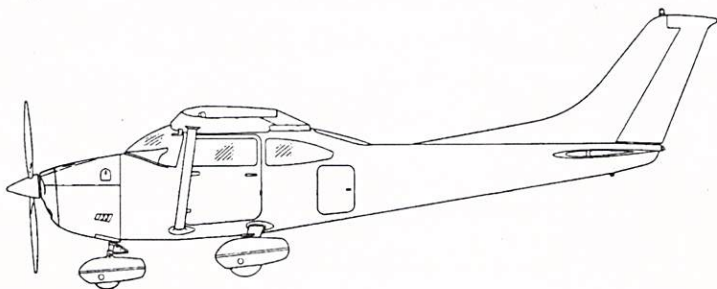


PILOT'S OPERATING HANDBOOK

and

FAA APPROVED AIRPLANE FLIGHT MANUAL



CESSNA AIRCRAFT COMPANY

1980 MODEL 182Q

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

Serial No. 18267531

Registration No. N5124N

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

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CESSNA AIRCRAFT COMPANY
WICHITA, KANSAS, USA

 Member of GAMA

1 OCTOBER 1979

THIS MANUAL WAS PROVIDED FOR THE AIRPLANE
IDENTIFIED ON THE TITLE PAGE ON _____.
SUBSEQUENT REVISIONS SUPPLIED BY CESSNA
AIRCRAFT COMPANY MUST BE PROPERLY IN-
SERTED.

CESSNA AIRCRAFT COMPANY, PAWNEE DIVISION

Note: This Airframe Has
Been Modified by STC SA03608AT
To Allow max Ramp Wt to be 3110
max Takeoff Wt is 3100. max Landing
Wt Remains at 2950

This Aircraft & Engine & Prop Have
Been Modified with STC's SA01581AT
SE 03701AT. Eng 252 HP @ 2625 RPM

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. World-wide, 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 Service Letters and Service News Letters, published by Cessna Aircraft Company.

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

A current Cessna Dealer 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

CESSNA
MODEL 182Q

PERFORMANCE - SPECIFICATIONS

SPEED:

Maximum at Sea Level	148 KNOTS
Cruise, 75% Power at 8000 Ft	144 KNOTS

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

75% Power at 8000 Ft	Range	840 NM
88 Gallons Usable Fuel	Time	5.9 HRS
Maximum Range at 10,000 Ft	Range	1090 NM
88 Gallons Usable Fuel	Time	9.7 HRS

RATE OF CLIMB AT SEA LEVEL	1010 FPM
SERVICE CEILING	16,500 FT

TAKEOFF PERFORMANCE:

Ground Roll	705 FT
Total Distance Over 50-Ft Obstacle	1350 FT

LANDING PERFORMANCE:

Ground Roll	590 FT
Total Distance Over 50-Ft Obstacle	1350 FT

STALL SPEED (CAS):

Flaps Up, Power Off	56 KNOTS
Flaps Down, Power Off	50 KNOTS

MAXIMUM WEIGHT:

Ramp	3110 LBS
Takeoff or Landing	3100 LBS

STANDARD EMPTY WEIGHT:

Skylane	1827 BS
Skylane II	1762 LBS

MAXIMUM USEFUL LOAD:

Skylane	1273 LBS
Skylane II	1198 LBS

BAGGAGE ALLOWANCE 200 LBS

WING LOADING: Pounds/Sq Ft 16.9

POWER LOADING: Pounds/HP 12.8

FUEL CAPACITY: Total 92 GAL.

OIL CAPACITY 12 QTS

ENGINE: Teledyne Continental

252-BHP at 2625 RPM

PROPELLER: Constant Speed, Diameter 82 IN.

**CESSNA
MODEL 182Q**

**COVERAGE/REVISIONS/
LOG OF EFFECTIVE PAGES**

COVERAGE

The Pilot's Operating Handbook in the airplane at the time of delivery from Cessna Aircraft Company contains information applicable to the 1980 Model 182Q airplane designated by the serial number and registration number shown on the Title Page of this handbook.

REVISIONS

Changes and/or additions to this handbook will be covered by revisions published by Cessna Aircraft Company. These revisions are distributed to all Cessna Dealers and to owners of U. S. Registered aircraft according to FAA records at the time of revision 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 Dealer 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 are:			
Original	1 October 1979		
Revision 1	28 March 1980		
Page	Date	Page	Date
Title	1 October 1979	5-3 thru 5-29	1 October 1979
Assignment Record ...	1 October 1979	5-30 Blank	1 October 1979
i thru ii	1 October 1979	6-1	1 October 1979
*iii	28 March 1980	6-2 Blank	1 October 1979
iv	1 October 1979	6-3 thru 6-13	1 October 1979
1-1 thru 1-8	1 October 1979	6-14 Blank	1 October 1979
2-1	1 October 1979	6-15 thru 6-25	1 October 1979
2-2 Blank	1 October 1979	6-26 Blank	1 October 1979
2-3 thru 2-10	1 October 1979	7-1 thru 7-43	1 October 1979
*2-11	28 March 1980	7-44 Blank	1 October 1979
2-12 Blank	1 October 1979	8-1	1 October 1979
3-1 thru 3-9	1 October 1979	8-2 Blank	1 October 1979
3-10 Blank	1 October 1979	8-3 thru 8-17	1 October 1979
3-11 thru 3-18	1 October 1979	8-18 Blank	1 October 1979
4-1 thru 4-11	1 October 1979	9-1 thru 9-3	1 October 1979
4-12 Blank	1 October 1979	9-4 Blank	1 October 1979
4-13 thru 4-23	1 October 1979		
4-24 Blank	1 October 1979		
5-1	1 October 1979		
5-2 Blank	1 October 1979		

NOTE
Refer to Section 9 Table of Contents for Supplements applicable to optional systems.

1 October 1979

Revision 1 - 28 March 1980 D1176-1-13PH — CES — 1050 — 4/80

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SECTION 1
GENERAL

CESSNA
MODEL 182Q

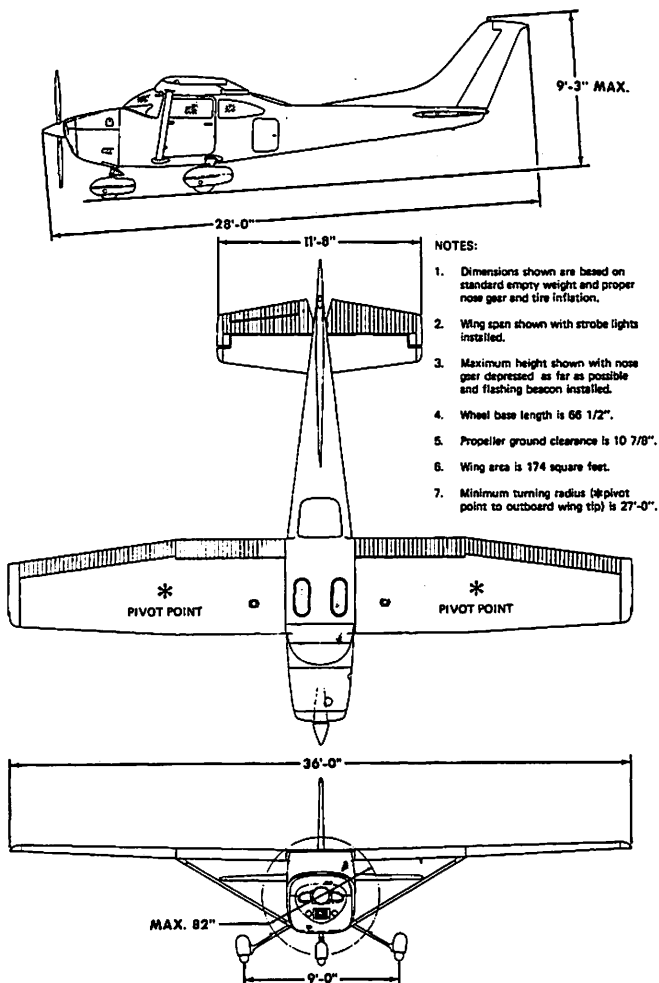


Figure 1-1. Three View

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: Teledyne Continental.

Engine Model Number: O-470-U-~~204~~

Engine Type: Normally-aspirated, direct-drive, air-cooled, horizontally-opposed, carburetor-equipped, six-cylinder engine with 470 cu. in. displacement.

Horsepower Rating and Engine Speed: 252 rated BHP at 2600 RPM.

PROPELLER

Propeller Manufacturer: McCauley Accessory Division.

Propeller Model Number: C2A34C204/90DCB-8.

Number of Blades: 2.

Propeller Diameter, Maximum: 82 inches.

Minimum: 80.5 inches.

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

FUEL

14.54-0.2'

31.04-0.5'

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.

**SECTION 1
GENERAL**

**CESSNA
MODEL 182Q**

Total Capacity: 92 gallons.
Total Capacity Each Tank: 46 gallons.
Total Usable: 88 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 to minimize cross-feeding.

OIL

Oil Grade (Specification):

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

NOTE

The airplane was delivered from the factory with a corrosion preventive aircraft engine oil. This oil should be drained after the first 25 hours of operation.

Continental Motors Specification MHS-24 (and all revisions thereto).
Ashless Dispersant Oil: This oil must be used after first 50 hours or oil consumption has stabilized.

Recommended Viscosity for Temperature Range:

All temperatures, use SAE 20W-50 or
Above 4°C (40°F), use SAE 50.
Below 4°C (40°F), use SAE 30.

NOTE

Multi-viscosity oil with a range of SAE 20W-50 is recommended for improved starting in cold weather.

Oil Capacity:

Sump: 12 Quarts.

Total: 13 Quarts (if oil filter installed).

MAXIMUM CERTIFICATED WEIGHTS

Ramp: 3110 lbs.

Takeoff: 3100 lbs.

Landing: 2950 lbs.

Weight in Baggage Compartment:

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

Baggage Area "B" and Hatshelf-Station 108 to 136: 80 lbs. See note below.

NOTE

The maximum combined weight capacity for baggage areas A and B, including the hatshelf, is 200 lbs. The maximum hatshelf load is 25 lbs.

STANDARD AIRPLANE WEIGHTS

Standard Empty Weight, Skylane: 1827 lbs.

Skylane II: 1762 lbs.

Maximum Useful Load, Skylane: 1773 lbs.

Skylane II: 1198 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: 16.9 lbs./sq. ft.

Power Loading: 12.8 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.

**SECTION 1
GENERAL**

**CESSNA
MODEL 182Q**

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 you may use abrupt control travel.
V_{FE}	Maximum Flap Extended Speed is the highest speed permissible with wing flaps in a prescribed extended position.
V_{NO}	Maximum Structural Cruising Speed is the speed that should not be exceeded except in smooth air, then only with caution.
V_{NE}	Never Exceed Speed is the speed limit that may not be exceeded at any time.
V_S	Stalling Speed or the minimum steady flight speed at which the airplane is controllable.
V_{So}	Stalling Speed or the minimum steady flight speed at which the airplane is controllable in the landing configuration at the most forward center of gravity.
V_X	Best Angle-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.
MP	Manifold Pressure is a pressure measured in the engine's induction system and is expressed in inches of mercury (Hg).

AIRPLANE PERFORMANCE AND FLIGHT PLANNING TERMINOLOGY

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

**SECTION 1
GENERAL**

**CESSNA
MODEL 182Q**

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 run.

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.

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INTRODUCTION

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

NOTE

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

NOTE

The airspeeds listed in the Airspeed Limitations chart (figure 2-1) and the Airspeed Indicator Markings chart (figure 2-2) are based on Airspeed Calibration data shown in Section 5 with the normal static source. 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. 3A13 as Cessna Model No. 182Q.

**SECTION 2
LIMITATIONS**

**CESSNA
MODEL 182Q**

AIRSPPEED LIMITATIONS

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

	SPEED	KCAS	KIAS	REMARKS
V _{NE}	Never Exceed Speed	172	179	Do not exceed this speed in any operation.
V _{NO}	Maximum Structural Cruising Speed	139	143	Do not exceed this speed except in smooth air, and then only with caution.
V _A	Maneuvering Speed: 2950 Pounds 2450 Pounds 1950 Pounds	109 99 89	111 100 89	Do not make full or abrupt control movements above this speed.
V _{FE}	Maximum Flap Extended Speed: To 10° Flaps 10° - 40° Flaps	137 95	140 95	Do not exceed these speeds with the given flap settings.
	Maximum Window Open Speed	172	179	Do not exceed this speed with windows open.

Figure 2-1. Airspeed Limitations

AIRSPPEED INDICATOR MARKINGS

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

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
White Arc	45 - 95	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	48 - 143	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	143 - 179	Operations must be conducted with caution and only in smooth air.
Red Line	179	Maximum speed for all operations.

Figure 2-2. Airspeed Indicator Markings

POWER PLANT LIMITATIONS

Engine Manufacturer: Teledyne Continental.

Engine Model Number: O-470-U²3A

Engine Operating Limits for Takeoff and Continuous Operations:

Maximum Power: 262 HP rating.

Maximum Engine Speed: 2675 RPM.

Maximum Cylinder Head Temperature: 460°F (238°C).

Maximum Oil Temperature: 240°F (116°C).

Oil Pressure, Minimum: 10 psi.

Maximum: 100 psi.

Propeller Manufacturer: McCauley Accessory Division.

Propeller Model Number: C2A34C204/90DCB-8

Propeller Diameter, Maximum: 82 inches.

Minimum: 80.5 inches.

Propeller Blade Angle at 30 Inch Station, Low: $14.5^\circ \pm 0.2^\circ$
High: $31.0^\circ \pm 0.5^\circ$

**SECTION 2
LIMITATIONS**

**CESSNA
MODEL 182Q**

POWER PLANT INSTRUMENT MARKINGS

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

INSTRUMENT	RED LINE	GREEN ARC	RED LINE
	MINIMUM LIMIT	NORMAL OPERATING	MAXIMUM LIMIT
Tachometer	---	2100 - <i>2625</i> RPM	<i>2625</i> RPM
Manifold Pressure	---	15-23 in. Hg	---
Oil Temperature	---	100° - 240°F	240°F
Cylinder Head Temperature	---	200° - 460°F	460°F
Oil Pressure	10 psi	30-60 psi	100 psi
Suction	---	4.5-5.4 in. Hg	---
Fuel Quantity	E (2.0 Gal. Unusable Each Tank)	---	---

Figure 2-3. Power Plant Instrument Markings

WEIGHT LIMITS

Maximum Ramp Weight: *3110* bs.

Maximum Takeoff Weight: *3160* bs.

Maximum Landing Weight: 2950 lbs.

Maximum Weight in Baggage Compartment:

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

Baggage Area "B" and Hatshelf- Station 108 to 136: 80 lbs. See note below.

NOTE

The maximum combined weight capacity for baggage areas A and B, including the hatshelf, is 200 lbs. The maximum hatshelf load is 25 lbs.

CENTER OF GRAVITY LIMITS

Center of Gravity Range:

Forward: 33.0 inches aft of datum at 2250 lbs. or less, with straight line variation to 39.5 inches aft of datum at 2100 lbs.

Aft: 48.5 inches aft of datum at all weights.

Reference Datum: Front face of firewall.

MANEUVER LIMITS

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

Aerobatic maneuvers, including spins, are not approved.

FLIGHT LOAD FACTOR LIMITS

Flight Load Factors:

*Flaps Up: -3.8g, -1.52g

*Flaps Down: +2.0g

*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.

**SECTION 2
LIMITATIONS**

**CESSNA
MODEL 182Q**

FUEL LIMITATIONS

2 Standard Tanks: 46 U.S. gallons each.
Total Fuel: 92 U.S. gallons.
Usable Fuel (all flight conditions): 88 U.S. gallons.
Unusable Fuel: 4 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.

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

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

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

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 20°.
Approved Landing Range: 0° to 40°.

PLACARDS

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

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

The markings and placards installed in this airplane contain operating limitations which must be complied with when operating this airplane in the Normal Category. Other operating limitations which must be complied with when operating this airplane in this category are contained in the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

No acrobatic maneuvers, including spins, approved.

Flight into known icing conditions prohibited.

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

DAY-NIGHT-VFR-IFR

2. On control lock:

CONTROL LOCK- REMOVE BEFORE STARTING ENGINE

3. On the fuel selector valve plate:

OFF
LEFT - 44 GAL. LEVEL FLIGHT ONLY
BOTH - 88 GAL. ALL FLIGHT ATTITUDES
BOTH ON FOR TAKEOFF AND LANDING
RIGHT - 44 GAL. LEVEL FLIGHT ONLY

**SECTION 2
LIMITATIONS**

**CESSNA
MODEL 182Q**

4. On the baggage door:

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

**AFT OF BAGGAGE DOOR LATCH
80 POUNDS MAXIMUM
BAGGAGE INCLUDING 25 LBS MAXIMUM IN
BAGGAGE WALL HAT SHELF**

**MAXIMUM 200 POUNDS COMBINED
FOR ADDITIONAL LOADING INSTRUCTIONS SEE
WEIGHT AND BALANCE DATA**

5. On flap control indicator:

0° to 10°

**(Partial flap range with blue
code and 140 kt callout; also,
mechanical detent at 10°.)**

10° to 20° to FULL

**(Indices at these positions with white
color code and 95 kt callout; also,
mechanical detent at 10° and 20°.)**

6. Forward of fuel tank filler cap:

FUEL

**100LL/100 MIN. GRADE AVIATION GASOLINE
CAP. 48.0 U.S. GAL.
CAP. 34.5 U.S. GAL. TO BOTTOM OF FILLER NECK**

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

8. On oil filler cap:

OIL
12 QTS

9. Near airspeed indicator:

MANEUVER SPEED
111 KIAS

10. Forward of each fuel tank filler cap in line with fwd arrow.

FUEL CAP FWD ▲ ARROW ALIGNMENT
CAP MUST NOT ROTATE DURING CLOSING

SECTION 3

EMERGENCY PROCEDURES

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INTRODUCTION

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

AIRSPEDS FOR EMERGENCY OPERATION

Engine Failure After Takeoff:	
Wing Flaps Up	70 KIAS
Wing Flaps Down	65 KIAS
Maneuvering Speed:	
2950 Lbs	111 KIAS
2450 Lbs	100 KIAS
1950 Lbs	89 KIAS
Maximum Glide	70 KIAS
Precautionary Landing With Engine Power	65 KIAS
Landing Without Engine Power:	
Wing Flaps Up	70 KIAS
Wing Flaps Down	65 KIAS

OPERATIONAL CHECKLISTS

ENGINE FAILURES

ENGINE FAILURE DURING TAKEOFF RUN

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

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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 (40° recommended).
6. Master Switch -- OFF.

ENGINE FAILURE DURING FLIGHT

1. Airspeed -- 70 KIAS.
2. Carburetor Heat -- ON.
3. Fuel Selector Valve -- BOTH
4. Mixture -- RICH.
5. Ignition Switch -- BOTH (or START if propeller is stopped).
6. Primer -- IN and LOCKED.

FORCED LANDINGS

EMERGENCY LANDING WITHOUT ENGINE POWER

1. Airspeed -- 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 (40° 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. Airspeed -- 65 KIAS.
2. Wing Flaps -- 20°.
3. Selected Field -- FLY OVER, noting terrain and obstructions, then retract flaps upon reaching a safe altitude and airspeed.
4. Electrical Switches -- OFF.
5. Wing Flaps -- 40° (on final approach).
6. Airspeed -- 65 KIAS.
7. Avionics Power and Master Switches -- 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. Flaps -- 20° - 40°.
4. Power -- ESTABLISH 300 FT/MIN DESCENT at 60 KIAS.
5. Approach -- High Winds, Heavy Seas -- INTO THE WIND.
Light Winds, Heavy Swells -- PARALLEL TO
SWELLS.

NOTE

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

6. Cabin Doors -- UNLATCH.
7. Touchdown -- LEVEL ATTITUDE AT ESTABLISHED 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.

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EMERGENCY PROCEDURES**

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

WARNING

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

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

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

CABIN FIRE

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

WARNING

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

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

WING FIRE

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

NOTE

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

ICING

INADVERTENT ICING ENCOUNTER

1. Turn pitot heat switch ON (if installed).
2. Turn back or change altitude to obtain an outside air temperature that is less conducive to icing.
3. Pull cabin heat control full out and rotate defroster control clockwise to obtain maximum defroster airflow.
4. Increase engine speed to minimize ice build-up on propeller blades.
5. Watch for signs of carburetor air filter ice and apply carburetor heat as required. An unexplained loss in manifold pressure could be caused by carburetor ice or air intake filter ice. Lean the mixture if carburetor heat is used continuously.
6. Plan a landing at the nearest airport. With an extremely rapid ice build-up, select a suitable "off airport" landing site.
7. With an ice accumulation of 1/4 inch or more on the wing leading edges, be prepared for significantly higher stall speed.
8. Leave wing flaps retracted. With a severe ice build-up on the horizontal tail, the change in wing wake airflow direction caused

SECTION 3 EMERGENCY PROCEDURES

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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 ice accumulation.
12. Perform a landing in level attitude.

STATIC SOURCE BLOCKAGE (Erroneous Instrument Reading Suspected)

1. Alternate Static Source Valve (if installed) -- PULL ON.
2. Airspeed -- Consult appropriate table in Section 5.
3. Altitude -- Cruise 50 feet higher and approach 30 feet higher than normal.

LANDING WITH A FLAT MAIN TIRE

1. Approach -- NORMAL.
2. Wing Flaps -- FULL DOWN.
3. Touchdown -- GOOD TIRE FIRST, hold airplane off flat tire as long as possible with aileron control.

ELECTRICAL POWER SUPPLY SYSTEM MALFUNCTIONS

AMMETER SHOWS EXCESSIVE RATE OF CHARGE (Full Scale Deflection)

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

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

NOTE

Illumination of the low-voltage light may occur during low RPM conditions with an electrical load on the system

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

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

If low-voltage light illuminates again:

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

AMPLIFIED PROCEDURES

ENGINE FAILURE

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

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

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

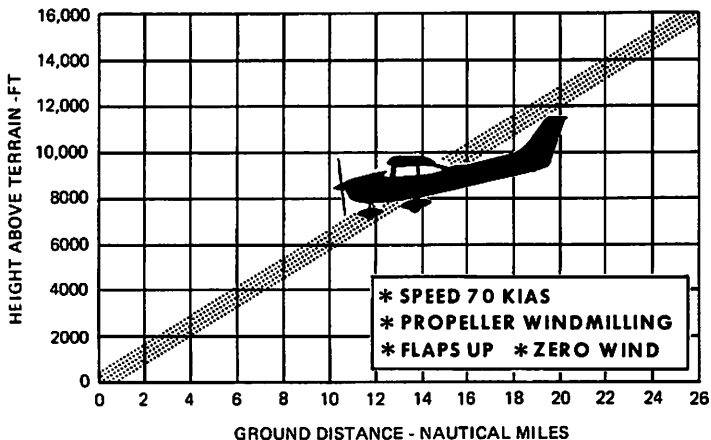


Figure 3-1. Maximum Glide

FORCED LANDINGS

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

Before attempting an "off airport" landing with engine power available, one should fly over the landing area at a safe but low altitude to inspect the terrain for obstructions and surface conditions, proceeding as discussed under the Precautionary Landing With Engine Power checklist.

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

LANDING WITHOUT ELEVATOR CONTROL

Trim for horizontal flight with an airspeed of approximately 80 KIAS by using throttle and elevator trim control. Then do not change the elevator trim control setting; control the glide angle by adjusting power exclusively.

At flareout, the nose-down moment resulting from power reduction is an adverse factor and the airplane may hit on the nose wheel. Consequently, at flareout, the elevator trim control should be adjusted toward the 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 vacuum system failure during flight, the directional indicator and attitude indicator will be disabled, and the pilot will have to rely on the turn coordinator if he inadvertently flies into clouds. The following instructions assume that only the electrically-powered turn coordinator is operative, and that the pilot is not completely proficient in instrument flying.

EXECUTING A 180° 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.

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

RECOVERY FROM A SPIRAL DIVE

If a spiral is encountered, proceed as follows:

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

INADVERTENT FLIGHT INTO ICING CONDITIONS

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

STATIC SOURCE BLOCKED

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

NOTE

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

A calibration table is provided in Section 5 to illustrate the effect of the alternate static source on indicated airspeeds. With the windows and vents closed the airspeed indicator may typically read as much as 3 knots faster and the altimeter 45 feet higher in cruise. With the vents open, this variation reduces to zero. If the alternate static source must be used for landing, the normal indicated approach speed may be used since the indicated airspeed variations in this configuration are 2 knots or less.

SPINS

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

1. RETARD THROTTLE TO IDLE POSITION.
2. PLACE AILERONS IN NEUTRAL POSITION.
3. APPLY AND HOLD FULL RUDDER OPPOSITE TO THE DIRECTION OF ROTATION.
4. JUST AFTER THE RUDDER REACHES THE STOP, MOVE THE WHEEL BRISKLY FORWARD FAR ENOUGH TO BREAK THE STALL.
5. HOLD THESE CONTROL INPUTS UNTIL ROTATION STOPS
Premature relaxation of the control inputs may extend the recovery.
6. AS ROTATION STOPS, NEUTRALIZE RUDDER, AND MAKE A SMOOTH RECOVERY FROM THE RESULTING DIVE.

NOTE

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

ROUGH ENGINE OPERATION OR LOSS OF POWER

CARBURETOR ICING

An unexplained drop in manifold pressure and eventual engine

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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.

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 damaged or improperly adjusted alternator control unit can also cause malfunctions. Problems of this nature constitute an electrical emergency and should be dealt with immediately. Electrical power malfunctions usually fall into two categories: excessive rate of charge and insufficient rate of charge. The paragraphs below describe the recommended remedy for each situation.

EXCESSIVE RATE OF CHARGE

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

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

INSUFFICIENT RATE OF CHARGE

NOTE

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

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If the over-voltage sensor should shut down the alternator or if the alternator circuit breaker should trip, a discharge rate will be shown on the ammeter followed by illumination of the low-voltage warning light. Since this may be a "nuisance" trip-out, an attempt should be made to reactivate the alternator system. To do this, turn the avionics power switch off, check that the alternator circuit breaker is in, then turn both sides of the master switch off and then on again. If the problem no longer exists, normal alternator charging will resume and the low-voltage light will go off. The avionics power switch may then be turned back on. If the light illuminates again, a malfunction is confirmed. In this event, the flight should be terminated and/or the current drain on the battery minimized because the battery can supply the electrical system for only a limited period of time. If the emergency occurs at night, power must be conserved for later use of the landing lights and flaps during landing.

SECTION 4

NORMAL PROCEDURES

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INTRODUCTION

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

SPEEDS FOR NORMAL OPERATION

Unless otherwise noted, the following speeds are based on a maximum weight of 2950 pounds and may be used for any lesser weight. However, to achieve the performance specified in Section 5 for takeoff distance, the speed appropriate to the particular weight must be used.

Takeoff:

Normal Climb Out	70-80 KIAS
Short Field Takeoff, Flaps 20°, Speed at 50 Feet	57 KIAS

Enroute Climb, Flaps Up:

Normal	85-95 KIAS
Best Rate of Climb, Sea Level	78 KIAS
Best Rate of Climb, 10,000 Feet	72 KIAS
Best Angle of Climb, Sea Level	54 KIAS
Best Angle of Climb, 10,000 Feet	62 KIAS

Landing Approach:

Normal Approach, Flaps Up	70-80 KIAS
Normal Approach, Flaps 40°	60-70 KIAS
Short Field Approach, Flaps 40°	60 KIAS

Balked Landing:

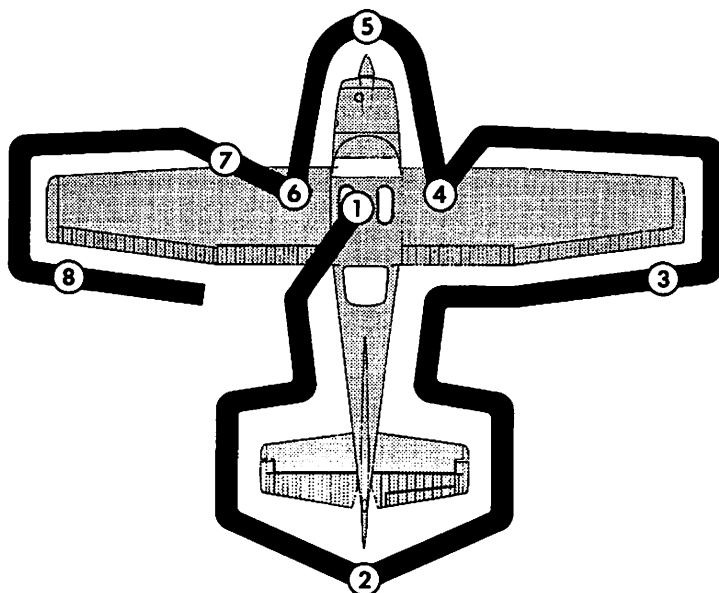
Maximum Power, Flaps 20°	55 KIAS
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Maximum Recommended Turbulent Air Penetration Speed:

2950 Lbs	111 KIAS
2450 Lbs	100 KIAS
1950 Lbs	89 KIAS

Maximum Demonstrated Crosswind Velocity:

Takeoff	20 KNOTS
Landing	15 KNOTS



NOTE

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

Figure 4-1. Preflight Inspection

CHECKLIST PROCEDURES

PREFLIGHT INSPECTION

① CABIN

1. Pilot's Operating Handbook -- AVAILABLE IN THE AIRPLANE.
2. Control Wheel Lock -- REMOVE.
3. Ignition Switch -- OFF.
4. Avionics Power Switch -- OFF.
5. 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.

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

② EMPENNAGE

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

③ RIGHT WING Trailing Edge

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

④ RIGHT WING

1. Wing Tie-Down -- DISCONNECT.
2. Fuel Tank Vent Opening -- CHECK for stoppage.
3. Main Wheel Tire -- CHECK for proper inflation.

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4. Before first flight of the day and after each refueling, use sampler cup and drain small quantity of fuel from fuel tank sump quick-drain valve to check for water, sediment, and proper fuel grade.
5. Fuel Quantity -- CHECK VISUALLY for desired level.
6. Fuel Filler Cap -- SECURE and vent unobstructed.

⑤ NOSE

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

⑥ LEFT WING

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

⑦ LEFT WING Leading Edge

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

⑧ LEFT WING Trailing Edge

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

BEFORE STARTING ENGINE

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

CAUTION

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

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

STARTING ENGINE

1. Mixture -- RICH.
2. Propeller -- HIGH RPM.
3. Carburetor Heat -- COLD.
4. Throttle -- OPEN 1/2 INCH.
5. Prime -- AS REQUIRED.
6. Master Switch -- ON.
7. Propeller Area -- CLEAR.
8. Ignition Switch -- START (release when engine starts).

NOTE

If engine has been overprimed, start with throttle 1/4 to 1/2 open. Reduce throttle to idle when engine fires.

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

BEFORE TAKEOFF

1. Cabin Doors and Windows -- CLOSED and LOCKED.
2. Parking Brake -- SET.
3. Flight Controls -- FREE and CORRECT.
4. Flight Instruments -- SET.
5. Fuel Selector Valve -- BOTH.
6. Mixture -- RICH.

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7. Elevator and Rudder Trim -- TAKEOFF.
8. Throttle -- 1700 RPM.
 - a. Magnetos -- CHECK (RPM drop should not exceed 150 RPM on either magneto or 50 RPM differential between magnetos).
 - b. Propeller -- CYCLE from high to low RPM; return to high RPM (full in).
 - c. Carburetor Heat -- CHECK (for RPM drop).
 - d. Engine Instruments and Ammeter -- CHECK.
 - e. Suction Gage -- CHECK.
9. Throttle -- 800 - 1000 RPM..
10. Radios -- SET.
11. Autopilot (if installed) -- OFF.
12. Strobe Lights -- AS DESIRED.
13. Throttle Friction Lock -- ADJUST.
14. Parking Brake -- RELEASE.

TAKEOFF

NORMAL TAKEOFF

1. Wing Flaps -- 0° - 20°.
2. Carburetor Heat -- COLD.
3. Power -- FULL THROTTLE and 2400 RPM.
4. Elevator Control -- LIFT NOSE WHEEL at 50 KIAS.
5. Climb Speed -- 70 KIAS (flaps 20°).
80 KIAS (flaps UP).

SHORT FIELD TAKEOFF

1. Wing Flaps -- 20°.
2. Carburetor Heat -- COLD.
3. Brakes -- APPLY.
4. Power -- FULL THROTTLE and 2400 RPM.
5. Brakes -- RELEASE.
6. Elevator Control -- MAINTAIN SLIGHTLY TAIL LOW ATTITUDE.
7. Climb Speed -- 57 KIAS (until all obstacles are cleared).
8. Wing Flaps -- RETRACT slowly after reaching 70 KIAS.

ENROUTE CLIMB

NORMAL CLIMB

1. Airspeed -- 85-95 KIAS.
2. Power -- 23 INCHES Hg and 2400 RPM.

3. Fuel Selector Valve -- BOTH.
4. Mixture -- FULL RICH (mixture may be leaned above 5000 feet).
5. Cowl Flaps -- OPEN as required.

MAXIMUM PERFORMANCE CLIMB

1. Airspeed -- 78 KIAS at sea level to 72 KIAS at 10,000 feet.
2. Power -- FULL THROTTLE and 2400 RPM.
3. Fuel Selector Valve -- BOTH.
4. Mixture -- FULL RICH (mixture may be leaned above 5000 feet).
5. Cowl Flaps -- FULL OPEN.

CRUISE

1. Power -- 15-23 INCHES Hg, 2100-2400 RPM (no more than 75% power).
2. Elevator and Rudder Trim -- ADJUST.
3. Mixture -- LEAN.
4. Cowl Flaps -- CLOSED.

DESCENT

1. Fuel Selector Valve -- BOTH.
2. Power -- AS DESIRED.
3. Carburetor Heat -- FULL HEAT AS REQUIRED to prevent carburetor icing.
4. Mixture -- ENRICHEN as required.
5. Cowl Flaps -- CLOSED.
6. Wing Flaps -- AS DESIRED (0° - 10° below 140 KIAS, 10° - 40° below 95 KIAS).

BEFORE LANDING

1. Seats, Belts, Harnesses -- ADJUST and LOCK.
2. Fuel Selector Valve -- BOTH.
3. Mixture -- RICH.
4. Carburetor Heat -- ON (apply full heat before reducing power).
5. Propeller -- HIGH RPM.
6. Autopilot (if installed) -- OFF.

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LANDING

NORMAL LANDING

1. Airspeed -- 70-80 KIAS (flaps UP).
2. Wing Flaps -- AS DESIRED (0° - 10° below 140 KIAS, 10° - 40° below 95 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 -- 70-80 KIAS (flaps UP).
2. Wing Flaps -- 40° (below 95 KIAS).
3. Airspeed -- MAINTAIN 60 KIAS.
4. Trim -- ADJUST.
5. Power -- REDUCE to idle as obstacle is cleared.
6. Touchdown -- MAIN WHEELS FIRST.
7. Brakes -- APPLY HEAVILY.
8. Wing Flaps -- RETRACT for maximum brake effectiveness.

BALKED LANDING

1. Power -- FULL THROTTLE and 2400 RPM.
2. Carburetor Heat -- COLD.
3. Wing Flaps -- RETRACT to 20°.
4. Climb Speed -- 55 KIAS.
5. Wing Flaps -- RETRACT slowly after reaching 70 KIAS.
6. Cowl Flaps -- OPEN.

AFTER LANDING

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

SECURING AIRPLANE

1. Parking Brake -- SET.
2. Avionics Power Switch. Electrical Equipment -- OFF.

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3. Throttle -- IDLE.
4. Mixture -- IDLE CUT-OFF (pulled full out).
5. Ignition Switch -- OFF.
6. Master Switch -- OFF.
7. Control Lock -- INSTALL.
8. Fuel Selector Valve -- RIGHT.

AMPLIFIED PROCEDURES

STARTING ENGINE

Ordinarily the engine starts easily with one or two strokes of the primer in warm temperatures to six strokes in cold weather with the throttle open approximately 1/2 inch. In extremely cold temperatures, it may be necessary to continue priming while cranking. Weak intermittent firing followed by puffs of black smoke from the exhaust stack indicates overpriming or flooding. Excess fuel can be cleared from the combustion chambers by the following procedure: Set the mixture control full lean and the throttle full open; then crank the engine through several revolutions with the starter. Repeat the starting procedure without any additional priming.

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

NOTE

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

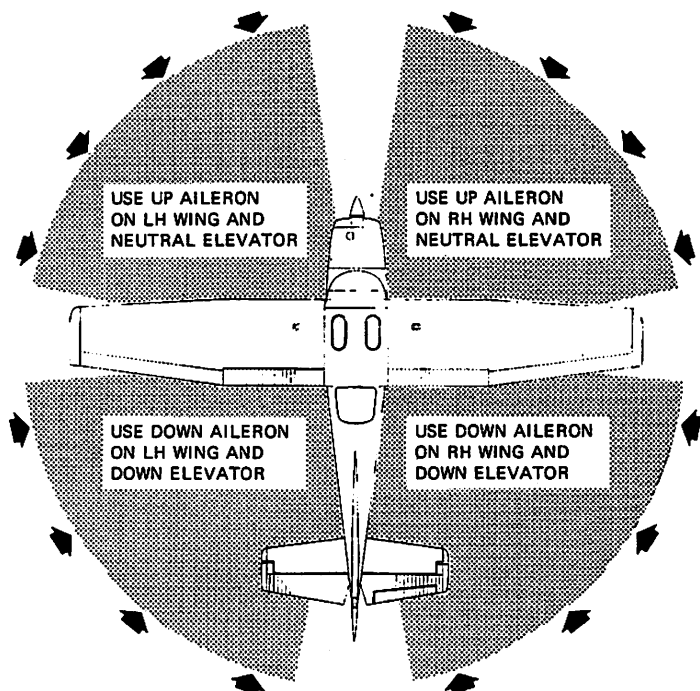
TAXIING

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.

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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

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

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

MAGNETO CHECK

The magneto check should be made at 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 150 RPM on either magneto or show greater than 50 RPM differential between magnetos. If there is a doubt concerning operation of the ignition system, RPM checks at higher engine speeds will usually confirm whether a deficiency exists.

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

ALTERNATOR CHECK

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

TAKEOFF

POWER CHECK

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

Full power runups over loose gravel are especially harmful to pro-

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propeller tips. When takeoffs must be made over a gravel surface, it is very important that the throttle be advanced slowly. This allows the airplane to start rolling before high RPM is developed, and the gravel will be blown back of the propeller rather than pulled into it. When unavoidable small dents appear in the propeller blades they should be corrected immediately as described in Section 8 under Propeller Care.

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

WING FLAP SETTINGS

Normal takeoffs are accomplished with wing flaps 0° to 20°. Using 20° wing flaps reduces the ground run and total distance over an obstacle by approximately 20 per cent. Flap deflections greater than 20° are not approved for takeoff.

If 20° wing flaps are used for takeoff, they should be left down until all obstacles are cleared and a safe flap retraction speed of 70 KIAS is reached. To clear an obstacle with wing flaps 20°, an obstacle clearance speed of 57 KIAS should be used.

Soft field takeoffs are performed with 20° 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 safer climb speed.

With wing flaps retracted and no obstructions ahead, a climb-out speed of 80 KIAS would be most efficient.

CROSSWIND TAKEOFF

Takeoffs into strong crosswinds normally are performed with the minimum flap setting necessary for the field length, to minimize the drift angle immediately after takeoff. With the ailerons partially deflected into the wind, the airplane is accelerated to a speed slightly higher than normal, and then pulled off abruptly to prevent possible settling back to the runway while drifting. When clear of the ground, make a coordinated turn into the wind to correct for drift.

ENROUTE CLIMB

Normal climbs are performed at 85-95 KIAS with flaps up, 23 In. Hg. or full throttle (whichever is less) and 2400 RPM for the best combination of

engine cooling, rate of climb and forward visibility. If it is necessary to climb rapidly to clear mountains or reach favorable winds at high altitudes, the best rate-of-climb speed should be used with maximum power. This speed is 78 KIAS at sea level, decreasing to 72 KIAS at 10,000 feet.

If an obstruction ahead requires a steep climb angle, a best angle-of-climb speed should be used with flaps up and maximum power. This speed is 54 KIAS at sea level, increasing to 62 KIAS at 10,000 feet.

The mixture should be full rich during climb at altitudes up to 5000 feet. Above 5000 feet, the mixture may be leaned for smooth engine operation and increased power.

CRUISE

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

NOTE

Cruising should be done at 75% power as much as practical until a total of 50 hours has accumulated or oil consumption has stabilized. This is to ensure proper seating of the rings and is applicable to new engines, and engines in service following cylinder replacement or top overhaul of one or more cylinders.

The Cruise Performance Table, figure 4-3, illustrates the true airspeed and nautical miles per gallon during cruise for various altitudes and percent powers. This table should be used as a guide, along with the available winds aloft information, to determine the most favorable altitudes and power setting for a given trip. The selection of cruise altitude on the basis of the most favorable wind conditions and the use of low power settings are significant factors that should be considered on every trip to reduce fuel consumption.

For reduced noise levels, it is desirable to select the lowest RPM in the green arc range for a given percent power that will provide smooth engine operation. The cowl flaps should be opened, if necessary, to maintain the cylinder head temperature at approximately two-thirds of the normal operating range (green arc).

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	75% POWER		65% POWER		55% POWER	
ALTITUDE	KTAS	NMPG	KTAS	NMPG	KTAS	NMPG
4000 Feet	139	10.8	131	11.8	121	12.8
6000 Feet	141	11.0	133	12.0	123	13.0
8000 Feet	144	11.2	135	12.2	125	13.2
10,000 Feet	---	---	138	12.4	127	13.4
Standard Conditions					Zero Wind	

Figure 4-3. Cruise Performance Table

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

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

For best fuel economy at 65% power or less, the engine may be operated at the leanest mixture that results in smooth engine operation. This will result in approximately 5% greater range than shown in this handbook accompanied by approximately a 3 knot decrease in speed.

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

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

The use of full carburetor heat is recommended during flight in very heavy rain to avoid the possibility of engine stoppage due to excessive water ingestion. The mixture setting should be readjusted for smoothest operation.

LEANING WITH A CESSNA ECONOMY MIXTURE INDICATOR (EGT)

Exhaust gas temperature (EGT) as shown on the optional Cessna

MIXTURE DESCRIPTION	EXHAUST GAS TEMPERATURE
RECOMMENDED LEAN (Pilot's Operating Handbook and Power Computer)	50°F Rich of Peak EGT
BEST ECONOMY (65% Power or Less)	Peak EGT

Figure 4-4. EGT Table

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

Continuous operation at peak EGT is authorized only at 65% power or less. This best economy mixture setting results in approximately 5% greater range than shown in this handbook accompanied by approximately a 3 knot decrease in speed.

NOTE

Operation on the lean side of peak EGT is not approved.

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

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. are presented in Section 5.

LANDING

NORMAL LANDING

Landings should be made on the main wheels first to reduce the

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landing speed and the subsequent need for braking in the landing roll. The nose wheel is lowered gently to the runway after the speed has diminished to avoid unnecessary nose gear load. This procedure is especially important in rough field landings.

SHORT FIELD LANDING

For a short field landing, make a power-off approach at 60 KIAS with 40° flaps and land on the main wheels first. Immediately after touchdown, lower the nose gear to the ground and apply heavy braking as required. For maximum brake effectiveness after all three wheels are on the ground, retract the flaps, hold full nose up elevator and apply maximum possible brake pressure without sliding the tires.

CROSSWIND LANDING

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

BALKED LANDING

In a balked landing (go-around) climb, the wing flap setting should be reduced to 20° immediately after full power is applied. After all obstacles are cleared and a safe altitude and airspeed are obtained, the wing flaps should be retracted.

COLD WEATHER OPERATION

STARTING

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

NOTE

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

In extremely cold (-18°C and lower) weather, the use of an external preheater and an external power source are recommended whenever

possible to obtain positive starting and to reduce wear and abuse to the engine and the electrical system. Pre-heat will thaw the oil trapped in the oil cooler, which probably will be congealed prior to starting in extremely cold temperatures. When using an external power source, the position of the master switch is important. Refer to Section 9, Supplements, for Ground Service Plug Receptacle operating details.

Cold weather starting procedures are as follows:

With Preheat:

1. With ignition switch turned OFF, mixture full rich and throttle open 1/2 inch, prime the engine four to eight strokes as the propeller is being turned over by hand.

NOTE

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

2. Propeller -- CLEAR.
3. Avionics Power Switch -- OFF.
4. Master Switch -- ON.
5. Ignition Switch -- START (release to BOTH when engine starts).
6. Pull carburetor heat on after engine has started, and leave on until the engine is running smoothly.

Without Preheat:

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

NOTE

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

CAUTION

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

OPERATION

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

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

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

1. Use carburetor heat during engine warm-up and ground check. Full carburetor heat may be required for temperatures below -12°C whereas partial heat could be used in temperatures between -12°C and 4°C.
2. Use the minimum carburetor heat required for smooth operation in take-off, climb, and cruise.

NOTE

Care should be exercised when using partial carburetor heat to avoid icing. Partial heat may raise the carburetor air temperature to 0° to 21°C range where icing is critical under certain atmospheric conditions.

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

HOT WEATHER OPERATION

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

NOISE ABATEMENT

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

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

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

NOTE

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

The certificated noise level for the Model 182Q at 2950 pounds maximum weight is 69.1 dB(A). No determination has been made by the Federal Aviation Administration that the noise levels of this airplane are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

SECTION 5

PERFORMANCE

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INTRODUCTION

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

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

USE OF PERFORMANCE CHARTS

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

SAMPLE PROBLEM

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

AIRPLANE CONFIGURATION

Takeoff weight	2900 Pounds
Usable fuel	65 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

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CRUISE CONDITIONS

Total distance	450 Nautical Miles
Pressure altitude	7500 Feet
Temperature	18°C (16°C above standard)
Expected wind enroute	10 Knot Headwind

LANDING CONDITIONS

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

TAKEOFF

The takeoff distance chart, figure 5-4, should be consulted, keeping in mind that the distances shown are based on the short field technique. Conservative distances can be established by reading the chart at the next higher value of weight, altitude and temperature. For example, in this particular sample problem, the takeoff distance information presented for a weight of 2950 pounds, pressure altitude of 2000 feet and a temperature of 30°C should be used and results in the following:

Ground roll	930 Feet
Total distance to clear a 50-foot obstacle	1800 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	930
Decrease in ground roll (930 feet × 13%)	<u>121</u>
Corrected ground roll	809 Feet
Total distance to clear a 50-foot obstacle, zero wind	1800
Decrease in total distance (1800 feet × 13%)	<u>234</u>
Corrected total distance to clear 50-foot obstacle	1566 Feet

CRUISE

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

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

The cruise performance chart for 8,000 feet pressure altitude is entered using 20°C above standard temperature. These values most nearly correspond to the planned altitude and expected temperature conditions. The power setting chosen is 2200 RPM and 21 inches of manifold pressure, which results in the following:

Power	65%
True airspeed	137 Knots
Cruise fuel flow	11.0 GPH

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

FUEL REQUIRED

The total fuel requirement for the flight may be estimated using the performance information in figures 5-6 and 5-7. For this sample problem, figure 5-6 shows that a normal climb from 2000 feet to 8000 feet requires 2.8 gallons of fuel. The corresponding distance during the climb is 15 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:

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

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

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

Using a similar procedure for the distance during climb results in 17 nautical miles.

The resultant cruise distance is:

Total distance	450
Climb distance	<u>-17</u>
Cruise distance	433 Nautical Miles

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

$$\begin{array}{r} 137 \\ -10 \\ \hline 127 \text{ Knots} \end{array}$$

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

$$\frac{433 \text{ Nautical Miles}}{127 \text{ Knots}} = 3.4 \text{ Hours}$$

The fuel required for cruise is:

$$3.4 \text{ hours} \times 11.0 \text{ gallons/hour} = 37.4 \text{ Gallons}$$

A 45-minute reserve requires:

$$\frac{45}{60} \times 11.0 \text{ gallons/hour} = 8.3 \text{ Gallons}$$

The total estimated fuel required is as follows:

Engine start, taxi, and takeoff	1.7
Climb	3.2
Cruise	37.4
Reserve	<u>8.3</u>
Total fuel required	50.6 Gallons

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

LANDING

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

Ground roll	670 Feet
Total distance to clear a 50-foot obstacle	1480 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**

FLAPS UP															
KIAS		50	60	70	80	90	100	110	120	130	140	150	160	---	
KCAS		60	64	71	80	89	99	108	117	127	136	145	155	---	
FLAPS 20°															
KIAS		40	50	60	70	80	90	95	---	---	---	---	---	---	
KCAS		52	57	64	72	81	90	95	---	---	---	---	---	---	
FLAPS 40°															
KIAS		40	50	60	70	80	90	95	---	---	---	---	---	---	
KCAS		51	56	63	72	81	91	95	---	---	---	---	---	---	

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

AIRSPPEED CALIBRATION ALTERNATE STATIC SOURCE

HEATER/VENTS AND WINDOWS CLOSED

FLAPS UP													
NORMAL KIAS		60	70	80	90	100	110	120	130	140	150	160	
ALTERNATE KIAS		59	70	80	91	102	112	122	133	143	153	163	
FLAPS 20°													
NORMAL KIAS		50	60	70	80	90	95	---	---	---	---	---	
ALTERNATE KIAS		51	62	72	82	92	97	---	---	---	---	---	
FLAPS 40°													
NORMAL KIAS		40	50	60	70	80	90	95	---	---	---	---	
ALTERNATE KIAS		43	51	60	71	81	90	95	---	---	---	---	

HEATER/VENTS OPEN AND WINDOWS CLOSED

FLAPS UP													
NORMAL KIAS		60	70	80	90	100	110	120	130	140	150	160	
ALTERNATE KIAS		60	70	80	90	100	110	120	130	140	150	160	
FLAPS 20°													
NORMAL KIAS		50	60	70	80	90	95	---	---	---	---	---	
ALTERNATE KIAS		50	60	70	79	89	93	---	---	---	---	---	
FLAPS 40°													
NORMAL KIAS		40	50	60	70	80	90	95	---	---	---	---	
ALTERNATE KIAS		41	49	59	68	78	87	92	---	---	---	---	

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

TEMPERATURE CONVERSION CHART

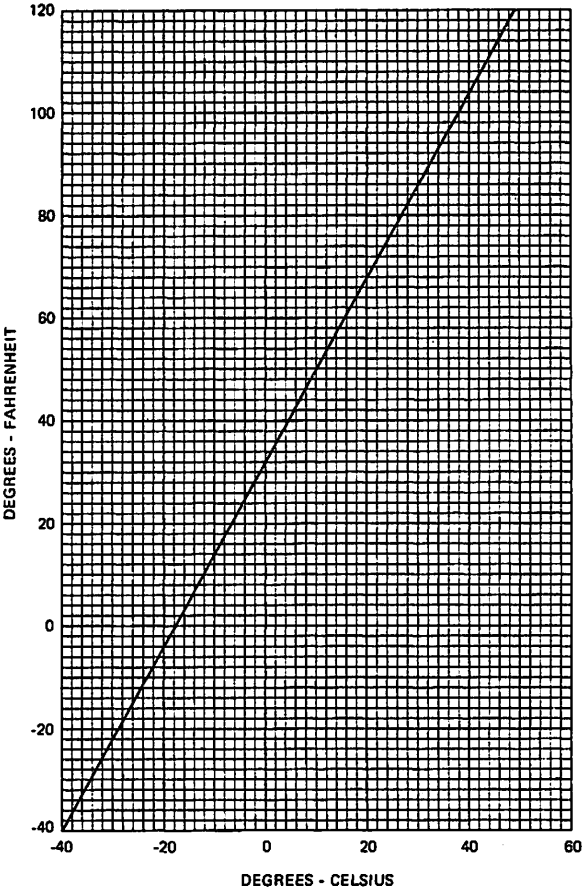


Figure 5-2. Temperature Conversion Chart

STALL SPEEDS

CONDITIONS:
Power Off

NOTES:

1. Maximum altitude loss during a stall recovery may be as much as 160 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
2950	UP	41	56	44	60	49	67	58	79
	20°	38	51	41	55	45	61	54	72
	40°	38	50	41	54	45	59	54	71

MOST FORWARD CENTER OF GRAVITY

WEIGHT LBS	FLAP DEFLECTION	ANGLE OF BANK							
		0°		30°		45°		60°	
		KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
2950	UP	48	59	52	63	57	70	68	83
	20°	47	55	51	59	56	65	66	78
	40°	45	54	48	58	54	64	64	76

Figure 5-3. Stall Speeds

TAKEOFF DISTANCE

MAXIMUM WEIGHT 2950 LBS

CONDITIONS:

Flaps 20°

2400 RPM, Full Throttle and Mixture Set Prior to

Brake Release

Cowl Flaps Open

Paved, Level, Dry Runway

Zero Wind

SHORT FIELD**NOTES:**

1. Short field technique as specified in Section 4.
2. Prior to takeoff from fields above 5000 feet elevation, the mixture should be leaned to give maximum power in a full throttle, static runup.
3. Decrease distances 10% for each 9 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2 knots.
4. Where distance value has been deleted, climb performance after lift-off is less than 150 fpm at takeoff speed.
5. For operation on a dry, grass runway, increase distances by 15% of the "ground roll" figure.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
2950	49	57	S.L.	635	1220	680	1305	730	1395	780	1490	835	1590
			1000	690	1335	745	1430	795	1530	850	1635	910	1745
			2000	755	1465	810	1565	870	1680	930	1800	995	1925
			3000	825	1605	890	1725	950	1850	1020	1985	1090	2130
			4000	905	1770	970	1905	1045	2050	1120	2205	1195	2370
			5000	995	1965	1085	2115	1145	2280	1230	2460	1315	2655
			6000	1090	2185	1175	2360	1260	2555	1350	2765	1450	3005
			7000	1200	2450	1290	2655	1390	2885	1490	3145	---	---
			8000	1325	2765	1425	3015	1530	3300	---	---	---	---

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

TAKEOFF DISTANCE
2700 LBS AND 2400 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	TO CLEAR 50 FT OBS	TOTAL ROLL	GRND ROLL	TO CLEAR 50 FT OBS	TOTAL ROLL	GRND ROLL	TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
2700	47	55	S.L.	520	1000	555	1065	595	1135	635	1210	680	1285
			1000	565	1085	605	1160	650	1235	695	1320	740	1405
			2000	615	1185	660	1265	710	1355	760	1445	810	1540
			3000	675	1285	725	1385	775	1485	830	1585	885	1695
			4000	735	1425	790	1525	850	1630	910	1745	970	1870
			5000	805	1565	865	1680	930	1800	995	1930	1065	2075
			6000	885	1730	950	1860	1020	1985	1095	2150	1170	2310
			7000	970	1920	1045	2065	1120	2225	1205	2400	1290	2595
2400	44	52	S.L.	1070	2140	1150	2310	1235	2500	1325	2705	1420	2935
			1000	395	775	425	825	455	875	485	930	520	990
			2000	430	840	465	895	495	950	530	1010	565	1075
			3000	470	915	505	975	540	1035	575	1105	615	1175
			4000	515	995	550	1060	590	1130	630	1205	675	1285
			5000	560	1085	600	1160	645	1235	690	1320	735	1405
			6000	615	1185	655	1270	705	1355	755	1445	805	1545
			7000	670	1300	720	1395	770	1490	825	1595	885	1705
			8000	735	1435	790	1535	845	1645	900	1765	970	1890
				810	1585	870	1700	930	1825	1000	1960	1070	2105

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

MAXIMUM RATE OF CLIMB

CONDITIONS:
Flaps Up
2400 RPM
Full Throttle
Cowl Flaps Open

NOTE:
Mixture leaned above 5000 feet for smooth engine operation and increased power.

WEIGHT LBS	PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
			-20°C	0°C	20°C	40°C
2950	S.L.	78	1155	1070	990	910
	2000	76	1020	945	865	780
	4000	75	890	815	740	670
	6000	74	760	690	620	550
	8000	73	635	565	500	430
	10,000	72	510	440	375	---
	12,000	71	385	320	255	---
	14,000	70	260	195	---	---
	16,000	68	140	75	---	---

Figure 5-5. Maximum Rate of Climb

TIME, FUEL, AND DISTANCE TO CLIMB

MAXIMUM RATE OF CLIMB

CONDITIONS:
Flaps Up
2400 RPM
Full Throttle
Cowl Flaps Open
Standard Temperature

NOTES:

1. Add 1.7 gallons of fuel for engine start, taxi and takeoff allowance.
2. Mixture leaned above 5000 feet for smooth engine operation and increased power.
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
2950	S.L.	15	78	1010	0	0	0
	2000	11	76	900	2	0.7	3
	4000	7	75	790	5	1.5	6
	6000	3	74	680	7	2.3	10
	8000	- 1	73	570	11	3.2	14
	10,000	- 5	72	460	15	4.3	20
	12,000	- 9	71	350	20	5.6	27
	14,000	- 13	70	240	27	7.3	37
	16,000	- 17	68	130	39	10.0	55

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

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TIME, FUEL, AND DISTANCE TO CLIMB

NORMAL CLIMB - 90 KIAS

CONDITIONS:

Flaps Up
2400 RPM
23 Inches Hg or Full Throttle
Cowl Flaps Open
Standard Temperature

NOTES:

1. Add 1.7 gallons of fuel for engine start, taxi and takeoff allowance.
2. Mixture leaned above 5000 feet for smooth engine operation and increased power.
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	RATE OF CLIMB FPM	FROM SEA LEVEL		
				TIME MIN	FUEL USED GALLONS	DISTANCE NM
2950	S.L.	15	670	0	0	0
	2000	11	670	3	0.8	5
	4000	7	670	6	1.7	9
	6000	3	640	9	2.6	14
	8000	- 1	510	13	3.6	20
	10,000	- 5	385	17	4.8	28

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

CRUISE PERFORMANCE

PRESSURE ALTITUDE 2000 FEET

CONDITIONS:
2950 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

NOTE

For best fuel economy at 65% power or less, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -9°C			STANDARD TEMPERATURE 11°C			20°C ABOVE STANDARD TEMP 31°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	22	77	134	13.1	74	135	12.6	71	136	12.2
	21	72	131	12.3	69	132	11.8	67	133	11.4
	20	67	128	11.5	65	128	11.1	63	129	10.7
	19	62	124	10.7	60	124	10.3	58	125	10.0
2300	23	78	135	13.3	75	136	12.8	72	137	12.4
	22	73	132	12.5	70	133	12.0	68	133	11.6
	21	68	128	11.7	66	129	11.3	64	130	10.9
	20	64	125	10.9	62	125	10.5	60	126	10.2
2200	23	73	132	12.5	70	133	12.0	68	133	11.6
	22	69	129	11.7	66	129	11.3	64	130	10.9
	21	64	125	11.0	62	126	10.6	60	126	10.2
	20	60	121	10.2	58	122	9.9	56	122	9.6
2100	23	68	128	11.6	66	129	11.2	64	130	10.8
	22	64	125	10.9	62	126	10.5	60	126	10.2
	21	60	121	10.2	58	122	9.9	56	122	9.6
	20	56	118	9.6	54	118	9.3	52	118	9.0
	19	52	113	9.0	50	114	8.7	48	113	8.5
	18	47	109	8.4	46	109	8.1	44	108	7.9

Figure 5-7. Cruise Performance (Sheet 1 of 8)

SECTION 5
PERFORMANCE

CESSNA
MODEL 182Q

CRUISE PERFORMANCE
PRESSURE ALTITUDE 4000 FEET

CONDITIONS:
2950 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

NOTE
For best fuel economy at 65% power or less, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -13°C			STANDARD TEMPERATURE 7°C			20°C ABOVE STANDARD TEMP 27°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	22	---	---	---	76	139	13.0	73	140	12.5
	21	74	135	12.6	71	136	12.1	69	136	11.7
	20	69	131	11.8	66	132	11.3	64	133	11.0
	19	64	127	10.9	62	128	10.6	60	128	10.2
2300	23	---	---	---	76	140	13.1	74	141	12.6
	22	75	135	12.8	72	136	12.3	70	137	11.9
	21	70	132	12.0	68	133	11.5	65	134	11.2
	20	66	128	11.2	63	129	10.8	61	130	10.4
2200	23	75	135	12.8	72	136	12.3	70	137	11.9
	22	70	132	12.0	68	133	11.6	66	134	11.2
	21	66	129	11.3	64	129	10.9	61	130	10.5
	20	62	125	10.5	59	126	10.2	57	126	9.8
2100	19	57	121	9.8	55	121	9.5	53	121	9.2
	23	70	132	11.9	67	133	11.5	65	133	11.1
	22	66	128	11.2	63	129	10.8	61	130	10.4
	21	62	125	10.5	59	126	10.1	57	126	9.8
	20	57	121	9.8	55	121	9.5	53	122	9.3
	19	53	117	9.2	51	117	8.9	50	117	8.7
	18	49	112	8.6	47	112	8.3	46	112	8.1
	17	45	107	8.0	43	107	7.8	42	106	7.6

Figure 5-7 Cruise Performance (Sheet 2 of 8)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 6000 FEET

CONDITIONS:
2950 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

NOTE

For best fuel economy at 65% power or less, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -17°C			STANDARD TEMPERATURE 3°C			20°C ABOVE STANDARD TEMP 23°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	22	---	---	---	77	143	13.3	75	144	12.8
	21	75	138	12.9	73	139	12.4	70	140	12.0
	20	71	135	12.1	68	136	11.6	66	136	11.2
	19	66	131	11.2	64	132	10.8	61	132	10.5
2300	22	77	139	13.1	74	140	12.6	71	141	12.2
	21	72	136	12.3	69	137	11.8	67	137	11.4
	20	67	132	11.5	65	133	11.1	63	133	10.7
	19	63	128	10.7	60	129	10.3	58	129	10.0
2200	22	72	136	12.3	69	137	11.9	67	137	11.5
	21	68	132	11.6	65	133	11.1	63	134	10.8
	20	63	129	10.8	61	129	10.4	59	130	10.1
	19	59	125	10.1	57	125	9.7	55	125	9.5
2100	22	67	132	11.5	65	133	11.1	63	133	10.7
	21	63	129	10.8	61	129	10.4	59	129	10.1
	19	55	121	9.5	53	121	9.2	51	121	8.9
	18	51	116	8.8	49	116	8.6	47	115	8.3
	17	47	111	8.2	45	110	8.0	43	109	7.8

Figure 5-7. Cruise Performance (Sheet 3 of 8)

SECTION 5
PERFORMANCE

CESSNA
MODEL 182Q

CRUISE PERFORMANCE
PRESSURE ALTITUDE 8000 FEET

CONDITIONS:
2950 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

NOTE
For best fuel economy at 65% power or less, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -21°C			STANDARD TEMPERATURE -1°C			20°C ABOVE STANDARD TEMP 19°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	21	77	142	13.3	74	143	12.7	72	144	12.3
	20	72	139	12.4	70	139	11.9	67	140	11.5
	19	68	135	11.5	65	135	11.1	63	136	10.7
	18	63	130	10.7	60	131	10.3	58	131	10.0
2300	21	74	139	12.6	71	140	12.1	69	141	11.7
	20	69	136	11.8	66	137	11.3	64	137	11.0
	19	64	132	11.0	62	132	10.6	60	133	10.2
	18	60	127	10.2	58	128	9.9	56	128	9.6
2200	21	69	136	11.8	67	137	11.4	65	137	11.0
	20	65	132	11.1	63	133	10.7	60	133	10.3
	19	61	128	10.3	58	129	10.0	56	129	9.7
	18	56	124	9.7	54	124	9.3	52	124	9.1
2100	21	65	132	11.1	63	133	10.7	60	133	10.3
	20	61	128	10.4	59	129	10.0	57	129	9.7
	19	57	124	9.7	54	124	9.4	53	124	9.1
	18	52	120	9.1	50	120	8.8	49	119	8.5
	17	48	115	8.5	46	114	8.2	45	113	8.0

Figure 5-7. Cruise Performance (Sheet 4 of 8)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 10,000 FEET

CONDITIONS:
2950 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

NOTE

For best fuel economy at 65% power or less, operate at the leanest mixture that results in smooth engine operation or at peak EGT if an EGT indicator is installed.

		20°C BELOW STANDARD TEMP -25°C			STANDARD TEMPERATURE -5°C			20°C ABOVE STANDARD TEMP 15°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	20	74	142	12.7	71	143	12.2	69	144	11.8
	19	69	138	11.8	67	139	11.4	64	140	11.0
	18	65	134	11.0	62	135	10.6	60	135	10.2
	17	60	129	10.2	57	130	9.8	55	130	9.5
2300	20	71	140	12.1	68	140	11.6	66	141	11.2
	19	66	136	11.3	64	136	10.9	61	136	10.5
	18	61	131	10.5	59	131	10.1	57	132	9.8
	17	57	126	9.7	55	126	9.4	53	126	9.1
2200	20	67	136	11.4	64	137	11.0	62	137	10.6
	19	62	132	10.6	60	132	10.2	58	133	9.9
	18	58	128	9.9	56	128	9.6	54	128	9.3
	17	53	123	9.2	51	123	8.9	50	122	8.7
2100	20	63	132	10.7	60	133	10.3	58	133	9.9
	19	58	128	10.0	56	128	9.6	54	128	9.4
	18	54	123	9.3	52	123	9.0	50	123	8.8
	17	50	118	8.7	48	118	8.4	46	116	8.2
	16	46	112	8.1	44	111	7.8	42	109	7.6

Figure 5-7. Cruise Performance (Sheet 5 of 8)

**SECTION 5
PERFORMANCE**

**CESSNA
MODEL 182Q**

**CRUISE PERFORMANCE
PRESSURE ALTITUDE 12,000 FEET**

CONDITIONS:
2950 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

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

		20°C BELOW STANDARD TEMP -29°C			STANDARD TEMPERATURE -9°C			20°C ABOVE STANDARD TEMP 11°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	18	66	138	11.3	64	139	10.9	61	139	10.5
	17	61	133	10.5	59	133	10.1	57	133	9.8
	16	56	128	9.7	54	128	9.4	52	127	9.1
	15	51	122	9.0	50	121	8.7	48	120	8.4
2300	18	63	135	10.8	61	135	10.4	59	135	10.0
	17	58	130	10.0	56	130	9.7	54	130	9.4
	16	54	125	9.3	52	125	9.0	50	124	8.7
	15	49	119	8.6	47	118	8.3	45	116	8.1
2200	18	59	131	10.2	57	131	9.8	55	131	9.5
	17	55	126	9.5	53	126	9.2	51	125	8.9
	16	51	121	8.8	49	120	8.5	47	119	8.3
	15	46	114	8.2	44	113	7.9	43	111	7.7
2100	18	56	127	9.6	54	127	9.3	52	126	9.0
	17	51	122	8.9	49	121	8.7	48	120	8.4
	16	47	116	8.3	45	115	8.1	44	113	7.8

Figure 5-7. Cruise Performance (Sheet 6 of 8)

CRUISE PERFORMANCE

PRESSURE ALTITUDE 14,000 FEET

CONDITIONS:
2950 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

NOTE

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

		20°C BELOW STANDARD TEMP -33°C			STANDARD TEMPERATURE -13°C			20°C ABOVE STANDARD TEMP 7°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	16	58	132	9.9	56	132	9.6	54	131	9.3
	15	53	126	9.2	51	125	8.9	49	124	8.6
	14	48	119	8.5	46	117	8.2	45	116	8.0
2300	16	55	129	9.5	53	129	9.2	51	127	8.9
	15	51	123	8.8	49	122	8.5	47	120	8.3
	14	46	115	8.1	44	113	7.9	42	111	7.7
2200	16	52	125	9.0	50	124	8.8	48	122	8.5
	15	48	118	8.4	46	116	8.1	44	115	7.9
2100	16	49	120	8.5	47	118	8.3	45	117	8.0

Figure 5-7. Cruise Performance (Sheet 7 of 8)

SECTION 5
PERFORMANCE

CESSNA
MODEL 182Q

CRUISE PERFORMANCE
PRESSURE ALTITUDE 16,000 FEET

CONDITIONS:
2950 Pounds
Recommended Lean Mixture
Cowl Flaps Closed

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

		20°C BELOW STANDARD TEMP -37°C			STANDARD TEMPERATURE -17°C			20°C ABOVE STANDARD TEMP 3°C		
RPM	MP	% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2400	15	55	130	9.4	53	129	9.1	51	128	8.8
	14	50	123	8.7	48	121	8.4	46	119	8.2
2300	15	52	127	9.1	50	126	8.8	48	124	8.5
	14	47	119	8.4	46	117	8.1	44	115	7.9
2200	15	49	122	8.6	47	120	8.3	46	118	8.1
2100	15	46	117	8.2	44	115	7.9	43	112	7.7

Figure 5-7. Cruise Performance (Sheet 8 of 8)

CESSNA
MODEL 182Q

SECTION 5
PERFORMANCE

RANGE PROFILE 45 MINUTES RESERVE 65 GALLONS USABLE FUEL

CONDITIONS:
2950 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature
Zero Wind

NOTE:
This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the distance during a normal climb up to 10,000 feet and maximum climb above 10,000 feet.

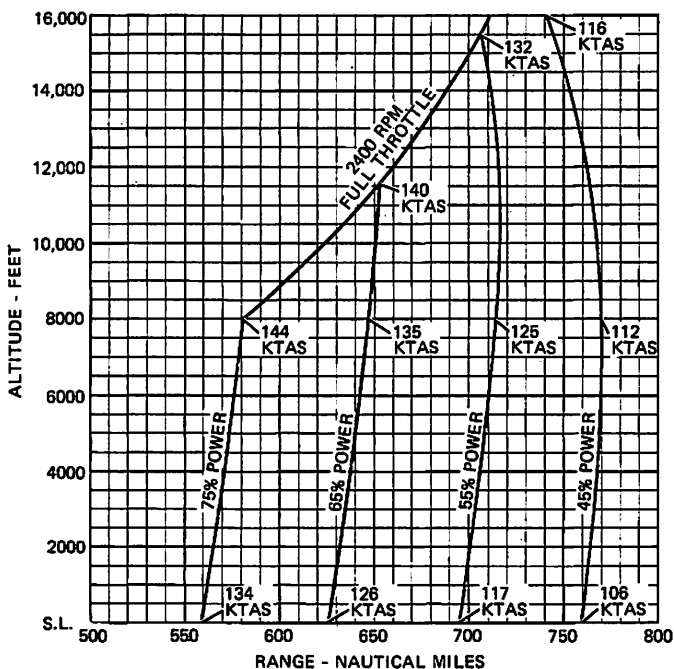


Figure 5-8. Range Profile (Sheet 1 of 2)

RANGE PROFILE
45 MINUTES RESERVE
88 GALLONS USABLE FUEL

CONDITIONS:
2950 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature
Zero Wind

NOTE:
This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the distance during a normal climb up to 10,000 feet and maximum climb above 10,000 feet.

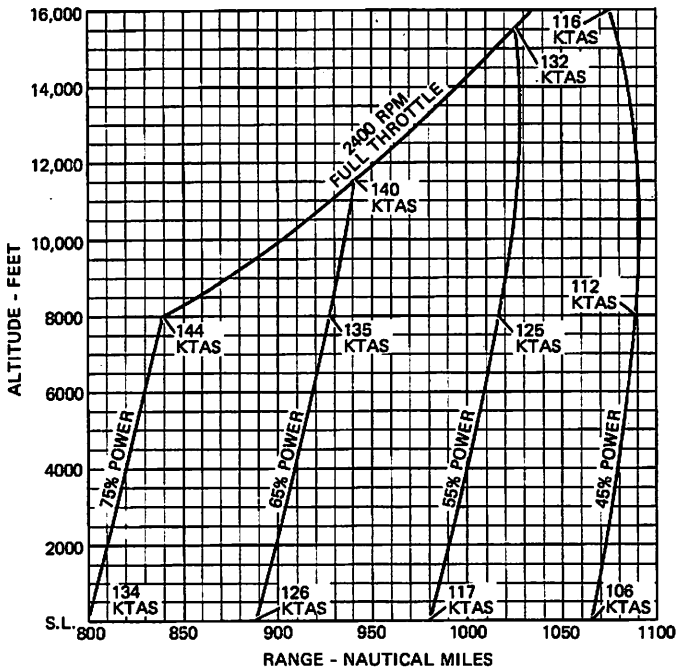


Figure 5-8. Range Profile (Sheet 2 of 2)

ENDURANCE PROFILE

45 MINUTES RESERVE
65 GALLONS USABLE FUEL

CONDITIONS:
2950 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature

NOTE:
This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during a normal climb up to 10,000 feet and maximum climb above 10,000 feet.

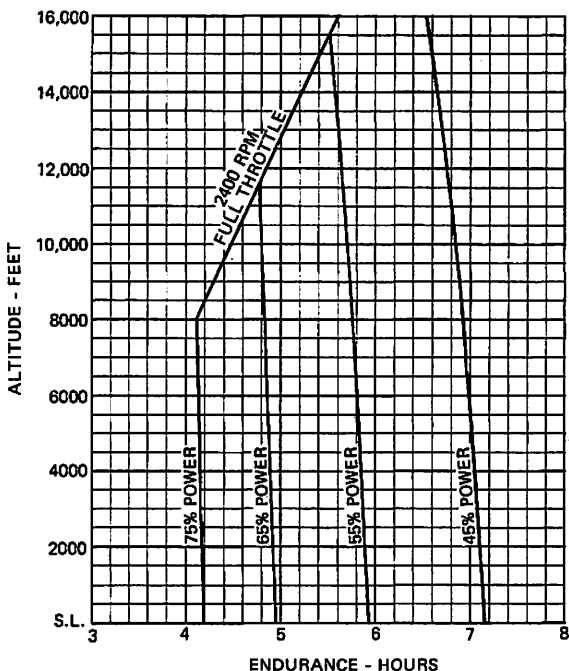


Figure 5-9. Endurance Profile (Sheet 1 of 2)

SECTION 5
PERFORMANCE

CESSNA
MODEL 182Q

ENDURANCE PROFILE
45 MINUTES RESERVE
88 GALLONS USABLE FUEL

CONDITIONS:
2950 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature

NOTE:

This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during a normal climb up to 10,000 feet and maximum climb above 10,000 feet.

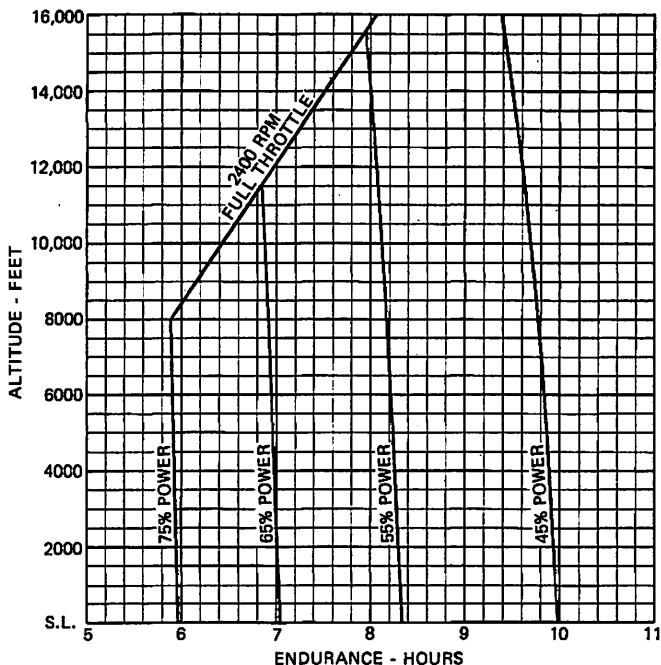


Figure 5-9. Endurance Profile (Sheet 2 of 2)

1 October 1979

LANDING DISTANCE

SHORT FIELD

CONDITIONS:

Flaps 40°

Power Off

Maximum Braking

Paved, Level, Dry Runway

Zero Wind

NOTES:

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

WEIGHT LBS	SPEED AT 50 FT KIAS	PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
			GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
2950	60	S.L.	560	1300	580	1335	600	1365	620	1400	640	1435
		1000	580	1335	600	1365	620	1400	645	1440	665	1475
		2000	600	1370	625	1405	645	1440	670	1480	690	1515
		3000	625	1410	645	1445	670	1485	695	1525	715	1560
		4000	650	1450	670	1485	695	1525	720	1565	740	1600
		5000	670	1485	695	1525	720	1565	745	1610	770	1650
		6000	700	1530	725	1575	750	1615	775	1660	800	1700
		7000	725	1575	750	1615	780	1665	805	1710	830	1750
		8000	755	1625	780	1665	810	1715	835	1760	865	1805

Figure 5-10. Landing Distance

CESSNA
MODEL 182QSECTION 5
PERFORMANCE

5-28/(5-30 blank)

CESSNA
MODEL 182Q

SECTION 6
WEIGHT & BALANCE/
EQUIPMENT LIST

SECTION 6

WEIGHT & BALANCE/ EQUIPMENT LIST

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Baggage and Cargo Tie-Down	6-6
Equipment List	6-15

INTRODUCTION

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

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

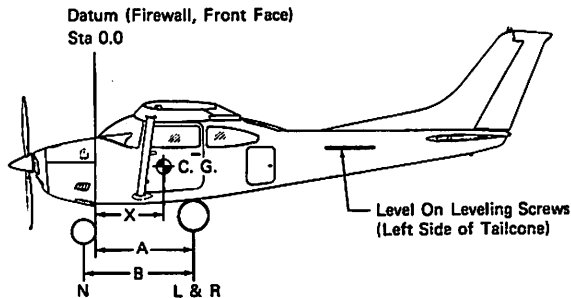
It is the responsibility of the pilot to ensure that the airplane is loaded properly.

AIRPLANE WEIGHING PROCEDURES

1. Preparation:
 - a. Inflate tires to recommended operating pressures.
 - b. Remove the fuel tank sump quick-drain fittings and fuel selector valve drain plug to drain all fuel.
 - c. Remove oil sump drain plug to drain all oil.
 - d. Move sliding seats to the most forward position.
 - e. Raise flaps to the fully retracted position.
 - f. Place all control surfaces in neutral position.
2. Leveling:
 - a. Place scales under each wheel (minimum scale capacity, 1000 pounds).
 - b. Deflate nose tire and/or lower or raise the nose strut to properly center bubble on 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.

SECTION 8
WEIGHT & BALANCE/
EQUIPMENT LIST

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

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

Item	Moment/1000		
	Weight (Lbs.)	X C.G. Arm (In.)	= (Lbs.-In.)
Airplane Weight (From Item 5, page 6-3)			
Add Oil:			
No Oil Filter (12 Qts at 7.5 Lbs/Gal)		-15.0	
With Oil Filter (13 Qts at 7.5 Lbs/Gal)		-15.0	
Add:			
Unusable Fuel (4 Gal at 6 Lbs/Gal)	24	48.0	1.2
Equipment Changes			
Airplane Basic Empty Weight			

Figure 6-1. Sample Airplane Weighing

३-५

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

[illegible]

**SECTION 8
WEIGHT & BALANCE/
EQUIPMENT LIST**

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, baggage/cargo and hatshelf is based on seats positioned for average occupants and baggage/cargo or hatshelf items loaded in the center of these 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 limitation (seat travel and baggage/cargo or hatshelf 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 AND CARGO TIE-DOWN

A nylon baggage net having six tie-down straps is provided as standard equipment to secure baggage in the area aft of the rear seat and on the hatshelf. 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 92; two center eyebolts mount on the floor slightly inboard of each sidewall just aft of the baggage door approximately at station 109; the two aft eyebolts secure at the top of the rear baggage wall at station 124. If a child's seat is installed, only the center and aft eyebolts will be needed for securing the net in the area remaining behind the seat. A placard on the baggage door defines the weight limitations in the baggage areas.

Cargo tie-down blocks and latch assemblies are available from any Cessna Dealer if it is desired to remove the rear seat (and child's seat, if installed) and utilize the rear cabin area to haul cargo. Two tie-down blocks may be clamped to the aft end of the two outboard front seat rails and are locked in place by a bolt which must be tightened to a minimum of fifty inch pounds. Seven tie-down latches may be bolted to standard attach points in the cabin floor, including three rear seat mounting points. The seven attach points are located as follows: two are located slightly inboard and just aft of the rear doorposts approximately at station 69; two utilize the aft outboard mounting points of the rear seat; one utilizes the rearmost mounting point of the aft center attach point for the rear seat approximately at station 84 (a second mounting point is located just forward of this point but is not used); and two are located just forward of the center baggage net tie-down eyebolts approximately at station 108. The maximum allowable floor loading of the rear cabin area is 200 pounds/square foot; however, when items with small or sharp support areas are carried, the installation of a 1/4" plywood floor is recommended to protect the airplane structure. The maximum rated load weight capacity for each of the seven tie-downs is 140 pounds and for the two seat rail tie-downs is 100 pounds. Rope, strap, or cable used for tie-down should be rated at a minimum of ten times the load weight capacity of the tie-down fittings used. Weight and balance calculations for cargo in the area of the rear seat, baggage and hatshelf area can be figured on the Loading Graph using the lines labeled 2nd Row Passengers or Cargo and/or Baggage or Passengers on Child's Seat.

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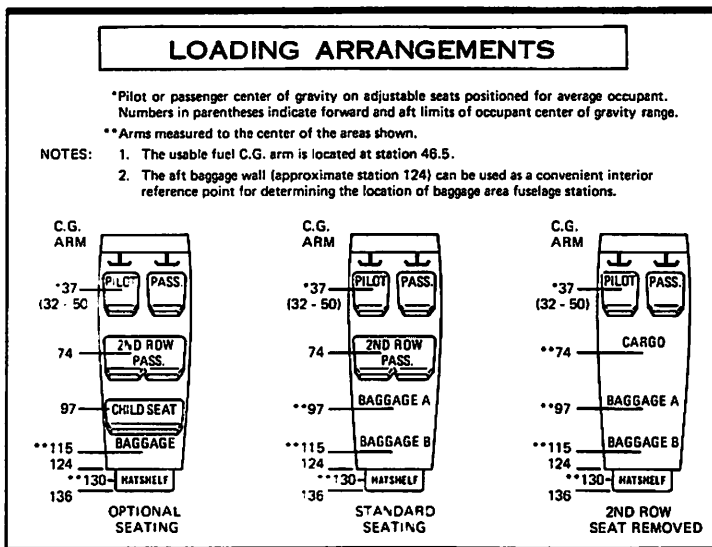
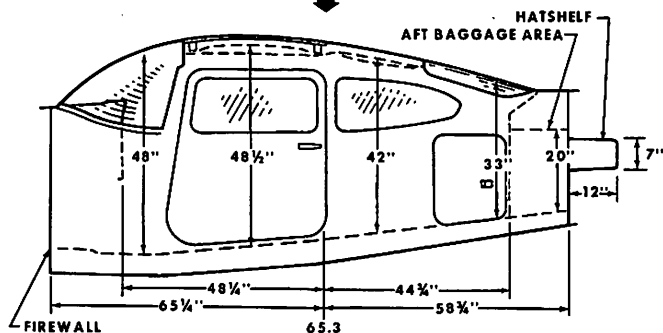


Figure 6-3. Loading Arrangements

CABIN HEIGHT MEASUREMENTS



DOOR OPENING DIMENSIONS

	WIDTH (TOP)	WIDTH (BOTTOM)	HEIGHT (FRONT)	HEIGHT (REAR)
CABIN DOOR	32"	36 1/2"	41"	38 1/2"
BAGGAGE DOOR	15 1/2"	15 1/2"	22"	20 1/2"

— WIDTH —
● LWR WINDOW
LINE
* CABIN FLOOR

CABIN WIDTH MEASUREMENTS

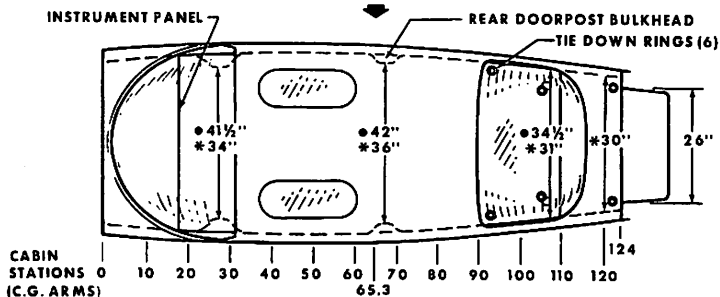


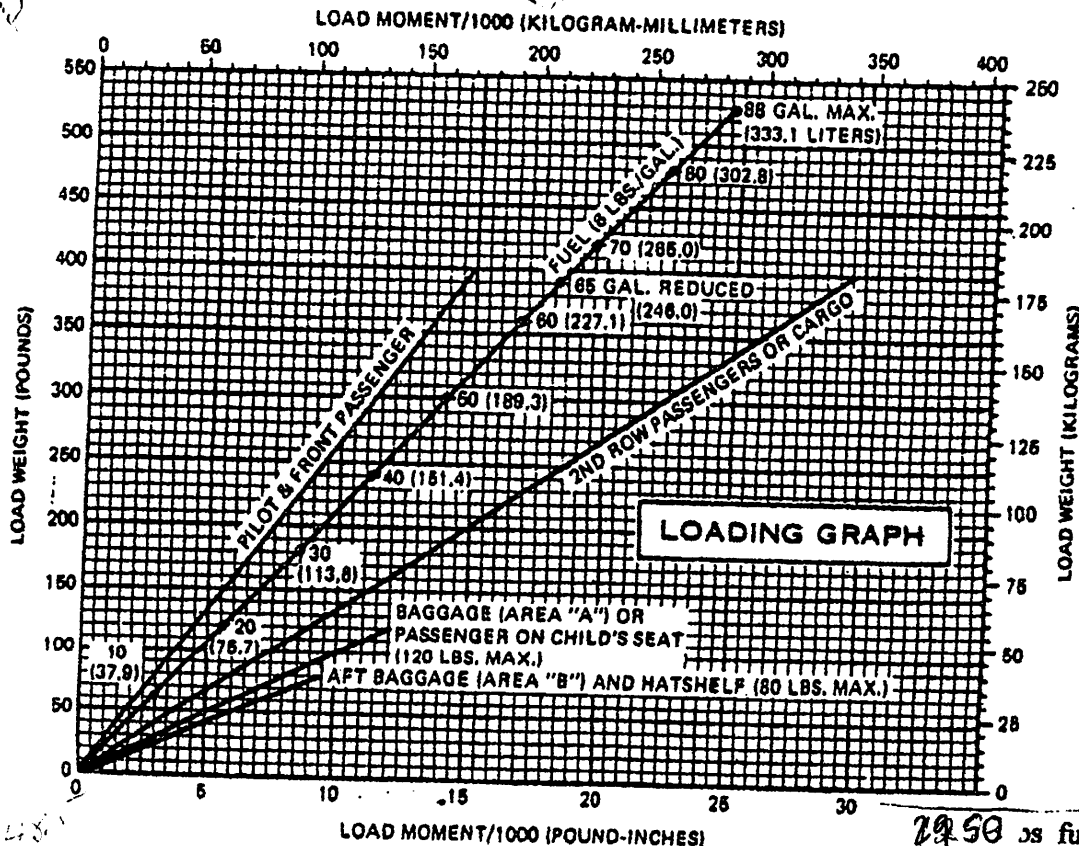
Figure 6-4. Internal Cabin Dimensions

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)	1800	63.3		
2. Usable Fuel (At 6 Lbs./Gal.)				
Standard Tanks (88 Gal. Maximum)				
Reduced Fuel (65 Gal.)	390	18.1		
3. Pilot and Front Passenger (Station 32 to 50)	340	12.6		
4. Second Row Passengers	340	25.2		
Cargo Replacing Second Row Seats (Sta. 65 to 82)				
5. Baggage (Area "A") or Passenger on Child's Seat (Sta. 82 to 108) 120 Lbs. Maximum	90	8.7		
6. Baggage-Aft (Area "B") and Hatshelf (Sta. 108 to 136) 80 Lbs. Maximum				
7. RAMP WEIGHT AND MOMENT	2960	127.9		
8. Fuel allowance for engine start, taxi and runup	- 10	-.5		
9. TAKEOFF WEIGHT AND MOMENT (Subtract step 8 from step 7)	2950	127.4		
10. Locate this point (2950 at 127.4) on the Center of Gravity Moment Envelope, and since this point falls within the envelope, the loading is acceptable.				

Figure 6-5. Sample Loading Problem

C182Q NV5124N

February 22, 2009



- NOTES: 1. Line representing adjustable seats shows pilot and front seat 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.
2. Hatch/elf Maximum Load 25 Lbs.

2050 lbs full load max
 - 1827 lbs empty wt.
 223 lbs useful load
 528 lbs fuel load

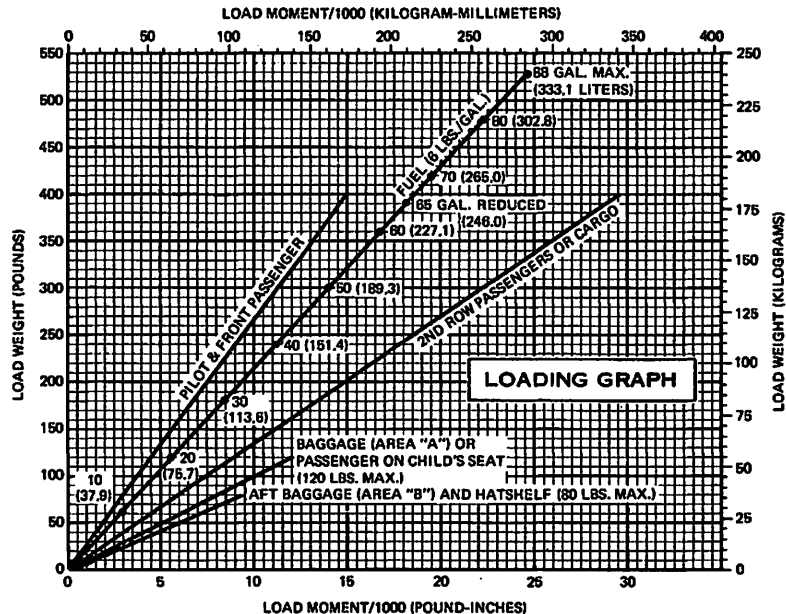
NOTE: For pilot and front passenger weight greater than 400 pounds, multiply ^{745 lbs (max load)} weight x 0.0373 to get load moment /1000

Empty Wt. C.G. 37.05

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)	1800	63.3	1827.00	67693.50
2. Usable Fuel (At 6 Lbs./Gal.) Standard Tanks (88 Gal. Maximum)			528	24.6
Reduced Fuel (65 Gal.)	390	18.1		
3. Pilot and Front Passenger (Station 32 to 50),	340	12.6		
4. Second Row Passengers	340	25.2		
Cargo Replacing Second Row Seats (Sta. 65 to 82)				
5. Baggage (Area "A") or Passenger on Child's Seat (Sta. 82 to 108) 120 Lbs. Maximum	90	8.7		
6. Baggage-Aft (Area "B") and Hatchelf (Sta. 108 to 136) 80 Lbs. Maximum				
7. RAMP WEIGHT AND MOMENT	3110	127.9		
8. Fuel allowance for engine start, taxi and runup	-10	-5		
9. TAKEOFF WEIGHT AND MOMENT (Subtract step 8 from step 7)	3110	127.4		
10. Locate this point (2950 at 127.4) on the Center of Gravity moment Envelope, and since this point falls within the envelope, the loading is acceptable.				

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- NOTES: 1. Line representing adjustable seats shows pilot and front seat 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.
2. Hatshelf Maximum Load 26 Lbs.

Figure 6-6. Loading Graph

CESSNA
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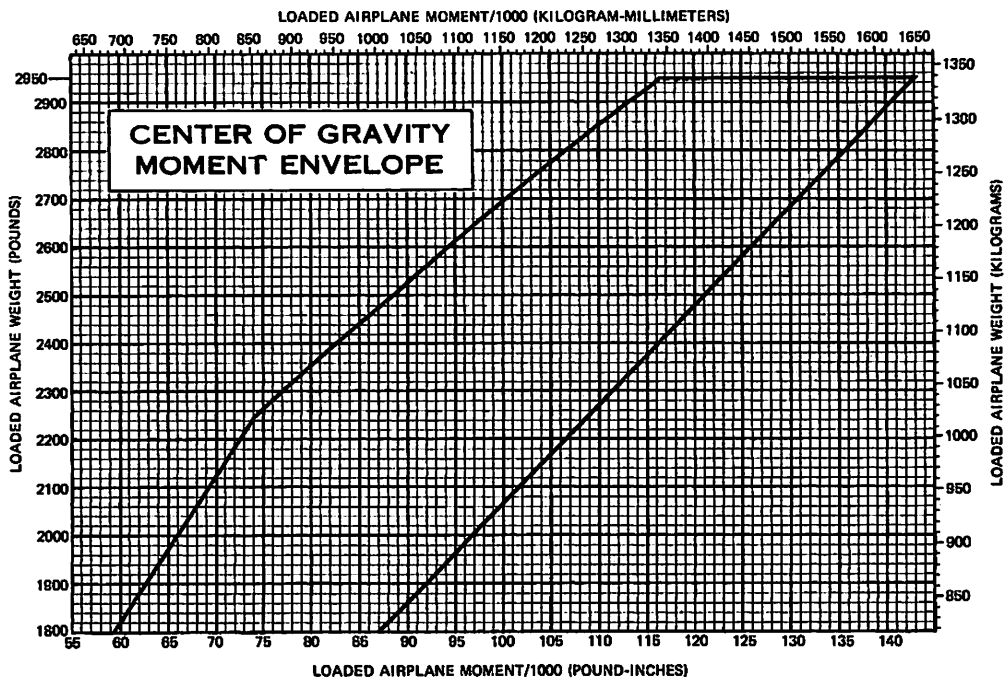


Figure 6-7. Center of Gravity Moment Envelope

CESSNA
MODEL 182Q

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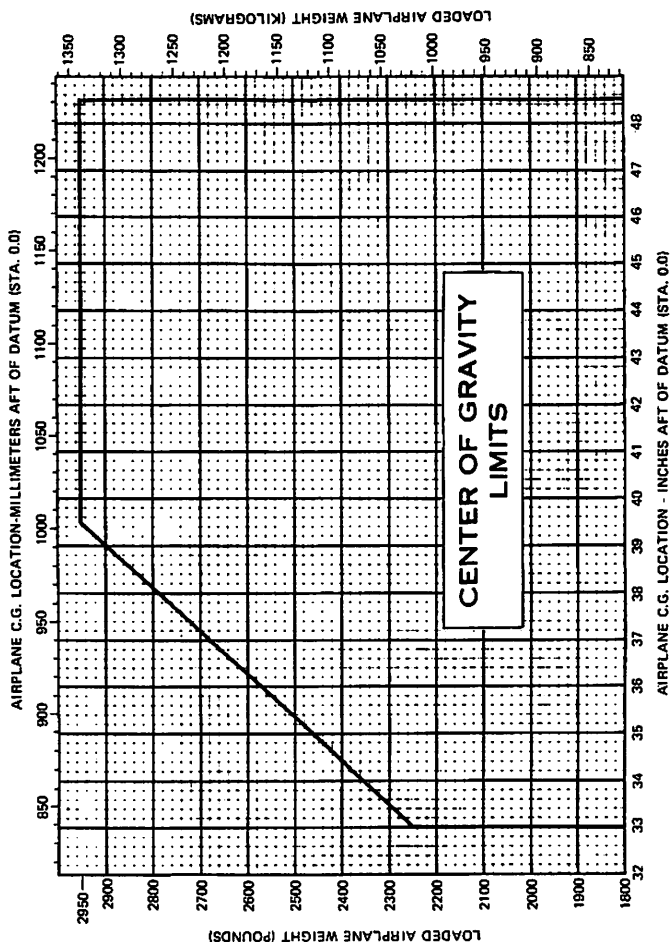


Figure 6-8. Center of Gravity Limits

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.

SECTION 6
WEIGHT & BALANCE/
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ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
4. POWERPLANT & ACCESSORIES				
A01-R	ENGINE, CONTINENTAL O-470-U SPEC 5 TWO MAGNETOS WITH IMPULSE COUPLING C11 COILS-HARRISON TWELVE 18MM X 3/4 20-3A SPARK PLUGS STARTER, 24 VOLT PRESTOLITE CARBURETOR, MARVEL SCHEBLER	0750201 SLICK-6214 TCM 621392 SH 2004 TCT 635994 MA-4-5	443.0* 10.3 14.6 2.8 17.8 5.8	-16.5* -14.5 -15.0 -4.5 -2.6
A05-R	FILTER, CARBURETOR AIR	0750038-4	1.0	-33.0
A09-L	ALTERNATOR, 28 VOLT, 60 AMP	C611503-0102	10.8	-5.5
A17-C	OIL COOLER, NON-CONGEAL MODINE IE-1605-D REPLACES OIL COOLER ON ITEM A01-R AND CHANGES ENGINE DESIGNATION TO O-470-U SPEC 6 (NET CHANGE)	0750201	1.5	-31.5
A21-A	FILTER INSTALLATION, FULL FLOW ENGINE OIL ADAPTOR ASSEMBLY	1656025-2 1250922-2	3.3* 1.5	-3.5* -4.2
A23-R	FILTER ASSEMBLY (SPIN ON TYPE)	-	1.8	-3.0
A33-R	PROPELLER, MCCAULEY C2A34C204/90DCH-8	C161009-0106	50.8	-4.5
A37-R	GOVERNOR, PROPELLER (MCCAULEY C290-D3/T14)	C161031-0107	3.0	-3.5
A41-R	SPINNER INSTALLATION, PROPELLER SPINNER DOG FORWARD SPINNER SUPPORT AFT SPINNER BULKHEAD	0752637 0752637-11 1250412-3 0752637-1	3.0* 1.7 0.2 1.1	-48.0* -44.0 -46.0 -3.8
A61-S	VACUUM SYSTEM, ENGINE DRIVEN VACUUM PUMP	0706003-1 C431003-0102	3.1* 1.8	-3.4* -3.1
A70-A	PRIMING SYSTEM, SIX CYLINDER	0750125	1.0	-15.0
A73-A	OIL QUICK DRAIN VALVE (NET CHANGE)	1701315-4	NEGL	-
P. LANDING GEAR & ACCESSORIES				
R01-R-1	WHEEL, BRAKE & TIRE ASSY, 6.00X6 MAIN (2) WHEEL ASSY, CLEVELAND 40-113 (EACH) BRAKE ASSY, CLEVELAND 30-75 (LEFT) BRAKE ASSY, CLEVELAND 30-75 (RIGHT) TIRE, 6-PLY RATED BLACKWALL (EACH) TUBE (EACH)	1241156-138 C163001-0104 C163030-0113 C163030-0114 C262023-0102 0741625	39.6* 7.4 1.9 1.9 8.4 2.1	55.6* 55.6 55.6 55.6 55.6 55.6
R01-R-2	WHEEL, BRAKE & TIRE ASSY, 6.00X6 MAIN (2) WHEEL ASSY, MCCAULEY C-30018 (EACH) BRAKE ASSY, MCCAULEY C-30018 (LEFT)	C163006-0101 C163032-0111	39.6* 7.6 1.8	55.6* 55.6 55.6

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ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
R74-K-1	PRAKE ASSY. MCCAULEY C-3C018 (RIGHT)	C163032-0112	1.8	55.5
	TIRE. 6-PLY RATED BLACKWALL (EACH)	-	1.8	58.9
	TIRE. 6-PLY RATED BLACKWALL (EACH)	C262026-0102	1.9	58.9
	WHFFL & TIRE ASSY. 5.00X5 NCSE	1241156-104	1.4*	-7.1*
R74-K-2	WHFFL ASSY. CLEVELAND 40-77	1241156-12	1.8	-7.1
	TIRE. 6-PLY RATED BLACKWALL	-	1.2	-7.1
	TUMF	C262023-0101	1.4*	-7.1*
	WHFFL & TIRE ASSY. 5.00X5 NCSE	C16301880103	1.2	-7.1*
H10-A	WHFFL ASSEMBLY. MCCAULEY	C163005-0201	1.2	-7.1
	TIRE. 6-PLY RATED BLACKWALL	-	1.2	-7.1
	TIRE	C262023-0101	1.4*	-7.1*
	FAIRING INSTALLATION. WHEEL (SET OF 3)	0741638	18.4*	45.5*
H16-H	NCSE WHEEL FAIRING	0543079	1.9	-6.0
	MAIN WHFFL FAIRING (EACH)	0541223	1.7	60.2
	PRAKE DISC FAIRING (EACH)	0741641	0.6	58.0
	AXLE. STANDARD DUTY MAIN GEAR (SET OF 2)	0541124-1	0.6	58.0
H16-D	AXLE. HEAVY DUTY MAIN GEAR (SET OF 2)	1441003-1	4.5	58.0
C. ELECTRICAL SYSTEMS				
C31-B	BATTERY. 24 VOLT. STANDARD DUTY	C614002-0101	23.2	130.0
C01-C	BATTERY. 24 VOLT. HEAVY DUTY	C614002-0102	23.2	130.0
C74-K	ALTERNATOR CENTRAL UNIT. 28 VOLT WITH HIGH AND LOW VOLTAGE SENSING	C611005-01C1	0.4	-0.3
C07-A	GROUND SERVICE PLUG RECEPTACLE	0771919-2	3.2	-2.6
C10-A	ELECTRIC ELEVATOR TRIM INSTL	2279307-2	1.9*	21.7*
C15-C	ELECTRIC DRIVE ASSEMBLY	0770724-2	0.5	26.5
	HEATING SYSTEM. PITOT & STALL WARNING SWITCH	-	0.5	26.5
C22-B	LIGHTS. INSTRUMENT POST	2201003-2	0.5	17.5
C23-A	PANEL LIGHTS. ELECTRIC-LUMINESCENT INSTL.	0770419	2.1	16.5
C25-A	MAP LIGHT. CONTROL WHEEL MCLATED (CHANGES CONTROL WHEEL. EBS-D, FROM 1260243-2 TO 1260243-9)	1260243-9	0.1	27.0
C31-A	LIGHTS. COURTESY (NET CHANGE)	0730615-11	0.5	61.7
C40-A	DEFECTORS. NAVIGATION LIGHT (SET OF 2)	0701013	NEGL	-
C43-A	GNMI FLASHING BEACON LIGHT	0701042-2	1.8*	20.8*
	LIGHT ASSY. (IN FIN TIP)	C621001-0102	1.0	55.3
	FLASHER ASSY. (IN FIN TIP)	C554502-0102	0.4	55.3
	LOCATING RESISTOR	OR 95-6	0.2	212.0

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C46-A	STRCPH LIGHTS, WHITE (EACH HING TIP) POWER SUPPLY (AEROFASH 152-3009) LIGHT ASSY. (AEROFASH 73-145)(2)	2271008-1 C622308-0102 C622306-0107	2.6* 2.3 0.3	44.4* 46.7 42.0
C49-S	LIGHT INSTL. COWL MOUNTED LANDING & TAXI LIGHT BULBS (SET OF 2)	7770417 4591	1.6* 1.0	-25.0* -32.5
D. INSTRUMENTS				
001-H	INDICATOR, AIRSPEED	C661064-0212	0.6	16.0
001-H	INDICATOR, TRUE AIRSPEED (NET CHANGE)	1201108-7	0.2	16.5
004-A	STATIC ALTERNATE AIR SOURCE	0771028-1	0.3	14.4
007-R	ALTIMETER, SENSITIVE	C661071-0101	0.7	15.3
007-C-1	ALTIMETER, SENSITIVE (FEET & MILLIBARS)	C661071-0102	0.7	15.3
007-C-2	ALTIMETER, SENSITIVE (20 FT. MARKINGS)	C661025-0102	0.7	15.0
010-A	ALTIMETER INSTALLATION (2ND UNIT)	1213681	0.8	16.0
016-A-1	ENCODING ALTIMETER (REQUIRES RELOCATING STANDARD TYPE ALTIMETER)	1213732	3.0	14.0
016-A-2	ENCODING ALTIMETER, FEET AND MILLIBARS (REQUIRES RELOCATING STANDARD TYPE ALTIMETER)	1213732	3.0	14.0
016-A-3	ALTITUDE ENCODER, BLIND (INSTRUMENT PANEL INSTALLATION NOT REQUIRED)	0701099-1	1.5*	13.6*
C22-A	GAGE, CARBURETOR AIR TEMPERATURE	0750610-2	1.2	16.0
C25-S	CLOCK, ELECTRIC, DIAL READ	C664508-0102	0.4	16.6
C25-D	CLOCK, ELECTRIC, DIGITAL READOUT	C664511-0101	0.4	16.6
028-R	COMPASS, MAGNETIC & MOUNT	1213679-3	1.1	20.5
034-R	INSTRUMENT CLUSTER, ENGINE & FUEL	C669545-0103	1.3	16.5
C49-A	INDICATOR INSTALLATION, ECONOMY MIXTURE EGT INDICATOR	0750609-2 C668501-0211	0.7* 0.4	8.2* 17.1
	THERMOCOUPLE PROBE	C668501-0204	0.1	-20.5
	THERMOCOUPLE LEAD WIRE (IC)	C668501-0206	0.1	-20.5
064-S	GYRO SYSTEM DIRECTIONAL INDICATOR ATTITUDE INDICATOR	0701030-2 C661075-0101 C661076-0102	6.4* 2.9 2.2	13.7* 14.0 14.6
	NCSFS, FITTINGS, SCREWS, CLAMPS ETC. (ALTERNATE C661075 & C661076 GYRO'S MAY BE USED)		1.3	11.5
064-D	GYRO SYSTEM INSTL. FOR NAV-C-MATIC 300A AUTOPILOT (ITEM H31-A-2) ATTITUDE INDICATOR	0701038-1 C661076-0102	6.7* 2.2	13.4* 14.6

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	PERCUSSIONAL INDICATOR (ALTERNATE C661076 ATTITUDE GYRO MAY BE USED)	40763-0104	3.2	13.4
D47-A	HOURMETER, INSTALLATION	1270744	0.5*	7.6*
	RECORDING INDICATOR	C664503-3101	0.1	17.5
	CIT PRESSURE SWITCH	S1711-1	0.2	-1.0
D73-R	GAGE, MANIFOLD PRESSURE	C662035-0101	0.2	15.8
D82-S	GAGE, OUTSIDE AIR TEMPERATURE	C668507-0101	0.1	13.3
D85-R	TACHOMETER INSTALLATION, ENGINE	0706006	0.4*	13.3*
	RECORDING TACH INDICATOR	C668020-0117	0.7	16.9
D88-S-1	INDICATOR, TURN COORDINATOR (28 VOLT ONLY)	C661003-0505	1.3	16.0
D88-S-2	INDICATOR, TURN COORDINATOR (10/30 VOLT)	C661003-0506	1.3	16.0
D88-D-1	INDICATOR TURN COORDINATOR (FOR NOM'S)	42320-0028	1.3	16.0
D88-D-2	INDICATOR, TURN & BANK	S-1303N2	2.0	15.5
D91-S	INDICATOR, VERTICAL SPEED	C661080-0101	1.0	15.4
	F. CABIN ACCOMMODATIONS			
F05-R	SEAT, ADJUSTABLE FORE & AFT - PILOT	0714042-1	13.0	44.0
F06-D	SEAT, ARTICULATING VEHT. ADJ. - PILOT	0714043-1	24.0	41.5
F07-S	SEAT, ADJUSTABLE FORE & AFT - CO-PILOT	0714042-1	13.0	44.0
F07-C	SEAT, ARTICULATING VEHT. ADJ. - CO-PILOT	0714043-2	24.0	41.5
F09-S	SEAT, 2ND ROW BENCH	0714041-1	23.0	80.5
F11-A	SEAT INSTALLATION, AUXILIARY (CHILD)	0501009-5	8.2*	104.2*
	SEAT ASSY, FOLD-AWAY (120 LB MAX CAP.)	0714050-4	6.9	104.4
	RELT ASSY, LAP	S1746-5	1.0	101.1
F15-R	RELT ASSY, LAP (PILOT SEAT)	S2275-103	1.0	101.1
F15-S	SHOULDER HARNESS ASSY, PILOT	S2275-201	0.6	37.0
F19-C	PILOT & CO-PILOT INERTIA REEL INSTL. (NET CHANGE)	0701077	3.6	92.0
F23-S	RELT & SHOULDER HARNESS ASSY, CO-PILOT	S2275-3	1.6	37.0
F27-S	RELT ASSY, 2ND ROW OCCUPANTS (SET OF 2)	S-1746-1	1.6	74.5
F27-D	RELT & SHOULDER HARNESS ASSY, 2ND ROW	S-2275-7	3.2	74.5
F35-A-1	INTERIOR, VINYL SEAT COVERS (NET CHANGE)	CES-1154	0.0	0.0
F35-A-2	INTERIOR, LEATHER SEAT COVERS (NET CHANGE)	CES-1154	0.0	0.0
F37-C	OPENABLE RH CABIN DOOR WINDOW (NET CHANGE)	0701065-6	2.0	62.3
F39-A	WINDOWS, OVERHEAD CABIN TOP (NET CHANGE)	0701017-4	0.6	43.0
F43-A	VENTILATION SYSTEM, 2ND ROW SEATING	0701084-1	0.5	63.0
F45-S	CURTAIN, REAR WINDOW	112	1.5	112.0
F47-A	OXYGEN SYSTEM, 4 PORT	0700707-12 0701091-2	34.0*	125.2*

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	OXYCIN CYLINDER-EMPTY	C166001-0601	25.0	128.3
	OXYCIN - 48 CU FT @ 1800 PSI		4.0	128.3
F49-A	OXYCIN MASKS, PILOT & 3 PASSENGER	C166005	1.5	55.0
F50-A	CLIP MOUNTING, RETRACTABLE (SET OF 2)	1201124	0.1	16.0
F51-A	WACREST, 1ST ROW (INSTALLED ARM) (EACH)	1215073-1	0.9	47.0
F52-A	WACREST, 2ND ROW (INSTALLED ARM) (EACH)	1215073-1	0.9	47.0
F53-A	SUN VISORS (SET OF 2)	0701024-1	0.0	33.0
F54-A	APPROACH PLATE HOLDER	1515151	0.1	27.5
F55-A	PAGGAGE TIE DOWN NET	1215042-1	0.5	108.0
F71-A	CARGO TIE DOWN LATCHES & SEAT RAIL CLAMPS (USE INSTALLED CARGO ARM)(STOWED) (NOT FACTORY INSTALLED)	0701029-1	1.2	
F85-A	DUAL CONTROLS	0760101-5	6.7	14.1
F99-C	WHEEL PEDALS & ICE BRAKES	0760650-3		
F93-R	CONTROL WHEEL, PILOT ALL PURPOSE (AFT CHG)	1260243-9	NEGL	-
	HEATING SYSTEM, CABIN & CARBURETOR AIR (INCLUDES EXHAUST SYSTEM)	0750201	18.0	-16.0
F. PLACARDS, WARNINGS & MANUALS				
F01-B	PLACARD, OPERATIONAL LIMITATIONS-VFR DAY	0505087-7	NEGL	-
F01-C-1	PLACARD, OPERATIONAL LIMITATIONS-VFR DAY- NIGHT	0505087-8	NEGL	-
F01-D-2	PLACARD, OPERATIONAL LIMITATIONS-IFR DAY- NIGHT	0505087-9	NEGL	-
F04-E	INDICATOR, STALL WARNING HORN-AUDIO	S-2077-8	1.0	17.5
F16-R	PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL, STOWED	D1176-13PH	1.3	-
G. AUXILIARY EQUIPMENT				
G01-A	TAILCONE LIFT HANDLES (SET OF 2)	2201009-1	1.0	186.5
G07-A	HOISTING RINGS, AIRPLANE (NOT FACTORY INSTALLED)	0770612-1	1.5	45.0
G13-A	CORROSION PROOFING, INTERNAL	0760007-1	7.0	70.0
G16-A	STATIC DISCHARGERS (SET OF 10)	1201131-2	0.4	130.5
G19-A	STABILIZER ABRASION SCOTS	0500041-2	2.7	206.0
G22-S	TOWBAR, AIRCRAFT (STOWED ARM SHOWN)	0501019-1	1.6	57.0

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ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
G25-A	PAINT, OVERALL EXTERIOR, MODIFIED POLY-URETHANE CYFRALL WHITE BASE COLLORED STRIPS	0704942	12.7*	91.9*
G31-A	CABLES, CORROSION RESISTANT (NET CHANGE)	0760007-1	11.9	92.2
G35-A-1	FIRE EXTINGUISHER, HAND TYPE (FOR USE WITH STANDARD PILOT SEAT)	0701014-1	0.4	82.3
G45-A-2	FIRE EXTINGUISHER, HAND TYPE (FOR USE WITH VERTICAL ADJUSTING PILOT SEAT)	0701014-2	3.0	35.0
G61-A	WRITING TABLE	1715072-1	3.2	29.0
G67-A	PEDAL EXTENSIONS, RUDDER, REMOVABLE - SET OF 2 (STOWABLE - INSTALLED ARM SHOWN)	0701048	3.6	41.5
G99-A	WINTERIZATION KIT, ENGINE WINTER FRONT INSTALLED ARM SHOWN	0752647-2	2.3	8.0
			1.1*	-29.9*
			0.5	-34.3
	H. AVIONICS & AUTOPILOTS			
H01-A-1	CESSNA 300 ADF WITH BFO RECEIVER WITH BFC (R-546E) GENIOMETER INDICATOR (IN-346A) ADF LOOP ANTENNA & ASSOC. WIRING ADF SENSE ANTENNA MOUNTING RGX & MISC ITEMS	41240-0001 41420-0001 40980-1001 3960104-1 0770750-608	8.5*	22.1*
H01-A-2	CESSNA 400 ADF (w/BFO) ADF RECEIVER WITH BFC (R-446A) GENIOMETER INDICATOR (IN-346A) ADF LOOP ANTENNA & ASSOC. WIRING ADF SENSE ANTENNA MOUNTING RGX & MISC ITEMS	3910160-1 43090-1028 40980-1001 3960104-1 0770750-608	18.5*	17.0*
H03-A	AM/FM STEREO RECEIVER & CASSETTE PLAYER HEADSET (SET OF 2, 4 MAY BE USED) STEREO RECEIVER INSTALLATION ANTENNA WIRING & MISC ITEMS	C596532-0101 K741C 3930194	16.0*	31.5*
H04-A-1	DME INSTALLATION, NARCO TRANSCIVER (CME 190) MOUNT ASSY ANTENNA	3910166-6 3312-406 -	6.3*	14.3*
H04-A-2	CESSNA 400 DME INSTALLATION RECEIVER-TRANSMITTER INDICATOR	3910167-16 44000 44020-1100	1.9*	101.9*

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ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
H05-A-1	ANTENNA	42942	0.2	88.4
	INDICATOR DELETED. IN-385A	3910168-18	4.7*	12.0*
	A DPFI (INDICATOR NET CHANGE)			
	P-NAV COMPUTER (R-478A)	44120-0000	3.8	12.5
H05-A-2	INDICATOR ADDED. IN-442AR	43910-1000	1.0	15.5
	INDICATOR DELETED. IN-385A		-1.6	15.5
	FOSTER R-NAV 511	3910203	4.4*	15.5
	COMPUTER-INDICATOR		3.0*	15.5
H07-A	CESSNA 400 GLIDEPLOPE (INCLUDES VOR/ILS	3910157	4.0*	100.0*
	INDICATOR EXCHANGE FOR VCR/LOC)			
	RECEIVER 40 CHANNEL (R-443B)	421J0-0000	2.1	130.1
	RECEIVER MOUNT	36450-0000	0.3	130.1
H08-A-1	ANTENNA (MOUNTED ON UPPER WINDSHIELD)	1270098-1	0.2	26.6
	VCR/ILS INDICATOR (IN-386A) (INDICATOR	46860-2000	0.1	15.5
	ACTUAL WT IS 1.7 LBS)			
	AUTO RADIAL CENTERING INDICATOR ARC/LCC	3910196	0.2*	15.5*
H08-A-2	EXCHANGE FOR VOR/LCC IN ITEMS H22-A AND			
	H25-A (WT NET CHANGE)			
	ARC/LOC INDICATOR ADDED	46860-1200	1.8	15.5
	VOR/LOC INDICATOR DELETED	46860-1000	-1.6	15.5
H11-A-1	AUTO RADIAL CENTERING INDICATOR ARC/ILS	3910196	0.1*	15.5*
	EXCHANGE FOR VOR/ILS INDICATOR IN ITEM			
	H07-A ONLY			
	ARC/ILS INDICATOR (IN-386AC) ADDED	46860-2200	1.9	15.5
H11-A-2	VOR/ILS INDICATOR (IN-386A) DELETED	46860-2000	-1.8	15.5
	PANTRONICS HF TRANSCEIVER 2ND UNIT	3910193	19.8*	98.0*
	PTTC-A TRANSCEIVER (HIGH FREQUENCY	C582103-0101	3.8	11.7
	PT-10PS-28 REMOTE POWER SUPPLY	C582103-0301	8.6	130.1
H13-A	DX-10RL-28 REMOTE ANTENNA LOAD BOX	C589502-0201	4.2	117.0
	ANTENNA INSTL 351 INCHES LONG	3960117	0.3	152.1
	SUNARF SSR HF TRANSCEIVER 2ND UNIT	3960158	2.5*	96.1*
	RE-1000 SINGLE BAND VCR (ASB-125)	99681	0.3	11.7
H16-A-1	PAI/10A REMOTE POWER AMPLIFIER	99683	0.3	128.0
	CU-110 ANTENNA COUPLER (LOAD BCX)	99816	0.3	117.0
	ANTENNA INSTL 351 INCHES LONG	3960117	0.3	152.1
	CESSNA 400 MARKER BEACON	3910164	0.5*	67.4*
H16-A-2	RECEIVER (R-402A)	42410-5128	0.7	11.0
	ANTENNA, FLUSH MOUNTED IN TAILCONE	1270720-1	0.0	133.4*
	CESSNA 400 TRANSPONDER	3910127	1.1*	32.5*
	RECEIVER-TRANSMITTER (RT-359A)	41420-0028	1.7	167.0*
H16-A-2	ANTENNA	42940-0000	4.0	32.5
	CESSNA 400 TRANSPONDER	3910128-2	1.1*	32.5*

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H72-A-1	RECEIVER-TRANSMITTER (RT-459A)	41470-1028	2.8	12.5
	ANTENNA	42940-0000	0.2	167.0
	CESSNA 300 NAV/COM 720 CH COM 1ST UNIT	3910183-16	8.3*	12.9*
H72-A-3	REQUIRES H34-A TO BE OPERATIONAL			
	RECEIVER-TRANSMITTER (RT-385A)	46660-1000	5.5	12.5
	VCR/LOC INDICATOR (IN-385A)	46860-1000	1.6	15.5
H75-A-1	MCUNT. WIRING & MISC HARDWARE		1.2	11.8
	CESSNA 400 NAV/COM WITH IN-385A (300)	3910189-5	8.3*	12.9*
	SERIES INDICATOR 1ST UNIT			
H75-A-2	REQUIRES H34-A TO BE OPERATIONAL			
	RECEIVER-TRANSMITTER (RT-485A)	47360-1000	5.5	12.5
	VCR/LOC INDICATOR (IN-385A)	46860-1000	1.6	15.5
H75-A-7	MCUNT. WIRING & MISC HARDWARE		1.2	11.8
	CESSNA 300 NAV/COM 720 CH COM 2ND UNIT	3910183-19	8.3*	12.9*
	REQUIRES H37-A TO BE OPERATIONAL			
H75-A-7	RECEIVER-TRANSMITTER (RT-385A)	46660-1000	5.5	12.5
	VCR/LOC INDICATOR (IN-385A)	46860-1000	1.6	15.5
	MCUNT. WIRING & MISC HARDWARE		1.2	11.8
H75-A-7	CESSNA 400 NAV/COM 720 CH COM, WITH 300	3910189-6	8.3*	12.9*
	SERIES INDICATOR, 2ND UNIT			
	REQUIRES H37-A TO BE OPERATIONAL			
H75-A-7	RECEIVER-TRANSMITTER (RT-485A)	47360-1000	5.5	12.5
	VCR/LOC INDICATOR (IN-385A)	46860-1000	1.6	15.5
	MCUNT. WIRING & MISC HARDWARE		1.2	11.8
H75-A-7	EMERGENCY LOCATOR TRANSMITTER	0470419	3.5*	134.6*
	TRANSMITTER ASSY (O & M MELT-6-1)	C589511-0117	3.3	134.5
	ANTENNA	C589511-0109	0.1	137.8
H75-A-7	EMERGENCY LOCATOR TRANSMITTER (USED IN CANADA)	0470419	3.5*	134.6*
	TRANSMITTER ASSY (O & M MELT-6-1C)	C589511-0113	3.3	134.5
	ANTENNA	C589511-0109	0.1	137.8
H75-A-7	NAV-C-MATIC 200A INSTALLATION (AF-295B)	3910162	9.1*	57.1*
	CONTROLLER-AMPLIFIER	43610-1202	1.1	15.0
	TURN COORDINATOR (C88-C-1)(NET CHANGE)	42320-0028	1.0	-
H75-A-7	WING SERVO INSTALLATION	0700215	1.0	78.6
	NAV-C-MATIC 303A INSTALLATION (AF-395-A)	3910163	1.1	15.0
	CONTROLLER-AMPLIFIER (C-395A)	42660-1202	1.0	78.6
H75-A-7	GYRC INSTALLATION (NET CHANGE)	0701038	1.0	78.6
	TURN COORDINATOR (C88-O-1)(NET CHANGE)	42320-0028	1.0	78.6
	WING SERVO INSTALLATION	0700215	1.0	78.6
H75-A-7	NAV-C-MATIC 303A INSTALLATION WITH NCN-SLAVED HSI		10.4*	75.9*

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H34-A	CONTROLLER-AMPLIFIER	42660-2202	1.4	15.0
	NON-SLAVED HSI, 1G-R32C	44690-2030	4.5	14.0
	1ST CONVERTER INSTALLATION		1.1	130.5
	DBR-0-1 TURN COORDINATOR (NET CHANGE)	42320-0028	1.0	-
	WING SERVICE INSTALLATION	0700215	0.8	78.6
	STANDARD DIRECTIONAL INDICATOR DELETED		0.4	14.0
	VCR/HS INDICATOR DELETED		1.7	15.5
	MISC ITEMS & HARDWARE		7.8	78.6
	BASIC AVIONICS KIT (REQUIRED BY AND AVAILABLE WITH 1ST UNIT ONLY)	3910186-8	7.8*	54.4*
	CARIN SPEAKER INSTL.	0770750-741	1.9	45.1
	RADIO COILING	3930208	1.0	12.5
	NOISE FILTER (ON ALTERNATOR)	3940148-2	0.1	-6.0
	RECEIVER INSTALLATION KIT	3930186	0.1	11.9
	CABLE ASSY FOR CCM ANTENNA	3950126-40	0.4	27.8
H37-A	CABLE ASSY FOR CMNI ANTENNA	3950126-9	0.8	139.8
	CMNI ANTENNA INSTALLATION	3960102-6	0.6	69.6
	CCM ANTENNA, RM SPIKE ON CABIN TOP	3960113-2	0.6	69.6
	AUDIO CONTROL PANEL AND WIRING	3970147	1.9	12.5
	HFACSET INSTALLATION	3970137-2	0.3	14.6
	MICROPHONE INSTALLATION	3970139-1	0.3	18.5
H46-A	ANTENNA & COUPLER KIT (ROD & AVAILABLE WITH 2ND NAV/COM INSTL.)	3910185	1.0*	38.9*
	ANTENNA & CABLE, LF VHF CCM		0.8	47.4
H52-A	ADF ANT PRECIP SENSE ANTENNA	5-2212-1	0.8	19.0
H52-A	FLUSH MOUNTED COM ANTENNA	3910154-64	0.8	141.8
H55-A	(FLUSH MTD IN LEADING EDGE VERTICAL FIN	3910154-63	1.4	184.6
H55-A	MIC-HFADSET COMBINATION, LIGHT WT REQUIRES	C596530-0101	0.2	12.0
H56-A	HFACSET INSTALLATION			
H56-A	HFACSET-MICROPHONE, PADDED (STOWED)	C596531-0101	1.1	14.0
H77-A	REQUIRES R89-C INSTALLATION			
	REMOTE TRANSPONDER IDENT SWITCH	3910205	0.2	17.0
J. SPECIAL OPTICAL PACKAGES				
J31-A	SKYLANE II KIT	-	55.6*	53.3*
	C07-A GROUND SERVICE RECEPTACLE	0701019-1	3.0	26.6
	C19-0 HEATED PITOT & STALL WARNING	0770724-1	0.9	26.6
	C31-A COURTESY ENTRANCE LIGHTS (2)	0700615-9	0.9	61.7

SECTION 8
WEIGHT & BALANCE/
EQUIPMENT LISTCESSNA
MODEL 182Q

CESSNA
MODEL 182Q

SECTION 6
WEIGHT & BALANCE/
EQUIPMENT LIST

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
J04-A	C40-A NAV LIGHT DETECTORS	0731013	NEGL	-
	C41-A FLASHING BEACON LIGHT	0731042-1	1.8	208.6
	C01-0 TRUE AIRSPEED IND. (NET CHANGE)	1201108-7	0.2	16.5
	C04-A STATIC ALTERNATE AIR SOURCE	0731028-1	0.3	14.4
	C49-A F. G. T. INDICATOR		0.7	8.2
	F05-A DUAL CNTRLCS	0760101-5	6.7	14.1
	G16-A STATIC DISCHARGERS (SET OF 10)	1201121-2	0.4	130.5
	H01-A-1 CESSNA 300 ADF (R-546F)	3910159-1	8.5	22.8
	H16-A-1 CESSNA 300 TRANSPONDER (RT359A)	3910127-6	4.1	21.9
	H22-A-1 CESSNA 300 NAV/CCM (RT-385A)	3910183	3.3	12.9
	H28-A-1 EMERGENCY LOCATOR TRANSMITTER	0470419	3.5	134.6
	H31-A-1 CESSNA 200A ALTO-PILOT	-	5.1	57.1
	H34-A BASIC AVIONICS KIT	3910186	7.8	54.4
	NAV-PAC (SKYLANE II ONLY) (NET CHANGE)	-	15.8*	45.2*
	H07-A 400 GLIDESLOPE (R-4438)	3910157	4.0	100.0
	H13-A 400 MARKER BEACON (H-402A)	3910164	8.0	67.4
	H25-A-1 NAV/CCM 385A VOR/LCC 2ND UNIT	3910183	8.0	12.9
	H37-A ANTENNA & COUPLER KIT	3910185	1.0	38.5

1 October 1979

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SECTION 7

AIRPLANE & SYSTEMS DESCRIPTIONS

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INTRODUCTION

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

AIRFRAME

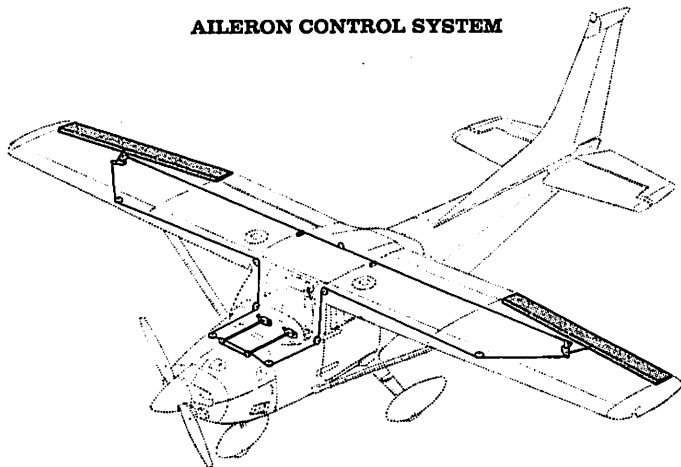
The airplane is an all-metal, four-place, high-wing, single-engine airplane equipped with tricycle landing gear and designed for general utility purposes.

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 attaching plates 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 balance weights and the addition of a formed sheet metal leading edge section.

The empennage (tail assembly) consists of a conventional vertical stabilizer, rudder, horizontal stabilizer, and elevator. The vertical stabilizer consists of a forward and aft spar, formed sheet metal ribs and reinforcements, four skin panels, formed leading edge skins, and a dorsal. The rudder is constructed of a forward and aft spar, formed sheet metal ribs and reinforcements, and a wrap-around skin panel. The top of the rudder incorporates a leading edge extension which contains a balance weight. The horizontal stabilizer is constructed of a forward and aft spar, ribs and stiffeners, center upper and lower skin panels, and two left and two right wrap-around skin panels which also form the leading edges. The horizon-

AILERON CONTROL SYSTEM



**RUDDER AND RUDDER TRIM
CONTROL SYSTEMS**

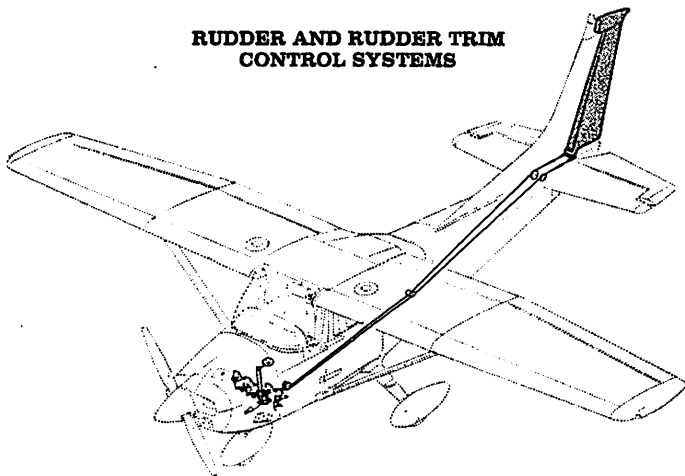
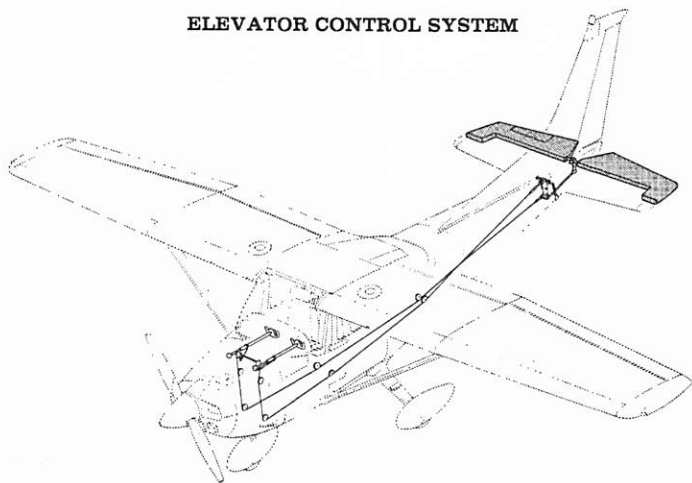


Figure 7-1. Flight Control and Trim Systems (Sheet 1 of 2)

ELEVATOR CONTROL SYSTEM



**ELEVATOR TRIM
CONTROL SYSTEM**

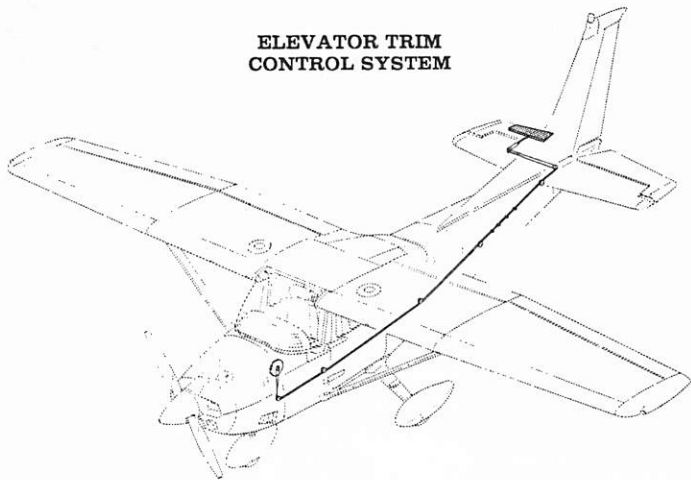


Figure 7-1. Flight Control and Trim Systems (Sheet 2 of 2)

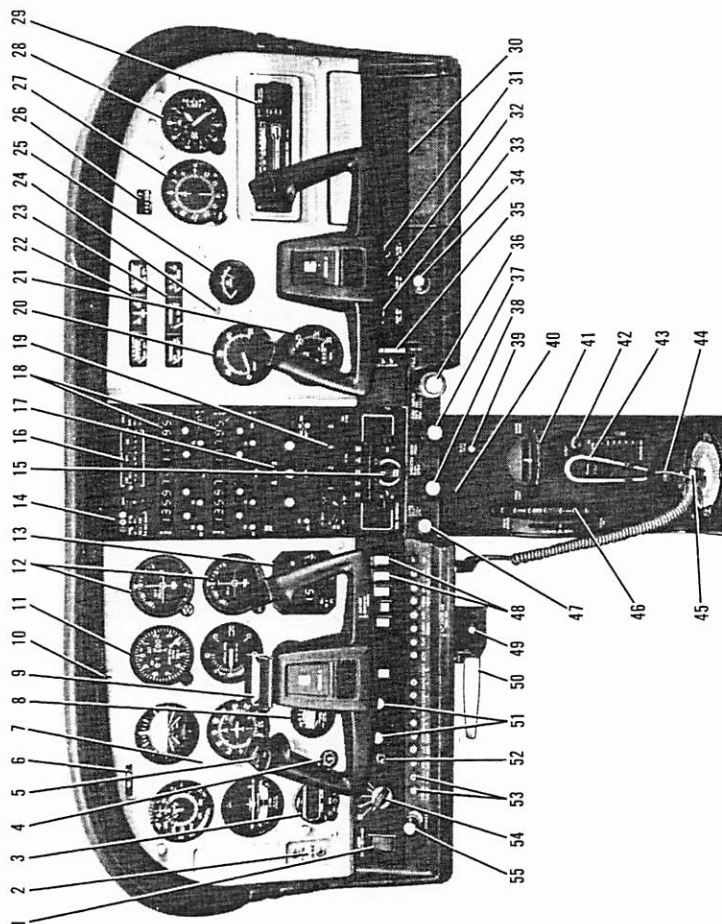


Figure 7-2. Instrument Panel (Sheet 1 of 2)

1. Master Switch
2. Phone and Auxiliary Mike Jacks
3. Digital Clock
4. Suction Gage
5. Electric Elevator Trim Switch
6. Airplane Registration Number
7. Flight Instrument Group
8. Carburetor Air Temperature Gage
9. Approach Plate Holder
10. Approach Plate Light and Switch
11. Encoding Altimeter
12. Course Deviation and ILS
Glide Slope Indicators
13. DME
14. Marker Beacon Indicator
Lights and Switches
15. Autopilot Control Unit
16. Audio Control Panel
17. ADF Radio
18. Nav/Com Radios
19. Transponder
20. Manifold Pressure Gage
21. Tachometer
22. Fuel Quantity Indicators
and Ammeter
23. Cylinder Head Temperature,
Oil Temperature, and Oil
Pressure Gages
24. Low-Voltage Warning Light
25. Economy Mixture Indicator
26. Flight Hour Recorder
27. ADF Bearing Indicator
28. Secondary Altimeter
29. Cassette Stereo, AM/FM
Multiplex Radio
30. Map Compartment
31. Defroster Control Knob
32. Cabin Air Control Knob
33. Cabin Heat Control Knob
34. Cigar Lighter
35. Wing Flap Switch and
Position Indicator
36. Mixture Control Knob
37. Propeller Control Knob
38. Throttle (With Friction Lock)
39. Electric Elevator Trim
Circuit Breaker
40. Control Pedestal Light
41. Rudder Trim Control Wheel and
Position Indicator
42. Cowl Flap Control Lever
43. Microphone
44. Fuel Selector Light
45. Fuel Selector Valve Handle
46. Elevator Trim Control Wheel
and Position Indicator
47. Carburetor Heat Control Knob
48. Electrical Switches
49. Static Pressure Alternate
Source Valve
50. Parking Brake Handle
51. Instrument and Radio Dial
Light Dimming Rheostats
52. Avionics Power Switch
53. Circuit Breakers
54. Ignition Switch
55. Primer

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

tal stabilizer also contains the elevator trim tab actuator. Construction of the elevator consists of formed leading edge skins, a forward spar, ribs, torque tube and bellcrank, left upper and lower "V" type corrugated skins, and right upper and lower "V" type corrugated skins incorporating a trailing edge cut-out for the trim tab. The elevator trim tab consists of a spar and upper and lower "V" type corrugated skins. Both elevator tip leading edge extensions incorporate balance weights.

FLIGHT CONTROLS

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

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

TRIM SYSTEMS

Manually-operated rudder and elevator trim is provided (see figure 7-1). Rudder trimming is accomplished through a bungee connected to the rudder control system and a trim control wheel mounted on the control pedestal. Rudder trimming is accomplished by rotating the horizontally mounted trim control wheel either left or right to the desired trim position. Rotating the trim wheel to the right will trim nose-right; conversely rotating it to the left will trim nose-left. Elevator trimming is accomplished through the elevator trim tab by utilizing the vertically mounted trim control wheel. Forward rotation of the trim wheel will trim nose-down; conversely, aft rotation will trim nose-up. The airplane may also be equipped with an electric elevator trim system. For details concerning this system, refer to Section 9, Supplements.

INSTRUMENT PANEL

The instrument panel (see figure 7-2) is designed around the basic "T" configuration. The gyros are located immediately in front of the pilot, and

arranged vertically. The airspeed indicator and altimeter are located to the left and right of the gyros, respectively. The remainder of the flight instruments are located around the basic "T". Avionics equipment is stacked approximately on the centerline of the panel, with the right side of the panel containing the manifold pressure gage, low-voltage warning light, tachometer, map compartment, and space for additional instruments and avionics equipment. The engine instrument cluster and fuel quantity indicators are on the right side of the avionics stack near the top of the panel. A switch and control panel, at the lower edge of the instrument panel, contains most of the switches, controls, and circuit breakers necessary to operate the airplane. The left side of the panel contains the master switch, engine primer, ignition switch, avionics power switch, light intensity controls, electrical switches, and circuit breakers. The center area contains the carburetor heat control, throttle, propeller control, and mixture control. The right side of the panel contains the wing flap switch and position indicator, cabin heat, cabin air, and defroster control knobs and the cigar lighter. A pedestal, extending from the switch and control panel to the floorboard, contains the elevator and rudder trim control wheels, cowl flap control lever, and microphone bracket. The fuel selector valve handle is located at the base of the pedestal. A parking brake handle is mounted below the switch and control panel, in front of the pilot. A static pressure alternate source valve control knob may also be installed below the switch and control panel adjacent to the parking brake handle.

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

GROUND CONTROL

Effective ground control while taxiing is accomplished through nose wheel steering by using the rudder pedals; left rudder pedal to steer left and right rudder pedal to steer right. When a rudder pedal is depressed, a spring-loaded steering bungee (which is connected to the nose gear and to the rudder bars) will turn the nose wheel through an arc of approximately 11° each side of center. By applying either left or right brake, the degree of turn may be increased up to 29° each side of center.

Moving the airplane by hand is most easily accomplished by attaching a tow bar to the nose gear strut. If a tow bar is not available, or pushing is required, use the wing struts as push points. Do not use the vertical or horizontal surfaces to move the airplane. If the airplane is to be towed by vehicle, never turn the nose wheel more than 29° either side of center or structural damage to the nose gear could result.

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

WING FLAP SYSTEM

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

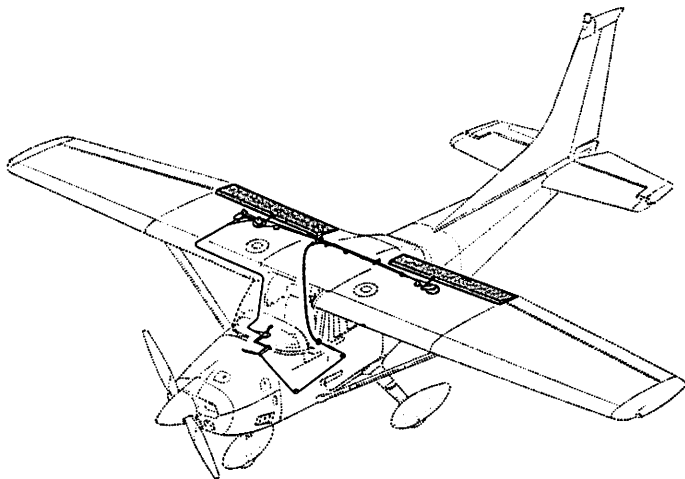


Figure 7-3. Wing Flap System

LANDING GEAR SYSTEM

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

BAGGAGE COMPARTMENT

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

SEATS

The seating arrangement consists of two individually adjustable four-way or six-way seats for the pilot and front seat passenger, and a split-backed fixed seat for the rear seat passengers. A child's seat (if installed) is located at the aft cabin bulkhead behind the rear seat.

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

SECTION 7 AIRPLANE & SYSTEMS DESCRIPTIONS

**CESSNA
MODEL 182Q**

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

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

A child's seat may be installed aft of the rear passengers' seat, and is held in place by two brackets mounted on the floorboard. The seat is designed to swing upward into a stowed position against the aft cabin bulkhead when not in use. To stow the seat, rotate the seat bottom up and aft as far as it will go. When not in use, the seat should be kept in the stowed position.

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

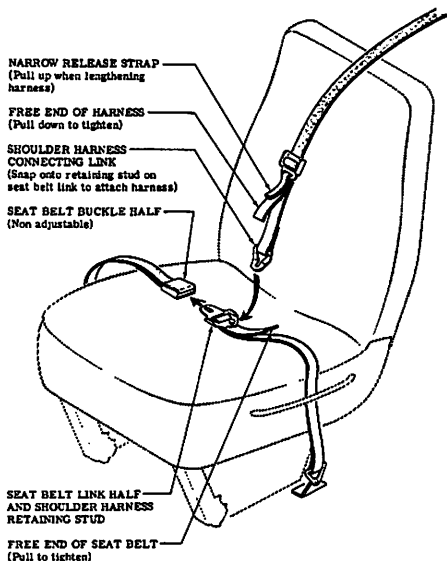
SEAT BELTS AND SHOULDER HARNESSSES

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

SEAT BELTS

The seat belts used with the pilot's and front passenger's seats, and the child's seat (if installed), are attached to fittings on the floorboard. The

STANDARD SHOULDER
HARNESS



(PILOT'S SEAT SHOWN)

SEAT BELT/SHOULDER
HARNESS WITH INERTIA
REEL

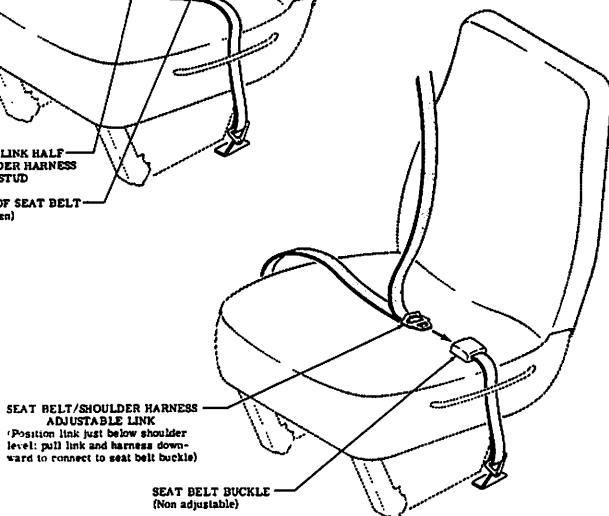


Figure 7-4. Seat Belts and Shoulder Harnesses

buckle half is inboard of each seat and the link half is outboard of each seat. The belts for the rear seat are attached to the seat frame, with the link halves on the left and right sides of the seat bottom, and the buckles at the center of the seat bottom.

To use the seat belts for the front seats, position the seat as desired, and then lengthen the link half of the belt as needed by grasping the sides of the link and pulling against the belt. Insert and lock the belt link into the buckle. Tighten the belt to a snug fit. Seat belts for the rear seat and the child's seat, are used in the same manner as the belts for the front seats. To release the seat belts, grasp the top of the buckle opposite the link and pull upward.

SHOULDER HARNESSSES

Each front seat shoulder harness is attached to a rear doorpost above the window line and is stowed behind a stowage sheath above the cabin door. To stow the harness, fold it and place it behind the sheath. When rear seat shoulder harnesses are furnished, they are attached adjacent to the lower corners of the aft side windows. Each rear seat harness is stowed behind a stowage sheath above an aft side window. No harness is available for the child's seat.

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

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

INTEGRATED SEAT BELT/SHOULDER HARNESSSES WITH INERTIA REELS

Integrated seat belt/shoulder harnesses with inertia reels are available for the pilot and front seat passenger. The seat belt/shoulder harnesses extend from inertia reels located in the cabin top structure, through slots in the overhead console marked PILOT and COPILOT, to attach points inboard of the two front seats. A separate seat belt half and buckle is

located outboard of the seats. Inertia reels allow complete freedom of body movement. However, in the event of a sudden deceleration, they will lock automatically to protect the occupants.

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

ENTRANCE DOORS AND CABIN WINDOWS

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

To open the doors from outside the airplane, utilize the recessed door handle near the aft edge of each door. Depress the forward end of the handle to rotate it out of its recess, and then pull outboard. To close or open the doors from inside the airplane, use the combination door handle and arm rest. The inside door handle has three positions and a placard at its base which reads OPEN, CLOSE, and LOCK. The handle is spring-loaded to the CLOSE (up) position. When the door has been pulled shut and latched, lock it by rotating the door handle forward to the LOCK position (flush with the arm rest). When the handle is rotated to the LOCK position, an over-center action will hold it in that position. Both cabin doors should be locked prior to flight, and should not be opened intentionally during flight.

NOTE

Accidental opening of a cabin door in flight due to improper closing does not constitute a need to land the airplane. The best procedure is to set up the airplane in a trimmed condition at approximately 80 KIAS, open a window, momentarily shove the door outward slightly, and forcefully close and lock the door.

Exit from the airplane is accomplished by rotating the door handle from the LOCK position, past the CLOSE position, aft to the OPEN position and pushing the door open. To lock the airplane, lock the right cabin door

with the inside handle, close the left cabin door, and using the ignition key, lock the door.

The left cabin door is equipped with an openable window which is held in the closed position by a detent equipped latch on the lower edge of the window frame. To open the window, rotate the latch upward. The window is equipped with a spring-loaded retaining arm which will help rotate the window outward and hold it there. An openable window is also available for the right door, and functions in the same manner as the left window. If required, either window may be opened at any speed up to 179 KIAS. The cabin top windows (if installed), rear side windows, and rear window are of the fixed type and cannot be opened.

CONTROL LOCKS

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

ENGINE

The airplane is powered by a horizontally-opposed, six-cylinder, overhead-valve, air-cooled, carbureted engine with a wet sump oil system. The engine is a Continental Model O-470-U and is rated at 230 horsepower at 2400 RPM. Major accessories include a propeller governor on the front of the engine and dual magnetos, starter, belt-driven alternator, and vacuum pump on the rear of the engine. Provisions are also made for a full flow oil filter.

ENGINE CONTROLS

Engine manifold pressure is controlled by a throttle located on the center area of the switch and control panel. The throttle operates in a

conventional manner; in the full forward position, the throttle is open, and in the full aft position, it is closed. A friction lock, which is a round knurled disk, is located at the base of the throttle and is operated by rotating the lock clockwise to increase friction or counterclockwise to decrease it.

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

ENGINE INSTRUMENTS

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

The oil pressure gage, located on the right side of the instrument panel, is operated by oil pressure. A direct pressure oil line from the engine delivers oil at engine operating pressure to the oil pressure gage. Gage markings indicate that minimum idling pressure is 10 PSI (red line), the normal operating range is 30 to 60 PSI (green arc), and maximum pressure is 100 PSI (red line).

Oil temperature is indicated by a gage adjacent to the oil pressure gage. The gage is operated by an electrical-resistance type temperature sensor which receives power from the airplane electrical system. Gage markings indicate the normal operating range (green arc) which is 100°F (38°C) to 240°F (116°C), and the maximum (red line) which is 240°F (116°C).

The cylinder head temperature gage, under the left fuel quantity indicator, is operated by an electrical-resistance type temperature sensor on the engine which receives power from the airplane electrical system. Gage markings indicate the normal operating range (green arc) which is 200°F (93°C) to 460°F (238°C) and the maximum (red line) which is 460°F (238°C).

The engine-driven mechanical tachometer is located on the lower right side of the instrument panel. The instrument is calibrated in increments of 100 RPM and indicates both engine and propeller speed. An hour meter below the center of the tachometer dial records elapsed engine time in hours and tenths. Instrument markings include a normal operating range

(green arc) of 2100 to 2400 RPM, and a maximum allowable (red line) of 2400 RPM.

The manifold pressure gage is located on the right side of the instrument panel above the tachometer. The gage is direct reading and indicates induction air manifold pressure in inches of mercury. It has a normal operating range (green arc) of 15 to 23 inches of mercury.

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

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

NEW ENGINE BREAK-IN AND OPERATION

The engine underwent a run-in at the factory and is ready for the full range of use. It is, however, suggested that cruising be accomplished at 75% power until a total of 50 hours has accumulated or oil consumption has stabilized. This will ensure proper seating of the rings.

The airplane is delivered from the factory with corrosion preventive oil in the engine. If, during the first 25 hours, oil must be added, use only aviation grade straight mineral oil conforming to Specification No. MIL-L-6082.

ENGINE OIL SYSTEM

Oil for engine lubrication and propeller governor operation is supplied from a sump on the bottom of the engine. The capacity of the sump is 12 quarts (one additional quart is required if a full flow oil filter is installed). Oil is drawn from the sump through a filter screen on the end of a pickup tube to the engine-driven oil pump. Oil from the pump passes through an oil pressure screen (full flow oil filter, if installed), a pressure relief valve at the rear of the right oil gallery, and a thermostatically controlled oil cooler. Oil from the cooler is then circulated to the left gallery and propeller governor. The engine parts are then lubricated by oil from the galleries. After lubricating the engine, the oil returns to the sump by gravity. If a full flow oil filter is installed, the filter adapter is equipped with a bypass valve which will cause lubricating oil to bypass the filter in

the event the filter becomes plugged, or the oil temperature is extremely cold.

An oil dipstick is located at the rear of the engine on the left side, and an oil filler tube is on top of the crankcase near the front of the engine. The dipstick and oil filler are accessible through doors on the engine cowling. The engine should not be operated on less than nine quarts of oil. To minimize loss of oil through the breather, fill to 10 quarts for normal flights of less than three hours. For extended flight, fill to 12 quarts (dipstick indication only). For engine oil grade and specifications, refer to Section 8 of this handbook.

The oil cooler may be replaced by a non-congealing oil cooler for operations in temperatures consistently below 20°F (-7°C). The non-congealing oil cooler provides improved oil flow at low temperatures. Once installed, the non-congealing oil cooler is approved for permanent use in both hot and cold weather.

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

IGNITION-STARTER SYSTEM

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

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

AIR INDUCTION SYSTEM

The engine air induction system receives ram air through an intake in

the lower front portion of the engine cowl. The intake is covered by an air filter which removes dust and other foreign matter from the induction air. Airflow passing through the filter enters an airbox. After passing through the airbox, induction air enters the inlet in the carburetor which is under the engine, and is then ducted to the engine cylinders through intake manifold tubes. In the event carburetor ice is encountered or the intake filter becomes blocked, alternate heated air can be obtained from a shroud around an exhaust riser through a duct to a valve, in the airbox, operated by the carburetor heat control on the instrument panel. Heated air from the exhaust riser shroud is obtained from unfiltered air inside the cowl. Use of full carburetor heat at full throttle will result in a loss of approximately one to two inches of manifold pressure.

EXHAUST SYSTEM

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

CARBURETOR AND PRIMING SYSTEM

The engine is equipped with an up-draft, float-type, fixed jet carburetor mounted on the bottom of the engine. The carburetor is equipped with an enclosed accelerator pump, an idle cut-off mechanism, and a manual mixture control. Fuel is delivered to the carburetor by gravity flow from the fuel system. In the carburetor, fuel is atomized, proportionally mixed with intake air, and delivered to the cylinders through intake manifold tubes. The proportion of atomized fuel to air may be controlled, within limits, by the mixture control on the instrument panel.

To facilitate starting in cold weather, the engine is equipped with a manual primer. The primer is actually a small pump which draws fuel from the fuel strainer when the plunger is pulled out, and injects it into the intake manifold when the plunger is pushed back in. The plunger is equipped with a lock and, after being pushed full in, must be rotated either left or right until the knob cannot be pulled out. A six-port primer is available which injects the fuel into individual cylinder intake ports in lieu of the intake manifold. Both primers are identical in appearance, except for the plumbing, and operate in the same manner.

COOLING SYSTEM

Ram air for engine cooling enters through two intake openings in the front of the engine cowl. The cooling air is directed around the cylinders and other areas of the engine by baffling, and is then exhausted through cowl flaps on the lower aft edge of the cowl. The cowl flaps are mechanically operated from the cabin by means of a cowl flap lever on the

right side of the control pedestal. The pedestal is labeled OPEN, COWL FLAPS, CLOSED. Before starting the engine, takeoff and high power operation, the cowl flap lever should be placed in the OPEN position for maximum cooling. This is accomplished by moving the lever to the right to clear a detent, then moving the lever up to the OPEN position. Anytime the lever is repositioned, it must first be moved to the right. While in cruise flight, cowl flaps should be adjusted to keep the cylinder head temperature at approximately two-thirds of the normal operating range (green arc). During extended let-downs, it may be necessary to completely close the cowl flaps by pushing the cowl flap lever down to the CLOSED position.

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

PROPELLER

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

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

FUEL SYSTEM

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

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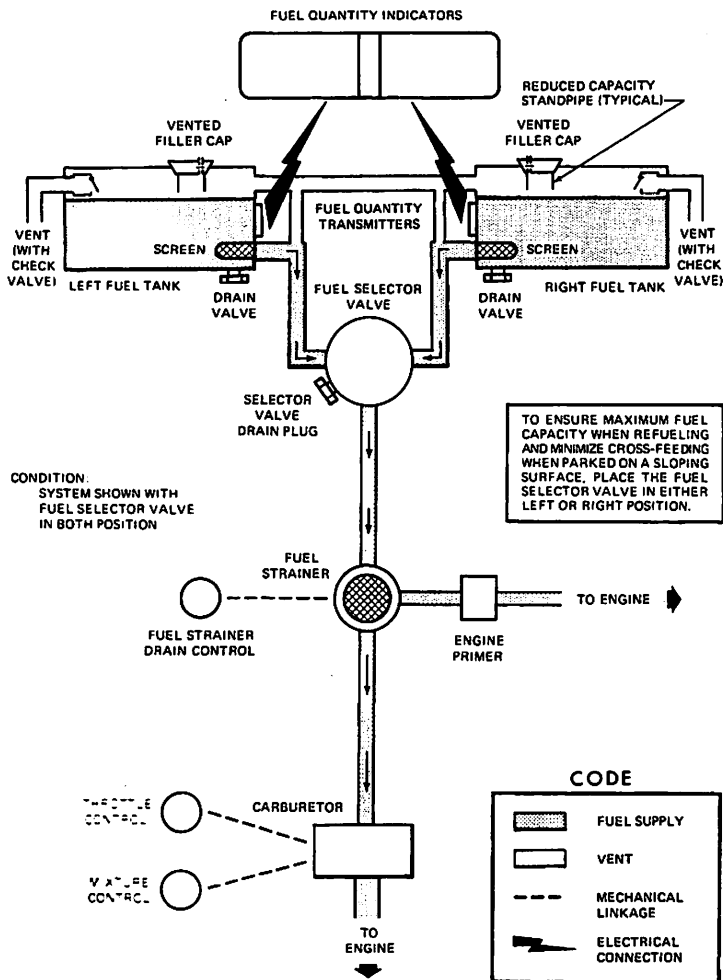


Figure 7-5. Fuel System

Fuel flows by gravity from the two integral wing tanks to a four-position selector valve, labeled BOTH, RIGHT, LEFT, and OFF. With the selector valve in either the BOTH, RIGHT, or LEFT position, fuel flows through a strainer to the carburetor. From the carburetor, mixed fuel and air flows to the cylinders through intake manifold tubes. The manual primer draws its fuel from the fuel strainer and injects it into the intake manifold.

The airplane may be serviced to a reduced capacity to permit heavier cabin loadings. This is accomplished by filling each tank to the bottom edge of the fuel filler neck, thus giving a reduced fuel load of 34.5 gallons in each tank (32.5 gallons usable in all flight conditions).

Fuel system venting is essential to system operation. Complete blockage of the venting system will result in a decreasing fuel flow and eventual engine stoppage. Venting consists of an interconnecting vent line between the tanks, and check valve equipped overboard vents in each tank. The overboard vents protrude from the bottom surfaces of the wings behind the wing struts, slightly below the upper attach points of the struts. The fuel filler caps are vacuum vented; the vents will open and allow air to enter the fuel tanks in case the overboard vents become blocked.

Fuel quantity is measured by two float-type fuel quantity transmitters (one in each fuel tank) and indicated by two electrically-operated fuel quantity indicators on the right side of the instrument panel. The fuel quantity indicators are calibrated in gallons (lower scale) and pounds (upper scale). An empty tank is indicated by a red line and the letter E. When an indicator shows an empty tank, approximately 2.0 gallons remain in a tank as unusable fuel. The indicators cannot be relied upon for accurate readings during skids, slips, or unusual flight attitudes. If both indicator pointers should rapidly move to a zero reading, check the

FUEL QUANTITY DATA (U. S. GALLONS)			
TANKS	TOTAL USABLE FUEL ALL FLIGHT CONDITIONS	TOTAL UNUSABLE FUEL	TOTAL FUEL VOLUME
STANDARD (46 Gal. Each)	88	4	92
REDUCED FUEL (34.5 Gal. Each)	65	4	69

Figure 7-6. Fuel Quantity Data

cylinder head temperature and oil temperature gages for operation. If these gages are not indicating, an electrical malfunction has occurred.

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

NOTE

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

NOTE

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

NOTE

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

If a fuel tank quantity is completely exhausted in flight, it is recommended that the fuel selector valve be switched back to the BOTH position for the remainder of the flight. This will allow some fuel from the fuller tank to transfer back through the selector valve to the empty tank while in coordinated flight which in turn will assure optimum fuel feed during slipping or skidding flight.

The fuel system is equipped with drain valves to provide a means for the examination of fuel in the system for contamination and grade. The system should be examined before the first flight of every day and after

each refueling, by using the sampler cup provided to drain fuel from the wing tank sumps, and by utilizing the fuel strainer drain under an access panel on the left side of the engine cowling. The fuel tanks should be filled after each flight to prevent condensation.

BRAKE SYSTEM

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

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

Some of the symptoms of impending brake failure are: gradual decrease in braking action after brake application, noisy or dragging brakes, soft or spongy pedals, and excessive travel and weak braking action. If any of these symptoms appear, the brake system is in need of immediate attention. If, during taxi or landing roll, braking action decreases, let up on the pedals and then re-apply the brakes with heavy pressure. If the brakes become spongy or pedal travel increases, pumping the pedals should build braking pressure. If one brake becomes weak or fails, use the other brake sparingly while using opposite rudder, as required, to offset the good brake.

ELECTRICAL SYSTEM

The airplane is equipped with a 28-volt, direct-current electrical system (see figure 7-7). The system is powered by a belt-driven, 60-amp alternator and a 24-volt battery (a heavy duty battery is available) located in the tailcone aft of the baggage compartment wall. Power is supplied to most general electrical and all avionics circuits through the primary bus bar and the avionics bus bar, which are interconnected by an avionics power switch. The primary bus is on anytime the master switch is turned on, and is not affected by starter or external power usage. Both bus bars are on anytime the master switch and avionics power switches are turned on.

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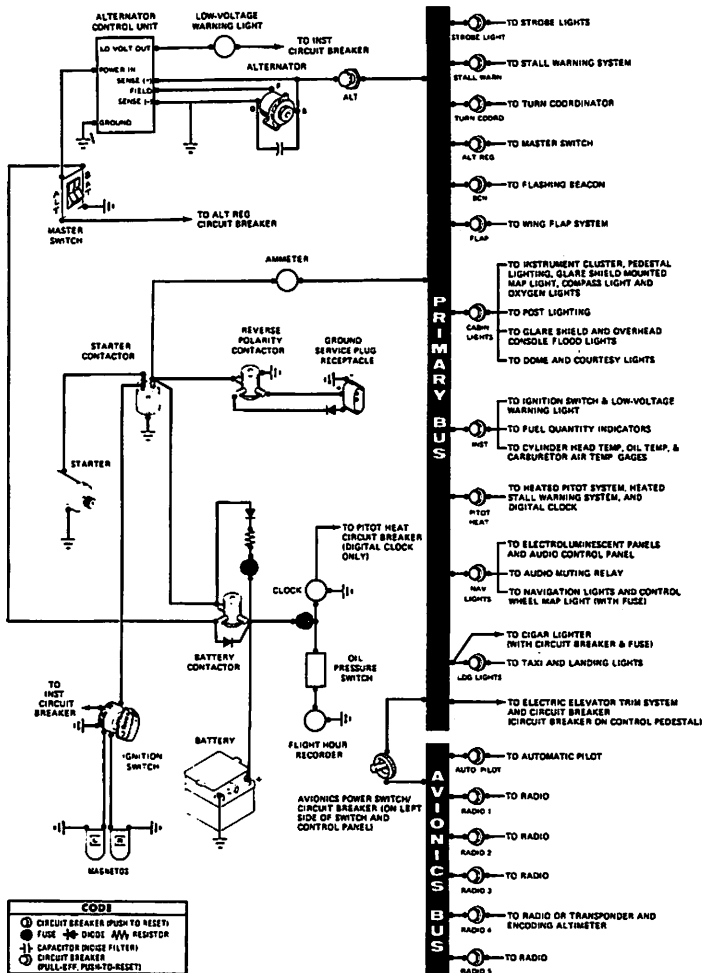


Figure 7-7. Electrical System

CAUTION

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

MASTER SWITCH

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

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

AVIONICS POWER SWITCH

Electrical power from the airplane primary bus to the avionics bus (see figure 7-7) is controlled by a toggle switch/circuit breaker labeled AVIONICS POWER. The switch is located on the left side of the switch and control panel and is ON in the up position and off in the down position. With the switch in the off position, no electrical power will be applied to the avionics equipment, regardless of the position of the master switch or the individual equipment switches. The avionics power switch also functions as a circuit breaker. If an electrical malfunction should occur and cause the circuit breaker to open, electrical power to the avionics equipment will be interrupted and the switch will automatically move to the off position. If this occurs, allow the circuit breaker to cool approximately two minutes before placing the switch in the ON position again. If the circuit breaker opens again, do not reset it. The avionics power switch should be placed in the off position prior to turning the master switch ON or off, starting the engine, or applying an external power source, and may be utilized in place of the individual avionics equipment switches.

AMMETER

The ammeter, located between the fuel gages, indicates the amount of

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

ALTERNATOR CONTROL UNIT AND LOW-VOLTAGE WARNING LIGHT

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

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

NOTE

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

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

CIRCUIT BREAKERS AND FUSES

Most of the electrical circuits in the airplane are protected by "push-to-reset" type circuit breakers mounted on the left side of the switch and control panel. However, alternator output is protected by a "pull-off" type circuit breaker. In addition to the individual circuit breakers, a toggle switch/circuit breaker, labeled AVIONICS POWER, on the left switch and

control panel also protects the avionics systems. The cigar lighter is protected by a manually-reset type circuit breaker on the back of the lighter, and a fuse behind the instrument panel. The control wheel map light (if installed) is protected by the NAV LIGHTS circuit breaker and a fuse behind the instrument panel. Electrical circuits which are not protected by circuit breakers are the battery contactor closing (external power) circuit, clock circuit, and flight hour recorder circuit. These circuits are protected by fuses mounted adjacent to the battery.

GROUND SERVICE PLUG RECEPTACLE

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

LIGHTING SYSTEMS

EXTERIOR LIGHTING

Conventional navigation lights are located on the wing tips and tail stinger, and dual landing/taxi lights are installed in the cowl nose cap. Additional lighting is available and includes a strobe light on each wing tip, a flashing beacon on top of the vertical stabilizer, and two courtesy lights, one under each wing, just outboard of the cabin doors. Details of the strobe light system are presented in Section 9, Supplements. The courtesy lights are operated by a switch located on the left rear door post. All exterior lights, except the courtesy lights, are operated by rocker switches on the left switch and control panel. The switches are ON in the up position and off in the down position.

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

INTERIOR LIGHTING

Instrument and control panel lighting is provided by flood and integral lighting, with electroluminescent and post lighting also available. Dual concentric light dimming rheostats on the left side of the switch and control panel control the intensity of all lighting. The following paragraphs describe the various lighting systems and their controls.

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The left and right sides of the switch and control panel, and the audio control panel may be lighted by electroluminescent panels which do not require light bulbs for illumination. To utilize this lighting, turn the NAV light rocker switch to the ON position and rotate the inner knob labeled EL PANEL, on the right dimming rheostat, clockwise to the desired light intensity.

Instrument panel flood lighting consists of four red lights on the underside of the glare shield, and two red flood lights in the forward section of the overhead console. This lighting is controlled by rotating the outer knob labeled FLOOD, on the left dimming rheostat, clockwise to the desired intensity.

The instrument panel may be equipped with post lights which are mounted at the edge of each instrument or control and provide direct lighting. This lighting is controlled by rotating the inner knob labeled POST, on the left dimming rheostat, clockwise to the desired light intensity. Flood and post lights may be used simultaneously by rotating both the FLOOD and POST knobs clockwise to the desired intensity for each type of lighting.

The engine instrument cluster, radio equipment, and magnetic compass have integral lighting and operate independently of post or flood lighting. To operate these lights, rotate the outer knob labeled ENG-RADIO, on the right dimming rheostat, clockwise to the desired light intensity. However, for daylight operation, the compass and engine instrument lights may be turned off while still maintaining maximum light intensity for the digital readouts in the radio equipment. This is accomplished by rotating the ENG-RADIO knob full counterclockwise. Check that the flood lights, post lights, and electroluminescent lights are turned off for daylight operation by rotating the FLOOD, POST, and EL PANEL knobs full counterclockwise.

The control pedestal has two integral lights and, if the airplane is equipped with oxygen, the overhead console is illuminated by post lights. Pedestal and console light intensity is controlled by the knob labeled ENG-RADIO, on the right dimming rheostat.

Map lighting is provided by overhead console map lights and a glare shield mounted map light. The airplane may also be equipped with a control wheel map light. The overhead console map lights operate in conjunction with instrument panel flood lighting and consist of two openings just aft of the red instrument panel flood lights. The map light openings have sliding covers controlled by small round knobs which uncover the openings when moved toward each other. The covers should be kept closed unless the map lights are required. A map light and toggle switch, mounted in front of the pilot on the underside of the glare shield, is

used for illuminating approach plates or other charts when using a control wheel mounted approach plate holder. The switch is labeled MAP LIGHT, ON, OFF and light intensity is controlled by the knob labeled FLOOD, on the left dimming rheostat. The pilot's control wheel map light (if installed) illuminates the lower portion of the cabin in front of the pilot, and is used for checking maps and other flight data during night operation. The light is utilized by turning the NAV light switch to the ON position and adjusting light intensity with the rheostat control knob on the bottom of the control wheel.

The airplane is equipped with a dome light aft of the overhead console. The light is operated by a slide-type switch, aft of the light lens, which turns the light on when moved to the right.

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

CABIN HEATING, VENTILATING AND DEFROSTING SYSTEM

The temperature and volume of airflow into the cabin can be regulated by manipulation of the push-pull CABIN HEAT and CABIN AIR control knobs (see figure 7-8). Both control knobs are the double button type with locks to permit intermediate settings.

NOTE

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

Front cabin heat and ventilating air is supplied by outlet holes spaced across a cabin manifold just forward of the pilot's and copilot's feet. Rear cabin heat and air is supplied by two ducts from the manifold, one extending down each side of the cabin to an outlet at the front door post at floor level. Windshield defrost air is also supplied by a duct leading from

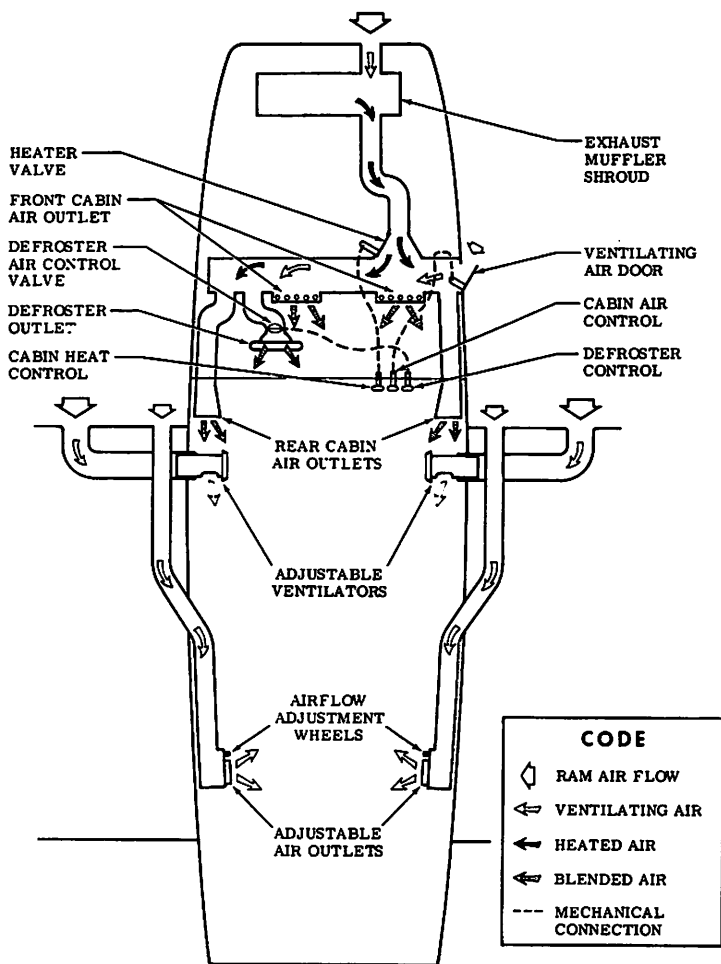


Figure 7-8. Cabin Heating, Ventilating, and Defrosting System

the cabin manifold to an outlet on top of the anti-glare shield. Defrost air flow is controlled by a rotary type knob labeled DEFROST.

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

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

PITOT-STATIC SYSTEM AND INSTRUMENTS

The pitot-static system supplies ram air pressure to the airspeed indicator and static pressure to the airspeed indicator, vertical speed indicator and altimeter. The system is composed of either an unheated or heated pitot tube mounted on the lower surface of the left wing, two external static ports on the lower left and right sides of the forward fuselage, and the associated plumbing necessary to connect the instruments to the sources.

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

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

If erroneous instrument readings are suspected due to water or ice in the pressure line going to the standard external static pressure source, the

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alternate static source valve should be pulled on.

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

AIRPEED INDICATOR

The airspeed indicator is calibrated in knots and miles per hour. Limitation and range markings (in KIAS) include the white arc (45 to 95 knots), green arc (48 to 143 knots), yellow arc (143 to 179 knots), and a red line (179 knots).

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

VERTICAL SPEED INDICATOR

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

ALTIMETER

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

VACUUM SYSTEM AND INSTRUMENTS

An engine-driven vacuum system (see figure 7-9) provides the suction

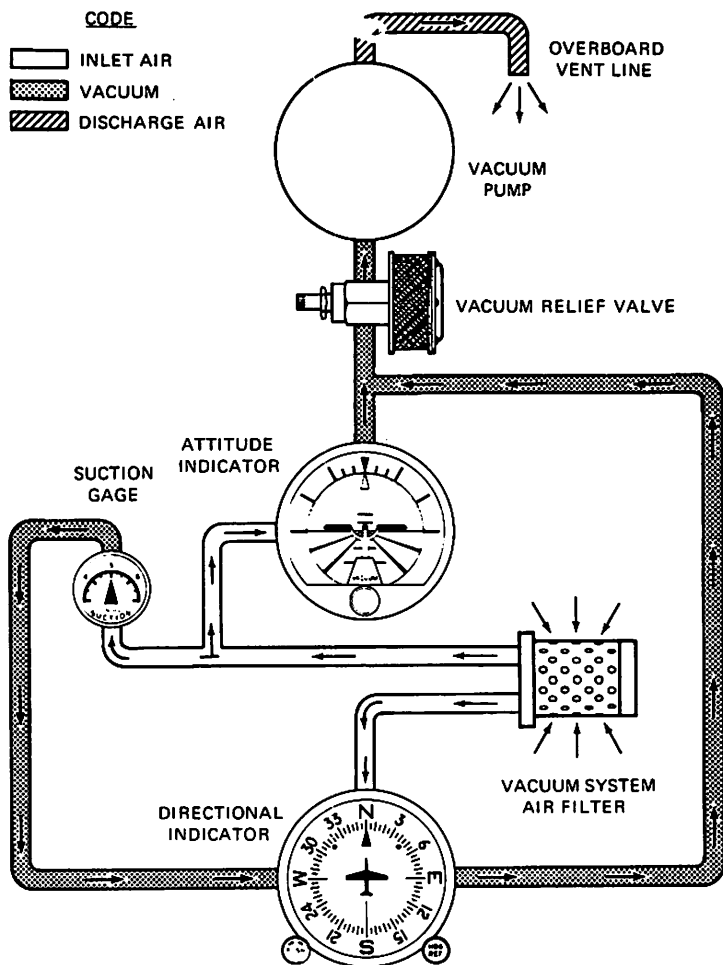


Figure 7-9. Vacuum System

necessary to operate the attitude indicator and directional indicator. The system consists of a vacuum pump mounted on the engine, a vacuum relief valve and vacuum system air filter on the aft side of the firewall below the instrument panel, and instruments (including a suction gage) on the left side of the instrument panel.

ATTITUDE INDICATOR

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

DIRECTIONAL INDICATOR

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

SUCTION GAGE

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

STALL WARNING SYSTEM

The airplane is equipped with a vane-type stall warning unit, in the leading edge of the left wing, which is electrically connected to a stall warning horn under the map compartment. A 5-amp push-to-reset circuit breaker labeled STALL WARN. on the left side of the switch and control

panel, protects the stall warning system. The vane in the wing senses the change in airflow over the wing, and operates the warning horn at airspeeds between 5 and 10 knots above the stall in all configurations.

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

The stall warning system should be checked during the pre-flight inspection by momentarily turning on the master switch and actuating the vane in the wing. The system is operational if the warning horn sounds as the vane is pushed upward.

AVIONICS SUPPORT EQUIPMENT

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

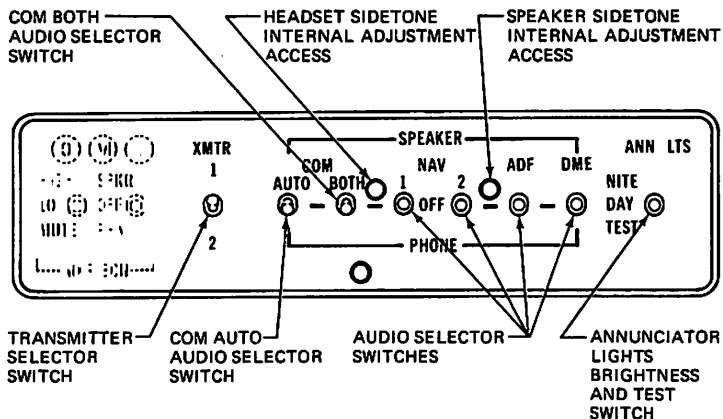
AUDIO CONTROL PANEL

Two types of audio control panels (see figure 7-10) are available for this airplane, depending upon how many transmitters are included. The operational features of both audio control panels are similar and are discussed in the following paragraphs.

TRANSMITTER SELECTOR SWITCH

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

USED WITH ONE OR TWO TRANSMITTERS



USED WITH THREE TRANSMITTERS

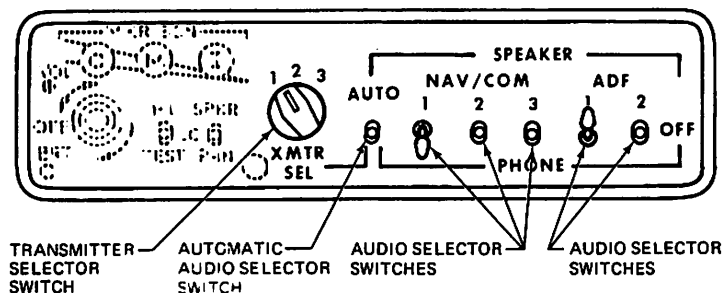


Figure 7-10. Audio Control Panel

The action of selecting a particular transmitter using the transmitter selector switch simultaneously selects the audio amplifier associated with that transmitter to provide speaker audio. For example, if the number one transmitter is selected, the audio amplifier in the number one NAV/COM is also selected and is used for ALL speaker audio. In the event the audio amplifier in use fails, as evidenced by loss of all speaker audio, selecting an alternate transmitter will reestablish speaker audio using the alternate transmitter audio amplifier. Headset audio is not affected by audio amplifier operation.

AUDIO SELECTOR SWITCHES

Both audio control panels (see figure 7-10) incorporate three-position toggle-type audio selector switches for individual control of the audio from systems installed in the airplane. These switches allow receiver audio to be directed to the airplane speaker or to a headset, and heard singly or in combination with other receivers. To hear a particular receiver on the airplane speaker, place that receiver's audio selector switch in the up (SPEAKER) position. To listen to a receiver over a headset, place that receiver's audio selector switch in the down (PHONE) position. The center (OFF) position turns off all audio from the associated receiver.

NOTE

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

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

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

COM AUTO AUDIO SELECTOR SWITCH

The audio control panel used with either one or two transmitters incorporates a three-position toggle switch, labeled COM AUTO, which is provided to automatically match the audio of the appropriate NAV/COM communications receiver to the transmitter selected by the transmitter selector switch. When the COM AUTO selector switch is placed in the up

(SPEAKER) position, audio from the communications receiver selected by the transmitter selector switch will be heard on the airplane speaker. Switching the transmitter selector switch to the other transmitter automatically switches the other communications receiver audio to the speaker. This automatic audio switching feature may also be utilized when listening on a headset by placing the COM AUTO switch in the down (PHONE) position. If automatic audio selection is not desired, the COM AUTO selector switch should be placed in the center (OFF) position.

COM BOTH AUDIO SELECTOR SWITCH

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

NOTE

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

AUTO AUDIO SELECTOR SWITCH

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

NOTE

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

ANNUNCIATOR LIGHTS BRIGHTNESS AND TEST SWITCH

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

SIDETONE OPERATION

Cessna radios are equipped with sidetone capability (monitoring of the operator's own voice transmission). While adjusting sidetone, be aware that if the sidetone volume level is set too high, audio feedback (squeal) may result when transmitting.

When the airplane has one or two transmitters, sidetone is provided in both the speaker and headset anytime the COM AUTO selector switch is utilized. Placing the COM AUTO selector switch in the OFF position will eliminate sidetone. Sidetone internal adjustments are available to the pilot through the front of the audio control panel (see figure 7-10). Adjustment can be made by removing the appropriate plug-button from the audio control panel (left button for headset adjustment and right button for speaker adjustment), inserting a small screwdriver into the adjustment potentiometer and rotating it clockwise to increase the sidetone volume level.

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

NOTE

Sidetone is not available on HF Transceivers (Types PT10-A and ASB-125), when installed.

MICROPHONE-HEADSET INSTALLATIONS

Three types of microphone-headset installations are offered. The standard system provided with avionics equipment includes a hand-held microphone and separate headset. The keying switch for this microphone is on the microphone. Two optional microphone headset installations are also available; these feature a single-unit microphone-headset combination which permits the pilot to conduct radio communications without interrupting other control operations to handle a hand-held microphone. One microphone-headset combination is offered without a padded headset and the other version has a padded headset. The microphone-headset combinations utilize a remote keying switch located on the left grip of the pilot's control wheel. The microphone and headset jacks are located on the left side of the instrument panel. Audio to all three headsets is controlled by the individual audio selector switches and adjusted for volume level by using the selected receiver volume controls.

NOTE

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

STATIC DISCHARGERS

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

Installation of static dischargers reduces interference from precipitation static, but it is possible to encounter severe precipitation static

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

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1 October 1979

SECTION 8

AIRPLANE HANDLING, SERVICE & MAINTENANCE

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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 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 FOLLOW-UP SYSTEM

Your Cessna Dealer has an Owner Follow-Up System to notify you when he receives information that applies to your Cessna. In addition, if you wish, you may choose to receive similar notification, in the form of Service Letters, directly from the Cessna Customer Services Department. A subscription form is supplied in your Customer Care Program book for your use, should you choose to request this service. Your Cessna Dealer will be glad to supply you with details concerning these follow-up programs, 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

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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
- AVIONICS OPERATION GUIDE
- PILOT'S CHECKLISTS
- POWER COMPUTER
- CUSTOMER CARE DEALER DIRECTORY
- DO'S AND DON'TS ENGINE BOOKLET

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 or writing directly to the Customer Services Department, Cessna Aircraft Company, Wichita, Kansas. 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, Power Computer, 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.

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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 at 50-hour intervals during a 200-hour period. The 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.

Coupons attached to the Program book entitle you to an initial inspection and either a Progressive Care Operation No. 1 or the first 100-hour inspection 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 reasonably soon 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. When towing with a vehicle, do not exceed the nose gear turning angle of 29° either side of center, or damage to the gear will result. If the airplane is towed or pushed over a rough surface during hangaring, watch that the normal cushioning action of the nose strut does not cause excessive vertical movement of the tail and the resulting contact with low hangar doors or structure. A flat nose tire or

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deflated strut will also increase tail height.

PARKING

When parking the airplane, head into the wind and set the parking brakes. Do not set the parking brakes during cold weather when accumulated moisture may freeze the brakes, or when the brakes are overheated. Close the cowl flaps, install the control wheel lock and chock the wheels. In severe weather and high wind conditions, tie the airplane down as outlined in the following paragraph.

TIE-DOWN

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

1. Set the parking brake and install the control wheel lock.
2. Install a surface control lock over the fin and rudder.
3. Tie sufficiently strong ropes or chains (700 pounds tensile strength) to the wing and tail tie-down fittings and secure each rope to a ramp tie-down.
4. Tie a rope (no chains or cables) to the nose gear torque link and secure to a ramp tie-down.
5. Install a pitot tube cover.

JACKING

When a requirement exists to jack the entire airplane off the ground, or when wing jack points are used in the jacking operation, refer to the Service Manual for specific procedures and equipment required.

Individual main gear may be jacked by using the jack pad which is incorporated in the main landing gear strut step assembly. When using the individual gear strut jack pad, flexibility of the gear strut will cause the main wheel to slide inboard as the wheel is raised, tilting the jack. The jack must then be lowered for a second jacking operation. Do not jack both main wheels simultaneously using the individual main gear jack pads.

If nose gear maintenance is required, the nose wheel may be raised off the ground by pressing down on a tailcone bulkhead, just forward of the horizontal stabilizer, and allowing the tail to rest on the tail tie-down ring.

NOTE

Do not apply pressure on the elevator or outboard stabilizer surfaces. When pushing on the tailcone, always apply pressure at a bulkhead to avoid buckling the skin.

To assist in raising and holding the nose wheel off the ground, weight down the tail by placing sand-bags, or suitable weights, on each side of the horizontal stabilizer, next to the fuselage. If ground anchors are available, the tail should be securely tied down.

NOTE

Ensure that the nose will be held off the ground under all conditions by means of suitable stands or supports under weight supporting bulkheads near the nose of the airplane.

LEVELING

Longitudinal leveling of the airplane is accomplished by placing a level on the leveling screws located on the left side of the tailcone. Deflate the nose tire and/or lower or raise the nose strut to properly center the bubble in the level. Corresponding points on both upper door sills may be used to level the airplane laterally.

FLYABLE STORAGE

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

WARNING

For maximum safety, check that the ignition switch is OFF, the throttle is closed, the mixture control is in the idle cut-off position, and the airplane is secured before rotating the propeller by hand. Do not stand within the arc of the propeller blades while turning the propeller.

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

Engine runup also helps to eliminate excessive accumulations of water in the fuel system and other air spaces in the engine. Keep fuel tanks full to minimize condensation in the tanks. Keep the battery fully charged to prevent the electrolyte from freezing in cold weather. If the airplane is to be stored temporarily, or indefinitely, refer to the Service Manual for proper storage procedures.

SERVICING

In addition to the PREFLIGHT INSPECTION covered in Section 4, COMPLETE servicing, inspection, and test requirements for your airplane are detailed in the Service Manual. The Service Manual outlines all items which require attention at 50, 100, and 200 hour intervals plus those items which require servicing, inspection, and/or testing at special intervals.

Since Cessna Dealers conduct all service, inspection, and test procedures in accordance with applicable Service Manuals, it is recommended that you contact your Cessna Dealer concerning these requirements and begin scheduling your airplane for service at the recommended intervals.

Cessna Progressive Care ensures that these requirements are accomplished at the required intervals to comply with the 100-hour or ANNUAL inspection as previously covered.

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

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

ENGINE OIL

GRADE AND VISCOSITY FOR TEMPERATURE RANGE --

All temperatures, use SAE 20W-50 or

Above 4°C (40°F), use SAE 50.

Below 4°C (40°F), use SAE 30.

Multi-viscosity oil with a range of SAE 20W-50 is recommended for improved starting in cold weather. Ashless dispersant oil, conforming to Continental Motors Specification MHS-24A (and all revisions thereto), must be used.

NOTE

Your Cessna was delivered from the factory with a corrosion preventive aircraft engine oil. If oil must be added during the first 25 hours, use only aviation grade straight mineral oil conforming to Specification No. MIL-L-6082.

CAPACITY OF ENGINE SUMP -- 12 Quarts.

Do not operate on less than 9 quarts. To minimize loss of oil through breather, fill to 10 quart level for normal flights of less than 3 hours. For extended flight, fill to 12 quarts. These quantities refer to oil dipstick level readings. During oil and oil filter changes, one addi-

tional quart is required when the filter is changed.

OIL AND OIL FILTER CHANGE --

After the first 25 hours of operation, drain engine oil sump and clean the oil pressure screen. If an oil filter is installed, change the filter at this time. Refill sump with straight mineral oil and use until a total of 50 hours has accumulated or oil consumption has stabilized; then change to dispersant oil. On airplanes not equipped with an oil filter, drain the engine oil sump and clean the oil pressure screen each 50 hours thereafter. On airplanes which have an oil filter, the oil change interval may be extended to 100-hour intervals, providing the oil filter is changed at 50-hour intervals. Change engine oil at least every 6 months even though less than the recommended hours have accumulated. Reduce intervals for prolonged operation in dusty areas, cold climates, or when short flights and long idle periods result in sludging conditions.

NOTE

During the first 25-hour oil and filter change, a general inspection of the overall engine compartment is required. Items which are not normally checked during a preflight inspection should be given special attention. Hoses, metal lines and fittings should be inspected for signs of oil and fuel leaks, and checked for abrasions, chafing, security, proper routing and support, and evidence of deterioration. Inspect the intake and exhaust systems for cracks, evidence of leakage, and security of attachment. Engine controls and linkages should be checked for freedom of movement through their full range, security of attachment and evidence of wear. Inspect wiring for security, chafing, burning, defective insulation, loose or broken terminals, heat deterioration, and corroded terminals. Check the alternator belt in accordance with Service Manual instructions, and retighten if necessary. A periodic check of these items during subsequent servicing operations is recommended.

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 in quantities not to exceed 1% or .15% by volume, respectively, of the total. Refer to

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Fuel Additives in later paragraphs for additional information.

**CAPACITY EACH TANK -- 46.0 U.S. Gallons.
REDUCED CAPACITY EACH TANK (WHEN FILLED TO BOTTOM OF
FUEL FILLER NECK) -- 34.5 Gallons.**

NOTE

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

NOTE

Service the fuel system after each flight, and keep fuel tanks full to minimize condensation in the tanks.

FUEL ADDITIVES --

Strict adherence to recommended preflight draining instructions as called for in Section 4 will eliminate any free water accumulations from the tank sumps. While small amounts of water may still remain in solution in the gasoline, it will normally be consumed and go unnoticed in the operation of the engine.

One exception to this can be encountered when operating under the combined effect of: (1) use of certain fuels, with (2) high humidity conditions on the ground (3) followed by flight at high altitude and low temperature. Under these unusual conditions, small amounts of water in solution can precipitate from the fuel stream and freeze in sufficient quantities to induce partial icing of the engine fuel system.

While these conditions are quite rare and will not normally pose a problem to owners and operators, they do exist in certain areas of the world and consequently must be dealt with, when encountered.

Therefore, to alleviate the possibility of fuel icing occurring under these unusual conditions, it is permissible to add isopropyl alcohol or ethylene glycol monomethyl ether (EGME) compound to the fuel supply.

The introduction of alcohol or EGME compound into the fuel provides two distinct effects: (1) it absorbs the dissolved water from the gasoline and (2) alcohol has a freezing temperature depressant effect.

Alcohol, if used, is to be blended with the fuel in a concentration of 1% by volume. Concentrations greater than 1% are not recommended since they can be detrimental to fuel tank materials.

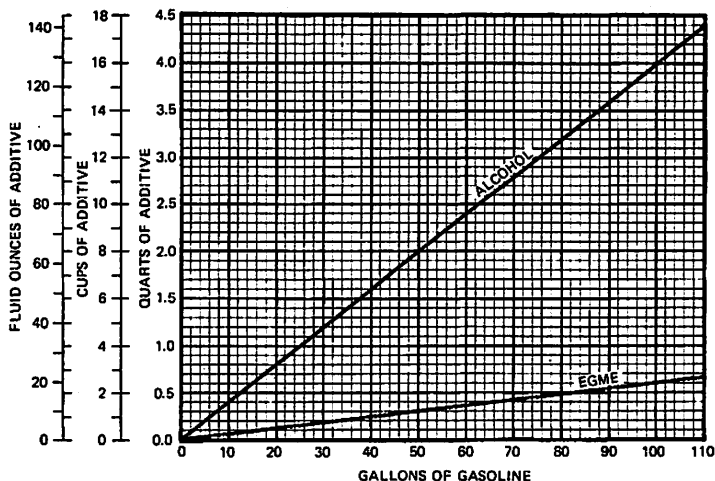


Figure 8-1. Additive Mixing Ratio

The manner in which the alcohol is added to the fuel is significant because alcohol is most effective when it is completely dissolved in the fuel. To ensure proper mixing, the following is recommended:

1. For best results, the alcohol should be added during the fueling operation by pouring the alcohol directly on the fuel stream issuing from the fueling nozzle.
2. An alternate method that may be used is to premix the complete alcohol dosage with some fuel in a separate clean container (approximately 2-3 gallon capacity) and then transferring this mixture to the tank prior to the fuel operation.

Any high quality isopropyl alcohol may be used, such as Anti-Icing Fluid (MIL-F-5566) or Isopropyl Alcohol (Federal Specification TT-I-735a). Figure 8-1 provides alcohol-fuel mixing ratio information.

Ethylene glycol monomethyl ether (EGME) compound, in compliance with MIL-I-27686 or Phillips PFA-55MB, if used, must be carefully mixed with the fuel in concentrations not to exceed .15% by volume. Figure 8-1 provides EGME-fuel mixing ratio information.

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CAUTION

Mixing of the EGME compound with the fuel is extremely important because a concentration in excess of that recommended (.15% by volume maximum) will result in detrimental effects to the fuel tanks, such as deterioration of protective primer and sealants and damage to O-rings and seals in the fuel system and engine components. Use only blending equipment that is recommended by the manufacturer to obtain proper proportioning.

CAUTION

Do not allow the concentrated EGME compound to come in contact with the airplane finish or fuel cell as damage can result.

Prolonged storage of the airplane will result in a water buildup in the fuel which "leeches out" the additive. An indication of this is when an excessive amount of water accumulates in the fuel tank sumps. The concentration can be checked using a differential refractometer. It is imperative that the technical manual for the differential refractometer be followed explicitly when checking the additive concentration.

LANDING GEAR

NOSE WHEEL TIRE PRESSURE -- 49 PSI on 5.00-5. 6-Ply Rated Tire.
MAIN WHEEL TIRE PRESSURE -- 42 PSI on 6.00-6. 6-Ply Rated Tires.
NOSE GEAR SHOCK STRUT --

Keep filled with MIL-H-5606 hydraulic fluid and inflated with air to 55-60 PSI. Do not over-inflate.

OXYGEN

AVIATOR'S BREATHING OXYGEN -- Spec. No. MIL-O-27210.
MAXIMUM PRESSURE (cylinder temperature stabilized after filling) --
1800 PSI at 21°C (70°F). Refer to Oxygen Supplement (Section 9) for
filling pressures.

CLEANING AND CARE

WINDSHIELD-WINDOWS

The plastic windshield and windows should be cleaned with an aircraft

windshield cleaner. Apply the cleaner sparingly with soft cloths, and rub with moderate pressure until all dirt, oil scum and bug stains are removed. Allow the cleaner to dry, then wipe it off with soft flannel cloths.

If a windshield cleaner is not available, the plastic can be cleaned with soft cloths moistened with Stoddard solvent to remove oil and grease.

NOTE

Never use gasoline, benzine, alcohol, acetone, fire extinguisher or anti-ice fluid, lacquer thinner or glass cleaner to clean the plastic. These materials will attack the plastic and may cause it to craze.

Follow by carefully washing with a mild detergent and plenty of water. Rinse thoroughly, then dry with a clean moist chamois. Do not rub the plastic with a dry cloth since this builds up an electrostatic charge which attracts dust. Waxing with a good commercial wax will finish the cleaning job. A thin, even coat of wax, polished out by hand with clean soft flannel cloths, will fill in minor scratches and help prevent further scratching.

Do not use a canvas cover on the windshield unless freezing rain or sleet is anticipated since the cover may scratch the plastic surface.

PAINTED SURFACES

The painted exterior surfaces of your new Cessna have a durable, long lasting finish and, under normal conditions, require no polishing or buffing. Approximately 10 days are required for the paint to cure completely; in most cases, the curing period will have been completed prior to delivery of the airplane. In the event that polishing or buffing is required within the curing period, it is recommended that the work be done by someone experienced in handling uncured paint. Any Cessna Dealer can accomplish this work.

Generally, the painted surfaces can be kept bright by washing with water and mild soap, followed by a rinse with water and drying with cloths or a chamois. Harsh or abrasive soaps or detergents which cause corrosion or scratches should never be used. Remove stubborn oil and grease with a cloth moistened with Stoddard solvent.

Waxing is unnecessary to keep the painted surfaces bright. However, if desired, the airplane may be waxed with a good automotive wax. A heavier coating of wax on the leading edges of the wings and tail and on the engine nose cap and propeller spinner will help reduce the abrasion encountered in these areas.

When the airplane is parked outside in cold climates and it is necessary

**SECTION 8
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**CESSNA
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to remove ice before flight, care should be taken to protect the painted surfaces during ice removal with chemical liquids. Isopropyl alcohol will satisfactorily remove ice accumulations without damaging the paint. While applying the de-icing solution, keep it away from the windshield and cabin windows since the alcohol will attack the plastic and may cause it to craze.

PROPELLER CARE

Preflight inspection of propeller blades for nicks, and wiping them occasionally with an oily cloth to clean off grass and bug stains will assure long, trouble-free service. Small nicks on the propeller, particularly near the tips and on the leading edges, should be dressed out as soon as possible since these nicks produce stress concentrations, and if ignored, may result in cracks. Never use an alkaline cleaner on the blades: remove grease and dirt with Stoddard solvent.

ENGINE CARE

The engine may be cleaned with Stoddard solvent, or equivalent, then dried thoroughly.

CAUTION

Particular care should be given to electrical equipment before cleaning. Cleaning fluids should not be allowed to enter magnetos, starter, alternator and the like. Protect these components before saturating the engine with solvents. All other openings should also be covered before cleaning the engine assembly. Caustic cleaning solutions should be used cautiously and should always be properly neutralized after their use.

INTERIOR CARE

To remove dust and loose dirt from the upholstery and carpet, clean the interior regularly with a vacuum cleaner.

Blot up any spilled liquid promptly with cleansing tissue or rags. Don't pat the spot; press the blotting material firmly and hold it for several seconds. Continue blotting until no more liquid is taken up. Scrape off sticky materials with a dull knife, then spot-clean the area.

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

the fabric with a volatile solvent; it may damage the padding and backing materials.

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

If your airplane is equipped with leather seating, cleaning of the seats is accomplished using a soft cloth or sponge dipped in mild soap suds. The soap suds, used sparingly, will remove traces of dirt and grease. The soap should be removed with a clean damp cloth.

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

SECTION 9

SUPPLEMENTS

(Optional Systems Description & Operating Procedures)

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Introduction

Supplements (General):

1 Carburetor Air Temperature Gage	(2 pages)
1A Convenience Table	(2 pages)
2 Digital Clock	(4 pages)
3 Electric Elevator Trim System	(2 pages)
4 Ground Service Plug Receptacle	(4 pages)
5 Oxygen System	(6 pages)
6 Strobe Light System	(2 pages)
7 Winterization Kit	(2 pages)

Supplements (Avionics):

8 AM/FM Cassette Stereo Entertainment Center (Type EC-100)	(8 pages)
9 DME (Type 190)	(4 pages)
10 Emergency Locator Transmitter (ELT)	(4 pages)
11 Foster Area Navigation System (Type 511)	(8 pages)
12 HF Transceiver (Type PT10-A)	(4 pages)
13 SSB HF Transceiver (Type ASB-125)	(4 pages)
14 Unslaved Horizontal Situation Indicator (Type IG-832C)	(6 pages)
15 200A Navomatic Autopilot (Type AF-295B)	(6 pages)
16 300 ADF (Type R-546E)	(6 pages)
17 300 Nav/Com (Type RT-385A)	(8 pages)
18 300 Nav/Com (Type RT-385A) With 400 Area Navigation System (Type RN-478A)	(8 pages)
19 300 Transponder (Type RT-359A) And Optional Altitude Encoder (Blind)	(6 pages)
20 300 Transponder (Type RT-359A) And Optional Encoding Altimeter (Type EA-401A)	(6 pages)
21 300A Navomatic Autopilot (Type AF-395A)	(6 pages)
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27	400 Nav/Com (Type RT-485A)	(10 pages)
28	400 Nav/Com (Type RT-485A) With 400 Area Navigation System (Type RN-478A)	(10 pages)
29	400 Transponder (Type RT-459A) And Optional Altitude Encoder (Blind)	(6 pages)
30	400 Transponder (Type RT-459A) And Optional Encoding Altimeter (Type EA-401A)	(6 pages)

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

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 left side of the instrument panel below the gyros. 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

CONVENIENCE TABLE

SECTION 1

GENERAL

The convenience table and its stowage compartment is installed on the back of the pilot's or copilot's seat for use by the second row passengers. The table is equipped with guides which follow tracks inside the stowage compartment.

SECTION 2

LIMITATIONS

The following information must be presented in the form of a placard located on the back of the convenience table.

<p>STOW LEAF DURING TAKEOFF AND LANDING</p>
--

SECTION 3

EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when the convenience table is installed.

SECTION 4

NORMAL PROCEDURES

To remove the table from the stowage compartment, grasp the handle near the top edge of the leaf, slide it upward and aft until the leaf contacts the stops at the top of the compartment. Stowing the table is accomplished by rotating it upward and sliding it back down into the stowage compartment.

SECTION 5

PERFORMANCE

There is no change to the airplane performance when the convenience table is installed.

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 ENG-RADIO lights 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.

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DIGITAL CLOCK MODEL 182Q

PILOT'S OPERATING HANDBOOK SUPPLEMENT

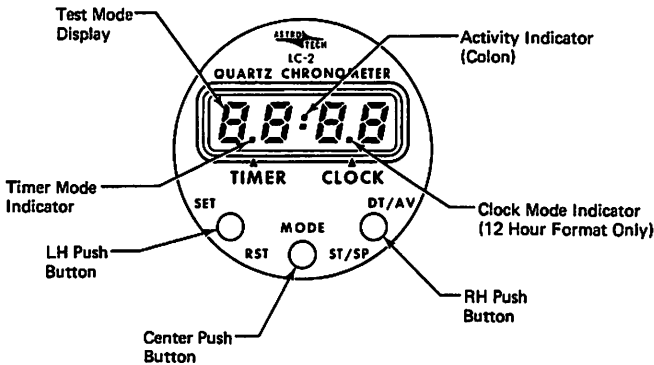


Figure 1. Digital Clock

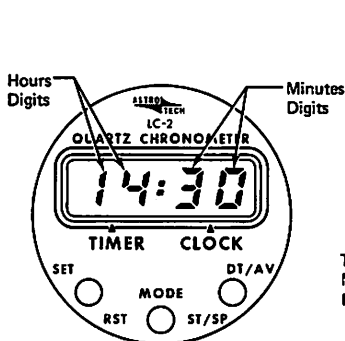
SECTION 4 NORMAL PROCEDURES

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 selected by changing the position of an internal slide

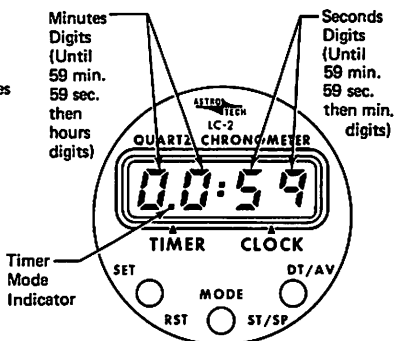


LH Button: Sets date and time of day (when used with RH button).

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

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 until February 29 of each leap year, at which time one day must be added manually.

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

ELECTRIC ELEVATOR TRIM SYSTEM

SECTION 1 GENERAL

The electric elevator trim system provides a simple method of relieving pitch control pressures without interrupting other control operations to adjust the manual elevator trim wheel. The system is controlled by a slide-type trim switch on the top of the left control wheel grip and a disengage switch located on the upper left side of the control wheel pad. Pushing the trim switch to the forward position, labeled DN, moves the elevator trim tab in the "nose down" direction; conversely, pulling the switch aft to the UP position moves the tab in the "nose up" direction. When the switch is released, it automatically returns to the center off position, and elevator trim tab motion stops. The disengage switch, labeled ELEC TRIM DISENGAGE, disables the system when placed in the DISENGAGE (aft) position.

A servo unit (which includes a motor and chain-driven, solenoid-operated clutch) actuates the trim tab to the selected position. When the clutch is not energized (trim switch off) the electric portion of the trim system freewheels so that manual operation is not affected. The electric trim system can be overridden at any time by manually rotating the elevator trim wheel, thus overriding the servo that drives the trim tab.

SECTION 2 LIMITATIONS

The following limitation applies to the electric elevator trim system:

1. The maximum altitude loss during an electric elevator trim malfunction may be as much as 200 feet.

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**ELECTRIC ELEVATOR
TRIM SYSTEM
MODEL 182Q**

**PILOT'S OPERATING HANDBOOK
SUPPLEMENT**

SECTION 3 EMERGENCY PROCEDURES

1. Elevator Trim Disengage Switch -- DISENGAGE.
2. Manual Trim -- AS REQUIRED.

SECTION 4 NORMAL PROCEDURES

To operate the electric elevator trim system, proceed as follows:

1. Master Switch -- ON.
2. Elevator Trim Disengage Switch -- ON.
3. Trim Switch -- ACTUATE as desired.
4. Elevator Trim Position Indicator -- CHECK.

NOTE

To check the operation of the disengage switch, actuate the elevator trim switch with the disengage switch in the DISENGAGE (aft) position. Observe that the manual trim wheel and indicator do not rotate when the elevator trim switch is activated.

SECTION 5 PERFORMANCE

There is no change to the airplane performance when this trim system 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 lengthy maintenance work on the electrical and electronic equipment. The receptacle is located behind a door on the left side of the fuselage near the aft edge of the cowlings.

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.

The battery and external power circuits have been designed to completely eliminate the need to "jumper" across the battery contactor to close it for charging a completely "dead" battery. A special fused circuit in the external power system supplies the needed "jumper" across the contacts so that with a "dead" battery and an external power source applied, turning the master switch ON will close the battery contactor.

SECTION 2

LIMITATIONS

The following information must be presented in the form of a placard located on the inside of the ground service plug access door:

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

There is no change to the airplane emergency procedures when the ground service plug receptacle is installed.

SECTION 4

NORMAL PROCEDURES

Just before connecting an external power source (generator type or battery cart), the avionics power switch should be turned off, and the master switch turned 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.

The ground service plug receptacle circuit incorporates a polarity reversal protection. Power from the external power source will flow only if the ground service plug is correctly connected to the airplane. If the plug is accidentally connected backwards, no power will flow to the electrical system, thereby preventing any damage to electrical equipment.

SECTION 5 PERFORMANCE

There is no change to the airplane performance when the ground service plug receptacle is installed.

SUPPLEMENT

OXYGEN SYSTEM

SECTION 1 GENERAL

A four-place oxygen system provides the supplementary oxygen necessary for continuous flight at high altitude. In this system, an oxygen cylinder, located behind the rear baggage compartment wall, supplies the oxygen. Cylinder pressure is reduced to an operating pressure of 70 psi by a pressure regulator attached to the cylinder. A shutoff valve is included as part of the regulator assembly. An oxygen cylinder filler valve is located on the left side of the rear baggage compartment wall. Cylinder pressure is indicated by a pressure gage located in the overhead oxygen console.

Four oxygen outlets are provided; two in the overhead oxygen console and two in the cabin ceiling just above the side windows, one at each of the seating positions. One permanent, microphone-equipped mask is provided for the pilot, and three disposable type masks are provided for the passengers. All masks are the partial-rebreathing type equipped with vinyl plastic hoses and flow indicators.

NOTE

The hose provided for the pilot is of a higher flow rate than those for the passengers; it is color-coded with an orange band adjacent to the plug-in fitting. The passenger hoses are color-coded with a green band. If the airplane owner prefers, he may provide higher flow hoses for all passengers. In any case, it is recommended that the pilot use the larger capacity hose. The pilot's mask is equipped with a microphone to facilitate use of the radio while using oxygen. An adapter cord is furnished with the microphone-equipped mask to mate the mask microphone lead to the auxiliary microphone jack located on the left side of the instrument panel. To connect the oxygen mask microphone, connect the mask lead to the adapter cord and plug the cord into the auxiliary microphone jack. (If an optional microphone-headset combination has been in

use, the microphone lead from this equipment is already plugged into the auxiliary microphone jack. It will be necessary to disconnect this lead from the auxiliary microphone jack so that the adapter cord from the oxygen mask microphone can be plugged into the jack). A switch is incorporated on the left hand control wheel to operate the microphone.

A remote shutoff valve control, located adjacent to the pilot's oxygen outlet, is used to shut off the supply of oxygen to the system when not in use. The control is mechanically connected to the shutoff valve at the cylinder. With the exception of the shutoff function, the system is completely automatic and requires no manual regulation for change of altitude.

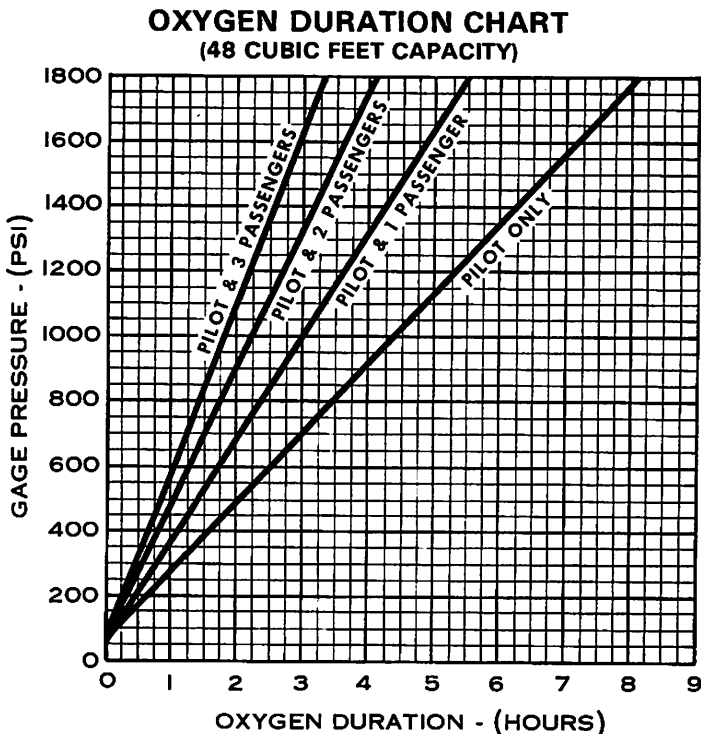
The oxygen cylinder, when fully charged, contains approximately 48 cubic feet of oxygen, under a pressure of 1800 psi at 70°F (21°C). Filling pressures will vary, however, due to the ambient temperature in the filling area, and because of the temperature rise resulting from compression of the oxygen. Because of this, merely filling to 1800 psi will not result in a properly filled cylinder. Fill to the pressures indicated in figure 1 for ambient temperature.

WARNING

Oil, grease or other lubricants in contact with oxygen create a serious fire hazard, and such contact must be avoided when handling oxygen equipment.

AMBIENT TEMPERATURE °F	FILLING PRESSURE PSIG	AMBIENT TEMPERATURE °F	FILLING PRESSURE PSIG
0	1600	50	1825
10	1650	60	1875
20	1700	70	1925
30	1725	80	1975
40	1775	90	2000

Figure 1. Oxygen Filling Pressures



NOTE: This chart is based on a pilot with an orange color-coded oxygen line fitting and passengers with green color-coded line fittings.

Figure 2. Oxygen Duration Chart

For FAA requirements concerning supplemental oxygen, refer to FAR 91.32. Supplemental oxygen should be used by all occupants when cruising above 12,500 feet. As described in the Cessna booklet "Man At Altitude," it is often advisable to use oxygen at altitudes lower than 12,500 feet under conditions of night flying, fatigue, or periods of physiological or emotional disturbances. Also, the habitual and excessive use of tobacco or alcohol will usually necessitate the use of oxygen at less than 10,000 feet.

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OXYGEN SYSTEM MODEL 182Q

PILOT'S OPERATING HANDBOOK SUPPLEMENT

The Oxygen Duration Chart (figure 2) should be used in determining the usable duration (in hours) of the oxygen supply in your airplane. The following procedure outlines the method of finding the duration from the chart.

1. Note the available oxygen pressure shown on the pressure gage.
2. Locate this pressure on the scale on the left side of the chart, then go across the chart horizontally to the right until you intersect the line representing the number of persons making the flight. After intersecting the line, drop down vertically to the bottom of the chart and read the duration in hours given on the scale.
3. As an example of the above procedure, 1400 psi of pressure will safely sustain the pilot only for nearly 6 hours and 15 minutes. The same pressure will sustain the pilot and three passengers for approximately 2 hours and 30 minutes.

NOTE

The Oxygen Duration Chart is based on a standard configuration oxygen system having one orange color-coded hose assembly for the pilot and green color-coded hoses for the passengers. If orange color-coded hoses are provided for pilot and passengers, it will be necessary to compute new oxygen duration figures due to the greater consumption of oxygen with these hoses. This is accomplished by computing the total duration available to the pilot only (from PILOT ONLY line on chart), then dividing this duration by the number of persons (pilot and passengers) using oxygen.

SECTION 2 LIMITATIONS

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

SECTION 3 EMERGENCY PROCEDURES

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

SECTION 4 NORMAL PROCEDURES

Prior to flight, check to be sure that there is an adequate oxygen supply for the trip, by noting the oxygen pressure gage reading, and referring to the Oxygen Duration Chart (figure 2). Also, check that the face masks and hoses are accessible and in good condition.

WARNING

For safety reasons, no smoking should be allowed in the airplane while oxygen is being used.

When ready to use the oxygen system, proceed as follows:

1. Mask and Hose -- SELECT. Adjust mask to face and adjust metallic nose strap for snug mask fit.
2. Delivery Hose -- PLUG INTO OUTLET nearest to the seat you are occupying.

NOTE

When the oxygen system is turned on, oxygen will flow continuously at the proper rate of flow for any altitude without any manual adjustments.

3. Oxygen Supply Control Knob -- ON.
4. Face Mask Hose Flow Indicator -- CHECK. Oxygen is flowing if the indicator is being forced toward the mask.
5. Delivery Hose -- UNPLUG from outlet when discontinuing use of oxygen. This automatically stops the flow of oxygen.
6. Oxygen Supply Control Knob -- OFF when oxygen is no longer required.

SECTION 5 PERFORMANCE

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

SUPPLEMENT

STROBE LIGHT SYSTEM

SECTION 1

GENERAL

The high intensity strobe light system enhances anti-collision protection for the airplane. The system consists of two wing tip-mounted strobe lights (with integral power supplies), a rocker switch, labeled STROBE LIGHTS, and a 5-amp push-to-reset circuit breaker. The rocker switch and circuit breaker are located on the left side of the switch and control panel.

SECTION 2

LIMITATIONS

Strobe lights must be turned off when taxiing in the vicinity of other airplanes, or during night flight through clouds, fog or haze.

SECTION 3

EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when strobe lights are installed.

SECTION 4

NORMAL PROCEDURES

To operate the strobe light system, proceed as follows:

1. Master Switch -- ON.
2. Strobe Light Switch -- ON.

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**STROBE LIGHT SYSTEM
MODEL 182Q**

**PILOT'S OPERATING HANDBOOK
SUPPLEMENT**

SECTION 5 PERFORMANCE

The installation of strobe lights will result in a minor reduction in cruise performance.

SUPPLEMENT

WINTERIZATION KIT

SECTION 1 GENERAL

The winterization kit consists of two cover plates (with placards) which attach to the air intakes in the cowl nose cap, a restrictive cover plate for the induction air inlet, a placard to be installed on the instrument panel, and insulation for the crankcase breather line. This equipment should be installed for operations in temperatures consistently below 20° F (-7°C). Once installed, the crankcase breather insulation is approved for permanent use in both hot and cold weather.

SECTION 2 LIMITATIONS

The following information must be presented in the form of placards when the airplane is equipped with a winterization kit.

1. On each nose cap cover plate and induction air inlet cover plate:

THIS PLATE NOT TO BE USED WHEN
TEMPERATURE EXCEEDS +20° F.

2. On right side of instrument panel:

WINTERIZATION KIT MUST BE REMOVED
WHEN OUTSIDE AIR TEMPERATURE IS
ABOVE 20°F.

SECTION 3

EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when the winterization kit is installed.

SECTION 4

NORMAL PROCEDURES

There is no change to the airplane normal procedures when the winterization kit is installed.

SECTION 5

PERFORMANCE

There is no change to the airplane performance when the winterization kit is installed.

SUPPLEMENT

AM/FM CASSETTE STEREO ENTERTAINMENT CENTER

(Type EC-100)

SECTION 1

GENERAL

The EC-100 Cassette Stereo Player and AM/FM Radio is a compact, fully automatic AM/FM Mpx radio and stereo cassette player mounted in the instrument panel above the glove box, or in the alternate location utilizing the glove box. In addition to the player/radio, the system consists of stereo headphones and an externally mounted, fixed-wire antenna. All operating controls for the player/radio and headphones are shown and described in figure 1.

The AM/FM Mpx Radio will receive AM frequencies between 525 and 1650 kHz or FM frequencies between 88 and 108 MHz. AM or FM reception is selected by an AM/FM pushbutton located on the front of the set and with strong FM stations, at altitude, the radio can receive FM stations for over 200 miles.

The cassette stereo player is equipped with four-track, two-channel stereo cassette type playback with a tape speed of 4.76 cm/sec. Any standard-size monaural or stereo cassette may be used in the player. Cassettes are automatically activated when inserted in cassette receptacle (with tape play side to the right) with radio ON and AM/FM switch in either AM or FM position. When cassette is removed, radio play will automatically resume. Annunciator lights will illuminate monitoring the STEREO, TAPE, or COM Interrupt modes.

A COM Interrupt mode in this system, when activated, will interrupt stereo and cassette audio to provide selected aircraft radio audio to the stereo headphones. After a short delay, preselected stereo or cassette play will return following the completion of the aircraft communications.

A COM ONLY mode in the EC-100, allows the pilot to eliminate all entertainment modes and activate uninterrupted navigation and communications audio.

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AM/FM CASSETTE STEREO
(TYPE EC-100)PILOT'S OPERATING HANDBOOK
SUPPLEMENT

Headphones are equipped with individual earphone volume controls and a phone plug which must be attached to one of the phone jacks mounted overhead. Stereo phone jacks are placarded either "STEREO" or "STEREO HEADPHONE".

NOTICE

Sound from the player/radio is only available through stereo headphones.

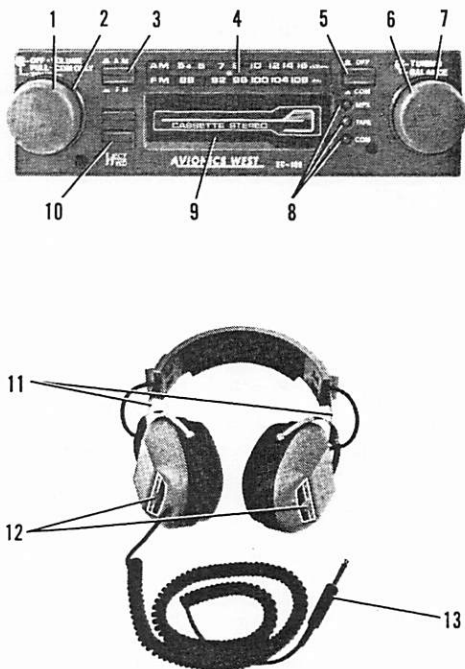


Figure 1. AM/FM Cassette Stereo Entertainment Center, Operating Controls. (Sheet 1 of 3)

1. OFF/VOLUME AND PULL-COM ONLY CONTROL KNOB:

OFF-VOLUME CONTROL - Turning knob fully counterclockwise to detent turns off entire system. Advancing the knob clockwise passed the detent, applies power to the unit. Advancing it further clockwise increases the volume of audio level.

NOTE

This control affects the audio level of both the radio/tape system as well as the communications audio.

PULL-COM ONLY - Pull out on this knob to eliminate all entertainment modes and enable the NAV/COM input only.

2. RADIO/PLAYER AND COM TONE CONTROL (TONE) - Normal position of this control is fully clockwise for flat audio response. If excessive high frequency hiss is evident in the headphones, the control may be rotated counterclockwise to reduce the high frequency response.
3. AM/FM PUSHBUTTON SELECTOR SWITCH (AM/FM) - Selects AM or FM radio reception; IN for FM and OUT for AM.
4. AM and FM RADIO FREQUENCY INDICATOR DIAL (AM/FM) - Indicates selected operating radio frequencies for AM between 525 and 1650 kHz and FM between 88 and 108 MHz.
5. COM INTERRUPT PUSHBUTTON SELECTOR SWITCH (OFF/COM) - To activate the communications override feature, pushbutton is pushed in. Communications override is eliminated by pushing button completely in and releasing (button out).
6. TUNING SELECTOR CONTROL KNOB (TUNING) - Rotate to tune in desired AM or FM operating frequencies.
7. RADIO/PLAYER AND COM SPEAKER BALANCE CONTROL KNOB (BALANCE) - Left and right speaker balance is controlled by counterclockwise and clockwise rotation of control knob.
8. MODE ANNUNCIATOR LIGHTS:

MPX (GREEN) - Illuminates green to indicate that a stereo FM station has been tuned-in.

TAPE (AMBER):

Dim Position - Illuminates dim amber to indicate tape mode of operation.

Bright Position - Illuminates bright amber to indicate cassette has reached end of tape and requires changing.

COM (RED) - Illuminates red to indicate com mode has been activated and a com transmission is being received.

9. CASSETTE RECEPTACLE - Insert cassette cartridge, turned sideways, with tape play side to the right. When the cartridge is inserted far enough, the mechanism will snap it into place and the EJECT pushbutton will move to the extended

Figure 1. AM/FM Cassette Stereo Entertainment Center, Operating Controls. (Sheet 2 of 3)

position (button out). Top numbered side will play. Either monaural or standard stereo cassettes may be used.

10. **TAPE EJECT AND FAST FORWARD PUSHBUTTON (EJECT/F. FWD)** - This pushbutton has two modes of control. For fast forward (rewind), pushbutton is pushed in slightly. Cassette is ejected when button is pushed completely in.
11. **HEADPHONE EXTENSION-ADJUSTMENT ARMS** - Located on both sides of the headphones. Earphone extension is adjusted by sliding the adjustment arms in, or out, of the head pad to a comfortable listening position.
12. **EARPHONE VOLUME CONTROL LEVERS** - Regulates volume of audio to individual earphones. Volume increases as levers are moved to higher settings.
13. **HEADPHONE PLUG** - Inserts into one of the phone jacks located overhead and placarded "STEREO" or "STEREO HEADPHONE". Jacks are for 1/4-inch stereo plugs only.

CAUTION

To prevent damage to the entertainment center, use only 8-ohm headphones with 1/4-inch stereo type plugs.

Figure 1. AM/FM Cassette Stereo Entertainment Center, Operating Controls. (Sheet 3 of 3)

SECTION 2 LIMITATIONS

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

SECTION 3 EMERGENCY PROCEDURES

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

SECTION 4 NORMAL PROCEDURES

AM/FM RADIO OPERATIONS:

1. Headphones -- INSERT headphone plug(s) into jack(s) mounted

- overhead and placarded either "STEREO" or "STEREO HEADPHONE".
2. Earphone Volume Control Levers -- SELECT a position slightly lower than medium volume for both volume control levers on the headphones.
 3. Headphone Extension-Adjustment Arms -- ADJUST to comfortable listening position.
 4. OFF/VOLUME AND PULL-COM ONLY CONTROL KNOB -- ROTATE control knob clockwise past detent to activate unit. Continue to rotate knob clockwise to desired volume setting.

NOTE

Audio can only be heard through stereo headphones.

CUTION

The stall and gear warning horn may not be heard with the stereo headphones in use.

With headphones plugged in, extended play at full volume should be avoided in order to prevent damage to headphones and hearing.

5. AM/FM Pushbutton Selector Switch -- SELECT as desired; IN for FM, OUT for AM.
6. TUNING Knob -- SELECT desired frequency.
7. MPX Stereo Annunciator Light -- CHECK ON (green light will illuminate) if FM radio station reception is selected.
8. Earphone Volume Control Levers -- ADJUST to desired audio setting. Volume is increased by moving levers to HI settings, and lowered by moving levers to LO settings.

NOTE

Improper tuning will result in poor tone and excessive noise.

9. TONE Control -- ROTATE to a fully clockwise position for normal operation.

NOTE

If excessive high frequency hiss is evident in the head-

phones, the control may be rotated counterclockwise to reduce the high frequency response.

10. **BALANCE** Control -- ADJUST to desired audio setting.

CASSETTE PLAYER OPERATIONS:

1. **Tape Receptacle** -- INSERT CASSETTE with tape play side to right and adjust listening controls on unit and headphones. Player will play top numbered side.

NOTE

When tape is ejected, radio play will automatically resume.

2. **TAPE Annunciator Light** -- CHECK ON; Light will illuminate dim amber when cassette is installed and will illuminate bright amber when cassette has reached end of tape play and requires changing.

CAUTION

To insure the best performance and operation of your cassette player, follow these simple rules:

- a. Loose cassette tape should not be played. If your tape is loose, rewind it before playing.
 - b. Do not keep cassette tape in your player long after cassette play is finished.
 - c. Do not use non-standard cassette tapes. Damage to your player will result.
3. **Tape EJECT/Fast Forward Pushbutton:**
 - a. To Eject Tape -- PUSH IN button all the way to eject cassette at end of play or at any point desired.
 - b. To Select Fast Forward (Rewind) -- PUSH SLIGHTLY in for fast forward position (push button in approximately half way).
 - c. To Cancel Fast Forward -- RELEASE BUTTON.

COM INTERRUPT OPERATIONS:

NOTE

Aircraft radio(s) must be turned on and the desired audio, to be monitored by COM Interrupt, must have the associated receiver's SPEAKER/PHONE selector switch(es) placed in the PHONE position on the audio control panel in order for the COM Interrupt feature to be operational. Audio signals that the pilot does not want to monitor, by the COM Interrupt feature, must have their associated receiver's SPEAKER/PHONE selector switch(es) on the audio control panel placed in the OFF position.

1. AM/FM Radio/Cassette Player -- SELECT and TURN ON desired system to be operated.
2. VOL Control -- SET to desired listening level.

NOTES

This control affects the stereo headphone audio level of the radio/tape system and other aircraft radios selected.

If the audio level from the Nav/Com Radio is too weak getting to the entertainment center, the COM Interrupt circuit will not be activated. If the audio level is too strong, distortion will be produced in the audio signal.

3. Com Interrupt Pushbutton Selector Switch (on EC-100) -- PUSH button in halfway and release to activate COM Interrupt circuit.
4. Aircraft's COM Radio SQ Control -- ROTATE clockwise until background noise is noticable and note that the red (COM) annunciator illuminates on the EC-100 to verify COM Interrupt operation. and then, backoff slightly on the SQ Control until background noise disappears. Repeat this operation periodically in normal flight.

COM ONLY OPERATIONS:

1. PULL-COM ONLY Selector Knob -- PULL knob out to override all audio modes in the EC-100 and activate audio signals as selected by the PHONE switches on the audio control panel.
2. COM Annunciator Light -- CHECK ON (Red) when selected audio is being received.

SECTION 5

PERFORMANCE

There is no change to the airplanes performance when this avionics 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

DME

(TYPE 190)

SECTION 1 GENERAL

The DME 190 (Distance Measuring Equipment) system consists of a panel mounted 200 channel UHF transmitter-receiver and an externally mounted antenna. The transceiver has a single selector knob that changes the DME's mode of operation to provide the pilot with: distance-to-station, time-to-station, or ground speed readouts. The DME is designed to operate at altitudes up to a maximum of 50,000 feet at ground speeds up to 250 knots and has a maximum slant range of 199.9 nautical miles.

The DME can be channeled independently or by a remote NAV set. When coupled with a remote NAV set, the MHz digits will be covered over by a remote (REM) flag and the DME will utilize the frequency set by the NAV set's channeling knobs. When the DME is not coupled with a remote NAV set, the DME will reflect the channel selected on the DME unit. The transmitter operates in the frequency range of 1041 to 1150 MHz and is paired with 108 to 117.95 MHz to provide automatic DME channeling. The receiver operates in the frequency range of 978 to 1213 MHz and is paired with 108 to 117.95 MHz to provide automatic DME channeling.

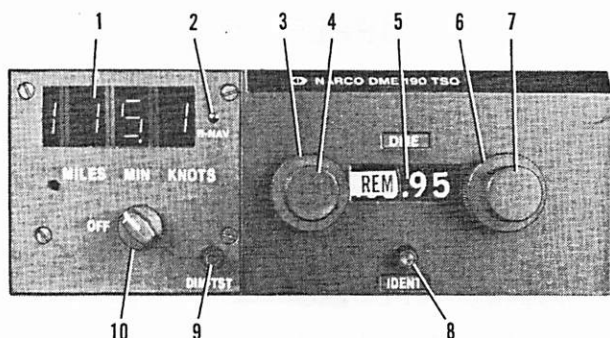
All operating controls (except for a SPEAKER/PHONE selector switch mounted on the audio control panel supplied with one or two transmitters as described in Section 7) for the DME are mounted on the front panel of the DME and are described in Figure 1.

SECTION 2 LIMITATIONS

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

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DME
(TYPE 190)

PILOT'S OPERATING HANDBOOK
SUPPLEMENT



1. READOUT WINDOW - Displays function readout in nautical miles (distance-to-station), minutes (time-to-station) or knots (ground speed).
2. R-NAV INDICATOR LAMP - The green R-NAV indicator lamp is provided to indicate the DME is coupled to an R-NAV system. Since this DME is not factory installed with an R-NAV system on Cessna airplanes, the R-NAV indicator lamp should never be illuminated. However, if an R-NAV system is coupled to the DME, and when in R-NAV mode, the R-NAV lamp will light which indicates that the distance readout is the "way point" instead of the DME station. The DME can only give distance (MILES) in R-Nav mode.
3. REMOTE CHANNELING SELECTOR - Two position selector. In the first position, the DME will utilize the frequency set by the DME channeling knobs. In the second position, the MHz digits will utilize the frequency set by the NAV 1 unit's channeling knobs.
4. WHOLE MEGAHERTZ SELECTOR KNOB - Selects operating frequency in 1-MHz steps between 108 and 117 MHz.
5. FREQUENCY INDICATOR - Shows operating frequency selected on the DME or displays remote (REM) flag to indicate DME is operating on a frequency selected by the remote NAV 1 receiver.
6. FRACTIONAL MEGAHERTZ SELECTOR KNOB - Selects operating frequency in 50 kHz steps. This knob has two positions, one for the 0 and one for the 5.
7. FRACTIONAL MEGAHERTZ SELECTOR KNOB - Selects operating frequency in tenths of a Megahertz (0-9).

Figure 1. DME 190 Operating Controls (Sheet 1 of 2)

8. IDENT KNOB - Rotation of this control increases or decreases the volume of the received station's Ident signal. An erratic display, accompanied by the presence of two Ident signals, can result if the airplane is flying in an area where two stations using the same frequency are transmitting.
9. DIM - TST KNOB -
DIM: Controls the brilliance of the readout lamp's segments. Rotate the control as desired for proper lamp illumination in the function window (The frequency window is dimmed by the aircraft's radio light dimming control).

TST (PUSH TEST): This control is used to test the illumination of the readout lamps, with or without being tuned to a station. Press the control, a readout of 188.8 should be seen with the mode selector switch in the MIN or KNOTS position. The decimal point along with 188.8 will light in the MILES mode. When the control is released, and had the DME been channeled to a nearby station, the distance to that station will appear. If the station channeled was not in range, a "bar" readout will be seen (--- or -- -).

10. MODE SELECTOR SWITCH -
OFF: Turns the DME OFF.
MILES: Allows a digital readout to appear in the window which represents slant range (in nautical miles) to or from the channeled station.
MIN: Allows a digital readout (in minutes) to appear in the window that it will take the airplane to travel the distance to the channeled station. This time is only accurate when flying directly TO the station and after the ground speed has stabilized.
KNOTS: Allows a digital readout (in knots) to appear in the window that is ground speed and is valid only after the stabilization time (approximately 2 minutes) has elapsed when flying directly TO or FROM the channeled station.

Figure 1. DME 190 Operating Controls (Sheet 2 of 2)

SECTION 3

EMERGENCY PROCEDURES

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

SECTION 4

NORMAL PROCEDURES

TO OPERATE:

1. Mode Selector Switch -- **SELECT** desired DME function.
2. Frequency Selector Knobs -- **SELECT** desired frequency and allow equipment to warm-up at least 2 minutes.

NOTE

If remote channeling selector is set in REM position, select the desired frequency on the #1 Nav radio.

3. PUSH TEST Control -- PUSH and observe reading of 188.8 in function window.
4. DIM Control -- **ADJUST**.
5. DME SPEAKER/PHONE Selector Switch (on audio control panel) -- **SELECT** as desired.
6. IDENT CONTROL -- **ADJUST** audio output in speaker or headset.
7. Mode Selector Functions:
 - MILES Position -- Distance-to-Station is slant range in nautical miles.
 - MIN Position -- Time-to-Station when flying directly to station.
 - KNOTS Position -- Ground Speed in knots when flying directly to or from station.

CAUTION

After the DME 190 has been turned OFF, do not turn it on again for 5 seconds to allow the protective circuits to reset.

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

EMERGENCY LOCATOR TRANSMITTER (ELT)

SECTION 1 GENERAL

The ELT consists of a self-contained dual-frequency radio transmitter and battery power supply, and is activated by an impact of 5g or more as may be experienced in a crash landing. The ELT emits an omni-directional signal on the international distress frequencies of 121.5 and 243.0 MHz. (Some ELT units in export aircraft transmit only on 121.5 MHz.) General aviation and commercial aircraft, the FAA, and CAP monitor 121.5 MHz, and 243.0 MHz is monitored by the military. Following a crash landing, the ELT will provide line-of-sight transmission up to 100 miles at 10,000 feet. The ELT supplied in domestic aircraft transmits on both distress frequencies simultaneously at 75 mw rated power output for 50 continuous hours in the temperature range of -4°F to +131°F (-20°C to +55°C). The ELT unit in export aircraft transmits on 121.5 MHz at 25 mw rated power output for 50 continuous hours in the temperature range of -4°F to +131°F (-20°C to +55°C).

The ELT is readily identified as a bright orange unit mounted behind the baggage compartment wall in the tailcone. To gain access to the unit, remove the baggage compartment wall. The ELT is operated by a control panel at the forward facing end of the unit (see figure 1).

SECTION 2 LIMITATIONS

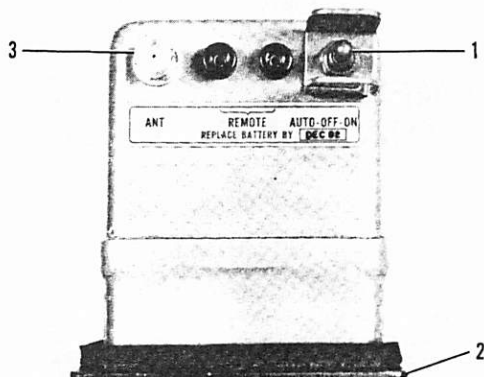
The following information is presented in the form of a placard located on the baggage compartment wall.

EMERGENCY LOCATOR TRANSMITTER
INSTALLED AFT OF THIS PARTITION.
MUST BE SERVICED IN ACCORDANCE
WITH FAR PART 91.52

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EMERGENCY LOCATOR TRANSMITTER (ELT)

PILOT'S OPERATING HANDBOOK SUPPLEMENT



1. FUNCTION SELECTOR SWITCH (3-position toggle switch):
 - ON - Activates transmitter instantly. Used for test purposes and if "g" switch is inoperative
 - OFF - Deactivates transmitter. Used during shipping, storage and following rescue.
 - AUTO - Activates transmitter only when "g" switch receives 5g or more impact.
2. COVER - Removable for access to battery pack.
3. ANTENNA RECEPTACLE - Connects to antenna mounted on top of tailcone.

Figure 1. ELT Control Panel

SECTION 3 EMERGENCY PROCEDURES

Immediately after a forced landing where emergency assistance is required, the ELT should be utilized as follows.

1. ENSURE ELT ACTIVATION --Turn a radio transceiver ON and select 121.5 MHz. If the ELT can be heard transmitting, it was activated by the "g" switch and is functioning properly. If no emergency tone is audible, gain access to the ELT and place the function selector switch in the ON position.

2. **PRIOR TO SIGHTING RESCUE AIRCRAFT --** Conserve airplane battery. Do not activate radio transceiver.
3. **AFTER SIGHTING RESCUE AIRCRAFT --** Place ELT function selector switch in the OFF position, preventing radio interference. Attempt contact with rescue aircraft with the radio transceiver set to a frequency of 121.5 MHz. If no contact is established, return the function selector switch to ON immediately.
4. **FOLLOWING RESCUE --** Place ELT function selector switch in the OFF position, terminating emergency transmissions.

SECTION 4 NORMAL PROCEDURES

As long as the function selector switch remains in the AUTO position, the ELT automatically activates following an impact of 5g or more over a short period of time.

Following a lightning strike, or an exceptionally hard landing, the ELT may activate although no emergency exists. To check your ELT for inadvertent activation, select 121.5 MHz on your radio transceiver and listen for an emergency tone transmission. If the ELT can be heard transmitting, place the function selector switch in the OFF position and the tone should cease. Immediately place the function selector switch in the AUTO position to re-set the ELT for normal operation.

SECTION 5 PERFORMANCE

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

SUPPLEMENT

FOSTER AREA NAVIGATION SYSTEM (Type 511)

SECTION 1 GENERAL

The Foster Area Navigation System (RNAV - Type 511) consists of a 511 Area Nav Computer, a compatible VHF navigation receiver, a DME Adapter Module and DME.

The RNAV 511 is a basic Area Navigation Computer with two thumb-wheel programmable waypoints. It performs continuous computation of triangulation problems.

The VOR and DME equipment in the aircraft provides information to the computer on aircraft position relative to the VORTAC station. A waypoint is dialed into one set of waypoint thumbwheels by inserting the RADIAL and DISTANCE of the waypoint (the position the pilot would like to fly over, or to) relative to the VORTAC station. The RNAV 511 computer calculates the Magnetic Bearing (BEARING) and Distance (RANGE NM) from the aircraft to the waypoint repeatedly to provide continual information on WHICH WAY and HOW FAR to the waypoint.

The pilot can monitor BEARING and RANGE on RNAV 511 to fly straight line paths to waypoints up to 200 NM distance from the aircraft position. Waypoints can be precisely dialed into the thumbwheels to 0.1° and 0.1 NM resolution.

The RNAV 511 also provides immediate position orientation relative to the VORTAC (VOR/DME) station being used for computation. Merely press the VOR/DME pushbutton to display the RADIAL and DME distance from the VORTAC.

Another feature of the RNAV 511 is its ability to provide evidence of proper computation in the system. The system can be tested at anytime before flight or while airborne to confirm proper computer operation. An acceptable "test" is evidenced by the active waypoint's RADIAL/DISTANCE being displayed in the BEARING and RANGE windows of the RNAV 511 while TEST pushbutton is pressed. In addition to the "test" feature, diagnostic functions are provided to alert the pilot of why the system is not functional.

SECTION 2

LIMITATIONS

This RNAV installation is not approved for IFR operations and the following information is displayed on individual placards:

1. Adjacent to panel unit when used with the DME 190:

RNAV FOR VFR FLIGHT ONLY
TUNE DME & NAV 1 TO SAME
VORTAC FOR RNAV OPERATION

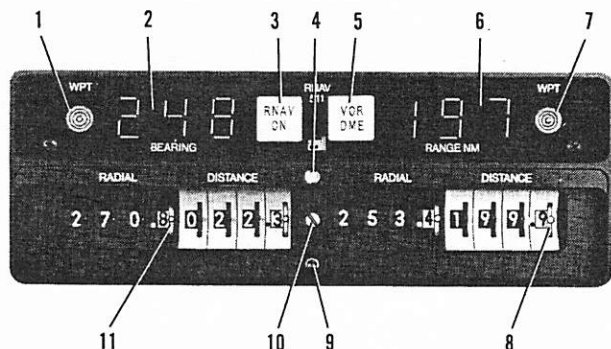
2. Adjacent to panel unit when used with the 400 DME:

RNAV FOR VFR FLIGHT ONLY
DME MODE SELECTOR ON
NAV 1 OR NAV 2 ONLY

SECTION 3

EMERGENCY PROCEDURES

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



1. WAYPOINT PUSHBUTTON (WPT) - Activates the waypoint data dialed into the left side thumbwheels (11). When pressed, the WPT pushbutton lights to indicate which waypoint is "active". The WPT pushbutton light intensity is controlled by a photocell (4).
2. MAGNETIC BEARING DISPLAY READOUT - Digitally displays the magnetic bearing from the airplane to the waypoint. While VOR/DME pushbutton (5) is pressed, the digital display reads RADIAL from the VOR station on which the airplane is presently positioned.
3. RNAV ON/OFF PUSHBUTTON (RNAV ON) - When pressed, RNAV ON light will illuminate and set is turned ON. When pressed again, set will be turned OFF and the RNAV ON light will go out. The pushbutton lighting is automatically dimmed by the photocell (4).
4. PHOTOCCELL - Senses ambient cockpit light and controls brightness of pushbuttons (1, 3, 5 & 7) and digital displays (2 & 6).
5. VOR DME PUSHBUTTON - Provides PRESENT POSITION information as to VOR RADIAL and DME DISTANCE digitally in positions (2) and (6) respectively when the pushbutton is pressed.
6. DISTANCE DISPLAY READOUT - Digitally displays airplane DISTANCE TO or FROM the waypoint. Reads by 0.1 NM increments up to 99.9 NM and by 1.0 NM increments over 100 NM. Maximum range readout is 199 NM. While VOR/DME pushbutton (5) is pressed, the digital display reads DME distance to the VORTAC station from the airplane.

Figure 1 Foster Area Nav (Type 511) Computer Operating Controls and Indicators (Sheet 1 of 2)

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FOSTER AREA NAVIGATION (TYPE 511)

PILOT'S OPERATING HANDBOOK SUPPLEMENT

7. **WAYPOINT PUSHBUTTON (WPT)** - Activates the waypoint data dialed into the RIGHT side thumbwheels (8). When pressed, the WPT pushbutton lights to indicate which waypoint is "active". The WPT pushbutton light intensity is controlled by photocall (4).
8. **RADIAL AND DISTANCE THUMBWHEELS** - Waypoint location (RADIAL and DISTANCE) is dialed into thumbwheels to 0.1° and 0.1 NM resolution. Maximum waypoint offset from the VORTAC is 199.9 NM.
9. **TEST PUSHBUTTON** - Press to check proper calibration of RNAV 511. If the computer is properly calibrated, the displays (2 & 6) read the "active" WPT RADIAL and DISTANCE as dialed into the thumbwheels. Test may be performed anytime, (during or before flight).
10. **LOCKING SCREW** - Secures RNAV 511 in dustcover. Turn locking screw counterclockwise several turns to release unit from panel.
11. **RADIAL AND DISTANCE THUMBWHEELS** - Waypoint location (RADIAL AND DISTANCE) is dialed into thumbwheels to 0.1° and 0.1 NM resolution. Maximum waypoint offset from the VORTAC is 199.9 NM.

Figure 1 Foster Area Nav (Type 511) Computer Operating
Controls and Indicators (Sheet 2 of 2)

SECTION 4

NORMAL OPERATION

VOR/LOC OPERATION

VOR NAVIGATION CIRCUITS VERIFICATION TESTS:

1. See appropriate Nav/Com supplement.

AREA NAVIGATION OPERATING NOTES

1. Proper RNAV operation requires valid VOR and DME inputs to the RNAV system. In certain areas, the ground station antenna patterns and transmitter power may be inadequate to provide valid signals to the RNAV. For this reason, intermittent RNAV signal loss may be experienced enroute.
2. When a waypoint from one VORTAC is displaced over a second VORTAC, interference from the second VORTAC sometimes causes erratic and unusable BEARING and RANGE displays on the RNAV at low altitude.
3. The RNAV BEARING readout (to the waypoint) becomes extremely sensitive and may become unusable within 1 - 1 1/2 miles of the waypoint. Thus, the RANGE readout is the primary means of approximating waypoint passage.
4. Tracking from a waypoint is not recommended since the pilot would have to fly a reciprocal bearing and make error corrections in the opposite direction from flying to a waypoint.

DIAGNOSTIC FUNCTIONS

All RNAV systems are rendered inoperative under certain conditions. The RNAV 511 provides a Flag mode and permits a diagnostic interpretation of why the system is inoperative.

FLAG MODE INDICATIONS:

1. Six "Bars" Appear in the Digital Displays (2 & 6):
 - a. PRESS VOR/DME button (5) to determine if the VOR radial signal is absent. If VOR radial signal is absent, bars will change to show as "000" in the BEARING window (2). (One possible cause of this condition could be that the NAV receiver is channeled to a localizer signal.)
 - b. Excess RADIAL waypoint address entry (11 or 8) such as 360.1° or 389° -- The computer will not accept this entry.

- c. Excess RANGE to Waypoint (6) -- This would be any value over 199 NM. (A check of aircraft position relative to the VORTAC and Waypoint will detect and verify this condition.)
2. Missing DME Signal Display -- This will show as "00.0" in the RANGE NM digital display (6) when the VOR/DME button (2) is held in. The missing DME signal is then the reason for the FLAG condition. (If valid VOR and DME data is displayed, then another cause must be sought.)
3. Temporary Display of Unchanging Random Digits in the BEARING and RANGE Windows (2 & 6) at Time of Initial Turn-ON -- Such a condition is caused by a random interpretation of the micro processor cycle. The RNAV 511 will Flag this malfunction by a complete blanking of all display functions. The pilot can reset the micro processor cycle by turning the RNAV OFF and then ON.

WAYPOINT PROGRAMMING

1. Using a VFR Sectional or other appropriate maps -- DETERMINE distance and bearing for desired waypoint(s) from appropriate VOR/DME stations.
2. VHF Navigation Receiver -- ON (When installed with DME 190, RNAV 511 is connected to the Nav 1 Rcvr. When installed with the 400 DME, RNAV 511 may be connected to either the Nav 1 or Nav 2 Rcvr.) and channeled to the desired VORTAC.
3. DME ON/OFF Switch -- ON.
4. DME Remote Channeling Selector on DME 190 Selector -- SET to REM position on DME 190.
5. DME Mode Selector on 400 DME -- SET TO desired NAV 1 or NAV 2 position on 400 DME.

NOTE

RNAV and HOLD positions on the 400 DME Mode Selector are not used with this installation. RNAV is automatically channeled to the selected Nav receiver.

6. GS/TTS Selector Switch (on 400 DME) -- SET as desired. (Will only display ground speed component or time-to-station at that speed to the selected VOR -- not the waypoint.)
7. RADIAL and DISTANCE Thumbwheels -- SET to first waypoint RADIAL and DISTANCE. (Typically, the first waypoint is set into the left side set of thumbwheels.)
8. RADIAL and DISTANCE Thumbwheels -- SET to second waypoint RADIAL and DISTANCE. (Typically, the second waypoint is set into the right set of thumbwheels.)
9. Left WPT Pushbutton Switch -- PUSH in.
 - a. First waypoint RADIAL and DISTANCE are placed in unit as a waypoint.

10. RNAV BEARING Readout -- OBSERVE readout for magnetic BEARING to waypoint.
11. RNAV RANGE Readout -- OBSERVE readout of first waypoint distance.
12. TEST Pushbutton -- PRESS and observe that the desired BEARING and RANGE readouts of the waypoint thumbwheel settings are displayed.
 - a. BEARING Display Readout -- DISPLAYS readout of first waypoint bearing.
 - b. RANGE Display Readout -- DISPLAYS readout of first waypoint distance.
13. DG or HSI -- CONTROL AIRCRAFT as required to maintain desired track to or from waypoint.

NOTE

Due to wind drift, it will be necessary to fly a few degrees plus or minus the calculated BEARING readout in order to maintain the desired BEARING readout on the computer.

14. VOR/DME Pushbutton -- PRESS at anytime to observe the radial and DME distance from the VORTAC associated with the waypoint.
15. Upon Waypoint Passage -- CHECK or SELECT next desired waypoint's VORTAC frequency on the selected Nav receiver and then PRESS next WPT Pushbutton in and repeat steps 9 through 12 to proceed to next waypoint which was dialed in the right set of thumbwheels.

NOTE

Waypoint passage will begin to be reflected on the RNAV BEARING display about 1.5 NM from the waypoint. Waypoint passage will be reflected by a rapid change of BEARING displays. Therefore, the pilot should fly the established inbound predetermined DG heading until waypoint passage has occurred or until the next waypoint is selected.

16. Left Hand RADIAL and DISTANCE Thumbwheels -- SET to next waypoint RADIAL and DISTANCE.

NOTE

As first waypoint is reached, it can be replaced with the next waypoint RADIAL and DISTANCE. Then a new

waypoint, if necessary, can be set into the right-hand thumbwheels after the initial right-hand waypoint is passed. This procedure can be followed for as many waypoints as necessary, providing that the desired Nav receiver is selected and the VORTAC frequency has been re-channelled to each VORTAC station.

SECTION 5

PERFORMANCE

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

SUPPLEMENT

HF TRANSCEIVER

(TYPE PT10-A)

SECTION 1

GENERAL

The PT10-A HF Transceiver, shown in Figure 1, is a 10-channel AM transmitter-receiver which operates in the frequency range of 2.0 to 18.0 Megahertz. The transceiver is automatically tuned to the operating frequency by a Channel Selector. The operating controls for the unit are mounted on the front panel of the transceiver. The system consists of a transceiver, antenna load box, fixed wire antenna and associated wiring.

The Channel Selector Knob determines the operating frequency of the transmitter and receiver. The frequencies of operation are shown on the frequency chart adjacent to the channel selector.

The VOLUME control incorporates the power switch for the transceiver. Clockwise rotation of the volume control turns the set on and increases the volume of audio.

The meter on the face of the transceiver indicates transmitter output.

The system utilizes the airplane microphone, headphone and speaker. Operation and description of the audio control panel used in conjunction with this radio is shown and described in Section 7 of this handbook.

SECTION 2

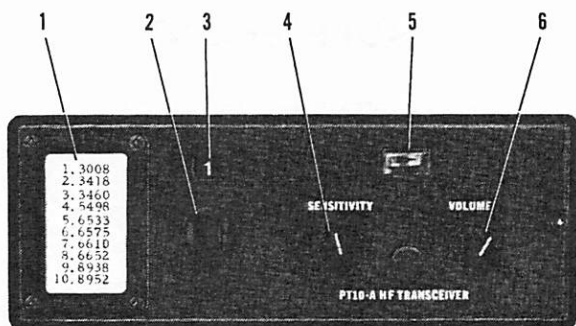
LIMITATIONS

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

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HF TRANSCEIVER (TYPE PT10-A)

PILOT'S OPERATING HANDBOOK SUPPLEMENT



1. FREQUENCY CHART - Shows the frequency of the channel in use (frequencies shown may vary and are shown for reference purposes only).
2. CHANNEL SELECTOR - Selects channels 1 thru 10 as listed in the frequency chart.
3. CHANNEL READOUT WINDOW - Displays channel selected in frequency chart.
4. SENSITIVITY CONTROL - Controls the receiver sensitivity for audio gain.
5. ANTENNA TUNING METER - Indicates the energy flowing from the transmitter into the antenna. The optimum power transfer is indicated by the maximum meter reading.
6. ON/OFF VOLUME CONTROL - Turns complete set on and controls volume of audio.

Figure 1. HF Transceiver (Type PT10-A)

SECTION 3

EMERGENCY PROCEDURES

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

SECTION 4

NORMAL PROCEDURES

COMMUNICATIONS TRANSCEIVER OPERATION:

1. XMTR SEL Switch (on audio control panel) -- SELECT transmitter.
2. SPEAKER/PHONE Selector Switch (on audio control panel) -- SELECT desired mode.
3. VOLUME Control -- ON (allow equipment to warm up and adjust audio to comfortable listening level).
4. Frequency Chart -- SELECT desired operating frequency.
5. Channel Selector -- DIAL in frequency selected in step 4.
6. SENSITIVITY Control -- ROTATE clockwise to maximum position.

NOTE

If receiver becomes overloaded by very strong signals, back off SENSITIVITY control until background noise is barely audible.

NOTE

The antenna tuning meter indicates the energy flowing from the airplane's transmitter into the antenna. The optimum power transfer is indicated by the maximum meter reading.

7. Mike Button:
 - a. To Transmit -- DEPRESS and SPEAK into microphone.

NOTE

Sidetone is not available on this radio.

- b. To Receive -- RELEASE mike button.

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

SSB HF TRANSCEIVER

(TYPE ASB-125)

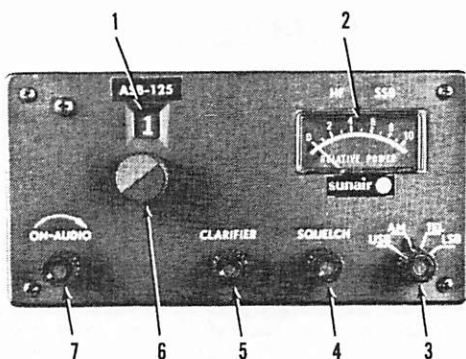
SECTION 1

GENERAL

The ASB-125 HF transceiver is an airborne, 10-channel, single sideband (SSB) radio with a compatible amplitude modulated (AM) transmitting-receiving system for long range voice communications in the 2 to 18 MHz frequency range. The system consists of a panel mounted receiver/exciter, a remote mounted power amplifier/power supply, an antenna coupler and an externally mounted, fixed wire, medium/high frequency antenna.

A channel selector knob determines the operating frequency of the transceiver which has predetermined crystals installed to provide the desired operating frequencies. A mode selector control is provided to supply the type of emission required for the channel, either sideband, AM or telephone for public correspondence. An audio knob, clarifier knob and squelch knob are provided to assist in audio operation during receive. In addition to the aforementioned controls, which are all located on the receiver/exciter, a meter is incorporated to provide antenna loading readouts.

The system utilizes the airplane microphone, headphone and speaker. Operation and description of the audio control panel used in conjunction with this radio is shown and described in Section 7 of this handbook.



1. CHANNEL WINDOW - Displays selected channel.
2. RELATIVE POWER METER - Indicates relative radiated power of the power amplifier/antenna system.
3. MODE SELECTOR CONTROL - Selects one of the desired operating modes:
 - USB - Selects upper sideband operation for long range voice communications.
 - AM - Selects compatible AM operation and full AM reception.
 - TEL - Selects upper sideband with reduced carrier, used for public correspondence telephone and ship-to-shore.
 - LSB - (Optional) Selects lower sideband operation (not legal in U.S., Canada and most other countries).
4. SQUELCH CONTROL - Used to adjust signal threshold necessary to activate receiver audio. Clockwise rotation increases background noise (decreases squelch action); counterclockwise rotation decreases background noise.
5. CLARIFIER CONTROL - Used to "clarify" single sideband speech during receive while in USB mode only.
6. CHANNEL SELECTOR CONTROL - Selects desired channel. Also selects AM mode if channel frequency is 2003 kHz, 2182 kHz or 2638 kHz.
7. ON - AUDIO CONTROL - Turns set ON and controls receiver audio gain.

Figure 1. SSB HF Transceiver Operating Controls

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

COMMUNICATIONS TRANSCEIVER OPERATION:

NOTE

The pilot should be aware of the two following radio operational restrictions:

- a. For sideband operation in the United States, Canada and various other countries, only the upper sideband may be used. Use of lower sideband is prohibited.
 - b. Only AM transmissions are permitted on frequencies 2003 kHz, 2182 kHz and 2638 kHz. The selection of these channels will automatically select the AM mode of transmission.
1. XMTR SEL Switch (on audio control panel) -- SELECT transceiver.
 2. SPEAKER/PHONE Selector Switches (on audio control panel) -- SELECT desired mode.
 3. ON-AUDIO Control -- ON (allow equipment to warm up for 5 minutes for sideband or one minute for AM operation and adjust audio to comfortable listening level).
 4. Channel Selector Control -- SELECT desired frequency.
 5. Mode Selector Control -- SELECT operating mode.
 6. SQUELCH Control -- ADJUST clockwise for normal background noise output, then slowly adjust counterclockwise until the receiver is silent.

7. CLARIFIER Control -- ADJUST when upper single sideband RF signal is being received for maximum clarity.
8. Mike Button:
 - a. To Transmit -- DEPRESS and SPEAK into microphone.

NOTE

Sidetone is not available on this radio.

- b. To Receive -- RELEASE mike button.

NOTE

Voice communications are not available in the LSB mode.

NOTE

Lower sideband (LSB) mode is not legal in the U.S., Canada, and most other countries.

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

OPTIONAL UNSLAVED HORIZONTAL SITUATION INDICATOR (HSI) (TYPE IG-832C)

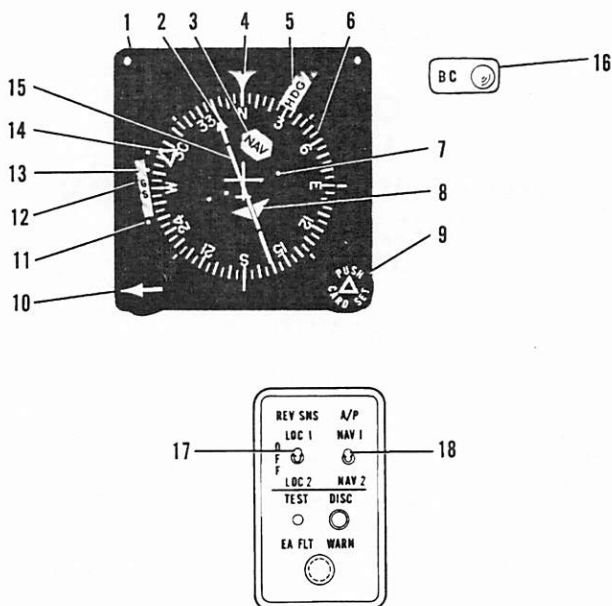
SECTION 1 GENERAL

The IG-832C Horizontal Situation Indicator (HSI) is an additional navigation indicator option which provides a heading reference with respect to an unslaved directional gyro, a heading reference bug, VOR course selection, and a pictorial presentation of the airplane position relative to VOR and localizer courses and glide slopes. This indicator is used with Cessna 300 and 400 Nav/Com radios. When dual Nav/Com radios are installed, the HSI is coupled to the number 1 NAV/COM and a standard 300 or 400 series VOR/LOC course deviation indicator is coupled to the number 2 NAV/COM.

This system consists of a Horizontal Situation Indicator (HSI-Type IG-832C) and a remote mounted VOR/LOC Converter (Type B-445A). The indicator is unslaved and course datum is not available. When the HSI is installed with a 300A or 400B Autopilot system, a BC light is installed on the instrument panel, adjacent to the HSI, to alert the pilot of back-course operation. Each control and indicator function is described in Figure 1.

SECTION 2 LIMITATIONS

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



USED WITH 400B AUTOPILOT
ON 210 SERIES MODELS

1. HORIZONTAL SITUATION INDICATOR (HSI) - Provides a pictorial presentation of aircraft deviation relative to VOR radials and localizer beams. It also displays glide slope deviations and gives heading reference with respect to magnetic north when compass card is set to agree with compass.
2. OMNI BEARING POINTER - Indicates selected VOR course or localizer course on compass card (6). The selected VOR radial or localizer heading remains set on the compass card when the compass card (6) is rotated.
3. NAV FLAG - When flag is in view, indicates that the NAV receiver signal being received is not reliable.

Figure 1. Horizontal Situation Indicator (HSI) (Type IG-832C)
(Sheet 1 of 3)

4. **HEADING REFERENCE (LUBBER LINE)** - Indicates aircraft magnetic heading on compass card (6).
5. **HEADING WARNING FLAG (HDG)** - When flag is in view, the heading display is invalid due to interruption of either electrical or vacuum power.
6. **COMPASS CARD** - Rotates to display heading of airplane with reference to lubber line (4). Must be set to agree with aircraft compass using Card Set Knob (9).
7. **COURSE DEVIATION DOTS** - Indicates aircraft displacement from VOR, or localizer beam center. A full scale (2 dots) course deviation bar (15) displacement represents the following deviations from beam center:
 - a. VOR = $\pm 10^\circ$ approx.
 - b. LOC = $\pm 2-1/2^\circ$ approx.
8. **TO/FROM INDICATOR FLAG** - Indicates direction of VOR station relative to selected course.
9. **HEADING SELECTOR AND CARD SET KNOB (PUSH \blacktriangle CARD SET)** - When rotated in normal (out) position, positions heading "bug" (14) on compass card (6) to indicate selected heading for reference or for autopilot tracking. When pushed in and rotated, sets compass card (6) to agree with magnetic compass. The omni bearing pointer (2), heading bug (14), and deviation bar (15) rotate with the compass card (6).

NOTE

The compass card (6) must be reset periodically to compensate for precessional errors in the gyro.

10. **COURSE SELECTOR $\cdot \frac{1}{2}$ KNOB** - When rotated, positions omni bearing pointer (2) on the compass card (6) to select desired VOR radial or localizer course.
11. **GLIDE SLOPE SCALE** - Indicates displacement from glide slope beam center. A glide slope deviation bar displacement of 2 dots, represents full scale (0.7°) deviation above or below glide slope beam centerline.
12. **GLIDE SLOPE POINTER** - Indicates on glide slope scale (11) aircraft displacement from glide slope beam center.
13. **GLIDE SLOPE FLAG** - When in view, indicates glide slope receiver signal is not reliable.
14. **HEADING BUG** - Indicates selected reference heading relative to compass card (6).
15. **COURSE (OMNI) DEVIATION BAR** - Bar is center portion of omni bearing pointer and moves laterally to pictorially indicate relationship of aircraft to selected course. It relates in degrees of angular displacement from VOR radials or localizer beam center (see Item 7).

Figure 1. Horizontal Situation Indicator (HSI) (Type IG-832C)
(Sheet 2 of 3)

16. BACK-COURSE LIGHT (BC) (Installed in a remote position, as shown, with 300A and 400B autopilots only.) - The remote amber BC light will illuminate when back-course operation is selected by the REV SNS LOC 1 switch (17) mounted in the lower center portion of the instrument panel or the BC function of 300A autopilot. Light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.

CAUTION

When back-course operation is selected, the course (omni) deviation bar (15) on the HSI does not reverse. However, selection of back-course operation will always cause the localizer signal to the autopilot to reverse for back-course operation.

17. BACK COURSE REVERSE SENSE (REV SNS) LOC 1 OR LOC 2 SELECTOR SWITCH - With AP switch ON (on 400A or 400B Autopilot control units) and either LOC 1 or LOC 2 selected, localizer signals to the Cessna 400A or 400B Autopilots will reverse for back-course operation. With autopilot ON or OFF, the course (omni) deviation bar on the HSI will not reverse but the standard CDI pointer will reverse depending on the position of the REV SNS switch.
18. AUTOPILOT (A/P) NAV 1 OR NAV 2 SELECTOR SWITCH - (Installed with 400B Autopilot only) Selects appropriate signals from the desired navigation receiver to be coupled to the autopilot.

SECTION 3

EMERGENCY PROCEDURES

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

Figure 1. Horizontal Situation Indicator (HSI) (Type IG-832C)
(Sheet 3 of 3)

SECTION 4

NORMAL PROCEDURES

NOTE

Both electrical and vacuum power must be supplied to this instrument for proper functioning. Absence of either will result in unreliable heading information.

Normal procedures for operation of this system differ little from those required for the more conventional Course Deviation Indicators. However, several small differences are worth noting.

The rectilinear movement of the omni deviation bar in combination with the rotation of the compass card in response to heading changes, provides an intuitive picture of the navigation situation at a glance when turned to an omni station. When tuned to a localizer frequency, the omni bearing pointer must be set to the inboard front course for both front and back-course approaches to retain this pictorial presentation.

When the HSI system is installed with a Cessna 300A (Type AF-395A) or Cessna 400B (Type IF-550A) Autopilot, a back-course indicator light labeled BC, is mounted adjacent to the HSI and will illuminate amber when the reverse sense (REV SNS) switch (mounted in the autopilot's accessory unit on 210 Models) is placed in the ON (LOC 1) position to alert the pilot that back-course operation is selected. The HSI needle will not be reversed but the LOC signals to the autopilot will be. Light dimming for the BC light is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.

For normal procedures with autopilots, refer to the 300A or 400B Autopilot Supplements in this handbook if they are listed in this section as options.

SECTION 5

PERFORMANCE

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

SUPPLEMENT

CESSNA NAVOMATIC 200A AUTOPILOT

(Type AF-295B)

SECTION 1 GENERAL

The Cessna 200A 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, 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. 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.

The 200A Navomatic will also capture and track a VOR or localizer course using signals from a VHF navigation receiver.

The operating controls for the Cessna 200A Navomatic are located on the front panel of the computer-amplifier, shown in Figure 1. The primary function pushbuttons (DIR HOLD, NAV CAPT, and NAV TRK), are interlocked so that only one function can be selected at a time. The HISENS and BACK CRS pushbuttons are not interlocked so that either or both of these functions can be selected at any time.

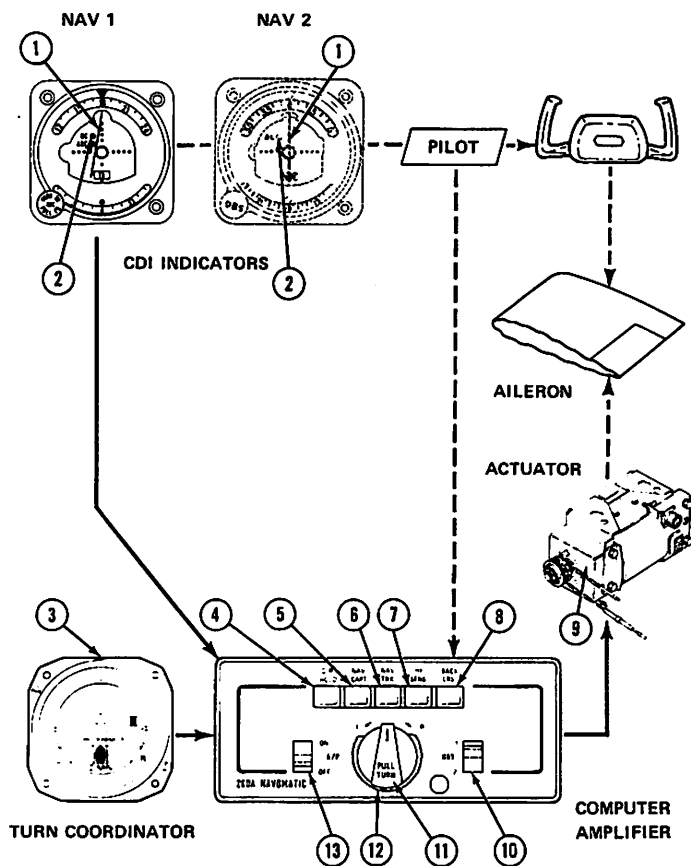


Figure 1. Cessna 200A Autopilot. Operating Controls and Indicators
(Sheet 1 of 2)

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 turned to a localizer frequency). This light is located within the CDI indicator.
3. TURN COORDINATOR - Senses roll and yaw for wings leveling and command turn functions.
4. DIR HOLD PUSHBUTTON - Selects direction hold mode. Airplane holds direction it is flying at time button is pushed.
5. NAV CAPT PUSHBUTTON - Selects NAV capture mode. When parallel to desired course, the airplane will turn to a pre-described intercept angle and capture selected VOR or LOC course.
6. NAV TRK PUSHBUTTON - Selects NAV track mode. Airplane tracks selected VOR or LOC course.
7. HISENS PUSHBUTTON - During NAV CAPT 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.
8. 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.
9. ACTUATOR - The torque motor in the actuator causes the ailerons to move in the commanded direction.
10. NAV SWITCH - Selects NAV 1 or NAV 2 navigation receiver.
11. 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.
12. TRIM - Used to trim autopilot to compensate for minor variations in aircraft trim or weight distribution. (For proper operation, the aircraft's rudder trim, if so equipped, must be manually trimmed before the autopilot is engaged.)
13. A P SWITCH - Turns autopilot ON or OFF.

Figure 1. Cessna 200A Autopilot, Operating Controls and Indicators
(Sheet 2 of 2)

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 anytime without damage.

TO TURN OFF AUTOPILOT:

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

SECTION 4 NORMAL PROCEDURES

BEFORE TAKE-OFF AND LANDING:

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

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 -- CENTER and PULL out.
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 -- CENTER, PULL out and ROTATE.

DIRECTION HOLD:

1. PULL-TURN Knob -- CENTER and PULL out.
2. Autopilot TRIM Control -- ADJUST for zero turn rate.
3. Airplane Rudder Trim -- ADJUST for zero slip ("Ball" centered).
4. DIR HOLD Button -- PUSH.
5. PULL-TURN Knob -- PUSH in detent position when airplane is on desired heading.
6. Autopilot TRIM Control -- READJUST for zero turn rate.

NAV CAPTURE (VOR/LOC):

1. PULL-TURN Knob -- CENTER and PULL out.
2. NAV 1-2 Selector Switch -- SELECT desired VOR 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 amber warning light should be off.

4. NAV CAPT Button -- PUSH.
5. HI SENS Button -- PUSH for localizer and "close-in" omni intercepts.

- 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.

- PULL-TURN Knob -- Turn airplane parallel to desired course.

NOTE

Airplane must be turned until heading is within $\pm 5^\circ$ of desired course.

- PULL TURN Knob -- CENTER and PUSH in. The airplane should then turn toward desired course at $45^\circ \pm 10^\circ$ intercept angle (if the CDI needle is in full deflection).

NOTE

If more than 15 miles from the station or more than 3 minutes from intercept, use a manual intercept procedure.

NAV TRACKING (VOR/LOC):

- NAV TRK Button -- PUSH when CDI centers and airplane is within $\pm 5^\circ$ of course heading.
- HI SENS BUTTON -- DISENGAGE for enroute omni tracking (leave ENGAGED for localizer).
- Autopilot TRIM Control -- READJUST as required to maintain track.

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 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 300 ADF

(Type R-546E)

SECTION 1

GENERAL

The Cessna 300 ADF is a panel-mounted, digitally tuned automatic direction finder. It is designed to provide continuous 1 kHz digital tuning in the frequency range of 200 kHz to 1,699 kHz and eliminates the need for mechanical band switching. The system is comprised of a receiver, a bearing indicator, a loop antenna, and a sense antenna. Operating controls and displays for the Cessna 300 ADF are shown and described in Figure 1. The audio system used in conjunction with this radio for speaker-phone selection is shown and described in Section 7 of this handbook.

The Cessna 300 ADF can be used for position plotting and homing procedures, and for aural reception of amplitude-modulated (AM) signals.

With the function selector knob at ADF, the Cessna 300 ADF provides a visual indication, on the bearing indicator, of the bearing to the transmitting station relative to the nose of the airplane. This is done by combining signals from the sense antenna with signals from the loop antenna.

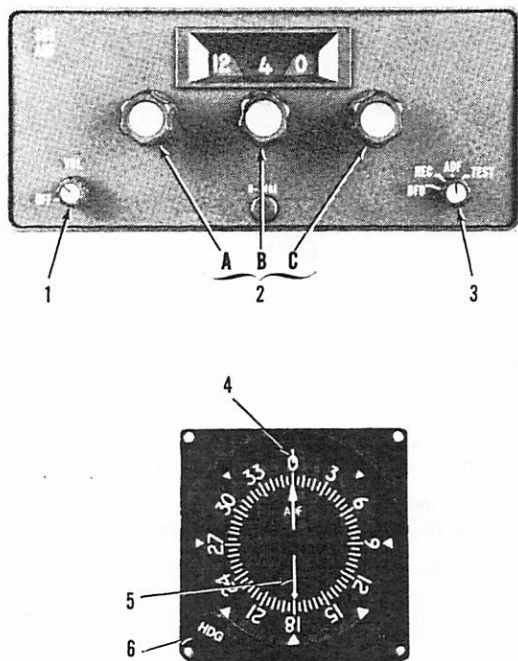
With the function selector knob at REC, the Cessna 300 ADF uses only the sense antenna and operates as a conventional low-frequency receiver.

The Cessna 300 ADF is designed to receive transmission from the following radio facilities: commercial AM broadcast stations, low-frequency range stations, non-directional radio beacons, ILS compass locators

SECTION 2

LIMITATIONS

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



1. OFF VOL CONTROL - Controls primary power and audio output level. Clockwise rotation from OFF position applies primary power to receiver; further clockwise rotation increases audio level.
2. FREQUENCY SELECTORS - Knob (A) selects 100-kHz increments of receiver frequency; knob (B) selects 10-kHz increments, and knob (C) selects 1 kHz increments.

Figure 1. Cessna 300 ADF Operating Controls and Indicators (Sheet 1 of 2)

3. FUNCTION SWITCH:

BFO: Selects operation as communication receiver using only sense antenna and activates 1000-Hz tone beat frequency oscillator to permit coded identifier of stations transmitting keyed CW signals (Morse Code) to be heard.

REC: Selects operation as standard communication receiver using only sense antenna.

ADF: Set operates as automatic direction finder using loop and sense antennas.

TEST: Momentary-on position used during ADF operation to test bearing reliability. When held in TEST position, slews indicator pointer clockwise; when released, if bearing is reliable, pointer returns to original bearing position.

- 4. INDEX (ROTATABLE CARD)** - Indicates relative, magnetic, or true heading of aircraft, as selected by HDG control.
- 5. POINTER** - Indicates station bearing in degrees of azimuth, relative to the nose of the aircraft. When heading control is adjusted, indicates relative, magnetic, or true bearing of radio signal.
- 6. HEADING CARD CONTROL (HDG)** - Rotates card to set in relative, magnetic, or true bearing information.

SECTION 3

EMERGENCY PROCEDURES

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

SECTION 4

NORMAL PROCEDURES

TO OPERATE AS A COMMUNICATIONS RECEIVER ONLY:

1. OFF/VOL Control -- ON.
2. Function Selector Knob -- REC.
3. Frequency Selector Knobs -- SELECT operating frequency.
4. ADF SPEAKER/PHONE Selector Switch (on audio control panel)
-- SELECT speaker or phone position as desired.
5. VOL Control -- ADJUST to desired listening level.

TO OPERATE AS AN AUTOMATIC DIRECTION FINDER:

1. OFF/VOL Control -- ON.
2. Frequency Selector Knobs -- SELECT operating frequency.
3. ADF SPEAKER/PHONE Selector Switch (on audio control panel)
-- SELECT AS DESIRED.
4. Function Selector Knob -- ADF position and note relative bearing on indicator.

TO TEST RELIABILITY OF AUTOMATIC DIRECTION FINDER:

1. Function Selector Knob -- ADF position and note relative bearing on indicator.
2. Function Selector Knob -- TEST position and observe that pointer moves away from relative bearing at least 10 to 20 degrees.
3. Function Selector Knob -- ADF position and observe that pointer returns to same relative bearing as in step (1).

TO OPERATE BFO:

1. OFF/VOL Control -- ON.
2. Function Selector Knob -- BFO.
3. Frequency Selector Knobs -- SELECT operating frequency.
4. ADF SPEAKER/PHONE Selector Switch (on audio control panel)
-- SELECT speaker or phone position as desired.

5. VOL Control -- ADJUST to desired listening level.

NOTE

A 1000-Hz tone is heard in the audio output when a CW signal (Morse Code) is tuned in properly.

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 related external antennas, will result in a minor reduction in cruise performance.

SUPPLEMENT

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

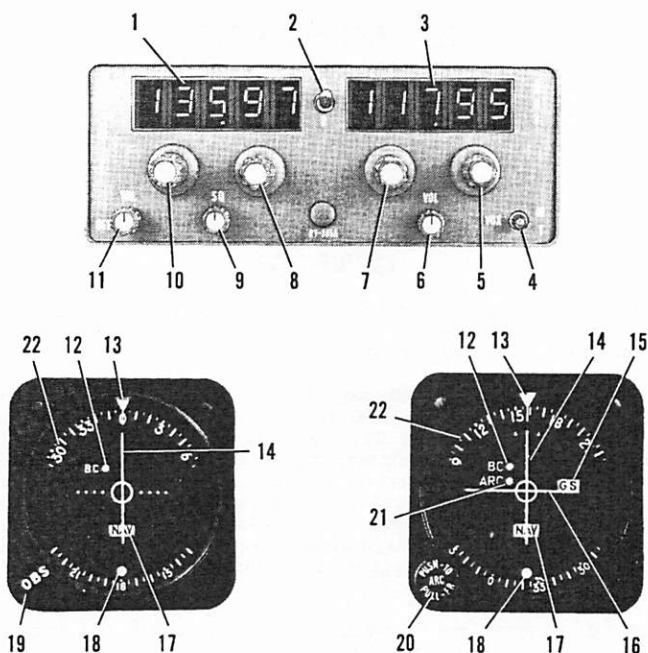
SECTION 1 GENERAL

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 single-pointer and related NAV flag for VOR/LOC indication only, or dual pointers and related NAV and GS flags for both VOR/LOC and glide slope indications. Both types of course deviation indicators incorporate a back-course lamp (BC) which lights when optional back course (reversed sense) operation is selected. 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.



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 - Indicates course deviation from selected omni course or localizer centerline.
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 - Indicates deviation from ILS glide slope.

Figure 1. Cessna 300 Nav/Com (Type RT-385A), Operating Controls and Indicators (Sheet 3 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 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. COURSE CARD - Indicates selected VOR course under course index.

Figure 1. Cessna 300 Nav/Com (Type RT-385A), Operating Controls and Indicators (Sheet 2 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 Section 7 of this handbook.

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 two or less 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 many Cessna airplanes equipped with the windshield 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 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.
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. 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 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.

7. 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.
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 avionics 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 NAV/COM (Type RT-385A)

WITH

CESSNA 400 AREA NAVIGATION SYSTEM (Type RN-478A)

SECTION 1 GENERAL

The Cessna 300 Nav/Com (Type RT-385A) Set with Cessna 400 Area Navigation (RNAV-Type RN-478A) consists of a RT-385A Nav/Com, a R-476A DME system, a RN-478A Area Navigation Computer and a IN-442AR Course Deviation Indicator. The RN-478A includes circuits which combine the VOR navigation information with distance information from the R-476A DME system to provide data for area navigation. Operating information for the communication set and for VOR/localizer navigation is presented in this supplement. Operating information for area navigation and for DME is presented in separate supplements.

The RT-385A Receiver-Transmitter includes a 720-channel VHF communication receiver-transmitter which receives and transmits signals between 118.000 MHz and 135.975 MHz in 25-kHz steps. It also includes a 200-channel VHF navigation receiver which receives VOR and localizer signals between 108.00 MHz and 117.95 MHz in 50-kHz steps. The communication receiver-transmitter and the navigation receiver can be operated simultaneously.

The VOR or localizer signal from the No. 2 Navigation Receiver is applied to the converter circuits in the RN-478A Area Navigation Compu-

ter. The converter processes the received navigation signal to provide omni bearing or localizer information for display by the course indicator.

CAUTION

If the RNAV set is removed from the airplane or becomes inoperative, the associated VHF navigation indicator will be inoperative.

The course indicator includes a Course Deviation Indicator (CDI), an Omni Bearing Selector (OBS) and OFF/TO-FROM Indicator Flags. It also includes an RNAV lamp (RN) which lights when area navigation operation is selected, and a back-course lamp (BC) which lights when back-course operation is selected. The IN-442AR is offered as the standard Course Deviation Indicator.

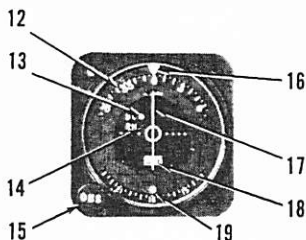
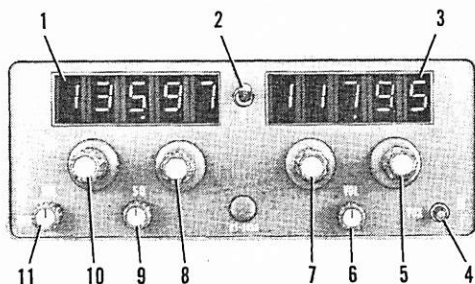
All operating controls and indicators for the Cessna 300 Nav/Com are included on the front panel of the RT-385A Receiver-Transmitter and the associated Course Deviation Indicator. These controls and indicators are shown and described in Figure 1. Operating controls for the RN-478A Area Navigation Computer, which are used for area navigation, and operating controls for the associated Type R-476A DME are shown in the appropriate supplements in this manual. Operating controls for the audio control panels used in conjunction with this radio are shown and described in Section 7 of this handbook.

SECTION 2 LIMITATIONS

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

SECTION 3 EMERGENCY PROCEDURES

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



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 Set, 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 center VOX (Voice) position, identifier signal is suppressed; in T (Momentary On) position, the VOR navigational self-test function is selected.
5. NAVIGATIONAL RECEIVER FRACTIONAL MEGAHERTZ FREQUENCY SELECTOR - Selects NAV frequency in .05 MHz steps between .00 and .95 MHz; simultaneously selects paired glide slope frequency and DME channel.
6. NAV VOLUME CONTROL (VOL) - Adjusts volume of navigation receiver audio. Clockwise rotation increases audio level.
7. NAVIGATION RECEIVER MEGAHERTZ FREQUENCY 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 MHz FREQUENCY SELECTOR - Depending on position of the 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 MHz FREQUENCY 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 RNAV Computer circuits; controls volume of communication receiver audio.
12. COURSE CARD - Indicates selected VOR course under course index.
13. BACK COURSE LAMP (BC) - Amber light illuminates when an autopilot with reverse sense feature is installed and the reverse sense switch or the autopilot's back-course function is engaged and receiver is tuned to a localizer frequency; indicates course deviation pointer is reversed. BC light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.
14. AREA NAV LAMP (RN) - When green light is illuminated, indicates that RNAV operation is selected. RN light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.
15. OMNI BEARING SELECTOR (OBS) - Rotates course card (12) to select desired bearing to or from a VOR station or to a selected RNAV waypoint.

Figure 1. Cessna 300 Nav/Com Set, Operating Controls and Indicators
(Sheet 2 of 3)

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SUPPLEMENT**

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**CESSNA 300 NAV/COM
(RT-385A) WITH CESSNA
400 RNAV (RN-478A)**

16. **COURSE INDEX** - Indicates selected VOR or RNAV course (bearing).
17. **COURSE DEVIATION POINTER** - Indicates deviation from selected VOR or RNAV course or localizer centerline.
18. **OFF/TO-FROM INDICATOR** - Operates only with VOR or localizer signal. OFF position (flag) indicates unusable signal. With usable VOR signal, when OFF position disappears, indicates whether selected course is TO or FROM station or waypoint. With usable localizer signal, shows TO.
19. **RECIPROCAL COURSE INDEX** - Indicates reciprocal of selected VOR or RNAV course.

**Figure 1. Cessna 300 Nav/Com Set, Operating Controls and Indicators
(Sheet 3 of 3)**

SECTION 4

NORMAL PROCEDURES

COMMUNICATIONS OPERATION:

1. COM OFF/VOL Control -- TURN ON; adjust to desired audio level.
2. XMTR SEL Switch (on audio control panel)-- SET to desired 300 NAV/COM.
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 Knobs -- SELECT desired operating frequency.
6. SQ Control -- ROTATE counterclockwise to just eliminate background noise.
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, or 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

NOTE

The pilot should be aware that on many Cessna airplanes equipped with the windshield 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 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.
4. NAV VOL Control -- ADJUST to desired audio level.
5. ID-VOX-T Switch:
 - a. To Identify Station -- SET to ID to hear navigation station identifier (Morse Code) signal.
 - b. To Filter Out Station Identifier Signal -- SET to VOX (center) position to include filter in audio circuit.
6. OBS Knob -- SELECT desired course.

TO SELF TEST VOR NAVIGATION CIRCUITS:

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 index; CDI pointer centers or deflects left or right, depending on bearing of signal; OFF/TO-FROM indicator shows TO or FROM.
4. ID-VOX-T Switch -- PRESS to T and HOLD at T; CDI pointer should center and OFF/TO-FROM indicator should show FROM.
5. OBS Knob -- TURN to displace course approximately 10° to either side of 0° (while holding ID-VOX-T switch at T); CDI pointer should deflect full scale in direction corresponding to course displacement. OFF/TO-FROM indicator should still show FROM.

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 avionics 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)

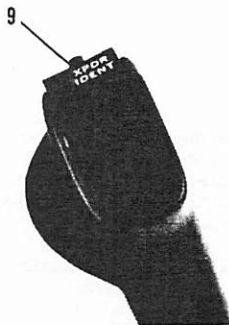
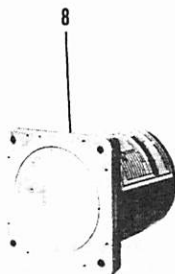
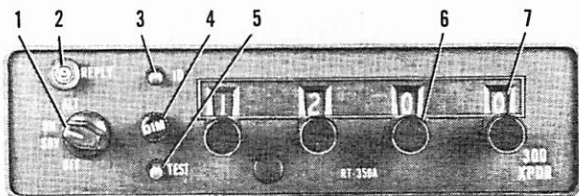
SECTION 1

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, an externally-mounted antenna and an optional control wheel-mounted XPDR IDENT switch. 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 capabilities are available in 100-foot increments between -1000 and +20,000 feet.

All Cessna 300 Transponder operating controls, with the exception of the optional XPDR IDENT switch, are located on the front panel of the unit. The remote XPDR IDENT switch is located on the right hand grip of the pilot's control wheel. Functions of the operating controls are described in Figure 1.



1. FUNCTION 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 either Mode A (aircraft identification) reply pulses or Mode C (altitude reporting) pulses selected automatically by the interrogating signal.

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

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 (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 of -1000 feet up to the airplane's maximum service ceiling.
9. **REMOTE ID SWITCH (XPDR IDENT)** - Same as panel-mounted ID switch described in Item 3.

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 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 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 Switch -- SBY.

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

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

2. Function 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 Knobs -- SELECT assigned code.
2. Function Switch -- ALT.

NOTE

When directed by ground controller to "stop altitude squawk", turn Function 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 Switch -- SBY and wait 30 seconds for equipment to warm-up.
2. Function 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)

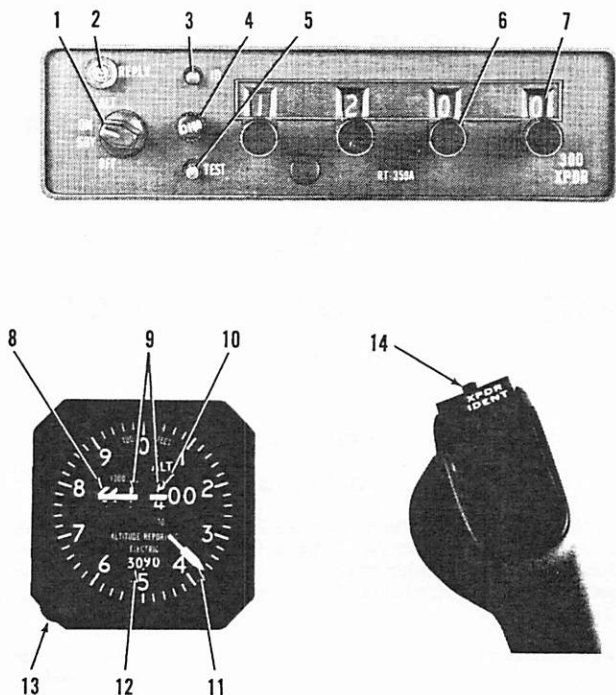
SECTION 1

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, an externally-mounted antenna and an optional control wheel-mounted XPDR IDENT switch. The transponder receives interrogating pulse signals on 1030 MHz and transmits pulse-train reply signals on 1090 MHz. It is capable of replying to Mode A (aircraft identification) and also to 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 avionics configuration, the transponder can provide altitude reporting in the 100-foot increments between -1000 and +35,000 feet.

All Cessna 300 Transponder operating controls, with the exception of the optional altitude encoder's altimeter setting knob and the optional remote XPDR IDENT switch, are located on the front panel of the unit. The altimeter setting knob is located on the encoding altimeter and the remote XPDR IDENT switch is located on the right hand grip of the pilot's control wheel. Functions of the operating controls are described in Figure 1.



1. FUNCTION 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 stand-by 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 either Mode A (aircraft identification) reply pulses or Mode C (altitude reporting) pulses selected automatically by the interrogating signal.

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

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 (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 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.
14. **REMOTE ID SWITCH (XPDR IDENT)** - Same as panel-mounted ID switch described in Item 3.

Figure 1. Cessna 300 Transponder and Encoding Altimeter (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 to be installed as a back-up altimeter.

SECTION 3

EMERGENCY PROCEDURES

TO TRANSMIT AN EMERGENCY SIGNAL:

1. Function 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 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 Switch -- SBY.

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

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

2. Function 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 Knobs -- SELECT assigned code.
4. Function Switch -- ALT.

NOTE

When directed by ground controller to "stop altitude squawk", turn Function 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 Switch -- SBY and wait 30 seconds for equipment to warm-up.
2. Function 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 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.

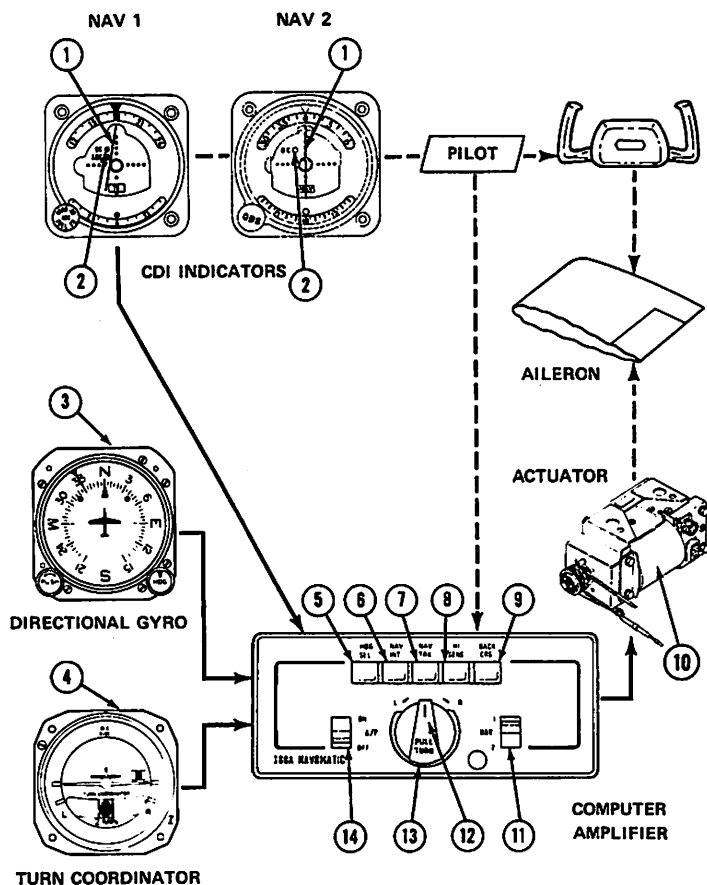


Figure 1. Cessna 300A Autopilot, Operating Controls and Indicators
(Sheet 1 of 2)

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. **DIRECTIONAL GYRO INDICATOR** - Provides heading information to the autopilot for heading intercept and hold. Heading bug on indicator is used to select desired heading or VOR/LOC course to be flown.
4. **TURN COORDINATOR** - Senses roll and yaw for wings leveling and command turn functions.
5. **HDG SEL PUSHBUTTON** - Aircraft will turn to and hold heading selected by the heading "bug" on the directional gyro.
6. **NAV INT PUSHBUTTON** - When heading "bug" on DG is set to selected course, aircraft will turn to and intercept selected VOR or LOC course.
7. **NAV TRK PUSHBUTTON** - When heading "bug" on DG is set to selected course, aircraft will track selected VOR or LOC course.
8. **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 (push-button 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.
9. **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.
10. **ACTUATOR** - The torque motor in the actuator causes the ailerons to move in the commanded direction.
11. **NAV SWITCH** - Selects NAV 1 or NAV 2 navigation receiver.
12. **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.
13. **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.
14. **A/P SWITCH** - Turns autopilot ON or OFF.

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

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.

SECTION 4

NORMAL PROCEDURES

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 -- CENTER and PULL out.
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 -- CENTER, 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 -- CENTER and PULL out.
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 $\pm 10^\circ$ of course heading.
2. HI SENS Button -- Disengage for enroute omni tracking (leave engaged for localizer).

NOTE

Optional ARC feature, 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 and reintercept the course. If deviation persists, progressively make slight adjustments of the autopilot TRIM control 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 ADF **(Type R-446A)**

SECTION 1

GENERAL

The Cessna 400 ADF is an automatic direction finder set which provides continuous, visual bearing indications of the direction from which an RF signal is being received. It can be used for plotting position, for homing, and for aural reception of AM signals between 200 kHz and 1699 kHz. In addition, a crystal-controlled, beat frequency oscillator (BFO) permits coded identifier of stations transmitting keyed CW signals (Morse Code) to be heard.

The basic units of the Cessna 400 ADF are a R-446A Receiver with dual frequency selectors, a goniometer-indicator (IN-346A), a sense antenna and a loop antenna. The receiver and goniometer-indicator are panel-mounted units. The sense and loop antennas are mounted on the external airplane surfaces. The goniometer indicator presents station bearing in degrees of azimuth. An automatic pointer-stow feature alerts the operator to non-ADF operation by slewing the pointer to the 3:00 o'clock position when the REC mode is selected. Operating controls and displays for the Cessna 400 ADF are shown and described in Figure 1. The audio control panels used in conjunction with this radio for speaker-phone selection are shown and described in Section 7 of this handbook.

The frequency range of the Cessna 400 ADF is electronically divided into three bands: 200-399 kHz, 400-799 kHz, and 800-1699 kHz. Frequency spacing within each band is in 1-kHz increments. The operating frequency and band are selected by a four-section Minilever switch which displays a digital readout of the frequency selected and supplies a binary code to control the logic circuits within the set. A secondary (standby) operating frequency is selected by another four-section Minilever switch. Frequency control of the ADF is switched to the primary or the secondary operating frequency by a toggle switch. The operating modes (ADF and REC) are selected by individual pushbutton switches. Additional pushbutton switches are used to select the BFO and to test signal reliability during ADF operation.

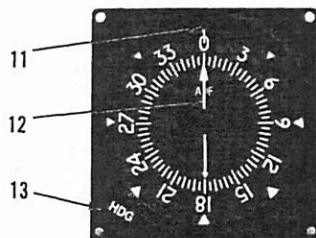
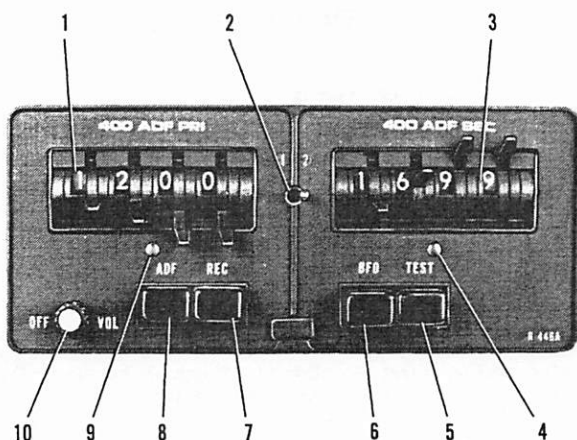


Figure 1. Cessna 400 ADF Operating Controls and Indicator
(Sheet 1 of 2)

1. **PRI (PRIMARY FREQUENCY SELECTOR)** - Selects and displays "primary" frequency.
2. **1-2** - The "1" position activates "primary" (PRI) frequency. The "2" position activates "secondary" (SEC) frequency.
3. **SEC (SECONDARY FREQUENCY SELECTOR)** - Selects and displays "secondary" frequency.
4. **SECONDARY RESELECT LAMP** - Lamp will flash only when "secondary" (SEC) frequency selection is outside of operating range of the receiver and 1-2 switch is in the "2" position.
5. **TEST** - Momentary-on switch used only with ADF function to test bearing reliability. When held depressed, slews indicator pointer; when released, if bearing is reliable, pointer returns to original position.
6. **BFO** - Pushed in: Activates beat frequency oscillator tone to permit coded identifier of stations transmitting keyed CW signals (Morse Code) to be heard.
7. **REC** - Pushed in: Selects receive mode (set operates as a standard communications receiver using sense antenna only).

NOTE

In this position an automatic pointer stow feature will alert the pilot to non-ADF operation by positioning and retaining the pointer at the 3:00 o'clock position when the 400 ADF is in the REC function.

8. **ADF** - Pushed in: Selects ADF mode (set operates as automatic direction finder using loop and sense antennas).
9. **PRIMARY RESELECT LAMP** - Lamp will flash only when "primary" (PRI) frequency selection is outside of operating range of the receiver and 1-2 switch is in the "1" position.
10. **OFF-VOL** - Turns set on or off and adjusts receiver volume.
11. **INDEX** - Fixed reference line for dial rotation adjustment.
12. **POINTER** - When HDG control is adjusted, indicates either relative, magnetic, or true bearings of a radio station.
13. **HDG** - Rotates dial to facilitate relative, magnetic, or true bearing information.

Figure 1. Cessna 400 ADF Operating Controls and Indicator
(Sheet 2 of 2)

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

TO OPERATE AS A COMMUNICATIONS RECEIVER ONLY:

1. OFF/VOL Control -- ON.
2. REC Pushbutton -- PUSH in.

NOTE

ADF indicator pointer will stow at a 90-degree position to alert the pilot to non-ADF operation.

3. PRI Frequency Selectors -- SELECT desired operating frequency.
4. SEC Frequency Selectors -- SELECT desired operating frequency.
5. 1-2 Selector Switch -- 1 position.

NOTE

1-2 selector switch can be placed in the 2 position for operation on secondary frequency. The re-select lamp will flash only when frequency selection is outside of operating range of the receiver.

6. ADF SPEAKER/PHONE Selector Switch (on audio control panel)
-- SELECT speaker or phone position.
7. VOL Control -- ADJUST to desired listening level.

TO OPERATE AS AN AUTOMATIC DIRECTION FINDER:

1. OFF/VOL Control -- ON.
2. PRI Frequency Selectors -- SELECT desired operating frequency.
3. SEC Frequency Selectors -- SELECT desired operating frequency.
4. 1-2 Selector Switch -- 1 position.

NOTE

1-2 selector switch can be placed in the 2 position for operation on secondary frequency. The re-select lamp will flash only when frequency selection is outside of operating range of the receiver.

5. ADF SPEAKER/PHONE Selector Switch (on audio control panel) -- SELECT speaker or phone position as desired.
6. ADF Pushbutton -- PUSH in and note relative bearing on ADF indicator.
7. HDG Control -- SET goniometer-indicator dial so that index indicates 0°, magnetic, or true heading of airplane. Pointer then indicates relative, magnetic, or true bearing to station.
8. VOL Control -- ADJUST to desired listening level.

NOTE

When switching stations, place function pushbutton in the REC position. Then, after station has been selected, place function pushbutton in the ADF position to resume automatic direction finder operation. (This practice prevents the bearing indicator from swinging back and forth as frequency dial is rotated.)

TO TEST RELIABILITY OF AUTOMATIC DIRECTION FINDER:

1. ADF Pushbutton -- PUSH in and note relative bearing on indicator.
2. TEST Pushbutton -- PUSH in and hold TEST button until indicator pointer slews off indicated bearing at least 10 to 20 degrees.
3. TEST Pushbutton -- RELEASE and OBSERVE that indicator pointer returns to the same relative bearing as in step (1).

TO OPERATE BFO:

1. OFF/VOL Control -- ON.
2. ADF SPEAKER/PHONE Selector Switch (on audio control panel) -- SELECT speaker or phone position as desired.
3. BFO Pushbutton -- PUSH in.
4. 1-2 Selector Switch -- SELECT 1 position to activate PRI frequency

or 2 to activate SEC frequency that is transmitting keyed CW signals (Morse Code).

5. VOL Control -- ADJUST to desired listening level.

NOTE

A 1000-Hz tone is heard in the audio output when CW signal (Morse Code) is tuned in properly.

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 AREA NAVIGATION SYSTEM (Type RN-478A)

SECTION 1 GENERAL

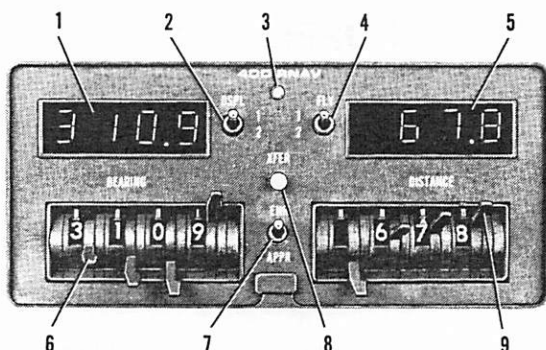
The Cessna 400 Area Navigation System (Type RN-478A) consists of an RN-478A Area NAV Computer (RNAV), a compatible VHF navigation receiver and course deviation indicator, and the Type R-478A distance measuring equipment (DME). The RNAV includes converter circuits which operate with the VHF navigation receiver and produce positional information for display by the course deviation indicator. It also includes computer circuits which combine the bearing information from the navigation set with the distance information from the R-478A DME to establish navigation data for selected waypoints. During RNAV operation, a course scalloping suppressor circuit suppresses the spurious navigation signal phases to provide stable waypoint information which enhances autopilot operation. The 400 RNAV is coupled to the number 2 Nav/Com and includes storage for 3 waypoints.

Ground speed/time-to-station information to the selected VOR (not the waypoint) is available on this system. This capability, along with the course scalloping suppression (radial straightening), may be used to an advantage while tracking inbound or outbound from the VOR station by programming a waypoint directly over the associated VOR (000.0°/000.0 nautical miles) and using RNAV for course smoothing while enroute.

CAUTION

If RNAV set is removed from the airplane or becomes inoperative, the associated VHF navigation indicator will be inoperative.

All operating controls and displays which are part of the RN-478A are shown and described in Figure 1. Other controls required for operation of the Cessna 400 Area Navigation System are included on the VHF navigation receiver and on the R-478A DME control; these controls are shown and described in the respective supplements included for this equipment.



1. BEARING DISPLAY READOUT - Depending on position of DSPL Switch, displays bearing programmed for waypoint 1 or waypoint 2.
2. DISPLAY 1-2 SWITCH (DSPL) - Determines information shown on DISTANCE and BEARING displays: In position 1, distance and bearing programmed for waypoint 1 are displayed; in position 2, distance and bearing programmed for waypoint 2 are displayed.
3. FLY DISPLAY LAMP - Flashes amber when FLY Switch and DSPL Switch are not set to same number; indicates that waypoint information being displayed is not waypoint information being flown.
4. FLY SWITCH - Determines waypoint being used for navigation. In position 1, waypoint 1 is in use; in position 2, waypoint 2 is in use.
5. DISTANCE DISPLAY READOUT - Depending on position of DSPL Switch, displays distance programmed for waypoint 1 or waypoint 2.
6. BEARING MINILEVER SWITCHES (4) - Select bearing of desired waypoint from VOR/DME station. May be used to store bearing of 3rd waypoint.
7. ENROUTE/APPROACH SWITCH (ENR/APPR) - Controls width of navigation corridor. ENR position provides standard (± 5 NM) enroute sensitivity; APPR position provides standard ($\pm 1-1/4$ NM) approach course sensitivity.

NOTE

Due to unreliable signals, do not operate in the APPR position when computed distance to waypoint exceeds 51 nautical miles.

8. TRANSFER PUSHBUTTON SWITCH (XFER) - Transfers waypoint distance and bearing from minilevers into either waypoint 1 or 2 as selected by DSPL switch position.
9. DISTANCE MINILEVER SWITCHES (4) - Select distance of desired waypoint from VOR/DME station. May be used to store distance of 3rd waypoint.

Figure 1. Cessna 400 Area Nav (Type RN-478A) Computer, Operating Controls and Indicators

SECTION 2

LIMITATIONS

The following RNAV IFR approach limitation must be adhered to during airplane operation.

OPERATING LIMITATION:

1. IFR Approaches -- Follow approved published RNAV instrument procedures.

SECTION 3

EMERGENCY PROCEDURES

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

SECTION 4

NORMAL PROCEDURES

VOR/LOC OPERATION

VOR NAVIGATION CIRCUITS VERIFICATION TESTS:

1. See appropriate Nav/Com supplement.

VOR/LOC NAVIGATION:

As a convenience to the pilot, a separate supplement (Avionic Operation Guide) is supplied to explain the various procedures for using the VHF Navigation Set for VOR and localizer navigation. Refer to the Avionic Operations Guide for flight procedures.

AREA NAVIGATION OPERATION

NOTE

Proper RNAV operation requires valid VOR and DME inputs to the RNAV system. In certain areas, the ground station antenna patterns and transmitter power may be inadequate to provide valid signals to the RNAV. For this

reason, intermittent RNAV signal loss may be experienced enroute. Prolonged loss of RNAV signal shall require the pilot to revert to other navigational procedures.

WAYPOINT PROGRAMMING:

1. Using a VFR sectional, enroute instrument chart, instrument approach plate, or enroute RNAV chart -- DETERMINE distance and bearing for desired waypoint(s) from appropriate VOR/DME stations.
2. VHF Navigation Receiver -- ON.
3. DME TEST/ON-OFF Switch -- ON.
4. DME Mode Selector Switch -- RNAV.
5. RNAV DSPL Switch -- 1.

NOTE

When DSPL and FLY switches are not set to the same waypoint number, the display/fly light slowly blinks on and off as a reminder to the pilot that values displayed are not those being used for navigation. This does not affect operation of the unit.

6. BEARING Minilever Switches -- SET to first waypoint bearing.
7. DISTANCE Minilever Switches -- SET to first waypoint distance.
8. XFER Pushbutton Switch -- PUSH in.
 - a. First waypoint bearing and distance are placed in memory as waypoint 1.
 - b. BEARING Display Readout -- DISPLAYS readout of first waypoint bearing.
 - c. DISTANCE Display Readout -- DISPLAYS readout of first waypoint distance.
9. RNAV DSPL Switch -- SET to 2.
10. BEARING Minilever Switches -- SET to second waypoint bearing.
11. DISTANCE Minilever Switches -- SET to second waypoint distance.
12. XFER Pushbutton Switch -- PUSH in.
 - a. Second Waypoint Readout -- BEARING and DISTANCE are placed in memory as waypoint 2.
 - b. BEARING Display Readout -- DISPLAYS readout of second waypoint bearing.
 - c. DISTANCE Display Readout -- DISPLAYS readout of second waypoint distance.
13. BEARING Minilever Switches -- SET to standby waypoint bearing.

14. DISTANCE Minilever Switches -- SET to standby waypoint distance.

NOTE

As first waypoint is reached, it can be replaced with the third "standby" waypoint (already set) before placing the RNAV "DSPL" switch to 2. Then a fourth waypoint, if necessary, can be set with the minilever selectors.

DISPLAY RELIABILITY TESTS:

NOTE

This test must be conducted following the "Waypoint Programming" procedures with the VHF Navigation Receiver and DME TEST/ON-OFF switches still in the ON position.

1. VHF Navigation Receiver Frequency Selector Switches -- SET to VOR frequency.
2. RNAV DSPL and FLY Switches -- DSPL set to 1, FLY set to 2.
 - a. Readout -- DISPLAYS first waypoint bearing and distance that was selected in Waypoint Programming.
 - b. Fly/Display Lamp (On RNAV Control Head) -- FLASHES.
3. RNAV DSPL and FLY Switches -- DSPL set to 2, FLY set to 1.
 - a. Readout -- DISPLAYS second waypoint bearing and distance.
 - b. Fly/Display Lamp (On RNAV Control Head) -- FLASHES.
4. RNAV DSPL and FLY Switches -- BOTH SET to same number.
 - a. Readout -- DISPLAYS waypoint bearing and distance as selected by DSPL switch.
 - b. Fly/Display Lamp (On RNAV Control Head) -- NOT LIGHTED.
5. DME Mode Selector Switch -- SET to RNAV.
 - a. Both RN and NM Annunciators on DME -- LIGHTED.
 - b. RN Lamp on Course Deviation Indicator -- LIGHTS.
6. VHF Navigation Receiver Frequency Selector Switches -- SET to LOC frequency.
 - a. Both RN and NM Annunciators -- LIGHTED.
 - b. RN Lamp on Course Deviation Indicator -- LIGHTED.
 - c. Course Deviation Indicator OFF(or NAV)/TO-FROM Indicator -- OFF (or NAV) flag in view.
7. DME Mode Selector Switch -- SET to NAV 1, NAV 2, or HOLD.
 - a. NM Annunciator on DME -- LIGHTED.
 - b. RN Annunciator on DME -- NOT LIGHTED.
 - c. RN Lamp on Course Deviation Indicator -- NOT LIGHTED.
 - d. Course Indicator OFF(or NAV)/TO-FROM Indicator -- Shows TO if a usable signal is received.

8. DME Mode Selector Switch -- RNAV.
9. DME TEST/ON-OFF Switch -- HOLD to TEST.
 - a. DME RN/NM Distance Display -- READOUT is 888.8.
 - b. DME KTS/MIN Ground Speed/Time-to-Station Display -- READOUT is 888.
 - c. RNAV BEARING Display -- READOUT is 888.8.
 - d. RNAV DISTANCE Display -- READOUT is 188.8.

AREA NAVIGATION CIRCUITS SELF-TEST:

1. VHF Navigation Receiver -- ON.
2. VHF Navigation Receiver Frequency Selector Switches -- SET to a usable VOR/DME frequency.
3. DME TEST/ON-OFF Switch -- ON.
4. DME Mode Selector Switch -- RNAV.
 - a. RN Lamp on Course Deviation Indicator -- LIGHTED.
5. RNAV Computer -- PROGRAMMED to waypoint.
6. DSPL and FLY Switches -- SET both to waypoint to be tested.
 - a. BEARING Display -- READOUT is waypoint bearing.
 - b. DISTANCE Display -- READOUT is waypoint distance.
 - c. Course Indicator -- RN LAMP lights.
7. Course Indicator OBS (or ARC) -- SET to waypoint bearing.
8. VHF Navigation Receiver ID/VOX/T Switch -- HOLD in T position.
 - a. Course Deviation Pointer -- CENTERS.
 - b. Course Deviation Indicator OFF(or NAV)/TO-FROM Flag -- Shows TO.
 - c. DME Distance Display -- READOUT is the same as the RNAV DISTANCE readout.

NOTE

After releasing the navigation receiver test (T) switch, the return to accurate computed bearing and distance data can take up to 60 seconds depending upon airplane position and waypoint.

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 DME

(TYPE R-476A)

SECTION 1

GENERAL

The Cessna 400 DME (Type R-476A) is the airborne "interrogator" portion of a navigation system which supplies continuous, accurate, slant range distance information from a fixed ground station to an aircraft in flight.

Except for selection of the operating channel, which is selected by the VHF navigation receiver frequency selector switches, the Cessna 400 DME is capable of independent operation. The equipment consists of a panel-mounted C-476A Control Unit which contains all of the operating controls and displays, and a remotely mounted RTA-476A Receiver-Transmitter. The RTA-476A transmits interrogating pulse pairs on 200 channels between 1041 MHz and 1150 MHz; it receives associated ground-to-air replies between 978 MHz and 1213 MHz. The C-476A Control Unit digitally displays distances up to 200 nautical miles and either ground speed or time-to-station information, as selected. All operating controls and displays for the DME are shown in Figure 1, and the functions of each are described.

SECTION 2

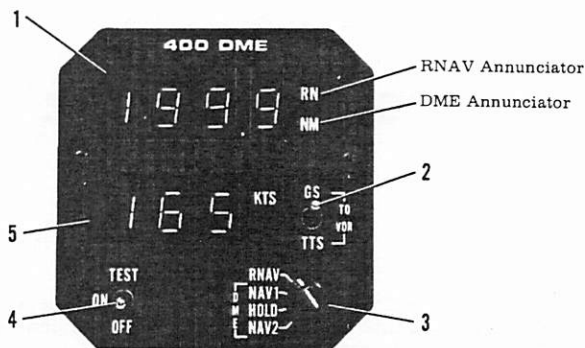
LIMITATIONS

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.



1. **DISTANCE DISPLAY** - In NAV 1, NAV 2, or HOLD mode, displays distance to selected VOR/DME station in nautical miles; only NM (Nautical Miles) annunciator lights. In RNAV mode, displays distance to selected waypoint in nautical miles; both RN (RNAV) and NM annunciators light.
2. **GS/TTS SELECTOR SWITCH** - In NAV 1, NAV 2, or HOLD mode, selects display of ground speed (GS) or time-to-station (TTS). In RNAV mode, display shows ground speed component to or from the VOR (not to waypoint) or the time to the VOR station at that indicated ground speed.
3. **DME MODE SELECTOR SWITCH** - Selects DME operating mode as follows:
 - RNAV:** Selects area navigation operation; selects display of nautical miles (distance) to selected RNAV waypoint.
 - NAV 1:** Selects DME operation with No. 1 VHF navigation set; enables channel selection by NAV 1 frequency selector switches.
 - HOLD:** Selects DME memory circuit; DME remains channeled to station to which it was channeled when HOLD was selected; display of distance continues to be nautical miles to that station. Both the NAV 1 and the NAV 2 sets may be set to new operation frequencies.

CAUTION

In the HOLD mode, there is no annunciation of the VOR/DME station frequency.

NAV 2: Selects DME operation with No. 2 VHF navigation set; enables channel selection by NAV 2 frequency selector switches.

Figure 1. Cessna 400 DME (Type R-476A) (Sheet 1 of 2)

4. **TEST/ON-OFF SWITCH** - Controls application of power to DME circuits (turns equipment on or off); selects display lamp test for DME and RNAV displays.
5. **GROUND SPEED/TIME DISPLAY** - Displays ground speed in knots or time-to-station in minutes, as follows:
 - a. With GS/TTS Switch set to GS, displays ground speed component to or from station in knots (aircraft must be flying directly to or from the VOR/DME station for true ground speed indication).
 - b. With GS/TTS Switch set to TTS, displays time to VOR/DME station in minutes at the ground speed component indicated.
 - c. With GS/TTS in RNAV mode will display ground speed component or time-to-station at that speed to the selected VOR (not the waypoint).

Figure 1. Cessna 400 DME (Type R-476A) (Sheet 2 of 2)

SECTION 4

NORMAL PROCEDURES

DME OPERATION:

1. TEST/ON-OFF Switch -- SET to ON.
2. DME Mode Selector Switch -- SET to NAV 1 or NAV 2.
3. NAV 1 and NAV 2 VHF Navigation Receivers -- ON; SET FREQUENCY selector switches to VOR/DME station frequencies, as required.

NOTE

When the VOR frequency is selected, the appropriate DME frequency is automatically channeled. Therefore, the system does not provide independent operation of the DME for reception of the DME Morse Code identifier.

4. DME SPEAKER/PHONE Selector Switch (on audio control panel) -- SET to desired mode.
5. GS/TTS Switch -- SET as desired.
6. TEST/ON-OFF Switch -- HOLD to TEST:
 - a. Distance-to-Station Display readout is 188.8.
 - b. Knots/Minutes Display readout is 888.
7. TEST/ON-OFF Switch -- RELEASE to ON; display readouts return to normal.

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 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.

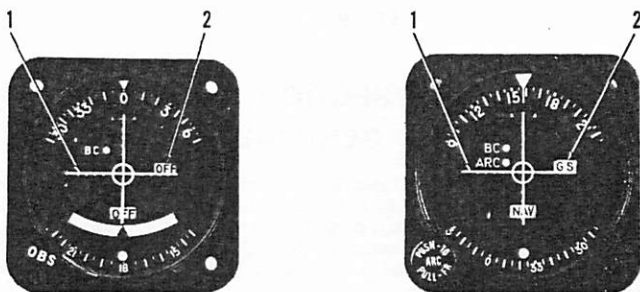
Operation of the Cessna 400 Glide Slope system is controlled by the associated navigation system. The functions and indications of typical 300 series glide slope indicators are pictured and described in Figure 1. The 300 series glide slope indicators shown in Figure 1 depict typical indications for Cessna-crafted glide slope indicators. However, refer to the 400 Nav/Com 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 avionics equipment is installed.

TYPICAL 300 SERIES GLIDE SLOPE INDICATORS



1. GLIDE SLOPE DEVIATION POINTER - Indicates deviation from normal glide slope.
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 many Cessna airplanes equipped with the windshield mounted glide slope antenna, pilots should avoid use of 2700 \pm 100 RPM on airplanes equipped with a two-bladed propeller or 1800 \pm 100 RPM on airplanes equipped with a three-bladed propeller during ILS approaches to avoid 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-402A)

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

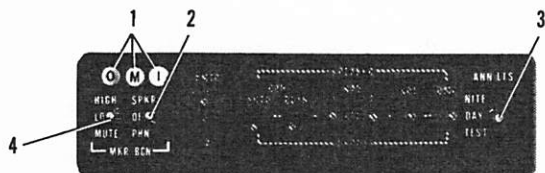
provides the pilot with HI-LO sensitivity selection and a TEST position to verify operation of all annunciator lights. The small, inner control knob labeled OFF/VOL, turns the set on or off and adjusts the audio listening level. The large, outer control knob labeled BRT, provides light dimming for the 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 (300 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 and FAN - Light illuminates white to indicate passage of inner and fan marker beacon.

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.

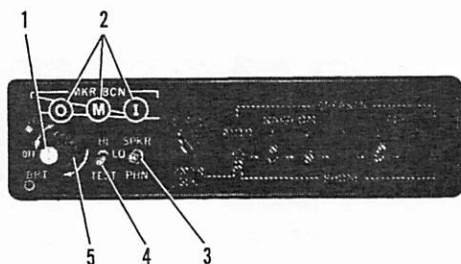
3. ANNUNCIATOR LIGHTS SWITCH:

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 (and other annunciators) in the full bright position to verify operation of annunciator 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 and FAN - Light illuminates white to indicate passage of inner or fan marker beacon.

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 all annunciator lights in the full bright position to verify operation of annunciator 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 the 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 NAV/COM **(720-Channel - Type RT-485A)**

SECTION 1 **GENERAL**

The Cessna 400 Nav/Com (Type RT-485A), shown in Figure 1, consists of a panel-mounted receiver-transmitter and a single or dual-pointer remote 300 or 400 Series 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. Microprocessor frequency management provides storage for 3 preset NAV and 3 preset COM frequencies in MEMORY. A "keep-alive" voltage prevents loss of the preset frequencies when the Nav/Com is turned off. 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, the associated VORTAC or VOR-DME station frequency will also be selected automatically; likewise, if a localizer frequency is selected, the associated glide slope frequency will be selected automatically.

The 400 Nav/Com may be installed with either 300 or 400 Series course deviation indicators. The 400 Series Nav/Com indicators incorporate Automatic Radial Centering and a Course Datum synchro as standard features. The 300 Series course deviation indicators do not incorporate Course Datum synchro but are offered with, or without, Automatic Radial Centering.

NOTE

An autopilot option utilizing Course Datum is not available on this aircraft.

Both the 300 and 400 Series course deviation indicators include either a single-pointer and related NAV flag for VOR/LOC indication only, or dual pointers and related NAV and GS flags for both VOR/LOC and glide slope indications. Both types of indicators incorporate a back-course lamp (BC) which lights when back course (reversed sense) operation is selected. Indicators with Automatic Radial Centering will, when selected, automatically indicate the bearing TO or FROM the VOR station.

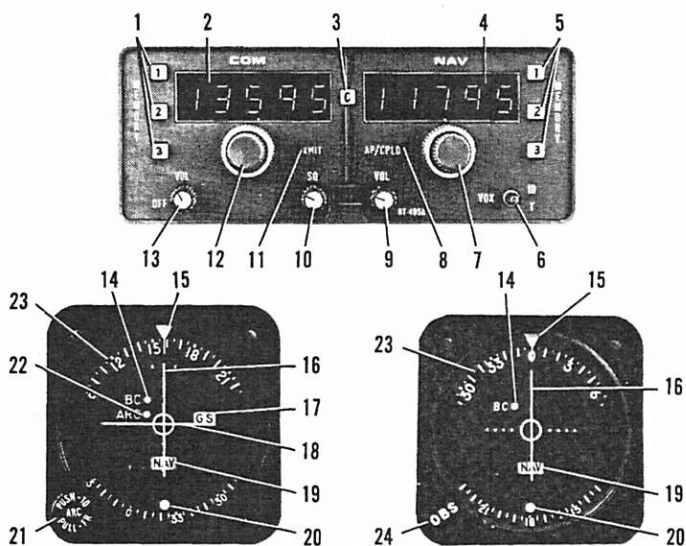
The Cessna 400 Nav/Com incorporates a variable threshold automatic squelch. With this squelch system, you set the threshold level for automatic operation - the further clockwise the lower the threshold - or the more sensitive the set. When the signal is above this level, it is heard even if the noise 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 omni bearing selector (OBS) knob or automatic radial centering (ARC) knob, which is located on the course deviation indicator, are mounted on the front panel of the receiver-transmitter. The audio control panels used in conjunction with this radio are shown and described in Section 7 of this handbook.

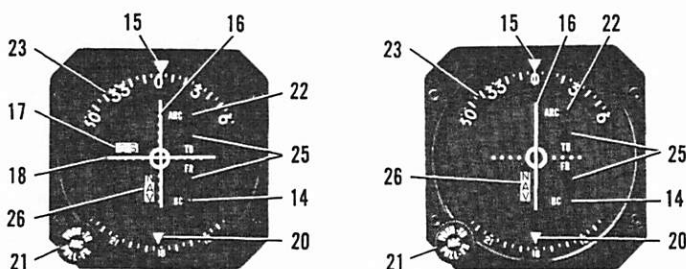
SECTION 2

LIMITATIONS

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



TYPICAL 300 SERIES INDICATORS



TYPICAL 400 SERIES INDICATORS

Figure 1. Cessna 400 Nav/Com (Type RT-485A), Operating Controls and Indicators (Sheet 1 of 4)

1. **COM MEMORY 1, 2 & 3 PUSHBUTTONS** - When a COM MEMORY pushbutton is pressed, the preset selected frequency will appear in the COM frequency window for use as the selected operating frequency. Each pushbutton will illuminate white when pressed and the light will go out on the previously selected pushbutton. Three preset frequencies may be stored in MEMORY and selected as desired, by merely pressing the appropriate COM MEMORY pushbutton to recall the desired operating frequency. If electrical power to the set's "keep-alive" circuit has not been interrupted, upon turn-on, the set will automatically recall the last COM MEMORY frequency selected by the MEMORY pushbutton. If electrical power is removed from the set's "keep-alive" circuit (such as radio removal or battery replacement) for more than 15 seconds, upon turn-on, the COM MEMORY circuits will have to be reset and COM 1 MEMORY will automatically be selected with the lowest operating frequency (118.000 MHz) selected.
2. **COMMUNICATION OPERATING FREQUENCY READOUT** - Indicates COM frequency in use. Third decimal place not shown.
3. **CYCLE BUTTON (C)** - Selects last illuminated decimal place on COM frequency in use. If last decimal place is 2 or 7, pressing C pushbutton changes number to 5 or 0, respectively. If last decimal place is 5 or 0, pressing C pushbutton changes number to 7 or 2, respectively. When the last illuminated digit on the set is 2 or 7, the third digit on the set (not shown) will always be 5. When the last illuminated digit on the set is 0 or 5, the third digit on the set (not shown) will always be 0. Also provides test function by holding C pushbutton pressed for more than 1.7 seconds. This lights each COM and NAV MEMORY pushbutton in turn, and displays the corresponding preset frequency in MEMORY.
4. **NAVIGATION OPERATING FREQUENCY READOUT** - Indicates NAV frequency in use.
5. **NAV MEMORY 1, 2 & 3 PUSHBUTTONS** - When a NAV MEMORY pushbutton is pressed, the preset selected frequency will appear in the NAV frequency window for use as the selected operating frequency. Each pushbutton will illuminate white when pressed and the light will go out on the previously selected pushbutton. Three preset frequencies may be stored in MEMORY and selected as desired, by merely pressing the appropriate NAV MEMORY pushbutton to recall the desired operating frequency. If electrical power to the set's "keep-alive" circuit has not been interrupted, upon turn-on, the set will automatically recall the last NAV MEMORY frequency selected by the MEMORY pushbutton. If electrical power is removed from the set's "keep-alive" circuit (such as radio removal or battery replacement) for more than 15 seconds, upon turn-on, the NAV MEMORY circuits will have to be reset and NAV 1 MEMORY will automatically be selected with the lowest operating frequency (108.000 MHz) selected.
6. **ID-VOX-T SWITCH** - In ID position, station identifier signal is audible; in VOX (Voice) position, identifier signal is suppressed; in T (Momentary On) position, the self-test function is selected, and the AP/CPLD annunciator illuminates amber and the XMIT annunciator illuminates green.
7. **NAVIGATION RECEIVER FREQUENCY SELECTORS** - Outer knob changes NAV frequency in 1-MHz steps between 108 and 117 MHz; inner knob changes NAV frequency in .05-MHz steps between .00 and .95 MHz; simultaneously selects paired glide slope frequency and DME channel.

Figure 1. Cessna 400 Nav/Com (Type RT-485A), Operating Controls and Indicators (Sheet 2 of 4)

8. AUTOPILOT COUPLED ANNUNCIATOR (AP/CPLD) - Illuminates amber when a 400B or 400B IFCS autopilot is coupled to NAV VOR/LOC converter output (non-operational with 200A, 300A, 400, 400A and 400A IFCS autopilots).
9. NAV VOLUME CONTROL (VOL) - Adjusts volume of navigation receiver audio.
10. 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.
11. TRANSMIT ANNUNCIATOR (XMIT) - Illuminates green when transmitter output is normal while mike is keyed.
12. COMMUNICATION RECEIVER FREQUENCY SELECTORS - Outer knob changes COM frequency in 1-MHz steps between 118 and 135 MHz; inner knob changes COM frequency in .05 MHz steps between .025 and .975 MHz or between .000 and .950 MHz depending on selection of C button.
13. COM OFF-VOLUME CONTROL (OFF-VOL) - Combination ON/OFF switch and volume control; turns on Nav/Com set and controls volume of COM receiver audio.
14. BACK-COURSE LAMP (BC) - Amber light illuminates when an autopilot's back-course function is engaged and receiver is tuned to a localizer frequency; indicates course deviation pointer is reversed. BC light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.
15. COURSE INDEX - Indicates selected VOR COURSE.
16. COURSE DEVIATION POINTER - Indicates course deviation from selected omni course or localizer centerline.
17. 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.
18. GLIDE SLOPE DEVIATION POINTER - Indicates deviation from ILS glide slope.
19. 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 VOR course is TO or FROM station. With usable localizer signal, TO flag is in view.
20. RECIPROCAL COURSE INDEX - Indicates reciprocal of selected VOR course.
21. AUTOMATIC RADIAL CENTERING (ARC) PUSH-TO/PULL-FR SELECTOR - In center detent, functions as conventional OBS. Pushed to inner (Momentary On) position, rotates 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

Figure 1. Cessna 400 Nav/Com (Type RT-485A). Operating Controls and Indicators (Sheet 3 of 4)

course deviation pointer centered, with a FROM flag. ARC function will not operate on localizer frequencies.

NOTE

Engaging either Automatic Radial Centering (ARC) functions will alter the airplane's course anytime the autopilot is engaged and coupled to any frequency other than a localizer frequency.

22. AUTOMATIC RADIAL CENTERING (ARC) LAMP - Amber light illuminates when Automatic Radial Centering is in use. ARC light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.
23. COURSE CARD - Indicates selected VOR course under course index.
24. OMNI BEARING SELECTOR (OBS) - Rotates course card to select desired VOR radial.
25. TO/FROM INDICATOR (TO/FR) - Operates only with a usable VOR or localizer signal. When white flag is in view, indicates whether selected course is TO or FROM station. With usable localizer signal, TO flag is in view.
26. NAV INDICATOR FLAG - When in view, red NAV position (Flag) indicates the selected VOR or localizer signal is unusable.

Figure 1. Cessna 400 Nav/Com (Type RT-485A), Operating Controls and Indicators (Sheet 4 of 4)

SECTION 3 EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures when this avionics equipment is installed. However, if the frequency readouts fail, the frequency controls should not be moved due to the difficulty of obtaining a known frequency under this condition. The radio will remain operational on the last frequency selected, and the preset frequencies in MEMORY may be selected by pressing the appropriate MEMORY pushbutton.

SECTION 4

NORMAL PROCEDURES

PRESETTING NAV/COM FREQUENCIES IN MEMORY:

1. COM OFF/VOL CONTROL -- TURN ON; adjust to desired audio level.
2. MEMORY 1 Pushbutton -- PRESS desired NAV or COM pushbutton 1 momentarily to alert the memory bank of a forthcoming frequency to be stored.
3. FREQUENCY SELECTORS -- MANUALLY ROTATE corresponding NAV or COM frequency selectors (press C pushbutton as required to select the desired third fractional COM digit) until the desired frequency is shown in the operating frequency readout window. The frequency displayed will be automatically transferred into MEMORY 1.

NOTE

Do not press the C pushbutton more than about 2 seconds while selecting fractional frequencies or you will activate the MEMORY test function.

4. MEMORY 2 and 3 Pushbuttons -- REPEAT STEPS 2 and 3 using next desired NAV or COM MEMORY to be stored. Up to 3 NAV and 3 COM frequencies may be stored for automatic recall frequency selection.

NOTE

The operating frequency set in the selected MEMORY position will automatically be changed in the MEMORY bank any time the operating frequency is manually changed.

COMMUNICATION RECEIVER-TRANSMITTER OPERATION:

1. COM OFF/VOL Control -- TURN ON.
2. XMTR SEL Switch (on audio control panel) -- SET to desired 400 Nav/Com.
3. SPEAKER/PHONE Selector Switches (on audio control panel) -- SET to desired mode.
4. COM Frequency Selection -- SELECT desired operating frequency by either pressing a COM MEMORY 1, 2 or 3 pushbutton to recall a preset frequency, or by manually selecting the desired operating frequency using the COM frequency selectors and C pushbutton.

5. VOL Control -- ADJUST to desired audio level.
6. SQ Control -- ROTATE counterclockwise to just eliminate background noise.
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, or 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. XMIT Annunciator Light -- CHECK ON (green light illuminated).
- c. To Receive -- RELEASE mike button.

NAVIGATION OPERATION:

NOTE

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

1. COM OFF/VOL Control -- TURN ON; adjust to desired audio level.
2. SPEAKER/PHONE Selector Switches (on audio control panel) -- SET to desired mode.
3. NAV Frequency Selection -- SELECT desired operating frequency by either pressing a NAV MEMORY 1, 2 or 3 pushbutton to recall a preset frequency, or by using NAV frequency selectors.
4. NAV VOL Control -- 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. 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 course card is moving to center 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 and the ARC knob to return to the center detent position and function as a normal OBS.

- 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. This system will continually drive to present the VOR radial the aircraft is on until manually returned to the center detent by the pilot.

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, NAV/TO-FROM indicator shows FROM and AP/CPLD and XMIT annunciators light.
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.
6. ID/VOX/T Switch -- RELEASE for normal operation.

NOTE

This test does not fulfill the requirements of FAR 91.25.

MEMORY TEST OPERATION:

1. C Pushbutton -- PUSH for about 2 seconds. Each COM and NAV MEMORY pushbutton (1, 2 & 3) will illuminate white, in turn, with the corresponding preset frequency displayed.

NOTE

If the "keep-alive" circuit has not been interrupted, the MEMORY test will always start with the last COM MEMORY selected and cycle through the remaining COM and NAV preset frequencies. The MEMORY test will always stop on the last selected COM and NAV preset frequencies.

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 NAV/COM (Type RT-485A)

WITH

CESSNA 400 AREA NAVIGATION SYSTEM (Type RN-478A)

SECTION 1

GENERAL

The Cessna 400 Nav/Com (Type RT-485A) Set with Cessna 400 Area Navigation (RNAV-Type RN-478A) consists of a RT-485A Nav/Com, a R-476A DME system, a RN-478A Area Navigation Computer and a Course Deviation Indicator, with or without, the optional Automatic Radial Centering (ARC) feature. The RN-478A includes circuits which combine the VOR navigation information with distance information from the R-476A DME system to provide data for area navigation. Operating information for the communication set and for VOR/localizer navigation is presented in this supplement. Operating information for area navigation and for DME is presented in separate supplements. Microprocessor frequency management provides storage for 3 preset NAV and 3 preset COM frequencies in MEMORY. A "keep-alive" voltage prevents loss of the preset frequencies when the NAV/COM Switch, Avionics Power Switch, or Master Switch is turned OFF.

The RT-485A Receiver-Transmitter includes a 720-channel VHF communication receiver-transmitter which receives and transmits signals between 118.000 MHz and 135.975 MHz in 25-kHz steps. It also includes a 200-channel VHF navigation receiver which receives VOR and localizer signals between 108.00 MHz and 117.95 MHz in 50-kHz steps. The communication receiver-transmitter and the navigation receiver can be operated simultaneously.

The VOR or localizer signal from the No. 2 Navigation Receiver is

applied to the converter circuits in the RN-478A Area Navigation Computer. The converter processes the received navigation signal to provide omni bearing or localizer information for display by the course indicator.

CAUTION

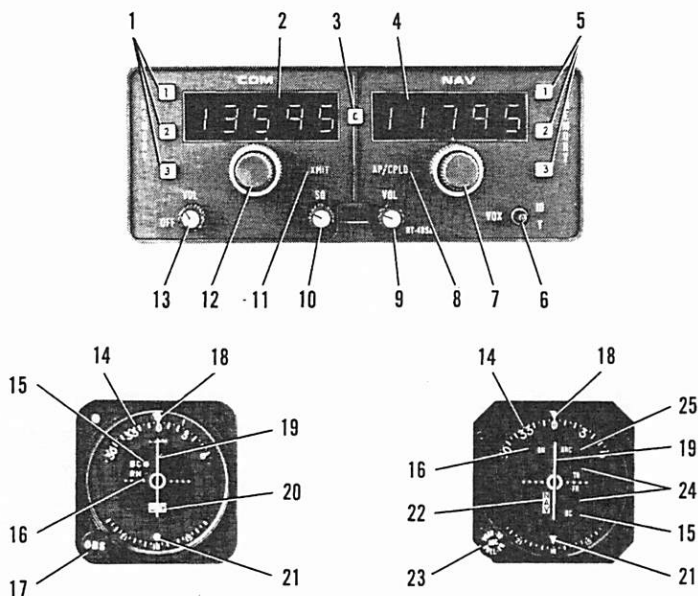
If the RNAV set is removed from the airplane or becomes inoperative, the associated VHF navigation indicator will be inoperative.

The course indicator includes a Course Deviation Indicator (CDI), an Omni Bearing Selector (OBS) or Automatic Radial Centering (ARC) knob, and OFF (or NAV)/To-From Indicator Flags. It also includes an RNAV lamp (RN) which lights when area navigation operation is selected, and a back-course lamp (BC) which lights when back-course operation is selected. The IN-442AR is offered as the standard Course Deviation Indicator and an optional IN-1048AC Course Deviation Indicator is also offered when Automatic Radial Centering (ARC) is desired. When the optional IN-1048AC Course Deviation Indicator is installed, an Automatic Radial Centering lamp (ARC) is incorporated in the CDI to alert the pilot that the Automatic Radial Centering feature has been selected.

All operating controls and indicators for the Cessna 400 Nav/Com are included on the front panel of the RT-485A Receiver-Transmitter and the associated Course Deviation Indicator. These controls and indicators are shown and described in Figure 1. Operating controls for the RN-478A Area Navigation Computer, which are used for area navigation, and operating controls for the associated Type R-476A DME are shown in the appropriate supplements in this manual. Operating controls for the audio control panels used in conjunction with this radio are shown and described in Section 7 of this handbook.

SECTION 2 LIMITATIONS

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



IN-442AR STANDARD VOR/LOC CDI
WITHOUT
AUTOMATIC RADIAL CENTERING

IN-1048AC OPTIONAL VOR/LOC CDI
WITH
AUTOMATIC RADIAL CENTERING

1. COMM MEMORY 1, 2 & 3 PUSHBUTTONS - When a COM MEMORY pushbutton is pressed, the preset selected frequency will appear in the COM frequency window for use as the selected operating frequency. Each pushbutton will illuminate white when pressed and the light will go out on the previously selected pushbutton. Three preset frequencies may be stored in MEMORY and selected as desired, by merely pressing the appropriate COM MEMORY pushbutton to recall the desired operating frequency. If electrical power to the set's "keep-alive" circuit has not been interrupted, upon turn-on, the set will automatically recall the last COM MEMORY frequency selected by the MEMORY pushbutton. If electrical power is removed from the set's "keep-alive" circuit (such as radio removal or battery replacement) for more than 15 seconds, upon turn-on, the COM MEMORY circuits will have to be reset and COM 1 MEMORY will automatically be selected with the lowest operating frequency (118.000 MHz) selected.

Figure 1. Cessna 400 Nav/Com Set, Operating Controls and Indicators
(Sheet 1 of 4)

2. COMMUNICATION OPERATING FREQUENCY READOUT - Indicates COM frequency in use. Third decimal place not shown.
3. CYCLE BUTTON (C) - Selects last illuminated decimal place on COM frequency in use. If last decimal place is 2 or 7, pressing C pushbutton changes number to 5 or 0, respectively. If last decimal place is 5 or 0, pressing C pushbutton changes number to 7 or 2, respectively. When the last illuminated digit on the set is 2 or 7, the third digit on the set (not shown) will always be 5. When the last illuminated digit on the set is 0 or 5, the third digit on the set (not shown) will always be 0. Also provides test function by holding C pushbutton pressed for more than 1.7 seconds. This lights each COM and NAV MEMORY pushbutton in turn, and displays the corresponding preset frequency in MEMORY.
4. NAVIGATION OPERATING FREQUENCY READOUT - Indicates NAV frequency in use.
5. NAV MEMORY 1, 2 & 3 PUSHBUTTONS - When a NAV MEMORY pushbutton is pressed, the preset selected frequency will appear in the NAV frequency window for use as the selected operating frequency. Each pushbutton will illuminate white when pressed and the light will go out on the previously selected pushbutton. Three preset frequencies may be stored in MEMORY and selected as desired, by merely pressing the appropriate NAV MEMORY pushbutton to recall the desired operating frequency. If electrical power to the set's "keep-alive" circuit has not been interrupted, upon turn-on, the set will automatically recall the last NAV MEMORY frequency selected by the MEMORY pushbutton. If electrical power is removed from the set's "keep-alive" circuit (such as radio removal or battery replacement) for more than 15 seconds, upon turn-on, the NAV MEMORY circuits will have to be reset and NAV 1 MEMORY will automatically be selected with the lowest operating frequency (108.000 MHz) selected.
6. ID-VOX-T SWITCH - In ID position, station identifier signal is audible; in VOX (Voice) position, identifier signal is suppressed; in T (Momentary On) position, the self-test function is selected, and the AP/CPLD annunciator illuminates amber and the XMIT annunciator illuminates green.
7. NAVIGATION RECEIVER FREQUENCY SELECTORS - Outer knob changes NAV frequency in 1-MHz steps between 108 and 117 MHz; inner knob changes NAV frequency in .05-MHz steps between .00 and .95 MHz; simultaneously selects paired glide slope frequency and DME channel.
8. AUTOPILOT COUPLED ANNUNCIATOR (AP/CPLD) - Non-operational with 200A, 300A and 400 autopilots.
9. NAV VOLUME CONTROL (VOL) - Adjusts volume of navigation receiver audio.
10. 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.
11. TRANSMIT ANNUNCIATOR (XMIT) - Illuminates green when transmitter output is normal while mike is keyed.

Figure 1. Cessna 400 Nav/Com Set, Operating Controls and Indicators
(Sheet 2 of 4)

12. COMMUNICATION RECEIVER FREQUENCY SELECTORS - Outer knob changes COM frequency in 1-MHz steps between 118 and 135 MHz; inner knob changes COM frequency in .05 MHz steps between .025 and .975 MHz or between .000 and .950 MHz depending on setting of C button.
13. COM OFF-VOLUME CONTROL (OFF-VOL) - Combination ON/OFF switch and volume control; turns on Nav/Com set and controls volume of COM receiver audio.
14. COURSE CARD - Indicates selected VOR course under course index.
15. BACK-COURSE LAMP (BC) - Amber light illuminates when an autopilot's back-course function is engaged and receiver is tuned to a localizer frequency; indicates course deviation pointer is reversed. Light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.
16. AREA NAV LAMP (RN) - When green light is illuminated, indicates that RNAV operation is selected. Light dimming is only available when installed with an audio control panel incorporating the annunciator lights DAY/NITE selector switch.
17. OMNI BEARING SELECTOR (OBS) - Rotates course card (12) to select desired bearing to or from a VOR station or to a selected RNAV waypoint.
18. COURSE INDEX - Indicates selected VOR or RNAV course (bearing).
19. COURSE DEVIATION POINTER - Indicates course deviation from selected VOR or RNAV course or localizer centerline.
20. OFF/TO-FROM INDICATOR - Operates only with VOR, localizer or RNAV signal. OFF position (flag) indicates unusable signal. With usable VOR signal, when OFF position disappears, indicates whether selected course is TO or FROM station or waypoint. With usable localizer signal, TO flag is in view.
21. RECIPROCAL COURSE INDEX - Indicates reciprocal of selected VOR or RNAV course.
22. NAV INDICATOR FLAG - When in view, red NAV position (Flag) indicates the selected VOR or localizer signal is unusable.
23. 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 (14) to center course deviation pointer (19) with a TO flag (24), then returns to conventional OBS selection. Pulled to outer detent, continuously drives OBS course card (14) to indicate bearing from VOR station, keeping course deviation pointer (19) centered, with a FROM flag (24). ARC function will not operate on localizer frequencies.

Figure 1. Cessna 400 Nav/Com Set, Operating Controls and Indicators
(Sheet 3 of 4)

NOTE

Engaging either Automatic Radial Centering (ARC) functions will alter the airplane's course anytime the autopilot is engaged and coupled to any frequency other than a localizer frequency.

24. INDICATOR (TO/FR) - Operates only with a usable VOR, localizer or RNAV signal. When white flag is in view, indicates whether selected course is TO or FROM station. With usable localizer signal, TO flag is in view.
25. 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.

Figure 1. Cessna 400 Nav/Com Set. Operating Controls and Indicators
(Sheet 4 of 4)

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 frequency controls should not be moved due to the difficulty of obtaining a known frequency under this condition. The radio will remain operational on the last frequency selected, and the preset frequencies in MEMORY may be selected by pressing the appropriate MEMORY pushbutton.

SECTION 4

NORMAL PROCEDURES

PRESETTING NAV/COM FREQUENCIES IN MEMORY:

1. COM OFF/VOL CONTROL -- TURN ON; adjust to desired audio level.
2. MEMORY 1 Pushbutton -- PRESS desired NAV or COM pushbutton 1 momentarily to alert the memory bank of a forthcoming frequency to be stored.
3. FREQUENCY SELECTORS -- MANUALLY ROTATE corresponding NAV or COM frequency selectors (press C pushbutton as required to select the desired third fractional COM digit) until the desired frequency is shown in the operating frequency readout window. The frequency displayed will be automatically transferred into MEMORY 1.

NOTE

Do not press the C pushbutton more than about 2 seconds while selecting fractional frequencies or you will activate the MEMORY test function.

4. MEMORY 2 and 3 Pushbutton -- REPEAT STEPS 2 and 3 using next desired NAV or COM MEMORY to be stored. Up to 3 NAV and 3 COM frequencies may be stored for automatic recall frequency selection.

NOTE

The operating frequency set in the selected MEMORY position will automatically be changed in the memory bank anytime the operating frequency is manually changed.

COMMUNICATIONS OPERATION:

1. COM OFF/VOL Control -- TURN ON.
2. XMTR SEL Switch (on audio control panel) -- SET to No. 2 400 Nav/Com.
3. SPEAKER/PHONE Selector Switches (on audio control panel) -- SET to desired mode.
4. COM Frequency Selection -- SELECT desired operating frequency by either pressing a COM MEMORY 1, 2 or 3 pushbutton to recall a preset frequency, or by manually selecting the desired operating frequency using the COM frequency selectors and C pushbutton.
5. VOL Control -- ADJUST to desired audio level.
6. SQ Control -- ROTATE counterclockwise to just eliminate background noise.
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, or 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 two or less transmitters have sidetone adjustment pots that are accessible through the front of the audio control panel with a small screwdriver.

- b. XMIT Annunciator Light -- CHECK ON (green light illuminated).
- c. To Receive -- RELEASE mike button.

NAVIGATION OPERATION:

NOTE

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

1. COM OFF/VOL Control -- TURN ON; adjust to desired audio level.
2. SPEAKER/PHONE Selector Switches (on audio control panel) -- SET to desired mode.

3. NAV Frequency Selection -- SELECT desired operating frequency by either pressing a NAV MEMORY 1, 2 or 3 pushbutton to recall a preset frequency, or by using NAV frequency selectors.
4. NAV VOL Control -- 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. 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 knob to inner (Momentary On) position.

NOTE

ARC lamp will illuminate amber while the course card is moving to center 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 and the ARC knob to return to center detent position and function as a normal OBS.

- 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. This system will continually drive to present the VOR radial the aircraft is on until manually returned to the center detent by the pilot.

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, NAV/TO-FROM indicator shows FROM and AP/CPLD and XMIT annunciators light.
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.
6. ID/VOX/T Switch -- RELEASE for normal operation.

NOTE

This test does not fulfill the requirements of FAR 91.25.

MEMORY TEST OPERATION:

1. C Pushbutton -- PUSH for about 2 seconds. Each COM and NAV MEMORY pushbutton (1, 2 & 3) will illuminate white, in turn, with the corresponding preset frequency displayed.

NOTE

If the "keep-alive" circuit has not been interrupted, the MEMORY test will always start with the last COM MEMORY selected and cycle through the remaining COM and NAV preset frequencies. The MEMORY test will always stop on the last selected COM and NAV preset frequencies.

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)

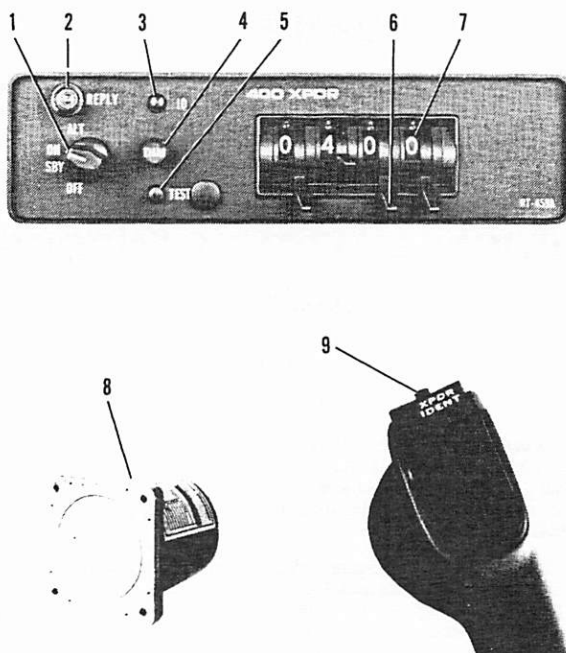
SECTION 1

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, an externally-mounted antenna and an optional control wheel-mounted XPDR IDENT switch. 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 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 300 Transponder system, altitude reporting capabilities are available in 100-foot increments between -1000 and the airplane's maximum service ceiling.

All Cessna 400 Transponder operating controls, with the exception of the optional XPDR IDENT switch, are located on the front panel of the unit. The remote XPDR IDENT switch is located on the right hand grip of the pilot's control wheel. Functions of the operating controls are described in Figure 1.



1. FUNCTION 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 either Mode A (aircraft identification) reply pulses or Mode C (altitude reporting) pulses selected automatically by the interrogating signal.

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

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. **REMOTE-MOUNTED DIGITIZER** - Provides an altitude reporting code range of -1000 feet up to the airplane's maximum service ceiling.
9. **REMOTE ID SWITCH (XPDR IDENT)** - Same as panel-mounted ID switch described in Item 3.

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 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 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 Switch -- SBY.

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

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

NOTE

When directed by ground controller to "stop altitude squawk", turn Function 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 Switch -- SBY and wait 30 seconds for equipment to warm-up.
2. Function 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)**

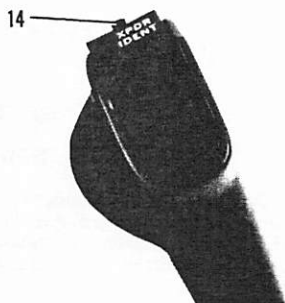
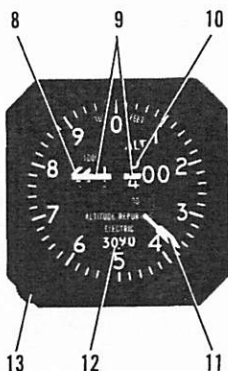
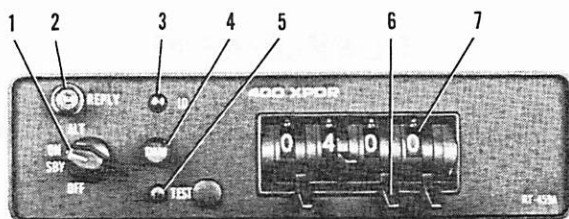
SECTION 1

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 Cessna 400 Transponder system consists of a panel-mounted unit, an externally-mounted antenna and an optional control wheel-mounted XPDR IDENT switch. 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 also to 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 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 and the optional remote XPDR IDENT switch, are located on the front panel of the unit. The altimeter setting knob is located on the encoding altimeter and the remote XPDR IDENT switch is located on the right hand grip of the pilot's control wheel. Functions of the operating controls are described in Figure 1.



1. FUNCTION 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 stand-by 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 either Mode A (aircraft identification) reply pulses or Mode C (altitude reporting) pulses selected automatically by the interrogating signal.

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

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 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 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.
14. **REMOTE ID SWITCH (XPDR IDENT)** - Same as panel-mounted ID switch described in Item 3.

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

SECTION 2

LIMITATIONS

There is no change to the airplane limitations when this avionics 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 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 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 Switch -- SBY.

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

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

2. Function 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 Switch -- ALT.

NOTE

When directed by ground controller to "stop altitude squawk", turn Function 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.

ELF-TEST TRANSPONDER OPERATION:

Function Switch -- SBY and wait 30 seconds for equipment to warm-up.
Function Switch -- ON or ALT.

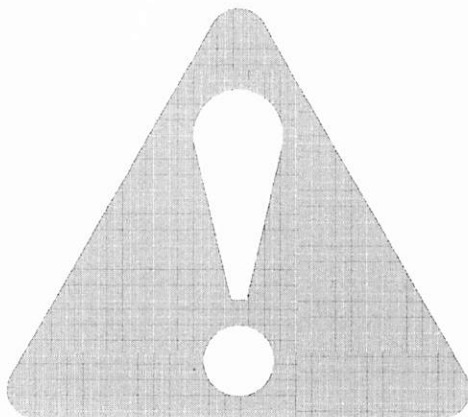
3. TEST Button -- DEPRESS and HOLD (reply lamp should light with full brilliance regardless of DIM control setting).
4. TEST Button -- RELEASE for normal operation.

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.

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) in its entirety.

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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**
- **AIR TRAFFIC CONTROL AND ENROUTE NAVIGATION FACILITIES**
- **FACILITIES AT AIRPORTS OF INTENDED USE**

(Continued Next Page)

WARNING (Continued)

- **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

INTRODUCTION

PILOT SAFETY AND WARNING SUPPLEMENTS

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 nonregulatory 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

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PHYSIOLOGICAL

PILOT SAFETY AND WARNING SUPPLEMENTS

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. Combatting 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.

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PHYSIOLOGICAL

PILOT SAFETY AND WARNING SUPPLEMENTS

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 (such as with a checklist) 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 to all 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).

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PILOT SAFETY AND WARNING SUPPLEMENTS

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

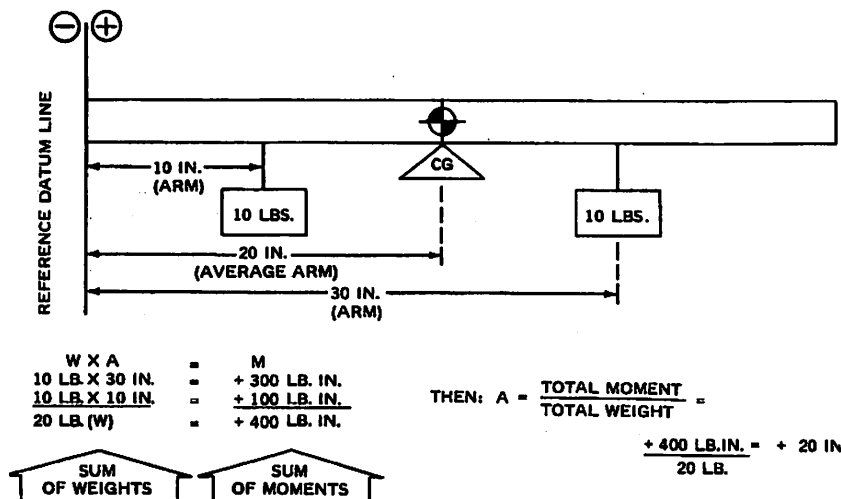


Figure 1. Computing the Center-of-Gravity

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



weight \times arm = moment
moment \div weight = arm
moment \div 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 tiedown.

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

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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 runup 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.

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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.

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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

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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 crossfeeding 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

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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 attitude indicator will be disabled, and the pilot will have to rely on the turn coordinator or the turn and bank indicator 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).

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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 overstress 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. 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. Spatial disorientation from these illusions can be prevented only by visual reference to reliable, fixed points on the ground, or to flight instruments.

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PILOT SAFETY AND WARNING SUPPLEMENTS

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 cues 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 cues upon which he or she depends for "indexing" a sense of balance. These cues 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.

When flying by reference to the natural horizon, the attitude of the airplane can be determined visually at all times. During instrument flight, when the natural horizon is not visible, the attitude of the airplane must be determined from the gyro horizon and other flight instruments. Sight, supported by other senses, maintains orientation in either case.

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.

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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 cross-country, 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 $+10^{\circ}\text{C}$ or below, or the RAT (ram air temperature) is $+10^{\circ}\text{C}$ 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 judgement 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 deicing 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

8 WEATHER

PILOT SAFETY AND WARNING SUPPLEMENTS

- 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 StormscopeTM) 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

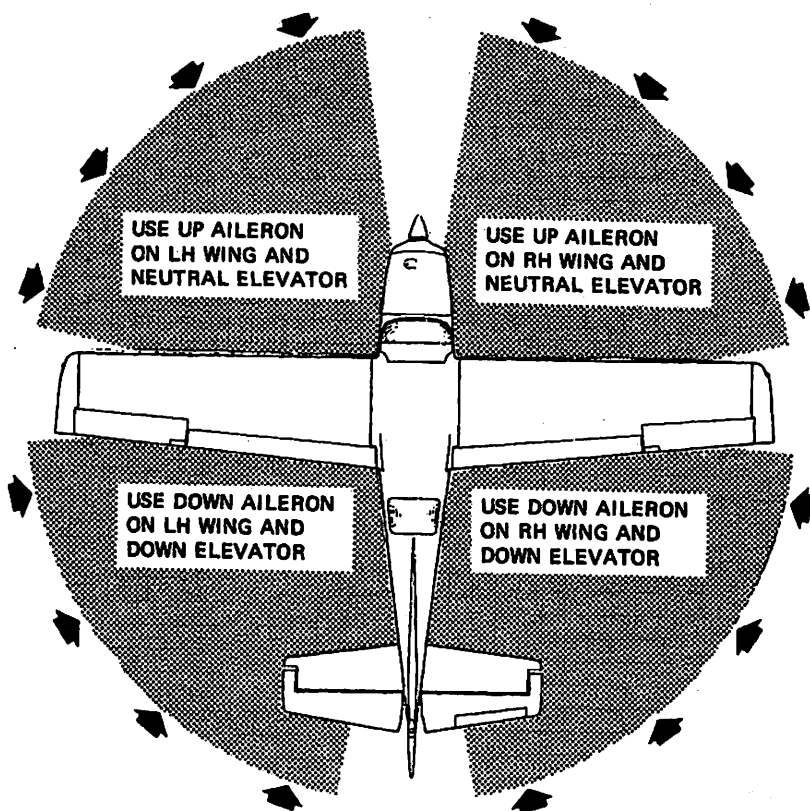
on its landing gear affects handling characteristics. If it sits nose down, the wing will be unloaded and the airplane will handle better in wind than an airplane which sits in a nose up attitude, creating a positive angle of attack. For the latter type, the full weight of the airplane cannot be on the 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.



CODE
WIND DIRECTION ➡

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.

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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

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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

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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.

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

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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.

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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 airspeed. 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 cowl 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 cowl, 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 cowl 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 to 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

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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 unpresurized 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.

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.

UNAUTHORIZED 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:

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PILOT SAFETY AND WARNING SUPPLEMENTS

1. Wing attach points and fuselage carry-through structure.
2. Wing spar capstrips, especially the lower ones.
3. Horizontal and vertical stabilizer attach points and spar structure.
4. Control surface structure and attach points.
5. Engine mounts, beams, and cowlings.
6. Landing gear structure and attach points.
7. Structural and flooring integrity of seat and equipment attachments.
8. Pressurized structures, especially around all doors, windows, windshields and other cutouts on pressurized airplanes.
9. Exhaust and cabin heater systems.

The final responsibility for airplane care rests with the owner/operator. All airplane owners/operators should use the following steps as a minimum guideline to ensure continued airworthiness of their airplanes:

1. Always follow recommended maintenance and inspection procedures.
2. Recognize that corrosion, overloading, or damage to structure can drastically shorten fatigue life.
3. Comply with all applicable Service Bulletins, Service Letters, and FAA Airworthiness Directives.
4. Use one of Cessna's Progressive Care Inspection and maintenance programs to get the maximum utilization of your airplane at a minimum cost and downtime.

CORROSION

Corrosion can cause structural failure if left unchecked. The appearance of the corrosion varies with the metal. On aluminum and magnesium, it appears as surface pitting and etching, often combined with a grey or white powdery deposit. On copper and copper alloys the corrosion forms a greenish oxide and on steel, a reddish rust. When grey, white, green or red deposits are removed, each of the surfaces may appear etched and pitted, depending upon the length of exposure and severity of the attack. If the damage is not too deep, it may not significantly alter the strength of the metal. However, the pits may become sites for crack development. Some types of corrosion can travel beneath surface coatings and spread until the part fails.

Remove corrosion as soon as possible because it attacks and holds moisture in contact with the metal, which causes more corrosion to form. Every visible trace must be removed by some mechanical or chemical means. The surface must then be chemically treated to form a film which prevents oxygen or moisture from contacting the surface. Then, the protective surface (paint) must be restored.

There are several different types of corrosion and different ways of detecting it in its early stages. Uniform surface corrosion is the most common type of corrosion. When an area of unprotected metal is exposed to the atmosphere, there will be a uniform attack over the entire unprotected area. On a polished

surface, this type of corrosion is first seen as a general dulling of the surface. If the corrosion is allowed to continue, the surface becomes rough and possibly frosted in appearance.

If surface corrosion is allowed to go untreated, it can progress into the next type of corrosion, called pitting. Pits form in localized areas and appear as white or grey powdery deposits. Metal is converted to salts, and when deposits are cleaned away, tiny pits or holes can be seen on the surface. If allowed to continue, pitting can progress completely through the metal in extreme cases.

Stress corrosion cracking is caused by the simultaneous effects of tensile stress and corrosion. Stress may be either internal or applied. Residual stress from the processes of heat treatment and forming, or sustained operating or static loads, can lead to stress corrosion.

Fretting corrosion is corrosion damage between close fitting parts which are allowed to rub together. It is the corrosive attack on one or both metals because of chafing under a load. The results of fretting are removal or pitting of the metal in the area of contact, galling, seizing, cracking or fatigue of the metal, loss of tolerance in accurately fitted parts, and loosening of bolted or clamped surfaces.

Corrosion is a universal problem that costs considerable amounts of time and money. It is essential that each airplane owner maintain his or her airplane based on the operating conditions, environment, and service experience. Corrosion can be effectively prevented and/or controlled if appropriate action is taken early.

SEAT AND RESTRAINT SYSTEMS

ADJUSTABLE SEAT ASSEMBLIES

Most Cessna manually-adjustable seats are suspended on two parallel, cabin floor mounted seat tracks by roller assemblies which allow the seat to move forward and rearward along the tracks. A series of holes are provided, usually in the forward end of either or both seat tracks, to accommodate a mechanical locking pin(s) which allows intermediate positioning and locking of the seat. To prevent the seat from disengaging from the seat tracks when reaching the ends, a mechanical seat stop is installed near both ends of the track(s).

Incidents of manually-adjustable seats slipping rearward or forward during acceleration or deceleration of the airplane have been reported. The investigations following these incidents have revealed discrepancies such as gouged lockpin holes, bent lockpins, excessive clearance between seat rollers and tracks, and missing seat stops, to name a few. Also, dust, dirt, and debris accumulations on seat tracks and in the intermediate adjustment holes have been found to contribute to the problem. A close check of each seat during daily preflight, improved cabin cleanliness, and replacement of parts when necessary will help prevent accidents involving seats. Visual checks of the airplane should always include the cabin interior.

When inspections are made, examination of the following items is recommended:

1. Check the seat assembly for structural integrity.
2. Inspect the roller assemblies for separation and wear.
3. Check the locking mechanism (actuating arm, linkage, locking pin or pins) for wear.
4. Check all seat track stops for security and proper installation.
5. Inspect seat tracks for condition and security, and the locking pin holes for wear, and dirt or debris accumulation.
6. Determine that the floor structure in the vicinity of the seat tracks is not cracked or distorted.
7. Ensure that the secondary seat stop addressed in mandatory Service Bulletin SEB89-32 is installed.

Damaged or worn parts are a potential hazard which should be immediately repaired or replaced. Cessna recommends repair and/or replacement of damaged components in accordance with the airplane's service or maintenance publications and Service Bulletins.

RESTRAINT SYSTEMS

While performing the cabin portion of the daily preflight, it is recommended that pilots check each restraint system installed in the airplane. This should include a functional check of the restraint belt locking and releasing mechanism. If new passengers or students are to be carried, it is a good practice to insist that they operate the restraint system to become familiar with the procedures.

During inspections, maintenance personnel should check each restraint system installation for serviceability in accordance with current publications applicable to the airplane. Special attention should be given to restraint attachment points and to the nylon bushing on the belt at the point where the shoulder restraint harness attaches. Undetected cracks or broken connections could cause a serious situation to develop when it is least expected. The restraint system webbing should be inspected for degradation. Repair or replace the restraint system per Cessna instructions if damage is detected.

EXHAUST AND FUEL SYSTEMS

THE ENGINE EXHAUST SYSTEM

The primary function of an engine exhaust system is to route exhaust gases safely overboard. Other functions of the exhaust system may include use as the driving source for a turbocharger turbine and/or use as a heat source for carburetor and/or cabin heat requirements.

Heat and carbon monoxide are the unavoidable byproducts of all reciprocating engine operations. The temperatures within the exhaust system of an engine can exceed 1750°F. Consequently, if an exhaust leak should occur, heat damage can occur to the engine mounting structure, and accessories such as hoses, belts, wire bundles, etc. In some cases, the position of the leak could lead to engine stoppage and/or an engine compartment fire.

An exhaust system leak can also lead to carbon monoxide poisoning. This colorless, odorless, tasteless combustion byproduct is always present in exhaust fumes. For this reason, special seals are provided wherever cables, hoses, wire bundles, etc. pass through the engine firewall. For even greater protection from carbon monoxide, special window, door, and fuselage seals are installed. No leakage of exhaust into the cabin should be tolerated.

Exhaust systems should be checked for stains indicative of exhaust leaks at cylinder heads or cracks in the exhaust or tailpipe. The condition and security of the exhaust system in the area of the exhaust muffler shroud should be checked. Any cracks or leaks in this area could be a source for exhaust to enter the cabin.

ENGINE COMPARTMENT TEMPERATURES

High engine compartment temperatures can degrade the operational efficiency of the engine and also accelerate the deterioration of engine components. Several conditions could cause or contribute to a higher than normal engine compartment temperature; however, improper operating techniques are found to be the most common cause. Avoid excessive operation of an engine on the ground. Prolonged ground operations should be done into the wind at rich mixture settings. If the cowling has been removed for maintenance, cooling airflow is poor and cylinder head temperature and oil temperature gages must be monitored during engine runups.

On virtually all air-cooled reciprocating engines, the engine and engine compartment are cooled by utilizing a pressure cooling baffle system with airflow as the cooling medium. The condition of these baffles and their seals is important.

Baffles should be secure and baffle seals should be positioned in a direction which would seal airflow around the engine baffles. Even a slight reduction in cooling efficiency can cause the engine to operate hotter than normal, thus increasing the potential for heat damaged components.

An inspection of the engine compartment, plus careful observation of the engine temperatures during normal flight, can be of great assistance in verifying the condition of the engine. If the pilot takes the time to record engine temperatures on a regular basis, trends within the engine can be detected early and corrected before a serious condition occurs.

HOSES AND WIRE HARNESS INTEGRITY

All fuel, oil, and hydraulic components should be checked for condition, security and any evidence of leakage. All leaks should be repaired before starting the engine.

As airplanes and engines age, there is a need to re-emphasize the inspection or replacement requirements of engine hoses or lines that carry fuel, oil, or hydraulic fluid. For newer Cessnas, a replacement requirement for hoses in the engine compartment (except teflon lined) has been established at each 5 years or at engine overhaul, whichever occurs first. This is considered to include "shelf" life. All hose manufactured for airplane use is marked indicating the quarter-year in which they were manufactured. For instance, a listing of "4Q85" means the hose was manufactured in the fourth quarter of 1985. Maintenance personnel should not use hoses with a high "shelf" life age.

Like time, heat is always a detriment to hoses. The prudent pilot realizes during the daily preflight, that an engine hose might look good, but if it is wiggled, a telltale "crackle" may be heard. This means that the hose is brittle and should be replaced. Also if he slides his hand over the back side of the hose, he may find an abrasion or wear not visible from the front side.

Ignition leads/wire harnesses and spark plugs are also affected by excessive heating in the engine compartment. Overheating of the spark plug barrels, sometimes caused by damaged cylinder baffles or missing cooling air blast tubes, may seriously deteriorate the ignition leads. Any overheating of a spark plug by a defective baffle or exhaust gas leak at the exhaust pipe mounting flange can generate temperatures sufficient to cause pre-ignition and piston distress.

RETRACTABLE LANDING GEAR

The adjustment and rigging of a retractable landing gear system should be done by trained maintenance personnel. Continued reliability of the landing gear system is only possible if it is properly maintained in the prescribed published manner. The rigging process must be performed exactly as published in the Cessna Service/Maintenance Manual and Service Bulletins. For complete emergency procedures concerning landing gear extension, refer to the airplane operating handbook.

PRESSURIZED AIRPLANES

DOOR SECURITY

The conventional and air-stair doors on pressurized airplanes have a series of pins, actuated by an overcenter locking handle, to maintain the door seal during the pressurization cycle. Some air-stair doors are sealed by pressurization air pressing against the cabin door windlace which covers the door gap. Door security can be verified by visually checking the locking indicator for the door handle safety lock, in the case of single-engine airplanes, and checking for correct locking indications provided in the door of multi-engine airplanes. It is recommended that pilots check the locking pins and door seals for cracks or damage during each preflight. Any damaged parts should be repaired prior to pressurized flight.

WINDOWS AND WINDSHIELDS

The windows in pressurized airplanes are exposed to a fatigue cycle each time the airplane is pressurized. These cycles could lead to fatigue cracks in and around the windows. Windows should be inspected frequently for condition and serviceability. Windows or windshields having replacement life limits should be replaced prior to intervals defined in applicable service/maintenance manuals.

The windows and windshields on pressurized airplanes are particularly sensitive to crazing and scratches. Any crazing, cracks, or deep scratches cannot be tolerated for pressurized flight. Consult the airplane's operating manual when in doubt about the severity of the damage. Repairs should be completed prior to pressurized flight.

THE PRESSURE VESSEL

There are significant structural differences between the fuselage of a non-pressurized airplane and one which is pressurized. The pressure vessel is the portion of the cabin area to be pressurized. Pressure differential is the difference between the atmospheric pressure at the altitude at which the airplane is flying and the pressure inside the cabin.

Any seam, joint, or hole where wire bundles or tubing pass through the pressure vessel must be sealed to maintain the selected pressurization. If any of these seals are deteriorated or missing, the normal cabin pressure differential may be impossible to attain. Maintenance personnel should inspect the pressure seals for serviceability. Any cracks in the skin of the pressure

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PRESSURIZED AIRPLANES

PILOT SAFETY AND WARNING SUPPLEMENTS

vessel could lead to sudden depressurization. Maintenance personnel should carefully inspect the pressure vessel for cracks, corrosion, and deterioration. Any damage should be corrected before pressurized flight.

If the airplane cabin is pressurized and it becomes necessary to use the heated alternate induction air on both engines, the pressurization controls must be selected OFF to preventing nacelle fumes from entering the cabin. The cabin should be depressurized and maximum ventilation provided. Therefore, if the flight altitude is above 10,000 feet, all occupants should use oxygen, if available, or descent should be initiated.

POTENTIAL HAZARDS

PROPELLERS

WARNING

ALWAYS STAND CLEAR OF PROPELLER BLADE PATHS, ESPECIALLY WHEN MOVING THE PROPELLER. PARTICULAR CAUTION SHOULD BE PRACTICED AROUND WARM ENGINES.

Review of propeller accidents indicates that most were preventable. A propeller under power, even at slow idling speed, has sufficient force to inflict fatal injuries. Pilots can be most effective in ensuring that passengers arrive and depart the vicinity of the airplane safely by stopping the engine(s) during loading and unloading.

Cessna airplanes are delivered with propellers using paint schemes to increase visibility of the blades. Owners should maintain the original paint scheme.

Pilots and Service personnel should develop the following safety habits:

1. Before moving a propeller or connecting an external power source to an airplane, be sure that the airplane is chocked, ignition switches are in the OFF position, throttle is closed, mixture is in IDLE CUT-OFF position, and all equipment and personnel are clear of the propeller. Failed diodes in airplane electrical systems have caused starters to engage when external power was applied regardless of the switch position.
2. When removing an external power source from an airplane, keep the equipment and yourself clear of the propeller.
3. Pilots should make certain that all personnel are clear of the propeller, prior to engine start.
4. Attach pull ropes to wheel chocks located close to a rotating propeller(s).
5. Before removing the wheel chocks, the pilot should hold brakes or apply the parking brake.
6. Be absolutely sure that all equipment and personnel are clear of the airplane before releasing the brakes.
7. Ground personnel should be given recurrent propeller safety training to keep them alert to the dangers of working around airplanes.

The pilot should carefully inspect the propeller during each preflight inspection. Some constant speed propellers manufactured by McCauley are subject to a requirement that they be filled with a red-dyed oil. This oil helps lubricate and

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PILOT SAFETY AND WARNING SUPPLEMENTS

prevent corrosion of internal propeller parts and may assist in detection of cracks. If a crack is detected, the airplane should not be flown until the propeller is replaced.

AIR CONDITIONING FREON

The refrigerant R- 12 (FREON) is relatively safe to handle when using proper protective safety equipment. Since at sea level the boiling point of R- 12 is - 21.6°F, any contact with bare skin will immediately burn (freeze) the area. If R-12 should contact your eye, it will burn and can cause permanent blindness. Treat spills or splashes on your body by washing with clean, cool, water, and seek immediate medical attention. R-12, when heated to a high temperature such as with an open flame or spillage on a hot manifold, generates phosgene gas (a colorless gas with an unpleasant odor). This gas is a severe respiratory irritant and should be considered as a DEADLY POISON.

USED ENGINE OIL

Pilots and maintenance personnel who handle engine oil are advised to minimize skin contact with used oil, and promptly remove any used engine oil from their skin.

The following are some do's and don'ts concerning used engine oil:

1. Do follow work practices that minimize the amount of skin exposed, and the length of time used oil stays on the skin.
2. Do thoroughly wash used oil off skin as soon as possible.
3. Do wash oil-soaked clothing before wearing them again. Discard oil-soaked shoes.
4. Do use gloves made from material that oil cannot penetrate.
5. Don't use kerosene, gasoline, thinners, or solvents to remove used engine oil. These products can cause serious toxic effects.
7. Don't put oily rags in pockets, or tuck them under a belt. This can cause continuous skin contact.
8. Don't pour used engine oil on the ground, or down drains and sewers. This is a violation of Federal Law. The Environmental Protection Agency (EPA) encourages collection of used engine oil at collection points in compliance with appropriate state and local ordinances.

AVIATION FUEL ADDITIVE

Ethylene glycol monomethyl ether (EGME), which is a primary ingredient in aviation fuel additives, is toxic. It creates a dangerous health hazard when breathed or absorbed into the skin. When inhaled, EGME is primarily a central nervous system depressant, and acute inhalation overexposure may cause kidney injury. The primary symptoms of inhalation overexposure include

headache, drowsiness, blurred vision, weakness, lack of coordination, tremor, unconsciousness, and even death. EGME is irritating to the eyes and skin and can be readily absorbed through the skin in toxic amounts. Symptoms of overexposure due to skin absorption are essentially the same as those outlined for inhalation.

When servicing fuel with an anti-ice additive containing EGME, follow the manufacturers instructions and use appropriate personal protective equipment. These items would include chemical safety goggles or shield, respirator with organic vapor cartridges, nonabsorbing neoprene rubber gloves and an apron and long-sleeved shirt as additional skin protection from spraying or splashing anti-ice additive.

In the event EGME contact is experienced, the following emergency and first aid procedures should be used.

1. If EGME is inhaled, remove person to fresh air. If breathing is difficult, administer oxygen. If the person is not breathing give artificial respiration. Always call a physician.
2. If eye or skin contact is experienced, flush with plenty of water (use soap and water for skin) for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Thoroughly wash contaminated clothing and shoes before reuse.
3. If ingested, drink large quantities of water and induce vomiting by placing a finger far back in throat. Contact a physician immediately. If vomiting cannot be induced, or if victim is unconscious or in convulsions, take immediately to a hospital or physician. Do not induce vomiting or give anything by mouth to an unconscious person.

Diethylene glycol monomethyl ether (DIEGME), a fuel anti-icing additive approved for use in some airplanes, is slightly toxic if swallowed and may cause eye redness, swelling and irritation. DIEGME also is combustible. Before using DIEGME, refer to all safety information on the container.

BIRDS, INSECTS, AND RODENTS

Bird, insect, and mouse nests in airplanes are both hazardous and costly. They seem to find even the smallest opening on an airplane to make their nests. Evidence of nest building activities may include the following:

1. Any mud smears or droplets at pitot/static masts, fuel tank vents, crankcase breathers, stall warning vanes, cabin air vents, and any fluid drain holes are indications of mud dauber wasp activities.
2. Straw, string, or blades of grass extending from cowlings openings, carburetor air intakes, blast tubes, or exhaust stacks are signs of birds at work.
3. Cotton batting, shreds of fabric, and/or paper at wheel wells and empennage openings are frequently indicators that rodents such as

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POTENTIAL HAZARDS

PILOT SAFETY AND WARNING SUPPLEMENTS

mice have been or may still be on board. They may gnaw on any material in the airplane including wire bundles and rubber or plastic tubing.

If nests or building materials are found on the airplane, they must be removed before flight. It is strongly recommended that a qualified mechanic thoroughly inspect components such as pitot/static systems for remains of any nesting material after its removal and before flight to ensure complete removal. Even small amounts of foreign material can result in significant problems in flight.

Some precautions can be taken to prevent problems. Always use the pitot tube cover and any other external covers when the airplane is being stored. If the airplane is hangared, make sure the hangar is kept clean and neat to prevent insects and mice from lodging in the hangar in the first place. If need be, set traps for rodents and/or spray the area for insects. Models of predators that appear life-like such as owls or snakes may also be effective at preventing some birds from lodging in a hangar.

Removal of the nest of an insect, bird, or rodent does not prevent reconstruction elsewhere on the airplane or even in the same location again. Some creatures are not easily discouraged and may return to cause problems within a very short time period. Regardless of precautions used to prevent such problems, the pilot should be alert to the evidence of small animal activities during every preflight inspection.

FIRE EXTINGUISHER AGENTS

Halon, Bromochloromethane (CB), Carbon Dioxide (CO₂), and dry chemical extinguishing agents are four of the most common types of fire extinguishing agents found in and around airplanes. Prolonged exposure (5 minutes or more) to any of these agents in a confined area could cause serious injury or even death. Pilots and ground personnel should become familiar with the precautions associated with each particular agent. Adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

The discharge of large amounts of carbon dioxide to extinguish a fire may create hazards to personnel such as oxygen deficiency and reduced visibility. The dilution of the oxygen in the air, by the carbon dioxide concentrations that will extinguish a fire, may create an atmosphere that will not sustain life. Personnel rendered unconscious under these conditions can usually be revived without any permanent ill effects when promptly removed from the adverse condition.

The discharge of large amounts of dry chemical agents may create hazards to personnel such as reduced visibility and temporary breathing difficulty. Where there is a possibility that personnel may be exposed to dry chemical agents, suitable safeguards should be provided to ensure prompt evacuation.

OXYGEN

Before servicing any airplane with oxygen, consult the specific airplane service/maintenance manual to determine the proper type of servicing equipment to be used. Airplanes should not be serviced with oxygen during refueling, defueling, or other maintenance work which could provide fuel and a source of ignition. Also, oxygen servicing of an airplane should be accomplished outside, not in hangars.

Oxygen is a very reactive material, combining with most of the chemical elements. The union of oxygen with another substance is known as oxidation. Extremely rapid or spontaneous oxidation is known as combustion. While oxygen is non-combustible in itself, it strongly and rapidly accelerates the combustion of all flammable materials; some to an explosive degree.

The following are some do's and don'ts when handling or using oxygen:

1. Do check that only "aviators breathing oxygen" is going into the airplane system.
2. Don't confuse aviators breathing oxygen with "hospital/medical" oxygen. (The latter is pure enough for breathing, but the moisture content is usually higher which could freeze and plug the lines and valves of an airplane oxygen system.)
3. Do reject any oxygen that has an abnormal odor (good oxygen is odorless).
4. Do follow the published applicable instructions regarding charging, purging, and maintenance of airplane oxygen systems.
5. Don't use oil or grease (including certain lipsticks and lip balms) around oxygen systems.
6. Don't expose oxygen containers to high temperatures.

COMPRESSED AIR

Compressed air is a mechanic's tool as versatile as electricity, and can be as deadly. The use of compressed air to blow dust or dirt from parts of the body or clothing is a dangerous practice. As little as 12 psi can dislocate an eyeball. Air can enter the navel through a layer of clothing and inflate and rupture the intestines. Compressed air has been known to strike a small wound on a person's hand and inflate the arm.

Never look into or point any compressed air apparatus toward any part of the body. Always wear prescribed personal protective equipment. Also, continuously check the condition of air tools and air hoses to make sure they do not show signs of damage or looseness. A loose hose carrying pressure is like a bullwhip and can cause serious injury to personnel and/or cause damage

to surrounding equipment. If a situation such as this should occur, do not attempt to catch the hose end; shut off the air source first.

STATIC ELECTRICITY

Static electricity, by definition, is a negative or positive charge of electricity that an object accumulates, and creates a spark when the object comes near another object. Static electricity may accumulate on an airplane during flight or while it is on the ground, as long as air is flowing over its surfaces. Unless static electricity is carried away by ground wires, an explosion may be caused during any fueling operations.

Grounding an airplane is a good safety precaution because static electricity cannot be seen until it's too late. To properly ground an airplane, attach one end of a static ground wire to an unpainted point on the airplane and the other end to an approved grounding stake. Attaching the ground wire to the airplane first will ensure that any spark of static electricity will occur at the grounding stake and not at the airplane. Do not attach a ground wire to any antenna. Antennas are poor grounding attachment points because they are insulated from the airplane structure.

On some airplanes, wick-type static dischargers are installed to improve radio communications during flight through dust or various forms of precipitation (rain, snow or ice crystals). Under these conditions, the build-up and discharge of static electricity from the trailing edges of wings, rudder, elevator, and propeller tips can result in loss of usable radio signals on all communications and navigation radio equipment. Usually the ADF is first to be affected and VHF communication equipment is the last to be affected. Installation of static dischargers reduces interference from precipitation static, but it is possible to encounter severe precipitation static conditions which might cause the loss of radio signals, even with static dischargers installed.

Static dischargers lose their effectiveness with age, and therefore should be checked at every scheduled inspection by a qualified technician. If testing equipment is not available, it is recommended that the wicks be replaced every two years, especially if the airplane is operated frequently in IFR conditions.

ELT BATTERY AND GAS SPRING/DAMPER DISPOSAL

To prevent bodily injury, do not compact (compress) or incinerate an ELT battery-pack or gas spring/damper. The ELT battery pack should be discarded in accordance with local EPA standards.

A gas spring or gas damper contains an inert gas and oil under pressure, and reacts much like an aerosol can when compressed or heated; it may explode. Therefore, all unserviceable gas springs or dampers should be depressurized, using the maintenance manual instructions.

HEARING LOSS

Hearing loss due to overexposure to loud noise levels is a real possibility while working near operating airplane engines. Continuous exposure to excessive noise diminishes hearing acuity, with high frequency response failing first. If the overexposure continues, the middle frequencies, most important in conversation, are also lost. Ear muffs, some headset types, and earplugs are very useful to avoid hearing loss. By far, the earplug has proven to be the best protection overall. Limits have been established which relate sound level (dB) to exposure time. These limits are based on daily exposures for long intervals.

Sound Level (dB)	115	110	105	100
Maximum Time (min.)	15	30	60	120

WEATHER RADAR EXPOSURE

The dangers of exposure to airborne weather radar operated on the ground include the possibility of damage to low tolerance parts of the human body and ignition of combustible materials by radiated energy. Low tolerance parts of the body include the eyes and testes. Airborne weather radar should be operated on the ground only by qualified personnel. The radar should not be operated while the airplane is in a hangar or other enclosure unless the radar transmitter is disconnected, or the energy is directed toward an absorption shield which dissipates the radio frequency (RF) energy.

Personnel should never stand near or directly in front of a radar antenna which is transmitting. When the antenna is transmitting and scanning, personnel should not be allowed within 15 feet of the area being scanned by the antenna.

Personnel should not be allowed at the end of an open waveguide (hollow duct work through which electromagnetic waves are conducted to and from the antenna) unless the radar is off and will remain off. Radar should not be operated with an open waveguide unless a "dummy load" is connected to the portion which is connected to the transmitter. Personnel should not look into a waveguide, or the open end of a coaxial connector or line connected to a radar transmitter.

Weather radar installed on any airplane should not be operated while that airplane, or an adjacent airplane is being refueled or defueled.

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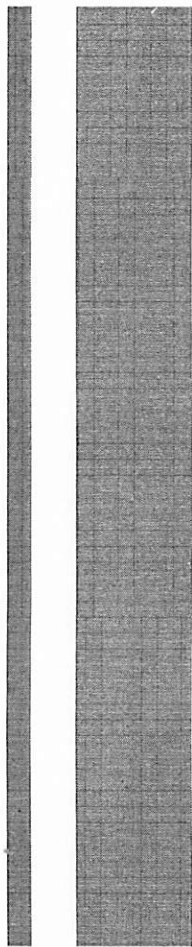


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Aircraft Weight and Balance Revision

Tail Number: N5124N		Date: 02-22-2009	
Prepared by: PROPEL AVIATION SERVICES LLC. 14300 SW 129 ST HANGAR M-5 MIAMI FLORIDA 33186		Work Order No:	
		Type Certificate 3A13 Data No:	
Aircraft Make: CESSNA	Model: 182Q	Serial No: 18267531	Time:
Registered Owner: PANAIR FLYING CLUB INC		Address: 14300 SW 129TH ST STE 108 MIAMI, FL, 33186-5304	
Maximum Weight 3100		CG Range FWD 33.0 AFT 48.5	
As Received; Date of Previous Weight and Balance:	Useful Load:	EW:	EWCG:
Moment:			
Notes: AIRCRAFT WEIGHED WITH FULL FUEL 88 USEABLE GALLONS AT +48 SEE BELOW FOR REMOVAL OF FUEL BY CALCULATION			
	Weight	Arm	Moment
NOSE WHEEL	692	-7.1	-4913.20
LEFT MAIN WHEEL	828	58.9	48769.20
RIGHT MAIN WHEEL	835	58.9	49181.50
SUBTRACT 88 GALLONS FUEL LOAD	628	48	25344.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
<input type="checkbox"/> As Calculated <input checked="" type="checkbox"/> As Weighed	Moment 67693.50 <hr/> Weight 1827.00		New Empty Weight CG <div style="text-align: center; font-size: 1.2em;">37.05</div>
		New Useful Load <div style="text-align: center; font-size: 1.5em;">1273</div>	
Signature JOE DOUGHERTY CHIEF INSPECTOR 		Repair Agency or License No: 08QR162B	

Note: This Weight & Balance is Modified BY STC SA03608AT