantly, it causes a chain reaction which may result in a conflict with other traffic and an interruption of the sequence established by the tower or approach controller. The pilot should always advise the controller of the need to make any maneuvering turns.

USE OF LIGHTS

Aircraft position (navigation) and anti-collision lights are required to be illuminated on aircraft operated at night. Anti-collision lights, however, may be turned off when the pilot in command determines that, because of operating conditions, it would be in the interest of safety to do so. For example, strobe lights should be turned off on the ground when they adversely affect ground personnel or other pilots, and in flight when there are adverse reflections from clouds.

To enhance the "see-and-avoid" concept, pilots are encouraged to turn on their rotation beacon any time the engine(s) are operating, day or night. Pilots are further encouraged to turn on their landing lights when operating within ten miles of any airport, day or night, in conditions of reduced visibility and areas where flocks of birds may be expected (i.e., coastal areas, around refuse dumps, etc.). Although turning on airplane lights does enhance the "see-and-avoid" concept, pilots should not become complacent about keeping a sharp lookout for other airplanes. Not all airplanes are equipped with lights and some pilots may not have their lights turned on. Use of the taxi light, in lieu of the landing light, on some smaller airplanes may extend the landing light service life.

Propeller and jet blast forces generated by large airplanes have overturned or damaged several smaller airplanes taxiing behind them. To avoid similar results, and in the interest of preventing upsets and injuries to ground personnel from such forces, the FAA recommends that air carriers and commercial operators turn on their rotating beacons anytime their airplane engine(s) are operating. All other pilots, using airplanes equipped with rotating beacons, are also encouraged to participate in this program which is designed to alert others to the potential hazard. Since this is a voluntary program, exercise caution and do not rely solely on the rotating beacon as an indication that airplane engines are operating.

PARTIAL PANEL FLYING

All pilots, and especially instrument rated pilots, should know the emergency procedures for partial instrument panel operation included in their respective operating handbook, as well as any FAA training material on the subject. Routine periodic practice under simulated instrument conditions with a partial instrument panel can be very beneficial to a pilot's proficiency. In this case, the pilot should have a qualified safety pilot monitoring the simulated instrument practice.

If a second vacuum system is not installed and a complete vacuum system failure occurs during flight, the vacuum-driven directional indicator and the attitude indicator will be disabled, and the pilot will have to control the airplane by reference to the turn coordinator or the turn and bank indicator, the magnetic compass and pitot-static instruments, if he or she flies into instrument meteorological conditions. If an autopilot is installed, it too will be affected, and should not be used. 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° TURN IN CLOUDS

Upon inadvertently entering a cloud(s), an immediate plan should be made to turn back as follows:

1. Note compass heading.
2. Note the time in both minutes and seconds.
3. When the seconds indicate the nearest half-minute, initiate a standard rate left turn, holding the turn coordinator (or turn and bank indicator if installed) symbolic airplane wing opposite the lower left wing index mark for 60 seconds. Then roll back to level flight by leveling the miniature airplane.
4. Assure level flight through and after the turn by referencing the altimeter, VSI, and airspeed indicator. Altitude may be maintained with cautious use of the elevator controls.
5. Check accuracy of turn by observing the compass heading which should be the reciprocal of the original heading.
6. If necessary, adjust heading primarily with skidding motions rather than rolling motions so that the compass will read more accurately.
7. Maintain altitude and airspeed by cautious application of elevator control. Avoid over-controlling by keeping the hands off the control wheel as much as possible and steering only with the rudder.

EMERGENCY DESCENT THROUGH CLOUDS

If conditions preclude reestablishment of VFR flight by a 180° turn, a descent through a cloud deck to VFR conditions may be appropriate. If possible, obtain ATC clearance for an emergency descent. 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 and bank or 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 the landing gear (if applicable).
2. Reduce power to set up a 500 to 800 ft/min rate of descent.
3. Adjust mixture(s) as required for smooth engine operation.

4. Adjust elevator or stabilizer, rudder and aileron trim controls for a stabilized descent.
5. Keep hands off the control wheel. Monitor turn and bank or turn coordinator and make corrections by rudder alone.
6. Check trend of compass card movement and make cautious corrections with rudder inputs to stop turn.
7. Upon breaking out of the clouds, resume normal cruising flight.

RECOVERY FROM A SPIRAL DIVE

If a spiral dive is encountered while in the clouds, proceed as follows:

1. Retard the throttle(s) to idle.
2. Stop the turn by using coordinated aileron and rudder control to align the symbolic airplane in the turn coordinator with the horizontal reference line, or center the turn needle and ball of the turn and bank indicator.
   a. With a significant airspeed increase or altitude loss while in the spiral, anticipate that the aircraft will pitch nose-up when the wings are level. Take care not to over stress the airframe as a result of this nose-up pitching tendency.
3. Cautiously apply control wheel back pressure (if necessary) to slowly reduce the airspeed.
4. Adjust the elevator or stabilizer trim control to maintain a constant glide airspeed.
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. If the power-off glide is of sufficient duration, adjust the mixture(s), as required.
7. Upon breaking out of the clouds, resume normal cruising flight.

USE OF LANDING GEAR AND FLAPS

A review of airplane accident investigation reports indicates a complacent attitude on the part of some pilots toward the use of checklists for landing gear and wing flap operation. The main confession of most pilots involved in involuntary gear-up landings is that they "forgot" to lower the gear prior to landing. Consistent use of the Before Landing Checklist would have alerted these pilots and prevented a potentially hazardous situation. Other causes of gear-up landings have been attributed to poor judgment, such as not leaving the landing gear extended while performing several landings while remaining in the traffic pattern. The following recommendations will lessen the possibility of a gear-up landing.

1. Never move the landing gear control switch, handle, or lever while the airplane is on the ground.

2. Do not deliberately disable any landing gear warning device or light unless indicated otherwise in the operating handbook.
3. Apply brakes before retraction of the landing gear to stop wheel rotation.
4. After takeoff, do not retract the landing gear until a positive rate of climb is indicated.
5. When selecting a landing gear position, whether up or down, allow the landing gear to complete the initial cycle to the locked position before moving the control switch, handle, or lever in the opposite direction.
6. Never exceed the published landing gear operating speed (V_{LO}) while the landing gear is in transit or the maximum landing gear extended speed (V_{LE}).
7. Prepare for landing early in the approach so that trim adjustments after lowering landing gear or flaps will not compromise the approach.
8. Leave landing gear extended during consecutive landings when the airplane remains in the traffic pattern unless traffic pattern speeds exceed the Maximum Landing Gear Extended Speed (V_{LE}).

A rare, but serious problem that may result from a mechanical failure in the flap system is split wing flaps. This phenomenon occurs when the wing flap position on one wing does not agree with the flap position on the opposite wing, causing a rolling tendency. Split flaps can be detected and safely countered if flap control movement is limited to small increments during inflight operations from full down to full up and full up to full down. If a roll is detected during flap selection, reposition the flap selector to the position from which it was moved and the roll should be eliminated. Depending on the experience and proficiency of the pilot, the rolling tendencies caused by a split flap situation may be controlled with opposite aileron (and differential power for multi-engine aircraft). Some documented contributing factors to split flaps are:

1. Pilots exceeding the Maximum Flap Extended (V_{FE}) speed for a given flap setting.
2. Mechanical failure.
3. Improper maintenance.

ILLUSIONS IN FLIGHT

Many different illusions can be experienced in flight. Some can lead to spatial disorientation (See related information in following pages). Others can lead to landing errors. Illusions rank among the most common factors cited as contributing to fatal airplane accidents.

Various complex motions and forces and certain visual scenes encountered in flight can create illusions of motion and position when visual references deteriorate, and the pilot is not trained to rely and fly by reference to the flight instruments. Spatial disorientation from these illusions can be prevented by learning to rely on the flight instruments, disregard sensory information and only use reliable visual references.

An abrupt correction of banked attitude, which has been entered too slowly to stimulate the motion sensing system in the middle ear, can create the illusion of banking in the opposite direction. The disoriented pilot will roll the airplane back to its original dangerous attitude or, if level flight is maintained, will feel compelled to lean in the perceived vertical plane until this illusion subsides. This phenomenon is usually referred to as the "leans" and the following illusions fall under this category.

1. **Coriolis illusion** - An abrupt head movement in a prolonged constant-rate turn that has ceased stimulating the motion sensing system can create the illusion of rotation or movement on an entirely different axis. The disoriented pilot will maneuver the airplane into a dangerous attitude in an attempt to stop this illusion of rotation. This most overwhelming of all illusions in flight may be prevented by not making sudden, extreme head movements, particularly while making prolonged constant-rate turns under IFR conditions.
2. **Graveyard spin** - A proper recovery from a spin that has ceased stimulating the motion sensing system can create the illusion of spinning in the opposite direction. The disoriented pilot will return the airplane to its original spin.
3. **Graveyard spiral** - An observed loss of altitude during a coordinated constant-rate turn that has ceased stimulating the motion sensing system can create the illusion of being in a descent with the wings level. In this case, the disoriented pilot will pull back on the controls, tightening the spiral and increasing the normal load factor on the airplane.
4. **Somatogravic illusion** - A rapid acceleration during takeoff can create the illusion of being in a nose up attitude. The disoriented pilot will push the airplane into a nose low, or dive attitude. A rapid deceleration by a quick reduction of the throttle(s) can have the opposite effect, with the disoriented pilot pulling the airplane into a nose up, or stall attitude.
5. **Inversion illusion** - An abrupt change from climb to straight and level flight can create the illusion of tumbling backwards. The disoriented pilot will push the airplane abruptly into a nose low attitude, possibly intensifying this illusion.
6. **Elevator illusion** - An abrupt upward vertical acceleration, usually caused by an updraft, can create the illusion of being in a climb. The disoriented pilot will push the airplane into a nose low attitude. An abrupt downward vertical acceleration, usually caused by a downdraft, has the opposite effect, with the disoriented pilot pulling the airplane into a nose up attitude.

7. **False horizon** - Sloping cloud formations, an obscured horizon, a dark scene spread with ground lights and stars, and certain geometric patterns of ground light can create illusions of not being aligned correctly with the horizon. The disoriented pilot will place the airplane in a dangerous attitude.
8. **Autokinesis** - In the dark, a static light will appear to move about when stared at for many seconds. The disoriented pilot will lose control of the airplane in attempting to align it with the light.

Various surface features and atmospheric conditions encountered during landing can create illusions of incorrect height above and distance away from the runway threshold. Landing errors from these illusions can be prevented by: anticipating them during approaches, aerial visual inspection of unfamiliar airports before landing, using an electronic glide slope or visual approach slope indicator (VASI) system when available, and maintaining optimum proficiency in landing procedures. The following illusions apply to this category.

1. **Runway width illusion** - A narrower than usual runway can create the illusion that the airplane is at a higher altitude than it actually is. The pilot who does not recognize this illusion will tend to fly a lower approach, with the risk of striking objects along the approach path, or land short. A wider than usual runway can have the opposite effect, with the risk of flaring high and landing hard or overshooting the runway.
2. **Runway and terrain slopes illusion** - An up sloping runway, up sloping terrain, or both, can create the illusion that the airplane is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach. A down sloping runway, down sloping approach terrain, or both, can have the opposite effect.
3. **Featureless terrain illusion** - An absence of ground features, as when landing over water, darkened areas and terrain made featureless by snow, can create the illusion that the airplane is at a higher altitude than it actually is. The pilot who does not recognize this illusion will tend to fly a lower approach.
4. **Atmospheric illusion** - Rain on the windshield can create an illusion of greater height, and a greater distance from the runway. The pilot who does not recognize this illusion will tend to fly a lower approach. Penetration of fog can create the illusion of pitching up. The pilot who does not recognize this illusion will steepen the approach, often quite abruptly.

5. **Ground lighting illusions** - Lights along a straight path, such as a road, and even lights on trains, can be mistaken for runway and approach lights. Bright runway and approach lighting systems, especially where few lights illuminate the surrounding terrain, may create the illusion of less distance to the runway. The pilot who does not recognize this illusion will tend to fly a higher approach. Conversely, the pilot overflying terrain which has few lights to provide height clues may make a lower than normal approach.

SPATIAL DISORIENTATION

Spatial disorientation is the confusion of the senses affecting balance, which occurs when a person is deprived of the normal clues upon which he or she depends for "indexing" a sense of balance. Loss of control can result from the pilot unable to understand what the airplane is doing. These clues include, most prominently, his or her visual reference to the earth's horizon and celestial bodies, and his or her acceptance of the force of gravity as acting vertically. When flying an airplane, the pilot may have all outside visual references obscured by clouds or complete darkness, and his interpretation of the direction of gravity may become confused by forces imposed on his or her body by centrifugal force, accelerations of maneuvering, and turbulence, which may act in any direction.

Spatial disorientation usually leads to vertigo, but is not necessarily identical to it. Vertigo is an uncertain feeling of disorientation, turning, or imbalance, which is usually accompanied by feelings of dizziness or incipient nausea.

During instrument flight, the attitude of the airplane must be determined from the gyro horizon ("attitude indicator") with cross-reference to other flight instruments.

Sometimes during conditions of low visibility, the supporting senses conflict with what is seen or what the pilot believes he sees. When this happens, there is a definite susceptibility to disorientation. The degree of disorientation varies considerably with individual pilots, their proficiency, and the conditions which induced the problem. Complete disorientation, even for a short period of time, can render a pilot incapable of controlling an airplane, to the extent that he cannot maintain level flight, or even prevent fatal turns and diving spirals.

Lack of effective visual reference is common on over-water flights at night, and in low visibility conditions over land. Other contributing factors to disorientation and vertigo are reflections from outside lights, and cloud reflections of beams from rotating beacons or strobe lights.

It is important that all pilots understand the possibility of spatial disorientation, and the steps necessary to minimize the loss of control as a result of it. The following basic items should be known to every pilot:

1. Obtain training and maintain proficiency in the control of an airplane by reference to instruments before flying in visibility of less than three miles.
2. Refer to the attitude instruments frequently when flying at night or in reduced visibility conditions.
3. To maintain competency in night operations, practice should include operations in the traffic pattern, subject to the confusion caused by reflections of ground lights, as well as the control of an airplane by reference to instruments.
4. Familiarization with the meteorological conditions which may lead to spatial disorientation is important. These include smoke, fog, haze, and other restrictions to visibility.
5. Familiarity with local areas and commonly used flight routes assists in the avoidance of disorientation by permitting the pilot to anticipate and look for prominent terrain features.
6. The most important precaution for avoiding disorientation is the habit of thoroughly checking the weather before each flight, while enroute, and near the destination.

A pilot without the demonstrated competence to control an airplane by sole reference to instruments has little chance of surviving an unintentional flight into IFR conditions. Tests conducted by the U.S. Air Force, using qualified instrument pilots, indicate that it may take as long as 35 seconds to establish full control by reference to instruments after disorientation during an attempt to maintain VFR flight in IFR weather. Instrument training and certification and ongoing recurrent training in accordance with FAR Part 61, are designed to provide the pilot with the skills needed to maintain control solely by reference to flight instruments and the ability to ignore the false kinesthetic sensations inherent with flight when no outside references are available.

MOUNTAIN FLYING

A pilot's first experience of flying over mountainous terrain (particularly if most of his or her flight time has been over flatlands) could be a never-to-be-forgotten experience if proper planning is not done and if the pilot is not aware of potential hazards. Those familiar section lines in some regions are not present in the mountains. Flat, level fields for forced landings are practically nonexistent; abrupt changes in wind direction and velocity may occur; severe updrafts and downdrafts are common during high wind conditions, particularly near or above abrupt changes of terrain, such as cliffs or rugged areas; and clouds can build up with startling rapidity. Mountain flying need not be hazardous if you follow the recommendations below:

1. For pilots with little or no mountain flying experience, always get dual instruction from a qualified flight instructor to become familiar with conditions which may be encountered before flying in mountainous terrain.
2. Plan your route to avoid topography which would prevent a safe forced landing. The route should be near populated areas and well known mountain passes. Sufficient altitude should be maintained to permit gliding to a safe landing in the event of engine failure.
3. Always file a flight plan.
4. Don't fly a light airplane when the winds aloft, at your proposed altitude, exceed 35 miles per hour. Expect the winds to be of much greater velocity over mountain passes than reported a few miles from them. Approach mountain passes with as much altitude as possible. Downdrafts of from 1500 to 2000 feet per minute are not uncommon on the leeward (downwind) side.
5. Severe turbulence can be expected near or above changes in terrain, especially in high wind conditions.
6. Some canyons run into a dead end. Don't fly so far into a canyon that you get trapped. Always be able to make a 180-degree turn, or if canyon flying is necessary, fly down the canyon (toward lower terrain), not up the canyon (toward higher terrain).
7. Plan the trip for the early morning hours. As a rule, the air starts to get turbulent at about 10 a.m., and grows steadily worse until around 4 p.m., then gradually improves until dark.
8. When landing at a high altitude airfield, the same indicated airspeed should be used as at low elevation fields. Due to the less dense air at altitude, this same indicated airspeed actually results in a higher true airspeed, a faster landing speed, and a longer landing distance. During gusty wind conditions, which often prevail at high altitude fields, a "power approach" is recommended. Additionally; due to the faster ground speed and reduced engine performance at altitude, the takeoff distance will increase considerably over that required at lower altitudes.

OBSTRUCTIONS TO FLIGHT

Pilots should exercise extreme caution when flying less than 2000 feet above ground level (AGL) because of the numerous structures (radio and television antenna towers) exceeding 1000 feet AGL, with some extending higher than 2000 feet AGL. Most truss type structures are supported by guy wires. The wires are difficult to see in good weather and can be totally obscured during periods of dusk and reduced visibility. These wires can extend approximately 1500 feet horizontally from a structure; therefore, all truss type structures should be avoided by at least 2000 feet, horizontally and vertically.

Overhead transmission and utility lines often span approaches to runways and scenic flyways such as lakes, rivers, and canyons. The supporting structures of these lines may not always be readily visible and the wires may be virtually invisible under certain conditions. Most of these installations do not meet criteria which determine them to be obstructions to air navigation and therefore, do not require marking and/or lighting. The supporting structures of some overhead transmission lines are equipped with flashing strobe lights. These lights indicate wires exist between the strobe equipped structures.

FUEL MANAGEMENT

POOR TECHNIQUES

Poor fuel management is often the cause of aircraft accidents. Some airplane accident reports have listed such poor fuel management techniques as switching to another fuel tank after the before takeoff runup was completed, and then experiencing engine problems on takeoff. Other reports tell of pilots switching fuel tanks at a critical point on the approach to a landing and inadvertently selecting an empty tank when there is not enough time to compensate for the subsequent loss of power. Flying low during day crosscountry, or moderately low at night, can be hazardous if a fuel tank runs dry. Too much altitude may be lost during the time it takes to discover the reason for power loss, select a different fuel tank, and restart the engine. Pilots should be thoroughly familiar with the airplane fuel system and tank switching procedures. Furthermore, it is an unsafe technique to run a fuel tank dry as a routine procedure, although there are exceptions. Any sediment or water not drained from the fuel tank could be drawn into the fuel system and cause erratic operation or even total power loss.

FUELING THE AIRCRAFT

The aircraft should be on level ground during all fueling operations, since filling the tanks when the aircraft is not level may result in a fuel quantity less than the maximum capacity. Rapid filling of a fuel tank, without allowing time for air in the tank to escape, may result in a lower fuel quantity. Some single engine aircraft that allow simultaneous use of fuel from more than one tank have fuel tanks with interconnected vent lines. If the tanks are filled with fuel and the aircraft allowed to sit with one wing lower than the other, fuel may drain from the higher tank to the lower and subsequently out the fuel vent. This will result in loss of fuel. This fuel loss may be prevented by placing the fuel selector in a position other than "both".

Some Cessna single-engine airplanes have long, narrow fuel tanks. If your airplane is so equipped, it may be necessary to partially fill each tank alternately, and repeat the sequence as required to completely fill the tanks to their maximum capacity. This method of fueling helps prevent the airplane from settling to a wing-low attitude because of increased fuel weight in the fullest wing tank.

It is always the responsibility of the pilot-in-command to ensure sufficient fuel is available for the planned flight. Refer to the airplane operating handbook for proper fueling procedures.

UNUSABLE FUEL

Unusable fuel is the quantity of fuel that cannot safely be used in flight. The amount of unusable fuel varies with airplane and fuel system design, and the maximum amount is determined in accordance with Civil or Federal Aviation Regulations (CARs or FARs). Unusable fuel is always included in the airplane's licensed or basic empty weight for weight and balance purposes. Unusable fuel should never be included when computing the endurance of any airplane.

FUEL PLANNING WITH MINIMUM RESERVES

Airplane accidents involving engine power loss continue to reflect fuel starvation as the primary cause or a contributing factor. Some of these accidents were caused by departing with insufficient fuel onboard to complete the intended flight. Fuel exhaustion in flight can mean only one thing - a forced landing with the possibility of serious damage, injury, or death.

A pilot should not begin a flight without determining the fuel required and verifying its presence onboard. To be specific, during VFR conditions, do not take off unless there is enough fuel to fly to the planned destination (considering wind and forecast weather conditions), assuming the airplane's normal cruising airspeed, fly after that for at least 30 minutes during the day, or at least 45 minutes at night.

Departure fuel requirements are a little different when operating under IFR conditions. Do not depart an airport on an IFR trip unless the airplane has enough fuel to complete the flight to the first airport of intended landing (considering weather reports and forecasts) and fly from that airport to the planned alternate airport, and afterwards still fly at least 45 minutes at normal cruising speed.

FLIGHT COORDINATION VS. FUEL FLOW

The shape of most airplane wing fuel tanks is such that, in certain flight maneuvers, the fuel may move away from the fuel tank supply outlet. If the outlet is uncovered, fuel flow to the engine may be interrupted and a temporary loss of power might result. Pilots can prevent inadvertent uncovering of the tank outlet by having adequate fuel in the tank selected and avoiding maneuvers such as prolonged uncoordinated flight or sideslips which move fuel away from the feed lines.

It is important to observe the uncoordinated flight or sideslip limitations listed in the respective operating handbook. As a general rule, limit uncoordinated flight or sideslip to 30 seconds in duration when the fuel level in the selected fuel tank is 1/4 full or less. Airplanes are usually considered in a sideslip anytime the turn and bank "ball" is more than one quarter ball out of the center (coordinated flight) position. The amount of usable fuel decreases with the severity of the sideslip in all cases.

FUEL SELECTION FOR APPROACH/LANDING

On some single-engine airplanes, the fuel selector valve handle is normally positioned to the BOTH position to allow symmetric fuel feed from each wing fuel tank. However, if the airplane is not kept in coordinated flight, unequal fuel flow may occur. The resulting wing heaviness may be corrected during flight by turning the fuel selector valve handle to the tank in the "heavy" wing. On other single-engine airplanes, the fuel selector has LEFT ON or RIGHT ON positions, and takeoffs and landings are to be accomplished using fuel from the fuller tank.

Most multi-engine airplanes have fuel tanks in each wing or in wing tip tanks, and it is advisable to feed the engines symmetrically during cruise so that approximately the same amount of fuel will be left in each side for descent, approach, and landing. If fuel has been consumed at uneven rates between the two wing tanks because of prolonged single-engine flight, fuel leak or siphon, or improper fuel servicing, it is desirable to balance the fuel load by operating both engines from the fuller tank. However, as long as there is sufficient fuel in both wing tanks, even though they may have unequal quantities, it is important to switch the left and right fuel selectors to the left and right wing tanks, respectively, feeling for the detent, prior to the approach. This will ensure that adequate fuel flow will be available to each operating engine if a go-around is necessary. In the case of single-engine operation, operate from the fuller tank, attempting to have a little more fuel in the wing on the side with the operating engine prior to descent.

On all multi-engine airplanes equipped with wing tip fuel tanks, the tip tanks are the main fuel tanks on the tank selector valve controls. Refer to Supplement 12 of this Pilot Safety and Warning Supplements Manual and the applicable airplane operating handbook.

AIRFRAME ICING

Pilots should monitor weather conditions while flying and should be alert to conditions which might lead to icing. Icing conditions should be avoided when possible, even if the airplane is certified and approved for flight into known icing areas. A climb normally is the best ice avoidance action to take. Alternatives are a course reversal or a descent to warmer air. If icing conditions are encountered inadvertently, immediate corrective action is required.

FLIGHT INTO KNOWN ICING

Flight into known icing is the intentional flight into icing conditions that are known to exist. Icing conditions exist anytime the indicated OAT (outside air temperature) is +10°C or below, or the RAT (ram air temperature) is +10°C or below, and visible moisture in any form is present. Any airplane that is not specifically certified for flight into known icing conditions, is prohibited by regulations from doing so.

Ice accumulations significantly alter the shape of the airfoil and increase the weight of the aircraft. Ice accumulations on the aircraft will increase stall speeds and alter the speeds for optimum performance. Flight at high angles of attack (low airspeed) can result in ice buildup on the underside of wings and the horizontal tail aft of the areas protected by boots or leading edge anti-ice systems. Trace or light amounts of icing on the horizontal tail can significantly alter airfoil characteristics, which will affect stability and control of the aircraft.

Inflight ice protection equipment is not designed to remove ice, snow, or frost accumulations on a parked airplane sufficiently enough to ensure a safe takeoff or subsequent flight. Other means (such as a heated hangar or approved deicing solutions) must be employed to ensure that all wing, tail, control, propeller, windshield, static port surfaces and fuel vents are free of ice, snow, and frost accumulations, and that there are no internal accumulations of ice or debris in the control surfaces, engine intakes, brakes, pitot-static system ports, and fuel vents prior to takeoff.

AIRPLANES CERTIFIED FOR FLIGHT INTO KNOWN ICING

An airplane certified for flight into known icing conditions must have all required FAA approved equipment installed and fully operational. Certain airplanes have a flight into known icing equipment package available which, if installed in its entirety and completely operational, allows intentional penetration of areas of known icing conditions as reported in weather sequences or by PIREPS.

This known icing package is designed specifically for the airplane to provide adequate in-flight protection during normally encountered icing conditions produced by moisture-laden clouds. It will not provide total protection under severe conditions such as those which exist in areas of freezing rain, nor will it necessarily provide complete protection for continuous operation in extremely widespread areas of heavy cloud moisture content The installed equipment should be used to protect the airplane from ice while seeking a different altitude or routing where ice does not exist. During all operations, the pilot must exercise good judgment and be prepared to alter his flight if conditions exceed the capacity of the ice protection equipment or if any component of this equipment fails.

The airplane's operating handbook will indicate the required equipment for intentional flight into known icing conditions. Such equipment may include: wing leading edge deice/anti-ice system, vertical and horizontal stabilizer leading edge deice/anti-ice system, propeller deice/ anti-ice system, windshield anti-ice, heated pitot tube, heated static ports and fuel vents, heated stall warning vane/transducer or optional angle-of-attack lift sensor vane, ice detector light(s), and increased capacity electrical and vacuum systems.

If there is any doubt whether the airplane is certified or has all the required equipment, the pilot should assume that the airplane is not certified for flight into known icing and avoid any encounters with areas of icing.

KINDS OF ICING

Airframe icing is a major hazard. It is at its worst when the supercooled (liquid below freezing temperature) water droplets are large and plentiful. Droplets of this type are usually found in cumulus clouds and are the cause of "clear ice". Clear ice is transparent ice deposited in layers, and may be either smooth or rough. This ice coats more of the wing than "rime ice" because the droplets flow back from the leading edge over the upper and lower wing surface before freezing, and the rate of accumulation is higher.

Rime ice is an opaque, granular, and rough deposit of ice that is usually encountered in stratus clouds. Small supercooled droplets freeze instantly when struck by the leading edges of the airplane. Rime ice can quickly change the drag characteristics of the airplane. Under some conditions, a large "double horn" buildup on the leading edges can occur which drastically alters the airfoil shape. Altitude changes usually work well as an avoidance strategy for rime ice. In colder temperatures, these types of supercooled water droplets quickly convert to ice crystals.

Icing in precipitation comes from freezing rain or drizzle which falls from warmer air aloft to colder air below. This results in a very rapid buildup of clear ice, and must be avoided by all means available to the pilot.

If it is snowing, the problem is not so much the snow sticking to the airplane as the icing caused by the supercooled water droplets in the clouds from which the snow is falling. The amount of ice will depend upon cloud saturation.

Pilots should report all icing conditions to ATC/FSS, and if operating under IFR conditions, request new routing or altitude if icing will be a hazard. Be sure to give type of airplane when reporting icing. The following describe how to report icing conditions:

1. **Trace** - Ice becomes visible. Rate of accumulation is slightly greater than the rate of sublimation. Anti-ice equipment must be on and deice equipment may or may not be required.
2. **Light** - The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of deicing equipment and continuous use of anti-icing equipment removes/prevents accumulation.
3. **Moderate** - The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/ anti-icing equipment and flight diversion is necessary.
4. **Severe** - The rate of accumulation is such that deicing/anti-icing equipment fails to reduce or control the hazard. Immediate flight diversion is necessary.

RESULTS OF ICING

Airplane performance can be severely reduced by ice accumulation. Accumulation of 1 /2 inch of ice on the leading edges of the wings and empennage can cause a large loss in rate of climb, a cruise speed reduction of up to 30 KIAS, as well as a significant buffet and stall speed increase. Even if the airplane is certified for flight into known icing and the equipment is working properly, ice remaining on unprotected areas of the airplane can cause large performance losses. With one inch of residual ice accumulation, these losses can double, or even triple. Ice accumulation also will increase airplane weight.

INADVERTENT ICING ENCOUNTER

Flight into icing conditions is not recommended. However, an inadvertent encounter with these conditions is possible. The following are things to consider doing if inadvertent icing is experienced. These items are not intended to replace procedures described in any operating handbook. Instead, this list has been generated to familiarize pilots of older model Cessnas with guidelines they can use in the event of an inadvertent icing condition. The best procedure is a change of altitude, or course reversal to escape the icing conditions.

1. Turn pitot heat, stall warning heat, propeller deice/anti-ice, and windshield anti-ice switches ON (if installed).
2. Change altitude (usually climb) or turn back to obtain an outside air temperature that is less conducive to icing.
3. Increase power as necessary to maintain cruise airspeed and to minimize ice accumulation. Maintain a minimum indicated airspeed of V_Y + 10 KIAS until assured that all ice is off the airframe.
4. Turn cabin heat and defroster controls full on and open defrost control to obtain maximum windshield defroster effectiveness.
5. Increase engine speed to minimize ice buildup on propeller blades. If excessive vibration is noted, momentarily reduce engine speed with the propeller control, and then rapidly move the control full forward. Cycling the RPM flexes the propeller blades and high RPM increases centrifugal force, causing ice to shed more readily.
6. Watch for signs of induction air filter ice. Regain manifold pressure by increasing the throttle setting and/or selecting alternate air or carburetor heat. If ice accumulates on the intake filter (requiring alternate air), a decrease of manifold pressure will be experienced, and the mixture should be adjusted as required.
7. If icing conditions are unavoidable, plan a landing at the nearest airport. In the event of an extremely rapid ice buildup, select a suitable "off airport" landing site.
8. Ice accumulation of 1/4 inch or more on the wing leading edges may require significantly higher power and a higher approach and landing speed, and result in a higher stall speed and longer landing roll.
9. If practical, open the window and scrape ice from a portion of the windshield for visibility in the landing approach.
10. Approach with reduced flap extension to ensure adequate elevator effectiveness in the approach and landing.
11. Avoid a slow and high flare-out.
12. Missed approaches should be avoided whenever possible, because of severely reduced climb capability. However, if a go-around is mandatory, make the decision much earlier in the approach than normal. Apply maximum power while retracting the flaps slowly in small increments (if extended). Retract the landing gear after immediate obstacles are cleared.

WEATHER

ALERTNESS

Most pilots pay particularly close attention to the business of flying when they are intentionally operating in instrument weather conditions. On the other hand, unlimited visibility tends to encourage a sense of security which may not be justified. The pilot should be alert to the potential of weather hazards, and prepared if these hazards are encountered on every flight.

VFR JUDGMENT

Published distance from clouds and visibility regulations establish the minimums for VFR flight. The pilot who uses even greater margins exercises good judgment. VFR operation in class D airspace, when the official visibility is 3 miles or greater, is not prohibited, but good judgment would dictate that VFR pilots keep out of the approach area under marginal conditions.

Precipitation reduces forward visibility. Although it is perfectly legal to cancel an IFR flight plan whenever the pilot feels he can proceed VFR, it is usually a good practice to continue IFR into a terminal area until the destination airport is in sight.

While conducting simulated instrument flights, pilots should ensure that the weather provides adequate visibility to the safety pilot. Greater visibility is advisable when flying in or near a busy airway or close to an airport.

IFR JUDGMENT

The following tips are not necessarily based on Federal Aviation Regulations, but are offered as recommendations for pilot consideration. They do, however, address those elements of IFR flight that are common causes of accidents.

1. All pilots should have an annual IFR proficiency check, regardless of IFR hours flown.
2. For the first 25 hours of pilot-in-command time in airplane type, increase ILS visibility minimums and raise nonprecision approach minimums.
3. An operating autopilot or wing leveler is strongly recommended for single pilot IFR operations.
4. Do not depart on an IFR flight without an independent power source for attitude and heading systems, and an emergency power source for at least one VHF communications radio, or a hand-held communications radio.

5. Be sure the airplane has enough fuel to fly to the destination with a headwind calculated at 125 percent of the forecast wind, and a tailwind calculated at 75 percent of forecast wind. Also, include enough fuel to miss the approach at the destination airport, climb to cruise altitude and fly an approach at an alternate airport, plus 45 minutes of fuel for low altitude holding.
6. The IFR takeoff runway should meet the criteria of the accelerate-stop/go distances for that particular twin-engine airplane, or 200 percent of the distance to clear a 50-foot obstacle for a single.
7. Do not enter an area of embedded thunderstorms without on-board weather detection equipment (radar and/or Stormscope$_{TM}$) and unless cloud bases are at least 2000 feet above the highest terrain, terrain is essentially level, and VFR can be maintained. Avoid all cells by five miles, and severe storms by 20 miles.
8. Do not enter possible icing conditions unless all deice and anti-ice systems are fully operational, or the weather provides at least a 1000 foot ceiling and three miles visibility for the entire route over level terrain, and the surface temperatures are greater than 5°C.
9. Adhere to weather minimums, missed approach procedures and requirements for visual contact with the runway environment. If an approach is missed, with the runway not in sight at the appropriate time because of weather conditions, do not attempt another approach unless there is a valid reason to believe there has been a substantial improvement in the weather.
10. Observe the minimum runway requirement for an IFR landing. The minimum IFR runway length for propeller driven airplanes should be considered 200 percent of maximum landing distance. Increase these distances 90 percent for a wet runway and 150 percent for ice on the runway.
11. Make a missed approach if speed and configuration are not stable inside the middle marker or on nonprecision final, or if the touchdown aiming point will be missed by more than 1000 feet. If an approach is missed because of pilot technique, evaluate the reasons and options before attempting another approach.
12. Use supplemental oxygen above a cabin altitude of 5000 feet at night, and above 10,000 feet during the day.

WIND

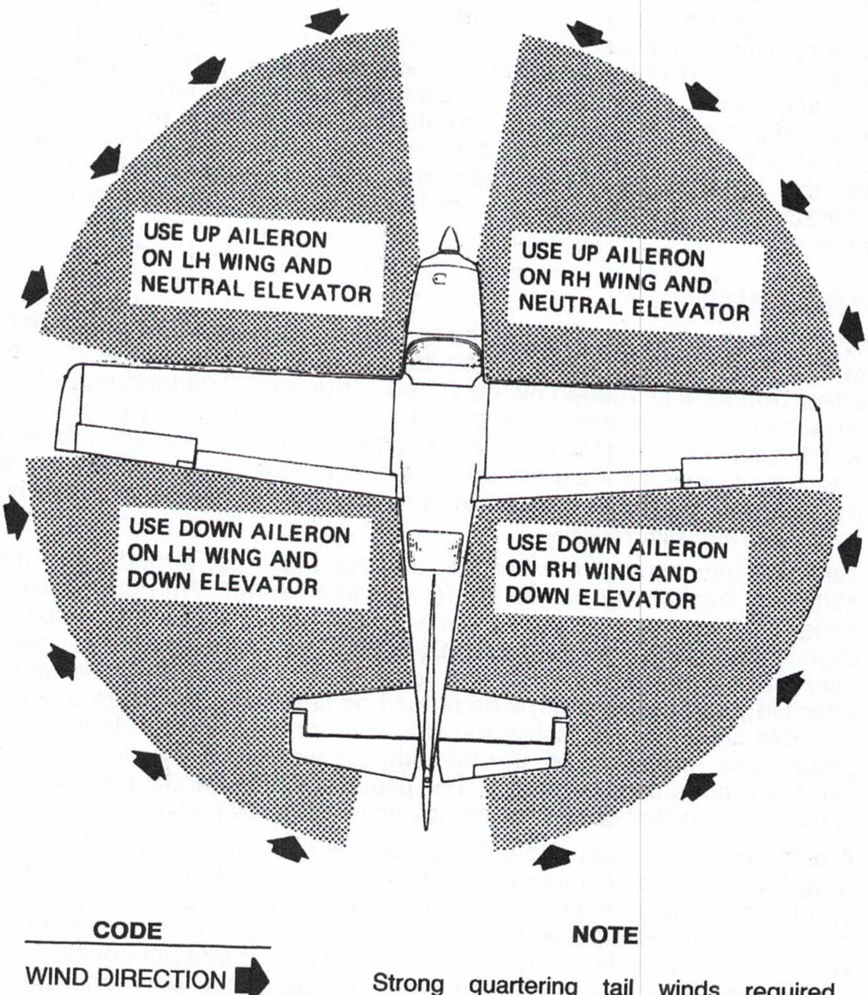
The keys to successfully counteracting the effects of wind are proficiency, understanding the wind response characteristics of the airplane, and a thoughtful approach to the operation. Some operating handbooks indicate a maximum demonstrated crosswind velocity, but this value is not considered to be limiting. There is an ultimate limit on wind for safe operation, which varies with the airplane and pilot. The lighter the airplane and the lower the stalling speed, the less wind it will take to exceed this limit. The way an airplane rests on its landing gear affects handling characteristics. If it sits nose down, the wing will be unloaded and the airplane will handle better in wind than an airplane which sits in a nose up attitude, creating a positive angle of attack. For the latter type, the full weight of the airplane cannot be on the wheels as the airplane is facing into the wind. Airplanes with these characteristics cause pilots to work harder to keep the airplane under control.

CROSSWIND

While an airplane is moving on the ground, it is affected by the direction and velocity of the wind. When taxiing into the wind, the control effectiveness is increased by the speed of the wind. The tendency of an airplane to weathervane is the greatest while taxiing directly crosswind, which makes this maneuver difficult. When taxiing in crosswind, speed and use of brakes should be held to a minimum and all controls should be utilized to maintain directional control and balance (see Crosswind Taxi Diagram, Figure 1).

Takeoffs into strong crosswinds are normally performed with the minimum flap setting necessary for the field length. With the ailerons deflected into the wind, the airplane should be accelerated to a speed slightly higher than normal (on multi-engine airplanes, additional power may be carried on the upwind engine until the rudder becomes effective), and then the airplane should be flown off abruptly to prevent possible settling back to the runway while drifting. When clear of the ground and any obstacle, the pilot should execute a coordinated turn into the wind to correct for drift. The pilot's ability to handle a crosswind is more dependent upon pilot proficiency than airplane limitations.

A crosswind approach and landing may be performed using either the wing-low, crab, or combination drift correction technique, depending upon the training, experience, and desires of the pilot. Use of the minimum flap setting required for the field length is recommended. Whichever method is used, the pilot should hold a straight course after touchdown with the steerable nose or tailwheel and occasional differential braking, if necessary.



NOTE

Strong quartering tail winds required caution. Avoid sudden bursts of the throttle and sharp braking when the airplane is in this attitude. Use the steerable nose or tail wheel and rudder to maintain direction.

Figure 1. Crosswind Taxi Diagram

On those airplanes with a steerable tailwheel, landings may be made with the tailwheel lock (if installed) engaged or disengaged. Although the use of the lock is left to the individual pilot's preference, it should be used during strong crosswind landings on rough fields with a heavily loaded airplane. If the lock were disengaged, this condition could lead to a touchdown with a deflected tailwheel and subsequent external forces on the tailwheel that are conducive to shimmy.

LOW LEVEL WIND SHEAR

Low level wind shear is the interflow of air masses near the ground, having different speeds and directions. As an airplane passes through the narrow boundary between the two air masses, large fluctuations in airspeed may be encountered depending on the difference in speed and direction of the air masses. Low level wind shear can be experienced through both the horizontal and vertical plane. One major risk with a wind shear encounter is that a sudden loss of airspeed may render the airplane out of control near the ground. Recovery depends on altitude and the magnitude of the airspeed loss.

A wind shear encounter can be reported as either positive or negative. A positive wind shear is one in which the headwind component suddenly increases. The airplane's inertia makes it tend to maintain the same velocity through space, not through air, so the first thing a pilot is likely to notice is an increase in airspeed. The opposite case, a negative wind shear, is a sudden decrease in headwind component. The airplane will begin to sink immediately, as lift is decreased by the reduced airspeed; and as the natural aerodynamics, and/or the pilot, lowers the nose, the descent rate increases.

The effects of wind shear on smaller airplanes are sometimes less severe than on large jetliners. Smaller airplanes have less mass (and therefore less inertia), and their speed can change more quickly. Thus, a smaller airplane can return to its trimmed speed, after encountering a wind shear, more rapidly than a larger, heavier one.

TYPES OF WIND SHEAR CONDITIONS

Wind shear is encountered in several distinct weather scenarios. Within a frontal zone, as one air mass overtakes another, variations in wind speed and direction can be significant. Fast moving cold fronts, squall lines, and gust fronts pose the highest risk.

A temperature inversion can present a fast moving air mass directly above a very stable calm layer at the surface. Under these conditions an airplane on approach with a headwind aloft will experience a rapid loss of airspeed during descent through the boundary layer to the calm air beneath.

The most violent type of wind shear is that induced by convective activity and thunderstorms. Downdrafts created by local areas of descending air (roughly 5 to 20 miles diameter) can exceed 700 feet per minute. At times, very small areas of descending air (1 mile or so in diameter), called microbursts, can reach vertical speeds of 6000 feet per minute or more. Such downdrafts generate significant turbulence and exceed the climb capability of many airplanes. In addition, as the downdraft/microburst reaches the ground, the air spreads in all directions. The pilot entering the area at relatively low altitude will likely experience an increase in airspeed followed by a dramatic decrease in airspeed and altitude while exiting the area.

INDICATIONS OF WIND SHEAR

The winds near or around the base of a thunderstorm are largely unpredictable, but there are identifiable signs that may indicate that wind shear conditions exist. Small areas of rainfall, or shafts of heavy rain are clues to possible wind shear conditions. Virga, or rain shafts that evaporate before reaching the ground, may indicate cool, dense air sinking rapidly and may contain microburst winds. On the ground, such signs as trees bending in the wind, ripples on water, or a line of dust clouds should alert the pilot.

With the presence of a strong temperature inversion, if low clouds are moving rapidly but winds are calm or from a different direction on the surface, a narrow wind shear zone might exist and the pilot may elect to use a higher climb speed until crossing the zone. Conversely, while in the landing pattern or on an approach, if the reported surface winds are significantly different than that being experienced in flight, it must be taken as a warning to the potential of wind shear.

A pilot who has been holding a wind correction angle on final approach, and suddenly finds that a change has to be made - i.e., the runway (or CDI needle) starts moving off to the side - most likely encountered wind shear. The usual techniques apply, such as an appropriate heading change, but more importantly, the pilot has been alerted to the presence of a wind shear situation and should be ready to deal with a more serious headwind to tailwind shear at any time.

COPING WITH WIND SHEAR

A pilot can cope with wind shear by maintaining a somewhat higher airspeed not to exceed V_A (maneuvering speed), since the conditions conducive to wind shear are also often conducive to turbulence. Pilots should be alert for negative wind shear; if the airspeed is suddenly decreasing, the sink rate increasing, or more than usual approach power is required, a negative wind shear may well have been encountered. Also, the closer the airplane gets to the ground, the smaller the margin for sink recovery.

Be prepared to go around at the first indication of a negative wind shear. A positive wind shear may be followed immediately by a negative shear.

Some larger airports are equipped with a low-level wind shear alerting system (LLWAS). Many have ATIS, and or AWOS wind information. All elements of the weather conditions including pilot reports should be carefully considered and any pilot who experiences wind shear should warn others.

In summary, all pilots should remain alert to the possibility of low level wind shear. If wind shear is encountered on final approach, usually characterized by erratic airspeed and altimeter indications and almost always associated with uncommanded airplane attitude changes, do not hesitate to go around. If the approach profile and airspeed cannot be reestablished, it cannot be emphasized too strongly that a go-around is often the pilot's best course of action, and the earlier the decision to go around, the better the chance of recovery.

THUNDERSTORM AVOIDANCE

Much has been written about thunderstorms. They have been studied for years, and while considerable information has been learned, the studies continue because questions still remain. Knowledge and weather radar have modified our attitudes toward thunderstorms. But any storm recognizable as a thunderstorm should be considered hazardous. Never regard any thunderstorm lightly, even when radar observers report the echoes are of light intensity. Avoiding all thunderstorms is the best policy.

The following are some do's and don'ts of thunderstorm avoidance:

1. Don't land or takeoff in the face of an approaching thunderstorm. A sudden gust front of low level turbulence (wind shear) could cause loss of control.
2. Don't attempt to fly under a thunderstorm, even if you can see through to the other side. Turbulence and wind shear under the storm is likely and hazardous.
3. Don't fly near clouds containing embedded thunderstorms. Scattered thunderstorms that are not embedded usually can be visually circumnavigated.
4. Don't trust the visual appearance to be a reliable indicator of the turbulence inside a thunderstorm.
5. Do avoid, by at least 20 miles, any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.
6. Do circumnavigate the entire area if the area has 6/10 thunderstorm coverage.
7. Do remember that vivid and frequent lightning indicates the probability of a severe thunderstorm.

8. Do regard, as extremely hazardous, any thunderstorm with tops 35,000 feet or higher, whether the top is visually sighted or determined by radar.
9. Do check the convective outlook during weather briefings.

The following are some do's and don'ts during inadvertent thunderstorm area penetration:

1. Do keep your eyes on the instruments. Looking outside the cabin can increase the danger of temporary blindness from lightning.
2. Don't change power settings; maintain settings for the recommended turbulent air penetration speed.
3. Do maintain a generally constant attitude.
4. Don't attempt to maintain altitude. Maneuvers made in attempting to maintain an exact altitude increase the stress on the airplane.
5. Exit the storm as soon as possible.

A pilot on an IFR flight plan must not deviate from an approved route or altitude without proper clearance, as this may place him in conflict with other air traffic. Strict adherence to traffic clearance is necessary to assure an adequate level of safety.

Always remember, all thunderstorms are potentially hazardous and the pilot is best advised to avoid them whenever possible.

FROM WARM WEATHER TO COLD WEATHER

Flying from warm weather to cold weather can do unusual things to airplanes. To cope with this problem, pilots must be alerted to a few preparations. If the airplane is serviced with a heavier grade of oil, such as SAE 50, the oil should be changed to a lighter grade such as SAE 30 before flying into very cold weather. If use of a multi-viscosity oil is approved, it is recommended for improved starting in cold weather. Refer to the airplane operating handbook or maintenance manual for approved oils. An engine/airplane winterization kit may be available for the airplane. It usually contains restrictive covers for the cowl nose cap and/or oil cooler and engine crankcase breather for flight in very cold weather. Proper preflight draining of the fuel system from all drains is especially important and will help eliminate any free water accumulation. The use of fuel additives, such as Prist or EGME, may also be desirable. Refer to the airplane operating handbook or maintenance manual for approved fuel additives.

In order to prevent propeller freeze-up when operating in very cold weather, it may be necessary to exercise the constant speed prop every few minutes. This can be accomplished by moving the prop controls forward or aft from their cruise position 300 RPM and back during flight.

ICE, SNOW, FROST, Etc.

For any extended time, it is always best to park an airplane in a hangar, particularly during inclement weather. When this is not possible, all ice, snow, frost, etc., must be removed from the entire airframe and engine(s) prior to starting.

The presence of ice, snow, frost, etc., on the wings, tail, control surfaces (externally and internally), etc., is hazardous. Safe operation depends upon their removal. Too often, their effects on airplane performance are not completely understood or appreciated.

WAKE TURBULENCE

Airplanes are significantly affected by the wake turbulence of any heavier aircraft or helicopter. Wake turbulence dissipation and displacement are functions of elapsed time and prevailing wind speed and direction. During calm conditions, severe turbulence generated by large aircraft can persist as long as 10 minutes. Delay takeoff to ensure dissipation and displacement of wake turbulence. When it is necessary to take off behind a heavier aircraft or helicopter, avoid wake turbulence, particularly wake vortices, by vertical or lateral spacing or an appropriate time delay.

Vertical avoidance is appropriate to longer runways where operations can be completed on portions of the runway not affected by the vortices of preceding aircraft and flying above areas where vortices will be present is possible. Become airborne well before the preceding aircraft rotation point and climb above its flight path, or lift off beyond the touchdown point of a landing aircraft. When it is necessary to land behind another aircraft, remain above its approach path and land beyond its touchdown point. Touchdown prior to the rotation point of a departing aircraft.

Lateral movement of wake vortices is only possible when a significant crosswind exists and is not detectable unless exhaust smoke or dust marks the vortices. Consider offsetting the takeoff path to the upwind side of the runway.

RESTRAINT SYSTEMS

SEAT RESTRAINTS

Records of general aviation airplane accident injuries reveal a surprising number of instances in which the occupants were not properly using the available restraint system, indicating the presence of a complacent attitude during airplane preflight briefing inspections. An unbuckled restraint system during a critical phase of flight, such as during turbulence, could cause loss of control of the airplane and/or injuries. Although the ultimate responsibility lies with the pilot-in-command, each user of a restraint system should be cognizant of the importance of proper use of the complete restraint system.

Pilots should ensure that all occupants properly use their individual restraint systems. The system should be adjusted snug across the body. A loose restraint belt will allow the wearer excessive movement and could result in serious injuries. The wearer should not allow sharp or hard items in pockets or other clothing to remain between their body and the restraint system to avoid discomfort or injury during adverse flight conditions or accidents. Each occupant must have their own restraint system. Use of a single system by more than one person could result in serious injury.

Occupants of adjustable seats should position and lock their seats before fastening their restraint system. Restraint belts can be lengthened before use by grasping the sides of the link on the link half of the belt and pulling against the belt. Then, after locking the belt link into the belt buckle, the belt can be tightened by pulling the free end. The belt is released by pulling upward on the top of the buckle. Restraint systems must be fastened anytime the airplane is in motion. Before takeoff, the pilot should brief all passengers on the proper use, including the method of unlatching the entire restraint system, in the event that emergency egress from the airplane is necessary.

Small children must be secured in an approved child restraint system as defined in FAR 91.107 "Use of safety belts, shoulder harnesses, and child restraint systems". The pilot should know and follow the instructions for installation and use provided by the seat manufacturer. The child restraint system should be installed in an aircraft seat other than a front seat. If the child restraint system is installed in a front seat, the pilot must ensure that it does not interfere with full control movement or restrict access to any aircraft controls. Also, the pilot should consider whether the child restraint system could interfere with emergency egress. Refer to AC 91-62A, "Use of Child Seats In Aircraft" for more information.

If shoulder restraints are not installed, kits are available from Cessna or from other approved sources. Cessna strongly recommends the installation of shoulder harnesses.

SEAT STOPS/LATCHES

The pilot should visually check the seat for security on the seat tracks and assure that the seat is locked in position. This can be accomplished by visually ascertaining pin engagement and physically attempting to move the seat fore and aft to verify the seat is secured in position. Failure to ensure that the seat is locked in position could result in the seat sliding aft during a critical phase of flight, such as initial climb. Mandatory Service Bulletin SEB89-32 installs secondary seat stops and is available from Cessna.

The pilot's seat should be adjusted and locked in a position to allow full rudder deflection and brake application without having to shift position in the seat. For takeoff and landing, passenger seat backs should be adjusted to the most upright position.

SECURITY IN AFT-FACING SEATS

Some aft-facing seats are adjustable fore and aft, within the limits of the seat stops. Ensure the seat stop pins are engaged with the holes in the seat tracks before takeoff and landing. The restraint system should be worn anytime the seat is occupied. Assure that the seats are installed in the correct positions. Approved seat designs differ between forward-facing and rear-facing seats and proper occupant protection is dependent upon proper seat installation.

FUEL SYSTEM CONTAMINATION

ADEQUATE PREFLIGHT OF THE FUEL SYSTEM

A full preflight inspection is recommended before each flight for general aviation airplanes. Inspection procedures for the fuel system must include checking the quantity of fuel with the airplane on level ground, checking the security of fuel filler caps and draining the fuel tank sumps, fuel reservoir(s), fuel line drain(s), fuel selector drains, and fuel strainer(s). To ensure that no unsampled fuel remains in the airplane, an adequate sample of fuel from the fuel strainer must be taken with the fuel selector valve placed in each of its positions (BOTH, LEFT, RIGHT, etc.). Some Cessna airplanes are equipped with a fuel reservoir(s). If so equipped, the pilot should be aware of the location of the fuel reservoir(s) and its drain plug or quick-drain. The fuel reservoir(s) on most single-engine airplanes is located near the fuel system low point where water will accumulate. Therefore, the fuel reservoir(s) must be drained routinely during each preflight inspection. Periodically check the condition of the fuel filler cap seals, pawls, and springs for evidence of wear and/or deterioration which indicates a need for replacement. Check fuel cap adapters and seals to insure that the sealing surfaces are clean and not rusted or pitted. Deformed pawls may affect the sealing capabilities of the seals and/or cause it to be exposed to detrimental weather elements. Precautions should be taken to prevent water entry into fuel tanks, due to damaged filler caps and every effort made to check and remove all water throughout the fuel system. Umbrella caps will assist in preventing water entry into the fuel tank through the fuel filler.

It is the pilot's responsibility to ensure that the airplane is properly serviced before each flight with the correct type of fuel. The pilot must take the time to inspect the airplane thoroughly, making sure all of the fuel filler caps are installed and secured properly after visually checking the fuel quantity with the airplane on level ground. During the check of the fuel tanks, observe the color and odor of the fuel while draining a generous sample from each sump and drain point into a transparent container. Check for the presence of water, dirt, rust, or other contaminants. Never save the fuel sample and risk the possibility of contaminating the system. Also, ensure that each fuel tank vent is clear of restrictions (i.e., dirt, insect nests, ice, snow, bent or pinched tubes, etc.). Refer to the airplanes Maintenance Manual for fuel tank vent removal and inspection if needed.

PROPER SAMPLING FROM QUICK DRAINS

The fuel system sumps and drains should always be drained and checked for contaminants after each refueling and during each preflight inspection. Drain at least a cupful of fuel into a clear container to check for solid and/or liquid contaminants, and proper fuel grade. If contamination is observed, take further samples at all fuel drain points until fuel is clear of contaminants; then, gently rock wings and, if possible, lower the tail to move any additional contaminants to the sampling points. Take repeated samples from all fuel drain points until all contamination has been removed. If excessive sampling is required, completely defuel, drain and clean the airplane fuel system, and attempt to discover where or how the contamination originated before the airplane flies again. Do not fly the airplane with contaminated or unapproved fuel. If an improper fuel type is detected, the mandatory procedure is to completely defuel and drain the fuel system.

Extra effort is needed for a proper preflight of all fuel drains on a float plane. If water is detected after rocking the wings and lowering the tail, the aircraft should not be flown until after the fuel system is completely drained and cleaned.

80 versus 100 OCTANE FUEL

When 80 octane (red) fuel began to be replaced by 100LL (blue) there was concern about the service life expectancy of low compression engines. It was claimed that some engines experienced accelerated exhaust valve erosion and valve guide wear from the use of highly leaded 100/130 (green) avgas in engines that were rated to use a minimum grade of 80 octane fuel. Engine manufacturers have provided amended operating procedures and maintenance schedules to minimize problems resulting from the use of high lead 100/130 avgas. Experience has now proven that low-compression aircraft engines can be operated safely on 100LL avgas providing they are regularly operated and serviced in accordance with the operating handbook or other officially approved document.

AVGAS versus JET FUEL

Occasionally, airplanes are inadvertently serviced with the wrong type of fuel. Piston engines may run briefly on jet fuel, but detonation and overheating will soon cause power failure. All piston-engine airplanes should have fuel filler restrictors installed to prevent jet fuel from being pumped into the fuel tanks. An engine failure caused by running a turbine engine on the wrong fuel may not be as sudden, but prolonged operation on avgas will severely damage the engine because of the lead content and differing combustion temperature of the fuel. Time limitations for use of avgas in turbine engines are listed in the operating handbook.

AUTOMOTIVE GASOLINE/FUEL

Never use automotive gasoline in an airplane unless the engine and airplane fuel system are specifically certified and approved for automotive gasoline use. The additives used in the production of automotive gasoline vary widely throughout the petroleum industry and may have deteriorating effects on airplane fuel system components. The qualities of automotive gasoline can induce vapor lock, increase the probability of carburetor icing, and can cause internal engine problems.

FUEL CAP SECURITY

The consequence of a missing or incorrectly installed fuel filler cap is inflight fuel siphoning. Inflight siphoning may distort the fuel cell on some airplanes with bladder-type fuel cells. This distortion will change the fuel cell capacity, and may interfere with the operation of the fuel quantity indicator sensing mechanism inside the cell. This condition will generally cause an erroneous and misleading fuel quantity reading and may result in incomplete filling for the next flight.

CONTAMINATION

Solid contamination may consist of rust, sand, pebbles, dirt, microbes or bacterial growth. If any solid contaminants are found in any part of the fuel system, drain and clean the airplane fuel system. Do not fly the airplane with fuel contaminated with solid material.

Liquid contamination is usually water, improper fuel type, fuel grade, or additives that are not compatible with the fuel or fuel system components. Liquid contamination should be addressed as set forth in the section entitled "Proper Sampling from Quick Drains", and as prescribed in the airplane's approved flight manual.

FUEL PUMP OPERATION

AUXILIARY FUEL PUMP OPERATION - GENERAL

The engine-driven fuel pump is designed to supply an engine with a steady, uninterrupted flow of fuel. Temperature changes, pressure changes, agitation in the fuel lines, fuel quality, and other factors can cause a release of vapor in the fuel system. Some airplanes (single and multi-engine) incorporate an auxiliary fuel pump to reduce excess fuel vapor in the fuel supply for each engine. This pump is also used to ensure that a positive supply of fuel is available in the event the engine driven fuel pump should fail.

FUEL VAPOR

Under hot, high altitude conditions, or in situations during a climb that are conducive to fuel vapor formation, it may be necessary to utilize the auxiliary fuel pump(s) to attain or stabilize the fuel flow required for proper engine operation. Use the auxiliary fuel pump(s) in all conditions where there is any possibility of excessive fuel vapor formation or temporary disruption of fuel flow in accordance with operating handbook procedures.

SINGLE ENGINE FUEL PUMP OPERATION (CARBURETED ENGINE)

On some carbureted, high wing, single engine airplanes, the auxiliary fuel pump should be turned on anytime the indicated fuel pressure falls below the minimum. Typically this would only occur in an extreme climb attitude following failure of the engine driven fuel pump. Consult the operating handbook of the affected model for a detailed description of the procedure.

SINGLE ENGINE FUEL PUMP OPERATION (PRECISION/BENDIX FUEL INJECTED ENGINE)

The auxiliary fuel pump is used primarily for priming the engine before starting. Priming is accomplished through the regular injection system. If the auxiliary fuel pump switch is placed in the ON position for prolonged periods with the master switch turned on, the mixture rich, and the engine stopped, the intake manifolds will become flooded.

The auxiliary fuel pump is also used for vapor suppression in hot weather. Normally, momentary use will be sufficient for vapor suppression. Turning on the auxiliary fuel pump with a normally operating engine pump will result in enrichment of the mixture. The auxiliary fuel pump should not be operated during takeoff and landing, since gravity and the engine driven fuel pump will supply adequate fuel flow to the fuel injector unit. In the event of failure of the engine driven fuel pump, use of the auxiliary fuel pump will provide sufficient fuel to maintain flight at maximum continuous power.

To ensure a prompt engine restart after running a fuel tank dry, switch the fuel selector to the opposite tank at the first indication of fuel flow fluctuation or power loss. Turn on the auxiliary fuel pump and advance the mixture control to full rich. After power and steady fuel flow are restored, turn off the auxiliary fuel pump and lean the mixture as necessary.

SINGLE ENGINE FUEL PUMP OPERATION (TCM FUEL INJECTED ENGINE)

The auxiliary fuel pump on single engine airplanes is controlled by a split rocker type switch labeled AUX PUMP. One side of the switch is red and is labeled HI; the other side is yellow and is labeled LO.

The LO side operates the pump at low speed, and, if desired, can be used for starting or vapor suppression. The HI side operates the pump at high speed, supplying sufficient fuel flow to maintain adequate power in the event of an engine driven fuel pump failure. In addition, the HI side may be used for normal engine starts, vapor elimination in flight, and inflight engine starts.

When the engine driven fuel pump is functioning and the auxiliary fuel pump is placed in the HI position, a fuel/air ratio considerably richer than best power is produced unless the mixture is leaned. Therefore, the auxiliary fuel pump must be turned off during takeoff or landing, and during all other normal flight conditions. With the engine stopped and the battery switch on, the cylinder intake ports can become flooded if the HI or LO side of the auxiliary fuel pump switch is turned on.

In hot, high altitude conditions, or climb conditions that are conducive to fuel vapor formation, it may be necessary to utilize the auxiliary fuel pump to attain or stabilize the fuel flow required for the type of climb being performed. Select either the HI or LO position of the switch as required, and adjust the mixture to the desired fuel flow. If fluctuating fuel flow (greater than 5 lbs/hr) is observed, place the auxiliary fuel pump switch in the HI or LO position as required to clear the fuel system of vapor. The auxiliary fuel pump may be operated continuously in cruise, if necessary, but should be turned off prior to descent. Each time the auxiliary fuel pump switch is turned on or off, the mixture should be readjusted.

MULTI-ENGINE FUEL PUMP OPERATION

Cessna multi-engine, low wing airplanes utilize engine driven fuel pumps to assist the continuous flow of fuel to the engine. As a general rule, the auxiliary fuel pumps should be utilized under the following conditions:

1. Every takeoff.
2. Initial climb after takeoff (unless the operating handbook indicates that it is not necessary).
3. When switching the fuel selector(s) from one tank to another.
4. Every approach and landing.
5. Anytime the fuel pressure is fluctuating and the engine is affected by the fluctuation.
6. During hot weather, such as hot engine ground operation where fuel vapor problems cause erratic engine operation.
7. High altitude. (For auxiliary fuel pump operation at high altitude consult the operating handbook.)
8. If the engine driven fuel pump should fail.
9. On some twins when using the auxiliary fuel tanks.

If the auxiliary fuel pump is used during ground operations, such as hot day engine starts or purging fuel vapor, pilots should check the condition of the engine driven fuel pump before takeoff by turning the auxiliary fuel pump OFF briefly, and then back ON for takeoff. If the engine driven fuel pump has failed, the engine will not continue to operate.

If the battery or master switch is on while an engine is stopped on the ground or in flight, the cylinder intake ports can become flooded if the auxiliary fuel pump is turned on. If this situation occurs in excess of 60 seconds, the cylinders must be purged as follows:

1. With the auxiliary fuel pump OFF, allow the induction manifold to drain at least five minutes or until fuel ceases to flow from the drains on the bottom of the engine.
2. If natural draining has occurred, ensure that the auxiliary fuel pump is OFF, the magnetos or ignition switch is OFF, the mixture is in IDLE CUT-OFF, and the throttle is FULL OPEN, then turn the engine with the starter.
3. If natural draining has not occurred, perform maintenance as required.

A mandatory service bulletin (MEB88-3) was issued to replace the automatic fuel pressure sensing and the cockpit auxiliary fuel pump switches for each engine with three-position lever lock type toggle switches. These modifications provide direct pilot activation of the auxiliary fuel pumps.

On low wing multi-engine airplanes (except model 310, 310A, and 310B, which are not affected by this change), the switches are labeled AUX PUMP, L (left engine) and R (right engine) and switch positions are labeled LOW, OFF, and HIGH. The LOW position operates the auxiliary fuel pumps at low pressure and can be used, when required, to provide supplementary fuel pressure for all normal operations. The switches are OFF in the middle position. The HIGH position is reserved for emergency operation, and operates the pumps at high pressure. The switches are locked out of the HIGH position and the switch toggle must be pulled to clear the lock before it can be moved to the HIGH setting. The toggle need not be pulled to return the switch to OFF.

The LOW position of the auxiliary fuel pump switches should be used whenever an original manual/handbook or checklist procedure specifies either LOW (PRIME, in 310C, 310D 310F, 310G, 310H, 320, and 320A.) or ON. The LOW position is also used anytime there are indications of vapor, as evidenced by fluctuating fuel flow. Auxiliary fuel pumps, if needed, are to be operated on LOW in all conditions except when an engine driven fuel pump fails.

The HIGH position supplies sufficient fuel flow to sustain partial engine power and should be used solely to sustain the operation of an engine in the event its engine driven fuel pump fails. Failure of an engine driven fuel pump will be evidenced by a sudden reduction in the fuel flow indication immediately prior to a loss of power while operating from a fuel tank containing adequate fuel. In an emergency, where loss of an engine driven fuel pump is involved, pull the applicable auxiliary fuel pump switch to clear the lock and select the HIGH position. Then adjust the throttle and mixture controls to obtain satisfactory operation. At high manifold pressure and RPM, auxiliary fuel pump output may not be sufficient for normal engine operation. In this case, reduce manifold pressure to a level compatible with the indicated fuel flow. At low power settings, the mixture may have to be leaned for smooth engine operation. If HIGH auxiliary pump output does not restore adequate fuel flow, a fuel leak may exist. The auxiliary pump should be shut off and the engine secured.

If the auxiliary fuel pump switches are placed in the HIGH position with the engine-driven fuel pump(s) operating normally, total loss of engine power may occur due to flooding.

When performing single engine operations, the auxiliary fuel pump of the engine to be shutdown should be turned OFF prior to any intentional engine shutdown, to preclude fuel accumulation in the engine intake system.

In models 310, 310A, and 310B, which are equipped with pressure type carburetors, the electric fuel boost pumps in the tanks provide a positive fuel flow as emergency pumps in the event of failure of the engine driven fuel pumps. They also provide fuel pressure for priming and starting. The boost pumps are operated by two electric switches, and the up position is ON. Always take off and land with these pumps turned ON. Anytime the boost pumps are turned on without the engines running, mixture controls must be in the idle cut-off position to prevent flooding the intake manifolds.

CENTERLINE THRUST TWINS (FUEL PUMP OPERATION)

The auxiliary fuel pumps on the centerline thrust models (336 and 337 Skymaster) are controlled by two split rocker type switches. The switches are labeled AUX PUMPS and F ENGINE R. One side of each switch is red and is labeled HI. The other side is yellow and is labeled LO. The LO side operates the pumps at low speed, and if desired, can be used for starting or vapor suppression. The HI side operates the pumps at high speed, supplying sufficient fuel flow to maintain adequate power in the event of an engine driven fuel pump failure. In addition, the HI side may be used for normal engine starts, vapor elimination in flight, and inflight engine starts.

When the engine driven fuel pump is functioning and the auxiliary fuel pump is placed in the HI position, a fuel/air ratio considerably richer than best power is produced unless the mixture is leaned. Therefore, these switches must be turned OFF during takeoff or landing, and during all other normal flight conditions. With the engine stopped and the battery switch ON, the cylinder intake ports can become flooded if the HI or LO side of the auxiliary fuel pump switch is turned on.

In hot, high altitude conditions, or climb conditions that are conducive to fuel vapor formation, it may be necessary to utilize the auxiliary fuel pumps to attain or stabilize the fuel flow required for the type of climb being performed. Select either the HI or LO position of the switches as required, and adjust the mixtures to the desired fuel flow. If fluctuating fuel flow (greater than 5 lbs/hr) is observed, place the appropriate auxiliary fuel pump switch in the HI or LO position as required to clear the fuel system of vapor. The auxiliary fuel pump may be operated continuously in cruise, if necessary, but should be turned off prior to descent. Each time the auxiliary fuel pump switches are turned on or off, the mixtures should be readjusted.

AUXILIARY FUEL TANKS

Many twin engine Cessna airplanes incorporate auxiliary fuel tanks to increase range and endurance. These tanks are usually bladder type cells located symmetrically in the outboard wing areas and contain no internal fuel pumps. When selected, the fuel from these tanks is routed to the engine driven fuel pump.

If the auxiliary fuel tanks are to be used, the pilot must first select main tank (tip tank) fuel for at least 60 minutes of flight (with use of 40-gallon auxiliary fuel tanks) or 90 minutes of flight (with use of 63-gallon auxiliary fuel tanks). This is necessary to provide space in the main fuel tanks for vapor and fuel returned from the engine driven fuel pumps when operating on the auxiliary fuel tanks. If sufficient space is not available in the main tanks for this returned fuel, the tanks can overflow through the overboard fuel vents. Since part of the fuel from the auxiliary fuel tanks is diverted back to the main tanks instead of being consumed by the engines, the auxiliary tanks will empty sooner than may be anticipated. However, the main tank volume or quantity will be increased by the returned fuel.

The fuel supply in the auxiliary fuel tanks is intended for use during cruise flight only. The shape of the auxiliary fuel tanks is such that during certain flight maneuvers, the fuel will move away from the fuel tank outlet. If the outlet is uncovered while feeding the engine, fuel flow to the engine will be interrupted and a temporary loss of power may result. Because of this, operation from the auxiliary fuel tanks is not recommended below 1000 feet AGL.

An optional auxiliary fuel tank may be installed on some centerline thrust twins (336 and 337 Skymaster). The system consists of two tanks, each containing 18 gallons (108 pounds) usable, one located in each inboard wing panel. The tanks feed directly to the fuel selector valves. The left auxiliary tank provides fuel to the front engine only and the right auxiliary tank provides fuel to the rear engine only. Fuel quantity for the auxiliary tanks is read on the same fuel quantity indicators used for the main fuel tanks. This is accomplished when the fuel selector valve handles are turned to the AUXILIARY position. As each selector valve handle is turned to this position, it depresses a gaging button, labeled PUSH TO GAGE, located in the AUXILIARY quadrant of the fuel selector valve placard. The depressed button actuates a microswitch and electrically senses auxiliary fuel rather than main fuel quantity. Auxiliary fuel quantity can be checked without changing the selector valve handle, by depressing the PUSH TO GAGE button manually. Depressing the gaging button, either manually or by rotating the selector valve handle to the AUXILIARY position, will illuminate the amber AUX FUEL ON indicator lights mounted above the engine instrument cluster. When fuel is being used from the auxiliary fuel tanks, any excess fuel and vapor from the engine driven pumps is returned to fuel line manifolds. The returned vapor passes through the fuel line manifolds to the vent lines and is routed overboard. The excess fuel passes into the fuel line manifold and is returned to the engine driven pumps.

On some early model Skymasters, fuel vapor from the engine driven fuel pumps is returned to the main fuel tanks. When the selector valve handles are in the AUXILIARY position, the left auxiliary tank feeds only the front engine and the right auxiliary tank feeds only the rear engine. If the auxiliary tanks are to be used, select fuel from the main tanks for 60 minutes prior to switching to auxiliary tanks. This is necessary to provide space in the main tanks for vapor and fuel returned from the engine driven fuel pumps when operating on auxiliary tanks. On some models, auxiliary fuel boost pumps are not provided for the auxiliary fuel tank. Therefore it is recommended to use the auxiliary fuel tanks only in straight and level flight. When unsure of the type of auxiliary tank installation, consult the operating handbook for the respective airplane.

A few single-engine airplanes contain an auxiliary fuel tank. The system's main components include a fuel tank installed on the baggage compartment floor and an electric fuel transfer pump. The auxiliary fuel system is plumbed into the right main fuel tank.

To use the auxiliary fuel system, select the right wing fuel tank in cruise and operate on that tank until the fuel tank has adequate room for the transfer of auxiliary fuel. After selecting the left main tank, turn on the auxiliary fuel transfer pump to refill the right main fuel tank from the auxiliary tank. Transfer will take from 45 minutes to 1 hour. Prior to transfer, ensure that adequate fuel is available in the left tank to allow time for the auxiliary tank to transfer.

Do not operate the transfer pump with the fuel selector valve turned to either the BOTH or RIGHT positions. Total or partial engine stoppage will result from air being pumped into fuel lines after fuel transfer has been completed. If this should occur the engine will restart in 3 to 5 seconds after turning off the transfer pump, as the air in the fuel line will be evacuated rapidly.

After transfer is complete and the pump has been turned off, the selector may be returned to BOTH or RIGHT. Takeoff, climb, and landing should always be conducted with the selector in the BOTH position for maximum safety.

WING LOCKER FUEL TANK USAGE

Some twins may have wing locker fuel tanks installed in the forward portion of each wing locker baggage area. These tanks are bladder type cells for storage of extra fuel to supplement the main tank fuel quantity. The fuel in these tanks cannot be fed directly to the engines. Instead, it has to be transferred to the main tanks by wing locker fuel transfer pumps. Fuel transfer should begin as soon as adequate volume is available in the main fuel tanks to hold the wing locker fuel. Waiting until the main tanks are low before transferring wing locker fuel does not allow early recognition of possible failure to transfer.

If wing locker fuel is to be used, consult the operating handbook for the quantity of main tank fuel which must first be used in the respective main tank for the transferred wing locker fuel. This will prevent overflowing of the main tank(s) when transferring the wing locker fuel.

Wing locker fuel transfer pump switches are provided to manually control the transfer of the wing locker fuel to the main tanks. These switches should be turned ON only to transfer fuel and turned OFF when indicator lights illuminate to show that fuel has been transferred. The transfer pumps use the fuel in the wing locker tank for lubrication and cooling. Therefore, transfer pump operation after fuel transfer is complete will shorten the life of the pump, Fuel should be cross fed, as required, to maintain fuel balance.

INSTRUMENT POWER

VACUUM POWER FAILURES

Many airplanes may be equipped with some type of back-up vacuum system for operation in the event the primary vacuum system becomes inoperative in flight. The backup system may be in the form of another engine-driven vacuum pump, in parallel with the primary pump, or an electric standby vacuum pump, also in parallel with the primary pump, or both. If a back-up system is not available and the attitude and directional indicators are disabled, the pilot must rely on partial instrument panel operation. This may include using the electrically-powered turn coordinator or turn and bank indicator and the magnetic compass, altimeter, airspeed indicator, and rate of climb indicator.

A suction gage, and in some airplanes a low-vacuum warning light, provides a means of monitoring the vacuum system for proper operation in flight. Operating handbooks reflect a desired suction range during normal operation of the airplane. A suction reading outside of this range may indicate a system malfunction, and in this case, the vacuum driven instruments should not be considered reliable. Whenever operation of the airplane's vacuum system is in doubt, land when practical for repairs.

In the event of a directional indicator and attitude indicator failure due to vacuum failure, the pilot must rely on partial instrument panel operation using the remaining instruments. VFR operations can generally be conducted satisfactorily without the vacuum instruments. However, instrument meteorological conditions (IMC) can be considerably more challenging. An instrument rated pilot should stay current on partial panel flying skills but both VFR and IFR pilots should maintain VFR conditions if a vacuum failure occurs while clear of clouds. All pilots should become familiar with the following procedure for executing a 180° turn in clouds with the aid of either the turn coordinator or the turn and bank indicator.

Upon inadvertently entering clouds, maintain control of the aircraft. If it is desired to turn back out of the clouds, the following action should be employed:

1. Note the compass heading.
2. Note the time in both minutes and seconds.
3. When the seconds indicate the nearest half minute, initiate a standard rate left turn, holding the turn coordinator or turn and bank indicator (if installed) 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 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 over controlling by keeping the hands off the control wheel as much as possible and steering only with the rudder.

If conditions dictate, a descent through a cloud deck to VFR conditions may be appropriate. 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 conditions as follows:

1. Extend landing gear (if applicable).
2. Enrichen the fuel mixture.
3. Use full carburetor heat (if applicable).
4. Reduce power to set up a 500 to 800 ft/min rate of descent.
5. Adjust the elevator trim and rudder trim (if installed) for a stabilized descent at 5 to 20 knots above the best glide speed for the airplane.
6. Keep hands off the control wheel.
7. Monitor turn coordinator and make corrections by rudder alone.
8. Check trend of compass card movement and make cautious corrections with rudder to stop the turn.
9. Upon breaking out of clouds, resume normal cruise flight.

ELECTRICAL POWER FAILURES

Many operating handbooks have emergency procedures for partial or total loss of electrical power in flight. These procedures should be reviewed periodically to remain knowledgeable of what to do in the event of an electrical problem. The pilot should maintain control of the airplane and land when practical if an electrical power loss is evident.

Early detection of an electrical power supply system malfunction can be accomplished by periodically monitoring the ammeter and, if equipped, low voltage warning light. The cause of these malfunctions is difficult to determine in flight. Common causes of alternator or generator failure are a broken drive belt, alternator or generator drive, a defective alternator control unit or voltage regulator or wiring. Problems of this nature constitute an electrical emergency and should be addressed immediately.

If alternator power cannot be restored, and a second or back up alternator is not available, the pilot must rely on the limited power of the battery only. Every effort should be made to conserve electrical power for use with the most essential equipment, such as communication and navigation radios, by turning off or not using any non-essential equipment. Electric or electro-hydraulic landing gear systems should be extended manually and flaps (if electrically operated) should remain retracted during approach and landing to conserve battery power, especially in instrument conditions.

If an electrical power loss is experienced, continued flight is possible but should be terminated as soon as practical. Such things as fuel quantity and engine temperature indicators and panel lights may no longer work. Hand-held nav/comm radios and other such products are widely available and marketed for just such a scenario; otherwise navigation by pilotage and appropriate loss of communication procedures for the airspace involved should be conducted. The pilot should always have a flashlight available for night flights.

LOSS OF PITOT/STATIC SOURCES

A thorough preflight inspection should reveal any blockage of the pitot tube, drain hole, or static port on the ground to allow corrective action to be taken prior to flight, Pilots should understand the various conditions and remedies associated with a loss of pitot-static sources.

Pitot heat should be used whenever flying in visible moisture and the temperature is near freezing. If airspeed is suspected to be in error while flying in possible icing conditions with the pitot heat on, the pitot heat switch should be cycled and the circuit breaker should be checked. If proper operation cannot be restored, the airspeed indicator must be considered unreliable.

If the pitot tube ram air inlet becomes blocked, the airspeed will drop to zero. If this blockage cannot be removed in flight, the pilot must rely on pitch attitude and power settings to maintain a safe airspeed. A slightly higher than normal power setting should be used to maintain a reasonable margin of extra airspeed on final.

When flying in clear ice conditions and pitot heat is unavailable, both the ram air inlet and the pitot drain hole could become blocked. This will cause the airspeed indicator to react like an altimeter, indicating a higher airspeed at higher altitudes and a lower airspeed at lower altitudes. The airspeed indicator must be ignored. A higher power setting appropriate to the overall icing problem should be used during the landing phase.

Many light single engine airplanes equipped with pitot heat may not be equipped with static source heat. If the static source becomes blocked, the airspeed indicator will still function, but will give erroneous indications. If the airplane climbs after the blockage occurs, the airspeed indicator will indicate lower than normal. If the airplane descends after the blockage occurs, the airspeed will indicate higher than actual. During the landing phase, this condition could deceive the pilot into thinking the airspeed is too high. The altimeter and vertical speed indicator will also be affected by a static source blockage. The altimeter will not indicate a change of altitude and the vertical speed indicator will indicate zero during climbs and descents. Neither instrument will reflect any altitude changes.

Many airplanes are equipped with an alternate static air source vented within the cabin area. If static port blockage is suspected, the alternate static source should be selected. The cabin pressure will be slightly lower than ambient air, but will provide a reasonable level of accuracy to the pitot static system. With slightly less dense air in the cabin, the airspeed indicator and altimeter will both show slightly higher than normal indications.

If the airplane is not equipped with an alternate static source, and pitot/static instruments are essential for continued flight, the glass on the vertical speed indicator may be broken to provide cabin air to the static system lines. The vertical speed indicator will no longer be reliable, but the airspeed indicator and altimeter will be functional again, with slightly higher than normal indications.

GYRO SPIN UP AND SPIN DOWN

Gyro instruments, such as attitude and directional indicators, contain a high-speed rotor assembly driven by either electric or vacuum power. These instruments normally operate at very high RPM and can take up to 10 minutes or more to spin down after power is removed. Although some gyro instruments have a "quick erect" mechanism to permit manual erection of the rotor, which effectively minimizes time required before use, some gyro instruments still require up to 5 minutes or more to spin up and stabilize after power is applied. During this spin up or spin down time, the gyro instruments should not be considered reliable. A failed gyro can be detected by first checking the suction gage and, if available, low-voltage or low-vacuum lights as applicable and, second, checking for slow or erratic indications of the gyro instruments by cross-referencing with other flight instruments for contradictory indications.

FAILED GYRO EFFECT ON AUTOPILOT

Some autopilot systems receive roll and/or yaw rate inputs from the electrically-driven turn coordinator or turn and bank indicator. Other autopilot systems depend on vacuum-driven attitude and directional indicators for horizontal and azimuth reference. If a failure should occur in any of these instruments, the autopilot should be turned off. Random signals generated by a malfunctioning gyro could cause the autopilot to position the airplane in an unusual attitude. Use of the autopilot after a gyro failure may result in an out of trim condition. Be prepared to correct for this when turning off the autopilot.

ALTERNATE AIR SYSTEM

An alternate source of air is provided to ensure satisfactory engine operation in the event the normal induction air filter or air inlet becomes obstructed. Although alternate air controls vary from one airplane to another, the types are: carburetor heat, direct manual control, automatic control, or a combination of automatic and manual controls. In most cases, the alternate air is extracted from inside the engine cowling and is, therefore, unfiltered and hotter than normal induction air. A loss of power will be caused by the hotter air. The richer mixture may require adjustment of the mixture control. Consult the applicable airplane operating handbook for details concerning the use of the alternate air system.

CARBURETOR HEAT AND INDUCTION ICING

Carburetor heat and manually operated alternate air valve(s) are controlled by the pilot. The carburetor heat system uses unfiltered air from inside the engine cowling. This air is drawn into a shroud around an exhaust riser or muffler and then ducted to the carburetor heat valve in the induction air manifold. The carburetor heat valve is controlled by the pilot and should be used during suspected or known carburetor icing conditions. Carburetor heat may also be used as an alternate air source should the induction air inlet or induction air filter become blocked for any reason.

The use of full carburetor heat at full throttle usually results in a 1 to 2 inch loss of manifold pressure or a loss of approximately 150 RPM, depending upon the airplane model. Application or removal of carburetor heat at higher power settings may require adjustment of the fuel mixture. It may be impractical to lean the mixture under low engine power conditions.

When a go-around or balked landing is initiated after use of carburetor heat during the landing approach, the pilot should usually advance the throttle first, then move the carburetor heat to off or cold. The throttle application must be smooth and positive. Rapid throttle advancement in some icing conditions could result in the engine failing to respond and the loss of power could become critical because of the low altitude and low airspeed.

When the relative humidity is more than 50 percent and the ambient air temperature is between 20°F to 90°F, it is possible for ice to form inside the carburetor, since the temperature of the air passing through the venturi may drop as much as 60°F below the ambient air temperature. If not corrected, ice accumulation may cause complete engine stoppage.

A drop in engine RPM on fixed pitch propeller airplanes and a drop in engine manifold pressure on constant speed propeller airplanes are indications of carburetor ice. If the airplane is equipped with a carburetor air temperature gage, the possibility of carburetor ice may be anticipated and prevented by maintaining the recommended amount of heat during cruise and letdown. Without the indications of a carburetor air temperature gage for reference, a pilot should use only the full heat or full cold position. An unknown amount of partial heat can cause carburetor ice. This can occur when ice that would ordinarily pass through the induction system is melted by partial carburetor heat and the water droplets then refreeze upon contact with the cold metal of the throttle plate. A carburetor air temperature gage may allow partial carburetor heat use, resulting in less power loss.

ALTERNATE AIR FOR FUEL INJECTED ENGINE ICING

Either an automatic alternate air system, a manually controlled alternate air system, or a combination automatic and manual system are incorporated on most fuel injected engines to address the potential of a blocked air induction system.

On engines equipped with automatic alternate air, ram air from the engine cowling inlet enters an air filter, which removes dust and other foreign matter that would be harmful to the engine. If the air inlet or the induction air filter should become blocked, suction created by the engine will open an alternate air door, allowing air to be admitted from either inside or outside the cowling, depending upon the airplane model. This air bypasses the filter and will result in a slight decrease in full throttle manifold pressure on non-turbocharged engines, and a notable decrease in manifold pressure from the selected cruise power setting on turbocharged engines. This manifold pressure, may be recoverable, up to a particular altitude, with throttle and/or RPM adjustment. The alternate air doors should be kept closed on the ground to prevent engine damage caused by ingesting debris through the unfiltered air ducts. For details concerning a specific model, consult the airplane operating handbook.

Most twin engine airplanes have a manually controlled alternate air door in each engine induction air system. If a decrease in manifold pressure is experienced when flying in icing conditions, the alternate air doors should be manually opened. On most twins, this manual control has two positions. When fully in, normal filtered ram air is provided; when fully out, warm unfiltered air from inside the cowling is provided. Other twins have alternate air controls with an additional intermediate or center detent to provide cool, unfiltered ram air to the induction system in the event the induction air filter is blocked by matter other than ice.

Since the higher intake air temperature of the alternate air results in a decrease in engine power and turbocharger capability, it is recommended that the alternate induction air not be utilized until indications of induction air blockage (decreased manifold pressure) are actually observed.

If additional power is required, the pilot should increase RPM as required, move the throttles forward to maintain desired manifold pressure and readjust the fuel mixture controls as required. These recommendations do not replace the procedure in the airplane operating handbook.

Although most pilots are aware of the potential of carburetor icing, many may think that a fuel injected engine is not subject to induction icing. Although a fuel injected engine will not form carburetor ice, other parts of the induction system such as bends in the system or the air filter can gather ice. Slush and/or snow can block the induction air filter. Induction air blockage can cause loss of manifold pressure or engine stoppage.

CARBON MONOXIDE

Carbon monoxide is a colorless, odorless, tasteless product of an internal combustion engine and is always present in exhaust fumes. Even minute quantities of carbon monoxide breathed over a long period of time may lead to dire consequences. Carbon monoxide has a greater ability to combine with the blood than oxygen. Once carbon monoxide is absorbed in the blood, it prevents the oxygen from being absorbed.

The symptoms of carbon monoxide poisoning are difficult to detect by the person afflicted and may include blurred thinking, a feeling of uneasiness, dizziness, headache, and loss of consciousness. If any of these symptoms occur, immediately open all cabin vents and turn the cabin heater off. Land as soon as possible at the nearest airport and seek medical attention if needed.

HEATER OPERATION

Many cabin heaters in general aviation airplanes operate by allowing ambient air to flow through an exhaust shroud where it is heated before being ducted into the cabin. Therefore, if anyone in the cabin smells exhaust fumes when using the cabin heater, immediately turn off the cabin heater and open all cabin vents. Land as soon as possible at the nearest airport and seek medical attention if needed.

WINDOW VENTILATION

If carbon monoxide is suspected in the cabin at any time, it is imperative that immediate ventilation be initiated, including the opening of cabin windows. Observe the maximum speed for window opening in flight. Opening a cabin window is probably the best means of ventilating the cabin while on the ground. However, care should be taken when parked with engine(s) operating or when in the vicinity of other airplanes that have their engines running. The exhaust gases from your airplane or the other airplane could enter the cabin through the open window. Also, engine exhaust could be forced into the cabin area during taxi operations or when taxiing downwind.

PRESSURIZED AIRPLANES

Refer to the operating handbook and/or approved flight manual for appropriate ventilation procedures.

TURBOCHARGER

When operating turbocharged engines, any power increases should be accomplished by increasing the propeller RPM first, then increasing the manifold pressure. Power reductions should be accomplished by reducing the manifold pressure first, then the RPM.

During cold weather operation, care should be exercised to insure that overboost does not occur during takeoff as a result of congealed oil in the waste gate actuating system. Before takeoff engine checks should not be accomplished until oil temperature is at least 75°F (minimum approved operating limit). Takeoff should not be started until oil temperature is above 100°F and oil pressure below 100 psi to assure proper oil flow to the turbocharger and its actuating system. Monitor manifold pressure during takeoff so as not to exceed specified takeoff limits. Advance the throttle slowly, pausing momentarily at approximately 30" MP to permit turbine speed to stabilize, then gradually open the throttle to obtain takeoff manifold pressure.

Prior to engine shut down, operate the engine at idle RPM for approximately 5 minutes to allow the turbocharger to cool and slow down. This reduces the possibility of turbine bearing coking caused by oil breakdown. This 5 minutes may be calculated from landing touchdown.

During pilot training, simulated engine out operation requiring the engine be shut down by closing the mixture should be held to an absolute minimum.

TURBOCHARGER FAILURE

The turbocharger system's purpose is to elevate manifold pressure and thus engine power to a level higher than can be obtained without it. A failure of the system will cause either an overboost condition or some degree of power loss. An overboost can be determined on the manifold pressure instrument and can be controlled by a throttle reduction.

If turbocharger failure results in power loss, it may be further complicated by an overly rich mixture. This rich mixture condition may be so severe as to cause a total power failure. Leaning the mixture may restore partial power. Partial or total power loss may also be caused by an exhaust system leak. A landing should be made as soon as practical for either an overboost or partial/total power loss.

IN-FLIGHT FIRES

FIRES IN FLIGHT

A preflight checklist is provided to aid the pilot in detecting conditions which could contribute to an airplane fire. Flight should not be attempted with known fuel, oil, or exhaust leaks, since they can lead to a fire. The presence of fuel or unusual oil or exhaust stains may be an indication of system leaks and should be corrected prior to flight.

Fires in flight must be controlled as quickly as possible by identifying and shutting down the affected system(s), then extinguishing the fire. Until this process is complete, the pilot should assume the worst and initiate action for an immediate landing. A pilot must not become distracted by the fire to the point that control of the airplane is lost. The pilot must be able to complete a deductive analysis of the situation to determine the source of the fire. Complete familiarity with the airplane and its systems will prove invaluable should a fire occur.

ENGINE COMPARTMENT FIRES

An engine compartment fire is usually caused by fuel contacting a hot surface, an electrical short, bleed air leak, or exhaust leak. If an engine compartment fire occurs on a single engine airplane, the first step should be to shut off the fuel supply to the engine by placing the mixture to idle cut off and the fuel selector/shutoff valve to the OFF position. The ignition switch should be left ON in order for the engine to use up the fuel which remains in the fuel lines and components between the fuel selector/shutoff valve and the engine. The airplane should be put into a sideslip, which will tend to keep the flames away from the occupants and the fuel tanks. If this procedure is ineffective, the pilot must make the most rapid emergency descent possible and an immediate landing.

In multi-engine airplanes, **both** auxiliary fuel pumps should be turned off to reduce pressure in the total fuel system (each auxiliary fuel pump pressurizes a crossfeed line to the opposite fuel selector). If equipped, the emergency crossfeed shutoff should also be activated. The engine on the wing in which the fire exists should be shut down and its fuel selector positioned to OFF even though the fire may not have originated in the fuel system. The cabin heater draws fuel from the crossfeed system on some airplanes, and should be turned off as well. The engine compartment fire extinguisher should be discharged if the airplane is so equipped.

An open foul weather window or emergency exit may produce a low pressure in the cabin. To avoid drawing the fire into the cabin area, the foul weather window, emergency exits, or any openable windows should be kept closed. This condition is aggravated on some models, with the landing gear and wing flaps extended. Therefore, it is recommended to lower the landing gear as late in the landing approach as possible. A no flap landing should also be attempted, if practical.

ELECTRICAL FIRES

The initial indication of an electrical fire is usually the distinct odor of burning insulation. Once an electrical fire is detected, the pilot should attempt to identify the effected circuit by checking circuit breakers, instruments, avionics, etc. If the affected circuit cannot be readily detected and flight conditions permit, the battery/master switch and alternator switch(es) should be turned OFF to remove the possible sources of the fire. If at night, ensure the availability of a flashlight before turning off electrical power. Then, close off ventilating air as much as practical to reduce the chances of a sustained fire. If an oxygen system is available in the airplane and no visible signs of flame are evident, occupants should use oxygen until smoke clears.

If electrical power is essential for the flight, an attempt may be made to identify and isolate the effected circuit by turning the Master Switch and other electrical (except magneto) switches off and checking the condition of the circuit breakers to identify the affected circuit. If the circuit can be readily identified, leave it deactivated and restore power to the other circuits. If the circuit cannot be readily identified, turn the Master Switch on, and select switches that were on before the fire indication, one at a time, permitting some time to elapse after each switch is turned on, until the short circuit is identified. Make sure the fire is completely extinguished before opening vents. Land as soon as possible for repairs.

CABIN FIRES

Fire or smoke in the cabin should be controlled by identifying and shutting down the affected system, which is most likely to be electrical in nature, and landing as soon as possible. Smoke may be removed by opening the cabin air controls. However, if the smoke increases in intensity when the air controls are opened, they should be closed as this indicates a possible fire in the heating system, nose compartment baggage area, or that the increase in airflow is aggravating this condition.

In pressurized airplanes, the pressurization air system will remove smoke from the cabin. However, if the smoke is intense, it may be necessary to either depressurize at altitude, if oxygen is available for all occupants, or execute an emergency descent to 10,000 feet, terrain permitting. "Ram Air Dump" handle may be pulled to aid the clearing of smoke from the cabin.

The pilot may choose to expel the smoke through the foul weather window(s). The foul weather window(s) should be closed immediately if the fire becomes more intense when the window(s) are opened. If smoke is severe, and there are no visible signs of flame, use oxygen masks (if installed) and begin an immediate descent.

If a fire extinguisher is used, ventilate the cabin promptly after extinguishing the fire to reduce the gases produced by thermal decomposition. If the fire cannot be extinguished immediately, land as soon as possible.

IN-FLIGHT OPENING OF DOORS

The occurrence of an inadvertent door opening is not as great of a concern to the safety of the flight, as the pilot's reaction to the opening. If the pilot is overly distracted, loss of airplane control may result even though disruption of airflow by the door is minimal. While the shock of a sudden loud noise and increase in sustained noise level may be surprising, mental preparation for this event and a plan of action can eliminate inappropriate pilot reaction.

INADVERTENT OPENING OF BAGGAGE/CARGO DOORS

The flight characteristics of an airplane will not normally be affected by an open baggage or cargo door. The aerodynamic effects on an open door can vary, depending on the location of the door on the airplane and the method used to hinge the door in relation to the slipstream. Baggage/cargo doors mounted on the side of the aft fuselage and hinged at the front will tend to stay in a nearly closed position at most airspeeds and pose no special problems as long as the airplane is not in uncoordinated flight in a direction which would permit unsecured baggage to fall out of the airplane. Because of the door location and the presence of baggage in the immediate area, the door may not be accessible for closing in flight. Passengers, especially children, should never be allowed to occupy the baggage portion of the cabin for the purpose of closing the door in flight. The pilot should slow the airplane to minimize buffeting of the door and land as soon as practical.

Top hinged baggage/cargo doors will react differently than front hinged doors if improperly latched before takeoff. Doors of this type, may pop open at rotation because of the increase in angle of attack and the slipstream pushing underneath the edge of the unsecured door. After the initial opening, a baggage door will generally tend to stay open and then may gently close as speed is reduced and the aircraft is configured for landing (the doors will probably tend to open again during flair). A top hinged door on the side of the aft fuselage of a high wing airplane can sometimes be moved to a nearly closed position by lowering the wing flaps full down (within approved airspeed limitations) so that wing downwash will act upon the door. Unlatched nose baggage doors and large cargo doors on the side of the aft fuselage cannot be closed in flight and a landing should be made as soon as practical. The pilot should avoid any abrupt airplane maneuvers in multi-engine airplanes with an open nose baggage door, as this could throw loose objects out of the baggage compartment and into the propeller.

Front hinged wing locker doors in the aft part of the engine nacelle of multi-engine airplanes will likely trail open a few inches if they become unlatched. Near stall speed just prior to landing, an unlatched door may momentarily float to a full open position.

If a door comes open on takeoff and sufficient runway remains for a safe abort, the airplane should be stopped. If the decision is made to continue the takeoff, maintain required airspeed and return for landing as soon as practical.

INADVERTENT OPENING OF CABIN/EMERGENCY EXIT DOORS (UNPRESSURIZED)

If a cabin or emergency exit door should inadvertently open during unpressurized flight, the primary concern should be directed toward maintaining control of the airplane. Then, if a determination is made to close the door in flight, establish a safe altitude, trim the airplane at a reduced airspeed, and attempt to close the door. To facilitate closing the door, slide the adjacent seat aft slightly to obtain a better grasp of the door handle. The door handle must be in the close position prior to pulling the door closed, followed by rotating the handle to the locked position. Under no circumstances should the pilot leave his/her seat, or unfasten the restraint system to secure a door.

If a cabin door reopens when latched closed, the flight should be terminated as soon as practical and repairs made.

INADVERTENT OPENING OF CABIN/EMERGENCY EXIT DOORS (PRESSURIZED)

An inadvertent opening of a cabin/emergency exit door while the cabin is pressurized and the aircraft is above 12,500 feet, will require the use of supplemental oxygen or an emergency descent to an altitude below 12,500 feet. The pilot may attempt to close the door after ensuring that all occupants are using supplemental oxygen or the cabin altitude is below 10,000 feet. However, the primary concern should be maintaining control of the airplane. The flight should be terminated as soon as practical and the cause of the door opening determined before pressurized flight is continued. Under no circumstances should the pilot leave his/her seat, or unfasten the restraint system to secure a door.

AUTOPILOTS AND ELECTRIC TRIM SYSTEMS

Because there are several different models of autopilots and electric trim systems installed in airplanes and different installations and switch positions are possible from airplane to airplane, it is essential that every pilot review the airplane operating handbook and/or the Garmin Integrated Flight Deck Cockpit Reference Guide (CRG) and Pilot's Guide (PG) if equipped with a Garmin Automatic Flight Control System (AFCS) for the specific autopilot and trim systems installed in their airplane. Each pilot prior to flight, must be fully aware of the proper procedures for operation, and particularly disengagement, for the system as installed.

In addition to ensuring compliance with the autopilot manufacturer's maintenance requirements, all pilots should thoroughly familiarize themselves with the operation, function and procedures described in the airplane operating handbook and/or the Garmin Integrated Flight Deck Cockpit Reference Guide (CRG) and Pilot's Guide. Ensure a full understanding of the methods of engagement and disengagement of the autopilot and trim systems. Compare the descriptions and procedures to the actual installation in the airplane to ensure it accurately describes the system installed. Test that all buttons, switches and circuit breakers function properly as described. If they do not function as described, have them repaired by a qualified service facility prior to using them in flight.

A preflight check as stated in all airplane operating handbooks for the autopilot and trim systems must be conducted before every flight. The preflight check assures not only that the systems and all the features are operating properly, but also that the pilot, before flight, is familiar with the proper means of engagement and disengagement of the autopilot and trim system.

Autopilot airplane operating handbooks caution against trying to override the autopilot system during flight without disengaging the autopilot because the autopilot will continue to trim the airplane and oppose the pilot's actions. This could result in a severely out of trim condition. This is a basic feature of all autopilots with electric trim follow-up.

Do not try to manually override the autopilot during flight.

WARNING

OVERRIDING AN ENGAGED AUTOPILOT SYSTEM DURING FLIGHT CAUSES THE TRIM SYSTEM TO TRIM THE AIRPLANE AND OPPOSE THE PILOT'S INPUT, RESULTING IN A SEVERELY OUT OF TRIM CONDITION.

CAUTION

IN CASE OF EMERGENCY, YOU CAN OVERPOWER THE AUTOPILOT TO CORRECT THE ATTITUDE, BUT THE AUTOPILOT AND ELECTRIC TRIM MUST THEN IMMEDIATELY BE DISENGAGED. DO NOT RE-ENGAGE THE AUTOPILOT OR USE THE ELECTRIC TRIM SYSTEM FOR THE REMAINDER OF THE FLIGHT OR ANY FUTURE FLIGHTS UNTIL THE SYSTEMS HAVE BEEN REPAIRED.

It is often difficult to distinguish an autopilot malfunction from an electric trim system malfunction. The safest course is to deactivate both. Do not re-engage either system until after you have safely landed. Then have the systems checked by a qualified service facility prior to further flight.

Depending upon the installation on your airplane, the following additional methods may be available to disengage the autopilot or electric trim in the event the autopilot or electric trim does not disengage utilizing the disengage methods specified in the Supplements and/or the Garmin CRG and PG.

CAUTION

TRANSIENT CONTROL FORCES MAY OCCUR WHEN THE AUTOPILOT IS DISENGAGED.

1. Push the autopilot or autopilot trim disconnect switch on the yoke, if installed.
2. Operate the electric trim switch on the yoke, if installed.
3. Push the autopilot (AP) switch or button on the autopilot controller (this switch or button when pushed alternately engages and disengages the autopilot), if installed.
4. Turn off the autopilot master switch, if installed.
5. Pull the autopilot and trim circuit breaker(s) or turn off the autopilot switch breaker, if installed.
6. Push the go around (GA) switch or button on throttle grip or located on the instrument panel by the throttle control.

The above ways may or may not be available on your autopilot. It is essential that you the pilot, read your airplane's AFM supplement and/

or the Garmin CRG and PG, for your autopilot system and check each function and operation on your system.

The engagement of the autopilot must be done in accordance with the instructions and procedures contained in the airplane operating handbook and/or the Garmin CRG and PG.

Particular attention must be paid to the autopilot settings prior to engagement. If the autopilot is engaged when the airplane is out of trim, a large attitude change may occur.

CAUTION

IT IS ESSENTIAL THAT THE PROCEDURES SET FORTH IN THE APPROVED AFM SUPPLEMENTS AND/OR THE GARMIN CRG AND PG, FOR YOUR SPECIFIC INSTALLATION BE FOLLOWED BEFORE ENGAGING THE AUTOPILOT.

MAINTENANCE

Airplanes require inspection and maintenance on a regular basis as outlined in the operating handbook, service/maintenance manuals, other servicing publications, and in Federal Aviation Regulations. A good visual inspection is a continuing maintenance procedure and should be performed by anyone who is involved with an airplane. This includes pilots, line personnel, and the maintenance department. When worn or damaged parts are discovered, it is essential that the defective parts be repaired or replaced to assure all systems remain operational. The source of information for proper maintenance is the airplane Service/Maintenance Manual and Service Letters or Service Bulletins. Cessna's Service/Maintenance Manuals are occasionally revised. Maintenance personnel should follow the recommendations in the latest revision. The owner/operator must ensure that all unacceptable conditions are corrected and the airplane receives repetitive and required inspections.

UNAUTHORISED REPAIRS/MODIFICATIONS

All repair facilities and personnel should follow established repair procedures. Cessna does not support modifications to Cessna airplanes, whether by Supplemental Type Certificate or otherwise, unless those modifications are approved by Cessna. Such modifications may void any and all warranties on the airplane, since Cessna may not know the full effects on the overall airplane. Cessna has not tested and approved all such modifications by other companies. Operating procedures and performance data specified in the operating handbook and maintenance procedures specified in the Service/Maintenance Manual may no longer be accurate for the modified airplane. Operating procedures, maintenance procedures and performance data that are effected by modifications not approved by Cessna should be obtained from the STC owner.

AIRWORTHINESS OF OLDER AIRPLANES

For an airplane to remain airworthy and safe to operate, it should be operated in accordance with Cessna recommendations and cared for with sound inspection and maintenance practices.

An aging airplane needs more care and attention during maintenance processes and may require more frequent inspection of structural components for damage due to the effects of wear, deterioration, fatigue, environmental exposure, and accidental damage. Typical areas requiring more frequent inspection are: