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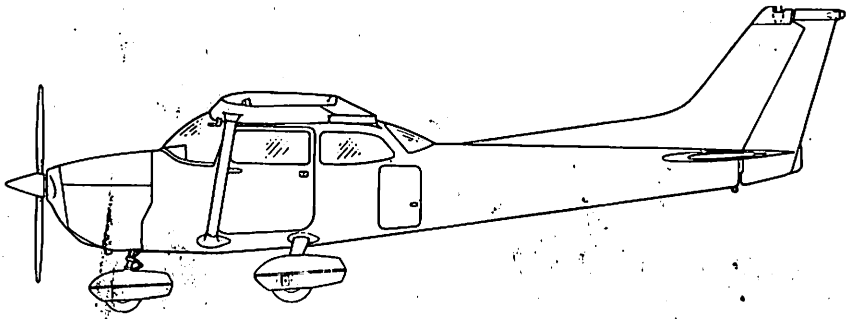
PILOT'S OPERATING HANDBOOK
and
FAA APPROVED AIRPLANE FLIGHT MANUAL



CESSNA AIRCRAFT COMPANY

1979 MODEL 172N

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

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

CESSNA AIRCRAFT COMPANY
WICHITA, KANSAS, USA

D1138-13PH–RPC–1,100–11/78

1 JULY 1978

COVERAGE

The Pilot's Operating Handbook in the airplane at the time of delivery from Cessna Aircraft Company contains information applicable to the 1979 Model 172N 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 July 1978

Page	Date
Title	1 July 1978
Assignment Record	1 July 1978
i thru iv	1 July 1978
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NOTE

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

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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

SPEED:		
Maximum at Sea Level		125 KNOTS
Cruise, 75% Power at 8000 Ft		122 KNOTS
CRUISE: Recommended lean mixture with fuel allowance for engine start, taxi, takeoff, climb and 45 minutes reserve at 45% power.		
75% Power at 8000 Ft	Range	485 NM
40 Gallons Usable Fuel	Time	4.1 HRS
75% Power at 8000 Ft	Range	630 NM
50 Gallons Usable Fuel	Time	5.3 HRS
Maximum Range at 10,000 Ft	Range	575 NM
40 Gallons Usable Fuel	Time	5.7 HRS
Maximum Range at 10,000 Ft	Range	750 NM
50 Gallons Usable Fuel	Time	7.4 HRS
RATE OF CLIMB AT SEA LEVEL		770 FPM
SERVICE CEILING		14,200 FT
TAKEOFF PERFORMANCE:		
Ground Roll		805 FT
Total Distance Over 50-Ft Obstacle		1440 FT
LANDING PERFORMANCE:		
Ground Roll		520 FT
Total Distance Over 50-Ft Obstacle		1250 FT
STALL SPEED (CAS):		
Flaps Up, Power Off		50 KNOTS
Flaps Down, Power Off		44 KNOTS
MAXIMUM WEIGHT:		
Ramp		2307 LBS
Takeoff or Landing		2300 LBS
STANDARD EMPTY WEIGHT:		
Skyhawk		1397 LBS
Skyhawk II		1424 LBS
MAXIMUM USEFUL LOAD:		
Skyhawk		910 LBS
Skyhawk II		883 LBS
BAGGAGE ALLOWANCE		120 LBS
WING LOADING: Pounds/Sq Ft		13.2
POWER LOADING: Pounds/HP		14.4
FUEL CAPACITY: Total		
Standard Tanks		43 GAL.
Long Range Tanks		54 GAL.
OIL CAPACITY		6 QTS
ENGINE: Avco Lycoming 160 BHP at 2700 RPM		O-320-H2AD
PROPELLER: Fixed Pitch, Diameter		75 IN.

SECTION 1
GENERAL

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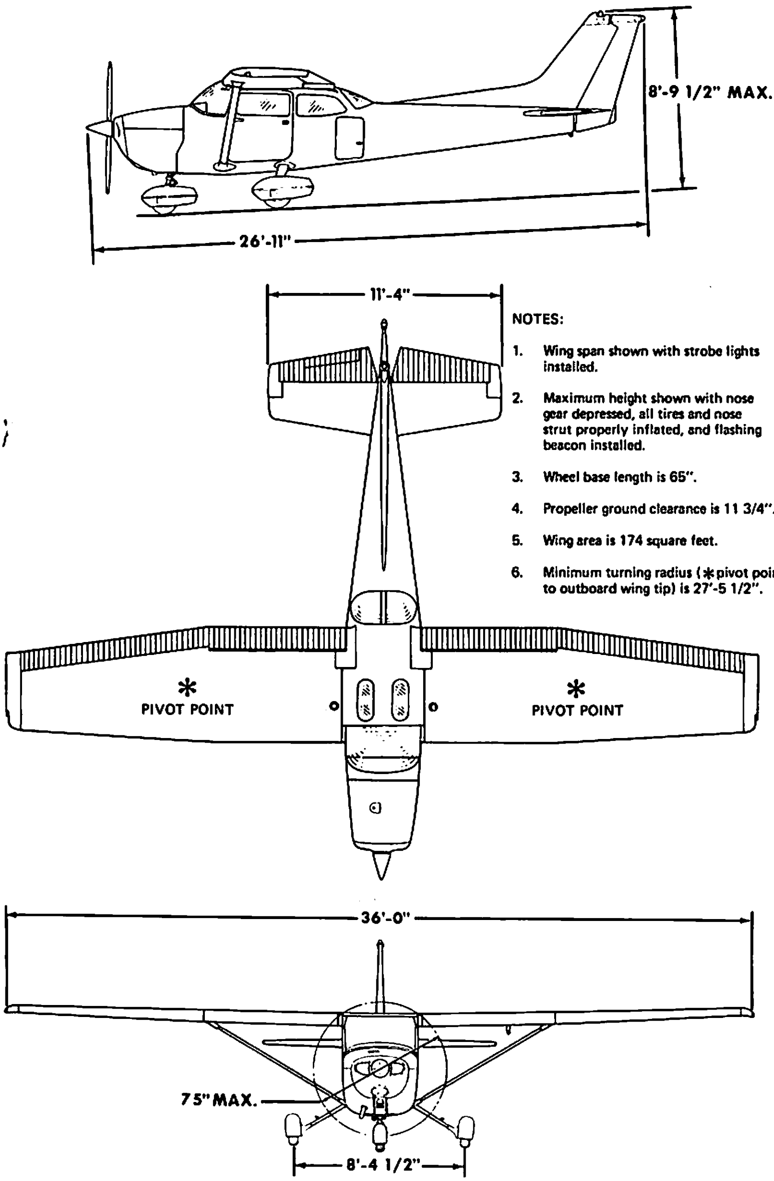

NOTES:

1. Wing span shown with strobe lights installed.
2. Maximum height shown with nose gear depressed, all tires and nose strut properly inflated, and flashing beacon installed.
3. Wheel base length is 65".
4. Propeller ground clearance is 11 3/4".
5. Wing area is 174 square feet.
6. Minimum turning radius (* pivot point to outboard wing tip) is 27'-5 1/2".

Figure 1-1. Three View

INTRODUCTION

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

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

DESCRIPTIVE DATA

ENGINE

Number of Engines: 1.
Engine Manufacturer: Avco Lycoming.
Engine Model Number: O-320-H2AD.
Engine Type: Normally-aspirated, direct-drive, air-cooled, horizontally-opposed, carburetor equipped, four-cylinder engine with 320 cu. in. displacement.
Horsepower Rating and Engine Speed: 160 rated BHP at 2700 RPM.

PROPELLER

Propeller Manufacturer: McCauley Accessory Division.
Propeller Model Number: 1C160/DTM7557.
Number of Blades: 2.
Propeller Diameter, Maximum: 75 inches.
Minimum: 74 inches.
Propeller Type: Fixed pitch.

FUEL

Approved Fuel Grades (and Colors):
100LL Grade Aviation Fuel (Blue).
100 (Formerly 100/130) Grade Aviation Fuel (Green).

Fuel Capacity:
Standard Tanks:
Total Capacity: 43 gallons.
Total Capacity Each Tank: 21.5 gallons.
Total Usable: 40 gallons.
Long Range Tanks:
Total Capacity: 54 gallons.
Total Capacity Each Tank: 27 gallons.
Total Usable: 50 gallons.

NOTE

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

OIL

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

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.

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

Recommended Viscosity for Temperature Range:
MIL-L-6082 Aviation Grade Straight Mineral Oil:
SAE 50 above 16°C (60°F).
SAE 40 between -1°C (30°F) and 32°C (90°F).
SAE 30 between -18°C (0°F) and 21°C (70°F).
SAE 20 below -12°C (10°F).
MIL-L-22851 Ashless Dispersant Oil:
SAE 40 or SAE 50 above 16°C (60°F).
SAE 40 between -1°C (30°F) and 32°C (90°F).
SAE 30 or SAE 40 between -18°C (0°F) and 21°C (70°F).
SAE 30 below -12°C (10°F).

Oil Capacity:
Sump: 6 Quarts.
Total: 7 Quarts (if oil filter installed).

MAXIMUM CERTIFICATED WEIGHTS

Ramp, Normal Category: 2307 lbs.
Utility Category: 2007 lbs.
Takeoff, Normal Category: 2300 lbs.
Utility Category: 2000 lbs.
Landing, Normal Category: 2300 lbs.
Utility Category: 2000 lbs.
Weight in Baggage Compartment, Normal Category:
Baggage Area 1 (or passenger on child's seat) - Station 82 to 108: 120 lbs. See note below.
Baggage Area 2 - Station 108 to 142: 50 lbs. See note below.

NOTE

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

Weight in Baggage Compartment, Utility Category: In this category, the baggage compartment and rear seat must not be occupied.

STANDARD AIRPLANE WEIGHTS

Standard Empty Weight, Skyhawk: 1397 lbs.
Skyhawk II: 1424 lbs.

Maximum Useful Load:

	Normal Category	Utility Category
Skyhawk:	910 lbs.	610 lbs.
Skyhawk II:	883 lbs.	583 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: 13.2 lbs./sq. ft.
Power Loading: 14.4 lbs./hp.

SYMBOLS, ABBREVIATIONS AND TERMINOLOGY

GENERAL AIRSPEED TERMINOLOGY AND SYMBOLS

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

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

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

V_A — **Manuevering 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_{S_o} — **Stalling Speed or the minimum steady flight speed** at which the airplane is controllable in the landing configuration at the most forward center of gravity.

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

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

METEOROLOGICAL TERMINOLOGY

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

	It is expressed in either degrees Celsius or degrees Fahrenheit.
Standard Temperature	**Standard Temperature** is 15°C at sea level pressure altitude and decreases by 2°C for each 1000 feet of altitude.
Pressure Altitude	**Pressure Altitude** is the altitude read from an altimeter when the altimeter's barometric scale has been set to 29.92 inches of mercury (1013 mb).

ENGINE POWER TERMINOLOGY

BHP	**Brake Horsepower** is the power developed by the engine.
RPM	**Revolutions Per Minute** is engine speed.
Static RPM	**Static RPM** is engine speed attained during a full-throttle engine runup when the airplane is on the ground and stationary.

AIRPLANE PERFORMANCE AND FLIGHT PLANNING TERMINOLOGY

Demonstrated Crosswind Velocity	**Demonstrated Crosswind Velocity** is the velocity of the crosswind component for which adequate control of the airplane during takeoff and landing was actually demonstrated during certification tests. The value shown is not considered to be limiting.
Usable Fuel	**Usable Fuel** is the fuel available for flight planning.
Unusable Fuel	**Unusable Fuel** is the quantity of fuel that can not be safely used in flight.
GPH	**Gallons Per Hour** is the amount of fuel (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 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.

SECTION 2
LIMITATIONS

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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. 3A12 as Cessna Model No. 172N.

AIRSPEED LIMITATIONS

Airspeed limitations and their operational significance are shown in figure 2-1. Maneuvering speeds shown apply to normal category operations. The utility category maneuvering speed is 97 KIAS at 2000 pounds.

	SPEED	KCAS	KIAS	REMARKS
V_{NE}	Never Exceed Speed	158	160	Do not exceed this speed in any operation.
V_{NO}	Maximum Structural Cruising Speed	126	128	Do not exceed this speed except in smooth air, and then only with caution.
V_A	Maneuvering Speed: 2300 Pounds 1950 Pounds 1600 Pounds	 96 88 80	 97 89 80	Do not make full or abrupt control movements above this speed.
V_{FE}	Maximum Flap Extended Speed: 10^{o} Flaps 10^{o} - 40^{o} Flaps	 108 86	 110 85	Do not exceed this speed with flaps down.
	Maximum Window Open Speed	158	160	Do not exceed this speed with windows open.

Figure 2-1. Airspeed Limitations

AIRSPEED INDICATOR MARKINGS

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

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
White Arc	41 - 85	Full Flap Operating Range. Lower limit is maximum weight V_{S_O} in landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	47 - 128	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	128 - 160	Operations must be conducted with caution and only in smooth air.
Red Line	160	Maximum speed for all operations.

Figure 2-2. Airspeed Indicator Markings

POWER PLANT LIMITATIONS

Engine Manufacturer: Avco Lycoming.
Engine Model Number: O-320-H2AD.
Engine Operating Limits for Takeoff and Continuous Operations:
Maximum Power: 160 BHP.
Maximum Engine Speed: 2700 RPM.

NOTE

The static RPM range at full throttle (carburetor heat off and full rich mixture) is 2280 to 2400 RPM.

Maximum Oil Temperature: 245°F (118°C).
Oil Pressure, Minimum: 25 psi.
Maximum: 100 psi.
Propeller Manufacturer: McCauley Accessory Division.
Propeller Model Number: 1C160/DTM7557.
Propeller Diameter, Maximum: 75 inches.
Minimum: 74 inches.

POWER PLANT INSTRUMENT MARKINGS

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

INSTRUMENT	RED LINE MINIMUM LIMIT	GREEN ARC NORMAL OPERATING	YELLOW ARC CAUTION RANGE	RED LINE MAXIMUM LIMIT
Tachometer: Sea Level 5000 Feet 10000 Feet	---	2100-2450 RPM 2100-2575 RPM 2100-2700 RPM	---	2700 RPM
Oil Temperature	---	100°-245°F	---	245°F
Oil Pressure	25 psi	60-90 psi	---	100 psi
Fuel Quantity (Standard Tanks)	E (1.5 Gal. Unusable Each Tank)	---	---	---
Fuel Quantity (Long Range Tanks)	E (2.0 Gal. Unusable Each Tank)	---	---	---
Suction	---	4.5-5.4 in. Hg	---	---

Figure 2-3. Power Plant Instrument Markings

WEIGHT LIMITS

NORMAL CATEGORY

Maximum Ramp Weight: 2307 lbs.
Maximum Takeoff Weight: 2300 lbs.
Maximum Landing Weight: 2300 lbs.
Maximum Weight in Baggage Compartment:
Baggage Area 1 (or passenger on child's seat) - Station 82 to 108: 120 lbs. See note below.
Baggage Area 2 - Station 108 to 142: 50 lbs. See note below.

NOTE

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

UTILITY CATEGORY

Maximum Ramp Weight: 2007 lbs.
Maximum Takeoff Weight: 2000 lbs.
Maximum Landing Weight: 2000 lbs.
Maximum Weight in Baggage Compartment: In the utility category, the baggage compartment and rear seat must not be occupied.

CENTER OF GRAVITY LIMITS

NORMAL CATEGORY

Center of Gravity Range:
Forward: 35.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 38.5 inches aft of datum at 2300 lbs.
Aft: 47.3 inches aft of datum at all weights.
Reference Datum: Lower portion of front face of firewall.

UTILITY CATEGORY

Center of Gravity Range:
Forward: 35.0 inches aft of datum at 1950 lbs. or less, with straight line variation to 35.5 inches aft of datum at 2000 lbs.
Aft: 40.5 inches aft of datum at all weights.
Reference Datum: Lower portion of front face of firewall.

MANEUVER LIMITS

NORMAL CATEGORY

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

UTILITY CATEGORY

This airplane is not designed for purely aerobatic flight. However, in the acquisition of various certificates such as commercial pilot and flight instructor, certain maneuvers are required by the FAA. All of these maneuvers are permitted in this airplane when operated in the utility category.

In the utility category, the baggage compartment and rear seat must not be occupied. No aerobatic maneuvers are approved except those listed below:

MANEUVER	RECOMMENDED ENTRY SPEED*
Chandelles	105 knots
Lazy Eights	105 knots
Steep Turns	95 knots
Spins	Slow Deceleration
Stalls (Except Whip Stalls)	Slow Deceleration

*Abrupt use of the controls is prohibited above 97 knots.

Aerobatics that may impose high loads should not be attempted. The important thing to bear in mind in flight maneuvers is that the airplane is clean in aerodynamic design and will build up speed quickly with the nose down. Proper speed control is an essential requirement for execution of any maneuver, and care should always be exercised to avoid excessive speed which in turn can impose excessive loads. In the execution of all maneuvers, avoid abrupt use of controls. Intentional spins with flaps extended are prohibited.

FLIGHT LOAD FACTOR LIMITS

NORMAL CATEGORY

Flight Load Factors (Maximum Takeoff Weight - 2300 lbs.):

*Flaps Up	+3.8g, -1.52g
*Flaps Down	+3.0g

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

UTILITY CATEGORY

Flight Load Factors (Maximum Takeoff Weight - 2000 lbs.):

*Flaps Up	+4.4g, -1.76g
*Flaps Down	+3.0g

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

KINDS OF OPERATION LIMITS

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

Flight into known icing conditions is prohibited.

FUEL LIMITATIONS

2 Standard Tanks: 21.5 U.S. gallons each.
    Total Fuel: 43 U.S. gallons.
    Usable Fuel (all flight conditions): 40 U.S. gallons.
    Unusable Fuel: 3 U.S. gallons.
2 Long Range Tanks: 27 U.S. gallons each.
    Total Fuel: 54 U.S. gallons.
    Usable Fuel (all flight conditions): 50 U.S. gallons.
    Unusable Fuel: 4 U.S. gallons.

NOTE

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

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

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

Approved Fuel Grades (and Colors):
    100LL Grade Aviation Fuel (Blue).
    100 (Formerly 100/130) Grade Aviation Fuel (Green).

OTHER LIMITATIONS

FLAP LIMITATIONS

Approved Takeoff Range: 0° to 10°.
Approved Landing Range: 0° to 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 or in the Utility Category are contained in the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.
>
> Normal Category - No acrobatic maneuvers, including spins, approved.
>
> Utility Category - No acrobatic maneuvers approved, except those listed in the Pilot's Operating Handbook.
>
> Baggage compartment and rear seat must not be occupied.
>
> Spin Recovery - Opposite rudder - forward elevator - neutralize controls.
>
> Flight into known icing conditions prohibited.
>
> This airplane is certified for the following flight operations as of date of original airworthiness certificate:
>
> DAY—NIGHT—VFR—IFR

2. On the fuel selector valve (standard tanks):

> BOTH - 40 GAL. ALL FLIGHT ATTITUDES.
> TAKEOFF, LANDING.
> LEFT - 20 GAL. LEVEL FLIGHT ONLY
> RIGHT - 20 GAL. LEVEL FLIGHT ONLY
> OFF

On the fuel selector valve (long range tanks):

BOTH - 50 GAL. ALL FLIGHT ATTITUDES. TAKEOFF, LANDING. LEFT - 25 GAL. LEVEL FLIGHT ONLY RIGHT - 25 GAL. LEVEL FLIGHT ONLY OFF

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

FUEL 100LL/100 MIN. GRADE AVIATION GASOLINE CAP. 21.5 U.S. GAL.

Near fuel tank filler cap (long range tanks):

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

4. Near wing flap switch:

AVOID SLIPS WITH FLAPS EXTENDED

5. On flap control indicator:

0° to 10°	(Partial flap range with blue color code and 110 kt callout; also, mechanical detent at 10°.)
10° to 40°	(Indices at these positions with white color code and 85 kt callout; also, mechanical detent at 10° and 20°.)

6. In baggage compartment:

120 POUNDS MAXIMUM BAGGAGE AND/OR AUXILIARY PASSENGER FORWARD OF BAGGAGE DOOR LATCH 50 POUNDS MAXIMUM BAGGAGE AFT OF BAGGAGE DOOR LATCH MAXIMUM 120 POUNDS COMBINED FOR ADDITIONAL LOADING INSTRUCTIONS SEE WEIGHT AND BALANCE DATA

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

8. On oil filler cap:

OIL 6 QTS

9. On control lock:

CONTROL LOCK - REMOVE BEFORE STARTING ENGINE

10. Near airspeed indicator:

MANEUVER SPEED - 97 KIAS

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.

AIRSPEEDS FOR EMERGENCY OPERATION

Engine Failure After Takeoff:
  Wing Flaps Up . . . . 65 KIAS
  Wing Flaps Down . . . . 60 KIAS
Maneuvering Speed:
  2300 Lbs . . . . 97 KIAS
  1950 Lbs . . . . 89 KIAS
  1600 Lbs . . . . 80 KIAS
Maximum Glide . . . . 65 KIAS
Precautionary Landing With Engine Power . . . . 60 KIAS
Landing Without Engine Power:
  Wing Flaps Up . . . . 65 KIAS
  Wing Flaps Down . . . . 60 KIAS

OPERATIONAL CHECKLISTS

ENGINE FAILURES

ENGINE FAILURE DURING TAKEOFF RUN

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

ENGINE FAILURE IMMEDIATELY AFTER TAKEOFF

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

ENGINE FAILURE DURING FLIGHT

1. Airspeed -- 65 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 -- 65 KIAS (flaps UP).
   60 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. Wing Flaps -- 20°.
2. Airspeed -- 60 KIAS.
3. Selected Field -- FLY OVER, noting terrain and obstructions, then retract flaps upon reaching a safe altitude and airspeed.
4. Avionics Power Switch and Electrical Switches -- OFF.
5. Wing Flaps -- 40° (on final approach).
6. Airspeed -- 60 KIAS.
7. Master Switch -- OFF.
8. Doors -- UNLATCH PRIOR TO TOUCHDOWN.

9. Touchdown -- SLIGHTLY TAIL LOW.
10. Ignition Switch -- OFF.
11. Brakes -- APPLY HEAVILY.

DITCHING

1. Radio -- TRANSMIT MAYDAY on 121.5 MHz, giving location and intentions and SQUAWK 7700 if transponder is installed.
2. Heavy Objects (in baggage area) -- SECURE OR JETTISON.
3. Approach -- High Winds, Heavy Seas -- INTO THE WIND.
   Light Winds, Heavy Swells -- PARALLEL TO SWELLS.
4. Wing Flaps -- 20° - 40°.
5. Power -- ESTABLISH 300 FT/MIN DESCENT AT 55 KIAS.

NOTE

If no power is available, approach at 65 KIAS with flaps up or at 60 KIAS with 10° flaps.

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

FIRES

DURING START ON GROUND

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

If engine starts:

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

If engine fails to start:

4. Throttle -- FULL OPEN.
5. Mixture -- IDLE CUT-OFF.

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

ENGINE FIRE IN FLIGHT

1. Mixture -- IDLE CUT-OFF.
2. Fuel Selector Valve -- OFF.
3. Master Switch -- OFF.
4. Cabin Heat and Air -- OFF (except overhead vents).
5. Airspeed -- 100 KIAS (If fire is not extinguished, increase glide speed to find an airspeed which will provide an incombustible mixture).
6. Forced Landing -- EXECUTE (as described in Emergency Landing Without Engine Power).

ELECTRICAL FIRE IN FLIGHT

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

NOTE

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

ICING

INADVERTENT ICING ENCOUNTER

1. Turn pitot heat switch ON (if installed).
2. Turn back or change altitude to obtain an outside air temperature that is less conducive to icing.
3. Pull cabin heat control full out and open defroster outlet to obtain maximum windshield defroster airflow. Adjust cabin air control to get maximum defroster heat and airflow.
4. Open the throttle to increase engine speed and minimize ice build-up on propeller blades.
5. Watch for signs of carburetor air filter ice and apply carburetor

heat as required. An unexplained loss in engine speed could be caused by carburetor ice or air intake filter ice. Lean the mixture for maximum RPM, if carburetor heat is used continuously.

6. Plan a landing at the nearest airport. With an extremely rapid ice build-up, select a suitable "off airport" landing site.
7. With an ice accumulation of 1/4 inch or more on the wing leading edges, be prepared for significantly higher stall speed.
8. Leave wing flaps retracted. With a severe ice build-up on the horizontal tail, the change in wing wake airflow direction caused by wing flap extension could result in a loss of elevator effectiveness.
9. Open left window and, if practical, scrape ice from a portion of the windshield for visibility in the landing approach.
10. Perform a landing approach using a forward slip, if necessary, for improved visibility.
11. Approach at 65 to 75 KIAS depending upon the amount of the accumulation.
12. Perform a landing in level attitude.

STATIC SOURCE BLOCKAGE
(Erroneous Instrument Reading Suspected)

1. Alternate Static Source Valve -- PULL ON.
2. Airspeed -- Consult appropriate calibration tables in Section 5.

LANDING WITH A FLAT MAIN TIRE

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

ELECTRICAL POWER SUPPLY SYSTEM MALFUNCTIONS

AMMETER SHOWS EXCESSIVE RATE OF CHARGE
(Full Scale Deflection)

1. Alternator -- OFF.
2. Nonessential Electrical Equipment -- OFF.
3. 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. Master Switch -- OFF (both sides).
3. Master Switch -- ON.
4. Low-Voltage Light -- CHECK OFF.
5. Avionics Power Switch -- ON.

If low-voltage light illuminates again:

6. Alternator -- OFF.
7. Nonessential Radio and Electrical Equipment -- OFF.
8. 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.

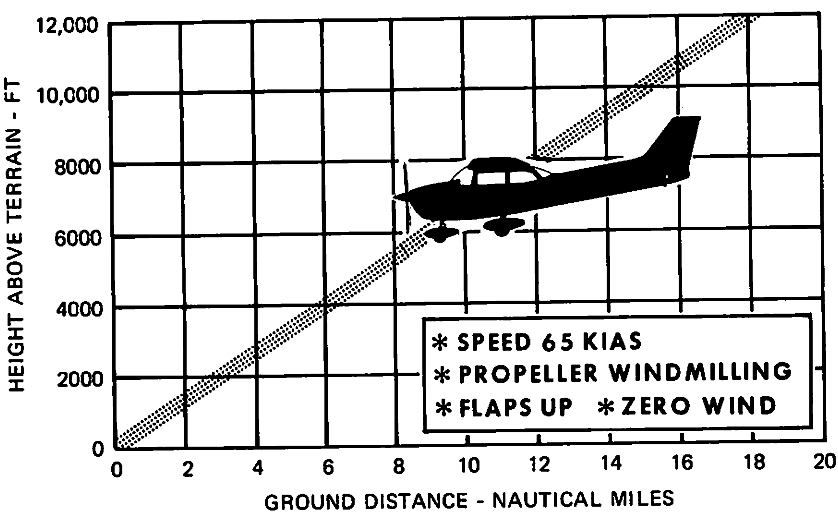

Figure 3-1. Maximum Glide

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 under the Emergency Landing Without Engine Power checklist.

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

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

LANDING WITHOUT ELEVATOR CONTROL

Trim for horizontal flight (with an airspeed of approximately 60 KIAS and flaps set to 20°) by using throttle and elevator trim controls. Then **do not change the elevator trim control setting**; control the glide angle by adjusting power exclusively.

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

FIRES

Although engine fires are extremely rare in flight, the steps of the appropriate checklist should be followed if one is encountered. After completion of this procedure, execute a forced landing. Do not attempt to restart the engine.

The initial indication of an electrical fire is usually the odor of burning insulation. The checklist for this problem should result in elimination of the fire.

EMERGENCY OPERATION IN CLOUDS (Vacuum System Failure)

In the event of a 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.
2. Use full carburetor heat.
3. Reduce power to set up a 500 to 800 ft/min rate of descent.
4. Adjust the elevator trim and rudder trim (if installed) for a stabilized descent at 70-80 KIAS.
5. Keep hands off the control wheel.
6. Monitor turn coordinator and make corrections by rudder alone.
7. Check trend of compass card movement and make cautious corrections with rudder to stop the turn.
8. Upon breaking out of clouds, resume normal cruising flight.

RECOVERY FROM A SPIRAL DIVE

If a spiral is encountered, proceed as follows:

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

INADVERTENT FLIGHT INTO ICING CONDITIONS

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

STATIC SOURCE BLOCKED

If erroneous readings of the static source instruments (airspeed, altimeter and rate-of-climb) are suspected, the alternate static source valve should be pulled on, thereby supplying static pressure to these instruments from the cabin.

NOTE

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

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

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

SPINS

Should an inadvertent spin occur, the following recovery procedure should be used:

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

NOTE

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

For additional information on spins and spin recovery, see the discussion under SPINS in Normal Procedures (Section 4).

ROUGH ENGINE OPERATION OR LOSS OF POWER

CARBURETOR ICING

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

SPARK PLUG FOULING

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

MAGNETO MALFUNCTION

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

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

SECTION 4
NORMAL PROCEDURES

TABLE OF CONTENTS

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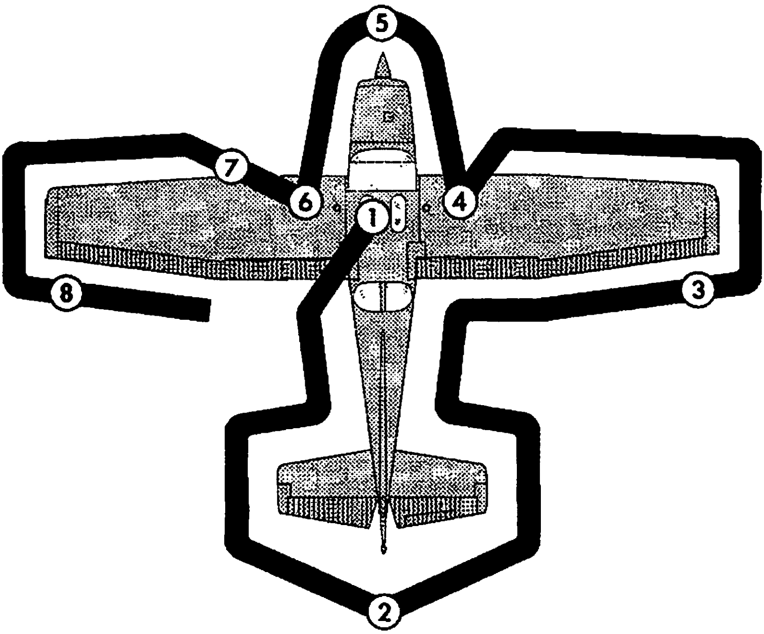
INTRODUCTION

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 2300 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, Flaps Up:	
Normal Climb Out	70-80 KIAS
Short Field Takeoff, Flaps Up, Speed at 50 Feet	59 KIAS
Enroute Climb, Flaps Up:	
Normal, Sea Level	75-85 KIAS
Normal, 10,000 Feet	70-80 KIAS
Best Rate of Climb, Sea Level	73 KIAS
Best Rate of Climb, 10,000 Feet	68 KIAS
Best Angle of Climb, Sea Level	59 KIAS
Best Angle of Climb, 10,000 Feet	61 KIAS
Landing Approach:	
Normal Approach, Flaps Up	60-70 KIAS
Normal Approach, Flaps 40°	55-65 KIAS
Short Field Approach, Flaps 40°	60 KIAS
Balked Landing:	
Maximum Power, Flaps 20°	55 KIAS
Maximum Recommended Turbulent Air Penetration Speed:	
2300 Lbs	97 KIAS
1950 Lbs	89 KIAS
1600 Lbs	80 KIAS
Maximum Demonstrated Crosswind Velocity:	
Takeoff or 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. Baggage Door -- CHECK, lock with key if child's seat is to be occupied.

(2) EMPENNAGE

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

(3) RIGHT WING Trailing Edge

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

(4) RIGHT WING

1. Wing Tie-Down -- DISCONNECT.
2. Main Wheel Tire -- CHECK for proper inflation.
3. 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.
4. Fuel Quantity -- CHECK VISUALLY for desired level.
5. Fuel Filler Cap -- SECURE.

(5) NOSE

1. Engine Oil Level -- CHECK, do not operate with less than four quarts. Fill to six quarts for extended flight.
2. 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.
3. Propeller and Spinner -- CHECK for nicks and security.
4. Landing Light(s) -- CHECK for condition and cleanliness.
5. Carburetor Air Filter -- CHECK for restrictions by dust or other foreign matter.
6. Nose Wheel Strut and Tire -- CHECK for proper inflation.
7. Nose Tie-Down -- DISCONNECT.
8. Static Source Opening (left side of fuselage) -- CHECK for stoppage.

(6) LEFT WING

1. Main Wheel Tire -- CHECK for proper inflation.
2. 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.
3. Fuel Quantity -- CHECK VISUALLY for desired level.
4. Fuel Filler Cap -- SECURE.

(7) LEFT WING Leading Edge

1. Pitot Tube Cover -- REMOVE and check opening for stoppage.
2. Fuel Tank Vent Opening -- CHECK for stoppage.
3. Stall Warning Opening -- CHECK for stoppage. To check the system, place a clean handkerchief over the vent opening and apply suction; a sound from the warning horn will confirm system operation.
4. Wing Tie-Down -- DISCONNECT.

(8) LEFT WING Trailing Edge

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

BEFORE STARTING ENGINE

1. Preflight Inspection -- COMPLETE.

2. Seats, Belts, Shoulder Harnesses -- ADJUST and 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. Circuit Breakers -- CHECK IN.

STARTING ENGINE

1. Mixture -- RICH.
2. Carburetor Heat -- COLD.
3. Master Switch -- ON.
4. Prime -- AS REQUIRED (2 to 6 strokes; none if engine is warm).
5. Throttle -- OPEN 1/8 INCH.
6. Propeller Area -- CLEAR.
7. Ignition Switch -- START (release when engine starts).
8. Oil Pressure -- CHECK.

BEFORE TAKEOFF

1. Parking Brake -- SET.
2. Cabin Doors and Window(s) -- CLOSED and LOCKED.
3. Flight Controls -- FREE and CORRECT.
4. Flight Instruments -- SET.
5. Fuel Selector Valve -- BOTH.
6. Mixture -- RICH (below 3000 feet).
7. Elevator Trim and Rudder Trim (if installed) -- TAKEOFF.
8. Throttle -- 1700 RPM.
   a. Magnetos -- CHECK (RPM drop should not exceed 125 RPM on either magneto or 50 RPM differential between magnetos).
   b. Carburetor Heat -- CHECK (for RPM drop).
   c. Engine Instruments and Ammeter -- CHECK.
   d. Suction Gage -- CHECK.
9. Avionics Power Switch -- ON.
10. Radios -- SET.
11. Autopilot (if installed) -- OFF.
12. Air Conditioner (if installed) -- OFF.

13. Flashing Beacon, Navigation Lights and/or Strobe Lights -- ON as required.
14. Throttle Friction Lock -- ADJUST.
15. Brakes -- RELEASE.

TAKEOFF

NORMAL TAKEOFF

1. Wing Flaps -- UP.
2. Carburetor Heat -- COLD.
3. Throttle -- FULL OPEN.
4. Elevator Control -- LIFT NOSE WHEEL (at 55 KIAS).
5. Climb Speed -- 70-80 KIAS.

SHORT FIELD TAKEOFF

1. Wing Flaps -- UP.
2. Carburetor Heat -- COLD.
3. Brakes -- APPLY.
4. Throttle -- FULL OPEN.
5. Mixture -- RICH (above 3000 feet, LEAN to obtain maximum RPM).
6. Brakes -- RELEASE.
7. Elevator Control -- SLIGHTLY TAIL LOW.
8. Climb Speed -- 59 KIAS (until all obstacles are cleared).

ENROUTE CLIMB

1. Airspeed -- 70-85 KIAS.

NOTE

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

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

CRUISE

1. Power -- 2200-2700 RPM (no more than 75% is recommended).
2. Elevator and Rudder Trim (if installed) -- ADJUST.
3. Mixture -- LEAN.

DESCENT

1. Mixture -- ADJUST for smooth operation (full rich for idle power).
2. Power -- AS DESIRED.
3. Carburetor Heat -- AS REQUIRED (to prevent carburetor icing).

BEFORE LANDING

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

LANDING

NORMAL LANDING

1. Airspeed -- 60-70 KIAS (flaps UP).
2. Wing Flaps -- AS DESIRED (0°-10° below 110 KIAS, 10°-40° below 85 KIAS).
3. Airspeed -- 55-65 KIAS (flaps DOWN).
4. Touchdown -- MAIN WHEELS FIRST.
5. Landing Roll -- LOWER NOSE WHEEL GENTLY.
6. Braking -- MINIMUM REQUIRED.

SHORT FIELD LANDING

1. Airspeed -- 60-70 KIAS (flaps UP).
2. Wing Flaps -- FULL DOWN (40°).
3. Airspeed -- 60 KIAS (until flare).
4. Power -- REDUCE to idle after clearing obstacle.
5. Touchdown -- MAIN WHEELS FIRST.
6. Brakes -- APPLY HEAVILY.
7. Wing Flaps -- RETRACT.

BALKED LANDING

1. Throttle -- FULL OPEN.
2. Carburetor Heat -- COLD.
3. Wing Flaps -- 20° (immediately).
4. Climb Speed -- 55 KIAS.
5. Wing Flaps -- 10° (until obstacles are cleared).
   RETRACT (after reaching a safe altitude and 60 KIAS).

AFTER LANDING

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

SECURING AIRPLANE

1. Parking Brake -- SET.
2. Avionics Power Switch, Electrical Equipment, Autopilot (if installed) -- OFF.
3. Mixture -- IDLE CUT-OFF (pulled full out).
4. Ignition Switch -- OFF.
5. Master Switch -- OFF.
6. Control Lock -- INSTALL.

AMPLIFIED PROCEDURES

STARTING ENGINE

During engine starting, open the throttle approximately 1/8 inch. In warm temperatures, one or two strokes of the primer should be sufficient. In cold weather, up to six strokes of the primer may be necessary. If the engine is warm, no priming will be required. In extremely cold temperatures, it may be necessary to continue priming while cranking the engine.

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

If the engine is underprimed (most likely in cold weather with a cold engine) it will not fire at all, and additional priming will be necessary. As soon as the cylinders begin to fire, open the throttle slightly to keep it running.

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.

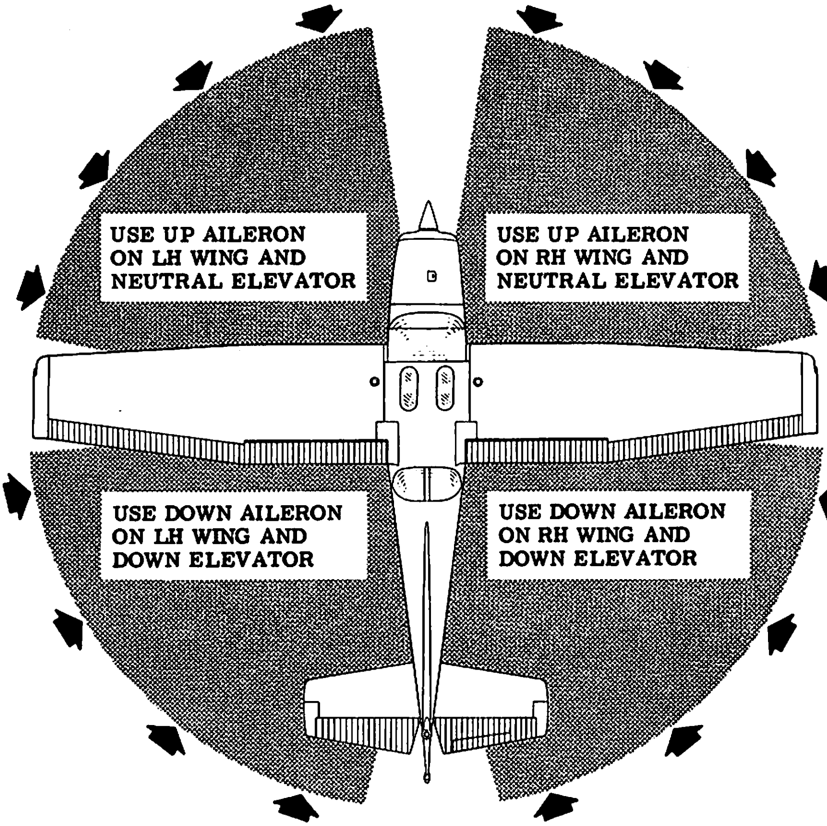
NOTE

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. When the knob is pulled out to the heat position, air entering the engine is not filtered.



CODE

WIND DIRECTION ➧

NOTE

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

Figure 4-2. Taxiing Diagram

obstacles when taking into account the turbulence often found near ground level. The takeoff performance data provided in Section 5 is based on the flaps up configuration.

If 10° of flaps are used on soft or rough fields with obstacles ahead, it is normally preferable to leave them extended rather than retract them in the climb to the obstacle. With 10° flaps, use an obstacle clearance speed of 55 KIAS. As soon as the obstacle is cleared, the flaps may be retracted as the airplane accelerates to the normal flaps-up climb-out speed.

CROSSWIND TAKEOFF

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

ENROUTE CLIMB

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

CRUISE

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

NOTE

Cruising should be done at 65% to 75% power 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 altitude and power setting for a given trip. The selection of cruise altitude on the basis of the most favorable wind conditions and the use of low power settings are significant factors that should be considered on every trip to reduce fuel consumption.

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

Should it be necessary to cruise at higher than 75% power, the mixture should not be leaned more than is required to provide peak RPM.

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

	75% POWER		65% POWER		55% POWER	
ALTITUDE	KTAS	NMPG	KTAS	NMPG	KTAS	NMPG
Sea Level	114	13.5	107	14.8	100	16.1
4000 Feet	118	14.0	111	15.3	103	16.6
8000 Feet	122	14.5	115	15.8	106	17.1
Standard Conditions						Zero Wind

Figure 4-3. Cruise Performance Table

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

Figure 4-4. EGT Table

The use of full carburetor heat is recommended during flight in heavy rain to avoid the possibility of engine stoppage due to excessive water ingestion or carburetor ice. The mixture setting should be readjusted for smoothest operation. Power changes should be made cautiously, followed by prompt adjustment of the mixture for smoothest operation.

LEANING WITH A CESSNA ECONOMY MIXTURE INDICATOR (EGT)

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

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

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

STALLS

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

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

SPINS

Intentional spins are approved in this airplane within certain restricted loadings. Spins with baggage loadings or occupied rear seat(s) are not approved.

However, before attempting to perform spins several items should be carefully considered to assure a safe flight. No spins should be attempted without first having received dual instruction both in spin entries and spin recoveries from a qualified instructor who is familiar with the spin characteristics of the Cessna 172N.

The cabin should be clean and all loose equipment (including the microphone and rear seat belts) should be stowed or secured. For a solo flight in which spins will be conducted, the copilot's seat belt and shoulder harness should also be secured. The seat belts and shoulder harnesses should be adjusted to provide proper restraint during all anticipated flight conditions. However, care should be taken to ensure that the pilot can easily reach the flight controls and produce maximum control travels.

It is recommended that, where feasible, entries be accomplished at high enough altitude that recoveries are completed 4000 feet or more above ground level. At least 1000 feet of altitude loss should be allowed for a 1-turn spin and recovery, while a 6-turn spin and recovery may require somewhat more than twice that amount. For example, the recommended entry altitude for a 6-turn spin would be 6000 feet above ground level. In any case, entries should be planned so that recoveries are completed **well above** the minimum 1500 feet above ground level required by FAR 91.71. Another reason for using high altitudes for practicing spins is that a greater field of view is provided which will assist in maintaining pilot orientation.

The normal entry is made from a power-off stall. As the stall is approached, the elevator control should be smoothly pulled to the full aft position. Just prior to reaching the stall "break", rudder control in the desired direction of the spin rotation should be applied so that full rudder deflection is reached almost simultaneously with reaching full aft elevator. A slightly greater rate of deceleration than for normal stall entries, application of ailerons in the direction of the desired spin, and the use of power at the entry will assure more consistent and positive entries to the spin. As the airplane begins to spin, reduce the power to idle and return the ailerons to neutral. Both elevator and rudder controls should be held full with the spin until the spin recovery is initiated. An inadvertent relaxation of either of these controls could result in the development of a nose-down spiral.

For the purpose of training in spins and spin recoveries, a 1 or 2 turn spin is adequate and should be used. Up to 2 turns, the spin will progress to a fairly rapid rate of rotation and a steep attitude. Application of recovery controls will produce prompt recoveries (within 1/4 turn). During extended spins of two to three turns or more, the spin will tend to change into a spiral, particularly to the right. This will be accompanied by an increase in airspeed and gravity loads on the airplane. If this occurs, recovery should be accomplished quickly by leveling the wings and recovering from the resulting dive.

Regardless of how many turns the spin is held or how it is entered, the following recovery technique should be used:

1. VERIFY THAT THROTTLE IS IN IDLE POSITION AND AILERONS ARE NEUTRAL.
2. APPLY AND **HOLD** FULL RUDDER OPPOSITE TO THE DIRECTION OF ROTATION.
3. JUST **AFTER** THE RUDDER REACHES THE STOP, MOVE THE CONTROL WHEEL **BRISKLY** FORWARD FAR ENOUGH TO BREAK THE STALL.
4. **HOLD** THESE CONTROL INPUTS UNTIL ROTATION STOPS.
5. 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.

Variations in basic airplane rigging or in weight and balance due to installed equipment or right seat occupancy can cause differences in behavior, particularly in extended spins. These differences are normal and will result in variations in the spin characteristics and in the spiraling tendencies for spins of more than 2 turns. However, the recovery technique should always be used and will result in the most expeditious recovery from any spin.

Intentional spins with flaps extended are prohibited, since the high speeds which may occur during recovery are potentially damaging to the flap/wing structure.

LANDING

NORMAL LANDING

Normal landing approaches can be made with power-on or power-off with any flap setting desired. Surface winds and air turbulence are usually the primary factors in determining the most comfortable approach speeds. Steep slips should be avoided with flap settings greater than 20° due to a slight tendency for the elevator to oscillate under certain combinations of airspeed, sideslip angle, and center of gravity loadings.

NOTE

Carburetor heat should be applied prior to any significant reduction or closing of the throttle.

Actual touchdown should be made with power-off and on the main wheels first to reduce the landing speed and subsequent need for braking the landing roll. The nose wheel is lowered to the runway gently after the speed has diminished to avoid unnecessary nose gear loads. This procedure is especially important in rough or soft field landings.

SHORT FIELD LANDING

For a short field landing in smooth air conditions, make an approach at the minimum recommended airspeed with full flaps using enough power to control the glide path. (Slightly higher approach speeds should be used under turbulent air conditions.) After all approach obstacles are cleared, progressively reduce power and maintain the approach speed by lowering the nose of the airplane. Touchdown should be made with power off and on the main wheels first. Immediately after touchdown, lower the nose wheel and apply heavy braking as required. For maximum brake effectiveness, retract the flaps, hold the control wheel full back, and apply maximum brake pressure without sliding the tires.

CROSSWIND LANDING

When landing in a strong crosswind, use the minimum flap setting required for the field length. If flap settings greater than 20° are used in sideslips with full rudder deflection, some elevator oscillation may be felt at normal approach speeds. However, this does not affect control of the airplane. 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.

The maximum allowable crosswind velocity is dependent upon pilot capability as well as aircraft limitations. With average pilot technique, direct crosswinds of 15 knots can be handled with safety.

BALKED LANDING

In a balked landing (go-around) climb, reduce the flap setting to 20° immediately after full power is applied. If obstacles must be cleared during the go-around climb, reduce the wing flap setting to 10° and maintain a safe airspeed until the obstacles are cleared. Above 3000 feet, lean the mixture to obtain maximum RPM. After clearing any obstacles, the flaps may be retracted as the airplane accelerates to the normal flaps-up climb speed.

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 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 7 under Ground Service Plug Receptacle for operating details.

Cold weather starting procedures are as follows:

With Preheat:

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

NOTE

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

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

Without Preheat:

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

NOTE

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.

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.

FLIGHT OPERATIONS

Takeoff is made normally with carburetor heat off. Avoid excessive leaning in cruise.

Carburetor heat may be used to overcome any occasional engine roughness due to ice.

When operating in temperatures below -18°C, avoid using partial carburetor heat. Partial heat may increase the carburetor air temperature to the 0° to 21°C range, where icing is critical under certain atmospheric conditions.

HOT WEATHER OPERATION

Refer to the general warm temperature starting information under Starting Engine in this section. 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 172N at 2300 pounds maximum weight is 73.8 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

TABLE OF CONTENTS

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 based on 45% 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	2250 Pounds
Usable fuel	40 Gallons
TAKEOFF CONDITIONS	
Field pressure altitude	1500 Feet
Temperature	28°C (16°C above standard)
Wind component along runway	12 Knot Headwind
Field length	3500 Feet

CRUISE CONDITIONS

Total distance	460 Nautical Miles
Pressure altitude	5500 Feet
Temperature	20°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 2300 pounds, pressure altitude of 2000 feet and a temperature of 30°C should be used and results in the following:

Ground roll	1075 Feet
Total distance to clear a 50-foot obstacle	1915 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	1075
Decrease in ground roll (1075 feet × 13%)	140
Corrected ground roll	935 Feet

Total distance to clear a 50-foot obstacle, zero wind	1915
Decrease in total distance (1915 feet × 13%)	249
Corrected total distance to clear 50-foot obstacle	1666 Feet

CRUISE

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

The range profile chart indicates that use of 65% power at 5500 feet yields a predicted range of 523 nautical miles with no wind. The endurance profile chart, figure 5-9, shows a corresponding 4.7 hours.

The range figure of 523 nautical miles is corrected to account for the expected 10 knot headwind at 5500 feet.

Range, zero wind	523
Decrease in range due to wind (4.7 hours × 10 knot headwind)	47
Corrected range	476 Nautical Miles

This indicates that the trip can be made without a fuel stop using approximately 65% power.

The cruise performance chart, figure 5-7, is entered at 6000 feet altitude and 20°C above standard temperature. These values most nearly correspond to the planned altitude and expected temperature conditions. The engine speed chosen is 2500 RPM, which results in the following:

Power	64%
True airspeed	114 Knots
Cruise fuel flow	7.1 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 climb from 2000 feet to 6000 feet requires 1.3 gallons of fuel. The corresponding distance during the climb is 9 nautical miles. These values are for a standard temperature and are sufficiently accurate for most flight planning purposes. However, a further correction for the effect of temperature may be made as noted on the climb chart. The approximate effect of a non-standard temperature is to increase the time, fuel, and distance by 10% for each 10°C above standard temperature, due to the lower rate of climb. In this case, assuming a temperature 16°C above standard, the correction would be:

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

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

Fuel to climb, standard temperature	1.3
Increase due to non-standard temperature (1.3 × 16%)	0.2
Corrected fuel to climb	1.5 Gallons

Using a similar procedure for the distance to climb results in 10 nautical miles.

The resultant cruise distance is:

Total distance	460
Climb distance	-10
Cruise distance	450 Nautical Miles

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

114
-10
104 Knots

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

$$\frac{450 \text{ Nautical Miles}}{104 \text{ Knots}} = 4.3 \text{ Hours}$$

The fuel required for cruise is:

4.3 hours × 7.1 gallons/hour = 30.5 Gallons

The total estimated fuel required is as follows:

Engine start, taxi, and takeoff	1.1
Climb	1.5
Cruise	30.5
Total fuel required	33.1 Gallons

This will leave a fuel reserve of:

40.0
-33.1
6.9 Gallons

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

LANDING

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

Ground roll	590 Feet
Total distance to clear a 50-foot obstacle	1370 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	40	50	60	70	80	90	100	110	120	130	140
KCAS	49	55	62	70	80	89	99	108	118	128	138
FLAPS 10°											
KIAS	40	50	60	70	80	90	100	110	---	---	---
KCAS	49	55	62	71	80	89	99	108	---	---	---
FLAPS 40°											
KIAS	40	50	60	70	80	85	---	---	---	---	---
KCAS	47	54	62	71	81	86	---	---	---	---	---

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

AIRSPEED CALIBRATION

ALTERNATE STATIC SOURCE

HEATER/VENTS AND WINDOWS CLOSED

FLAPS UP											
NORMAL KIAS	40	50	60	70	80	90	100	110	120	130	140
ALTERNATE KIAS	39	51	61	71	82	91	101	111	121	131	141
FLAPS 10°											
NORMAL KIAS	40	50	60	70	80	90	100	110	---	---	---
ALTERNATE KIAS	40	51	61	71	81	90	99	108	---	---	---
FLAPS 40°											
NORMAL KIAS	40	50	60	70	80	85	---	---	---	---	---
ALTERNATE KIAS	38	50	60	70	79	83	---	---	---	---	---

HEATER/VENTS OPEN AND WINDOWS CLOSED

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

WINDOWS OPEN

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

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

TEMPERATURE CONVERSION CHART

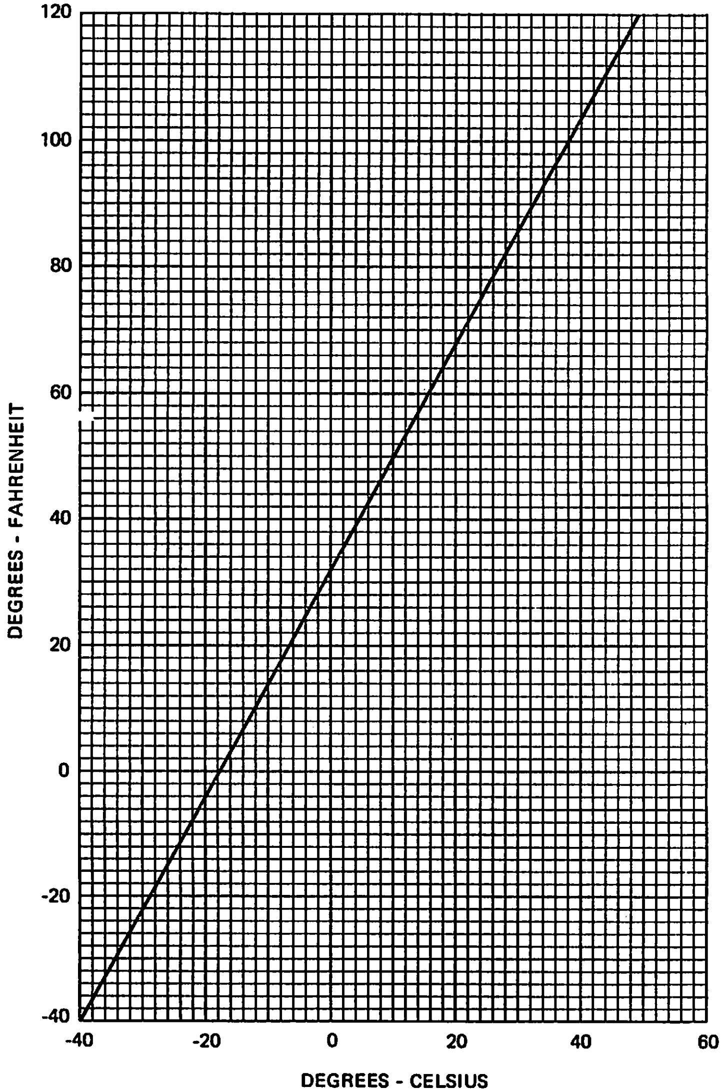


Figure 5-2. Temperature Conversion Chart

STALL SPEEDS

CONDITIONS:
Power Off

NOTES:
1. Maximum altitude loss during a stall recovery may be as much as 180 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
2300	UP	42	50	45	54	50	59	59	71
	10°	38	47	40	51	45	56	54	66
	40°	36	44	38	47	43	52	51	62

MOST FORWARD CENTER OF GRAVITY

WEIGHT LBS	FLAP DEFLECTION	ANGLE OF BANK							
		0°		30°		45°		60°	
		KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
2300	UP	47	53	51	57	56	63	66	75
	10°	44	51	47	55	52	61	62	72
	40°	41	47	44	51	49	56	58	66

Figure 5-3. Stall Speeds

TAKEOFF DISTANCE

MAXIMUM WEIGHT 2300 LBS

SHORT FIELD

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

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

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND ROLL	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
2300	52	59	S.L.	720	1300	775	1390	835	1490	895	1590	960	1700
			1000	790	1420	850	1525	915	1630	980	1745	1050	1865
			2000	865	1555	930	1670	1000	1790	1075	1915	1155	2055
			3000	950	1710	1025	1835	1100	1970	1185	2115	1270	2265
			4000	1045	1880	1125	2025	1210	2175	1300	2335	1400	2510
			5000	1150	2075	1240	2240	1335	2410	1435	2595	1540	2795
			6000	1265	2305	1365	2485	1475	2680	1585	2895	1705	3125
			7000	1400	2565	1510	2770	1630	3000	1755	3245	1890	3515
			8000	1550	2870	1675	3110	1805	3375	1945	3670	2095	3990

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

TAKEOFF DISTANCE
2100 LBS AND 1900 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	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
2100	50	56	S.L.	585	1070	630	1140	680	1220	725	1300	780	1390
			1000	640	1165	690	1245	740	1330	795	1420	850	1520
			2000	700	1270	755	1360	810	1455	870	1555	935	1665
			3000	770	1390	830	1490	890	1595	955	1710	1025	1830
			4000	845	1525	910	1640	980	1755	1050	1880	1130	2015
			5000	930	1680	1000	1805	1075	1935	1155	2075	1240	2230
			6000	1025	1850	1100	1990	1185	2140	1275	2300	1370	2475
			7000	1130	2050	1215	2210	1310	2380	1410	2560	1515	2755
			8000	1245	2275	1345	2460	1450	2655	1560	2865	1680	3090
1900	47	54	S.L.	470	865	505	920	540	985	580	1045	620	1115
			1000	515	940	550	1005	590	1070	635	1140	680	1215
			2000	560	1025	605	1095	645	1170	695	1245	745	1330
			3000	615	1115	660	1195	710	1275	760	1365	815	1455
			4000	670	1220	725	1305	780	1400	835	1495	895	1595
			5000	740	1340	795	1435	855	1535	920	1640	985	1755
			6000	810	1470	875	1575	940	1690	1010	1810	1085	1940
			7000	895	1620	965	1740	1035	1865	1115	2000	1195	2145
			8000	985	1790	1065	1925	1145	2065	1230	2220	1320	2385

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

RATE OF CLIMB

MAXIMUM

CONDITIONS:
Flaps Up
Full Throttle

NOTE:
Mixture leaned above 3000 feet for maximum RPM.

WEIGHT LBS	PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
			-20°C	0°C	20°C	40°C
2300	S.L.	73	875	815	755	695
	2000	72	765	705	650	590
	4000	71	655	600	545	485
	6000	70	545	495	440	385
	8000	69	440	390	335	280
	10,000	68	335	285	230	---
	12,000	67	230	180	---	---

Figure 5-5. Rate of Climb

TIME, FUEL, AND DISTANCE TO CLIMB

MAXIMUM RATE OF CLIMB

CONDITIONS:
Flaps Up
Full Throttle
Standard Temperature

NOTES:
1. Add 1.1 gallons of fuel for engine start, taxi and takeoff allowance.
2. Mixture leaned above 3000 feet for maximum RPM.
3. Increase time, fuel and distance by 10% for each 10°C above standard temperature.
4. Distances shown are based on zero wind.

WEIGHT LBS	PRESSURE ALTITUDE FT	TEMP °C	CLIMB SPEED KIAS	RATE OF CLIMB FPM	FROM SEA LEVEL		
					TIME MIN	FUEL USED GALLONS	DISTANCE NM
2300	S.L.	15	73	770	0	0.0	0
	1000	13	73	725	1	0.3	2
	2000	11	72	675	3	0.6	3
	3000	9	72	630	4	0.9	5
	4000	7	71	580	6	1.2	8
	5000	5	71	535	8	1.6	10
	6000	3	70	485	10	1.9	12
	7000	1	69	440	12	2.3	15
	8000	-1	69	390	15	2.7	19
	9000	-3	68	345	17	3.2	22
	10,000	-5	68	295	21	3.7	27
	11,000	-7	67	250	24	4.2	32
	12,000	-9	67	200	29	4.9	38

Figure 5-6. Time, Fuel, and Distance to Climb

CRUISE PERFORMANCE

CONDITIONS:
2300 Pounds
Recommended Lean Mixture

PRESSURE ALTITUDE FT	RPM	20°C BELOW STANDARD TEMP			STANDARD TEMPERATURE			20°C ABOVE STANDARD TEMP		
		% BHP	KTAS	GPH	% BHP	KTAS	GPH	% BHP	KTAS	GPH
2000	2500	---	---	---	75	116	8.4	71	115	7.9
	2400	72	111	8.0	67	111	7.5	63	110	7.1
	2300	64	106	7.1	60	105	6.7	56	105	6.3
	2200	56	101	6.3	53	100	6.1	50	99	5.8
	2100	50	95	5.8	47	94	5.6	45	93	5.4
4000	2550	---	---	---	75	118	8.4	71	118	7.9
	2500	76	116	8.5	71	115	8.0	67	115	7.5
	2400	68	111	7.6	64	110	7.1	60	109	6.7
	2300	60	105	6.8	57	105	6.4	54	104	6.1
	2200	54	100	6.1	51	99	5.9	48	98	5.7
	2100	48	94	5.6	46	93	5.5	44	92	5.3
6000	2600	---	---	---	75	120	8.4	71	120	7.9
	2500	72	116	8.1	67	115	7.6	64	114	7.1
	2400	64	110	7.2	60	109	6.8	57	109	6.4
	2300	57	105	6.5	54	104	6.2	52	103	5.9
	2200	51	99	5.9	49	98	5.7	47	97	5.5
	2100	46	93	5.5	44	92	5.4	42	91	5.2
8000	2650	---	---	---	75	122	8.4	71	122	7.9
	2600	76	120	8.6	71	120	8.0	67	119	7.5
	2500	68	115	7.7	64	114	7.2	60	113	6.8
	2400	61	110	6.9	58	109	6.5	55	108	6.2
	2300	55	104	6.2	52	103	6.0	50	102	5.8
	2200	49	98	5.7	47	97	5.5	45	96	5.4
10,000	2650	76	122	8.5	71	122	8.0	67	121	7.5
	2600	72	120	8.1	68	119	7.6	64	118	7.1
	2500	65	114	7.3	61	114	6.8	58	112	6.5
	2400	58	109	6.5	55	108	6.2	52	107	6.0
	2300	52	103	6.0	50	102	5.8	48	101	5.6
	2200	47	97	5.6	45	96	5.4	44	95	5.3
12,000	2600	68	119	7.7	64	118	7.2	61	117	6.8
	2500	62	114	6.9	58	113	6.5	55	111	6.2
	2400	56	108	6.3	53	107	6.0	51	106	5.8
	2300	50	102	5.8	48	101	5.6	46	100	5.5
	2200	46	96	5.5	44	95	5.4	43	94	5.3

Figure 5-7. Cruise Performance

RANGE PROFILE
45 MINUTES RESERVE
40 GALLONS USABLE FUEL

CONDITIONS:
2300 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature
Zero Wind

NOTES:
1. This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the distance during climb as shown in figure 5-6.
2. Reserve fuel is based on 45 minutes at 45% BHP and is 4.1 gallons.

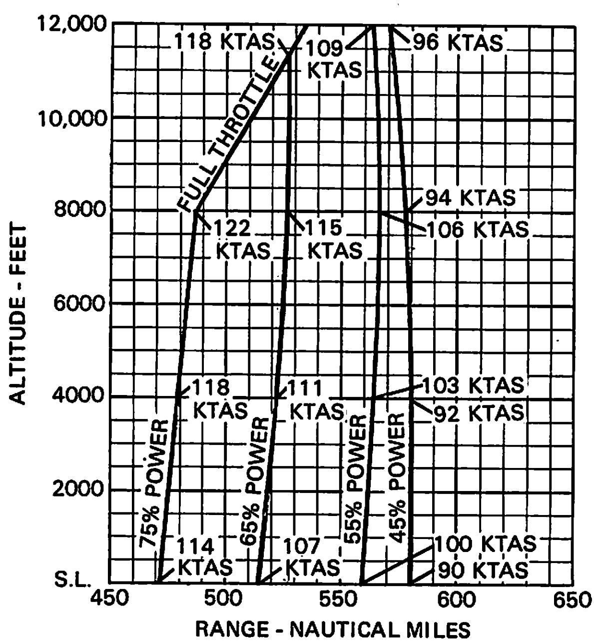


Figure 5-8. Range Profile (Sheet 1 of 2)

RANGE PROFILE
45 MINUTES RESERVE
50 GALLONS USABLE FUEL

CONDITIONS:
2300 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature
Zero Wind

NOTES:
1. This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the distance during climb as shown in figure 5-6.
2. Reserve fuel is based on 45 minutes at 45% BHP and is 4.1 gallons.

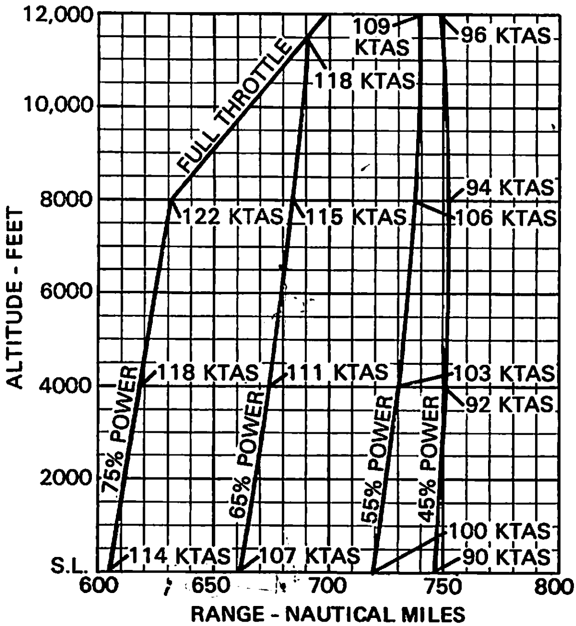


Figure 5-8. Range Profile (Sheet 2 of 2)

ENDURANCE PROFILE

45 MINUTES RESERVE
40 GALLONS USABLE FUEL

CONDITIONS:
2300 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature

NOTES:
1. This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during climb as shown in figure 5-6.
2. Reserve fuel is based on 45 minutes at 45% BHP and is 4.1 gallons.

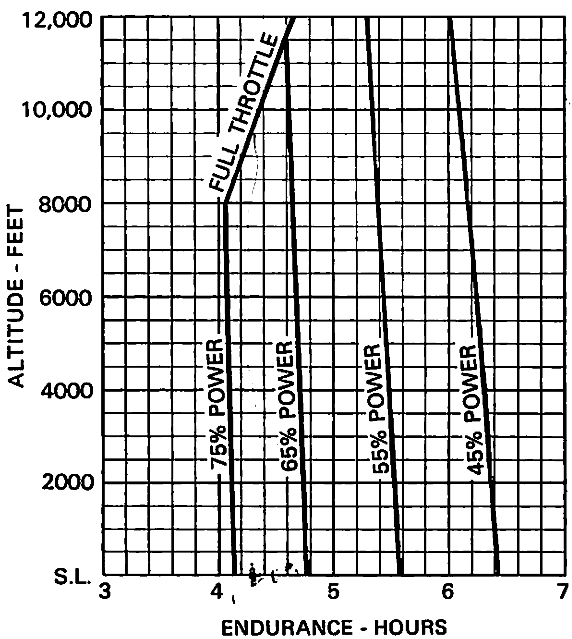


Figure 5-9. Endurance Profile (Sheet 1 of 2)

ENDURANCE PROFILE
45 MINUTES RESERVE
50 GALLONS USABLE FUEL

CONDITIONS:
2300 Pounds
Recommended Lean Mixture for Cruise
Standard Temperature

NOTES:
1. This chart allows for the fuel used for engine start, taxi, takeoff and climb, and the time during climb as shown in figure 5-6.
2. Reserve fuel is based on 45 minutes at 45% BHP and is 4.1 gallons.

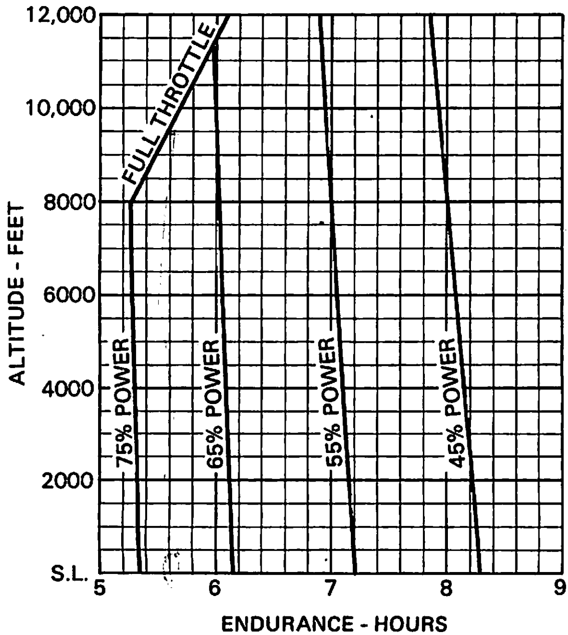


Figure 5-9. Endurance Profile (Sheet 2 of 2)

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 45% 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
2300	60	S.L.	495	1205	510	1235	530	1265	545	1295	565	1330
		1000	510	1235	530	1265	550	1300	565	1330	585	1365
		2000	530	1265	550	1300	570	1335	590	1370	610	1405
		3000	550	1300	570	1335	590	1370	610	1405	630	1440
		4000	570	1335	590	1370	615	1410	635	1445	655	1480
		5000	590	1370	615	1415	635	1450	655	1485	680	1525
		6000	615	1415	640	1455	660	1490	685	1535	705	1570
		7000	640	1455	660	1495	685	1535	710	1575	730	1615
		8000	665	1500	690	1540	710	1580	735	1620	760	1665

Figure 5-10. Landing Distance

SECTION 6
WEIGHT & BALANCE/ EQUIPMENT LIST

TABLE OF CONTENTS

INTRODUCTION

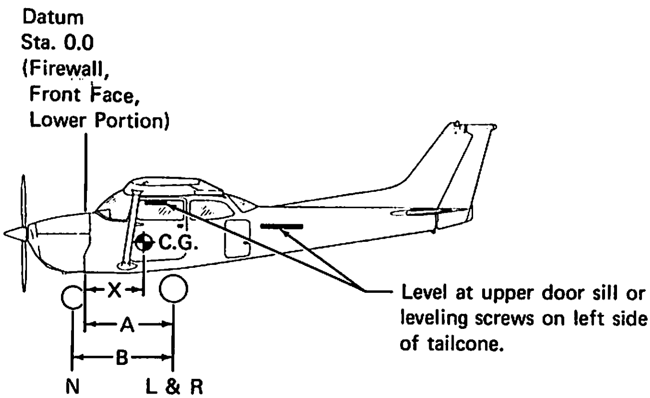
This section describes the procedure for establishing the basic empty weight and moment of the airplane. Sample forms are provided for reference. Procedures for calculating the weight and moment for various operations are also provided. A comprehensive list of all Cessna equipment available for this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

It should be noted that specific information regarding the weight, arm, moment and installed equipment 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, 500 pounds nose, 1000 pounds each main).
   b. Deflate the nose tire and/or lower or raise the nose strut to properly center the bubble in the level (see figure 6-1).
3. Weighing:
   a. With the airplane level and brakes released, record the weight shown on each scale. Deduct the tare, if any, from each reading.
4. Measuring:
   a. Obtain measurement A by measuring horizontally (along the airplane center line) from a line stretched between the main wheel centers to a plumb bob dropped from the firewall.
   b. Obtain measurement B by measuring horizontally and parallel to the airplane center line, from center of nose wheel axle, left side, to a plumb bob dropped from the line between the main wheel centers. Repeat on right side and average the measurements.
5. Using weights from item 3 and measurements from item 4, the airplane weight and C.G. can be determined.
6. Basic Empty Weight may be determined by completing figure 6-1.



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

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

Item	Weight (Lbs.)	X C.G. Arm (In.) =	Moment/1000 (Lbs.-In.)
Airplane Weight (From Item 5, page 6-3)			
Add Oil: No Oil Filter (6 Qts at 7.5 Lbs/Gal)		-14.0	
With Oil Filter (7 Qts at 7.5 Lbs/Gal)		-14.0	
Add Unusable Fuel: Std. Tanks (3 Gal at 6 Lbs/Gal)		46.0	
L.R. Tanks (4 Gal at 6 Lbs/Gal)		46.0	
Equipment Changes			
Airplane Basic Empty Weight			

Figure 6-1. Sample Airplane Weighing

SAMPLE WEIGHT AND BALANCE RECORD

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

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

Figure 6-2. Sample Weight and Balance Record

WEIGHT AND BALANCE

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

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

NOTE

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

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

NOTE

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

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

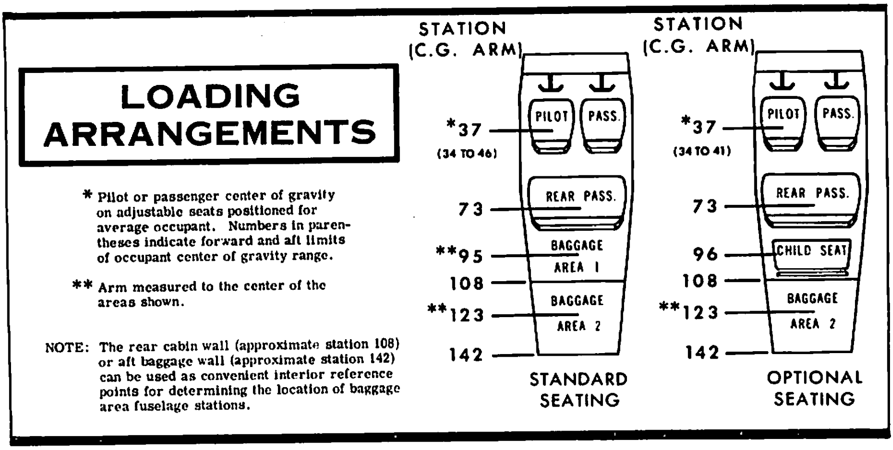
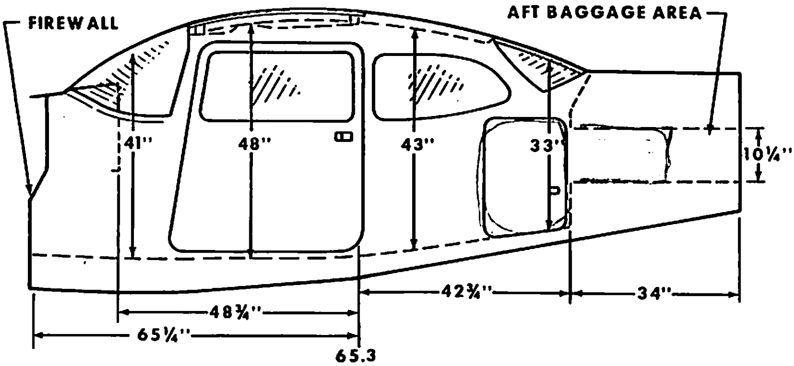


Figure 6-3. Loading Arrangements

CABIN HEIGHT MEASUREMENTS



DOOR OPENING DIMENSIONS

	WIDTH (TOP)	WIDTH (BOTTOM)	HEIGHT (FRONT)	HEIGHT (REAR)
CABIN DOOR	32"	37"	40"	41"
BAGGAGE DOOR	15¼"	15¼"	22"	21"

═WIDTH═
● LWR WINDOW LINE
* CABIN FLOOR

CABIN WIDTH MEASUREMENTS

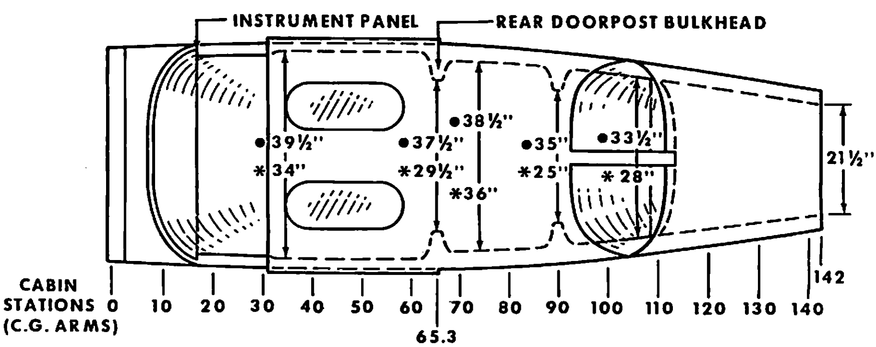


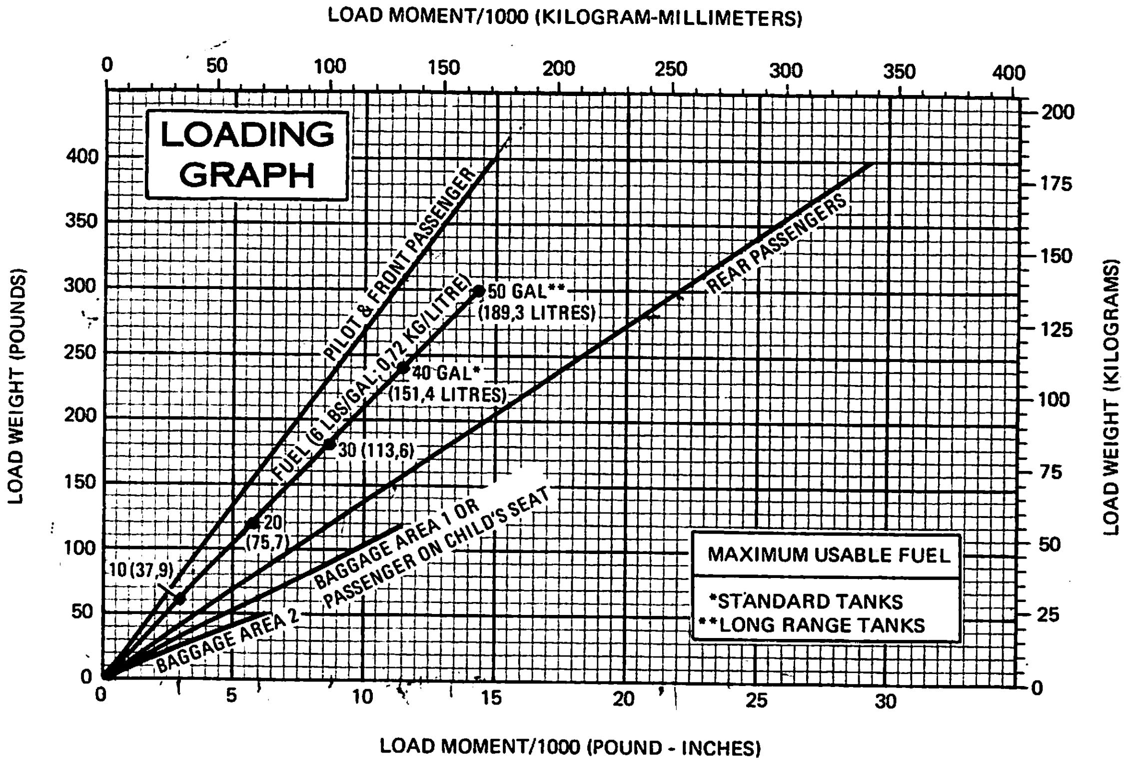
Figure 6-4. Internal Cabin Dimensions

SAMPLE LOADING PROBLEM	SAMPLE AIRPLANE		YOUR AIRPLANE	
	Weight (lbs.)	Moment (lb. -ins. /1000)	Weight (lbs.)	Moment (lb. - ins. /1000)
1. Basic Empty Weight (Use the data pertaining to your airplane as it is presently equipped. Includes unusable fuel and full oil)	1454	57.6		
2. Usable Fuel (At 6 Lbs./Gal.) Standard Tanks (40 Gal. Maximum)	240	11.5		
Long Range Tanks (50 Gal. Maximum)				
3. Pilot and Front Passenger (Station 34 to 46)	340	12.6		
4. Rear Passengers	170	12.4		
5. * Baggage Area 1 or Passenger on Child's Seat (Station 82 to 108, 120 Lbs. Max.)	103	9.8		
6. * Baggage Area 2 (Station 108 to 142, 50 Lbs. Max.)				
7. RAMP WEIGHT AND MOMENT	2307	103.9		
8. Fuel allowance for engine start, taxi, and runup	-7	-.3		
9. TAKEOFF WEIGHT AND MOMENT (Subtract Step 8 from Step 7)	2300	103.6		

10. Locate this point (2300 at 103.6) on the Center of Gravity Moment Envelope, and since this point falls within the envelope, the loading is acceptable.

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

Figure 6-5. Sample Loading Problem



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

Figure 6-6. Loading Graph

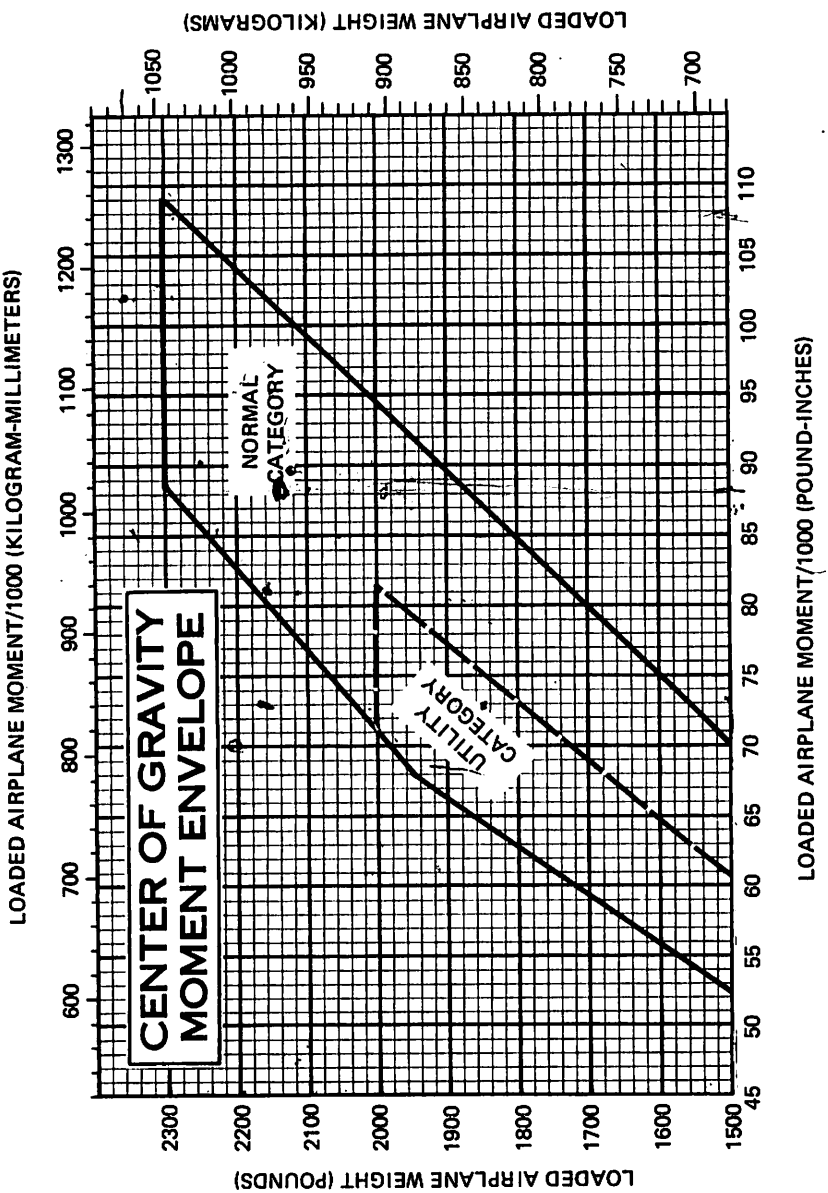


Figure 6-7. Center of Gravity Moment Envelope

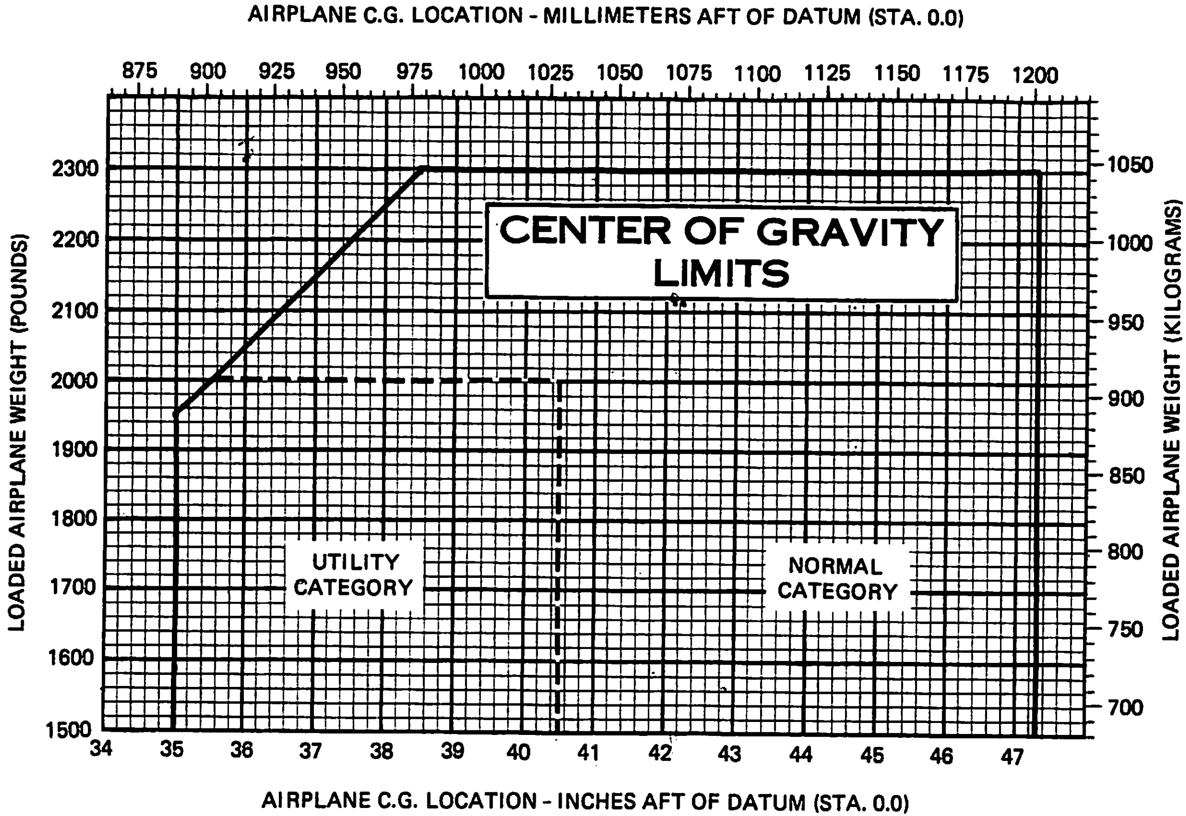


Figure 6-8. Center of Gravity Limits

EQUIPMENT LIST

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

This equipment list provides the following information:

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

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

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

NOTE

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

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

NOTE

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

NOTE

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

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	A. POWERPLANT & ACCESSORIES			
A01-R	ENGINE, LYCOMING O-320-H2AD (INCLUDES ELECTRIC STARTER, VACUUM PUMP PAD, SPARK PLUGS & CARBURETOR	0550333	269.5*	-19.7*
A05-R	FILTER, CARBURETOR AIR	C294510-0301	0.5	-26.0
A09-R	ALTERNATOR, 28 VOLT, 60 AMP (BELT DRIVE)	C611503-0102	10.7	-29.0
A17-R	OIL COOLER INSTALLATION	0550333	2.5*	-2.5*
	OIL COOLER	10599A	2.1	-2.5
A21-A	OIL FILTER INSTALLATION (SPIN-ON ELEMENT) NET CHANGE	0501060	2.5	-6.5
A33-R	PROPELLER ASSY. (FIXED PITCH-LANDPLANE)	C161001-0310	35.9*	-38.5*
	PROPELLER (MCCAULEY)	1C160/DTM7557	30.1	-39.1
	3.5 INCH PROP SPACER ADAPTOR (MCCAULEY)	C4516	3.6	-35.4
A33-O	PROPELLER ASSY. (FIXED PITCH-FLOATPLANE)	C161001-0307	37.5*	-38.6*
	PROPELLER (MCCAULEY)	1A175/ETM8042	31.8	-39.1
	3.5 INCH PROP SPACER ADAPTOR (MCCAULEY)	C4516	3.6	-35.4
A41-R	SPINNER INSTALLATION, PROPELLER	0550320	2.0*	-41.4*
	SPINNER DOME	0550236-8	1.2	-43.1
	FWD SPINNER BULKHEAD	0550321-4	0.3	-40.8
	AFT SPINNER BULKHEAD	0550321-10	0.4	-37.3
A61-S	VACUUM SYSTEM INSTALLATION	0501054	3.0*	-2.7*
	DRY VACUUM PUMP	C431003-0101	1.8	-6.3
	FILTER	1201075-2	0.2	5.4
	VACUUM GAUGE	C668509-0101	0.1	16.7
	RELIEF VALVE-REGULATOR	C482001-0401	0.4	5.0
A70-A	PRIMER SYSTEM, ENGINE THREE CYLINDER	0501056-1	0.3	-12.0
A73-A	OIL QUICK DRAIN VALVE (NET CHANGE)	1701015	0.0	- -
	B. LANDING GEAR & ACCESSORIES			
B01-R	WHEEL, BRAKE & TIRE ASSY, 6.00X6 MAIN (2)	C163018-0201	41.7*	57.8*
	WHEEL ASSY, MCCAULEY	C163005-0101	7.6	58.2
	BRAKE ASSY., MCCAULEY (LEFT)	C163032-0115	1.9	54.5
	BRAKE ASSY., MCCAULEY (RIGHT)	C163032-0114	1.9	54.5
	TIRE, 4-PLY BLACKWALL (EACH)	C262003-0101	8.5	58.2
	TUBE (EACH)	C262023-0102	1.8	58.2
B04-R	WHEEL & TIRE ASSY., 5.00X5 NOSE	C163018-0101	8.7*	-6.8*
	WHEEL ASSY., MCCAULEY	C163005-0201	2.4	-6.8

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	TIRE, 4-PLY BLACKWALL	C262003-0102	4.7	-6.8
	TUBE	C262023-0101	1.2	-6.8
B10-S	FAIRING INSTALLATION, WHEEL (SET OF 3)	0541225-1	17.8*	47.1*
	NOSE WHEEL FAIRING		4.0	-4.9
	MAIN WHEEL FAIRING (EACH)		5.7	60.3
	C. ELECTRICAL SYSTEMS			
C01-R	BATTERY, 24 VOLT, STANDARD DUTY	C614001-0105	22.8	0.0
C01-O	BATTERY, 24 VOLT, HEAVY DUTY	C614001-0106	24.8	0.0
C04-R	ALTERNATOR CONTROL UNIT, 28 VOLT WITH HIGH LOW VOLTAGE SENSING	C611004-0101	0.4	3.5
C07-A	GROUND SERVICE PLUG RECEPTACLE	0501064	2.7	-2.6
C16-O	HEATING SYSTEM, PITOT (NET CHANGE)	0422355	0.6	24.4
C22-A	LIGHTS, INSTRUMENT POST (REQUIRES INSTALLATION OF E34-O DELUXE GLARESHIELD)	0513094	0.5	16.5
C25-A	LIGHT, MAP (CONTROL WHEEL MTD, RQS E89-O)	0570087	0.2	21.5
C28-S	LIGHT, MAP & INSTRUMENT PANEL FLOOD (DOORPOST MOUNTED)	0700149	0.3	32.0
C31-A	LIGHTS, COURTESY ENTRANCE (SET OF 2)	0521101	0.5	61.0
C40-A	DETECTORS, NAVIGATION LIGHT (SET OF 2)	0701013-1, -2	NEGL	--
C43-A	LIGHT INSTALLATION, OMNIFLASH BEACON	0506003	2.1*	184.2*
	BEACON LIGHT ON FIN TIP	C621001-0102	0.4	243.0
	FLASHER POWER SUPPLY	C594502-0102	0.8	205.8
	RESISTOR (MEMCOR)	0R95-6	0.3	208.1
C46-A	LIGHT INSTALLATION, WING TIP STROBE	0501027	3.4*	43.3*
	FLASHER POWER SUPPLY (SET OF 2 IN WING)	C622008-0102	2.3	47.0
	STROBE LIGHT, WING TIP (SET OF 2)	C622006-0101	0.2	43.5
C49-S	LIGHT INSTALLATION, COWL MOUNTED LANDING	0570312	1.9*	-27.1*
	LAMP, 250 WATT (G.E.)	4553	0.8	-29.0
C49-O	LIGHTS, DUAL COWL MOUNTED LANDING	0552141	3.2*	-23.0*
	LAMP, 250 WATT (G.E.) (EACH)	4591	0.5	-29.0
	D. INSTRUMENTS			
D01-R	INDICATOR, AIRSPEED	C661064-0102	0.6	16.2
D01-O	INDICATOR, TRUE AIRSPEED	0513279	0.7	16.3
D04-A	STATIC AIR ALTERNATE SOURCE	0501017	0.2	15.5

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
D07-R	ALTIMETER (SENSITIVE)	C661071-0101	1.0	14.0
D07-O-1	ALTIMETER, SENSITIVE (50 FT. MARKINGS) (FEET AND MILLIBARS)	C661071-0102	1.0	14.0
D07-O-2	ALTIMETER (SENSITIVE) 20FT. MARKINGS (FEET AND MILLIBARS)	C661025-0102	1.0	14.0
D10-A	ALTIMETER, 2ND UNIT INSTALLATION (DUAL)	2001015	1.0	14.5
D16-A-1	ENCODING ALTIMETER (REQUIRES RELOCATION OF REGULAR ALTIMETER)	0501049	3.0	14.0
D16-A-2	ENCODING ALTIMETER, FEET & MILLIBARS (REQUIRES RELOCATION OF REGULAR ALTIMETER)	0501049	3.0	14.0
D16-A-3	ALTITUDE ENCODER (BLIND, DOES NOT REQUIRE INSTRUMENT PANEL MOUNTING)	0501059	1.5*	14.4*
D19-R	AMMETER	S-1320-5	0.3	16.5
D22-A	GAGE, CARBURETOR AIR TEMPERATURE	0513339	1.0	14.0
D25-S	CLOCK, ELECTRIC	C664508-0101	0.4	16.3
D28-R	COMPASS, MAGNETIC-INSTALLATION	0513262-1	0.4	14.0
D38-R	INSTRUMENT CLUSTER, LH & RH FUEL QUANTITY	C669511-0102	0.4	16.5
D41-R	INSTRUMENT CLUSTER, OIL PRESS, OIL TEMP.	C669512-0102	0.5	16.5
D49-A	INDICATOR, ECONOMY MIXTURE (EGT)	0501043-2	0.6	7.8
D64-S	GYROS, ATTITUDE & DIRECTIONAL INDICATORS (NON-NAV-O-MATIC)	0501054-1	6.3*	13.6*
	DIRECTIONAL INDICATOR	C661075-0104	2.7	14.7
	ATTITUDE INDICATOR	C661076-0101	2.5	14.3
D64-O	GYRO INSTALLATION FOR 300 NAV-O-MATIC	0501054-2	6.9*	13.4*
	DIRECTIONAL INDICATOR (ARC)	40760-0101	3.3	14.3
	ATTITUDE INDICATOR	C661076-0101	2.5	14.3
D67-A	RECORDER INSTALLATION, FLIGHT HOUR	0501052	0.5	6.3
D82-S	GAGE, OUTSIDE AIR TEMPERATURE	C668507-0101	0.1	28.6
D85-R	TACHOMETER INSTALLATION, ENGINE	0506004	1.0*	12.1*
	RECORDING TACH INDICATOR	C668020-0118	0.7	16.0
	FLEXIBLE TACH SHAFT	S-1605-10	0.3	3.0
D88-S-1	INDICATOR, TURN COORDINATOR, 28 VOLT ONLY	C661003-0505	1.3	15.8
D88-S-2	INDICATOR, TURN COORDINATOR, 10-30 VOLT	C661003-0506	1.3	15.8
D88-O	INDICATOR, TURN COORDINATOR (FOR USE WITH NAV-O-MATIC 200A AND 300A)	42320-0028	1.3	14.6
D91-S	INDICATOR, VERTICAL SPEED	C661080-0101	1.0	14.9
	E. CABIN ACCOMMODATIONS			

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
E02-S	ARM RESTS - 2ND ROW (SET OF 2)	0715039	1.5	72.5
E05-R	SEAT, ADJUSTABLE FORE & AFT PILOT	0514141	12.6	44.0
E05-O	SEAT, INFINITE ADJUSTABLE - PILOT	0514142	23.0	41.5
E07-S	SEAT, ADJUSTABLE FORE & AFT- CO-PILOT	0514141	12.6	44.0
E07-O	SEAT, INFINITE ADJUSTABLE - CO-PILOT	0514142	23.0	41.5
E09-S	SEAT, REAR (ONE PIECE BACK CUSHION)	0514144	22.0	79.5
E09-O	SEAT, REAR (TWO PIECE BACK CUSHION)	0514143	23.0	79.5
E15-R	PILOT LAP BELT ASSY	S-2275-103	1.0	37.0
E15-S	SHOULDER HARNESS ASSY, PILOT	S-2275-201	0.6	37.0
E19-O	SHOULDER HARNESS INERTIA REEL INSTALLATION PILOT & CO-PILOT - REPLACES STD BELTS AND HARNESS (NET CHANGE)	0501046-1	2.0	82.0
E23-S	BELT & SHOULDER ASSY - CO-PILOT	S-2275-3	1.6	37.0
E27-S	BELT ASSY, 2ND ROW (SET OF 2)	S-1746-39	2.0	70.0
E27-O	SEAT BELT & SHOULDER HARNESS ASSY FOR 2ND ROW SEATING	S-2275-8	3.2	70.0
E34-O	DELUXE GLARESHIELD (NET CHANGE)	0515034	1.0	21.0
E35-A-1	LEATHER SEAT COVERING (NET CHANGE	CES-1151	2.0	62.0
E35-A-2	LEATHER & VINYL OR FABRIC COVER-NET CHANGE	CES-1151	1.5	62.0
E37-O	WINDOW, HINGED, RH DOOR (NET CHANGE)	0501075	2.3	47.0
E39-A	WINDOWS, OVERHEAD CABIN TOP (NET CHANGE)	0511800	0.9	47.9
E43-A	VENTILATION SYSTEM, REAR SEAT (NOT COMPATABLE WITH E88-A-1 OR E88-A-2)	0700322	1.7	60.0
E49-A	BEVERAGE CUP HOLDER	0501023	0.1	15.0
E50-A	HEADREST, 1ST ROW (WT EACH)	1215073-11	0.7	47.0
E51-A	HEADREST, 2ND ROW (WT EACH)	1215073-11	0.7	86.0
E55-S	SUN VISORS (SET OF 2)	0500040	0.9	32.8
E57-A	WINDOWS, TINTED FRONT, SIDE & REAR (NET CHANGE)	0500267	0.0	- -
E65-S	BAGGAGE NET	2015009	0.5	95.0
E71-A	RINGS, CARGO TIE-DOWN (STOWED)(USE ARM AS INSTALLED WITH CARGO)	0500042	1.0	- -
E85-A	CONTROLS INSTALLATION, DUAL	0513335	4.9	12.4
E87-A	RUDDER TRIM SYSTEM	0513290	1.9	9.4
E88-A-1	CABIN AIR CONDITIONING SYSTEM-CHILLED AIR	0501066	63.5*	43.2*
	COMPRESSOR ASSEMBLY		20.2	-29.0
	EVAPORATOR (LOCATED ABOVE AFT BAGGAGE		9.1	123.5
	CONDENSOR (LOCATED UNDER SIDE FUSELAGE)		5.3	96.2
E88-A-2	CABIN AIR CIRCULATING FAN	0501072	10.0	100.0
E89-O	ALL PURPOSE CONTROL WHEEL, NET CHANGE		NEGL	--
E93-R	HEATING SYSTEM, CABIN & CARBURETOR AIR (INCLUDES EXHAUST SYSTEM)	0550333 0506004	17.5	-21.0

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	F. PLACARDS, WARNINGS & MANUALS			
F01-R	PLACARD, OPERATIONAL LIMITATIONS-DAY VFR	0505087	NEGL	- -
F01-O-1	PLACARD, OPERATIONAL LIMITATIONS-DAY NIGHT VFR	0505087	NEGL	- -
F01-O-2	PLACARD, OPERATIONAL LIMITATIONS-DAY NIGHT VFR IFR	0505087	NEGL	- -
F01-O-3	PLACARD, OPERATIONAL LIMITATIONS-DAY VFR FLOATPLANE	0505087	NEGL	- -
F01-O-4	PLACARD, OPERATIONAL LIMITATIONS-DAY NIGHT VFR FLOATPLANE	0505087	NEGL	- -
F01-O-5	PLACARD, OPERATIONAL LIMITATIONS-DAY NIGHT VFR IFR FLOATPLANE	0505087	NEGL	- -
	NOTE THE ABOVE PLACARDS ARE INSTALLED ACCORDING TO AIRCRAFT EQUIPMENT			
F04-R	INDICATOR, AUDIBLE PNEUMATIC STALL WARNING	0523112	0.2	28.5
F13-S	LOW VOLTAGE WARNING LIGHT, ALTERNATOR		NEGL	- -
F16-R	PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL	D1138-13PH	0.5	- -
	G. AUXILIARY EQUIPMENT			
G07-A	RINGS, AIRPLANE HOISTING (CABIN TOP)	0541115	0.9	49.1
G13-A	CORROSION PROOFING, INTERNAL	0500036	10.0	77.0
G16-A	STATIC DISCHARGERS	0501048	0.4	143.2
G19-A	STABILIZER ABRASION BOOTS	0500041	2.7	206.0
G22-S	TOW BAR (STOWED)	0501019	1.6	95.0
G25-S	PAINT, OVERALL EXTERIOR (MODIFIED POLY-URETHANE)	0504037	12.4*	90.9*
	OVERALL BASE WHITE		11.6	90.5
	WASH PRIME		0.4	90.5
	COLOR STRIPE		0.5	102.2
G25-A	OPTIONAL OVERALL PRIME COATING	0504037	3.3	90.5
G31-A	CABLES, CORROSION RESISTANT CONTROL (NET CHANGE)	0500036	0.0	- -
G55-A	FIRE EXTINGUISHER INSTALLATION	0501011	3.0*	43.8*
	FIRE EXTINGUISHER	C421001-0101	2.6	44.0
	FIRE EXTINGUISHER MOUNTING BRACKET	C421001-0102	0.3	42.2
G58-A	STEPS & HANDLES, REFUELING ASSISTING	0513415	1.7	16.3

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
G67-A	RUDDER PEDAL EXTENSIONS, REMOVABLE - SET OF 2 (STOWABLE - INSTALLED ARM SHOWN)	0701048	2.3	8.0
G88-A-1	WINTERIZATION KIT INSTALLATION, ENGINE	0501008	0.8*	-22.7*
	BREATHER TUBE INSULATION	0552011	0.4	-13.8
	TWO COWL INLET AIR COVERS (INSTALLED)	0552132-1, -2	0.3	-32.0
	(STOWED)	0552132-1, -2	0.3	95.0
G88-A-2	WINTERIZATION KIT INSTL., FLOATPLANE ONLY	0552011	1.0*	-7.2*
	BREATHER TUBE INSULATION		0.4	-12.0
	COWL OUTLET COVER (1) (INSTALLED)		0.6	-4.0
	(STOWED)		0.6	95.0
G92-D	FUEL SYSTEM, EXTENDED RANGE WING TANKS (NET CHANGE)	0501055	9.5	48.0
	H. AVIONICS & AUTOPILOTS			
H01-A	CESSNA 300 ADF INSTALLATION	3910159-2	7.0*	21.0*
	CONSISTS OF			
	RECEIVER WITH BFO (R-546E)	41240-0101	2.3	12.1
	INDICATOR (IN-346A)	40980-1001	0.9	14.0
	SENSE ANTENNA INSTALLATION	0570400-632	0.2	108.6
	LOOP ANTENNA INSTALLATION	3960104-1	1.4	39.3
	RECEIVER MOUNT, WIRES AND MISC ITEMS		2.2	13.7
H04-A	DME INSTALLATION, NARCO	3910166-1	7.5*	18.5*
	RECEIVER (DME-190)	3312-400	4.9	11.3
	MOUNTING BOX		0.6	11.3
	ANTENNA,	- -	0.2	86.1
H05-A	FOSTER R-NAV 511	3910203	3.4*	11.8*
	RECEIVER & MOUNT (511)		2.4	14.5
H07-A-1	CESSNA 400 GLIDESLOPE (INCLUDES VOR/ILS INDICATOR--NET CHANGE FOR VOR/LOC	3910157	4.4*	81.1*
	RECEIVER (R-443B)	42100-0000	2.1	117.0
	ANTENNA (LOCATED-UPPER WINDSHIELD)	1200098-2	0.2	30.0
	VOR/ILS INDICATOR (IN-386A)(INDICATOR WT NET CHANGE, ACTUAL WT IS 1.7 LBS)	46860-2000	0.1	15.5
H07-A-2	CESSNA 400 GLIDESLOPE (INCLUDES AUTOCOURSE VOR/ILS INDICATOR, WT NET CHANGE FOR VOR/LOC INDICATOR)	3910157	4.6*	78.2*
	RECEIVER (R-443B)	42100-0000	2.1	117.3
	ANTENNA (LOCATED-UPPER WINDSHIELD)	1200098-2	0.2	30.0
	VOR/ILS INDICATOR (IN-386AC)(INDICATOR	46860-2200	0.3	14.7

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	WT NET CHANGE, ACTUAL WT IS 1.9 LBS)			
H11-A-1	PANTRONICS PT-10A HF TRANSCEIVER 2ND UNIT	3910156-9	20.2*	88.8*
	TRANSCEIVER (PANEL MOUNTED)	C582103-0102	4.2	10.4
	ANTENNA LOAD BCX	C589502-0201	4.2	112.5
	HF POWER SUPPLY (REMOTE)	C582103-0301	8.5	114.4
	POWER & SIGNAL CABLES		2.5	41.0
	ANTENNA INSTALLATICN, 351 IN. LCNG	3960117	0.3	144.4
H11-A-2	SUNAIR ASB-125 HF TRANSCEIVER, 2ND UNIT	3910158-1	22.0*	82.8*
	ANTENNA LOAD BOX	99816	4.9	112.0
	POWER SUPPLY (REMOTE)	99683	8.5	114.0
	TRANSCEIVER (PANEL MOUNTED)	99681	4.6	10.4
	ANTENNA INSTALLATICN, 351 IN. LCNG	3960117	0.3	144.4
	MISC SWITCHES, WIRES AND ETC.	- -	3.7	57.5
H13-A	CESSNA 400 MARKER BEACON	3910164-1	2.3*	34.5*
	RECEIVER (R-402A)	42410-5128	0.7	11.8
	ANTENNA, L SHAPED ROD	0770681-1	0.7	136.0
H16-A-1	CESSNA 300 TRANSPONDER	3910127-17	4.0*	25.8*
	TRANSCEIVER (RT-359A)	41420-1128	2.7	11.1
	ANTENNA	- -	0.3	126.0
H16-A-2	CESSNA 400 TRANSPCNDER (USED FOR EXPCRT)	3910128-21	4.2*	25.1*
	TRANSCEIVER (RT-459A)	41470-1128	2.9	11.1
	ANTENNA	- -	0.3	126.0
H22-A-1	CESSNA 300 NAV/COM. 720 CH, FIRST UNIT	3910183-4	15.3*	30.5*
	WITH VCR/LOC			
	RECEIVER-TRANSCEIVER (RT-385A)	46660-1100	5.5	11.5
	VOR/LCC INDICATOR (IN-385A)	46860-1000	1.6	14.5
	H34-A BASIC AVICNICS KIT	3910186	7.0	52.6
	MOUNT, WIRE & MISC HARDWARE		1.2	10.0
H22-A-2	CESSNA 300 NAV/COM, 720 CH, FIRST UNIT	3910183	15.5*	30.3*
	WITH VCR/LOC AUTOCCURSE INDICATCR			
	RECEIVER-TRANSCEIVER (RT-385A)	46660-1100	5.5	11.5
	VOR/LCC INDICATCR (IN-385AC) (AUTOMATIC	46860-1200	1.8	14.5
	RADIAL CENTERING)			
	H34-A BASIC AVIONICS KIT	3910186	7.0	52.6
	MOUNT, WIRING & MISC HARDWARE		1.2	10.0
H25-A-1	CESSNA 300 NAV/COM 720 CH CCM 2ND UNIT	3910183-6	9.3*	14.6*
	WITH VOR/LOC			
	RECEIVER-TRANSCEIVER (RT-385A)	46660-1100	5.5	11.5
	VOR/LCC INDICATCR (IN-385A)	46860-1000	1.6	14.5
	H37-A ANTENNA COUPLER KIT	3910185	1.0	37.5
	MOUNT, WIRING & MISC ITEMS	3960111-1	1.2	10.0
H25-A-2	CESSNA 300 NAV/COM 720 CH CCM 2ND UNIT	3910183	9.5*	14.6*

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	WITH VOR/LOC ALTOCOURSE INDICATOR			
	RECEIVER-TRANSCEIVER (RT-385A)	46660-1100	5.5	11.5
	VOR/LOC INDICATOR (IN-385AC)(AUTOMATIC RADIAL CENTERING)	46860-1200	1.8	14.5
	H37-A ANTENNA COUPLER KIT	3910185	1.0	37.5
	MOUNT, WIRING & MISC ITEMS	3960111-1	1.2	10.0
H28-A-1	EMERGENCY LOCATOR TRANSMITTER	0470419-3	3.5*	116.5*
	TRANSMITTER (D & M DMELT-6-1)	C589511-0117	3.3	116.4
	ANTENNA	C589511-0109	0.1	122.0
H28-A-2	EMERGENCY LOCATOR TRANSMITTER (USED IN CANADA)	0470419-4	3.5*	116.5*
	TRANSMITTER (D & M DMELT-6-1C)	C589511-0113	3.3	116.4
	ANTENNA	C589511-0109	0.1	122.0
H31-A-1	NAV-O-MATIC 200A	3910162-1	9.2*	51.0*
	CONTROLLER-AMPLIFIER	3930144-6	1.6	13.1
	TURN COORDINATOR (NET CHNG) (G-300A)	42320-0014	0.0	- -
	WING INSTALLATION (SERVO IS 3.9 LBS AT 68.9 INCHES)(PA-495)	0522632-1	6.1	68.1
H31-A-2	NAV-O-MATIC 300A (AF395)	3910163-1	10.4*	46.2*
	CONTROLLER-AMPLIFIER & MOUNT	CA-395A	1.8	13.1
	D64-O GYRO INSTALLATION NET CHANGE	0501054	0.6	11.3
	D88-O TURN COORDINATOR NET CHANGE	42320-0028	0.0	- -
	WING INSTALLATION (SERVO IS 3.9 LBS AT 68.9 INCHES)(PA-495)	0522632-1	6.1	68.1
	RELAY INSTALLATION	3940151-1	0.4	4.0
H34-A	BASIC AVIONICS KIT--AVAILABLE WITH 1ST UNIT NAV/COM ONLY	3910186-2	7.0*	52.6*
	RADIO COOLING INSTL.	3930206	1.1	10.2
	NOISE FILTER-AUDIO (ON ALTERNATOR)	3940148-1	0.1	-26.1
	COM ANTENNA CABLE	3950122-3	0.4	27.8
	OMNI ANTENNA CABLE	3950122-4	0.6	116.0
	OMNI ANTENNA INSTALLATION	3960102-10	0.8	220.8
	LH VHF COM ANTENNA	3960113-1	0.4	62.4
	CABIN SPEAKER INSTL.	3970123-5	1.2	37.9
	MIKE INSTL--HANDHELD	3970124-1	0.3	17.2
	HEADPHONE INSTALLATION	3970125-4	0.2	14.2
	AUDIO CONTROL PANEL INSTL	3970131-1	1.9	12.5
H37-A	ANTENNA & COUPLER KIT	3910185-2	1.0	37.5
H55-A	MIKE-HEADSET COMBO. INSTL (HEADSET STOWED) (STOWED ARM SHOWN)(REQUIRES E89-O)	3970112-1	0.3	13.0
H56-A	PADDED HEADPHONES & MICROPHONE, REQUIRES E89-O ALL PURPOSE CONTROL WHEEL	C596531-0101	1.1	- -

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	J. SPECIAL OPTION PACKAGES			
J01-A	SKYHAWK II EQUIPMENT CONSISTS OF ITEMS	0500510	25.5*	46.0*
	D01-O TRUE AIRSPEED IND.(NET CHANGE)	0513279	0.1	16.7
	C16-O HEATED PITOT SYSTEM	0422355	0.6	24.4
	E85-A DUAL CONTROLS	0513335	4.9	12.4
	C40-A NAV LIGHT DETECTORS	0701013	NEGL	- -
	C31-A COURTESY LIGHTS	0521101	0.5	61.0
	C43-A FLASHING BEACON LIGHT	0506003	2.1	184.2
	D04-A STATIC ALTERNATE AIR SOURCE	0501017	0.2	15.5
	H28-A EMERGENCY LOCATOR XMTR (ELT)	470419	1.8	116.6
	G25-O SKYHAWK II PAINT (NET CHANGE)	0504035	0.0	- -
	H22-A-1 NAV/COM 385A VOR/LOC	3910183-4	15.3	30.5
J04-A	NAV-PAC INSTALLATION (SKYHAWK II ONLY)	3910161	20.3*	19.1*
	H25-A 385A NAV/COM VOR/LOC	- -	9.3	14.6
	H01-A 300 ADF (546E)		7.0	21.0
	H16-A-1 300 TRANSPONDER (RT-359)		4.0	26.1
J10-A	FLOATPLANE FUSELAGE STRUCTURAL MODIFICATIONS & FITTINGS (OPTION C)	0500083	6.1	45.5
J13-A	FLOATPLANE COWLDECK V BRACE (INSTALLED)	0513003	1.1	26.2
	(STOWED)		1.1	95.0
J15-A	FLOATPLANE AILERON-RUDDER INTERCONNECT FLOATPLANE ONLY (INSTALLED)	0560012	0.4	69.6
	(STOWED)		0.4	95.0
	ITEMS J10-A & J13-A ARE ALSO APPROVED FOR LANDPLANE OPERATIONS.			
J27-A	MODEL 89A2000 FLOATS & 502 ATTACHMENTS NET CHANGE BETWEEN STANDARD LANDING GEAR (ITEM NOS. B01-R, B04-R, B10-S AND BRAKE & NOSE WHEEL STEERING SYSTEMS) AND FLOATPLANE KIT (ITEM NO. J30-A-1) IS APPROXIMATELY 155 LBS. AT 58.3 IN. THE CORRECT VALUES OF WT & ARM CHANGE FOR WT & BALANCE CALCULATIONS SHOULD BE DETERMINED FROM THE ACTUAL INSTALLATION.	EDO-36335	- -	- -
J30-A-1	FLOATPLANE EQUIPMENT KIT WITH PROP CHANGE AND CORROSION PROOFING CONSISTS OF--	0500083	21.7*	52.3*
	A33-O PROPELLER, FLOATPLANE, EXCHANGE	0550320	1.3	-41.4
	F01-O- PLACARD, FLOATPLANE OPERATION	0505053	0.0	- -
	G31-A CABLES, CORROSION RESIST, EXCH.	0500036	0.0	- -

ITEM NO	EQUIPMENT LIST DESCRIPTION	REF DRAWING	WT LBS	ARM INS
	G13-A CORROSICN PROOFING, INTERNAL	0500036	10.0	77.0
	G07-A RINGS, AIRPLANE HCISTING	0541115	1.1	49.1
	G58-A STEP & HANDLE, REFUELING	0513415	1.7	17.8
	J10-A FUSELAGE MCDIFICATICN (OPT C)	0500083	6.1	45.5
	J13-A COWL DECK V-BRACE (INSTALLED)	0513003	1.1	26.2
	J15-A INTERCCNNECT SYSTEM, INSTALLED	0560012	0.4	69.6
	COWL ASSY, FLOATPLANE (NET CHG)	0552162	NEGL	- -
	FLOATPLANE PLACARD	0505085	NEGL	- -
J30-A-2	FLOATPLANE EQUIPMENT KIT WITH CCRROSION PROOFING, V-BRACE STOWED AND NC PROP CHANGE	0500083	20.4*	62.5*
	F01-O- PLACARD, FLCATPLANE OPERATION	0505053	0.0	- -
	G31-A CABLES, CORROSICN RESIST, EXCH	0500036	0.0	- -
	G13-A CCRROSICN PROOFING, INTERNAL	0500036	10.0	77.0
	G07-A RINGS, AIRPLANE HOISTING	0541115	1.1	49.1
	G58-A STEP & HANDLE,REFUELING	0513415	1.7	17.8
	J10-A FUSELAGE MCDIFICATICN	0500083	6.1	45.5
	J13-A COWL DECK V-BRACE (STCWED)	0513003	1.1	95.0
	J15-A INTERCCNNECT SYSTEM (STCWED)	0560012	0.4	95.0
	COWL ASSY, FLOATPLANE (NET CHG)	0552162	NEGL	- -
	FLOATPLANE PLACARD	0505085	NEGL	- -
J30-A-3	FLOATPLANE EQUIPMENT KIT WITH PROP CHANGE & NC CORROSION PROOFING CONSISTS OF--	0500083	11.7*	31.2*
	A33-0 PROPELLER, FLOATPLANE, EXCHANGE	0550320	1.3	-41.4
	F01-0 PLACARD, FLCATPLANE CPERATIONS	0505053	0.0	- -
	G07-A RINGS, AIRPLANE HOISTING	0541115	1.1	49.1
	G58-A STEP & HANDLE, REFUELING	0513415	1.7	17.8
	J10-A FUSELAGE MODIFICATIONS	0500044	6.1	45.5
	J13-A COWL DECK V-BRACE (INSTALLED)	0513003	1.1	26.2
	J15-A INTERCCNNECT SYSTEM (INSTALLED)	0560012	0.4	69.6
	COWL ASSY, FLOATPLANE (NET CHG)	0552162	NEGL	- -
	FLOATPLANE PLACARD	0505085	NEGL	- -
J30-A-4	FLOATPLANE EQUIPMENT KIT WITH NC PRCP CHANGE OR CORROSIGN PROOFING (USED PRIMARILY IN CANADA)	0500083	10.4*	41.2*
	G07-A RINGS, AIRPLANE HCISTING	0541115	1.1	49.1
	G58-A STEP & HANDLE, REFUELING		1.7	17.8
	J10-A FUSELAGE MCDIFICATICNS	0500083	6.1	45.5
	J13-A COWL DECK V-BRACE (INSTALLED)	0513003	1.1	26.2
	J15-A INTERCCNNECT SYSTEM (STOWED)	0560012	0.4	95.0
	COWL ASSY, FLOATPLANE (NET CHG)	0552162	NEGL	- -
	FLOATPLANE PLACARD	0505085	NEGL	- -

SECTION 7
AIRPLANE & SYSTEMS DESCRIPTIONS

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TABLE OF CONTENTS (Continued)

INTRODUCTION

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

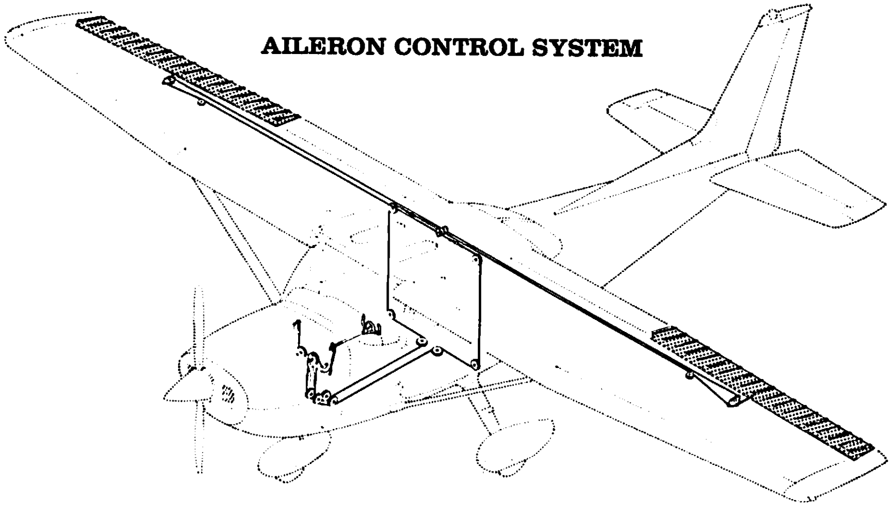
AIRFRAME

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

The construction of the fuselage is a conventional formed sheet metal bulkhead, stringer, and skin design referred to as semimonocoque. Major items of structure are the front and rear carry-through spars to which the wings are attached, a bulkhead and forgings for main landing gear attachment at the base of the rear door posts, and a bulkhead with 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 the balance weights and the addition of a formed sheet metal leading edge section.

The empennage (tail assembly) consists of a conventional vertical stabilizer, rudder, horizontal stabilizer, and elevator. The vertical stabilizer consists of a spar, formed sheet metal ribs and reinforcements, a wrap-around skin panel, formed leading edge skin and a dorsal. The rudder is constructed of a formed leading edge skin containing hinge halves, a center wrap-around skin panel, ribs, an aft wrap-around skin panel which is joined at the trailing edge of the rudder by a filler strip, and a ground adjustable trim tab at the base of the trailing edge. The top of the rudder incorporates a leading edge extension which contains a balance weight



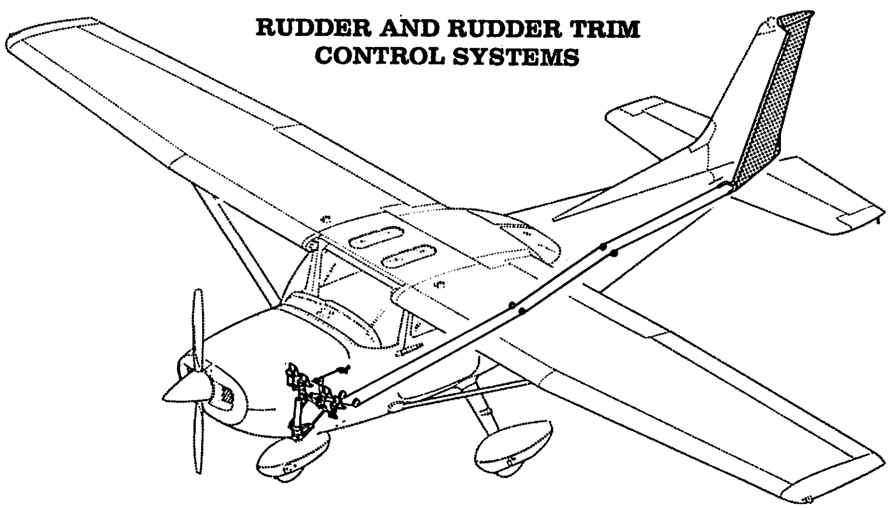
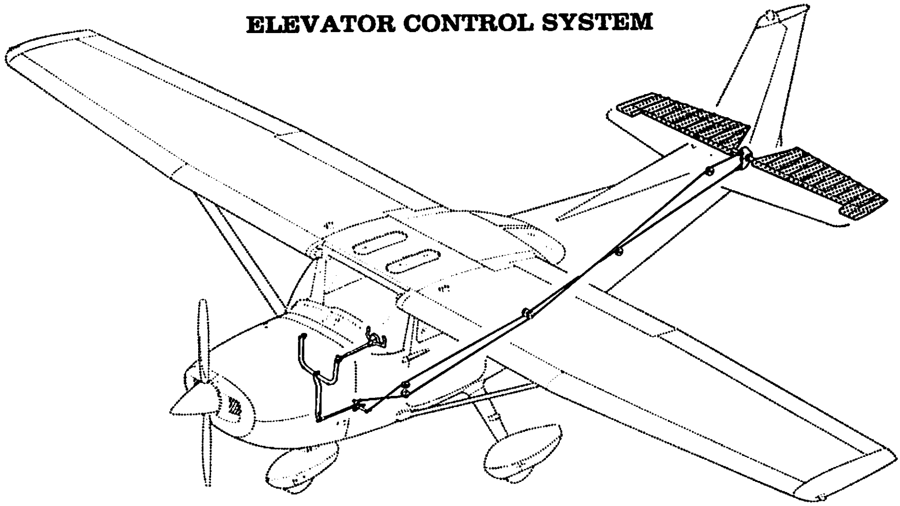


Figure 7-1. Flight Control and Trim Systems (Sheet 1 of 2)

ELEVATOR CONTROL SYSTEM



ELEVATOR TRIM CONTROL SYSTEM

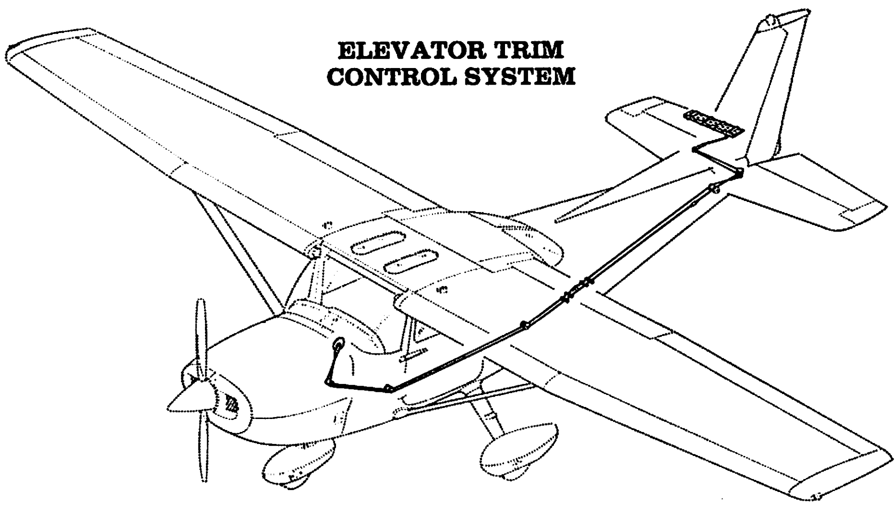


Figure 7-1. Flight Control and Trim Systems (Sheet 2 of 2)

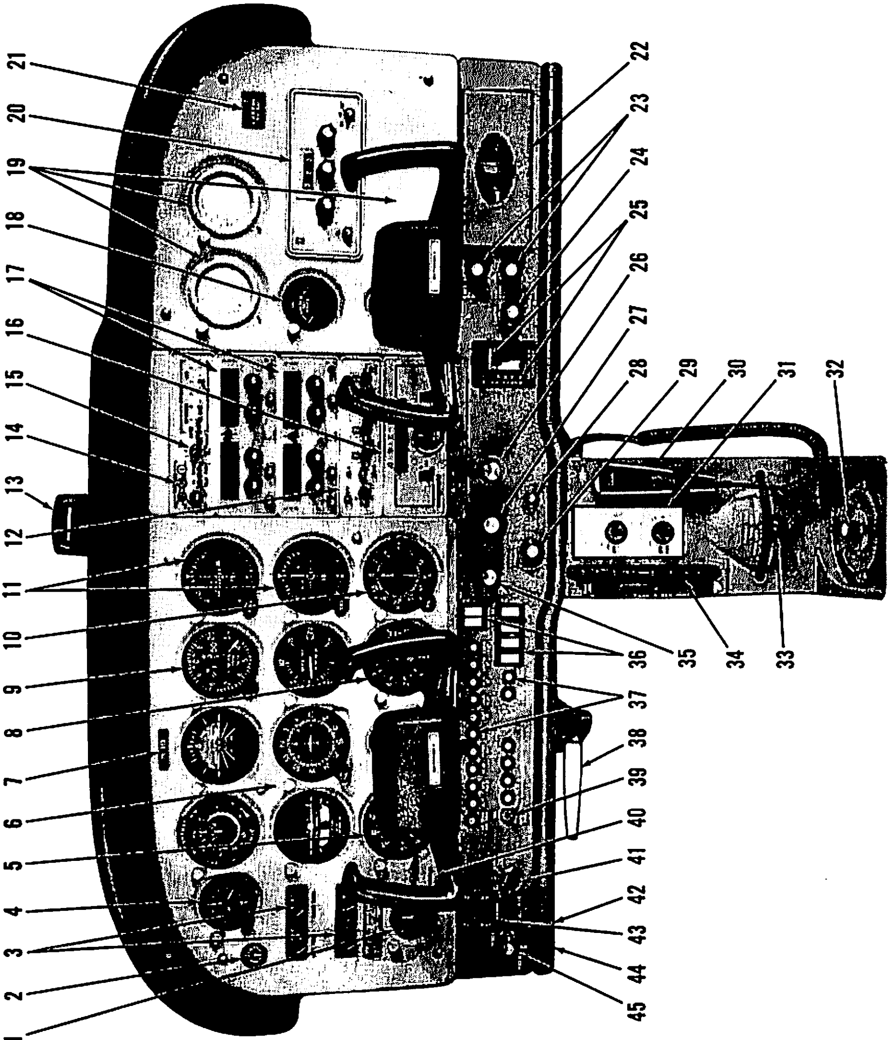


Figure 7-2. Instrument Panel (Sheet 1 of 2)

1. Ammeter
2. Suction Gage
3. Oil Temperature, Oil Pressure, and Fuel Quantity Indicators
4. Clock
5. Tachometer
6. Flight Instrument Group
7. Airplane Registration Number
8. Secondary Altimeter
9. Encoding Altimeter
10. ADF Bearing Indicator
11. Course Deviation Indicators
12. Transponder
13. Magnetic Compass
14. Marker Beacon Indicator Lights and Switches
15. Audio Control Panel
16. Autopilot Control Unit
17. Radios
18. Economy Mixture Indicator
19. Additional Instrument Space
20. ADF Radio
21. Flight Hour Recorder
22. Map Compartment
23. Cabin Heat and Air Control Knobs
24. Cigar Lighter
25. Wing Flap Switch and Position Indicator
26. Mixture Control Knob
27. Throttle (With Friction Lock)
28. Static Pressure Alternate Source Valve
29. Instrument and Radio Dial Light Dimming Rheostats
30. Microphone
31. Air Conditioning Controls
32. Fuel Selector Valve Handle
33. Rudder Trim Control Lever
34. Elevator Trim Control Wheel
35. Carburetor Heat Control Knob
36. Electrical Switches
37. Circuit Breakers
38. Parking Brake Handle
39. Avionics Power Switch
40. Low-Voltage Warning Light
41. Ignition Switch
42. Auxiliary Mike Jack
43. Master Switch
44. Phone Jack
45. Primer

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

The horizontal stabilizer is constructed of a forward and aft spar, ribs and stiffeners, center, left, and right wrap-around skin panels, and formed leading edge skins. The horizontal stabilizer also contains the elevator trim tab actuator. Construction of the elevator consists of formed leading edge skins, a forward spar, aft channel, ribs, torque tube and bellcrank, left upper and lower "V" type corrugated skins, and right upper and lower "V" type corrugated skins incorporating a trailing edge cut-out for the trim tab. The elevator trim tab consists of a spar, rib, and upper and lower "V" type corrugated skins. The leading edge of both left and right elevator tips incorporate extensions which contain balance weights.

FLIGHT CONTROLS

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

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

TRIM SYSTEM

A manually-operated elevator trim system is provided; a rudder trim system may also be installed (see figure 7-1). 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. Rudder trimming is accomplished through a bungee connected to the rudder control system and a trim lever, mounted on the control pedestal. Rudder trimming is accomplished by lifting the trim lever up to clear a detent, then moving it either left or right to the desired trim position. Moving the trim lever to the right will trim the airplane nose-right; conversely, moving the lever to the left will trim the airplane nose-left.

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 over the control column. 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". Engine instruments, fuel quantity indicators, an ammeter, and a low-voltage warning light are near the left edge of the panel. Avionics equipment is stacked approximately on the centerline of the panel, with the right side of the panel containing space for additional instruments and avionics equipment. A switch and control panel at the lower edge of the instrument panel contains the primer, master and ignition switches, avionics power switch, circuit breakers, and electrical switches on the left side, with the engine controls, light intensity controls, and static pressure alternate source valve in the center. The right side of the switch and control panel contains the wing flap switch lever and position indicator, cabin heat and air controls, cigar lighter, and map compartment. A control pedestal, installed below the switch and control panel, contains the elevator trim control wheel and position indicator, and provides a bracket for the microphone. A rudder trim control lever may be installed below the trim wheel 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.

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 10° each side of center. By applying either left or right brake, the degree of turn may be increased up to 30° each side of center.

Moving the airplane by hand is most easily accomplished by attaching a tow bar to the nose gear strut. If a tow bar is not available, or pushing is required, use the wing struts as push points. Do not use the vertical or horizontal surfaces to move the airplane. If the airplane is to be towed by vehicle, never turn the nose wheel more than 30° 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 5 and 1/2 inches. 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.

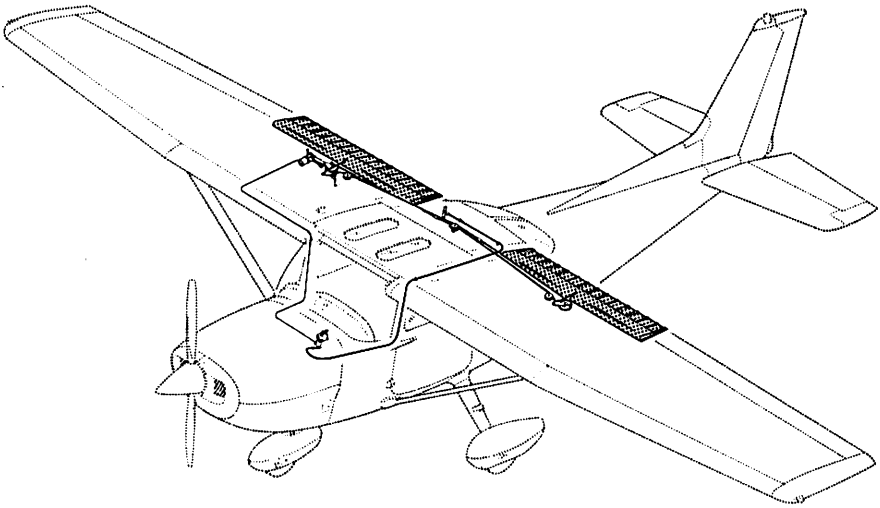


Figure 7-3. Wing Flap System

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 instrument 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-ampere circuit breaker, labeled FLAP, on the left side of the switch and control panel.

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 two areas, one extending from behind the rear passengers' seat to the aft cabin bulkhead, and an additional area aft of the bulkhead. Access to both baggage areas is gained through a lockable baggage door on the left side of the airplane, or from within the airplane cabin. A baggage net with eight tie-down straps is provided for securing baggage and is attached by tying the straps to tie-down rings provided in the airplane. When loading the airplane, children should not be placed or permitted in the baggage compartment, unless a child's seat is installed, 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 solid back or a split-backed fixed seat is for 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 adjusted to three positions. To position either seat, lift the tubular handle under the center of the seat, slide the seat into position, release the handle, and check that the seat is locked in place. The seat back is spring-loaded to the vertical position. To adjust its position, raise the lever under the outboard side of either seat, position the back to the desired angle, release the lever, and check that the back is locked in place. The seat backs will also fold full forward.

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 either one-piece or two-piece (individually adjustable) seat backs. The one-piece back is adjusted by raising a lever under the center of the seat cushion; the two-piece backs are adjusted by raising levers below the seat backs at the outboard ends of the seat cushion. After adjusting either type of seat back to the desired position (the one-piece and two-piece seat backs are spring-loaded to the vertical position), release the handle and check that the seat back is locked in place. The seat backs will also fold forward.

A child's seat may be installed behind the rear passengers' seat in the forward baggage compartment, and is held in place by two brackets mounted on the floorboard. When not occupied, the seat may be stowed by rotating the seat bottom up and aft until it contacts the aft cabin bulkhead.

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 HARNESSES

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; shoulder harnesses are 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

All of the seat belts are attached to fittings on the floorboard. The buckle half is inboard of each seat and the link half is outboard of each seat.

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 (if installed) 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 outward.

SHOULDER HARNESSES

Each front seat shoulder harness (see figure 7-4) 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. The rear seat shoulder harnesses are attached adjacent to the lower corners of the rear window. Each rear seat harness is stowed behind a

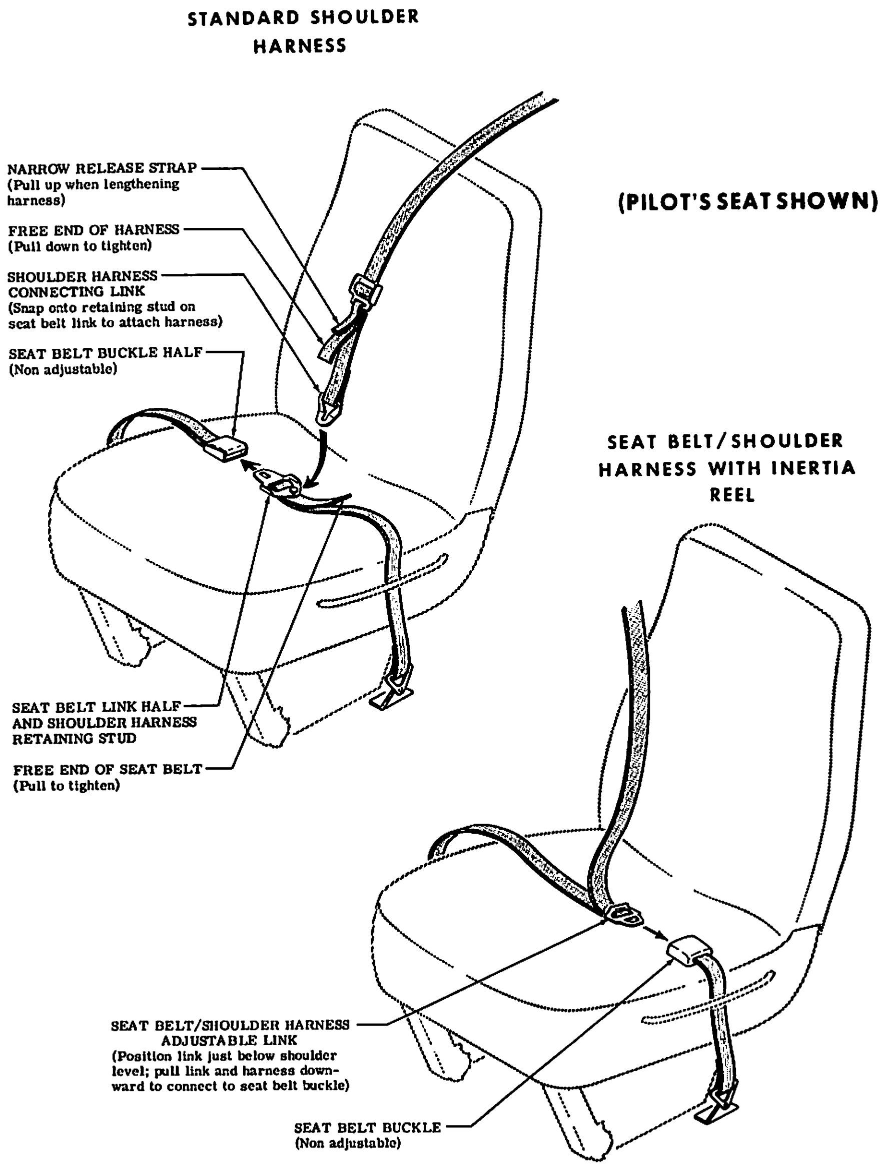


Figure 7-4. Seat Belts and Shoulder Harnesses

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 HARNESSES 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 ceiling 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.

NOTE

> The inertia reels are located for maximum shoulder harness comfort and safe retention of the seat occupants. This location requires that the shoulder harnesses cross near the top so that the right hand inertia reel serves the pilot and the left hand reel serves the front passenger. When fastening the harness, check to ensure the proper harness is being used.

To use the seat belt/shoulder harness, position the adjustable metal link on the harness just below shoulder level, pull the link and harness downward, and insert the link into 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 either door by grasping the forward edge of the handle and pulling outboard. To close or open the doors from inside the airplane, use the combination door handle and arm rest. The inside door handle has three positions and a placard at its base which reads OPEN, CLOSE, and LOCK. The handle is spring-loaded to the CLOSE (up) position. When the door has been pulled shut and latched, lock it by rotating the door handle forward to the LOCK position (flush with the arm rest). When the handle is rotated to the LOCK position, an over-center action will hold it in that position. Both cabin doors should be locked prior to flight, and should not be opened intentionally during flight.

NOTE

Accidental opening of a cabin door in flight due to improper closing does not constitute a need to land the airplane. The best procedure is to set up the airplane in a trimmed condition at approximately 75 KIAS, 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 160 KIAS. The cabin top windows (if installed), rear side windows, and rear windows are of the fixed type and cannot be opened.

CONTROL LOCKS

A control lock is provided to lock the ailerons and elevator control surfaces in a neutral position and 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. Proper installation of the lock will place the red flag over the ignition switch. In areas where high or gusty winds occur, a control surface lock should be installed over the vertical stabilizer and rudder. The control lock and any other type of locking device should be removed prior to starting the engine.

ENGINE

The airplane is powered by a horizontally-opposed, four-cylinder, overhead-valve, air-cooled, carbureted engine with a wet sump oil system. The engine is a Lycoming Model O-320-H2AD and is rated at 160 horsepower at 2700 RPM. Major accessories include a starter and belt-driven alternator mounted on the front of the engine, and dual magnetos and a vacuum pump which are mounted on an accessory drive pad on the rear of the engine. Provisions are also made for a full flow oil filter.

ENGINE CONTROLS

Engine power is controlled by a throttle located on the switch and control panel above the control pedestal. 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 above the right corner of the control pedestal, 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, and a tachometer. An economy mixture (EGT) indicator and a carburetor air temperature gage are also available.

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

Oil temperature is indicated by a gage 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. Oil temperature limitations are the normal operating range (green arc) which is 100°F (38°C) to 245°F (118°C), and the maximum (red line) which is 245°F (118°C).

The engine-driven mechanical tachometer is located on the instrument panel to the left of the pilot's control wheel. The instrument is calibrated in increments of 100 RPM and indicates both engine and propeller speed. An hour meter in the lower section of the dial records elapsed engine time in hours and tenths. Instrument markings include the normal operating range (multiple width green arc) of 2100 to 2700 RPM, and a maximum (red line) of 2700 RPM. The multiple width green arc has steps at 2450 RPM, 2575 RPM, and 2700 RPM which indicate a 75% engine power setting at altitudes of sea level, 5000 feet, and 10,000 feet.

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 tailpipe 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 65% to 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 is supplied from a sump on the bottom of the engine. The capacity of the engine sump is six quarts (one additional quart is required if a full flow oil filter is installed). Oil is drawn from the sump through an oil suction strainer screen into the engine-driven oil pump. From the pump, oil is routed to a bypass valve. If the oil is cold, the bypass valve allows the oil to bypass the oil cooler and go directly from the pump to the oil pressure screen (full flow oil filter if installed). If the oil is hot, the bypass valve routes the oil out of the accessory housing and into a flexible hose leading to the oil cooler on the lower right side of the firewall. Pressure oil from the cooler returns to the accessory housing where it passes through the pressure strainer screen (full flow oil filter, if installed). The filter oil then enters a pressure relief valve which regulates engine oil pressure by allowing excessive oil to return to the sump while the balance of the oil is circulated to various engine parts for lubrication. Residual oil is returned to the sump by gravity flow.

An oil filler cap/oil dipstick is located at the rear of the engine near the center. The filler cap/dipstick is accessible through an access door in the engine cowling. The engine should not be operated on less than four quarts of oil. For extended flight, fill to six quarts (dipstick indication only). For engine oil grade and specifications, refer to Section 8 of this handbook.

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

Ignition and starter operation is controlled by a rotary type switch located on the left switch and control panel. The switch is labeled 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 cowling. 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 shroud is obtained from an unfiltered outside source. Use of full carburetor heat at full throttle will result in a loss of approximately 100 to 225 RPM.

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.

For easy 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 cylinder intake ports when the plunger is pushed back in. The plunger knob is equipped with a lock and, after being pushed full in, must be rotated either left or right until the knob cannot be pulled out.

COOLING SYSTEM

Ram air for engine cooling enters through two intake openings in the front of the engine cowling. The cooling air is directed around the cylinders and other areas of the engine by baffling, and is then exhausted through an opening at the bottom aft edge of the cowling. No manual cooling system control is provided.

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

PROPELLER

The airplane is equipped with a two-bladed, fixed-pitch, one-piece forged aluminum alloy propeller which is anodized to retard corrosion. The propeller is 75 inches in diameter.

FUEL SYSTEM

The airplane may be equipped with either a standard fuel system or long range system (see figure 7-6). Both systems consist of two vented fuel tanks (one in each wing), a four-position selector valve, fuel strainer, manual primer, and carburetor. Refer to figure 7-5 for fuel quantity data for both systems.

Fuel flows by gravity from the two wing tanks to a four-position selector valve, labeled BOTH, RIGHT, LEFT, and OFF. With the selector valve in either the BOTH, LEFT, or RIGHT 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 cylinder intake ports.

Fuel system venting is essential to system operation. Blockage of the

FUEL QUANTITY DATA (U. S. GALLONS)			
TANKS	TOTAL USABLE FUEL ALL FLIGHT CONDITIONS	TOTAL UNUSABLE FUEL	TOTAL FUEL VOLUME
STANDARD (21.5 Gal. Each)	40	3	43
LONG RANGE (27 Gal. Each)	50	4	54

Figure 7-5. Fuel Quantity Data

system will result in decreasing fuel flow and eventual engine stoppage. Venting is accomplished by an interconnecting line from the right fuel tank to the left tank. The left fuel tank is vented overboard through a vent line, equipped with a check valve, which protrudes from the bottom surface of the left wing near the wing strut. The right fuel tank filler cap is also vented.

Fuel quantity is measured by two float-type fuel quantity transmitters (one in each tank) and indicated by two electrically-operated fuel quantity indicators on the left side of the instrument panel. An empty tank is indicated by a red line and the letter E. When an indicator shows an empty tank, approximately 1.5 gallons remain in a standard tank, and 2 gallons remain in a long range tank as unusuable fuel. The indicators cannot be relied upon for accurate readings during skids, slips, or unusual attitudes.

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

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

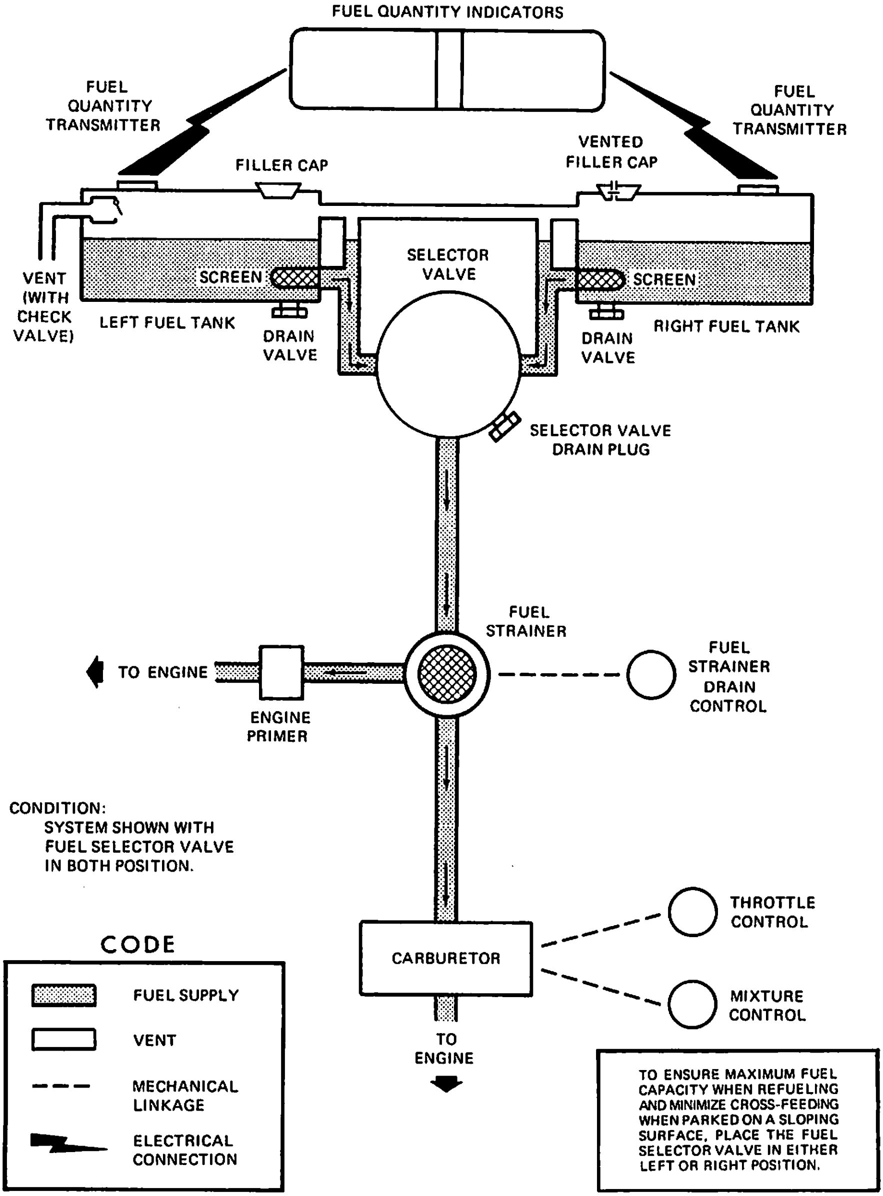


Figure 7-6. Fuel System (Standard and Long Range)

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.

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 right 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 under the left side of the instrument 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 an engine-driven, 60-

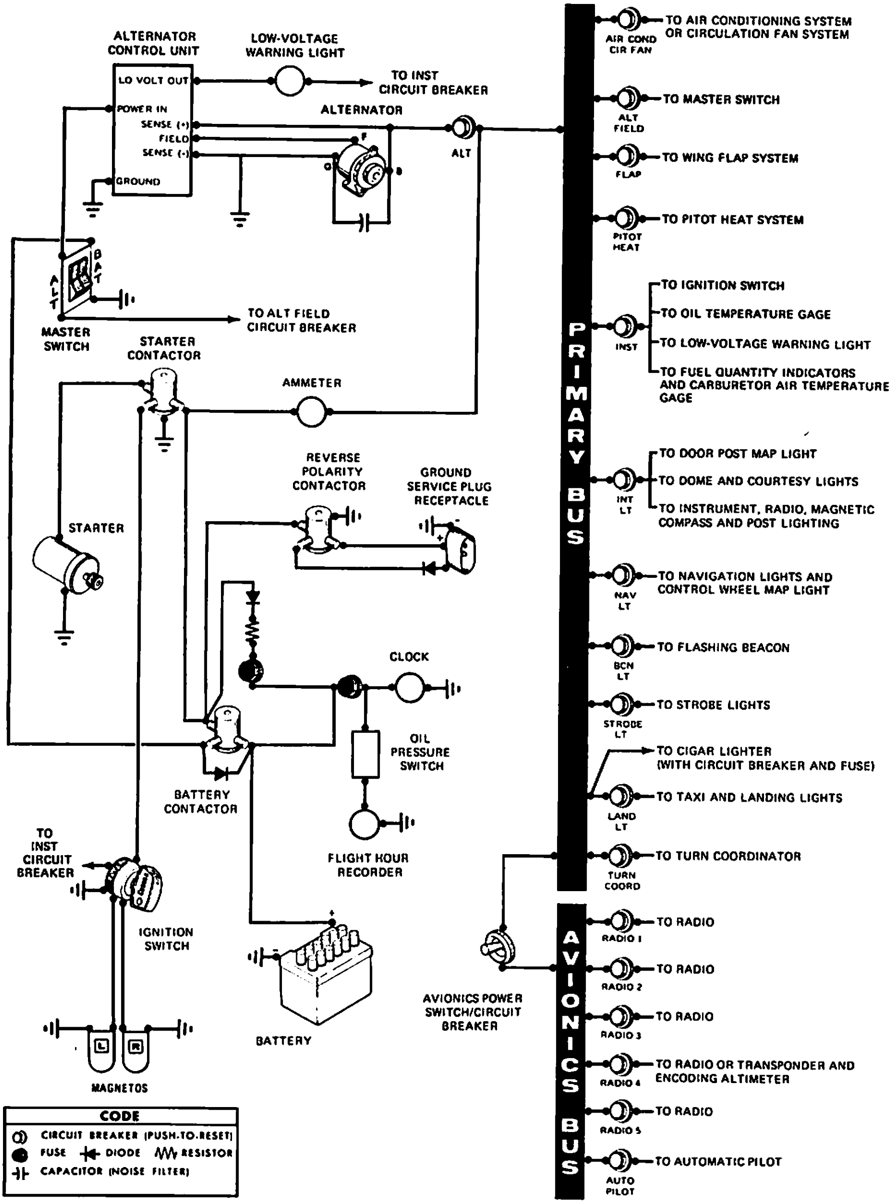


Figure 7-7. Electrical System

amp alternator and a 24-volt battery (a heavy duty battery is available), located on the left forward side of the firewall. 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 and avionics power switches are turned on.

CAUTION

Prior to turning the master switch on or off, starting the engine or applying an external power source, the avionics power switch, labeled 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 also 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 on the lower left side of the instrument panel, indicates the flow of current, in amperes, from the alternator to the battery or from the battery to the airplane electrical system. When the engine is operating and the master switch is turned on, the ammeter indicates the charging rate applied to the battery. In the event the alternator is not functioning or the electrical load exceeds the output of the alternator, the ammeter indicates the battery discharge rate.

ALTERNATOR CONTROL UNIT AND LOW-VOLTAGE WARNING LIGHT

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

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

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

INTERIOR LIGHTING

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

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

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

The engine instrument cluster (if post lights are installed), radio equipment, and magnetic compass have integral lighting and operate independently of post or flood lighting. The intensity of this lighting is controlled by the inner knob on the light dimming rheostat labeled RADIO LT; rotate the knob clockwise to obtain 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 RADIO LT knob full counterclockwise. Check that the flood lights/post lights are turned off for daylight operation by rotating the PANEL LT knob full counterclockwise.

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

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

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

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

CABIN HEATING, VENTILATING AND DEFROSTING SYSTEM

The temperature and volume of airflow into the cabin can be regulated by manipulation of the push-pull CABIN HT and CABIN AIR control knobs (see figure 7-8).

For cabin ventilation, pull the CABIN AIR knob out. To raise the air temperature, pull the CABIN HT knob out approximately 1/4 to 1/2 inch for a small amount of cabin heat. Additional heat is available by pulling the knob out farther; maximum heat is available with the CABIN HT knob pulled out and the CABIN AIR knob pushed full in. When no heat is desired in the cabin, the CABIN HT knob is pushed full in.

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 doorpost at floor level. Windshield defrost air is also supplied by a duct leading from the cabin manifold. Two knobs control sliding valves in the defroster outlet and permit regulation of defroster airflow.

Separate adjustable ventilators supply additional air; one near each

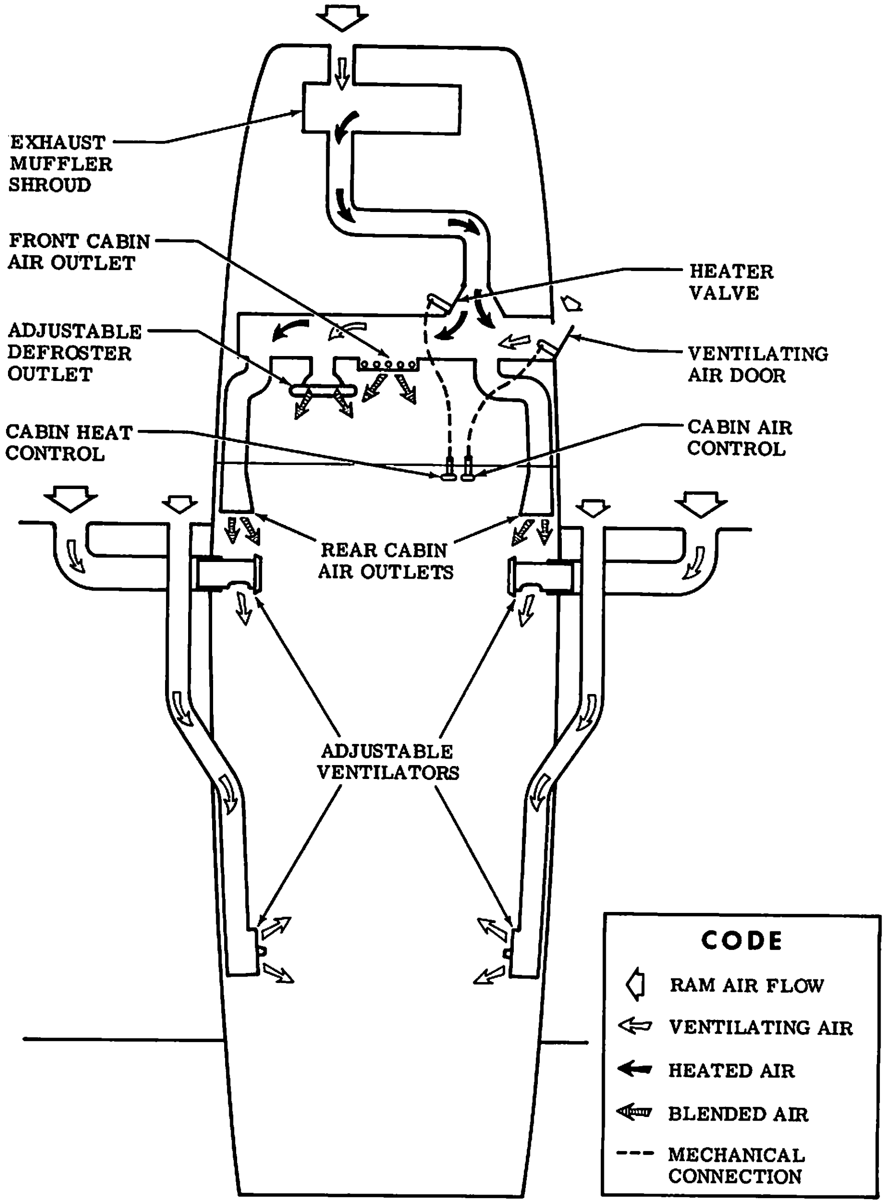


Figure 7-8. Cabin Heating, Ventilating, and Defrosting System

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. The airplane may also be equipped with an air conditioning system. For operating instructions and details concerning this system, refer to Section 9, Supplements.

PITOT-STATIC SYSTEM AND INSTRUMENTS

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

The heated pitot system (if installed) consists of a heating element in the pitot tube, a rocker switch labeled PITOT HT, a 5-amp circuit breaker, and associated wiring. The switch and circuit breaker are located on the left side of the switch and control panel. 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 on the switch and control panel below the throttle, and can be used if the external static source is malfunctioning. This valve supplies static pressure from inside the cabin instead of the external static port.

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

Pressures within the cabin will vary with open heater/vents and windows. Refer to Section 5 for the effect of varying cabin pressures on airspeed readings.

AIRSPEED INDICATOR

The airspeed indicator is calibrated in knots and miles per hour. Limitation and range markings (in KIAS) include the white arc (41 to 85 knots), green arc (47 to 128 knots), yellow arc (128 to 160 knots), and a red line (160 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.

RATE-OF-CLIMB INDICATOR

The rate-of-climb 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 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

The attitude indicator 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 in relation to the horizon bar. A knob at the bottom of the instrument is provided for in-flight adjustment of the miniature airplane to the horizon bar for a more accurate flight attitude indication.

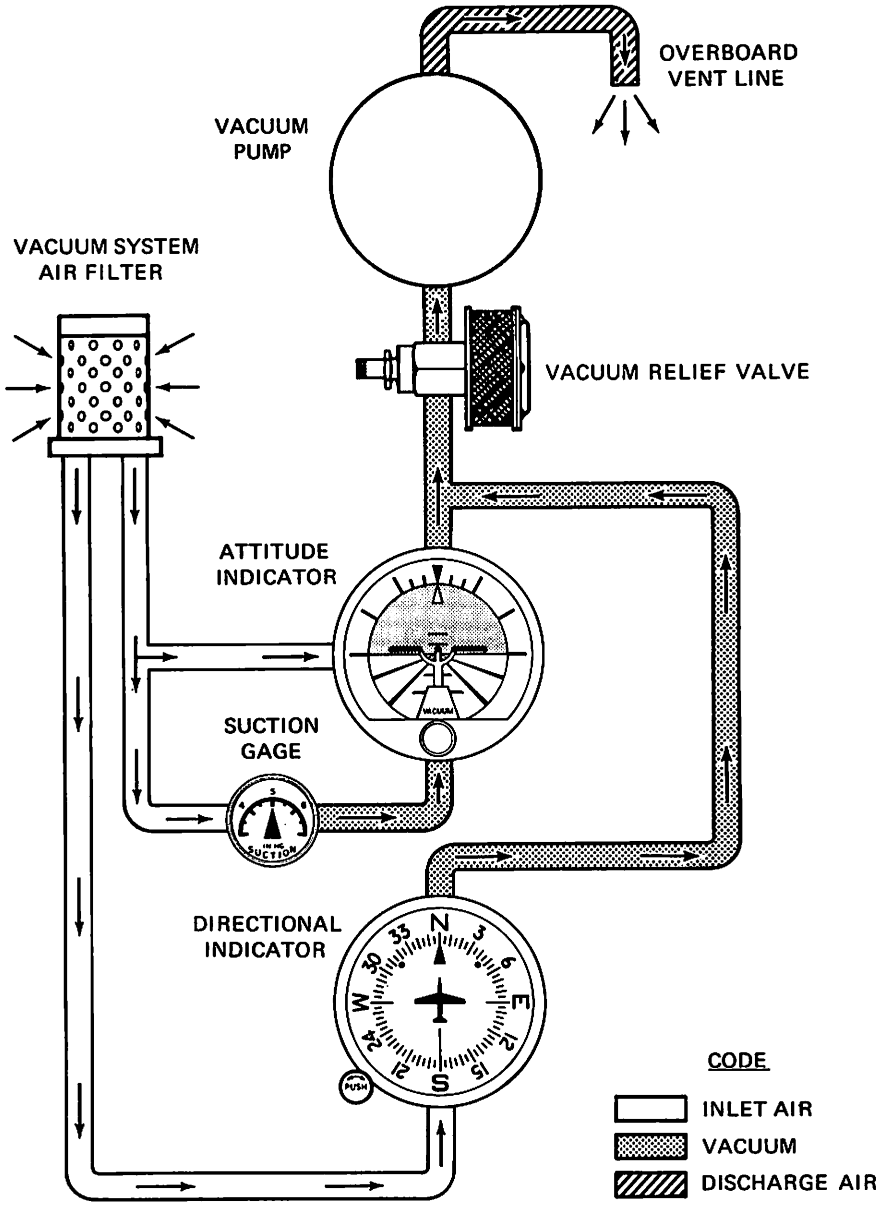


Figure 7-9. Vacuum System

DIRECTIONAL INDICATOR

A directional indicator displays airplane heading on a compass card in relation to a fixed simulated airplane image and index. The 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 precession.

SUCTION GAGE

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

STALL WARNING SYSTEM

The airplane is equipped with a pneumatic-type stall warning system consisting of an inlet in the leading edge of the left wing, an air-operated horn near the upper left corner of the windshield, and associated plumbing. As the airplane approaches a stall, the low pressure on the upper surface of the wings moves forward around the leading edge of the wings. This low pressure creates a differential pressure in the stall warning system which draws air through the warning horn, resulting in an audible warning at 5 to 10 knots above stall in all flight conditions.

The stall warning system should be checked during the preflight inspection by placing a clean handkerchief over the vent opening and applying suction. A sound from the warning horn will confirm that the system is operative.

AVIONICS SUPPORT EQUIPMENT

The airplane may, at the owner's discretion, be equipped with various types of avionics support equipment such as an audio control panel, microphone-headsets, and static dischargers. The following paragraphs discuss these items.

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 near the lower left corner of the instrument panel. Audio to all three headsets is controlled by the individual audio selector switches and adjusted for volume level by using the selected receiver volume controls.

NOTE

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

STATIC DISCHARGERS

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

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

SECTION 8
AIRPLANE HANDLING, SERVICE & MAINTENANCE

TABLE OF CONTENTS

Page

INTRODUCTION

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

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

IDENTIFICATION PLATE

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

OWNER 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 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 FOR YOUR
  - AIRPLANE
  - AVIONICS AND AUTOPILOT
- PILOT'S CHECKLISTS
- POWER COMPUTER
- SALES AND SERVICE DEALER DIRECTORY

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

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

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

NOTE

A Pilot's Operating Handbook and FAA Approved Airplane Flight Manual which is lost or destroyed may be replaced by contacting your Cessna Dealer 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.

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, the inspection and maintenance work load is divided into smaller operations that can be accomplished in shorter time periods. The operations are recorded in a specially provided Aircraft Inspection Log as each operation is conducted.

While Progressive Care may be used on any Cessna, its benefits depend primarily on the utilization (hours flown per year) and type of operation. The procedures for both the Progressive Care Program and the 100-hour/annual inspection program have been carefully worked out by the factory and are followed by the Cessna Dealer Organization. Your Cessna Dealer can assist you in selecting the inspection program most suitable for your type of aircraft and operation. 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 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 30° 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 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. 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, tail, and nose tie-down fittings and secure each rope or chain to a ramp tie-down.
4. 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 bracket. 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 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 specific 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 --

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, and the following oils used as specified for the average ambient air temperature in the operating area.

MIL-L-6082 Aviation Grade Straight Mineral Oil: Use to replenish supply during the 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.

SAE 50 above 16°C (60°F).
SAE 40 between -1°C (30°F) and 32°C (90°F).
SAE 30 between -18°C (0°F) and 21°C (70°F).
SAE 20 below -12°C (10°F).

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

SAE 40 or SAE 50 above 16°C (60°F).
SAE 40 between -1°C (30°F) and 32°C (90°F).
SAE 30 or SAE 40 between -18°C (0°F) and 21°C (70°F).
SAE 30 below -12°C (10°F).

CAPACITY OF ENGINE SUMP -- 6 Quarts.

Do not operate on less than 4 quarts. For extended flight, fill to 6 quarts. These quantities refer to oil dipstick level readings. During oil and oil filter changes, one additional quart is required when the filter is changed.

OIL AND OIL FILTER CHANGE --

After the first 25 hours of operation, drain the engine oil sump and oil cooler 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 oil cooler and clean the oil pressure screen each 50 hours thereafter.

On airplanes **which have** an oil filter, drain the engine oil sump and oil cooler and change the oil filter again at the first 50 hours; thereafter, the oil and filter change interval may be extended to 100-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).
CAPACITY EACH STANDARD TANK -- 21.5 Gallons.
CAPACITY EACH LONG RANGE TANK -- 27 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.

LANDING GEAR

NOSE WHEEL TIRE PRESSURE -- 31 PSI on 5.00-5, 4-Ply Rated Tire.
MAIN WHEEL TIRE PRESSURE -- 29 PSI on 6.00-6, 4-Ply Rated Tires.
NOSE GEAR SHOCK STRUT --
Keep filled with MIL-H-5606 hydraulic fluid and inflated with air to 45 PSI. Do not over-inflate.

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 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.

The Power of Experience

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2499 Bath Road
Penn Yan, New York 14527

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FAA APPROVED SUPPLEMENT

TO THE

PILOT'S OPERATING HANDBOOK AND

FAA APPROVED AIRPLANE FLIGHT MANUAL

FOR

CESSNA MODELS 172N or P

REG. NO. N5089G

SER. NO. 17273538

This Supplement must be attached to the "Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the aircraft is modified by the installation of a 180 HP engine and the gross weight is increased in accordance with STC SA703GL. The information contained herein supplements or supersedes the basic manual only in those areas listed. For limitations, procedures and performance information not contained in this Supplement, consult the basic "Pilot's Operating Handbook and FAA Approved Airplane Flight Manual."

FAA APPROVED: [signature]
FOR W. F. Horn, Manager
Chicago Aircraft
Certification Office
FAA Central Region

DATE: June 11, 1985

PENN YAN AERO SERVICE INC.
FAA APPROVED
AIRPLANE FLIGHT MANUAL SUPPLEMENT
FOR CESSNA 172 SERIES AIRCRAFT

LOG OF REVISIONS

Rev. No.	Page No.	Description	FAA Approved	Date
A	4	Added performance information to Section 5 for clarification. Added Log of Revisions Page 2 Renumbered pages	I. Brumer Irwin N. Brumer Manager, NYACO	3/8/94

Penn Yan Aero Service, Inc.
2499 Bath Road, Airport
Penn Yan, NY 14527-9599

SECTION I - General

DESCRIPTIVE DATA

A. Engine

Number of engines: 1
Engine Manufacturer: Avco Lycoming
Engine Model: O-360-A4A, -A4M, -A4N
Horsepower Rating and Speed: 180 rated BHP at 2700 RPM

B. Propeller

Propeller Manufacturer: Sensenich
Propeller Model Number: 76EM8S5 or 76EM8SPY
Number of Blades: 2
Propeller Diameter: 76 inches
Propeller Type: Fixed Pitch

SECTION II - Limitations

A. The following placard must be displayed in full view of the pilot:

THIS AIRCRAFT HAS BEEN MODIFIED BY THE INSTALLATION OF A 180 HP ENGINE PER STC SA703GL. IT MUST BE OPERATED AS A NORMAL CATEGORY AIRPLANE IN COMPLIANCE WITH THE OPERATING LIMITATIONS AS STATED IN THE FORM OF PLACARDS, MARKINGS AND MANUALS.

B. For the N model aircraft the following placard must be displayed adjacent to the flap position selector switch:

MAXIMUM FLAP TRAVEL IS 30°

C. The following limits apply to the normal category only.

Maximum Gross Weight - 2550 lbs.
C.G. Range - 41.0" to 47.3" at 2550 lbs.
35.0" to 47.3" at 1950 lbs. or less
Straight line variation between points given.

FAA APPROVED
DATED: JUN 11 1985

Section 3 Emergency Procedures

NO CHANGE

Section 4 Normal Procedures

NO CHANGE

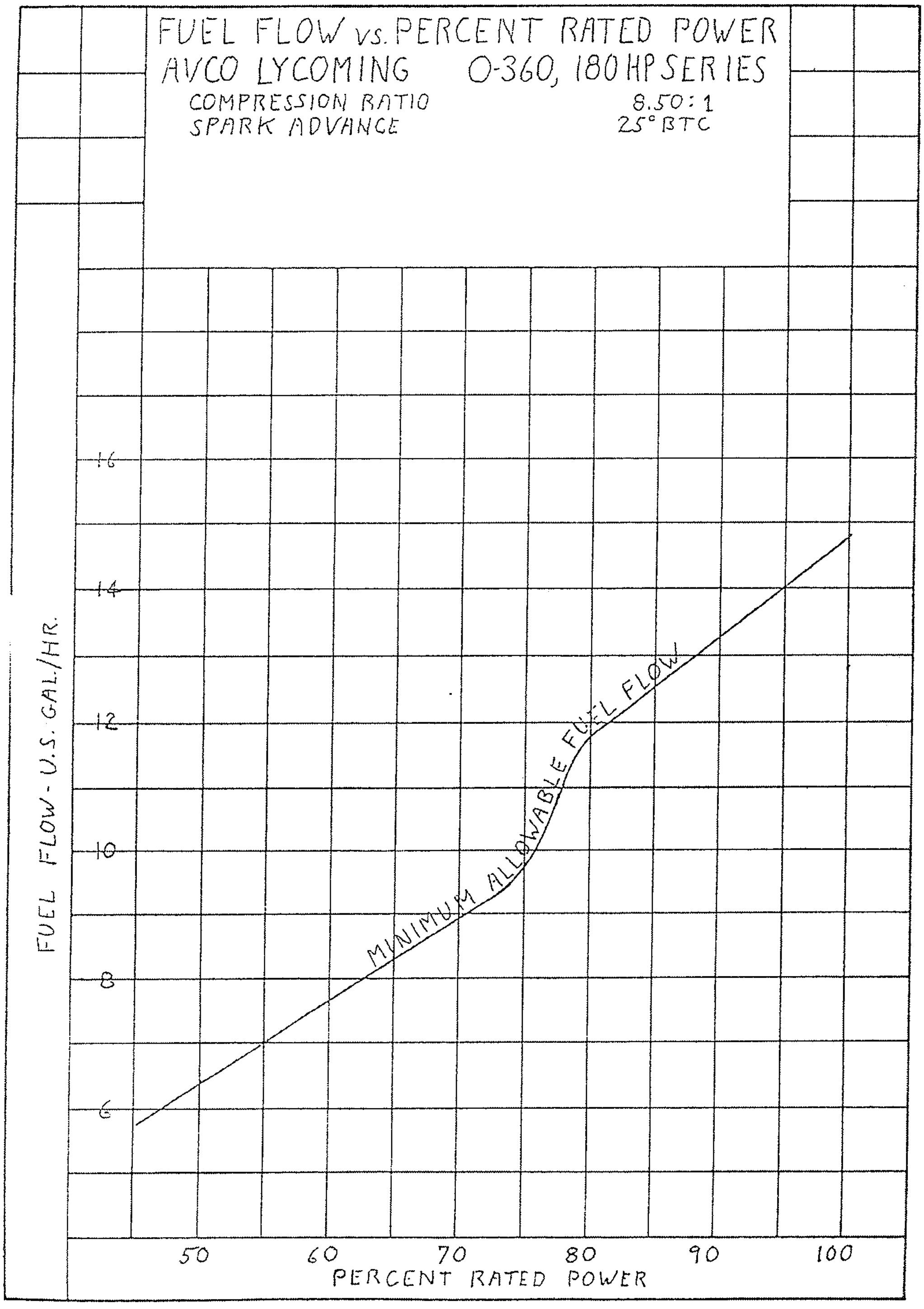
Section 5 Performance

Performance of the Cessna 172 series aircraft, when it is modified by the installation of a 180 HP engine and the gross weight is increased, in accordance with STC SA703GL, will be equal to or better than the basic airplane

CAUTION:- The fuel consumption and range/endurance information originally presented for this model do not apply to this STC modification; increased fuel consumption and reduced range/endurance can be expected with the 180 hp engine installed.

FAA APPROVED
DATE:
Revised: APR 13 1994

CURVE NO. 13357



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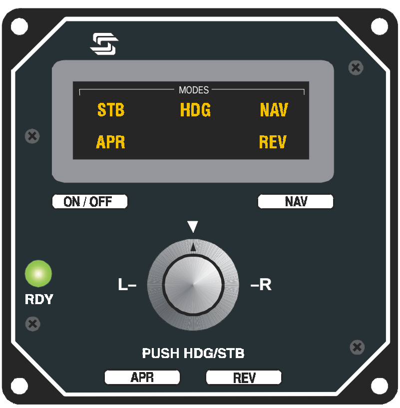
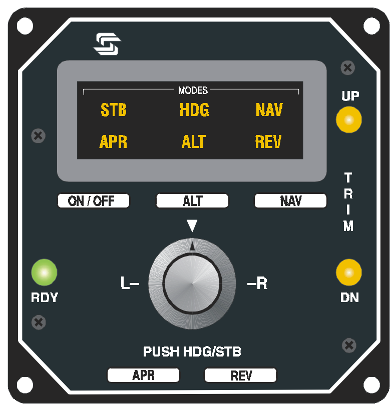
System 40/50 Autopilots
Pilot's Operating Handbook





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List of Effective Pages	* Asterisk indicates pages changed, added, or deleted by revision.

Record of Revisions	Retain this record in front of handbook. Upon receipt of a revision, insert changes and complete table below.

Edition Number	Publication Date	Insertion Date/Initials
1st Edition	February 01, 2000	
2nd Edition	October 25, 2002	

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Table of Contents

List of Figures

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SECTION 1
INTRODUCTION

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1.0 Introduction

The primary purpose of the System 40/50 **Pilot Operating Handbook (POH)** is to provide pilots with step-by-step functional Preflight and In-Flight Operating Procedures for the installed system.

1.1 Notice

This manual may be used in conjunction with FAA approved autopilot Airplane Flight Manual Supplement (AFMS), Pilots Operating Handbook Supplement (POHS), or Supplemental Flight Manual (SFM). Refer to the specific AFMS, POHS, or SFM for your aircraft specific information and emergency operating procedures.

If the autopilot is to be used during Instrument Flight Rules (IFR) operations, we recommend that you develop a thorough understanding of the autopilot system, its functions, and characteristics in Visual Meteorological Conditions (VMC). Accomplish this before undertaking an IFR flight.

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SECTION 2
BLOCK DIAGRAM

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2.0 Block Diagrams

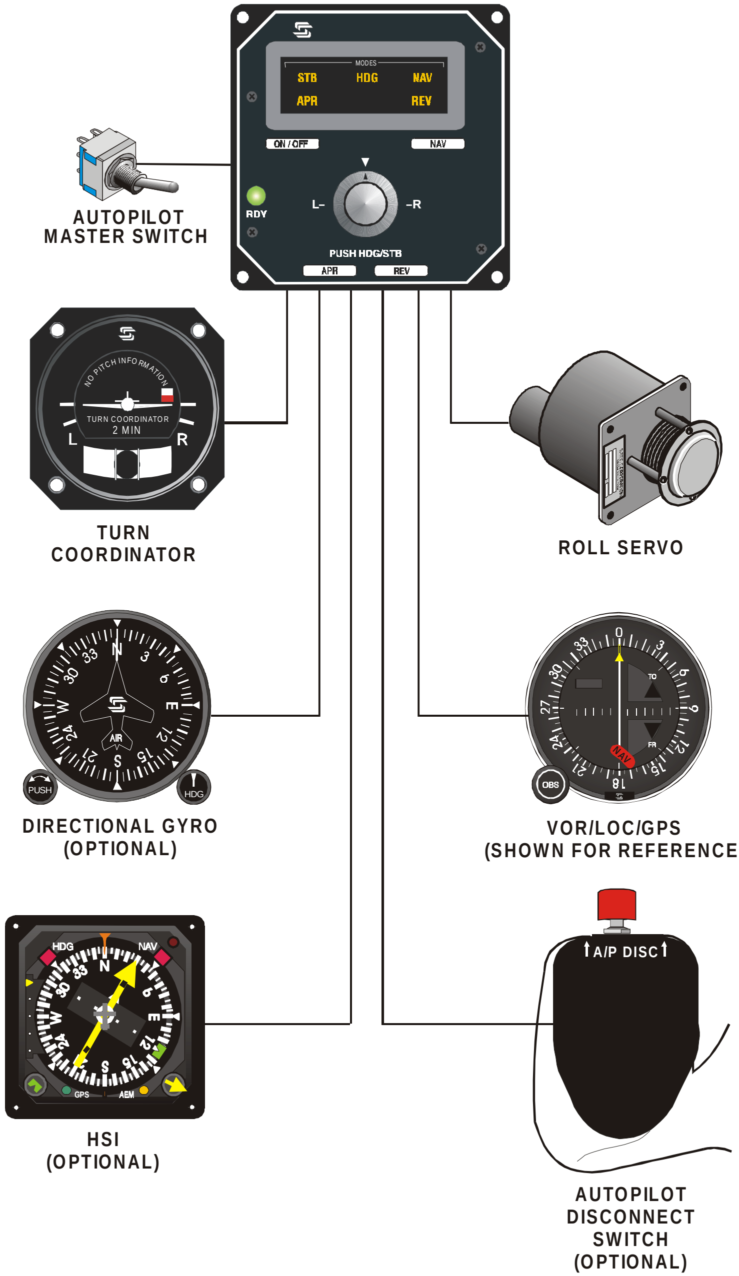

Fig. 2-1. System 40 Programmer/Computer

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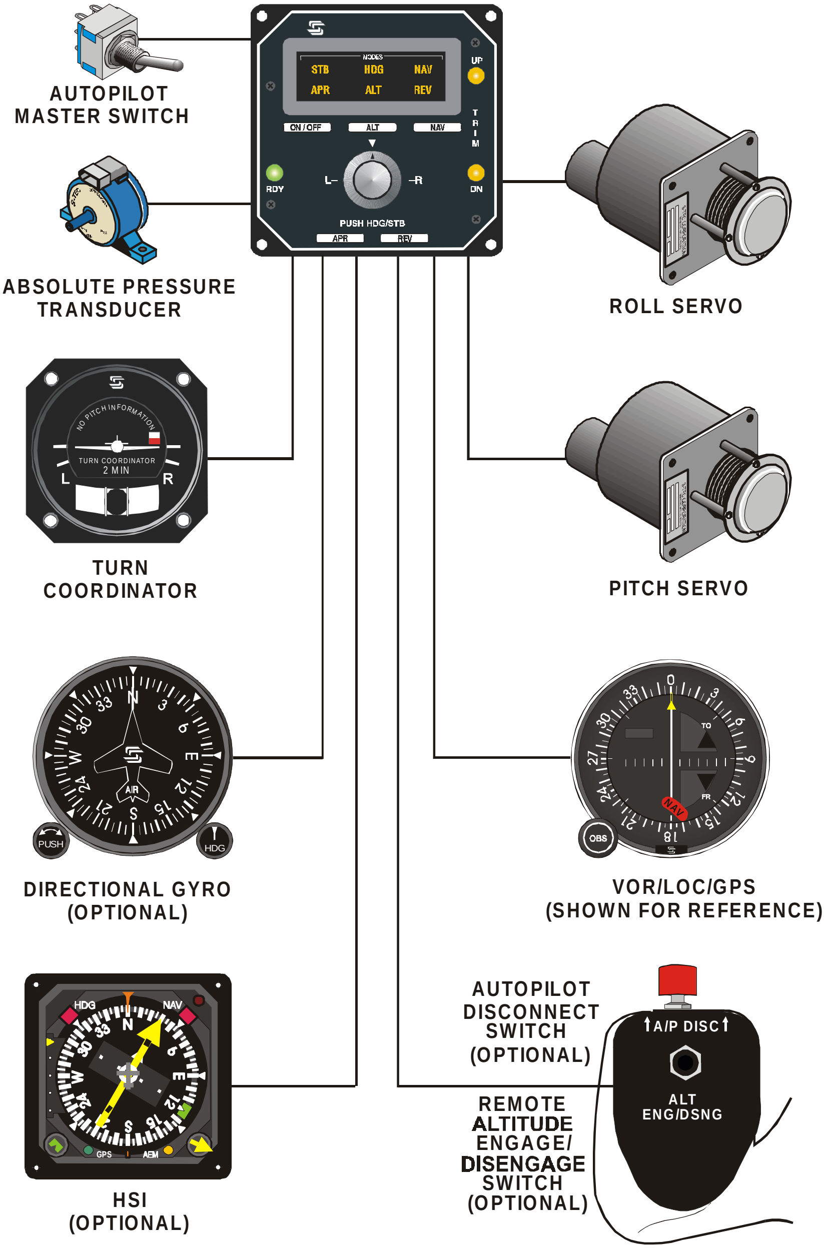

Fig. 2-2. System 50 Programmer/Computer

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SECTION 3
THEORY OF OPERATION

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3.0 Theory of Operation

3.1 System 40 Modes of Operation

NOTE: The Aircraft (AC) instrument light rheostat controls the annunciator and indicator brightness.

1. The System 40 provides the aircraft with Roll Axis control only.

2. The Turn Coordinator contains the Rate Gyro, Autopilot pick-off, Rate Gyro RPM detector, and an instrument power monitor that will flag if low system voltage occurs.

3. The System 40 Programmer/Computer, which contains the Roll Computer, receives power through the battery buss and connects to the panel mounted ON/OFF/TEST switch through the A/P circuit breaker (CB).

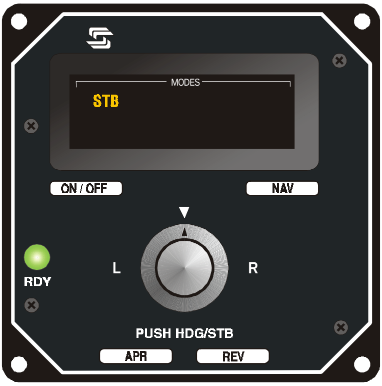
4. The Rate Gyro is the basic sensor for roll stabilization.

5. The Rate Gyro signal combines either with the Turn Command Knob, Heading Error Signal, or NAV inputs to generate a Roll Error signal, which then drives the roll servo as needed.

6. The System 40 operates in one of five Roll Modes, three of which are Navigation (NAV) Modes. The Roll modes are Stabilizer (STB) and Heading (HDG); the NAV Modes are Approach (APR), Navigation (NAV), and Reverse (REV).

7. The Programmer/Computer Unit provides the Mode Select Switches and annunciation for the system.

8. Mode Annunciation Window displays mode in use.



10. ON/OFF Mode Switch engages the roll system in the Stabilizer (STB) Mode. This allows use of the Turn Knob to command up to a standard rate turn. (90%).

11. Navigation Mode Switch (NAV) will engage the VOR/GPS/LORAN Tracking Mode. This provides low system gain for comfortable cross-country tracking.

12. Approach Mode Switch (APR) engages the VOR/GPS/LORAN or Localizer Tracking Mode. This provides a higher level of system gain for more active tracking of VOR, GPS or Localizer front course signals.

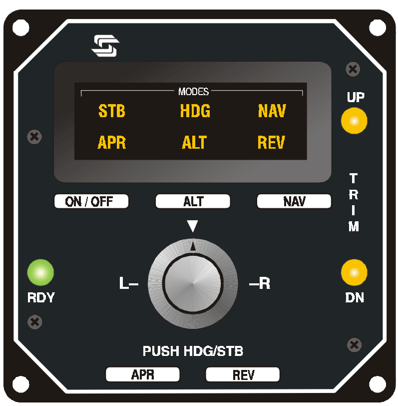
13. Reverse Approach Mode Switch (REV) will engage the Reverse Tracking Mode for use when tracking a localizer back course. This provides APR mode system gain with reverse needle sensing.

14. HDG/STB Turn Knob/Switch allows left or right proportional turn commands to the roll servo in the STB Mode only. It activates the turn command for roll axis maneuvers up to 90% of standard turn rate.

15. To engage the Heading Mode (HDG), if optional DG or HSI is installed, press and release the Turn Knob. To return to STB Mode, press and release the Turn Knob again. When the system is in a NAV Mode and there is a DG or HSI installed, press and release the Turn Knob to return to HDG Mode.

3.2 System 50 Modes of Operation

NOTE: The System 50 Roll Axis function is identical to the System 40. Refer to the System 40 section for Roll Axis procedures.



1. The System 50 incorporates an accelerometer and absolute pressure transducer as pitch sensors.

2. When the Altitude Hold Mode is engaged, an elevator trim sensor in the pitch servo will detect the elevator trim condition.

3. Green Ready Light (RDY) illuminates when autopilot is ready for engagement.

4. Select a Roll mode.

5. Altitude Mode Switch (ALT) when pressed and released engages or disengages the Altitude Hold mode.

6. If the aircraft requires elevator trim, the indicator on the programmer/ computer unit will illuminate to indicate the direction of trim required to return the elevator to the trimmed position.

7. Trim Down Light (DN) illuminates to indicate the need for nose down trim.

8. Trim UP Light (UP) illuminates the need for nose up trim.

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SECTION 4
PROCEDURES

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4.0 Procedures

4.1 System 40 Functional Pre-Flight Procedures

NOTE: There must be adequate aircraft DC voltage (14 or 28VDC) to perform these checks. Low voltage may adversely effect the Functional Pre-flight Procedures.

1. Position the Avionics Master Switch ON, then position the A/P Master Switch to ON.

2. Position the A/P Master Switch to Test. RDY, STB, HDG, NAV, APR, and REV annunciators will illuminate. The lights remain on until positioning the Test Switch ON or OFF.

3. Position the A/P Master Switch to ON after the Turn Coordinator has reached its' rated RPM. Observe that the green Ready (RDY) light is on.

4. Press the ON/OFF switch; the STB light illuminates. Rotate Turn Knob left then right; observe that the control wheel moves respectively. Center Turn Knob; control wheel stops.

5. Set DG or HSI (if installed) and place HDG bug under lubber line, push Turn Knob to engage HDG mode. Observe HDG annunciator illuminates . Move HDG bug left and right; observe that the control wheel follows.

6. Override Test: Grasp the control wheel; slowly override the roll servo left then right to ensure proper clutch action.

CAUTION

Control Wheel movements should be smooth. If any unusual noise or restriction occur, have the system inspected for proper installation and proper clutch setting, immediately. Have repaired as needed. Do not operate the Autopilot under these conditions.

7. Radio Check: Tune the NAV radio to a valid VOR signal. Press and release the NAV Mode Switch the NAV lamp illuminates. Move VOR OBS so that the CDI needle moves left and right. Observe the control wheel moves respectively. Perform the same tests for the REV and APR modes.

NOTE: In REV Mode, observe that the control wheel moves opposite of the NAV needle and with more authority than in the NAV Mode.

NOTE: In APR Mode, observe that the control wheel follows the radio needle movement and with more authority than in the NAV Mode.

8. Use one of the following to disconnect the A/P. Press and release the remote AP Disconnect Switch on the control wheel (if installed). Press and release the "ON/OFF" Switch on the Autopilot Programmer Unit. Move the Autopilot Master Switch to Off. Pull the A/P Circuit breaker.

4.2 System 40 In-Flight Procedures

1. A/P Master Switch ON; RDY light illuminates.
2. Trim aircraft to desired flight conditions. Maintain yaw trim during all autopilot operations.
3. Center Turn Knob, press and release ON/OFF Switch.
4. Set Turn Knob to level or turning flight, as desired.
5. Set HDG bug (if installed) to a desired heading, press and release the Turn Knob to engage HDG Mode.

4.3 VOR Tracking and VOR Approach

NOTE: The System 40/50 does not provide intercept capability but will accurately **track** a reliable navigation signal when following one of the procedures listed.

1. Tune the NAV receiver, verify a valid NAV Signal, and then select a Radial.
2. Maneuver aircraft to the selected radial within +/- one needle width and within 10 degrees of the course heading.
3. Press and release NAV Mode for VOR cross-country tracking.
4. Press and release APR Mode for VOR approaches and more sensitive tracking, such as LORAN/GPS tracking.

NOTE: Approach Mode may be used to track VOR radials cross-country if desired. Use of APR Mode for cross country tracking may result in some course scalloping if the VOR signal is weak or otherwise "noisy". In areas of poor signal quality, NAV Mode may provide more accurate tracking even with reduced gain.

4.4 Localizer Approach

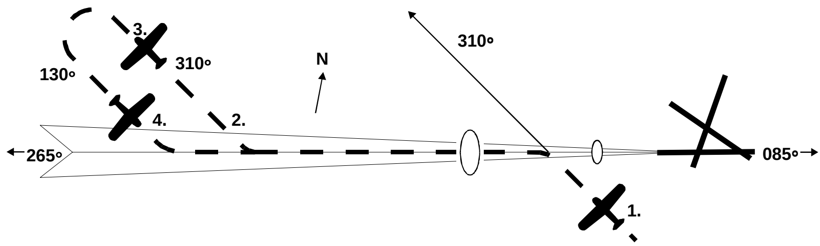
1. Tune the NAV receiver to desired Localizer frequency.
2. Maneuver aircraft to selected Localizer, within +/- one needle width and within 10 degrees of the course heading.
3. To track the Localizer **front course outbound**, maneuver to the Localizer center. When on the **OUTBOUND** heading, select **REV Mode**.
4. To track the Localizer **back courses inbound**, maneuver to the Localizer back course centerline. When on the **INBOUND** heading, select **REV Mode**.

4.5 GPS Tracking and GPS Approach

1. Enter desired waypoint in GPS receiver.
2. Maneuver aircraft to within +/- one needle width and within 10 degrees of the course heading.
3. Select APR Mode for GPS cross-country tracking or GPS Approach.

NOTE: When flying multiple waypoints repeat steps 2 & 3 for each leg if it involves more than 10 degrees of course change.

4.6 Procedure Turn Localizer Approach and Tracking with Standard DG



1. A. Tune navigation to LOC frequency. Verify signal.

   B. Select HDG Mode, position the aircraft on **OUTBOUND** LOC HDG.

   C. Select REV Mode, autopilot will track Localizer **OUTBOUND.**

2. A. Set HDG bug to **OUTBOUND** procedure turn HDG.

   B. Press HDG Mode Switch.

3. A. In 90° increments, set heading bug to **INBOUND** procedure turn heading.

4. A. Set heading bug to **INBOUND** LOC course heading.

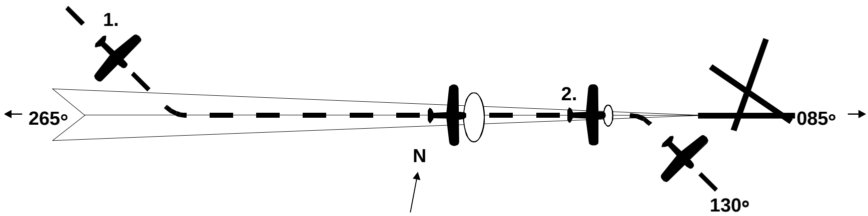
   B. When established on the Localizer inbound, press and release APR Mode Switch. Autopilot will track Localizer course to the airport.

If a missed approach is declared at the Middle Marker:

5. A. Disconnect the autopilot and stabilize the aircraft for a missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.7 Straight In Localizer Approach and Tracking with Standard DG



1. A. Tune navigation radio to Localizer frequency. Verify signal.

   B. Select the HDG Mode and position aircraft on the published LOC **INBOUND** heading course. (See note)

   C. Press and release APR Mode Switch. Autopilot will track the Localizer to the airport.

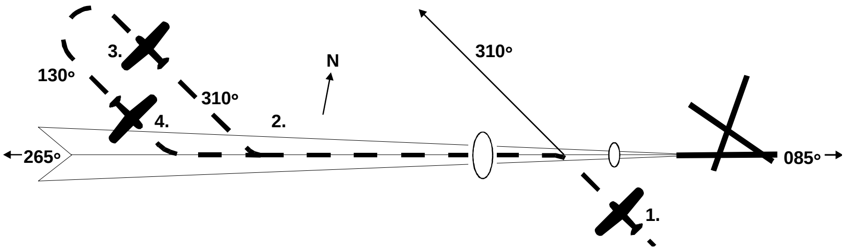
NOTE: In NO to LOW wind, turn to the published course for the airport. Engage APR Mode. With strong cross winds, select a HDG providing cross wind correction prior to engaging the APR Mode. **This is true for all Localizer Approach Procedures.**

If a missed approach is declared at the Middle Marker:

2. A. Disconnect the autopilot and stabilize the aircraft for a missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.8 Procedure Turn Localizer Approach and Tracking, Optional HSI



1. A. Tune navigation radio to LOC frequency.

   B. Set course pointer on published **INBOUND** LOC course HDG.

   C. Select HDG Mode and position aircraft on LOC **OUTBOUND**.

   D. Press and release REV Mode and the autopilot will track **OUTBOUND.**

2. A. Set heading bug to published **OUTBOUND** procedure turn heading.

   B. Press **HDG** Mode Switch.

3. A. In 90° increments, set heading bug to **INBOUND** procedure turn heading.

4. A. Set HDG bug to **INBOUND** LOC course heading.

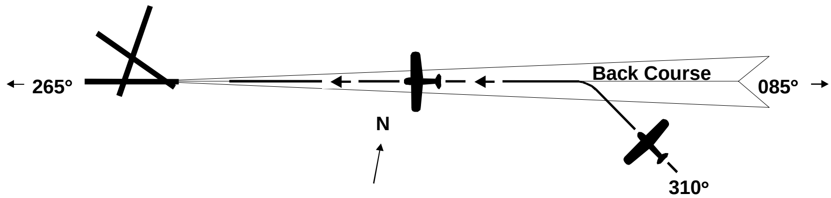
   B. When established on Localizer, press and release APR Mode Switch and the autopilot will track the Localizer to the airport.

If a missed approach is declared at the Middle Marker:

5. A. Disconnect the autopilot and stabilize the aircraft for a missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.9 Back Course Straight-In Approach, Optional HSI



Use the Reverse Mode to track the front course **OUTBOUND** or the back course **INBOUND** to the airport. Set the HSI Course Pointer to the front course **INBOUND** heading.

1. A. Tune navigation radio to LOC frequency.

   B. Set Course Pointer to published **INBOUND** front course heading.

   C. In HDG Mode, position the aircraft on the Localizer Back Course HDG to the airport.

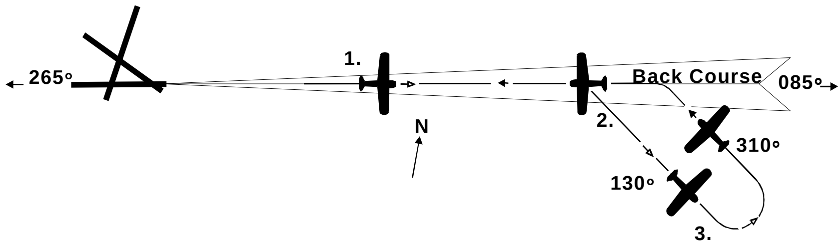
   D. Press and release the REV Mode Switch and the autopilot will track the Localizer to the airport.

If a missed approach is declared at the Middle Marker:

2. A. Disconnect the autopilot and stabilize the aircraft for a missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.10 Back Course Procedure Turn with Optional HSI



Use the Reverse Mode to track the front course **OUTBOUND** or the back course **INBOUND** to the airport. It is required to set the HSI Course Pointer to the front course **INBOUND** heading.

1. A. Tune the navigation receiver to LOC frequency.

   B. Set the course pointer to published **INBOUND** LOC front course heading.

   C. In HDG Mode, position the aircraft on the LOC back course.

   D. Press APR Mode Switch. Autopilot will capture and track back course **OUTBOUND.**

2. A. Set heading bug to published **OUTBOUND** procedure turn heading.

   B. Press HDG Mode Switch.

3. A. In 90° increments, set heading bug to **INBOUND** procedure turn heading.

   B. While still in the HDG Mode, position the aircraft on the Localizer back course to the airport.

   C. Press and release the REV Mode and the autopilot will track the Localizer back course to the airport.

If a missed approach is declared at the Middle Marker:

4. A. Disconnect the autopilot and stabilize the aircraft for the missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.11 System 50 Functional Pre-Flight Procedures

NOTE: Refer to the System 40 Pre-Flight Procedures for Roll Command checks.

NOTE: During the functional checks, the system requires adequate DC voltage of 14 or 28 VDC minimum, as appropriate.

NOTE: The System 50 uses a vertical acceleration accelerometer to detect short-term AC motions, which, with the altitude transducer, controls AC Altitude. The accelerometer interrupts the pitch axis of the A/P any time the AC experiences a vertical acceleration of more than ± .6 "G" for more than .5 sec. The following procedure conducts a test of the automatic pitch interrupt feature. During the test the servo will engage and disengage automatically. If the test fails, the RDY light will not illuminate and the A/P will not engage.

1. Move A/P Master Switch to "TEST" position.

   A. Observe all lights and annunciators illuminate.

   B. Observe the following light sequence of the trim indicators: (Sequence requires 6-9 seconds).

      1. Initially, both trim UP & DN lights are illuminated. Pitch servo solenoid engages.

      2. UP light extinguishes. Pitch servo solenoid disengages.

      3. UP light illuminates. Pitch servo solenoid engages.

      4. DN light then extinguishes and will remain off. Pitch servo solenoid disengages.

      5. Observe that the green ready (RDY) light illuminates.

2. Move AP Master Switch to "ON" position.

NOTE: If the ready light does not illuminate after the test, this indicates a failure and the system requires service.

3. Engage STB Mode, move control wheel to the neutral position using the Left/Right Control knob.

NOTE: The A/P can be engaged and disengaged repeatedly without repeating the test sequence, unless electrical power is interrupted. If a power interruption occurs, accomplish the test again to get a RDY indication.

4. Move the Control Wheel to neutral elevator position.

5. Press and release the ALT Switch; ALT Annunciator illuminates. Move control wheel forward then AFT to override the Pitch Servo Clutch.

6. Engage Altitude Mode 15-20 sec. After successful completion of the Test sequence and engagement of the A/P in STB Mode.

CAUTION

Control wheel movements should be smooth. If any unusual noise or restrictions occur, immediately have the system inspected for proper installation and proper clutch settings.Have repaired as needed. <u>Do not operate the Autopilot under these conditions.</u>

7. <u>Trim check:</u> slowly apply back pressure to control wheel for 2-3 seconds. Observe the DN trim light illuminates. Slowly apply forward pressure to the control wheel for 2-3 seconds. DN light extinguishes and UP trim light illuminates. Move the control wheel to the center. UP light extinguishes.

8. Hold the control wheel, press and release the ON/OFF Switch, note that roll and pitch servos release. Move control wheel to confirm roll and pitch motions are free with no control restrictions or binding.

NOTE: If the optional Control Wheel disconnect switch is installed it may be used to disconnect the A/P for this check.

4.12 System 50 In-Flight Procedures

CAUTION

Conduct the required Pre-flight test, if necessary, in flight. However, the pitch servo will engage and disengage as part of the Self-Test. Therefore do not attempt flight maneuvers during the power-up test.

CAUTION

If the pilot fails to trim the aircraft, the UP or DN Trim Light will annunciate and after 4 seconds the trim light will flash.

1. Check the RDY light ON.
2. Trim aircraft for desired flight conditions. Maintain Yaw Trim during all Autopilot operations.
3. Center Turn Knob and press and release ON/OFF Switch.
4. Set Turn Knob to level flight or turn, as desired.
5. Set HDG bug to desired heading (if installed) and press and release Turn Knob to engage HDG Mode. Select headings as desired.

NOTE: Although the ALT Hold may be selected whether in a climb or descent, Step 6 is the preferred method for selecting ALT Hold to prevent the need for excessive trim corrections.

6. At the desired altitude, trim aircraft for level flight conditions, set power/elevator trim and engage ALT Hold.
7. Disengage ALT Mode to climb or descend.

NOTE: If the aircraft encounters turbulence, it is normal for the Trim Annunciator Lights to flicker. Elevator trim is only required if the Trim Annunciator Lights remain illuminated.

4.13 Emergency Procedures

This information is supplemental to and does not supercede or amend the information provided in the AFMS, POHS, SFM, for specific aircraft and autopilot installation manuals.

NOTE: If the aircraft does not have a copy of the required AFMS, POHS, or SFMs' please contact customer service and S-TEC will provide a copy at no cost. Have the aircraft make, model, and type of autopilot when calling for this supplement.

If the aircraft encounters any malfunctions with the A/P, follow the procedures below:

WARNING

In case of an autopilot malfunction, do not attempt to diagnose the problem in flight.

1. Immediately regain manual control of the aircraft by overriding the servo(s) and then disconnect the autopilot system.

NOTE: The system includes a friction override clutch on each servo. Overriding the Servo will not damage the system.

2. To disconnect the Autopilot, use one of the following means: Press and release the remote AP Disconnect Switch on the Control Wheel (if installed). Press and release the ON/OFF Switch on the Programmer/Computer. Move the Autopilot Master Switch to "OFF". Pull the autopilot circuit breaker.

3. If improper operations occur during an instrument approach, disconnect the system and fly a manual approach. If a failure occurs inside the Final Approach Fix, it is advisable to conduct a Missed Approach, notify the Air Traffic Control (ATC) of the problem and fly the approach manually seeking ATC's assistance as necessary.

4. If a particular mode of operation, including ALT Hold, develops a fault peculiar to that mode only, it is acceptable to operate the system in other modes as long as a determination can be made as to their satisfactory function.

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SECTION 5
APPENDICES

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Appendix A: Specifications

System Requirements

Programmer/Computer

Power required	14/28 Vdc
Weight	2.2 lbs. (40), 2.8 lbs. (50)
Dimensions	3.28 x 3.28 x 7.4 in.
TSO	C9c

Directional Gyro (optional)

Power required	Vacuum or pressure, 4.5-5.2 Hg
Minimal air flow	2.2 CFM
Air filtration	3 Micron, 95%
Autopilot pick-off	AC, linear transformer, 5kHz, 8 VAC (pp) supplied by autopilot.
Weight	3.4 Lbs.
Dimensions	3.38 x 3.38 x 8.35 in.
Internal lights	14/28 Vdc

Roll Servo

Power required	14/28 Vdc
Current Requirements	Included in system requirements
Weight	2.9 lbs.
Dimensions	3.75 x 3.75 x 7.25 in.

Absolute Pressure Transducer

Power required	10 Vdc
Pressure Range	0-15 PSI Absolute
Overpressure	150% of operating maximum
Weight	0.2 lbs.

Pitch Servo

Same as Roll Servo

Turn Coordinator

Power required	14/28 Vdc
Flag Voltage Detector	9 Vdc (Approx.)
Tach RPM Detector	Normal less 10%
Current Requirements	.8 Amps/.4 AMPS
Dimensions	3.275 x 3.275 x 5.62 in.
Weight	1.8 lbs.

System Current Requirements

Average Operating Current

System	@14 Vdc	@28 Vdc
40	1.0 Amps	0.5 Amps
50	2.0 Amps	1.0 Amps

Max Current

System	@14 Vdc	@28 Vdc
40	3.0 Amps	2.0 Amps
50	5.0 Amps	3.0 Amps

SECTION 6
GLOSSARY

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GLOSSARY

Term	Meaning
AC	Aircraft
ALT	Altitude
AFMS	Airplane Flight Manual Supplement
A/P	Auto Pilot
CB	Circuit Breaker
CDI	Course Deviation Indicator
DG	Directional Gyro
FAA	Federal Aviation Administration
GPS	Global Positioning System
HDG	Heading
Hg	Mercury
HSI	Horizontal Situation Indicator
IFR	Instrument Flight Rules
IFP	In Flight Procedures
IMC	Instrument Meteorological Conditions
LOC	Localizer
LORAN	Long Range Navigation
NAV	Navigation
REV	Reverse
OBS	Omnibearing Selector
POH	Pilot's Operating Handbook
POHS	Pilot's Operating Handbook Supplement
PSI	Pounds Per Square Inch
RDY	Ready
SFM	Supplement Flight Manual
STB	Stabilizer
TSO	Technical Standard Order
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omnidirectional Radio Range

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P/N: 8780
Date: 25 October 2002
Printed in USA

ASPEN AVIONICS

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Document A-01-175-00 Revision B

FAA APPROVED

EFD1000 (Pro) AIRPLANE FLIGHT MANUAL SUPPLEMENT

The information contained in this Supplement must be attached to the *FAA Approved Airplane Flight Manual* when the Aspen EFD1000 Electronic Flight Instrument System PRO MODEL is installed in accordance with AML STC **SA10822SC**.

The information in this Supplement supplements or supersedes the information in the FAA Approved Airplane Flight Manual only as set forth herein.

For limitations, procedures, and performance data not contained in this Supplement, consult the Airplane Flight Manual.

Airplane Make:
Listed on Aspen EFD1000 Approved Model List (AML) ______________________________
Airplane Model:
Listed on Aspen EFD1000 Approved Model List (AML) ______________________________

Airplane Registration Number: ______________________________

Airplane Serial Number: ______________________________

FAA APPROVED By: Gary A Shaw
for S. Frances Cox, Manager
Special Certification Office
Federal Aviation Administration
Fort Worth, TX

Document Revisions

Document Revision	Pages Revised	Description of Change	FAA Approval	ECO
A	All	Internal Release		1160
B	N/A	FAA APPROVED Release	S. Frances Cox	1267

Prepared By:	PDL		Original signatures on file. See ECO for release date and dispositions.	Release Authorization	
Reviewed By:	TAG			Release Date:	3/3/08
Usage Authorization / Master Control Number:				Release Initials:	DTS
				Release Signature	David T. Stewart

TABLE OF CONTENTS

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1 General

1.1 System Overview

The Aspen Avionics' EFD1000 is a panel-mounted Electronic Flight Instrument System (EFIS) that presents the pilot with displays of attitude, altitude, indicated airspeed, heading, rate of turn, slip/skid, and navigation course deviation information. The system also displays supplemental flight data such as winds, TAS, OAT, etc., moving maps, pilot-selectable indices ("bugs"), and various annunciations that increase situational awareness and enhance flight safety. Moving map situational awareness information is displayed when the unit is connected to compatible GPS equipment. This aircraft flight manual supplement applies to the EFD1000 "Pro" configuration.

The EFD1000 "Pro" system components include the EFD1000 display head, a Remote Sensor Module (RSM), a Configuration Module (CM), and the optional Analog Converter Unit (ACU). The optional ACU enables the integration of the EFD1000 system to legacy panel-mounted GPS navigators, VOR/Localizer radios, and autopilots systems.

When interfaced with a compatible autopilot, the EFD1000 system provides heading and course datum information to the autopilot, which enables the autopilot to follow the Course and Heading values set by the pilot on the EFD1000, the same as is done with a mechanical HSI. When interfaced to a compatible GPS system, the EFD1000 can convert the digital GPS steering (GPSS) signals that are output from the GPS into analog GPSS signals that are compatible with the autopilot heading mode.

See Section 6 of this Aircraft Flight Manual Supplement for a description of the operation of the EFD1000 System.

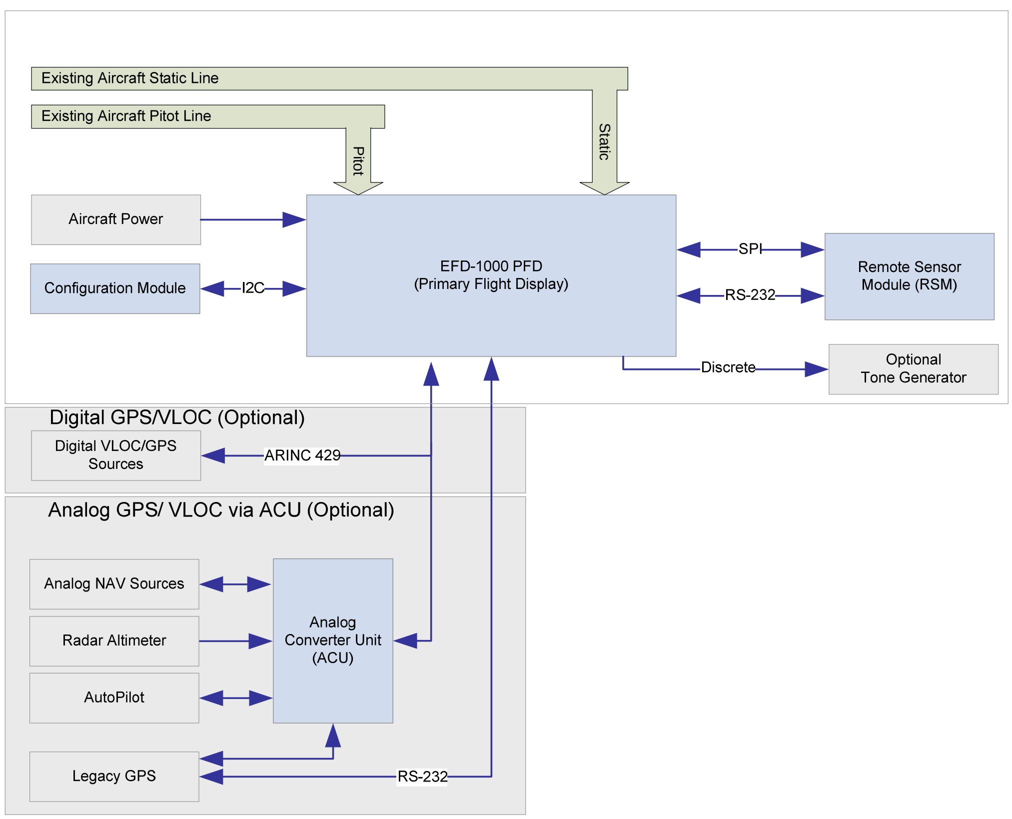


Figure 1 - EFD1000 "Pro" System Overview

2 Limitations

2.1 Software Versions

The EFD1000 System must utilize the software versions listed below (or later FAA-approved versions). The system software version for the Main Application Processor (MAP) and for the Input-Output Processor (IOP), both of which are contained within the EFD display head, is displayed via the Main menu SYSTEM STATUS page. The ACU software version number is recorded on a software version label affixed to the ACU hardware.

Software Name	Version	AFM Supplement Revision
A-02-127-1.0 EFD1000 MAP SOFTWARE	RELEASE 1.0	A-01-175-00 Revision B
A-02-147-1.0 EFD1000 IOP SOFTWARE	RELEASE 1.0	A-01-175-00 Revision B
A-02-178-1.0 EFD1000 ACU SOFTWARE	RELEASE 1.0	A-01-175-00 Revision B

2.2 Airspeed Limitation

The maximum approved operating airspeed for this system is 210 KTS (242 MPH).

2.3 Weight & Center of Gravity

Installation of the EFD1000 system may result in a small net change to the aircraft empty weight and associated moment arm. Refer to the revised weight and balance records carried in the aircraft for details.

2.4 RSM GPS Usage

The EFD1000 RSM GPS is authorized for emergency use only. Position data from the RSM GPS will ONLY be presented following the loss or failure of a certified external GPS navigator.

NOTE:

When the RSM GPS is in use, magnetic variation data used by the basemap is not updated. This can result in misaligned basemap symbology whenever the external GPS position source is lost and the aircraft travels far enough to produce a significant change in the local magnetic variation.

2.5 Geographic Limitation

Like all compass systems, the magnetometer used in the EFD1000 system will experience degraded performance in the vicinity of the magnetic poles. When the horizontal component of the earth's magnetic field is no longer strong enough to provide reliable heading data, the EFD1000 System will present a "CROSS CHECK ATTITUDE" annunciation, and will subsequently flag the magnetometer data as invalid, resulting in the annunciated loss of heading and attitude. Depending on the aircraft latitude and longitude, this effect could be observed as far away as 750 nm from the magnetic pole. In the Northern Hemisphere, this equates to operations in the Arctic Islands found north of continental North America

Use of the EFD1000 system for IFR operations with in 750 nautical miles of the Magnetic Poles, based solely upon the attitude and heading data provided by the EFD1000, is prohibited.

2.6 Placards and Decals

The following electronic placard is provided on the EFD1000 display whenever the RSM GPS is providing position data for the basemap display:

"RSM GPS REVERSION
EMER USE ONLY"

2.7 Seaplane Operation

The EFD1000 system may not be able to align when on water as a function of the wave action being experienced by the aircraft. When aligning on water, always perform a visual verification of the attitude reference with a secondary source, such as a mechanical gyro or the horizon. If the alignment is not successful, it is acceptable to depart under VFR/VMC and, while maintaining VFR/VMC, perform an AHRS in flight alignment per section 3.

3 Emergency and Abnormal Procedures

3.1 In-Flight AHRS Reset

ATTITUDE .... Maintain straight and level flight

MENU .... Select “GENERAL SETTINGS” Page

“AHRS: RESET?” LINE SELECT KEY...................... PRESS

“AHRS: RESET?” LINE SELECT KEY...................... PRESS AGAIN TO CONFIRM RESET

NOTE:

When the EFD1000 AHRS is reset in flight, it performs an abbreviated initialization.

During the initialization, the aircraft should not be subjected to excessive turn rates. Typical in-flight initialization will take approximately 30 seconds, but can take longer if the reset is initiated while banked or maneuvering.

The AHRS reset is considered complete when the EFD1000 attitude and heading is once again displayed, stable, and correct with respect to the horizon or standby indicator.

3.2 Pitot/Static System Blockage

CAUTION:

Most light aircraft have only a single pitot and static port available for flight instrument use. As such, the pitot and static lines used by the EFD1000 system are shared with those lines used by the standby airspeed indicator and altimeter. Should these lines become blocked, such as might occur due to inadvertent icing encounter, both the standby indicators and the EFD1000 indicators will display erroneous airspeed and/or altitude information.

In the event of erroneous airspeed and altitude information at the EFD1000, the EFD1000 Attitude Monitor will present a “CROSS CHECK ATTITUDE” annunciation.

A static line blockage will result in altitude remaining fixed and a zero vertical speed despite aircraft pitch and/or power setting changes. In addition, IAS indications will be incorrect if the static line is blocked. Errors will typically be noticed in the climb or descent phase of flight. When descending, ambient pressure increases which will result in the indicated airspeed reading less than the actual airspeed. The opposite effect will be observed in a climb.

A pitot line blockage will result in the airspeed indicator behaving like an altimeter when the aircraft altitude changes, and it would not respond to airspeed changes.

If a blocked pitot or static line is suspected, take the following actions:

ALTERNATE STATIC SOURCE............................... SELECT

PITOT HEAT .... ON

3.3 Loss of External Power

In the event that external power to the unit is degraded or fails, the EFD1000 will automatically switch to its internal battery.

When operating on internal battery, the display backlight intensity is capped at a value of 70.

An annunciation of this operating state and the estimated battery charge remaining is displayed in the lower portion of the attitude indicator.

CAUTION:

> **During situations where a high electrical demand is placed on the aircraft electrical system, electrical transients that cause aircraft voltage to momentarily drop below 12.8V (14V Electrical System) or 25.6V (28V Electrical System) will cause the EFD to automatically switch to its internal battery.**
>
> **This will be accompanied by an "ON BAT" annunciation.**
>
> **The "ON BAT" annunciation should extinguish shortly after the electric transient demand goes away. If the "ON BAT" annunciation does not extinguish then an external power source failure has most likely occurred**

NOTE:

> **When fully charged the EFD1000 internal battery will allow for operation for the AHRS, display and RSM emergency GPS for at least 30 minutes.**

3.4 Power Override

In the event that the pilot wishes to override the automatic power configuration of the equipment:

MENU.. Select "POWER SETTINGS" Page

To switch <u>FROM</u> External Power <u>TO</u> Battery:

"BATTERY" LINE SELECT KEY .... PRESS

To switch <u>FROM</u> Battery <u>TO</u> External Power:

"EXT PWR" LINE SELECT KEY .... PRESS

NOTE:

> **When airborne, if the EFIS input voltage is below the 12.8V (14V Electrical System) or 25.6V (28V Electrical System) automatic battery transition threshold, and "EXT PWR" is selected the EFD will automatically transition back to its internal battery.**

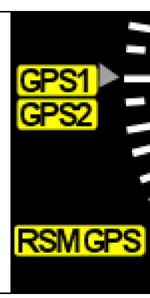
3.5 Abnormal Shutdown Procedure

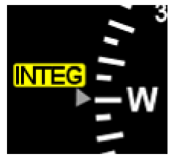
Circuit Breaker.. PULL

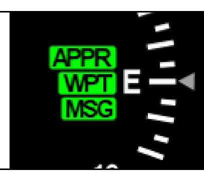
REV Button... HOLD UNTIL DISPLAY BLANKS

3.6 Warning, Caution, and Advisory Summary

WARNINGS		
ON BAT		Red annunciation presented whenever the EFD1000 is operating on the internal battery. Will be accompanied by an indication of the estimated battery charge remaining.
Function FAIL (“X”)		Red annunciation presented whenever the EFD1000 has determined that the associated function is invalid or failed and should not be used. The data is removed from the display and replaced by a red “X” over the affected display feature.

CAUTIONS		
CROSS CHECK ATTITUDE		Amber annunciation presented centered in the upper half of the attitude indicator whenever the EFD1000 AHRS internal integrity monitor determines that attitude is potentially degraded. If a CROSS CHECK ATTITUDE annunciation is provided the pilot should cross check attitude, airspeed and altitude against the standby displays.
GPS1 GPS 2 and/or RSM GPS		Amber annunciation presented on the left edge of the display to indicate when a configured GPS flight plan and mapping data is invalid or not available.

CAUTIONS		
RSM GPS REVERSION EMER USE ONLY		Amber annunciation presented whenever the EFD1000 reverts to RSM GPS data and indicates that the RSM GPS is the current GPS source. RSM GPS usage is limited to "EMER USE ONLY"
INTEG		Amber annunciation presented when the GPS source coupled to the HSI "flags" the GPS integrity. See the GPS AFMS for more information.
MINIMUMS		Amber annunciation presented whenever the aircraft is at or below the MINIMUMS altitude set by the pilot. May be accompanied by an optional one-second stuttered tone.

ADVISORY		
Altitude alerter		Amber flag presented to indicate the aircraft is reaching (steady) or deviating (flashing) from the preselected altitude. May be accompanied by an optional one-second steady tone.
DH alert		Yellow "DH" annunciation provided whenever a connected radio altimeter indicates it has reached the altitude set by the pilot. See the Radio Altimeter AFMS for more information.
GPS Annunciations: "APPR" "WPT" "MSG"		Green Annunciations associated with the GPS coupled to the HSI. See the GPS AFMS for more information.

INVALID DATA		
Slashing (red line)		A horizontal or vertical red line through the source legend of selected data indicates that the data is invalid or unavailable.

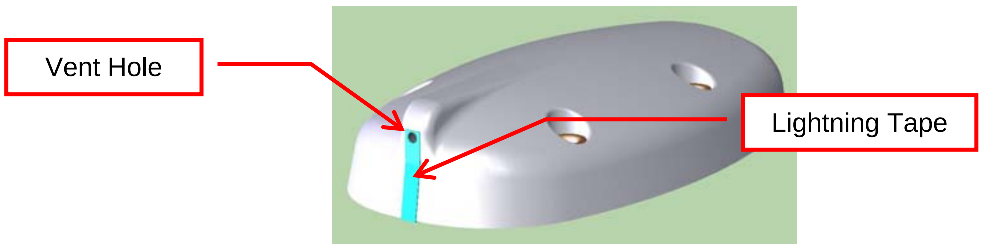
4 Normal Procedures

4.1 Exterior Inspection

RSM.. Check condition and security

RSM Vent Hole.. CLEAR OF OBSTRUCTIONS

RSM Lightning Tape.. Check Condition and security



4.2 Before Taxi Checks

EFIS MASTER (If installed)... ON

Avionics and Instruments .... SET as desired

NOTE:

> **The AHRS will perform an internal test during EFD1000 power up.**
>
> **The aircraft should remain stationary during the AHRS power up and alignment sequence.**
>
> **If the aircraft is moved during AHRS alignment it will take longer for accurate attitude and heading information to be presented to the pilot.**
>
> **Attitude and heading information is presented once the AHRS completes the alignment process**

4.3 Before Take-Off Checks

EFIS POWER SETTINGS PAGE.................................... Check Battery Status

EFIS POWER SETTINGS PAGE.................................... Check Input Voltage > 12.8V/25.6V

NOTE:

> **If the EFIS input voltage is below 12.8V (14V Electrical System) or 25.6V (28V Electrical System) then the EFD will transition to internal battery as soon as the indicated airspeed exceeds 30 KIAS.**
>
> **Voltages below these thresholds are indicative of an aircraft electrical system charging problem and should be resolved prior to flight.**

4.4 Shutdown Checks

EFIS MASTER (If installed)... OFF

5 Performance

No change.

6 System Description

6.1 General

The EFD1000 system is a flat-panel LCD primary flight instrument that presents the pilot with displays of attitude, airspeed, altitude, vertical speed, slaved compass, slip/skid, and rate of turn information. The display head incorporates a solid-state Air Data and Attitude Heading Reference System (ADAHRS) to provide data for the flight instruments. The ADAHRS system uses data from its internal solid state rate gyros and accelerometers, pitot and static sensors, solid state magnetometer, and solid state temperature probes, all contained within the display head and RSM, to derive the aircraft attitude and air data solutions. An optional analog converter unit (ACU) provides interfaces necessary for third party navigation and autopilot equipment that accept or transmit data in analog signal formats.

NOTE:

Although intuitive, a reasonable degree of familiarity is required to use the EFD1000.

6.2 Pilot Controls

6.2.1 Overview

Pilot interaction with the EFD1000 is accomplished through two knobs with push/rotate function and 11 buttons located on the display bezel. Refer to Figure 2.

Two control knobs are used to control pilot settable bugs and references.

Three lower push buttons, located between the control knobs, are used to select navigation sources for the bearing pointers and the HSI.

Three dedicated buttons on the upper side of the right bezel control map range, display reversion, and provide access to the main menu.

Five soft keys on the lower half of the right bezel control frequently used commands, such as the HSI mode or map declutter setting. These five keys are also used when navigating the main menu.

6.2.2 Power Control

To enhance safety, the EFD1000 includes an internal battery that allows the system to continue to operate in the event of a failure of the aircraft electrical system. This ensures that in addition to the standby instruments, the EFD1000 primary flight instrument continues to remain available for a period of time following the loss of all external supply power.

This internal battery is not required by regulation; however, it is good practice to verify that the status of the battery prior to takeoff.

The typical EFD1000 installation receives aircraft power from the battery bus via a dedicated circuit breaker and optionally, via an EFIS Master Switch.

Whenever indicated airspeed is invalid or below 30 KIAS the EFD1000 will power up and power down with the application or removal of external power. To turn on the system, turn on the aircraft Battery Master switch and, if installed, the optional EFIS Master switch. Reverse this process to turn the system off. A message is presented during the normal power down sequence to enable the pilot to abort the shutdown and switch to internal battery.

When IAS is greater than 30 KIAS and the input voltage is below 12.8V (14V Electrical

System) or 25.6V (28V Electrical System) the EFD will automatically switch to its internal battery (e.g. aircraft charging system failure).

The EFD1000 internal battery will provide at least 30 minutes of power when it is fully charged. The battery provides power to the display head, RSM and emergency GPS. Reducing the backlight intensity will extend the battery operating time.

When operating from battery, a red "ON BAT" annunciation and battery charge status indication is presented in the lower portion of the Attitude Indicator.

NOTE:

As a protection mechanism, the EFD1000 internal battery may not charge when the battery temperature is at extreme high or low temperatures. This situation may occur when the battery was being used and system power is subsequently restored, or it may occur under high or low ambient temperatures.

If operation from the internal battery occurs during night and/or IFR operations, one should land as soon as possible, even if external power is restored, as the battery will not recharge following restoration of external power until the battery temperature has returned to normal. .

A unit operating from battery may be powered off using the "Shut Down" command available in the Power Settings Menu.

In the unlikely event that the normal power control is not working, the EFD may be forced to shut down by first pulling its associated circuit breaker and then pressing and holding the REV button for at least 5 seconds. (Refer to section 3.4 Abnormal Shutdown Procedure)

Battery charge status may be viewed from the "Power Settings" page of the Main Menu. See section 6.7 for more information.

6.2.3 Display Screen and Control Layout

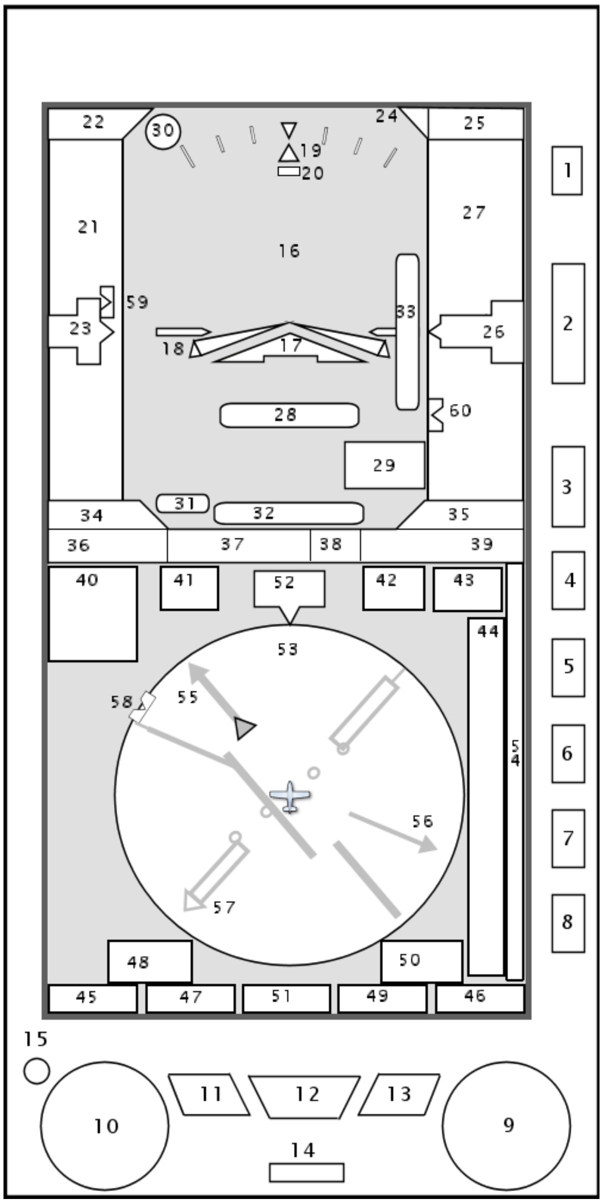


Figure 2 - PFD Display Features

1) Reversion Control
2) Range Control
3) Menu Control
4) “TPS” Tapes ON/OFF Control
5) “MIN” Minimums ON/OFF Control
6) “360/ARC” HSI View Control
7) “MAP” Map declutter logic Control
8) “GPSS” GPS Steering ON/OFF Control
9) Right Control Knob
10) Left Control Knob
11) Single-Line Bearing Pointer Source Select
12) CDI Source Control
13) Dual-Line Bearing Pointer Source Select
14) Micro SD Card slot
15) Automatic Dimming Photocell
16) Attitude Indicator
17) Aircraft Symbol
18) Single Cue Flight Director (optional – compatible autopilot required)
19) Roll Pointer
20) Slip / Skid Indicator
21) Airspeed Indicator Tape
22) Selected Airspeed Field
23) Airspeed Drum/Pointer
24) Altitude Alert
25) Selected Altitude Field
26) Altitude Drum/Pointer
27) Altitude Tape
28) MINIMUMS annunciation
29) Selected Minimums Field
30) Decision Height “DH” Annunciation (compatible Radar Altimeter required)
31) LDI Navigation Source Indication
32) Lateral Deviation Indicator
33) Vertical Deviation Indicator
34) True Airspeed
35) Barometric Pressure Setting Field
36) Ground Speed
37) OAT
38) Wind Direction Arrow
39) Wind Direction and Speed
40) Selected Source Information Field
41) Selected Course (CRS)Field
42) Selected Heading Field
43) Vertical Speed Digital Value
44) Vertical Speed Tape
45) Left Control Knob state
46) Right Control Knob state
47) Single-Needle Bearing Pointer Source
48) Single-Needle Source Info Block
49) Dual-Needle Bearing Pointer Source
50) Dual-Needle Source Info Block
51) CDI Navigation Source
52) Magnetic Heading
53) Compass Scale
54) Hot Key legend
55) CRS Pointer
56) Single-Needle Bearing Pointer
57) Double-Needle Bearing Pointer
58) Heading Bug
59) Airspeed Bug
60) Altitude Bug

6.2.4 Control Knobs

General

Two control knobs on the EFD bezel are used to adjust pilot editable data fields. The left knob adjusts data fields on the left side of the display, and the right knob adjusts data fields on the right side of the display.

The knob logic includes active and inactive states to prevent inadvertent adjustment of editable fields. After 10 seconds of inactivity, the knob returns to an inactive state and also returns to the "home" state defined for that knob. A single push activates an inactive knob. Pushing the knob again will advance the knob to the next editable field in a round-robin sequence.

When inactive, the knob legend is rendered in Cyan. Once activated, the knob legend and associated data field and bug (where appropriate) are rendered in magenta.

Left control knob

The left control knob adjusts the CDI Course Set "CRS" and Indicated Airspeed Bug "IAS" editable fields. To adjust these values **PUSH** the knob in a round robin fashion until the desired field text turns magenta, then **ROTATE** the knob to set the value (clockwise to increase, counterclockwise to decrease).

The home state for the left knob is "CRS."

Right control knob

The right control knob controls Heading Bug "HDG", Altitude Bug "ALT", Barometric Pressure Setting "BARO", and Minimums setting "MIN" editable fields in that order. To adjust these values **PUSH** the knob in a round robin fashion until the desired field text turns magenta, then **ROTATE** the knob to set the value (clockwise to increase, counterclockwise to decrease).

To adjust the "MIN" field the field must first be enabled using the MINs hot key. See section 6.2.7 for more information.

The home state for the right knob is "HDG."

6.2.5 Setting Flight Instruments

The following procedures are used to adjust pilot-editable data on the EFD1000:

Heading Bug Set

To set the heading bug, repeatedly **PUSH** the right control knob until the HDG field is enabled for editing. **ROTATE** the knob to the desired setting.

Altitude Bug Set

To set the altitude bug, repeatedly **PUSH** the right control knob until the ALT field is enabled for editing. **ROTATE** the knob to the desired setting

Barometric Pressure Set

To set the barometric pressure, repeatedly **PUSH** the right control knob until the BARO field is enabled for editing. **ROTATE** the knob to the desired setting.

NOTE:

The barometric pressure setting on the standby altimeter must be set whenever the value is adjusted on the EFD1000

Minimums Set

To set the MINIMUMS alert, repeatedly **PUSH** the right control knob until the MIN field is enabled for editing. **ROTATE** the knob to the desired setting.

The MIN field must first be enabled via the Hot Keys before it may be adjusted.

See section 6.2.7 for a description of Hot Key operation.

CDI Course Set

To select the CDI value, repeatedly **PUSH** the left control knob until the CRS field is enabled for editing. **ROTATE** the knob to the desired value.

NOTE:

When the CDI navigation source is selected to a GPS receiver, and AUTOCRS is enabled via the main menu, the course is automatically set by the GPS and is not pilot adjustable.

Indicated Airspeed Bug Set

To set the indicated airspeed bug, repeatedly **PUSH** the left control knob until the IAS field is enabled for editing. **ROTATE** the knob to the desired setting.

6.2.6 Knob Sync Function

Editable fields may be synchronized as a function of data type as described in Table 1 below. Whenever a control knob is held for approximately one second the active data type will be "sync'd" as follows:

Left Knob Data Type	SYNC Behavior	Right Knob Data Type	SYNC Behavior
IAS	The airspeed bug is set to the current IAS.	HDG	The heading bug is set to the current heading.
VOR CRS	The CRS is set to the bearing to the tuned VOR Station (this will result in the deviation bar centering with a "TO" indication).	ALT	The altimeter bug is set to the current altitude.
ILS CRS	The CRS is set to the current aircraft heading.	BARO	The barometric pressure is set to standard pressure of 29.92 in Hg or 1013 mB.
GPS CRS	AUTOCRS disabled – CRS is set to the Desired Track to the GPS active waypoint. AUTOCRS enabled – No effect. **NOTE**: AUTOCRS is enabled/disabled via the Main menu.	MIN	The MINIMUMS value is set to the current altitude.

Table 1 - Knob "Sync" Operation

6.2.7 Hot Key Operation

During normal operations, the five line select soft-keys on the lower right side of the display bezel are referred to as “Hot Keys.” Hot Keys provide single-action access to frequently used functions. An electronic legend adjacent to each Hot Key indicates its hot key function. When the legend is green, the function is active. When it is grey, the function is inactive. The legend always annunciates the current state.

Figure 3 - Hot Keys and Legend

Tapes

When enabled at installation, Hot Key 1 enables/disables the display of the airspeed and altitude tapes. If not enabled at installation, the TPS hot key will be disabled and it will not be possible for the pilot to disable the airspeed and altitude tapes.

Minimums

Hot Key 2 enables / disables the MINIMUMS display. When enabled, the minimums field is available for editing and minimums alerts are provided. When disabled, no minimums alerting is provided and the field may not be selected for editing. Upon enabling the MINs field, the right knob is activated for editing the MINs value.

Compass Presentation Format

Hot Key 3 toggles the compass between a 360 rose display and a 100 deg ARC display.

Basemap and Declutter Level

Hot Key 4 is used to enable the basemap and control the amount of basemap symbology that is presented to the pilot. Refer to Section 6.5 for additional information about the basemap.

Each successive push of the MAP hot key will change the basemap declutter level in a round-robin sequence. Available selections are HIGH, MEDIUM, LOW, FP ONLY, and OFF. In the HIGH, MEDIUM, and LOW settings the basemap symbology is rendered according to selections made by the pilot in the main menu.

The FP ONLY selection displays just the flight plan legs and waypoints associated with the GPS flight plan, and no other basemap features.

OFF removes all basemap and flight plan symbology.

Separate basemap declutter and range settings are retained for the 360 and ARC compass modes.

A basemap feature display level icon is presented with the range in the lower left portion of the display as follows:

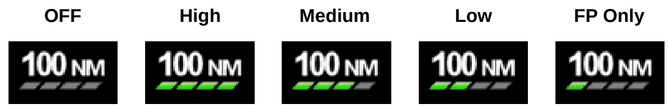


Figure 4 - Basemap Range and Declutter Settings

GPSS

Hot Key 5 is used to enable or disable GPS Steering (GPSS) outputs to the autopilot. See Section 6.6 for more information about GPSS.

6.2.8 CDI and Bearing Pointer Source Selection

Overview

The pilot may couple navigation data from external GPS or VOR/Localizer (VLOC) radio system to the HSI and bearing pointers. Navigation source selection is controlled by the three buttons located between the control knobs.

The center button is used to control the source coupled to the Course Deviation Indicator on the HSI.

The left button controls the source coupled to the single-needle bearing pointer.

The right button controls the source coupled to the double-needle bearing pointer.

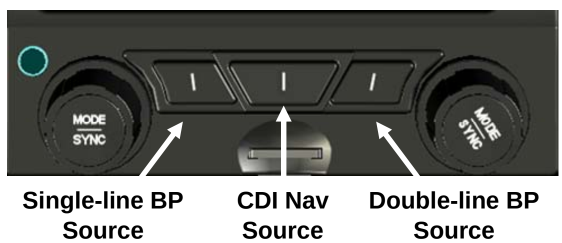


Figure 5 - Navigation Source Selection Controls

Nav Source Selection

To couple a navigation source to a bearing pointer or the CDI press the associated button to sequence between the available sources in a round-robin sequence. Available sources are VLOC1, GPS1, VLOC2 and GPS2.

For integrated GPS/VHF radios, such as the Garmin GNS4xx/5xx, control of the data type (i.e. GPS or VLOC) coupled to HSI course deviation indicator (but not for bearing pointers) is controlled by the radio. When coupled to a radio of this type, the EFD1000 will not toggle the operating state of the radio, but will annunciate the radio's current operating state in the CDI Nav Source display field. If the integrated radio is not reporting its current state to the EFD1000, such as when the equipment is OFF, failed, or a GPS waypoint has not been programmed, the EFD1000 will default to the VLOC mode.

Refer to the operating instructions or Aircraft Flight Manual Supplement for the associated GPS or VLOC radio system for instructions on how to operate that equipment.

Nav Source Display

The name of the currently coupled CDI or bearing pointer navigation source will be displayed directly above the associated button. When the coupled source data is invalid or not available, the legend is slashed with a red line.

Figure 6 - Source Selection Display

Figure 7 – Invalid Data Annunciation

6.2.9 Back Light Control

The EFD includes an adjustable LCD backlight that provides both automatic and manual brightness adjustments over a wide dimmable range. A single bezel-mounted photocell measures the ambient light, allowing an automatic dimming mode to be selected by the pilot.

Manual dimming control is enabled by the pilot to override the photocell input and adjust the display to any desired intensity level (except off).

In either mode, the bezel-key backlighting is maintained at a fixed brightness level.

To adjust backlight intensity, press the MENU button and then press the left control knob to toggle between auto (BRT AUTO) and manual brightness (BRT ADJUST) control.

To manually adjust the brightness, with BRT ADJUST displayed above the left knob rotate the knob until the desired brightness level is set. Valid brightness settings are 1 to 100.

On power up, the display defaults to AUTO brightness control.

When operating on the internal battery, backlight intensity setting is capped at a value of 70 for both manual and automatic operation.

Under extreme temperature conditions, such as may be encountered during ground operations on extremely hot days, the system backlight will automatically dim to an intensity of 30 whenever internal sensors determine that the system operating temperature has exceeded 65ºC. Should this occur the pilot should take steps to reduce the cockpit ambient temperature.

Figure 8 - Lighting control adjustment

6.2.10 Map Range Control

The EFD1000 basemap range may be set to ranges of 2.5, 5, 10, 15, 20, 30, 40, 60, 80, 100, and 200 nautical miles. Map range is measured from the own ship position to the outside of the compass arc.

To increase the range push the '+' side of the range key located on the upper right side of the bezel. To decrease the range push the '–' side of the key. The currently selected map range is displayed in the lower left corner of the display.

6.2.11 Display Reversion Control and Abnormal Shutdown

Single PFD installations do not have a display reversion capability that can be activated by the REV button. As such, the reversion function is inoperative in single display installations.

In addition to display reversion control, the REV button may be used to force the unit to power off should, for example, the display stop responding to pilot inputs. When external power has been removed, pressing and holding the REV button for 5 Seconds will produce in an immediate system shut down. When external power is available, pressing and holding the REV button for 5 seconds will result in a system restart.

While the button is pressed, the following annunciation is provided adjacent to the button:

Figure 9 - Power Reversion Annunciation

6.3 Primary Flight Instruments

6.3.1 Attitude Indicator

The Attitude Indicator consists of a conventional blue over brown attitude 'ball' rendered behind a fixed aircraft symbol to display pitch, roll and slip/skid information. The horizon line is represented by a fixed white line extending to each edge of the display area separating the blue sky and brown ground of the artificial horizon. A fixed roll pointer reads degrees of bank against a moveable roll scale.

The AHRS attitude solution continually self-monitors and will present a "CROSS CHECK ATTITUDE" annunciation whenever it determines that the AHRS solution may be degraded. Should this alert be presented, the pilot should immediately cross compare the attitude against backup sources of attitude information.

If the AHRS attitude is suspect, the pilot may perform an in-flight ARHS reset as described in Section 6.3.2.

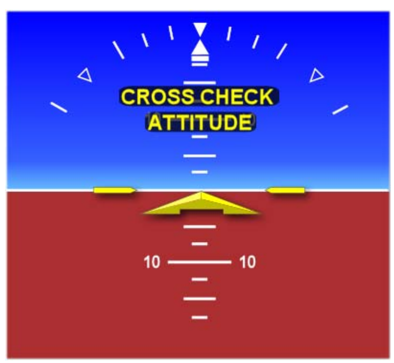


Figure 10 - Attitude Indicator

Pitch Markings

The pitch scale consists of minor pitch marks in 2.5º increments up to ±20º and major pitch marks in 10º increments up to ±90º

Roll Markings

The roll scale is indicated by tick marks at 10º, 20º, 30º, 45º and 60º on both sides of the zero roll inverted solid white triangle. The 45º marks are represented as hollow triangles.

Slip / Skid Indicator

Slip / skid is indicated by the lateral position of the white rectangle under the roll pointer. One rectangle width is equivalent to one ball width of a conventional inclinometer.

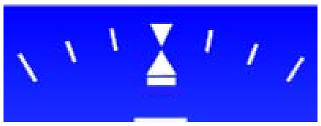


Figure 11 - Slip/ Skid Indicator

Unusual Attitude Cues

Red chevrons are presented on the pitch ladder to guide in unusual attitude recovery. The Chevrons begin to come into view at pitch attitudes greater than approximately 15º nose up or 10º nose down. The Chevrons indicate the direction to the horizon.

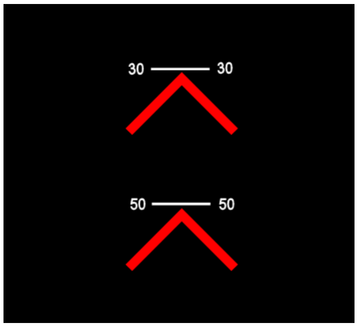


Figure 12 - Excessive Pitch Down

Figure 13 - Excessive Pitch Up

6.3.2 AHRS in-Flight Reset

Should an in-flight degradation of AHRS performance be experienced, an airborne reset and re-alignment of the AHRS may be performed.

During in-flight AHRS alignment the aircraft should be nominally operated in straight and level un-accelerated flight to ensure the quickest alignment times. Mild maneuvers up to 20 degrees of bank are permitted, however this may result in longer AHRS initialization times.

To perform an AHRS in flight alignment, perform the following steps:

1. Maintain straight and level un-accelerated flight.
2. Access the Main Menu by pressing the MENU button.
3. Rotate the right control knob until reaching the GENERAL SETTINGS page.
4. Press the “AHRS: RESET?” line select key
5. Press the “AHRS: RESET?” line select key again to confirm the reset.

The AHRS will then re-initialize and all AHRS data will be flagged invalid (red X’d) until the initialization is complete. AHRS data is again displayed once the AHRS initialization is complete and AHRS data is valid.

Typical AHRS in flight alignments will be completed in less than 30 seconds.

6.3.3 Airspeed Indicator

Airspeed is indicated by a moving airspeed tape against a fixed position airspeed pointer. A digital, rolling drum readout indicating airspeed values to the closest one knot or mile per hour is provided adjacent to the fixed pointer. Tick marks are provided on the airspeed tape every 10 knots (or mph if so configured). The integral ADC will compute airspeeds between 20 kts (23mph)to 450 kts (518mph). Outside of this range the airspeed value is dashed.

NOTE*:*

The airspeed tape and drum may be de-cluttered from the display by pilot selection or through installer configuration.

Speed Bands

Color speed bands are displayed on the indicated airspeed tape corresponding to the colored arcs found on a traditional airspeed instrument. The range of these markings are determined by the Federal Regulations, and correspond to the aircraft limiting speeds that are identified in the Aircraft Flight Manual.

The color bands are configured during installation and are not pilot adjustable.

Band Color	Band Range	Description
Red	$>V_{NE}$	Red arc displayed at all speeds above aircraft never exceed speed (V_{NE})
Yellow	$V_{NO} – V_{NE}$	Yellow arc extending from maximum structural cruising speed (V_{NO}) to never exceed speed (V_{NE}).
Green	V_S - V_{NO}	Green arc corresponding to the normal operating range extending between the no flap stall speed (V_S) to the maximum structural cruising speed (V_{NO}).
White	V_{SO} - V_{FE}	White arc corresponding to the flap operating range extending from the full-flap stall speed (V_{S0}) up to the full flap extend speed (V_{FE})
Red	$<V_{SO}$	Red arc extending from the bottom of the airspeed tape range up to full flap stall speed (V_{S0}). This band is disabled on the ground and during takeoff.

Table 2 - Airspeed Bands

Speed Markers

Color speed markers are displayed on the indicated airspeed tape corresponding to the colored radial lines found on traditional airspeed instruments. These speed markers are depicted in accordance with requirements in the Federal Regulations, and correspond to the aircraft limiting speeds that are identified in the Aircraft Flight Manual.

The color bands are configured during installation and are not pilot adjustable.

Speed Marker	Value	Description
Red Line	V_{NE}	A Red line is displayed across the airspeed tape at the aircraft never exceed speed (V_{NE})
Blue Line	V_{VSE}	**Multi Engine Aircraft Only.** A blue line is displayed across the airspeed tape at the aircraft single engine best rate of climb speed
Red Line (multi engine only)	V_{MC}	**Multi Engine Aircraft Only.** A red line is displayed across the airspeed tape at the aircraft single engine minimum control speed.
◁	Initial flap extension airspeed	If the aircraft manufacturer has published an initial flap extension speed, a white triangle will be presented on the airspeed tape at the speed corresponding to this limitation.

Table 3 - Speed Markers

V-Speed Markings

Pilot-adjustable V-speeds can be configured and/or viewed via the Main Menu. Choices include: V_a, V_{bg} (best glide speed), V_r, V_{ref}, V_x, and V_y, and for retractable gear aircraft: V_{le} and V_{lo}

NOTE:

V-speed editing can be locked during installation to prevent inadvertent or unauthorized adjustment.

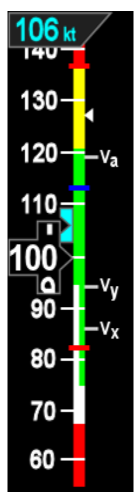


Figure 14 - Airspeed Indicator

6.3.4 Altimeter

Altitude is indicated by a moving altitude tape against a fixed position altitude pointer. A digital, rolling drum readout indicating altitude values to the closest 20 feet is provided adjacent to the fixed pointer. Minor tick marks are provided on the tape at 20 foot intervals, and major tick marks are provided at 100 foot intervals. The thousands and ten-thousands digits are larger than other digits on the tape. Negative altitudes are indicated by a "-" sign preceding the numerical altitude value in the drum.

The calibrated range of the altimeter is -1,600 to +51,000 and the value will be "dashed" if it is outside of this range..

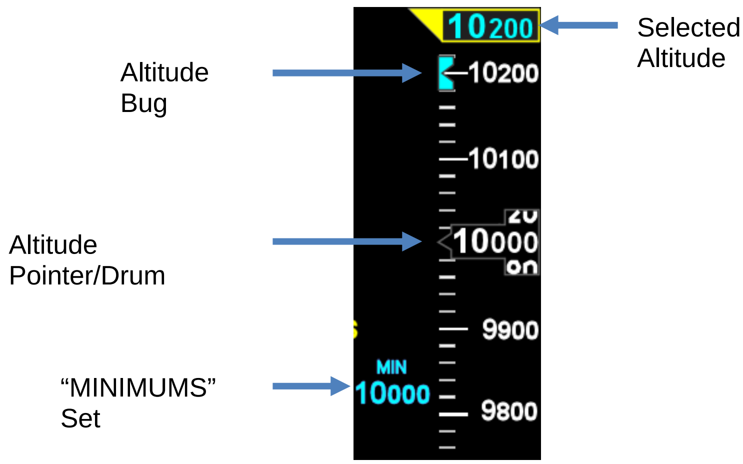


Figure 15 - Altitude Tape

Altitude Alerts

Visual (and optional aural) altitude alerts are generated for level-off and deviation conditions. A yellow, level-off alert illuminates next to the selected altitude numerical field when the aircraft is within 15 seconds or 50 feet (whichever is greater) of the selected altitude. When an optional aural alerter is installed, a steady tone of one-second duration is also provided.

After reaching the selected altitude if the aircraft altitude deviates by more than ±200 feet from the preselect value then a flashing yellow altitude deviation alert is generated, accompanied by a steady one-second tone from the optional aural alerter.

Figure 16 - Alert ON

Figure 17 - Alert OFF

6.3.5 Vertical Speed Indicator (VSI)

Whenever the vertical speed exceeds +/- 100 fpm the vertical speed is indicated by presenting a rising / sinking white vertical tape and associated scale markers immediately to the right of the compass rose. A numerical indication or current aircraft vertical speed is shown directly above the tape. Rates of ±2000 feet per minute (FPM) are indicated by the tape while the numerical value will display rates of up to ±9990 FPM. A triangle caps the tape whenever rates exceed ±2000 FPM. The vertical speed data field will be "dashed" whenever the vertical speed is 10,000 fpm or greater.

In the ARC compass mode only the digital vertical speed value is presented.

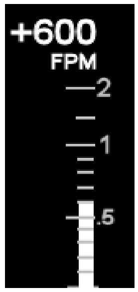


Figure 18 - Positive Rate of Climb

Figure 19 - Rate exceeding 2000fpm

6.3.6 Rate of Turn Indicator

A rate of turn indicator with a range of 0 to 6 degrees per second is provided for both the 360 and ARC Compass modes. The indicator consists of a curved white tape originating from the heading index mark and extending in the direction of the turn along the outer curve of the compass card.

The rate of turn indicator features scale marks for full (thick tick mark) and half "standard" (thin tick mark) rate turns ("standard" rate of turn = 3 degrees per second). When the rate of turn exceeds 6 degrees per second, an arrowhead is added to the end of the tape to show that the rate of turn has exceeded the limits of the instrument.

6.3.7 Data Bar (TAS, GS, OAT, Winds, Barometric pressure Set)

The Data Bar visually separates the upper and lower halves of the EFD display. When available, True Airspeed (TAS), GPS Ground Speed (GS), Outside Air Temperature (OAT), Wind Direction, Wind Speed, and Barometric Pressure Setting data are presented in the data bar. When any of these values are unavailable or invalid, the corresponding data field is "dashed."

Figure 20 - Data Bar

6.4 Navigation Flight Instruments

6.4.1 Horizontal Situation Indicator

The traditional HSI is an instrument which combines a Direction Indicator overlaid with a rotating Course Deviation Indicator (CDI). The HSI on the EFD1000 can be presented in either a full 360 degree compass rose mode, or in a 100 degree ARC format.

Figure 21 - 360 Compass Mode

Within the ARC mode, the pilot may select (via the main menu) between two different formats of CDI presentation – ARC HSI mode and ARC CDI mode. The ARC HSI mode, presents traditional rotating CDI symbology which resembles that used in the HSI 360 Compass mode. The ARC CDI mode presents a fixed, non-rotating CDI resembling that used in contemporary GPS navigation displays.

Figure 22 - ARC HSI Mode

Figure 23 - ARC CDI Mode

Lateral and Vertical Deviation Indicators

A Lateral Deviation Indicator (LDI) is presented on the attitude indicator whenever the pilot has coupled an ILS, LOC, LOC(BC), or a GPS in Approach Mode to the HSI and valid lateral guidance is being provided.

Back course deviation indications are automatically corrected for reverse sensing. Therefore, there is no further pilot action required to enable reverse sensing other than setting the inbound course on the HSI. “BC” will be annunciated to the left of the “LDI” indicator.

A Vertical Deviation Indicator (VDI) is presented on the attitude indicator whenever the LDI is shown and valid vertical guidance is provided, such as from an ILS or WAAS GPS.

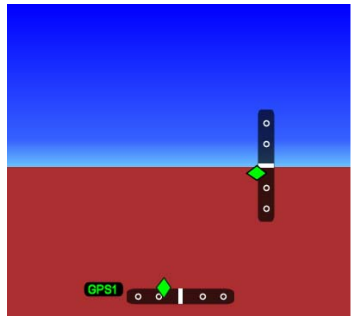


Figure 24 - LDI &VDI Displays

Navigation Source Information Block

A Navigation Source Information Block is presented in the upper left corner of the HSI display area. The Source Information Block indicates the navigation source coupled to the HSI and its associated mode (e.g. VOR, ILS, LOC, etc). Information is provided related to the coupled source including, when available, waypoint or navaid identifier or frequency, bearing and distance, and the estimated time to the active waypoint.

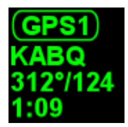


Figure 25 – Navigation Source Information Block

Off Scale Indication

Whenever the lateral deviation exceeds the maximum displayable range of 2.5 dots, the deviation needle of the CDI and the deviation diamond of the LDI or VDI are rendered as hollow ghosted images "pegged" to the corresponding side.

.

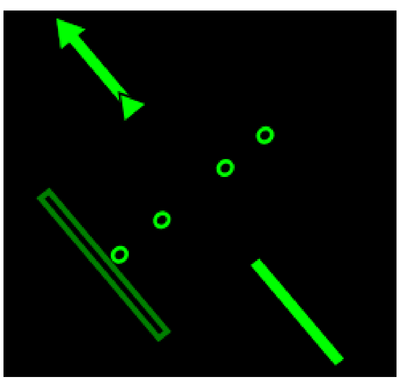


Figure 26 - Off Scale CDI

Figure 27 - Off Scale LDI

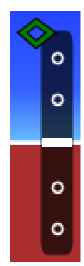


Figure 28 - Off Scale VDI

Auto Course Control

The pilot may configure the EFD1000 (via the main menu) to enable "Auto Course Select" whereby a connected GPS will automatically set the course (CRS) value whenever the GPS is auto sequencing between waypoints. This capability relieves the pilot from manually setting the course at each waypoint transition along a GPS route. When Auto Course Select is active the pilot can not adjust the CRS value.

Auto Course Select is indicated by an inverted green "A" presented adjacent to both the numerical CRS value and the "CRS" knob legend.

Figure 29 – Auto Course Select Legends

GPS Annunciations

When a compatible GPS system is coupled to the HSI, annunciations of MSG, WPT, TERM or APPR, and INTEG that are associated with that GPS navigation source are shown on the HSI display whenever these annunciations are output by the GPS. If a configured GPS fails, an amber failure annunciation is also provided indicating the failed GPS (i.e. “GPS1”, “GPS2”, “RSMGPS”). No other GPS annunciations are provided on the EFD1000 display. Refer to the GPS Flight Manual for information related to GPS annunciations, including a list of all possible annunciations that can be provided by any particular GPS system.

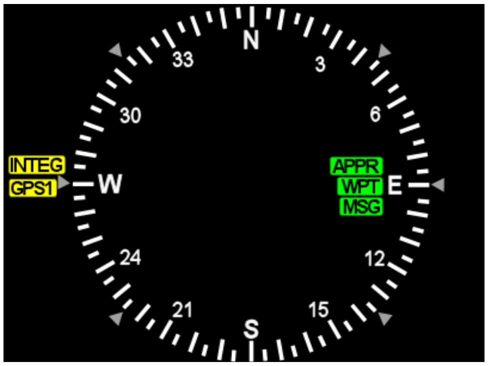


Figure 30 - GPS Annunciations

GPS Track Indicator

Whenever the EFD1000 is connected to a compatible GPS a track indicator is provided. Track is indicated as a blue diamond rendered on the compass scale at the value that corresponds to the current aircraft track.

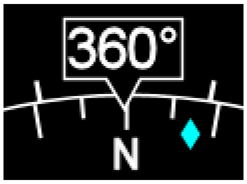


Figure 31 - Ground Track Indicator

6.4.2 Bearing Pointers

General

Two bearing pointers that show the radial of a VOR station or the bearing to a GPS waypoint are provided. Bearing Pointers are only available in the 360 Compass mode. Any available navigation source may be coupled to either bearing pointer. If coupled to a source that does not provide angular bearing data, such as a localizer, the bearing pointer is not presented and the source is flagged as invalid.

Figure 32 - Bearing Pointers

Bearing Pointer Source Information Block

Each bearing pointer has an associated source information block that can display miscellaneous information about the source of the bearing pointer data. Information that can be displayed includes distance to station (if coupled to a GPS waypoints) and either the station identifier or the tuned frequency for a VLOC radio. This data is only presented when it is reported to the EFD1000 by the connected equipment, and thus is not available in all installations.

6.5 Situational Awareness Map Display

Basemap

The basemap presents map symbols for nearby navaids, intersections, airports, and GPS flight plan waypoints, including curved and straight flight legs. Basemap data is presented whenever the EFD1000 system is connected to a compatible GPS. These basemap symbols underlay all other instruments and annunciations in the lower half of the display. Map and flight plan elements are received from the GPS and are only available when connected to compatible GPS equipment, such as the Garmin GNS4xx/5xx navigators.

The base map is always oriented with magnetic heading up and centered so that the current aircraft position coincides with the aircraft own ship symbol.

Map Features

When available, flight plan waypoints, airports, VORs, DMEs, NDBs, and intersection symbols are rendered as shown in Figure 33. Identifiers, when displayed, are shown adjacent to their associated symbol.

Figure 33 - Map Feature Symbols

Flight Plan

When a flight plan is received from a compatible GPS system the Basemap will show the current and future flight plan waypoints and legs. The active leg waypoint and its associated identifier are displayed in magenta. Other waypoints and legs are white. Depending on the range and selected feature display level, waypoint identifiers are displayed adjacent to their associated waypoints.

Flight plan depictions are rotated within the display to maintain their correct compass orientations at all times.

Figure 34 - Basemap Flight Plan

Basemap Position Source and Reversion

Position and flight plan data for the basemap is provided at all times by GPS1, except when GPS2 is the navigation source coupled to the HSI. In the event that the basemap position source fails an amber GPS failure annunciation will be provided, but the basemap will continue to present flight plan and mapping symbols that were associated with the failed GPS sensor by using position data from another available GPS sensor. When the basemap position is in the reversion mode, no flight leg or fly-to waypoint is indicated as 'active' (i.e. in magenta), no fly to waypoint data is provided (e.g. bearing, distance, etc), no flight plan waypoint sequencing is provided, and navigation data coupled to the CDI is flagged as invalid.

When an alternate GPS is being used as the Base map position source, the message "GPS# REVERSION" (where "#" indicates the source of the reversionary GPS position, either "1" or "2") is presented.

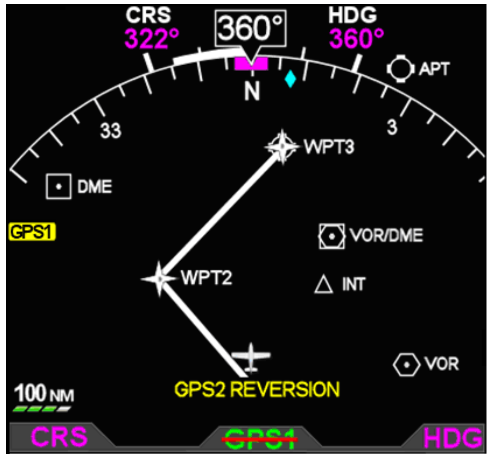


Figure 35 – GPS1 Failure, Reversionary Navigation

Emergency GPS Position Reversion

When the RSM GPS is enabled at installation this emergency-use only GPS may be used as the basemap position source, but only if all external GPS systems have failed or become invalid. In this case, the basemap will continue to show the last programmed flight plan information from the external GPS system, but no flight leg or fly-to waypoint is indicated as 'active' (i.e. in magenta), no fly to waypoint data is provided (e.g. bearing, distance, etc), no flight plan waypoint sequencing is provided, and navigation data coupled to the CDI is flagged as invalid..

The RSM GPS will only be activated upon failure of the external GPS system and can not be used as a primary source of position data.

When the RSM GPS is being used as the base map position source, the message: "RSM GPS REVERSION EMER USE ONLY" is presented.

Figure 36 – GPS Failure, RSM GPS Reversion

6.6 Autopilot Integration

General

The EFD1000 can connect with many different legacy autopilot systems that are typically found in general aviation aircraft. The EFD1000 emulates the HSI and/or Flight Director (FD) indicator with which the autopilot was originally certified. Autopilot integration is limited to heading and navigation modes, including vertical approach modes.

When connected to an autopilot system that includes Nav or Approach couplers, the EFD also acts as the navigation source selector switch to the autopilot. This assures that the navigation information presented on the EFD1000 is the same as that being provided to the autopilot. This arrangement also eliminates the need for external autopilot navigation source selector switches and relays that were previously used to select which navigation radio would be connected to the autopilot. Selection of autopilot modes and mode control is unaffected by installation of the EFD1000 system.

The EFD1000 does not currently provide vertical coupling to barometric references such as altitude hold, vertical speed, or altitude capture.

NOTE:

Refer to the autopilot AFMS for information on the operation of the autopilot or flight director.

See the "Typical Autopilot Operation" section below for additional details on EFD1000 operation with the autopilot systems during typical aircraft operations, such as VOR/ILS/GPS approaches.

GPSS

GPS Steering represents a modernized approach to flying between flight plan waypoints, and offers many advantages of over traditional methods of flying direct course lines between waypoints.

With traditional point-to-point navigation the autopilot is provided with desired course and cross-tack deviation information associated with the current flight leg. From there, it will maneuver the aircraft to center the needle and track the desired course. The autopilot does not anticipate upcoming course change, nor can it fly curved flight paths without pilot assistance. Upon reaching a waypoint, the pilot must set the course for the next leg (unless Auto Course Select is enabled – see 6.4.1), and the autopilot will then intercept and track that leg. In this type of operation, the CDI must always be set to the current desired navigation course.

With GPS Steering, the EFD1000 can unlock the GPS Steering capability already available in many models of General Aviation GPS computers. In GPS systems with this capability, the GPS continually computes the desired bank angle to track the GPS flight plan, and outputs that information over an ARINC 429 data bus. The GPS Steering command includes anticipation of upcoming turns, including the turn rate and turn initiation point required to roll out centered on the next leg with the deviation needle centered. Some GPS systems, such as the Garmin 4xx/5xxW series of WAAS navigators, even provide GPS Steering commands for complex procedures, such as DME arcs, holding patterns, procedure turns, etc., allowing the autopilot to fly these maneuvers without pilot input. Check with your GPS manufacturer to see if your GPS supports these capabilities.

The EFD1000 translates GPS steering commands received over an ARINC 429 bus into a signal that is compatible with the autopilot Heading channel. Thus, by selecting GPSS on the EFD1000 and the Heading mode of the autopilot, the autopilot is able to fly GPS Steering commands.

When GPSS is not selected, the autopilot will follow the heading bug value manually set by the pilot.

If the connected GPS system does not provide the required roll steering command, the GPSS legend adjacent to the GPSS Hot Key will be rendered in grey and it will not be possible to enable GPSS operation via the Hot Key.

NOTE:

Refer the Aircraft Flight Manual Supplement for your GPS system for information about GPSS steering commands that may be output by that system.

The autopilot must be in Heading Mode to receive GPSS signals from the EFD1000.

Flight Director

When connected to a compatible autopilot system the EFD1000 will display a single-cue flight director. The flight director command bars visually represent the lateral and vertical steering cues transmitted to the EFD by the autopilot. When the FD output from the autopilot is unavailable or flagged invalid, the FD command bars are removed from the display.

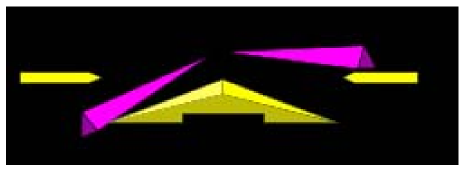


Figure 37 – Flight Director

Typical Autopilot Operations

Whenever the EFD1000 installed configuration includes connections to GPS, VLOC and autopilot systems, the EFD1000 acts as a conduit of data between the navigation radios and the autopilot system. This configuration enables any navigation sensor available for display on the EFD system to be coupled to the autopilot.

NOTE:

Refer the autopilot system Aircraft Flight Manual Supplement and/or POH for details regarding use and operation of the autopilot system. Examples provided here are provided for reference only, and actual operation may vary depending on the autopilot system installed in your aircraft.

It is your responsibility as Pilot in Command to ensure that you are conversant with the operation of all installed equipment. Operation of the EFD1000 system in IMC conditions should not be undertaken unless you are proficient in its use and operation, as described herein.

NOTE:

When GPSS is selected on the EFD1000, the HSI heading bug is not coupled to the autopilot. To connect the heading bug to the autopilot, deselect GPSS via the GPSS Hot Key

NOTE:

The autopilot must be in Heading Mode to receive GPSS signals from the EFD1000.

NOTE:

When using an integrated VLOC/GPS radio system, select the VLOC or GPS portion of the integrated radio by pressing the CDI source select until the desired source is indicated above the EFD1000 HSI source select button.

NOTE:

The EFD1000 enables GPS LPV approaches by providing the autopilot with GPS lateral and vertical deviation signals that are identical to those typically provided by an ILS radio. To fly GPS LPV approaches, configure and operate the autopilot as you would for an ILS approach.

“HDG” Mode Operation – Heading Bug Steering

1. Set the heading bug on the EFD1000 to the desired heading
2. Verify that GPSS is not selected (GPSS Legend on Hot Keys shown in GREY)
3. Select the autopilot’s heading mode.
4. Engage the autopilot
5. Verify that the autopilot turns the aircraft to the desired heading.

“HDG” Mode Operation – GPS Steering (GPSS)

1. Couple the EFD1000 HSI to a GPS sensor
2. Select GPSS by pressing the GPSS Hot Key so that GPSS is rendered in GREEN (e.g. GPSS Active).
3. Select the autopilot’s heading mode.
4. Engage the autopilot
5. Verify that the autopilot turns the aircraft to follow the GPS flight plan.

“NAV” Mode Operation – VLOC Navigation

1. Using the CDI Nav Source Select switch, couple a tuned/valid VLOC radio to the HSI and set the desired course (See 6.2.8)
2. Set the EFD1000 heading bug to a value that will intercept the desired course
3. Engage the autopilot in heading mode and verify that the aircraft turns to the desired heading
4. ARM the nav mode of the autopilot by selecting its NAV mode.
5. Monitor the CDI deflection and verify that upon intercepting the desired course that the autopilot switches to NAV Capture, and turns to track the desired course

“NAV” Mode Operation – GPS Navigation

1. With a valid flight plan programmed in the GPS, use the CDI Nav Source Select Switch to couple the GPS to the HSI (See 6.2.8).
2. With GPSS OFF, set the EFD1000 heading bug to a value that will intercept the active leg of the flight plan.

- OR-

Select GPSS ON via the GPSS Hot Key.

3. Engage the autopilot in heading mode and verify that the aircraft turns to a heading to intercept the active leg of the flight plan.
4. ARM the nav mode of the autopilot by selecting its NAV mode.
5. Monitor the CDI deflection and verify that upon intercepting the flight plan leg that the autopilot switches to NAV Capture, and turns to track the desired course.

<u>"APPR" Mode Operation – ILS Approach</u>

1. Use the CDI Nav Source Select Switch, couple a tuned/valid ILS radio frequency to the HSI, and set the desired approach course (See 6.2.8).
2. Set the EFD1000 heading bug to a value that will intercept the desired course, or as instructed by ATC
3. Engage the autopilot in heading mode and verify that the aircraft turns to the desired heading
4. Once cleared for the ILS approach, arm the autopilot's Approach mode.
5. Monitor the CDI localizer deflection and verify upon intercepting the localizer that the autopilot switches to Approach NAV Capture, turns to track the localizer course, and arms the glide slope.
6. Monitor the autopilot localizer tracking performance. Upon intercepting the glide slope verify that the autopilot switches from glide slope ARM to glide slope capture, and initiates a descent to track the glide slope.

<u>"APPR" Mode Operation – GPS or GPS LPV WAAS Approach</u>

1. With a valid GPS Approach programmed in the GPS, use the CDI Nav Source Select switch to couple the GPS to the HSI (See 6.2.8).
2. With GPSS OFF, set the EFD1000 heading bug to a value that will intercept the active leg of the flight plan.

   - OR-

   Select GPSS ON via the GPSS Hot Key.
3. Engage the autopilot in heading mode and verify that the aircraft turns to a heading to intercept the active leg of the approach
4. Monitor the CDI cross track deviation and verify that upon intercepting the active leg of the approach that the autopilot turns to track the GPS Approach guidance

THE FOLLOWING APPLIES FOR GPS LPV APPROACHES ONLY

5. Once cleared for the GPS LPV approach, arm the autopilot's Approach mode.
6. Monitor the CDI GPS Lateral Deviation and verify that while tracking and/or intercepting the final approach course that once the GPS APPROACH mode goes active and LPV vertical deviation is presented on the EFD that the autopilot arms the glide slope.
7. Monitor the autopilot lateral approach course tracking. Upon intercepting the LPV glide slope verify that the autopilot switches from glide slope ARM to glide slope capture, and initiates a descent to track the LPV glide slope.

<u>GPSS "APPR" Mode Operation – GPS Underlay to ILS Approach</u>

1. With a valid GPS Approach programmed in the GPS, use the CDI Nav Source Select switch to couple the GPS to the HSI (See 6.2.8).
2. Select GPSS ON via the GPSS Hot Key.
3. Engage the autopilot in heading mode and verify that the aircraft turns to a heading to intercept the active leg of the approach
4. Monitor the CDI cross track deviation and progress along the ILS GPS Approach Underlay
5. Verify that the ILS frequency is tuned

6. Once cleared for the ILS approach, couple the EFD1000 HSI to the tuned ILS (if not done automatically by the coupled radio) and arm the autopilot's Approach mode.
7. Monitor the CDI localizer deflection and verify that upon intercepting the localizer that the autopilot switches to Approach NAV Capture, turns to track the localizer course, and arms the glide slope.
8. Monitor the autopilot localizer tracking performance. Upon intercepting the glide slope verify that the autopilot switches from glide slope ARM to glide slope capture, and initiates a descent to track the glide slope.

6.7 Main Menu Operation

6.7.1 Menu Controls

The EFD1000 Main menu is used to adjust various system configuration settings and preferences. To select the Main Menu, press the MENU button on the right side of the display bezel. To leave the menu, press the MENU button again. Menu items are shown exclusively in the lower half of the EFD1000 display in the region below the data bar.

Main Menu Navigation

Once the Main menu is activated, rotating the lower right control knob selects between the various menu pages. Figure 38 below shows a typical menu structure when the main menu is activated. In this example, the "360 Map Settings" page is selected. The current menu page is indicated by the page name and legend "page # of #", and by the location of the green segment within the segmented menu navigation bar displayed at the bottom of the display.

Figure 38 - Main Menu Navigation

Configuring Menu Items

Each menu page shows a series of menu selections adjacent to the right bezel line select keys (See Fig. 39). Editable menu selections are indicated by white text, while status only or non-editable items are shown in green. Items that have been inhibited from editing are shown in gray.

Pressing a line select key adjacent to an editable field enables the item for editing, indicated by showing the editable value in magenta. Rotating the lower right control knob adjusts the editable value. Changes are effective immediately.

Figure 39 - Main Menu Line select keys

To exit the edit mode press the adjacent line select key, press the right control knob, or leave the menu by pressing the MENU button.

6.7.2 Menu Options

General Settings Page

From the GENERAL SETTINGS page the pilot may:

- Configure the barometric altimeter setting units to inches or millibars (IN / mB)
- ENABLE or DISABLE the display of V-Speeds
- ENABLE or DISABLE GPS Auto Course operations
- Select between ARC HSI and ARC CDI compass view modes.
- Perform an AHRS RESET.

360 and ARC Map Settings Display Level Pages

From the 360 and ARC Map Settings Pages the pilot may configure the way basemap features are displayed in either the 360 or ARC HSI view modes. Separate settings are possible for each view mode. For each feature, the pilot may select either “ON”, “AUTO”, or “OFF”.

When a display feature is selected “ON”, it will always be displayed on the basemap.

When a feature is “OFF”, it will never be displayed on the basemap.

When a feature is set to “AUTO”, it will be displayed in accordance with a pre-set relationship that is a function of the feature display level setting (e.g. High, Medium of Low), the current map range, and the type of feature.

For example, when set to “AUTO” Terminal VOR/DME’s are shown at range scales less than 30nm on the HIGH feature display level setting, but would not otherwise be shown. Similar logic is employed for all basemap features.

V-Speed Setting Pages

The V-Speed settings page allows the pilot to set the values at which V-Speed markers will be presented on the airspeed tape. When set to a value of zero the associated V-Speed icon is not rendered.

V-Speed values may be set for:

- V_a – Design Maneuvering Speed
- V_{bg} – Best Glide Speed
- V_{ref} – Approach Reference Speed

- V_r – Rotation Speed
- V_x – Best Angle of Climb Speed
- V_y – Best Rate of Climb Speed
- V_{lo} – Maximum Landing Gear Operating Speed
- V_{le} – Maximum Landing Gear Extended Speed

NOTE:

V-Speed editing may be inhibited in the installation configuration menus. When inhibited, V-speed values are rendered in grey and can not be adjusted by the pilot.

Power Settings Page

The POWER SETTINGS page is used to monitor and control the source of power to the EFD1000, including over riding automatic power states. From the POWER SETTINGS Page the pilot may:

- Switch to Battery Power from External Power
- Switch to External Power from Battery Power
- Shut down or Restart the unit
- View the External Power Source Voltage
- View the Internal Battery Status

System Status

The SYSTEM STATUS page is used to display information about the EFD1000 system and software. From the SYSTEM STATUS page the pilot may:

- View the Main Application Processor software version
- View the Input Output Processor software version
- View the EFD1000 Feature load version

6.8 List of Acronyms

ACU ..... Analog Converter Unit
AFMS ..... Airplane Flight Manual Supplement
AHRS ..... Attitude Heading Reference System
BARO ..... Barometric Pressure Setting
BC ..... Back Course
BP ..... Bearing Pointer
CDI ..... Course Deviation Indicator
CM ..... Configuration Module
DH ..... Decision Height
DME ..... Distance Measuring Equipment
EFIS ..... Electronic Flight Instrument System
GPS ..... Global Positioning System
GPSS ..... GPS Steering
GS ..... Ground Speed
HDG ..... Heading
HSI ..... Horizontal Situation Indicator
IAS ..... Indicated Airspeed
IMC ..... Instrument Meteorological Conditions
LDI ..... Lateral Deviation Indicator
MSL ..... Mean Sea Level
NDB ..... Non-Directional Beacon
OAT ..... Outside Air Temperature
OBS ..... Omni Bearing Selector
PFD ..... Primary Flight Display
RMI ..... Radio Magnetic Indicator
RSM ..... Remote Sensor Module
TAS ..... True Airspeed
VDI ..... Vertical Deviation Indicator
VLOC ..... VOR / Localizer navigation
VOR ..... VHF Omni-directional Radio Range
VSI ..... Vertical Speed Indicator