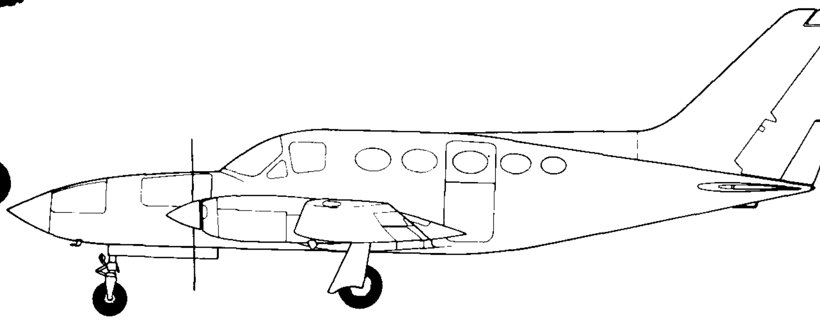
PILOT'S OPERATING HANDBOOK
and
FAA APPROVED AIRPLANE FLIGHT MANUAL



CESSNA AIRCRAFT COMPANY

1981 MODEL 414A

Serial Number 414A0641

Registration Number N78DQ

FAA APPROVED IN NORMAL CATEGORY BASED ON CAR PART 3 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
Wallace Division
Wichita, Kansas

Member of GAMA

3 NOVEMBER 1980

Serial No. 0641 Registration No. XB-CPM

AUXILIARY FUEL PUMP SWITCHING SYSTEM IN THIS AIRPLANE HAS BEEN MODIFIED IN COMPLIANCE WITH SERVICE BULLETIN MEB88-3. OPERATE THE AUXILIARY FUEL PUMPS PER SEPARATE SUPPLEMENT FURNISHED RATHER THAN PROCEDURES IN THIS PUBLICATION.

Signature ______________________ Date ________
(OWNER)

Address ______________________________

____

D1627-13

This manual is issued to replace one originally provided for the airplane identified on the cover page on 03-12-81. All revisions, if any, have been incorporated as of 06-23-95.

Subsequent revisions supplied by Cessna Aircraft Company must be properly inserted.

Cessna Aircraft Company

REVISION

1981
MODEL 414A

PILOT'S OPERATING HANDBOOK

REVISION 2

1 JUNE 1994

D1594R2-13PH

INSERT THE FOLLOWING REVISED PAGES INTO BASIC PILOT'S OPERATING HANDBOOK

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 and FAA Approved Airplane Flight Manual 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, performance, and suggestions for its servicing and care. We urge you to read it from cover to cover, and to refer to it frequently.

Our interest in your flying pleasure has not ceased with your purchase of a Cessna. Worldwide, the Cessna Dealer Organization backed by Cessna Customer Services Department stands ready to serve you. The following services are offered by 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 the Customer Care Handbook 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. Cessna Dealers have all of the Service Manuals and Parts Catalogs, and are kept current by Service Information Letters published by Cessna Aircraft Company.

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

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

Cessna MODEL **414A**

PERFORMANCE AND SPECIFICATIONS

MAXIMUM WEIGHT:	
Ramp	6785 Pounds
Takeoff	6750 Pounds
Landing	6750 Pounds
Zero Fuel	6515 Pounds
*SPEED, BEST POWER MIXTURE:	
Maximum - 20,000 Feet	235 KTAS
Maximum Recommended Cruise	
74.8% Power at 10,000 Feet	193 KTAS
74.8% Power at 24,500 Feet	224 KTAS
*RANGE, RECOMMENDED LEAN MIXTURE:	
Maximum Recommended Cruise	
74.8% Power at 10,000 Feet (600 Pounds Usable Fuel)	382 Nautical Miles, 2.06 Hours and 191 KTAS
74.8% Power at 10,000 Feet (900 Pounds Usable Fuel)	665 Nautical Miles, 3.53 Hours and 191 KTAS
74.8% Power at 10,000 Feet (1236 Pounds Usable Fuel)	984 Nautical Miles, 5.18 Hours and 192 KTAS
74.8% Power at 24,500 Feet (600 Pounds Usable Fuel)	404 Nautical Miles, 2.03 Hours and 219 KTAS
74.8% Power at 24,500 Feet (900 Pounds Usable Fuel)	730 Nautical Miles, 3.50 Hours and 220 KTAS
74.8% Power at 24,500 Feet (1236 Pounds Usable Fuel)	1099 Nautical Miles, 5.15 Hours and 221 KTAS
Maximum Range	
10,000 Feet (600 Pounds Usable Fuel)	532 Nautical Miles, 3.69 Hours and 143 KTAS
10,000 Feet (900 Pounds Usable Fuel)	899 Nautical Miles, 6.27 Hours and 143 KTAS
10,000 Feet (1236 Pounds Usable Fuel)	1327 Nautical Miles, 9.34 Hours and 141 KTAS
25,000 Feet (600 Pounds Usable Fuel)	482 Nautical Miles, 2.70 Hours and 181 KTAS
25,000 Feet (900 Pounds Usable Fuel)	855 Nautical Miles, 4.73 Hours and 183 KTAS
25,000 Feet (1236 Pounds Usable Fuel)	1293 Nautical Miles, 7.20 Hours and 181 KTAS
RATE-OF-CLIMB AT SEA LEVEL:	
All Engines	1520 Feet Per Minute
Single-Engine	290 Feet Per Minute
SERVICE CEILING:	
All Engines	30,800 Feet
Single-Engine	19,850 Feet
TAKEOFF PERFORMANCE: (98 KIAS, 0° Wing Flaps And 6750 Pounds Weight)	
Ground Roll	2185 Feet
Total Distance Over 50-Foot Obstacle	2595 Feet
LANDING PERFORMANCE: (94 KIAS, 45° Wing Flaps And 6750 Pounds Weight)	
Ground Roll	1013 Feet
Total Distance (Over 50-Foot Obstacle)	2393 Feet
STANDARD EMPTY WEIGHTS: (Approximate)	
414A Chancellor	4358 Pounds
414A Chancellor II	4533 Pounds
414A Chancellor III	4767 Pounds
BAGGAGE ALLOWANCE:	1500 Pounds
WING LOADING:	29.89 Pounds Per Square Foot
POWER LOADING:	10.89 Pounds Per Horsepower
FUEL CAPACITY: (Total)	
Standard (206 Gallons Usable)	213.4 Gallons
OIL CAPACITY: (Total)	26 Quarts
ENGINES:	
Continental Six-Cylinder, Turbocharged, Fuel-Injected Engines	TSIO-520-NB

310 Rated Horsepower At 2700 Propeller RPM And 38.0 Inches Hg. Manifold Pressure To 20,000 Feet (For Takeoff and Single-Engine Operation), 298 Horsepower at 2600 RPM and 38.0 Inches Hg. Manifold Pressure to 20,000 Feet (Normal Operating Power.

PROPELLERS:
Constant Speed, Full Feathering, Three-Bladed 6'4.5" Diameter 0850334-38

*Range data includes allowances for start, taxi, takeoff, climb, descent and 45-minute reserve at the particular cruise power and altitude. Speeds shown are based on estimated mid-cruise weight.

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

COVERAGE

The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual in the airplane at the time of delivery from Cessna Aircraft Company contains information applicable to the 1981 Model 414A airplane designated by the serial number and registration number shown on the Title Page of this handbook. This information is based on data available at the time of publication.

REVISIONS

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

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

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

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

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

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

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

LOG OF EFFECTIVE PAGES

Dates of issue for original and revised pages are:

Original .... 3 Nov 1980
Revision 1 .... 2 Apr 1982
Revision 2 .... 1 Jun 1994

Page	Date	Page	Date
Title	3 Nov 80	1-5 thru 1-8	3 Nov 80
Assignment Record	3 Nov 80	1-9 /1-10	3 Nov 80
i thru ii	3 Nov 80	2-1 thru 2-3	3 Nov 80
* iii thru iv	1 Jun 94	2-4	2 Apr 82
Contents	3 Nov 80	2-5 thru 2-16	3 Nov 80
1-1 thru 1-2	3 Nov 80	2-17/2-18	3 Nov 80
1-3 thru 1-4	2 Apr 82	3-1	2 Apr 82

LOG OF EFFECTIVE PAGES (Continued)

NOTE

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

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL PART NUMBER

D1594-2-13PH

TABLE OF CONTENTS

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SECTION 1
GENERAL

TABLE OF CONTENTS

INTRODUCTION

This handbook consists of 9 sections and an alphabetical index as shown on the Contents page. This handbook includes the material required to be furnished to the pilot by CAR Part 3. It also contains supplemental data supplied by Cessna Aircraft Company. Specific information can be rapidly found by referring to the Contents page for the appropriate section, then referring to the Table Of Contents on the first page of the appropriate section, or by the use of the Alphabetical Index.

Section 1 of this handbook presents basic airplane data and general information which will be of value to the pilot.

ENGINES

Number of Engines: 2

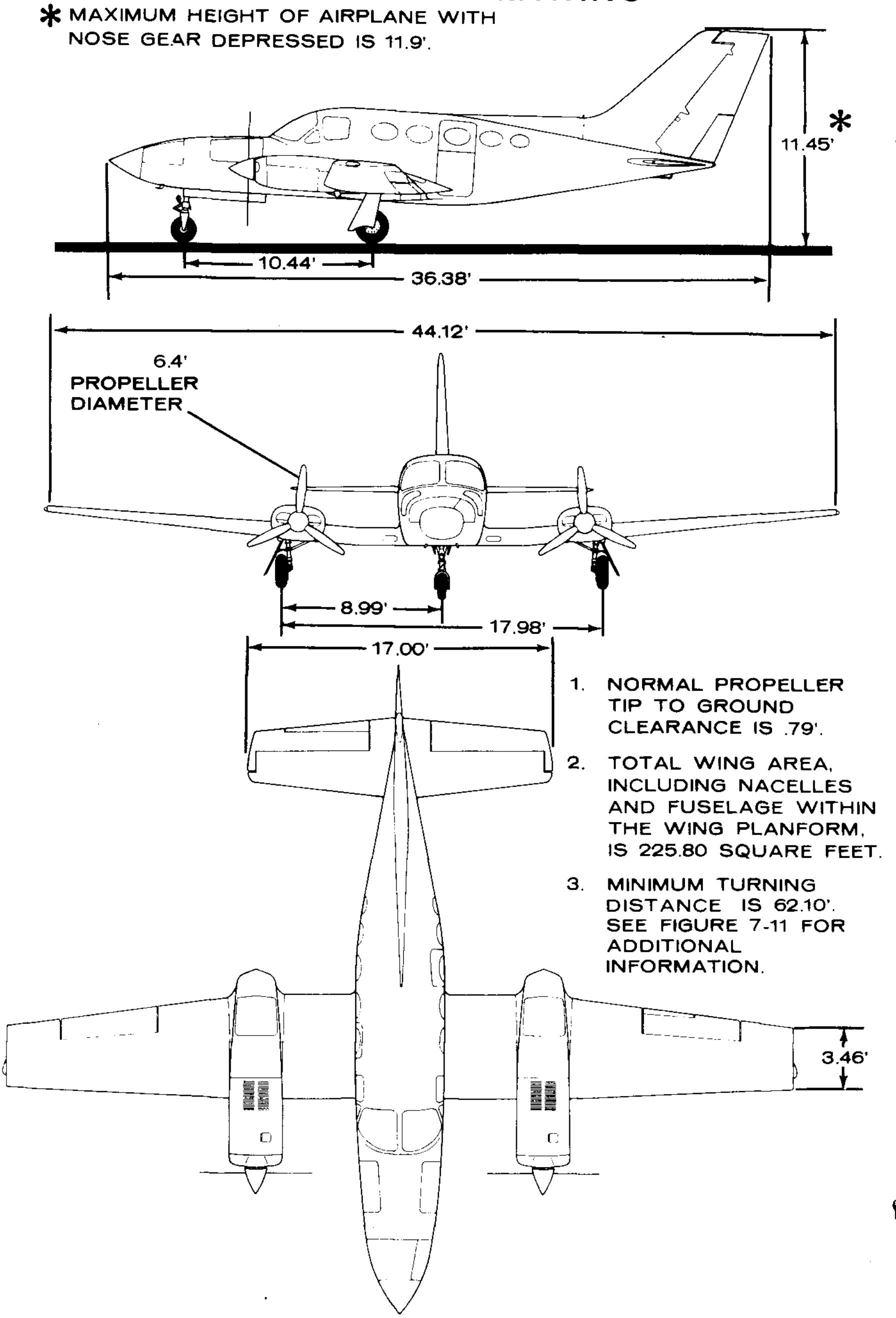
Manufacturer: Teledyne Continental Motors

Engine Model Number: TSIO-520-NB

Engine Type: Turbocharged, fuel-injected, direct drive, air cooled, horizontally opposed, six-cylinder, 520 cubic-inch displacement.

Horsepower: 310 rated horsepower at 2700 propeller RPM and 38.0 inches Hg. manifold pressure to the critical altitude of 20,000 feet.

THREE-VIEW DRAWING



1. NORMAL PROPELLER TIP TO GROUND CLEARANCE IS .79'.
2. TOTAL WING AREA, INCLUDING NACELLES AND FUSELAGE WITHIN THE WING PLANFORM, IS 225.80 SQUARE FEET.
3. MINIMUM TURNING DISTANCE IS 62.10'. SEE FIGURE 7-11 FOR ADDITIONAL INFORMATION.

Figure 1-1

PROPELLERS

Number of Propellers:	2
Manufacturer:	McCauley Accessory Division, Cessna Aircraft Company
Propeller Part Number:	0850334-38
Number of Blades:	3
Propeller Diameter:	6'4.5"
Propeller Type:	Constant speed, full feathering, nonreversible hydraulically actuated
Blade Range:	(At 30-Inch Station) a. Low Pitch 14.9° ±0.2° b. Feather 81.2° ±0.3°

FUEL (Approved Fuel Grades and Colors)*

PRIMARY - 100 (Formerly 100/130) Grade Aviation Fuel (Green).
ALTERNATE - 100LL Grade Aviation Fuel (Blue).

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

Total Fuel Capacity (U.S. Gallons) - 213.4

Usable Fuel (U.S. Gallons) - 206.0

OIL

Grade: Aviation grade engine oil. Refer to Section 8 for additional information.

Viscosity:

SAE Rating	Ambient Temperature - °C (°F)
50	Above 4.4 (40)
30	Below 4.4 (40)
Multiviscosity	Unrestricted - After 25 Hours

Total Sump Capacity: 12 quarts per engine

Drain and Refill Quantity:	13 quarts per engine including one quart for oil filter.
Oil Quantity Operating Range:	Do not operate engine on less than 9 quarts. To minimize loss of oil through breather, fill to 10-quart level for normal flights of less than 3 hours. For extended flight, fill to capacity.

NOTE

Dip stick indicates the quantity of oil in the engine and does not account for the 1 quart of oil in the oil filter.

MAXIMUM CERTIFICATED WEIGHTS

Maximum Ramp Weight: 6785 pounds

Maximum Takeoff Weight: 6750 pounds

Maximum Landing Weight: 6750 pounds

Maximum Zero Fuel Weight: 6515 pounds

Maximum Weights in Baggage Compartments:

a. Left and Right Wing Lockers - 200 pounds each.

b. Avionics Bay - 250 pounds less installed optional equipment. Refer to the loading placard in the airplane avionics baggage bay.

c. Nose Bay - 350 pounds less installed optional equipment. Refer to the loading placard in the airplane nose baggage bay.

d. Aft Cabin (Bay A) See Figure 1-2 - 400 pounds (200 Pounds Per Side).

e. Aft Cabin (Bay B) See Figure 1-2 - 100 pounds (50 Pounds Per Side).

STANDARD AIRPLANE WEIGHTS

Standard Empty Weight: 4358 pounds for 414A Chancellor (4533 pounds for 414A Chancellor II) (4767 pounds for 414A Chancellor III)

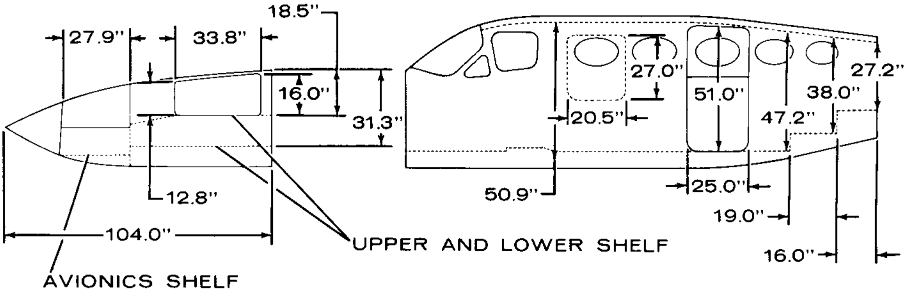
Maximum Useful Load: 2427 pounds for 414A Chancellor (2252 pounds for 414A Chancellor II) (2018 pounds for 414A Chancellor III)

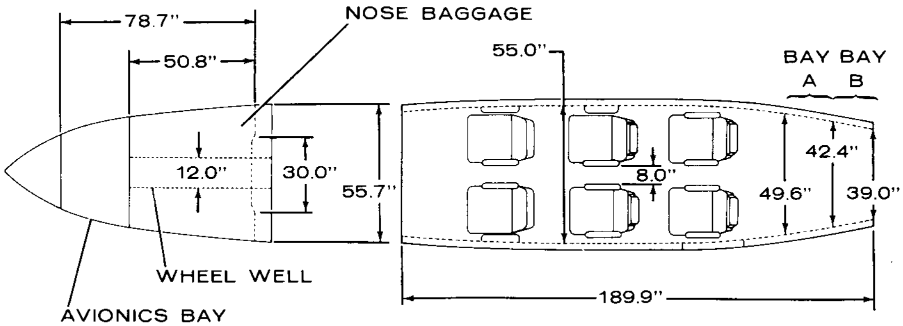
SPECIFIC LOADINGS

Wing Loading: 29.89 pounds per square foot

Power Loading: 10.89 pounds per horsepower

CABIN, BAGGAGE AND ENTRY DIMENSIONS





BAGGAGE COMPARTMENT
VOLUME - CUBIC FEET

AVIONICS BAY	11.0
NOSE	25.0
WING LOCKER EACH (STD)	9.25
AFT CABIN (BAY A AND B)	30.6

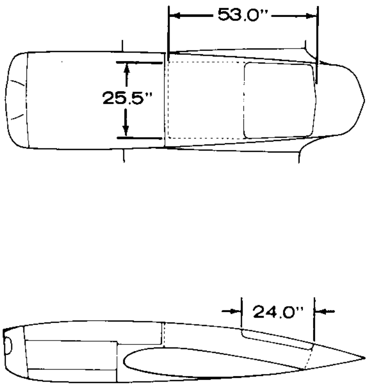


Figure 1-2

SYMBOLS, ABBREVIATIONS AND TERMINOLOGY

GENERAL AIRSPEED TERMINOLOGY AND SYMBOLS

CAS — Calibrated Airspeed is the indicated speed corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.

G — G is acceleration due to gravity.

IAS — Indicated Airspeed is the speed as shown on the airspeed indicator. IAS values published in this handbook assume zero instrument error.

KCAS — Calibrated Airspeed expressed in knots.

KIAS — Indicated Airspeed expressed in knots.

KTAS — True Airspeed expressed in knots.

TAS — True Airspeed is the airspeed relative to undisturbed air which is the CAS corrected for altitude, temperature and compressibility.

V_A — Maneuvering Speed is the maximum speed at which application of full available aerodynamic control will not overstress the airplane.

V_{FE} — Maximum Flap Extended Speed is the highest speed permissible with wing flaps in a prescribed extended position.

V_{LE} — Maximum Landing Gear Extended Speed is the maximum speed at which an airplane can be safely flown with the landing gear extended.

V_{LO} — Maximum Landing Gear Operating Speed is the maximum speed at which the landing gear can be safely extended or retracted.

V_{MC_A} — Air Minimum Control Speed is the minimum flight speed at which the airplane is directionally controllable as determined in accordance with Federal Aviation Regulations. Airplane certification conditions include one engine becoming inoperative and windmilling; not more than a 5^o bank towards the operative engine; takeoff power on operative engine; landing gear up; flaps in takeoff position; and most rearward CG.

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

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

V_{SSE}	Intentional One Engine Inoperative Speed is a minimum speed selected by the manufacturer for intentionally rendering one engine inoperative in flight for pilot training.
V_X	Best Angle-of-Climb Speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance.
V_Y	Best Rate-of-Climb Speed is the airspeed which delivers the greatest gain in altitude in the shortest possible time.

METEOROLOGICAL TERMINOLOGY

^{o}C	Temperature in degrees Celsius.
^{o}F	Temperature in degrees Fahrenheit.
ISA	International Standard Atmosphere in which: (1) The air is a dry perfect gas; (2) The temperature at sea level is 15^{o} Celsius (59^{o} Fahrenheit); (3) The pressure at sea level is 29.92 inches Hg. (1013.2 mb); (4) The temperature gradient from sea level to the altitude at which the temperature is $-56.5^{o}C$ ($-69.7^{o}F$) is $-1.98^{o}C$ ($-3.5^{o}F$) per 1000 feet.
OAT	Outside Air Temperature is the free air static temperature, obtained either from inflight temperature indications adjusted for instrument error and compressibility effects or ground meteorological sources.
Pressure Altitude	Altitude measured from standard sea-level pressure (29.92 inches Hg.) by a pressure or barometric altimeter. It is the indicated pressure altitude corrected for position and instrument error. In this handbook, altimeter instrument errors are assumed to be zero.
Wind	The wind velocities recorded as variables on the charts of this handbook are to be understood as the headwind or tailwind components of the reported winds.

POWER TERMINOLOGY

BHP	Brake horsepower means the power delivered at the propeller shaft of an airplane engine.
Critical Altitude	The maximum altitude at which in standard temperature it is possible to maintain a specified power.
Maximum Continuous Power	The power developed in a standard atmosphere from sea level to the critical altitude at the maximum RPM and manifold pressure approved for use during periods of unrestricted duration.

RPM	The revolutions per minute (RPM) of an engine refers to the rotational speed of the propeller shaft, as shown on a tachometer.

AIRPLANE PERFORMANCE AND FLIGHT PLANNING TERMINOLOGY

Accelerate-Go Distance	The distance required to accelerate an airplane to a specified speed and, assuming failure of an engine at that speed after liftoff and with gear in transit, continue takeoff on the remaining engine to a height of 50 feet.
Accelerate-Stop Distance	The distance required to accelerate an airplane to a specified speed and, assuming failure of an engine at the instant that speed is attained, to bring the airplane to a stop.
Aerobatic Maneuver	An intentional maneuver involving an abrupt change of an airplane's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.
Balked Landing	A balked landing is an aborted landing (i.e., all engines go-around in the landing configuration).
Balked Landing Transition Speed	The minimum speed at which a transition to a balked landing climb should be attempted from 50-foot obstacle height.
Demonstrated Crosswind Velocity	The 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. This value is not an aerodynamic limit for the airplane.
Maneuvering Fuel	Maneuvering fuel is the usable fuel as shown in Section 2 for all airplane configurations provided the maximum side slip duration is not exceeded.
Maximum Effective Braking	The maximum amount of braking pressure that can be applied to the toe brakes without locking the wheels.

WEIGHT AND BALANCE TERMINOLOGY

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

Center of Gravity (C.G.)	The point at which an airplane would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.
Jack Point	One of the three points on the airplane designed to rest on a jack.
MAC	The mean aerodynamic chord of a wing is the chord of an imaginary airfoil which throughout the flight range will have the same force vectors as those of the wing.
Maximum Landing Weight	Maximum weight approved for the landing touchdown.
Maximum Ramp Weight	Maximum weight approved for ground maneuver. (It includes weight of start, taxi and run up fuel.)
Maximum Takeoff Weight	Maximum weight approved for the start of the takeoff run.
Maximum Zero Fuel Weight	Maximum weight exclusive of usable fuel.
Moment	The product of the weight of an item multiplied by its arm. (Moment divided by a constant is used to simplify balance calculations by reducing the number of digits.)
Payload	Weight of occupants, cargo and baggage.
Reference Datum	An imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Residual Fuel	The undrainable fuel remaining when the airplane is defueled in a specific attitude by the normal means and procedures specified for draining the tanks.
Standard Empty Weight	Weight of a standard airplane including unusable fuel, full operating fluids and full oil.
Station	A location along the airplane fuselage given in terms of distance from the reference datum.
Tare	Tare is the weight of chocks, blocks, stands, etc. used when weighing an airplane, and is included in the scale readings. Tare is deducted from the scale reading to obtain the actual (net) airplane weight.
Unusable Fuel	Fuel remaining after fuel runout tests have been completed in accordance with governmental regulations.
Usable Fuel	Fuel available for flight planning.

SECTION 2
LIMITATIONS
TABLE OF CONTENTS

INTRODUCTION

Section 2 of this handbook presents the operating limitations, the significance of such limitations, instrument markings, color coding and basic placards necessary for the safe operation of the airplane, its powerplants, standard systems and standard equipment. The limitations included in this section and Section 9 have been approved by the Federal Aviation Administration. Observance of these operating limitations is required by law.

Operation in countries other than the United States may require observance of other limitations, procedures or performance data in applicable supplements.

NOTE

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

AIRSPEED LIMITATIONS (See Figure 2-1)

AIRSPEED LIMITATIONS TABLE

SPEED	KIAS	KCAS	REMARKS
Maneuvering Speed V_A (Knots)	145	144	Do not make abrupt control movements above this speed.
Maximum Flap Extended Speed V_{FE} (Knots) 15° / 45°	177 / 146	175 / 145	Do not exceed this speed with the given flap setting.
Maximum Gear Operating Speed V_{LO} (Knots)	177	175	Do not extend or retract landing gear above this speed.
Maximum Gear Extended Speed V_{LE} (Knots)	177	175	Do not exceed this speed with landing gear extended.
Air Minimum Control Speed - V_{MC_A} (Knots)	79	79	This is the minimum flight speed at which the airplane is controllable with one engine inoperative and with a 5° bank towards the operative engine.
One Engine Inoperative Best Rate-of-Climb Speed V_Y (Knots)	108	108	This speed delivers the greatest gain in altitude in the shortest possible time with one engine inoperative at sea level, standard day conditions and 6750 pounds weight.
Never Exceed Speed V_{NE} (Knots)	237	232	Do not exceed this speed in any operation.
Maximum Structural Cruising Speed V_{NO} (Knots)	203	200	Do not exceed this speed except in smooth air and then only with caution.

Figure 2-1

Airspeed Indicator Markings: See Figure 2-2

AIRSPEED INDICATOR TABLE

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
Red Radial	79	Air minimum control speed.
White Arc	71 to 146	Operating speed range with 45° wing flaps. Lower limit is maximum weight stalling speed in landing configuration. Upper limit is maximum speed permissible with wing flaps extended 45°.
Green Arc	81 to 203	Normal operating range. Lower limit is maximum weight stalling speed with flaps and landing gear retracted. Upper limit is maximum structural cruising speed.
Blue Radial	108	One engine inoperative best rate-of-climb speed at sea level standard day conditions and 6750 pounds weight.
Yellow Arc	203 to 237	Caution range. Operations must be conducted with caution and only in smooth air.
Red Radial	237	Maximum speed for all operations.

Figure 2-2

ENGINE LIMITATIONS

Number of Engines: 2

Engine Manufacturer: Teledyne Continental Motors

Engine Model Number: TSIO-520-NB

Engine Operating Limits:

a. Maximum power for takeoff and single engine operation.

Altitude - Feet	Allowable Manifold Pressure - Inches Hg.	Engine RPM	Rated Horse-power	Time	Max. Head Temp. oF	Max. Oil Temp. oF
S.L. to 20,000	38.0	2700	310	Continuous	460	240
22,000	35.2	2700	285	Continuous	460	240
24,000	32.3	2700	264	Continuous	460	240
26,000	29.8	2700	242	Continuous	460	240
28,000	27.4	2700	219	Continuous	460	240
30,000	25.0	2700	197	Continuous	460	240

b. Maximum normal operating power.

Altitude-Feet	Allowable Manifold Pressure-Inches Hg.	Engine-RPM	Rated Horse-power	Time	Max. Head Temp. °F	Max. Oil Temp. °F
S.L. to 20,000	38.0	2600	298	Continuous	460	240
22,000	35.2	2600	282	Continuous	460	240
24,000	32.3	2600	260	Continuous	460	240
26,000	29.8	2600	240	Continuous	460	240
28,000	27.4	2600	216	Continuous	460	240
30,000	25.0	2600	195	Continuous	460	240

Oil Pressure:

a. Minimum: 10 PSI (Idle Power)

b. Maximum: 100 PSI

Oil Viscosity:

SAE Rating	Ambient Temperature - °C (°F)
50	Above 4.4 (40)
30	Below 4.4 (40)
Multiviscosity	Unrestricted - After 25 Hours

Propellers:

a. Number of Propellers: 2

b. Manufacturer: McCauley Accessory Division, Cessna Aircraft Company

c. Part Number: 0850334-38

d. Number of Blades: 3

e. Diameter: 6'4.5"

f. Blade Range: (At 30-Inch Station)

(1) Low Pitch 14.9° ±0.2°

(2) Feather 81.2° ±0.3°

g. Operating Limits: 2700 RPM maximum speed

Engine Instrument Markings:

a. Tachometer:

(1) Normal Operating 2100 to 2450 RPM (Green Arc)

(2) Takeoff and engine inoperative 2600 to 2700 RPM (Yellow Arc).

(3) Maximum 2700 RPM (Red Radial)

b. Manifold Pressure:

(1) Normal Operating 17.0 to 31.5 Inches Hg. Manifold Pressure (Green Arc)

(2) Conditional Normal Operating 31.5 to 34.0 Inches Hg. Manifold Pressure at 2200 to 2300 RPM (Narrow Green Arc)

(a) 2450 RPM Mark at 31.5 Inches Hg. Manifold Pressure

(b) 2300 RPM Mark at 34.0 Inches Hg. Manifold Pressure

(3) Maximum 38.0 Inches Hg. Manifold Pressure (Red Radial)

c. Oil Temperature:

(1) Normal Operating 75 to 240°F (Green Arc)

(2) Maximum 240°F (Red Radial)

d. Oil Pressure:

(1) Minimum Operating 10 PSI (Red Radial)

(2) Normal Operating 30 to 60 PSI (Green Arc)

(3) Maximum 100 PSI (Red Radial)

e. Cylinder Head Temperature:

(1) Normal Operating 200 to 460°F (Green Arc)

(2) Maximum 460°F (Red Radial)

f. Fuel Flow:

(1) Minimum Operating 0 Pounds per hour (3.0 PSI) (Red Radial)

(2) Normal Operating 10.0 Pounds per hour (3.5 PSI) to 186.0 Pounds per hour (21.1 PSI) (Green Arc)

(a) Green Dots 45% Power - 64.5 Pounds per hour (5.9 PSI)
55% Power - 77.0 Pounds per hour (6.9 PSI)
65% Power - 89.0 Pounds per hour (7.9 PSI)
75% Power - 102.0 Pounds per hour (9.3 PSI)

(b) Blue Arc - Takeoff and Engine Inoperative Climb
28,000 Feet - 129.0 Pounds per hour (12.6 PSI)
26,000 Feet - 141.0 Pounds per hour (14.2 PSI)
24,000 Feet - 154.3 Pounds per hour (16.1 PSI)
22,000 Feet - 169.3 Pounds per hour (18.4 PSI)

(c) Blue Triangle (77.5% Power) - 120.0 Pounds per hour (11.4 PSI) (Cruise Climb and Best Power)

(d) White Triangle (Maximum Normal Operating Power) 170 Pounds per hour (18.5 PSI)

(e) White Arc - Takeoff and Engine Inoperative Power to 21,000 Feet 180.0 Pounds per hour (20.1 PSI) to 186.0 Pounds per hour (21.1 PSI)

(3) Maximum Operating 195.0 Pounds per hour (22.5 PSI) (Red Radial)

(4) On Face of Indicator: FUEL FLOW LBS/HR T.O. & ENG. INOP MAX CLIMB 77.5% CLIMB CRUISE POWER

MISCELLANEOUS INSTRUMENT MARKINGS

Instrument Vacuum:

a. Red Line: 4.75 Inches Hg.
b. Green Arc: 4.75 to 5.25 Inches Hg.

Oxygen Pressure:

a. Yellow Arc: 0 to 300
b. Green Arc: 1550 to 1850
c. Red Line: 2000
d. The Cubic Foot Capacity Of The Bottles Installed Will Be Indicated On The Face Of The Gage.

WEIGHT LIMITS

Maximum Ramp Weight: 6785 Pounds

Maximum Takeoff Weight: 6750 Pounds

Maximum Landing Weight: 6750 Pounds

Maximum Zero Fuel Weight: 6515 Pounds

Maximum Weights in Baggage Compartments:

a. Left and Right Wing Lockers - 200 pounds each.
b. Avionics Bay - 250 pounds less installed optional equipment.
c. Nose Bay - 350 pounds less installed optional equipment.
d. Aft Cabin (Bay A) - 400 pounds (200 Pounds Per Side).
e. Aft Cabin (Bay B) - 100 pounds (50 Pounds Per Side).

Center of Gravity Limits (Gear Extended):

a. Aft Limit: 160.04 inches aft of reference datum (33% MAC) at 6750 pounds or less.
b. Forward Limit: 151.27 inches aft of reference datum (19.0% MAC) at 6750 pounds or less and 147.82 inches aft of reference datum (13.5% MAC) at 5800 pounds or less with straight line variation between these points.
c. See Weight and Balance Data in Section 6 for loading schedule. The reference datum is 100 inches forward of the forward face of the fuselage bulkhead forward of the rudder pedals. The mean aerodynamic chord (MAC) is 62.65 inches in length. The leading edge of the MAC is 139.37 inches aft of the reference datum.

MANEUVER LIMITS

This is a normal category airplane. Aerobatic maneuvers, including spins, are prohibited.

FLIGHT LOAD FACTOR LIMITS

The design load factors are 150% of the following, and in all cases the structure exceeds design loads.

At Design Takeoff Weight of 6750 Pounds:

a. Landing gear up, wing flaps 0° +3.6G to -1.44G
b. Landing gear down, wing flaps 45° 0.0G to +2.0G

FLIGHT CREW LIMITS

Minimum Flight Crew for FAR 91 operations is one pilot.

OPERATION LIMITS

The standard airplane is approved for day and night operation under VFR conditions. With the proper optional equipment installed, the airplane is approved for day and night IFR operations and flight into icing conditions as defined by the FAA.

FUEL LIMITATIONS (See Figure 2-3)

Fuel Pressure:

a. Minimum: 3.0 PSI (0 Pounds Per Hour)
b. Maximum: 22.5 PSI (195.0 Pounds Per Hour)

Fuel Quantity:

a. Minimum fuel for takeoff is 20 gallons in each main tank.

Maneuvering Fuel:

a. Maximum side slip duration time is 30 seconds. The airplane is considered in a side slip anytime the turn and bank "ball" is more than one half ball out of the center (coordinated flight) position.

Fuel (Approved Fuel Grades And Colors):

PRIMARY - 100 (Formerly 100/130) Grade Aviation Fuel (Green).
ALTERNATE - 100LL Grade Aviation Fuel (Blue).

Total Fuel Capacity (U.S. Gallons) - 213.4

Usable Fuel (U.S. Gallons) - 206.0

MAXIMUM OPERATING ALTITUDE LIMIT

Without Oxygen Equipment: 25,000 Feet
With Oxygen Equipment: 30,000 Feet

CABIN PRESSURIZATION LIMIT

Maximum: 5.3 PSI
Normal: 0.0 to 5.0 PSI

Cabin Shall Be Depressurized During:

a. Takeoff.
b. Landing.
c. In flight when both engines are operating on hot alternate air.
d. All ground operations.

REQUIRED PLACARDS

On Emergency Exit Window Trim:

> EMERGENCY EXIT
> 1. TURN HANDLE ← OPEN
> 2. PULL DOOR INBD & DOWN

On Emergency Exit Window Trim (With Optional Right Aft Facing Seat):

> EMERGENCY EXIT
> 1. TURN HANDLE ← OPEN
> 2. PULL DOOR INBD & DOWN
>
> AFT FACING SEAT MUST BE
> FULL ← FWD WITH BACK ERECT
> FOR TAKEOFF & LANDING
>
> 5300181 82

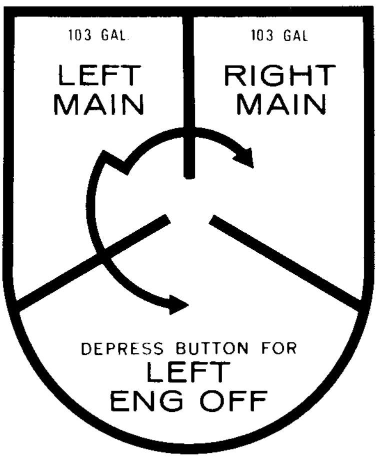
On Executive Table Top And Writing Desk Top:

> TABLE MUST BE STOWED
> DURING TAKE-OFF AND
> LANDING

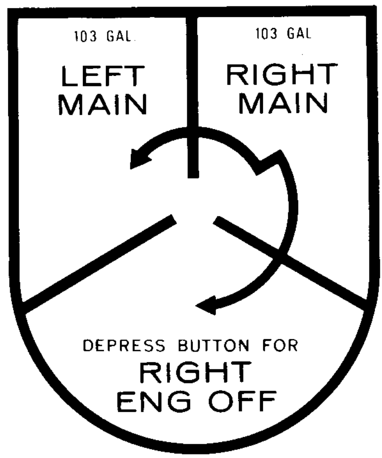
On Wall Opposite Emergency Exit Window:

> AFT FACING SEAT BACK MUST BE
> ERECT FOR TAKEOFF & LANDING

Left Left Engine Fuel Selector:



On Right Engine Fuel Selector:



On Floor Forward of Fuel Selectors:

SET FUEL SELECTOR VALVES TO LEFT MAIN FOR LEFT ENGINE AND RIGHT MAIN FOR RIGHT ENGINE FOR TAKEOFF, DESCENT, LANDING, AND ALL NORMAL OPERATIONS.

TAKEOFF AND LAND WITH AUXILIARY FUEL PUMPS ON.

EMERGENCY CROSSFEED SHUTOFF VALVE MUST BE OPEN FOR ALL NORMAL OPERATIONS.

100 GRADE AVIATION FUEL MINIMUM.

On Floor Forward of Fuel Emergency Crossfeed Shutoff Valve:

EMERGENCY CROSSFEED
SHUTOFF VALVE
PULL
TO SHUT OFF

In Recess on Fuel Emergency Crossfeed Shutoff Valve Bezel (Visible When Lever is Up):

LEVER UP
CROSSFEED
OFF

On Pilot's Sun Visor:

OPERATIONAL LIMITS

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 THE NORMAL CATEGORY ARE CONTAINED IN THE "PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL".
NO ACROBATIC MANEUVERS, INCLUDING SPINS, APPROVED.

AIR MINIMUM CONTROL SPEED	79 KIAS
MAXIMUM GEAR OPERATING SPEED	177 KIAS
MAXIMUM GEAR EXTENDED SPEED	177 KIAS
MAXIMUM FLAP EXTENDED SPEED, 15° FLAP	177 KIAS
MAXIMUM FLAP EXTENDED SPEED, 45° FLAP	146 KIAS
MAXIMUM MANEUVERING SPEED	145 KIAS

LANDING WITH CABIN PRESSURIZED PROHIBITED.
THIS AIRPLANE IS APPROVED FOR DAY-NIGHT VFR CONDITIONS. IT IS APPROVED FOR DAY-NIGHT IFR CONDITIONS AND FLIGHTS INTO ICING CONDITIONS IF THE PROPER EQUIPMENT IS INSTALLED AND OPERATIONAL.

Near Heater and Pressurization Heat Exchanger Controls:

OPEN ONE
CONTROL
MINIMUM
FOR
HEATER
OPERATION

Near Pressurization Controls:

PRESSURIZE
+ CABIN
DEPRESSURIZE

RAM DUMP
PULL
+

PRESS AIR
PULL
TO DUMP
+

If Optional Unfeathering Accumulators Are Installed:

NA

PROP UNFEATHERING ACCUMULATORS
ARE INSTALLED ON THIS AIRPLANE

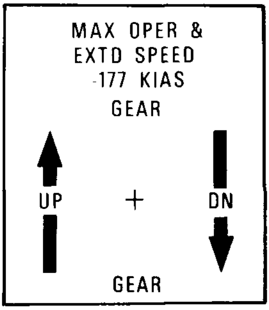
Near Engine Induction Alternate Air Controls:

LH RH
+
+ ALT AIR +
PULL
TO OPEN
+

Induction Air Controls (Optional EL Panel Installed):

ALT AIR
LEFT PULL RIGHT

Around Landing Gear Selector Switches:

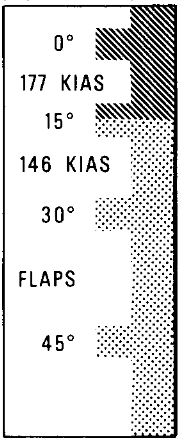


On Landing Gear Indicator Lights:

GEAR UNLOCKED

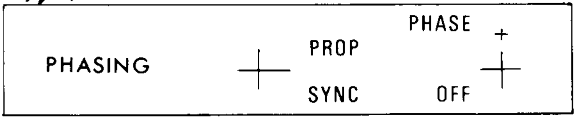
NOSE
LH RH

Adjacent to Wing Flap Position Switch: NA - RAM Installed



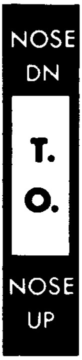
Near Propeller Synchrophaser Switch, If Optional Propeller Synchrophaser is Installed:

NA - RAM Installed



On Engine Control Pedestal:

T.O. Range on Elevator Trim Tab Indicator
2° Nose Down to 8° Nose Up:



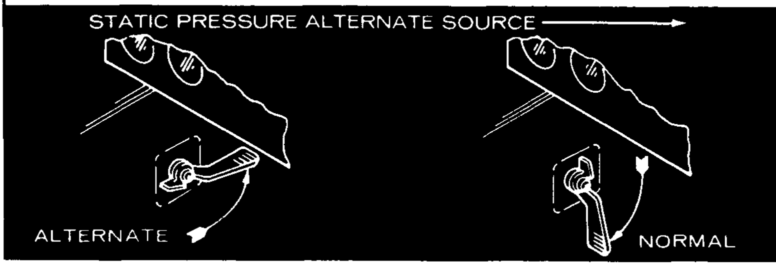
Rudder Trim Indicator:

Aileron Trim Indicator:

Adjacent to Static Source in Pilot's Compartment:

PARKING BRAKE

TO APPLY BRAKES, DEPRESS RUDDER PEDALS, THEN PULL KNOB.
TO RELEASE PUSH IN KNOB. DO NOT DEPRESS RUDDER PEDALS.



On Pilot's Compartment Right Sidewall:

STATIC SOURCE
DRAIN

DO NOT OPEN
WHILE PRESSURIZED

On Horizontal Part of First Baggage Step (Station 257):

MAXIMUM BAGGAGE ALLOWANCE
400 POUNDS (200 POUNDS/SIDE)

FOR AIRPLANE LOADING SEE WEIGHT & BALANCE DATA IN THE PILOT'S OPERATING HANDBOOK.

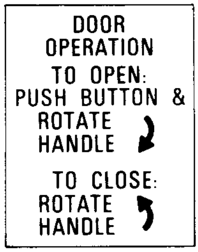
On Horizontal Part of Second Baggage Step (Station 276):

MAXIMUM BAGGAGE ALLOWANCE
100 POUNDS (50 POUNDS/SIDE)

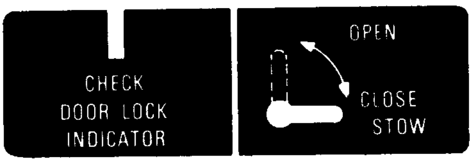
FOR AIRPLANE LOADING SEE WEIGHT & BALANCE DATA IN THE PILOT'S OPERATING HANDBOOK.

Near Upper Cabin Door Latch Mechanism:

External:



Internal:



Near Main Tank Filler Cap:

On Wing Locker Doors:

MAX
BAGGAGE
200 LBS

AIRCRAFT REGISTRATION NO

adNote

98-4-28 N/M

AD NUMBER

AIRCRAFT SERIAL NO

AFM Limitation

TYPE AIRCRAFT

COMPLIANCE DATE	TOTAL TIME AT COMPLIANCE	TACH OR RECORDING METER TIME AT COMPLIANCE	METHOD OF COMPLIANCE	AUTHORIZED SIGNATURE & NUMBER

Amendment 39-10340; Docket No. 97-CE-63-AD.

Applicability: Models T303, 310R, T310R, 335, 340A, 402B, 402C, 404, F406, 414, 414A, 421B, 421C, 425, and 441 airplanes (all serial numbers), certificated in any category.

NOTE 1: This AD applies to each airplane identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (d) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, the request should include specific proposed actions to address it.

Compliance: Required as indicated, unless already accomplished.

To minimize the potential hazards associated with operating the airplane in severe icing conditions by providing more clearly defined procedures and limitations associated with such conditions, accomplish the following:

(a) Within 30 days after the effective date of this AD, accomplish the requirements of paragraphs (a)(1) and (a)(2) of this AD.

NOTE 2: Operators should initiate action to notify and ensure that flight crewmembers are apprised of this change.

(1) Revise the FAA-approved Airplane Flight Manual (AFM) by incorporating the following into the Limitations Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"WARNING

Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems, and may seriously degrade the performance and controllability of the airplane.

- During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues. If one or more of these visual cues exists, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions.
- Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.
- Accumulation of ice on the upper surface of the wing, aft of the protected area.
- Accumulation of ice on the engine nacelles and propeller spinners farther aft than normally observed.
- Since the autopilot, when installed and operating, may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in severe icing conditions.
- All wing icing inspection lights must be operative prior to flight into icing conditions at night. **[NOTE: This supersedes any relief provided by the Master Minimum Equipment List (MMEL).]"**

(2) Revise the FAA-approved AFM by incorporating the following into the Normal Procedures Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"THE FOLLOWING WEATHER CONDITIONS MAY BE CONDUCIVE TO SEVERE IN-FLIGHT ICING:

- Visible rain at temperatures below 0 degrees Celsius ambient air temperature.
- Droplets that splash or splatter on impact at temperatures below 0 degrees Celsius ambient air temperature.

PROCEDURES FOR EXITING THE SEVERE ICING ENVIRONMENT:

These procedures are applicable to all flight phases from takeoff to landing. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as -18 degrees Celsius, increased vigilance is warranted at temperatures around freezing with visible moisture present. If the visual cues specified in the Limitations Section of the AFM for identifying severe icing conditions are observed, accomplish the following:

- Immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.
- Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
- Do not engage the autopilot.
- If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.
- If an unusual roll response or uncommanded roll control movement is observed, reduce the angle-of-attack.
- Do not extend flaps when holding in icing conditions. Operation with flaps extended can result in a reduced wing angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.
- If the flaps are extended, do not retract them until the airframe is clear of ice.
- Report these weather conditions to Air Traffic Control."

(b) Incorporating the AFM revisions, as required by this AD, may be performed by the owner/operator holding at least a private pilot certificate as authorized by section 43.7 of the Federal Aviation Regulations (14 CFR 43.7), and must be entered into the aircraft records showing compliance with this AD in accordance with section 43.9 of the Federal Aviation Regulations (14 CFR 43.9).

(c) Special flight permits may be issued in accordance with sections 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the airplane to a location where the requirements of this AD can be accomplished.

(d) An alternative method of compliance or adjustment of the compliance time that provides an equivalent level of safety may be approved by the Manager, Small Airplane Directorate, FAA, 1201 Walnut, suite 900, Kansas City, Missouri 64106. The request shall be forwarded through an appropriate FAA Maintenance Inspector, who may add comments and then send it to the Manager, Small Airplane Directorate.

NOTE 3: Information concerning the existence of approved alternative methods of compliance with this AD, if any, may be obtained from the Small Airplane Directorate.

(e) All persons affected by this directive may examine information related to this AD at the FAA, Central Region, Office of the Regional Counsel, Room 1558, 601 E. 12th Street, Kansas City, Missouri 64106.

(f) This amendment (39-10340) becomes effective on March 13, 1998.

FOR FURTHER INFORMATION CONTACT: Mr. John P. Dow, Sr., Aerospace Engineer, Small Airplane Directorate, Aircraft Certification Service, 1201 Walnut, suite 900, Kansas City, Missouri 64106, telephone (816) 426-6932, facsimile (816) 426-2169.

Inside Nose Baggage Doors:

MAXIMUM BAGGAGE

MAX. CAPACITY 350 LBS. LESS
OPTIONAL EQUIP.

Inside Left Nose Baggage Door:

**EXTERNAL HYD.
RESERVOIR FILL
MIL-H-5606**

On Hydraulic Reservoir:

MAX FULL —

ADD —

On Avionics Bay Door Forward Partition:

MAXIMUM BAGGAGE

MAX. CAPACITY 250 LBS. LESS
OPTIONAL EQUIP.

SECTION 3
EMERGENCY PROCEDURES

TABLE OF CONTENTS

INTRODUCTION

Section 3 of this handbook describes the recommended procedures for emergency situations. The first part of this section provides emergency procedural action required in an abbreviated checklist form. Amplification of the abbreviated checklist is presented in the second part of this section.

NOTE

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

EMERGENCY PROCEDURES ABBREVIATED CHECKLIST

NOTE

This Abbreviated Emergency Procedures Checklist is included as a supplement to the Amplified Emergency Procedures Checklist. Use of the Abbreviated Emergency Procedures Checklist should not be used until the flight crew has become familiar with the airplane and systems. All amplified emergency procedure items must be accomplished regardless of which checklist is used.

Procedures in the Abbreviated Checklist portion of this section outlined in black [ ] are immediate-action items and should be committed to memory.

SINGLE-ENGINE AIRSPEEDS FOR SAFE OPERATION

Conditions:
1. Takeoff Weight 6750 Pounds
2. Landing Weight 6750 Pounds
3. Standard Day, Sea Level

(1) Air Minimum Control Speed	79 KIAS
(2) Intentional One Engine Inoperative Speed	98 KIAS
(3) One Engine Inoperative Best Angle-of-Climb Speed . .	100 KIAS
(4) One Engine Inoperative Best Rate-of-Climb Speed (Wing Flaps UP)	108 KIAS

Figure 3-1

ENGINE INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE

1. Throttle - CLOSE.
2. Mixture - IDLE CUT-OFF.
3. Propeller - FEATHER.
4. Fuel Selector - OFF (Feel For Detent).
5. Auxiliary Fuel Pump - OFF.
6. Magneto Switches - OFF.
7. Propeller Synchrophaser - OFF (Optional System).
8. Alternator - OFF.
9. Cowl Flap - CLOSE.

ENGINE FAILURE DURING TAKEOFF (Speed Below 98 KIAS Or Gear Down)

1. Throttles - CLOSE IMMEDIATELY.
2. Brake Or Land And Brake - AS REQUIRED.

ENGINE FAILURE AFTER TAKEOFF (Speed Above 98 KIAS With Gear Up Or In Transit)

1. Mixtures - FULL RICH.
2. Propellers - FULL FORWARD.
3. Throttles - FULL FORWARD (38.0 Inches Hg.).
4. Landing Gear - CHECK UP.
5. Inoperative Engine:
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
6. Establish Bank - 5° toward operative engine.
7. Climb To Clear 50-Foot Obstacle - 98 KIAS.
8. Climb At One Engine Inoperative Best Rate-of-Climb Speed - 108 KIAS.
9. Trim Tabs - ADJUST 5° bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.
10. Cowl Flap - CLOSE (Inoperative Engine).
11. Inoperative Engine - SECURE as follows:
    a. Fuel Selector - OFF (Feel For Detent).
    b. Auxiliary Fuel Pump - OFF.
    c. Magneto Switches - OFF.
    d. Alternator - OFF.
12. As Soon As Practical - LAND.

ENGINE FAILURE DURING FLIGHT (Speed Above V_{MCA})

1. Inoperative Engine - DETERMINE.
2. Operative Engine - ADJUST as required.

Before Securing Inoperative Engine:

3. Fuel Flow - CHECK. If deficient, position auxiliary fuel pump to ON.
4. Fuel Selectors - MAIN TANKS (Feel For Detent).
5. Fuel Quantity - CHECK.
6. Oil Pressure and Oil Temperature - CHECK.
7. Magneto Switches - CHECK ON.
8. Mixture - ADJUST. Lean until manifold pressure begins to increase, then enrichen as power increases.

If Engine Does Not Start, Secure As Follows:

9. Inoperative Engine - SECURE.
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
   d. Fuel Selector - OFF (Feel For Detent).
   e. Auxiliary Fuel Pump - OFF.
   f. Magneto Switches - OFF.
   g. Propeller Synchrophaser - OFF (Optional System).
   h. Alternator - OFF.
   i. Cowl Flap - CLOSE.
10. Operative Engine - ADJUST.
    a. Power - AS REQUIRED.
    b. Mixture - ADJUST for power.
    c. Fuel Selector - AS REQUIRED (Feel For Detent).
    d. Auxiliary Fuel Pump - ON.
    e. Cowl Flap - AS REQUIRED.

11. Trim Tabs - ADJUST 5° bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.
12. Electrical Load - DECREASE to minimum required.
13. As Soon As Practical - LAND.

ENGINE FAILURE DURING FLIGHT (Speed Below V_{MC_A})

1. Rudder - APPLY towards operative engine.
2. Power - REDUCE to stop turn.
3. Pitch Attitude - LOWER NOSE to accelerate above V_{MC_A}.
4. Inoperative Engine Propeller - FEATHER.
5. Operative Engine - INCREASE POWER as airspeed increases above V_{MC_A}.
6. Inoperative Engine - SECURE.
7. Trim Tabs - ADJUST 5° bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.
8. Operative Engine Cowl Flap - AS REQUIRED.

ENGINE INOPERATIVE LANDING

1. Fuel Selector - MAIN TANK (Feel For Detent).
2. Auxiliary Fuel Pump - ON (Operative Engine).
3. Alternate Air Control - IN.
4. Mixture - FULL RICH or lean as required for smooth operation.
5. Propeller Synchrophaser - OFF (Optional System).
6. Propeller - FULL FORWARD.
7. Approach - 108 KIAS with excessive altitude.
8. Landing Gear - DOWN within gliding distance of field.
9. Wing Flaps - DOWN when landing is assured.
10. Speed - DECREASE below 94 KIAS only if landing is assured.
11. Air Minimum Control Speed - 79 KIAS.

ENGINE INOPERATIVE GO-AROUND (Speed Above 98 KIAS)

1. Throttle - FULL FORWARD (38.0 Inches Hg.).
2. Wing Flaps - UP (If Extended).
3. Positive Rate-of-Climb - ESTABLISH.
4. Landing Gear - UP.
5. Cowl Flap - OPEN.
6. Climb at One Engine Inoperative Best Rate-of-Climb Speed - 108 KIAS.
7. Trim Tabs - ADJUST 5° bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.

AIRSTART

Airplane Without Optional Propeller Unfeathering System:

1. Auxiliary Fuel Pump - CHECK OFF. If ON or LOW, purge engine by turning OFF auxiliary fuel pump, mixture to IDLE CUT-OFF, throttle full open, magneto switches OFF, and rotating engine 15 revolutions with starter.
2. Magneto Switches - ON.
3. Fuel Selector - MAIN TANK (Feel For Detent).
4. Throttle - FORWARD approximately one and one-half inches.
5. Mixture - FULL RICH then retard approximately two inches.
6. Propeller - FORWARD of detent.
7. Starter Button - PRESS.
8. Primer Switch - ACTIVATE.
9. Starter and Primer Switch - RELEASE when engine fires.
10. Auxiliary Fuel Pump - LOW.
11. Mixture - ADJUST for smooth engine operation.
12. Power - INCREASE after cylinder head temperature reaches 200°F with gradual mixture enrichment as power increases.
13. Cowl Flap - AS REQUIRED.
14. Alternator - ON.

Airplane With Optional Propeller Unfeathering System:

1. Auxiliary Fuel Pump - CHECK OFF. If ON or LOW, purge engine by turning OFF auxiliary fuel pump, mixture to IDLE CUT-OFF, throttle full open, magneto switches OFF, and rotating engine 15 revolutions with starter.
2. Magneto Switches - ON.
3. Fuel Selector - MAIN TANK (Feel For Detent).
4. Throttle - FORWARD approximately one and one-half inches.
5. Mixture - FULL RICH then retard approximately two inches.
6. Propeller - FULL FORWARD.
7. Propeller - RETARD to detent when propeller reaches 1000 RPM.
8. Auxiliary Fuel Pump - LOW.
9. Mixture - ADJUST for smooth engine operation.
10. Power - INCREASE after cylinder head temperature reaches 200°F with gradual mixture enrichment as power increases.
11. Cowl Flap - AS REQUIRED.
12. Alternator - ON.

BOTH ENGINES FAILURE DURING CRUISE FLIGHT

1. Wing Flaps - UP.
2. Landing Gear - UP.
3. Propellers - FEATHER.
4. Cowl Flaps - CLOSE.
5. Airspeed - 120 KIAS (See Figure 3-3).
6. Landing - Refer to FORCED LANDING (Complete Power Loss) in this section.

FIRE PROCEDURES

FIRE ON THE GROUND (Engine Start, Taxi And Takeoff With Sufficient Distance Remaining To Stop)

1. Throttles - CLOSE.
2. Brakes - AS REQUIRED.
3. Mixtures - IDLE CUT-OFF.
4. Battery - OFF (Use Gang Bar).
5. Magnetos - OFF (Use Gang Bar).
6. Evacuate airplane as soon as practical.

FLIGHT WING OR ENGINE FIRE

1. Both Auxiliary Fuel Pumps - OFF.
2. Operative Engine Fuel Selector - MAIN TANK (Feel For Detent).
3. Emergency Crossfeed Shutoff - OFF (Pull Up).
4. Appropriate Engine - SECURE.
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
   d. Fuel Selector - OFF (Feel For Detent).
   e. Magnetos - OFF.
   f. Propeller Synchrophaser - OFF (Optional System).
   g. Alternator - OFF.
   h. Cowl Flap - CLOSE.
5. Cabin Heater - OFF.
6. Land and evacuate airplane as soon as practical.

INFLIGHT CABIN ELECTRICAL FIRE OR SMOKE

1. Electrical Load - REDUCE to minimum required.
2. Fuel Selectors - MAIN TANK (Feel For Detent).
3. Emergency Crossfeed Shutoff - OFF (Pull Up).
4. Attempt to isolate the source of fire or smoke.
5. Cabin Air Controls - OPEN all vents including windshield defrost. CLOSE if intensity of smoke increases.
6. Pressurization Air Contamination Procedure - INITIATE if required.
7. Land and evacuate airplane as soon as practical.

EMERGENCY DESCENT PROCEDURES

PREFERRED PROCEDURE

1. Throttles - IDLE.
2. Propellers - FULL FORWARD.
3. Mixtures - ADJUST for smooth engine operation.
4. Wing Flaps - UP.
5. Landing Gear - UP.
6. Moderate Bank - INITIATE.
7. Airspeed - 235 KIAS.

IN TURBULENT ATMOSPHERIC CONDITIONS

1. Throttles - IDLE.
2. Propellers - FULL FORWARD.
3. Mixtures - ADJUST for smooth engine operation.
4. Wing Flaps - DOWN 45°.
5. Landing Gear - DOWN.
6. Moderate Bank - INITIATE.
7. Airspeed - 146 KIAS.

EMERGENCY LANDING PROCEDURES

FORCED LANDING (With Power)

1. Landing Site - CHECK. Overfly site at 105 KIAS and 15° wing flaps.
2. Landing Gear - DOWN if surface is smooth and hard.
   a. Normal Landing - INITIATE. Keep nosewheel off ground as long as practical.
3. Landing Gear - UP if surface is rough or soft.
   a. Approach - 105 KIAS with 15° wing flaps.
   b. Pressurization Air Controls - PULL.
   c. All Switches Except Magnetos - OFF.
   d. Mixtures - IDLE CUT-OFF.
   e. Magneto Switches - OFF.
   f. Fuel Selectors - OFF (Feel For Detent).
   g. Emergency Crossfeed Shutoff - OFF (Pull Up).
   h. Landing Attitude - NOSE HIGH.

FORCED LANDING (Complete Power Loss)

1. Mixtures - IDLE CUT-OFF.
2. Propellers - FEATHER.
3. Fuel Selectors - OFF (Feel For Detent).
4. Emergency Crossfeed Shutoff - OFF (Pull Up).
5. All Switches Except Battery - OFF.
6. Approach - 120 KIAS.
7. If Smooth and Hard Surface:
   a. Landing Gear - DOWN within gliding distance of field.
      (1) Landing Gear Switch - DOWN.
      (2) GEAR HYD Circuit Breaker - PULL.
      (3) Emergency Gear Extension T-Handle - PULL.
      (4) Gear Down Lights - ON; Unlocked Light - OFF.
      (5) Gear Warning Horn - CHECK.
   b. Wing Flaps - AS REQUIRED.
   c. Approach - 105 KIAS.
   d. Battery Switch - OFF.
   e. Normal Landing - INITIATE. Keep nosewheel off ground as long as practical.
8. If Rough or Soft Surface:
   a. Landing Gear - UP.
   b. Wing Flaps - DOWN 15°.
   c. Approach - 105 KIAS.
   d. Battery Switch - OFF.
   e. Landing Attitude - NOSE HIGH.

LANDING WITH FLAT MAIN GEAR TIRE

1. Landing Gear - Leave DOWN.
2. Fuel Selectors - SELECT main tank on same side as defective tire; feel for detent.
3. Fuel Selectors - MAIN TANKS (Feel For Detent) before landing.
4. Wind should be headwind or crosswind opposite the defective tire.
5. Wing Flaps - DOWN 45°.
6. In approach, align airplane with edge of runway opposite the defective tire, allowing room for a mild turn in the landing roll.
7. Land slightly wing low on the side of the inflated tire and lower the nosewheel to the ground immediately for positive steering.
8. Use full aileron in landing roll to lighten the load on the defective tire.
9. Apply brakes only on the inflated tire to minimize landing roll and maintain directional control.
10. Stop airplane to avoid further damage unless active runway must be cleared for other traffic.

LANDING WITH DEFECTIVE MAIN GEAR

1. Fuel Selectors - SELECT main tank on the same side as defective gear; feel for detent.
2. Fuel Selectors - MAIN TANKS (Feel For Detent) before landing.
3. Emergency Crossfeed Shutoff - OFF (Pull Up).
4. Wind - HEADWIND or crosswind opposite defective gear.
5. Landing Gear - DOWN.
6. Wing Flaps - DOWN 45°.
7. Approach - ALIGN AIRPLANE with the edge of runway opposite the defective landing gear.
8. Battery Switch - OFF.
9. Land wing low toward operative landing gear. Lower nosewheel immediately for positive steering.
10. Ground Loop - INITIATE into defective landing gear.
11. Mixtures - IDLE CUT-OFF.
12. Use full aileron in landing roll to lighten the load on the defective gear.
13. Apply brakes only on the operative landing gear to hold desired rate of turn and shorten landing roll.
14. Fuel Selectors - OFF (Feel For Detent).
15. Airplane - EVACUATE.

LANDING WITH FLAT NOSE GEAR TIRE

1. Landing Gear - Leave DOWN.
2. Passengers and Baggage - MOVE AFT.
3. Approach - 105 KIAS with 15° wing flaps.
4. Landing Attitude - NOSE HIGH.
5. Nose - HOLD OFF during landing roll.
6. Brakes - MINIMUM in landing roll.
7. Throttles - RETARD in landing roll.
8. Control Wheel - FULL AFT until airplane stops.
9. Minimize additional taxiing to prevent further damage.

LANDING WITH DEFECTIVE NOSE GEAR

1. If Smooth and Hard Surface:
   a. Baggage and Passengers - MOVE AFT.
   b. Landing Gear - DOWN.
   c. Approach - 105 KIAS with 15° wing flaps.
   d. All Switches Except Magnetos - OFF.
   e. Landing Attitude - NOSE HIGH.
   f. Mixtures - IDLE CUT-OFF.
   g. Magneto Switches - OFF.
   h. Nose - LOWER as speed dissipates.
2. If Rough or Sod Surface:
   a. Landing Gear - UP.
   b. Approach - 105 KIAS with 15° wing flaps.
   c. All Switches Except Magnetos - OFF.
   d. Landing Attitude - NOSE HIGH.
   e. Mixtures - IDLE CUT-OFF.
   f. Magneto Switches - OFF.
   g. Fuel Selectors - OFF (Feel For Detent).
   h. Emergency Crossfeed Shutoff - OFF (Pull Up).

LANDING WITHOUT FLAPS (0° Extension)

1. Mixtures - FULL RICH or lean as required for smooth operation.
2. Propellers - FULL FORWARD.
3. Fuel Selectors - MAIN TANKS (Feel For Detent).
4. Minimum Approach Speed - 107 KIAS (See Figure 5-25).
5. Landing Gear - DOWN.

DITCHING

1. Landing Gear - UP.
2. Approach - HEADWIND if high winds.
   PARALLEL to SWELLS if light wind and heavy swells.
3. Wing Flaps - DOWN 45°.
4. Power - AS REQUIRED. (300 Feet Per Minute Descent).
5. Airspeed - 105 KIAS minimum.
6. Attitude - DESCENT ATTITUDE through touchdown.

FUEL SYSTEM EMERGENCY PROCEDURES

ENGINE-DRIVEN FUEL PUMP FAILURE

1. Fuel Selector - MAIN TANK (Feel For Detent).
2. Auxiliary Fuel Pump - ON.
3. Cowl Flap - AS REQUIRED.
4. Mixture - FULL RICH. Adjust fuel flow to coincide with power setting.
5. As Soon As Practical - LAND.
6. Crossfeed is unusable if the other engine is operating.

ELECTRICAL SYSTEM EMERGENCY PROCEDURES

ALTERNATOR FAILURE (Single)

1. Electrical Load - REDUCE.
2. If Circuit Breaker is tripped:
   a. Turn off affected alternator.
   b. Reset affected alternator circuit breaker.
   c. Turn on affected alternator switch.
   d. If circuit breaker reopens, turn off alternator.
3. If Circuit Breaker does not trip:
   a. Select affected alternator on voltammeter and monitor output.
   b. If output is normal and failure light remains on, disregard fail indication and have indicator checked after landing.
   c. If output is insufficient, turn off alternator and reduce electrical load to one alternator capacity.
   d. If complete loss of alternator output occurs, check field fuse and replace if necessary.
   e. If an intermittent light indication accompanied by voltammeter fluctuation is observed, turn off affected alternator and reduce load to one alternator capacity.
   f. Restrict on remaining alternator to 80% of rated load.

ALTERNATOR FAILURE (Dual)

1. Electrical Load - REDUCE.
2. If Circuit Breakers are tripped:
   a. Turn off alternators.
   b. Reset circuit breakers.
   c. Turn on left alternator and monitor output on voltammeter.
   d. If alternator is charging, leave it on. Disregard failure light if still illuminated.
   e. If still inoperative, turn off left alternator.
   f. Repeat steps c through e for right alternator.
   g. If circuit breakers reopen, prepare to terminate flight.
3. If Circuit Breakers have not tripped:
   a. Turn off alternators.
   b. Check field fuses and replace as required.
   c. Turn on left alternator and monitor output on voltammeter.
   d. If alternator is charging, leave it on. Disregard failure light if still illuminated.
   e. If still inoperative, turn off left alternator.
   f. Repeat steps c through e for right alternator.
   g. If both still inoperative, turn off alternators and turn on emergency power alternator field switch.
   h. Repeat steps c through e for each alternator.
   i. If still inoperative, turn off alternators, nonessential electrical items and prepare to terminate flight.

AVIONICS BUS FAILURE

1. Avionics Bus Switch - OFF.
2. Emergency Power Avionics Bus Switch - ON.

LANDING GEAR EMERGENCY PROCEDURES

HYD PRESS LIGHT ILLUMINATED AFTER GEAR CYCLE

1. Landing Gear Switch - RAPIDLY RECYCLE.
2. If HYD PRESS light still illuminated:
   a. Landing Gear - DOWN.
   b. GEAR HYD Circuit Breaker - PULL.
   c. If HYD PRESS light remains illuminated - LAND as soon as practical.

LANDING GEAR DOWN AND LOCKED LIGHT ILLUMINATED WITH GEAR HANDLE UP AND HYD PRESS LIGHT OUT

Perform "LANDING GEAR WILL NOT EXTEND HYDRAULICALLY" Checklist.

LANDING GEAR WILL NOT EXTEND HYDRAULICALLY

1. Airspeed - 130 KIAS or less.
2. Landing Gear Switch - DOWN.
3. GEAR HYD Circuit Breaker - PULL.
4. Emergency Gear Extension T-Handle - PULL.
5. Gear Down Lights - ON; Unlocked Light - OFF.
6. If Main Gear Does Not Lock Down - YAW AIRPLANE. Airloads will lock main gear down if up locks have released.
7. Gear Warning Horn - CHECK.
8. As Soon As Practical - LAND.

LANDING GEAR WILL NOT RETRACT HYDRAULICALLY

1. Landing Gear Switch - DOWN.
2. Gear Down Lights - ON; Unlocked Light - OFF.
3. Gear Warning Horn - CHECK.
4. As Soon As Practical - LAND.

FLIGHT INSTRUMENTS EMERGENCY PROCEDURES

VACUUM PUMP FAILURE (Attitude And Directional Gyros)

1. Failure indicated by left or right red failure button exposed on vacuum gage.
2. Automatic valve will select operative source.
3. Vacuum Pressure - CHECK proper vacuum from operative source.

OBSTRUCTION OR ICING OF STATIC SOURCE

1. Static Source - ALTERNATE.
2. Excess Altitude and Airspeed - MAINTAIN to compensate for change in calibration (See Figures 5-2 and 5-4).

ENGINE INLET AIR SYSTEM ICING EMERGENCY PROCEDURES

AIR INLET OR FILTER ICING

1. Alternate Air Control(s) - PULL OUT.
2. Propeller(s) - INCREASE (2550 RPM For Normal Cruise).
3. Mixture(s) - LEAN as required.
4. Pressurization Air Control(s) - PULL LH and/or RH as necessary.
   a. With Both Pressurization Air Sources Dumped:
      (1) Cabin Vent Control - PULL.
      (2) Cabin Pressurization Switch - DEPRESSURIZE.
   b. Above 10,000 Feet with both pressurization air sources dumped:
      (1) If Supplementary Oxygen is Not Available - EMERGENCY DESCENT TO 10,000 FEET.
      (2) If Supplementary Oxygen is Available:
         (a) Oxygen Knob - PULL ON.
         (b) Assure each occupant is using oxygen.
         (c) Descend as soon as practical to 10,000 Feet.

PRESSURIZATION SYSTEM EMERGENCY PROCEDURES

IMPENDING SKIN PANEL OR WINDOW FAILURE

1. Cabin Pressurization Switch - DEPRESSURIZE.
2. Cabin Vent Control - PULL.
3. Pressurization Air Controls - PULL.
4. If Above 10,000 Feet and Supplementary Oxygen is Not Available - EMERGENCY DESCENT TO 10,000 FEET.
5. If Above 10,000 Feet and Supplementary Oxygen is Available:
   a. Oxygen Knob - PULL ON.
   b. Assure each occupant is using oxygen.
   c. Descend as soon as practical to 10,000 Feet.

CABIN OVERPRESSURE (Over 5.3 PSI)

1. Pressurization Air Controls - PULL.
2. If Above 10,000 Feet and Supplementary Oxygen is Not Available - EMERGENCY DESCENT TO 10,000 FEET.
3. If Above 10,000 Feet and Supplementary Oxygen is Available:
   a. Oxygen Knob - PULL ON.
   b. Assure each occupant is using oxygen.
   c. Descend as soon as practical to 10,000 Feet.

LOSS OF PRESSURIZATION ABOVE 10,000 FEET

1. Without Supplementary Oxygen - EMERGENCY DESCENT TO 10,000 FEET.
2. With Supplementary Oxygen:
   a. Oxygen Knob - PULL ON.
   b. Assure each occupant is using oxygen.
   c. Descend as soon as practical to 10,000 Feet.

PRESSURIZATION AIR CONTAMINATION

1. Pressurization Air Control(s) - PULL LH and/or RH as necessary.
   a. With Both Air Sources Dumped:
      (1) Cabin Vent Control - PULL.
      (2) Cabin Pressurization Switch - DEPRESSURIZE.
2. Above 10,000 Feet with Both Air Sources Dumped:
   a. If Supplementary Oxygen is Not Available - EMERGENCY DESCENT TO 10,000 FEET.
   b. If Supplementary Oxygen is Available:
      (1) Oxygen Knob - PULL ON.
      (2) Assure each occupant is using oxygen.
      (3) Descend as soon as practical to 10,000 Feet.

PROPELLER SYNCHROPHASER

ENGINE INOPERATIVE PROCEDURE

1. Propeller Synchrophaser - OFF (Optional System).

SYNCHROPHASER FAILURE

1. Propeller Synchrophaser - OFF (Optional System).
2. Propeller Synchrophaser Circuit Breaker - PULL (Optional System).

EMERGENCY EXIT WINDOW REMOVAL

1. Emergency Release Handle Plastic Cover - PULL OFF.
2. Release Handle - TURN COUNTERCLOCKWISE.
3. Emergency Exit Window - PULL IN and DOWN.

SPINS

1. Throttles - CLOSE IMMEDIATELY.
2. Ailerons - NEUTRALIZE.
3. Rudder - HOLD FULL RUDDER opposite the direction of rotation.
4. Control Wheel - FORWARD BRISKLY, 1/2 turn after applying full rudder.
5. Inboard Engine - INCREASE POWER to slow rotation. (If Necessary).

After rotation has stopped:

6. Rudder - NEUTRALIZE.
7. Inboard Engine (If used) - DECREASE POWER to equalize engines.
8. Control Wheel - PULL to recover from resultant dive. Apply smooth steady control pressure.

AMPLIFIED EMERGENCY PROCEDURES

NOTE

A complete knowledge of the procedures set forth in this section will enable the pilot to cope with various emergencies that can be encountered; however, this does not diminish the fact that the primary responsibility of the pilot is to maintain control at all times. Good judgment and precise action are essential and can only be developed through frequent practice of emergency and simulated single-engine procedures. The pilot must have a thorough knowledge of all emergency procedures so that in the event of an emergency, reaction will be precise and done with confidence. This is required so the pilot can cope with the demands of an emergency situation.

ENGINE INOPERATIVE AIRSPEEDS FOR SAFE OPERATION

The most critical time for an engine failure condition in a multi-engine airplane is during a two or three second period late in the takeoff run while the airplane is accelerating to a safe engine failure speed. A detailed knowledge of recommended engine inoperative airspeeds is essential for safe operation of the airplane.

The airspeed indicator is marked with a red radial at the air minimum control speed and a blue radial at the one engine inoperative best rate-of-climb speed to facilitate instant recognition. The following paragraphs present a detailed discussion of the problems associated with engine failures during takeoff.

AIR MINIMUM CONTROL SPEED

The multi-engine airplane must reach the air minimum control speed (79 KIAS) before full control deflections can counteract the adverse rolling and yawing tendencies associated with one engine inoperative and full power operation on the other engine. This speed is indicated by a red radial on the airspeed indicator.

INTENTIONAL ONE ENGINE INOPERATIVE SPEED

Although the airplane is controllable at the air minimum control speed, the airplane performance is so far below optimum that continued flight near the ground is improbable. A more suitable intentional one engine inoperative speed is 98 KIAS. At this speed, altitude can be maintained more easily while the landing gear is being retracted and the propeller is being feathered.

ONE ENGINE INOPERATIVE BEST ANGLE-OF-CLIMB SPEED

The one engine inoperative best angle-of-climb speed becomes important when there are obstacles ahead on takeoff. Once the one engine inoperative best angle-of-climb speed is reached, altitude becomes more important than airspeed until the obstacle is cleared. The one engine inoperative best angle-of-climb speed is approximately 100 KIAS with wing flaps and landing gear up.

ONE ENGINE INOPERATIVE BEST RATE-OF-CLIMB SPEED

The one engine inoperative best rate-of-climb speed becomes important when there are no obstacles ahead on takeoff, or when it is difficult to maintain or gain altitude in single-engine emergencies. The one engine inoperative best rate-of-climb speed is 108 KIAS with wing flaps and landing gear up. This speed is indicated by a blue radial on the airspeed indicator.

The variations of wing flaps up one engine inoperative best rate-of-climb speed with altitude are shown in Section 5. For one engine inoperative best climb performance, the wings should be banked 5° toward the operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.

Procedures in the amplified portion of this section outlined in black ☐ are immediate-action items and should be committed to memory.

ENGINE INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE

1. Throttle - CLOSE.
2. Mixture - IDLE CUT-OFF.
3. Propeller - FEATHER.
4. Fuel Selector - OFF (Feel For Detent).
5. Auxiliary Fuel Pump - OFF.
6. Magneto Switches - OFF.
7. Propeller Synchrophaser - OFF (Optional System).
8. Alternator - OFF.
9. Cowl Flap - CLOSE.

ENGINE FAILURE DURING TAKEOFF (Speed Below 98 KIAS Or Gear Down)

1. Throttles - CLOSE IMMEDIATELY.
2. Brake Or Land And Brake - AS REQUIRED.

NOTE

The distance required for the airplane to be accelerated from a standing start to 98 KIAS on the ground, and to decelerate to a stop with heavy braking, is presented in the Accelerate Stop Distance Chart in Section 5 for various combinations of conditions.

ENGINE FAILURE AFTER TAKEOFF (Speed Above 98 KIAS With Gear Up Or In Transit)

1. Mixtures - FULL RICH.
2. Propellers - FULL FORWARD.
3. Throttles - FULL FORWARD (38.0 Inches Hg.).
4. Landing Gear - CHECK UP.
5. Inoperative Engine:
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.

6. Establish Bank - 5° toward operative engine.
7. Climb to Clear 50-Foot Obstacle - 98 KIAS.
8. Climb at One Engine Inoperative Best Rate-of-Climb Speed - 108 KIAS.
9. Trim Tabs - ADJUST 5° bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.
10. Cowl Flap - CLOSE (Inoperative Engine).
11. Inoperative Engine - SECURE as follows:
    a. Fuel Selector - OFF (Feel For Detent).
    b. Auxiliary Fuel Pump - OFF.
    c. Magneto Switches - OFF.
    d. Alternator Switch - OFF.
12. As Soon As Practical - LAND.

Upon engine failure after reaching 98 KIAS on takeoff, the multi-engine pilot has a significant advantage over a single-engine pilot, for he has a choice of stopping or continuing the takeoff. This would be similar to the choice facing a single-engine pilot who has suddenly lost slightly more than half of his takeoff power. In this situation, the single-engine pilot would be extremely reluctant to continue the takeoff if he had to climb over obstructions. However, if the failure occurred at an altitude as high or higher than surrounding obstructions, he would feel free to maneuver for a landing back at the airport.

Fortunately, the airplane accelerates through this "area of decision" in just a few seconds. However, to make an intelligent decision in this type of emergency, one must consider the field length, obstruction height, field elevation, air temperature, headwind, and takeoff weight. The flight paths illustrated in Figure 3-2 indicate that the "go no-go area of decision" is bounded by: (1) the point at which 98 KIAS is reached and (2) the point where the obstruction altitude is reached. An engine failure in this area requires an immediate decision. Beyond this area, the airplane, within the limitations of single-engine climb performance shown in Section 5, may be maneuvered to a landing back at the airport.

ENGINE FAILURE DURING TAKEOFF GO NO-GO DECISION

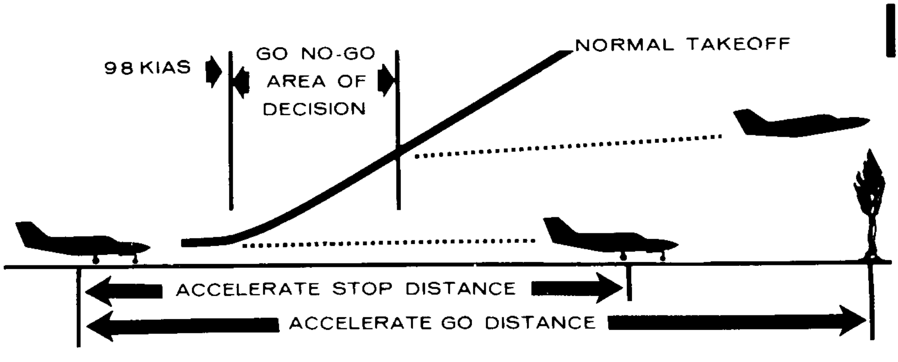


Figure 3-2

At sea level standard day, with zero wind and 6750 pounds weight, the distance to accelerate to 98 KIAS and stop is 4245 feet, while the total unobstructed distance required to takeoff and climb over a 50-foot obstacle after an engine failure at 98 KIAS is 3885 feet. This total distance over an obstacle can be reduced slightly under more favorable conditions of weight, headwind, or obstruction height. However, it is recommended that in most cases it would be better to discontinue the takeoff, since any slight mismanagement of single-engine procedure would more than offset the small distance advantage offered by continuing the takeoff. Still higher field elevations will cause the engine failure takeoff distance to lengthen disproportionately until the altitude is reached where a successful takeoff is improbable unless the airspeed and height above the runway at engine failure are great enough to allow a slight deceleration and altitude loss while the airplane is being prepared for an engine inoperative climb.

During engine inoperative takeoff procedures over an obstacle, only one condition presents any appreciable advantage; this is headwind. A decrease of approximately 6% in ground distance required to clear a 50-foot obstacle can be gained for each 10 knots of headwind. Excessive speed above one engine inoperative best rate-of-climb speed at engine failure is not nearly as advantageous as one might expect since deceleration is rapid and ground distance is used up quickly at higher speeds while the airplane is being cleaned up for climb. However, the extra speed is important for controllability.

The following facts should be used as a guide at the time of engine failure during takeoff: (1) discontinuing a takeoff upon engine failure is advisable under most circumstances; (2) altitude is more valuable to safety after takeoff than is airspeed in excess of the one engine inoperative best rate-of-climb speed since excess airspeed is lost much more rapidly than is altitude; (3) climb or continued level flight at moderate altitude is improbable with the landing gear extended and the propeller windmilling; (4) in no case should the airspeed be allowed to fall below the intentional one engine inoperative speed, even though altitude is lost, since this speed will always provide a better chance of climb, or a smaller altitude loss, than any lesser speed; and (5) if the requirement for an immediate climb is not present, allow the airplane to accelerate to the one engine inoperative best rate-of-climb speed as this is the optimum climb speed and will always provide the best chance of climb or least altitude loss.

WARNING

The propeller on the inoperative engine must be feathered, landing gear retracted and wing flaps up or continued flight may be impossible.

ENGINE OVERSPEED

Should an overspeed condition occur, the pilot should reduce airspeed as quickly as possible by closing both throttles. On reaching an airspeed below 120 KIAS and above the one engine inoperative best rate-of-climb speed (Blue Radial), set the propeller control on the overspeeding engine for feather. If propeller will not feather, the power on the normally operating engine should be advanced to maximum and the power on the overspeeding engine should be advanced to 50 RPM below the maximum allowable RPM (Red Line). Maintain the one engine inoperative best rate-of-climb speed (Blue Radial) and land as soon as practical. This will provide more than zero thrust at altitudes up to approximately 10,000 feet. During landing, the application of partial throttle on the malfunctioning engine (within limits of the tachometer red line) will minimize asymmetrical thrust.

ENGINE FAILURE DURING FLIGHT (Speed Above Air Minimum Control Speed)

1. Inoperative Engine - DETERMINE. Idle engine same side as idle foot.
2. Operative Engine - ADJUST as required.

Before Securing Inoperative Engine:

3. Fuel Flow - CHECK. If deficient, position auxiliary fuel pump switch to ON.
4. Fuel Selectors - MAIN TANKS (Feel For Detent).
5. Fuel Quantity - CHECK. Switch to opposite MAIN TANK if necessary.
6. Oil Pressure and Oil Temperature - CHECK. Shutdown engine if oil pressure is low.
7. Magneto Switches - CHECK ON.
8. Mixture - ADJUST. Lean until manifold pressure begins to increase, then enrichen as power increases.

If Engine Does Not Start, Secure As Follows:

9. Inoperative Engine - SECURE.
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
   d. Fuel Selector - OFF (Feel For Detent).
   e. Auxiliary Fuel Pump - OFF.
   f. Magneto Switches - OFF.
   g. Propeller Synchrophaser - OFF (Optional System).
   h. Alternator Switch - OFF.
   i. Cowl Flap - CLOSE.
10. Operative Engine - ADJUST.
    a. Power - AS REQUIRED.
    b. Mixture - ADJUST for power.
    c. Fuel Selector - AS REQUIRED (Feel For Detent).
    d. Auxiliary Fuel Pump - ON.
    e. Cowl Flap - AS REQUIRED.
11. Trim Tabs - ADJUST 5^{o} bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.
12. Electrical Load - DECREASE to minimum required.
13. As Soon As Practical - LAND.

NOTE

Schedule fuel use such that an adequate amount of fuel is available in the operative engine main tank for landing. Crossfeed as required to maintain lateral balance within 120 pounds per side. When crossfeeding, maintain level flight, maintain altitude greater than 1000 feet AGL and position inoperative engine auxiliary fuel pump to LOW.

ENGINE FAILURE DURING FLIGHT (Speed Below Air Minimum Control Speed)

1. Rudder - APPLY towards operative engine.
2. Power - REDUCE to stop turn.
3. Pitch Attitude - LOWER NOSE to accelerate above air minimum control speed.
4. Inoperative Engine Propeller - FEATHER.
5. Operative Engine - INCREASE POWER as airspeed increases above air minimum control speed.
6. Inoperative Engine - SECURE.
7. Trim Tabs - ADJUST 5° bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.
8. Operative Engine Cowl Flap - AS REQUIRED.

ENGINE INOPERATIVE LANDING

1. Fuel Selector - MAIN TANK (Feel For Detent).
2. Auxiliary Fuel Pump - ON (Operative Engine).
3. Alternate Air Control - IN.
4. Mixture - FULL RICH or lean as required for smooth operation.
5. Propeller Synchrophaser - OFF (Optional System).
6. Propeller - FULL FORWARD.
7. Approach at 108 KIAS with excessive altitude.
8. Landing Gear - DOWN within gliding distance of field.
9. Wing Flaps - DOWN when landing is assured.
10. Decrease speed below 94 KIAS only if landing is assured.
11. Air Minimum Control Speed - 79 KIAS.

ENGINE INOPERATIVE GO-AROUND (Speed Above 98 KIAS)

WARNING

Level flight may not be possible for certain combinations of weight, temperature and altitude. In any event, do not attempt an engine inoperative go-around after wing flaps have been extended beyond 15°.

1. If absolutely necessary and speed is above 98 KIAS, increase engine speed to 2700 RPM and apply full throttle.
2. Wing Flaps - UP (If Extended).
3. Positive Rate-of-Climb - ESTABLISH.
4. Landing Gear - UP.
5. Cowl Flap - OPEN.
6. Climb at 108 KIAS (99 KIAS With Obstacles Directly Ahead).
7. Trim Tabs - ADJUST 5° bank toward operative engine with approximately 1/2 ball slip indicated on the turn and bank indicator.

AIRSTART (After Feathering)

Airplane Without Optional Propeller Unfeathering System:

1. Auxiliary Fuel Pump - CHECK OFF. If ON or LOW, purge engine by turning OFF auxiliary fuel pump, mixture to IDLE CUT-OFF, throttle full open, magneto switches OFF, and rotating engine 15 revolutions with starter.

2. Magneto Switches - ON.
3. Fuel Selector - MAIN TANK (Feel For Detent).
4. Throttle - FORWARD approximately one and one-half inches.
5. Mixture - FULL RICH then retard approximately two inches.
6. Propeller - FORWARD of detent.
7. Starter Button - PRESS.
8. Primer Switch - ACTIVATE.
9. Starter and Primer Switch - RELEASE when engine fires.
10. Auxiliary Fuel Pump - LOW.
11. Mixture - ADJUST for smooth engine operation.
12. Power - INCREASE after cylinder head temperature reaches 200°F with gradual mixture enrichment as power increases.
13. Cowl Flap - AS REQUIRED.
14. Alternator - ON.

Airplane With Optional Propeller Unfeathering System:

1. Auxiliary Fuel Pump - CHECK OFF. If ON or LOW, purge engine by turning OFF auxiliary fuel pump, mixture to IDLE CUT-OFF, throttle full open, magneto switches OFF, and rotating engine 15 revolutions with starter.
2. Magneto Switches - ON.
3. Fuel Selector - MAIN TANK (Feel For Detent).
4. Throttle - FORWARD approximately one and one-half inches.
5. Mixture - FULL RICH then retard approximately two inches.
6. Propeller - FULL FORWARD.

NOTE

The propeller will automatically windmill when the propeller lever is moved out of the FEATHER position.

7. Propeller - RETARD to detent when propeller reaches 1000 RPM.
8. Auxiliary Fuel Pump - LOW.
9. Mixture - ADJUST for smooth engine operation.
10. Power - INCREASE after cylinder head temperature reaches 200°F with gradual mixture enrichment as power increases.
11. Cowl Flap - AS REQUIRED.
12. Alternator - ON.

BOTH ENGINES FAILURE DURING CRUISE FLIGHT

1. Wing Flaps - UP.
2. Landing Gear - UP.
3. Propellers - FEATHER.
4. Cowl Flaps - CLOSE.
5. Airspeed - 120 KIAS (See Figure 3-3).

NOTE

Vacuum instruments will be inoperative. Electrical power available will be limited to the amount of energy contained in the battery.

6. Landing - Refer to FORCED LANDING (Complete Power Loss) in this section.

MAXIMUM GLIDE

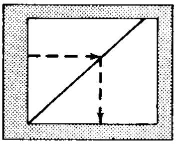
In the event of an all engines failure condition, maximum gliding distance can be obtained by feathering both propellers, and maintaining approximately 120 KIAS with landing gear and wing flaps up. The speed which provides the "absolute maximum" glide distance varies with weight as shown in Figure 3-3.

MAXIMUM GLIDE

CONDITIONS:
1. Landing Gear - UP.
2. Wing Flaps - UP.
3. Propellers - FEATHERED.
4. Cowl Flaps - CLOSED.
5. Best Glide Speed.
6. Zero Wind.

BEST GLIDE SPEED

WEIGHT POUNDS	KIAS
6750	120
6200	115
5700	110
5200	105



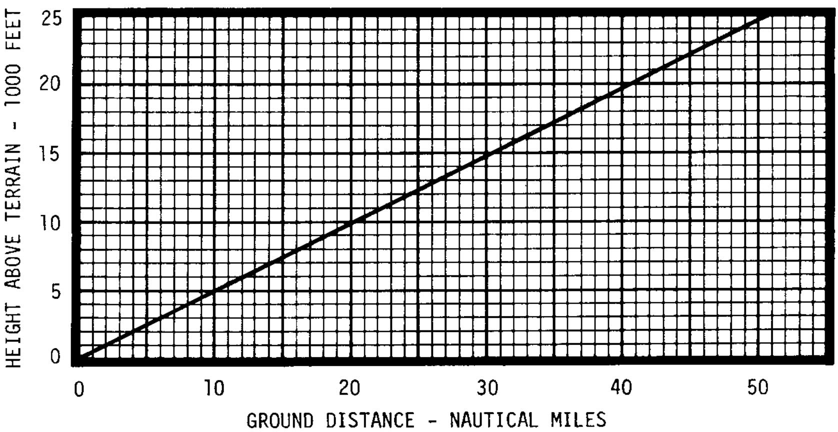


Figure 3-3

FIRE PROCEDURES

Refer to Section 9 if Fire Detection and Extinguishing System is installed.

FIRE ON THE GROUND (Engine Start, Taxi And Takeoff With Sufficient Distance Remaining To Stop)

1. Throttles - CLOSE.
2. Brakes - AS REQUIRED.
3. Mixtures - IDLE CUT-OFF.
4. Battery - OFF (Use Gang Bar).
5. Magnetos - OFF (Use Gang Bar).
6. Evacuate airplane as soon as practical.

INFLIGHT WING OR ENGINE FIRE

1. Both Auxiliary Fuel Pumps - OFF.
2. Operative Engine Fuel Selector - MAIN TANK (Feel For Detent).
3. Emergency Crossfeed Shutoff - OFF (Pull Up).
4. Appropriate Engine - SECURE.
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
   d. Fuel Selector - OFF (Feel For Detent).
   e. Magnetos - OFF.
   f. Propeller Synchrophaser - OFF (Optional System).
   g. Alternator - OFF.
   h. Cowl Flap - CLOSE.
5. Cabin Heater - OFF.
6. Land and evacuate airplane as soon as practical.

INFLIGHT CABIN ELECTRICAL FIRE OR SMOKE

1. Electrical Load - REDUCE to minimum required.
2. Fuel Selectors - MAIN TANK (Feel For Detent).
3. Emergency Crossfeed Shutoff - OFF (Pull Up).
4. Attempt to isolate the source of fire or smoke.
5. Cabin Air Controls - OPEN all vents including windshield defrost.
   CLOSE if intensity of smoke increases.
6. Pressurization Air Contamination Procedure - INITIATE if required.

CAUTION

Opening the foul weather windows or emergency exit window will create a draft in the cabin and may intensify a fire.

7. Land and evacuate airplane as soon as practical.

SUPPLEMENTARY INFORMATION CONCERNING AIRPLANE FIRES

With the use of modern installation techniques and material, the probability of an airplane fire occurring in your airplane is extremely remote. However, in the event a fire is encountered, the following information will be helpful in dealing with the emergency as quickly and safely as possible.

The preflight checklist is provided to aid the pilot in detecting conditions which could contribute to an airplane fire. As a fire requires both fuel and an ignition source, close preflight inspection should be given to the engine compartment and wing leading edge and lower surfaces. Leaks in the fuel system, oil system, or exhaust system can lead to a ground or inflight fire.

NOTE

Flight should not be attempted with known fuel, oil or exhaust leaks. The presence of fuel, unusual oil or exhaust stains may be an indication of system leaks and should be corrected prior to flight.

If an airplane fire is discovered on the ground or during takeoff, but prior to committed flight, the airplane is to be landed and/or stopped and the passengers and crew evacuated as soon as practical.

Fires originating inflight must be controlled as quickly as possible in an attempt to prevent major structural damage. Both auxiliary fuel pumps should be turned off and the emergency crossfeed shutoff pulled up to reduce pressure on the total fuel system (each auxiliary pump pressurizes a crossfeed line to the opposite fuel selector). The engine on the wing in which the fire exists should be shut down and its fuel selector positioned to OFF even though the fire may not have originated in the fuel system. The cabin heater draws fuel from the crossfeed system and should also be turned off. Descent for landing should be initiated immediately.

An open emergency exit or foul weather window produces a low pressure in the cabin. To avoid drawing the fire into the cabin, the emergency exit and foul weather window should be kept closed. This condition is aggravated with the landing gear and flaps extended. Therefore, the pilot should lower the gear as late in the landing approach as possible. A no-flap landing should also be attempted if practical.

A fire or smoke in the cabin should be controlled by identifying and shutting down the faulty system. Smoke may be removed by opening the cabin air controls. If the smoke increases in intensity when the air controls are opened, they should be closed as this indicates a possible fire in the heater or nose compartment. Normally the pressurization air system will remove smoke from the cabin; however, if the smoke is intense, it may be necessary to initiate the pressurization air contamination procedure presented in this section. When the smoke is intense, the pilot may choose to expel the smoke through the foul weather windows. The foul weather windows should be closed immediately if the fire becomes more intense when the windows are opened.

EMERGENCY DESCENT PROCEDURES

PREFERRED PROCEDURE

1. Throttles - IDLE.
2. Propellers - FULL FORWARD.
3. Mixtures - ADJUST for smooth engine operation.
4. Wing Flaps - UP.
5. Landing Gear - UP.
6. Moderate Bank - INITIATE until descent attitude has been established.
7. Airspeed - 235 KIAS.

IN TURBULENT ATMOSPHERIC CONDITIONS

1. Throttles - IDLE.
2. Propellers - FULL FORWARD.
3. Mixtures - ADJUST for smooth engine operation.
4. Wing Flaps - DOWN 45°.
5. Landing Gear - DOWN.
6. Moderate Bank - INITIATE until descent attitude has been established.
7. Airspeed - 146 KIAS.

EMERGENCY LANDING PROCEDURES

FORCED LANDING (With Power)

1. Drag over selected field with 15° wing flaps and 105 KIAS noting type of terrain and obstructions.
2. Plan a wheels-down landing if surface is smooth and hard.
   a. Execute a normal landing, keeping nosewheel off ground until speed is decreased.
3. If terrain is rough or soft, plan a wheels-up landing as follows:
   a. Approach at 105 KIAS with 15° wing flaps.
   b. Pressurization Air Controls - PULL.
   c. All Switches Except Magneto Switches - OFF.
   d. Mixtures - IDLE CUT-OFF.
   e. Magneto Switches - OFF.
   f. Fuel Selectors - OFF (Feel For Detent).
   g. Emergency Crossfeed Shutoff - OFF (Pull Up).
   h. Land in a slightly nose-high attitude.

> NOTE
>
> On smooth sod with landing gear retracted, the airplane will slide straight ahead about 800 feet with very little damage.

FORCED LANDING (Complete Power Loss)

1. Mixtures - IDLE CUT-OFF.
2. Propellers - FEATHER.
3. Fuel Selectors - OFF (Feel For Detent).
4. Emergency Crossfeed Shutoff - OFF (Pull Up).
5. All Switches Except Battery Switch - OFF.
6. Approach - 120 KIAS.
7. If field is smooth and hard, plan a landing as follows:
   a. Landing Gear - DOWN within gliding distance of field.
      (1) Landing Gear Switch - DOWN.
      (2) GEAR HYD Circuit Breaker - PULL.
      (3) Emergency Gear Extension T-Handle - PULL.
      (4) Gear Down Lights - ON; Unlocked Light - OFF.
      (5) Gear Warning Horn - CHECK.
   b. Wing Flaps - EXTEND as necessary within gliding distance of field.
   c. Approach - 105 KIAS.
   d. Battery Switch - OFF.
   e. Make a normal landing, keeping nosewheel off the ground as long as practical.
8. If field is rough or soft, plan a wheels-up landing as follows:
   a. Landing Gear - UP.
   b. Approach at 105 KIAS with 15° wing flaps.
   c. Battery Switch - OFF.

d. Land in a slightly nose-high attitude.

NOTE

On smooth sod with landing gear retracted, the airplane will slide straight ahead about 800 feet with very little damage.

LANDING WITH FLAT MAIN GEAR TIRE

If a blowout occurs during takeoff, proceed as follows:

1. Landing Gear - Leave DOWN.

NOTE

Do not attempt to retract the landing gear if a main gear tire blowout occurs. The main gear tire may be distorted enough to bind the main gear strut within the wheel well and prevent later extension.

2. Fuel Selectors - Turn to main tank on same side as defective tire and feel for detent.

NOTE

Fuel should be used from this tank first, to lighten the load on the wing, prior to attempting a landing if inflight time permits. However, an adequate supply of fuel should be left in this tank so that it may be used during landing.

3. Fuel Selectors - Left Engine - LEFT MAIN (Feel For Detent).
   Right Engine - RIGHT MAIN (Feel For Detent).
4. Select a runway with a crosswind from the side opposite the defective tire, if a crosswind landing is required.
5. Wing Flaps - DOWN 45°.
6. In approach, align airplane with edge of runway opposite the defective tire, allowing room for a mild turn in the landing roll.
7. Land slightly wing-low on the side of inflated tire and lower nosewheel to ground immediately for positive steering.
8. Use full aileron in landing roll to lighten load on defective tire.
9. Apply brakes only on the inflated tire to minimize landing roll and maintain directional control.
10. Stop airplane to avoid further damage unless active runway must be cleared for other traffic.

LANDING WITH DEFECTIVE MAIN GEAR

1. Fuel Selectors - Turn to main tank on same side as defective gear and feel for detent. Proceed to destination to reduce fuel load.

> **NOTE**
>
> Fuel should be used from this tank first, to lighten the load on the wing, prior to attempting a landing if in-flight time permits. However, an adequate supply of fuel should be left in this tank so that it may be used during landing.

2. Fuel Selectors - Left Engine - LEFT MAIN (Feel For Detent).
   Right Engine - RIGHT MAIN (Feel For Detent).
3. Emergency Crossfeed Shutoff - OFF (Pull Up).
4. Select a wide, hard surface runway, or if necessary, a wide sod runway. Select a runway with crosswind from the side opposite the defective landing gear, if a crosswind landing is necessary.
5. Landing Gear - DOWN.
6. Wing Flaps - DOWN 45°.
7. In approach, align airplane with edge of runway opposite the defective landing gear, allowing room for a ground-loop in landing roll.
8. Battery Switch - OFF.
9. Land slightly wing-low toward the operative landing gear and lower the nosewheel immediately for positive steering.
10. Start moderate ground-loop into defective landing gear until airplane stops.
11. Mixtures - IDLE CUT-OFF.
12. Use full aileron in landing roll to lighten the load on the defective landing gear.
13. Apply brakes only on the operative landing gear to maintain desired rate of turn and minimize the landing roll.
14. Fuel Selectors - OFF (Feel For Detent).
15. Evacuate the airplane as soon as it stops.

LANDING WITH FLAT NOSE GEAR TIRE

If a blowout occurred on the nose gear tire during takeoff, proceed as follows:

1. Landing Gear - Leave DOWN.

> **NOTE**
>
> Do not attempt to retract the landing gear if a nose gear tire blowout occurs. The nose gear tire may be distorted enough to bind the nosewheel strut within the wheel well and prevent later extension.

2. Move disposable load to baggage area and passengers to available rear seat space. Do not exceed aft flight center of gravity limits.
3. Approach at 105 KIAS with 15° wing flaps.
4. Land in a nose-high attitude with or without power.

5. Maintain back pressure on control wheel to hold nosewheel off the ground in landing roll.
6. Use minimum braking in landing roll.
7. Throttles - RETARD in landing roll.
8. As landing roll speed diminishes, hold control wheel fully aft until airplane is stopped.
9. Avoid further damage by holding additional taxi to a minimum.

LANDING WITH DEFECTIVE NOSE GEAR

1. If Smooth and Hard Surface:
   a. Move disposable load to baggage area and passengers to available rear seat space. Do not exceed aft flight center of gravity limits.
   b. Landing Gear - DOWN.
   c. Approach at 105 KIAS with 15° wing flaps.
   d. All Switches Except Magneto Switches - OFF.
   e. Land in a slightly nose-high attitude.
   f. Mixtures - IDLE CUT-OFF.
   g. Magneto Switches - OFF.
   h. Hold nose off throughout ground roll. Lower gently as speed dissipates.
2. If Rough or Sod Surface:

> NOTE
>
> This procedure will produce a minimum amount of airplane damage on smooth runways. This procedure is also recommended for short, rough or uncertain field conditions where passenger safety, rather than minimum airplane damage is the prime consideration.

   a. Landing Gear - UP.
   b. Approach at 105 KIAS with 15° wing flaps.
   c. All Switches Except Magneto Switches - OFF.
   d. Land in a slightly nose-high attitude.
   e. Mixtures - IDLE CUT-OFF.
   f. Magneto Switches - OFF.
   g. Fuel Selectors - OFF (Feel For Detent).
   h. Emergency Crossfeed Shutoff - OFF (Pull Up).

LANDING WITHOUT FLAPS (0° Extension)

1. Mixtures - FULL RICH or lean as required for smooth operation.
2. Propellers - FULL FORWARD.
3. Fuel Selectors - MAIN TANKS (Feel For Detent).
4. Minimum Approach Speed - 107 KIAS (See Figure 5-25).
5. Landing Gear - DOWN.

DITCHING

1. Landing Gear - UP.
2. Plan approach into wind if winds are high and seas are heavy. With heavy swells and light wind, land parallel to swells, being careful not to allow wing tips to hit first.
3. Wing Flaps - DOWN 45°.
4. Carry sufficient power to maintain approximately 300 feet per minute rate-of-descent.
5. Airspeed - 105 KIAS at 5800 pounds weight. Reduce airplane weight by fuel burn-off as much as practical.
6. Maintain a continuous descent until touchdown to avoid flaring and touching down tail-first, pitching forward sharply, and decelerating rapidly. Strive for initial contact at fuselage area below rear cabin section (point of maximum longitudinal curvature of fuselage).

> NOTE
>
> The airplane has not been flight tested in actual ditchings, thus the above recommended procedure is based entirely on the best judgment of Cessna Aircraft Company.

FUEL SYSTEM EMERGENCY PROCEDURES

ENGINE-DRIVEN FUEL PUMP FAILURE

1. Fuel Selector - MAIN TANK (Feel For Detent).
2. Auxiliary Fuel Pump - ON.
3. Cowl Flap - AS REQUIRED.
4. Mixture - FULL RICH. Adjust fuel flow to coincide with power setting.
5. As Soon as Practical - LAND.
6. Crossfeed is unusable if other engine is operating.

> NOTE
>
> If both an engine-driven fuel pump and an auxiliary fuel pump fail on the same side of the airplane, the failing engine cannot be supplied with fuel from the opposite main tank since that auxiliary fuel pump will operate on the low pressure setting as long as the corresponding engine-driven fuel pump is operative.

ELECTRICAL SYSTEM EMERGENCY PROCEDURES

ALTERNATOR FAILURE (Single)

Indicated By Illumination Of Failure Light

1. Electrical Load - REDUCE.
2. If Circuit Breaker is tripped:
   a. Turn off affected alternator.
   b. Reset affected alternator circuit breaker.
   c. Turn on affected alternator switch.
   d. If circuit breaker reopens, turn off alternator.
3. If Circuit Breaker does not trip:
   a. Select affected alternator on voltammeter and monitor output.
   b. If output is normal and failure light remains on, disregard fail indication and have indicator checked after landing.
   c. If output is insufficient, turn off alternator and reduce electrical load to one alternator capacity.
   d. If complete loss of alternator output occurs, check field fuse and replace if necessary. Spare fuses are located on the left side of the console forward of the field fuses.
   e. If an intermittent light indication accompanied by voltammeter fluctuation is observed, turn off affected alternator and reduce load to one alternator capacity.
   f. Restrict load on remaining alternator to 80% of the rated load.

ALTERNATOR FAILURE (Dual)

Indicated By Illumination Of Failure Lights

1. Electrical Load - REDUCE.
2. If Circuit Breakers are tripped:
   a. Turn off alternators.
   b. Reset circuit breakers.
   c. Turn on left alternator and monitor output on voltammeter.
   d. If alternator is charging, leave it on. Disregard failure light if still illuminated.
   e. If still inoperative, turn off left alternator.
   f. Repeat steps c through e for right alternator.
   g. If circuit breakers reopen, prepare to terminate flight.
3. If Circuit Breakers have not tripped:
   a. Turn off alternators.
   b. Check field fuses and replace if necessary. Spare fuses are located on the left side of the console forward of the field fuses.
   c. Turn on left alternator and monitor output on voltammeter.
   d. If alternator is charging, leave it on. Disregard failure light if still illuminated.
   e. If still inoperative, turn off left alternator.
   f. Repeat steps c through e for right alternator.
   g. If both alternators are still inoperative, turn off alternators and turn on emergency power alternator field switch.
   h. Repeat steps c through e for each alternator.
   i. If still inoperative, turn off alternator, nonessential electrical items and prepare to terminate flight.

AVIONICS BUS FAILURE

1. Avionics Bus Switch - OFF.
2. Emergency Power Avionics Bus Switch - ON.

LANDING GEAR EMERGENCY PROCEDURES

HYD PRESS LIGHT ILLUMINATED AFTER GEAR CYCLE

1. Landing Gear Switch - RAPIDLY RECYCLE.
2. If HYD PRESS light still illuminated:
   a. Landing Gear - DOWN.
   b. GEAR HYD Circuit Breaker - PULL.
   c. If HYD PRESS light remains illuminated - LAND as soon as practical.

NOTE

Insure the GEAR HYD circuit breaker is reset before further extension or retraction of the landing gear is attempted.

LANDING GEAR DOWN AND LOCKED LIGHT ILLUMINATED WITH GEAR HANDLE UP AND HYD PRESS LIGHT OUT

Perform "LANDING GEAR WILL NOT EXTEND HYDRAULICALLY" Checklist.

NOTE

Failure of any one of the three down lock switches in the down position may result in that gear not locking down during a gear down cycle if the other two gears lock down first. The down and locked light for the affected gear may remain on continually regardless of actual gear position.

.ANDING GEAR WILL NOT EXTEND HYDRAULICALLY

1. Airspeed - 130 KIAS or less.

NOTE

As low an airspeed as practical is recommended as a lower airspeed will decrease the airloads on the nose gear during extension, thereby insuring the greatest probability of gear extension.

2. Landing Gear Switch - DOWN.
3. GEAR HYD Circuit Breaker - PULL.
4. Emergency Gear Extension T-Handle - PULL.
5. Gear Down Lights - ON; Unlocked Light - OFF.
6. If Main Gear Does Not Lock Down - YAW AIRPLANE. Airloads will lock main gear down if up locks have released.

7. Gear Warning Horn - CHECK.
8. As Soon As Practical - LAND.

CAUTION

The landing gear cannot be retracted inflight, once the emergency gear extension T-handle has been pulled. Ground servicing is required.

LANDING GEAR WILL NOT RETRACT HYDRAULICALLY

1. Landing Gear Switch - DOWN.
2. Gear Down Lights - ON; Unlocked Light - OFF.
3. Gear Warning Horn - CHECK.
4. As Soon as Practical - LAND.

FLIGHT INSTRUMENTS EMERGENCY PROCEDURES

VACUUM PUMP FAILURE (Attitude And Directional Gyros)

1. Failure indicated by left or right red failure button exposed on vacuum gage.
2. Automatic valve will select operative source.
3. Vacuum Pressure - CHECK proper vacuum from operative source.

OBSTRUCTION OR ICING OF STATIC SOURCE

1. Static Source - ALTERNATE. Alternate static source is for pilot's instruments only when dual static system is installed.
2. Excess Altitude and Airspeed - MAINTAIN to compensate for change in calibration.

NOTE

See Figures 5-2 and 5-4 for airspeed and altimeter corrections with static source to ALTERNATE.

ENGINE INLET AIR SYSTEM ICING EMERGENCY PROCEDURES

AIR INLET OR FILTER ICING

1. Alternate Air Control(s) - PULL OUT.
2. Propeller(s) - INCREASE (2550 RPM For Normal Cruise).
3. Mixture(s) - LEAN as required.
4. Pressurization Air Control(s) - PULL LH and/or RH as necessary.
   a. With Both Pressurization Air Sources Dumped:
      (1) Cabin Vent Control - PULL.
      (2) Cabin Pressurization Switch - DEPRESSURIZE.

b. Above 10,000 Ft. with both pressurization air sources dumped:
   (1) If Supplementary Oxygen is Not Available - EMERGENCY DESCENT TO 10,000 FEET.
   (2) If Supplementary Oxygen is Available:
      (a) Oxygen Knob - PULL ON.
      (b) Assure each occupant is using oxygen.
      (c) Descend as soon as practical to 10,000 Feet.

PRESSURIZATION SYSTEM EMERGENCY PROCEDURES

IMPENDING SKIN PANEL OR WINDOW FAILURE

1. Cabin Pressurization Switch - DEPRESSURIZE.
2. Cabin Vent Control - PULL.
3. Pressurization Air Controls - PULL.
4. If Above 10,000 Feet and Supplementary Oxygen is Not Available - EMERGENCY DESCENT TO 10,000 FEET.
5. If Above 10,000 Feet and Supplementary Oxygen is Available:
   a. Oxygen Knob - PULL ON.
   b. Assure each occupant is using oxygen.
   c. Descend as soon as practical to 10,000 Feet.

CABIN OVERPRESSURE (Over 5.3 PSI)

1. Pressurization Air Controls - PULL.
2. If Above 10,000 Feet and Supplementary Oxygen is Not Available - EMERGENCY DESCENT TO 10,000 FEET.
3. If Above 10,000 Feet and Supplementary Oxygen is Available:
   a. Oxygen Knob - PULL ON.
   b. Assure each occupant is using oxygen.
   c. Descend as soon as practical to 10,000 Feet.

LOSS OF PRESSURIZATION ABOVE 10,000 FEET

1. Without Supplementary Oxygen - EMERGENCY DESCENT TO 10,000 FEET.
2. With Supplementary Oxygen:
   a. Oxygen Knob - PULL ON.
   b. Assure each occupant is using oxygen.
   c. Descend as soon as practical to 10,000 Feet.

PRESSURIZATION AIR CONTAMINATION

1. Pressurization Air Control(s) - PULL LH and/or RH as necessary.
   a. With Both Air Sources Dumped:
      (1) Cabin Vent Control - PULL.
      (2) Cabin Pressurization Switch - DEPRESSURIZE.
2. Above 10,000 Feet with Both Air Sources Dumped:
   a. If Supplementary Oxygen is Not Available - EMERGENCY DESCENT TO 10,000 FEET.
   b. If Supplementary Oxygen is Available:
      (1) Oxygen Knob - PULL ON.
      (2) Assure each occupant is using oxygen.
      (3) Descend as soon as practical to 10,000 Feet.

PROPELLER SYNCHROPHASER

ENGINE INOPERATIVE PROCEDURES

1. Propeller Synchrophaser - OFF (Optional System).

SYNCHROPHASER FAILURE

1. Propeller Synchrophaser - OFF (Optional System).
2. Propeller Synchrophaser Circuit Breaker - PULL (Optional System).

EMERGENCY EXIT WINDOW REMOVAL

The forward oval cabin window on the right side of the passenger compartment should be removed as follows:

1. Emergency Release Handle Plastic Cover - PULL OFF.
2. Release Handle - TURN COUNTERCLOCKWISE.
3. Emergency Exit Window - PULL IN and DOWN.

SPINS

Intentional spins are not permitted in this airplane. Should a spin occur, however, the following recovery procedures should be employed:

1. Throttles - CLOSE IMMEDIATELY.
2. Ailerons - NEUTRALIZE.
3. Rudder - HOLD FULL RUDDER opposite the direction of rotation.
4. Control Wheel - FORWARD BRISKLY, 1/2 turn after applying full rudder.
5. Inboard Engine - INCREASE POWER to slow rotation. (If Necessary).

After rotation has stopped:

6. Rudder - NEUTRALIZE.
7. Inboard Engine (If used) - DECREASE POWER to equalize engines.
8. Control Wheel - PULL to recover from resultant dive. Apply smooth steady control pressure.

NOTE

The airplane has not been flight tested in spins, thus the above recommended procedure is based entirely on the best judgment of Cessna Aircraft Company.

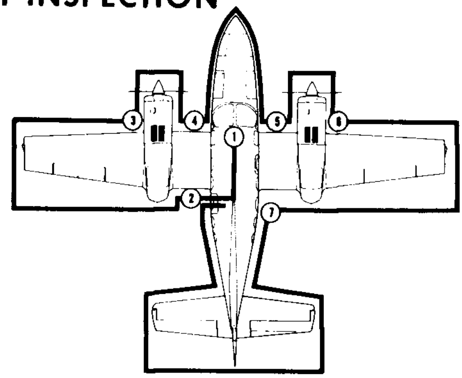
SECTION 4
NORMAL PROCEDURES
TABLE OF CONTENTS

INTRODUCTION

Section 4 of this handbook describes the recommended procedures for normal operations. The first part of this section provides normal procedural action required in an abbreviated checklist form. Amplification of the abbreviated checklist is presented in the second part of this section.

> **NOTE**
>
> Refer to Section 9 of this handbook for amended operating limitations, operating procedures, performance data and other necessary information for airplanes equipped with specific options.

PREFLIGHT INSPECTION



NOTE

- Visually check inspection plates and general airplane condition during walk-around inspection. If night flight is planned, check operation of all lights and make sure a flashlight is available.
- Refer to Section 8 for quantities, materials and specifications of frequently used service items.

(1)
a. Control Lock(s) - REMOVE and stow.
b. Parking Brake - SET.
c. Static Source Selector - NORMAL.
d. All Switches - OFF.
e. All Circuit Breakers - IN.
f. Voltammeter Selector - BATT.
g. Oxygen - ON; Quantity, Masks and Hoses - CHECK; Oxygen - OFF.
h. Landing Gear Switch - DOWN.
i. Trim Tab Controls (3) - SET for takeoff.
j. Left Fuel Selector - LEFT MAIN (Feel For Detent).
k. Right Fuel Selector - RIGHT MAIN (Feel For Detent).
l. Emergency Crossfeed Shutoff - OPEN (Push Down).
m. Battery Switch - ON.
n. Fuel Gages - CHECK quantity and operation.
o.*Fuel Totalizer - SET.
p. Wing Flaps - DOWN 45°.
q. Anti-Collision Lights - CHECK operation.
r.*Electric Windshield - CHECK operation by observing discharge on voltammeter if inflight use is anticipated. Ensure system is turned off after operational check.
s. Pitot, Stall and Vent Heat Switch(es) - ON 20 seconds then OFF. Ensure pitot tube cover(s) are removed before actuating pitot heat switch(es).
t. Navigation Lights - ON.
u. Windshields and Windows - CHECK for cracks and general condition.
v.*Cabin Fire Extinguisher - CHECK SECURITY.

(2)
a. Battery Compartment Cover - SECURE.
b. Wing Locker Baggage Door - SECURE.
c. Wing Flap - CHECK security and attachment.
d. Control Surface Lock - REMOVE, if installed.
e. Aileron and Tab - CHECK condition, freedom of movement and tab position.
f. Navigation Light - CHECK operation.
g. Landing Light Filament - CHECK condition.
h. Stall Warning Vane - CHECK freedom of movement, audible warning and warm.
i. Main Tank Fuel Vent - CLEAR.
j. Bottom Outboard Wing - CHECK for fuel leaks or stains.
k. Main Tank Fuel Quantity - CHECK; Cap - SECURE.
l.*Outboard Deice Boot - CHECK condition and security.
m. Main Tank Fuel Sumps - DRAIN (2 Drains).
n. Fuel Strainer - DRAIN.

(3)
a. Engine Compartment General Condition - CHECK for fuel, oil, hydraulic fluid and exhaust leaks or stains.
b. Intake Air and Intercooler Opening - CLEAR.
c. Oil Level - CHECK minimum 9 quarts.
d. Propeller and Spinner - EXAMINE for nicks, security and oil leaks.
e. Engine Openings - CLEAR.
f.*Inboard Deice Boot - CHECK condition and security.
g. Main Gear, Strut, Door, Tire and Wheel Well - CHECK.
h. Wing Tie Down - REMOVE.
i. Crossfeed Line - DRAIN.
j. Lower Fuselage, Nose and Center Section - CHECK for fuel and oil leaks or stains and antenna security.
k. Heat Exchanger Opening - CLEAR.
l.*Engine Fire Extinguisher Bottle Pressure - CHECK temp/charge pressure schedule.

Figure 4-1 (Sheet 1 of 2)

PREFLIGHT INSPECTION

(4)
a. Hydraulic Fluid Reservoir Level - CHECK.
b. Emergency Landing Gear Blow Down Bottle Pressure - CHECK in the green arc. Check that red ring is not showing on the control rod. If red ring is visible, refer to the Airplane Service Manual before flight.
c. Nose Baggage Door - SECURE.
d. Avionics Bay Door - SECURE.
e. Nose Gear, Strut, Stop Block, Door, Tire and Wheel Well - CHECK.
f. Tie Down - REMOVE.
g. Pitot Cover - REMOVE; Pitot Tube - CLEAR and WARM.
h. Ram Air Inlet - CLEAR.
i.*Pitot Cover - REMOVE; Pitot Tube - CLEAR and WARM.
j.*Oxygen Overboard Discharge Indicator - CHECK green disc installed.
k. Heater Inlet and Outlet - CLEAR.
l. Baggage Door - SECURE.

(5)
a. Heat Exchanger Opening - CLEAR.
b.*Inboard Deice Boot - CHECK condition and security.
c. Lower Fuselage, Nose and Center Section - CHECK for fuel and oil leaks or stains and antenna security.
d. Main Gear, Strut, Door, Tire and Wheel Well - CHECK.
e. Wing Tie Down - REMOVE.
f. Crossfeed Line - DRAIN.
g.*Engine Fire Extinguisher Bottle Pressure - CHECK temp/charge pressure schedule.
h.*Air Conditioning Outlet Air Opening - CLEAR.
i. Intake Air and Intercooler Opening - CLEAR.
j. Oil Level - CHECK minimum 9 quarts.
k. Propeller and Spinner - EXAMINE for nicks, security and oil leaks.
l. Engine Openings - CLEAR.

(6)
a.*Air Conditioning Fluid Level - CHECK.
b.*Air Conditioning Inlet Air Opening - CHECK DOOR CLOSED.
c. Engine Compartment General Condition - CHECK for fuel, oil, hydraulic fluid and exhaust leaks or stains.
d. Fuel Strainer - DRAIN.
e. Main Tank Fuel Sumps - DRAIN (2 Drains).
f.*Outboard Deice Boot - CHECK condition and security.
g. Main Tank Fuel Quantity - CHECK; Cap - SECURE.
h. Fuel Vent - CLEAR.
i. Bottom Outboard Wing - CHECK for fuel leaks or stains.
j.*Landing Light Filament - CHECK condition.
k. Navigation Light - CHECK operation.
l. Control Surface Lock - REMOVE, if installed.
m. Aileron and Servo Tab - CHECK condition, freedom of movement and tab position. Move aileron up; tab should move down.
n. Wing Flap - CHECK security and attachment.
o. Wing Locker Baggage Door - SECURE.
p.*Alcohol Deice Tank - CHECK quantity.

(7)
a. Static Port(s) - CLEAR. Do not blow into static ports.
b. Tailcone Drain Holes - CHECK clear of obstructions.
c.*Deice Boots - CHECK condition and security.
d. Control Surface Lock(s) - REMOVE, if installed.
e. Elevator and Tab - CHECK condition, freedom of movement and tab position.
f. Rudder and Tab - CHECK condition, freedom of movement and tab position. Move rudder right; tab should move left.
g. Tie Down - REMOVE.
h.*Deice Boots - CHECK condition and security.
i.*Rudder Lock - RELEASED.
j. Static Port(s) - CLEAR. Do not blow into static ports.
k. Cabin Door and Seal - CHECK security and condition.
l. Wing Flaps - UP. Visually check retraction.
m. Battery Switch - OFF.
n. Navigation Lights - OFF.

*Denotes items to be checked if the applicable optional equipment is installed on your airplane.

Figure 4-1 (Sheet 2 of 2)

NORMAL PROCEDURES
ABBREVIATED CHECKLIST

NOTE

This Abbreviated Normal Procedures Checklist is included as a supplement to the Amplified Normal Procedures Checklist. Use of the Abbreviated Normal Procedures Checklist should not be used until the flight crew has become familiar with the airplane and systems. All amplified normal procedure items must be accomplished regardless of which checklist is used.

AIRSPEEDS FOR SAFE OPERATION

Conditions:
1. Takeoff Weight 6750 Pounds
2. Landing Weight 6750 Pounds
3. Sea Level, Standard Day

(1) Air Minimum Control Speed	79 KIAS
(2) Takeoff and Climb to 50 Feet (0° Wing Flaps)	98 KIAS
(3) All Engines Best Angle-of-Climb Speed (0° Wing Flaps)	88 KIAS
(4) All Engines Best Rate-of-Climb Speed (0° Wing Flaps)	108 KIAS
(5) All Engines Landing Approach Speed (45° Wing Flaps)	94 KIAS
(6) Maneuvering Speed	145 KIAS
(7) Structural Cruise Speed	203 KIAS
(8) Never Exceed Speed	237 KIAS
(9) Speed for Transition to Balked Landing Conditions	82 KIAS
(10) Maximum Demonstrated Crosswind Velocity	19 KNOTS

Figure 4-2

BEFORE STARTING ENGINES

1. Preflight - COMPLETE.
2. Cabin Door - LATCHED and SECURE.
3. Control Locks - REMOVE.
4. Seat, Seat Belts and Shoulder Harness - ADJUST and SECURE.
5. Fuel Selectors - MAIN TANKS.
6. Landing Gear Switch - DOWN.
7. Mixtures, Propellers and Throttles - SET.
8. All Switches and Circuit Breakers - SET.
9. Battery and Alternators - ON.
10. Landing Gear Position Indicator Lights - Check green lights ON.
11. Annunciator Panel - PRESS-TO-TEST.
12. Lights - AS REQUIRED.

STARTING ENGINES

1. Propellers - CLEAR.
2. Magneto Switches - ON.
3. Engines - START.
4. Auxiliary Fuel Pumps - LOW.
5. Engine Instruments - CHECK.

BEFORE TAXIING

1. Avionics - ON and SET.

TAXIING

1. Brakes - CHECK.
2. Flight Instruments - CHECK.

BEFORE TAKEOFF

1. Engine Runup - COMPLETE.
   a. Throttles - 1700 RPM.
   b. L and R HYD FLOW Lights - OFF.
   c. Alternators - CHECK.
   d. Vacuum System - CHECK.
   e. Magnetos - CHECK.
   f. Propellers - CHECK.
   g. Engine Instruments - CHECK.
   h. Throttles - 1000 RPM.
2. Fuel Quantity - CHECK.
3. Fuel Selectors - MAIN TANKS.
4. Emergency Crossfeed Shutoff - CHECK OPEN (Push Down).
5. Cowl Flaps - OPEN.
6. Trim Tabs - SET.
7. Wing Flaps - UP.
8. Propeller Synchrophaser - OFF (Optional System).
9. Flight Instruments and Avionics - SET.
10. Lights - AS REQUIRED.
11. All Cabin Doors and Windows - CLOSED.
12. Pressurization - SET.
13. Annunciator Panel - CLEAR.
14. Auxiliary Fuel Pumps - ON.
15. Flight Controls - CHECK.
16. Ice Protection - AS REQUIRED.
17. Seat Belts and Shoulder Harness - SECURE.

TAKEOFF

1. Power - SET FOR TAKEOFF.
2. Mixtures - CHECK fuel flows in the white arc.
3. Engine Instruments - CHECK.
4. Air Minimum Control Speed - 79 KIAS.
5. Takeoff and Climb to 50 Feet - 98 KIAS at 6750 pounds. Refer to Section 5 for speeds at reduced weights.

AFTER TAKEOFF

1. Landing Gear - RETRACT.
2. Best Angle-of-Climb Speed - 88 KIAS at sea level to 92 KIAS at 20,000 feet with obstacle.
3. Best Rate-of-Climb Speed - 108 KIAS at sea level and 6750 pounds. Refer to Section 5 for speed at reduced weight.

CLIMB

1. Power - SET.
2. Mixtures - ADJUST.
3. Cowl Flaps - AS REQUIRED.
4. Pressurization - SET.

CRUISE

1. Cruise Power - SET.
2. Mixtures - LEAN.
3. Cowl Flaps - AS REQUIRED.
4. Propellers - SYNCHRONIZE manually.
5. Propeller Synchrophaser - ON.
6. Auxiliary Fuel Pumps - OFF or LOW if required.
7. Fuel Selectors - MAIN TANKS.
8. Cabin Altitude and Delta Pressure - CHECK.

DESCENT

1. Fuel Selectors - MAIN TANKS.
2. Auxiliary Fuel Pumps - ON.
3. Pressurization - SET.
4. Power - AS REQUIRED.
5. Cowl Flaps - CLOSE.
6. Mixtures - ADJUST.
7. Altimeter - SET.

BEFORE LANDING

1. Seat Belts and Shoulder Harness - SECURE.
2. Propeller Synchrophaser - OFF (Optional System).
3. Wing Flaps - AS REQUIRED.
4. Landing Gear - DOWN.
5. Mixtures - ADJUST.
6. Propellers - FULL FORWARD.
7. Approach Speed - 94 KIAS at 6750 pounds. Refer to Section 5 for speeds at reduced weights.

AFTER LANDING

1. Auxiliary Fuel Pumps - LOW.
2. Cowl Flaps - OPEN.
3. Wing Flaps - UP.

SHUTDOWN

1. Parking Brake - SET if brakes are cool.
2. Accessory Switches - OFF.
3. Auxiliary Fuel Pumps - OFF.
4. Engines - SHUT DOWN.
5. Battery, Alternator And Magneto Switches - OFF.

AMPLIFIED NORMAL PROCEDURES

PREFLIGHT INSPECTION

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

After major maintenance has been performed, the flight and trim tab controls should be double-checked for free and correct movement and security. The security of all inspection plates on the airplane should be checked following periodic inspections. Since avionics and heater maintenance requires the mechanic to work in the nose compartments, the nose compartment doors are opened for access to equipment. Therefore, it is important after such maintenance to double-check the security of these doors. If the airplane has been waxed or polished, check the external static pressure source holes for stoppage.

If the airplane has been exposed to much ground handling in a crowded hangar, it should be checked for dents and scratches on wings, main tanks, fuselage and tail surfaces, as well as damage to navigation, anti-collision and landing lights, deice boots and avionics antennas. Outside storage for long periods may result in water and obstructions in airspeed system lines, condensation in fuel tanks, and dust and dirt on the intake air filters and engine cooling fins. Outside storage in windy or gusty areas, or adjacent to taxiing airplanes, calls for special attention to control surface stops, hinges and brackets to detect presence of wind damage.

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

Airplanes that are operated from rough fields, especially at high altitudes, are subjected to abnormal landing gear abuse. Check frequently all components of the landing gear retracting mechanisms, shock struts, tires and brakes. Undue landing and taxi loads will be subjected on the airplane structure when the shock struts are insufficiently extended. A completely collapsed (zero extension) shock strut could cause a malfunction in the landing gear retraction system.

To prevent loss of fuel in flight, make sure the fuel tank filler caps are tightly sealed. The fuel tank vents on the lower surface of the tanks should also be inspected for obstructions, ice or water, especially after operation in cold, wet weather.

The interior inspection will vary according to the planned flight and the optional equipment installed. Prior to high-altitude flights, it is important to check the condition and quantity of oxygen face masks and hose assemblies. The oxygen supply system should be functionally checked to insure that it is in working order. The oxygen pressure gage should indicate 300 to 1800 PSI (11.0 cubic foot system) or 300 to 1850 PSI (114.9 cubic foot system) depending upon the anticipated requirements.

While operating in the pressurized mode, an immediate depressurization would cause extreme passenger discomfort. For this reason, it is important to inspect the cabin door seal for condition. Also, the emergency exit, windows and windshields must be free of cracks and deep scratches.

Satisfactory operation of the pitot tube(s) and stall warning transmitter heating elements is determined by observing a discharge on the voltammeter when the pitot and stall heat switches are turned ON. The effectiveness of these heating elements may be verified by cautiously feeling the heat of these devices while the switches are ON.

If the emergency landing gear extension T-handle was noticed to be partly extended during the cockpit preflight inspection, the emergency landing gear extension blowdown valve assembly should be reset at the blowdown bottle in the left nose compartment. Check the valve assembly position. If the red band is visible, the blowdown bottle must be serviced in accordance with the airplane Service Manual before flight. If the red band is not showing, push the cable towards the valve assembly, then check the bottle pressure gage for normal pressure.

Flights at night and in cold weather involve a careful check of other specific areas which will be discussed later in this section.

BEFORE STARTING ENGINES

1. Preflight Inspection - COMPLETE (See Figure 4-1).
2. Cabin Door - LATCHED and SECURE.
3. Control Locks - REMOVE.
4. Seat, Seat Belts and Shoulder Harness - ADJUST and SECURE.
5. Brakes - SET.
6. Fuel Selectors - Left Engine - LEFT MAIN (Feel For Detent).
   Right Engine - RIGHT MAIN (Feel For Detent).
7. Landing Gear Switch - DOWN.
8. Mixtures - FULL RICH.
9. Propellers - FULL FORWARD.
10. Throttles - OPEN ONE INCH.
11. All Switches - OFF.
12. Circuit Breakers - IN.
13. Emergency Power Alternator Field Switch - OFF.
14. Emergency Power Avionics Bus Switch - OFF.
15. Avionics Bus Switch - OFF.
16. Auxiliary Fuel Pump Switches - OFF.
17. Battery and Alternators - ON.
18. Master Light Dimming Switch - AS REQUIRED.
19. Landing Gear Position Indicator Lights - Check green lights ON.
20. Annunciator Light Panel - PRESS-TO-TEST.
21. Altimeter and Clock - SET.
22. Fuel Quantity - CHECK.
23. Cabin Air Controls - AS REQUIRED.
24. Alternate Air Controls - IN.
25. External Lights - AS REQUIRED.

NOTE

Ground operation of the high intensity anti-collision lights can be of considerable annoyance to ground personnel and other pilots.

STARTING (Left Engine First Without External Power)

1. Propeller - CLEAR.
2. Magneto Switches - ON.
3. Engine - START.
   a. Starter Button - PRESS.
   b. Primer Switch - Left Engine - LEFT.
      Right Engine - RIGHT.

CAUTION

- If the primer is activated for excessive periods of time with the engine inoperative on the ground or during flight, damage may be incurred to the engine and/or airplane due to fuel accumulation in the induction system. Similar conditions may develop when the engine is shutdown with the auxiliary fuel pump ON.
- Should fuel priming or auxiliary fuel pump operation periods in excess of 60 seconds occur, the engine manifold must be purged by one of the following procedures:
  a. With auxiliary fuel pump OFF, allow manifold to drain at least 5 minutes or until fuel ceases to flow out of the drain under the nacelle.
  b. If circumstances do not allow natural draining periods recommended above, with the auxiliary fuel pump OFF, magnetos OFF, mixture IDLE CUT-OFF and throttle FULL OPEN, turn engine with starter or by hand a minimum of 15 revolutions.

4. Auxiliary Fuel Pump - LOW to purge vapor from fuel system.
5. Throttle - 800 to 1000 RPM.
6. Oil Pressure - 10 PSI minimum in 30 seconds in normal weather, or 60 seconds in cold weather. If no indication appears, shutdown engine and investigate.
7. Right Engine - START. Repeat steps 1 through 6.
8. Alternators - CHECK.

STARTING ENGINES (Left Engine First With External Power)

1. Battery Switch - ON.
2. Alternator Switches - OFF.
3. External Power Source - ATTACH.

NOTE

For complete external power source operation refer to Section 7.

4. Propeller - CLEAR.
5. Magneto Switches - ON.
6. Engine - START.
   a. Starter Button - PRESS.
   b. Primer Switch - Left Engine - LEFT.
      Right Engine - RIGHT.

CAUTION

- If the primer is activated for excessive periods of time with the engine inoperative on the ground or during flight, damage may be incurred to the engine and/or airplane due to fuel accumulation in the induction system. Similar conditions may develop when the engine is shutdown with the auxiliary fuel pump ON.
- Should fuel priming or auxiliary fuel pump operation periods in excess of 60 seconds occur, the engine manifold must be purged by one of the following procedures:
  a. With auxiliary fuel pump OFF, allow manifold to drain at least 5 minutes or until fuel ceases to flow out of the drain under the nacelle.
  b. If circumstances do not allow natural draining periods recommended above, with the auxiliary fuel pump OFF, magnetos OFF, mixture IDLE CUT-OFF and throttle FULL OPEN, turn engine with starter or by hand a minimum of 15 revolutions.

7. Auxiliary Fuel Pump - LOW to purge vapor from fuel system.
8. Throttle - 800 to 1000 RPM.
9. Oil Pressure - 10 PSI minimum in 30 seconds in normal weather, or 60 seconds in cold weather. If no indication appears, shutdown engine and investigate.
10. Right Engine - START. Repeat steps 4 through 9.
11. External Power Source - REMOVE.
12. Alternator Switches - ON.
13. Alternators - CHECK.

The left engine is normally started first because the cable from the battery to this engine is much shorter permitting more electrical power to be delivered to the starter. If battery is low, the left engine should start more readily.

When using an external power source, it is recommended that the airplane be started with the alternator switches OFF.

NOTE

Release starter button as soon as engine fires or engine will not accelerate and flooding can result.

The continuous flow fuel injection system will start spraying fuel in the engine intake ports as soon as the primer switch is actuated and the throttle and mixture controls are opened. If the auxiliary pump is turned on accidentally while the engine is stopped with the throttle open and the mixture rich, liquid fuel will collect temporarily in the cylinder intake ports. The quantity of fuel deposited will depend upon the amount of throttle opening and the length of time the pump has been operating. If this happens, it is advisable to wait a few minutes until the fuel drains away, then turn the propeller through 15 complete revolutions. This is done to prevent the possibility of engine damage due to hydrostatic lock before starting the engine. To avoid flooding, begin cranking the engine prior to priming the engine.

Engine mis-starts, characterized by weak intermittent explosions followed by black puffs of smoke from the exhaust, are the result of flooding or overpriming. This situation is more apt to develop in hot weather, or when the engines are hot. If it occurs, repeat the starting procedure with the throttle approximately 1/2 open, the mixture in IDLE CUT-OFF and the primer switch OFF. As the engine fires, move the mixture control to FULL RICH and close the throttle to idle.

If an engine is underprimed, as may occur in cold weather with a cold engine, repeat the starting procedure while holding the primer switch ON for 5 to 10 seconds until the engine fires.

If cranking longer than 30 seconds is required, allow starter-motor to cool five minutes before cranking again since excessive heat may damage the armature windings.

After the engines are started, the auxiliary fuel pumps should be switched to LOW to provide for improved purging and vapor clearing in the fuel system.

BEFORE TAXIING

1. Avionics Bus Switch - ON.
2. Avionics - SET.
3. Lights - AS REQUIRED.
4. Cabin Temperature - AS REQUIRED.
   a. If heating and defrosting is required:
      (1) Cabin Vent Control - PUSH IN.
      (2) Pressurization Air Temperature Controls - FULL CLOCKWISE.
      (3) Forward and Aft Cabin Air Knobs - PULL OUT.
      (4) Defrost Knob - AS REQUIRED.
      (5) Cabin Heat Knob - AS REQUIRED.
      (6) Cabin Heat Switch - ON.
      (7) Heat Registers - AS REQUIRED.
   b. If ventilation is required:
      (1) Cabin Vent Control - PULL OUT.
      (2) Pressurization Air Temperature Controls - FULL COUNTERCLOCKWISE.
      (3) Forward and Aft Cabin Air Knobs - PULL OUT.
      (4) Cabin Fan Switch - NORMAL or HIGH.
      (5) Heat Registers - AS REQUIRED.
5. Brakes - RELEASE. Pushing in the parking brake knob releases the trapped brake fluid, allowing the brakes to be released.

TAXIING

1. Throttles - AS REQUIRED.
2. Brakes - CHECK.
3. Flight Instruments - CHECK.

A steerable nosewheel, interconnected with the rudder system, provides positive control up to 18° left or right, and free turning from 18° to 52° for sharp turns during taxiing. Normal steering may be aided through use of differential power and differential braking on the main wheels. These aids are listed in the preferred order of use. Do not use excessive brake on the inboard side to effect a turning radius as decreased tire life will result.

NOTE

If the airplane is parked with the nosewheel castered in either direction, initial taxiing should be done with caution. To straighten the nosewheel, use full opposite rudder and differential power instead of differential braking. After a few feet of forward travel, the nosewheel will steer normally.

When taxiing near buildings or other stationary objects, observe the minimum turning distance limits as stated in Figure 7-11. No abnormal precautions are required when taxiing in conditions of high winds.

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

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

Do not operate engines at high RPM when taxiing over gravel or loose material that may cause damage to the propeller blades.

BEFORE TAKEOFF

1. Brakes - SET.
2. Engine Runup:
   a. Throttles - 1700 RPM.
   b. L and R HYD FLOW Lights - OFF.
   c. Alternators - CHECK.
   d. Vacuum System - CHECK 4.75 to 5.25 inches Hg.
   e. Magnetos - CHECK 150 RPM maximum drop with a maximum differential of 50 RPM.

f. Propellers - CHECK feathering to 1200 RPM; return to high RPM (Full Forward Position).

CAUTION

During propeller feathering checks, do not allow the propeller RPM to fall below 1000 RPM as this may damage the hub mechanism.

g. Engine Instruments - CHECK green arc.
h. Throttles - 1000 RPM.

NOTE

It is important that the engine oil temperature be within the normal operating range prior to applying takeoff power. Even cautious power applications with cool oil may result in momentarily exceeding the 38.0 inches Hg. manifold pressure limit. Refer to Section 7 if momentary overboost of manifold pressure occurs.

3. Fuel Quantity - CHECK.
4. Fuel Selectors - RECHECK - Left Engine - LEFT MAIN (Feel For Detent).
   Right Engine - RIGHT MAIN (Feel For Detent).
5. Emergency Crossfeed Shutoff - RECHECK OPEN (Push Down).
6. Alternate Air Controls - IN.
7. Cowl Flaps - OPEN.
8. Trim Tabs - SET elevator, aileron and rudder tabs in the TAKEOFF range.
9. Wing Flaps - UP.
10. Propeller Synchrophaser - OFF (Optional System).
11. Flight Instruments and Avionics - SET.
12. Lights - AS REQUIRED.
13. All Cabin Doors and Windows - CLOSED.
14. Alternate Air Controls - IN.
15. Pressurization Air Controls - PUSH IN and LOCK.
16. Cabin Pressurization Switch - PRESSURIZE.
17. Cabin Rate - ARROW UP (Optional System).
18. Cabin Altitude - SET 500 feet above field pressure altitude (Optional System).
19. Cabin Vent Control - PUSH IN.
20. Annunciator Panel - CLEAR.
21. Auxiliary Fuel Pumps - ON.
22. Flight Controls - CHECK, free and correct.
23. Ice Protection Equipment - AS REQUIRED.
24. Seat Belts and Shoulder Harness - SECURE.
25. Brakes - RELEASE. Push in parking brake control.

Full throttle checks on the ground are not recommended unless there is good reason to suspect that the engines are not operating properly. Do not runup the engines over loose gravel or cinders because of possible stone damage or abrasion to the propeller tips.

If the ignition system produces an engine speed drop in excess of 150 RPM, or if the drop in RPM between the left and right magneto differs by more than 50 RPM, continue warm-up a minute or two longer before rechecking the system. If there is doubt concerning operation of the ignition system, checks at higher engine speed will usually confirm if a deficiency exists. In general, a drop in excess of 150 RPM is not considered acceptable.

A careful check should be made of the vacuum system. The minimum and maximum allowable suctions are 4.75 and 5.25 inches Hg., respectively, on the instrument. Good alternator condition is also important for instrument flight since satisfactory operation of all avionics equipment and electrical instruments is essential. The alternators are checked during engine runup (1700 RPM) by positioning the selector switch in the L ALT and R ALT position and observing the charging rate on the voltammeter.

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

NOTE

Make sure that weight does not exceed 6750 pounds before attempting takeoff.

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

TAKEOFF

1. Power - 2700 RPM and FULL THROTTLE.

NOTE

Apply full throttle smoothly to avoid propeller surging and excessive manifold pressures. Refer to Section 7 if momentary overboost of manifold pressure occurs.

2. Mixtures - CHECK fuel flows in the white arc.
3. Engine Instruments - CHECK.
4. Air Minimum Control Speed - 79 KIAS.
5. Elevator Control - Raise nosewheel at 93 KIAS.
6. Lift-Off - 98 KIAS.

Before initiating the takeoff roll, a go, no-go decision should have been made in the event an engine failure should occur. Review the anticipated performance presented in the Accelerate-Stop Distance, Accelerate-Go Distance and Engine Inoperative Rate-of-Climb charts in Section 5. In addition, review the applicable procedures and speeds associated with single-engine operation so that the transition (in the event of an engine failure) will be smooth, positive and safe. If the anticipated performance exceeds the runway length available or obstacle clearance requirements cannot be achieved, it is recommended to takeoff on a more favorable runway, off-load the airplane until the anticipated performance is consistent with existing conditions or delay the takeoff until more favorable atmospheric conditions exist.

Since the use of full throttle is not recommended in the static runup, closely observe full-power engine operation early in the takeoff run. The maximum allowable manifold pressure of 38.0 inches Hg. manifold pressure should not be exceeded. Throttle action should be smooth and slow in order that the waste gate can become operative as early as possible. Signs of rough engine operation, unequal power between engines, or sluggish engine acceleration are good cause for discontinuing the takeoff. If this occurs, make a thorough full throttle static runup before another takeoff is attempted.

Full throttle operation is recommended on takeoff since it is important that a speed well above air minimum control speed (79 KIAS) be obtained as rapidly as possible. It is desirable to accelerate the airplane to 98 KIAS (intentional one engine inoperative speed) before lift-off for additional safety in case of an engine failure. This safety may have to be compromised slightly where short and rough fields prohibit such high speed before takeoff.

For crosswind takeoffs, additional power may be carried on the upwind engine until the rudder becomes effective. The airplane is accelerated to a slightly higher than normal takeoff speed, and then is pulled off abruptly to prevent possible settling back to the runway while drifting. When clear of the ground, a coordinated turn is made into the wind to correct for drift.

A takeoff with one main tank full and the opposite tank low on fuel creates a lateral unbalance. This is not recommended since gusty air or premature lift-off could create a serious control problem.

After takeoff, it is important to maintain the intentional one engine inoperative climb speed (98 KIAS) to 50 feet. As the airplane accelerates still further to all engines best rate-of-climb speed (108 KIAS), it is good practice to climb rapidly to an altitude at which the airplane is capable of circling the field on one engine.

AFTER TAKEOFF

1. Brakes - APPLY momentarily.
2. Landing Gear - RETRACT. Check gear unlocked and HYD PRESS lights off.
3. Best Angle-of-Climb Speed (Sea Level) - 88 KIAS after reaching 50 feet if immediate obstacle clearance is a consideration.
4. Best Rate-of-Climb Speed - 108 KIAS at sea level and 6750 pounds. Refer to Section 5 for climb speed at altitude and reduced weight.
5. Auxiliary Fuel Pumps - CHECK ON.

To establish climb configuration, retract the landing gear, set climb power, check auxiliary fuel pumps on and adjust the mixtures for the selected power setting.

Before retracting the landing gear, apply the brakes momentarily to stop the rotation of the main wheels. Centrifugal force caused by the rapidly rotating wheels expands the diameter of the tires, and if ice or mud has accumulated in the wheel wells, the rotating wheels may rub as they enter.

On long runways, the landing gear should be retracted at the point over the runway where a wheels-down forced landing on that runway would become impractical. However, on short runways it may be preferable to retract the landing gear after the airplane is safely airborne.

Power reduction will vary according to the requirements of the traffic pattern or surrounding terrain, weight, field elevation, temperature, environmental considerations and engine condition. However, a normal after takeoff power setting is 2450 RPM and 31.5 inches Hg. manifold pressure.

CLIMB

CRUISE CLIMB

1. Power - 2450 RPM and 31.5 inches Hg.
2. Airspeed - 115 to 140 KIAS.
3. Mixtures - ADJUST to climb fuel flow.
4. Cowl Flaps - AS REQUIRED.
5. Cabin Altitude Control - SET SLOWLY after cabin pressure has stabilized. Reset cabin altitude control to destination field pressure altitude plus 500 feet (outer scale) or cruise altitude plus 500 feet (inner scale) whichever gives the highest cabin altitude (Optional System).
6. Cabin Rate Control - SET to reach selected cabin altitude at approximately the same time the airplane reaches cruise altitude (Optional System).
7. Propellers - SYNCHRONIZE manually.
8. Quadrant Friction Lock - TIGHTEN securely (With Synchrophaser Installed).
9. Propeller Synchrophaser - PHASE (Optional System). Light should illuminate continuously.
   a. Phasing Knob - ADJUST for desired position.

MAXIMUM CLIMB

1. Power - 2600 RPM and FULL THROTTLE below 20,000 feet. Placarded manifold pressure above 20,000 feet.
2. Airspeed - 108 KIAS.
3. Mixtures - FULL RICH below 20,000 feet (White Triangle). LEAN as required above 20,000 feet (Blue Arc).
4. Cowl Flaps - AS REQUIRED.
5. Cabin Altitude Control - SET SLOWLY after cabin pressure has stabilized. Reset cabin altitude control to destination field pressure altitude plus 500 feet (outer scale), or cruise altitude plus 500 feet (inner scale) whichever gives the highest cabin altitude (Optional System).
6. Cabin Rate Control - SET to reach selected cabin altitude at approximately the same time the airplane reaches cruise altitude (Optional System).

Power settings for climb must be limited to 2600 RPM and 38.0 inches Hg. manifold pressure below 20,000 feet and placarded manifold pressures above 20,000 feet.

Normal cruising climb is recommended where practical and should be conducted at 115 to 140 KIAS, using approximately 77.5% power (2450 RPM and 31.5 inches Hg. manifold pressure). The mixture should be leaned in this type of climb to give the desired fuel flow in the climb dial range (blue triangle) which is approximately best power mixture.

If it is necessary to climb rapidly to clear mountains or reach favorable winds at high altitudes, the all engines best rate-of-climb speed of 108 KIAS should be used with maximum normal operating power. During maximum performance climbs, the mixture should remain at the white triangle up to the engine critical altitude and at the appropriate climb power range above critical altitude. It is recommended that the auxiliary fuel pumps be ON, and the mixture remain at the climb mixture setting for approximately 5 minutes after establishing cruising flight before leaning is initiated. This procedure will eliminate fuel vaporization problems likely to occur from rapid altitude changes.

If an obstruction ahead requires a steep climb angle, the airplane should be flown at the all engines best angle-of-climb speed with wing flaps up and maximum normal operating power. This speed varies from 88 KIAS at sea level to 92 KIAS at 20,000 feet.

If the optional pressurization system is installed, adjust the cabin altitude and cabin rate controls as follows. After the cabin pressure has stabilized, slowly reset the cabin altitude control to the destination field pressure altitude plus 500 feet on the outer scale or cruise altitude plus 500 feet on the inner scale. Make the selection which will provide the highest cabin altitude. When a cabin altitude change is required, adjust the cabin rate control as the climb progresses such that the selected cabin altitude is reached at approximately the same time the airplane reaches cruising altitude. This will permit a high airplane rate-of-climb to be used and still provide a comfortable environment for the passengers.

During cruise climbs, positioning the propeller synchrophaser to PHASE will eliminate the unpleasant audio beat accompanying unsynchronized operation. The propeller synchronizer can also provide a significant reduction in cabin vibration.

With the propellers slightly out of synchronization so that an audio beat is obtained approximately once each 5 seconds, it should be noted that the vibration level of the cabin and instrument panel will increase and decrease at a rate of approximately once each 20 seconds. Optimum operation will be obtained by manually synchronizing the propellers and positioning the synchrophaser switch to PHASE. Best propeller synchronizing is obtained by making the final adjustment of the propeller controls in a DECREASE RPM direction. For best operation, securely tighten the quadrant friction lock to prevent the slaved propeller control from creeping.

CRUISE

1. Cruise Power - 2100 to 2450 RPM and 17.0 to 31.5 inches Hg. or 2200 to 2300 RPM and 17.0 to 34.0 inches Hg.

NOTE

Maintain sufficient power for pressurization requirements.

2. Mixtures - LEAN for desired cruise fuel flow as determined from your power computer. Recheck mixtures if power, altitude or OAT changes.
3. Cowl Flaps - AS REQUIRED.
4. Propellers - SYNCHRONIZE manually.
5. Quadrant Friction Lock - TIGHTEN securely (With Synchrophaser Installed).
6. Propeller Synchrophaser - PHASE (Optional System). Light should illuminate continuously.
   a. Phasing Knob - ADJUST for desired phasing position.
7. Auxiliary Fuel Pumps - OFF or LOW, if required.
   a. Crossfeeding - LOW.
8. Fuel Selectors - Left Engine - LEFT MAIN (Feel For Detent).
   Right Engine - RIGHT MAIN (Feel For Detent).

NOTE

Turn auxiliary fuel pumps to LOW and mixtures to FULL RICH when switching tanks.

9. Cabin Altitude Control - SET SLOWLY if cruising altitude changes. Reset cabin altitude control to destination field pressure altitude plus 500 feet (outer scale), or cruise altitude plus 500 feet (inner scale) whichever gives the highest cabin altitude (Optional System).
10. Cabin Rate Control - ARROW UP.
11. If Cabin Altitude Light Illuminates (cabin altitude above 10,000 feet) - DESCEND or use supplementary oxygen as follows:
    a. Mask - Connect mask and hose assembly and put mask on.
    b. Hose Coupling - Plug into oxygen outlet inside access door in outboard armrest.
    c. Oxygen Flow Indicator - Check Flow. (Indicator Toward Mask Indicates Proper Flow.)
    d. Disconnect hose coupling when not in use.
12. Trim Tabs - ADJUST.

Normal cruising requires between 50% and 70% power. The manifold pressure and RPM settings required to obtain these powers at various altitudes and outside air temperatures can be determined with your cruise computer. A maximum cruising power of approximately 74.8% (31.5 inches Hg. manifold pressure and 2450 RPM or 34.0 inches Hg. manifold pressure and 2300 RPM) may be used if desired. Various percent powers can be obtained with a number of combinations of manifold pressure, engine speed, altitude and outside air temperature. For a given throttle setting, select the lowest engine speed in the green arc range that will give smooth engine operation without evidence of laboring.

CAUTION

The use of 34.0 inches Hg. manifold pressure (narrow green arc on manifold pressure gage) is restricted to the 2200 to 2300 RPM range only.

The use of lower power settings and the selection of cruise altitude on the basis of the most favorable wind conditions are significant factors that should be considered on every trip to reduce fuel consumption. Additional range can be achieved when operating at select power combinations, see Figure 5-21, by leaning to peak exhaust gas temperature (EGT) for Best Economy mixture. This setting results in an airspeed loss of 4 KTAS and range increase of 8% compared to the Recommended Lean mixture. Do not lean to the extent that engine roughness or excessive speed loss occurs.

CAUTION

Operation at Best Economy mixture is not recommended until oil consumption stabilizes or during the first 50 hours of operation. The purpose of this interval of operation at higher power levels (65% to 77.5% power) is to insure 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.

When leaning, accomplish the procedure as precisely as possible. A little extra effort in setting the mixtures will yield significant dividends.

For normal cruise conditions, your cruise computer should be utilized to set the fuel flows. The cruise computer is based on indicated OAT, therefore, the ram rise does not have to be subtracted. The cruise computer is marked with two fuel flow scales. These scales are provided to insure that you can obtain the maximum performance and utilization from your airplane. The inner fuel flow scale (marked Recommended Lean) should be utilized for all normal cruise performance. Data shown in Section 5 are based on Recommended Lean mixture. The outer fuel flow scale (marked Best Power) will provide maximum speed for a given power setting. The speed will be approximately two knots greater than the speed with Recommended Lean mixture.

The cowl flaps should be adjusted to maintain the cylinder head temperature within the normal operating range (green arc).

Best propeller synchrophasing is obtained by making the final adjustment of the propeller controls in a DECREASE RPM direction. Manually synchronize the propellers as closely as possible and tighten the quadrant friction lock securely. Position the synchrophaser switch to PHASE. The phasing knob should then be adjusted until the desired sound and vibration characteristics are obtained. This setting will vary from flight to flight. If non-synchronized operation occurs during long cruise flights, manually re-synchronize the propeller controls as closely as possible and synchronized operation should reoccur. Securely tighten the quadrant friction lock, then adjust the phasing knob as desired.

On long cruise flights, where the slaved governor can eventually operate near either end of its operating range, it may be necessary to periodically select the OFF position, reset the propeller controls and reengage the synchrophaser.

If the optional pressurization system is installed, the cabin rate-of-climb control should be positioned with the arrow straight up to provide the proper cabin rate-of-climb as small altitude changes occur.

Normal operations may be conducted without supplemental oxygen for extended periods up to a cabin altitude of approximately 10,000 feet. An oxygen system is required when the cabin altitude exceeds 10,000 feet. An altitude warning light will illuminate when the cabin altitude is higher than 10,000 feet, at which time oxygen should be used by all occupants.

WARNING

Permit no smoking when using oxygen. Oil, grease, soap, lipstick, lip balm, and other fatty materials constitute a serious fire hazard when in contact with oxygen. Be sure hands and clothing are oil-free before handling oxygen equipment.

For flight in an icing environment, refer to the Alternate Induction Air paragraphs in this section and other sections dealing with flight in an icing environment.

DESCENT

1. Fuel Selectors - Left Engine - LEFT MAIN (Feel For Detent).
   Right Engine - RIGHT MAIN (Feel For Detent).
2. Auxiliary Fuel Pumps - ON.
3. Cabin Pressurization - SET (Optional System).
   a. Cabin Altitude - SET SLOWLY. During the initial portion of the letdown, set the cabin altitude control to field pressure altitude plus 500 feet (outer scale) (Optional System).
   b. Cabin Rate Control - SET to reach selected cabin altitude (zero cabin pressure) at approximately the same time the airplane reaches field pressure altitude plus 500 feet (Optional System).
4. Power - AS REQUIRED to maintain engine temperatures in the green.

NOTE

Maintain sufficient power for pressurization requirements (manifold pressure in the green arc).

5. Mixtures - ADJUST for smooth operation with gradual enrichment as altitude is lost.
6. Cowl Flaps - CLOSE.
7. Propeller Synchrophaser - AS REQUIRED (Optional System).
8. Altimeter - SET.

Power should be reduced slowly to a manifold pressure and RPM which will provide the desired airspeed and rate-of-descent. Sufficient power should be maintained, however, to keep cylinder head temperatures in the green arc and maintain cabin pressurization. The optimum engine speed in a descent is usually the lowest one in the RPM green arc range that will allow cylinder head temperature to remain in the recommended operating range.

The combination of high pressure altitudes and above-standard temperatures has a significant effect on engine operation. Power output at any manifold pressure or power setting will be lower at high ambient temperatures than under standard atmospheric conditions. As temperatures increase, a constant fuel flow rate will result in a progressively richer mixture.

When operating at high altitudes and/or high ambient temperatures, careful attention should be paid to proper leaning of the mixture for both fuel economy and engine performance. This is especially important during prolonged low-power or idle-power operation. Overly rich mixtures during a long idle-power descent from cruising altitude could result in loss of power. During low-power operations, mixtures should always be leaned for smooth operation.

If the optional pressurization system is installed, the cabin altitude control should be set to give a cabin altitude equal to field pressure altitude plus 500 feet. The cabin altitude control should be set as early as practical in the descent in order to allow the lowest cabin rate-of-descent.

As the descent continues, the cabin rate-of-climb control is adjusted to reach the selected cabin altitude (zero cabin pressure differential) at the same time the airplane reaches field pressure altitude plus 500 feet. This system permits high rates of airplane descent while maintaining a comfortable environment for passengers.

NOTE

To obtain the approximate field pressure altitude, add 100 feet to the field elevation for each .1 inch Hg. the altimeter is below 29.92 inches Hg. or subtract 100 feet from the field elevation for each .1 inch Hg. the altimeter is above 29.92 inches Hg.

If synchronized operation is lost during large power changes, manually re-synchronize the propeller controls as closely as possible and synchronized operation should reoccur. Securely tighten the quadrant friction lock, then adjust the phasing knob as desired.

To prevent confusion in interpreting which 10,000-foot segment of altitude is being displayed on the altimeter, a striped warning segment is exposed on the face of the altimeter at all altitudes below 10,000 feet.

If fuel has been consumed at uneven rates between the two main tanks because of prolonged one engine flight, it is desirable to balance the fuel load by operating both engines from the fullest tank. However, if there is sufficient fuel in both tanks, even though they may have unequal quantities, it is important to switch the left and right fuel selectors to the left and right main tanks, respectively; feel for detent; and check the auxiliary fuel pumps ON for the landing. This will provide an adequate fuel flow to each engine if a balked landing is necessary.

BEFORE LANDING

1. Seat Belts and Shoulder Harness - SECURE.
2. Propeller Synchrophaser - OFF (Optional System).
3. Alternate Air Controls - CHECK IN.
4. Wing Flaps - DOWN 15° below 177 KIAS.
5. Landing Gear - DOWN below 177 KIAS.
6. Landing Gear Position Indicator Lights - Check down lights ON; Unlocked Light - OFF.
7. Cabin Differential Pressure - ZERO DIFFERENTIAL.
8. Mixtures - FULL RICH or lean as required for smooth operation.
9. Propellers - FULL FORWARD.

10. Wing Flaps - DOWN 45° below 146 KIAS.
11. Minimum Multi-Engine Approach Speed - 94 KIAS at 6750 pounds. Refer to Section 5 for speeds at reduced weights.

Landing gear extension before landing is easily detected by a slight change in airplane trim and a slight "bump" as the gear locks down. Illumination of the gear-down indicator lights (green) is further proof that the gear is down and locked. The gear unlocked indicator light (red) will illuminate when the gear uplocks are released and will remain illuminated while the gear is in transit. The unlocked light will extinguish when the gear has locked down. If it is reasonably certain that the gear is down and one of the gear-down indicator lights is still not illuminated, the malfunction could be caused by a burned out light bulb. This can be checked by pushing the press-to-test button. If the bulb is burned out, it can be replaced with the bulb from any post light, or the landing gear unlocked indicator light.

A simple last-minute recheck on final approach should confirm that all applicable switches are on, the gear-down indicator lights (green) are illuminated, the gear unlocked indicator light (red) is extinguished, the propeller controls are full forward, the mixtures are set for smooth operation, and the cabin pressure is at zero differential pressure.

Landings are conventional in every respect. A power approach is used down to 50 feet above ground level using power as required to stabilize the approach speed and attitude with wing flaps fully extended, landing gear extended and airspeed of 94 KIAS. A decision must be made at the 50-foot point to complete the landing or initiate a balked landing climb using the appropriate procedure. The landing is completed by closing the throttles while passing the 50-foot point and initiating a flare into the landing attitude.

Normally, the throttles are continuously retarded throughout the landing flare while allowing the airplane to touchdown, main wheels first, slightly above stall speed. The nose is then gently lowered to the runway and brakes applied as required. An abrupt power reduction at five feet altitude could result in a hard landing if the airplane is near stall speed. Short field landings on rough or soft runways are done in a similar manner except that the nosewheel is lowered to the runway at a lower speed to prevent excessive nose gear loads.

When a short ground run is the major consideration, the airplane is held off until a full stall touchdown occurs. Maximum effective braking is initiated immediately while continuing to hold the control wheel full aft. Refer to Normal Landing Distance in Section 5 for anticipated ground roll and total distance requirements.

Crosswind landings are performed with the least effort by using the crab method. However, either the wing-low, crab or combination method may be used. Crab the airplane into the wind in a normal approach using a minimum flap setting for the field length. Immediately before touchdown, the airplane is aligned with the flight path by applying down-wind rudder. The landing is made in nearly three-point attitude, and the nosewheel is lowered to the runway immediately after touchdown. A straight course is maintained with the steerable nosewheel and occasional braking if necessary.

BALKED LANDING

1. Increase engine speed to 2700 RPM and apply full throttle if necessary.
2. Balked Landing Transition Speed - 82 KIAS.
3. Landing Gear - RETRACT during IFR go-around or simulated IFR go-around after establishing a positive rate of climb.

> **NOTE**
>
> ● Experience indicates that retracting the landing gear during an operational VFR go-around, when an immediate landing is contemplated, has been conducive to gear up landings.
>
> ● Always follow the Before Landing Checklist.

4. Wing Flaps - 15°.
5. Trim airplane for climb.
6. Cowl Flaps - OPEN.
7. Wing Flaps - UP as soon as all obstacles are cleared and a safe altitude and airspeed are obtained.

AFTER LANDING

1. Auxiliary Fuel Pumps - LOW during landing roll.
2. Cowl Flaps - OPEN.
3. Wing Flaps - UP.

Maximum braking effectiveness is obtained by applying full even pressure to the toe brakes without locking the wheels and applying full back pressure to the control column. This procedure is recommended only for emergency stops as excessive brake pad and tire wear will occur. Maximum brake wear occurs at high speed. This brake wear can be reduced using aerodynamic braking supplemented with the use of wheel brakes. Maximum aerodynamic braking occurs with the wing flaps fully extended and control wheel held aft to keep the nose off the runway as long as possible.

After leaving the active runway, the wing flaps should be retracted. Be sure the wing flaps switch is identified before placing it in the UP position. The auxiliary fuel pump switches are turned to LOW during the landing roll.

SHUTDOWN

1. Parking Brake - SET if brakes are cool.
2. Avionics Bus Switch - OFF.
3. All Switches Except Battery, Alternator and Magneto Switches - OFF.
4. Auxiliary Fuel Pumps - OFF.

> **NOTE**
>
> The fuel pumps must be turned OFF prior to stopping engines.

5. Throttles - IDLE.
6. Mixtures - IDLE CUT-OFF.
7. Battery and Alternators - OFF.
8. Magneto Switches - OFF, after engines stop.
9. Control Locks - INSTALL.
10. Fuel Selectors - OFF if a long period of inactivity is anticipated (Feel For Detent).
11. Cabin Door - CLOSE after checking internal upper door handle stowed in the lock plate.

With the mixture levers in IDLE CUT-OFF, the fuel flow is effectively blocked at the fuel metering unit. Thus, it is unnecessary to place the fuel selectors in the OFF position if the airplane is receiving normal usage. However, if a long period of inactivity is anticipated, the fuel selectors should be turned OFF to preclude any possible fuel seepage that might develop through the metering valve.

To preclude battery discharge when the airplane is temporarily inactive, refer to FLYABLE STORAGE Section 8 for applicable servicing instructions.

STALL

The stall characteristics of the airplane are conventional. Aural warning is provided by the stall warning horn between 5 and 10 KIAS above the stall in all configurations. The stall is also preceded by a mild aerodynamic buffet which increases in intensity as the stall is approached. The power-on stall occurs at a very steep pitch angle with or without flaps. It is difficult to inadvertently stall the airplane during normal maneuvering.

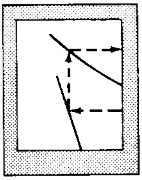
MANEUVERING FLIGHT

No aerobatic maneuvers, including spins, are approved in this airplane; however, the airplane is conventional in all respects through the maneuvering range encountered in normal flight.

PROCEDURES FOR PRACTICE DEMONSTRATION OF V_{MCA}

Single-engine procedures should be practiced in anticipation of an emergency. This practice should be conducted at a safe altitude, with full power operation on both engines, and should be started at a safe speed of at least 115 KIAS. As recovery ability is gained with practice, the starting speed may be lowered in small increments until the feel of the airplane in emergency conditions is well known. It should be noted that as the speed is reduced, directional control becomes more difficult. Emphasis should be placed on stopping the initial large yaw angles by the IMMEDIATE application of rudder supplemented by banking slightly away from the yaw. Practice should be continued until: (1) an instinctive corrective reaction is developed and the corrective procedure is automatic and, (2) airspeed, altitude, and heading can be maintained easily while the airplane is being prepared for a climb. In order to simulate an engine failure, set both engines at full power operation; then at a chosen speed, pull the throttle control of one engine to idle, and proceed with single-engine emergency procedures. Simulated single-engine flight characteristics can be practiced by setting propeller RPM to simulate a critical engine inoperative condition as shown in Figure 4-3.

RPM TO SIMULATE CRITICAL (LEFT) ENGINE INOPERATIVE AND FEATHERED



CONDITIONS:
1. Propellers in Low Pitch (Full Forward Position).
2. Manifold Pressure Adjusted to Obtain Proper RPM.

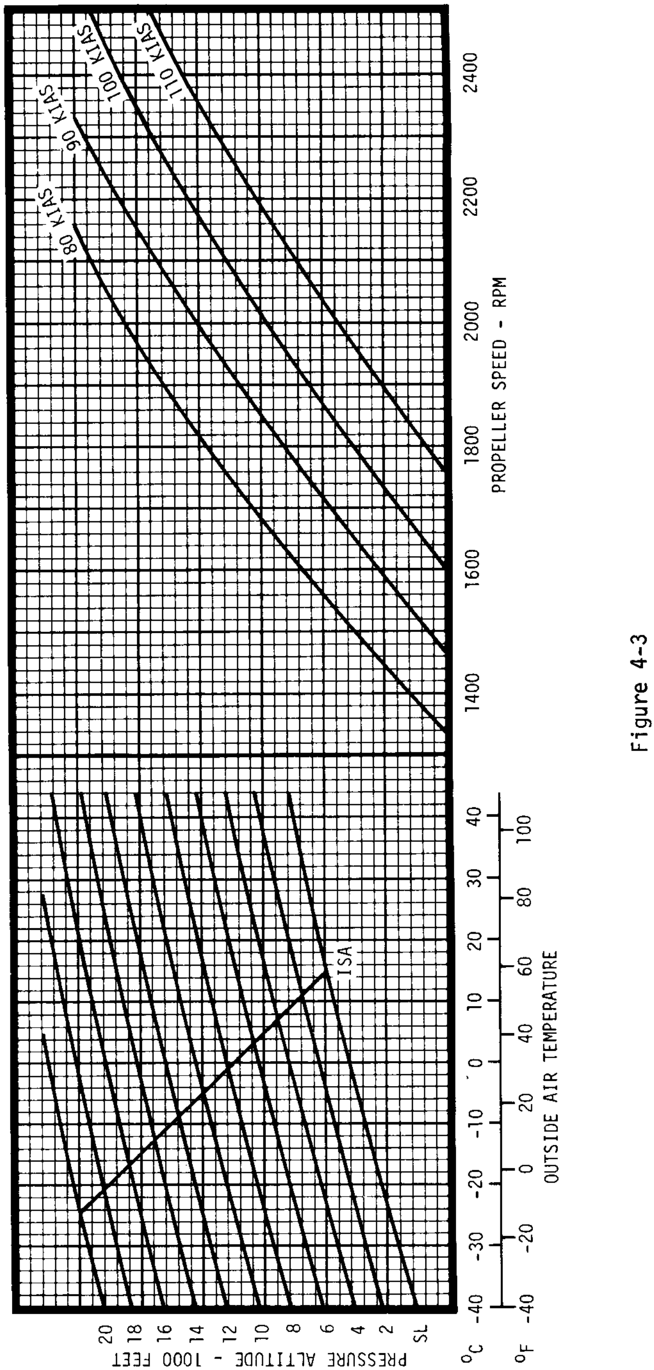


Figure 4-3

1. Wing Flaps - UP.
2. Landing Gear - UP.
3. Airspeed - V_{SSE} (98 KIAS) or above.
4. Inoperative Engine - IDLE POWER.
5. Operative Engine - 2700 RPM and FULL THROTTLE.
6. Airspeed - DECREASE at approximately 1 knot per second until V_{MC_A} (red radial) or stall warning, whichever occurs first, is obtained.

V_{SSE} is used in training and is not a limitation. It is recommended, however, that except for training, demonstrations, takeoffs and landings, this airplane should not be flown at a speed slower than V_{SSE}.

Under no circumstances should V_{MC_A} demonstration be attempted at a speed slower than the red radial on the airspeed indicator.

NIGHT FLYING

Before starting the engines for a night flight, position the master panel lighting switch to NIGHT and adjust the rheostats to provide enough illumination to check all switches, controls, etc.

Operation of the anti-collision lights should be checked by observing the reflections on the ground and on the wing tips. After starting the engines, the retractable landing lights (the right landing light is optional equipment) may be extended and checked momentarily. Returning the landing light switches to OFF turns the lights off, but leaves them extended ready for instant use.

Before taxi, the interior lighting intensity is normally decreased to the minimum at which all the controls and switches are visible. The taxi light should be turned on prior to taxiing at night. The landing lights, if used during taxiing, should be used intermittently to avoid excessive drain on the battery. In the engine runups, special attention should be directed to alternator operation by individually turning the voltammeter selector switch to L ALT, R ALT and BATT and noting response on the voltammeter.

Night takeoffs are conventional, although the gear retraction operation is usually delayed slightly to insure that the airplane is well clear of the runway.

In cruising flight, the interior lighting intensity should be decreased to the minimum which will provide adequate instrument legibility.

COLD WEATHER OPERATION

Whenever possible, external preheat should be utilized in cold weather. The use of preheat materially reduces the severity of conditions imposed on both engines and electrical systems. It is the preferred or best method of starting engines in extremely cold weather. Preheat will thaw the oil trapped in the oil coolers and oil filters, which will probably be congealed prior to starting in very cold weather. Refer to the Airplane Service Manual for additional information when operating in extremely cold weather.

When the oil pressure gage is extremely slow in indicating pressure, it may be advisable to fill the pressure line to the gage with kerosene or JP-4.

NOTE

During cold weather operation it is advisable to rotate propellers through four complete revolutions, by hand, before starting engines.

PRESSURIZATION AIR TEMPERATURE CONTROLS

OUTSIDE AIR TEMPERATURE AT GROUND LEVEL	MANUAL SHUTOFF CONTROL POSITION
ABOVE 21.1°C (70°F)	BOTH CONTROLS – FULL COUNTERCLOCKWISE
1.7°C TO 21.1°C (35°F TO 70°F)	RIGHT CONTROL ONLY – FULL CLOCKWISE
BELOW 1.7°C (35°F)	BOTH CONTROLS – FULL CLOCKWISE

Figure 4-4

If preheat is not available, external power should be used for starting because of the higher cranking power required and the decreased battery output at low temperatures. The starting procedure is normal; however, if the engines do not start immediately, it may be necessary to position the primer switch to LEFT or RIGHT for 5 to 10 seconds.

Manual pressurization air temperature controls have been provided to increase passenger comfort and heating system efficiency during cold weather operation. These manual controls, see Figure 4-4, are located on the instrument panel.

During cold weather operation, it is suggested that the right or both the right and left pressurization air temperature controls be rotated full clockwise. This will allow higher pressurization air temperatures, eliminating cold air drafts and decreasing cabin heater requirements.

Figure 4-4 can be used as a guide in positioning the pressurization air temperature controls. If the position of the right or both temperature controls is questionable due to the temperature at ground level, it is suggested that the colder temperature be assumed. If it then becomes too warm in the cabin, the manual control(s) may be rotated counterclockwise to emit cooling air. This procedure is recommended as it allows a more rapid cabin temperature adjustment.

NOTE

When necessary to position only one control full clockwise, rotate the right control as this will allow the left heat exchanger to provide cool air through the upper cabin air outlets, when desired.

After a suitable warm-up period (2 to 5 minutes at 1000 RPM, if preheat is not used) accelerate the engines several times to higher RPM. The propellers should be operated through several complete cycles to warm the governors and propeller hubs. If the engines accelerate smoothly and the oil pressure remains normal and steady, the airplane is ready for takeoff.

WARNING

The wings and tail surfaces must be clear of ice, snow and frost prior to takeoff as flight characteristics can be adversely affected.

NOTE

The waste gate actuators will not operate satisfactorily with engine oil temperatures below the lower limit of the operating range 23.9°C (75°F). With oil temperatures near the bottom of the operating range, the throttle motions should be very slow and care exercised to prevent exceeding the 38.0 inches Hg. manifold pressure limit.

During operation in cold wet weather, the possibility of brake freezing exists; therefore, special precautions should be taken. If ice is found on the brakes during preflight inspection, heat the brakes with a ground heater until the ice melts and all traces of moisture are removed. If a ground heater is not available, spray or pour isopropyl alcohol (MIL-F-5566) on the brakes to remove the ice.

CAUTION

If brakes are deiced using alcohol, insure alcohol has evaporated from the ramp prior to starting engines as a fire could result.

If neither heat nor alcohol are available, frozen brakes can sometimes be freed by cycling the brakes asymmetrically while applying engine power. Caution should be exercised if the airplane is setting on ice or in close proximity to other parked airplanes.

After takeoff from slush-covered runways or taxiways, leave landing gear down for a short period, allowing wheels to spin. This will allow centrifugal force to throw off any accumulated slush which should preclude frozen brakes on landing. Insure wheels are stopped before retracting wheels to prevent buildup of ice or slush in the wheel wells.

During cruise, the propellers should be exercised at half-hour intervals to flush the cold oil from the governors and propeller hubs. Electrical equipment should be managed to assure adequate alternator charging throughout the flight, since cold weather adversely affects battery capacity.

During letdown, watch engine temperatures closely and carry sufficient power to maintain them above operating minimums.

The pitot heat and stall warning heater switches should be turned ON at least 5 minutes before entering potential icing conditions (2 minutes if on ground) so that these units will be warm enough to prevent formation of ice. Preventing ice is preferable to attempting its removal once it has formed.

ALTERNATE INDUCTION AIR

The induction system employed on this airplane is not significantly affected by icing. However, a manually operated alternate induction air system is incorporated to assure satisfactory operation. Should the induction air inlet, or the induction system air filter become obstructed, the alternate air doors should be manually opened by turning and pulling the alternate air controls full open, which will admit warm unfiltered air to the engines. This system will provide continued satisfactory engine operation.

Since the higher intake air temperature when using alternate intake air results in a decrease in engine power and turbocharger capability, it is recommended that the alternate intake air not be utilized until indications of intake filter icing, (decreased manifold pressure) are actually observed.

Should additional power be required, the following procedures may be employed:

1. Increase RPM as required.
2. Move throttles forward to maintain desired manifold pressure.
3. Readjust mixture controls for smooth engine operation.

WARNING

Should it become necessary to use heated alternate air, the pressurization air controls must be pulled out to prevent nacelle fumes from entering the cabin. The cabin vent control should also be pulled out and the cabin pressurization switch positioned to DEPRESSURIZE to provide cabin ventilation. Placing the controls in the DUMP position will result in the cabin being depressurized. Therefore, if the flight altitude is above 10,000 feet, all occupants should use oxygen or initiate Emergency Descent Procedures.

During ground operation, the alternate air doors should be closed to prevent engine damage caused by ingesting debris through unfiltered air inlet.

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 airplanes 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 take-off and descent for landing should be made so as to avoid prolonged flight at low altitude near noise-sensitive areas. Avoidance of noise-sensitive areas, if practical, is preferable to overflight at relatively low altitudes.

NOTE

The preceding 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 to adequately exercise his duty to see and avoid other airplanes.

The flyover noise level, established in compliance with FAR 36 at maximum normal operating power is 76.6 dB(A).

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

OXYGEN USE AND THE PRESSURIZED AIRPLANE

Although this airplane exceeds the safety requirements for operation of pressurized airplanes at high altitude, it is felt that some words of caution are desirable in order to avoid unnecessary hazards. Normal operations may be conducted without supplemental oxygen for extended periods up to a cabin altitude of approximately 10,000 feet. Although the cabin altitude will not exceed 11,900 feet for operation up to the maximum altitude of 30,000 feet, it should be pointed out that the expected time that a person will remain conscious in the event the cabin must be depressurized is less than one minute if supplementary oxygen is not used.

An altitude warning light is provided which indicates when the cabin altitude is higher than 10,000 feet. This indication is controlled by a barometric switch which senses cabin altitudes and is functional when the battery switch is ON.

An oxygen system is required when the cabin altitude exceeds 10,000 feet. It is recommended that oxygen be used by all occupants when the cabin altitude warning light illuminates.

WARNING

Permit no smoking when using oxygen. Oil, grease, soap, lipstick, lip balm, and other fatty materials constitute a serious fire hazard when in contact with oxygen. Be sure hands and clothing are oil-free before handling oxygen equipment.

AIRCRAFT REGISTRATION NO	**adNote**	98-4-28 N/M
AIRCRAFT SERIAL NO		AD NUMBER
TYPE AIRCRAFT		

AFM Limitation

COMPLIANCE DATE	TOTAL TIME AT COMPLIANCE	TACH OR RECORDING METER TIME AT COMPLIANCE	METHOD OF COMPLIANCE	AUTHORIZED SIGNATURE & NUMBER
		-		

Amendment 39-10340; Docket No. 97-CE-63-AD.

Applicability: Models T303, 310R, T310R, 335, 340A, 402B, 402C, 404, F406, 414, 414A, 421B, 421C, 425, and 441 airplanes (all serial numbers), certificated in any category.

NOTE 1: This AD applies to each airplane identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For airplanes that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (d) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, the request should include specific proposed actions to address it.

Compliance: Required as indicated, unless already accomplished.

To minimize the potential hazards associated with operating the airplane in severe icing conditions by providing more clearly defined procedures and limitations associated with such conditions, accomplish the following:

(a) Within 30 days after the effective date of this AD, accomplish the requirements of paragraphs (a)(1) and (a)(2) of this AD.

NOTE 2: Operators should initiate action to notify and ensure that flight crewmembers are apprised of this change.

(1) Revise the FAA-approved Airplane Flight Manual (AFM) by incorporating the following into the Limitations Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"WARNING

Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems, and may seriously degrade the performance and controllability of the airplane.

- During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues. If one or more of these visual cues exists, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions.
- Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.
- Accumulation of ice on the upper surface of the wing, aft of the protected area.
- Accumulation of ice on the engine nacelles and propeller spinners farther aft than normally observed.
- Since the autopilot, when installed and operating, may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in severe icing conditions.
- All wing icing inspection lights must be operative prior to flight into icing conditions at night. [NOTE: This supersedes any relief provided by the Master Minimum Equipment List (MMEL).]"

(2) Revise the FAA-approved AFM by incorporating the following into the Normal Procedures Section of the AFM. This may be accomplished by inserting a copy of this AD in the AFM.

"THE FOLLOWING WEATHER CONDITIONS MAY BE CONDUCIVE TO SEVERE IN-FLIGHT ICING:

- Visible rain at temperatures below 0 degrees Celsius ambient air temperature.
- Droplets that splash or splatter on impact at temperatures below 0 degrees Celsius ambient air temperature.

PROCEDURES FOR EXITING THE SEVERE ICING ENVIRONMENT:

These procedures are applicable to all flight phases from takeoff to landing. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as -18 degrees Celsius, increased vigilance is warranted at temperatures around freezing with visible moisture present. If the visual cues specified in the Limitations Section of the AFM for identifying severe icing conditions are observed, accomplish the following:

- Immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.
- Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
- Do not engage the autopilot.
- If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.
- If an unusual roll response or uncommanded roll control movement is observed, reduce the angle-of-attack.
- Do not extend flaps when holding in icing conditions. Operation with flaps extended can result in a reduced wing angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.
- If the flaps are extended, do not retract them until the airframe is clear of ice.
- Report these weather conditions to Air Traffic Control."

(b) Incorporating the AFM revisions, as required by this AD, may be performed by the owner/operator holding at least a private pilot certificate as authorized by section 43.7 of the Federal Aviation Regulations (14 CFR 43.7), and must be entered into the aircraft records showing compliance with this AD in accordance with section 43.9 of the Federal Aviation Regulations (14 CFR 43.9).

(c) Special flight permits may be issued in accordance with sections 21.197 and 21.199 of the Federal Aviation Regulations (14 CFR 21.197 and 21.199) to operate the airplane to a location where the requirements of this AD can be accomplished.

(d) An alternative method of compliance or adjustment of the compliance time that provides an equivalent level of safety may be approved by the Manager, Small Airplane Directorate, FAA, 1201 Walnut, suite 900, Kansas City, Missouri 64106. The request shall be forwarded through an appropriate FAA Maintenance Inspector, who may add comments and then send it to the Manager, Small Airplane Directorate.

NOTE 3: Information concerning the existence of approved alternative methods of compliance with this AD, if any, may be obtained from the Small Airplane Directorate.

(e) All persons affected by this directive may examine information related to this AD at the FAA, Central Region, Office of the Regional Counsel, Room 1558, 601 E. 12th Street, Kansas City, Missouri 64106.

(f) This amendment (39-10340) becomes effective on March 13, 1998.

FOR FURTHER INFORMATION CONTACT: Mr. John P. Dow, Sr., Aerospace Engineer, Small Airplane Directorate, Aircraft Certification Service, 1201 Walnut, suite 900, Kansas City, Missouri 64106, telephone (816) 426-6932, facsimile (816) 426-2169.

ENGINE START/SHUTDOWN PROCEDURES

(VACUUM SYSTEM CHECK)

SUPPLEMENT

TO

PILOT'S OPERATING HANDBOOK /OWNER'S MANUAL

FOR

ALL CESSNA 300 SERIES AIRPLANES
and
ALL 1976 THRU 1985 400 SERIES AIRPLANES

D5317-13

ORIGINAL ISSUE

2 JUNE 1999

THIS SUPPLEMENT MUST BE INSERTED IN, OR ATTACHED TO, THE LATEST VERSION OF THE PILOT'S OPERATING HANDBOOK, OR OWNER'S MANUAL.

Cessna
A Textron Company

ENGINE START/SHUTDOWN PROCEDURES
(VACUUM SYSTEM CHECK)

SUPPLEMENT
TO
PILOT'S OPERATING HANDBOOK/OWNER'S MANUAL
FOR THE FOLLOWING MODELS:

ALL T303, 310/T310, 320, 336, 337/T337, P337, F337, 335, 340/340A

ALL 1976 THRU 1985 402B/402C, 404, 414/414A, 421C

SERIAL NO. ____________________________

REGISTRATION NO. ______________________

This supplement must be inserted in, or attached to, the latest version of the Pilot's Operating Handbook, or Owner's Manual for the above listed airplane models.

APPROVED BY:

Michael McClary
Executive Engineer
Cessna Aircraft Company
Delegation Option Manufacturer CE-1

DATE OF APPROVAL:
06-02-99

APPROVED BY:

Wendell W. Corneil
Executive Engineer
Cessna Aircraft Company
Delegation Option Manufacturer CE-3

DATE OF APPROVAL:
11 MAY 1999

Member of GAMA

SUPPLEMENT

ENGINE START/SHUTDOWN PROCEDURES
(VACUUM SYSTEM CHECK)

Use the Log of Effective Pages to determine the current status of this supplement.

Pages affected by the current revision are indicated by an asterisk (*) preceding the page number.

Supplement Status	Date
Original	2 June 1999

LOG OF EFFECTIVE PAGES

Page	Page Status	Revision Number
1 thru 8	Original	0

SUPPLEMENT

ENGINE START/SHUTDOWN PROCEDURES (VACUUM SYSTEM CHECK)

SECTION 1

GENERAL

VACUUM SYSTEM

A vacuum system is installed to provide a source of vacuum for the vacuum instruments. The system consists of an engine-driven vacuum pump on each engine, pressure relief valve for each pump, a common vacuum manifold, vacuum air filter, suction gage and gyro instruments.

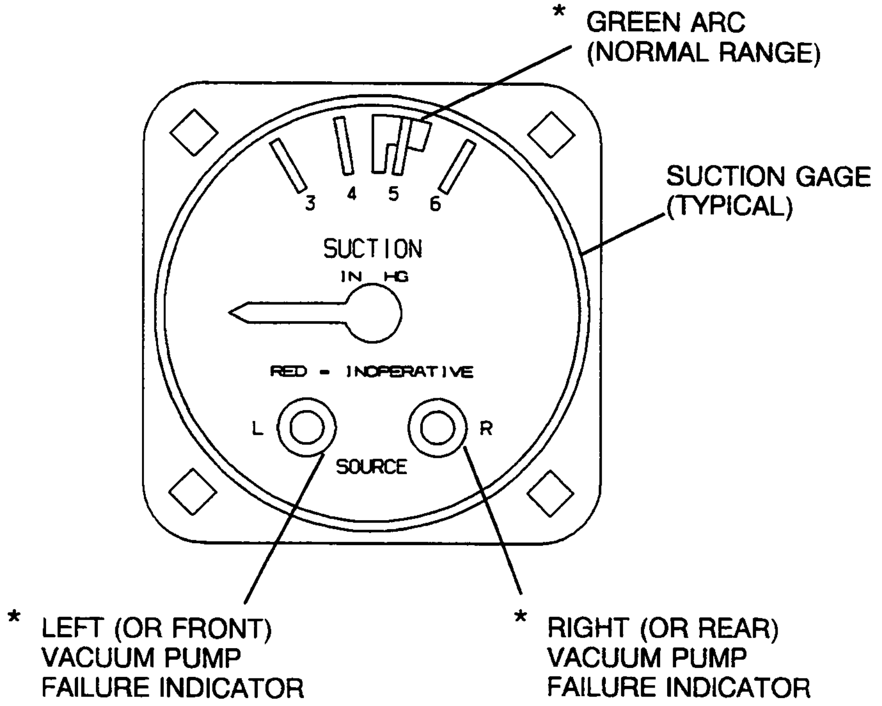
NOTE

> Some earlier 300 series airplanes may have separate in-line check valves instead of a common vacuum manifold containing the check valves. These airplanes also have one common pressure relief valve in the system instead of separate relief valves for each vacuum pump.

Each vacuum pump pulls a vacuum on the common manifold, exhausting the air overboard. The maximum amount of vacuum pulled on the manifold by each vacuum pump is controlled to a preset level by each pressure relief valve. Should either of the pumps fail, a check valve is provided in each end of the manifold to isolate the inoperative vacuum pump from the system.

The exhaust air side of each attitude gyro is connected to the vacuum manifold thus providing a smooth steady vacuum for the gyros. The vacuum pressure being applied to the gyros is constantly presented on the suction gage. On later 300 series airplanes, and 400 series airplanes, this gage also provides failure indicators for the left and right vacuum pumps (refer to Figure 1). These indicators are small red buttons located in the lower portion of the suction gage which are spring-loaded to the extended (failed) position. When normal vacuum is applied in the manifold, the failure buttons are pulled flush with the gage face. Should insufficient vacuum occur on either side, the respective red button will extend. The system will automatically isolate the failed vacuum source, allowing normal operation on the remaining operative vacuum pump. Maintenance should be performed to reinstate the failed vacuum source before initiating flight into instrument meteorological conditions (IMC).

The inlet air side of the attitude gyros are connected to a common vacuum air filter which cleans the ambient cabin air before allowing it to enter the gyros.



*** NOTE**

Suction gages on some earlier airplanes may not have failure indicator buttons, or a green arc on the face of the gage.

Figure 1. Typical Suction Gage with Failure Indicators

SECTION 2
LIMITATIONS

There is no change to the airplane Limitations.

SECTION 3
EMERGENCY PROCEDURES

There is no change to the airplane Emergency Procedures.

SECTION 4
NORMAL PROCEDURES

Add the following Vacuum System Check to existing Engine Start and Shutdown procedures in the Normal Procedures Abbreviated Checklist, and Amplified Normal Procedures of the Pilot's Operating Handbook or Owner's Manual.

NOTE

If the following procedures detect a defective vacuum system check valve, or failed vacuum pump, maintenance should be performed before initiating flight into instrument meteorological conditions (IMC).

(Continued Next Page)

SECTION 4 - NORMAL PROCEDURES (Continued)

NORMAL PROCEDURES ABBREVIATED CHECKLIST

STARTING ENGINES

Vacuum System - perform check per Amplified Normal Procedures.

SHUTDOWN

Vacuum System - perform check per Amplified Normal Procedures.

AMPLIFIED NORMAL PROCEDURES

AIRPLANES HAVING A SUCTION GAGE WITH FAILURE INDICATORS

STARTING ENGINES

AFTER FIRST ENGINE IS STARTED:

With throttle set at 1000 RPM or higher:

1. Suction Gage - CHECK (reading in green arc).
2. Check that the red vacuum failure button in the suction gage for that engine is flush with the gage face, prior to starting the opposite engine.
   a. If failure button remains extended (not flush with gage face), a vacuum source failure has occurred.
   b. If both failure buttons are flush with face of gage, a vacuum system check valve is defective.

(Continued Next Page)

AMPLIFIED NORMAL PROCEDURES (Continued)

AIRPLANES HAVING A SUCTION GAGE WITH FAILURE INDICATORS

STARTING ENGINES

AFTER SECOND ENGINE IS STARTED:

With throttle set at 1000 RPM or higher:

1. Suction Gage - CHECK (reading in green arc).
2. Check that the red vacuum failure button in the suction gage for that engine is flush with the gage face.
   a. If failure button remains extended (not flush with gage face), a vacuum source failure has occurred.

SHUTDOWN

ENGINES:

1. Shut down engine that was started first.
   a. The red vacuum failure button for that engine in the suction gage should extend.
   b. If the failure button for the shutdown engine remains flush with the face of the gage, a vacuum system check valve is defective.
2. With throttle set at 1000 RPM or lower on the running engine, check that the red vacuum failure button in the suction gage for that engine is flush with the gage face.
   a. If the red vacuum failure button for the running engine extended when the first engine was shutdown, a vacuum system check valve and/or pump is defective.

(Continued Next Page)

AMPLIFIED NORMAL PROCEDURES (Continued)

AIRPLANES HAVING A SUCTION GAGE WITHOUT FAILURE INDICATORS

STARTING ENGINES

AFTER FIRST ENGINE IS STARTED:

With throttle set at 1000 RPM or higher:

1. Suction Gage - CHECK (reading in normal range).

    a. A vacuum reading in the normal range indicates the vacuum pump for that engine is working properly.

    b. No vacuum reading on the gage, or a reading outside the normal range, indicates a vacuum source failure or malfunction.

SHUTDOWN

ENGINES:

1. Shutdown engine that was started first.

With throttle set at 1000 RPM or higher on the running engine:

2. Suction Gage - CHECK (reading in normal range).

    a. A vacuum reading in the normal range indicates the vacuum pump for that engine is working properly.

    b. No vacuum reading on the gage, or a reading outside the normal range, indicates a vacuum source failure or malfunction.

SECTION 5
PERFORMANCE

There is no change to the airplane performance.

SECTION 5
PERFORMANCE
TABLE OF CONTENTS

INTRODUCTION

Section 5 of this handbook contains all the performance information required to operate the airplane safely and to help you plan your flights in detail with reasonable accuracy. Safe and precise operation of the airplane requires the pilot to be thoroughly familiar with and understand the data and calculations of this section.

The data on these graphical and tabular charts have been compiled from actual flight tests, with the airplane and engines in good condition, using average pilot techniques. Note that the cruise performance data makes no allowance for wind and/or navigational errors. Allowances for start, taxi, takeoff, climb, descent and 45 minutes reserve fuel at the particular cruise power are provided in the range profile chart.

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

DEMONSTRATED OPERATING TEMPERATURE

Satisfactory engine cooling has been demonstrated for this airplane with an outside air temperature 23°C (41°F) above standard. This is not to be considered as an operating limitation. Reference should be made to Section 2 for engine operating limitations.

INTRODUCTION TO TABULATED PERFORMANCE

The performance tables are presented in increments of temperature, altitude and any other variables involved. Performance for a given set of conditions can be approximated as follows:

(1) Takeoff, Accelerate Stop, Accelerate Go, Landing - Enter tables at the next higher increment of weight, altitude and temperature.
(2) Cruise - Enter tables at next lower increment of temperature and altitude.

To obtain exact performance values from the tables, it is necessary to interpolate between the increment values. The following is an example of approximation and interpolation, using an excerpt from the Normal Takeoff Distance Chart.

EXAMPLE

Given:

Weight	6500 Pounds
Temperature	(16°C) 61°F
Pressure Altitude	2400 Feet
Headwind	19 Knots

Find:

Takeoff Speed	____ KIAS
Ground Roll	____ Feet
Total Distance to Clear 50-Foot Obstacle	____ Feet

Weight Pounds	Takeoff and Climb Speed KIAS	Pressure Altitude Feet	10°C (50°F)		20°C (68°F)	
			Ground Roll - Feet	Total Distance to Clear 50-Ft - Feet	Ground Roll - Feet	Total Distance to Clear 50-Ft - Feet
6750	98	2000 3000	2350 2500	2770 2930	2570 2730	3030 3210
6200	94	2000 3000	1880 2040	2220 2400	2100 2230	2480 2620

Approximation Method

Extract from the chart the next increment of weight, altitude and temperature which is more conservative than the actual conditions [i.e.: 6750 pounds, 3000 feet and 20°C (68°F)].

Takeoff and Climb Speed . . . . 98 KIAS
Ground Roll . . . . 2730 Feet
Total Distance to Clear 50-Foot Obstacle . . . . . . 3210 Feet

Interpolation Method

If the approximation method yields a value larger than can be tolerated, a more exact value should be determined using the interpolation method.

The example weight (6500 pounds) is 6200 pounds plus 300/550 or .55 times the difference between 6200 pounds and 6750 pounds [i.e.: 6200-pound value +.55 (6750-pound value - 6200-pound value)]

The example pressure altitude (2400 feet) is 2000 feet plus 400/1000 or .4 times the difference between 2000 feet and 3000 feet [i.e.: 2000-foot value + .4 (3000-foot value - 2000-foot value)].

The example temperature of 16°C (61°F) is 10°C plus 6/10 or .6 times the difference between 10°C and 20°C [i.e.: 10°C value + .6 (20°C value - 10°C value)].

Interpolating Values for Normal Takeoff Distance:

Ground Roll (7 interpolations required)

Altitude interpolation at 10°C (50°F) and 6750 pounds
= 2000-foot value + [.4 (3000-foot value - 2000-foot value)]
= 2350 feet + [.4 (2500 feet - 2350 feet)]
= 2350 feet + [60 feet]
= 2410 feet

Altitude interpolation at 20°C (68°F) and 6750 pounds
= 2000-foot value + [.4 (3000-foot value - 2000-foot value)]
= 2570 feet + [.4 (2730 feet - 2570 feet)]
= 2570 feet + [64 feet]
= 2634 feet

Altitude interpolation at 10°C (50°F) and 6200 pounds
= 2000-foot value + [.4 (3000-foot value - 2000-foot value)]
= 1880 feet + [.4 (2040 feet - 1880 feet)]
= 1880 feet + [64 feet]
= 1944 feet

Altitude interpolation at 20°C (68°F) and 6200 pounds
= 2000-foot value + [.4 (3000-foot value - 2000-foot value)]
= 2100 feet + [.4 (2230 feet - 2100 feet)]
= 2100 feet + [52 feet]
= 2152 feet

The Normal Takeoff Distance chart, with altitude interpolation, looks as follows:

Weight Pounds	Takeoff and Climb Speed KIAS	Pressure Altitude Feet	10°C (50°F)		20°C (68°F)	
			Ground Roll - Feet	Total Distance to Clear 50-Ft - Feet	Ground Roll - Feet	Total Distance to Clear 50-Ft - Feet
6750	98	2400	2410	----	2634	----
6200	94	2400	1944	----	2152	----

Weight interpolation at 10°C (50°F) and 2400 feet = 6200-pound value + [.55 (6750-pound value - 6200-pound value)]

= 1944 feet + [.55 (2410 feet - 1944 feet)]

= 1944 feet + [256 feet]

= 2200 feet

Weight interpolation at 20°C (68°F) and 2400 feet = 6200-pound value + [.55 (6750-pound value - 6200-pound value)]

= 2152 feet + [.55 (2634 feet - 2152 feet)]

= 2152 feet + [265 feet]

= 2417 feet

Takeoff and Climb Speed = 6200-pound value + [.55 (6750-pound value - 6200-pound value)]

= 94 KIAS + [.55 (98 KIAS - 94 KIAS)]

= 94 KIAS + [2.2 KIAS]

= 96 KIAS

The Normal Takeoff Distance chart, with altitude and weight interpolation, looks as follows:

Weight Pounds	Takeoff and Climb Speed KIAS	Pressure Altitude Feet	10°C (50°F)		20°C (68°F)	
			Ground Roll - Feet	Total Distance to Clear 50-Ft - Feet	Ground Roll - Feet	Total Distance to Clear 50-Ft - Feet
6500	96	2400	2200	----	2417	----

Temperature interpolation at 2400 feet and 6500 pounds	= 10°C (50°F) value + [.6 (20°C (68°F) value - 10°C (50°F) value)]
	= 2200 feet + [.6 (2417 feet - 2200 feet)]
	= 2200 feet + [130 feet]
	= 2330 feet

The Normal Takeoff Distance chart, with altitude, weight and temperature, looks as follows:

Weight Pounds	Takeoff and Climb Speed KIAS	Pressure Altitude Feet	16°C (61°F)	
			Ground Roll - Feet	Total Distance to Clear 50-Ft - Feet
6500	96	2400	2330	----

Ground Roll with 19-knot headwind

$$= 2330 \text{ feet} - [2330 \text{ feet} \left(\frac{19 \text{ knots headwind}}{10 \text{ knots headwind}} \right) (7\%)]$$

= 2330 feet - 310 feet

= 2020 feet

Total Distance to Clear 50-Foot Obstacle (7 interpolations required)

The interpolations required are identical to the ground roll interpolations, except "total distance to clear 50-foot obstacle" values are substituted for the "ground roll" values.

The interpolated value for the total distance to clear 50-foot obstacle is 2744 feet (no wind) and 2379 feet (19-knot headwind).

SAMPLE FLIGHT

The following is an example of a typical flight using the performance data contained in Figures 5-9 through 5-25. The approximation method is used in tabular performance except where noted.

AIRPLANE CONFIGURATION

Airplane Weight . . . . 6500 Pounds
Usable Fuel Load . . . . 978 Pounds

TAKEOFF AIRPORT CONDITIONS

Field Length . . . . 5000 Feet (Runway 23)
Temperature . . . . 16°C (61°F)
Field Pressure Altitude . . . . 2400 Feet
Wind . . . . 270° at 25 Knots
Obstacles . . . . None

CRUISE CONDITIONS

Distance	600 Nautical Miles
Cruise Altitude	17,500 Feet
Temperature	$-10^{o}C$ ($14^{o}F$)
Wind	15-Knot Tailwind
Power	Maximum Recommended Cruise Power at Recommended Lean Mixture

LANDING AIRPORT CONDITIONS

Field Length	3500 Feet (Runway 19)
Temperature	$7^{o}C$ ($45^{o}F$)
Field Pressure Altitude	1700 Feet
Wind	210^{o} at 17 Knots
Landing Weight	To be Calculated
Obstacles	50-Foot Trees

SAMPLE CALCULATIONS

Wind Component Chart (Figure 5-9)

(1) The angle between the runway and the prevailing wind is 40^{o}.
(2) Enter Figure 5-9 on the 40^{o} wind line and proceed out to the intersection with the 25-knot arc.
(3) Read horizontally left from this intersection; the headwind component is 19 knots.

Normal Takeoff Distance (Figure 5-10)

(1) Enter Figure 5-10 at 6750 pounds weight; the takeoff and climb speed is 98 KIAS.
(2) Proceed horizontally right from 3000-foot pressure altitude to the vertical columns for $20^{o}C$ ($68^{o}F$). The takeoff ground run is 2730 feet and the total distance required to clear a 50-foot obstacle is 3210 feet without wind correction. With a 19-knot headwind component, the corrected takeoff ground run is 2367 feet and the corrected total distance required is 2783 feet.

$$\frac{\text{19 Knots Headwind}}{\text{10 Knots Headwind}} (7\%) = 13.3\%$$

Corrected Takeoff Ground Run = 2730 feet - [13.3% (2730 feet)]

= 2730 feet - [363 feet]

= 2367 feet

Corrected Total Distance Required = 3210 feet - [13.3% (3210 feet)]

= 3210 feet - [427 feet]

= 2783 feet

Accelerate Stop Distance (Figure 5-11)

(1) Enter Figure 5-11 at 6750 pounds weight; engine failure speed is 98 KIAS.

(2) Proceed horizontally right from 3000-foot pressure altitude to the vertical columns for 20°C (68°F). The distance required to accelerate to 98 KIAS and stop is 5070 feet without wind correction. With a 19-knot headwind component, the accelerate stop distance can be reduced by:

$$\frac{\text{19 Knots Headwind}}{\text{4 Knots Headwind}} (3\%) = 14.25\%$$

Corrected Accelerate Stop Distance = 5070 feet - [14.25% (5070 feet)]

= 5070 feet - [722 feet]

= 4348 feet

Accelerate Go Distance (Figure 5-12)

(1) Enter Figure 5-12 at 6750 pounds weight; engine failure speed is 98 KIAS.
(2) Proceed horizontally right from 3000-foot pressure altitude to the vertical columns for 20°C (68°F). The distance required to clear a 50-foot obstacle, after losing an engine at 98 KIAS, is 5090 feet without wind correction. With a 19-knot headwind component, the distance can be reduced by:

$$\frac{\text{19 Knots Headwind}}{\text{10 Knots Headwind}} (6\%) = 11.4\%$$

Corrected Accelerate Go Distance = 5090 feet - [11.4% (5090 feet)]

= 5090 feet - [580 feet]

= 4510 feet

NOTE

- The distance required to accelerate go using the approximation method is often so great that a more exact value should be obtained using the interpolation method.
- The interpolation method gives an accelerate go distance of 4111 feet without wind or 3642 feet with 19 knots of headwind.

Rate-Of-Climb — Maximum Climb (Figure 5-13)

(1) Enter Figure 5-13 at 16°C (61°F).
(2) Proceed vertically up to the 2400-foot pressure altitude line.
(3) Proceed horizontally right to the reference line. Follow the slope of the adjacent rate-of-climb lines until intersecting the vertical 6500-pound line.
(4) Proceed horizontally right to obtain rate-of-climb. (1500 Feet per minute)
(5) Enter the climb speed data to determine the climb speed corrected for 2400 feet. (108 KIAS)

Rate-Of-Climb — Cruise Climb (Figure 5-14)

(1) Enter Figure 5-14 at 16°C (61°F).
(2) Proceed vertically up to the 2400-foot pressure altitude line.
(3) Proceed horizontally right to the reference line. Follow the slope of the adjacent rate-of-climb lines until intersecting the vertical 6500-pound line.
(4) Proceed horizontally right to obtain rate-of-climb. (1055 Feet per minute)
(5) Climb speed is 120 KIAS for all conditions.

Rate-Of-Climb — Single Engine (Figure 5-15)

(1) Enter Figure 5-15 at 16°C (61°F).
(2) Proceed vertically up to the 2400-foot pressure altitude line.
(3) Proceed horizontally right to the reference line. Follow the slope of the adjacent rate-of-climb lines until intersecting the vertical 6500-pound line.
(4) Proceed horizontally right to obtain rate-of-climb. (280 Feet per minute)
(5) Enter the climb speed data to determine the climb speed corrected for 2400 feet. (108 KIAS)

Time, Fuel And Distance To Climb — Cruise Climb (Figure 5-19)

Time, fuel and distance to climb are determined by finding the difference between the airport and the cruise conditions; thus, two calculations are required, one for the airport condition and the second for the cruise condition.

Airport Condition:
(1) Enter Figure 5-19 at 16°C (61°F).
(2) Proceed vertically up to 2400-foot pressure altitude line.
(3) Proceed horizontally right to the 6500-pound line.
(4) Proceed vertically down to obtain time to climb (2.3 minutes), fuel to climb (9.5 pounds) and distance to climb (5 nautical miles).

Cruise Condition:
(5) Enter Figure 5-19 at -10°C (14°F).
(6) Proceed vertically up to 17,500-foot pressure altitude line.
(7) Proceed horizontally right to the 6500-pound line.
(8) Proceed vertically down to obtain time to climb (22.0 minutes), fuel to climb (88 pounds) and distance to climb (52 nautical miles).

Final Calculations:

Time to Climb = Cruise time to climb - Airport time to climb

= 22 minutes - 2.3 minutes

= 20 minutes

Fuel to Climb = Cruise fuel to climb - Airport fuel to climb

= 88 pounds - 9.5 Pounds

= 78.5 pounds (add 32 pounds for start, taxi and runup) (110.5 pounds total)

Distance to Climb = Cruise distance to climb - Airport distance to climb

= 52 nautical miles - 5 nautical miles

= 47 nautical miles

Adjusted for wind (use 60% of the wind at altitude for climb wind),

= 47 ± wind contribution

$$= 47 + \left[\frac{20 \text{ minutes}}{60 \text{ minutes}} (.6 \times 15 \text{ knots}) \right]$$

= 47 nautical miles + 3 nautical miles

= 50 nautical miles

Time, Fuel And Distance To Descend (Figure 5-24)

Time, fuel and distance to descend are determined by finding the difference between the cruise and the landing airport conditions; thus two calculations are required, one for the cruise condition and the second for the landing airport condition.

Cruise Condition:
(1) Enter Figure 5-24 at the cruise altitude of 17,500 feet.
(2) Proceed horizontally right to the guideline.
(3) Proceed vertically down to obtain time to descend (14.4 minutes), fuel to descend (34 pounds) and distance to descend (48 nautical miles).

Landing Airport Condition:
(4) Enter Figure 5-24 at the airport altitude of 1700 feet.
(5) Proceed horizontally right to the guideline.
(6) Proceed vertically down to obtain time to descend (2.0 minutes), fuel to descend (5 pounds) and distance to descend (6.5 nautical miles).

Final Calculations:
Time to Descend = Cruise time to descend - Airport time to descend

= 14.4 minutes - 2.0 minutes

= 12.4 minutes

Fuel to Descend	= Cruise fuel to descend - Airport fuel to descend
	= 34 pounds - 5 pounds
	= 29 pounds
Distance to Descend	= Cruise distance to descend - Airport distance to descend.
	= 48 nautical miles - 6.5 nautical miles
	= 41.5 nautical miles
	Adjusted for wind (use 40% of the wind at altitude for descent wind),
	= 41.5 ± wind contribution
	$= 41.5 + [\frac{12.4 \text{ minutes}}{60 \text{ minutes}} (.4 \times 15 \text{ knots})]$
	= 41.5 nautical miles + 1.2 nautical miles
	= 42.7 nautical miles

Cruise Performance With Recommended Lean Mixture (Figure 5-20)

Maximum recommended cruise can be obtained with either 2450 RPM and 31.5 Inches Hg. manifold pressure or 2300 RPM and 34 Inches Hg. manifold pressure.

The approximation method for extracting data from the cruise tables is to select the next lower temperature and altitude values, which are generally conservative with respect to fuel economy.

(1) Enter the 15,000-foot data at 2450 RPM and 31.5 Inches Hg. manifold pressure.
(2) Use -15°C (5°F) data for a power of 74.8%, airspeed of 199 KTAS and a total fuel flow of 204 pounds per hour.
(3) Correcting for a weight of 6500 pounds, the airspeed increases to:

$$199 \text{ KTAS} + \frac{(6750 \text{ pounds} - 6500 \text{ pounds})}{1000 \text{ pounds}} (6 \text{ KTAS}) =$$

$$199 \text{ KTAS} + 1.5 \text{ KTAS} = 200 \text{ KTAS}$$

Using the interpolation method, interpolating altitude, temperature and weight, the actual performance is 72.5% power, 204 KTAS and total fuel flow of 198 pounds per hour.

In the above calculations, for convenience, the weight was assumed to be equal to the takeoff weight of 6500 pounds. More realistic data can be determined if the average cruise weight is used. This average cruise weight is determined as follows:

Cruise Fuel $= \dfrac{\text{Total distance} - \text{climb distance} - \text{descent distance}}{\text{True airspeed} + \text{wind correction}} \times$ [Total fuel flow per hour]

$= \dfrac{\text{600 Nautical Miles} - \text{50 Nautical Miles} - \text{42.7 Nautical Miles}}{\text{204 KTAS} + \text{15 Knot Tailwind}} \times$ [198 pounds per hour]

$= \dfrac{\text{507.3 Nautical miles}}{219} \times$ 198 pounds per hour

= 2.32 hours x 198 pounds per hour

= 458 pounds

Average Cruise Weight $=$ Takeoff weight - start, taxi and climb fuel - $\dfrac{\text{Cruise fuel}}{2}$

$=$ 6500 pounds - 110.5 pounds - $\dfrac{\text{458 pounds}}{2}$

= 6161 pounds

Average Cruise Speed = True airspeed from Figure 5-20 + weight correction

$= 204 \text{ KTAS} + 6 \left(\dfrac{340}{1000} \right)$

= 206 KTAS

Average Ground Speed = 206 KTAS + tailwind

= 206 KTAS + 15 knots

= 221 knots

Distance During Cruise = Total distance - Climb distance - Descent distance

= 600 - 50 - 42.7

= 507.3 Nautical Miles

Time During Cruise $= \dfrac{\text{Cruise distance}}{\text{ground speed}}$

$= \dfrac{507.3}{221}$

= 2.30 hours

Normal Landing Distance (Figure 5-25)

Landing Weight = Takeoff weight - climb fuel - cruise fuel - descent fuel

= 6500 pounds - 110.5 pounds - 458 pounds - 29 pounds

= 5903 pounds

Wind	= 210° at 17 knots. Determine headwind component from Figure 5-9. (16 knots headwind)

Enter Figure 5-25 at 6200 pounds; the approach speed is 91 KIAS. Proceed horizontally right from 2000-foot pressure altitude to the vertical column for 10°C (50°F). The landing distance ground roll is 890 feet and the total distance required to clear a 50-foot obstacle is 2270 feet without wind correction. With a 16-knot headwind component, the corrected ground roll distance is 783 feet and the corrected total distance required is 1998 feet.

$$\frac{\text{16 Knots Headwind}}{\text{4 Knots Headwind}} (3\%) = 12\%$$

Corrected Landing Ground Roll	= 890 feet - [12% (890)]
	= 890 feet - 107 feet
	= 783 feet
Corrected Total Distance Required	= 2270 - [12% (2270)]
	= 2270 feet - 272 feet
	= 1998 feet

Rate-Of-Climb — Balked Landing Climb (Figure 5-16)

(1) Enter Figure 5-16 at 7°C (45°F).
(2) Proceed vertically up to the 1700-foot pressure altitude line.
(3) Proceed horizontally right to the weight reference line. Follow the guidelines up and to the right until intersecting the vertical 5903-pound weight line.
(4) Proceed horizontally right to determine the rate-of-climb. (1035 Feet per minute)

Total Fuel Required	= Start, taxi and climb fuel + cruise fuel + descent fuel
	= 111 pounds + 458 pounds + 29 pounds = 598 pounds (Without Holding Fuel) or 598 pounds + 97 pounds = 695 pounds (With 45 Minutes Holding Fuel)

Holding Time (Figure 5-23)

To determine holding time, the fuel available for holding must be determined.

Fuel Available for Holding	= Initial fuel - [start, taxi and climb fuel + cruise fuel + descent fuel]
	= 978 pounds - [111 pounds + 458 pounds + 29 pounds]
	= 380 pounds

(1) Enter Figure 5-23 at 380 pounds of fuel available.
(2) Proceed vertically up to the intersection with the guideline.
(3) Proceed horizontally left to obtain holding time available. (2.9 hours)

AIRSPEED CALIBRATION
NORMAL STATIC SOURCE

NOTE:
1. Indicated airspeed assumes zero instrument error.

2. The following calibrations are not valid in the prestall buffet.

3. The following calibrations are valid for the pilot's and copilot's airspeed indicators when the standard or optional dual static system is installed.

Gear Up Flaps 0°		Gear Down Flaps 15°		Gear Down Flaps 45°	
KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
70	70	70	71	70	71
80	80	80	81	80	80
90	90	90	91	90	90
--	--	--	--	94 *	93 *
100	100	100	100	100	99
110	110	110	109	110	109
120	119	120	119	120	117
140	139	130	128	130	127
160	158	140	138	140	136
180	178	150	147	145	140
200	197	160	157	---	---
220	216	170	166	---	---
230	226	179	175	---	---
237	232	---	---	---	---

*Recommended Minimum All Engines Approach Speed At 6750 Pounds With 45° Wing Flaps.

Figure 5-1

AIRSPEED CALIBRATION
ALTERNATE STATIC SOURCE

NOTE:

1. Indicated airspeed assumes zero instrument error.

2. The following calibrations are not valid in the prestall buffet.

3. The following calibrations are valid for pilot's and copilot's airspeed indicators when the standard static system is installed.

4. An alternate static source is not available for copilot's instruments when optional dual static system is installed.

Gear Up Flaps 0°		Gear Down Flaps 15°		Gear Down Flaps 45°	
KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
---	---	---	---	70	75
80	89	80	85	80	83
90	98	90	94	90	92
---	---	---	---	92 *	93 *
100	108	100	102	100	100
110	117	110	111	110	109
120	126	120	119	120	117
140	144	130	128	130	126
160	163	140	136	140	134
180	181	150	145	150	143
200	199	160	153	---	---
220	218	180	170	---	---
240	236	---	---	---	---

*Recommended Minimum All Engines Approach Speed At 6750 Pounds With 45° Wing Flaps.

Figure 5-2

ALTIMETER CORRECTION
NORMAL STATIC SOURCE

NOTE:
1. Add correction to indicated altimeter reading.

2. The following calibrations are valid for the pilot's and copilot's altimeters when the standard or optional dual static system is installed.

Altitude	Sea Level			10,000 Feet			20,000 Feet		
Gear	Up	Down	Down	Up	Down	Down	Up	Down	Down
Flaps	0°	15°	45°	0°	15°	45°	0°	15°	45°
KIAS	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet
70	+3	+8	+5	+3	+10	+6	+5	+14	+9
80	+1	+6	0	+1	+7	0	+2	+11	0
90	0	+4	-5	0	+5	-6	0	+7	-9
94*	----	----	-8	----	----	-9	----	----	-14
100	-1	0	-10	-2	0	-12	-3	0	-17
110	-2	-5	-19	-2	-6	-22	-3	-9	-33
120	-2	-8	-25	-3	-9	-29	-4	-14	-43
140	-13	-21	-50	-15	-24	-63	-22	-37	-90
160	-21	-39	----	-24	-49	----	-36	-68	----
180	-31	-58	----	-39	-78	----	-55	-110	----
200	-55	----	----	-69	----	----	-100	----	----
220	-73	----	----	-90	----	----	-130	----	----
230	-87	----	----	-111	----	----	-157	----	----
237	-100	----	----	-132	----	----	-183	----	----

*Recommended Minimum All Engines Approach Speed At 6750 Pounds With 45° Wing Flaps.

ALTITUDE CORRECTION PROCEDURE

[INDICATED ALTITUDE TO FLY] = [DESIRED ALTITUDE (MSL)] - [ALTIMETER CORRECTION]

Figure 5-3

ALTIMETER CORRECTION
ALTERNATE STATIC SOURCE

NOTE:
1. Add correction to indicated altimeter reading.

2. The following calibrations are valid for pilot's and copilot's altimeters when the standard static system is installed.

3. An alternate static source is not available for copilot's instruments when the optional dual static system is installed.

Altitude	Sea Level			10,000 Feet			20,000 Feet		
Gear	Up	Down	Down	Up	Down	Down	Up	Down	Down
Flaps	0°	15°	45°	0°	15°	45°	0°	15°	45°
KIAS	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet
80	64	36	24	87	48	32	120	67	44
90	68	28	16	91	38	22	127	53	30
92 *	68	26	14	91	36	19	127	49	26
100	68	18	5	92	24	6	128	34	8
120	63	-11	-30	85	-15	-41	122	-20	-57
140	51	-48	-76	69	-65	-103	95	-90	-143
160	36	-102	----	49	-138	----	68	-191	----
180	12	-174	----	16	-235	----	22	-326	----
200	-13	----	----	-18	----	----	-24	----	----
220	-51	----	----	-70	----	----	-96	----	----
240	-90	----	----	-123	----	----	-170	----	----

*Recommended Minimum All Engines Approach Speed At 6750 Pounds With 45° Wing Flaps

ALTITUDE CORRECTION PROCEDURE

[INDICATED ALTITUDE TO FLY] = [DESIRED ALTITUDE (MSL)] - [ALTIMETER CORRECTION]

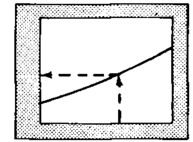
Figure 5-4

TEMPERATURE RISE DUE TO RAM RECOVERY

RECOVERY FACTOR (K) = .90

NOTE:

1. Subtract temperature rise from indicated outside air temperature to obtain true outside air temperature



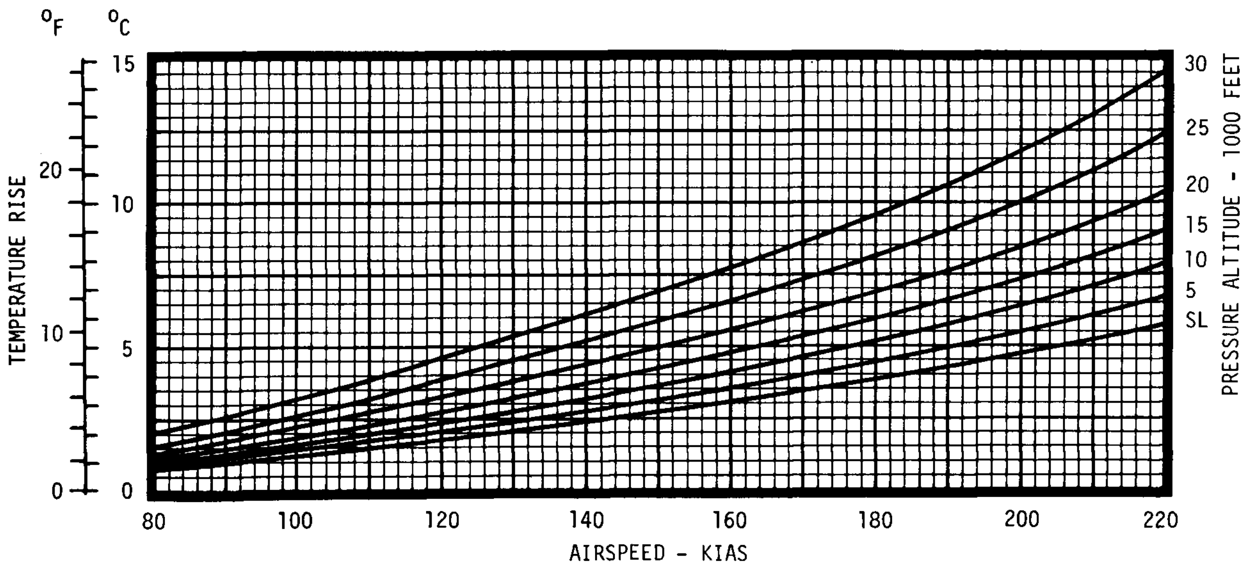
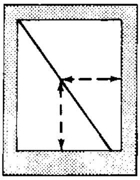


Figure 5-5



TEMPERATURE CONVERSION FROM FAHRENHEIT TO CELSIUS

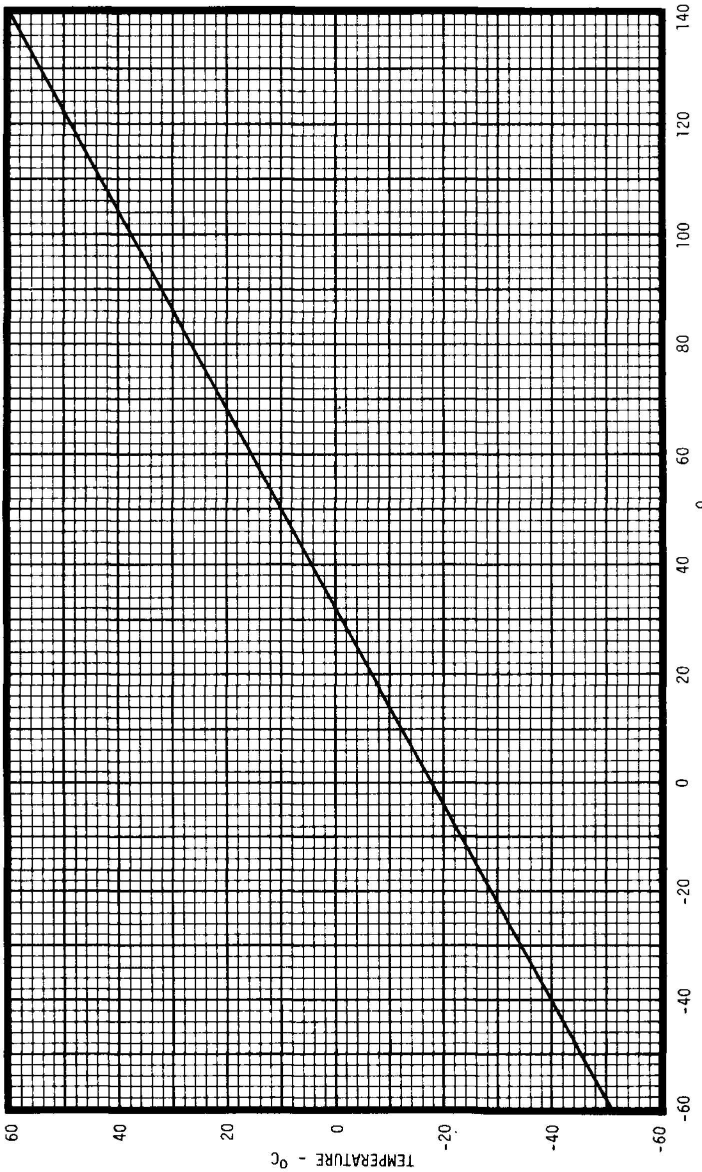


Figure 5-6

PRESSURE CONVERSION
INCHES OF MERCURY TO MILLIBARS

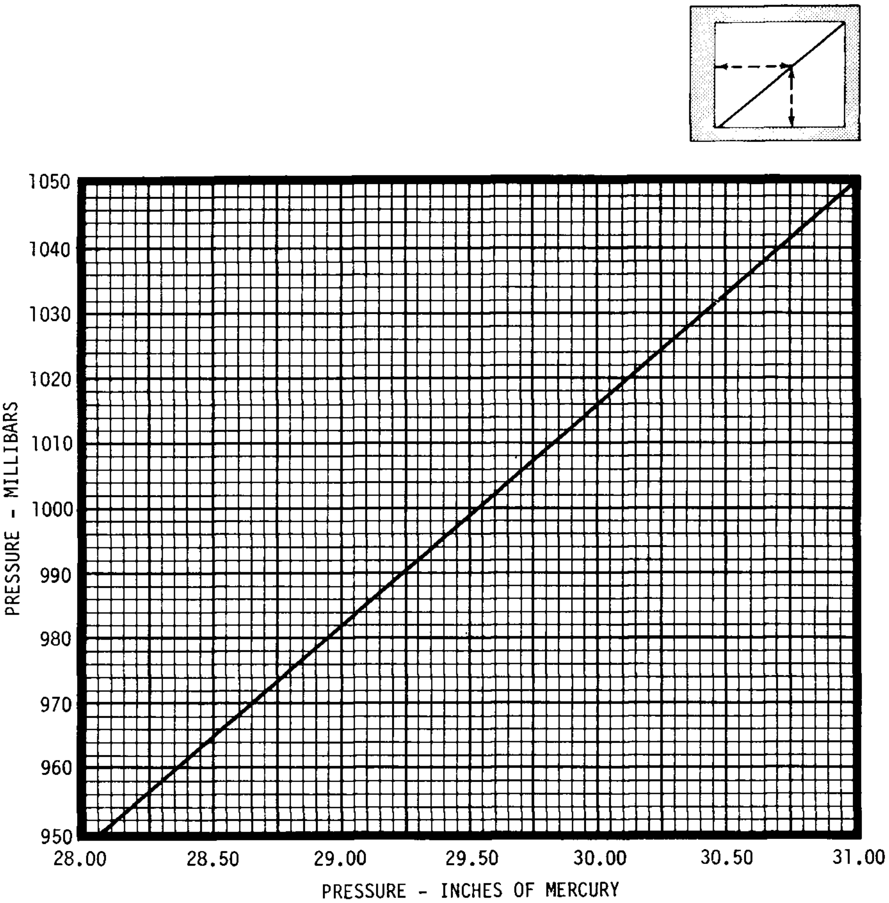


Figure 5-7

STALL SPEEDS

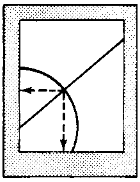
CONDITIONS:
Throttles - IDLE

NOTE:
Maximum altitude lost during a stall is 300 feet.

WEIGHT Pounds	Configuration		ANGLE OF BANK							
			0°		20°		40°		60°	
	Flaps	Gear	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
6750	0°	Up	82	82	85	85	94	94	116	116
	15°	Down	76	77	79	80	87	88	111	110
	45°	Down	71	72	73	74	82	82	103	102
6200	0°	Up	79	79	81	81	90	90	111	111
	15°	Down	73	74	76	77	84	85	105	105
	45°	Down	67	69	70	71	79	79	98	97
5700	0°	Up	75	75	78	78	86	86	107	107
	15°	Down	70	71	72	73	80	81	101	101
	45°	Down	65	66	67	68	74	75	94	93
5200	0°	Up	72	72	74	74	82	82	102	102
	15°	Down	67	68	69	70	77	78	96	96
	45°	Down	61	63	63	65	71	72	90	89

Figure 5-8

WIND COMPONENT



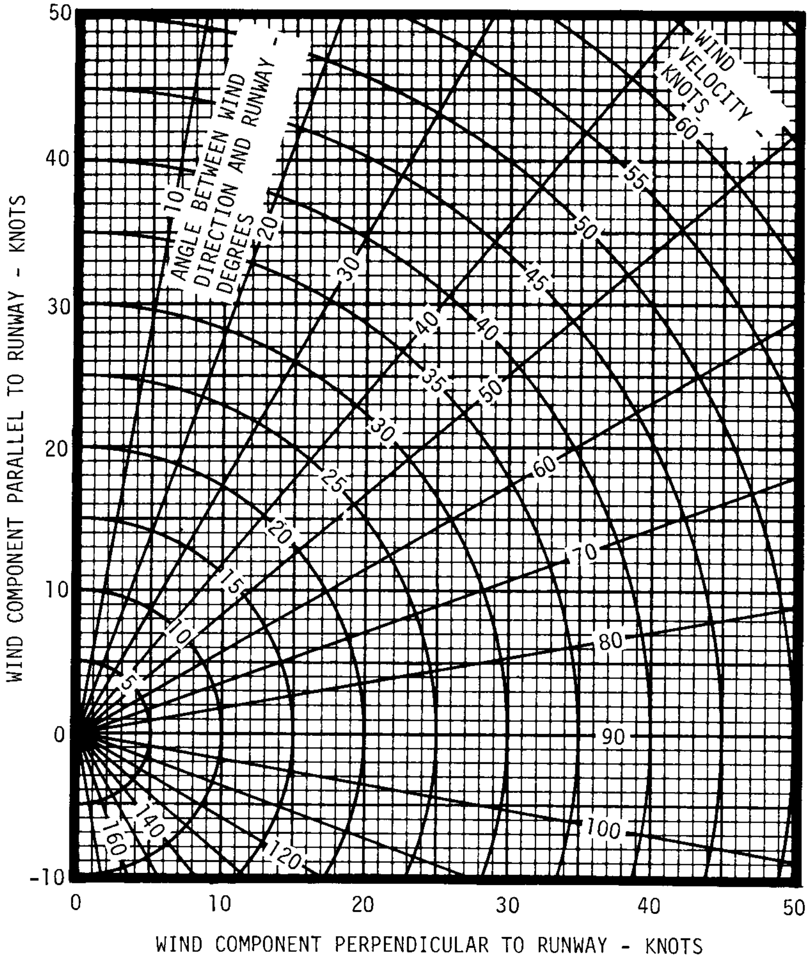


Figure 5-9

NORMAL TAKEOFF DISTANCE

CONDITIONS:
1. 2700 RPM and 38.0 Inches Hg. Manifold Pressure Before Brake Release.
2. Mixtures - CHECK Fuel Flows In the White Arc.
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.

NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 7% for each 10 knots headwind.
3. Increase distance 5% for each 2 knots tailwind.

WEIGHT-POUNDS	TAKEOFF TO 50-FOOT OBSTACLE SPEED-KIAS	PRESSURE ALTITUDE-FEET	-20°C (-4°F)		-10°C (14°F)		0°C (32°F)		10°C (50°F)	
			GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET
6750	98	Sea Level	1560	1870	1710	2040	1870	2230	2040	2430
		1000	1660	1970	1810	2150	1980	2350	2220	2620
		2000	1760	2080	1920	2270	2150	2530	2350	2770
		3000	1860	2200	2090	2450	2280	2680	2500	2930
		4000	2020	2370	2210	2590	2420	2830	2650	3100
		5000	2150	2500	2350	2740	2570	2990	2820	3280
		6000	2280	2650	2500	2900	2730	3170	3000	3480
		7000	2420	2800	2650	3070	2910	3360	3190	3690
		8000	2580	2970	2830	3250	3100	3570	3400	3920
		9000	2740	3150	3010	3450	3310	3790	3630	4170
		10,000	2930	3350	3210	3670	3530	4030	3880	4440
6200	94	Sea Level	1280	1540	1400	1680	1530	1830	1670	1990
		1000	1360	1630	1480	1770	1620	1930	1770	2100
		2000	1440	1720	1570	1870	1720	2040	1880	2220
		3000	1530	1810	1670	1980	1820	2150	2040	2400
		4000	1620	1910	1770	2090	1980	2320	2160	2530
		5000	1720	2030	1920	2250	2100	2450	2300	2680
		6000	1870	2180	2040	2380	2230	2590	2440	2840
		7000	1980	2300	2170	2520	2370	2750	2600	3010
		8000	2110	2440	2310	2670	2530	2920	2770	3190
		9000	2250	2590	2460	2830	2690	3100	2950	3390
		10,000	2390	2740	2620	3000	2870	3290	3150	3610
5700	90	Sea Level	1050	1280	1150	1390	1250	1510	1360	1640
		1000	1120	1350	1220	1460	1330	1590	1450	1730
		2000	1180	1420	1290	1540	1410	1680	1530	1830
		3000	1260	1500	1370	1630	1490	1770	1630	1930
		4000	1330	1580	1460	1720	1590	1880	1730	2040
		5000	1420	1670	1550	1820	1690	1990	1880	2200
		6000	1510	1770	1650	1930	1830	2140	2000	2330
		7000	1600	1880	1780	2070	1950	2260	2130	2470
		8000	1730	2010	1890	2200	2070	2400	2260	2620
		9000	1840	2130	2020	2330	2200	2540	2410	2780
		10,000	1960	2260	2150	2470	2350	2700	2570	2950
5200	86	Sea Level	850	1040	930	1130	1010	1230	1100	1330
		1000	900	1100	980	1190	1070	1290	1160	1400
		2000	960	1160	1040	1260	1130	1370	1240	1480
		3000	1010	1220	1110	1330	1200	1440	1310	1570
		4000	1080	1290	1170	1400	1280	1520	1390	1660
		5000	1140	1360	1250	1480	1360	1610	1480	1750
		6000	1220	1440	1330	1570	1450	1710	1580	1860
		7000	1300	1530	1410	1660	1540	1810	1680	1970
		8000	1380	1620	1510	1760	1640	1920	1820	2110
		9000	1470	1720	1630	1890	1770	2060	1940	2240
		10,000	1580	1840	1730	2000	1890	2180	2060	2380

Figure 5-10 (Sheet 1 of 2)

NORMAL TAKEOFF DISTANCE

CONDITIONS:
1. 2700 RPM and 38.0 Inches Hg. Manifold Pressure Before Brake Release.
2. Mixtures - CHECK Fuel Flows In the White Arc.
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.

NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 7% for each 10 knots headwind.
3. Increase distance 5% for each 2 knots tailwind.

WEIGHT-POUNDS	TAKEOFF TO 50-FOOT OBSTACLE SPEED-KIAS	PRESSURE ALTITUDE-FEET	20°C (68°F)		30°C (86°F)		40°C (104°F)	
			GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET
6750	98	Sea Level	2290	2720	2510	2980	2750	3270
		1000	2430	2870	2660	3150	2920	3460
		2000	2570	3030	2820	3330	3100	3660
		3000	2730	3210	3000	3520	3290	3880
		4000	2900	3400	3190	3730	3500	4120
		5000	3090	3600	3390	3960	3730	4370
		6000	3290	3820	3610	4210	3980	4650
		7000	3500	4060	3850	4470	4250	4950
		8000	3740	4310	4110	4760	4540	5270
		9000	3990	4590	4400	5070	4850	5630
		10,000	4270	4890	4700	5410	5200	6010
6200	94	Sea Level	1820	2170	1990	2370	2230	2660
		1000	1930	2300	2160	2560	2370	2810
		2000	2100	2480	2290	2710	2510	2970
		3000	2230	2620	2440	2860	2670	3140
		4000	2360	2770	2590	3030	2840	3330
		5000	2510	2930	2750	3210	3020	3530
		6000	2670	3110	2930	3410	3220	3750
		7000	2850	3300	3120	3620	3430	3990
		8000	3040	3500	3330	3850	3660	4240
		9000	3240	3720	3560	4090	3920	4520
		10,000	3460	3960	3800	4360	4190	4820
5700	90	Sea Level	1490	1790	1620	1950	1770	2120
		1000	1580	1890	1720	2060	1880	2240
		2000	1670	1990	1830	2170	2050	2430
		3000	1780	2110	1990	2340	2170	2560
		4000	1930	2270	2110	2480	2310	2710
		5000	2050	2400	2240	2620	2460	2880
		6000	2180	2540	2390	2780	2620	3050
		7000	2320	2700	2540	2950	2790	3240
		8000	2480	2860	2710	3130	2970	3440
		9000	2640	3040	2890	3330	3170	3660
		10,000	2820	3230	3090	3550	3390	3900
5200	86	Sea Level	1190	1450	1300	1570	1420	1710
		1000	1270	1530	1380	1660	1500	1810
		2000	1350	1610	1470	1750	1600	1910
		3000	1430	1700	1560	1850	1700	2020
		4000	1520	1800	1660	1960	1810	2140
		5000	1620	1910	1760	2080	1960	2310
		6000	1720	2020	1910	2240	2090	2440
		7000	1860	2170	2040	2370	2230	2590
		8000	1980	2300	2170	2520	2370	2750
		9000	2110	2440	2310	2670	2530	2920
		10,000	2260	2600	2470	2840	2700	3110

Figure 5-10 (Sheet 2 of 2)

ACCELERATE STOP DISTANCE

CONDITIONS:
1. 2700 RPM and 38.0 Inches Hg. Manifold Pressure Before Brake Release.
2. Mixtures - CHECK Fuel Flows In the White Arc.
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.
6. Engine Failure at Engine Failure Speed.
7. Idle Power and Maximum Effective Braking After Engine Failure.

NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 3% for each 4 knots headwind.
3. Increase distance 5% for each 2 knots tailwind.

WEIGHT - POUNDS	ENGINE FAILURE SPEED - KIAS	PRESSURE ALTITUDE - FEET	TOTAL DISTANCE - FEET						
			-20°C -4°F	-10°C +14°F	0°C 32°F	+10°C +50°F	+20°C +68°F	+30°C +86°F	+40°C +104°F
6750	98	Sea Level	3370	3590	3820	4120	4390	4670	4980
		1000	3530	3760	4060	4320	4600	4900	5240
		2000	3700	3990	4250	4530	4830	5150	5500
		3000	3880	4180	4460	4750	5070	5410	5790
		4000	4120	4390	4680	4990	5330	5690	6090
		5000	4320	4610	4920	5250	5610	5990	6420
		6000	4540	4840	5170	5520	5900	6320	6770
		7000	4770	5090	5440	5810	6220	6660	7140
		8000	5010	5360	5730	6130	6560	7030	7550
		9000	5280	5640	6040	6460	6920	7420	7980
		10,000	5560	5950	6370	6820	7310	7850	8450
6200	94	Sea Level	2780	2960	3150	3340	3560	3780	4090
		1000	2910	3100	3300	3510	3730	4030	4290
		2000	3050	3250	3460	3680	3970	4230	4510
		3000	3200	3410	3630	3910	4170	4440	4740
		4000	3360	3580	3850	4110	4380	4670	4990
		5000	3530	3800	4050	4310	4600	4910	5250
		6000	3740	3990	4250	4540	4840	5170	5530
		7000	3930	4190	4470	4770	5100	5450	5840
		8000	4130	4410	4710	5030	5370	5750	6160
		9000	4350	4640	4960	5300	5670	6070	6510
		10,000	4580	4890	5230	5590	5990	6410	6880
5700	90	Sea Level	2300	2450	2600	2760	2930	3120	3310
		1000	2410	2560	2720	2890	3080	3270	3480
		2000	2530	2690	2860	3040	3230	3430	3710
		3000	2650	2820	3000	3190	3390	3650	3890
		4000	2780	2960	3150	3350	3610	3840	4100
		5000	2920	3110	3310	3560	3790	4040	4310
		6000	3060	3260	3510	3740	3980	4250	4540
		7000	3220	3460	3690	3930	4190	4480	4780
		8000	3410	3640	3880	4140	4420	4720	5050
		9000	3590	3830	4090	4360	4660	4980	5330
		10,000	3780	4030	4310	4600	4920	5260	5630
5200	86	Sea Level	1870	1990	2110	2240	2380	2520	2680
		1000	1960	2080	2210	2350	2490	2650	2810
		2000	2050	2180	2320	2460	2610	2780	2950
		3000	2150	2290	2430	2580	2750	2920	3110
		4000	2260	2400	2550	2710	2890	3070	3270
		5000	2370	2520	2680	2850	3030	3230	3480
		6000	2490	2650	2820	3000	3190	3430	3660
		7000	2620	2790	2970	3190	3390	3620	3860
		8000	2750	2930	3150	3350	3570	3810	4070
		9000	2900	3110	3310	3530	3760	4020	4290
		10,000	3070	3270	3490	3720	3970	4240	4530

Figure 5-11

ACCELERATE GO DISTANCE

CONDITIONS:
1. 2700 RPM and 38.0 Inches Hg. Manifold Pressure Before Brake Release.
2. Mixtures - CHECK Fuel Flows In The White Arc.
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level Hard Surface Dry Runway.
6. Engine Failure At Engine Failure Speed.
7. Landing Gear Up On In Transit And Propeller Feathered During Climb.
8. Maintain Engine Failure Speed Until Clear of Obstacle.

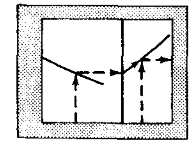
NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 6% for each 10 knots headwind.
3. Increase distance 2% for each knot of tailwind.
4. Distance in boxes represent rates of climb less than 50 ft/min.

WEIGHT - POUNDS	ENGINE FAILURE - SPEED - KIAS	PRESSURE ALTITUDE - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE - FEET						
			-20°C -4°F	-10°C +14°F	0°C 32°F	+10°C +50°F	+20°C +68°F	+30°C +86°F	+40°C +104°F
6750	98	Sea Level	2590	2870	3200	3600	4160	4830	5800
		1000	2730	3030	3390	3880	4430	5190	6330
		2000	2880	3210	3640	4120	4740	5610	6970
		3000	3050	3440	3860	4390	5090	6090	7770
		4000	3270	3650	4110	4690	5480	6660	8780
		5000	3460	3870	4380	5030	5930	7340	10,160
		6000	3660	4110	4670	5410	6450	8190	12,170
		7000	3890	4380	5000	5840	7070	9280	15,500
		8000	4140	4680	5380	6330	7820	10,770	------
		9000	4410	5010	5800	6910	8750	12,990	------
		10,000	4710	5380	6280	7600	9970	16,780	------
6200	94	Sea Level	2070	2270	2500	2770	3080	3470	4010
		1000	2180	2390	2640	2930	3270	3740	4280
		2000	2290	2520	2790	3090	3510	3970	4570
		3000	2420	2660	2940	3320	3730	4240	4910
		4000	2550	2810	3160	3520	3960	4520	5290
		5000	2690	3010	3340	3740	4220	4850	5720
		6000	2880	3190	3540	3970	4510	5210	6220
		7000	3040	3370	3760	4230	4830	5260	6810
		8000	3220	3580	4000	4520	5180	6100	7520
		9000	3420	3810	4270	4840	5590	6650	8410
		10,000	3630	4060	4560	5200	6050	7300	9560
5700	90	Sea Level	1690	1840	2010	2200	2430	2690	2990
		1000	1770	1930	2110	2320	2560	2840	3170
		2000	1860	2030	2230	2450	2700	3000	3420
		3000	1960	2140	2350	2580	2860	3230	3630
		4000	2060	2260	2480	2730	3070	3420	3860
		5000	2170	2380	2620	2930	3250	3630	4110
		6000	2290	2510	2800	3100	3440	3870	4400
		7000	2420	2690	2960	3280	3660	4120	4710
		8000	2580	2840	3140	3480	3900	4400	5060
		9000	2730	3010	3330	3710	4160	4720	5460
		10,000	2900	3200	3540	3950	4440	5070	5910
5200	86	Sea Level	1360	1480	1610	1750	1910	2100	2310
		1000	1430	1550	1690	1840	2010	2210	2440
		2000	1500	1630	1770	1940	2120	2330	2570
		3000	1570	1710	1870	2040	2240	2460	2720
		4000	1650	1800	1970	2150	2360	2600	2880
		5000	1740	1900	2070	2270	2490	2750	3100
		6000	1830	2000	2190	2400	2640	2950	3290
		7000	1940	2110	2310	2540	2830	3130	3490
		8000	2040	2240	2450	2720	3000	3320	3720
		9000	2160	2380	2620	2880	3180	3540	3970
		10,000	2300	2520	2770	3050	3380	3700	4240

Figure 5-12

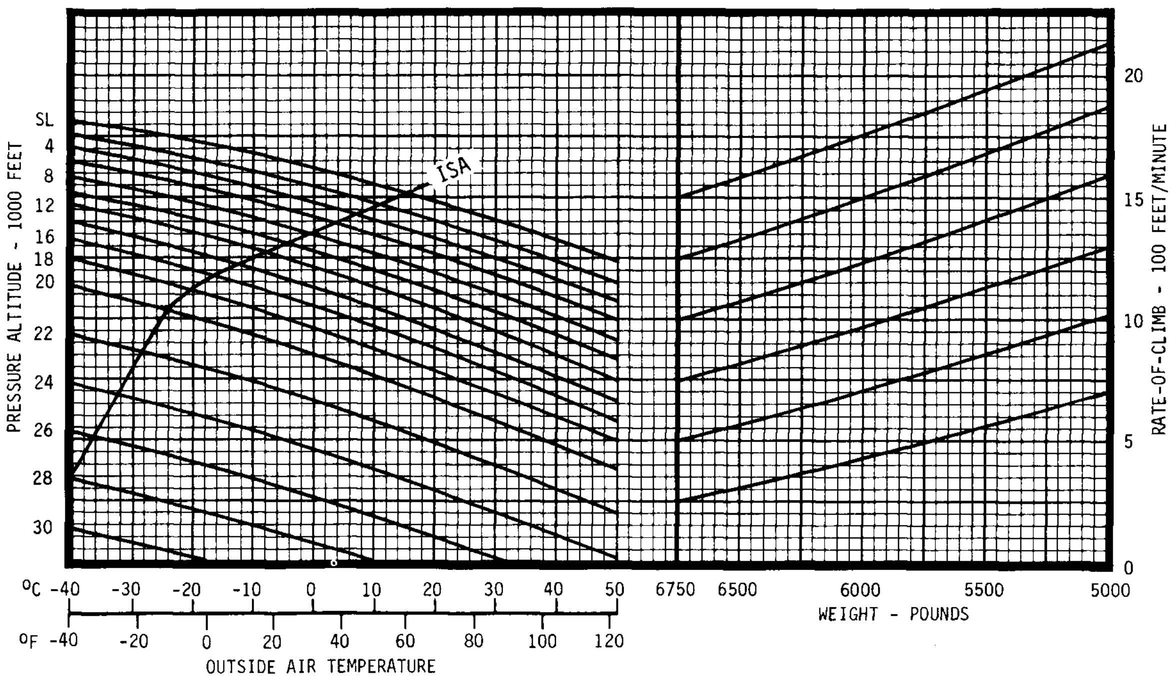
RATE-OF-CLIMB - MAXIMUM CLIMB

ALTITUDE - FEET	CLIMB SPEED - KIAS
SL	108
20,000	107
30,000	104



CONDITIONS:
1. 2600 RPM and 38.0 Inches Hg.*
2. Mixture - Fuel Flow White Triangle.
3. Landing Gear - UP.
4. Wing Flaps - UP.
5. Cowl Flaps - OPEN.

*Above 20,000 Feet, Use Placarded Manifold Pressure

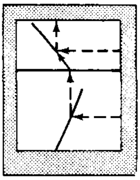


54847044

Figure 5-13

RATE-OF-CLIMB - CRUISE CLIMB

CONDITIONS:
1. 2450 RPM and 31.5 Inches Hg.
2. Landing Gear - UP.
3. Wing Flaps - UP.
4. Cowl Flaps - AS REQUIRED.
5. Airspeed - 120 KIAS.
6. Mixtures - 120 Lbs/Hr Fuel Flow (Blue Triangle).



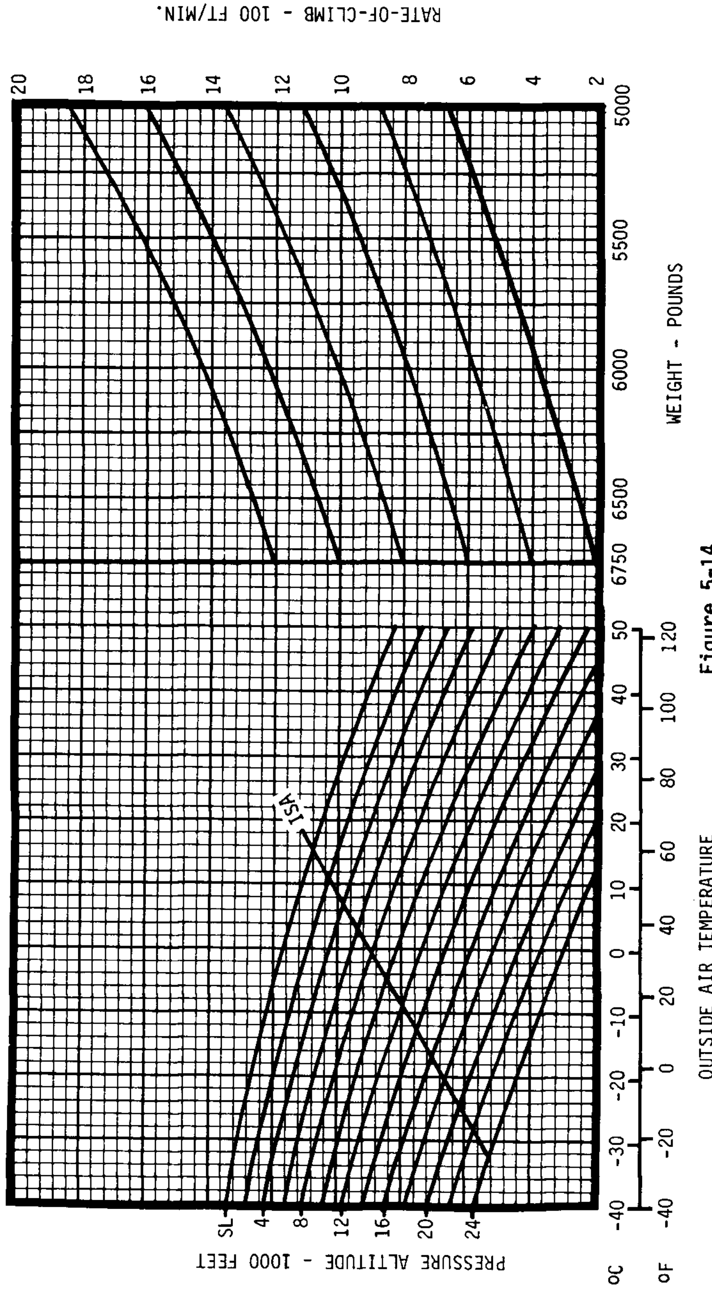
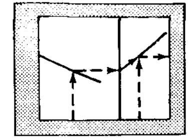


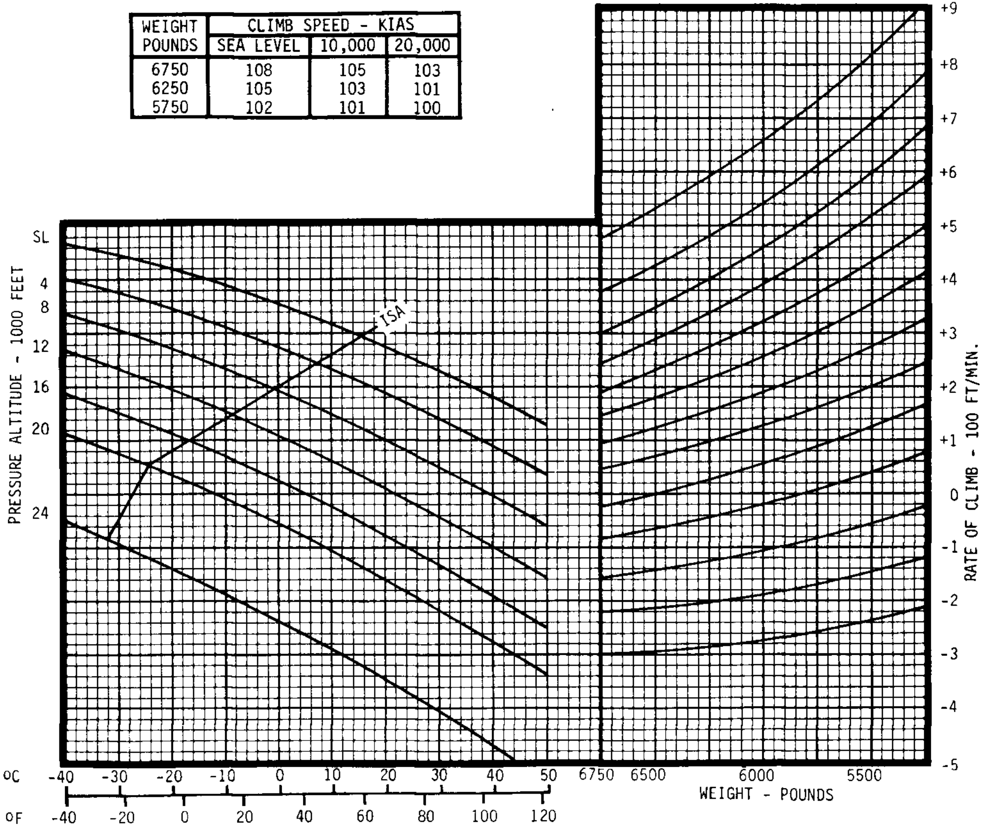
Figure 5-14

54847040

RATE-OF-CLIMB - ONE ENGINE INOPERATIVE

WEIGHT POUNDS	CLIMB SPEED - KIAS		
	SEA LEVEL	10,000	20,000
6750	108	105	103
6250	105	103	101
5750	102	101	100





CONDITIONS:
1. 2700 RPM and 38.0 Inches Hg.*
2. Mixture - Check Fuel Flow in White Arc.*
3. Landing Gear - UP.
4. Wing Flaps - UP.
5. Inoperative Propeller - FEATHERED.
6. Wings Banked 5° Toward Operative Engine with Approximately 1/2 Ball Slip Indicated on the Turn and Bank Indicator.
7. Cowl Flaps - Closed on Inoperative Engine.

*Above 20,000 Feet, Use Placarded Manifold Pressure and Climb Fuel Flow.

NOTE: Approximate Effect of Configuration on Single-Engine Rate-of-Climb.

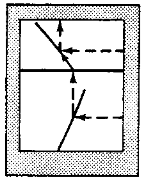
Subtract values listed below from value obtained in the graph. Effects for a combination of gear, flap or windmilling propeller may be obtained by adding the effects for each.

Inoperative Engine Windmilling	400 Ft/Min
Gear Down	350 Ft/Min
Flaps Down 15°	200 Ft/Min
Flaps Down 45°	800 Ft/Min

Figure 5-15

54847041

RATE-OF-CLIMB - BALKED LANDING CLIMB



CONDITIONS:
1. 2700 RPM and 38.0 Inches Hg.
2. Mixtures - Check Fuel Flows In White Arc.
3. Landing Gear - DOWN.
4. Wing Flaps - 45°.
5. Cowl Flaps - OPEN.
6. Climb Speed - 82 KIAS.

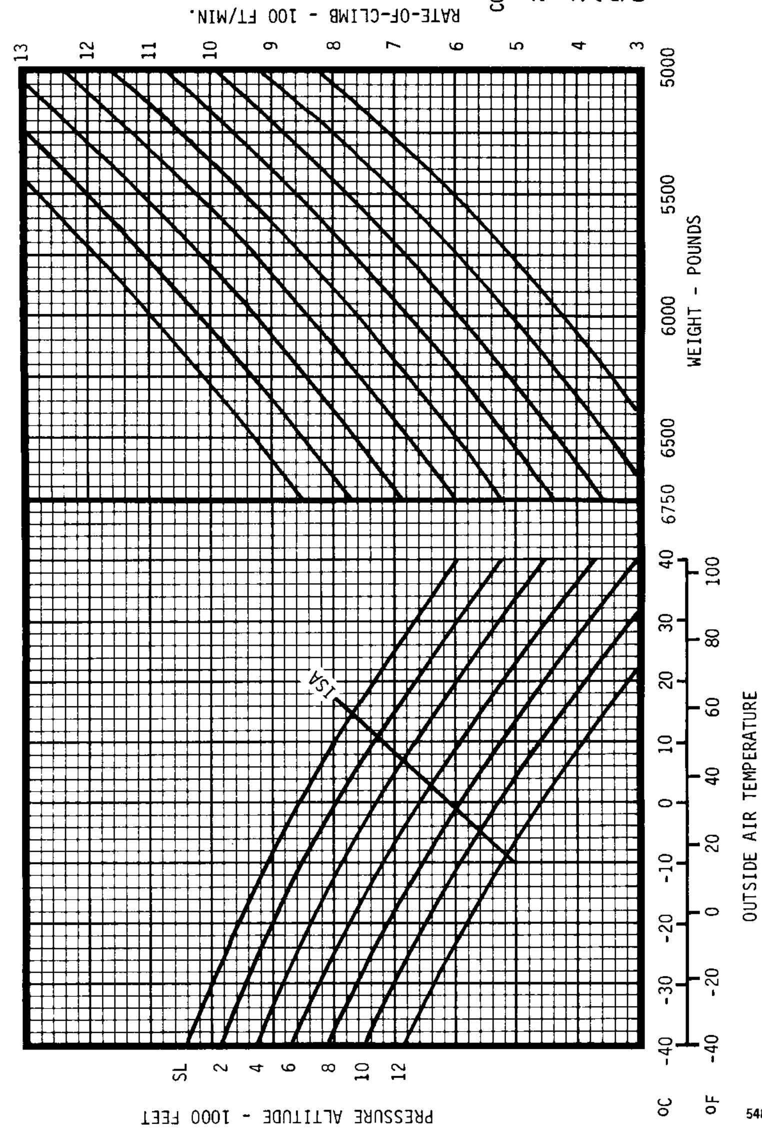


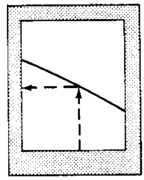
Figure 5-16

54847042

ENGINE INOPERATIVE SERVICE CEILING

CONDITIONS:
1. One Engine Inoperative Climb Configuration.

NOTE:
1. Engine inoperative service ceiling is the maximum altitude where the airplane has the capability of climbing 50 feet per minute with one engine inoperative and feathered.
2. Increase indicated service ceiling 100 feet for each 0.10 inch Hg. altimeter setting greater than 29.92.
3. Decrease indicated service ceiling 100 feet for each 0.10 inch Hg. altimeter setting less than 29.92.
4. This chart provides performance information to aid in route selection when operating under FAR 135.181 and 91.119 requirements.



WEIGHT	CLIMB SPEED - KIAS		
POUNDS	SL	10,000	20,000
6750	108	105	103
6200	105	103	101
5700	102	101	100
5200	99	98	97

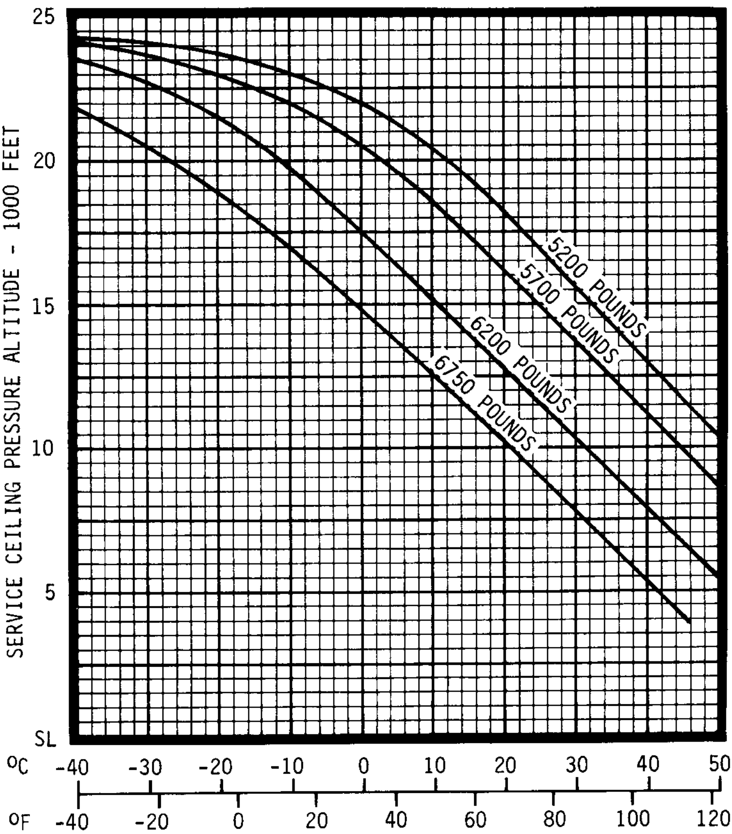
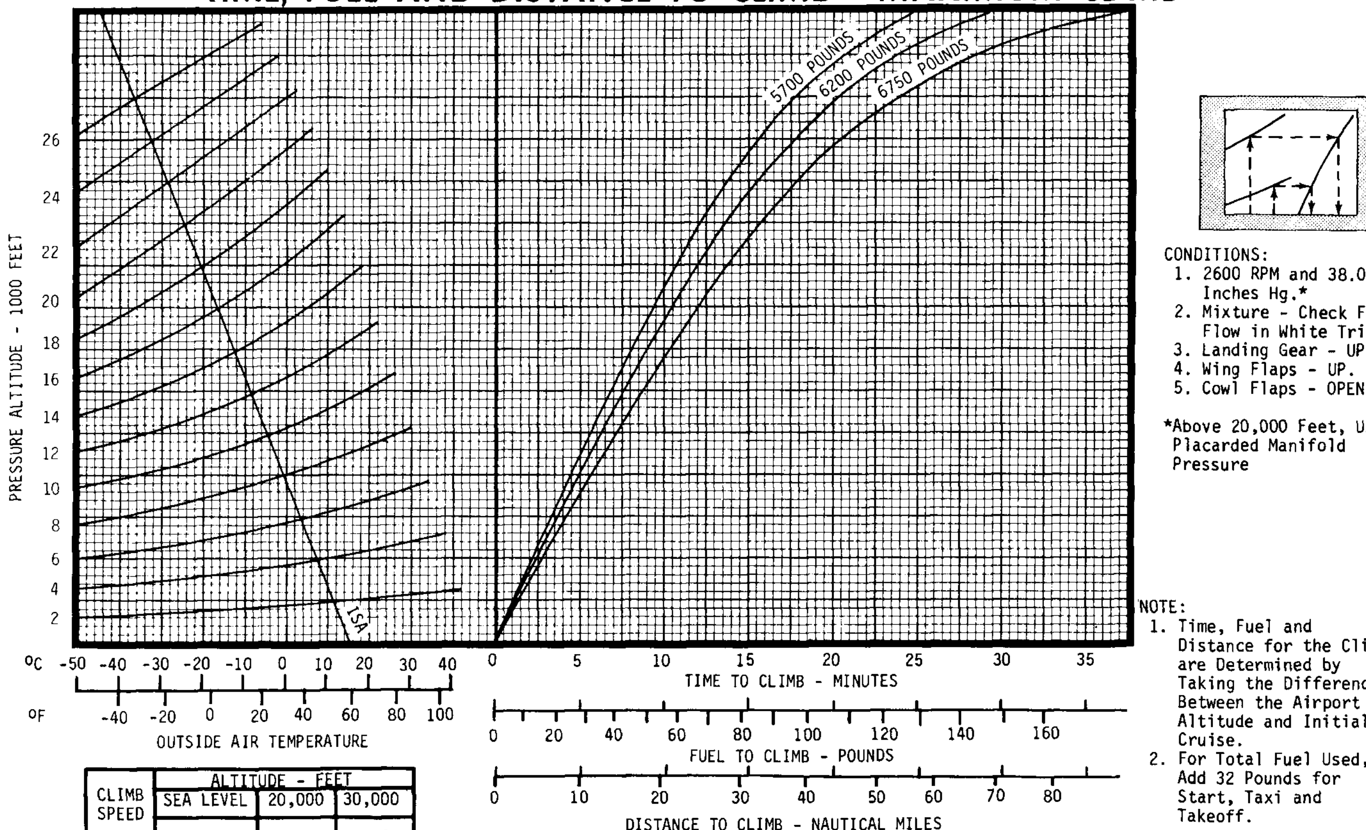


Figure 5-17

TIME, FUEL AND DISTANCE TO CLIMB - MAXIMUM CLIMB



CONDITIONS:
1. 2600 RPM and 38.0 Inches Hg.*
2. Mixture - Check Fuel Flow in White Triangle.
3. Landing Gear - UP.
4. Wing Flaps - UP.
5. Cowl Flaps - OPEN.

*Above 20,000 Feet, Use Placarded Manifold Pressure

NOTE:
1. Time, Fuel and Distance for the Climb are Determined by Taking the Difference Between the Airport Altitude and Initial Cruise.
2. For Total Fuel Used, Add 32 Pounds for Start, Taxi and Takeoff.

CLIMB SPEED	ALTITUDE - FEET		
	SEA LEVEL	20,000	30,000
	108	107	104

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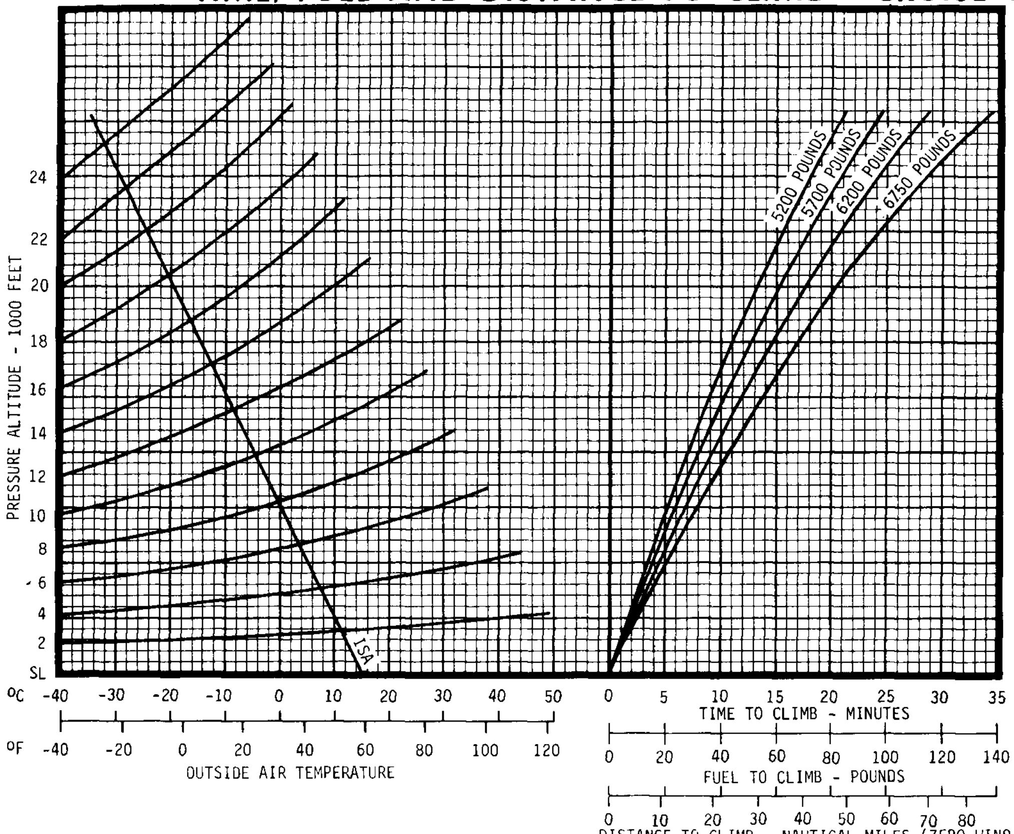
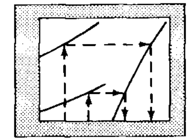
Figure 5-18

TIME, FUEL AND DISTANCE TO CLIMB - CRUISE CLIMB





CONDITIONS:
1. 2450 RPM And 31.5 Inches Hg.
2. Landing Gear - UP.
3. Wing Flaps - UP
4. Cowl Flaps - AS REQUIRED.
5. Airspeed - 120 KIAS.
6. Mixtures - 120 Pounds/Hour Fuel Flow (Blue Triangle).

NOTE:
1. Time, fuel and distance for the climb are determined by taking the difference between the airport altitude and initial cruise altitude conditions.
2. For total fuel used, add 32 pounds for start, taxi and takeoff.

Figure 5-19

CRUISE PERFORMANCE
WITH RECOMMENDED LEAN MIXTURE

NOTE:

1. At Sea Level, increase speed by 4 KTAS for each 1000 pounds below 6750 pounds.
2. At 5000 feet, increase speed by 5 KTAS for each 1000 pounds below 6750 pounds.
3. Operations at peak EGT may be utilized with power settings within the boxes if the airplane is equipped with the optional EGT system.

			-5°C (23°F)			15°C (STD TEMP) (59°F)			35°C (95°F)		
ALTITUDE	RPM	MP	PERCENT BHP	KTAS	TOTAL LB/HR	PERCENT BHP	KTAS	TOTAL LB/HR	PERCENT BHP	KTAS	TOTAL LB/HR
SEA LEVEL	2450	31.5	79.5	174	215	74.8	174	204	70.2	173	192
	2450	29.0	73.5	169	200	69.2	169	189	64.9	167	178
	2450	27.0	67.9	164	186	63.9	163	175	60.0	162	166
	2450	25.5	62.9	159	173	59.2	158	164	55.6	156	155
	2300	34.0	79.5	174	215	74.8	174	204	70.2	173	192
	2300	32.5	76.8	172	208	72.3	172	197	67.9	171	185
	2300	30.5	72.2	168	197	68.0	167	186	63.8	166	175
	2300	29.0	67.6	163	185	63.6	163	175	59.7	162	165
	2300	27.0	62.3	158	171	58.6	157	163	55.0	155	154
	2300	25.0	57.3	153	160	53.9	151	151	50.6	149	143
	2200	34.0	74.5	170	203	70.2	169	191	65.8	168	180
	2200	33.0	72.2	168	197	68.0	167	186	63.8	166	175
	2200	31.0	67.9	164	186	63.9	163	175	60.0	162	166
	2200	29.0	63.3	159	174	59.6	158	165	55.9	156	156
	2200	27.0	58.3	154	162	54.9	152	154	51.5	150	146
	2200	25.0	53.7	148	151	50.5	146	143	47.4	144	135
	2100	31.5	64.6	160	177	60.8	160	168	57.0	158	159
	2100	29.0	59.3	155	164	55.8	154	156	52.4	152	148
	2100	27.5	55.0	150	154	51.8	148	146	48.6	146	138
	2100	25.5	50.3	144	143	47.4	142	135	44.5	139	128
			-15°C (5°F)			5°C (STD TEMP) (41°F)			25°C (77°F)		
5000 FEET	2450	31.5	79.5	182	215	74.8	182	204	70.2	181	192
	2450	29.5	73.5	177	200	69.2	176	189	64.9	175	178
	2450	27.5	68.1	171	186	64.1	170	176	60.1	169	166
	2450	25.5	63.3	166	174	59.6	165	165	55.9	163	156
	2300	34.0	79.5	182	215	74.8	182	204	70.2	181	192
	2300	33.0	76.8	180	208	72.3	179	197	67.9	178	185
	2300	31.0	72.4	175	197	68.1	175	186	63.9	174	175
	2300	29.0	68.1	171	186	64.1	170	176	60.1	169	166
	2300	27.0	62.6	165	172	58.9	164	163	55.3	162	155
	2300	25.5	57.6	159	160	54.3	158	152	50.9	155	144
	2200	34.0	74.7	178	203	70.3	177	192	66.0	176	180
	2200	33.0	72.4	175	197	68.1	175	186	63.9	174	175
	2200	31.0	68.2	171	186	64.2	171	176	60.2	169	167
	2200	29.0	63.6	166	175	59.9	165	166	56.2	163	157
	2200	27.0	58.6	160	163	55.2	159	154	51.8	156	146
	2200	25.5	54.3	155	152	51.1	153	145	48.0	150	137
	2100	32.0	65.2	168	179	61.4	167	169	57.6	165	160
	2100	29.5	59.6	162	165	56.1	160	157	52.6	158	148
	2100	27.5	55.6	156	156	52.4	155	148	49.1	152	140
	2100	26.0	51.3	150	145	48.3	148	138	45.3	145	130

Figure 5-20 (Sheet 1 of 3)

CRUISE PERFORMANCE WITH RECOMMENDED LEAN MIXTURE

NOTE:

1. At 10,000 Feet, increase speed by 5 KTAS for each 1000 pounds below 6750 pounds.
2. At 15,000 Feet, increase speed by 6 KTAS for each 1000 pounds below 6750 pounds.
3. Operations at Peak EGT may be utilized with power settings within the boxes if the airplane is equipped with the optional EGT system.

ALTITUDE	RPM	MP	-25°C (-13°F) PERCENT BHP	KTAS	TOTAL LB/HR	-5°C (STD TEMP) (23°F) PERCENT BHP	KTAS	TOTAL LB/HR	15°C (59°F) PERCENT BHP	KTAS	TOTAL LB/HR
10,000 FEET	2450	31.5	79.5	191	215	74.8	190	204	70.2	189	192
	2450	29.5	73.5	185	200	69.2	184	189	64.9	182	178
	2450	27.5	68.2	179	186	64.2	178	176	60.2	176	167
	2450	26.0	63.6	174	175	59.9	172	166	56.2	169	157
	2300	34.0	79.5	191	215	74.8	190	204	70.2	189	192
	2300	33.0	76.8	188	208	72.3	188	197	67.9	186	185
	2300	31.0	72.5	184	198	68.3	183	187	64.1	181	176
	2300	29.0	68.2	179	186	64.2	178	176	60.2	176	167
	2300	27.0	62.9	173	173	59.2	171	164	55.6	168	155
	2300	25.5	58.0	166	161	54.6	164	153	51.2	161	145
	2200	34.0	74.8	186	204	70.5	185	192	66.1	184	181
	2200	33.0	72.5	184	198	68.3	183	187	64.1	181	176
	2200	31.0	68.6	179	187	64.5	178	177	60.5	176	167
	2200	29.0	63.9	174	175	60.2	173	166	56.4	170	157
	2200	27.5	59.3	168	164	55.8	166	156	52.4	163	148
	2200	25.5	55.0	162	154	51.8	159	146	48.6	155	138
	2100	32.0	65.9	176	180	62.1	175	171	58.2	172	162
	2100	30.0	60.3	169	167	56.8	167	158	53.2	164	150
	2100	28.0	56.3	164	157	53.0	161	149	49.7	158	141
	2100	26.0	52.3	157	148	49.3	155	140	46.2	150	132
			-35°C (-30°F)			-15°C (STD TEMP) (6°F)			5°C (42°F)		
15,000 FEET	2450	31.5	79.5	200	215	74.8	199	204	70.2	197	192
	2450	29.5	73.5	193	200	69.2	192	189	64.9	190	178
	2450	27.5	68.4	187	187	64.4	186	177	60.4	183	167
	2450	26.0	63.9	181	175	60.2	179	166	56.4	176	157
	2300	34.0	79.5	200	215	74.8	199	204	70.2	197	192
	2300	33.0	76.8	197	208	72.3	196	197	67.9	194	185
	2300	31.0	72.7	192	198	68.4	191	187	64.2	189	176
	2300	29.0	68.4	187	187	64.4	186	177	60.4	183	167
	2300	27.0	63.3	180	174	59.6	178	165	55.9	175	156
	2300	25.5	58.3	173	162	54.9	171	154	51.5	166	146
	2200	34.0	75.0	195	204	70.6	194	193	66.2	192	181
	2200	33.0	72.7	192	198	68.4	191	187	64.2	189	176
	2200	31.5	68.9	188	188	64.9	186	178	60.8	183	168
	2200	29.5	64.2	182	176	60.5	180	167	56.7	177	158
	2200	27.5	59.9	175	166	56.4	173	157	52.9	169	149
	2200	26.0	55.6	169	156	52.4	166	148	49.1	160	140
	2100	32.5	66.6	185	182	62.7	183	172	58.8	180	163
	2100	30.5	60.9	177	168	57.4	175	160	53.8	171	151
	2100	28.0	57.0	171	159	53.6	168	151	50.3	163	143
	2100	26.5	53.3	165	150	50.2	161	142	47.1	152	134

Figure 5-20 (Sheet 2 of 3)

CRUISE PERFORMANCE
WITH RECOMMENDED LEAN MIXTURE

NOTE:
1. At 20,000 Feet, increase speed by 6 KTAS for each 1000 pounds below 6750 pounds.
2. At 23,500 Feet, increase speed by 6 KTAS for each 1000 pounds below 6750 pounds.
3. At 25,000 Feet, increase speed by 7 KTAS for each 1000 pounds below 6750 pounds.
4. Operations at peak EGT may be utilized with power settings within the boxes if the airplane is equipped with the optional EGT system.

ALTITUDE	RPM	MP	PERCENT BHP	KTAS	TOTAL LB/HR	PERCENT BHP	KTAS	TOTAL LB/HR	PERCENT BHP	KTAS	TOTAL LB/HR
			-45°C (-48°F)			-25°C (STD TEMP) (-12°F)			-5°C (24°F)		
20,000 FEET	2450	31.5	79.5	209	215	74.8	208	204	70.2	206	192
	2450	29.5	73.5	202	200	69.2	201	189	64.9	198	178
	2450	27.5	68.6	196	187	64.5	193	177	60.5	190	167
	2450	26.0	64.1	189	176	60.3	187	167	56.6	182	158
	2300	34.0	79.5	209	215	74.8	208	204	70.2	206	192
	2300	33.0	76.8	206	208	72.3	205	197	67.9	202	185
	2300	31.0	72.9	201	198	68.6	200	187	64.3	197	176
	2300	29.0	68.6	196	187	64.5	193	177	60.5	190	167
	2300	27.0	63.6	188	175	59.9	186	166	56.2	181	157
	2300	25.5	58.6	180	163	55.2	176	154	51.8	168	146
	2200	34.0	75.2	204	204	70.8	203	193	66.4	200	182
	2200	33.0	72.9	201	198	68.6	200	187	64.3	197	176
	2200	31.5	69.2	196	189	65.2	194	178	61.1	191	169
	2200	29.5	64.6	190	177	60.8	187	168	57.0	183	159
	2200	28.0	60.3	183	167	56.8	180	158	53.2	173	150
	2200	26.0	56.3	176	157	53.0	171	149	49.7	158	141
	2100	32.5	66.9	193	183	63.0	191	173	59.1	187	164
	2100	30.5	61.6	185	170	58.0	182	161	54.4	176	153
	2100	28.5	57.6	178	160	54.3	174	152	50.9	164	144
	2100	27.0	54.3	172	152	51.1	166	145	----	---	---
			-52°C (-61°F)			-32°C (STD TEMP) (-25°F)			-12°C (11°F)		
23,500 FEET	2450	31.0	77.0	213	209	72.5	212	198	68.0	208	186
	2450	29.5	73.5	209	200	69.2	206	189	64.9	203	178
	2450	27.5	68.8	202	188	64.8	199	178	60.8	194	168
	2450	26.0	64.2	194	176	60.4	191	167	56.7	184	158
	2300	29.5	68.7	202	188	64.7	199	177	60.7	194	168
	2300	27.5	63.8	194	175	60.0	190	166	56.3	183	157
	2300	26.0	59.0	185	163	55.5	180	155	52.1	161	147
	2200	30.0	64.9	196	178	61.1	193	169	57.3	186	160
	2200	28.0	60.6	188	167	57.1	184	159	53.5	172	150
	2200	26.0	57.0	181	159	53.6	174	151	----	---	---
			-54°C (-66°F)			-34°C (STD TEMP) (-30°F)			-14°C (6°F)		
25,000 FEET	2450	31.0	77.0	216	209	72.5	214	198	68.0	211	186
	2450	29.5	73.5	211	200	69.2	209	189	64.9	205	178
	2450	27.5	68.9	204	188	64.9	202	178	60.8	196	168
	2450	26.0	64.2	197	176	60.5	193	167	56.7	184	158
	2300	29.0	68.9	204	188	64.9	202	178	60.8	196	168
	2300	27.0	63.9	196	175	60.2	192	166	56.4	183	157
	2300	26.0	59.3	188	164	55.8	182	156	----	---	---
	2200	30.0	65.2	199	179	61.4	195	169	57.6	187	160
	2200	28.0	60.9	191	168	57.4	186	160	53.8	170	151
	2200	27.0	57.6	184	160	54.3	176	152	----	---	---

Figure 5-20 (Sheet 3 of 3)

RANGE PROFILE

CONDITIONS:
1. Takeoff Weight - 6750 Pounds.
2. Cruise Climb to Desired Altitude.
3. Recommended Lean Fuel Flow.
4. Zero Wind
5. Standard Day.

NOTE:
1. Range computations include fuel required for start, taxi, takeoff, cruise climb to altitude, cruise, descent and 45 minutes reserve fuel at the particular cruise power.
2. The distances shown are the sum of the distances to climb, cruise and descend.

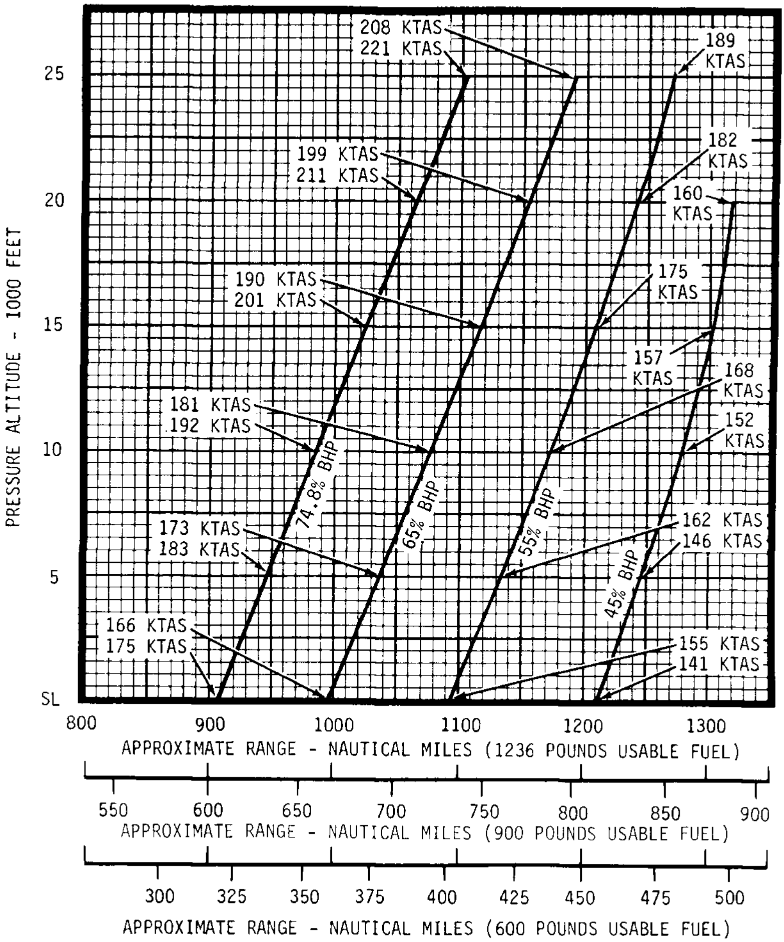
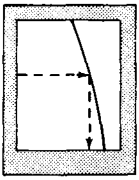


Figure 5-21

54847043

ENDURANCE PROFILE



CONDITIONS:
1. Takeoff Weight - 6750 Pounds.
2. Cruise Climb to Desired Altitude.
3. Recommended Lean Fuel Flow.
4. Standard Day.

NOTE:
1. Endurance computations include fuel required for start, taxi, takeoff, cruise climb to altitude, cruise, descent and 45 minutes reserve fuel at the particular cruise power.
2. The endurance shown is the sum of the times to climb, cruise and descend.

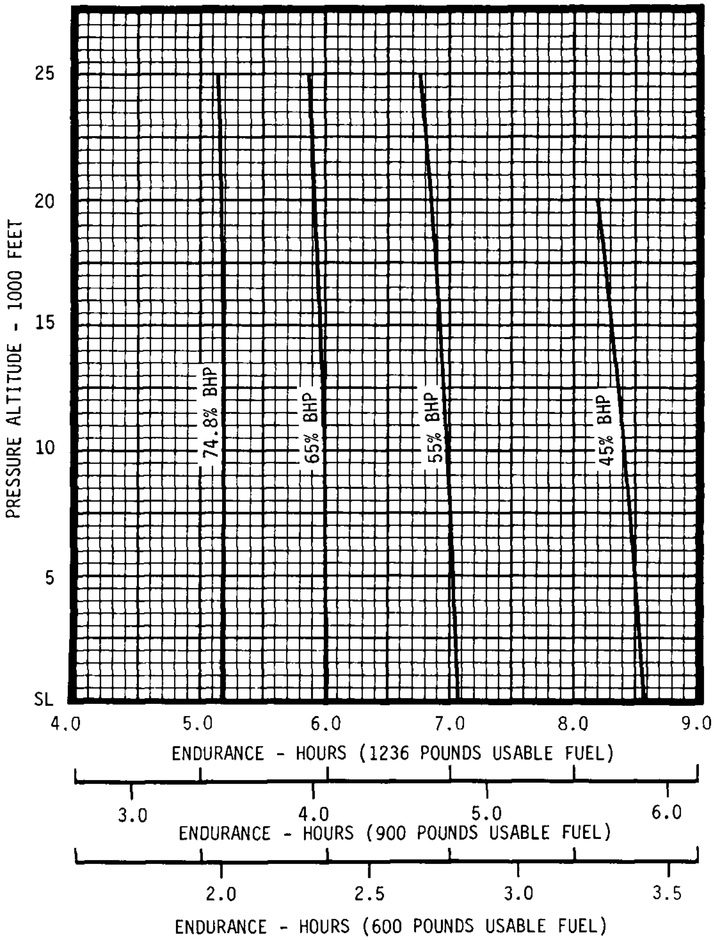
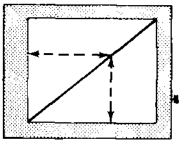


Figure 5-22

54847043

HOLDING TIME

CONDITIONS:
1. 2100 RPM and 24 Inches Hg. Manifold Pressure (45% Power).
2. Recommended Lean Fuel Flow (129 Pounds Per Hour Total).



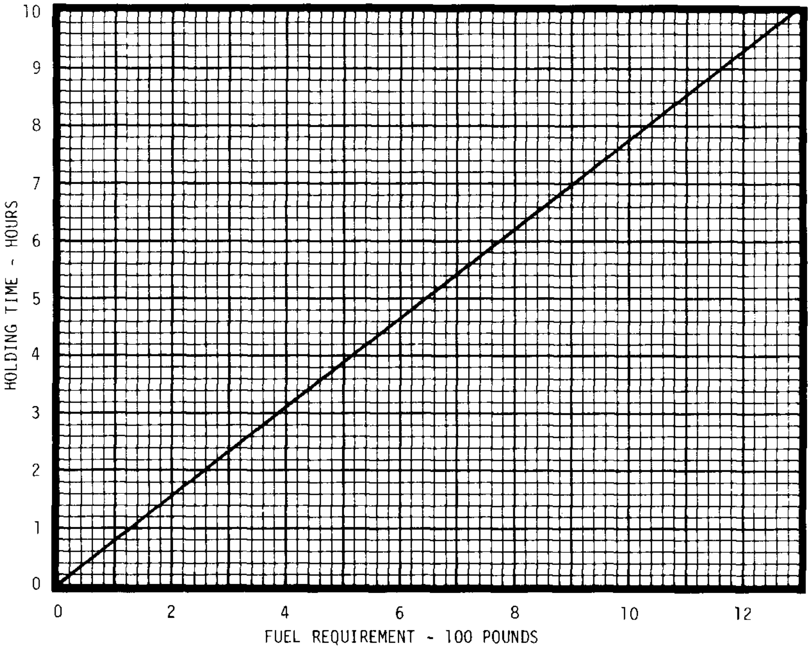
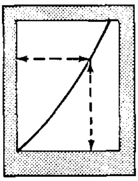


Figure 5-23

TIME, FUEL AND DISTANCE TO DESCEND

CONDITIONS:
1. Power - 2200 RPM and 24.5 Inches Hg. Manifold Pressure.
2. Landing Gear - UP.
3. Wing Flaps - UP.
4. Airspeed - 180 KIAS
5. Cowl Flaps - CLOSED.



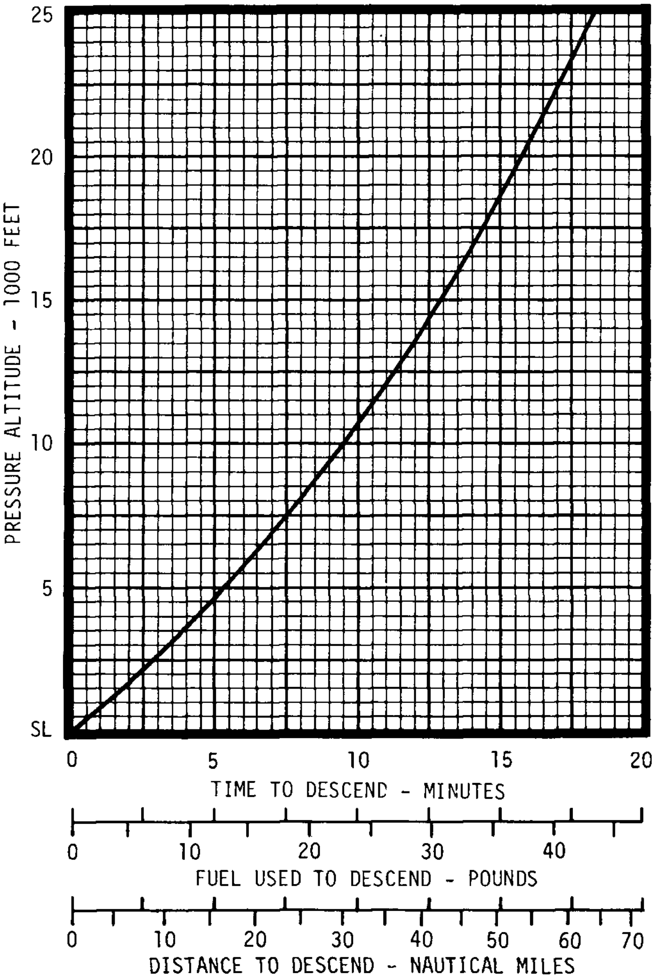


Figure 5-24

NORMAL LANDING DISTANCE

CONDITIONS:
1. Throttles - IDLE.
2. Landing Gear - DOWN.
3. Wing Flaps - 45°.
4. Cowl Flaps - CLOSE.
5. Level, Hard Surface Runway.
6. Maximum Effective Braking.

NOTE:
1. If necessary to land with wing flaps UP, the approach speed should be increased above the normal approach speed by 13 knots. Expect total landing distance to increase by 35%.
2. Decrease total distances by 3% for each 4 knots headwind. For operations with tailwinds up to 10 knots, increase total distances by 8% for each 3 knots wind.

WEIGHT-POUNDS	SPEED AT 50-FOOT OBSTACLE KIAS	PRESSURE ALTITUDE - FEET	-20°C (-4°F)		-10°C (14°F)		0°C (32°F)		10°C (50°F)	
			GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE
6750	94	Sea Level	890	2270	930	2310	970	2350	1000	2380
		1000	930	2310	960	2340	1000	2380	1040	2420
		2000	960	2340	1000	2380	1040	2420	1080	2460
		3000	1000	2380	1040	2420	1080	2460	1120	2500
		4000	1040	2420	1080	2460	1120	2500	1160	2540
		5000	1070	2450	1120	2500	1160	2540	1200	2580
		6000	1120	2500	1160	2540	1200	2580	1250	2630
		7000	1160	2540	1200	2580	1250	2630	1300	2680
		8000	1200	2580	1250	2630	1300	2680	1350	2730
		9000	1250	2630	1300	2680	1350	2730	1400	2780
		10,000	1300	2680	1350	2730	1400	2780	1450	2830
6200	91	Sea Level	740	2120	770	2150	800	2180	830	2210
		1000	770	2150	800	2180	830	2210	860	2240
		2000	800	2180	830	2210	860	2240	890	2270
		3000	830	2210	860	2240	890	2270	930	2310
		4000	860	2240	890	2270	930	2310	960	2340
		5000	890	2270	930	2310	960	2340	1000	2380
		6000	930	2310	960	2340	1000	2380	1040	2420
		7000	960	2340	1000	2380	1040	2420	1080	2460
		8000	1000	2380	1040	2420	1080	2460	1120	2500
		9000	1040	2420	1080	2460	1120	2500	1160	2540
		10,000	1080	2460	1120	2500	1160	2540	1210	2590
5700	86	Sea Level	620	2000	640	2020	670	2050	690	2070
		1000	640	2020	670	2050	690	2070	720	2100
		2000	660	2040	690	2070	720	2100	740	2120
		3000	690	2070	720	2100	740	2120	770	2150
		4000	720	2100	740	2120	770	2150	800	2180
		5000	740	2120	770	2150	800	2180	830	2210
		6000	770	2150	800	2180	830	2210	860	2240
		7000	800	2180	830	2210	860	2240	890	2270
		8000	830	2210	860	2240	900	2280	930	2310
		9000	860	2240	900	2280	930	2310	970	2350
		10,000	900	2280	930	2310	970	2350	1000	2380
5200	84	Sea Level	570	1950	590	1970	620	2000	640	2020
		1000	590	1970	620	2000	640	2020	660	2040
		2000	610	1990	640	2020	660	2040	690	2070
		3000	640	2020	660	2040	690	2070	710	2090
		4000	660	2040	690	2070	710	2090	740	2120
		5000	690	2070	710	2090	740	2120	770	2150
		6000	710	2090	740	2120	770	2150	800	2180
		7000	740	2120	770	2150	800	2180	830	2210
		8000	770	2150	800	2180	830	2210	860	2240
		9000	800	2180	830	2210	860	2240	890	2270
		10,000	830	2210	860	2240	890	2270	930	2310

Figure 5-25 (Sheet 1 of 2)

NORMAL LANDING DISTANCE

CONDITIONS:
1. Throttles - IDLE.
2. Landing Gear - DOWN
3. Wing Flaps - 45°.
4. Cowl Flaps - CLOSE.
5. Level, Hard Surface Runway.
6. Maximum Effective Braking.

NOTE:
1. If necessary to land with wing flaps UP, the approach speed should be increased above the normal approach speed by 13 knots. Expect total landing distance to increase by 35%.
2. Decrease total distances by 3% for each 4 knots headwind. For operations with tailwinds up to 10 knots, increase total distances by 8% for each 3 knots wind.

WEIGHT-POUNDS	SPEED AT 50-FOOT OBSTACLE KIAS	PRESSURE ALTITUDE - FEET	20°C (68°F)		30°C (86°F)		40°C (104°F)	
			GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE
6750	94	Sea Level	1040	2420	1070	2450	1110	2490
		1000	1070	2450	1110	2490	1150	2530
		2000	1110	2490	1150	2530	1190	2570
		3000	1150	2530	1190	2570	1230	2610
		4000	1200	2580	1240	2620	1280	2660
		5000	1240	2620	1290	2670	1330	2710
		6000	1290	2670	1330	2710	1380	2760
		7000	1340	2720	1390	2770	1430	2810
		8000	1390	2770	1440	2820	1490	2870
		9000	1450	2830	1500	2880	1550	2930
		10,000	1500	2880	1550	2930	1610	2990
6200	91	Sea Level	860	2240	890	2270	920	2300
		1000	890	2270	920	2300	950	2330
		2000	920	2300	960	2340	990	2370
		3000	960	2340	990	2370	1020	2400
		4000	990	2370	1030	2410	1060	2440
		5000	1030	2410	1070	2450	1100	2480
		6000	1070	2450	1110	2490	1140	2520
		7000	1110	2490	1150	2530	1190	2570
		8000	1160	2540	1200	2580	1230	2610
		9000	1200	2580	1240	2620	1280	2660
		10,000	1250	2630	1290	2670	1330	2710
5700	86	Sea Level	720	2100	740	2120	760	2140
		1000	740	2120	770	2150	790	2170
		2000	770	2150	800	2180	820	2200
		3000	800	2180	820	2200	850	2230
		4000	830	2210	860	2240	880	2260
		5000	860	2240	890	2270	920	2300
		6000	890	2270	920	2300	950	2330
		7000	930	2310	960	2340	990	2370
		8000	960	2340	990	2370	1030	2410
		9000	1000	2380	1030	2410	1070	2450
		10,000	1040	2420	1070	2450	1110	2490
5200	84	Sea Level	660	2040	680	2060	710	2090
		1000	690	2070	710	2090	730	2110
		2000	710	2090	740	2120	760	2140
		3000	740	2120	760	2140	790	2170
		4000	770	2150	790	2170	820	2200
		5000	790	2170	820	2200	850	2230
		6000	820	2200	850	2230	880	2260
		7000	860	2240	890	2270	910	2290
		8000	890	2270	920	2300	950	2330
		9000	920	2300	960	2340	990	2370
		10,000	960	2340	990	2370	1030	2410

Figure 5-25 (Sheet 2 of 2)

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SECTION 6
WEIGHT & BALANCE/EQUIPMENT LIST

TABLE OF CONTENTS

INTRODUCTION

Section 6 of this handbook provides procedures for establishing the airplane's basic empty weight and moment and procedures for determining the weight and balance for flight. This section also describes all items on the Weight and Balance Data sheet which was provided with the airplane (located in the back of this handbook in a plastic envelope) as delivered from Cessna Aircraft Company. An equipment list, provided at the end of this section, provides arms and weights of all equipment available for installation on the airplane.

AIRPLANE WEIGHING PROCEDURES

To Establish Basic Empty Weight

The airplane must be weighed in the following configuration.

1. Wing flaps shall be fully retracted and all other control surfaces shall be in neutral.
2. Service engine oil as required to obtain a normal full indication.
3. Check landing gear down and parking brake released.
4. Remove all equipment and items not to be included in basic empty weight.
5. Adjust all seats to the normal operating position.
6. Close all baggage doors, main cabin door and emergency exit window.
7. Clean the airplane inside and out.
8. Remove all snow, ice or water which may be on the airplane.
9. Weigh the airplane in a closed hangar to avoid errors caused by air currents.
10. Defuel the airplane in accordance with the following steps.

WARNING

Conduct all defueling operations at a safe distance from other airplanes and buildings. Fire fighting equipment must be readily available. Attach two ground wires from different points on the airplane to separate approved grounding stakes. The use of two ground wires will prevent ungrounding of the airplane due to accidental disconnecting of either wire.

a. Turn off all electrical power.
b. Turn fuel selectors OFF.
c. Remove engine cowling.
d. Disconnect inlet fuel supply hose at the inlet side of the engine-driven fuel pump.
e. Connect defueling hose to inlet fuel supply hose.
f. Turn fuel selectors ON and defuel wing until all possible fuel is removed.
g. Drain the remaining fuel through the drain valves into an appropriate container.
   (1) The main tanks are drained by opening the drain valve on the bottom of each tank sump. The main tank fuel lines are drained by removing a fuel sump drain valve located at the wing gap fairings, inboard of the respective engine nacelle. The right and left fuel filters are drained aft of the main spar inboard of each main fuel tank.
   (2) Each drain should remain open until the defueling rate slows to approximately 1 drop per second.
   (3) Drain fuel selector valves and fuel crossfeed lines.
h. The fuel remaining on-board after defueling is residual fuel and is included in the basic empty weight.
i. Drainable unusable fuel must be added after the weighing to obtain basic empty weight. Figure 6-1 includes the weight and arms necessary to add the drainable unusable fuel.

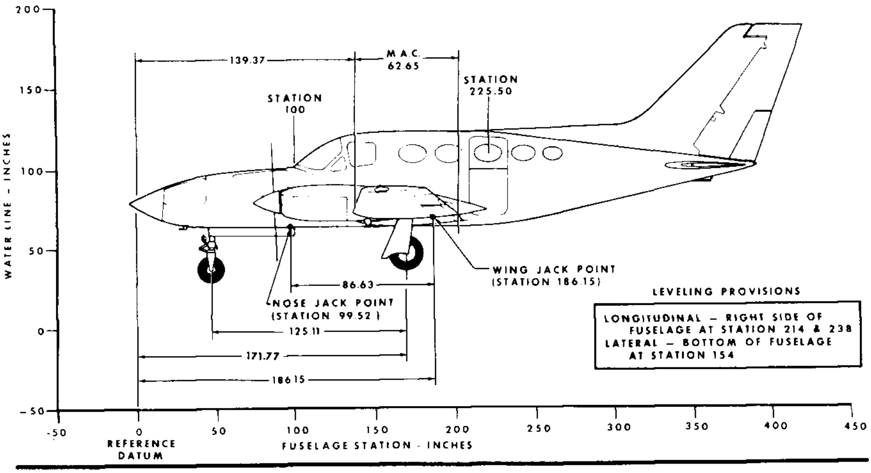
11. The airplane must be level when weighed.
   a. For longitudinal leveling, two bolts are located on the right side of the fuselage at stations 214.00 and 238.00. Unscrew these two bolts approximately 1/4 inch so a spirit level can be placed on them.
   b. For lateral leveling, use a spirit level on the underside of the fuselage at station 154.0.
12. When weighing on the wheels or jack points with mechanical scales, insure that the scales are in calibration and used per the applicable manufacturer's recommendations. When weighing on the wheels, deflate or inflate the gear struts and/or tires until the airplane is level.

CAUTION

- Keep the airplane level while jacking to prevent the airplane from slipping off the jacks and damaging the airplane.
- Jack pads, provided with the airplane, must be installed in each wing jack point prior to jacking the airplane.

13. When weighing on the jack points with electronic weighing scales, attach the electronic weighing cells to the proper mounting adapters to prevent slipping.
   a. Prepare the electronic weighing kit for use by following the manufacturer's instructions provided with the weighing kit. Adjust all jacks simultaneously until the cells are in contact with the jack points. Continue jacking, keeping the airplane level, until the airplane is supported at the jack points only.
14. Determine scale reading, scale drift and tare from all three scales.
15. Lower the airplane and clear the weighing cells as soon as the readings are obtained.

AIRPLANE WEIGHING FORM



AIRPLANE AS WEIGHED TABLE

POSITION	SCALE READING	SCALE DRIFT	TARE	NET WEIGHT
LEFT WING				
RIGHT WING				
NOSE				
AIRPLANE TOTAL AS WEIGHED				

CG ARM OF AIRPLANE AS WEIGHED USING JACK POINTS OR WHEELS* = ([FUSELAGE STATION OF AFT WEIGHING POINT]) − (([IF WEIGHED ON JACK POINTS USE 86.63; IF WEIGHED ON WHEELS USE 125.11]) × ([NOSE NET WEIGHT]) / ([TOTAL AS WEIGHED])) = ( ) INCHES AFT OF DATUM

NOTE

IT IS THE RESPONSIBILITY OF THE OPERATOR TO INSURE THAT THE AIRPLANE IS LOADED PROPERLY.

LEGEND

* IF WEIGHED ON WHEELS CROSS OUT JACK POINTS OR IF WEIGHED ON JACK POINTS CROSS OUT OR WHEELS

▲ INCLUDES ALL UNDRAINABLE FLUIDS AND FULL OIL

BASIC EMPTY WEIGHT AND CENTER OF GRAVITY TABLE

ITEM		WEIGHT - POUNDS	CG ARM - INCHES	MOMENT (INCH-POUNDS/100)
▲ AIRPLANE (CALCULATED OR AS WEIGHED)				
DRAINABLE UNUSABLE FUEL AT 6 POUNDS PER GALLON	LEFT AND RIGHT WING	41.0	165.2	67.7
BASIC EMPTY WEIGHT				

Figure 6-1

16. Computations (see Figure 6-1).
   a. Enter the scale reading, scale drift and tare from all three scales in the columns in the Airplane As Weighed Table. Compute and enter values for the Net Weight and Airplane Total As Weighed columns.
   b. Determine the CG arm of the airplane using the formula presented in Figure 6-1, if the jack points are used for weighing. If the airplane is weighed on the wheels, use the following formula.

$$\text{CG Arm of Airplane As Weighed} = 171.77 - \frac{125.11\ W_N}{W_T} = \text{Inches Aft of Datum}$$

   where W_N = net weight on nosewheel and W_T = total net weight on all three wheels
   c. Enter the total Net Weight and CG Arm in the Basic Empty Weight and Center of Gravity Table columns. Multiply the Weight (Lbs) entry times the CG Arm (In) entry to determine Moment (In-Lbs/100) entry. Total each of the three columns to determine basic empty weight, CG arm and moment.

NOTE

An attempt should be made to verify the results of each weighing, when data for comparison is available.

   d. Enter Basic Empty Weight, CG arm and moment in the Weight and Balance Record, see Figure 6-4.

WEIGHT AND BALANCE DETERMINATION FOR FLIGHT

The following is a sample weight and balance determination. For an actual determination for your airplane, refer to the equivalent illustrations on the Weight and Balance Data sheet provided in your airplane.

To compute the weight and balance for your airplane, use Figures 6-2 through 6-4 as follows:

Take the Basic Empty Weight and Moment/100 from the latest entry shown on the Weight and Balance Data sheet or in Figure 6-4 and enter them in on item 1 (Basic Empty Weight) of Figure 6-3. For this sample, assume a weight of 4628 pounds and moment/100 of 7122.

NOTE

A blank Weight and Balance Form is provided, for the operator's convenience, at the end of this section.

Determine arm, weight and Moment/100 of the crew, passengers, baggage and cabinet contents from Figure 6-2 and enter them under Payload Computations in Figure 6-3. The crew and passenger loading table is applicable only when the CG of the occupant is at the location specified.

If the seats are in any other position than stated in Figure 6-2, the moment must be computed by multiplying occupant weight times the arm in inches. A point 9 inches forward of the intersection of the seat bottom and seat back with seat cushions compressed can be assumed to be the occupant CG. For a reference in determining the arm, the forward face of the cabin doorway structure is fuselage station 212.87.

See Figure 6-3. Total the Payload Computations items and enter the resulting Weight and Moment/100 in item 2.

See Figure 6-3. Total items 1 (Basic Empty Weight) and 2 (Payload) to determine appropriate entries for item 3 (Zero Fuel Weight).

See Figure 6-3. Item 4 (Fuel Loading), is determined from the applicable columns of Figure 6-2.

Total items 3 and 4 to determine 5 (Ramp Weight).

See Figure 6-3. Subtract item 6 (Less Fuel For Taxiing) from item 5 (Ramp Weight to determine item 7 (Takeoff Weight). Enter item 7 in Figure 6-2 to determine if the loading is within allowable limits. If the point falls within the envelope, the loading is approved. If the point falls outside the envelope, it will be necessary to redistribute the load.

Refer to Section 5 for estimated fuel used during the flight. After determining the fuel used, obtain the appropriate weights and Moment/100 from Figure 6-2. Enter the total of these weights and Moment/100 in item 8 (Less Fuel To Destination).

Item 9 (Landing Weight) is determined by subtracting item 8 from item 7. Enter item 9 in Figure 6-2 to determine if the loading is within allowable limits. If the point falls within the envelope, the loading is approved. If the point falls outside the envelope, it will be necessary to redistribute the load.

WEIGHT AND BALANCE RECORD

The Weight and Balance Record, see Figure 6-4, provides a record to reflect the continuous history of changes in airplane structure and/or equipment which affect the weight and balance of the airplane.

The Basic Empty Weight of your airplane is entered at the appropriate location on the Weight and Balance Data sheet as delivered from the factory. Changes to the structure or equipment should be entered on the Weight and Balance Record when any modifications are made to the airplane. It is the responsibility of the airplane owner to assure this record is up to date, as all loadings will be based on the latest entry.

WEIGHT AND MOMENT TABLES

CREW AND PASSENGERS

WEIGHT (POUNDS)	1ST OR 2ND SEATS ARM = 137"	3RD OR 4TH SEATS FORWARD FACING ARM = 175"	3RD OR 4TH SEATS AFT FACING ARM = 178"	5TH OR 6TH SEATS ARM = 218"	TOILET SEAT ARM = 250"	7TH OR 8TH SEATS ARM = 261"
	MOMENT/100					
10	14	18	18	22	25	26
20	27	35	36	44	50	52
30	41	52	53	65	75	78
40	55	70	71	87	100	104
50	68	88	89	109	125	130
60	82	105	107	131	150	157
70	96	122	125	153	175	183
80	110	140	142	174	200	209
90	123	158	160	196	225	235
100	137	175	178	218	250	261
110	151	192	196	240	275	287
120	164	210	214	262	300	313
130	178	228	231	283	325	339
140	192	245	249	305	350	365
150	206	262	267	327	375	392
160	219	280	285	349	400	418
170	233	298	303	371	425	444
180	247	315	320	392	450	470
190	260	332	338	414	475	496
200	274	350	356	436	500	522
210	288	368	374	458	525	548
220	301	385	392	480	550	574
230	315	402	409	501	575	600
240	329	420	427	523	600	626
250	342	438	445	545	625	652
260	356	455	463	567	650	679
270	370	472	481	589	675	705
280	384	490	498	610	700	731
290	397	508	516	632	725	757
300	411	525	534	654	750	783

FUEL

GALLONS (AT 6.0 POUNDS PER GALLON)	WEIGHT (POUNDS)	MOMENT/100 ARM VARIES	GALLONS (AT 6.0 POUNDS PER GALLON)	WEIGHT (POUNDS)	MOMENT/100 ARM VARIES
5	30	50	105	630	1022
10	60	99	110	660	1070
15	90	148	115	690	111[illegible]
20	120	197	120	720	1166
25	150	246	125	750	1214
28	168	275	130	7[illegible]0	1262
30	180	294	135	[illegible]10	1310
35	210	343	140	840	1359
40	240	392	145	870	1407
45	270	440	150	900	1455
50	300	489	155	930	1503
55	330	537	160	960	1550
56	336	547	165	990	1598
60	360	586	170	1020	1646
65	390	635	175	1050	1694
70	420	683	180	1080	1742
75	450	731	185	1110	1790
80	480	780	190	1140	1838
85	510	828	195	1170	1886
90	540	877	200	1200	1934
95	570	925	204	1224	1971
100	600	973			

BAGGAGE AND CABINET CONTENTS

WEIGHT (POUNDS)	AVIONICS BAY ARM = 32"	NOSE COMPARTMENT ARM = 71"	WING LOCKERS ARM = 186"	AFT CABIN BAY "A" ARM = 266"	AFT CABIN BAY "B" ARM = 282"	AFT CABIN REFRESHMENT BAR ARM = 279"	AFT CABIN OVERHEAD CABINET ARM = 282"
	MOMENT/100						
10	3	7	19	26	28	28	28
20	6	14	37	53	56	56	56
30	10	21	56	80	85		
40	13	28	74	106	113		
50	16	36	93	133	141		
60	19	43	112	160	169		
70	22	50	130	186	197		
80	26	57	149	213	226		
90	29	64	167	239	254		
100	32	71	186	266	282		
110	35	78	205	293			
120	38	85	223	319			
130	42	92	242	346			
140	45	99	260	372			
150	48	107	279	399			
160	51	114	298	426			
170	54	121	316	452			
180	58	128	335	479			
190	61	135	353	505			
200	64	142	372	532			
210	67	149	391	559			
220	70	156	409	585			
230	74	163	428	612			
240	77	170	446	638			
250	80	178	465	665			
260		185	484	692			
270		192	502	718			
280		199	521	745			
290		206	539	771			
300		213	558	798			
310		220	577	825			
320		227	595	851			
330		234	614	878			
340		241	632	904			
350		248	651	931			
360			570	958			
370			688	984			
380			707	1011			
390			725	1037			
400			744	1064			

CREW AND PASSENGER SEATS AND BAGGGAGE MOMENT ARMS

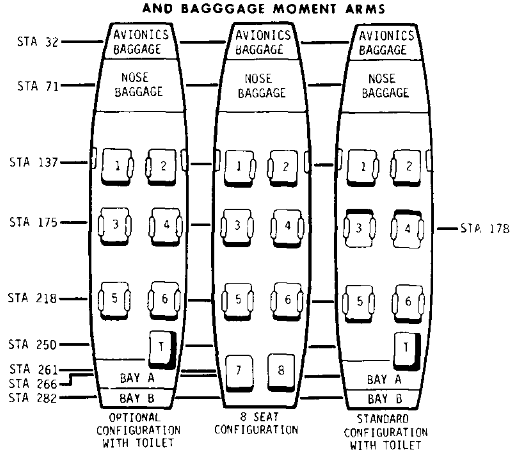
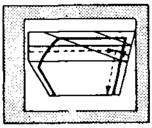


Figure 6-2 (Sheet 1 of 2)

WEIGHT AND MOMENT TABLES



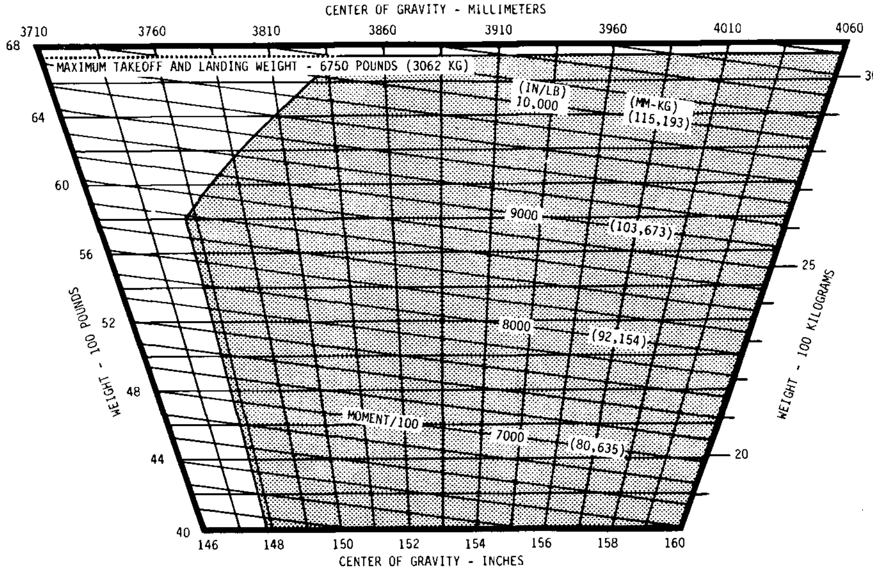


Figure 6-2 (Sheet 2 of 2)

SAMPLE WEIGHT AND BALANCE FORM

PAYLOAD COMPUTATIONS			
ITEM OCCUPANTS OR CARGO	ARM	WEIGHT	MOMENT/100
SEAT 1	137	160	219
SEAT 2	137	170	233
SEAT 3	175	120	210
SEAT 4	175	190	332
SEAT 5	218	160	349
SEAT 6			
SEAT 7			
SEAT 8			
TOILET			
BAGGAGE			
WING LOCKERS			
AVIONICS			
NOSE	71	107	76
BAY A			
BAY B			
CABINET CONTENTS			
PAYLOAD	---	907	1419

REF	ITEM	WEIGHT	MOMENT/100
1.	BASIC EMPTY WEIGHT	4628	7122
2.	PAYLOAD	907	1419
3.	ZERO FUEL WEIGHT (sub-total) (Do not exceed maximum zero fuel weight of 6515 pounds)	5535	8541
4.	FUEL LOADING	800	1294
5.	RAMP WEIGHT (sub-total) (Do not exceed maximum ramp weight of 6785 pounds)	6335	9835
6.	LESS FUEL FOR TAXIING	35	58
7.	TAKEOFF WEIGHT (Do not exceed maximum takeoff weight of 6750 pounds)	6300	9777
8.	LESS FUEL TO DESTINATION	597	968
9.	LANDING WEIGHT (Do not exceed maximum landing weight of 6750 pounds)	5703	8809

Totals must be within approved weight and C.G. limits. It is the responsibility of the operator to insure that the airplane is loaded properly. The Basic Empty Weight C.G. is noted on the Airplane Weighing Form. If the airplane has been altered, refer to the Weight and Balance Record for this information.

Figure 6-3

LOADING

WARNING

If a tail ground strike has occurred or there is evidence of any damage to the tailcone or empennage area, the airplane must be examined by a qualified aircraft mechanic and repaired, if necessary, before the next flight.

Due to differences in optional equipment installed on the airplane, a wide center of gravity range exists. Under certain loading conditions, it is possible to exceed the aft CG limits which could cause the tail to tip and allow the tail bumper to strike the ground. The force of a tail ground strike could damage internal aircraft structure, resulting in possible interference with elevator control system operation.

To prevent tail tipping during airplane loading, it is recommended that owners and operators study their individual airplane's weight and balance information to become familiar with its capabilities and limitations. When loading, it is recommended the following steps be followed:

1. During unusual loading conditions where the airplane aft CG limits could possibly be exceeded, use a suitable padded tail stand under the tailcone, whenever possible. The tail stand should be removed by a crew member or ground service personnel only when airplane loading is complete.

2. Load the baggage in the nose and avionics compartments prior to boarding of the crew and passengers.

3. Avoid carrying baggage in the aft cabin.

4. When boarding people, have the pilot or person who is to occupy the copilot seat be the first to board with remaining persons filling the most forward seats first and the aft seats last. Arrange to have heavier people occupy the most forward seats.

5. When unloading the aircraft, have one person remain in the copilot or pilot seat while the other flight deck occupant goes aft to open the door. Arrange to have the passengers in the aft seats to be the first to deplane.

WEIGHT AND BALANCE RECORD

(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

DATE	ITEM		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						BASIC EMPTY WEIGHT	
				ADDED (+)			REMOVED (-)				
	IN	OUT		WT. (LB)	ARM (IN)	MOMENT /100	WT. (LB)	ARM (IN)	MOMENT /100	WT. (LB)	MOMENT /100

Figure 6-4

EQUIPMENT LIST

The following pages of this handbook contain a comprehensive listing of all equipment available from the factory for the airplane. This equipment list is divided into two sections, the first of which (Section A) lists all equipment required to be installed. The second section (Section B) lists the remaining standard equipment and all available optional equipment.

NOTE

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

A "Mark If Installed" column has been provided after each item in the equipment list. If desired, the operator may check each appropriate item which is installed in his particular airplane. Columns showing weight in pounds and arm in inches provide the weight and center of gravity location for the equipment.

A customized equipment list, detailing only the equipment installed in your airplane as delivered from the factory, is provided with your airplane papers. This list is presented in the same order and format as the comprehensive listing.

EQUIPMENT LIST

THE FOLLOWING IS A LIST OF EQUIPMENT INSTALLED IN THE AIRPLANE WHEN DELIVERED BY THE MANUFACTURER. DATUM STATION 0.0 IS 100.0 INCHES FORWARD OF THE AFT FACE OF THE FUSELAGE BULKHEAD JUST FORWARD OF THE RUDDER PEDALS.
POSITIVE ARMS ARE DISTANCES AFT OF DATUM STATION 0.0.
AN ASTERISK (*) INDICATES EXCHANGE WEIGHT.
THE TOTAL OPTIONAL EQUIPMENT WEIGHT AND MOMENT IS THE WEIGHT OF THE OPTION PACKAGE ONLY AND NOT THE SUM OF ALL ITEMS LISTED.
INSTALLATION APPROVAL OF EQUIPMENT INCLUDED IN THIS LIST IS MAINTAINED EITHER BY THE MANUFACTURER'S STC WITH THE APPROVAL NUMBER NOTED WITH EQUIPMENT OR IN THE MANUFACTURER'S TYPE DESIGN FILE IN ACCORDANCE WITH THE DELEGATION OPTION AUTHORIZATION CE-3.

SECTION A
REQUIRED EQUIPMENT

FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
	WHEEL-MAIN GEAR	9910393 2		2	17.5	171.8
	TIRE-MAIN GEAR 650X10 8 PLY	C262003210		2	29.6	171.8
	BRAKE-MAIN GEAR	9910393 3		2	28.5	171.8
	TUBE-MAIN GEAR	C262023105		2	5.6	171.8
	WHEEL-NOSE GEAR	9910194 5		1	5.5	47.0
	TIRE-NOSE GEAR 600X6 6 PLY III	9910336 1		1	9.8	47.0
	TUBE-NOSE GEAR	C262C23102		1	1.7	47.0
	ENGINE CMC 6 CYL	TSIO-520NB		2	861.6	115.4
	CONTROLLER VAR & THROTTLE BODY	633388 10		2	14.8	140.1
	TURBOCHARGERS AIR RESEARCH	635630 1		2	60.0	139.8
	FILTER AIR INDUCTION	9913001 1		2	2.5	135.8
	OIL RADIATOR	637132		2	15.0	115.4
	OIL FILTER & ADAPTER	631641		2	5.4	127.5
	FUEL PUMP-ENGINE DRIVEN CMC	641583-639 1		2	5.2	125.0

SECTION A
REQUIRED EQUIPMENT

FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
	FUEL PUMP-BOOST	9910202 2		2	7.0	174.7
	PROP 3-BLADE */82NEA-5.5	3AF32C505-		2	140.0	87.4
75	POLISHED PROP SPINNER & BKHD	D5212D5214		2	9.8	83.5
	PROP SPINNER & BULKHEAD	D3534D3796		2	9.9	83.5
	PROP GOVERNOR LH 3 STD	DCF290D7/T		1	2.8	96.5
76D	PROP GOVERNOR LH W/SYNC T3	DCFS290D8/		1	3.9	96.5
76E	PROP GOVERNOR LH W/SYNC/UNF2/T3	DCFUS290D1		1	4.0	96.5
77	PROP GOVERNOR LH W/UNF /T3	DCFU290D13		1	2.9	96.5
	PROP GOVERNOR RH 3 STD	DCF290D7/T		1	2.8	96.5
76D	PROP GOVERNOR RH W/SYNC T3	DCFS290D7/		1	2.9	96.5
76E	PROP GOVERNOR RH W/SYNC/UNF3/T3	DCFUS290D1		1	3.0	96.5
77	PROP GOVERNOR RH W/UNF /T3	DCFU290D13		1	2.9	96.5
	AIRSPEED INDICATOR STD	C661040212		1	0.7	112.6
04	AIRSPEED INDICATOR TAS LH	C661045316		1	2.8	112.6
	ALTIMETER	C661014101		1	1.1	112.6
01A	ALTIMETER FT & MILIBARS	C661025101		1	1.1	112.6
624C	400 ENCODING ALTIMETER-INCHES	EA-401A		1	2.6	111.9
624E	400 ENCODING ALTIMETER-MILIBARS	EA-401A		1	2.6	111.9
675A	800 ENCODING ALTIMETER-INCHES	EA-801A		1	2.8	111.9
675B	800 ENCODING ALTIMETER-MILIBARS	EA-801A		1	2.8	111.9
	TACHOMETER-DUAL STD	C668017110		1	1.8	112.6
09	TACHOMETER-SYNCHRONOUS, DUAL	C668016110		1	1.8	112.6
	FUEL QUANTITY INDICATOR-DUAL	9910232 1		1	1.1	112.6
	FUEL FLOW INDICATOR-DUAL STD	C662020116		1	2.1	158.0
39	FUEL FLOW GAGE & MGMT COMPUTER	9910395 8		1	2.2	114.6
	GAGE-MANIFOLD PRESSURE-DUAL	C662026113		1	1.1	112.6
	GAGE-UNIT LEFT ENGINE COMB	C662019101		1	1.1	112.6
	GAGE-UNIT RIGHT ENGINE COMB	C662019101		1	1.1	112.6
	RATE OF CHANGE CABIN PRESSURE	C668517101		1	0.9	115.8
	COMPASS	C660501401		1	0.7	118.3

SECTION A
REQUIRED EQUIPMENT

FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
	DIFF & ALT CABIN PRESSURE	C668516104		1	0.5	115.8
	STALL WARNING HORN	9910080 1		1	0.0	114.0
	STALL WARNING TRANSMITTER	186-14		1	0.2	142.6
11	ANGLE OF ATTACK SYSTEM	0800302 3		1	1.0	124.6
	ALTERNATOR 50 AMP STD	CM641668		1	24.3	98.8
16A	ALTERNATOR 100 AMP	9910385 1		2	36.9	98.8
	VOLTAGE REGULATOR STD	9910126 3		2	1.7	132.7
	STROBE LIGHTS ASSY	9910366 1&2		3	3.5	157.5
96A	LIGHT ASSY HIGH INTENSITY	9910366 3&4		2	4.0	157.5
96B	LIGHT ASSY (ICAORED)	9910366 5&6		2	4.4	157.5
	LIGHT POWER SUPPLY	9910368 1		3	3.5	157.5
96A	LIGHT POWER SUPPLY (HI INT)	9910368 2		2	3.8	168.8
96B	LIGHT POWER SUPPLY (ICAO)	9910368 2		2	3.8	168.8
	BATTERY 24 VOLTS	R-2425		1	40.0	171.5
	MASTER SWITCH	8501KA		3	0.3	123.0
	SEAT-PILOT ADJUSTABLE STD	0812782 1		1	15.3	140.0
L	SEAT-PILOT ADJUSTABLE LEATHER	0812782 1		1	15.7	140.0
89	SEAT-PILOT VERT ADJUST TILTING	0812780 1		1	22.9	140.8
89 L	SEAT-PILOT VERT ADJ TILT LTHR	0812780 1		1	23.5	140.8
	SAFETY BELT-SHOULDER HARNESS	CM40C8&9		1	0.6	151.5
181	SAFETY BELT-SHOULDER HARNS-REEL	5119565 11		1	0.9	151.8
	OUTFLOW VALVE-CABIN PRESSURE	103576 9		1	1.3	287.9
20	OUTFLOW VALVE-CABIN PRESSURE	103576 17		1	1.3	287.9
	SOLENOID VALVE	3423000 9		1	0.4	280.3
	SAFETY VALVE CABIN PRESSURE	103576 5		1	1.3	287.9
	PILOT'S OPERATING HANDBOOK	D1594R1-13PH		1	1.4	144.0

SECTION B
STANDARD AND OPTIONAL EQUIPMENT

FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
	CONTROLS & AUTOFLIGHT					
	GYRO-DIRECTIONAL C661053-0101			1	2.6	113.0
53301	GYRO-DIRECT G-502A			1	3.6	113.0
53302	GYRO-DIRECT G-504A			1	3.5	113.0
53303	GYRO-HSI (3 IN) IG-832A			1	5.0	113.0
53304	GYRO-HSI (4 IN) IG-895A			1	5.3	113.0
	GYRO-HORIZONTAL C661055-0103			1	1.9	112.5
53310	GYRO-HORIZ G-519B-1			1	2.5	112.5
53311	GYRO-ADI (3-IN) G-550A			1	3.5	112.5
53312	GYRO-ADI (4-IN) G-1050A			1	5.0	112.5
53000	400B NAV-O-MATIC INSTL			1	16.6	198.4
53000	COMPUTER CA-550A/FD & MOUNT			1	6.3	303.1
53000	CONTROLLER C-530A			1	1.7	109.7
53000	ACTUATOR PA-495A-1 & MOUNT			1	4.1	294.6
53000	ACTUATOR PA-495A-2 & MOUNT			1	4.1	220.0
53000	ACTUATOR TA-495A & MOUNT			1	2.1	300.4
53000	ALTITUDE SENSOR AS-895A			1	2.3	318.6
53100	400B NAV-O-MATIC SLAVED DG OPT			1	2.8	215.4
53100	FLUX DETECTOR CT-504A			1	0.5	361.9
53101	SLAVE ACCESS W/O BS SA-832A			1	0.8	35.0
53102	SLAVE ACCESS W/BS SA-832B			1	2.2	35.0
53200	400B NAV-O-MATIC HSI (3 IN) OPT			1	3.1	213.6
53201	CONVERTER B-445A & MOUNT			1	1.3	33.0
53200	FLUX DETECTOR CT-504A			1	0.5	361.9
53202	SLAVE ACCESS W/O BS SA-832A			1	0.8	35.0
53203	SLAVE ACCESS W/BS SA-832B			1	2.2	35.0
53400	YAW DAMPER INSTL YD-840B			1	3.9	234.3
53400	ACTUATOR PA-495A-1 & MOUNT			1	4.1	298.2
55000	400B IFCS INSTL			1	25.1	197.1
55000	COMPUTER CA-550A/FD & MOUNT			1	6.3	303.1

SECTION B
STANDARD AND OPTIONAL EQUIPMENT

FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
55000	CONTROLLER C-531A			1	1.5	109.7
55000	ACTUATOR PA-495A-1 & MOUNT			1	4.1	294.6
55000	ACTUATOR PA-495A-2 & MOUNT			1	4.1	220.0
55000	ACTUATOR TA-495A & MOUNT			1	2.1	300.4
55000	ALTITUDE SENSOR AS-895A			1	2.3	318.6
55000	MODE SELECTOR S-550A			1	2.6	112.9
55001	CONVERTER B-445A & MOUNT			1	1.3	33.0
55000	FLUX DETECTOR CT-504A			1	0.5	361.9
55002	SLAVE ACCESS W/O BS SA-832A			1	0.8	35.0
55003	SLAVE ACCESS W/BS SA-832B			1	2.2	35.0
56000	800B IFCS INSTL			1	24.6	190.9
56000	COMPUTER CA-550A/FD & MOUNT			1	6.3	303.1
56000	CONTROLLER C-830FD			1	1.5	109.7
56000	ACTUATOR PA-495A-1 & MOUNT			1	4.1	294.6
56000	ACTUATOR PA-495A-2 & MOUNT			1	4.1	220.0
56000	ACTUATOR TA-495A & MOUNT			1	2.1	300.4
56000	ALTITUDE SENSOR AS-895A			1	2.3	318.6
56000	MODE SELECTOR S-550A			1	2.6	112.9
56001	CONVERTER B-445A & MOUNT			1	1.3	33.0
56000	FLUX DETECTOR CT-504A			1	0.5	361.9
56003	SLAVE ACCESS W/O BS SA-832A			1	0.8	35.0
56004	SLAVE ACCESS W/BS SA-832B			1	2.2	35.0
56000	YAW DAMPER INSTL			1	3.9	234.3
56000	ACTUATOR PA-495A-1 & MOUNT			1	4.1	298.2
57000	HSI & ADI 3 IN OPTION, RH			1	3.3	211.8
57000	INDICATOR IN-832R			1	0.8	112.9
57001	CONVERTER B-445A & MOUNT			1	1.3	33.0
57000	FLUX DETECTOR CT-504A			1	0.5	361.9
57002	SLAVE ACCESS W/O BS SA-832A			1	0.8	35.0
57003	SLAVE ACCESS W/BS SA-832B			1	2.2	35.0

SECTION B
STANDARD AND OPTIONAL EQUIPMENT

FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
27	CORROSION PROOFING-INTERNAL	5600009009		1	10.5	194.2
33	ELECTRIC ELEVATOR TRIM	5618105 7		1	3.2	216.7
47B	GUST LOCK-RUDDER	5130387 1		1	1.1	375.6
	PROPELLER					
77	PROP UNFEATHERING SYSTEM	5650116 1		1	10.8	111.7
76D	PROP SYNCHROPHASER SYSTEM	5618124 1		1	2.7	134.8
76E	PROP SYNC & UNFEATH SYSTEM	5650116 2		1	13.5	116.2
	INSTRUMENTS					
675A	ALTITUDE ALERTER AA-801A			1	0.8	114.0
675B	ALTITUDE ALERTER AA-801A			1	0.8	114.0
624B	400 ENCODING ALTIMETER-INCHES	EA-401A		1	2.6	111.9
624D	400 ENCODING ALTIMETER-MILIBARS	EA-401A		1	2.6	111.9
676A	800 ENCODING ALTIMETER-INCHES	EA-801A		1	2.8	111.9
676A	ALTITUDE ALERTER AA-801A			1	0.8	114.0
676B	800 ENCODING ALTIMETER-MILIBARS	EA-801A		1	2.8	111.9
676B	ALTITUDE ALERTER AA-801A			1	0.8	114.0
	CLOCK-ELECTRIC STD	C664509101		1	0.4	114.1
23A	CLOCK-DIGITAL, ELECTRONIC	C664510101		1	0.6	114.1
	RATE OF CLIMB INDICATOR STD	C661035101		1	0.9	113.1
08	INSTANT VERTICAL SPEED IND	C661009101		1	1.9	113.1
	TURN & BANK INDICATOR (3 IN)STD	C661031101		1	1.4	112.1
534	GYRO-COMPUTER G-840A			1	2.6	112.8
560	GYRO-COMPUTER G-840A			1	2.6	112.8
03	FLIGHT HOUR RECORDER, PNL MTD	CM2926 1		1	0.8	112.1
03A	HEATER HOUR METER INSTL	C664503101		1	0.4	96.0
02	ECONOMY MIXTURE	9910247 2		1	3.5	123.2
07	RH PANEL & PLUMBING SYSTEM	5114244 5		1	4.1	112.5
0710	ALTIMETER FT & INCHES RH	C661014101		1	1.1	112.6
01B	ALTIMETER FT & MILIBARS RH	C661025101		1	1.1	112.6
0720	AIRSPEED INDICATOR RH	C661040216		1	0.7	112.6

SECTION B
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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
04A	AIRSPEED INDICATOR (TAS) RH	C661040216		1	2.8	112.6
0730	RATE CF CLIMB INDICATOR RH	C661035101		1	0.9	113.1
08A	INSTANT VERTICAL SPEED IND RH	C661009101		1	1.9	113.1
0740	GYRO-DIRECTIONAL RH	C661053101		1	2.6	113.0
53305	GYRO-HSI (3 IN) IG-832A RH			1	5.0	113.0
0750	GYRO-HORIZONTAL RH	C661055103		1	1.9	112.5
53313	GYRO-ADI (3-IN) G-550A			1	3.5	112.5
0760	DUAL PITOT SYSTEM RH	5614202 1		1	1.3	54.6
0770	STATIC SOURCE-DUAL	5114220 5		1	0.3	257.0
19	TURN & BANK INDICATOR (3 IN)	C661031101		1	1.4	112.1
19A	TURN & BANK INDICATCR (2 IN)	C661032101		1	1.2	114.5
45	FUEL LOW LEVEL WARNING	5118628 5		1	0.6	152.0
	PNEUMATIC					
	VACUUM PUMPS-PWR FOR GYROS STD	212CW		2	3.8	126.3
32	VACUUM PUMPS-PWR FOR WING DEICE	442CW		2	6.5	126.3
194	VACUUM PUMPS-PWR FOR KNOWN ICE	442CW		2	6.5	126.3
	ELECTRICAL					
26	CONVERTER 110 VOLT	5618118 4		1	3.3	273.8
52	LIGHT-TAXI	5618101 8		1	1.5	54.6
49	LIGHT-LANDING RH (RETRACTABLE)	5118652 1		1	4.6	161.5
48	LIGHT-ICE DETECTION LH	5618701 1		1	0.4	133.5
48A	LIGHT-ICE DETECTICN RH	5618701 2		1	0.4	133.5
43	LIGHT-COURTESY-NACELLE & NOSE	0851862 8		1	1.1	141.3
85	TIMER-COURTESY LIGHT	5618712 1		1	0.4	128.6
87A	STATIC DISCHARGE WICKS-SET OF 8	5100015 10		1	0.4	296.6
46	GROUND SERVICE PLUG	5118116 4		1	4.3	173.4
54	VERTICAL TAIL FLOOD LIGHT	40200001		1	2.9	291.0
	ELECTRONICS					
400	400 NAV/COM INSTL NO. 1			1	3.9	70.3
400	TRANSCEIVER RT-485A & MOUNT			1	6.3	109.4

SECTION B
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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
40001	INDICATOR IN-486AC			1	2.1	111.9
40002	400 NAV/COM INSTL NO. 2			1	3.9	70.3
40002	TRANSCEIVER RT-485A & MOUNT			1	6.3	109.4
40003	INDICATOR IN-485AC			1	2.1	111.9
40103	INDICATOR IN-486AC			1	2.1	111.9
40004	400 GLIDESLOPE INSTL NO. 1			1	3.2	51.0
40004	RECEIVER R-443B & MOUNT			1	3.3	33.0
40004	ANTENNA CI-212			1	0.2	7.4
40044	400 GLIDESLOPE INSTL NO. 2			1	3.2	51.0
40044	RECEIVER R-443B & MOUNT			1	3.3	33.0
40044	ANTENNA COUPLER & CABLE			1	0.3	7.4
40005	400 ADF INSTL			1	3.2	91.9
40005	RECEIVER R-446A & MOUNT			1	4.0	109.4
40106	INDICATOR IN-346A			1	1.1	111.9
40106	ACCESSORY UNIT RA-446A			1	1.4	140.0
40105	ANTENNA-LOOP L-346A	9751002 28		1	1.6	162.4
40005	ANTENNA-SENSE	9751042 1		1	1.9	195.3
40007	400 MARKER BEACON INSTL			1	3.2	33.0
40007	RECEIVER R-402A & MOUNT			1	1.1	33.0
40007	ANTENNA CI-102			1	0.8	73.0
10000	1000 COM INSTL NO. 1			1	3.9	72.9
10000	TRANSCEIVER RT-1038A & MOUNT			1	6.6	33.0
10000	CONTROL C-1038A & MOUNT			1	2.0	112.9
10001	1000 COM INSTL NO. 2			1	3.9	72.9
10001	TRANSCEIVER RT-1038A & MOUNT			1	6.6	33.0
10001	CONTROL C-1038A & MOUNT			1	2.0	112.9
10002	1000 NAV INSTL NO. 1			1	2.9	72.4
10102	RECEIVER R-1048A & MOUNT			1	4.5	33.0
10112	RECEIVER R-1048B & MOUNT			1	5.0	33.0
10002	CONTROL C-1048A & MOUNT			1	2.0	112.9

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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
10003	INDICATOR IN-1049AC			1	1.7	111.9
10004	1000 NAV INSTL NO. 2			1	2.9	72.4
10104	RECEIVER R-1048A & MOUNT			1	4.5	33.0
10114	RECEIVER R-1048B & MOUNT			1	5.0	33.0
10004	CONTROL C-1048A & MOUNT			1	2.0	112.9
10005	INDICATOR IN-1048AC			1	1.6	111.9
10105	INDICATOR IN-1049AC			1	1.7	111.9
10006	1000 GLIDESLOPE INSTL NO. 1			1	3.2	51.0
10006	RECEIVER R-1043A & MOUNT			1	2.6	33.0
10006	ANTENNA CI-212			1	0.2	7.4
10066	1000 GLIDESLOPE INSTL NO. 2			1	3.2	51.0
10066	RECEIVER R-1043A & MOUNT			1	2.6	33.0
10066	ANTENNA COUPLER & CABLE			1	0.3	13.9
10007	1000 ADF INSTL			1	3.2	118.9
10007	RECEIVER R-846A & MOUNT			1	4.6	33.0
10007	CONTROL C-1046A & MOUNT			1	2.0	112.5
10007	POWER SUPPLY P-1000A			1	1.2	33.0
10008	INDICATOR IN-346A			1	1.1	111.9
10009	ACCESSORY UNIT RA-846A			1	1.4	140.0
10107	ANTENNA-LOOP L-346A	9751002 28		1	1.6	162.4
10007	ANTENNA-SENSE	9751042 1		1	1.9	195.3
10010	400 MARKER BEACON INSTL			1	3.2	33.0
10010	RECEIVER R-402A & MOUNT			1	1.1	33.0
10010	ANTENNA CI-102			1	0.8	73.0
20001	HAND MICROPHONE			1	0.4	120.3
20002	HEADSET & BOOM MIC COMBINATION			1	0.3	110.0
20003	800 AUDIO AMPLIFIER AA-108			1	1.2	111.9
20004	1000 AUDIO AMPLIFIER F1010A			1	1.6	111.9
20005	FWD PRESSURE BULKHEAD FEEDTHRU			1	0.5	100.0
20006	AVIONICS BUS			1	4.5	142.3

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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
20007	APPROACH PLATE HOLDERS			2	0.2	124.6
20008	JUNCTION BLOCK			1	2.6	31.5
20009	CABLE COVER INSTL	9756118 1		1	1.4	42.1
20011	ANTENNA-COM NO. 1 A-29C			1	1.6	105.8
20012	ANTENNA-COM NO. 2 VF10-122			1	1.6	417.0
20013	ANTENNA-DUAL NAV CI120-200			1	2.3	376.7
20021	AVIONICS COOLING-PANEL			1	0.9	111.0
20022	AVIONICS COOLING-NOSE (ONE)			1	2.4	25.7
20023	AVIONICS COOLING-NOSE (TWO)			1	4.3	29.7
20024	BLOWER INSTL	9754125 1		1	1.0	125.6
20025	SPEAKER INSTL	9715028 1		1	3.3	195.2
20031	SHELF INSTL	9756112 1		1	2.2	36.4
20032	COVER SHELF	9756113 1		1	7.0	30.0
622	400 TRANSPONDER INSTL NO. 1			1	0.6	121.7
622	TRANSCEIVER RT-459A & MOUNT			1	3.2	109.5
622	ANTENNA L10-216			1	0.3	134.0
622C	400 TRANSPONDER INSTL NO. 2			1	0.6	134.1
622C	TRANSCEIVER RT-459A & MOUNT			1	3.2	109.5
622C	ANTENNA L10-216			1	0.3	158.8
623	800 TRANSPONDER INSTL NO. 1			1	0.6	121.7
623	TRANSCEIVER RT-859A & MOUNT			1	3.2	109.5
623	ANTENNA L10-216			1	0.3	134.0
623B	800 TRANSPONDER INSTL NO. 2			1	0.6	134.1
623B	TRANSCEIVER RT-859A & MOUNT			1	3.2	109.5
623B	ANTENNA L10-216			1	0.3	158.8
681	400 DME INSTL NO. 1			1	2.9	60.7
681	TRANSCEIVER RTA-476A & MOUNT			1	9.8	33.0
681	CONTROL C-476A			1	1.7	111.0
681	ANTENNA L10-216			1	0.3	38.0
681C	400 DME INSTL NO. 2			1	2.9	72.9

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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
681C	TRANSCEIVER RTA-476A & MOUNT			1	9.8	33.0
681C	CONTROL C-476A			1	1.7	111.0
681C	ANTENNA L10-216			1	0.3	74.7
681C	MULTIPLEXER MU876A & MOUNT			1	1.1	33.0
681F	800 DME INSTL NO. 1			1	2.9	60.7
681F	TRANSCEIVER RTA-876A & MOUNT			1	9.3	33.0
681F	CONTROL C-876A			1	1.7	111.0
681F	ANTENNA L10-216			1	0.3	38.0
681G	800 DME INSTL NO. 2			1	2.9	72.9
681G	TRANSCEIVER RTA-876A & MOUNT			1	9.3	33.0
681G	CONTROL C-876A			1	1.7	111.0
681G	ANTENNA L10-216			1	0.3	74.7
677	HORIZONTAL SITUATION INDICATOR			1	3.2	213.0
677	(3 IN) TO BE USED W/O AUTOPILOT					
67701	CONVERTER B-445A & MOUNT			1	1.3	33.0
677	FLUX DETECTOR CT-504A			1	0.5	361.9
67702	SLAVE ACCESS W/O BS SA-832A			1	0.8	35.0
67703	SLAVE ACCESS W/BS SA-832B			1	2.2	35.0
692	MARKER BEACON MUTE TIMER R-14A			1	0.1	33.0
629G	RDR-150 RADAR INSTL			1	3.0	59.1
629G	TRANSCEIVER RT-131A & MOUNT			1	13.0	24.9
629G	INDICATOR IN-152A & MOUNT			1	6.8	103.9
629G	WAVEGUIDE			1	2.6	18.0
629G	ANTENNA DA-144A			1	3.6	9.0
629G	REFLECTOR AA-1212A			1	1.2	7.5
629G	RADOME NOSE			1*	-0.3	7.4
629P	RDR-150 RADAR INSTL (COLOR)			1	3.0	59.1
629P	TRANSCEIVER RT-131A & MT			1	13.0	24.9
629P	INDICATOR IN-2026A			1	11.0	103.9
629P	WAVEGUIDE			1	2.6	18.0

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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
629P	REFLECTOR AA-1212A			1	1.2	7.5
629P	ANTENNA DA-144A			1	3.6	9.0
629P	RADOME NOSE			1*	-0.3	7.4
629D	RDR-160 RADAR INSTL			1	3.0	57.5
629D	TRANSCEIVER, ANTENNA & MOUNT	ANT-161A		1	10.5	11.0
629D	INDICATOR IN-152A & MOUNT			1	6.8	103.9
629D	RADOME NOSE			1*	-0.3	7.4
627F	RDR-160 RADAR INSTL (COLOR)			1	3.0	57.5
627F	TRANSCEIVER, ANTENNA & MT			1	10.5	11.0
627F	INDICATOR IN-2026A			1	11.0	103.9
627F	RADOME NOSE			1*	-0.3	7.4
627G	RADAR CHECK LIST CONTROL UNIT			1	1.5	113.0
627H	RADAR CHECK LIST PROGRAMMER			1	0.5	135.0
629U	PRIMUS 200 COLOR RADAR INSTL			1	3.0	57.5
629U	XCVR & ANT RT A-1003 & MT			1	18.0	11.0
629U	INDICATOR DI- 2008 & MT			1	11.0	103.9
629U	RADOME NOSE (XCHANGE)			1*	-0.3	73.5
633D	COLLINS HF-200 NSTL			1	2.7	152.4
633D	CONTROL HEAD CTL-201	9752007155		1	1.1	112.9
633D	TRANSCEIVER TCR-200	9756031242		1	6.4	33.0
633D	POWER AMPLIFIER PWR-200	9756031243		1	7.4	33.0
633D	ANT & COUPLER AAC-200	9751094 1		1	11.0	308.3
63300	R. F. FILTER A2597			1	1.1	33.0
63300	ANTENNA-STRAIGHT, 30 FEET			1	1.3	218.0
65100	400 ADF INSTL NO. 2			1	3.2	91.9
65100	RECEIVER R-446A & MOUNT			1	4.0	109.4
65101	INDICATOR IN-346A			1	1.1	111.9
65102	INDICATOR IN-13A-1			1	1.4	111.9
65103	ACCESSORY UNIT RA-446A			1	1.4	140.0
65104	ACCESSORY UNIT RA-446A			1	1.4	140.0

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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
65105	INVERTER DV-1060A			1	5.2	33.0
65106	ANTENNA-LOOP L-346A	9751002 29		1	1.6	219.0
65100	ANTENNA-SENSE	9751042 2		1	1.9	195.3
65600	1000 ADF INSTL NO. 2			1	3.2	118.9
65600	RECEIVER R-846A & MOUNT			1	4.6	33.0
65600	CONTROL C-1046A & MOUNT			1	2.0	112.5
65600	POWER SUPPLY P-1000A			1	1.2	33.0
65601	INDICATOR IN-346A			1	1.1	111.9
65602	INDICATOR IN-13A-1			1	1.4	111.9
65603	ACCESSORY UNIT RA-846A			1	1.4	140.0
65604	ACCESSORY UNIT RA-846A			1	1.4	140.0
65605	INVERTER DV-1060A			1	5.2	33.0
65606	ANTENNA-LOOP L-346A	9751002 29		1	1.6	219.0
65600	ANTENNA-SENSE	9751042 2		1	1.9	195.3
66000	ADF IN-346B			1	1.3	111.9
66200	ADF RA-446A			1	1.4	140.0
66300	ADF RA-846A			1	1.4	140.0
68500	400 AREA NAVIGATION INSTL			1	2.8	111.0
68501	INDICATOR IN-1048AC			1	1.6	111.9
68502	INDICATOR IN-1049AC			1	1.7	111.9
68500	COMPUTER RN-478A & MOUNT			1	5.1	112.0
68700	800 AREA NAVIGATION INSTL			1	2.8	72.5
68700	COMPUTER RN-878A & MOUNT			1	5.4	112.0
67200	AA-215 RADIO ALTIMETER INSTL			1	0.5	195.5
67200	TRANSCEIVER RT-220			1	6.8	279.0
67200	INDICATOR RA-215			1	2.6	112.0
67200	ANTENNA AT-220			1	0.8	244.4
68800	AA-100 RADIO ALTIMETER INSTL			1	0.5	216.0
68800	TRANSCEIVER RT-100			1	3.6	320.0
68800	INDICATOR RA-100			1	1.3	112.0

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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
68800	ANTENNA AT-100			1	1.1	284.6
67000	400 RMI INSTL			1	1.2	95.0
67000	INDICATOR IN-404A			1	2.3	111.0
67000	INVERTER DV-1060A			1	5.2	33.0
67100	1000 RMI INSTL			1	1.2	95.0
67100	INDICATOR IN-1004A			1	2.4	111.0
67100	INVERTER DV-1060A			1	5.2	33.0
668	AERONETIC 7100 RMI INSTL			1	1.2	95.0
668	INDICATOR 5207131-014			1	1.6	111.0
668	CONVERTER 5207100-002			1	1.7	33.0
7900	RADOME NOSE	9711019 1		1*	-0.3	7.4
674A	FLITEFONE III (CABIN CONTROL)			1	21.3	281.2
674B	FLITEFONE III (COCKPIT CONTROL			1	12.2	294.4
14100	COMBINATION BOOM MIC & HEADSET	9754030 5		1	0.4	120.9
141A	COMBINATION BOOM MIC & HEADSET	9754030 6		2	0.8	120.9
141D	COMBINATION BOOM MIC & HEADSET	9754030 5		1	0.4	120.9
5500	BOOM MIC	5618110 1		1	0.6	138.7
55A	PASSENGER MIC AFT CABIN I/C	9715030 1		1	1.0	186.4
	FURNISHINGS					
	SEAT-COPILOT ADJUSTABLE STD	0812782 2		1	15.1	140.0
AL	SEAT-COPILOT ADJUSTABLE-LEATHER	0812782 2		1	15.7	140.0
89A	SEAT-COPILOT VERT ADJUST TILT	0812780 2		1	22.9	140.8
89AL	SEAT-COPILOT VERT ADJ TILT LTHR	0812780 2		1	23.5	140.8
	SAFETY BELT-SHOULDER HARNS	CM400869		1	1.1	153.1
18100	INERTIA REEL INSTL-COPILOT	5119565 11		1	1.3	153.1
	STD SEATING INSTL	5619203 1		1	15.1	263.6
11100	SEATING OPTION NO. 1 INSTL	5619203 2		1	11.6	265.8
11200	SEATING OPTION NO. 2 INSTL	5619203 3		1	11.6	264.6
11300	SEATING OPTION NO. 3 INSTL	5619203 4		1	8.2	266.5

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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
11400	SEATING OPTION NO. 4 INSTL	5619203 5		1	8.2	264.5
	SEAT-3RD PLACE AFT FACING STD	5619154 13		1	25.6	170.5
111	SEAT-3RD PLACE FWD FACING	5619153 14		1	24.0	182.5
113	SEAT-3RD PLACE FWD FACING	5619153 14		1	24.0	182.5
	SEAT-4TH PLACE AFT FACING STD	5619154 14		1	25.6	170.5
111	SEAT-4TH PLACE FWD FACING	5619153 15		1	24.0	182.5
113	SEAT-4TH PLACE FWD FACING	5619153 15		1	24.0	182.5
	SEAT-5TH PLACE FWD FACING	5619153 16		1	24.0	225.2
	SEAT-6TH PLACE FWD FACING	5619153 14		1	24.0	225.2
111	SEAT-7TH PLACE FWD FACING	5119412 15		1	15.2	266.0
112	SEAT-7TH PLACE FWD FACING	5119412 15		1	15.2	266.0
113	SEAT-7TH PLACE FWD FACING	5119412 15		1	15.2	266.0
114	SEAT-7TH PLACE FWD FACING	5119412 15		1	15.2	266.0
113	SEAT-8TH PLACE FWD FACING	5119412 15		1	15.2	266.0
114	SEAT-8TH PLACE FWD FACING	5119412 15		1	15.2	266.0
99600	SEATS, ALL LTHR STD	5619203800		1	2.4	197.9
996A1	SEATS, ALL LTHR OPT 1	5619203802		1	3.0	216.2
996A2	SEATS, ALL LTHR OPT 2	5619203804		1	3.0	211.0
996B3	SEATS, ALL LTHR OPT 3	5619203806		1	3.6	224.5
996B4	SEATS, ALL LTHR OPT 4	5619203808		1	3.6	220.6
99700	SEAT TRIM LTHR STD	5619203810		1	0.6	197.9
997A1	SEAT TRIM LTHR OPT 1	5619203812		1	0.8	216.2
997A2	SEAT TRIM LTHR OPT 2	5619203814		1	0.8	211.0
997B3	SEAT TRIM LTHR OPT 3	5619203816		1	0.9	224.5
997B4	SEAT TRIM LTHR OPT 4	5619203818		1	0.9	220.6
104J	STOWAGE DRAWER 3RD AFT SEAT	5319031 2		1	5.4	176.5
104H	STOWAGE DRAWER 3RD FWD SEAT	5319031 4		1	5.4	176.5
104L	STOWAGE DRAWER 4TH AFT SEAT	5319031 1		1	5.4	176.5
104K	STOWAGE DRAWER 4TH FWD SEAT	5319031 3		1	5.4	176.5

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FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
104M	STOWAGE DRAWER 5TH FWD SEAT	3319031 4		1	5.4	219.2
104N	STOWAGE DRAWER 6TH FWD SEAT	5319031 3		1	5.4	219.2
998	SIDE PANELS, ALL LEATHER	5600300800		1	3.6	186.0
17	BAGGAGE RETAINER (NOSE)	5113016 1		1	1.0	43.0
130B	TOILET, DIVIDER, RACK & CURTAIN	5119435 3		1	37.6	238.8
130A	TOILET, CURTAIN & TISSUE HOLDER	5119435 1		1	22.5	239.2
130E	FLUSH TOILET, CURTAIN & HOLDER	5119567 2		1	35.0	251.2
130F	FLUSH TOILET, DIVIDER & RACK	5119567 1		1	50.2	247.3
128	REFRESHMENT CENTER	5119467 1		1	28.1	273.0
128Q	THERMOS CARRIER FWD CABIN	5119071 1		1	8.8	156.9
65	OXYGEN SYS 11.0 CU. FT.	5114006 1		1	14.9	88.8
63	OXYGEN SYS 114.9 CU. FT.	5217541 5		1	54.9	41.5
63A	OXYGEN SYS 114.9 CU. FT			1	54.9	41.5
97	TINTED WINDOWS	5111601 24		1*		
138Y	STEREO INSTL W/AVN	9715029 3		1	9.5	165.0
138G	STEREO INSTL W/O AVN	9715029 4		1	11.8	170.4
35C	EXTENDER INSTL WR CABIN DOOR	5111134 1		1	1.9	235.7
42	AVIONICS BAY ACCESS DOOR	5113001 18		1	2.2	32.0
41	FENDER INSTL-NOSE GEAR	5042021 1		1	1.0	51.2
28	CURTAIN, FLIGHT DECK DIVIDER	5119465 5		1	3.4	156.0
120G	FLIGHT DECK DIVIDER & CURTAIN	5119465 4		1	13.6	155.1
120L	INSTRUMENT CONSOLE/ALT&AIRSP	5119465 1		1	1.4	155.1
84A	SIGNS/SEAT BELT,OXYGEN&CLOCK	5119465 2		1	0.2	145.7
124A	EXECUTIVE TABLE LH	5119138 3		1	9.8	194.0
124B	EXECUTIVE TABLE RH	5119138 4		1	9.8	194.0
199A	PAINT, ALUMIGRIP	5600350000		1*		
31	CAA CONVERSION KIT	5600011 4		1	1.0	43.6
31E	LBA CONVERSION K	5600002 5		1	0.0	212.9

SECTION B
STANDARD AND OPTIONAL EQUIPMENT

FACTORY KIT	ITEM	PART NUMBER	MARK IF INSTALLED	QTY	WEIGHT (POUNDS)	ARM (INCHES)
	EMERGENCY EQUIPMENT					
37A	FIRE EXTINGUISHER HALON	5114243 6		1	5.2	130.7
44	NACELLE FIRE EXTINGUISHER	5118705 13		1	16.8	133.6
44B	FIRE EXTINGUISHER, CABIN FLOOD	5114586 1		1	31.6	173.8
177	LOCATOR BEACON	9754083 47		1	3.7	312.4
177A	LOCATOR BEACON (CANADA)	9754083 42		1	3.7	312.4
177B	LOCATOR BEACON (CANADA)	9754083 42		1	3.7	312.4
	AIR CONDITIONING & ANTI-ICE					
20	CABIN PRESSURE CONTROL VARIABLE	5614600 4		1*	2.0	116.1
15	AIR CONDITIONING INSTL	5114524 7		1	116.9	158.3
15M	AIR OUTLETS-TOILET	5114578 23		1	2.3	263.1
15N	AIR OUTLETS-7TH & TOILET	5114578 41		1	2.3	263.1
92	VENTILATING FAN SYSTEM	5114579 1		1	21.4	155.3
30	DE-ICE PROPELLER	5250131 6		1	10.9	101.7
67	DE-ICE WING & TAIL,PART PLBG	5115565 4		1	3.6	167.7
32	DE-ICE WING & TAIL-TOTAL SYSTEM	5115565 3		1	42.2	182.8
194	DE-ICE SYSTEM FLIGHT IN ICING	5114400 3		1	75.7	158.4
94A	WINDSHIELD ANTI-ICE, ALCOHOL	5114136 4		1	30.7	189.1
78	FUSELAGE ICE PROTECTION PLATES	5113115168		1	5.1	90.7
88	STATIC SOURCE-DUAL HEATED	5114220 6		1	0.3	257.0

WEIGHT AND BALANCE FORM

PAYLOAD COMPUTATIONS

ITEM OCCUPANTS OR CARGO	ARM	WEIGHT	MOMENT/ 100
SEAT 1			
SEAT ___			
SEAT ___			
SEAT ___			
SEAT ___			
SEAT ___			
SEAT ___			
SEAT ___			
TOILET			
BAGGAGE			
WING LOCKERS			
AVIONICS			
NOSE			
BAY A			
BAY B			
CABINET CONTENTS			
PAYLOAD			

REF	ITEM	WEIGHT	MOMENT/ 100
1.	BASIC EMPTY WEIGHT		
2.	PAYLOAD		
3.	ZERO FUEL WEIGHT (sub-total) (Do not exceed maximum zero fuel weight of 6515 pounds)		
4.	FUEL LOADING		
5.	RAMP WEIGHT (sub-total) (Do not exceed maximum ramp weight of 6785 pounds)		
6.	LESS FUEL FOR TAXIING		
7.	TAKEOFF WEIGHT (Do not exceed maximum takeoff weight of 6750 pounds)		
8.	LESS FUEL TO DESTINATION		
9.	LANDING WEIGHT (Do not exceed maximum landing weight of 6750 pounds)		

Totals must be within approved weight and C.G. limits. It is the responsibility of the operator to insure that the airplane is loaded properly. The Basic Empty Weight C.G. is noted on the Airplane Weighing Form. If the airplane has been altered, refer to the Weight and Balance Record for this information.

SECTION 7
AIRPLANE & SYSTEMS DESCRIPTIONS

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

INTRODUCTION

Section 7 of this handbook provides a description and operation of the airplane and its systems.

> **NOTE**
>
> Operational procedures for optional systems and equipment are presented in Section 9.

AIRFRAME

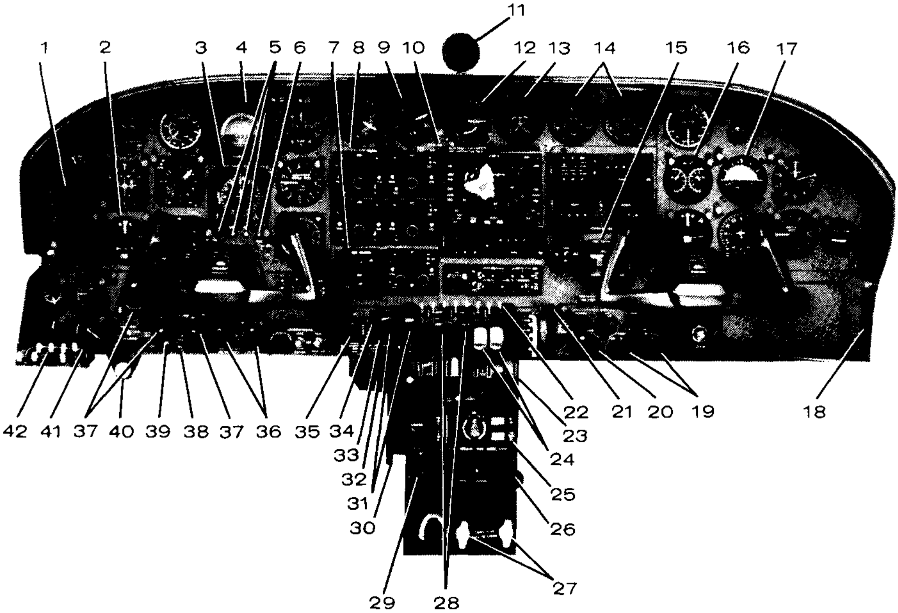
The Model 414 Chancellor is a 6-to 8-place, all-metal, low-wing, pressurized airplane. The fuselage and empennage are of semimonocoque construction. The cabin area is sealed and structurally reinforced for pressurization. The wing and horizontal and vertical tail surfaces are of conventional aluminum construction. The wing uses 2 main spars which attach to the carry-thru spars. The retractable landing gear is a tricycle design using air-over-oil shock struts.

The 414 Chancellor II and 414 Chancellor III are identical to the 414 Chancellor except a selection of popular optional equipment has been included as standard equipment.

INSTRUMENT PANEL

The instrument panel, see Figure 7-1, contains the instruments and controls necessary for safe flight. The instrument panel presented is typical, as it contains all standard items and a good selection of popular optional equipment. The function and operation of the instrument panel features not described here have been explained in this section or Section 9 under the applicable system.

INSTRUMENT PANEL



1. ANNUNCIATOR PANEL
2. FLIGHT INSTRUMENT GROUP
3. FLIGHT DIRECTOR HSI (OPTIONAL)
4. FLIGHT DIRECTOR FDI (OPTIONAL)
5. MARKER BEACON LIGHTS (OPTIONAL)
6. MARKER BEACON TEST SWITCH (OPTIONAL)
7. FLIGHT DIRECTOR MODE SELECTOR (OPTIONAL)
8. AVIONICS CONTROL PANEL
9. ENGINE INSTRUMENT GROUP
10. PROPELLER SYNCHROPHASER SWITCH (OPTIONAL)
11. COMPASS
12. FUEL FLOW GAGE
13. ECONOMY MIXTURE INDICATOR (OPTIONAL)
14. COMBINATION ENGINE GAGES
15. FIRE DETECTION PANEL (OPTIONAL)
16. FUEL QUANTITY GAGE
17. RIGHT FLIGHT INSTRUMENT GROUP (OPTIONAL)
18. RIGHT SIDE CONSOLE
19. PRESSURIZATION AIR TEMPERATURE CONTROLS
20. HEATER AND CABIN AIR CONTROL PANEL
21. FLAP POSITION SWITCH
22. LIGHT DIMMING CONTROLS
23. QUADRANT FRICTION LOCK
24. MIXTURE CONTROLS
25. AUTOPILOT CONTROL HEAD (OPTIONAL)
26. RUDDER TRIM CONTROL
27. COWL FLAP CONTROLS
28. PROPELLER CONTROLS
29. AILERON TRIM CONTROL
30. ELEVATOR TRIM CONTROL
31. THROTTLE CONTROLS
32. EMERGENCY LANDING GEAR EXTENSION T-HANDLE
33. LANDING GEAR POSITION INDICATOR LIGHTS
34. GEAR UNLOCKED LIGHT
35. LANDING GEAR SWITCH
36. ALTERNATE AIR CONTROLS
37. CABIN PRESSURIZATION CONTROLS AND INDICATORS
38. OXYGEN CONTROL
39. CABIN DOOR LIGHT SWITCH
40. PARKING BRAKE CONTROL
41. OXYGEN CYLINDER PRESSURE GAGE (OPTIONAL)
42. LEFT SIDE CONSOLE

Figure 7-1

OVERHEAD CONSOLE

The overhead console, see Figure 7-2, includes the avionics speaker and instrument panel floodlight and aisle courtesy lights with dimming control and pilot and copilot overhead directional air vents.

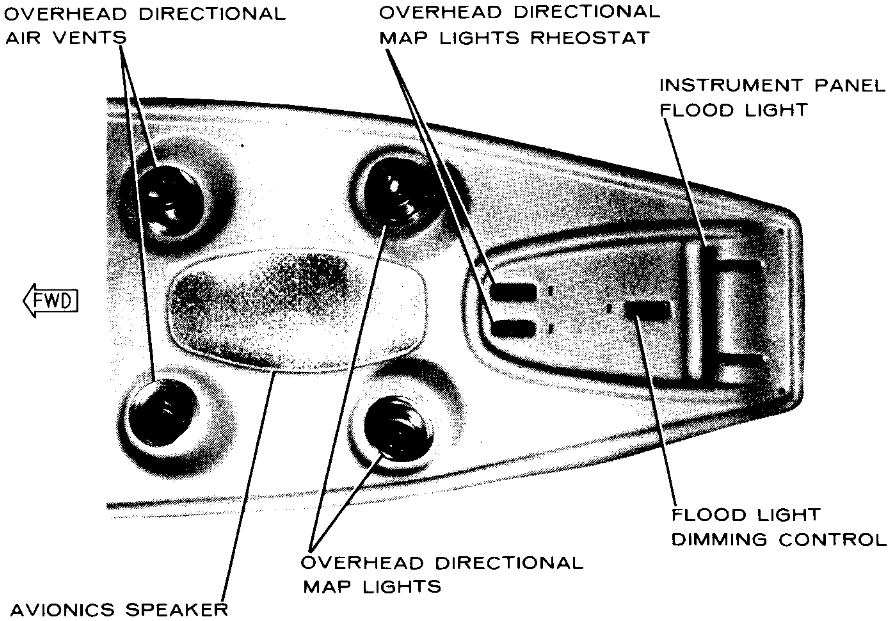


Figure 7-2

ANNUNCIATOR PANEL

The annunciator panel, see Figure 7-3, is located on the left side of the pilot's instrument panel. The panel annunciates items of interest to the pilot in the applicable color of red, amber, green or white. No dimming capability of the annunciator lights is provided.

When a hazardous condition exists, requiring immediate corrective action, a red warning light will illuminate. When an impending possibly dangerous condition exists, requiring attention but not necessarily immediate action, an amber light will illuminate. A green or white light will illuminate to indicate a safe or normal configuration, condition of performance, operation of essential equipment or to attract attention and impart information for routine action purposes.

A press-to-test button is provided to the left of the annunciator panel. When the button is pressed, all annunciator panel lights, landing gear position and unlocked lights, propeller synchrophaser light and marker beacon lights will be tested and should illuminate. If the throttles are retarded or flaps are extended more than 15 degrees, the gear warning horn will sound when the button is pressed.

ANNUNCIATOR PANEL

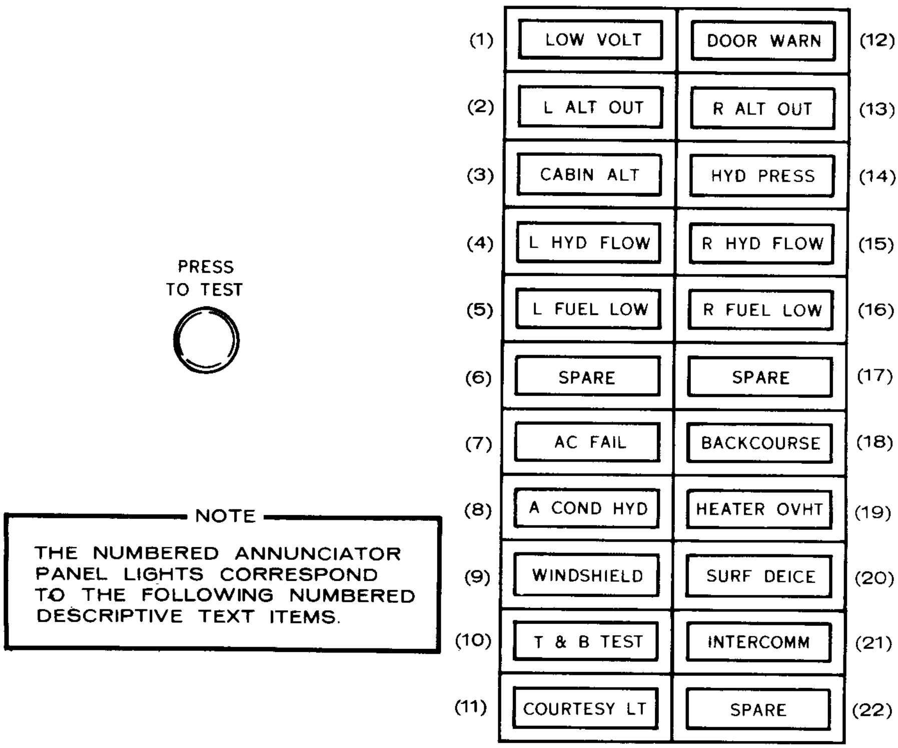


Figure 7-3

NOTE

A spare light lens is installed in each blank location of the annunciator panel when the optional system is not installed. These lenses can be replaced with the appropriate lens when additional optional equipment is installed.

The following numbered items, see Figure 7-3, describe the applicable system condition when the annunciator light is illuminated.

1. The red low voltage light advises that the airplane bus voltage is less than 25 volts.
2. The amber left alternator out light advises that the left alternator is not generating.

3. The amber cabin altitude light advises that cabin altitude is above 10,000 feet.
4. The amber left hydraulic flow light advises that insufficient flow exists at 1000 propeller RPM or above and that the cause may be a result of pump, lines, filter or bypass valve failure.
5. The amber left main tank fuel low light advises that approximately 60 pounds of fuel remains in the left main tank.
6. The white spare light is reserved for optional equipment.
7. The amber alternating current failure light advises that a loss of AC power has occurred.
8. The green air conditioning hydraulic pressure light advises that the optional air conditioning compressor is in operation.
9. The green electric windshield heater light advises that the heating elements in the optional electric windshield are operating.
10. The green turn-and-bank test light will only illuminate when the press-to-test button is pushed and power is being provided to the turn-and-bank electrical circuit.
11. The white courtesy light advises that the overhead flight deck flood light and main cabin door entry lights are illuminated.
12. The red door warning light advises that the main cabin door is not secured for flight.
13. The amber right alternator out light advises that the right alternator is not generating.
14. The amber hydraulic pressure light advises that hydraulic pressure is being applied to the landing gear retraction and extension system.
15. The amber right hydraulic flow light advises that insufficient flow exists at 1000 propeller RPM or above and that the cause may be a result of pump, lines, filter or bypass valve failure.
16. The amber right main tank fuel low light advises that approximately 60 pounds of fuel remains in the right main tank.
17. The white spare light is reserved for optional equipment.
18. The amber back course light advises that the optional navigation equipment is programmed for a back course approach.
19. The amber heater overheat light advises that the heater has reached an abnormal temperature and has been automatically deenergized. Once this light illuminates, the heater cannot be operated until resetting of the safety device has been completed.
20. The green surface deice light advises that the optional tail deice boots have reached full inflation pressure.
21. The white intercom light advises that the optional flight deck or passenger compartment microphone switch is pressed and communication is possible.
22. The white spare light is reserved for optional equipment.

FLIGHT CONTROLS SYSTEM

The flight controls consist of the ailerons, elevators and rudder and their respective trim systems. All of these surfaces are constructed of aluminum and are statically mass balanced.

AILERON SYSTEM

Each aileron, see Figure 7-4, is attached to the rear main wing spar at two points. The aileron is actuated by a bell crank which is attached to a wheel in the wing. The wheel is actuated by cables attached to the pilot's control wheel. When the rudder is actuated, a spring assembly, interconnected to the aileron system, causes the ailerons to automatically assist the turn.

AILERON SYSTEM

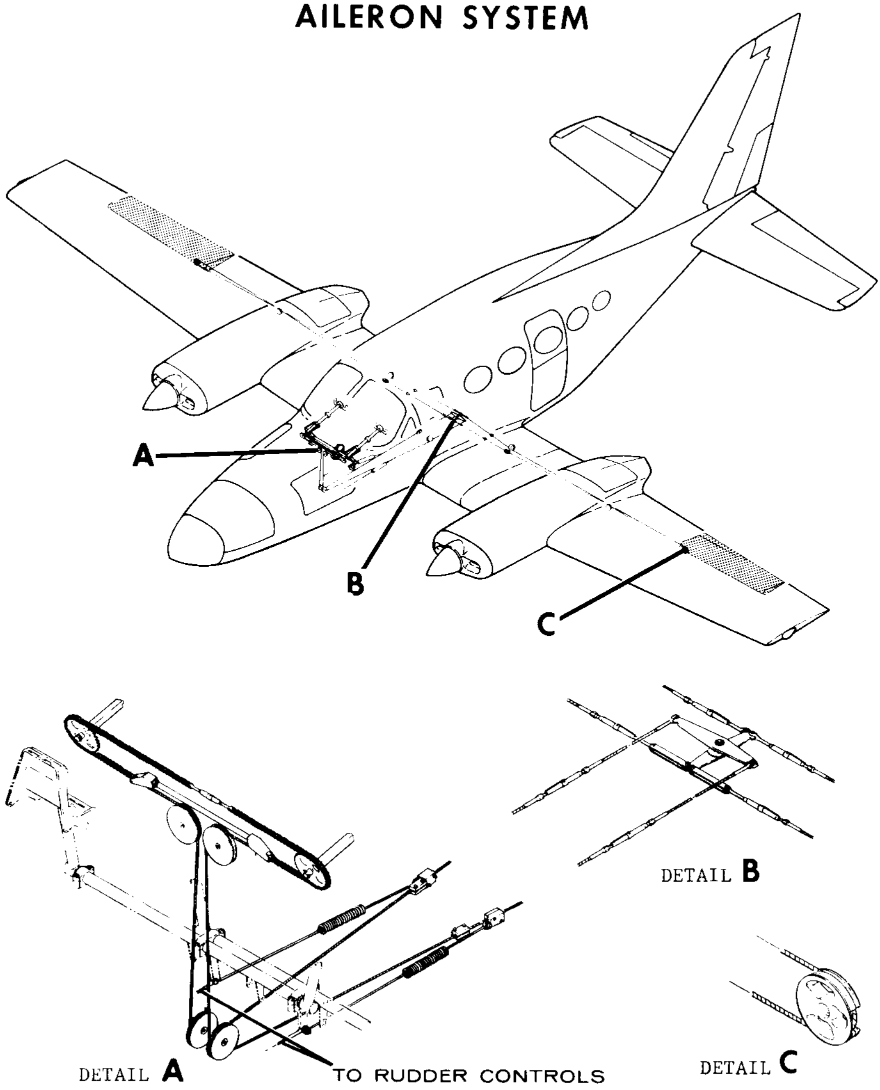


Figure 7-4

AILERON TRIM SYSTEM

Aileron trim, see Figure 7-5, is achieved by a trim tab attached to the left aileron with a full length piano-type hinge. The trim tab is actuated by a push-pull rod which is attached to a jack screw type actuator in the wing. The actuator is driven by cables attached to the trim control knob on the cockpit control pedestal. The aileron trim tab also acts as a servo tab so that aerodynamic forces on the tab will move the ailerons to the selected position, which reduces the forces required to activate the ailerons in flight.

AILERON TRIM SYSTEM

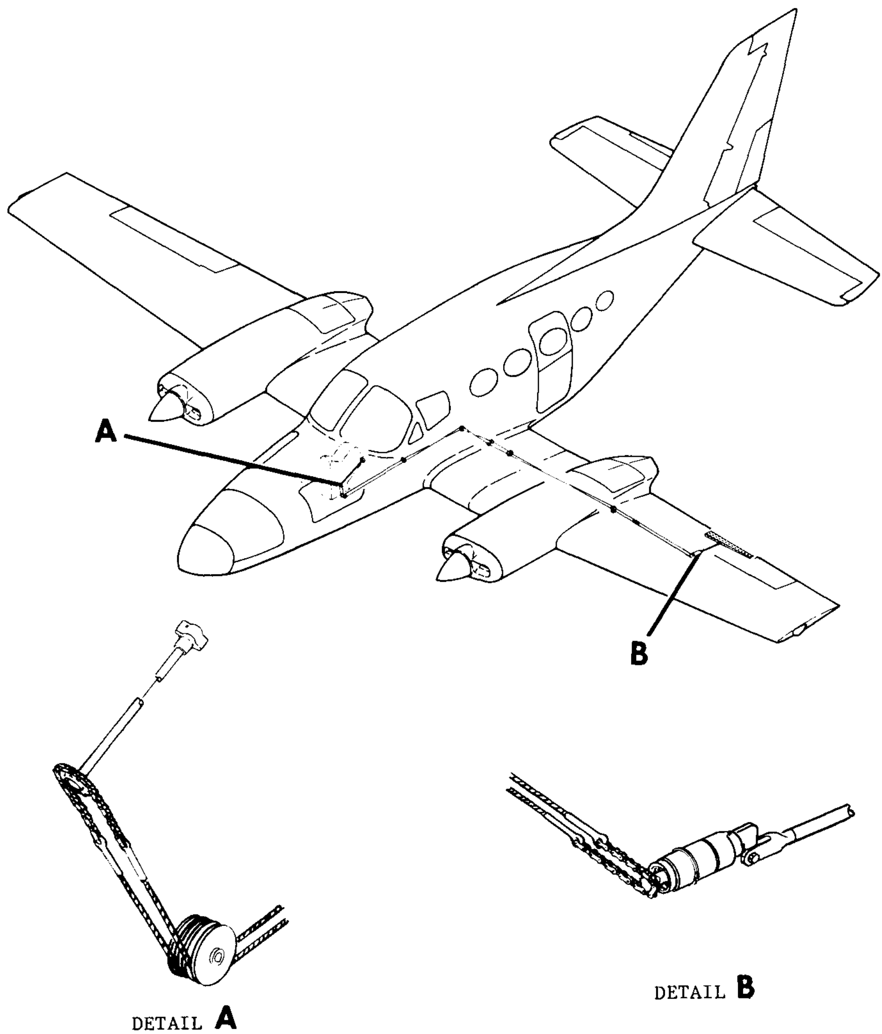


Figure 7-5

ELEVATOR SYSTEM

The two elevator control surfaces, see Figure 7-6, are connected by a torque tube. The resulting elevator assembly is attached to the rear spar of the horizontal stabilizer at six points. The elevator assembly is actuated by a push-pull rod which is attached to a bell crank in the empennage. The bell crank is actuated by cables attached to the pilot's control wheel.

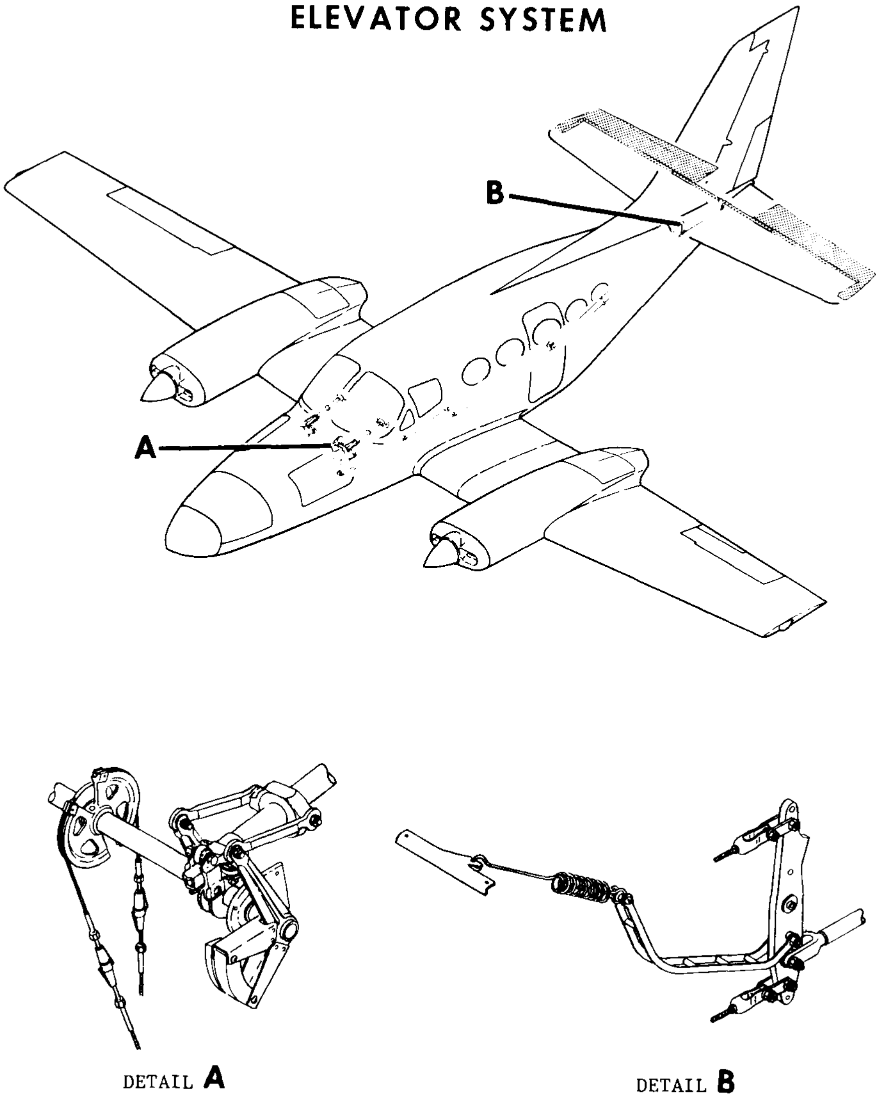


Figure 7-6

ELEVATOR TRIM SYSTEM

Elevator trim, see Figure 7-7, is achieved by an elevator trim tab attached to the right elevator with a full length, piano-type hinge. The trim tab is actuated by a push-pull rod which is attached to a jack screw type actuator in the horizontal stabilizer. The actuator is driven by cables attached to the trim control wheel on the cockpit control pedestal.

ELEVATOR TRIM SYSTEM

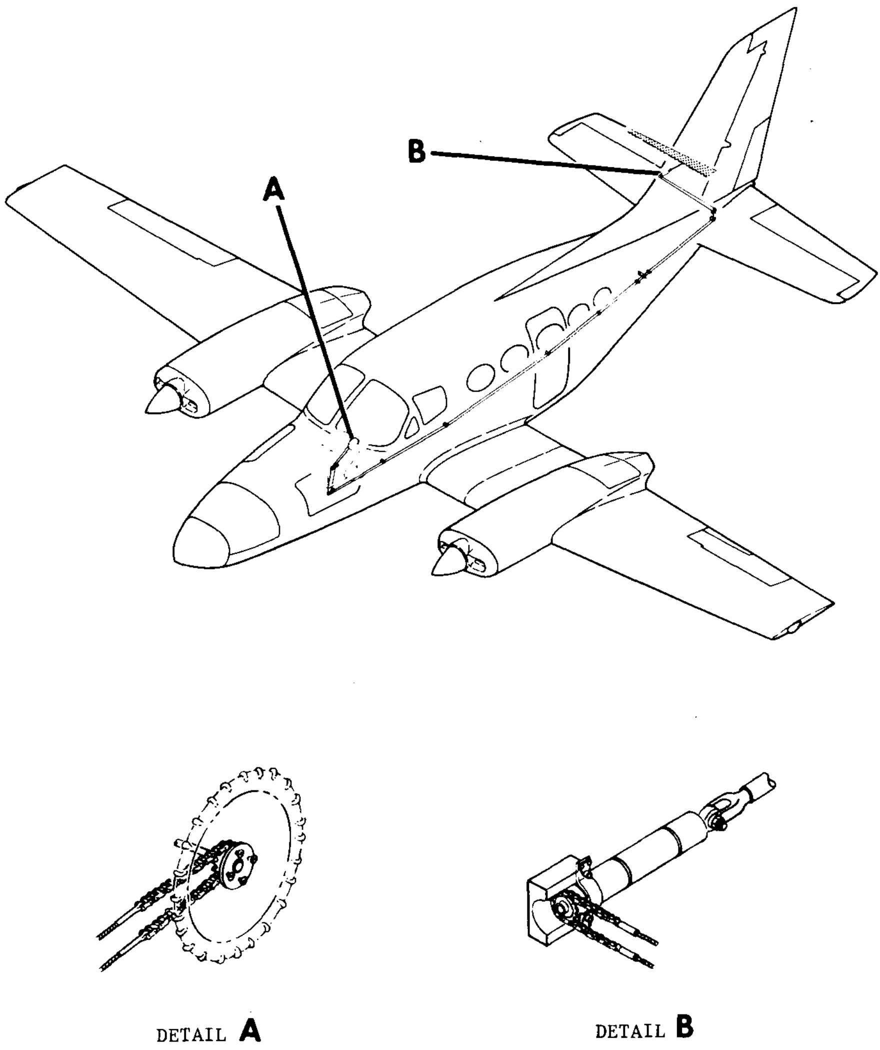


Figure 7-7

RUDDER SYSTEM

The rudder, see Figure 7-8, is attached to the vertical stabilizer rear main spar at three points. The rudder is actuated by a bell crank attached to the bottom of the rudder. The bell crank is actuated by cables attached to the cockpit rudder pedals. When the rudder is actuated, a cable and spring assembly that is connected to the aileron system causes the ailerons to automatically assist the turn.

RUDDER SYSTEM

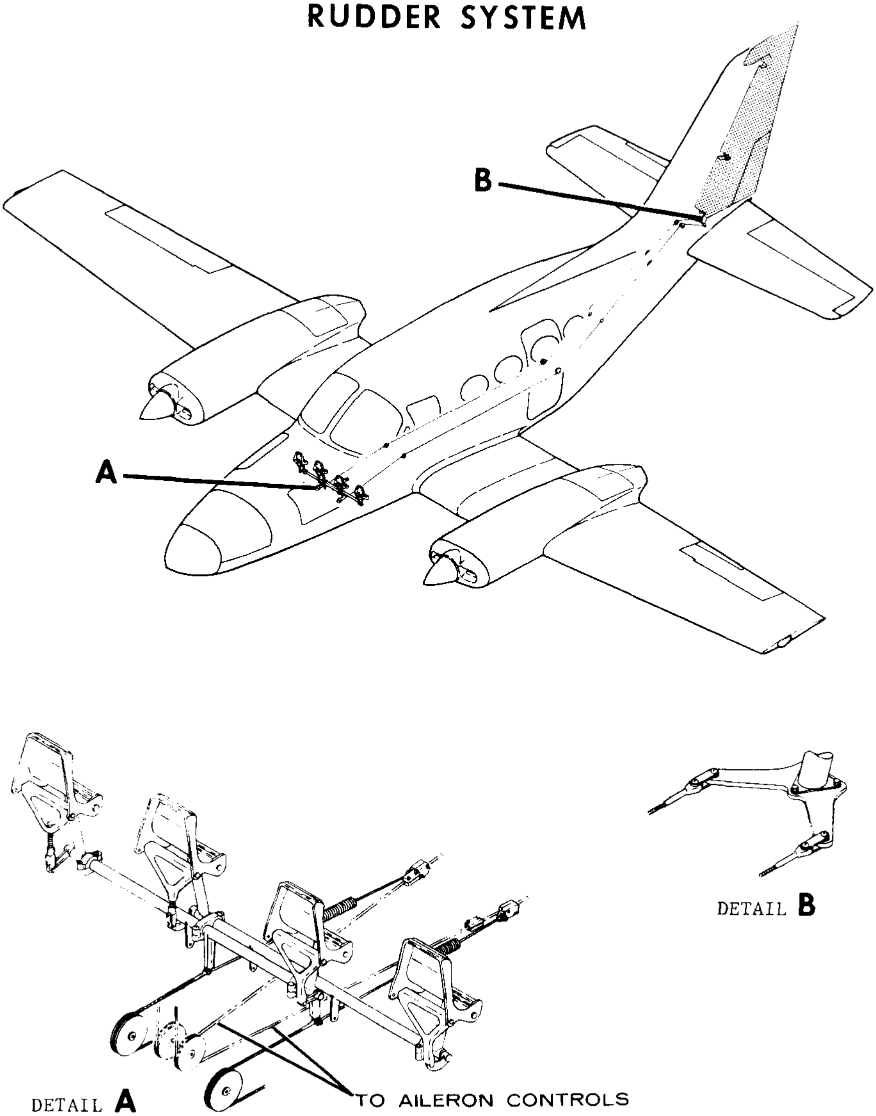


Figure 7-8

RUDDER TRIM SYSTEM

Rudder trim, see Figure 7-9, is achieved by a trim tab attached to the lower half of the rudder with a full length piano-type hinge. The trim tab is actuated by a push-pull rod which is attached to a jack screw type actuator in the vertical stabilizer. The actuator is driven by cables attached to the rudder trim wheel on the cockpit control pedestal. The rudder trim tab also acts as a servo tab so that aerodynamic forces on the tab will move the rudder to the selected position, which reduces the forces required to activate the rudder in flight.

RUDDER TRIM SYSTEM

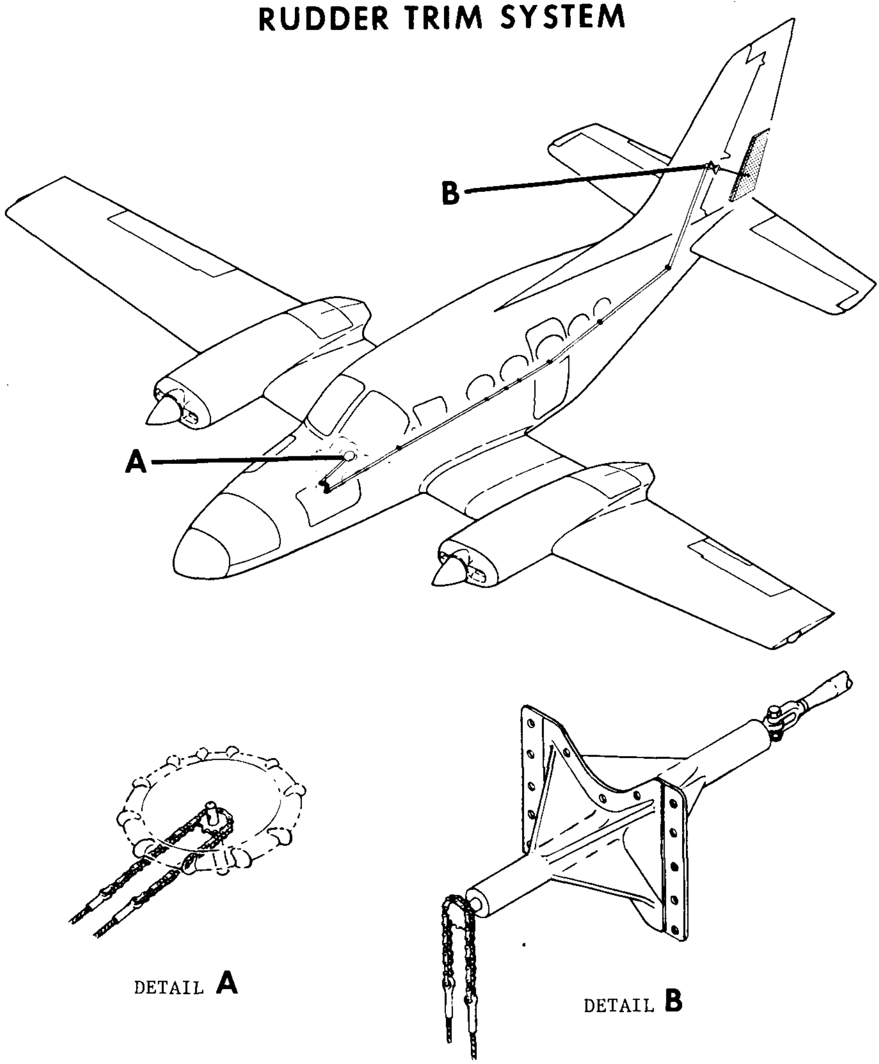


Figure 7-9

NOSEWHEEL STEERING SYSTEM

The nosewheel steering system, see Figure 7-10, consists of the rudder pedals, nose gear, bungee spring assembly and cables. During ground operation, the nose gear automatically engages the nosewheel steering system, allowing normal directional control.

NOSEWHEEL STEERING SYSTEM

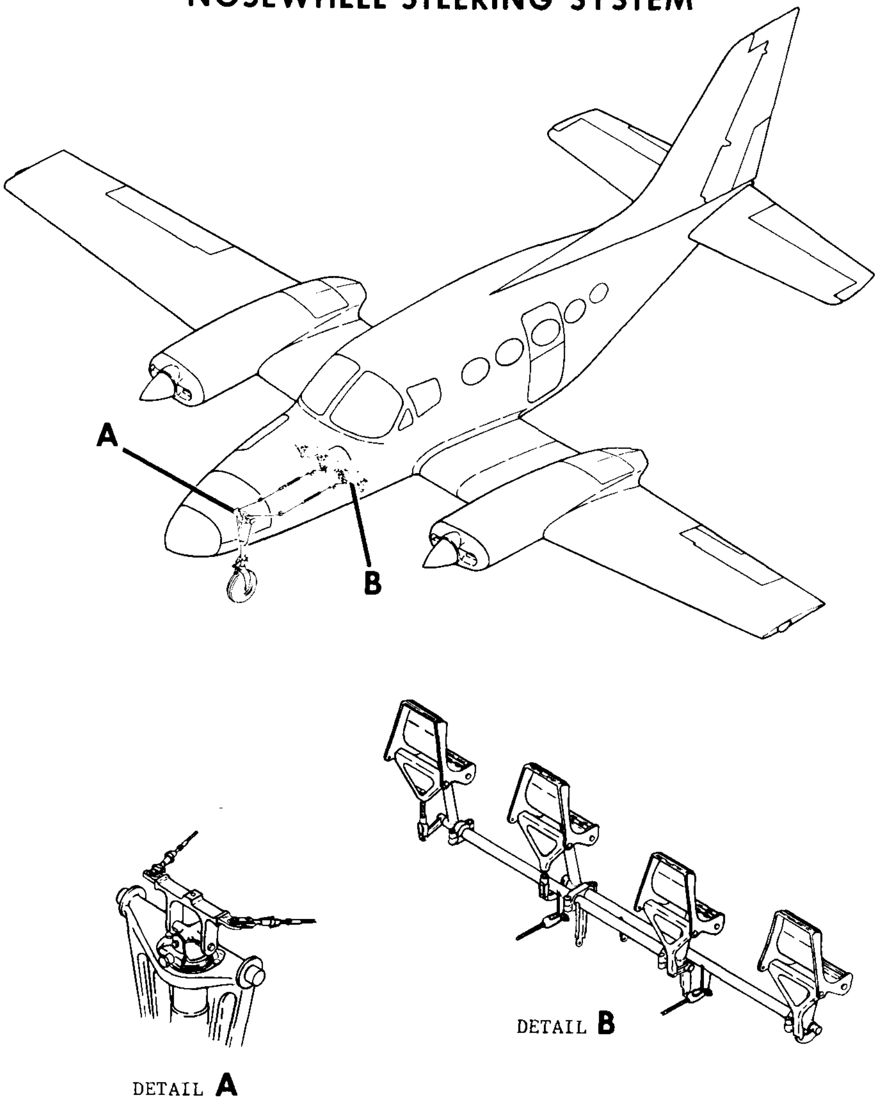


Figure 7-10

The minimum turning distance is presented in Figure 7-11. Always use as large a radius of turn as is practical. Turning tighter than necessary requires excessive braking on the inboard wheel which decreases the tire life.

NOTE

Minimum turning distance is effected with inboard wheel brake locked, full rudder and differential power.

MINIMUM TURNING DISTANCE

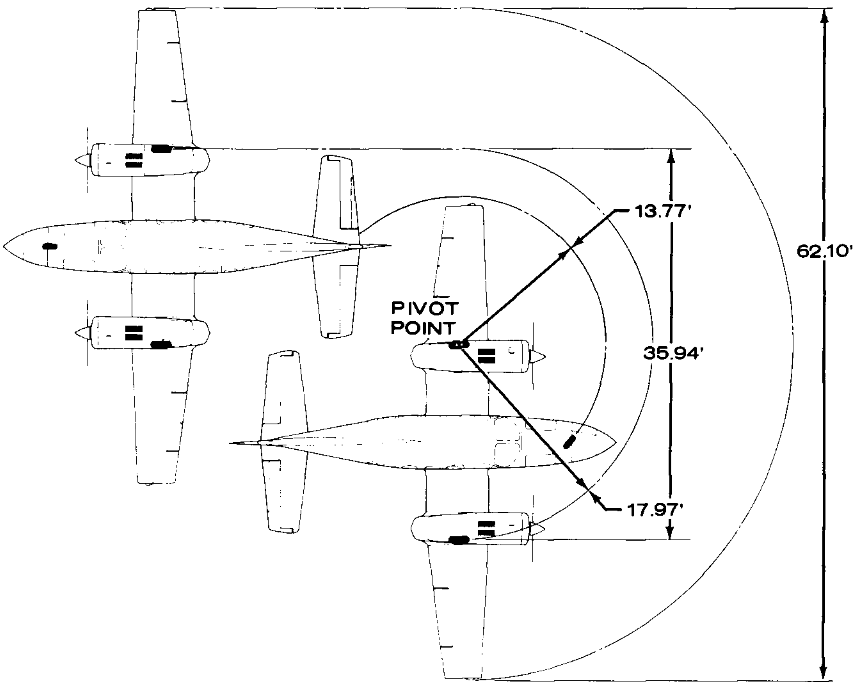


Figure 7-11

WING FLAPS SYSTEM

The wing flaps, see Figure 7-12, are of the split flap design. Each wing flap (two per side) is attached to the rear wing main spar lower surface and is actuated by two push-pull rods attached to bell cranks in the wing. The bell cranks in each wing are ganged together with push-pull rods. Each inboard push-pull rod is attached to a cable which is actuated by an electric motor with reduction gear in the fuselage center section.

The electric flap motor is controlled by the wing flap position switch, see Figure 7-1, in the cockpit. This switch incorporates a preselect feature which allows the pilot to select the amount of flap extension desired. When the 0°, 15°, 30° or 45° position is selected, the flap motor is electrically actuated and drives the flaps toward the selected position. As the flaps move, an intermediate cable feeds position information back to the preselect assembly. When the actual flap position equals the selected position, a microswitch deenergizes the flap motor.

WING FLAPS SYSTEM

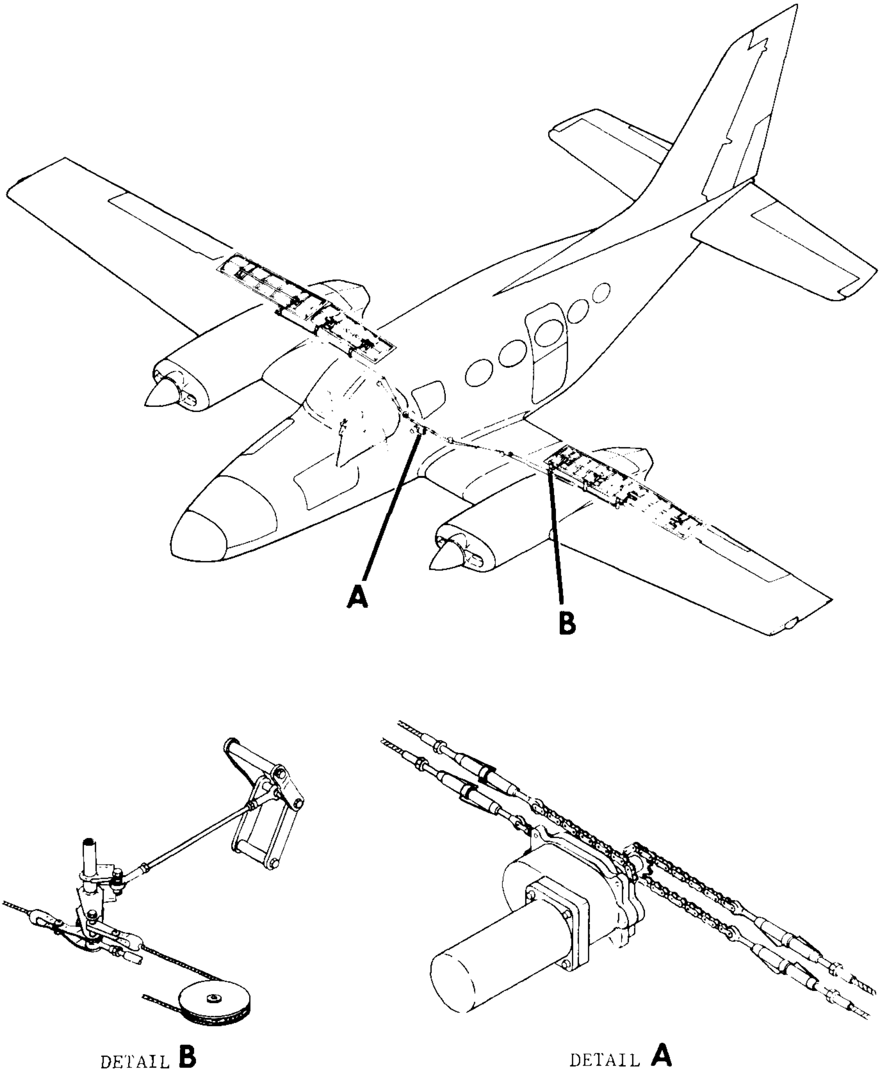


Figure 7-12

LANDING GEAR SYSTEM

The retractable tricycle landing gear, see Figure 7-13, is electrically controlled and hydraulically actuated. The individual landing gear actuators incorporate an internal lock to hold the landing gear in the extended position. The landing gear is held in the retracted position by mechanical uplocks that are released hydraulically during gear extension. During ground operation, accidental gear retraction, regardless of gear switch position, is prevented by a safety switch located on the left landing gear shock strut. The weight of the airplane compresses the shock strut, causing the safety switch to open, thus preventing electrical power from reaching the landing gear control valve.

The landing gear doors are mechanically linked to their respective landing gear, retracting and extending with each landing gear. The landing gear is operated by a switch, see Figure 7-16, which is identified by a wheel-shaped knob. The switch positions are UP and DOWN. To operate the gear, pull out the landing gear switch and move it to the desired position. This allows electrical power to energize the gear control valve and the hydraulic pressure to drive the landing gear towards the selected position. The hydraulic pressure light, located on the annunciator panel, see Figure 7-3, will remain on until the landing gear is locked into position. The system also incorporates a left and right hydraulic flow light which illuminates at low engine RPM or in the event of a hydraulic pump failure.

LANDING GEAR SYSTEM

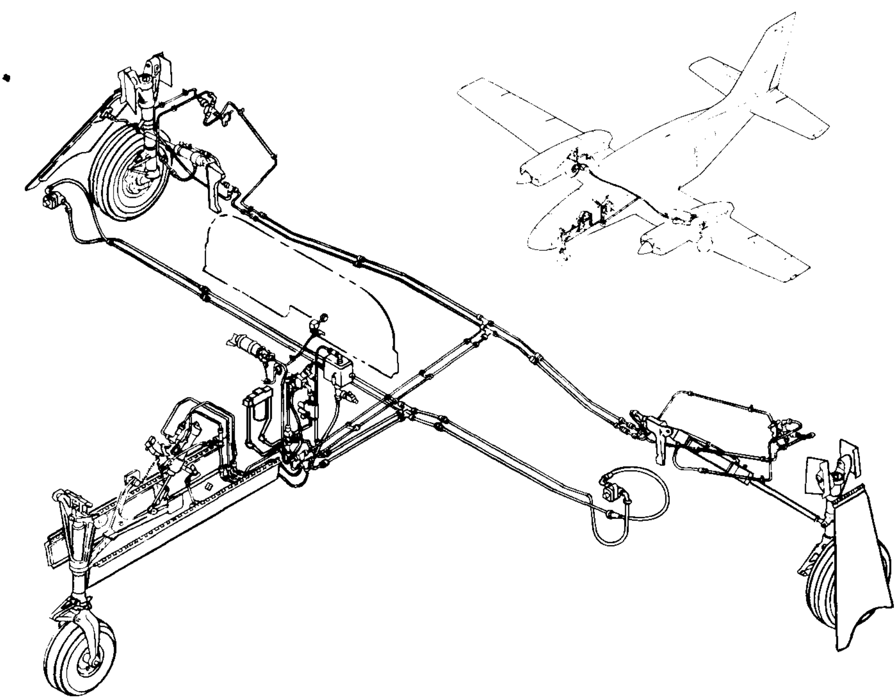


Figure 7-13

HYDRAULIC SYSTEM SCHEMATIC

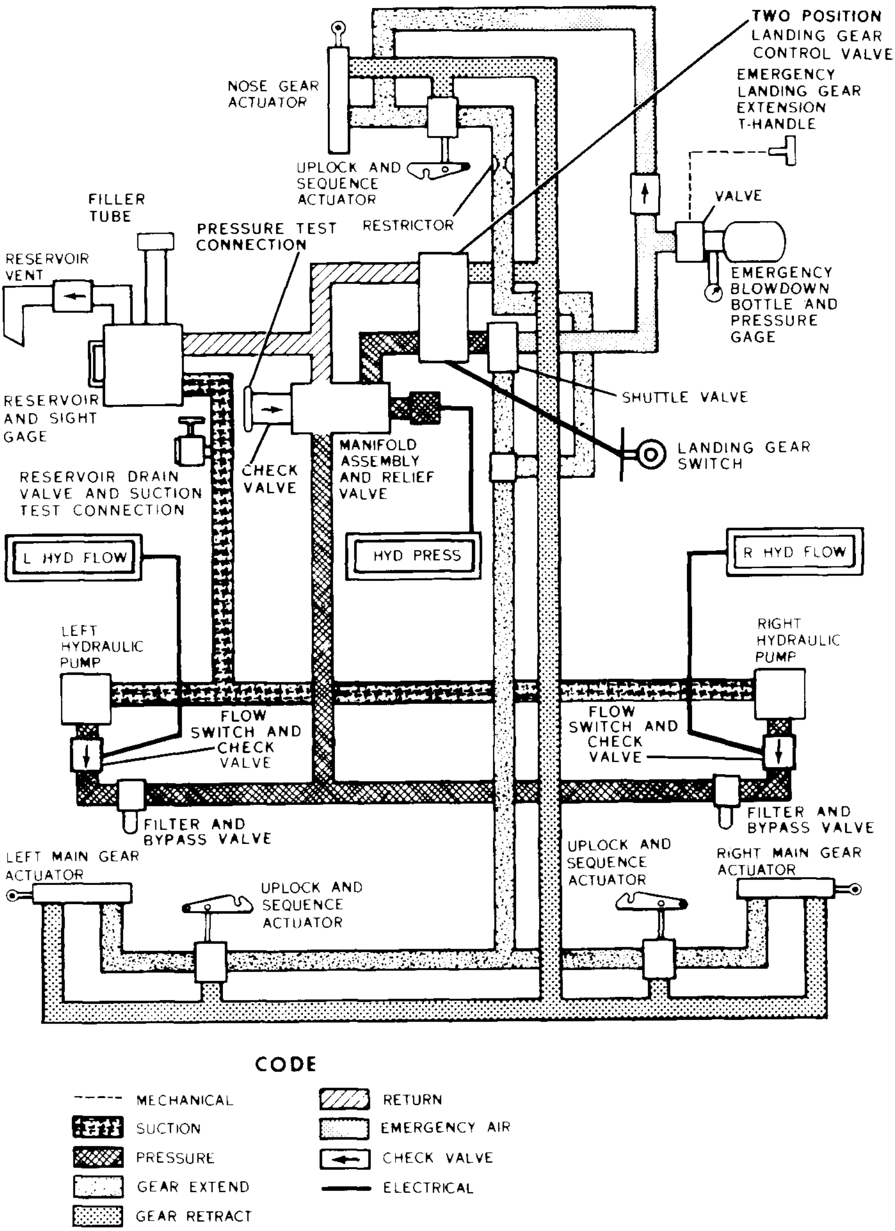
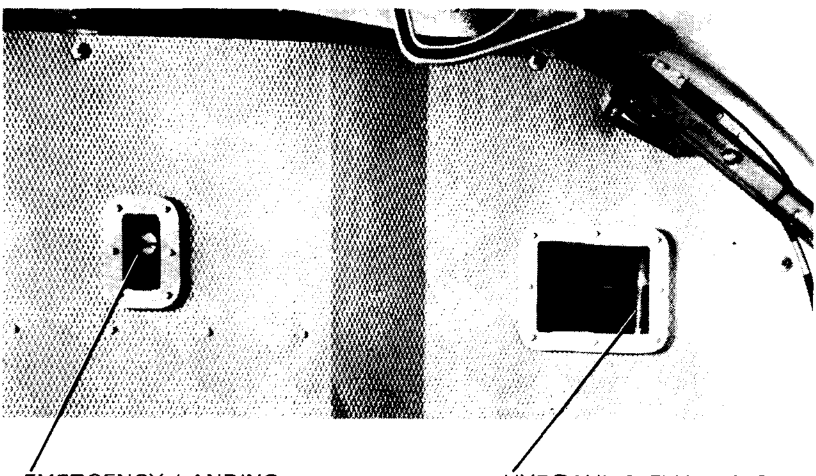


Figure 7-14

LANDING GEAR HYDRAULIC SYSTEM

Hydraulic pressure at 1750 psi is supplied on demand by the hydraulic pump which is mounted on each engine, see Figure 7-14. The hydraulic reservoir, located in the nose baggage compartment, see Figure 7-15, incorporates a sight gage for checking the fluid level while the gear is extended. An electrically actuated gear control valve controls the flow of hydraulic fluid to the individual gear cylinders. The gear control valve receives power through the landing gear position switch. The landing gear completes the retraction cycle in approximately 4.5 seconds at maximum engine RPM. The actuation cycle time increases as engine RPM decreases or with the loss of an engine-driven hydraulic pump.

HYDRAULIC RESERVOIR SIGHT GAGE AND EMERGENCY BLOW DOWN BOTTLE PRESSURE GAGE



VIEW LOOKING AFT THROUGH LEFT NOSE BAGGAGE DOOR

Figure 7-15

LANDING GEAR POSITION LIGHTS

Four landing gear position indicator lights, see Figure 7-16, are contained in two modules located beneath the avionics control panel just left of the center of the instrument panel. One module contains three of these lights (one for each gear) which are green and will illuminate when each landing gear is fully extended and locked. The other light module is red and will illuminate when any or all the gears are unlocked (intermediate position). When the gear unlocked light and gear down lights are not illuminated, the landing gear is in the UP and locked position.

LANDING GEAR WARNING HORN

The landing gear warning horn is controlled by the throttles and the wing flap position. The warning horn will sound intermittently if either throttle is retarded below approximately 15.0 inches Hg. manifold pressure with the landing gear retracted or if the wing flaps are lowered past the 15° position with the landing gear in any position except extended and locked. The warning horn can be activated by either the wing flap position switch or by throttle position as each functions independently of the other. The warning horn is also connected to the UP position of the landing gear position switch and will sound if the switch is placed in the UP position while the airplane is on the ground. The system can be checked by activating the PRESS-TO-TEST button, see Figure 7-3, located near the annunciator panel while retarding one throttle at a time. Also, lowering the wing flaps past the 15° position with the PRESS-TO-TEST button activated will cause the landing gear warning horn to sound.

LANDING GEAR EMERGENCY EXTENSION SYSTEM

The landing gear emergency extension system, see Figure 7-16, consists of a red emergency gear extension T-handle, a blowdown bottle, located in the nose baggage compartment, and associated plumbing. The procedure for emergency gear extension is given in Section 3. Pulling the emergency control releases dry nitrogen under pressure into the shuttle valve, caus-

EMERGENCY LANDING GEAR EXTENSION SYSTEM

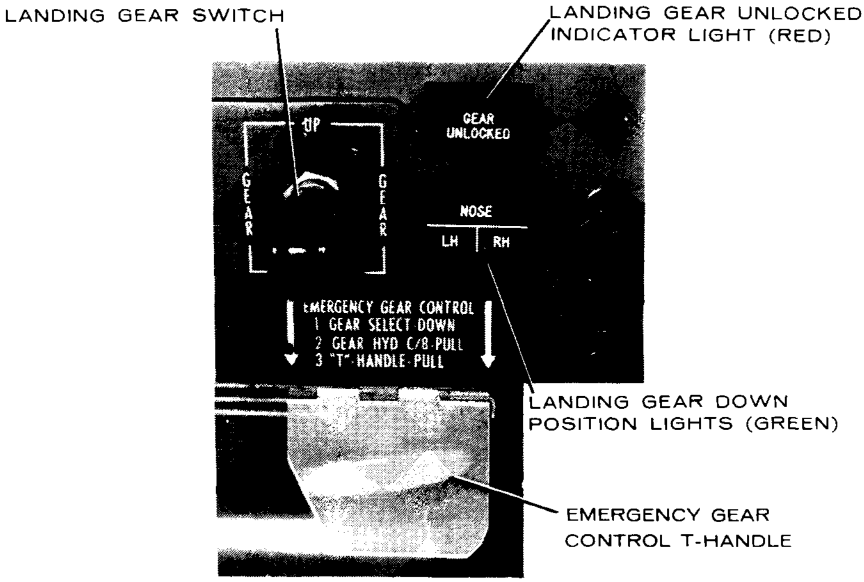


Figure 7-16

ing the shuttle valve to move from the hydraulic to the air position. The nitrogen then flows into the uplocks which releases the gear to the free-fall position, and then into the landing gear cylinders, which drives the landing gear into the down and locked position.

NOTE

The landing gear cannot be retracted after emergency gear extension until the system has been ground serviced.

LANDING GEAR SHOCK STRUTS

Shock absorption is provided on each gear by an air-over-oil shock strut. This strut is composed of two basic parts: an upper barrel assembly and an inner tube assembly which fits inside the upper barrel assembly. The inner barrel assembly contains an orifice and tapered metering pin which vary the resistance to shock according to severity transmitted to the upper barrel assembly.

FUEL SYSTEM

The fuel system, see Figure 7-17, consists of two main tanks, two fuel selectors, emergency crossfeed shutoff valves and necessary components to complete the system.

MAIN TANKS

The main fuel tanks are an integral portion of the sealed wet wing. These tanks supply their respective engine with fuel for normal operations, including takeoffs and landings. An auxiliary fuel pump, located outside the tank, provides fuel pressure for priming during engine start. In the event of an engine fuel pump failure, the auxiliary fuel pump will supply fuel to the engine if the auxiliary fuel pump switches are on. The main tank is vented to the atmosphere by a combination flush vent and a .50-inch diameter drain located on the lower surface of the wing. The flush mounted vent eliminates the need for heated vents. The fuel tanks are serviced through a flush filler located in the top surface of each wing.

FUEL SELECTORS

Two fuel selectors, one for each engine, are provided on the floor between the pilot and copilot seats. The selectors allow selection of main fuel, crossfeed and off.

During normal flight operations, position the left fuel selector to LEFT MAIN and the right fuel selector to RIGHT MAIN. This allows fuel to flow from each main tank, through the fuel selector, to the respective engine-driven fuel pump. Fuel may be crossfed from the left main tank to the right engine or from the right main tank to the left engine. Both engines will be supplied with fuel from the right main tank when both fuel selectors are positioned to RIGHT MAIN. Conversely, both engines will be supplied with fuel from the left main tank when both fuel selectors are positioned to LEFT MAIN. The crossfeed function is used for balancing asymmetric fuel loads and supplying the engine-driven fuel pump from the

FUEL SYSTEM SCHEMATIC

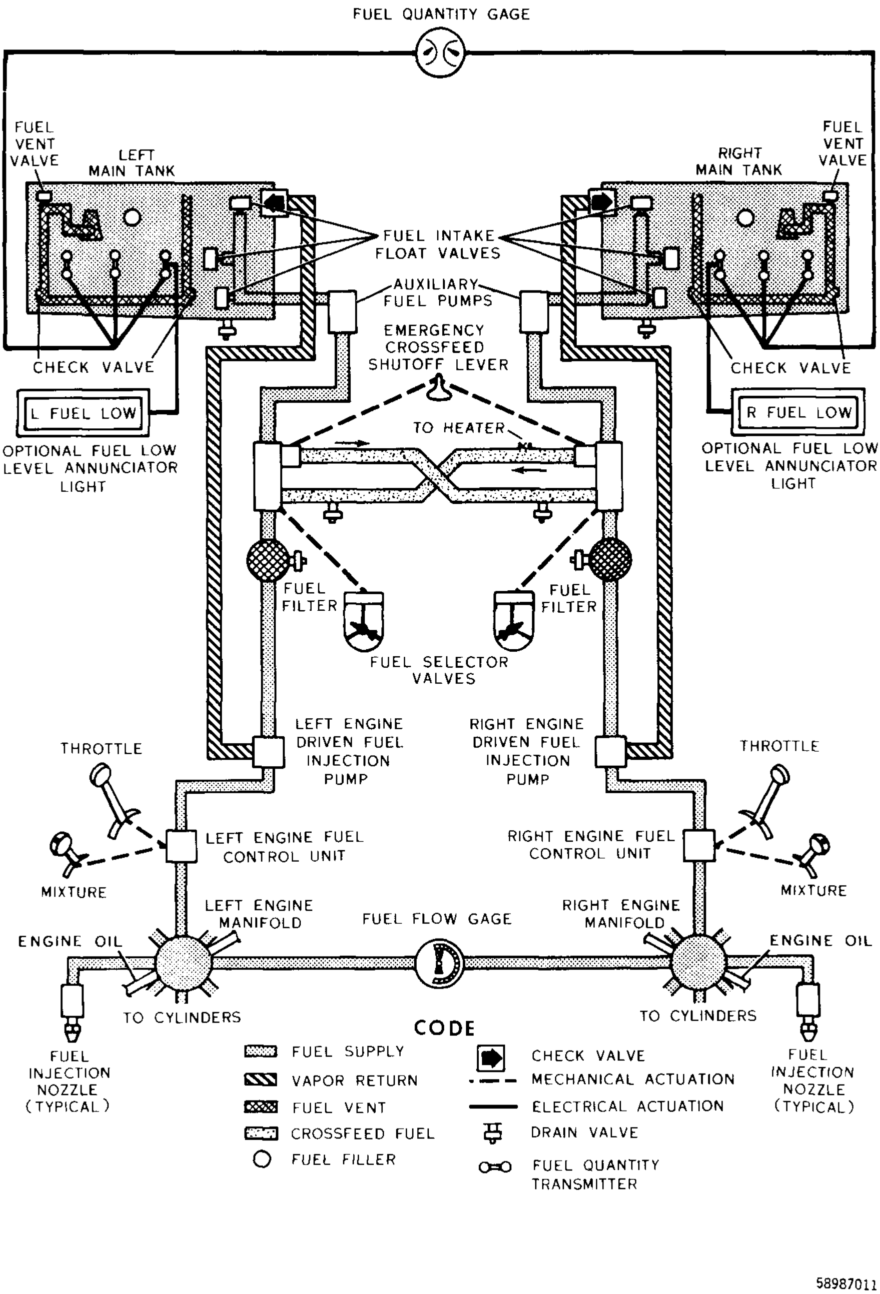


Figure 7-17

opposite main tank. The LEFT ENG OFF position or RIGHT ENG OFF position (the center button must be depressed as the selector valve is rotated to the off position) on the fuel selectors allows no fuel to flow to the engine-driven fuel pump.

The fuel selector handles form the pointers for the selectors. The ends of the handles are arrow-shaped and point to the position on the selector placard which corresponds to the position of the control valves.

EMERGENCY CROSSFEED SHUTOFF LEVER

A two-position emergency crossfeed shutoff lever is located between the fuel selector handles. When the shutoff lever is pulled up, crossfeeding of main tank fuel and heater operation is stopped. This lever is for emergency crossfeed control only, since its function is to isolate the fuel crossfeed lines from the fuel tanks in the event of a nacelle, wing or center section fire or a wheels up landing.

AUXILIARY FUEL PUMP SWITCHES

A 3-position auxiliary fuel pump switch, see Figure 7-19, is provided for each main fuel tank pump providing 5.5 PSI pressure for vapor clearing and purging. In the LOW position, the auxiliary fuel pumps operate at low speed. The ON position runs the auxiliary fuel pumps at low speed, as long as the engine-driven pumps are functioning. With an engine-driven pump failure and the switch in the ON position, the auxiliary pump on that side will switch to high speed automatically, providing sufficient fuel for all partial-power engine operations.

FUEL DRAIN VALVES

Fuel quick-drain valves are provided for each fuel tank, fuel filter and crossfeed line. The drains provide a location for removing moisture and sediment from the fuel system. The drains, located on the lower surface of the main tanks, are actuated by depressing the lower portion of the valve. A special screwdriver is provided with the airplane which allows a 2-ounce sample to be drained and inspected without fuel spillage.

FUEL FLOW GAGE

The fuel flow gage, see Figure 7-1, is a dual instrument which indicates the approximate fuel consumption of each engine in pounds per hour. The fuel flow gage used with the injection system senses the pressure at which fuel is delivered to the engine spray nozzles. Since fuel pressure at this point is approximately proportional to the fuel consumption of the engine, the gage is marked as a flowmeter.

The gage dial is marked with arc segments corresponding to proper fuel flow for various power settings and maximum power altitudes and is used as a guide to quickly set the mixtures. These gage markings are predicated on the use of 100 grade aviation fuel. Increase fuel flow 2% above markings when 100LL grade aviation fuel is used.

The gage has takeoff, climb and cruise markings for various percentages of power. The takeoff range (white arc) presents the desired fuel flow (full rich schedule for proper engine cooling) for full power (2700 RPM and 38.0 inches Hg. manifold pressure) operation under all conditions up to

20,000 feet altitude. A white triangle represents the desired fuel flow for maximum normal operating power (38.0 inches Hg. at 2600 RPM) for operation at all conditions up to 20,000 feet altitude. The climb range (blue segments) presents the desired fuel flow for best power mixture at 75% power with an enriched mixture for higher power settings to allow proper engine cooling during climb conditions. The cruise range presents the desired fuel flow for recommended lean mixture at the specified percent power.

FUEL QUANTITY GAGE

The dual indicating fuel quantity gage, see Figure 7-1, is calibrated in pounds and will accurately indicate the weight of fuel contained in the tanks regardless of whether 100 grade aviation or 100LL grade aviation fuel is used; however, fuel density varies with temperature, therefore a full tank will weigh more on a cold day than on a warm day. This will be reflected by the weight shown on the gage. A gallons scale is provided in blue on the indicator for convenience in allowing the pilot to determine the approximate volume of fuel on board. The volume markings are predicated on the use of 100 grade aviation fuel. Reduce the indicated gallonage reading by 4% when 100LL grade aviation fuel is used.

FUEL LOW LEVEL WARNING LIGHTS

The optional fuel low level warning lights, see Figure 7-3, provide a warning when the left and/or right main tanks contain approximately 60 pounds of fuel. The warning is provided by the L FUEL LOW and R FUEL LOW lights located on the annunciator panel. These lights are actuated by a float switch located in each main fuel tank. Each light operates independently from the fuel quantity indicating system.

ENGINE-DRIVEN FUEL PUMPS

Each engine is equipped with a mechanically driven fuel pump which provides fuel to the metering unit. Each pump also contains a bypass which returns excess fuel and vapor to the main tanks at all times. Should these pumps fail, the main tank auxiliary pumps can provide sufficient fuel flow for all partial-power engine operations. These auxiliary pumps, however, operate at a fixed pressure, consequently the mixture must be leaned when operating at a low power setting to prevent flooding in the engines. Conversely, if an engine-driven pump failure should occur during high power operation, adequate fuel flow may not be available to insure rated power and adequate engine cooling.

BRAKE SYSTEM

The airplane is provided with an independent hydraulically actuated brake system for each main wheel. A hydraulic master cylinder is attached to each pilot's rudder pedal. Hydraulic lines and hoses are routed from each master cylinder to the wheel cylinder on each brake assembly. No manual adjustment is necessary on these brakes. The brakes can be operated from either pilot's or copilot's pedals. The parking brake system consists of a manually operated handle assembly, see Figure 7-1, connected to the parking brake valves located in each main brake line. When pressure is applied to the brake system and the parking brake handle is pulled, the valve holds pressure on the brake assemblies until released. To release the parking brakes, push the parking brake handle in. It is not necessary to depress the rudder pedals when releasing the parking brake.

ELECTRICAL SYSTEM

Electrical energy, see Figure 7-18, is supplied by a 28-volt, negative-ground, direct current system powered by an alternator on each engine. The electrical system has independent circuits for each side with each alternator having its own regulator and overvoltage protection relay. The voltage regulators are connected to provide proper load sharing. A 24-volt battery is located in the left stub wing. Immediate detection of low system voltage is provided by a LOW VOLT light on the annunciator panel, see Figure 7-3. The light will illuminate when the airplane bus voltage decreases below approximately 25 volts.

NOTE

Insure all circuit breakers are engaged and serviceable fuses are installed before all flights. Never operate with any blown fuses or disengaged circuit breakers without a thorough knowledge of the consequences.

BATTERY AND ALTERNATOR SWITCHES

Separate battery and alternator switches, see Figure 7-19, are provided as a means of checking for a malfunctioning alternator circuit and to permit such a circuit to be turned off. If an alternator circuit fails or malfunctions, or when one engine is not running, the switch for that alternator should be turned off. Operation should be continued on the functioning alternator, using only necessary electrical equipment. If both alternator circuits should malfunction, equipment can be operated at short intervals on the battery alone. In either case, a landing should be made as soon as practical to check and repair the circuits.

EMERGENCY POWER ALTERNATOR FIELD SWITCH

An emergency power alternator field switch, see Figure 7-19, is located on the aft top side of the side console. The switch is used when the alternators will not self-excite. Placing the switch in the ON position provides excitation from the battery even through the battery is considered to have failed.

OVERVOLTAGE RELAYS

Two overvoltage relays in the electrical system constantly monitor their respective alternator output. Should an alternator exceed the normal operating voltage, the overvoltage relay will trip, taking the affected alternator off the line. The overvoltage relay can be reset by cycling the applicable alternator switch.

VOLTAMMETER

A voltammeter, see Figure 7-19, located on the left side console, is provided to monitor alternator current output, battery charge or discharge rate and bus voltage. A selector switch, see Figure 7-19, labeled L ALT, R ALT, BATT, and VOLTS is located to the left of the voltammeter. By positioning the switch to L ALT, R ALT, or BATT position, the respective alternator or battery amperage can be monitored. By positioning the switch to the VOLTS position, the electrical system bus voltage can be monitored.

ELECTRICAL SYSTEM SCHEMATIC

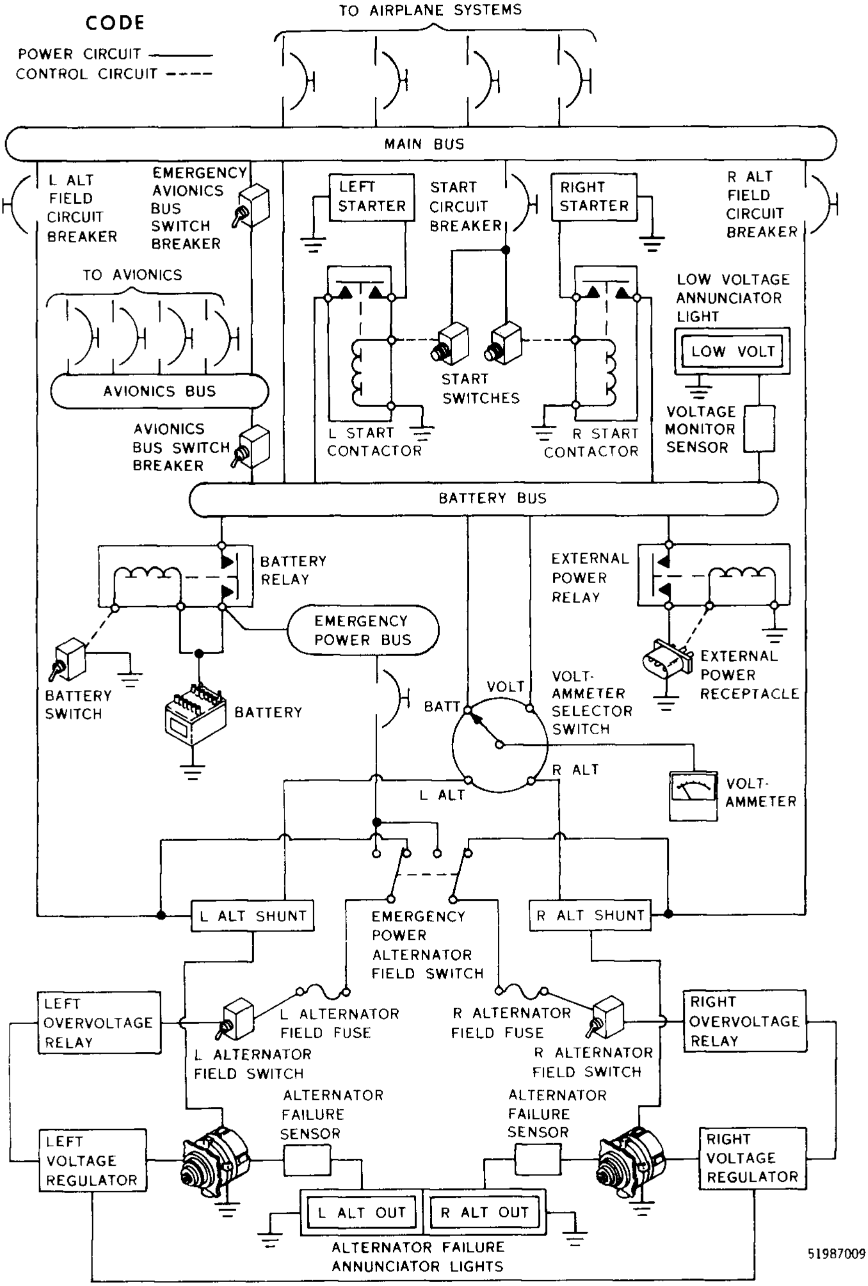


Figure 7-18

LEFT AND RIGHT SIDE CONSOLES

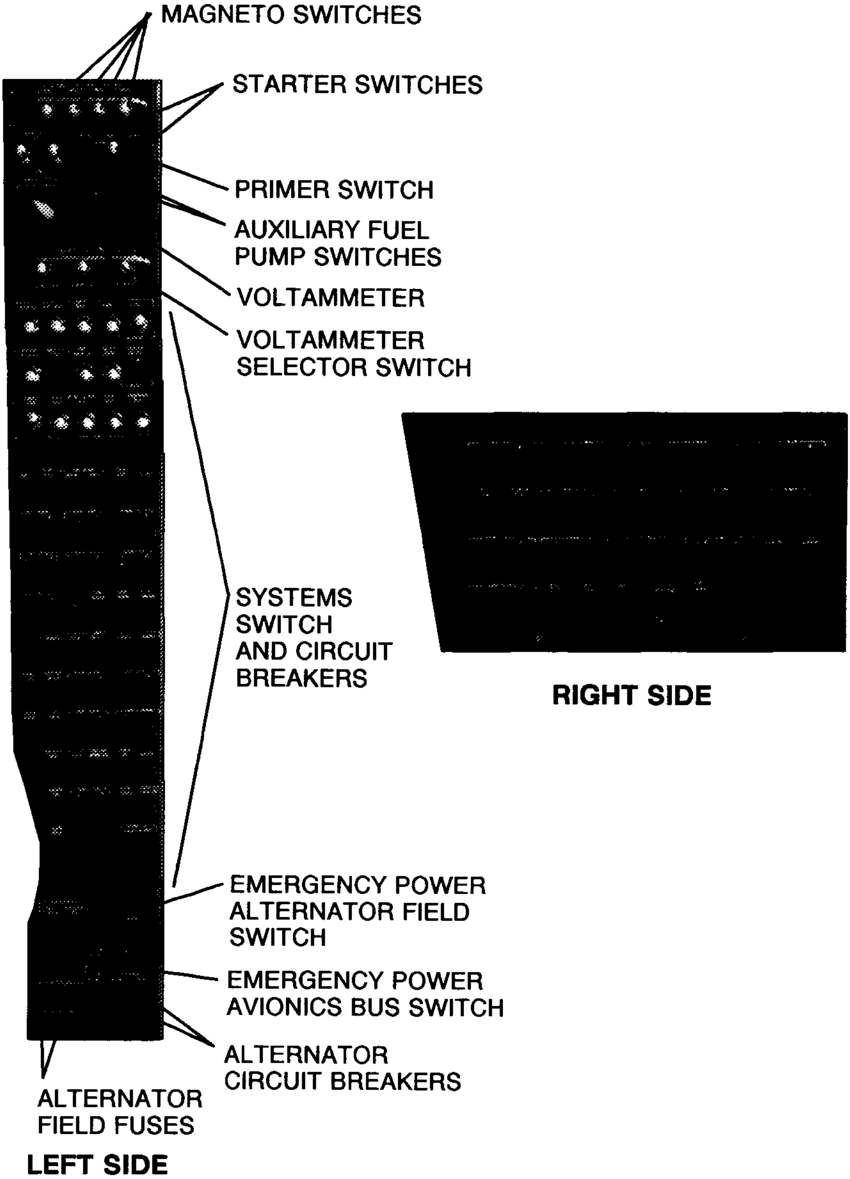


Figure 7-19

CIRCUIT BREAKERS AND SWITCH BREAKERS

All electrical systems in the airplane are protected by push-to-reset type circuit breakers or switch breakers, see Figure 7-17. Should an overload occur in any circuit, the resulting heat rise will cause the controlling circuit breaker to "pop" out, opening the circuit or allowing the switch breaker to return to the "OFF" position. After allowing to cool for approximately three minutes, the circuit breaker may be pushed in (until a click is heard or felt) or the switch breaker may be returned to the ON position to reenergize the circuit. However, the circuit breaker should not be held in nor the switch breaker forced to remain in the ON position if it opens the circuit a second time as this indicates a short circuit.

EXTERNAL POWER RECEPTACLE

An optional external power receptacle may be installed in the left wing aft nacelle fairing. The receptacle accepts a standard AN-type external power source plug. The following precautions must be observed when starting an airplane using an external power source:

1. Avionics Master Switch - OFF.
2. Battery Switch - ON (The battery will tend to absorb transients that are present in some external power sources).
3. Alternator Switches - OFF.
4. Airplane Voltammeter - READ battery voltage.

NOTE

Set External Power Source Output Voltage to 28 volts.

5. External Power Source - TURN OFF before connecting to airplane.
6. External Power Source - ATTACH and TURN ON.
7. Airplane Voltammeter - READ VOLTAGE (If external power source is properly connected, the reading will be greater than when reading battery voltage only).

LIGHTING SYSTEM

EXTERNAL LIGHTING

The airplane is equipped with four navigation lights, two retractable landing lights (right light is optional), an optional taxi light, two anti-collision lights and two optional wing deice lights.

Navigation Lights

The navigation lights are located in the tailcone stinger and in each wing tip assembly. These lights are energized with the navigation lights switch breaker on the side console, see Figure 7-19. Proper operation can be checked by observing reflections on the ground below the tail light and from objects surrounding the airplane.

Landing Lights

The retractable landing lights (right light is optional) are located in the lower surface of the wing tips. These lights are extended, retracted and illuminated by the landing light switch breaker on the side console, see Figure 7-19. With the switch positioned to LDG, the landing lights will extend and illuminate. In the OFF (center) position, the lights will remain extended but will not illuminate. In the RETRACT position, the lights will retract flush with the respective wing tip. It is recommended that the landing light extension speed be limited to 180 KIAS to improve the landing light service life.

Taxi Lights

The optional taxi light, attached to the nose gear, provides adequate illumination for night taxiing. The taxi light is controlled by the taxi light switch breaker on the side console, see Figure 7-19.

Anti-Collision Lights

The anti-collision lights, with individual power supplies, are located in the wing tips. These lights are actuated by the anti-collision light switch breaker on the side console, see Figure 7-19.

> **NOTE**
>
> Do not operate the anti-collision lights in conditions of fog, clouds or haze as the reflection of the light beam can cause disorientation or vertigo.

Wing Deice Lights

The optional wing deice lights are installed in the outboard side of each engine nacelle and illuminate the outboard wing leading edge deice boots. The lights allow the pilot to check for ice accumulation on the wing leading edges. The lights are actuated by the deice light switch breaker on the side console, see Figure 7-19.

All exterior lighting should be checked for proper operation before night flying. Cockpit recognition of operational exterior lighting can be determined by looking for ground illumination by the various lights.

INTERNAL LIGHTING

The airplane is equipped with lighting for baggage areas, cabin doorway, cockpit controls and indicators, cockpit illumination and cabin illumination.

COCKPIT LIGHTING CONTROLS

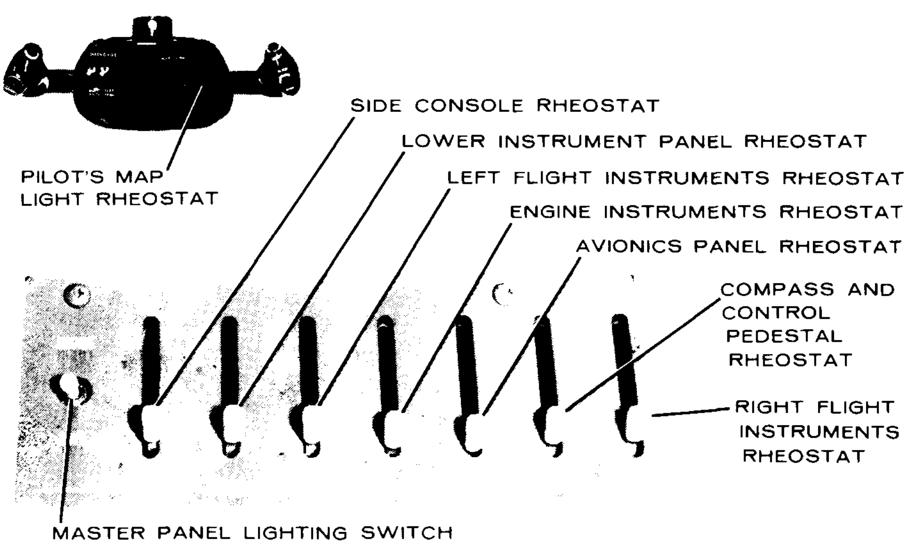


Figure 7-20

Optional baggage area lights are provided for both wing lockers and the nose baggage areas. The lights are actuated when the applicable baggage door is opened and extinguish when the door is closed.

The cabin doorway and instrument panel floodlight provides adequate illumination for night boarding. These lights are controlled by a switch immediately inside the cabin doorway, see Figure 7-21, or by a switch on the instrument panel, see Figure 7-1. An optional timer is available which will automatically extinguish the cabin doorway and instrument panel floodlights 15 minutes after leaving the airplane if the lights were not switched off. The system operation is as follows:

1. The cabin doorway and instrument panel floodlights can be actuated by either of the two switches described above. Any time the lights come on, the timer begins to count down for 15 minutes.
2. With the cabin door closed, the lights will operate in a normal fashion (i.e., lights out, movement of either switch turns lights on; lights on, movement of either switch turns lights off), unless the timer has extinguished the lights, thus requiring cycling of either switch to turn the lights on again.
3. Opening the door will turn the lights on unless the timer extinguished the lights, in which case, one movement of the door switch is also required in order to turn the lights on.
4. With the cabin door open, the lights will always be on unless the timer has turned them off. Movement of the door switch is required to reset the lights to on for an additional 15 minutes.
5. Closing the door will extinguish the lights only if the system is switched off. If the system is on, the timer must continue to run down to extinguish the lights.

CABIN LIGHTING AND CONTROLS

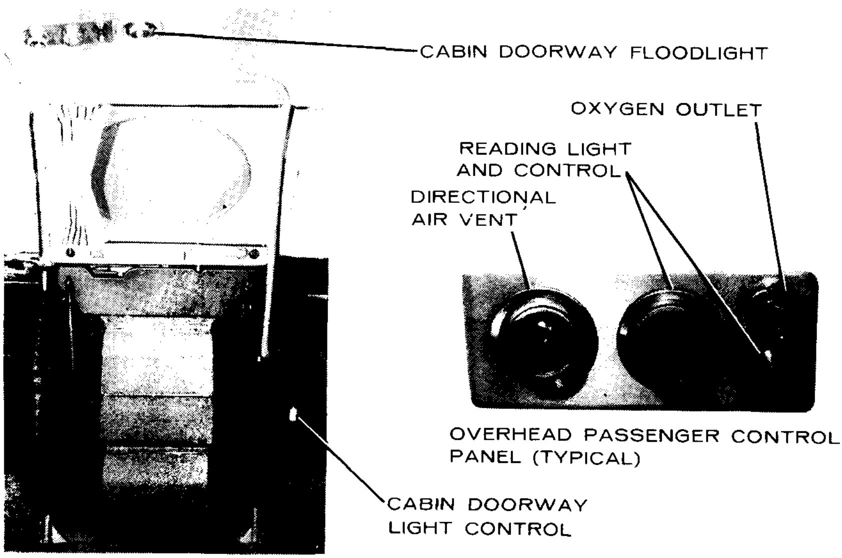


Figure 7-21

Cockpit lighting is provided by the instrument panel floodlight, instrument postlights and overhead map lights. All cockpit lights are variable intensity and are controlled by rheostats on the top of the control pedestal and pilot's control wheel, see Figure 7-20.

NOTE

The master lighting switch must be positioned to DAY during daylight operations to insure maximum illumination of the annunciator panel lights.

Individual reading lights and controls, see Figure 7-21, are provided in the cabin for each passenger seat.

PITOT PRESSURE SYSTEM

The standard pitot pressure system, see Figure 7-22, consists of an electrically heated pitot tube mounted on the left side at the bottom of the fuselage nose, suitable plumbing and an airspeed indicator.

When the pitot heat switch is placed in the ON position, the heating elements in the pitot tube are electrically heated to maintain proper operation of the system during icing conditions. Do not operate for prolonged periods while on the ground to prevent overheating of the heating elements.

When the optional copilot's instruments are installed, a second pitot system is used. This second pitot head is located on the right side at the bottom of the fuselage nose and is connected to the copilot's airspeed indicator. This dual system allows a completely independent second presentation of airspeed pitot pressure. Pitot heat for the additional head is controlled by an additional pitot heat switch located adjacent to the standard pitot heat switch.

STATIC PRESSURE SYSTEM

Static pressure for the pilot's airspeed, altimeter and rate-of-climb indicators, see Figure 7-22, is obtained by a normal external static source or an alternate internal static source should the external source fail.

A static source selector, installed in the static system directly below the parking brake handle, allows selection of the normal or alternate static source. When the selector is positioned to NORMAL, the pilot's instruments reference the static source located aft of the main cabin door. When the selector is positioned to ALTERNATE, the pilot's instruments reference the alternate static source in the nose compartment. Refer to Section 5 for airspeed and altimeter corrections when the static source is positioned to ALTERNATE. A drain valve is located behind the map pocket on the copilot's side.

CAUTION

Do not open the drain valve while the cabin is pressurized as flight instrument damage will result.

When the optional copilot's instruments are installed, a second set of static ports are installed aft of the main cabin door below the standard static ports. The added static ports are manifolded together and are used as a reference for the copilot's instruments only. This dual system allows a completely independent second static pressure source. No alternate static source is provided for the copilot's instruments. Optional static port heaters are controlled by the stall and vent heat switch.

PITOT STATIC SYSTEM SCHEMATIC

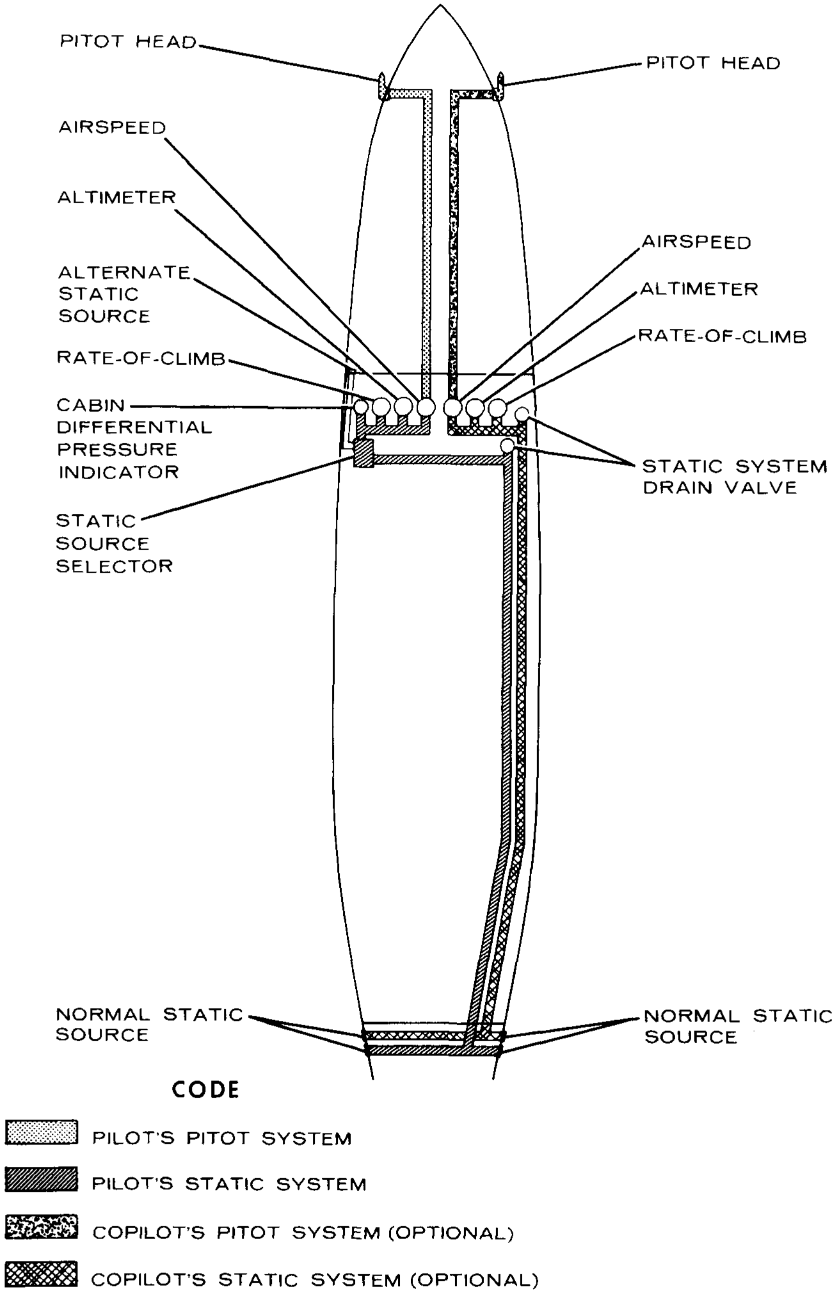


Figure 7-22

VACUUM SYSTEM

A vacuum system, see Figure 7-23, is installed to provide a source of vacuum for the vacuum instruments. The system consists of an engine-driven vacuum pump on each engine, a pressure relief valve for each pump, a common vacuum manifold, a vacuum air filter, a suction gage and gyro instruments.

Each vacuum pump pulls a vacuum on the common manifold, exhausting the air overboard. The maximum amount of vacuum pulled on the manifold by each vacuum pump is controlled to a preset level by each pressure relief valve. Should either of the pumps fail, a check valve is provided in each end of the manifold to isolate the inoperative vacuum pump from the system.

The exhaust air side of each attitude gyro is connected to the vacuum manifold thus providing a smooth steady vacuum for the gyros. The vacuum pressure being applied to the gyros is constantly presented on the suction gage. This gage also provides failure indicators for the left and right vacuum pumps. These indicators are small red buttons located in the lower portion of the suction gage which are spring-loaded to the extended (failed) position. When normal vacuum is applied in the manifold, the failure buttons are pulled flush with the gage face. Should insufficient vacuum occur on either side, the respective red button will extend. No corrective action is required by the pilot, as the system will automatically isolate the failed vacuum source, allowing normal operation on the remaining operative vacuum pump.

The inlet air side of the attitude gyros are connected to a common vacuum air filter which cleans the ambient nose compartment air before allowing it to enter the gyros.

FLIGHT INSTRUMENTS

The basic flight instruments, see Figure 7-1, consist of airspeed, altimeter and rate-of-climb indicators, electric turn-and-bank and vacuum horizon and directional gyros.

Operation of the airspeed, altimeter and rate-of-climb indicators can be determined by cross-checking the copilot's instruments, if installed. Also, when a climb or descent is initiated, these instruments should indicate the appropriate change. If no change is indicated, it is reasonable to assume static source blockage has occurred and the alternate static source should be selected. If the possibility of static source icing is present, actuation of the stall and vent heat switch might deice the static sources, allowing a return to the normal static source, if the optional heated static sources are installed. If only the airspeed indicator appears to be affected when the climb or descent is initiated, it is reasonable to assume a pitot system blockage has occurred. If the possibility of pitot source icing is present, actuation of the pitot heat switch will clear the ice blockage. Reference the optional copilot's instruments and optional angle-of-attack indicator for airspeed information until a reliable airspeed indication can be obtained. If neither optional system is installed, fly attitude and power references.

Operation of the turn-and-bank needle can be checked by initiating a standard rate turn and cross-checking the turn rate with the directional gyro. An indicated standard rate turn should show a turning rate of 3 degrees per second on the directional gyro. Pushing the PRESS-TO-TEST

VACUUM SYSTEM SCHEMATIC

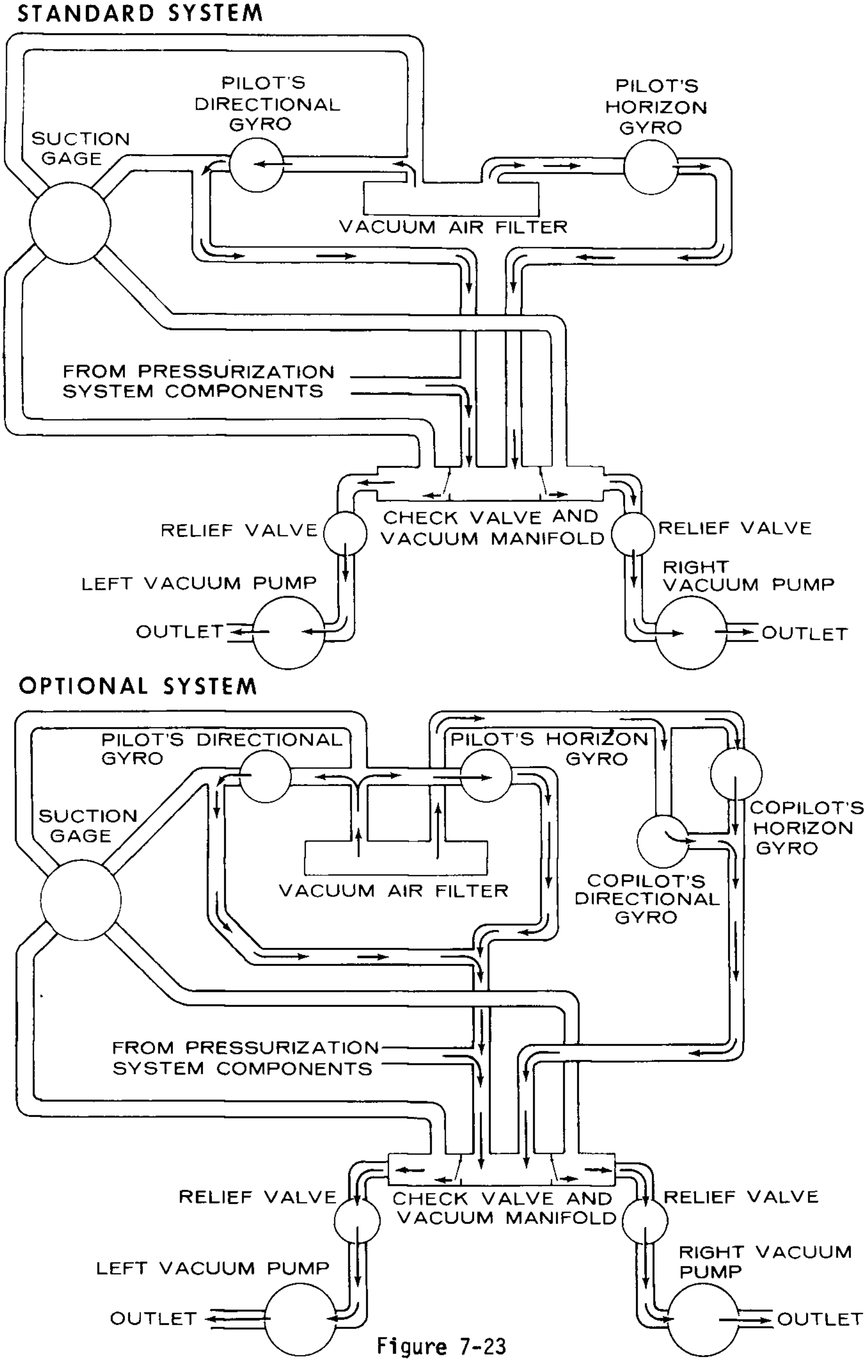


Figure 7-23

button adjacent to the annunciator panel will illuminate the T & B TEST annunciator light if power is being applied to the turn-and-bank indicator. After shutdown of the airplane on the ground, abnormal noise coming from the turn-and-bank can indicate a near failure condition. The ball part of the turn-and-bank is virtually failure proof. Inaccuracy can result only if the indicator is not level in the instrument panel. With the airplane on level ground, the ball should be centered in the race.

Operation of the directional and horizon gyros can be checked during taxiing by watching for an abnormally slow erection rate and erratic operation. After shutdown of the airplane on the ground, abnormal noise coming from either gyro can indicate a near failure condition. Checking the suction gage for proper vacuum and no failure buttons exposed will assure proper gyro vacuum is available.

In flight, the directional gyro can be checked by flying a standard rate turn and observing the directional gyro for a turning rate of 3 degrees per second. Also, the precession rate in straight and level flight should not exceed 5 degrees in 10 minutes. The horizon gyro operation can be checked by establishing a level flight attitude; the gyro should indicate wings level within 1 degree. Initiate a 20-degree bank for a 180-degree turn, then smoothly return to level flight; gyro should indicate wings level within 3 degrees. Establish level flight at 150 KIAS; gyro should indicate level airplane within 1 degree. Smoothly pitch airplane nose down 10 degrees, then return to level flight; gyro should indicate level flight within 1 degree.

STALL WARNING SYSTEM

A stall warning system is required equipment which consists of a stall warning transmitter vane located in the left outboard wing leading edge, a flight deck warning horn and the necessary wiring to complete the system.

The stall warning horn will sound 5 to 10 KIAS above the stall in all flight configurations. Proper operation of the warning system can be checked during preflight inspection by moving the stall warning vane; the horn should sound. Condition of the stall warning vane heater should also be checked during preflight by actuating the stall and vent heat switch and feeling the vane for heat.

AVIONICS

AVIONICS INTERFERENCE

NOTE

When tuned to a weak NAV signal, keying the COM transmitter may cause momentary interference within the NAV receiver causing a NAV flag to appear. Should circumstances warrant, ATC should be requested to assign another COM frequency.

AVIONICS MASTER SWITCHES

Two optional avionics master switches are provided with factory installed avionics. The master switch breaker, labeled AVIONICS BUS, is located on the top forward section of the side console, see Figure 7-19. This switch supplies power from the battery bus through a circuit breaker located forward of the battery box to the individual avionics circuit breakers and is used for all normal operations. An emergency power avionics bus switch breaker labeled EMER POWER AVIONICS BUS is located in the lower section of the outside console and is protected by a red switch guard cover, see Figure 7-19. This switch supplies power from the alternator bus to the individual avionics circuit breakers. The emergency power avionics bus switch is recommended for use only when the avionics bus switch associated wiring or battery circuits become inoperative.

ENGINES

The airplane is equipped with two, 6-cylinder, turbocharged fuel-injected engines with provisions for cabin pressurization. Each engine is rated at 310 horsepower at 2700 RPM and 38.0 inches Hg. manifold pressure. Each engine is provided with an oil pump, fuel pump, vacuum pump, propeller governor, tachometer generator, starter and alternator.

ENGINE CONTROLS

The control pedestal contains all engine controls except the alternate air controls. The three primary engine controls are in groups of two at the top of the pedestal; starting from left to right they are: (1) throttle, (2) propeller and (3) mixture.

Throttle Control

The throttle control lever, see Figure 7-1, is used to increase or decrease the engine power by moving the butterfly valve in the fuel-air control unit.

Propeller Control

The propeller control lever, see Figure 7-1, is used to change the propeller pitch to maintain or set a desired engine RPM.

Mixture Control

The mixture control lever, see Figure 7-1, is used to control the amount of fuel to be metered by the fuel-air control unit.

Quadrant Friction Lock

A quadrant friction lock, see Figure 7-1, is provided to prevent the three primary engine controls (six total levers) from creeping once they have been set. The locking knob (approximately one and one-half inches in diameter) is located on the right side of the pedestal.

Cowl Flap Control

Two cowl flap controls, see Figure 7-1, are located just below the rudder trim tab wheel; one control for each engine. These controls are used to set the cowl flaps in any position from full open to full closed. A locking feature is provided for each control to prevent inadvertent cowl flap position change. Rotating the control clockwise engages the locking mechanism.

Alternate Air Control

An alternate air control is provided for each engine, see Figure 7-1. These mechanically actuated, two-position controls are located on the instrument panel below the pilot's control wheel. Normally, the controls are pushed in, providing cold filtered ram air to the engines. When the controls are pulled fully out, warm unfiltered air from inside the cowling is provided to the engines. A locking feature is provided for each control to prevent inadvertent alternate air control position change. Rotating the control clockwise engages the locking mechanism.

Oil Heated Manifold Valve

The fuel manifold valves are heated with engine oil to reduce the possibility of power loss due to fuel system icing. The manifold valve, located on the top-forward part of the engine case, regulates metered fuel distribution to the injector nozzles.

ENGINE OIL SYSTEM

The engines installed in the airplane have a wet sump type, pressure lubricating system. Oil temperature is controlled by a thermally operated valve which either routes oil through the externally mounted cooler or bypasses the oil around the cooler. Oil is routed through internal passages to all moving parts of the engine which require lubrication.

In addition to providing lubrication and cooling for the engine, the oil is used for control of the propeller, actuating the turbocharger waste gate and for lubricating the turbocharger.

Oil pressures from both engines are routed into the fuselage, to the left and right engine gages, see Figure 7-1, where direct oil pressure readings are mechanically displayed. The oil temperatures of both engines are measured on the output side of the oil coolers. The measurements are electrically transmitted to the left and right engine gages where the oil temperatures are displayed.

IGNITION SYSTEM

Each engine is equipped with a dual ignition system. The ignition systems are entirely independent from each other such that a failure of any part of one system will have no effect on the other system. Each system consists of a magneto located on the rear engine accessory case, ignition harness to distribute the electrical energy and a spark plug in each engine cylinder. The left magneto fires the lower right and upper left spark plugs while the right magneto fires the upper right and lower left spark plugs. When the primary circuit of each magneto is electrically grounded by placing the magneto switch in the OFF position, the magneto will not produce a spark. With the magneto switch positioned to ON, the primary magneto circuit is ungrounded, allowing a high voltage spark to be produced to fire the spark plugs. During engine starting, a high voltage vibrator supplements the magneto spark to assure a fast start.

FUEL INJECTION SYSTEM

Fuel is supplied to the engine using a low-pressure injection system. The fuel is injected into the cylinder head adjacent to the intake valve on all cylinders. This continuous flow type injection system controls fuel flow to match engine airflow. A manual mixture control and a flow gage, see Figure 7-1, indicating fuel flow are provided for precise leaning at any combination of altitude and power setting. There are no moving parts in this system except for the engine-driven fuel injection pump.

COWL FLAP SYSTEM

A cowl flap system, consisting of a cowl flap located on the bottom of the nacelle, is provided for each engine to allow manual control of the engine cooling airflow. Cowl flap actuation is achieved by use of a push-pull cable assembly. The cowl flap controls, located on the lower control pedestal, allow any intermediate position to be selected. A locking feature is provided for each control to prevent inadvertent cowl flap control position change. Rotating the control fully clockwise engages the locking mechanism.

STARTING SYSTEM

The starting system consists of a 24-volt lead acid battery, a direct-drive starter mounted on each engine, a starter button for each engine and necessary wiring and components to complete the system.

The starter is engaged when the starter button, located on the side console, is pushed, see Figure 7-19. Pushing the button closes the starting contactor, allowing the starter to be energized. While the starter is energized, a starting vibrator provides a high-voltage current through the left magneto at a retarded position to assist the normal magneto ignition during the start.

ENGINE INSTRUMENTS

Engine instrumentation for each engine, see Figure 7-1, consists of mechanical oil pressure, electrical oil temperature and electrical cylinder head temperature presented on the combination engine gage, a mechanical manifold pressure gage, electric tachometer and mechanical fuel flow gage. The gages are placarded as to their operational parameters.

ENGINE MOUNTS

The engine is mounted to the nacelle structure by four engine mounts. Each mount incorporates two rubber pads capable of sustaining operational loads and providing absorption for engine vibrations.

ENGINE BREAK-IN PROCEDURE

The engine underwent a run-in at the factory and is ready for the full range of use. It is, however, recommended that cruising be accomplished at 65% to 77.5% power until a total of 50 hours has accumulated or oil consumption has stabilized.

CAUTION

The purpose of operating at 65% to 77.5% power with Best Power or Recommended Lean mixture is to insure 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 airplane is delivered from the factory with corrosion preventative oil in the engine. This oil allows fast ring seating and should not be used any longer than 25 hours. If, during the first 25 hours, oil must be added, use only aviation grade straight mineral oil conforming to Specification MIL-L-6082. Refer to Section 8 for additional oil servicing information.

TURBO-SYSTEM

Each engine is equipped with a turbocharger and related components to allow rated power to 20,000 feet.

The engines work and act just like any normally aspirated engines; however, because the engines are turbocharged, some of the engine characteristics are different. The intent of this section is to point out some of the items that are affected by turbocharging, and outline the correct procedures to be followed.

For a better understanding of the Turbo-System, let us follow the induction air through the engine until it is expelled as exhaust gases. Reference should be made to the Turbo-System Schematic shown in Figure 7-24 when reading through the following steps.

1. Engine induction air is taken in through the ram air inlet (1), located in the bottom of the engine nacelle, at which point it passes through a filter and then into the compressor (2).
2. The compressor compresses the induction air.
3. Most of the pressurized induction air from the compressor then passes through an intercooler (7), then into the cylinders through the induction manifold (3). A small portion of this pressurized air is routed to the cabin for pressurization.
4. The air and fuel are burned and the exhaust gases are then routed to the turbine through the exhaust manifold (4).
5. The exhaust gases drive the turbine (5) which, in turn, drives the compressor.
6. The turbine has enough power to allow the engine to operate in excess of the maximum 38.0 inches Hg. manifold pressure. Therefore, in order not to exceed 38.0 inches Hg. manifold pressure, a bypass or waste gate (6) is used so the excess exhaust gas will be expelled overboard instead of passing through the turbine.

TURBO-SYSTEM SCHEMATIC

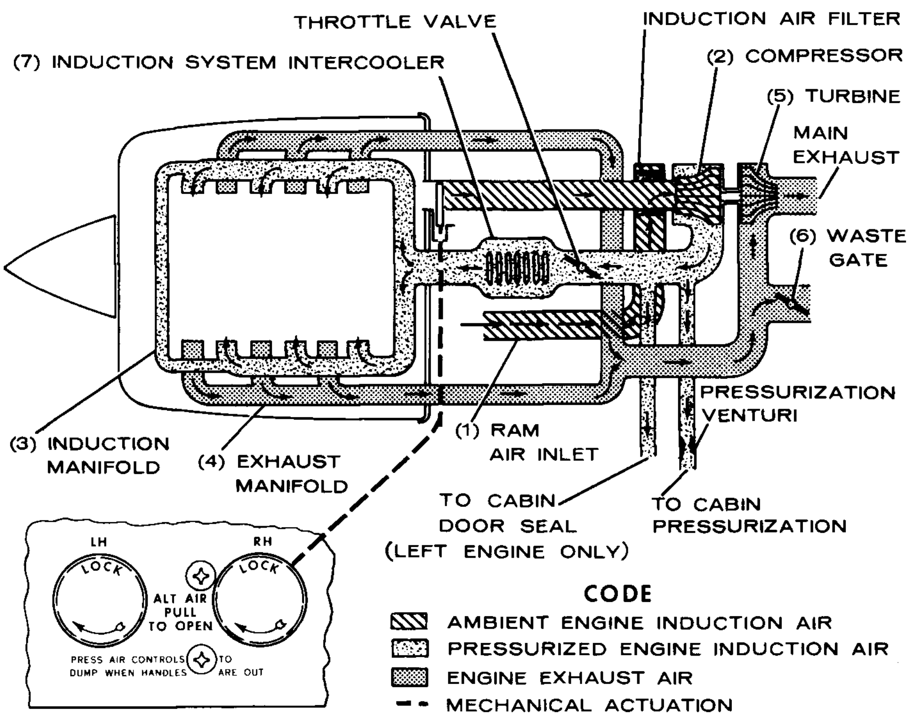


Figure 7-24

It can be seen from studying steps (1) through (6) that anything that affects the flow of induction air into the compressor, or the flow of exhaust gases into the turbine, will increase or decrease the speed of the turbocharger. This resultant change in flow will have no effect on the engine if the waste gate is still open, because the waste gate position will automatically change to hold compressor discharge pressure constant. The waste gate automatically maintains allowable compressor discharge pressure when below 20,000 feet with full throttle and full RPM. Above 20,000 feet, the throttles must be retarded to maintain the manifold pressure within the allowable limits. When the waste gate is closed, any change in the turbocharger speed will mean a change in engine operation. Anything that causes an increase or decrease in turbine speed will cause an increase or decrease in manifold pressure. If turbine speed increases, the manifold pressure increases; if the turbine speed decreases, the manifold pressure decreases. Any change in exhaust flow to the turbine or ram induction air pressure, whether it is an increase or decrease, will be magnified approximately 8 to 10 times by the compression ratio and the change in flow through the exhaust system.

Manifold Pressure Variation With Altitude

At full throttle, the turbocharger is capable of maintaining the maximum allowable 38.0 inches Hg. manifold pressure, well above 20,000 feet; however, engine operating limitations establish the maximum manifold pressure that may be used. From 20,000 feet to higher altitudes, the throttles must be retarded to maintain the manifold pressure within the allowable limits.

Manifold Pressure Variation With Airspeed

When the waste gate is open at low altitude, changes in airspeed have little or no effect on manifold pressure. However, at high altitudes when the waste gate is closed, manifold pressure will vary with variations in airspeed. This is because any change in pressure at the compressor inlet is magnified 8 to 10 times at the compressor outlet due to compression ratio and exhaust flow changes.

Fuel Flow Variations With Changes In Manifold Pressure

The engine-driven fuel pump output is regulated by engine speed and compressor discharge pressure. Engine fuel flow is regulated by fuel pump output and the metering effects of the throttle and mixture control. When the waste gate is open, fuel flow will vary directly with manifold pressure, engine speed, mixture or throttle position. In this case, manifold pressure is controlled by throttle position and the waste gate controller, while fuel flow varies with throttle movement and manifold pressure.

When the waste gate is closed and manifold pressure changes are due to turbocharger output, as discussed previously, fuel flow will follow manifold pressure even though the throttle position is unchanged. This means that fuel flow adjustments required by the pilot are minimized to the following: (1) small initial adjustments on takeoff or climb-out for the proper rich climb setting, (2) lean-out in cruise to the recommended lean cruise setting, and (3) return to the full rich position for approach and landing.

Manifold Pressure Variation With Increasing Or Decreasing Fuel Flow

When the waste gate is open, movement of the mixture control has little or no effect on the manifold pressure of the turbocharged engine.

When the waste gate is closed, any change in fuel flow to the engine will have a corresponding change in manifold pressure. That is, increasing the fuel flow will increase the manifold pressure and decreasing the fuel flow will decrease the manifold pressure. This is because an increased fuel flow to the engine increases the mass flow of the exhaust. This turns the turbocharger faster, increasing the induction airflow and raising the manifold pressure.

Momentary Overboost Of Manifold Pressure

Under some circumstances (such as rapid throttle movement, especially with cold oil) it is possible that the engine can be overboosted above the maximum allowable 38.0 inches Hg. manifold pressure. This would most likely be experienced during the takeoff roll or during a change to full throttle operation in flight. Therefore, it is still necessary that the pilot observe and be prepared to control the manifold pressure.

Slight overboosting is not considered detrimental to the engine so long as it is momentary. Momentary overboost of 2 to 3 inches Hg. manifold pressure can usually be controlled by slower throttle movement and no corrective action is required when momentary overboost corrects itself and is followed by normal engine operation. However, if overboosting of this nature persists, or if the amount of overboost goes as high as 4 inches Hg. manifold pressure or more, the controller system should be checked for necessary replacement or adjustment of components.

Altitude Operation

Turbocharged airplanes can maintain higher power settings and fuel flows to higher altitudes than are possible with normally aspirated airplanes. As a result, turbocharged airplanes climb faster and higher. Due to the higher fuel flows and the more rapid temperature and barometric pressure changes during these climbs, fuel vaporization in the fuel lines is more probable than with normally aspirated airplanes. Fuel vaporization is usually indicated by fuel flow fluctuations and can be eliminated by pressurizing the fuel system with the auxiliary fuel pumps. Refer to the Normal Procedures Checklist for recommended positioning of the auxiliary fuel pump switches.

High Altitude Engine Acceleration

The engines will accelerate normally from idle to full throttle with full rich mixture at any altitude below 20,000 feet. At higher altitudes, it is usually necessary to lean the mixture to get smooth engine operation from idle to maximum power. At altitudes above 25,000 feet, and with temperatures above standard, it takes one to two minutes for the turbine to accelerate from idle to maximum RPM, although adequate power is available in 20 to 30 seconds. If fuel flow has been interrupted for any reason, the mixture should be leaned until the engine begins to accelerate as shown by an increase in manifold pressure (with throttle open). Thereafter, adjust the mixture control for smooth engine operation.

Engine Shutdown

After extended periods of ground engine operation above 1600 RPM or when the cylinder head temperature indicator shows values within the upper half of the green arc, reduce power to between 600 and 800 RPM for a period of not less than 2 to 3 minutes prior to engine shutdown. This procedure is intended to reduce internal turbocharger temperatures and preclude the possibility of premature accumulation of carbon on the turbine shaft seals.

CABIN AIR SYSTEM

The cabin air system provides for cabin heating, ventilating and defrosting. The system consists of an air inlet in the nose, a cabin fan, a gasoline combustion-type heater, pressurization air temperature controls, and controllable heat outlets in the cabin. Two heat outlets are located at the base of the windshield for defrosting purposes. One outlet duct is located on each side of the aft cabin and two are located on the forward pressure bulkhead, see Figure 7-25 or 7-26.

Cabin heating and ventilating is accomplished by the cabin air DEFROST, AFT and FWD controls, see Figure 7-25 or 7-26. The overhead directional vents also supply unheated ventilating air in the pressurized mode. Forced ventilation is obtained with the two-speed cabin fan which may be operated independently of the heater. When the heater is actuated, the fan automatically operates in low speed; if additional airflow is desired, the HIGH position may be selected.

HEATING AND DEFROSTING

Depressurized

Fresh air is picked up from the air inlet in the nose of the airplane, heated by the heater, and directed to the pilot and passenger compartments. The heating and ventilating air is not recirculated, but exhausts overboard through the cabin pressure regulating valve.

The heating system can be used for ventilation by placing the cabin fan switch, see Figure 7-19, in either the NORMAL or HIGH position. The fan provides unheated fresh air to the cabin through the cabin heat outlets. In flight, ram air pressure can be used for ventilation by placing the cabin heat switch to the OFF position, pulling out the cabin air knobs and opening the heat outlets as desired.

Pressurized

Pressurization air is heated by the heater and ducted to the pilot and passenger compartments. To increase passenger comfort and heating system efficiency, the pressurization air temperature controls, see Figure 4-3, may be rotated fully clockwise. This will allow higher pressurization air temperatures, reducing cabin heater requirements. With the left pressurization air temperature control rotated fully clockwise, the overhead vents will supply warm air.

CABIN HEAT SWITCH BREAKER

The cabin heater is controlled by a two-position cabin heat switch breaker, see Figure 7-19. Switch positions are ON and OFF. Placing the switch breaker in the ON position starts and maintains heater operation and turns the cabin fan on low.

CABIN FAN SWITCH

The ventilating fan is controlled by a three-position cabin fan switch, see Figure 7-19. Switch positions are NORMAL, OFF and HIGH.

CABIN AIR TEMPERATURE CONTROL KNOB

The cabin air temperature is controlled by the cabin heat knob, see Figure 7-1. Clockwise rotation of this knob increases the desired temperature.

This knob adjusts a thermostat, which in turn controls heated air temperature in a duct located just aft of the heater. When the temperature of the heated air exceeds the setting of the thermostat, the thermostat automatically opens and shuts off the heater. When the heated air cools to the thermostat setting, the heater starts again. Thus the heater cycles on and off to maintain an even air temperature. Operation is identical for the pressurized and depressurized modes.

FORWARD CABIN AIR KNOB

The forward cabin air knob directs warm air to two outlets located on the forward pressure bulkhead. These direct outlets allow fast warm-up when the airplane is on the ground. Airflow through the direct outlets is completely shut off by pushing the knob all the way in. The knob may be set at any intermediate position to regulate the quantity of air to the pilot's compartment.

AFT CABIN AIR KNOB

The aft cabin air knob controls airflow to all passenger compartment heat registers. When the knob is pulled out, the air flows to heat registers in the passengers' compartment. Airflow to the heat registers is completely shutoff by pushing the knob all the way in. The knob may be set in any intermediate position to regulate the quantity of air to the cabin.

DEFROST KNOB

Windshield defrosting and defogging is controlled by the push-pull defrost knob. When the knob is pulled out, air flows from the defroster outlets at the base of the windshield. When the knob is pushed all the way in, airflow to the defroster outlets is shut off. The knob may be set in any intermediate position to regulate the defroster airflow.

HEATER OVERHEAT WARNING LIGHT

An amber overheat warning light provided in the annunciator panel is labeled HEATER OVHT, see Figure 7-3. When illuminated, the light indicates that the heater overheat switch has been actuated and that the temperature of the air in the heater has exceeded 163°C (325°F). Once the heater overheat switch has been actuated, the heater turns off and cannot be

CABIN AIR SYSTEM SCHEMATIC

DEPRESSURIZED MODE, HEATER ON

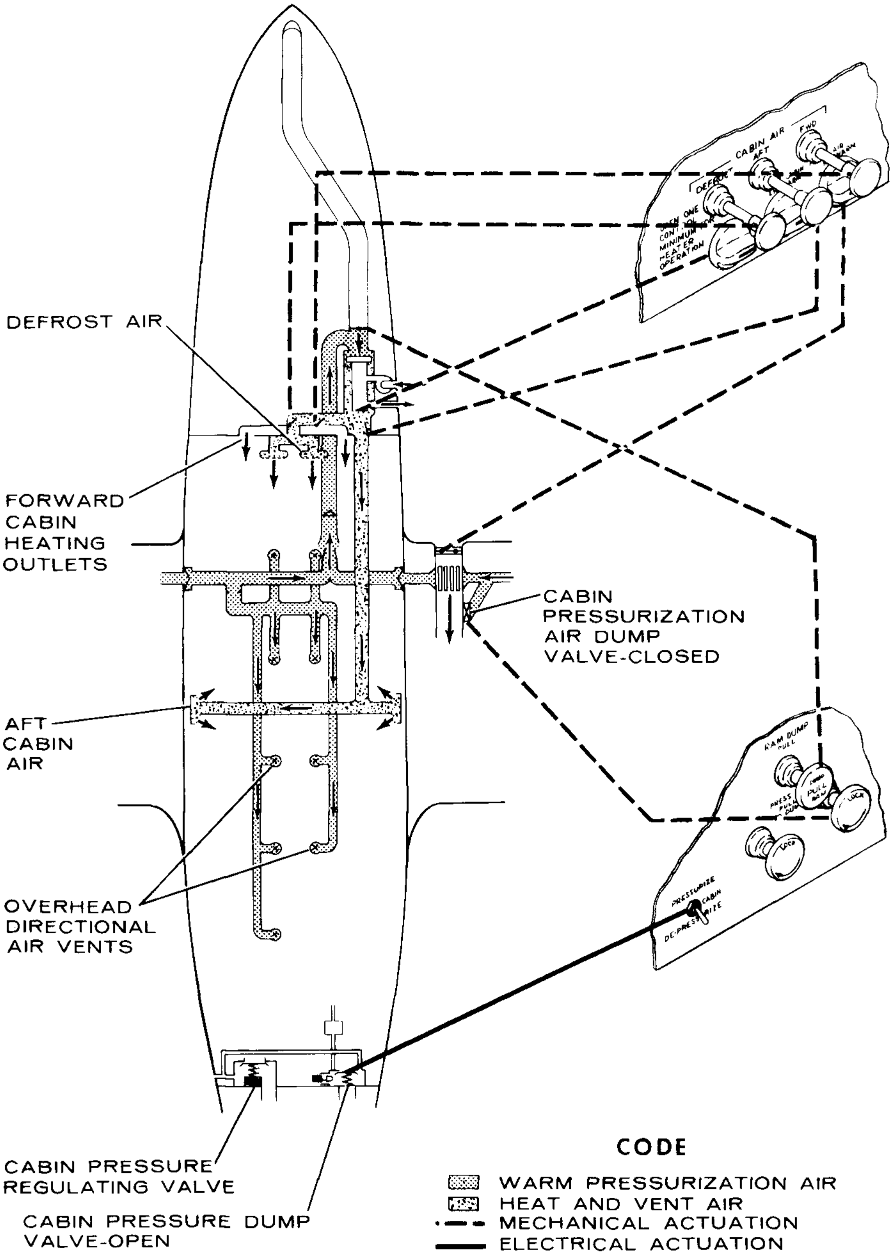


Figure 7-25

restarted until the overheat switch, located in the right forward nose compartment, has been reset. This switch is accessible from inside the nose wheel well. Prior to resetting the overheat switch, the heater should be thoroughly checked to determine the reason for the malfunction.

HEATER OPERATION FOR HEATING AND DEFROSTING

(1) Battery Switch - ON.
(2) Pressurization Air Controls - PUSH IN.
(3) Cabin Vent Control - PUSH IN.
(4) Cabin Air Knobs - PULL OUT.
(5) Defrost Knob - Adjust as desired (if defrosting is desired).
(6) Cabin Heat Knob - MAX or as desired.
(7) Pressurization Air Temperature Controls - CLOCKWISE.
(8) Cabin Heat Switch - ON.
(9) Heat Registers - As desired.

NOTE

- If no warm air is coming out of the registers within one minute, turn cabin heat switch breaker OFF and try another start. If heater still does not start, no further starting attempt should be made.
- During heater operation, defrost and/or cabin air knobs must be out.

HEATER USED FOR VENTILATION

(1) Battery Switch - ON.
(2) Cabin Air Knobs - PULL OUT as desired.
(3) Cabin Fan Switch - NORMAL or HIGH as desired.
(4) Heat Registers - As desired.

CABIN PRESSURIZATION SYSTEM

OPERATING DETAILS

The airplane may be operated in either the pressurized mode or depressurized mode. The mode selection is made with the cabin pressurization switch and/or the cabin vent control, see Figure 7-27 or 7-29. Mode of operation should be selected prior to takeoff. If a mode selection must be made while airborne, the cabin vent control should be moved very slowly to minimize pressure transients which would cause discomfort to the passengers.

Pressurization air is supplied from each engine turbocharger through the sonic venturi (flow limiter), the heat exchanger and then into the cabin. Adequate flow to maintain pressurization is provided by either engine at normal power settings. Power changes should be made smoothly to prevent sudden changes in pressurization air inflow resulting in cabin pressure transients.

The pressurization controls and indicators of your airplane, see Figure 7-27 (standard system) or 7-29 (optional system), consist of right and left pressurization air controls, a cabin vent control, a cabin pressurization switch, a cabin rate-of-climb indicator and a combination cabin altimeter and differential pressure indicator.

CABIN AIR SYSTEM SCHEMATIC

PRESSURIZED MODE, HEATER ON

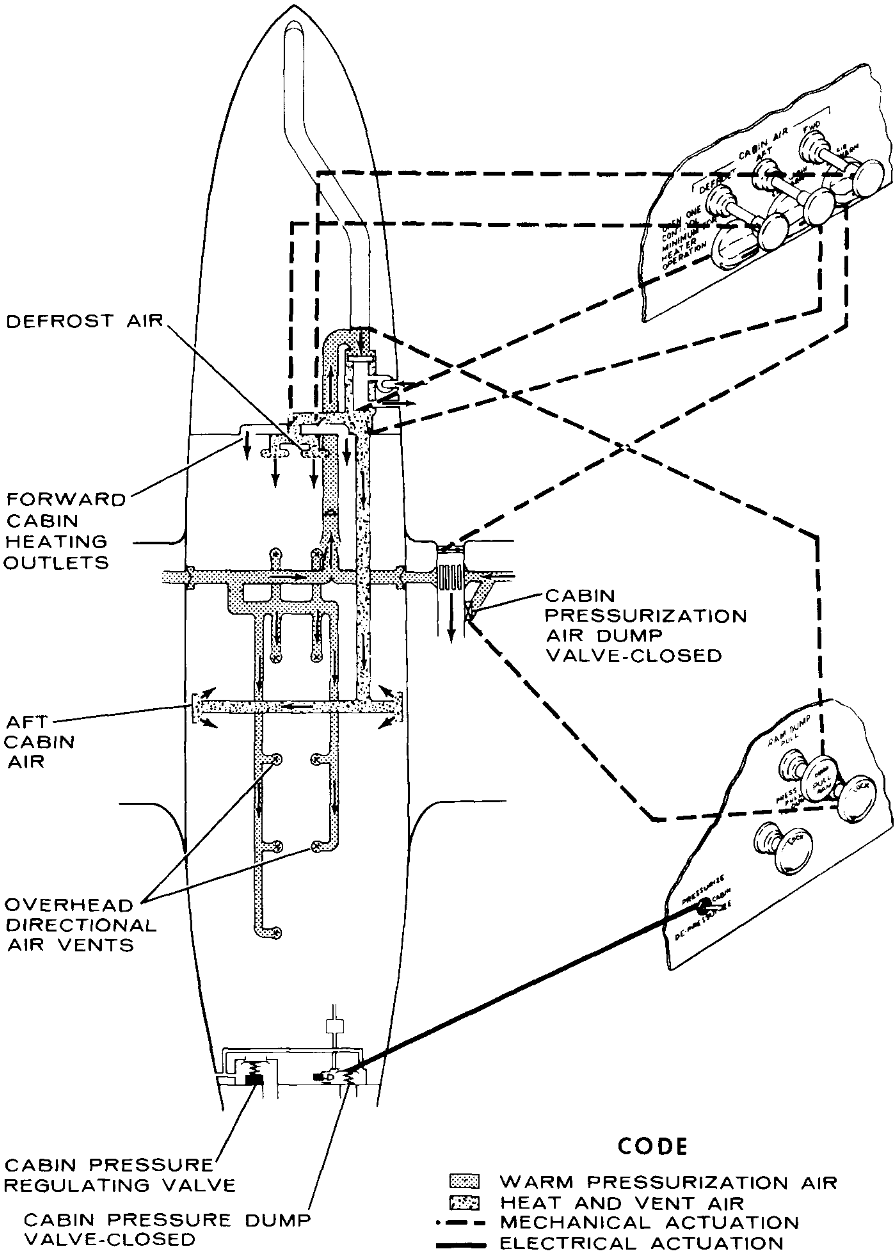


Figure 7-26

A warning light, which illuminates at approximately 10,000 feet cabin altitude indicating a need for oxygen, is located in the annunciator panel.

To optimize normal operation in the pressurized mode, position the pressurization controls as follows:

1. Pressurization Air Controls - PUSH IN for all flight operations and ground operation when additional ground ventilation is desired.
2. Cabin Vent Control - PUSH IN for all flight operations and normal ground operation.
   - PULL OUT for additional ground ventilation.
3. Cabin Pressurization Switch - PRESSURIZE.

To optimize normal operation in the depressurized mode, position the pressurization controls as follows:

1. Pressurization Air Controls - PUSH IN if heater operation or additional ground ventilation is desired.
   - PULL OUT if heater operation is not desired.
2. Cabin Vent Control - PUSH IN if in-flight heater operation is desired.
   - PULL OUT if additional ground ventilation is desired.
3. Cabin Pressurization Switch - DEPRESSURIZE.

STANDARD PRESSURIZATION SYSTEM

The PRESSURIZE position of the cabin pressurization switch, see Figure 7-26, provides for cabin pressurization at altitudes above 8000 feet. The cabin altitude is maintained at 8000 feet at all airplane altitudes between 8000 and 23,120 feet. From 23,120 feet to the operating ceiling of 30,000 feet, 5.0 PSI differential is maintained between cabin and atmosphere.

Until reaching 8000 feet, the cabin rate-of-climb, see Figure 7-27, will be equal to the airplane rate-of-climb. At 8000 feet, the cabin rate-of-climb will drop to zero as pressurization begins. The cabin rate-of-climb will remain approximately at this indication until the airplane has reached an altitude of 23,120 feet. Above this altitude, the cabin altitude will again begin to ascend as the airplane ascends, but at a lesser rate than the airplane rate-of-climb because of the difference in ambient air density and cabin air density. The cabin altitude reaches approximately 10,000 feet at an airplane altitude of 26,500 feet; at this time the altitude warning light on the annunciator panel will illuminate, indicating the need for oxygen.

The cabin differential pressure of 5.0 PSI is limited by the pressure regulator valve, see Figure 7-26, located in the aft portion of the cabin. This valve automatically permits air to leave the cabin to maintain the desired pressure. If the regulating valve should fail in the closed position, a dump valve, see Figure 7-26, also located in the aft portion of the cabin, operates as a safety valve to regulate maximum cabin differential pressure at 5.3 PSI. This is a dual function valve which functions as a cabin dump when the DEPRESSURIZE position is selected with the cabin pressurization switch.

The cabin altitude which is maintained at a given airplane altitude is shown in Figure 7-28.

STANDARD PRESSURIZATION CONTROLS AND INDICATORS

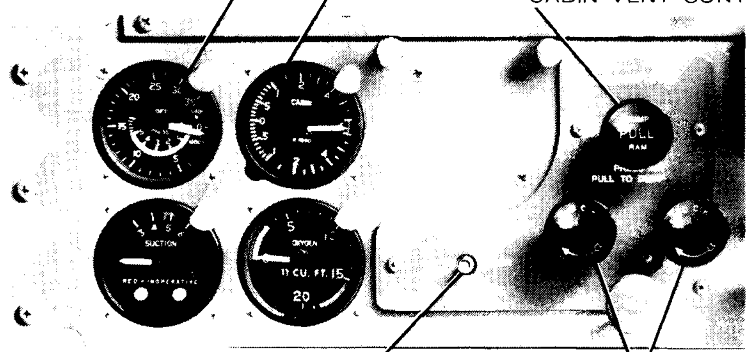


Figure 7-27

The aft cabin dump valve is used during ground operation to assure the cabin pressure differential is zero. The dump valve is opened automatically by the landing gear safety switch when the weight of the airplane is on the landing gear or can be opened manually by selecting the DEPRESSURIZE position of the cabin pressurization switch. Normally, the cabin pressurization switch can be left in the PRESSURIZE position. However, should a malfunction occur or if a landing is attempted above 8000 feet pressure altitude, select the DEPRESSURIZE position. This airplane is not certified for landings with the cabin pressurized.

NOTE

The airplane cannot be pressurized on the ground as the landing gear safety switch circuit is interconnected with the aft cabin dump valve circuit.

STANDARD PRESSURIZATION SCHEDULE

AIRPLANE ALTITUDE	CABIN ALTITUDE
SEA LEVEL TO 8000 FEET	SAME AS AIRPLANE ALTITUDE
8000 to 23,120 FEET	8000 FEET
24,790 FEET	9000 FEET
26,500 FEET	10,000 FEET
28,260 FEET	11,000 FEET
30,000 FEET	11,950 FEET

Figure 7-28

In the event that an emergency should require immediate depressurization, place the cabin pressurization switch in the DEPRESSURIZE position, see Figure 7-25, and pull out the cabin vent control. These actions electrically open the aft cabin dump valve and mechanically open the ram air inlet butterfly valve located in the nose; however, pressurization air will still flow into the cabin.

OPTIONAL PRESSURIZATION SYSTEM

For the pressurization system to operate, the cabin pressurization switch must be in the PRESSURIZE position and the cabin vent control and pressurization air controls must be pushed in, see Figure 7-29. The desired cabin altitude can then be selected by the cabin altitude control and the desired cabin rate-of-climb can be selected by the cabin rate control, see Figure 7-29. The selected values can be maintained until a cabin altitude is reached which results in a 5.0 PSI differential between the cabin and atmosphere. To obtain the optimum benefit from the cabin altitude control and the cabin rate control, set in the field pressure altitude plus 500 feet on the outer CABIN ALT scale just prior to takeoff with the arrow on the cabin rate control positioned straight up. After takeoff, with the cabin pressure stabilized, slowly reset the cabin altitude control to cruise altitude plus 500 feet on the inner AIRCRAFT ALT scale or destination field pressure altitude plus 500 feet on the outer CABIN ALT scale. Make the selection which will provide the highest cabin altitude. For cruising altitudes below the inner scale values, always select the destination field pressure altitude plus 500 feet on the outer scale. The selection should be made slowly to provide maximum comfort. Adjust the cabin rate control as the climb progresses such that the selected cabin altitude is reached at approximately the same time that the airplane reaches cruising altitude.

OPTIONAL PRESSURIZATION CONTROLS AND INDICATORS

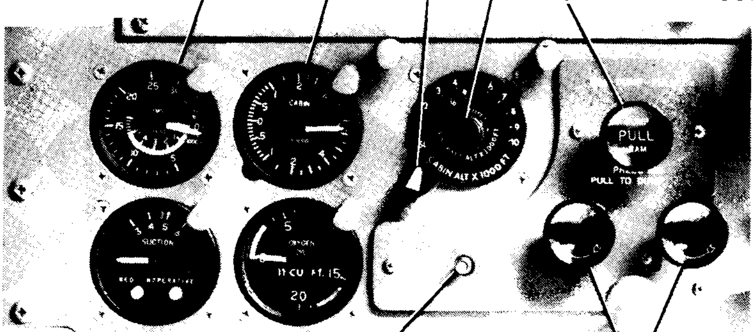


Figure 7-29

The above procedure is recommended because once the engines have been started and a source of vacuum is available, the pressure control system will begin to "climb" to the preset cabin altitude; thus, if cabin altitude required for cruise is selected too soon, the pressure control system will have climbed to an altitude approaching the desired cabin altitude before the airplane leaves the ground. Since the cabin pressure can never be less than outside ambient pressure, the cabin will be unpressurized until the airplane "catches up" with the pressure control system or the desired cabin altitude is reached, whichever occurs first. This will result in no cabin rate control being available as the cabin rate-of-climb will be equal to the airplane rate-of-climb.

The cabin differential pressure of 5.0 PSI is limited by the pressure regulator valve, see Figure 7-26, located in the aft portion of the cabin. This valve automatically permits air to leave the cabin to maintain the desired pressure. If the regulating valve should fail in the closed position, a dump valve, see Figure 7-26, also located in the aft portion of the cabin, operates as a safety valve to regulate maximum cabin differential pressure to 5.3 PSI. This is a dual function valve which also functions as a cabin dump when the DEPRESSURIZE position is selected with the cabin pressurization switch.

OPTIONAL PRESSURIZATION SCHEDULE

AIRPLANE ALTITUDE	CABIN ALTITUDE
SEA LEVEL TO 10,060 FEET	SEA LEVEL
13,910 FEET	2000 FEET
16,850 FEET	4000 FEET
19,920 FEET	6000 FEET
23,120 FEET	8000 FEET
26,500 FEET	10,000 FEET
30,000 FEET	11,950 FEET

Figure 7-30

The aft cabin dump valve is used during ground operation to assure the cabin pressure differential is zero. The dump valve is opened automatically by the landing gear safety switch when the weight of the airplane is on the landing gear or can be opened manually by selecting the DEPRESSURIZE position of the cabin pressurization switch. Normally, the cabin pressurization switch can be left in the PRESSURIZE position. However, should a malfunction occur or if the cabin altitude is inadvertently set at a lower altitude than field pressure altitude, select the DEPRESSURIZE position. It is important, therefore, to select a cabin altitude approximately 500 feet above field pressure altitude and check cabin pressure differential at zero prior to landing. This will prevent any cabin pressure transients on landing and provide maximum passenger comfort.

NOTE

The airplane cannot be pressurized on the ground as the landing gear safety switch circuit is interconnected with the aft cabin dump valve circuit.

The lowest cabin altitude which can be maintained at any given airplane altitude is shown in the chart in Figure 7-30.

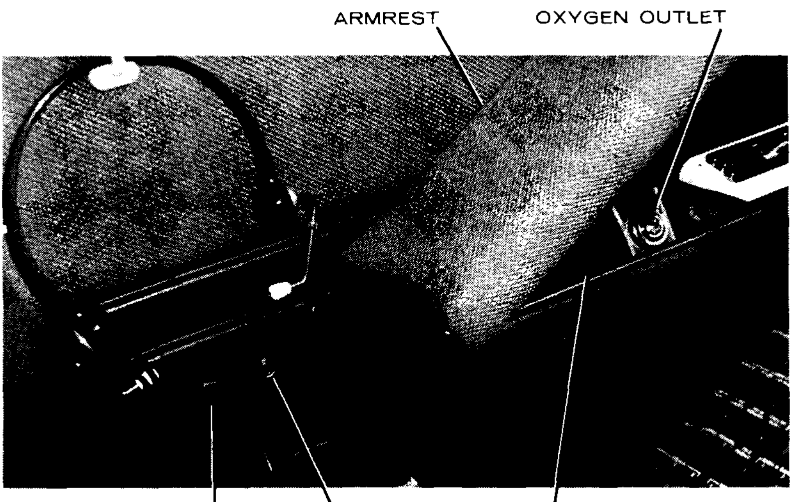
OXYGEN SYSTEM

The oxygen system provides individual service for the pilot, copilot and each passenger. The oxygen supply is stored in either an 11.0 or 114.9 cubic foot bottle located in the nose compartment. Cabin plumbing, including outlets for each occupant, is standard with each airplane and will vary with individual airplane seating configuration. The oxygen control, pressure gage (see Figure 7-1), bottle, regulator and nose compartment plumbing are optional.

The oxygen system is activated by pulling the oxygen control knob, see Figure 7-1, to the ON position, allowing oxygen to flow from the regulator to all cabin outlets. A normally closed valve in each oxygen outlet is opened by inserting the connector of the mask and hose assembly. After flights using oxygen, the pilot should insure that the oxygen system has been deactivated by unplugging all masks and pushing the oxygen control knob completely to the OFF position.

> NOTE
>
> If the oxygen control knob is left in an intermediate position between ON and OFF, it may allow low pressure oxygen to bleed through the regulator into the nose compartment of the airplane.

COCKPIT OXYGEN OUTLETS



PILOT'S SIDE SHOWN; IDENTICAL CONTROLS ARE PROVIDED FOR THE COPILOT.

Figure 7-31

The oxygen system, with optional 114.9 cubic foot oxygen bottle, provides adequate oxygen flow rates up to 30,000 feet cabin altitude and is suitable for cruising at altitudes in excess of 25,000 feet for extended periods, see Figure 7-32. The oxygen outlets for the pilot and copilot are located inside the stowage compartment under the outboard armrests, see Figure 7-31. Oxygen outlets for passengers are located overhead of each seat position, see Figure 7-21. The pilot, copilot and passengers shall always use the blue hose assemblies.

OXYGEN DURATION CHART

114.9 CUBIC FOOT OXYGEN SYSTEM

$$\frac{\text{OXYGEN DURATION IN HOURS}}{\text{NUMBER OF PERSONS}} = \text{TOTAL HOURS DURATION}$$

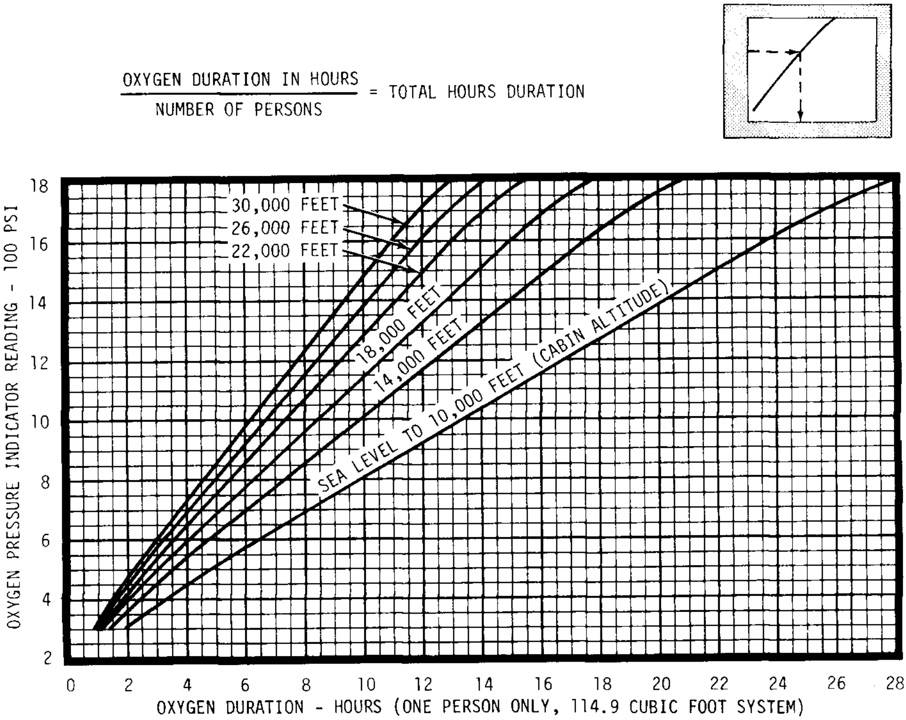


Figure 7-32

The oxygen system with optional 11.0 cubic foot bottle provides adequate oxygen flow rates up to 30,000 feet cabin altitude, see Figure 7-33. This system is designed solely to provide for emergency descents as described in Section 3. The system is calibrated for two different altitude ranges, which are: 14,000 to 22,000 feet cabin altitude and 22,000 to 30,000 feet cabin altitude. Selection of the desired altitude range is accomplished by appropriate selection of color-coded hose assemblies. The oxygen outlets for the pilot and copilot are located inside the stowage compartment under the outboard armrests, see Figure 7-31. Oxygen outlets for passengers are located overhead of each seat position, see Figure 7-21. The pilot shall always use the red hose assembly.

NOTE

Some airplanes are delivered with red oxygen hose mask connectors only. If your airplane is so equipped, disregard all information pertaining to orange oxygen hose mask connectors.

OXYGEN CONSUMPTION RATE CHART

11.0 CUBIC FOOT OXYGEN SYSTEM

OXYGEN DURATION CALCULATION:

TOTAL OXYGEN DURATION (HOURS) = OXYGEN PRESSURE INDICATOR READING ÷ [OXYGEN CONSUMPTION (PSI/HR) × NUMBER OF PASSENGERS + PILOT CONSUMPTION RATE].

CABIN ALTITUDE RANGE-FEET	HOSE ASSEMBLY COLOR	CONSUMPTION PSI/HR
14,000 22,000	ORANGE	965
22,000 30,000	RED	1352

Figure 7-33

PASSENGER LOADING

Due to the differences in installed optional equipment on the airplane, a wide CG range exists. Under certain passenger loading conditions, it is possible to exceed the aft CG limits, which can lead to tail tipping. To prevent this from occurring, owners and pilots should study their airplane's weight and balance information to become familiar with the airplane's capabilities and limitations. It is recommended that the loading of passengers be as follows:

(1) Load the baggage in the nose and avionics compartments prior to boarding of the crew and passengers.
(2) Avoid carrying baggage in the aft cabin.
(3) When boarding people, have the pilot, or person who is to occupy the copilot seat, be the first to board with the remaining people filling the most forward seats first and the aft seats last. Arrange to have the heavier people occupy the most forward seats.
(4) When unloading the airplane, have one person remain in the copilot or pilot seat while the other flight deck occupant goes aft to oper. the door. Arrange to have the passengers in the aft seats be the first to deplane.

BAGGAGE COMPARTMENTS

Six baggage locations, see Figure 1-3, are available: two in the fuselage nose section, two in the aft cabin area and one location in the aft portion of each engine nacelle.

These baggage areas are intended primarily for low-density items such as luggage and briefcases. The floors of the wing locker baggage areas are primary structure. Therefore, care should be exercised during loading and unloading to prevent damage. When loading high-density objects, insure that adequate protection is available to prevent damage to any of the airplane's primary structure. Without optional equipment installed, 120 pounds can be carried in each wing locker, 250 pounds in the avionics bay, 350 pounds in the nose baggage compartment, 400 pounds in the aft cabin Bay A and 100 pounds in the aft cabin Bay B. With optional equipment installed, refer to Section 2 or the loading placards in your airplane's baggage compartments.

WARNING

- The transportation of hazardous materials is discouraged. However, if transport of this material is necessary, it shall be done in accordance with FAR 103 and any other applicable regulations.
- Under no circumstances, allow the loading of people or animals in the nose baggage area or wing lockers. These areas do not qualify for carriage of animate objects.

AIRPLANE TIE-DOWN PROVISIONS AND JACK POINTS

A wing tie-down fitting is provided on the lower surface of each wing aft of each main gear. The fittings retract into the wing when not in use. The empennage is secured at the tail tie-down fitting located on the fuselage bottom, below the elevator hinge line. In addition the nose gear can be secured with ropes attached to the nose gear assembly above the scissors linkage.

Three jack points are provided on the underside of the airplane. The main gear jack points are located inboard of an in-line with the wing flap hinge. The nose gear jack point is located aft of the left nose gear door hinge. Jack pads, which are provided with the airplane, are required to be installed in each wing jack point before the airplane can be jacked.

SEATS, SEAT BELTS AND SHOULDER HARNESSES

PILOT AND COPILOT PROVISIONS

The pilot and copilot seats are secured to seat pan assemblies which are attached to the forward main spar carry-thru structure. The seats are adjustable fore and aft on seat rails by lifting the handle located on the forward face of the seat.

Seat belts are provided for both seats and are attached to airplane structure on the floor. The shoulder harnesses attach aft and outboard of the pilot's and copilot's seats to overhead structure. The opposite end of each harness can be attached permanently to the outboard pilot's or copilot's seat belt. An adjustment is provided between the attach points With the optional shoulder harnesses, inertia reels are bolted to overhead structure aft and outboard of the pilot's and copilot's seats. The opposite end of the harnesses attach to the seat belts with a detachable fastener. The inertia reels allow normal fore and aft movement of the occupants until a violent movement occurs, at which time the reel will lock, restricting forward movement of the seat occupant.

PASSENGER PROVISIONS

The passenger seats are attached to continuous seat rails located on each side of the cabin area. The seats are adjustable fore and aft, within the limits of the seat stops, by raising the handle located on the front of the seat. If the optional adjustable seats are installed, a second handle is provided on the front of the seat which allows reclining of the seat back. Insure the seat stop pins are engaged with the holes in the seat rails before takeoff and landing. Each seat is equipped with a seat belt which is attached to the seat structure. An optional stowage drawer may be installed beneath each seat.

DOORS, WINDOWS AND EXITS

CABIN DOOR

The main cabin door is a two-section, outward opening, airstair door. The lower section folds down to provide two steps for ease in boarding and deplaning passengers, while the top portion folds up.

CAUTION

> When entering or exiting airplane, equiped with pneumatic lower door extender, ensure lower cabin door is fully extended before putting weight on steps.

The lower door handle is located such that the upper door must be open to gain access to it. In addition, the locking pin receptacles can be visually inspected for positive engagement, see Figure 7-34.

As an additional safety feature, a cabin door warning light is provided. This light is located in the annunciator panel, see Figure 7-3, and is illuminated when the cabin door is not securely latched.

Cabin door sealing is provided by a pneumatic tube door seal that is inflated by pressurization air from the left engine. With the left engine operating and the cabin door closed and locking pins fully engaged, the door seal is inflated to provide positive fuselage to door sealing. When the cabin door locking pins are disengaged, the door seal is depressurized to allow the door to be opened and closed easily.

WINDOWS

Seven windows are provided on each side of the airplane. All windows are fixed except the foul weather windows located forward of the pilot's and copilot's side windows. These foul weather windows can be opened during all ground operations and in-flight operations with the cabin depressurized. Airspeed is not restricted with the foul weather windows open.

EMERGENCY EXIT WINDOW

The forward oval cabin window on the right side of the passenger compartment can be removed for emergency exit. Pull off the plastic cover over the emergency release handle under the window. Turn the release handle counterclockwise to release the window retainers, then pull the window in and down.

CABIN DOOR SAFETY AND LOCKING PINS

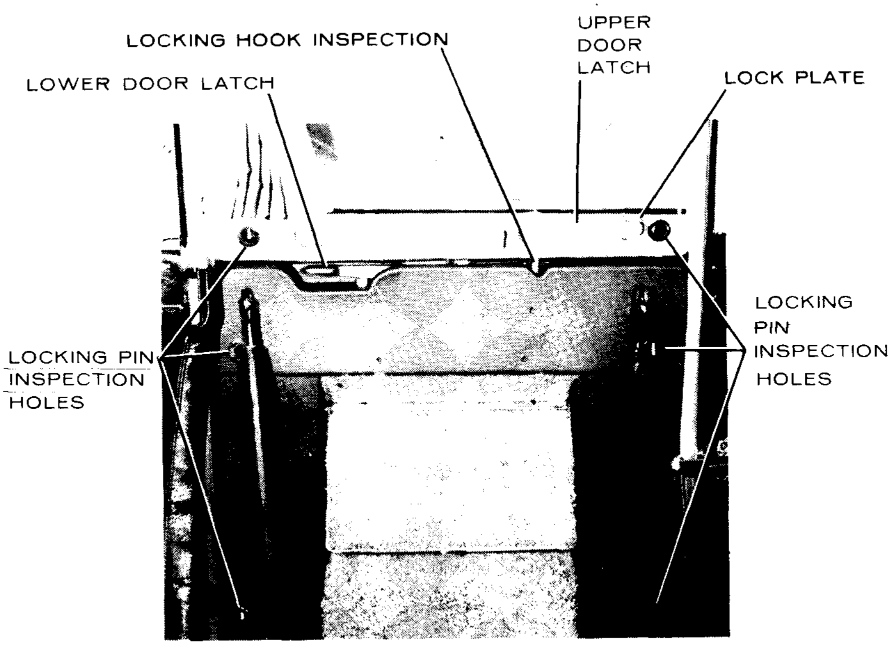


Figure 7-34

CONTROL LOCKS

A control column lock is provided to restrict the control column from moving. This restriction holds the ailerons in a neutral position and the elevators approximately 10° down, thus preventing damage to the control surfaces in gusty wind conditions.

The rudder is secured with the optional rudder gust lock. To engage the lock, center the rudder, insure the elevator is fully down, then move the external rudder lock handle to the lock position. The rudder lock is disengaged by rotating the external rudder lock handle to the unlock position. The rudder lock handle is located above the left horizontal stabilizer in the side of the fuselage. If the optional rudder lock is not installed, the rudder can be secured by placing an external control surface lock over the vertical stabilizer and rudder. If neither rudder lock is available, caster the nosewheel to the full left or right position. This action will deflect the rudder against its stop, thus restricting rudder movement.

WARNING

Insure all control locks are removed before starting the engines.

PROPELLERS

The airplane is equipped with all-metal, three-bladed, constant-speed, full-feathering, single-acting, governor-regulated propellers. Each propeller utilizes oil pressure which opposes the force of springs and counterweights to obtain correct pitch for engine load. Oil pressure from the propeller governor drives the blades toward low pitch (increasing RPM) while the springs and counterweights drive blades toward high pitch (decreasing RPM). The source of oil pressure for propeller operation is furnished by the engine oil system, boosted in pressure by the governor gear pump, and supplied to the propeller hub through the engine crankshaft flange

To feather the propeller blades, the propeller control levers on the control pedestal must be placed in the feather position. Unfeathering the propeller is accomplished by positioning the propeller control lever to the increase RPM position. The optional unfeathering system uses accumulator air and oil to force the propeller out of feather and into the low pitch condition.

PROPELLER SYNCHROPHASER

The optional propeller synchrophaser system, see Figure 7-35, is designed to match propeller RPM and propeller phase angle of the two engines. The propeller RPM and phase angle of the slaved (left) engine will follow changes in RPM and phase angle of the master (right) engine over a limited range. This limited range feature prevents the left engine from losing more than 50 propeller RPM should the right engine be feathered with the synchrophaser system on.

With the function switch in the OFF position, the system is deenergized and the automatic phaser RPM control is positioned to its mid-range to insure normal operation when next turned on. When the left engine is manually synchronized to the right engine and the synchrophaser switch is positioned to PHASE, the propeller RPM of the left and right engines will be automatically synchronized. The phase relationship of the left engine propeller relative to the right engine propeller can be adjusted by rotating the phasing knob. After initial synchrophaser engagement, the propellers will remain synchronized and can be phased as long as the RPM difference between the left and right engines does not exceed 50 RPM. When the RPM difference between the left and right engines exceeds 100 RPM, the synchrophaser light will flash and the automatic phaser control circuits will be disabled, causing the actuator drive motor to stop at a random position. If the propeller control of the left engine is again adjusted as close as possible to the right engine, the synchrophaser light will illuminate continuously and the propeller RPM of the left and right engines will be automatically synchronized.

Make certain that both engines are functioning properly with the synchrophaser turned OFF. Since the left propeller is slaved to the right propeller, and the slaving range is limited, the synchrophaser should not be operated at either extreme of the RPM governing range.

For best operation, it is important to guard against propeller control creeping by setting the quadrant friction lock tightly, see Figure 7-1. On extended flights, it may be necessary to periodically switch to the OFF position, reset the propeller control levers and reengage the synchrophaser.

NOTE

Manually synchronize the propellers as close as possible prior to selecting the PHASE position.

PROPELLER SYNCHROPHASER

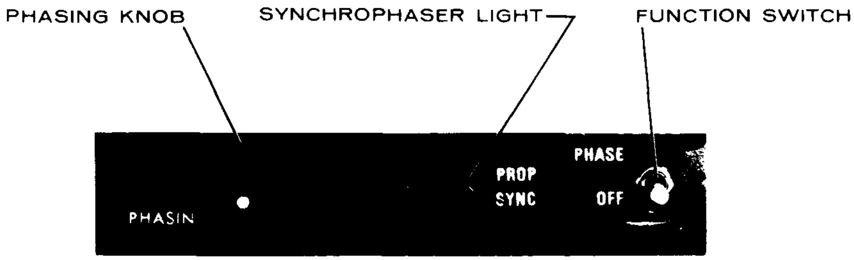


Figure 7-35

CABIN FEATURES

CABIN FIRE EXTINGUISHER (If Installed)

A portable 2½ pound Halon 1211 fire extinguisher is provided in case of an inadvertent cabin fire. The fire extinguisher, located beneath the copilot's seat, should be checked prior to each flight to ensure that bottle pressure, as indicated by the gage on the bottle, is within the green arc (approximately 125 PSI). To operate the bottle:

1. Loosen the retaining clamp and remove extinguisher from bracket.
2. Hold bottle upright, pull retaining pin, and press lever to discharge.

NOTE

- Begin discharge 5 feet from fire, at base of the flame, and sweep as required across the flame.
- Extinguisher should be recharged after each use.

SECTION 8

AIRPLANE HANDLING, SERVICE AND MAINTENANCE

TABLE OF CONTENTS

INTRODUCTION

Section 8 of this handbook provides information on cleaning, inspection, servicing and maintenance of the airplane.

If your airplane is to retain new plane performance and dependability, certain inspection and maintenance requirements must be followed. 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 Service Station 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.

All correspondence concerning your airplane should include the airplane model and serial number. This information may be obtained from the FAR-45 required identification plate located on the forward door post. Refer , to the Airplane Service Manual for an illustration of the identification plate.

PUBLICATIONS

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

CUSTOMER CARE HANDBOOK
PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL
PILOT'S CHECKLIST
CRUISE COMPUTER
WORLDWIDE CUSTOMER CARE DIRECTORY

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

INFORMATION MANUAL (Contains Pilot's Operating Handbook and FAA Approved Airplane Flight Manual Information)
SERVICE MANUALS AND PARTS CATALOGS FOR:
- AIRPLANE
- ENGINE AND ACCESSORIES
- AVIONICS

Your Cessna Service Station 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 Service Station. 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.

OWNER NOTIFICATION SYSTEM

As the owner of a Cessna, you will receive applicable Cessna Owner Advisories at no charge. Owner Advisories are used to announce Service Bulletins, Service Information Letters and Service Newsletters to Cessna airplane owners of record.

If the airplane is registered in the United States, Owner Advisories are mailed to the latest airplane registration name and address on record with the FAA. Owner Advisory service to FAA owners of record is automatic and continuous, without any additional action required of the owner. However, the owner is required to notify the FAA whenever the registration address or ownership changes. If the owner requires a duplicate Owner Advisory to be sent to an address different than the FAA airplane registration address, the owner must complete and return to Cessna an Owner Advisory Application form part number D5514-1-13.

If the airplane is not registered in the United States, Owner Advisories are initially mailed to the address that is provided to Cessna on the Owner Advisory Application or Warranty Registration Application card. This address will used for one year unless Cessna is notified otherwise. Prior to the end of one year, Cessna will send a renewal notice to the owner. The renewal notice must be completed and returned to Cessna to continue this service for another year.

Owner Advisory Applications are available from a Cessna Service Station or directly fromCessna Parts Distribution by ordering part number D5514-1-13.

A subscription service for Service Bulletins and other service information is available directly from Cessna Propeller Aircraft Product Support. Your Cessna Service Station will be glad to supply you with details concerning this subscription program, and stands ready, through their service department, to supply you with fast and efficient service.

INSPECTION REQUIREMENTS

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

In lieu of the above 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.

Additional inspections may be required by the FAA. These inspections are issued in the form of Airworthiness Directives and can apply to the airframe, engines and/or components of the airplane. It is the owner's responsibility to insure compliance with these directives. In some cases, the Airworthiness Directives require repetitive compliance; therefore, the owner should insure inadvertent noncompliance does not occur at future inspection intervals.

NOTE

Refer to FAR Parts 43 and 91 for properly certificated agency or personnel to accomplish the inspections. Contact your local Cessna dealer for additional information.

CESSNA CUSTOMER CARE PROGRAM

The Cessna Progressive Care Program has been designed to help you realize maximum utilization of your airplane at a minimum cost and downtime. Under this program, your airplane is inspected and maintained in four operations at 50-hour intervals during a 200-hour period. The operations are recycled each 200 hours and are recorded in a specially provided Aircraft Inspection Log as each operation is conducted.

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

CESSNA PROGRESSIVE CARE PROGRAM

Specific benefits and provisions of the Cessna Warranty plus other important benefits for you are contained in your Customer Care Handbook supplied with your airplane. You will want to thoroughly review this Handbook and keep it in your airplane at all times.

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

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

SERVICING REQUIREMENTS

For quick and ready reference, quantities, materials, and specifications for frequently used service items (such as fuel, oil, etc.) are shown in this section.

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

Since Cessna Dealers conduct all service, inspection, and test procedures in accordance with applicable Service Manuals, it is recommended that you contact your 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.

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 insure 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 (AC Form 8050-3).
   (3) Aircraft Radio Station License (Form FCC-556, if transmitter installed).
   (4) Radio Telephone Station License (Form FCC-407, if Flitefone III Radio Telephone is installed).
B. To be carried in the airplane at all times:
   (1) Weight and Balance, and associated papers (latest copy of the Repair and Alteration Form, Form 337, if applicable).
   (2) Airplane Equipment List.
   (3) Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.
   (4) Pilot's Checklist.
C. To be made available upon request:
   (1) Airplane Log Book.
   (2) Engine Log Books.

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 power computer, Customer Care Handbook and Customer Care Card, be carried in the airplane at all times.

PREVENTIVE MAINTENANCE

Part 43 of the FAR's allows the holder of a pilot certificate, issued under Part 61, to perform preventive maintenance on any airplane owned or operated by him that is not used in air carrier service. Refer to FAR Part 43 for a list of preventive maintenance items the pilot is authorized to accomplish.

NOTE

- Prior to performance of preventive maintenance, review the applicable procedures in the Airplane Service Manual to insure the procedure is properly completed.
- All maintenance other than preventive maintenance must be accomplished by appropriately licensed personnel. Contact your Cessna Dealer for additional information.
- Pilots operating airplanes of other than United States registry should refer to the regulations of the country of certification for information on preventive maintenance that may be performed by pilots.

ALTERATIONS OR REPAIRS TO THE AIRPLANE

Alterations or repairs to the airplane must be accomplished by appropriately licensed personnel. If alterations are considered, the FAA should be consulted to insure that the airworthiness of the airplane is not violated.

GROUND HANDLING

TOWING

The airplane should be moved on the ground with the aid of the nosewheel towing bar provided with the airplane. The tow bar is designed to attach to the nose gear strut fork.

CAUTION

> Remove all rudder locks before ground handling. When using the tow bar, never exceed the nosewheel turning radius limits of 52° either side of the center. Structural damage may occur if the turn limits are exceeded. Do not push or pull on propellers or control surfaces when moving the airplane on the ground.

Should towing operations be required which cannot be accomplished with the nosewheel towing bar, refer to the Airplane Service Manual for proper power towing procedures using either the nose or main landing gear.

PARKING

Parking is normally accomplished with the nosewheel aligned straight ahead. This minimizes stress on the nose gear during starting and simplifies the steering during subsequent departures from the parking area. If gusty wind conditions prevail and the optional rudder gust lock is not installed, restrict rudder travel with an external rudder gust lock or caster the nosewheel to the extreme right or left position. This forces the rudder against the rudder stop which minimizes buffeting of the rudder in gusty weather. When parking the airplane, head into the wind and set the parking brake.

CAUTION

> Do not set parking brakes when the brakes are overheated or during cold weather when accumulated moisture may freeze the brakes.

When setting the parking brake is impractical, chock the main and nose wheels to prevent airplane movement.

With the mixture levers in IDLE CUT-OFF, the fuel flow is effectively blocked at the fuel metering unit. Thus, it is unnecessary to place the fuel selectors in the OFF position if the airplane is receiving normal usage. However, if a long period of inactivity is anticipated, the fuel selectors should be turned OFF to preclude any possible fuel seepage that might develop through the metering valve.

TIE-DOWN

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

1. Head airplane into the wind if possible. Close engine cowl flaps after engines have cooled sufficiently.
2. Set parking brake and install control locks to restrict travel of all movable surfaces.

CAUTION

> Do not set parking brake when the brakes are overheated or during cold weather when accumulated moisture may freeze the brakes.

3. If a rudder gust lock is not available, caster the nosewheel to the extreme left or right positions.
4. Install pitot tube cover(s) if available.
5. Set elevator, aileron and rudder trim tabs to neutral, so the trim tabs fair with the control surfaces.
6. Use ropes or chains of at least 700 pounds tensile strength. Secure the nose gear with a rope or chain attached above the nose gear torque link. The other end should be attached to a substantial ground anchor. The rope or chain angle to the ground should be 45 degrees. Attach a second rope or chain in a similar manner to the opposite side of the nose gear. Secure the tail tie-down fitting in a similar manner.

JACKING AND LEVELING

Three jack points are provided on the underside of the airplane. One jack point is located just aft of the nosewheel well, and one is located on the lower surface of each wing, inboard and in-line with the wing flap hinge. Jack pads, which are provided with the airplane, are required to be installed in each wing jack point before the airplane can be jacked.

NOTE

- To prevent the flight hour recorder from recording while the airplane is on jacks and the battery switch is in the ON position, remove fuse located in the side console. Reinstall fuse when finished.
- Special two-ton jacks, ideally suited to the airplane, can be supplied by the Cessna Aircraft Company. Three jacks are required to lift the airplane.

To level the airplane longitudinally and laterally, use the three jacking points provided on the airplane. Level longitudinally by backing out the two screws at "Level Point" on the right outside fuselage (opposite cabin door) at Stations 214.00 and 238.00 and place a spirit level on these screws, then level longitudinally. To level laterally, place a spirit level at Station 154.00 (aft of front spar) on the underside of fuselage. Refer to the Airplane Service Manual for additional information.

FLYABLE STORAGE

Flyable storage applies to all airplanes which will not be flown for an indefinite period but which are to be kept ready to fly with the least possible preparation. If the airplane is to be stored temporarily, or indefinitely, refer to the Airplane Service Manual for proper storage procedures.

Airplanes which are not in daily flight should have the propellers rotated, by hand, six revolutions at least once each week. In damp climates and in storage areas where the daily temperature variation can cause condensation, propeller rotation should be accomplished more frequently. Rotating the propeller and stopping at 45° to 90° from it's original position redistributes residual oil on the cylinder walls, crankshaft and gear surfaces and repositions the pistons in the cylinders, thus minimizing corrosion. Rotate propellers as follows:

1. Throttles - IDLE.
2. Mixtures - IDLE CUT-OFF.
3. Magneto Switches - OFF.
4. Propellers - ROTATE CLOCKWISE. Manually rotate propellers six revolutions, standing clear of arc of propeller blades. Stop the propeller 45° to 90° from it's original position.

Keep fuel tanks full to minimize condensation in the fuel tanks. Maintain battery at full charge to prevent electrolyte from freezing in cold weather. If the optional 1000 series avionics and/or optional fuel flow indicating system are installed, the battery will discharge continuously, regardless of battery switch position. This flow of current is required to maintain the memories of the referenced equipment. If the airplane is not in frequent use (inactive for longer than two days), battery discharge can be avoided by disconnecting the battery or disengaging the FREQ MEM circuit breaker for the avionics or CABIN LTS circuit breaker for the fuel flow indicating system.

NOTE

- A malfunctioning nose baggage or wing locker light will completely deplete the battery in approximately four days, depending on the degree of charge and condition of the battery.
- Airplanes inactive for long periods of time should have the battery serviced in accordance with BATTERY servicing, this section.

If the airplane is stored outside, tie-down airplane in anticipation of high winds. Secure airplane as follows:

1. Secure rudder with the optional rudder gust lock or with a control surface lock over the fin and rudder. If a lock is not available, caster the nosewheel to the full left or right position.
2. Install pitot tube cover(s) if available.
3. Set elevator, aileron and rudder trim tabs to neutral so the trim tabs fair with the control surfaces.
4. Install control column lock in pilot's control column, if available. If column lock is not available, tie the pilot's control wheel full aft with a seat belt.
5. Tie ropes or chains of at least 700 pounds tensile strength to the wing tie-down fittings located on the underside of each wing, aft of the main landing gear. Secure the opposite ends of the ropes or chains to ground anchors. Chock the main landing gear tires; do not set the parking brake if a long period of inactivity is anticipated as brake seizing can result.
6. Secure a rope (no chains or cables) to the upper nose gear trunnion and secure opposite end of rope to a ground anchor. Chock the nose landing gear tire.
7. Secure the middle of a rope or chain to the tail tie-down fitting. Pull each end of the rope or chain at a 45-degree angle and secure to ground anchors at each side of the tail.
8. At the end of 30 days, the airplane should be flown for 30 minutes until oil and cylinder temperatures reach normal operating range. If the airplane is not flown at the end of 30 days, the airplane should be placed in temporary or indefinite storage.

SERVICING

NOTE

Refer to the Airplane Service Manual for complete servicing requirements.

FUEL (Approved Fuel Grades And Colors)

PRIMARY - 100 (Formerly 100/130) Grade Aviation Fuel (Green)
ALTERNATE - 100LL Grade Aviation Fuel (Blue)

Service after each flight. Keep tanks full to retard condensation in the tanks. Tank capacities are:

Each Main Tank - 106.7 Gallons

Isopropyl alcohol or ethylene glycol monomethyl ether may be added to the fuel supply in quantities not to exceed 1% or .15% by volume, respectively, of the total. Refer to Fuel Additive paragraphs in this section for additional information.

WARNING

- Do not operate any avionics or electrical equipment on the airplane during fueling. Do not allow open flame or smoking in the vicinity of the airplane while fueling.
- During all fueling operations, fire fighting equipment must be available. Two ground wires from different points on the airplane to separate approved grounding stakes shall be used.

Fuel Additive

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

One exception to this can be encountered when operating under the combined effect of: 1) use of certain fuels, with 2) high humidity conditions on the ground 3) followed by flight at high altitude and low temperature (flight levels of 20,000 feet or above and temperatures of -28.9°C (-(-20°F) or below). Under these unusual conditions small amounts of water in solution can precipitate from the fuel stream and freeze in sufficient quantities to induce partial icing of the engine fuel injection system.

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

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

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

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

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

1. For best results the alcohol should be added during the fueling operation by pouring the alcohol directly on the fuel stream issuing from the fueling nozzle.

2. An alternate method that may be used is to premix the complete alcohol dosage with some fuel in a separate clean container (approximately 2-3 gallon capacity) and then transferring this mixture to the tank prior to the fuel operation.

Any high quality isopropyl alcohol may be used, such as:

Anti-icing fluid (MIL-F-5566) or
Isopropyl alcohol (Federal Specification TT-I-735a).

Figure 8-1 provides alcohol-fuel ratio mixing information.

Ethylene glycol monomethyl ether (EGME) compound in compliance with MIL-I-27686 or Phillips PFA-55MB, if used, must be carefully mixed with the fuel in concentrations not to exceed 0.15% by volume.

CAUTION

- Mixing of the EGME compound with the fuel is extremely important because concentration in excess of that recommended (0.15 percent by volume maximum) will result in detrimental affects to the fuel tanks, such as deterioration of protective primer and sealants and damage to O-rings and seals in the fuel system and engine components. Use only blending equipment that is recommended by the manufacturer to obtain proper proportioning.

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

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

ALCOHOL - FUEL MIXING RATIO CHART

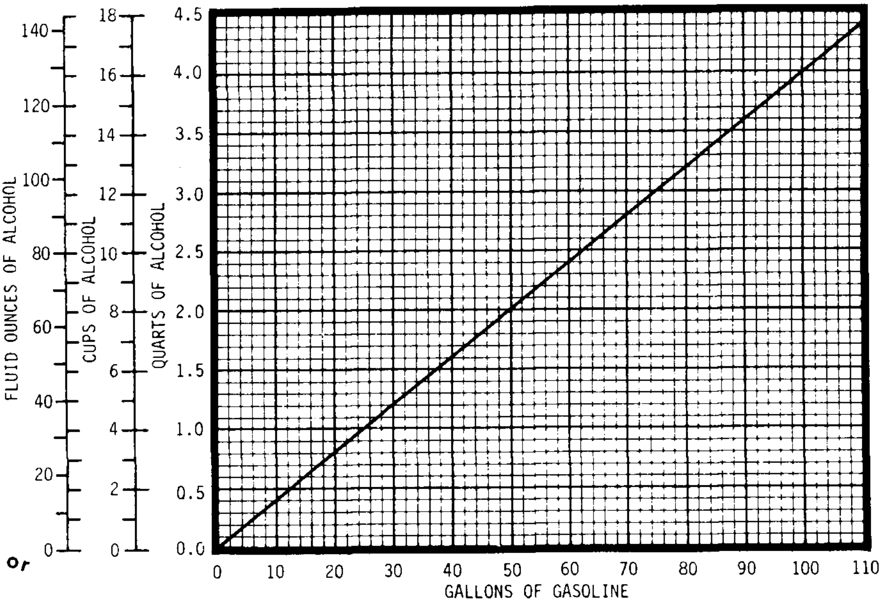


Figure 8-1

OIL (Aviation Grade Engine Oil; SAE 50 Above 4.4°C (40°F), SAE 30 Below 4.4°C (40°F) or Multiviscosity Unrestricted Temperature Range - Filter Element 643226 or 643227)

Multiviscosity oil is recommended for use after the first 25 hours of engine operation for improved starting and turbocharger controller operation in temperatures below 4.4°C (40°F). When operating temperatures overlap indicated ranges, use the lighter grade of oil. Ashless dispersant oil, conforming to the latest issue of Continental Motors Specification MHS-24 must be used. No oil additives are approved for use. Airplanes equipped with short filters (4.80 inches) should change the oil and filter every 50 hours or six months, whichever occurs first. Airplanes equipped with long filters (5.80 inches), may extend the recommended oil change interval to 100 hours or six months, whichever occurs first. Reduce oil and filter change intervals for prolonged operation in dusty areas, cold climates, or when short flights and long idle periods result in sludging conditions.

NOTE

For faster ring seating and improved oil control, your Cessna was delivered from the factory with corrosion preventive oil conforming to MIL-C-6529, Type II. This break-in oil must be used only for the first 25 hours of operation; at that time it must be replaced with ashless dispersant oil. If oil must be added during this first 25 hours of operation, use straight mineral oil conforming to MIL-L-6082.

Check oil level before each flight. Do not operate on less than 9 quarts. To minimize loss of oil through breather, fill to 10-quart level for normal flights of less than 3 hours. For extended flight, fill to capacity which is 13 quarts for each engine sump including 1 quart for oil filter.

OXYGEN (Aviators Breathing Oxygen - Specification MIL-O-27210)

Check pressure gage for anticipated requirements before each flight. Refill whenever pressure drops below 300 PSI.

The small oxygen cylinder, when fully charged and allowed to stabilize at a temperature of 21.1°C (70°F), contains approximately 11.0 cubic feet of oxygen under a pressure of 1800 PSI. The large oxygen cylinder, when fully charged and allowed to stabilize at a temperature of 21.1°C (70°F), contains approximately 114.9 cubic feet of oxygen under a pressure of 1850 PSI. Filling pressures will vary, however, due to the ambient temperature in the filling area, and because of the temperature rise resulting from compression of the oxygen. Because of this, merely filling to 1800 or 1850 PSI will not result in a properly filled cylinder. Fill to the pressures indicated in Figure 8-2 for the ambient temperature.

WARNING

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

The 11.0 cubic foot capacity cylinder is serviced through a filler valve located on the forward face of the left nose baggage door jamb, and the 114.9 cubic foot capacity cylinder is serviced through the right nose baggage door in a similar manner.

OXYGEN SERVICING CHART

AMBIENT TEMPERATURE °C	°F	FILLING PRESSURE PSIG	AMBIENT TEMPERATURE °C	°F	FILLING PRESSURE PSIG
–17.8	0	1600	21.1	70	1925
–12.2	10	1650	26.7	80	1950
–6.7	20	1675	32.2	90	2000
–1.1	30	1725	37.8	100	2050
4.4	40	1775	43.3	110	2100
10.0	50	1825	48.9	120	2150
15.6	60	1875	54.4	130	2200

THE NUMBERS SHOWN ABOVE ARE APPLICABLE TO 1800 PSI OXYGEN BOTTLES. IF AN 1850 PSI OXYGEN BOTTLE IS INSTALLED, INCREASE EACH FILLING PRESSURE BY 50 PSI.

Figure 8-2

AIR CONDITIONING RESERVOIR (Hydraulic Fluid MIL-H-5606)

Check reservoir fluid level above screen bottom. Reservoir capacity is 2.75 quarts.

LANDING GEAR HYDRAULIC RESERVOIR (Hydraulic Fluid MIL-H-5606)

Check reservoir fluid level; fill as required to maintain fluid level between the ADD and MAX FULL marks. Reservoir capacity is approximately 1.2 quarts when the landing gear is down and locked.

ALCOHOL WINDSHIELD DEICE RESERVOIR (Isopropyl Alcohol MIL-F-5566)

Check reservoir fluid level; fill as required. Reservoir capacity is 3.0 gallons.

BATTERY

Low electrolyte level, inadequate charging and long idle periods in a discharged condition can cause batteries to become sulfated and unserviceable. Airplanes intended to be idle for long periods of time should have the batteries removed and placed on charge.

NOTE

Water consumption will increase during warmer temperatures and should be checked regularly. Fifty (50) hour inspection intervals are recommended, but may need to be reduced to maintain proper electrolyte level, depending on use and weather conditions.

TIRES

Tire pressure should be maintained at 70 PSI for the main wheel tires and 35 PSI for the nosewheel tire.

FLUSH TOILET RESERVOIR

The optional flush toilet uses a reservoir tank that contains water and chemicals. The reservoir tank should be removed and serviced after excessive use or after 35 or 40 cycles of the system. Service the reservoir with a 2-quart solution of water and a 3-ounce package of Monogram DG-19 chemical.

CAUTION

During cold weather operation, where cabin temperatures can fall below 0°C (32°F), an ethylene glycol base anti-freeze should be added to the reservoir tank to prevent freezing of the flush solution.

AIRPLANE CLEANING AND CARE

PAINTED SURFACES

The painted exterior surfaces of your new airplane require an initial curing period which may be as long as 90 days after the finish is applied. During this curing period some precautions should be taken to avoid damaging the finish or interfering with the curing process. The finish should be cleaned only by washing with clean water and mild soap, followed by a rinse water and drying with cloths or a chamois. Do not use polish or wax, which would exclude air from the surface, during this 90-day curing period. Do not rub or buff the finish and avoid flying through rain, hail or sleet.

Once the finish has cured completely, it may be waxed with a good automotive wax. A heavier coating of wax on the leading edges of the wings, tail, engine nose cap and propeller spinner will help reduce the abrasion encountered in these areas.

PROPELLER

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. It is vital that small nicks on the propeller, particularly near the tips and on the leading edges, are 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.

LANDING GEAR

Cessna Dealer's mechanics have been trained in the proper adjustment of the landing gear system. To assure trouble-free gear operation, have your Cessna Dealer check the gear regularly and make any necessary adjustments. Only properly trained mechanics should attempt to repair or adjust the landing gear components and system.

DEICE BOOTS

The optional deice boots have a special, electrically conductive coating to bleed-off static charges which cause radio interference and may perforate the boots. Fueling and other servicing operations should be done carefully, to avoid damaging this conductive coating or tearing the boots.

To prolong the life of surface and propeller deice boots, they should be washed and serviced on a regular basis. Keep the boots clean and free from oil, grease and other solvents which cause rubber to swell and deteriorate. Outlined below are recommended cleaning and servicing procedures.

CAUTION

Use only the following instructions when cleaning boots. Disregard instructions which recommend petroleum base liquids (Methyl-Ethyl-Ketone, non-leaded gasoline, etc.) which can harm the boot material.

Clean the boots with mild soap and water, then rinse thoroughly with clean water.

NOTE

Isopropyl alcohol can be used to remove grime which cannot be removed using soap. If isopropyl alcohol is used for cleaning, wash area with mild soap and water, then rinse thoroughly with clean water.

To possibly improve the service life of deice boots and to reduce the adhesion of ice, it is recommended that the deice boots be treated with AGE MASTER No.1 and ICEX.

AGE MASTER No.1, used to protect the rubber against deterioration from ozone, sunlight, weathering, oxidation and pollution, and ICEX, used to help retard ice adhesion and for keeping deice boots looking new longer, are both products of and recommended by B.F. Goodrich.

The application of both AGE MASTER No. 1 and ICEX should be in accordance with the manufacturer's recommended directions as outlined on the containers.

CAUTION

- Protect adjacent areas, clothing, and use plastic or rubber gloves during applications, as AGE MASTER Number 1 stains and ICEX contains silicone which makes paint touchup almost impossible.
- Ensure that the manufacturer's warnings and cautions are adhered to when using AGE MASTER Number 1 and ICEX.

Small tears and abrasions in surface deice boots can be repaired temporarily without removing the boots and the conductive coating can be renewed. Your Cessna Service Station has the proper materials and know-how to do this correctly.

ENGINES

The engine compartments should be cleaned, using a suitable solvent. Most efficient cleaning is done using a spray-type cleaner. Before spray cleaning, ensure protection is afforded for other components which might be adversely affected by the solvent. Refer to the Airplane Service Manual for proper lubrication of components after engine cleaning.

INTERIOR CARE

To remove dust and loose dirt from the upholstery, headliner 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 of 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.

WARNING

- Use all cleaning agents in accordance with the manufacturer's recommendations.
- The use of toxic or inflammable cleaning agents is discouraged. If these cleaning agents are used, insure adequate ventilation is provided to prevent harm to the user and/or damage to the airplane.

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

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

WINDOWS AND WINDSHIELDS

The cabin windows and windshield panels are constructed of prestretched acrylic in lieu of the cast acrylic used on unpressurized airplanes. Stretched acrylic was chosen to provide the added safety offered by the ability to withstand higher stress concentration and improve resistance to crack propagation. The surface hardness of acrylic is approximately equal to that of copper or brass. Care must be exercised to avoid scratches and gouges which may be caused by a dirty, hard or rough cloth used for cleaning. To prevent possible damage, items such as wrist watch, rings, etc. should be removed before cleaning windshield and windows. Do not use a canvas cover on the windshield unless freezing rain or sleet is anticipated. Canvas covers may scratch the plastic surface.

Proper window care and maintenance are particularly important in a pressurized airplane. If the airplane must be flown with a cracked window, DO NOT PRESSURIZE the cabin. When cleaning and waxing windshield and windows, use only the following prescribed methods and materials.

Windshield and Window Maintenance Procedures

The following procedures provide the most current information regarding cleaning and servicing windshields and windows. Improper cleaning, or use of unapproved cleaning agents can cause damage to the windows.

CAUTION

Windshields and windows (acrylic or glass) are easily damaged by improper handling and cleaning techniques.

1. Place airplane inside hangar or in shaded area and allow to cool from heat of sun's direct rays.
2. Using clean (preferable running) water, flood the surface. Use bare hands with no jewelry to feel and dislodge any dirt or abrasive materials.

3. Using a mild soap or detergent (such as a dishwashing liquid) in water, wash the surface. Again, use only the bare hand to provide rubbing force. (A clean cloth may be used to transfer the soap solution to the surface, but extreme care must be exercised to prevent scratching the surface).
4. On acrylic windshields and windows only, if soils which cannot be removed by a mild detergent remain, Type II aliphatic naphtha applied with a soft clean cloth may be used as a cleaning solvent. Be sure to frequently refold the cloth to avoid redepositing soil and/or scratching windshield with any abrasive particles. DO NOT USE aliphatic naphtha on glass windshields.
5. Rinse surface thoroughly with clean, fresh water and dry with a clean cloth.

CAUTION

- Do not use any of the following on or for cleaning windshields and windows: methanol, denatured alcohol, gasoline, benzene, xylene, MEK, acetone, carbon tetrachloride, lacquer thinners, commercial or household window cleaning sprays. Additionally, strong acids or bases may destroy antistatic coatings on glass windshields. When in doubt, do not use it.
- Never use an abrasive cleaner, wax, or polish on glass windshields.

6. Hard polishing wax should be applied to acrylic surfaces. (The wax has an index of refraction nearly the same as transparent acrylic and will tend to mask any shallow scratches on the windshield surface).
7. Acrylic surfaces may be polished using polish meeting Federal Specification P-P-560 applied per the manufacturer's instructions.

NOTE

When applying or removing wax or polish, use a clean soft cloth.

8. Glass windshields may have rain repellent applied per the manufacturer's instructions. Caution should be used not to get rain repellent on painted surfaces surrounding the glass windshield. DO NOT USE rain repellent on acrylic surfaces.

Windshield and Window Preventive Maintenance

NOTE

Utilization of the following techniques will help minimize windshield and window crazing.

1. Keep all surfaces of windshields and windows clean.
2. If desired, wax acrylic surfaces.

3. Carefully cover all surfaces during any painting, powerplant cleaning or other procedure that calls for the use of any type of solvents or chemicals. The following coatings are approved for use in protecting surfaces from solvent attack:
   a. White Spray Lab, MIL-C-6799, Type I, Class II.
   b. WPL-3 Masking Paper - St. Regis, Newton, MA.
   c. 5 X N - Poly-Spotstick - St. Regis, Newton, MA.
   d. Protex 40 - Mask Off Company, Monrovia, CA and Southwest Paper Co., Wichita, KS.
   e. Protex 10VS - Mask Off Company, Monrovia, CA and Southwest Paper Co., Wichita, KS.
   f. Scotch 344 Black Tape - 3M Company.
4. Do not park or store airplane where it might be subjected to direct contact with or vapors from ethanol, denatured alcohol, gasoline, benzene, xylene, MEK, acetone, carbon tetrachloride, lacquer thinners, commercial or household window cleaning sprays, paint strippers, or other types of solvents.
5. Do not leave sunvisors up against windshield when not in use. The reflected heat from these items causes elevated temperatures on the windshield. If solar screens are installed on the inside of the airplane, make sure they are the silver appearing, reflective type.
6. Do not use power drill motor or any powered device to clean, polish or wax windshield.

Materials Required for Acrylic Windshields and Windows

MATERIAL	MANUFACTURER	USE
Mild soap or detergent (hand dishwashing type without abrasives)	Commercially available	Cleaning windshields and windows.
Aliphatic naphtha Type II conforming to Federal Specification TT-N-95	Commercially available	Removing deposits which cannot be removed with mild soap solution on acrylic windshields and windows.
Polishing wax: (Refer to Note 1)		Waxing acrylic windshields and windows.
Turtle Wax (paste)	Turtle Wax, Inc. Chicago, IL 60638	
Great Reflections Paste Wax	E.I. du Pont de Nemours and Co., (Inc.) Wilmington, DE 19898	
Slip-stream Wax (paste)	Classic Chemical Grand Prairie, TX 75050	
Acrylic polish conforming to Federal Specification P-P-560 such as:		Cleaning and polishing acrylic windshields and windows.
Permatex plastic cleaner Number 403D	Permatex Company, Inc. Kansas City, KS 66115	
Soft cloth, such as:		
Cotton flannel or cotton terry cloth material	Commercially available	Applying and removing wax and polish.

(Continued on next page)

Materials Required for Glass Windshields

MATERIAL	MANUFACTURER	USE
Mild soap or detergent hand dishwashing type without abrasives)	Commercially available	Cleaning windshields and windows.
Rain repellent: (Refer to Note 2)		Optional for rain shedding on glass windshields only.
REPCON or RAIN-X	UNELKO Corp., 727 E. 110 St., Chicago, IL 60628	

NOTE 1: These are the only polishing waxes tested and approved for use by Cessna Aircraft Company.
NOTE 2: This is the only rain repellent approved for use by Cessna Aircraft Company.

OXYGEN MASKS

The pilot's mask is a permanent-type mask which contains a microphone for radio transmissions. The remaining masks are basically the same as the pilot's, except they do not have the microphone provision. All masks can be cleaned with alcohol. Additional masks and hoses are available from your Cessna Service Station.

Cessna
A Textron Company

SEVERE INFLIGHT ICING CONDITIONS SUPPLEMENT

TO

PILOT'S OPERATING HANDBOOK

FOR THE FOLLOWING MODELS WHICH HAVE AN OPERATIONAL ICING EQUIPMENT PACKAGE, AND WHICH ARE CERTIFICATED FOR FLIGHT IN KNOWN ICING CONDITIONS:

T210N	T303	340A	F406	425
T210R	310R	402B	414	441
P210N	T310R	402C	414A	
P210R	335	404	421C	

NOTE

This supplement is applicable to the above models which have a factory-installed icing equipment package (refer to applicable Pilot's Operating Handbook and Airplane Equipment List), or have been modified by installation of Accessory Kit AK210-162, AK421-106, or Service Kit SK303-39.

Refer to Page 2 for specific model years, and airplane and kit serial effectivity.

SERIAL NO. ____________________

REGISTRATION NO. ____________________

This supplement satisfies the requirements of AD 98-05-14 or AD 98-04-28. It must be attached to the latest version of the Pilot's Operating Handbook for the airplanes listed on page 2.

APPROVED BY: Nicholas Anderson for
Michael McClary
Executive Engineer
Cessna Aircraft Company
Delegation Option Manufacturer CE-1

DATE OF APPROVAL: 12 MARCH 1998

APPROVED BY: Wendell W. Corneil
Wendell W. Corneil
Executive Engineer
Cessna Aircraft Company
Delegation Option Manufacturer CE-3

DATE OF APPROVAL: 12 MARCH 1998

Member of GAMA

SEVERE INFLIGHT ICING CONDITIONS

AIRPLANE MODELS AND SERIAL EFFECTIVITY

Model	Year	Serial Numbers	Kit Part No. (If Applicable)
T210N	Mid 1979 thru 1984	21063253 thru 21064897	AK210-162
T210R	1985 thru 1986	21064898 thru 21065009	AK210-162
P210N	Mid 1979 thru 1983	P21000225 thru P21000834	AK210-162
P210R	1985 thru 1986	P21000835 thru P21000874	AK210-162
T303	1982 thru 1984	T30300001 thru T30300315	SK303-39
310R/T310R	1977 thru 1981	310R0801 thru 310R2140	AK421-106
335	1980	335-0001 thru 335-0065	AK421-106
340A	1977 thru 1984	340A0201 thru 340A1817	AK421-106
402B	1976 thru 1978	402B1001 thru 402B1384	AK421-106
402C	1979 thru 1985	402C0001 thru 402C1020, 689	AK421-106
404	1977 thru 1981	404-0001 thru 404-0859	AK421-106
F406	N/A	F406-0001 and on	AK421-106
414	1976 thru 1977	414-0801 thru 414-0965	AK421-106
414A	1978 thru 1985	414A0001 thru 414A1212	AK421-106
421C	1976 thru 1985	421C0001 thru 421C1807	AK421-106
425	N/A	425-0001 thru 425-0236	AK421-106
441	N/A	441-0001 thru 441-0362, 698	AK421-106

NOTE

Some airplanes identified in the above effectivity list may be originally equipped with anti-ice and/or deice equipment that could make the airplane appear to be certified for flight in known icing conditions. These airplanes may not have all required equipment installed. Refer to the Pilot's Operating Handbook and Airplane Equipment List for flight in known icing equipment requirements, and what anti-ice/deice equipment is actually installed on the airplane.

SUPPLEMENT

SEVERE INFLIGHT ICING CONDITIONS

Use the Log of Effective Pages to determine the current status of this supplement.

Pages affected by the current revision are indicated by an asterisk (*) preceding the page number.

Supplement Status	Date
Original	12 March 1998

LOG OF EFFECTIVE PAGES

Page	Page Status	Revision Number
1 thru 8	Original	0

SUPPLEMENT

SEVERE INFLIGHT ICING CONDITIONS

SECTION 1

GENERAL

This supplement provides information for recognizing potential or existing severe icing conditions, and contains procedures for exiting a severe icing environment. It must be used in conjunction with flight in icing conditions information in the basic pilot's operating handbook.

Flight into known icing equipment packages for airplanes listed on page two of this supplement allow flight penetration of icing conditions as defined by FAR Part 25 envelopes for continuous maximum and intermittent maximum icing. These conditions do not include, nor were tests conducted in, all icing conditions that may be encountered (e.g., freezing rain, freezing drizzle, mixed conditions or conditions defined as severe). Flight in these conditions must be avoided. Icing conditions not defined in FAR Part 25 have the potential of producing hazardous ice accumulations, which (1) exceed the capabilities of the airplane's ice protection equipment, and/or (2) create unacceptable airplane performance. Flight into icing conditions which are outside the FAR defined certificated requirements is not specifically prohibited, however, pilots are advised to be prepared to divert the flight promptly if hazardous ice accumulations occur.

NOTE

> Whenever severe icing conditions are encountered, immediate action should be taken to leave these conditions before airplane performance is degraded to a point where a climb, which is normally the best action to take, may not be achievable due to the residual ice buildup.

SECTION 2
LIMITATIONS

SEVERE INFLIGHT ICING VISUAL CUES

WARNING

Severe icing may result from environmental conditions outside of those for which the airplane is certificated. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) may result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or may result in ice forming aft of the protected surfaces. This ice may not be shed using the ice protection systems, and may seriously degrade the performance and controllability of the airplane.

- During flight, severe icing conditions that exceed those for which the airplane is certificated shall be determined by the following visual cues. If one or more of these visual cues exists, immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the icing conditions.

    1. Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.
    2. Accumulation of ice on the upper surface of the wing (300 and 400 series airplanes), or lower surface of the wing (T210 and P210 airplanes), aft of the protected area.
    3. Accumulation of ice on the engine nacelles and propeller spinners, farther aft than normally observed (300 and 400 series airplanes).

- Since the autopilot, when installed and operating, may mask tactile cues that indicate adverse changes in handling characteristics, use of the autopilot is prohibited when any of the visual cues specified above exist, or when unusual lateral trim requirements or autopilot trim warnings are encountered while the airplane is in severe icing conditions.

- All wing icing inspection lights must be operative prior to flight into icing conditions at night.

NOTE

This supersedes any relief provided by the Master Minimum Equipment List (MMEL).

SECTION 3
EMERGENCY PROCEDURES

There is no change to the airplane emergency procedures.

SECTION 4
NORMAL PROCEDURES

THE FOLLOWING WEATHER CONDITIONS MAY BE CONDUCIVE TO SEVERE INFLIGHT ICING (As Specified by AD 98-05-14 or AD 98-04-28):

- Visible rain at temperatures below 0 degrees Celsius ambient air temperature.
- Droplets that splash or splatter on impact at temperatures below 0 degrees Celsius ambient air temperature.

PROCEDURES FOR EXITING THE SEVERE ICING ENVIRONMENT (As Specified by AD 98-05-14 or AD 98-04-28):

These procedures are applicable to all flight phases from takeoff to landing. Monitor the ambient air temperature. While severe icing may form at temperatures as cold as -18 degrees Celsius, increased vigilance is warranted at temperatures around freezing with visible moisture present. If the visual cues specified in Section 2 Limitations for identifying severe icing conditions are observed, accomplish the following:

- Immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.
- Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
- Do not engage the autopilot.
- If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.

(Continued on next page)

- If an unusual roll response or uncommanded roll control movement is observed, reduce the angle-of-attack.
- Do not extend flaps when holding in icing conditions. Operation with flaps extended can result in a reduced wing angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possibly aft of the protected area.
- If the flaps are extended, do not retract them until the airframe is clear of ice.
- Report these weather conditions to Air Traffic Control.

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Cessna

FAA APPROVED
Airplane Flight Manual Supplement

FOR

MODELS	SERIALS
T303	T30300001 thru T30300315
310	310R1501 thru 310R2140
335	335-0001 thru 335-0065
340	340A0601 thru 340A1817
401	401-0001 thru 401B0221
402	402-0001 thru 402C1020
404	404-0001 thru 404-0859
411	411-0001 thru 411A0300
414	414-0001 thru 414A1212
421	421-0001 thru 421C1807

Serial No. 414A 0641
Registration No. N78DG

This supplement must be attached to the FAA Approved Airplane Flight Manual or Pilot's Operating Handbook/FAA Approved Airplane Flight Manual when the Auxiliary Fuel Pump Switching System is installed in accordance with Cessna Multi-Engine Service Bulletin MEB88-3.

The information contained herein supplements or supersedes the information of the basic Airplane Flight Manual or Pilot's Operating Handbook/FAA Approved Airplane Flight Manual and all Checklists. For limitations, procedures, and performance information not contained in this supplement, consult the basic Airplane Flight Manual or Pilot's Operating Handbook/FAA Approved Airplane Flight Manual.

FAA APPROVED
D. D. McDonald Executive Engineer
Cessna Aircraft Co., Aircraft Div.
Delegation Option Manufacturer, CE-3

Date 2-10-89

Original Issue - 20 December 1988
Revision 1 - 10 February 1989

D1625-1-13-CPS-2000-10/93

SECTION 1
GENERAL

AUXILIARY FUEL PUMP SWITCHING SYSTEM

To improve the reliability of the auxiliary fuel pump systems in Cessna conventional twin-engine airplanes (except Model 310 airplanes prior to Model 310C which are not affected by this change), the automatic fuel pressure sensing switch and auxiliary fuel pump switch for each engine have been removed and replaced with new three-position, lever lock, toggle-type auxiliary fuel pump switches and circuitry. This modification provides direct pilot control of the output pressure of the two auxiliary fuel pumps. The switches are labeled AUX PUMP, L (left engine) and R (right engine) and switch positions are LOW, OFF, and HIGH. The LOW position operates the auxiliary pumps at low speed and can be used, when required, to provide supplementary fuel pressure for all normal operations. The switches are OFF in the middle position. The HIGH position is reserved for emergency operation, and operates the pumps at high speed. The HIGH position supplies sufficient fuel flow to sustain partial engine power in the event of an engine-driven fuel pump failure. The switches are locked out of the HIGH position and the switch toggle must be pulled out to clear a detent before it can be moved to the HIGH setting. The toggle need not be pulled to return the switch to OFF.

In Models 340A, 414, 421, 421A and 421B, additional fuel tank selector logic is added to activate the auxiliary fuel tank system in-line fuel pumps when the auxiliary fuel tanks are selected, thereby making the auxiliary tank in-line pump operation independent of the auxiliary fuel pump switches.

SWITCH OPERATION

Operation of the new switching system is simple and straightforward. The new LOW position of the auxiliary fuel pump switches should be used whenever an original manual/handbook or checklist procedure specifies either LOW (PRIME in early 310 or 320 airplanes) or ON. The LOW position is also used anytime there are indications of vapor, as evidenced by a "nervous" fuel flow needle. Auxiliary fuel pumps, if needed, are to be operated on LOW in all conditions except when an engine-driven fuel pump fails.

The new HIGH position supplies sufficient fuel flow to sustain partial engine power and should be used solely to sustain the operation of an engine in the event its engine-driven fuel pump fails. Failure of an engine-driven fuel pump will be evidenced by a sudden reduction in the fuel flow indication **immediately prior to a loss of power** while operating from a fuel tank containing adequate fuel. In an emergency where loss of an engine-driven fuel pump is involved, pull out on the applicable auxiliary fuel pump switch to clear the detent and select the HIGH position. Then adjust the throttle and mixture controls to obtain satisfactory operation. At high manifold pressure and RPM, auxiliary fuel pump **output may not be sufficient for normal engine operation.** In this case, reduce manifold pressure to a level compatible with the indicated fuel flow. At low powers, the mixture may have to be leaned as necessary for smooth engine operation. If HIGH auxiliary pump output does not restore adequate fuel flow, a fuel leak may exist and the auxiliary pump should be shut off, the engine secured and propeller feathered, and the flight terminated on the remaining engine.

On rare occasions, such as during engine starting in cold weather, the HIGH position (instead of LOW) may be needed for a few seconds to ensure a good ground start or restart in flight.

CAUTION

If the auxiliary fuel pump switches are placed in the HIGH position with the engine-driven fuel pump(s) operating normally, total loss of engine power may occur.

When performing training in single-engine operations, the auxiliary fuel pump of the engine to be shutdown should be turned OFF (if it was on LOW) prior to any simulated engine failure or prior to any intentional engine shutdown to preclude fuel accumulation in the engine intake system.

The following limitations and procedures apply only to the operational changes of the auxiliary fuel pump switches and not the entire procedure.

SECTION 2
LIMITATIONS

The following new placard is provided to identify that the airplane has been modified and show the proper switch positions for normal operation. It is located on the left cabin sidewall near the auxiliary fuel pump switches and must be installed when the airplane is modified in accordance with Cessna Multi-Engine Service Bulletin MEB88-3.

THE AUXILIARY FUEL PUMP
SYSTEMS IN THIS AIRPLANE
HAVE BEEN MODIFIED BY
SERVICE BULLETIN MEB88-3.

AUX PUMP LOW FOR TAKEOFF,
LANDING AND VAPOR CLEARING.
AUX PUMP HIGH FOR ENGINE
DRIVEN PUMP FAILURE
(VERY LOW OR NO FUEL PRESS).
SEE POH OR AFM SUPPLEMENT
OR SUPPLEMENTAL AFM.

2505059-6

The following additional placard is provided to overlay an existing placard (if installed) near the fuel selector.

TAKEOFF AND LAND WITH AUXILIARY FUEL PUMPS LOW. 2505059-4

SECTION 3
EMERGENCY PROCEDURES

ENGINE FAILURE DURING FLIGHT

BEFORE SECURING INOPERATIVE ENGINE

Fuel Flow - CHECK. If deficient, position auxiliary fuel pump to HIGH.

IF ENGINE DOES NOT START

Operative Engine - Auxiliary Fuel Pump LOW.

ENGINE INOPERATIVE LANDING

Operative Engine - Auxiliary Fuel Pump LOW.

ENGINE-DRIVEN FUEL PUMP FAILURE

Auxiliary Fuel Pump - HIGH.

AIRSTART

Auxiliary Fuel Pump - CHECK OFF. If on LOW or HIGH, purge engine.

SECTION 4
NORMAL PROCEDURES

BEFORE TAKEOFF

Auxiliary Fuel Pumps - LOW.

AFTER TAKEOFF, CLIMB OR LOW ALTITUDE CRUISE

Auxiliary Fuel Pumps - OFF (LOW if necessary to suppress vapor).

CRUISE (Above 12,000 Feet)

Auxiliary Fuel Pumps - LOW for 5 minutes after leveling off to suppress vapor tendencies.

DESCENT

Auxiliary Fuel Pumps - LOW.

BEFORE LANDING

Auxiliary Fuel Pumps - LOW.

AFTER LANDING

Auxiliary Fuel Pumps - OFF (LOW if necessary to suppress vapor).

PRACTICE SINGLE ENGINE PROCEDURES

Auxiliary Fuel Pumps - OFF.

SWITCHING FUEL TANKS

Auxiliary Fuel Pumps - LOW.

SECTION 5
PERFORMANCE

There is no change in airplane performance with the auxiliary fuel pump switching system modification.

Copy N78DG

For A/C

AIRCRAFT CORPORATION

F.A.A. APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR

CESSNA MODEL 414A CHANCELLOR

REGISTRATION NUMBER N78DG

SERIAL NUMBER 414A0641

This Supplement must be attached to the F.A.A. approved Airplane Flight Manual dated 1 November 1977 when RAM Winglets are installed in accordance with STC SA4943SW. The information contained herein supplements the information of the basic Airplane Flight Manual. For Limitations, Procedures, and Performance information not contained in this supplement, consult the basic Airplane Flight Manual.

I. GENERAL

A. ENGINES

Number Of Engines:	2
Manufacturer:	Teledyne-Continental Motors
Engine Model Number:	TSIO-520-NB Modified by STC SE4327SW.
Horsepower:	325 Rated Horsepower at 2700 Propeller RPM and 40.0 inches Hg. manifold pressure to the critical altitude of 13,000 feet.
	Or for engines equipped with RAM economy camshaft P/N 1058-3 installed:
	325 Rated Horsepower at 2700 Propeller RPM and 41.0 inches Hg. manifold pressure to the critical altitude of 13,000 feet.

B. PROPELLERS

Number Of Propellers:	2
Manufacturer:	Hartzell Propeller Inc.
Propeller Part Number:	PHC-C3YF-2UF/FC7663DB-2Q or FC7663D-2Q
Number Of Blades:	3
Propeller Diameter:	6'4"
Blade Range:	(at-30 inch station) a. Low Pitch 14.0 degrees b. Feather 84 degrees

Date: SEP 22 1986

AIRCRAFT CORPORATION

C. MAXIMUM CERTIFICATED WEIGHTS

Maximum Ramp Weight:	7087 pounds
Maximum Takeoff Weight:	7087 pounds
Maximum Landing Weight:	6750 pounds
Maximum Zero Fuel Weight:	6200 pounds

D. SPECIFIC LOADINGS

Wing Loading:	31.39 pounds per square foot
Power Loading:	10.90 pounds per horsepower

II. LIMITATIONS

A. AIRPSEED LIMITATIONS TABLE

SPEED	KIAS	KCAS	REMARKS
Maneuvering Speed VA (Knots)	151	146	Do not make abrupt control movements above this speed.
Maximum Flap Extended Speed VFE (Knots) 15 degrees 45 degrees	171 140	175 145	Do not exceed this speed with the given flap setting.
Maximum Gear Operating Speed VLO (Knots)	178	175	Do not extend or retract landing gear above this speed.
Maximum Gear Extended Speed VLE (Knots)	178	175	Do not exceed this speed with landing gear extended.
Air Minimum Control Speed VMCA (Knots)	80	79	This is the minimum flight speed at which the airplane is controllable with one engine inoperative and with a 5 degree bank towards the operative engine.
One Engine Inoperative Best Rate-Of-Climb VY (Knots)	112	108	This speed delivers the greatest gain in altitude in the shortest possible time with one engine inoperative at sea level, standard day conditions and 7087 lbs. weight.
Never Exceed Speed VNE (Knots)	230	232	Do not exceed this speed in any operation.
Maximum Structural Cruising Speed VNO (Knots)	201	200	Do not exceed this speed except in smooth air and then only with caution.

RAM AIRCRAFT CORPORATION

B. AIRSPEED INDICATOR TABLE

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
Red Radial	80	Air minimum control speed.
White Arc	77 to 140	Operating speed range with 45 degree wing flaps. Lower limit is maximum weight stalling speed in landing configuration. Upper limit is maximum speed permissible with wing flaps extended 45 degrees.
Green Arc	79 to 201	Normal operating range. Lower limit is maximum weight stalling speed with flaps and landing gear retracted. Upper limit is maximum structural cruising speed.
Blue Radial	112	One engine inoperative best rate-of-climb speed at sea level standard day conditions and 7087 lbs. weight.
Yellow Arc	201 to 230	Caution range. Operations must be conducted with caution and only in smooth air.
Red Radial	230	Maximum speed for all operations.

C. ENGINE LIMITATIONS

Number Of Engines: 2
Engine Manufacturer: Teledyne-Continental Motors
Engine Model Number: TSIO-520-NB Modified by STC SE4327SW

Engine Operating Limits For Takeoff And Continuous Operation
Maximum Power For All Operations.

Maximum Continuous Power:
325 HP - 2700 RPM - 40.0 In. Hg. - S.L.
325 HP - 2700 RPM - 40.0 In. Hg. - 13,000 Ft.
310 HP - 2700 RPM - 38.0 In. Hg. - 20,000 Ft.
200 HP - 2700 RPM - 25.0 In. Hg. - 30,000 Ft.

Or with optional economy camshaft p/n 1058-3 installed:

Maximum Continuous Power:
325 HP - 2700 RPM - 41.0 In. Hg. - S.L.
325 HP - 2700 RPM - 41.0 In. Hg. - 13,000 Ft.
310 HP - 2700 RPM - 39.0 In. Hg. - 20,000 Ft.
200 HP - 2700 RPM - 25.0 In. Hg. - 30,000 Ft.

RAM AIRCRAFT CORPORATION

D. PROPELLERS

1.	Number Of Propellers:	2
2.	Manufacturer:	Hartzell Propeller Inc.
3.	Part Number:	PHC-C3YF-2UF/FC7663DB-2Q or FC7663D-2Q
4.	Number Of Blades:	3
5.	Diameter:	6'4"
6.	Blade Range:	(at 30-inch station)
		a. Low Pitch 14.0 + 0.5 degrees
		b. Feather 84 degrees
7.	Operating Limits:	2700 RPM maximum speed

E. ENGINE INSTRUMENT MARKINGS

1. Tachometer:
   a. Normal operating 2100 to 2700 RPM (Green Arc)
   b. Maximum 2700 RPM (Red Radial)

2. Manifold Pressure:
   a. Normal operating 17.0 to 35.0 inches Hg. manifold pressure (Green Arc)
   b. Maximum 40.0 inches Hg. manifold pressure (Red Radial) (Or for engines equipped with RAM economy camshaft P/N 1058-3)
   c. Maximum 41.0 inches Hg. manifold pressure (Red Radial)

3. Oil Temperature:
   a. Lower operating limits 75 degrees F (Red Radial)
   b. Conditional operating 75 degrees F to 140 degrees F (Narrow Green Arc)
   c. Normal operating 140 degrees F to 190 degrees F (Wide Green Arc)
   d. Conditional operating 190 degrees F to 240 degrees F (Narrow Green Arc)
   e. Maximum 240 degrees F (Red Radial)

4. Oil Pressure:
   a. Minimum operating 10 PSI (Red Radial)
   b. Normal operating 30 to 60 PSI (Green Arc)
   c. Maximum 100 PSI (Red Radial)

5. Cylinder Head Temperature:
   a. Conditional operating 200 degrees F to 320 degrees F (Narrow Green Arc)
   b. Normal operating 320 degrees F to 400 degrees F (Wide Green Arc)
   c. Conditional operating 400 degrees F to 460 degrees F (Narrow Green Arc)
   d. Maximum 460 degrees F (Red Radial)

RAM AIRCRAFT CORPORATION

F. WEIGHT LIMITS

Maximum Ramp Weight:	7087 pounds
Maximum Takeoff Weight:	7087 pounds
Maximum Landing Weight:	6750 pounds
Maximum Zero Fuel Weight:	6200 pounds

G. CENTER OF GRAVITY LIMITS

Aft Limits: 159.04 inches aft of reference datum @ 7087 lbs. and 160.04 inches aft of reference datum @ 6750 lbs. or less. There is a straight line variation between 7087 and 6750 lbs.

Forward Limits: 152.2 inches aft of reference datum @ 7087 lbs. and 147.82 inches aft of reference datum @ 5800 lbs. or less with straight line variations between these points.

H. MANEUVER LIMITS

This is a normal category airplane. Aerobatic maneuvers, including spins, are prohibited.

I. FLIGHT LOAD FACTOR LIMITS

The design load factors are 150% of the following and in all cases the structure exceeds design loads.

At design Takeoff Weight of 7087 pounds:
a. Landing Gear Up, Wing Flaps 0 degrees + 3.53g to -1.44g
b. Landing Gear Down, Wing Flaps 45 degrees + 2.0g to 0.0g

J. REQUIRED PLACARDS

1. On Instrument Panel In Plain View:

TURBO LIMITATIONS

ALT. x1000	MAX. M.P.
13	40.0
20	38.0
22	35.2
24	32.3
26	29.8
28	27.4
30	25.0

Or for engines equipped with the RAM economy camshaft P/N 1058-3.

TURBO LIMITATIONS

ALT. x1000	MAX. M.P.
13	41.0
20	39.0
22	35.2
24	32.3
26	29.8
28	27.4
30	25.0

J. REQUIRED PLACARDS (continued)

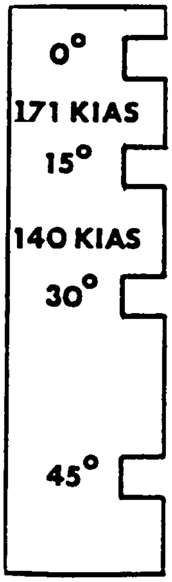
2. Near Operational Limits placard or on pilot's instrument panel in plain view:

WARNING: With Visible Ice Accumulation on the Aircraft DO NOT EXCEED 185 KIAS

3. On Operations Limitations placard these airspeeds replace the previously listed airspeeds.

Air Minimum Control Speed	80 KIAS
Maximum Gear Operating Speed	178 KIAS
Maximum Gear Extended Speed	178 KIAS
Maximum Flap Extended Speed:15 Degree Flap	171 KIAS
Maximum Flap Extended Speed:45 Degree Flap	140 KIAS
Maximum Maneuvering Speed	151 KIAS

4. On the Flap Handle Console these airspeeds replace the previously listed airspeeds:



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5. On Trim Wheel Console this placard replace the existing Cessna placar

Date SEP 22 1986

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K. COMPATIBILITY

This modification has been found compatible with the following optional Cessna equipment as listed in Section 9 of the Basic Airplane Flight Manual.

Cessna Supplement	Equipment
1	Air Conditioning System
2	Angle Of Attack System
3	400 Area Navigation System (Type RN-478A)
4	800 Area Navigation System (Type RN-378A)
6	800 Audio Control Panel
7	1000 Audio Control Panel
9	400 Automatic Direction Finder (Type R-446A)
10	1000 Automatic Direction Finder (Type 1046B)
11	400B Nav-O-Matic Autopilot System (Type AF-550A)
12	Davtron 811B Digital Clock
13	1000 Communication System (Type RT-1038A0)
14	400 DME (Type RTA-476A)
15	800 DME (Type RTA-876A)
16	Economy Mixture Indicator
17	Electric Elevator Trim
18	400 Encoding Altimeter (Type EA-401A)
19	800 Altitude Encoding/Alerting Pre-Select (Type EA-801A)
20	Fire Detection and Extinguishing System
21	Fuel Flow Indicating System
22	400 and 1000 Glide Slope (Type R-443B and Type R-1043A)
23	ASB-130 HF Transceiver
25	Alcohol Windshield De-Ice System
26	De-Ice Boot System
27	Electrical Windshield
28	Flight In Icing Conditions
29	Propeller De-Ice System
30	400B Integrated Flight Control System (Type IF-550A)
31	800B Integrated Flight Control System (Type IF-500A)
32	Locator Beacon (DMELT-6)
33	400 Mark Beacon (Type R-402A)
34	1000 Navigation System (Type 1048A)
36	400 Nav/Com System (Type RT-485A)
38	RDR-150 and RDR-160 Weather Radar
39	AA-100 and AA-215 Radio Altimeter
40	400 Radio Magnetic Indicator (Type IN-403A)
41	1000 Radio Magnetic Indicator (Type IN-1004A)
42	Flitefone III Radio Telephone
43	Manually Adjusted Seat
44	400 Transponder (Type 459A)
45	800 Transponder (Type 359A)
46	Yaw Damper

III. EMERGENCY PROCEDURES

A. ENGINE INOPERATIVE PROCEDURES

Maximum continuous power setting for rate-of-climb - single engine: 325 HP - 2700 RPM - 41.0 in. Hg. - S.L. to 13,000 feet. Above 13,000 feet, see Turbo Limitations.

IV. NORMAL PROCEDURES

A. STARTING HOT ENGINES

1. Propellers - Clear
2. Throttles - Full Open
3. Mixtures - Idle - Cut-Off
4. Auxiliary Fuel Pumps - On (high 30-90 seconds) - OFF
5. Throttles - Set
6. Mixtures - Full Rich
7. Prime - One (1) Second
8. Magneto - Switches - On
9. Engines - Start
10. Auxiliary Fuel Pumps - Low
11. Engine Instruments - Check

B. EXHAUST GAS TEMPERATURE GAGE OPERATION: Refer to System Manufacturer's Instructions for proper operation.

C. DIGITAL FUEL FLOW METER OPERATIONS: Refer to Systems Manufacturer's Instructions for proper operation.

V. PERFORMANCE

The following charts replace the corresponding performance information in the Basic Airplane Flight Manual. The actual performance information is contained on the following pages.

Airspeed Calibration - Normal Static Source
Stall Speed
Normal Takeoff Distance
Accelerate-Stop Distance
Accelerate-Go Distance
Rate-Of-Climb - Maximum Climb
Rate-Of-Climb - One Engine Inoperative
Rate-Of-Climb - Balked Landing Climb

AIRSPEED CALIBRATION
NORMAL STATIC SOURCE

NOTE:

1. INDICATED AIRSPEED ASSUMES ZERO INSTRUMENT ERROR.
2. THE FOLLOWING CALIBRATIONS ARE NOT VALID IN THE PRESTALL BUFFET.
3. THE FOLLOWING CALIBRATIONS ARE VALID FOR THE PILOT'S AND COPILOT'S AIRSPEED INDICTORS WHEN THE STANDARD OR OPTIONAL DUAL STATIC SYSTEM IS INSTALLED.

GEAR UP FLAPS 0°		GEAR DOWN FLAPS 15°		GEAR DOWN FLAPS 45°	
KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
70	70	70	64	70	66
80	79	80	75	80	77
90	88	90	85	90	88
--	--	--	--	94*	93*
100	97	100	97	100	100
110	106	110	108	110	110
120	115	120	118	120	122
140	135	130	130	130	133
160	155	140	140	140	145
180	177	150	151	145	150
200	199	160	162	--	--
220	221	170	174	--	--
230	232	179	183	--	--
237	239	--	--	--	--

*RECOMMENDED MINIMUM ALL ENGINES APPROACH SPEED AT 6750 POUNDS WITH 45° WING FLAPS.

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STALL SPEEDS

CONDITIONS:
THROTTLES - IDLE

NOTE:
MAX. ALTITUDE LOST DURING A STALL IS 300 FEET.

WEIGHT POUNDS	CONFIGURATION		ANGLE OF BANK							
			0°		20°		40°		60°	
	FLAPS	GEAR	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
7087	0°	UP	79	78	81	80	91	89	114	110
	15°	DOWN	82	77	84	79	93	88	112	109
	45°	DOWN	77	74	79	76	87	85	105	105
6750	0°	UP	78	77	80	79	90	88	112	109
	15°	DOWN	80	75	82	77	90	86	109	106
	45°	DOWN	75	72	77	74	84	82	102	102
6200	0°	UP	73	73	76	75	84	83	107	103
	15°	DOWN	78	72	79	74	87	82	105	102
	45°	DOWN	73	69	75	71	82	79	98	98
5700	0°	UP	70	70	72	72	81	80	102	99
	15°	DOWN	74	69	77	71	84	79	101	98
	45°	DOWN	70	66	73	68	78	75	94	93
5200	0°	UP	67	67	69	69	78	77	98	95
	15°	DOWN	72	66	73	68	80	75	97	93
	45°	DOWN	67	63	69	65	76	72	91	89

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CESSNA 414A
AS MODI[illegible] Y RAM
STC SA4[illegible]SW

NORMAL TAKEOFF DISTANCE

CONDITIONS:
1. 2700 RPM AND 41.0 INCHES Hg. MANIFOLD PRESSURE BEFORE BRAKE RELEASE.
2. MIXTURES - 32 GPH MIN. FUEL FLOW.
3. WING FLAPS - UP.
4. COWL FLAPS - OPEN.
5. LEVEL, HARD SURFACE, DRY RUNWAY.

NOTE:
1. IF FULL POWER IS APPLIED WITHOUT BRAKES SET, DISTANCES APPLY FORM POINT WHERE FULL POWER IS APPLIED.
2. DECREASE DISTANCE 7% FOR EACH 10 KNOTS HEADWIND.
3. INCREASE DISTANCE 5% FOR EACH 2 KNOTS TAILWIND.

WEIGHT POUNDS	TAKEOFF TO 50-FOOT OBSTACLE SPEED-KIAS	PRESSURE ALTITUDE-FEET	-20°C (-4°F)		-10°C (14°F)		0°C (32°F)		10°C (50°F)		20°C (68°F)		30°C (86°F)		40°C (104°F)	
			GROUND ROLL FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL FEET	TOTAL DISTANCE TO CLEAR 50 FEET
7087	101	SEA LEVEL	1618	1973	1741	2123	1869	2279	2001	2440	2138	2607	2278	2778	2423	2955
		1000	1771	2161	1906	2326	2046	2497	2191	2673	2340	2856	2494	3043	2652	3237
		2000	1924	2349	2070	2528	2223	2714	2380	2905	2542	3104	2709	3308	2881	3578
		3000	2108	2576	2299	2772	2469	2976	2608	3186	2785	3403	2969	3627	3157	3858
		4000	2292	2802	2467	3016	2648	3237	2835	3466	3028	3702	3228	3946	3433	4197
		5000	2514	2658	2706	3310	2905	3557	3110	3806	3322	4064	3541	4331	3766	4606
		6000	2736	3349	2945	3604	3161	3869	3384	4143	3615	4425	3853	4716	4098	5016
		7000	3004	3680	3234	3961	3471	4252	3716	4553	3970	4863	4231	5183	4500	5572
		8000	3272	4011	3522	4317	3781	4634	4048	4962	4324	5300	4609	5649	4902	6008
		9000	3598	4413	3872	4750	4157	5098	4451	5459	4754	5831	5067	6215	5389	6610
		10,000	3923	4814	4222	5182	4532	5562	4853	5955	5184	6361	5525	6780	5876	7211
6750	98	SEA LEVEL	1425	1738	1534	1871	1647	2008	1763	2150	1883	2297	2007	2448	2135	2603
		1000	1560	1904	1679	2049	1803	2200	1930	2355	2061	2516	2197	2681	2337	2852
		2000	1695	2069	1824	2227	1958	2391	2097	2560	2239	2734	2387	2914	2539	3100
		3000	1857	2269	1999	2442	2146	2622	2298	2807	2459	2998	2616	3195	2782	3399
		4000	2019	2468	2173	2657	2333	2852	2498	3053	2668	3262	2844	3476	3024	3697
		5000	2215	2709	2384	2916	2559	3131	2740	3352	2927	3580	3119	3816	3317	4058
		6000	2410	2950	2594	3175	2785	3409	2982	3650	3186	3898	3394	4155	3610	4419
		7000	2647	3242	2849	3489	3058	3746	3275	4011	3498	3698	3727	4565	3965	4856
		8000	2883	3533	3103	3803	3331	4083	3567	4371	3810	4669	4060	4977	4319	5293
		9000	3170	3887	3412	4184	3662	4492	3921	4809	4189	5137	4464	5475	4748	5823
		10,000	3456	4241	3720	4565	3993	4900	4275	5247	4567	5604	4867	5973	5177	6353
6200	94	SEA LEVEL	1120	1427	1206	1536	1295	1649	1386	1765	1481	1886	1578	2010	1678	2138
		1000	1226	1563	1320	1683	1417	1806	1517	1934	1621	2066	1727	2202	1877	2342
		2000	1332	1699	1434	1829	1539	1963	1648	2102	1761	2245	1876	2393	1996	2546
		3000	1460	1863	1571	2006	1687	2153	1806	2305	1929	2462	2056	2624	2187	2791
		4000	1587	2027	1708	2182	1834	2343	1964	2508	2097	2679	2235	2855	2378	3037
		5000	1741	2226	1874	2396	2012	2177	2154	2754	2301	2941	2452	3135	2608	3334
		6000	1895	2424	2039	2609	2189	2801	2344	2999	2504	3203	2669	3414	2838	3631
		7000	2081	2664	2240	2868	2404	3078	2574	3296	2750	3520	2931	3752	3117	3991
		8000	2266	2904	2440	3126	2619	3355	2804	3592	2995	3837	3192	4090	3395	4350
		9000	2492	3195	2682	3440	2879	3692	3083	3953	3293	4222	3509	4500	3733	4786
		10,000	2717	3486	2924	3753	3139	4028	3361	4313	3590	4607	3826	4910	4070	5222
5700	90	SEA LEVEL	818	1042	881	1122	946	1204	1012	1289	1081	1377	1153	1468	1226	1561
		1000	896	1142	964	1229	1035	1319	1108	1412	1184	1509	1262	1608	1342	1710
		2000	973	1241	1047	1334	1124	1434	1204	1535	1286	1640	1371	1748	1458	1859
		3000	1066	1361	1148	1465	1232	1573	1319	1684	1409	1799	1502	1917	1598	2039
		4000	1159	1481	1248	1594	1340	1711	1434	1832	1532	1957	1633	2086	1737	2218
		5000	1272	1626	1369	1750	1470	1879	1573	2011	1681	2149	1719	2290	1905	2435
		6000	1384	1771	1490	1906	1599	2046	1712	2190	1829	2340	1949	2494	2673	2652
		7000	1520	1946	1636	2095	1756	2249	1880	2407	2009	2572	2141	2741	2277	2915
		8000	1655	2121	1782	2283	1913	2451	2048	2624	2188	2803	2332	2987	2480	3177
		9000	1820	2334	1959	2512	2103	2697	2252	2887	2405	3084	2564	3287	2727	3496
		10,000	1984	2547	2136	2741	2293	2942	2465	3150	2622	3365	2795	3586	2973	3815

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ACCELERATE STOP DISTANCE

CONDITIONS :
1. 2700 RPM AND 41.0 INCHES Hg. MANIFOLD PRESSURE BEFORE BRAKE RELEASE.
2. MIXTURES - 32.5GPH MIN. FUEL FLOW.
3. WING FLAPS - UP
4. COWL FLAPS - OPEN.
5. LEVEL, HARD SURFACE, DRY RUNWAY.
6. ENGINE FAILURE AT ENGINE FAILURE SPEED.
7. IDLE POWER AND MAXIMUM EFFECTIVE BRAKING AFTER ENGINE FAILURE.

NOTE:
1. IF FULL POWER IS APPLIED WITHOUT BRAKES SET, DISTANCES APPLY FROM POINT WHERE FULL POWER IS APPLIED.
2. DECREASE DISTANCE 3% FOR EACH 4 KNOTS HEADWIND.
3. INCREASE DISTANCE 5% FOR EACH 2 KNOTS TAILWIND.

WEIGHT POUNDS	ENGINE FAILURE SPEED-KIAS	PRESSURE ALTITUDE - FEET	TOTAL DISTANCE - FEET						
			-20°C -4°F	-10°C +14°F	0°C +32°F	-10°C +50°F	+20°C +68°F	+30°C +86°F	+40°C +104°F
7087	101	SEA LEVEL	3539	3770	4011	4326	4610	4904	5229
		1000	3707	3948	4263	4536	4830	5145	5502
		2000	3885	4190	4463	4757	5072	5408	5775
		3000	4074	4389	4683	4988	5324	5681	6080
		4000	4326	4610	4914	5240	5597	5975	6395
		5000	4536	4841	5166	5513	5891	6290	6741
		6000	4767	5082	5429	5796	6195	6636	7109
		7000	5010	5345	5712	6101	6531	6993	7497
		8000	5280	5630	6017	6437	6880	7382	7928
		9000	5545	5922	6342	6783	7266	7791	8379
		10,000	5840	6250	6689	7161	7676	8243	8873
6750	98	SEA LEVEL	3370	3590	3820	4120	4390	4670	4980
		1000	3530	3760	4060	4320	4600	4900	5240
		2000	3700	3990	4250	4530	4830	5150	5500
		3000	3880	4180	4460	4750	5070	5410	5790
		4000	4120	4390	4680	4990	5330	5690	6090
		5000	4320	4610	4920	5250	5610	5990	6420
		6000	4540	4840	5170	5520	5900	6320	6770
		7000	4770	5090	5440	5810	6220	6660	7140
		8000	5010	5360	5730	6130	6560	7030	7550
		9000	5280	5640	6040	6460	6920	7420	7980
		10,000	5560	5950	6370	6820	7310	7850	8450
6200	94	SEA LEVEL	2780	2960	3150	3340	3560	3780	4090
		1000	2910	3100	3300	3510	3730	4030	4290
		2000	3050	3250	3460	3680	3970	4230	4510
		3000	3200	3410	3630	3910	4170	4440	4740
		4000	3360	3580	3850	4110	4380	4670	4990
		5000	3530	3800	4050	4310	4600	4910	5250
		6000	3740	3990	4250	4540	4840	5170	5530
		7000	3930	4190	4470	4770	5100	5450	5840
		8000	4130	4410	4710	5030	5370	5750	6160
		9000	4350	4640	4980	5300	5670	6070	6510
		10,000	4580	4890	5230	5590	5990	6410	6880
5700	90	SEA LEVEL	2300	2450	2600	2760	2930	3120	3310
		1000	2410	2560	2720	2890	3080	3270	3480
		2000	2530	2690	2860	3040	3230	3430	3710
		3000	2650	2820	3000	3190	3390	3650	3890
		4000	2780	2960	3150	3350	3610	3840	4100
		5000	2920	3110	3310	3560	3790	4040	4310
		6000	3060	3260	3510	3740	3980	4250	4540
		7000	3220	3460	3690	3930	4190	4480	4780
		8000	3410	3640	3880	4140	4420	4720	5050
		9000	3590	3830	4090	4360	4660	4980	5330
		10,000	3780	4030	4310	4600	4920	5260	5630

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ACCELERATE GO DISTANCE

CONDITIONS:
1. 2700 RPM AND 41.0 INCHES HG. MANIFOLD PRESSURE BEFORE BRAKE RELEASE.
2. MIXTURE — 32.5 GPH MINIMUM FUEL FLOW.
3. WING FLAPS — UP.
4. COWL FLAPS — OPEN
5. LEVEL, HARD SURFACE, DRY RUNWAY.
6. ENGINE FAILURE AT ENGINE FAILURE SPEED.
7. LANDING GEAR UP ON TRANSIT AND PROPELLER FEATHERED DURING CLIMB.
8. MAINTAIN ENGINE FAILURE SPEED UNTIL CLEAR OF OBSTACLE.

NOTE:
1. IF FULL POWER IS APPLIED WITHOUT BRAKES SET, DISTANCES APPLY FROM POINT WHERE FULL POWER IS APPLIED.
2. DECREASE DISTANCE 6% FOR EACH 10 KNOTS HEADWIND.
3. INCREASE DISTANCE 2% FOR EACH KNOT OF TAILWIND.
4. DISTANCE IN BOXES REPRESENT RATES OF CLIMB LESS THAN 50 FT/MIN.

WEIGHT — POUNDS	ENGINE FAILURE — SPEED — KIAS	PRESSURE ALTITUDE —	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE — FEET						
			−20°C −4°F	−10°C +14°F	0°C +32°F	+10°C +50°F	+20°C +68°F	+30°C +86°F	+40°C +104°F
7087	101	SEA LEVEL	2720	3014	3360	3780	4368	5072	6090
		1000	2867	3182	3560	4074	4652	5450	6647
		2000	3024	3371	3822	4326	4977	5891	7319
		3000	3203	3612	4053	4610	5345	6395	8159
		4000	3434	3833	4316	4925	5754	6993	9219
		5000	3633	4064	4599	5282	6227	7707	10,668
		6000	3843	4316	4904	5681	6773	8600	12,779
		7000	4085	4599	5250	6132	7424	9744	16,275
		8000	4347	4914	5649	6647	8211	11,309	----
		9000	4631	5261	6090	7256	9188	13,640	----
		10,000	4946	5650	6594	7980	10,469	17,619	----
6750	98	SEA LEVEL	2590	2870	3200	3600	4160	4830	5800
		1000	2730	3030	3390	3880	4430	5190	6330
		2000	2880	3210	3640	4120	4740	5610	6970
		3000	3050	3440	3860	4390	5090	6090	7770
		4000	3270	3650	4110	4690	5480	6660	8780
		5000	3460	3870	4380	5030	5930	7340	10,160
		6000	3660	4110	4670	5410	6450	8190	12,170
		7000	3890	4380	5000	5840	7070	9280	15,500
		8000	4140	4680	5380	6330	7820	10,770	----
		9000	4410	5010	5800	6910	8750	12,990	----
		10,000	4710	5380	6280	7600	9970	16,780	----
6200	94	SEA LEVEL	2070	2270	2500	2770	3080	3470	4010
		1000	2180	2390	2640	2930	3270	3740	4280
		2000	2290	2520	2790	3090	3510	3970	4570
		3000	2420	2660	2940	3320	3730	4240	4910
		4000	2550	2810	3160	3520	3960	4520	5290
		5000	2690	3010	3340	3740	4220	4850	5720
		6000	2880	3190	3540	3970	4510	5210	6220
		7000	3040	3370	3760	4230	4830	5260	6810
		8000	3220	3580	4000	4520	5180	6100	7520
		9000	3420	3810	4270	4840	5590	6650	8410
		10,000	3630	4060	4560	5200	6050	7300	9560
5700	90	SEA LEVEL	1690	1840	2010	2200	2430	2690	2990
		1000	1770	1930	2110	2320	2560	2840	3170
		2000	1860	2030	2230	2450	2700	3000	3420
		3000	1960	2140	2350	2580	2860	3230	3630
		4000	2060	2260	2480	2730	3070	3420	3860
		5000	2170	2380	2620	2930	3250	3630	4110
		6000	2290	2510	2800	3100	3440	3870	4400
		7000	2420	2690	2960	3280	3660	4120	4710
		8000	2580	2840	3140	3480	3900	4400	5060
		9000	2730	3010	3330	3710	4160	4720	5460
		10,000	2900	3200	3540	3950	4440	5070	5910

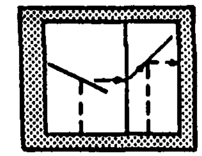
FAA APPROVED
DATE:

ALTITUDE — FEET	CLIMB SPEED — KIAS
SL	112
20,000	111
30,000	108

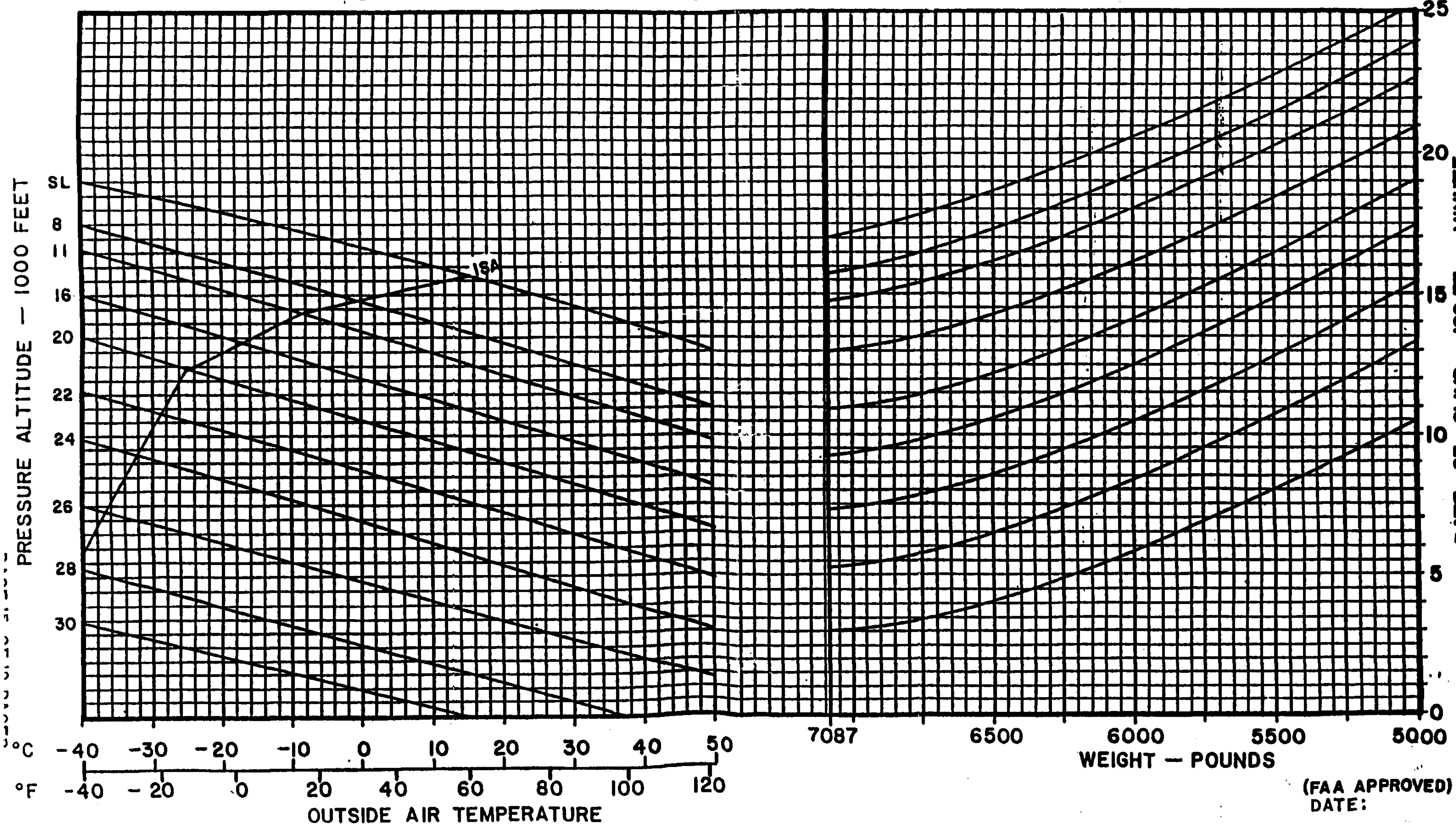
CONDITIONS:

1. 2700 RPM AND 41.0 INCHES Hg.*
2. MIXTURE — 32.5 GPH MINIMUM FUEL FLOW.
3. LANDING GEAR — UP.
4. WING FLAPS — UP.
5. COWL FLAPS — OPEN.

* ABOVE 13,000 FT. USE PLACARDED MANIFOLD PRESSURE



RATE - OF - CLIMB - MAXIMUM CLIMB



(FAA APPROVED)
DATE:

CONDITIONS:

1. 2700 RPM AND 41.0 INCHES Hg.
2. MIXTURE – 32.5 GPH. MINIMUM FUEL FLOW.
3. LANDING GEAR – UP
4. WING FLAPS – UP
5. INOPERATIVE PROPELLER – FEATHERED
6. WINGS BANKED 5° TOWARDS OPERATIVE ENGINE WITH APPOXIMATELY 1/2 BALL SLIP INDICATED ON THE TURN AND BANK INDICATOR.

* ABOVE 13,000 FEET, USE PLACARD MANIFOLD PRESSURE AND CLIMB FUEL FLOW.

NOTE:

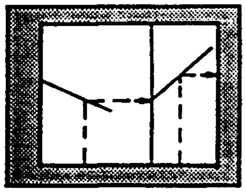
APPROXIMATE EFFECT OF CONFIGURATION ON SINGLE – ENGINE RATE – OF – CLIMB

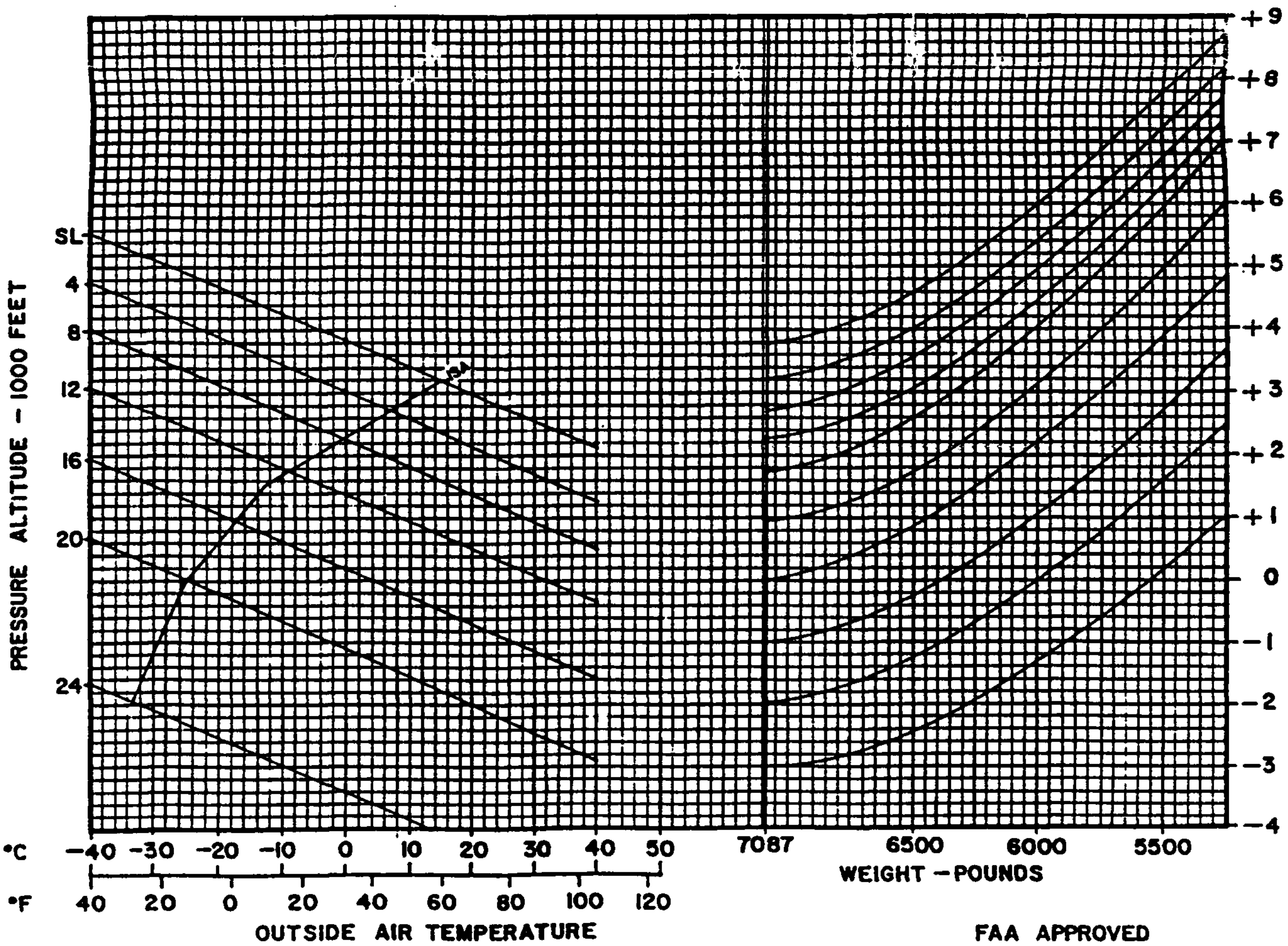
SUBTRACT VALUES LISTED BELOW FROM VALUE OBTAINED IN THE GRAPH. EFFECTS FOR A COMBINATION OF GEAR, FLAP OR WINDMILLING PROPELLER MAY BE OBTAINED BY ADDING THE EFFECTS FOR EACH.

INOPERATIVE ENGINE WINDMILLING	400 Ft/Min.
GEAR DOWN	350 Ft/Min.
FLAPS DOWN 15°	200 Ft/Min.
FLAPS DOWN 45°	800 Ft/Min.

RATE – OF – CLIMB – ONE ENGINE INOPERATIVE

WEIGHT POUNDS	CLIMB SPEED – KIAS		
	SEA LEVEL	10,000	20,000
7087	112	109	107
6250	105	103	101
5750	102	101	100

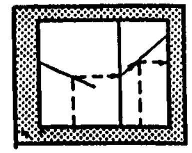




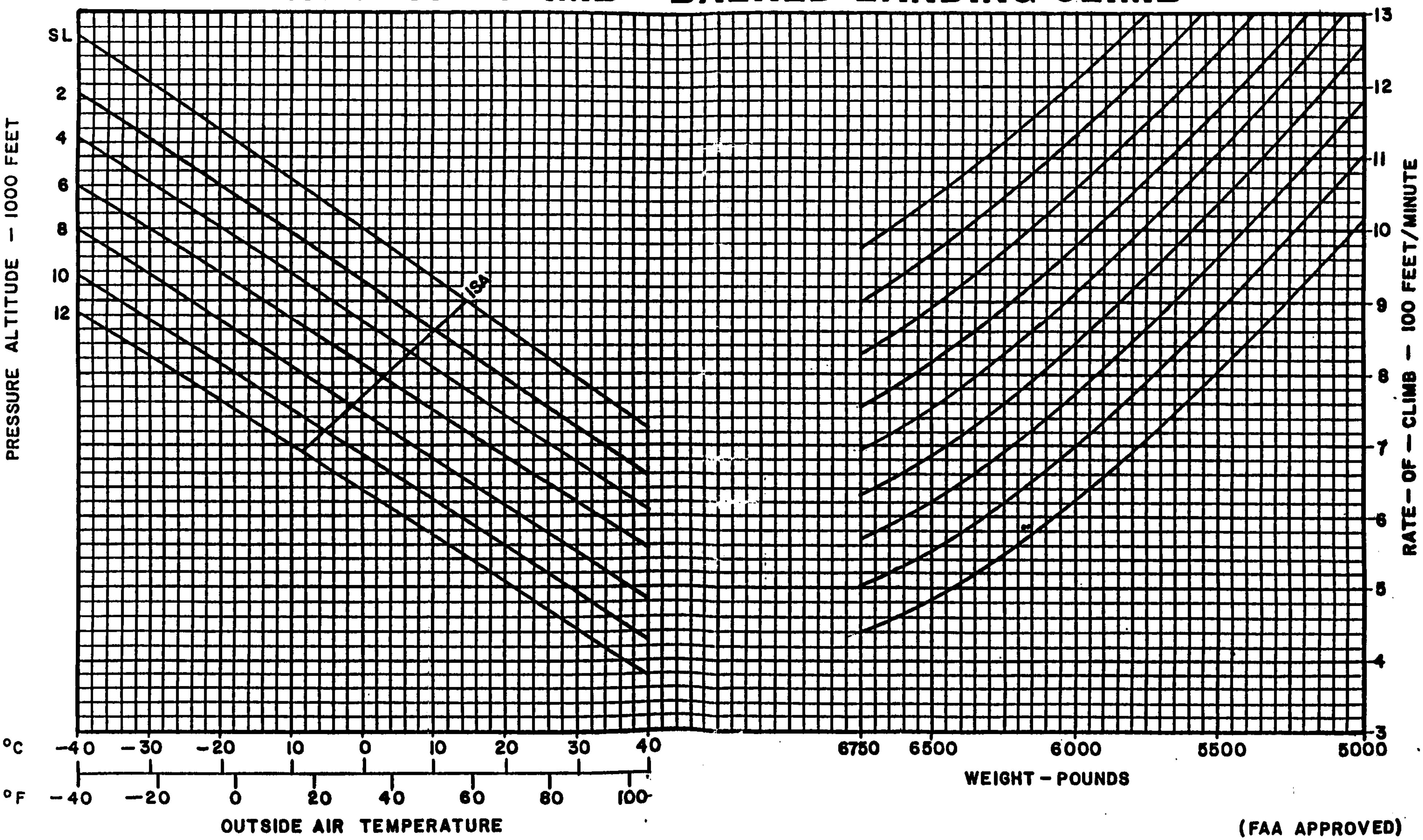
FAA APPROVED
DATE: SEP 2 2

CONDITIONS:

1. 2700 AND 41.0 INCHES Hg.
2. MIXTURE — 32.5 GPH MIN. FUEL FLOW
3. LANDING GEAR — DOWN
4. WING FLAPS — 45°
5. COWL FLAPS — OPEN
6. CLIMB SPEED — 84 KIAS



RATE-OF-CLIMB - BALKED LANDING CLIMB



(FAA APPROVED)
DATE: SEP 22 1986

The following charts are unchanged from previous approvals. These charts are

Airspeed Calibration - Alternate Static Source
Altimeter Correction - Normal Static Source
Altimeter Correction - Alternate Static Source
Rate-Of-Climb - Cruise Climb
Engine Inoperative Service Ceiling
Normal Landing Distance

VI. WEIGHT AND BALANCE

The following limits apply to the Cessna 414A modified by STC SA4943SW.

A. Maximum Zero Fuel Weight: The maximum weight with no useable fuel in the wings is 6200 lbs.

B. Maximum Landing Weight: The maximum weight for landing operations is 6750 lbs.

C. Maximum Takeoff Only: The maximum weight for takeoff operations is 7087 lbs.

D. Center of Gravity Limits: See table below and the following C.G. Chart.

WEIGHT	FORWARD LIMIT	AFT LIMIT
7087	152.2	159.04
6750	151.2	160.04
5800	147.8	160.04
4700	147.8	160.04

NOTE: Linear variation between points.

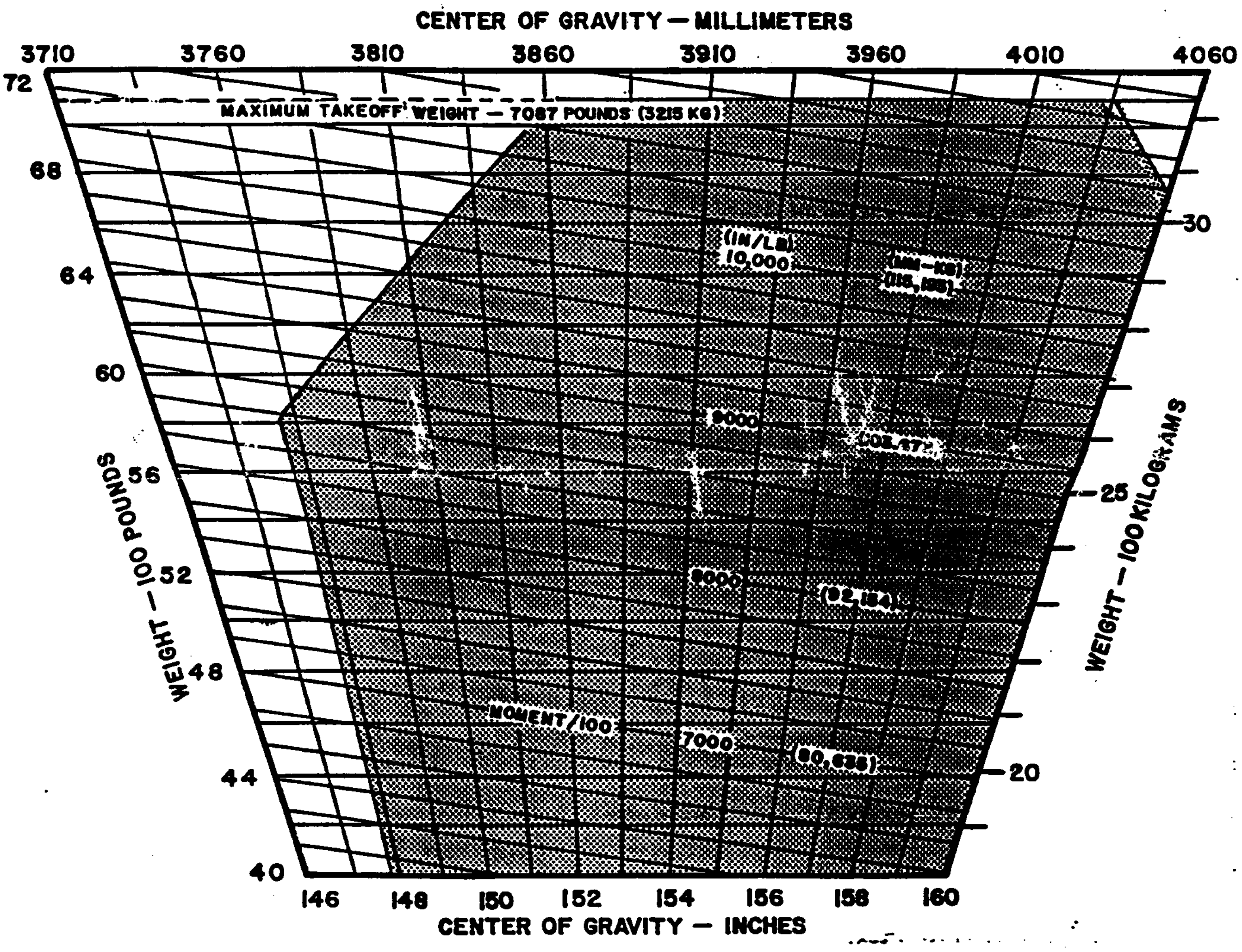
E. See Page 19 for Weight And Moment Tables.

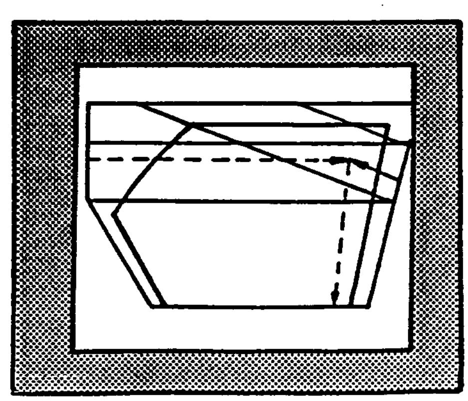
FAA APPROVED: ________________________
for Don P. Watson, Manager
Aircraft Certification Division
Southwest Region
Federal Aviation Administration
P.O. Box 1689
Fort Worth, Texas 76101

Date: SEP 22 1986

CESSNA MODEL 414A
AS MODIFIED BY RAM
STC SA 4943 SW

WEIGHT AND MOMENT TABLES





FAA APPROVED

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FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR

CESSNA MODELS: 402B, S/N 402B0301 and up
414, S/N 414-0351 and up
414A, 421B, 402C - all S/N's
421C - all S/N's (6,7,8,9,10 seat)

Registration No. N78DG

Serial No. 414A 0641

This supplement is part of the FAA approved operating limitations and must be carried in the aircraft when an airconditioning system is installed in accordance with STC SA8RM. The information contained herein supplements or supersedes the basic data only in those areas specified. For limitations, procedures, and performance information not contained in this supplement, consult the original approved manual material, markings, and placards.

FAA APPROVED Gerald E. Goodblood DATED February 21, 1973

GERALD E. GOODBLOOD, Chief
Engineering and Manufacturing Branch
ARM-210

I. LIMITATIONS:

Placard on Instrument Panel:

TURN AIRCONDITIONER OFF FOR T/O AND LANDING.

II. EMERGENCY PROCEDURES:

In the event of alternator failure, turn off airconditioner.

III. NORMAL PROCEDURES:

Airconditioning system operation. The airconditioning switch is located on the pilot's instrument panel.

Turn airconditioner off - when performing alternator checks.

To turn airconditioner ON - Move switch to 'AIRCONDITIONER'.

To turn airconditioner OFF - Move switch to 'OFF'.

For circulation without cooling - Move switch to 'FAN ONLY'.

IV. PERFORMANCE:

No change.

STC [illegible]

REVISION NUMBER	PAGES		DESCRIPTION	FAA APPROVED
	NO.	DATE		
A	1	9/24/79	Added Model 402C and changed format.	
B	All	1/22/80	Revised to show correct orig. release date.	
C	All	2/4/81	Revised to change company name. Added S/N to model callouts.	
D	2	10/5/82	Added: "Turn aircond. off when performing alternator checks."	

FAA APPROVAL ____________ DATE February 21, 1973

REVISION D

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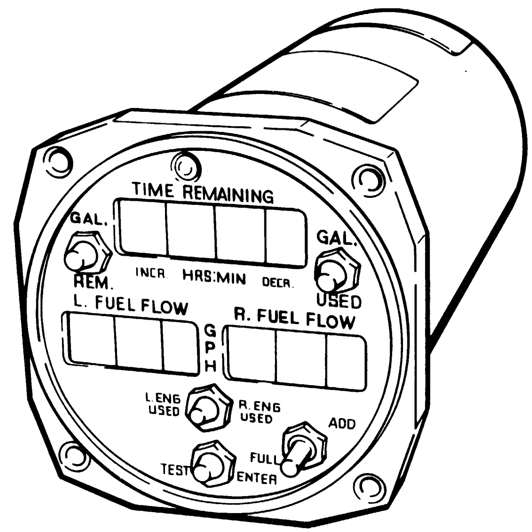
P/N OP91052B REV A

Digiflo™

DIGITAL FUEL MANAGEMENT SYSTEM



OPERATING MANUAL

For P/Ns: 91052X

SHADIN Co., Inc.

N78DG

NOTES:

TABLE OF CONTENTS

NOTE: **Though references are made in this manual to fuel measured in gallons, the information applies equally to measurements in pounds or liters.**

Shadin
COMPANY INCORPORATED
6831 Oxford Street
St. Louis Park, MN. 55426
U.S.A.
Sales: (800)-328-0584
Technical Support: (800)-388-2849

Digiflo™

Although the FAA does not require it, it is recommended that this manual be attached to the FAA-approved Flight Manual, or be always kept on board for handy reference.

1. SYSTEM DESCRIPTION

DIGIFLO is a Digital Fuel Management System designed to improve fuel monitoring and management through the use of a microprocessor to display fuel flow, fuel remaining, fuel used, and time remaining within an accuracy of ± 2% (better than 1% in some models).

The system is available with Gallons, Pounds or Liters readouts, and it can be installed on virtually any reciprocating or turbine engine by selecting the proper size fuel flow transducer. It can be used with injected or carbureted engines.

DIGIFLO features solid state electronic components and a microprocessor designed to process the pulses generated by the fuel flow transducer.

Fuel flow is continuously displayed in the lower window(s). Time remaining, fuel used, and fuel remaining are continuously computed and either displayed or stored for later display in the upper window.

During power shut-down, the amount of fuel remaining is stored in a non-volatile memory which requires no power to retain the data.

NOTES:

Display			Description
*L	xxxxx	=	Left K-factor (where xxxxx is valid from 0 to 20,000. These are in 10's. A setting of 1234 would be a K-Factor of 12,340)
*R(r)	xxxxx	=	Right K-factor (as above)
A	xxxxx	=	Left Fuel Flow Offset Frequency (Hz) for Analog Models
B(b)	xxxxx	=	Right Fuel Flow Offset Frequency (Hz) for Analog Models
*U	x	=	Units: 0 = Gallons 1 = Liters 2 = Lbs 5.8 3 = Lbs 6.7 4 = Kilograms 5 = Lbs 6.5 6 = Lbs 6.35
*E	x	=	Engine Type: 0 = Single Engine 1 = Twin Engine
*C	x	=	Low Flow Cutoff: 0 = Off 1 = On
O	x	=	Output Type: 0 = Off 1 = KLN-88 2 = AirData 3 = Arnav 4 = Trimble 5 = Generic
I	x	=	Loran Input: 0 = Off 1 = On
D(d)	x	=	Endurance Warning Time: 0 = 45 minutes 1 = 5 minutes 2 = 10 minutes 3 = 20 minutes 4 = 30 minutes
F	x	=	Filter Type: 0 = Injector 1 = Carburetor
W (ᵘ)	x	=	Ignore Loran Warnings 0 = No (default) 1 = Yes
S	xxxx	=	Low Fuel Level Warning: displayed in current units

* = Group 1 information.

Time remaining calculations are based on fuel remaining and actual ɹel flow, which means that reducing the power or leaning the mixture will result in increasing the time remaining. If the calculated time remaining at any particular power setting drops below 45 minutes, the "Time Remaining" digits in the display window will start flashing.

1.1 FUEL FLOW TRANSDUCER:

The fuel flow transducer mounted in the fuel line measures the flow of fuel and generates electrical pulses directly proportional to the fuel flow. The transducers are fail-safe designed; rotor locking will not interrupt fuel flow.

1.2 INDICATOR:

All system electronics, function controls and digital displays are contained in a single instrument that mounts in a standard 3 1/8" hole and requires no periodic maintenance, adjustment, or calibration once properly installed.

2. INITIAL PROGRAMMING

Initial programming is intended to enter the total useable fuel figure into the memory as defined in the flight manual. (Extra attention must be paid to aircraft with reduced fuel load devices.) It can then be recalled whenever you fill the fuel tanks up to the maximum useable fuel.

2.1 INITIAL PROGRAMMING PROCEDURE:

1. Power the unit by switching on the aircraft master switch.

2. Move toggle switch to "Full Fuel" and hold for the entire procedure.

3. Press the "Fuel Rem" and "Fuel Used" buttons simultaneously. The system will count down for 15 seconds, displaying the 15 second count in the lower left window.

4. The code message "FUL" will be displayed in the lower left window and the current full fuel value in the same units of display (gallons, lbs., etc.) will be displayed in the upper window. Release the "Fuel Rem" and "Fuel Used" buttons. Keep holding "Full Fuel."

5. Press the "Fuel Rem" button to increment the full fuel number or the "Fuel Used" button to decrement (the longer you hold, the faster it is updated).

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6. After reaching the correct total useable fuel figure, press the "Enter" button and the computer will store that number as full fuel. The word "FUL" disappears and the computer will return to the operate mode. Release the Full Fuel button.

7. To verify that the data is stored properly, press the "Test" button. The computer will run a diagnostic check and then display "Good." If the test is successful, it will display the newly entered maximum usable fuel value during its self-test routine.

FF: Once the settings have been programmed, Switches 1 and 2 should be set to *FF*. This is the *Operate Mode*, which is required for normal operations. In this mode, settings previously recorded for Groups 1 and 2 will be utilized, and not the switches. Group 2 can still be accessed through the manual entry mode, but Group 1 is not accessible.

* If neither of the above settings are used, the unit will be in Operate Mode and Group 2 information will be obtained from non-volatile memory. Group 1 information will be obtained from the current switch settings.

Manual Entry Mode

There are two ways to get to the Manual Entry Page.

1. Set Switches 1 and 2 to Calibrate Mode, and power up. This allows access to both groups.

2. If the Switches are not set to Calibrate Mode, while running under normal conditions, press the TEST/ENTER button to start the test mode. When the version is displayed, press and hold the TEST/ENTER button for 15 seconds. This allows access to Group 2 only.

In both cases you will the following:

MINI/DIGI = "ENT" in the left window.
or
MICRO = "ENTRY" in the left window.

The display can now be paged through with the USED and REM buttons. The values displayed can be adjusted with the ADD and FULL buttons. ADD increments the value, and FULL decrements the value. As you hold ADD or FULL the scrolling rate will increase, up to a maximum speed.

If you wish to jump directly into the fastest scrolling speed, while holding either ADD of FULL, press USED/REM.

Once the desired values are selected, press and hold the TEST/ENTER button for 5 seconds. When the settings have been recorded to the non-volatile memory. the display will read "SET". At this point you may release the TEST/ENTER button.

Note: It is recommended that you leave the unit powered up for at least one minute, then set Switches 1 and 2 to Operate Mode (FF) and reboot (Power OFF/ON). Then confirm the settings.
The Manual Entry Pages will be displayed as follows. Symbols in ( ) represent 7 segment characters.

Manual Entry Mode
Flow Meters Versions 61+

Overview
Previously, all settings depended upon the switches mounted on the processor board. Since software versions 60.XX.59, we have had a feature that is referred to as the *Manual Entry Mode*. In this mode, the Flow Meter settings are stored as two groups: *Group 1* and *Group 2* both shown in the table below.

Group 1	Group 2
Left & Right K Factors	Output Type (King, AirData, Arnav)
Fuel Units	Loran Input (On, or Off)
Single or Twin Engine Type	Endurance Warning Time (45, 30, 20, 10, or 5 minutes.
Low Flow Cutoff (On or Off)*	Filter Type (Injector or Carburetor)
	Low Fuel Level Warning (fuel level for warning to be issued)
	Ignore Loran Warning (Yes or No)

* This function is only applicable to DC systems.

Group 1 may be set up in one of two ways. Either program the information into the non volatile memory of the unit using *Manual Entry Mode* or use the switches to select the *Group 1* values.

Group 2 can no longer be set using the switches. These items must be set up by programming the unit in *Manual Entry Mode*.

Manual Entry Mode can be accessed in two ways, one which provides access to both *Group 1* and *Group 2* values, and one which provides access to only *Group 2* values. The access to Group 2 values can be obtained while the unit is installed in the aircraft. Access to Group 1 however, requires removal of the unit to adjust switch settings.

Operate Mode vs. Calibrate Mode*

FE: If Switch 1 is set to F and Switch 2 is set to E, the unit is in the *Calibrate Mode*. This is the only mode which will allow the setting of Group 1 values into the non-volatile memory of the unit. Once installed in the aircraft, this mode is no longer accessible. In this mode, both Groups can be set.

3. PREFLIGHT PROCEDURES

WARNING

DIGIFLO is a fuel flow measuring system and NOT a quantity-sensing device. Therefore, it cannot determine the amount of usable fuel in the fuel tanks. Thus it is imperative that an accurate figure of the useable fuel on board be entered into the system to ensure accurate readings.

3.1 NO FUEL ADDED:

As data is already stored, no action is needed.

3.2 MAXIMUM USABLE FUEL (FULL TANK):

1. Move the toggle switch to the "Full Fuel" position and hold. The maximum useable fuel figure will be displayed in the upper window.

2. Press the "Enter" button.

3. Return the toggle switch to the center position

4. To verify, move the toggle to "Fuel Rem". Total useable fuel will be displayed in the upper window.

3.3 PARTIAL FUEL ADDED:

1. Move the toggle switch to the "Add Fuel" position and hold.

2. Press the "Fuel Rem." button to increment fuel added figure. When the amount of fuel added figure is reached, release the "Fuel Rem." button. If the correct figure has been exceeded, move the toggle switch to the "Fuel Used" position to drecrement the added fuel figure.

3. Press "Enter" button when the correct figure is reached.

4. Return the "Add Fuel" toggle switch to the center position. The computer will add the fuel added to the fuel remaining and use the total as the current fuel remaining.

5. To verify, press the "Fuel Rem." button; current useable fuel remaining will be displayed in the upper window.

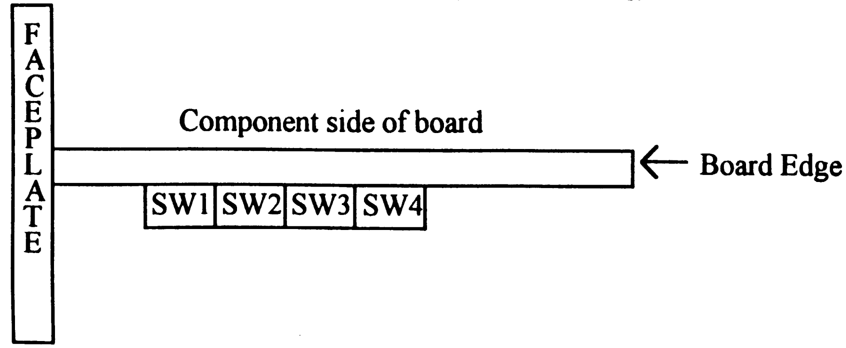
3.4 CORRECTING FUEL REMAINING FIGURE ENTRY ERRORS:

In case an error has been made by exceeding the correct amount in entering the amount of total usable fuel, press and hold the "Fuel Used" button and simultaneously press the "Enter/Test" button. Fuel used will be reset and the fuel remaining will appear and pause on display for 4 seconds. The figure will decrement. When the correct figure is reached (the longer you press, the faster it decrements), release both "Fuel Used" and "ENTER" buttons. To avoid repeating the 4 second pause while decrementing, do not release the "Fuel Used" button, but use the "ENTER" button to control the decrementing.

FLOW METER
PROCESSOR BOARD SWITCHES VERSION .61+

Hardware:	Software:
Processor Board 193802 Rev A	Flow Standard for Micro 60.08.59

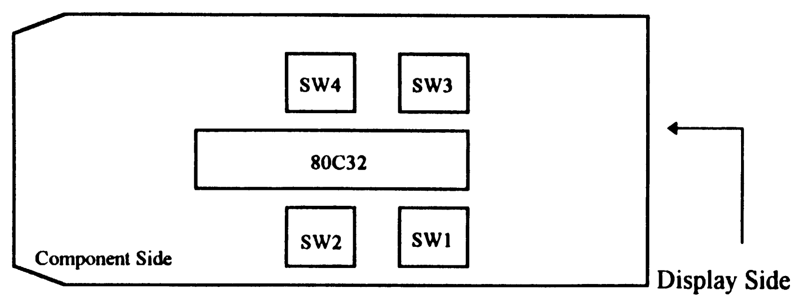
Location of the switches for the Micro Flow are as follows:



Each switch has 16 positions, 0-9,A,B,C,D,E,F.

Hardware:	Software:
Processor Board 190555 Rev B	Flow Standard for Mini 60.01.72
	Flow Standard for Digi 60.09.72
	Flow Standard for Micro 60.08.72

Location of the switches for the Mini/Digi Flow are as follows:



Each switch has 16 positions, 0-9,A,B,C,D,E,F.

Note: A hole has been cut into the can to allow access to switches normally covered by the red K factor sticker.

SHADIN *Co., Inc.*

Limited Warranty

SHADIN *Co., Inc.* warranties to the original buyer of this product that it is free from defects of material and manufacture under normal use and service conditions. SHADIN *Co., Inc.* will repair or replace without charge for a period of one (1) year from the date of purchase (invoice date) any part which upon examination it shall be disclosed to its satisfaction to be defective. The product must not have been previously modified, repaired or serviced by anyone other than the authorized service by SHADIN *Co., Inc.*, and the product must not have been subject to accident, negligence, alteration, abuse, misuse or operated in a manner contrary to the instructions pertaining to said product.

No other warranties, either expressed or implied, including warranties of merchantability and fitness for any particular purpose, will be applicable to the product. Under no circumstances will SHADIN *Co., Inc.* be liable for consequential damages sustained in connection with the product; and SHADIN *Co., Inc.* does not assume for it any obligation or liability whatsoever other than as is expressly set forth hereinabove.

3.5 TEST FUNCTION:

The Test Function enables the pilot to check the software and hardware against malfunction.

Press the "Enter/Test" button. All digits will display "8" sequentially for ten seconds. If the computer checks out, the word "Good" will appear in the top window. (If the test is not successful, the word "bAd" will be displayed. In such case, the unit must be considered unserviceable until corrective action is taken). This is followed by:

1. The K-factor setting for the flow transducer in the left flow window and units of display (i.e., gallons, lbs. or liters) in the upper window
2. Maximum usable fuel setting in the upper window and "FUL" in the left window
3. Software basic # and revision level in lower windows

NOTE: **Using the test function while engines are running will cause the computer to lose 13 seconds of fuel count.**

Garmin AFM Flight Supplements

GTN-750

GTX-330

GDL-88

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT
or
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL
for the
Garmin GDL 88 ADS-B Transceiver
as installed in

Cessna 414A
Make and Model Airplane

Registration Number: N78DG Serial Number: 414A-0641

This document serves as an Airplane Flight Manual Supplement or as a Supplemental Airplane Flight Manual when the aircraft is equipped in accordance with Supplemental Type Certificate SA02119SE for the installation and operation of the Garmin GDL 88 ADS-B Transceiver. This document must be incorporated into the FAA Approved Airplane Flight Manual or provided as an FAA Approved Supplemental Airplane Flight Manual.

The information contained herein supplements the information in the FAA Approved Airplane Flight Manual. For limitations, procedures, loading and performance information not contained in this document, refer to the FAA Approved Airplane Flight Manual, markings, or placards.

FAA APPROVED 28-DEC-2012
Robert Grove
Robert Grove
ODA STC Unit Administrator
GARMIN International, Inc
ODA-240087-CE

LOG OF REVISIONS		
Revision Number	Date	Description
1	12/18/2012	Complete Supplement

Table of Contents

Section 1. GENERAL

1.1 Garmin GDL 88 UAT Transceiver

The Garmin GDL 88 UAT Transceiver is an ADS-B system comprised of a Garmin TSO-C154c GDL 88, one or two UAT/1090 antenna(s), optional Garmin approved GPS/SBAS antenna, optional Garmin GPS/SBAS position source, and other interfaces as shown in the following block diagram.

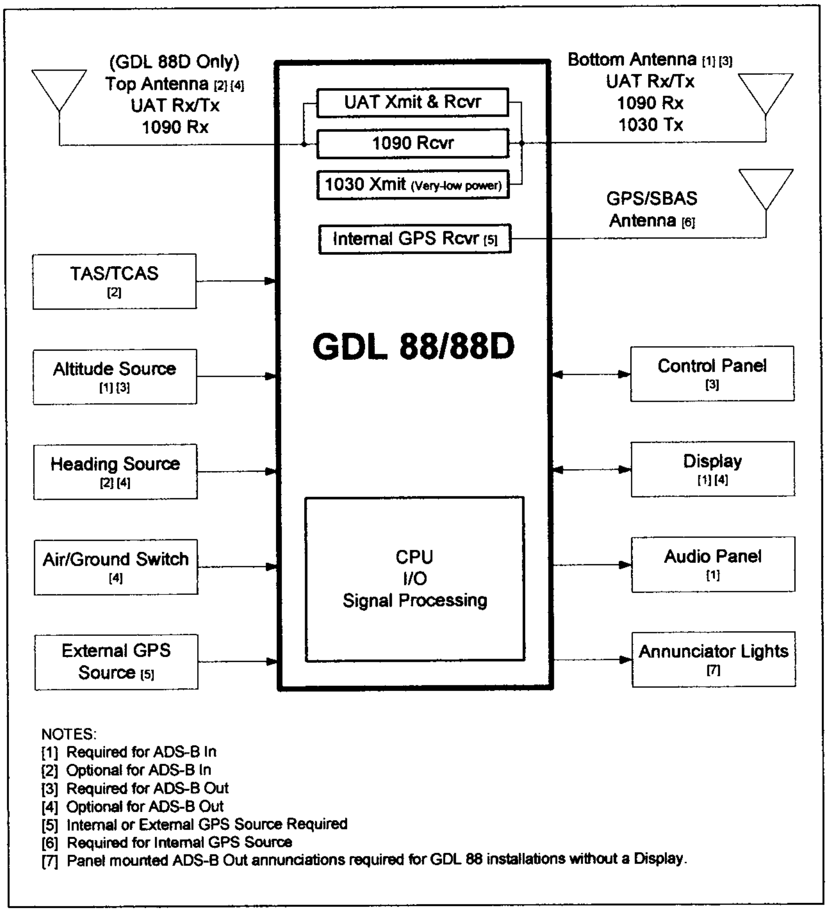


Figure 1 – GDL 88 Block Diagram

The GDL 88 system performs following functions:

- Transmission of ADS-B out data on UAT (978 MHz)
    - Integration of data from internal and external sources to transmit the following data per 14 CFR 91.227
        - GPS Position, Altitude, and Position Integrity
        - Ground Track and/or Heading, Ground Speed, and Velocity Integrity
        - Air Ground Status
        - Flight ID, Call Sign, ICAO Registration Number
        - Capability and Status Information
    - Transponder squawk code, IDENT, and emergency status
    - Anonymous Mode
    - Pressure Altitude Broadcast Inhibit
- Reception of ADS-B In data on UAT (978 MHz)
    - ADS-B (Data directly from another transmitting aircraft)
    - ADS-R (Rebroadcast of ADS-B data from a ground station)
    - TIS-B (Broadcast of secondary surveillance radar (SSR)-derived traffic information from a ground station)
    - FIS-B (Broadcast of aviation data from a ground station)
- Reception of ADS-B In data on 1090 MHz
    - ADS-B (Data directly from another transmitting aircraft)
    - ADS-R (Rebroadcast of ADS-B data from a ground station)
- Provide traffic information and alerting to the pilot via an optional display or annunciator lamp.
    - Correlation and consolidation of traffic data from multiple traffic sources
        - Output of traffic data to an external display
        - Aural and visual traffic alerting
- Provide FIS-B data to the pilot via an optional display
    - Processing and output of FIS-B data to an external display
        - Graphical and textual weather products
            - NEXRAD
            - PIREPs
            - AIRMET/SIGMETs
            - METARs
            - TAFs
            - Winds Aloft
        - Aviation Data
            - TFRs
            - NOTAMs

The GDL 88 may be installed as a stand-alone ADS-B system or, optionally, integrated with a compatible display for the display and control of traffic, FIS-B weather, and aviation data.

1.2 Capabilities

As installed in this aircraft, the Garmin GDL 88 system complies with the requirements of AC 20-165 and meets the equipment performance and functional requirements to comply with 14 CFR 91.227.

The GDL 88 meets the requirements of TSO-C154c for ADS-B Out operation.

Applicable to installations consisting of a GDL 88 interfaced with one or more GTNs with software version 3.00 or later:

The GDL 88 meets the requirements of TSO-C195a Class C1, C2, C3, C5, TIS-B Services TSO-C166b Class A1, and FIS-B TSO-C157a for ADS-B In Operation and AC 20-172A for Airworthiness Approval for ADS-B In Systems and Applications

1.3 Installation Configuration

This aircraft is equipped with a GDL 88 system with the following interfaces/ features:

Equipment Installed:

☐ GDL 88

☐ GDL 88D with dual antennas

☐ GDL 88 with internal GPS/SBAS position source

☐ GDL 88D with dual antennas and internal GPS/SBAS position source

Interfaced Active Traffic System:

☐ None

☐ TCAD

☐ TAS/TCAS I

Interfaced Transponder(s):

☐ Single Transponder serially interfaced to the GDL 88

☐ Dual Transponders serially interfaced to the GDL 88

☐ Single Transponder interfaced to the GDL 88 via self-interrogation

Interfaced Radio Altimeter(s):

☐ Yes

☐ No

Interfaced GPS/SBAS Position Source(s):

GPS #1:

- ☐ GNS 4XXW/5XXW
- ☐ GTN 6XX/7XX
- ☐ None

GPS #2:

- ☐ GNS 4XXW/5XXW
- ☐ GTN 6XX/7XX
- ☐ None

Definitions

The following terminology is used within this document:

ADS-B:	Automatic Dependent Surveillance-Broadcast
ADS-R:	Automatic Dependent Surveillance-Rebroadcast
CSA:	Conflict Situational Awareness
FIS-B:	Flight Information Service-Broadcast
GDL:	Garmin Datalink
GPS:	Global Positioning System
GTN:	Garmin Touchscreen Navigator
LRU:	Line Replaceable Unit
PABI:	Pressure Altitude Broadcast Inhibit
SBAS:	Satellite-Based Augmentation System
TAS:	Traffic Awareness System
TCAD:	Traffic Collision Avoidance Device
TCAS:	Traffic Collision Avoidance System
TIS-B:	Traffic Information Service-Broadcast
UAT:	Universal Access Transceiver
VFR:	Visual Flight Rules

Section 2. LIMITATIONS

2.1 Minimum Equipment

The GDL 88 must have the following system interfaces fully functional in order to be compliant with the requirements for 14 CFR 91.227 ADS-B Out operations:

	Interfaced Equipment	Number Installed	Number Required
OR	External ADS-B Annunciators	2 lamps	2 lamps (NO POSN and FAULT)
	Interfaced Display	1	1
	GPS SBAS Position Source	1 or more	1
	Transponder	1 or more	1

Table 1 – Required Equipment

2.2 ADS-B Out

The GDL 88 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational as indicated by external annunciators not illuminated or interfaced display ADS-B messages not being present.

2.3 Anonymous Mode

Anonymous Mode must only be operated while operating under VFR while squawking a VFR code. If requested by Air Traffic Control, Anonymous Mode must be turned off.

2.4 Applicable System Software

This AFMS/SAFM is applicable to the software versions shown in Table 2.

The Main software version is displayed on the External LRU page available on some interfaced display devices.

Software Item	Software Version *(or later FAA Approved versions for this STC)*
Main SW Version	2.01

Table 2 - Software Versions

2.5 Pressure Altitude Broadcast Inhibit (PABI)

While operating within airspace requiring an ADS-B Out compliant transmitter, per 14 CFR 91.227, Pressure Altitude Broadcast Inhibit shall only be enabled when requested by Air Traffic Control.

2.6 Traffic Alerting

Traffic alerting is an aid to visual acquisition and may not be used as the sole basis for aircraft maneuvering.

Section 3. EMERGENCY PROCEDURES

3.1 Emergency Procedures
None.

3.2 Abnormal Procedures

3.2.1 Abnormal Indications
The loss of an interfaced input GDL 88 may cause the GDL 88 to stop transmitting ADS-B Out data or providing ADS-B In function.

Depending on the nature of the fault or failure, the GDL 88 may no longer be transmitting all of the required data in the ADS-B Out messages and Traffic Alerts may not be provided by the system.

- For No Display installations:

  If the GDL 88 detects any internal faults or failures, the GDL 88 will annunciate this event via the two external annunciators on the ADS-B annunciator panel. Using these two lights, three messages/states are capable of being conveyed to the flight crew: NO POSN, FAULT, and TX FAIL.

  When the GDL 88 annunciates NO POSN, the GDL 88 has detected that it does not have a valid position from the internal or any of the external GPS/SBAS sources. (See Section 3.2.3 for further information.)

  When the GDL 88 annunciates FAULT to the flight crew, the GDL 88 has detected a loss of an input or internal fault resulting in the GDL 88 not transmitting full ADS-B information or degradation in performance.

  When both annunciator lights on the ADS-B annunciator panel are illuminated, the GDL 88 is annunciating TX FAIL. When the GDL 88 annunciates TX FAIL to the flight crew, the GDL 88 has detected a loss of required input or an internal failure resulting in the GDL 88 being unable to either transmit or receive ADS-B data.

  When a GDL 88 NO POSN, FAULT, or TX FAIL annunciation is received, verify proper operation of all interfaced equipment (refer to Section 1.3) as the failure of one of these devices could be the cause of the abnormal indication.

When the GDL 88 is interfaced to a transponder via self-interrogation, the FAULT annunciator will illuminate if the GDL 88 has not received communication from the transponder when the aircraft transitions from on the ground to airborne.

- For Display Installations:

  Reference Display Device documentation for applicable annunciations.

3.2.2 LOSS OF AIRCRAFT ELECTRICAL POWER GENERATION

Loss of electrical power generation..........**REMOVE POWER FROM GDL 88**

If the GDL 88 is load shed due to a loss of electrical power generation, ADS-B Out, ADS-B In, and the display of interfaced traffic system data will no longer be available.

NOTE

This guidance is supplementary to any guidance provided in the POH or AFM for the installed aircraft for loss of power generation.

3.2.3 LOSS OF GPS/SBAS NAVIGATION DATA

When the GPS/SBAS receiver is inoperative or GPS position information is not available or invalid, the GDL 88 will no longer be transmitting ADS-B Out data and ADS-B traffic alerting functions will be unavailable.

- For No Display installations:

  NO POSN annunciator illuminated:

  Interfaced GPS position sources...................... **VERIFY VALID POSITION**

- For Display Installations:

  Reference Display Device documentation for applicable annunciation:

  Interfaced GPS position sources........................ **VERIFY VALID POSITION**

3.2.4 VISUAL/AURAL TRAFFIC ALERT

Traffic Alert Annunciation and Aural

Traffic.. **VISUALLY ACQUIRE**

Section 4. NORMAL PROCEDURES

The procedures described below are specific only to the GDL 88. Cockpit Reference Guides and Pilot Guides for interfaced displays will provide additional operating information specific to the displays or other traffic systems.

4.1 Unit Power On

GDL 88 Annunciations .... **CONSIDERED**

NOTE

The GDL 88 Annunciators (or associated display annunciations) may illuminate as the unit powers on and begins to receive input from external systems, to include the SBAS position source.

The GDL 88 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational as indicated by external annunciators not illuminated.

4.2 Before Takeoff

GDL 88 Annunciations .... **CONSIDERED**

Section 5. PERFORMANCE

No change.

Section 6. WEIGHT AND BALANCE

See current weight and balance data.

Section 7. SYSTEM DESCRIPTIONS

7.1 Pilot's Guide

The Garmin GDL 88 Pilot's Guide, part number and revision listed below, contain additional information regarding GDL 88 system description, control, and function. Cockpit Reference Guides and Pilot Guides for interfaced displays provide additional operating information.

- GDL 88 Pilot's Guide P/N 190-01122-03 Rev A or later

7.2 Traffic Sources and Alerting

The GDL 88 is capable of receiving ADS-B, ADS-R, and TIS-B traffic reports in order to track traffic around the aircraft and provide alerts to the flight crew to aid in visual acquisition and avoidance.

Traffic alerting is provided via an installed visual annunciator and audio callouts for these alerts. The audio callout will include any available information regarding the intruder, to include direction, range, and relative altitude (high, low, same altitude).

Due to the nature of TIS-B, its service volumes, and incomplete equipage/adoption of ADS-B Out equipment, not all traffic will be tracked by the GDL 88. This is much like an active traffic system and does not track non-transponder equipped aircraft. The flight crew must use "see and avoid" procedures to visually acquire and avoid other aircraft.

7.3 Interfaced Active Traffic System (Optional)

When an active traffic system is interfaced with a GDL 88, the GDL 88 receives traffic from the active traffic system and attempts to correlate – or match – this traffic with ADS-B traffic the GDL 88 has received and is already tracking. When a correlation is made, the active traffic system or ADS-B target with the most accurate information is displayed to the flight crew. Any active traffic system or ADS-B traffic that is not correlated will also be displayed for the flight crew. The correlation of traffic by the GDL 88 ensures that only the most accurate, and no duplicate, traffic targets are displayed for the flight crew's situational awareness.

In addition, the GDL 88 will use its air-ground logic or inputs to automatically switch the active traffic from Standby to Operate when transitioning from ground to air, and from Operate to Standby when transitioning from air to ground.

If the GDL 88 fails then external traffic device data is no longer sent to the display, however aural traffic alerts from these traffic systems may continue to be received.

When interfaced to an active traffic system, traffic alerts are provided as follows:

TCAS Target Correlated With ADS-B Target	TAS/TCAS Alert Active?	CSA Alert Active?	Aural Alert Source	Visual Alert Source
Yes	Yes	N/A	TCAS/TAS	TCAS/TAS
Yes	No	N/A	None	None
No	Yes	Yes	TCAS/TAS (prioritized) GDL 88	TCAS/TAS GDL 88
No	No	Yes	GDL 88	GDL 88

Table 3 – GDL 88 Traffic Alerting with Interfaced Active Traffic System

The optional interfaced display's Pilot's Guides and supplements provide additional information regarding the functionality and control of the traffic device.

7.4 Power

Power to the GDL 88 is provided through a circuit breaker labeled "ADS-B."

7.5 External Switches

External switches may be installed in conjunction with the GDL 88. Table 4 lists the switches and function they perform:

Switch Label	Function
ALTITUDE REPORTING	Enables and disables Pressure Altitude Broadcast Inhibit functionality.
ANONYMOUS	Enables and disables Anonymous Mode functionality.
TRAFFIC MUTE	Acknowledges and mutes a currently playing aural Traffic Alert.
BRT/DIM	Enables GDL 88 annunciators to be dimmed appropriately for lighting conditions.

Table 4 – External Switches

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

or

SUPPLEMENTAL AIRPLANE FLIGHT MANUAL

for the

Garmin GDL 88 ADS-B Transceiver

as installed in

Cessna 414A

Make and Model Airplane

Registration Number: N78DG Serial Number: 414A-0641

This document serves as an Airplane Flight Manual Supplement or as a Supplemental Airplane Flight Manual when the aircraft is equipped in accordance with Supplemental Type Certificate SA02119SE for the installation and operation of the Garmin GDL 88 ADS-B Transceiver. This document must be incorporated into the FAA Approved Airplane Flight Manual or provided as an FAA Approved Supplemental Airplane Flight Manual.

The information contained herein supplements the information in the FAA Approved Airplane Flight Manual. For limitations, procedures, loading and performance information not contained in this document, refer to the FAA Approved Airplane Flight Manual, markings, or placards.

FAA APPROVED 28-DEC-2012

Robert Grove
ODA STC Unit Administrator
GARMIN International, Inc
ODA-240087-CE

LOG OF REVISIONS		
Revision Number	Date	Description
1	12/18/2012	Complete Supplement

Table of Contents

Section 1. GENERAL

1.1 Garmin GDL 88 UAT Transceiver

The Garmin GDL 88 UAT Transceiver is an ADS-B system comprised of a Garmin TSO-C154c GDL 88, one or two UAT/1090 antenna(s), optional Garmin approved GPS/SBAS antenna, optional Garmin GPS/SBAS position source, and other interfaces as shown in the following block diagram.

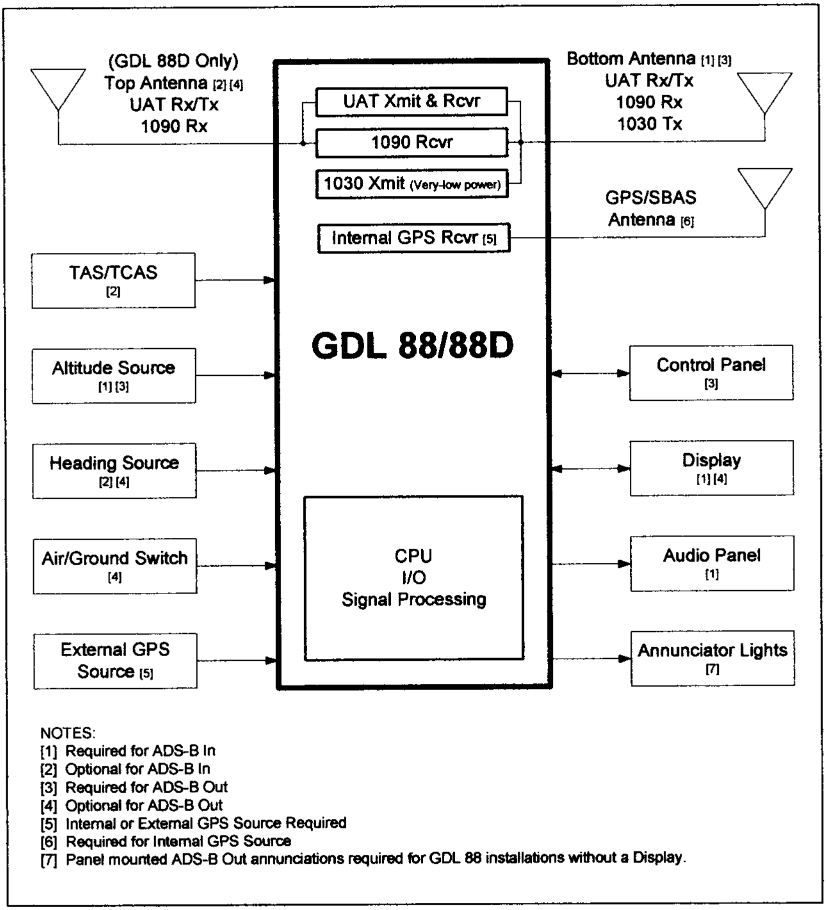


Figure 1 – GDL 88 Block Diagram

The GDL 88 system performs following functions:

- Transmission of ADS-B out data on UAT (978 MHz)
    - Integration of data from internal and external sources to transmit the following data per 14 CFR 91.227
        - GPS Position, Altitude, and Position Integrity
        - Ground Track and/or Heading, Ground Speed, and Velocity Integrity
        - Air Ground Status
        - Flight ID, Call Sign, ICAO Registration Number
        - Capability and Status Information
    - Transponder squawk code, IDENT, and emergency status
    - Anonymous Mode
    - Pressure Altitude Broadcast Inhibit
- Reception of ADS-B In data on UAT (978 MHz)
    - ADS-B (Data directly from another transmitting aircraft)
    - ADS-R (Rebroadcast of ADS-B data from a ground station)
    - TIS-B (Broadcast of secondary surveillance radar (SSR)-derived traffic information from a ground station)
    - FIS-B (Broadcast of aviation data from a ground station)
- Reception of ADS-B In data on 1090 MHz
    - ADS-B (Data directly from another transmitting aircraft)
    - ADS-R (Rebroadcast of ADS-B data from a ground station)
- Provide traffic information and alerting to the pilot via an optional display or annunciator lamp.
    - Correlation and consolidation of traffic data from multiple traffic sources
        - Output of traffic data to an external display
        - Aural and visual traffic alerting
- Provide FIS-B data to the pilot via an optional display
    - Processing and output of FIS-B data to an external display
        - Graphical and textual weather products
            - NEXRAD
            - PIREPs
            - AIRMET/SIGMETs
            - METARs
            - TAFs
            - Winds Aloft
        - Aviation Data
            - TFRs
            - NOTAMs

The GDL 88 may be installed as a stand-alone ADS-B system or, optionally, integrated with a compatible display for the display and control of traffic, FIS-B weather, and aviation data.

1.2 Capabilities

As installed in this aircraft, the Garmin GDL 88 system complies with the requirements of AC 20-165 and meets the equipment performance and functional requirements to comply with 14 CFR 91.227.

The GDL 88 meets the requirements of TSO-C154c for ADS-B Out operation.

> ***Applicable to installations consisting of a GDL 88 interfaced with one or more GTNs with software version 3.00 or later:***
>
> The GDL 88 meets the requirements of TSO-C195a Class C1, C2, C3, C5, TIS-B Services TSO-C166b Class A1, and FIS-B TSO-C157a for ADS-B In Operation and AC 20-172A for Airworthiness Approval for ADS-B In Systems and Applications

1.3 Installation Configuration

This aircraft is equipped with a GDL 88 system with the following interfaces/ features:

Equipment Installed:

- ☐ GDL 88
- ☐ GDL 88D with dual antennas
- ☐ GDL 88 with internal GPS/SBAS position source
- ☐ GDL 88D with dual antennas and internal GPS/SBAS position source

Interfaced Active Traffic System:

- ☐ None
- ☐ TCAD
- ☐ TAS/TCAS I

Interfaced Transponder(s):

☐ Single Transponder serially interfaced to the GDL 88

☐ Dual Transponders serially interfaced to the GDL 88

☐ Single Transponder interfaced to the GDL 88 via self-interrogation

Interfaced Radio Altimeter(s):

☐ Yes

☐ No

Interfaced GPS/SBAS Position Source(s):

GPS #1:

☐ GNS 4XXW/5XXW

☐ GTN 6XX/7XX

☐ None

GPS #2:

☐ GNS 4XXW/5XXW

☐ GTN 6XX/7XX

☐ None

Definitions

The following terminology is used within this document:

ADS-B:	Automatic Dependent Surveillance-Broadcast
ADS-R:	Automatic Dependent Surveillance-Rebroadcast
CSA:	Conflict Situational Awareness
FIS-B:	Flight Information Service-Broadcast
GDL:	Garmin Datalink
GPS:	Global Positioning System
GTN:	Garmin Touchscreen Navigator
LRU:	Line Replaceable Unit
PABI:	Pressure Altitude Broadcast Inhibit
SBAS:	Satellite-Based Augmentation System
TAS:	Traffic Awareness System
TCAD:	Traffic Collision Avoidance Device
TCAS:	Traffic Collision Avoidance System
TIS-B:	Traffic Information Service-Broadcast
UAT:	Universal Access Transceiver
VFR:	Visual Flight Rules

Section 2. LIMITATIONS

2.1 Minimum Equipment

The GDL 88 must have the following system interfaces fully functional in order to be compliant with the requirements for 14 CFR 91.227 ADS-B Out operations:

	Interfaced Equipment	Number Installed	Number Required
OR	External ADS-B Annunciators	2 lamps	2 lamps (NO POSN and FAULT)
	Interfaced Display	1	1
	GPS SBAS Position Source	1 or more	1
	Transponder	1 or more	1

Table 1 – Required Equipment

2.2 ADS-B Out

The GDL 88 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational as indicated by external annunciators not illuminated or interfaced display ADS-B messages not being present.

2.3 Anonymous Mode

Anonymous Mode must only be operated while operating under VFR while squawking a VFR code. If requested by Air Traffic Control, Anonymous Mode must be turned off.

2.4 Applicable System Software

This AFMS/SAFM is applicable to the software versions shown in Table 2.

The Main software version is displayed on the External LRU page available on some interfaced display devices.

Software Item	Software Version *(or later FAA Approved versions for this STC)*
Main SW Version	2.01

Table 2 - Software Versions

2.5 Pressure Altitude Broadcast Inhibit (PABI)

While operating within airspace requiring an ADS-B Out compliant transmitter, per 14 CFR 91.227, Pressure Altitude Broadcast Inhibit shall only be enabled when requested by Air Traffic Control.

2.6 Traffic Alerting

Traffic alerting is an aid to visual acquisition and may not be used as the sole basis for aircraft maneuvering.

Section 3. EMERGENCY PROCEDURES

3.1 Emergency Procedures

None.

3.2 Abnormal Procedures

3.2.1 Abnormal Indications

The loss of an interfaced input GDL 88 may cause the GDL 88 to stop transmitting ADS-B Out data or providing ADS-B In function.

Depending on the nature of the fault or failure, the GDL 88 may no longer be transmitting all of the required data in the ADS-B Out messages and Traffic Alerts may not be provided by the system.

- For No Display installations:

  If the GDL 88 detects any internal faults or failures, the GDL 88 will annunciate this event via the two external annunciators on the ADS-B annunciator panel. Using these two lights, three messages/states are capable of being conveyed to the flight crew: NO POSN, FAULT, and TX FAIL.

  When the GDL 88 annunciates NO POSN, the GDL 88 has detected that it does not have a valid position from the internal or any of the external GPS/SBAS sources. (See Section 3.2.3 for further information.)

  When the GDL 88 annunciates FAULT to the flight crew, the GDL 88 has detected a loss of an input or internal fault resulting in the GDL 88 not transmitting full ADS-B information or degradation in performance.

  When both annunciator lights on the ADS-B annunciator panel are illuminated, the GDL 88 is annunciating TX FAIL. When the GDL 88 annunciates TX FAIL to the flight crew, the GDL 88 has detected a loss of required input or an internal failure resulting in the GDL 88 being unable to either transmit or receive ADS-B data.

  When a GDL 88 NO POSN, FAULT, or TX FAIL annunciation is received, verify proper operation of all interfaced equipment (refer to Section 1.3) as the failure of one of these devices could be the cause of the abnormal indication.

When the GDL 88 is interfaced to a transponder via self-interrogation, the FAULT annunciator will illuminate if the GDL 88 has not received communication from the transponder when the aircraft transitions from on the ground to airborne.

- For Display Installations:

  Reference Display Device documentation for applicable annunciations.

3.2.2 LOSS OF AIRCRAFT ELECTRICAL POWER GENERATION

Loss of electrical power generation..........**REMOVE POWER FROM GDL 88**

If the GDL 88 is load shed due to a loss of electrical power generation, ADS-B Out, ADS-B In, and the display of interfaced traffic system data will no longer be available.

NOTE

This guidance is supplementary to any guidance provided in the POH or AFM for the installed aircraft for loss of power generation.

3.2.3 LOSS OF GPS/SBAS NAVIGATION DATA

When the GPS/SBAS receiver is inoperative or GPS position information is not available or invalid, the GDL 88 will no longer be transmitting ADS-B Out data and ADS-B traffic alerting functions will be unavailable.

- For No Display installations:

  NO POSN annunciator illuminated:

  Interfaced GPS position sources....................**VERIFY VALID POSITION**

- For Display Installations:

  Reference Display Device documentation for applicable annunciation:

  Interfaced GPS position sources......................**VERIFY VALID POSITION**

3.2.4 VISUAL/AURAL TRAFFIC ALERT

Traffic Alert Annunciation and Aural

Traffic...**VISUALLY ACQUIRE**

Section 4. NORMAL PROCEDURES

The procedures described below are specific only to the GDL 88. Cockpit Reference Guides and Pilot Guides for interfaced displays will provide additional operating information specific to the displays or other traffic systems.

4.1 Unit Power On

GDL 88 Annunciations .... **CONSIDERED**

NOTE

The GDL 88 Annunciators (or associated display annunciations) may illuminate as the unit powers on and begins to receive input from external systems, to include the SBAS position source.

The GDL 88 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational as indicated by external annunciators not illuminated.

4.2 Before Takeoff

GDL 88 Annunciations .... **CONSIDERED**

Section 5. PERFORMANCE

No change.

Section 6. WEIGHT AND BALANCE

See current weight and balance data.

Section 7. SYSTEM DESCRIPTIONS

7.1 Pilot's Guide

The Garmin GDL 88 Pilot's Guide, part number and revision listed below, contain additional information regarding GDL 88 system description, control, and function. Cockpit Reference Guides and Pilot Guides for interfaced displays provide additional operating information.

- GDL 88 Pilot's Guide P/N 190-01122-03 Rev A or later

7.2 Traffic Sources and Alerting

The GDL 88 is capable of receiving ADS-B, ADS-R, and TIS-B traffic reports in order to track traffic around the aircraft and provide alerts to the flight crew to aid in visual acquisition and avoidance.

Traffic alerting is provided via an installed visual annunciator and audio callouts for these alerts. The audio callout will include any available information regarding the intruder, to include direction, range, and relative altitude (high, low, same altitude).

Due to the nature of TIS-B, its service volumes, and incomplete equipage/adoption of ADS-B Out equipment, not all traffic will be tracked by the GDL 88. This is much like an active traffic system and does not track non-transponder equipped aircraft. The flight crew must use "see and avoid" procedures to visually acquire and avoid other aircraft.

7.3 Interfaced Active Traffic System (Optional)

When an active traffic system is interfaced with a GDL 88, the GDL 88 receives traffic from the active traffic system and attempts to correlate – or match – this traffic with ADS-B traffic the GDL 88 has received and is already tracking. When a correlation is made, the active traffic system or ADS-B target with the most accurate information is displayed to the flight crew. Any active traffic system or ADS-B traffic that is not correlated will also be displayed for the flight crew. The correlation of traffic by the GDL 88 ensures that only the most accurate, and no duplicate, traffic targets are displayed for the flight crew's situational awareness.

In addition, the GDL 88 will use its air-ground logic or inputs to automatically switch the active traffic from Standby to Operate when transitioning from ground to air, and from Operate to Standby when transitioning from air to ground.

If the GDL 88 fails then external traffic device data is no longer sent to the display, however aural traffic alerts from these traffic systems may continue to be received.

When interfaced to an active traffic system, traffic alerts are provided as follows:

TCAS Target Correlated With ADS-B Target	TAS/TCAS Alert Active?	CSA Alert Active?	Aural Alert Source	Visual Alert Source
Yes	Yes	N/A	TCAS/TAS	TCAS/TAS
Yes	No	N/A	None	None
No	Yes	Yes	TCAS/TAS (prioritized) GDL 88	TCAS/TAS GDL 88
No	No	Yes	GDL 88	GDL 88

Table 3 – GDL 88 Traffic Alerting with Interfaced Active Traffic System

The optional interfaced display's Pilot's Guides and supplements provide additional information regarding the functionality and control of the traffic device.

7.4 Power

Power to the GDL 88 is provided through a circuit breaker labeled "ADS-B."

7.5 External Switches

External switches may be installed in conjunction with the GDL 88. Table 4 lists the switches and function they perform:

Switch Label	Function
ALTITUDE REPORTING	Enables and disables Pressure Altitude Broadcast Inhibit functionality.
ANONYMOUS	Enables and disables Anonymous Mode functionality.
TRAFFIC MUTE	Acknowledges and mutes a currently playing aural Traffic Alert.
BRT/DIM	Enables GDL 88 annunciators to be dimmed appropriately for lighting conditions.

Table 4 – External Switches

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT
or
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL
for the
Garmin GTN 625, 635, 650, 725, or 750 GPS/SBAS Navigation System
as installed in

Cessna 414A
Make and Model Airplane

Registration Number: N78DG Serial Number: 414A-0641

This document serves as an Airplane Flight Manual Supplement or as a Supplemental Airplane Flight Manual when the aircraft is equipped in accordance with Supplemental Type Certificate SA02019SE-D for the installation and operation of the Garmin GTN 625, 635, 650, 725, or 750 GPS/SBAS Navigation System. This document must be carried in the airplane at all times.

The information contained herein supplements or supersedes the information made available to the operator by the aircraft manufacturer in the form of clearly stated placards or markings, or in the form of an FAA approved Airplane Flight Manual, only in those areas listed herein. For limitations, procedures and performance information not contained in this document, consult the basic placards or markings, or the basic FAA approved Airplane Flight Manual.

FAA APPROVED

Robert Grove
ODA STC Unit Administrator
GARMIN International, Inc
ODA-240087-CE

LOG OF REVISIONS				
	Page			
Revision Number	Date	Number	Description	FAA Approved
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Section 1. GENERAL

1.1 Garmin GTN Navigators

The Garmin GTN navigation system is a GPS system with a Satellite Based Augmentation System (SBAS), comprised of one or more Garmin TSO-C146c GTN 625, 635, 650, 725, or 750 navigator(s) and one or more Garmin approved GPS/SBAS antenna(s).

GTN navigation system functions are shown in Table 1.

	GTN 625	GTN 635	GTN 650	GTN 725	GTN 750
GPS SBAS Navigation: • Oceanic, enroute, terminal, and non-precision approach guidance • Precision approach guidance (LP, LPV)	X	X	X	X	X
VHF Com Radio, 118.00 to 136.990, MHz, 8.33 or 25 kHz increments		X	X		X
VHF Nav Radio, 108.00 to 117.95 MHz, 50 kHz increments			X		X
LOC and Glideslope non-precision and precision approach guidance for Cat 1 minimums, 328.6 to 335.4 MHz tuning range			X		X
Moving map including topographic, terrain, aviation, and geopolitical data	X	X	X	X	X
Display of datalink weather products (optional)	X	X	X	X	X
Display of terminal procedures data (optional)				X	X
Display of traffic data (optional)	X	X	X	X	X
Display of StormScope® data (optional)	X	X	X	X	X
Display of marker beacon annunciators				X	X
Remote audio panel control				X	X
Remote transponder control	X	X	X	X	X
Remote audio entertainment datalink control	X	X	X	X	X
TSO-C151b Class B TAWS	X	X	X	X	X
Supplemental calculators and timers	X	X	X	X	X

Table 1 – GTN Functions

The GPS navigation functions and optional VHF communication and navigation radio functions are operated by dedicated hard keys, a dual concentric rotary knob, or the touchscreen.

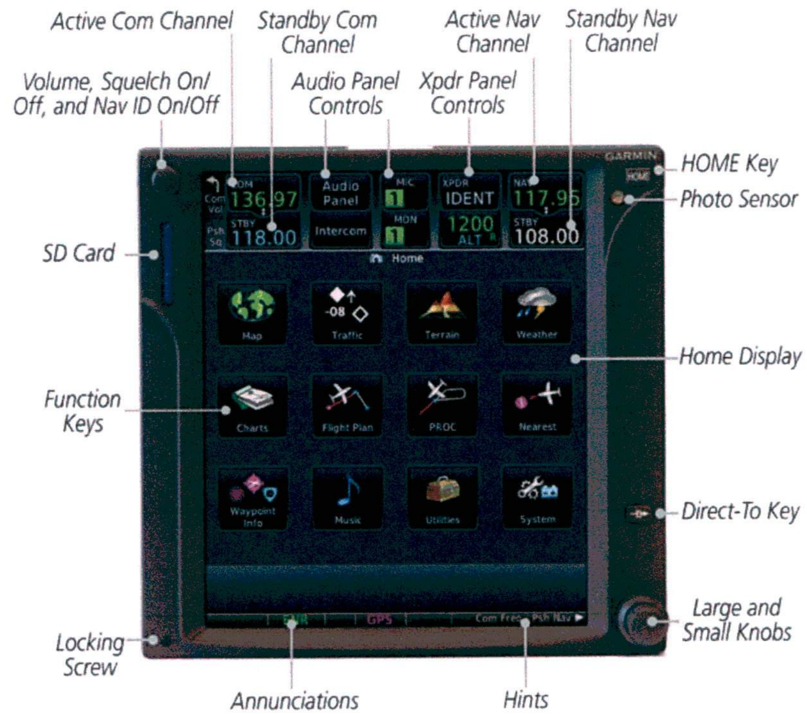

Figure 1 - GTN 750 Control and Display Layout

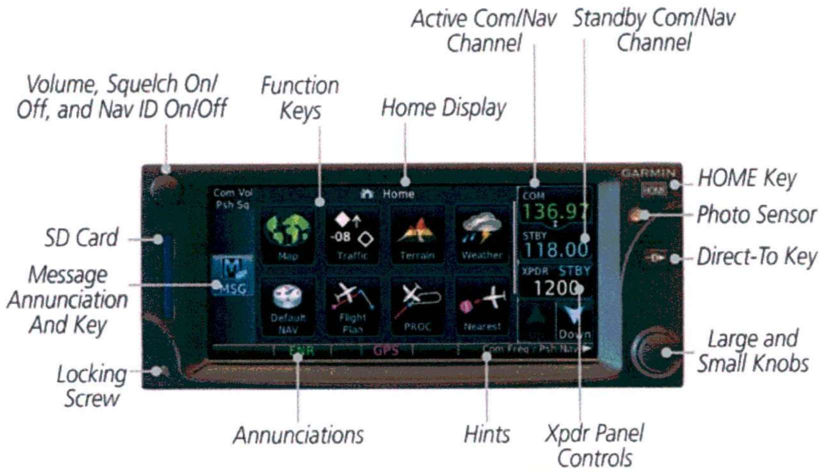

Figure 2 - GTN 635/650 Control and Display Layout

1.2 Capabilities

GPS/SBAS TSO-C146c Class 3 Operation:

The GTN, when installed in accordance with STC SA02019SE-D, has airworthiness approval for navigation using GPS and SBAS (within the coverage of a Satellite Based Augmentation System complying with ICAO Annex 10) for IFR en route, terminal area, and non-precision approach operations (including those approaches titled "GPS", "or GPS", and "RNAV (GPS)" approaches). The Garmin GNSS navigation system is composed of the GTN navigator and antenna, and is approved for approach procedures with vertical guidance including "LPV" and "LNAV/VNAV", within the U.S. National Airspace System.

The Garmin GNSS navigation system as installed in this aircraft, complies with the equipment requirements of AC 90-105 and meets the equipment performance and functional requirements to conduct RNP terminal departure and arrival procedures and RNP approach procedures without RF (radius to fix) legs. Part 91 subpart K, 121, 125, 129, and 135 operators require operational approval from the FAA.

The Garmin GNSS navigation system as installed in this aircraft complies with the equipment requirements of AC 90-100A for RNAV 2 and RNAV 1 operations. In accordance with AC 90-100A, Part 91 operators (except subpart K) following the aircraft and training guidance in AC 90-100A are authorized to fly RNAV 2 and RNAV 1 procedures. Part 91 subpart K, 121, 125, 129, and 135 operators require operational approval from the FAA.

Applicable to dual installations consisting of two GTNs: The Garmin GNSS navigation system, as installed in this aircraft, has been found to comply with the requirements for GPS Class II oceanic and remote navigation (RNP-10) without time limitations in accordance with AC 20-138A and FAA Order 8400.12A. The Garmin GNSS navigation system can be used without reliance on other long-range navigation systems. This does not constitute an operational approval.

Applicable to dual installations consisting of two GTNs: The Garmin GNSS navigation system, as installed in this aircraft, has been found to comply with the navigation requirements for GPS Class II oceanic and remote navigation (RNP-4) in accordance with AC 20-138A and FAA Order 8400.33. The Garmin GNSS navigation system can be used without reliance on other long-range navigation systems. Additional equipment may be required to obtain operational approval to utilize RNP-4 performance. This does not constitute an operational approval.

The Garmin GNSS navigation system, as installed in this aircraft, complies with the accuracy, integrity, and continuity of function, and contains the minimum system functions required for P-RNAV operations in accordance with JAA Administrative & Guidance Material Section One: General Part 3: Temporary Guidance Leaflets, Leaflet No 10 (JAA TGL-10 Rev 1). The GNSS navigation system has [one or more] TSO-C146c Class 3 approved Garmin GTN Navigation Systems. The Garmin GNSS navigation system as installed in this aircraft complies with the equipment requirements for P-RNAV and B-RNAV/RNAV 5 operations in accordance with AC 90-96A CHG 1 and JAA TGL-10 Rev 1. This does not constitute an operational approval.

Garmin International holds an FAA Type 2 Letter of Acceptance (LOA) in accordance with AC 20-153 for database integrity, quality, and database management practices for the Navigation database. Flight crew and operators can view the LOA status at FlyGarmin.com then select "Type 2 LOA Status." Navigation information is referenced to WGS-84 reference system.

Note that for some types of aircraft operation and for operation in non-U.S. airspace, separate operational approval(s) may be required in addition to equipment installation and airworthiness approval.

1.3 Electronic Flight Bag

The GTN as installed in this aircraft supports approval of AC 120-76A Hardware Class 3, Software Type C Electronic Flight Bag (EFB) electronic aeronautical chart applications when using current FliteChart or ChartView data. Additional operational approvals may be required. For operations under 14 CFR Part 91, Garmin suggests that a secondary or back up source of aeronautical information necessary for the flight be available to the pilot in the airplane. The secondary or backup information may be either traditional paper-based material or displayed electronically. If the source of aeronautical information is in electronic format, operators must determine non-interference with the GTN system and existing aircraft systems for all flight phases.

1.4 Definitions

The following terminology is used within this document:

ADF:	Automatic Direction Finder
APR:	Approach
CDI:	Course Deviation Indicator
DME:	Distance Measuring Equipment
EFB:	Electronic Flight Bag
EHSI:	Electronic Horizontal Situation Indicator
GNSS:	Global Navigation Satellite System
GPS:	Global Positioning System
GPSS:	GPS Roll Steering
GTN:	Garmin Touchscreen Navigator
HSI:	Horizontal Situation Indicator
IAP:	Instrument Approach Procedure
IFR:	Instrument Flight Rules
ILS:	Instrument Landing System
IMC:	Instrument Meteorological Conditions
LDA:	Localizer Directional Aid
LNAV:	Lateral Navigation
LNAV+V:	Lateral Navigation with advisory Vertical Guidance
L/VNAV:	Lateral/Vertical Navigation
LOC:	Localizer
LOC-BC:	Localizer Backcourse
LP:	Localizer Performance
LPV:	Localizer Performance with Vertical Guidance
MLS:	Microwave Landing System
OBS:	Omnibearing Select
RAIM:	Receiver Autonomous Integrity Monitoring
RMT:	Remote
RNAV:	Area Navigation
RNP:	Required Navigational Performance
SBAS:	Satellite Based Augmentation System
SD:	Secure Digital

SDF: Simplified Directional Facility

SUSP: Suspend

TACAN: Tactical Air Navigation System

TAS: Traffic Awareness System

TAWS: Terrain Awareness and Warning System

TCAS: Traffic Collision Avoidance System

TIS: Traffic Information Service

VHF: Very High Frequency

VFR: Visual Flight Rules

VLOC: VOR/Localizer

VMC: Visual Meteorological Conditions

VOR: VHF Omnidirectional Range

WAAS: Wide Area Augmentation System

WFDE: WAAS Fault Data Exclusion

XFR: Transfer

Section 2. LIMITATIONS

2.1 Cockpit Reference Guide

The Garmin GTN 6XX or GTN 7XX Cockpit Reference Guide, part number and revision listed below (or later revisions), *must* be immediately available to the flight crew whenever navigation is predicated on the use of the GTN.

- GTN 6XX Cockpit Reference Guide P/N 190-01004-04 Rev A
- GTN 7XX Cockpit Reference Guide P/N 190-01007-04 Rev A

2.2 Kinds of Operation

This AFM supplement does not grant approval for IFR operations to aircraft limited to VFR operations.

IFR approved aircraft may have a GTN installed that is limited to VFR operations only. GTN installations limited to VFR are placarded in close proximity to the GTN: "**GPS LIMITED TO VFR USE ONLY**". Systems with this placard are not approved for GPS navigation during IFR operations.

2.3 Minimum Equipment

If the installation of the GTN is not limited to VFR, the GTN must have the following system interfaces fully functional in order to be used for IFR operations:

Interfaced Equipment	Number installed	Number Required for IFR
External HSI/CDI/EHSI	1 or more	1
External GPS Annunciator	See Note 1	1

Table 1 – Required Equipment

Note 1: Certain installations require an external GPS annunciator panel. If installed, this annunciator must be fully functional to use the GTN for IFR operations.

Single engine piston aircraft under 6,000 lbs maximum takeoff weight:
Required Equipment for IFR operations: Single GTN Navigator

Single engine turbine aircraft or multi-engine piston aircraft under 6,000 lbs maximum takeoff weight:
Required Equipment for IFR operations: Single GTN Navigator plus a second source of GPS navigation or a separate source of VHF navigation.

Operation in remote or oceanic operation requires two sources of GPS navigation.

Aircraft over 6,000 lbs maximum takeoff weight:
Required Equipment for IFR operations: Single GTN Navigator plus a second source of GPS navigation or a separate source of VHF navigation.

Operation in remote or oceanic operation requires two sources of GPS navigation.

2.4 Flight Planning

For flight planning purposes, in areas where SBAS coverage is not available, the pilot must check RAIM availability. Within the United States, RAIM availability can be determined using the Garmin WFDE Prediction program, Garmin part number 006-A0154-04 (included in GTN trainer) software version 3.00 or later approved version with Garmin approved antennas or the FAA's en route and terminal RAIM prediction website: www.raimprediction.net, or by contacting a Flight Service Station. Within Europe, RAIM availability can be determined using the Garmin WFDE Prediction program or Europe's AUGER GPS RAIM Prediction Tool at http://augur.ecacnav.com/augur/app/home. For other areas, use the Garmin WFDE Prediction program. This requirement is not necessary if SBAS coverage is confirmed to be available along the entire route of flight. The route planning and WFDE prediction program may be downloaded from the Garmin website on the internet. For information on using the WFDE Prediction Program, refer to Garmin WAAS FDE Prediction Program, part number 190-00643-01, 'WFDE Prediction Program Instructions'.

For flight planning purposes, operations within the U.S. National Airspace System on RNP and RNAV procedures when SBAS signals are not available, the availability of GPS RAIM shall be confirmed for the intended route of flight. In the event of a predicted continuous loss of RAIM of more than five minutes for any part of the intended route of flight, the flight should be delayed, canceled, or rerouted on a track where RAIM requirements can be met. The flight may also be re-planned using non-GPS based navigational capabilities.

For flight planning purposes for operations within European B-RNAV/RNAV 5 and P-RNAV airspace, if more than one satellite is scheduled to be out of service, then the availability of GPS RAIM shall be confirmed for the intended flight (route and time). In the event of a predicted continuous loss of RAIM of more than five minutes for any part of the intended flight, the flight should be delayed, canceled, or rerouted on a track where RAIM requirements can be met.

Applicable to installations consisting of two GTNs: For flight planning purposes, operations where the route requires Class II navigation the aircraft's operator or pilot-in-command must use the Garmin WFDE Prediction program to demonstrate that there are no outages on the specified route that would prevent the Garmin GNSS navigation system to provide GPS Class II navigation in oceanic and remote areas of operation that requires (RNP-10 or RNP-4) capability. If the Garmin WFDE Prediction program indicates fault exclusion (FDE) availability will exceed 34 minutes in accordance with FAA Order 8400.12A for RNP-10 requirements, or 25 minutes in accordance with FAA Order 8400.33 for RNP-4 requirements, then the operation must be rescheduled when FDE is available.

Both Garmin GPS navigation receivers must be operating and providing GPS navigation guidance for operations requiring RNP-4 performance.

Applicable to installations consisting of two GTNs: North Atlantic (NAT) Minimum Navigational Performance Specifications (MNPS) Airspace operations per AC 91-49 and AC 120-33 require both GPS/SBAS receivers to be operating and receiving usable signals except for routes requiring only one Long Range Navigation sensor. Each display computes an independent navigation solution based on its GPS sensor.

Whenever possible, RNP and RNAV routes including Standard Instrument Departures (SIDs) and Obstacle Departure Procedures (ODPs), Standard Terminal Arrival (STAR), and enroute RNAV "Q" and RNAV "T" routes should be loaded into the flight plan from the database in their entirety, rather than loading route waypoints from the database into the flight plan individually. Selecting and inserting individual named fixes from the database is permitted, provided all fixes along the published route to be flown are inserted. Manual entry of waypoints using latitude/longitude or place/bearing is prohibited.

It is not acceptable to flight plan a required alternate airport based on RNAV(GPS) LP/LPV or LNAV/VNAV approach minimums. The required alternate airport must be flight planned using an LNAV approach minimums or available ground-based approach aid.

Navigation information is referenced to the WGS-84 reference system, and should only be used where the Aeronautical Information Publication (including electronic data and aeronautical charts) conform to WGS-84 or equivalent.

2.5 System Use

In installations with two GTNs and an external GPS annunciator (See Table 1) the GTN connected to the external GPS annunciator must be used as the navigation source for all operations.

The only approved sources of course guidance are on the external CDI, HSI, or EHSI display. The moving map and CDI depiction on the GTN display are for situational awareness only and are not approved for course guidance.

2.6 Applicable System Software

This AFMS/AFM is applicable to the software versions shown in Table 2.

The Main and GPS software versions are displayed on the start-up page immediately after power-on. All software versions displayed in Table 2 can be viewed on the System – System Status page.

Software Item	Software Version *(or later FAA Approved versions for this STC)*
Main SW Version	2.00
GPS SW Version	4.0
Com SW Version	2.00
Nav SW Version	6.01

Table 2 - Software Versions

2.7 SD Card

Proper function of the unit is predicated on the SD card being present. Garmin cannot assure functionality if the SD card is inserted or removed while the unit is powered on.

2.8 Navigation Database

GPS/SBAS based IFR enroute, oceanic, and terminal navigation is prohibited unless the pilot verifies and uses a valid, compatible, and current Navigation database or verifies each waypoint for accuracy by reference to current approved data.

"GPS", "or GPS", and "RNAV (GPS)" instrument approaches using the Garmin navigation system are prohibited unless the pilot verifies and uses the current Navigation database. GPS based instrument approaches must be flown in accordance with an approved instrument approach procedure that is loaded from the Navigation database.

Discrepancies that invalidate a procedure should be reported to Garmin International. The affected procedure is prohibited from being flown using data from the Navigation database until a new Navigation database is installed in the aircraft and verified that the discrepancy has been corrected. Navigation database discrepancies can be reported at FlyGarmin.com by selecting "Aviation Data Error Report." Flight crew and operators can view Navigation database alerts at FlyGarmin.com then select "NavData Alerts."

If the Navigation database cycle will change during flight, the pilot must ensure the accuracy of navigation data, including suitability of navigation facilities used to define the routes and procedures for flight. If an amended chart affecting navigation data is published for the procedure, the database must not be used to conduct the procedure.

2.9 Ground Operations

Do not use SafeTaxi or Chartview functions as the basis for ground maneuvering. SafeTaxi and Chartview functions do not comply with the requirements of AC 20-159 and are not qualified to be used as an airport moving map display (AMMD). SafeTaxi and Chartview are to be used by the flight crew to orient themselves on the airport surface to improve pilot situational awareness during ground operations.

2.10 Approaches

a) Instrument approaches using GPS guidance may only be conducted when the GTN is operating in the approach mode. (LNAV, LNAV+V, L/VNAV, LPV, or LP)
b) When conducting instrument approaches referenced to true North, the NAV Angle on the System -Units page must be set to **True**.
c) The navigation equipment required to join and fly an instrument approach procedure is indicated by the title of the procedure and notes on the IAP chart. Navigating the final approach segment (that segment from the final approach fix to the missed approach point) of an ILS, LOC, LOC-BC, LDA, SDF, MLS, VOR, TACAN approach, or any other type of approach not approved for GPS, is not authorized with GPS navigation guidance. GPS guidance can only be used for approach procedures with GPS or RNAV in the procedure title. When using the Garmin VOR/LOC/GS receivers to fly the final approach segment, VOR/LOC/GS navigation data must be selected and presented on the CDI of the pilot flying.
d) Advisory vertical guidance deviation is provided when the GTN annunciates LNAV + V. Vertical guidance information displayed on the VDI in this mode is only an aid to help pilots comply with altitude restrictions. When using advisory vertical guidance, the pilot must use the primary barometric altimeter to ensure compliance with all altitude restrictions.
e) Not all published Instrument Approach Procedures (IAP) are in the Navigation database. Pilots planning to fly an RNAV instrument approach must ensure that the Navigation database contains the planned RNAV Instrument Approach Procedure and that approach procedure must be loaded from the Navigation database into the GTN system flight plan by its name. Users are prohibited from flying any approach path that contains manually entered waypoints.

f) IFR approaches are prohibited whenever any physical or visual obstruction (such as a throw-over yoke) restricts pilot view or access to the GTN and/or the CDI.

2.11 Autopilot Coupling

IFR installations of a GTN allow the pilot to fly all phases of flight based on the navigation information presented to the pilot; however, not all modes may be coupled to the autopilot. All autopilots may be coupled in Oceanic (OCN), Enroute (ENR), and Terminal (TERM) modes.

This installation is limited to:

- ☐ Lateral coupling only for GPS approaches. Coupling to the vertical path for GPS approaches is not authorized.

2.12 Terrain Proximity Function (All Units)

Terrain and obstacle information appears on the map and terrain display pages as red and yellow tiles or towers, and is depicted for advisory use only. Aircraft maneuvers and navigation must not be predicated upon the use of the terrain display. Terrain and obstacle information is advisory only and is not equivalent to warnings provided by TAWS.

The terrain display is intended to serve as a situational awareness tool only. By itself, it may not provide either the accuracy or the fidelity on which to base decisions and plan maneuvers to avoid terrain or obstacles.

NOTE

Terrain and TAWS are separate features and mutually exclusive. If "TAWS B" is shown on the bottom right of the dedicated terrain page, then TAWS is installed.

2.13 TAWS Function (Optional)

Pilots are authorized to deviate from their current ATC clearance to the extent necessary to comply with TAWS warnings. Navigation must not be predicated upon the use of TAWS.

If an external TAWS annunciator panel is installed in the aircraft, this annunciator panel must be fully functional in order to use the TAWS system.

NOTE

Terrain and TAWS are separate features and mutually exclusive. If "TAWS B" is shown on the bottom right of the dedicated terrain page, then TAWS is installed.

2.14 Datalinked Weather Display (XM Weather, Optional)
Datalink weather data is provided by an optional GDL 69 or 69A interface. The weather information display on the GTN is a supplementary weather product for enhanced situational awareness only and may not be used in lieu of an official weather data source. Use of the datalink weather display for hazardous weather (e.g. thunderstorm) penetration is prohibited.

2.15 Traffic Display (Optional)
Traffic may be displayed on the GTN when connected to an approved optional TCAS I, TAS, or TIS traffic device. These systems are capable of providing traffic monitoring and alerting to the pilot. Traffic shown on the display may or may not have traffic alerting available. The display of traffic is an aid to visual acquisition and may not be utilized solely for aircraft maneuvering.

2.16 StormScope® Display (Optional)
StormScope® lightning information displayed by the GTN is limited to supplemental use only. The use of the StormScope® lightning data on the display for hazardous weather (thunderstorm) penetration is prohibited. StormScope® lightning data on the display is intended only as an aid to enhance situational awareness of hazardous weather, not penetration. It is the pilot's responsibility to avoid hazardous weather using official weather data sources.

When the GTN StormScope® page is operating in track up mode as indicated by the "TRK UP" label at the upper right corner of the StormScope® page, use of the GTN to display StormScope® information is prohibited while on the ground.

2.17 Flight Planner/Calculator Functions
When using the calculator/planner pages data must be entered into all data fields and verified by the pilot prior to use of the data. Depending on system configuration, the "Use Sensor Data" button may populate the Indicated ALT window with indicated altitude or pressure altitude. The pilot must verify the desired altitude and appropriate barometric pressure setting to ensure valid calculations. Aircraft performance or fuel loading must not be predicated upon the use of data derived from these functions.

2.18 Glove Use / Covered Fingers
No device may be used to cover fingers used to operate the GTN unless the Glove Qualification Procedure located in the Pilot's Guide has been successfully completed. The Glove Qualification Procedure is specific to a pilot / glove / GTN 725, 750 or GTN 625, 635, 650 combination.

2.19 Demo Mode

Demo mode may not be used in flight under any circumstances.

Section 3. EMERGENCY PROCEDURES

3.1 Emergency Procedures

3.1.1 TAWS WARNING

Red annunciator and aural "PULL UP":

Autopilot .... **DISCONNECT**
Aircraft Controls .... **INITIATE MAXIMUM POWER CLIMB**
Airspeed .... **BEST ANGLE OF CLIMB SPEED**

After Warning Ceases:

Power .... **MAXIMUM CONTINUOUS**
Altitude .... **CLIMB AND MAINTAIN SAFE ALTITUDE**
Advise ATC of Altitude Deviation, if appropriate.

NOTE

Only vertical maneuvers are recommended, unless either operating in visual meteorological conditions (VMC), or the pilot determines, based on all available information, that turning in addition to the escape maneuver is the safest course of action, or both.

3.2 Abnormal Procedures

3.2.1 LOSS OF GPS/SBAS NAVIGATION DATA

When the GPS/SBAS receiver is inoperative or GPS navigation information is not available or invalid, the GTN will enter one of two modes: Dead Reckoning mode (DR) or Loss Of Integrity mode (LOI). The mode is indicated on the GTN by an amber "DR" or "LOI".

If the Loss Of Integrity annunciation is displayed, revert to an alternate means of navigation appropriate to the route and phase of flight.

If the Dead Reckoning annunciation is displayed, the map will continue to be displayed with an amber 'DR' overwriting the ownship icon. Course guidance will be removed on the CDI. Aircraft position will be based upon the last valid GPS position, then estimated by Dead Reckoning methods. Changes in true airspeed, altitude, heading, or winds aloft can affect the estimated position substantially. Dead Reckoning is only available in Enroute and Oceanic modes. Terminal and Approach modes do not support Dead Reckoning.

If Alternate Navigation Sources (ILS, LOC, VOR, DME, ADF) Are Available:

Navigation.. **USE ALTERNATE SOURCES**

If No Alternate Navigation Sources Are Available:

DEAD RECKONING (DR) MODE:

Navigation.. **USE GTN**

NOTE

- All information normally derived from GPS will become less accurate over time.

LOSS OF INTEGRITY (LOI) MODE:

Navigation.................... **FLY TOWARDS KNOWN VISUAL CONDITIONS**

NOTE

- All information derived from GPS will be removed.
- The airplane symbol is removed from all maps. The map will remain centered at the last known position. "NO GPS POSITION" will be annunciated in the center of the map.

3.2.2 GPS APPROACH DOWNGRADE

During a GPS LPV, LNAV/VNAV, or LNAV+V approach, if GPS accuracy requirements cannot be met by the GPS receiver, the GTN will downgrade the approach. The downgrade will remove vertical deviation indication from the VDI and change the approach annunciation accordingly from LPV, L/VNAV, or LNAV+V to LNAV. The approach may be continued using the LNAV only minimums.

During a GPS approach in which GPS accuracy requirements cannot be met by the GPS receiver for any GPS approach type, the GTN will flag all CDI guidance and display a system message "ABORT APPROACH-GPS approach no longer available". Immediately upon viewing the message, the unit will revert to Terminal navigation mode alarm limits. If the position integrity is within these limits lateral guidance will be restored and the GPS may be used to execute the missed approach, otherwise alternate means of navigation must be utilized.

3.2.3 LOSS OF COM RADIO TUNING FUNCTIONS

If alternate COM is available:

Communications .... **USE ALTERNATE COM**

If no alternate COM is available:

COM RMT XFR key (if installed)...... **PRESS AND HOLD FOR 2 SECONDS**

NOTE

This procedure will tune the active COM radio the emergency frequency 121.5, regardless of what frequency is displayed on the GTN. Certain failures of the tuning system will automatically tune 121.5 without pilot action.

3.2.4 LOSS OF AUDIO PANEL FUNCTIONS (GMA 35 Only)

Audio Panel Circuit Breaker..**PULL**

NOTE

This procedure will force the audio panel to provide the pilot only with communications on the Non-GTN 750 radio. If only a GTN 750 is installed in the aircraft, then the pilot will have communications on the GTN 750. The crew and passenger intercom will not function.

3.2.5 TAWS CAUTION (Terrain or Obstacle Ahead, Sink Rate, Don't Sink)

When a TAWS CAUTION occurs, take corrective action until the alert ceases. Stop descending or initiate either a climb or a turn, or both as necessary, based on analysis of all available instruments and information.

3.2.6 TAWS INHIBIT

The TAWS Forward Looking Terrain Avoidance (FLTA) and Premature Descent Alerts (PDA) functions may be inhibited to prevent alerting, if desired. Refer to GTN Cockpit Reference Guide for additional information.

To Inhibit TAWS:

Home Hardkey .... PRESS
Terrain Button .... PRESS
Menu Button .... PRESS
TAWS Inhibit Button .... PRESS TO ACTIVATE

3.2.7 TER N/A and TER FAIL

If the amber **TER N/A** or **TER FAIL** status annunciator is displayed, the system will no longer provide TAWS alerting or display relative terrain and obstacle elevations. The crew must maintain compliance with procedures that ensure minimum terrain and obstacle separation.

3.2.8 HEADING DATA SOURCE FAILURE

Without a heading source to the GTN, the following features will not operate:

- GPSS will not be provided to the autopilot for heading legs. The autopilot must be placed in HDG mode for heading legs.
- Map cannot be oriented to Heading Up.
- All overlaying traffic data from a TAS/TCAS I system on the main map display. The pilot must use the dedicated traffic page on the GTN system to display TAS/TCAS I data.
- All overlaying StormScope® data on the main map display. The pilot must use the dedicated StormScope® page on the GTN system to display StormScope® data.

StormScope® must be operated in accordance with Section 7.8 when no heading is available.

3.2.9 PRESSURE ALTITUDE DATA SOURCE FAILURE

Without a pressure altitude source to the GTN, the following features will not operate:

- Automatic leg sequencing of legs requiring an altitude source. The pilot must manually sequence altitude legs, as prompted by the system.

Section 4. NORMAL PROCEDURES

Refer to the Cockpit Reference Guide defined in Section 2.1 of this document or the Pilot's Guide defined in Section 7.1 for normal operating procedures and a complete list of system messages and associated pilot actions. This includes all GPS operations, VHF communication and navigation, traffic, data linked weather, StormScope®, TAWS, and Multi-Function Display information.

The GTN requires a reasonable degree of familiarity to prevent operations without becoming too engrossed at the expense of basic instrument flying in IMC and basic see-and-avoid in VMC. Garmin provides training tools with the Pilot's Guide and PC based simulator. Pilots should take full advantage of these training tools to enhance system familiarization.

4.1 Unit Power On

Database .... **REVIEW EFFECTIVE DATES**
Self Test .... **VERIFY OUTPUTS TO NAV INDICATORS**
Self Test - TAWS Remote Annunciator:
- PULL UP .... **ILLUMINATED**
- TERR .... **ILLUMINATED**
- TERR N/A .... **ILLUMINATED**
- TERR INHB .... **ILLUMINATED**

Self Test - GPS Remote Annunciator:
- VLOC .... **ILLUMINATED**
- GPS .... **ILLUMINATED**
- LOI or INTG .... **ILLUMINATED**
- TERM .... **ILLUMINATED**
- WPT .... **ILLUMINATED**
- APR .... **ILLUMINATED**
- MSG .... **ILLUMINATED**
- SUSP or OBS .... **ILLUMINATED**

4.2 Before Takeoff

System Messages and Annunciators .... **CONSIDERED**

4.3 HSI and EHSI Operation

If an HSI is used to display navigation data from the GTN the pilot should rotate the course pointer as prompted on the GTN.

If an EHSI is used to display navigation data from the GTN the course pointer may autoslew to the correct course when using GPS navigation. When using

VLOC navigation the course pointer will not autoslew and must be rotated to the correct course by the pilot. For detailed information about the functionality of the EHSI system, refer to the FAA approved Flight Manual or Flight Manual Supplement for that system.

CAUTION

The pilot must verify proper course selection each time the CDI source is changed from GPS to VLOC.

4.4 Autopilot Operation

The GTN may be coupled to an optional autopilot, if installed in the aircraft, when operating as prescribed in the LIMITATIONS section of this manual.

Autopilots coupled to the GTN system in an analog (NAV) mode will follow GPS or VHF navigation guidance as they would with existing VOR receivers.

Autopilots that support GPSS or GPS Roll Steering in addition to the analog course guidance will lead course changes, fly arcing procedures, procedure turns, and holding patterns if coupled in GPSS mode.

For autopilot operating instructions, refer to the FAA approved Flight Manual or Flight Manual Supplement for the autopilot.

4.5 Coupling the Autopilot during approaches

CAUTION

When the CDI source is changed on the GTN, autopilot mode may change. Confirm autopilot mode selection after CDI source change on the GTN. Refer to the FAA approved Flight Manual or Flight Manual Supplement for the autopilot.

☐ This installation prompts the pilot and requires the pilot to enable the approach outputs just prior to engaging the autopilot in APR mode.

To couple an approach:
Once established on the final approach course with the final approach fix as the active waypoint, the GTN will issue a flashing message indication.

Flashing Message Button .... **PRESS**
"Enable APR Output" Button .... **PRESS**

If coupled, Autopilot will revert to ROL mode at this time.

Autopilot .... **ENGAGE APPROACH MODE**

☐ This installation supports coupling to the autopilot in approach mode once vertical guidance is available.

To couple an approach:
Once established on the final approach course with the final approach fix as the active waypoint, the GTN will enable vertical guidance.

Vertical Guidance .... **CONFIRM AVAILABLE**
Autopilot .... **ENGAGE APPROACH MODE**

☐ The autopilot does not support any vertical capture or tracking in this installation.

Analog only autopilots should use APR mode for coupling to LNAV approaches. Autopilots which support digital roll steering commands (GPSS) may utilize NAV mode and take advantage of the digital tracking during LNAV only approaches.

Section 5. PERFORMANCE

No change.

Section 6. WEIGHT AND BALANCE

See current weight and balance data.

Section 7. SYSTEM DESCRIPTIONS

7.1 Pilot's Guide

The Garmin GTN 6XX or GTN 7XX Pilot's Guide, part number and revision listed below, contain additional information regarding GTN system description, control and function. The Pilot's Guides *do not* need to be immediately available to the flight crew.

- GTN 6XX Pilot's Guide — P/N 190-01004-03 Rev A or later
- GTN 7XX Pilot's Guide — P/N 190-01007-03 Rev A or later

7.2 Leg Sequencing

The GTN supports all ARINC 424 leg types. Certain leg types require altitude input in order to sequence (course to altitude, for example). If a barometric corrected altitude source is not interfaced to the GTN, a popup will appear prompting the pilot to manually sequence the leg once the altitude prescribed in the procedure is reached.

☐ This installation *has* a barometric corrected altitude source. The GTN will automatically sequence altitude legs.

☐ This installation *does not have* a barometric corrected altitude source. The pilot will be prompted to manually sequence altitude legs.'

7.3 Auto ILS CDI Capture

Auto ILS CDI Capture will not automatically switch from GPS to VLOC for LOC-BC or VOR approaches.

7.4 Activate GPS Missed Approach

If the GTN displays a CDI key on the Map Page (GTN 750) or Default Nav Page (GTN 650) the GTN *will* autoswitch from VLOC to GPS when the "Activate GPS Missed Approach" button is pressed.

If the GTN *does not* display a CDI key on the Map Page (GTN 750) or Default Nav Page (GTN 650) the GTN *will not* autoswitch from VLOC to GPS when the "Activate GPS Missed Approach" button is pressed. The pilot must manually switch from VLOC to GPS if GPS guidance is desired after the missed approach point.

7.5 Terrain Proximity and TAWS

- The Terrain Database has an area of coverage from North 75° Latitude to South 60° Latitude in all longitudes.
- The Obstacle Database has an area of coverage that includes the United States and Europe, and is updated as frequently as every 56 days.
- To avoid unwanted alerts, TAWS may be inhibited when landing at an airport that is not included in the airport database.

NOTE

The area of coverage may be modified as additional terrain data sources become available.

☐ This installation supports *Terrain Proximity. No aural or visual alerts* for terrain or obstacles are provided. Terrain Proximity *does not* satisfy the TAWS requirement of 91.223.

☐ This installation supports *TAWS B*. Aural and visual alerts *will be* provided. This installation *does* support the TAWS requirement of 91.223.

7.6 GMA 35 Audio Panel (Optional)

The GTN 725 and 750 can interface to a GMA 35 remotely mounted audio panel and marker beacon receiver. Controls for listening to various radios, activating the cabin speaker, clearance playback control, and marker beacon are accessed by pressing the "Audio Panel" button on the GTN display screen. Volume controls for the audio panel are accessed by pressing the "Intercom" button on the GTN display screen.

7.7 Traffic System (Optional)

This system is configured for the following type of traffic system. The Garmin GTN 6XX or GTN 7XX Cockpit Reference Guide or Garmin GTN 6XX or GTN 7XX Pilot's Guide provides additional information regarding the functionality of the traffic device.

☐ No traffic system is interfaced to the GTN.

☐ A TAS/TCAS I traffic system is interfaced to the GTN.

☐ A TIS traffic system is interfaced to the GTN.

7.8 StormScope® (Optional)

When optionally interfaced to a StormScope® weather detection system, the GTN may be used to display the StormScope® information. Weather information supplied by the StormScope® will be displayed on the StormScope® page of the GTN system. For detailed information about the capabilities and limitations of the StormScope® system, refer to the documentation provided with that system.

<u>Heading Up mode:</u>
If the GTN system is receiving valid heading information, the StormScope® page will operate in the heading up mode as indicated by the label "HDG UP" presented at the upper right corner of the display. In this mode, information provided by the StormScope® system is displayed relative to the nose of the aircraft and is automatically rotated to the correct relative position as the aircraft turns.

<u>Track Up mode:</u>
If the GTN system is not receiving valid heading information, either because a compatible heading system is not installed, or the interfaced heading system has malfunctioned, the StormScope® page will operate in the track up mode as indicated by the label "TRK UP" in the upper right corner of the display. When operating in the track up mode, StormScope® information is displayed relative to the current GPS track of the aircraft and is automatically rotated as the aircraft turns. In track up mode, the pilot must be aware that, if the combination of aircraft speed and crosswind results in a crab angle to maintain the track, the relative bearing of StormScope® information on the GTN display will be offset by an amount equal to the aircraft crab angle. Because the difference between GPS track and aircraft heading can be very large when on the ground, use of the GTN to display StormScope® information in TRK UP mode is prohibited while on the ground.

7.9 Power

- Power to the GTN is provided through a circuit breaker labeled NAV/GPS (1/2).
- Power to the optional GTN COM is provided through a circuit breaker labeled COMM (1/2)
- Power to the optional GMA 35 is powered through a circuit breaker labeled AUDIO.

7.10 Databases

Database versions and effective dates are displayed on the start-up page immediately after power-on. Database information can also be viewed on the System – System Status page.

The Obstacle Database coverage area includes the United States and Europe.

7.11 External Switches

External switches may be installed and interfaced to the GTN. These switches may be stand alone, or integrated with a TAWS or GPS annunciator. Table 3 lists the switches and function they perform:

Switch Label	Function
CDI	Toggles between GPS / VLOC sources. This switch may be part of an external annunciator panel.
COM CHAN DN	Toggles down through the preset com frequencies.
COM CHAN UP	Toggles up through the preset com frequencies.
COM RMT XFR	Transfers the com active / standby frequencies.
NAV RMT XFR	Transfers the nav active / standby frequencies.
OBS	Performs an OBS or SUSP function. This switch is part of an external annunciator panel and is placarded with the following: "Green OBS indicates OBS or SUSP mode – GTN annunciator bar indicates which is active. Push OBS button to change OBS or SUSP mode."
OBS/SUSP	Performs an OBS or SUSP function.
TERR INHB	Toggles the TAWS Inhibit function on/off. This switch is part of an external annunciator panel. The terrain display is still presented if TAWS is Inhibited.

Table 3 – External Switches

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT
or
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL
for the
Garmin GTN 625, 635, 650, 725, or 750 GPS/SBAS Navigation System
as installed in

Cessna 414A
Make and Model Airplane

Registration Number: N78DG Serial Number: 414A-0641

This document serves as an Airplane Flight Manual Supplement or as a Supplemental Airplane Flight Manual when the aircraft is equipped in accordance with Supplemental Type Certificate SA02019SE-D for the installation and operation of the Garmin GTN 625, 635, 650, 725, or 750 GPS/SBAS Navigation System. This document must be carried in the airplane at all times.

The information contained herein supplements or supersedes the information made available to the operator by the aircraft manufacturer in the form of clearly stated placards or markings, or in the form of an FAA approved Airplane Flight Manual, only in those areas listed herein. For limitations, procedures and performance information not contained in this document, consult the basic placards or markings, or the basic FAA approved Airplane Flight Manual.

FAA APPROVED

Robert Grove
ODA STC Unit Administrator
GARMIN International, Inc
ODA-240087-CE

LOG OF REVISIONS				
	Page			
Revision Number	Date	Number	Description	FAA Approved
1	03/18/11	All	Complete Supplement	Robert Grove (signature) Robert Grove ODA STC Unit Administrator GARMIN International, INC ODA-240087-CE Date: 18 March 2011

Table of Contents

Section 1. GENERAL

1.1 Garmin GTN Navigators

The Garmin GTN navigation system is a GPS system with a Satellite Based Augmentation System (SBAS), comprised of one or more Garmin TSO-C146c GTN 625, 635, 650, 725, or 750 navigator(s) and one or more Garmin approved GPS/SBAS antenna(s).

GTN navigation system functions are shown in Table 1.

	GTN 625	GTN 635	GTN 650	GTN 725	GTN 750
GPS SBAS Navigation: • Oceanic, enroute, terminal, and non-precision approach guidance • Precision approach guidance (LP, LPV)	X	X	X	X	X
VHF Com Radio, 118.00 to 136.990, MHz, 8.33 or 25 kHz increments		X	X		X
VHF Nav Radio, 108.00 to 117.95 MHz, 50 kHz increments			X		X
LOC and Glideslope non-precision and precision approach guidance for Cat 1 minimums, 328.6 to 335.4 MHz tuning range			X		X
Moving map including topographic, terrain, aviation, and geopolitical data	X	X	X	X	X
Display of datalink weather products (optional)	X	X	X	X	X
Display of terminal procedures data (optional)				X	X
Display of traffic data (optional)	X	X	X	X	X
Display of StormScope® data (optional)	X	X	X	X	X
Display of marker beacon annunciators				X	X
Remote audio panel control				X	X
Remote transponder control	X	X	X	X	X
Remote audio entertainment datalink control	X	X	X	X	X
TSO-C151b Class B TAWS	X	X	X	X	X
Supplemental calculators and timers	X	X	X	X	X

Table 1 – GTN Functions

The GPS navigation functions and optional VHF communication and navigation radio functions are operated by dedicated hard keys, a dual concentric rotary knob, or the touchscreen.

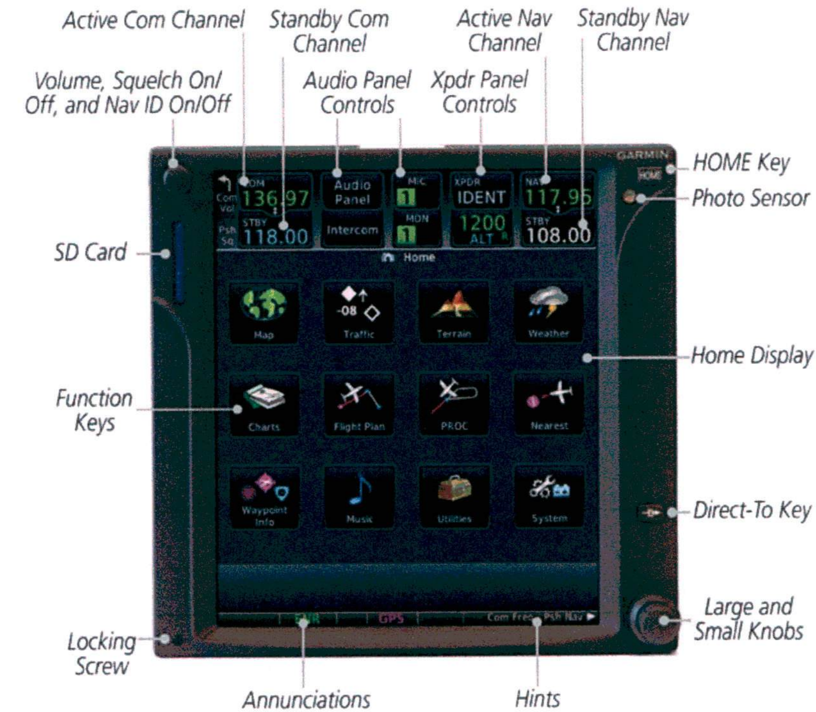

Figure 1 - GTN 750 Control and Display Layout

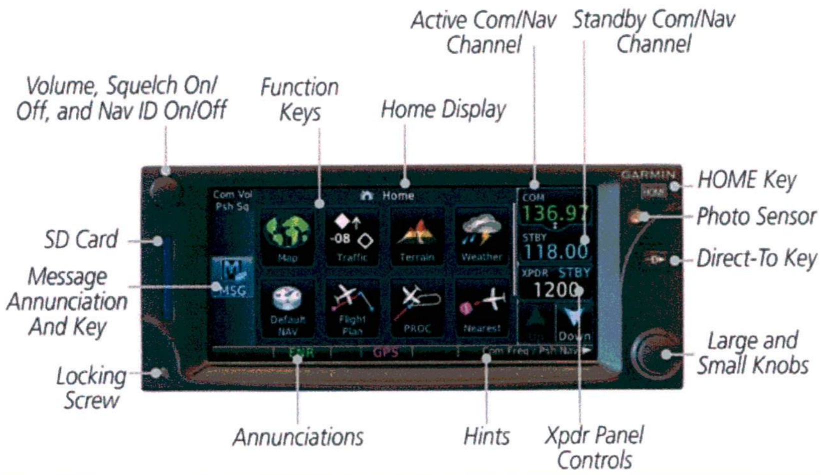

Figure 2 - GTN 635/650 Control and Display Layout

1.2 Capabilities

GPS/SBAS TSO-C146c Class 3 Operation:

The GTN, when installed in accordance with STC SA02019SE-D, has airworthiness approval for navigation using GPS and SBAS (within the coverage of a Satellite Based Augmentation System complying with ICAO Annex 10) for IFR en route, terminal area, and non-precision approach operations (including those approaches titled “GPS”, “or GPS”, and “RNAV (GPS)” approaches). The Garmin GNSS navigation system is composed of the GTN navigator and antenna, and is approved for approach procedures with vertical guidance including “LPV” and “LNAV/VNAV”, within the U.S. National Airspace System.

The Garmin GNSS navigation system as installed in this aircraft, complies with the equipment requirements of AC 90-105 and meets the equipment performance and functional requirements to conduct RNP terminal departure and arrival procedures and RNP approach procedures without RF (radius to fix) legs. Part 91 subpart K, 121, 125, 129, and 135 operators require operational approval from the FAA.

The Garmin GNSS navigation system as installed in this aircraft complies with the equipment requirements of AC 90-100A for RNAV 2 and RNAV 1 operations. In accordance with AC 90-100A, Part 91 operators (except subpart K) following the aircraft and training guidance in AC 90-100A are authorized to fly RNAV 2 and RNAV 1 procedures. Part 91 subpart K, 121, 125, 129, and 135 operators require operational approval from the FAA.

Applicable to dual installations consisting of two GTNs: The Garmin GNSS navigation system, as installed in this aircraft, has been found to comply with the requirements for GPS Class II oceanic and remote navigation (RNP-10) without time limitations in accordance with AC 20-138A and FAA Order 8400.12A. The Garmin GNSS navigation system can be used without reliance on other long-range navigation systems. This does not constitute an operational approval.

Applicable to dual installations consisting of two GTNs: The Garmin GNSS navigation system, as installed in this aircraft, has been found to comply with the navigation requirements for GPS Class II oceanic and remote navigation (RNP-4) in accordance with AC 20-138A and FAA Order 8400.33. The Garmin GNSS navigation system can be used without reliance on other long-range navigation systems. Additional equipment may be required to obtain operational approval to utilize RNP-4 performance. This does not constitute an operational approval.

The Garmin GNSS navigation system, as installed in this aircraft, complies with the accuracy, integrity, and continuity of function, and contains the minimum system functions required for P-RNAV operations in accordance with JAA Administrative & Guidance Material Section One: General Part 3: Temporary Guidance Leaflets, Leaflet No 10 (JAA TGL-10 Rev 1). The GNSS navigation system has [one or more] TSO-C146c Class 3 approved Garmin GTN Navigation Systems. The Garmin GNSS navigation system as installed in this aircraft complies with the equipment requirements for P-RNAV and B-RNAV/RNAV 5 operations in accordance with AC 90-96A CHG 1 and JAA TGL-10 Rev 1. This does not constitute an operational approval.

Garmin International holds an FAA Type 2 Letter of Acceptance (LOA) in accordance with AC 20-153 for database integrity, quality, and database management practices for the Navigation database. Flight crew and operators can view the LOA status at FlyGarmin.com then select "Type 2 LOA Status." Navigation information is referenced to WGS-84 reference system.

Note that for some types of aircraft operation and for operation in non-U.S. airspace, separate operational approval(s) may be required in addition to equipment installation and airworthiness approval.

1.3 Electronic Flight Bag

The GTN as installed in this aircraft supports approval of AC 120-76A Hardware Class 3, Software Type C Electronic Flight Bag (EFB) electronic aeronautical chart applications when using current FliteChart or ChartView data. Additional operational approvals may be required. For operations under 14 CFR Part 91, Garmin suggests that a secondary or back up source of aeronautical information necessary for the flight be available to the pilot in the airplane. The secondary or backup information may be either traditional paper-based material or displayed electronically. If the source of aeronautical information is in electronic format, operators must determine non-interference with the GTN system and existing aircraft systems for all flight phases.

1.4 Definitions

The following terminology is used within this document:

ADF:	Automatic Direction Finder
APR:	Approach
CDI:	Course Deviation Indicator
DME:	Distance Measuring Equipment
EFB:	Electronic Flight Bag
EHSI:	Electronic Horizontal Situation Indicator
GNSS:	Global Navigation Satellite System
GPS:	Global Positioning System
GPSS:	GPS Roll Steering
GTN:	Garmin Touchscreen Navigator
HSI:	Horizontal Situation Indicator
IAP:	Instrument Approach Procedure
IFR:	Instrument Flight Rules
ILS:	Instrument Landing System
IMC:	Instrument Meteorological Conditions
LDA:	Localizer Directional Aid
LNAV:	Lateral Navigation
LNAV+V:	Lateral Navigation with advisory Vertical Guidance
L/VNAV:	Lateral/Vertical Navigation
LOC:	Localizer
LOC-BC:	Localizer Backcourse
LP:	Localizer Performance
LPV:	Localizer Performance with Vertical Guidance
MLS:	Microwave Landing System
OBS:	Omnibearing Select
RAIM:	Receiver Autonomous Integrity Monitoring
RMT:	Remote
RNAV:	Area Navigation
RNP:	Required Navigational Performance
SBAS:	Satellite Based Augmentation System
SD:	Secure Digital

SDF:	Simplified Directional Facility
SUSP:	Suspend
TACAN:	Tactical Air Navigation System
TAS:	Traffic Awareness System
TAWS:	Terrain Awareness and Warning System
TCAS:	Traffic Collision Avoidance System
TIS:	Traffic Information Service
VHF:	Very High Frequency
VFR:	Visual Flight Rules
VLOC:	VOR/Localizer
VMC:	Visual Meteorological Conditions
VOR:	VHF Omnidirectional Range
WAAS:	Wide Area Augmentation System
WFDE:	WAAS Fault Data Exclusion
XFR:	Transfer

Section 2. LIMITATIONS

2.1 Cockpit Reference Guide

The Garmin GTN 6XX or GTN 7XX Cockpit Reference Guide, part number and revision listed below (or later revisions), *must* be immediately available to the flight crew whenever navigation is predicated on the use of the GTN.

- GTN 6XX Cockpit Reference Guide P/N 190-01004-04 Rev A
- GTN 7XX Cockpit Reference Guide P/N 190-01007-04 Rev A

2.2 Kinds of Operation

This AFM supplement does not grant approval for IFR operations to aircraft limited to VFR operations.

IFR approved aircraft may have a GTN installed that is limited to VFR operations only. GTN installations limited to VFR are placarded in close proximity to the GTN: "**GPS LIMITED TO VFR USE ONLY**". Systems with this placard are not approved for GPS navigation during IFR operations.

2.3 Minimum Equipment

If the installation of the GTN is not limited to VFR, the GTN must have the following system interfaces fully functional in order to be used for IFR operations:

Interfaced Equipment	Number installed	Number Required for IFR
External HSI/CDI/EHSI	1 or more	1
External GPS Annunciator	See Note 1	1

Table 1 – Required Equipment

Note 1: Certain installations require an external GPS annunciator panel. If installed, this annunciator must be fully functional to use the GTN for IFR operations.

Single engine piston aircraft under 6,000 lbs maximum takeoff weight:
Required Equipment for IFR operations: Single GTN Navigator

Single engine turbine aircraft or multi-engine piston aircraft under 6,000 lbs maximum takeoff weight:
Required Equipment for IFR operations: Single GTN Navigator plus a second source of GPS navigation or a separate source of VHF navigation.

Operation in remote or oceanic operation requires two sources of GPS navigation.

Aircraft over 6,000 lbs maximum takeoff weight:
Required Equipment for IFR operations: Single GTN Navigator plus a second source of GPS navigation or a separate source of VHF navigation.

Operation in remote or oceanic operation requires two sources of GPS navigation.

2.4 Flight Planning

For flight planning purposes, in areas where SBAS coverage is not available, the pilot must check RAIM availability. Within the United States, RAIM availability can be determined using the Garmin WFDE Prediction program, Garmin part number 006-A0154-04 (included in GTN trainer) software version 3.00 or later approved version with Garmin approved antennas or the FAA's en route and terminal RAIM prediction website: www.raimprediction.net, or by contacting a Flight Service Station. Within Europe, RAIM availability can be determined using the Garmin WFDE Prediction program or Europe's AUGER GPS RAIM Prediction Tool at http://augur.ecacnav.com/augur/app/home. For other areas, use the Garmin WFDE Prediction program. This requirement is not necessary if SBAS coverage is confirmed to be available along the entire route of flight. The route planning and WFDE prediction program may be downloaded from the Garmin website on the internet. For information on using the WFDE Prediction Program, refer to Garmin WAAS FDE Prediction Program, part number 190-00643-01, 'WFDE Prediction Program Instructions'.

For flight planning purposes, operations within the U.S. National Airspace System on RNP and RNAV procedures when SBAS signals are not available, the availability of GPS RAIM shall be confirmed for the intended route of flight. In the event of a predicted continuous loss of RAIM of more than five minutes for any part of the intended route of flight, the flight should be delayed, canceled, or rerouted on a track where RAIM requirements can be met. The flight may also be re-planned using non-GPS based navigational capabilities.

For flight planning purposes for operations within European B-RNAV/RNAV 5 and P-RNAV airspace, if more than one satellite is scheduled to be out of service, then the availability of GPS RAIM shall be confirmed for the intended flight (route and time). In the event of a predicted continuous loss of RAIM of more than five minutes for any part of the intended flight, the flight should be delayed, canceled, or rerouted on a track where RAIM requirements can be met.

Applicable to installations consisting of two GTNs: For flight planning purposes, operations where the route requires Class II navigation the aircraft's operator or pilot-in-command must use the Garmin WFDE Prediction program to demonstrate that there are no outages on the specified route that would prevent the Garmin GNSS navigation system to provide GPS Class II navigation in oceanic and remote areas of operation that requires (RNP-10 or RNP-4) capability. If the Garmin WFDE Prediction program indicates fault exclusion (FDE) availability will exceed 34 minutes in accordance with FAA Order 8400.12A for RNP-10 requirements, or 25 minutes in accordance with FAA Order 8400.33 for RNP-4 requirements, then the operation must be rescheduled when FDE is available.

Both Garmin GPS navigation receivers must be operating and providing GPS navigation guidance for operations requiring RNP-4 performance.

Applicable to installations consisting of two GTNs: North Atlantic (NAT) Minimum Navigational Performance Specifications (MNPS) Airspace operations per AC 91-49 and AC 120-33 require both GPS/SBAS receivers to be operating and receiving usable signals except for routes requiring only one Long Range Navigation sensor. Each display computes an independent navigation solution based on its GPS sensor.

Whenever possible, RNP and RNAV routes including Standard Instrument Departures (SIDs) and Obstacle Departure Procedures (ODPs), Standard Terminal Arrival (STAR), and enroute RNAV "Q" and RNAV "T" routes should be loaded into the flight plan from the database in their entirety, rather than loading route waypoints from the database into the flight plan individually. Selecting and inserting individual named fixes from the database is permitted, provided all fixes along the published route to be flown are inserted. Manual entry of waypoints using latitude/longitude or place/bearing is prohibited.

It is not acceptable to flight plan a required alternate airport based on RNAV(GPS) LP/LPV or LNAV/VNAV approach minimums. The required alternate airport must be flight planned using an LNAV approach minimums or available ground-based approach aid.

Navigation information is referenced to the WGS-84 reference system, and should only be used where the Aeronautical Information Publication (including electronic data and aeronautical charts) conform to WGS-84 or equivalent.

2.5 System Use

In installations with two GTNs and an external GPS annunciator (See Table 1) the GTN connected to the external GPS annunciator must be used as the navigation source for all operations.

The only approved sources of course guidance are on the external CDI, HSI, or EHSI display. The moving map and CDI depiction on the GTN display are for situational awareness only and are not approved for course guidance.

2.6 Applicable System Software

This AFMS/AFM is applicable to the software versions shown in Table 2.

The Main and GPS software versions are displayed on the start-up page immediately after power-on. All software versions displayed in Table 2 can be viewed on the System – System Status page.

Software Item	**Software Version** *(or later FAA Approved versions for this STC)*
Main SW Version	2.00
GPS SW Version	4.0
Com SW Version	2.00
Nav SW Version	6.01

Table 2 - Software Versions

2.7 SD Card

Proper function of the unit is predicated on the SD card being present. Garmin cannot assure functionality if the SD card is inserted or removed while the unit is powered on.

2.8 Navigation Database

GPS/SBAS based IFR enroute, oceanic, and terminal navigation is prohibited unless the pilot verifies and uses a valid, compatible, and current Navigation database or verifies each waypoint for accuracy by reference to current approved data.

"GPS", "or GPS", and "RNAV (GPS)" instrument approaches using the Garmin navigation system are prohibited unless the pilot verifies and uses the current Navigation database. GPS based instrument approaches must be flown in accordance with an approved instrument approach procedure that is loaded from the Navigation database.

Discrepancies that invalidate a procedure should be reported to Garmin International. The affected procedure is prohibited from being flown using data from the Navigation database until a new Navigation database is installed in the aircraft and verified that the discrepancy has been corrected. Navigation database discrepancies can be reported at FlyGarmin.com by selecting "Aviation Data Error Report." Flight crew and operators can view Navigation database alerts at FlyGarmin.com then select "NavData Alerts."

If the Navigation database cycle will change during flight, the pilot must ensure the accuracy of navigation data, including suitability of navigation facilities used to define the routes and procedures for flight. If an amended chart affecting navigation data is published for the procedure, the database must not be used to conduct the procedure.

2.9 Ground Operations

Do not use SafeTaxi or Chartview functions as the basis for ground maneuvering. SafeTaxi and Chartview functions do not comply with the requirements of AC 20-159 and are not qualified to be used as an airport moving map display (AMMD). SafeTaxi and Chartview are to be used by the flight crew to orient themselves on the airport surface to improve pilot situational awareness during ground operations.

2.10 Approaches

a) Instrument approaches using GPS guidance may only be conducted when the GTN is operating in the approach mode. (LNAV, LNAV+V, L/VNAV, LPV, or LP)
b) When conducting instrument approaches referenced to true North, the NAV Angle on the System -Units page must be set to **True**.
c) The navigation equipment required to join and fly an instrument approach procedure is indicated by the title of the procedure and notes on the IAP chart. Navigating the final approach segment (that segment from the final approach fix to the missed approach point) of an ILS, LOC, LOC-BC, LDA, SDF, MLS, VOR, TACAN approach, or any other type of approach not approved for GPS, is not authorized with GPS navigation guidance. GPS guidance can only be used for approach procedures with GPS or RNAV in the procedure title. When using the Garmin VOR/LOC/GS receivers to fly the final approach segment, VOR/LOC/GS navigation data must be selected and presented on the CDI of the pilot flying.
d) Advisory vertical guidance deviation is provided when the GTN annunciates LNAV + V. Vertical guidance information displayed on the VDI in this mode is only an aid to help pilots comply with altitude restrictions. When using advisory vertical guidance, the pilot must use the primary barometric altimeter to ensure compliance with all altitude restrictions.
e) Not all published Instrument Approach Procedures (IAP) are in the Navigation database. Pilots planning to fly an RNAV instrument approach must ensure that the Navigation database contains the planned RNAV Instrument Approach Procedure and that approach procedure must be loaded from the Navigation database into the GTN system flight plan by its name. Users are prohibited from flying any approach path that contains manually entered waypoints.

f) IFR approaches are prohibited whenever any physical or visual obstruction (such as a throw-over yoke) restricts pilot view or access to the GTN and/or the CDI.

2.11 Autopilot Coupling

IFR installations of a GTN allow the pilot to fly all phases of flight based on the navigation information presented to the pilot; however, not all modes may be coupled to the autopilot. All autopilots may be coupled in Oceanic (OCN), Enroute (ENR), and Terminal (TERM) modes.

This installation is limited to:

- ☐ Lateral coupling only for GPS approaches. Coupling to the vertical path for GPS approaches is not authorized.

2.12 Terrain Proximity Function (All Units)

Terrain and obstacle information appears on the map and terrain display pages as red and yellow tiles or towers, and is depicted for advisory use only. Aircraft maneuvers and navigation must not be predicated upon the use of the terrain display. Terrain and obstacle information is advisory only and is not equivalent to warnings provided by TAWS.

The terrain display is intended to serve as a situational awareness tool only. By itself, it may not provide either the accuracy or the fidelity on which to base decisions and plan maneuvers to avoid terrain or obstacles.

NOTE

Terrain and TAWS are separate features and mutually exclusive. If "TAWS B" is shown on the bottom right of the dedicated terrain page, then TAWS is installed.

2.13 TAWS Function (Optional)

Pilots are authorized to deviate from their current ATC clearance to the extent necessary to comply with TAWS warnings. Navigation must not be predicated upon the use of TAWS.

If an external TAWS annunciator panel is installed in the aircraft, this annunciator panel must be fully functional in order to use the TAWS system.

NOTE

Terrain and TAWS are separate features and mutually exclusive. If "TAWS B" is shown on the bottom right of the dedicated terrain page, then TAWS is installed.

2.14 Datalinked Weather Display (XM Weather, Optional)

Datalink weather data is provided by an optional GDL 69 or 69A interface. The weather information display on the GTN is a supplementary weather product for enhanced situational awareness only and may not be used in lieu of an official weather data source. Use of the datalink weather display for hazardous weather (e.g. thunderstorm) penetration is prohibited.

2.15 Traffic Display (Optional)

Traffic may be displayed on the GTN when connected to an approved optional TCAS I, TAS, or TIS traffic device. These systems are capable of providing traffic monitoring and alerting to the pilot. Traffic shown on the display may or may not have traffic alerting available. The display of traffic is an aid to visual acquisition and may not be utilized solely for aircraft maneuvering.

2.16 StormScope® Display (Optional)

StormScope® lightning information displayed by the GTN is limited to supplemental use only. The use of the StormScope® lightning data on the display for hazardous weather (thunderstorm) penetration is prohibited. StormScope® lightning data on the display is intended only as an aid to enhance situational awareness of hazardous weather, not penetration. It is the pilot's responsibility to avoid hazardous weather using official weather data sources.

When the GTN StormScope® page is operating in track up mode as indicated by the "TRK UP" label at the upper right corner of the StormScope® page, use of the GTN to display StormScope® information is prohibited while on the ground.

2.17 Flight Planner/Calculator Functions

When using the calculator/planner pages data must be entered into all data fields and verified by the pilot prior to use of the data. Depending on system configuration, the "Use Sensor Data" button may populate the Indicated ALT window with indicated altitude or pressure altitude. The pilot must verify the desired altitude and appropriate barometric pressure setting to ensure valid calculations. Aircraft performance or fuel loading must not be predicated upon the use of data derived from these functions.

2.18 Glove Use / Covered Fingers

No device may be used to cover fingers used to operate the GTN unless the Glove Qualification Procedure located in the Pilot's Guide has been successfully completed. The Glove Qualification Procedure is specific to a pilot / glove / GTN 725, 750 or GTN 625, 635, 650 combination.

2.19 Demo Mode

Demo mode may not be used in flight under any circumstances.

Section 3. EMERGENCY PROCEDURES

3.1 Emergency Procedures

3.1.1 TAWS WARNING

Red annunciator and aural "PULL UP":

Autopilot .... **DISCONNECT**
Aircraft Controls .... **INITIATE MAXIMUM POWER CLIMB**
Airspeed .... **BEST ANGLE OF CLIMB SPEED**

After Warning Ceases:

Power .... **MAXIMUM CONTINUOUS**
Altitude .... **CLIMB AND MAINTAIN SAFE ALTITUDE**
Advise ATC of Altitude Deviation, if appropriate.

NOTE

Only vertical maneuvers are recommended, unless either operating in visual meteorological conditions (VMC), or the pilot determines, based on all available information, that turning in addition to the escape maneuver is the safest course of action, or both.

3.2 Abnormal Procedures

3.2.1 LOSS OF GPS/SBAS NAVIGATION DATA

When the GPS/SBAS receiver is inoperative or GPS navigation information is not available or invalid, the GTN will enter one of two modes: Dead Reckoning mode (DR) or Loss Of Integrity mode (LOI). The mode is indicated on the GTN by an amber "DR" or "LOI".

If the Loss Of Integrity annunciation is displayed, revert to an alternate means of navigation appropriate to the route and phase of flight.

If the Dead Reckoning annunciation is displayed, the map will continue to be displayed with an amber 'DR' overwriting the ownship icon. Course guidance will be removed on the CDI. Aircraft position will be based upon the last valid GPS position, then estimated by Dead Reckoning methods. Changes in true airspeed, altitude, heading, or winds aloft can affect the estimated position substantially. Dead Reckoning is only available in Enroute and Oceanic modes. Terminal and Approach modes do not support Dead Reckoning.

If Alternate Navigation Sources (ILS, LOC, VOR, DME, ADF) Are Available:

Navigation.. **USE ALTERNATE SOURCES**

If No Alternate Navigation Sources Are Available:

DEAD RECKONING (DR) MODE:

Navigation... **USE GTN**

NOTE

- All information normally derived from GPS will become less accurate over time.

LOSS OF INTEGRITY (LOI) MODE:

Navigation..................... **FLY TOWARDS KNOWN VISUAL CONDITIONS**

NOTE

- All information derived from GPS will be removed.
- The airplane symbol is removed from all maps. The map will remain centered at the last known position. "NO GPS POSITION" will be annunciated in the center of the map.

3.2.2 GPS APPROACH DOWNGRADE

During a GPS LPV, LNAV/VNAV, or LNAV+V approach, if GPS accuracy requirements cannot be met by the GPS receiver, the GTN will downgrade the approach. The downgrade will remove vertical deviation indication from the VDI and change the approach annunciation accordingly from LPV, L/VNAV, or LNAV+V to LNAV. The approach may be continued using the LNAV only minimums.

During a GPS approach in which GPS accuracy requirements cannot be met by the GPS receiver for any GPS approach type, the GTN will flag all CDI guidance and display a system message "ABORT APPROACH-GPS approach no longer available". Immediately upon viewing the message, the unit will revert to Terminal navigation mode alarm limits. If the position integrity is within these limits lateral guidance will be restored and the GPS may be used to execute the missed approach, otherwise alternate means of navigation must be utilized.

3.2.3 LOSS OF COM RADIO TUNING FUNCTIONS

If alternate COM is available:

Communications .... **USE ALTERNATE COM**

If no alternate COM is available:

COM RMT XFR key (if installed)...... **PRESS AND HOLD FOR 2 SECONDS**

NOTE

This procedure will tune the active COM radio the emergency frequency 121.5, regardless of what frequency is displayed on the GTN. Certain failures of the tuning system will automatically tune 121.5 without pilot action.

3.2.4 LOSS OF AUDIO PANEL FUNCTIONS (GMA 35 Only)

Audio Panel Circuit Breaker ....**PULL**

NOTE

This procedure will force the audio panel to provide the pilot only with communications on the Non-GTN 750 radio. If only a GTN 750 is installed in the aircraft, then the pilot will have communications on the GTN 750. The crew and passenger intercom will not function.

3.2.5 TAWS CAUTION (Terrain or Obstacle Ahead, Sink Rate, Don't Sink)

When a TAWS CAUTION occurs, take corrective action until the alert ceases. Stop descending or initiate either a climb or a turn, or both as necessary, based on analysis of all available instruments and information.

3.2.6 TAWS INHIBIT

The TAWS Forward Looking Terrain Avoidance (FLTA) and Premature Descent Alerts (PDA) functions may be inhibited to prevent alerting, if desired. Refer to GTN Cockpit Reference Guide for additional information.

To Inhibit TAWS:

Home Hardkey .... PRESS
Terrain Button .... PRESS
Menu Button .... PRESS
TAWS Inhibit Button .... PRESS TO ACTIVATE

3.2.7 TER N/A and TER FAIL

If the amber **TER N/A** or **TER FAIL** status annunciator is displayed, the system will no longer provide TAWS alerting or display relative terrain and obstacle elevations. The crew must maintain compliance with procedures that ensure minimum terrain and obstacle separation.

3.2.8 HEADING DATA SOURCE FAILURE

Without a heading source to the GTN, the following features will not operate:

- GPSS will not be provided to the autopilot for heading legs. The autopilot must be placed in HDG mode for heading legs.
- Map cannot be oriented to Heading Up.
- All overlaying traffic data from a TAS/TCAS I system on the main map display. The pilot must use the dedicated traffic page on the GTN system to display TAS/TCAS I data.
- All overlaying StormScope® data on the main map display. The pilot must use the dedicated StormScope® page on the GTN system to display StormScope® data.

StormScope® must be operated in accordance with Section 7.8 when no heading is available.

3.2.9 PRESSURE ALTITUDE DATA SOURCE FAILURE

Without a pressure altitude source to the GTN, the following features will not operate:

- Automatic leg sequencing of legs requiring an altitude source. The pilot must manually sequence altitude legs, as prompted by the system.

Section 4. NORMAL PROCEDURES

Refer to the Cockpit Reference Guide defined in Section 2.1 of this document or the Pilot's Guide defined in Section 7.1 for normal operating procedures and a complete list of system messages and associated pilot actions. This includes all GPS operations, VHF communication and navigation, traffic, data linked weather, StormScope®, TAWS, and Multi-Function Display information.

The GTN requires a reasonable degree of familiarity to prevent operations without becoming too engrossed at the expense of basic instrument flying in IMC and basic see-and-avoid in VMC. Garmin provides training tools with the Pilot's Guide and PC based simulator. Pilots should take full advantage of these training tools to enhance system familiarization.

4.1 Unit Power On

Database .... **REVIEW EFFECTIVE DATES**
Self Test .... **VERIFY OUTPUTS TO NAV INDICATORS**
Self Test - TAWS Remote Annunciator:
  PULL UP .... **ILLUMINATED**
  TERR .... **ILLUMINATED**
  TERR N/A .... **ILLUMINATED**
  TERR INHB .... **ILLUMINATED**
Self Test - GPS Remote Annunciator:
  VLOC .... **ILLUMINATED**
  GPS .... **ILLUMINATED**
  LOI or INTG .... **ILLUMINATED**
  TERM .... **ILLUMINATED**
  WPT .... **ILLUMINATED**
  APR .... **ILLUMINATED**
  MSG .... **ILLUMINATED**
  SUSP or OBS .... **ILLUMINATED**

4.2 Before Takeoff

System Messages and Annunciators .... **CONSIDERED**

4.3 HSI and EHSI Operation

If an HSI is used to display navigation data from the GTN the pilot should rotate the course pointer as prompted on the GTN.

If an EHSI is used to display navigation data from the GTN the course pointer may autoslew to the correct course when using GPS navigation. When using

VLOC navigation the course pointer will not autoslew and must be rotated to the correct course by the pilot. For detailed information about the functionality of the EHSI system, refer to the FAA approved Flight Manual or Flight Manual Supplement for that system.

CAUTION

The pilot must verify proper course selection each time the CDI source is changed from GPS to VLOC.

4.4 Autopilot Operation

The GTN may be coupled to an optional autopilot, if installed in the aircraft, when operating as prescribed in the LIMITATIONS section of this manual.

Autopilots coupled to the GTN system in an analog (NAV) mode will follow GPS or VHF navigation guidance as they would with existing VOR receivers.

Autopilots that support GPSS or GPS Roll Steering in addition to the analog course guidance will lead course changes, fly arcing procedures, procedure turns, and holding patterns if coupled in GPSS mode.

For autopilot operating instructions, refer to the FAA approved Flight Manual or Flight Manual Supplement for the autopilot.

4.5 Coupling the Autopilot during approaches

CAUTION

When the CDI source is changed on the GTN, autopilot mode may change. Confirm autopilot mode selection after CDI source change on the GTN. Refer to the FAA approved Flight Manual or Flight Manual Supplement for the autopilot.

☐ This installation prompts the pilot and requires the pilot to enable the approach outputs just prior to engaging the autopilot in APR mode.

To couple an approach:
Once established on the final approach course with the final approach fix as the active waypoint, the GTN will issue a flashing message indication.

Flashing Message Button .... **PRESS**
"Enable APR Output" Button .... **PRESS**

If coupled, Autopilot will revert to ROL mode at this time.

Autopilot .... **ENGAGE APPROACH MODE**

☐ This installation supports coupling to the autopilot in approach mode once vertical guidance is available.

To couple an approach:
Once established on the final approach course with the final approach fix as the active waypoint, the GTN will enable vertical guidance.

Vertical Guidance .... **CONFIRM AVAILABLE**
Autopilot .... **ENGAGE APPROACH MODE**

☐ The autopilot does not support any vertical capture or tracking in this installation.

Analog only autopilots should use APR mode for coupling to LNAV approaches. Autopilots which support digital roll steering commands (GPSS) may utilize NAV mode and take advantage of the digital tracking during LNAV only approaches.

Section 5. PERFORMANCE

No change.

Section 6. WEIGHT AND BALANCE

See current weight and balance data.

Section 7. SYSTEM DESCRIPTIONS

7.1 Pilot's Guide

The Garmin GTN 6XX or GTN 7XX Pilot's Guide, part number and revision listed below, contain additional information regarding GTN system description, control and function. The Pilot's Guides *do not* need to be immediately available to the flight crew.

- GTN 6XX Pilot's Guide — P/N 190-01004-03 Rev A or later
- GTN 7XX Pilot's Guide — P/N 190-01007-03 Rev A or later

7.2 Leg Sequencing

The GTN supports all ARINC 424 leg types. Certain leg types require altitude input in order to sequence (course to altitude, for example). If a barometric corrected altitude source is not interfaced to the GTN, a popup will appear prompting the pilot to manually sequence the leg once the altitude prescribed in the procedure is reached.

☐ This installation *has* a barometric corrected altitude source. The GTN will automatically sequence altitude legs.

☐ This installation *does not have* a barometric corrected altitude source. The pilot will be prompted to manually sequence altitude legs.'

7.3 Auto ILS CDI Capture

Auto ILS CDI Capture will not automatically switch from GPS to VLOC for LOC-BC or VOR approaches.

7.4 Activate GPS Missed Approach

If the GTN displays a CDI key on the Map Page (GTN 750) or Default Nav Page (GTN 650) the GTN *will* autoswitch from VLOC to GPS when the "Activate GPS Missed Approach" button is pressed.

If the GTN *does not* display a CDI key on the Map Page (GTN 750) or Default Nav Page (GTN 650) the GTN *will not* autoswitch from VLOC to GPS when the "Activate GPS Missed Approach" button is pressed. The pilot must manually switch from VLOC to GPS if GPS guidance is desired after the missed approach point.

7.5 Terrain Proximity and TAWS

- The Terrain Database has an area of coverage from North 75° Latitude to South 60° Latitude in all longitudes.
- The Obstacle Database has an area of coverage that includes the United States and Europe, and is updated as frequently as every 56 days.
- To avoid unwanted alerts, TAWS may be inhibited when landing at an airport that is not included in the airport database.

NOTE

The area of coverage may be modified as additional terrain data sources become available.

☐ This installation supports *Terrain Proximity. No aural or visual alerts* for terrain or obstacles are provided. Terrain Proximity *does not* satisfy the TAWS requirement of 91.223.

☐ This installation supports *TAWS B*. Aural and visual alerts *will be* provided. This installation *does* support the TAWS requirement of 91.223.

7.6 GMA 35 Audio Panel (Optional)

The GTN 725 and 750 can interface to a GMA 35 remotely mounted audio panel and marker beacon receiver. Controls for listening to various radios, activating the cabin speaker, clearance playback control, and marker beacon are accessed by pressing the "Audio Panel" button on the GTN display screen. Volume controls for the audio panel are accessed by pressing the "Intercom" button on the GTN display screen.

7.7 Traffic System (Optional)

This system is configured for the following type of traffic system. The Garmin GTN 6XX or GTN 7XX Cockpit Reference Guide or Garmin GTN 6XX or GTN 7XX Pilot's Guide provides additional information regarding the functionality of the traffic device.

☐ No traffic system is interfaced to the GTN.

☐ A TAS/TCAS I traffic system is interfaced to the GTN.

☐ A TIS traffic system is interfaced to the GTN.

7.8 StormScope® (Optional)

When optionally interfaced to a StormScope® weather detection system, the GTN may be used to display the StormScope® information. Weather information supplied by the StormScope® will be displayed on the StormScope® page of the GTN system. For detailed information about the capabilities and limitations of the StormScope® system, refer to the documentation provided with that system.

Heading Up mode:

If the GTN system is receiving valid heading information, the StormScope® page will operate in the heading up mode as indicated by the label "HDG UP" presented at the upper right corner of the display. In this mode, information provided by the StormScope® system is displayed relative to the nose of the aircraft and is automatically rotated to the correct relative position as the aircraft turns.

Track Up mode:

If the GTN system is not receiving valid heading information, either because a compatible heading system is not installed, or the interfaced heading system has malfunctioned, the StormScope® page will operate in the track up mode as indicated by the label "TRK UP" in the upper right corner of the display. When operating in the track up mode, StormScope® information is displayed relative to the current GPS track of the aircraft and is automatically rotated as the aircraft turns. In track up mode, the pilot must be aware that, if the combination of aircraft speed and crosswind results in a crab angle to maintain the track, the relative bearing of StormScope® information on the GTN display will be offset by an amount equal to the aircraft crab angle. Because the difference between GPS track and aircraft heading can be very large when on the ground, use of the GTN to display StormScope® information in TRK UP mode is prohibited while on the ground.

7.9 Power

- Power to the GTN is provided through a circuit breaker labeled NAV/GPS (1/2).
- Power to the optional GTN COM is provided through a circuit breaker labeled COMM (1/2)
- Power to the optional GMA 35 is powered through a circuit breaker labeled AUDIO.

7.10 Databases

Database versions and effective dates are displayed on the start-up page immediately after power-on. Database information can also be viewed on the System – System Status page.

The Obstacle Database coverage area includes the United States and Europe.

7.11 External Switches

External switches may be installed and interfaced to the GTN. These switches may be stand alone, or integrated with a TAWS or GPS annunciator. Table 3 lists the switches and function they perform:

Switch Label	Function
CDI	Toggles between GPS / VLOC sources. This switch may be part of an external annunciator panel.
COM CHAN DN	Toggles down through the preset com frequencies.
COM CHAN UP	Toggles up through the preset com frequencies.
COM RMT XFR	Transfers the com active / standby frequencies.
NAV RMT XFR	Transfers the nav active / standby frequencies.
OBS	Performs an OBS or SUSP function. This switch is part of an external annunciator panel and is placarded with the following: "Green OBS indicates OBS or SUSP mode – GTN annunciator bar indicates which is active. Push OBS button to change OBS or SUSP mode."
OBS/SUSP	Performs an OBS or SUSP function.
TERR INHB	Toggles the TAWS Inhibit function on/off. This switch is part of an external annunciator panel. The terrain display is still presented if TAWS is Inhibited.

Table 3 – External Switches

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AIRPLANE FLIGHT MANUAL SUPPLEMENT

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SUPPLEMENTAL AIRPLANE FLIGHT MANUAL

Garmin GTX 330/33 with ADS-B Out

Dwg. Number: 190-00734-15 Rev. 1

This document serves as an FAA Approved Airplane Flight Manual Supplement or Supplemental Airplane Flight Manual when the GTX 330/33 with ADS-B Out is installed in accordance with Supplemental Type Certificate SA01714WI. This document must be incorporated into the FAA Approved Airplane Flight Manual or provided as an FAA Approved Supplemental Airplane Flight Manual.

The information contained herein supplements the FAA approved Airplane Flight Manual. For limitations, procedures, loading and performance information not contained in this document, refer to the FAA approved Airplane Flight Manual, markings, or placards.

Make and Model Airplane: Cessna 414A

Airplane Serial Number: 414A-0641

Airplane Registration Number: N78DG

FAA Approved:

[signature]

Robert Murray
ODA STC Unit Administrator
Garmin International, Inc
ODA-240087-CE

Date: 5/1/2013

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for

Garmin GTX 330/33 with ADS-B Out

Log of Revisions

REV NO.	PAGE NO(S)	DESCRIPTION	DATE OF APPROVAL	FAA APPROVED
1	ALL	Original Issue	See Cover	See Cover

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Section 1. General

1.1 GTX 330/33 ES

The Garmin GTX family consists of the GTX 330 and GTX 33 (Non-Diversity Mode S Transponders) and the GTX 330D and GTX 33D (Diversity Mode S Transponders). The ES option of any of the transponders provides ADS-B extended Squitter functionality.

All Garmin GTX transponders are a radio transmitter/receiver that operates on radar frequencies, receiving ground radar or TCAS interrogations at 1030 MHz and transmitting a coded response of pulses to ground-based radar on a frequency of 1090 MHz. Each unit is equipped with IDENT capability and will reply to ATCRBS Mode A, Mode C and Mode S All-Call interrogation. Interfaces to the GTX 330/33 are shown in the following block diagrams.

Figure 1. GTX 330 or GTX 330D Interface Summary

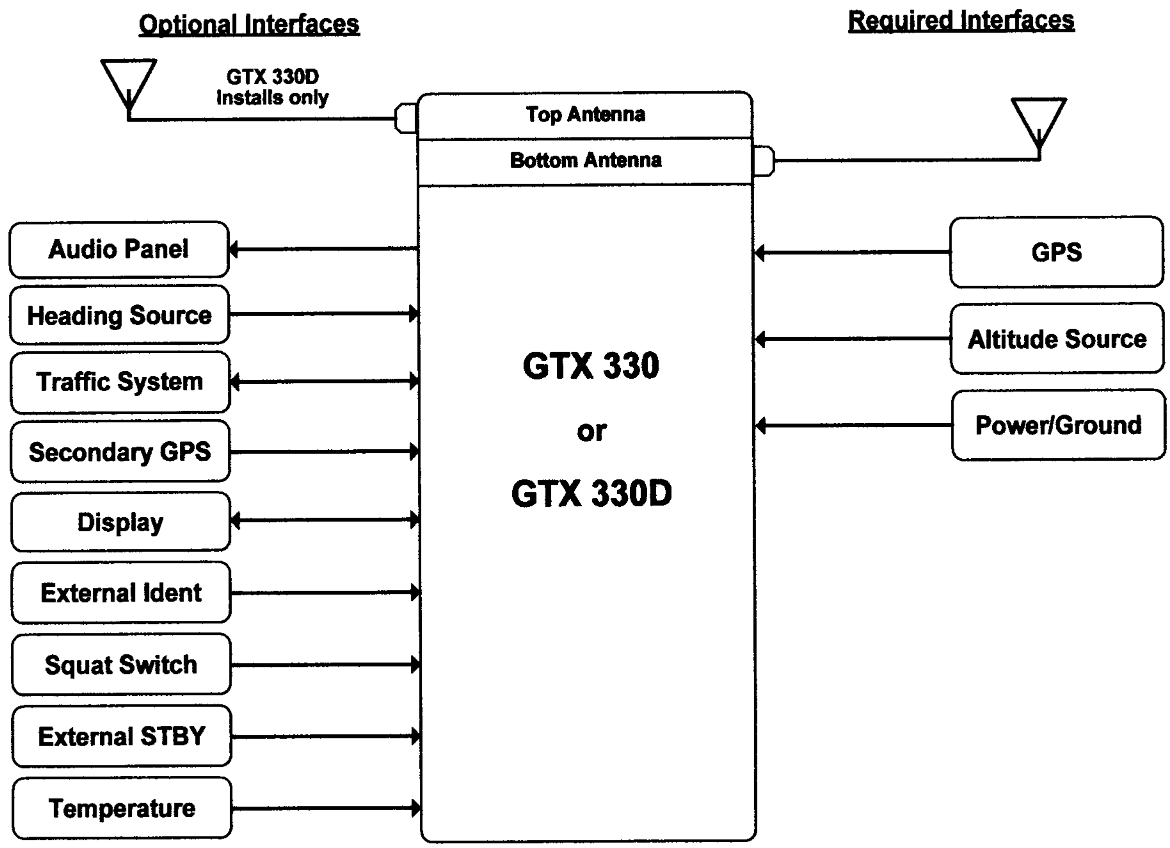
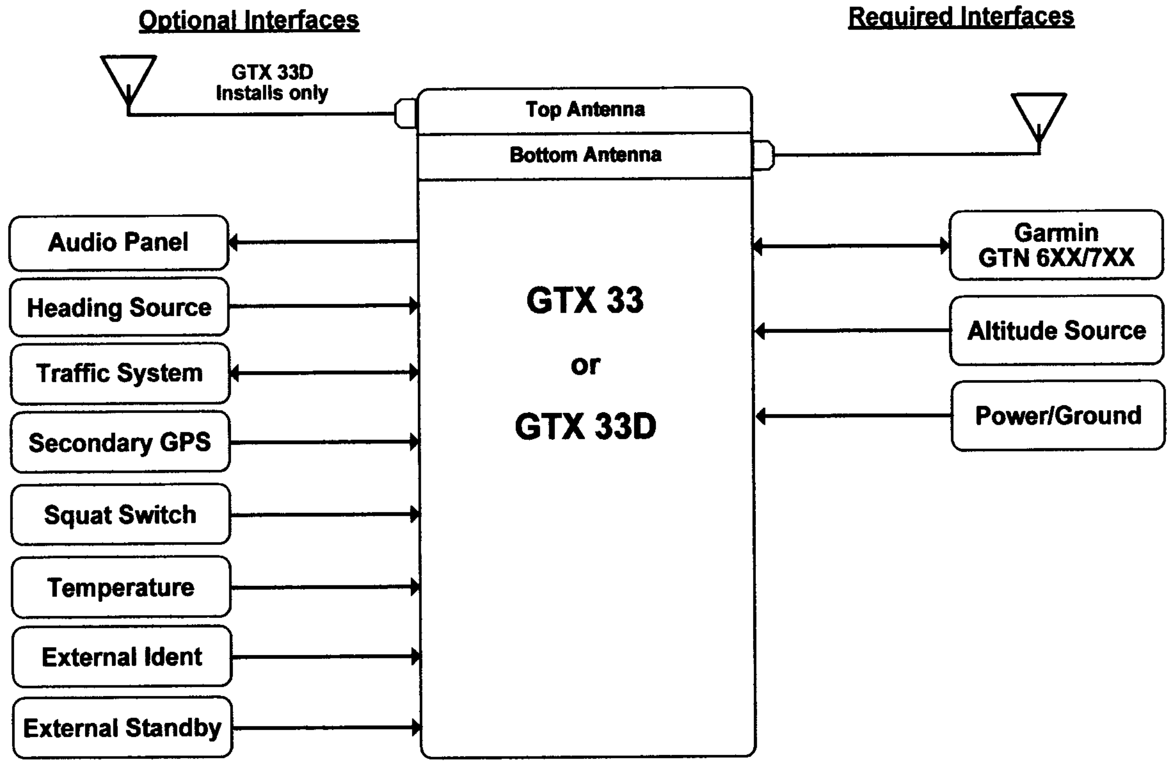


Figure 2. GTX 33 or GTX 33D Interface Summary



The GTX 330/33 performs the following ADS-B Out functions:

- Transmission of ADS-B out data on 1090 extended squitter (1090ES) (1090 MHz)
- Integration of data from internal and external sources to transmit the following data per 14 CFR 91.227:
    - GPS Position, Altitude, and Position Integrity
    - Ground Track and/or Heading, Ground Speed, and Velocity Integrity
    - Air Ground Status
    - Flight ID, Call Sign, ICAO Registration Number
    - Capability and Status Information
    - Transponder squawk code, IDENT, and emergency status
- Pressure Altitude Broadcast Inhibit

1.2 Capabilities

The Garmin GTX 330/33 with ADS-B Out functionality as installed in this aircraft has been shown to meet the equipment requirements of 14 CFR § 91.227.

1.3 Installation Configuration

This aircraft is equipped with a GTX 330/33 with ADS-B Out system with the following interfaces/ features:

Equipment Installed:

☐ #1 GTX 330	☐ #1 GTX 33
☐ #1 GTX 330D	☐ #1 GTX 33D
☐ #2 GTX 330	☐ #2 GTX 33
☐ #2 GTX 330D	☐ #2 GTX 33D

Interfaced GTN 6XX/7XX or GNS 4XX/5XX Position Source(s):

	Transponder (#1 or #2)		Transponder (#1 or #2)		Transponder (#1 or #2)
☐ GTN 725	______	☐ GNS 430AW	______	☐ GNS 530AW	______
☐ GTN 750	______	☐ GNS 430W	______	☐ GNS 530W	______
☐ GTN 625	______	☐ GNC 420AW	______	☐ GPS 500W	______
☐ GTN 635	______	☐ GNC 420W	______		
☐ GTN 650	______	☐ GPS 400W	______		

1.4 Definitions

The following terminology is used within this document:

ADS-B: Automatic Dependent Surveillance-Broadcast

AFM: Airplane Flight Manual

AFMS: Airplane Flight Manual Supplement

ATCRBS: Air Traffic Control Radar Beacon System

CFR: Code of Federal Regulations

ES: Extended Squitter

GNSS: Global Navigation Satellite System

GNS: Garmin Navigation System

GPS: Global Positioning System

GTX: Garmin Transponder

GTN: Garmin Touchscreen Navigator

ICAO: International Civil Aviation Organization

LRU: Line Replaceable Unit

PABI: Pressure Altitude Broadcast Inhibit

POH: Pilot Operating Handbook

SBAS: Satellite-Based Augmentation System

SW: Software

TCAS: Traffic Collision Avoidance System

TX: Transmit

Section 2. Limitations

2.1 Minimum Equipment

The GTX 330/33 with ADS-B Out must have the following system interfaces fully functional in order to be compliant with the requirements for 14 CFR 91.227 ADS-B Out operations:

Table 1. Required Equipment

Interfaced Equipment	Number Installed	Number Required
Uncorrected Pressure Altitude Source	1	1
GPS SBAS Position Source	1 or more	1
GTN series navigator (for aircraft equipped with GTX 33/33D only)	1 or more	1

2.2 ADS-B Out

The GTX 330/33 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational. When the system is not operational, ADS-B Out transmit failure messages will be present on the GTN control interface, or GTX 330 display.

2.3 Applicable System Software

This AFMS/AFM is applicable to the software versions shown in Table 2.

The Main GTX software version is displayed on the splash screen during start up, for the GTX 330, and the external LRU page on the GTN for the GTX 33.

Table 2. Software Versions

Software Item	Software Version *(or later FAA Approved versions for this STC)*
Main SW Version	7.02

2.4 Pressure Altitude Broadcast Inhibit (PABI)

Pressure Altitude Broadcast Inhibit shall only be enabled when requested by Air Traffic Control while operating within airspace requiring an ADS-B Out compliant transmitter, per 14 CFR 91.227. PABI is enabled by selecting the GTX to ON mode.

Section 3. Emergency Procedures

3.1 Emergency Procedures

None

3.2 Abnormal Procedures

3.2.1 Abnormal Indications

The loss of an interfaced input to the GTX 330/33 may cause the transponder to stop transmitting ADS-B Out data. Depending on the nature of the fault or failure, the GTX may no longer be transmitting all of the required data in the ADS-B Out messages.

For GTX 330 installations:

If the GTX 330 detects any internal faults or failures with the ADS-B Out functionality, the GTX 330 will annunciate this event via the NO ADSB annunciator on the GTX 330 display screen. When the GTX 330 annunciates the NO ADSB annunciation, one of the following failures or faults have occurred:

- Loss of adequate GPS position data
- ADS-B TX (transmit) is selected OFF

When the GTX 330 annunciates FAIL to the flight crew, the GTX 330 has detected an internal failure and no transponder data is transmitted.

When a GTX 330 NO ADSB, or FAIL annunciation is received, verify proper operation of all interfaced equipment (refer to Section 1.3) as the failure of one of these devices could be the cause of the abnormal indication.

For GTX 33 installations:

Reference Display Device documentation for applicable annunciations.

3.2.2 Loss of Aircraft Electrical Power Generation

Loss of electrical power generation .... **REMOVE POWER FROM GTX**

If the GTX should be load shed due to a loss of electrical power generation, ADS-B Out data will no longer be available.

NOTE

This guidance is supplementary to any guidance provided in the POH or AFM for the installed aircraft for loss of power generation.

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3.2.3 Loss of GPS/SBAS Navigation Data

When the GPS/SBAS receiver is inoperative or GPS position information is not available or invalid, the GTX will no longer be transmitting ADS-B Out data.

For GTX 330 installations:

NO ADSB annunciator illuminated:

Interfaced GPS position sources.. **VERIFY VALID POSITION**

For GTX 33 installations:

Reference Display Device documentation for applicable annunciation:

Interfaced GPS position sources.. **VERIFY VALID POSITION**

Section 4. Normal Procedures

The procedures described below are specific only to the GTX 330. Cockpit Reference Guides and Pilot Guides for interfaced displays will provide additional operating information specific to the displays or other traffic systems.

ADS-B Out functionality resides within the GTX transponders thereby providing a single point of entry for Mode 3/A code, Flight ID, IDENT functionality and activating or deactivating emergency status for both transponder and ADS-B Out functions. Details on performing these procedures are located in the GTX 330/330D Pilot's Guide.

4.1 Unit Power On

NO ADSB .... **CONSIDERED**

NOTE

The NO ADS-B Annunciation (or associated display annunciations) may illuminate as the unit powers on and begins to receive input from external systems, to include the SBAS position source.

4.2 Before Takeoff

NO ADSB .... **EXTINGUISHED**

NOTE

The NO ADS-B Annunciation (or associated display annunciations) must be **EXTINGUISHED** for the system to meet the requirements specified in 14 CFR 91.227. This system must be operational (NO ADSB annunciator **EXTINGUISHED**) in certain airspaces after January 1, 2020 as specified by 14 CFR 91.225.

Section 5. Performance

No Change

Section 6. Weight and Balance

See current Weight and Balance data

Section 7. Systems Description

The Garmin GTX 330 Pilot's Guide, part number and revision listed below, contain additional information regarding GTX system description, control, and function. Pilots Guides for interfaced displays, part number and revision listed below, provide additional operating information for the Garmin GTX 33.

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Title	**Part Number**	**Revision**
GTX 330 Pilot's Guide	190-00207-00	Rev G (or later)
Garmin GTN 725/750 Pilot's Guide	190-01007-03	Rev. E (or later)
Garmin GTN 625/635/650 Pilot's Guide	190-01004-03	Rev. E (or later)

Section 8. Handling, Service, and Maintenance

No Change

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Garmin GTX 330/33 with ADS-B Out

Dwg. Number: 190-00734-15 Rev. 1

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Make and Model Airplane: Cessna 414A

Airplane Serial Number: 414A-0641

Airplane Registration Number: N78DG

FAA Approved:

[signature]

Robert Murray
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ODA-240087-CE

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1.1 GTX 330/33 ES

The Garmin GTX family consists of the GTX 330 and GTX 33 (Non-Diversity Mode S Transponders) and the GTX 330D and GTX 33D (Diversity Mode S Transponders). The ES option of any of the transponders provides ADS-B extended Squitter functionality.

All Garmin GTX transponders are a radio transmitter/receiver that operates on radar frequencies, receiving ground radar or TCAS interrogations at 1030 MHz and transmitting a coded response of pulses to ground-based radar on a frequency of 1090 MHz. Each unit is equipped with IDENT capability and will reply to ATCRBS Mode A, Mode C and Mode S All-Call interrogation. Interfaces to the GTX 330/33 are shown in the following block diagrams.

Figure 1. GTX 330 or GTX 330D Interface Summary

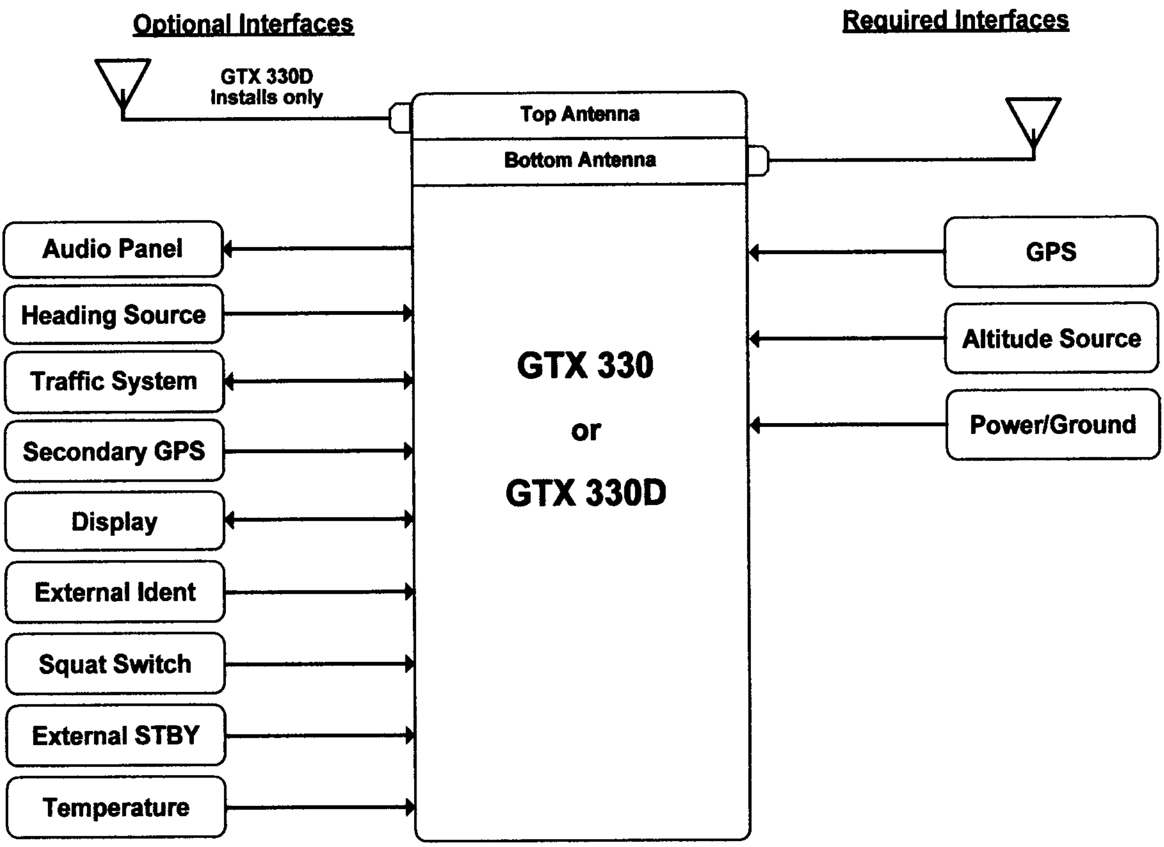
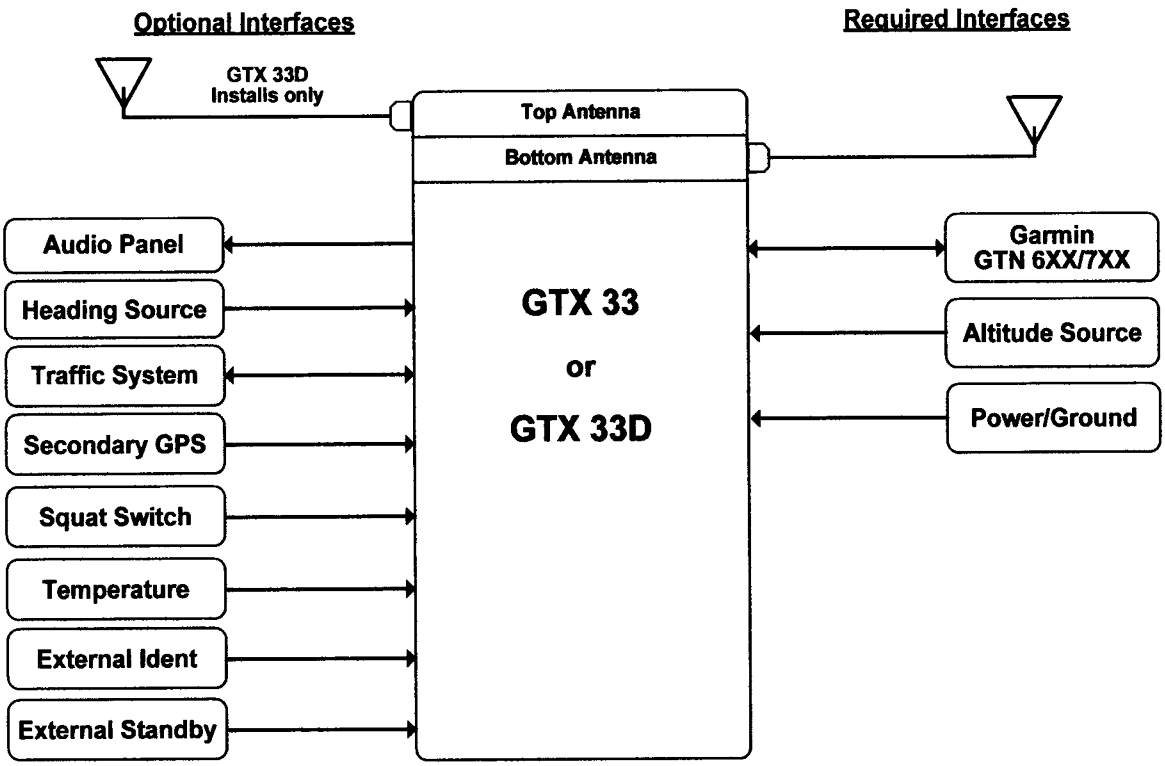


Figure 2. GTX 33 or GTX 33D Interface Summary



The GTX 330/33 performs the following ADS-B Out functions:

- Transmission of ADS-B out data on 1090 extended squitter (1090ES) (1090 MHz)
- Integration of data from internal and external sources to transmit the following data per 14 CFR 91.227:
    - oGPS Position, Altitude, and Position Integrity
    - oGround Track and/or Heading, Ground Speed, and Velocity Integrity
    - oAir Ground Status
    - oFlight ID, Call Sign, ICAO Registration Number
    - oCapability and Status Information
    - oTransponder squawk code, IDENT, and emergency status
- Pressure Altitude Broadcast Inhibit

1.2 Capabilities

The Garmin GTX 330/33 with ADS-B Out functionality as installed in this aircraft has been shown to meet the equipment requirements of 14 CFR § 91.227.

1.3 Installation Configuration

This aircraft is equipped with a GTX 330/33 with ADS-B Out system with the following interfaces/ features:

Equipment Installed:

☐ #1 GTX 330	☐ #1 GTX 33
☐ #1 GTX 330D	☐ #1 GTX 33D
☐ #2 GTX 330	☐ #2 GTX 33
☐ #2 GTX 330D	☐ #2 GTX 33D

Interfaced GTN 6XX/7XX or GNS 4XX/5XX Position Source(s):

	Transponder (#1 or #2)		Transponder (#1 or #2)		Transponder (#1 or #2)
☐ GTN 725	______	☐ GNS 430AW	______	☐ GNS 530AW	______
☐ GTN 750	______	☐ GNS 430W	______	☐ GNS 530W	______
☐ GTN 625	______	☐ GNC 420AW	______	☐ GPS 500W	______
☐ GTN 635	______	☐ GNC 420W	______		
☐ GTN 650	______	☐ GPS 400W	______		

1.4 Definitions

The following terminology is used within this document:

ADS-B: Automatic Dependent Surveillance-Broadcast

AFM: Airplane Flight Manual

AFMS: Airplane Flight Manual Supplement

ATCRBS: Air Traffic Control Radar Beacon System

CFR: Code of Federal Regulations

ES: Extended Squitter

GNSS: Global Navigation Satellite System

GNS: Garmin Navigation System

GPS: Global Positioning System

GTX: Garmin Transponder

GTN: Garmin Touchscreen Navigator

ICAO: International Civil Aviation Organization

LRU: Line Replaceable Unit

PABI: Pressure Altitude Broadcast Inhibit

POH: Pilot Operating Handbook

SBAS: Satellite-Based Augmentation System

SW: Software

TCAS: Traffic Collision Avoidance System

TX: Transmit

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Section 2. Limitations

2.1 Minimum Equipment

The GTX 330/33 with ADS-B Out must have the following system interfaces fully functional in order to be compliant with the requirements for 14 CFR 91.227 ADS-B Out operations:

Table 1. Required Equipment

Interfaced Equipment	Number Installed	Number Required
Uncorrected Pressure Altitude Source	1	1
GPS SBAS Position Source	1 or more	1
GTN series navigator (for aircraft equipped with GTX 33/33D only)	1 or more	1

2.2 ADS-B Out

The GTX 330/33 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational. When the system is not operational, ADS-B Out transmit failure messages will be present on the GTN control interface, or GTX 330 display.

2.3 Applicable System Software

This AFMS/AFM is applicable to the software versions shown in Table 2.

The Main GTX software version is displayed on the splash screen during start up, for the GTX 330, and the external LRU page on the GTN for the GTX 33.

Table 2. Software Versions

Software Item	Software Version *(or later FAA Approved versions for this STC)*
Main SW Version	7.02

2.4 Pressure Altitude Broadcast Inhibit (PABI)

Pressure Altitude Broadcast Inhibit shall only be enabled when requested by Air Traffic Control while operating within airspace requiring an ADS-B Out compliant transmitter, per 14 CFR 91.227. PABI is enabled by selecting the GTX to ON mode.

Section 3. Emergency Procedures

3.1 Emergency Procedures

None

3.2 Abnormal Procedures

3.2.1 Abnormal Indications

The loss of an interfaced input to the GTX 330/33 may cause the transponder to stop transmitting ADS-B Out data. Depending on the nature of the fault or failure, the GTX may no longer be transmitting all of the required data in the ADS-B Out messages.

For GTX 330 installations:

If the GTX 330 detects any internal faults or failures with the ADS-B Out functionality, the GTX 330 will annunciate this event via the NO ADSB annunciator on the GTX 330 display screen. When the GTX 330 annunciates the NO ADSB annunciation, one of the following failures or faults have occurred:

- Loss of adequate GPS position data
- ADS-B TX (transmit) is selected OFF

When the GTX 330 annunciates FAIL to the flight crew, the GTX 330 has detected an internal failure and no transponder data is transmitted.

When a GTX 330 NO ADSB, or FAIL annunciation is received, verify proper operation of all interfaced equipment (refer to Section 1.3) as the failure of one of these devices could be the cause of the abnormal indication.

For GTX 33 installations:

Reference Display Device documentation for applicable annunciations.

3.2.2 Loss of Aircraft Electrical Power Generation

Loss of electrical power generation .... **REMOVE POWER FROM GTX**

If the GTX should be load shed due to a loss of electrical power generation, ADS-B Out data will no longer be available.

NOTE

This guidance is supplementary to any guidance provided in the POH or AFM for the installed aircraft for loss of power generation.

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3.2.3 Loss of GPS/SBAS Navigation Data

When the GPS/SBAS receiver is inoperative or GPS position information is not available or invalid, the GTX will no longer be transmitting ADS-B Out data.

For GTX 330 installations:

NO ADSB annunciator illuminated:

Interfaced GPS position sources.. **VERIFY VALID POSITION**

For GTX 33 installations:

Reference Display Device documentation for applicable annunciation:

Interfaced GPS position sources.. **VERIFY VALID POSITION**

Section 4. Normal Procedures

The procedures described below are specific only to the GTX 330. Cockpit Reference Guides and Pilot Guides for interfaced displays will provide additional operating information specific to the displays or other traffic systems.

ADS-B Out functionality resides within the GTX transponders thereby providing a single point of entry for Mode 3/A code, Flight ID, IDENT functionality and activating or deactivating emergency status for both transponder and ADS-B Out functions. Details on performing these procedures are located in the GTX 330/330D Pilot's Guide.

4.1 Unit Power On

NO ADSB .... **CONSIDERED**

NOTE

The NO ADS-B Annunciation (or associated display annunciations) may illuminate as the unit powers on and begins to receive input from external systems, to include the SBAS position source.

4.2 Before Takeoff

NO ADSB .... **EXTINGUISHED**

NOTE

The NO ADS-B Annunciation (or associated display annunciations) must be **EXTINGUISHED** for the system to meet the requirements specified in 14 CFR 91.227. This system must be operational (NO ADSB annunciator **EXTINGUISHED**) in certain airspaces after January 1, 2020 as specified by 14 CFR 91.225.

Section 5. Performance

No Change

Section 6. Weight and Balance

See current Weight and Balance data

Section 7. Systems Description

The Garmin GTX 330 Pilot's Guide, part number and revision listed below, contain additional information regarding GTX system description, control, and function. Pilots Guides for interfaced displays, part number and revision listed below, provide additional operating information for the Garmin GTX 33.

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Title	Part Number	Revision
GTX 330 Pilot's Guide	190-00207-00	Rev G (or later)
Garmin GTN 725/750 Pilot's Guide	190-01007-03	Rev. E (or later)
Garmin GTN 625/635/650 Pilot's Guide	190-01004-03	Rev. E (or later)

Section 8. Handling, Service, and Maintenance

No Change

SECTION 9
SUPPLEMENTS
TABLE OF CONTENTS

LOG OF REVISIONS

Supplement pages which have been added/revised/deleted since the original issue of this manual are listed below.

Supplement Number and Name:		Pages Added/ Deleted/Revised		Revision Number/Date
2	Air Conditioning System	1 of 3	(Revised)	Revision 1 - 2 Apr 1982
6	Deice Boot System	1 of 4	(Revised)	Revision 1 - 2 Apr 1982
6	Deice Boot System	2 of 4	(Revised)	Revision 1 - 2 Apr 1982
6	Deice	3 of 4	(Revised)	Revision 1 - 2 Apr 1982
6	Deice Boot System	4 of 4	(Revised)	Revision 1 - 2 Apr 1982
8	Electric Elevator Trim	1 of 1	(Revised)	Revision 1 - 2 Apr 1982
9	AC Electrical Windshield Anti-Ice System	1 of 2	(Revised)	Revision 2 - 1 Jun 1994
10	DC Electrical Windshield Anti-Ice System	1 of 2	(Added)	Revision 2 - 1 Jun 1994
10	DC Electrical Windshield Anti-Ice System	2 of 2	(Added)	Revision 2 - 1 Jun 1994
11	Flight in Icing Conditions (w/AC Electrical Windshield)	1 of 4	(Revised)	Revision 2 - 1 Jun 1994
11	Flight In Icing Conditions (w/AC Electrical Windshield)	2 of 4	(Revised)	Revision 2 - 1 Jun 1994
11	Flight in Icing Conditions (w/AC Electrical Windshield)	3 of 4	(Revised)	Revision 2 - 1 Jun 1994
11	Flight in Icing Conditions (w/AC Electrical Windshield)	4 of 4	(Revised)	Revision 2 - 1 Jun 1994
11A	Flight in Icing Conditions (w/DC Electrical Windshield)	1 of 4	(Added)	Revision 2 - 1 Jun 1994
11A	Flight In Icing Conditions (w/DC Electrical Windshield)	2 of 4	(Added)	Revision 2 - 1 Jun 1994
11A	Flight in Icing Conditions (w/DC Electrical Windshield)	3 of 4	(Added)	Revision 2 - 1 Jun 1994
11A	Flight in Icing Conditions (w/DC Electrical Windshield)	4 of 4	(Added)	Revision 2 - 1 Jun 1994
12	Fire Detection and Extinguishing System	2 of 2	(Revised)	Revision 1 - 2 Apr 1982
27	100 Audio Control Panel	1 of 4	(Revised)	Revision 1 - 2 Apr 1982
27	100 Audio Control Panel	2 of 6	(Revised)	Revision 1 - 2 Apr 1982
27	100 Audio Control Panel	3 of 6	(Revised)	Revision 1 - 2 Apr 1982
27	100 Audio Control Panel	4 of 6	(Revised)	Revision 1 - 2 Apr 1982
27	100 Audio Control Panel	5 of 6	(Revised)	Revision 1 - 2 Apr 1982
27	100 Audio Control Panel	6 of 6	(Revised)	Revision 1 - 2 Apr 1982
31	Navomatic Autopilot System	2 of 12	(Revised)	Revision 1 - 2 Apr 1982
31	Navomatic Autopilot System	3 of 12	(Revised)	Revision 1 - 2 Apr 1982
38	400B Integrated Flight Control System	2 of 17	(Revised)	Revision 1 - 2 Apr 1982
38	400B Integrated Flight Control System	3 of 17	(Revised)	Revision 1 - 2 Apr 1982

LOG OF REVISIONS (Continued)

Supplement Number and Name:		Pages Added/ Deleted/Revised		Revision Number/Date
39	800B Integrated Flight Control System	2 of 16	(Revised)	Revision 1 - 2 Apr 1982
39	800B Integrated Flight Control System	3 of 16	(Revised)	Revision 1 - 2 Apr 1982
55	Weather Radar-Color Display Primus 200	1 of 4	(Revised)	Revision 1 - 2 Apr 1982
55	Weather Radar-Color Display Primus 200	2 of 4	(Revised)	Revision 1 - 2 Apr 1982

INTRODUCTION

Section 9 of this handbook provides supplemental information for optional equipment which may be installed on the airplane. Each supplement covers one item of optional equipment. To make it easier to locate a particular supplement within Section 9, supplements are arranged in alphabetical order and assigned reference numbers which are listed in sequence.

AIR CONDITION SYSTEM

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the air conditioning system.

Description

The air conditioning system, see Figure 1, consists of a hydraulically driven compressor and condenser in the right nacelle, two evaporators aft of the pilot's and copilot's seats, a control panel, located on the lower part of the left instrument panel, and a green monitor light on the annunciator panel.

The hydraulic drive for the compressor consists of an engine-driven hydraulic pump, a hydraulic fluid reservoir, an unloading valve and a hydraulic motor. During normal engine operation, with the air conditioning system switch to OFF or CIRCULATE, the unloading valve routes hydraulic fluid from the hydraulic pump back to the reservoir so that the hydraulic motor is disengaged; the green monitor light, see Figure 7-3, will be OFF during this condition. When the air conditioning system switch is turned to COOL, the unloading valve forces hydraulic fluid to flow from the hydraulic pump to the hydraulic motor and opens the condenser air inlet door. During preflight inspections, the spring-loaded condenser air inlet door may be actuated by hand without harm to the system. The hydraulic motor drives the compressor to provide conditioned air to the cabin. The green monitor light will come on when the compressor is operating and will cycle off when the cabin temperature corresponds with the temperature control rheostat setting. The monitor light may flicker for two to three minutes prior to turning off due to the required work load on the hydraulic system as the temperature condition becomes satisfied.

The two evaporators and blower motors distribute conditioned air to the cabin area via overhead ducts. Circuit breakers are provided for each blower, right and left, to allow limited operation of the system.

The system control panel consists of two switches and a rheostat. The system switch, placarded COOL-OFF-CIRCULATE, controls the mode of operation. The blower switch, placarded HIGH-LOW, controls the blower speed. The blower will operate whenever the system switch is in either the COOL or CIRCULATE mode. The temperature control rheostat, placarded COOLER, controls the temperature of the conditioned air. Clockwise rotation of the temperature control lowers the air temperature.

CAUTION

- To prevent damage to the air conditioning compressor, Do Not operate the air conditioning system in COOL when the outside air temperature is below 20°F (-6.7°C).
- When the outside air temperature is greater than 20°F (-6.7°C), freon loss and servicing intervals may be reduced by placing the air conditioning selector switch in COOL for 5 minutes each week.

AIR CONDITIONING SCHEMATIC

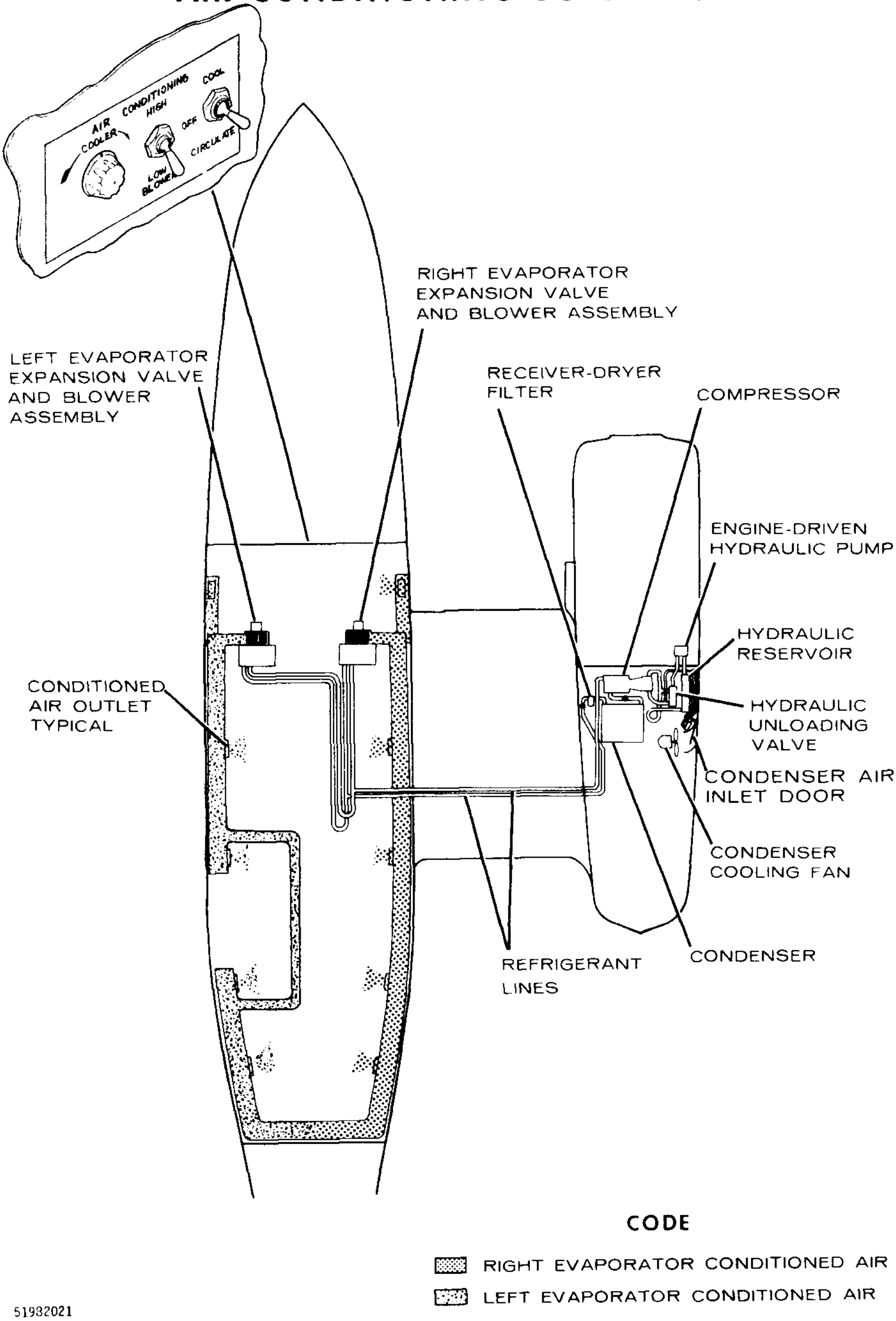


Figure 1

SECTION 2 — LIMITATIONS

A. System must be "OFF" or "CIRCULATE" for takeoff, landing and single-engine operation.
B. Required Placards:
   1. Inside Right Wing Locker Baggage Door.
      a. "MAXIMUM BAGGAGE - 120 LBS."

SECTION 3 — EMERGENCY PROCEDURES

A. Engine Inoperative Procedures
   1. Air Conditioner - OFF or CIRCULATE.

SECTION 4 — NORMAL PROCEDURES

A. Starting Procedures
   1. Air Conditioner - Check OFF.
B. Before Taxi
   1. Air Conditioner - As Desired.
C. Before Takeoff
   1. Air Conditioner - OFF or CIRCULATE.
D. After Takeoff
   1. Air Conditioner - As Desired.
E. Before Landing
   1. Air Conditioner - OFF or CIRCULATE.
F. After Landing
   1. Air Conditioner - As Desired.

SECTION 5 — PERFORMANCE

Not Applicable.

ALCOHOL WINDSHIELD DEICE SYSTEM

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the alcohol windshield deice system.

Description

The alcohol windshield deice system consists of an alcohol tank, a pump, a dispersal tube for each windshield and a switch breaker.

The alcohol tank, located in the aft end of the right wing locker, has a 3.0-gallon capacity. The tank should be filled with isopropyl alcohol only. Water dilution of the alcohol is not recommended, as any water contained in the alcohol will reduce the efficiency of ice removal and may freeze on the windshield at very low temperatures. The pump, located adjacent to the tank, provides positive pressure to each windshield dispersal tube. A dispersal tube, located at the forward base of each windshield, provides flow pattern control throughout the airplane's speed envelope. Each tube contains five holes which should be inspected and cleaned with a small diameter wire as necessary.

Abnormal operation of the alcohol windshield deice system is indicated by the switch breaker tripping to the OFF position or failure of alcohol to flow onto the windshield.

SECTION 2 — LIMITATIONS

A. Discontinue alcohol dispersal 20 seconds before reaching minimum descent altitude.
B. Do not operate system longer than 3 minutes without alcohol flow.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. Preflight Inspection
   1. Windshield Dispersal Tubes - CHECK condition and cleanliness.
   2. Alcohol Tank Level - CHECK. Full tank provides approximately 1 hour of continuous operation. If alcohol deicing is installed on left or right windshield only, approximately 2 hours of continuous operation is available.

B. Before Takeoff
   1. Alcohol Windshield Switch - ON. Allow 10 seconds for alcohol flow to begin. Check 5 dispersal holes for flow at the base of each windshield.
   2. Alcohol Windshield Switch - OFF.

C. In Flight
1. During Icing Encounters:
a. Alcohol Windshield Switch - ON.

NOTE

For operation in continuous enroute icing conditions, allow approximately 1/8 to 1/4 inch of ice to accumulate. The windshield deice system can be used as an anti-ice system by continuous use and should be so used during the approach to landing. However, the maximum endurance with a 3.0-gallon tank is approximately 1.0 hour of continuous operation. If alcohol deicing is installed on left or right windshield only, approximately 2 hours of continuous operation is available. Airspeed should be 140 KIAS or below for best results.

b. Alcohol Windshield Switch - OFF after ice removal.

D. Approach to Landing

WARNING

The windshield deice switch breaker must be positioned OFF 20 seconds prior to reaching minimum descent altitude. The alcohol film must be allowed to evaporate before a clear field of vision through the windshield is available.

SECTION 5 – PERFORMANCE

Not Applicable.

ANGLE-OF-ATTACK SYSTEM

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the angle-of-attack system.

Description

The angle-of-attack system, see Figure 1, is a sensitive lift measurement device which provides a continuous evaluation of lift performance of the airplane, regardless of weight, wing loading, attitude, air density, turbulence, and gear/flap configuration. The system consists of an indicator, stall warning horn test switch, computer and lift sensor. The lift sensor is located in the leading edge of the left wing. The standard airplane stall warning system is removed and its function is assumed by the angle-of-attack system.

The red "SLOW" zone on the left side of the indicator shows the trend toward stall. The stall warning horn will sound at least 5 KCAS above the airplane stall speed.

A PRESS-TO-TEST feature is incorporated to test the general condition of the system. When the test switch is pressed, the pointer should move to the SLOW end of the scale and the stall warning horn should sound.

ANGLE-OF-ATTACK INDICATOR

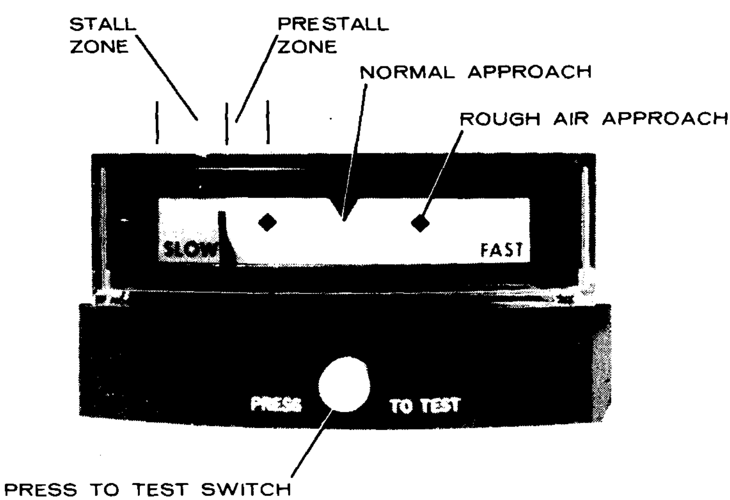


Figure 1

SECTION 2 – LIMITATIONS

The angle-of-attack indicating system may be used as a reference system but does not replace the airspeed indicator as a primary instrument. Operations utilizing the angle-of-attack indicating system, except as stated herein, are not approved.

SECTION 3 – EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 – NORMAL PROCEDURES

A. Preflight Inspection

1. Stall Warning Vane - CHECK freedom of movement and audible warning. Gently push the vane down to the stop; the indicator pointer should move to the full right FAST legend. Gently push the vane up to the stop; the indicator pointer should move to the full left SLOW legend and the prestall warning horn should activate.

NOTE

Satisfactory operation of the stall warning transmitter heating element is determined by observing a discharge on the voltammeter when the stall heat switch is turned on. The operation of the heating element may be verified by cautiously feeling the heat of this device while the switch is on.

B. Descent

1. Angle-of-Attack Indicator - CROSS-CHECK with airspeed indicator.

For a normal approach to landing, the pointer should be aligned with the center-mark. Alignment of the pointer with the "FAST" diamond provides a more comfortable airspeed margin for an approach in turbulent or gusty conditions.

To correct for an off-speed condition a small attitude correction should be held while waiting to see the result on the indicator. "Chasing" the pointer may result in a longitudinal, pilot-induced oscillation. The instrument is intended to be used as a reference to assist in determining the proper speed for the landing approach. The airspeed indicator is still the primary instrument for speed control.

SECTION 5 – PERFORMANCE

Not Applicable.

DAVTRON 811B DIGITAL CLOCK

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the Davtron 811B digital clock.

Description

The Davtron 811B, 24-hour, digital clock, see Figure 1, is a solid-state timing device which presents real time, flight time and elapsed time. The clock's internal memory is maintained, regardless of the airplane battery switch position, by a nonchargeable clock battery. This clock battery should be replaced every three years. The clock's light emitting diode (LED) displays require airplane electrical power.

All operating controls (four switches) are provided on the face of the clock.

The SET switch is used to make minor corrections to the real time memory of the clock. This switch should be used only after checking the clock with an accurate time reference such as the National Bureau of Standards time broadcast. If the clock is found to be inaccurate, position the SET switch to UP for the number of seconds the clock is slow or to D for the number of seconds the clock is fast. The flight time and elapsed time functions will operate normally during the setting of the real time function, therefore, the elapsed time display can be used to time the holding of the SET switch.

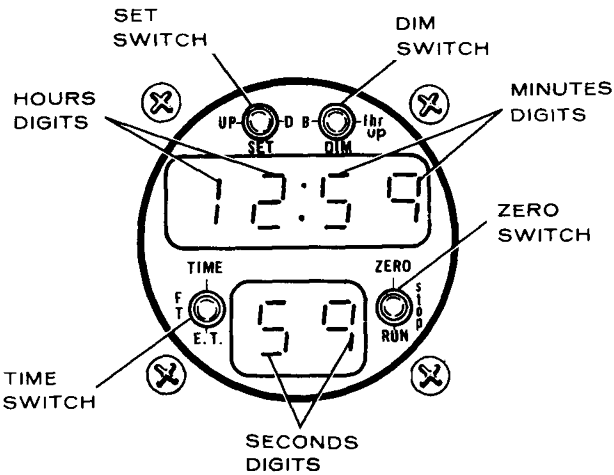
The DIM switch is used to make one-hour changes to the real time and to set the light intensity for day and night flight operations. If real time changes of hours only are required, each momentary actuation of the DIM switch to the 1 hr position will advance the real time one hour. During daylight operations, the switch should be positioned to B. During night operations, the DIM position will decrease illumination intensity to a desirable level.

The ZERO switch is used to zero, stop or run the flight time or elapsed time functions. Actuation of the switch to the ZERO position will zero the elapsed time and zero the flight time if the airplane battery switch is in the OFF position. Actuation of the switch to the STOP position will stop the elapsed time function. Actuation of the switch to the RUN position will start the elapsed time function.

The TIME switch is used to display real time, flight time or elapsed time in hours, minutes and seconds in the two display windows. When the switch is positioned to TIME, the real time will be displayed.

When the switch is positioned to ET, the elapsed time will be displayed. When the switch is positioned to FT, the flight time will be displayed. The flight time function is wired through the landing gear safety switch; thus, flight time can only be accumulated when the weight of the airplane is off the landing gear.

DIGITAL CLOCK



1. SET SWITCH - Used to correct real time in seconds. UP position advances real time while D position retards real time.
2. DIM SWITCH - Used to set display illumination intensity and to advance real time in one-hour increments.
3. ZERO SWITCH - Used to stop, start and zero the elapsed time function. The flight time function can also be zeroed if the airplane battery switch is OFF.
4. TIME SWITCH - Used to display real time, flight time or elapsed time functions in hours, minutes and seconds.

Figure 1

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 – NORMAL PROCEDURES

A. Before Starting The Engines
   1. Zero Switch - ZERO momentarily to zero the elapsed flight time functions.
   2. Dim Switch - AS REQUIRED.

SECTION 5 – PERFORMANCE

Not Applicable.

DEICE BOOT SYSTEM

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the deice boot system.

Description

This system is designed to remove ice after accumulation, rather than prevent ice formation.

The deice boot system consists of pneumatically operated boots, engine-driven pneumatic pumps, an annunciator light to monitor system operation and necessary hardware to complete the system.

The deice boots are attached to the leading edges of the wing and stabilizers. The boots expand and contract, using pressure and vacuum from the engine-driven vacuum pumps. Normally, vacuum is applied to all boots to hold them against the leading edge surfaces. When a deicing cycle is initiated, the vacuum is removed from the boots and a pressure is applied to "blow up" the boots. This change in contour will break the ice accumulation on the leading edges. Ice formations aft of this area will then be removed by normal in-flight air forces.

The deice system will operate satisfactorily on either or both engines. During single-engine operation, suction to the gyros will drop momentarily during the boot inflation cycle.

The deicing system is manually controlled by actuating the surface deice switch each time a deice cycle is desired. The switch will instantly spring back to OFF; however, a 12-second delay action by the sequencing system will complete the deicing inflation cycle.

The sequencing system inflates the tail section boots for approximately 6 seconds, then the wing boots for the next 6 seconds. The annunciator light, see Figure 7-3, should illuminate when the tail section boots reach proper operating pressure. No cyclic illumination after selecting a deice cycle indicates insufficient pressure for proper system operation and icing conditions should be avoided. The system may be recycled 6 seconds after the light goes out or anytime thereafter as required.

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

Not Applicable.

DEICE BOOT SYSTEM SCHEMATIC

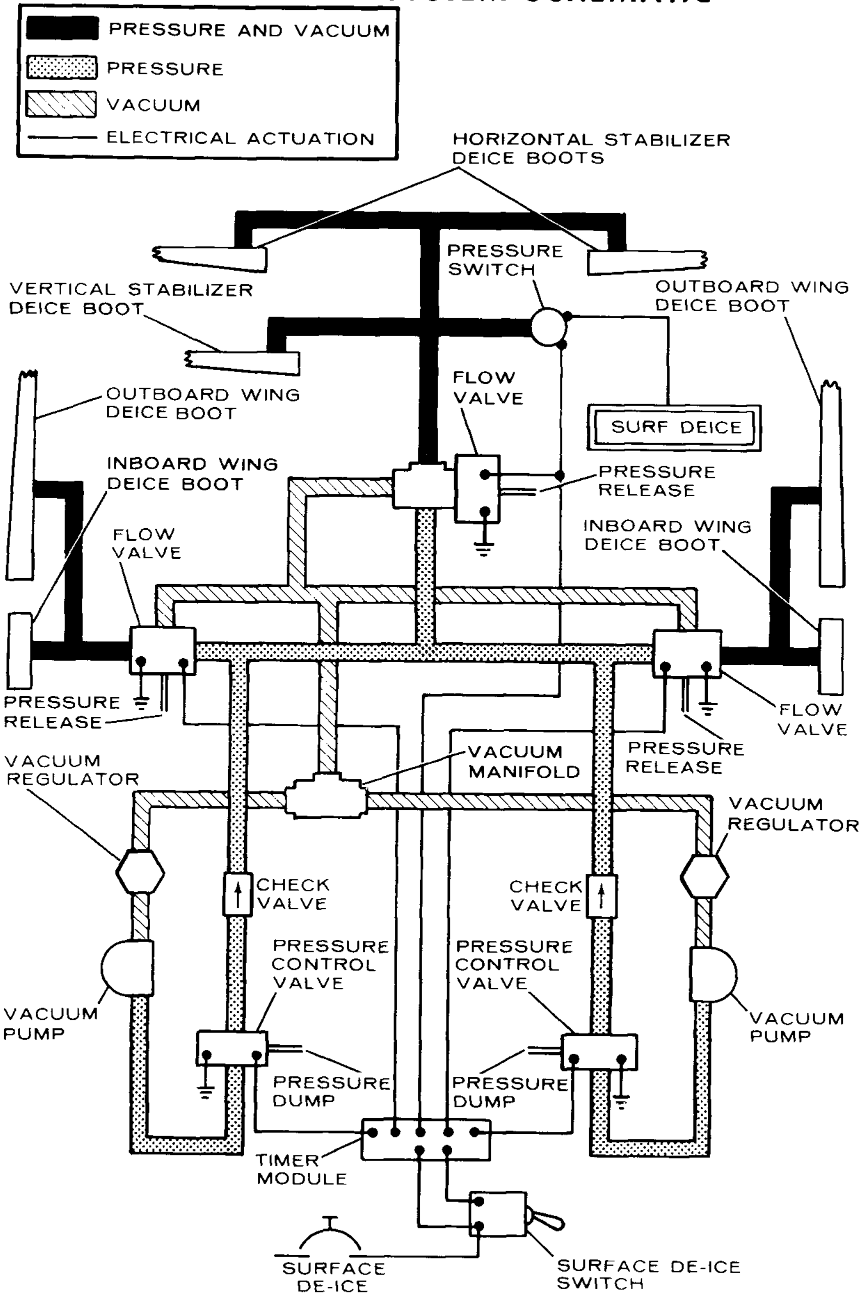


Figure 1

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SECTION 4 — NORMAL PROCEDURES

A. Preflight Inspection
   1. Deice Boots - CHECK for tears, abrasions and cleanliness.

B. Before Takeoff
   1. Surface Deice Switch - ACTUATE. Visually check operation of boots and annunciator light ON.

NOTE

Actuating the surface deice switch will result in one complete inflation and deflation cycle lasting approximately 45 seconds.

C. Inflight
   1. During Icing Encounters.
      a. Surface Deice Switch - ACTUATE when ice accumulates between 1/4 to 1/2 inch. Repeat as necessary, allowing at least 45 seconds between actuations.

NOTE

- Accumulation of a 1/2 inch of ice can cause a cruise speed reduction of up to 30 knots as well as heavy buffet and a significant stall speed increase. Increase power as required to maintain desired airspeed.
- Prestall buffet and stall speeds increase slightly when deice boots are actuated. Maintain extra speed, especially during an approach, before actuating the boots.
- After prolonged icing encounters, increase engine power to maintain desired airspeed as ice accumulates on the unprotected areas.
- Maintain extra airspeed on approach to compensate for the increased prestall buffet associated with ice on the unprotected areas.

   2. Leave icing conditions as soon as possible if airplane is not equipped for flight in icing conditions.

NOTE

Since wing, horizontal stabilizer and vertical stabilizer deice boots alone do not provide adequate protection for the entire airplane, icing conditions should be avoided whenever possible unless the airplane is equipped for flight in icing conditions. Refer to Flight In Icing Conditions supplement for details. If icing is encountered, close attention should be given to the pitot-static system, propellers, induction systems and other components subject to icing.

SECTION 5 – PERFORMANCE

A. When climbing through areas of light to moderate icing conditions, use cruise climb airspeeds and maximum climb power (full power) settings to preclude ice buildup on the fuselage undersurface and lower wing surfaces and minimize the exposure time to icing conditions.

B. During prolonged icing encounters in cruise, increase engine power to 75% or greater to maintain cruise speed as ice accumulates on the unprotected areas and preclude ice buildup on the fuselage undersurface and lower wing surfaces.

C. Prestall buffet and stall speeds increase slightly when deice boots are actuated. Maintain extra speed, especially during an approach, before actuating the boots.

D. Maintain extra airspeed on approach to compensate for the increased prestall buffet associated with ice on the unprotected areas and the increased weight.

E. Airplane general performance is decreased with ice on the unprotected areas.

ECONOMY MIXTURE INDICATOR

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the economy mixture indicator.

Description

The Cessna Economy Mixture Indicator is an exhaust gas temperature (EGT) sensing device which is used to aid the pilot in selecting the most desirable fuel-air mixture for cruising flight at less than 77.5% power. The EGT varies with the ratio of fuel-to-air mixture entering the engine cylinders.

SECTION 2 — LIMITATIONS

A. All exhaust gas temperature (EGT) operation must be accomplished in accordance with Figure 1.

MIXTURE DESCRIPTION CHART

MIXTURE DESCRIPTION	EXHAUST GAS TEMPERATURE	TAS LOSS FROM BEST POWER	RANGE INCREASE FROM BEST POWER
BEST POWER (Maximum Speed)	PEAK MINUS 130°F (Enrichen)	0 KNOTS	0%
RECOMMENDED LEAN (Section 5 And Power Computer Performance)	PEAK MINUS 50°F (Enrichen)	2 KNOTS	7%
BEST ECONOMY *	PEAK EGT	6 KNOTS	15%

* FOR POWER SETTINGS OF 55% OR LESS WITH RPM IN THE GREEN ARC OR FOR POWER SETTINGS OF 55% TO 65% WITH 2200 RPM OR LESS

Figure 1

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

(1) In takeoff and full power climb, lean the mixtures as indicated by the white or blue markings on the fuel flow indicator.

NOTE

Leaning in accordance with markings on the fuel flow indicator will provide sufficiently rich mixture for engine cooling. Leaner mixtures are not recommended for power settings in excess of 77.5%.

(2) In level flight (at less than 77.5% power), lean the mixture to peak EGT, then enrich as desired, using Figure 1 as a guide. For Best Economy mixture at power settings of 55 to 65% at 2200 RPM or lower, or power settings up to 55% for any RPM in the green arc, the engines may be operated at peak EGT.

CAUTION

Operation at Best Economy mixture is not recommended until oil consumption stabilizes or during the first 50 hours of operation. The purpose of operating at 65 to 77.5% power with Best Power or Recommended Lean mixture is to insure 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. Operation leaner than peak EGT is not approved.

NOTE

- Changes in altitude, OAT, or power settings require the EGT to be rechedked and the mixture reset.
- Operation up to one minute at peak EGT is authorized at power settings of 77.5% or less to establish peak EGT reference.
- Operation at peak EGT is authorized for normal continuous operation at power settings of 55 to 65% at 2200 RPM or lower, or power settings up to 55% for any RPM in the green arc. See Figure 1 for approved operating limits.

(3) Use rich mixture (or mixture appropriate for field elevation) in idle descents or landing approaches. Leaning technique for cruise descents may be with EGT reference method (at least every 5000 feet) or by simply enriching to avoid engine roughness.

SECTION 5 — PERFORMANCE

Not Applicable.

ELECTRIC ELEVATOR TRIM

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the electric elevator trim.

Description

The electric elevator trim system consists of an electrically operated drive motor and clutch assembly, which receives power through a "momentary on" two-way trim switch and an emergency disengage switch.

SECTION 2 – LIMITATIONS

A. Disengage electric elevator trim if malfunction occurs.
B. Required Placards:
   1. On Pilot's Control Wheel
      a. "AP/TRIM DISC"
      b. "DN" - "UP"

SECTION 3 – EMERGENCY PROCEDURES

A. Electric Elevator Trim Malfunction.
   1. Elevator Control - OVERPOWER as required.
   2. Control Wheel AP/TRIM DISC Switch - DEPRESS.
   3. Reduce airspeed below V_{NE}.
   4. Manual Trim - AS REQUIRED.

SECTION 4 – NORMAL PROCEDURES

A. Trim Switch - ACTUATE as desired.

NOTE

To check the operation of the AP/TRIM DISC switch: actuate the elevator trim switch with the AP/TRIM DISC switch depressed. Observe that the manual trim wheel and indicator do not rotate when the elevator trim switch is actuated.

SECTION 5 – PERFORMANCE

Not Applicable.

AC ELECTRICAL WINDSHIELD ANTI-ICE SYSTEM

SECTION 1 - GENERAL

This supplement provides information which must be observed when operating the alternating current (AC) electrical windshield.

Description

The AC electrical windshield anti-ice system consists of an electrically heated element in the pilot's windshield, an inverter, an annunciator light, a heat sensor and a switch breaker.

The inverter, located in the right wing stub, supplies AC power to the windshield. The heat sensor cycles the power to the windshield, providing temperature control. The green function indicator light, see Figure 7-3, will illuminate during each heating cycle.

If the indicator does not illuminate periodically, check the bulb by pressing the PRESS-TO-TEST button. A secondary means of checking proper windshield operation can be made by monitoring the voltammeter. When the voltammeter selector switch is positioned to BATT, a change in charge or discharge rate will be noted during each heating cycle.

Abnormal operation of the electrical windshield anti-ice system is indicated by the switch breaker tripping to the OFF position or failure of the indicator light to illuminate. Failure of the switch breaker to stay reset indicates that windshield anti-icing is impossible.

SECTION 2 - LIMITATIONS

If the pilot's windshield is covered with ice, do not leave the electrical windshield anti-ice switch on for more than 20 seconds. Operation in excess of 20 seconds will cause an overheat condition which can result in failure of the windshield heating element and/or permanent distortion of the windshield.

SECTION 3 - EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 - NORMAL PROCEDURES

A. Before Takeoff

1. Electrical Windshield Anti-Ice Switch - ON momentarily. Check voltammeter for discharge and WINDSHIELD annunciator light for illumination.

NOTE

Turn off windshield anti-ice switch as soon as the voltammeter and the annunciator light have been checked.

B. Inflight

1. Electrical Windshield Anti-Ice Switch - ON before entering visible moisture with outside air temperature below 4.4°C (40°F).

2. Leave icing conditions as soon as possible if airplane is not equipped for flight in icing conditions.

NOTE

Since the electrical windshield anti-ice system alone does not provide adequate protection for the entire airplane, icing conditions should be avoided whenever possible unless the airplane is equipped for flight in icing conditions. Refer to Flight in Icing Conditions supplement for details. If icing is encountered, close attention should be given to the pitot-static system, propellers, induction systems, wing and stabilizer leading edges and other components subject to icing.

C. After Landing

1. Electrical Windshield Anti-Ice Switch - OFF.

SECTION 5 - PERFORMANCE

Not Applicable.

DC ELECTRICAL WINDSHIELD ANTI-ICE SYSTEM

SECTION 1 - GENERAL

This supplement provides information which must be observed when operating the direct current (DC) electrical windshield.

Description

The DC electrical windshield anti-ice system consists of two electrically heated rectangular areas: one large mat (primary heated area) and an additional small mat (secondary heated area), a resistance wire sensor embedded in the windshield, a hi-low relay, a remote temperature controller, a fuse, a circuit breaker and a three-position temperature selector switch. With the switch in HI, only the large mat is heated. With the switch in LO, both mats are heated at a lower power density.

Power for the electrical windshield is supplied by the airplane's DC bus bar. The temperature controller, in conjunction with the resistance wire sensor embedded in the windshield provides ON-OFF control of the DC power through the use of the relay. The temperature sensor, an integral part of the windshield, is located in the large mat heated area.

SECTION 2 - LIMITATIONS

If the pilot's windshield is covered with ice, do not leave the electrical windshield anti-ice switch on for more than 20 seconds. Operation in excess of 20 seconds will cause an overheat condition which can result in failure of the windshield heating element and/or permanent distortion of the windshield.

The electrical windshield must be on HIGH with outside air temperature below -12°C (10°F) when in visible moisture.

Required Placards:

> MAGNETIC COMPASS
> DEVIATIONS GREATER
> THAN 10° CAN BE
> EXPECTED WHEN D.C.
> HEATED WINDSHIELD
> IS IN OPERATION.

SECTION 3 - EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 - NORMAL PROCEDURES

A. Before Takeoff

1. Electrical Windshield Anti-Ice Switch - HIGH momentarily. Check voltammeter for discharge and WINDSHIELD annunciator light for illumination.

> **NOTE**
>
> Turn off windshield anti-ice switch as soon as the voltammeter and the annunciator light have been checked.

B. Inflight

1. Electrical Windshield Anti-ice Switch - LOW before entering visible moisture with outside air temperature below 4.4°C (40°F) and above -12°C (10°F). HIGH before entering visible moisture with outside air temperature below -12°C (10°F).

NOTE

- When using the electrical windshield on LOW, correct indicated outside air temperature (see Section 5 for ram rise correction) for your particular altitude and airspeed to ensure the outside air temperature is not below -12°C (10°F).
- If ice begins to accumulate on the heated portion of the windshield while operating on LOW, switch to HIGH.
- After icing conditions are encountered with the windshield on HIGH, do not use LOW until the entire heated portion of the windshield is clear of ice.
- The magnetic compass will not be reliable with the electrical heated windshield in operation.

2. Leave icing conditions as soon as possible if airplane is not equipped for flight in icing conditions.

NOTE

Since the electrical windshield anti-ice system alone does not provide adequate protection for the entire airplane, icing conditions should be avoided whenever possible unless the airplane is equipped for flight in icing conditions. Refer to Flight In Icing Conditions supplement for details. If icing is encountered, close attention should be given to the pitot-static system, propellers, induction systems, wing and stabilizer leading edges and other components subject to icing.

C. After Landing

1. Electrical Windshield Anti-Ice Switch - OFF.

SECTION 5 - PERFORMANCE

Not Applicable.

FLIGHT IN ICING CONDITIONS
(AIRPLANES WITH AC ELECTRICAL WINDSHIELD)

SECTION 1 - GENERAL

NOTE

To determine which optional electrical windshield is installed, check the electrical windshield anti-ice switch. The AC windshield switch is labeled OFF and ON. The DC windshield switch is labeled HIGH, LOW and OFF.

This supplement provides information which must be observed when operating the ice protection equipment for flight in icing conditions.

Description

An icing equipment package is available which allows flight in icing conditions as defined by the FAA. The package consists of the following: heated stall warning vane or optional heated angle-of-attack lift sensor vane; heated pitot head (one minimum required); electric propeller deice boots (including fuselage ice protection plates); wing (inboard and outboard), stabilizer and fin deice boots; electrical windshield heated panel (pilot's side only); heated static ports; left ice detection light and 100 - ampere alternators.

The wing and empennage deice boots are designed to remove ice after it has formed rather than prevent its formation. The propeller deice boots will also remove accumulated ice; however, they should be activated prior to entering icing conditions. The remainder of the equipment is designed to prevent ice accumulation and should be activated prior to entering icing conditions.

SECTION 2 - LIMITATIONS

NOTE

This airplane is approved for flight into icing conditions, as defined by the FAA, if the following equipment is installed and operational.

1. Heated stall warning vane or optional angle-of-attack lift sensor vane.
2. Heated pitot head (one minimum required).
3. Deice System Kit [Cessna drawing 5114400, Factory Kit (FK) No. 194].
   a. Electric propeller deice boots.
   b. Wing (inboard and outboard) stabilizer and fin deice boots (including left ice detection light).
   c. Electrical anti-ice windshield heated panel (pilot's side only).
   d. Heated static ports.
4. 100 - ampere alternators.

If the pilot's windshield is covered with ice, do not leave the electrical windshield anti-ice switch on for more than 20 seconds. Operation in excess of 20 seconds will cause an overheat condition which can result in failure of the windshield heating element and/or permanent distortion of the windshield.

SECTION 3 - EMERGENCY PROCEDURES

A. If uneven deicing of propeller blades is indicated by excessive vibration:
   1. Propellers - EXERCISE to MAX RPM.
   2. Propeller Ammeter - CHECK for proper operation by periodic fluctuations within the green arc. If ammeter reading is below the green arc, the propeller blades may not be deicing uniformly:
      a. If both propellers are reading below the green arc:
         (1) Propeller Deice Switch - OFF.
      b. If either propeller is reading below the green arc:
         (1) PROP DEICE Circuit Breaker - Pull L or R circuit breaker as required.
   3. If vibration continues, leave icing conditions as soon as possible.

CAUTION

Do not operate propeller deice for prolonged periods when propellers are not turning.

B. Surface Deice Failure.
   1. Surface Deice Switch - RESET then ON.
   2. If normal operation does not occur, leave icing conditions as soon as possible.

SECTION 4 - NORMAL PROCEDURES

A. Preflight Inspection
   1. Pitot Heat Switch(es) - ON 20 seconds - OFF (Ensure Pitot Covers Are Removed).
   2. Stall and Vent Heat Switch - ON 20 seconds - OFF.
   3. Deice Boots - CHECK for tears, abrasions, and cleanliness.
   4. Fuel Vents - CLEAR.
   5. Pitot Tube(s) - CLEAR and WARM.
   6. Static Ports - CLEAR and WARM.

CAUTION

Do not operate system heaters for prolonged periods on the ground.

NOTE

Stall and vent heat switch operates stall vane heater or optional angle-of-attack lift sensor vane, and static port heaters. Pitot heat switch operates pitot heater(s).

B. Before Takeoff

1. Surface Deice Switch - ACTUATE. Visually check operation of boots and annunciator light ON.

NOTE

Actuating the surface deice switch will result in one complete inflation and deflation cycle lasting approximately 45 seconds.

2. Propeller Deice Switch - ON momentarily. Check propeller ammeter.

NOTE

Proper operation of propeller deice system is indicated by periodic fluctuations, within the green arc, on the propeller ammeter.

3. Electrical Windshield Anti-Ice Switch - ON momentarily. Check voltammeter for discharge and WINDSHIELD annunciator light for illumination.

NOTE

Turn off windshield anti-ice switch as soon as the voltammeter and the annunciator light have been checked.

C. Inflight

1. Before visible moisture is encountered with outside air temperature below 4.4°C (40°F):
   a. Pitot Heat Switch - ON.
   b. Stall and Vent Heat Switch - ON.
   c. Propeller Deice Switch - ON.

CAUTION

Do not operate the autopilot in altitude hold mode when flying in moderate to severe turbulence, mountain lee wave activity and/or moderate to severe icing conditions.

NOTE

Energizing the propeller deice system early in icing conditions will prevent ice buildup which will be thrown off and can chip the fuselage paint.

d. Electrical Windshield Anti-Ice Switch - ON.

2. During Icing Encounters:

a. Surface Deice Switch - ACTUATE when ice accumulates between 1/4 to 1/2 inch. Repeat as necessary, allowing at least 45 seconds between actuations.

NOTE

Accumulation of 1/2 inch of ice can cause a cruise speed reduction of up to 30 knots as well as heavy buffet and a significant stall speed increase. Increase power as required to maintain desired airspeed.

D. After Landing

1. Electrical Windshield Anti-Ice Switch - OFF.

SECTION 5 - PERFORMANCE

A. When climbing through areas of light to moderate icing conditions, use cruise climb airspeeds and maximum climb power (full power) settings to preclude ice buildup on the fuselage undersurface and lower wing surfaces and minimize the exposure time to icing conditions.

B. During prolonged icing encounters in cruise, increase engine power to 75% or greater to maintain cruise speed as ice accumulates on the unprotected areas and preclude ice buildup on the fuselage under surface and lower wing surfaces.

C. Prestall buffet and stall speeds increase slightly when deice boots are actuated. Maintain extra speed, especially during an approach, before actuating the boots.

D. Maintain extra airspeed on approach to compensate for the increased prestall buffet associated with ice on the unprotected areas and the increased weight. Maintaining extra airspeed on approach will increase the landing distance.

E. Airplane general performance is decreased with ice on the unprotected areas.

FLIGHT IN ICING CONDITIONS
(AIRPLANES WITH DC ELECTRICAL WINDSHIELD)

SECTION 1 - GENERAL

NOTE

To determine which optional electrical windshield is installed, check the electrical windshield anti-ice switch. The AC windshield switch is labeled OFF and ON. The DC windshield switch is labeled HIGH, LOW and OFF.

This supplement provides information which must be observed when operating the ice protection equipment for flight in icing conditions.

Description

An icing equipment package is available which allows flight in icing conditions as defined by the FAA. The package consists of the following: heated stall warning vane or optional heated angle-of-attack lift sensor vane; heated pitot head (one minimum required); electric propeller deice boots (including fuselage ice protection plates); wing (inboard and outboard), stabilizer and fin deice boots; electrical windshield heated panel (pilot's side only); heated static ports; left ice detection light and 100 - ampere alternators.

The wing and empennage deice boots are designed to remove ice after it has formed rather than prevent its formation. The propeller deice boots will also remove accumulated ice; however, they should be activated prior to entering icing conditions. The remainder of the equipment is designed to prevent ice accumulation and should be activated prior to entering icing conditions.

SECTION 2 - LIMITATIONS

NOTE

This airplane is approved for flight into icing conditions, as defined by the FAA, if the following equipment is installed and operational.

1. Heated stall warning vane or optional angle-of-attack lift sensor vane.
2. Heated pitot head (one minimum required).
3. Deice System Kit [Cessna drawing 5114400, Factory Kit (FK) No. 194].
    a. Electric propeller deice boots.
    b. Wing (inboard and outboard) stabilizer and fin deice boots (including left ice detection light).
    c. Electrical anti-ice windshield heated panel (pilot's side only).
    d. Heated static ports.
4. 100 - ampere alternators.

If the pilot's windshield is covered with ice, do not leave the electrical windshield anti-ice switch on for more than 20 seconds. Operation in excess of 20 seconds will cause an overheat condition which can result in failure of the windshield heating element and/or permanent distortion of the windshield.

The electrical windshield must be on HIGH with outside air temperature below -12°C (10°F) when in visible moisture.

REQUIRED PLACARDS:

1. MAGNETIC COMPASS DEVIATIONS GREATER THAN 10° CAN BE EXPECTED WHEN D.C. HEATED WINDSHIELD IS IN OPERATION.

SECTION 3 - EMERGENCY PROCEDURES

A. If uneven deicing of propeller blades is indicated by excessive vibration:
   1. Propellers - EXERCISE to MAX RPM.
   2. Propeller Ammeter - CHECK for proper operation by periodic fluctuations within the green arc.
   3. If reading is below the green arc indicating that the propeller blades may not be deicing uniformly:
      a. Propeller Deice Switch - OFF.
   4. If ammeter reading for either propeller is below the green arc, indicating the propeller blades may not be deicing uniformly:
      a. PROP DEICE Circuit Breaker - PULL L or R circuit breaker as required.
   5. If vibration continues, leave icing conditions as soon as possible.

CAUTION

Do not operate propeller deice for prolonged periods when propellers are not turning.

B. Surface Deice Failure.
   1. Surface Deice Switch - RESET then ON.
   2. If normal operation does not occur, leave icing conditions as soon as possible.

SECTION 4 - NORMAL PROCEDURES

A. Preflight Inspection
   1. Pitot Heat Switch(es) - ON 20 seconds - OFF (Ensure Pitot Covers Are Removed).
   2. Stall and Vent Heat Switch - ON 20 seconds - OFF.
   3. Deice Boots - CHECK for tears, abrasions, and cleanliness.
   4. Fuel Vents - CLEAR.
   5. Pitot Tube(s) - CLEAR and WARM.
   6. Static Ports - CLEAR and WARM.

CAUTION

Do not operate system heaters for prolonged periods on the ground.

> **NOTE**
>
> Stall and vent heat switch operates stall vane heater or optional angle-of-attack lift sensor vane, and static port heaters. Pitot heat switch operates pitot heater(s).

B. Before Takeoff

1. Surface Deice Switch - ACTUATE. Visually check operation of boots and annunciator light ON.

> **NOTE**
>
> Positioning the surface deice switch to ACTUATE will result in one complete inflation and deflation cycle lasting approximately 45 seconds.

2. Propeller Deice Switch - ON momentarily. Check propeller ammeter.

> **NOTE**
>
> Proper operation of propeller deice system is indicated by periodic fluctuations, within the green arc, on the propeller ammeter.

3. Electrical Windshield
   Anti-Ice Switch - HIGH momentarily. Check voltammeter for discharge and WINDSHIELD annunciator light for illumination.

> **NOTE**
>
> Turn off windshield anti-ice switch as soon as the voltammeter and the annunciator light have been checked.

C. Inflight

1. Before visible moisture is encountered with outside air temperature below 4.4°C (40°F):
   a. Pitot Heat Switch - ON.
   b. Stall and Vent Heat Switch - ON.
   c. Propeller Deice Switch - ON.

> **CAUTION**
>
> Do not operate the autopilot in altitude hold mode when flying in moderate to severe turbulence, mountain lee wave activity and/or moderate to severe icing conditions.

d. Electrical Windshield Anti-Ice Switch - LOW with outside air temperature above -12°C (10°F). HIGH with outside air temperature below -12°C (10°F).

NOTE

- When using the electrical windshield on LOW, correct indicated outside air temperature (see Section 5 for ram air temperature rise correction) for your particular altitude and airspeed to ensure the outside air temperature is not below -12°C (10°F).
- If ice begins to accumulate on the heated portion of the windshield while operating on LOW, switch to HIGH.
- After icing conditions are encountered with the windshield on HIGH, do not use LOW until the entire heated portion of the windshield is clear of ice.
- The magnetic compass will not be reliable with the electrical heated windshield in operation.

2. During Icing Encounters:
   a. Surface Deice Switch - ACTUATE when ice accumulates between 1/4 to 1/2 inch. Repeat as necessary, allowing at least 45 seconds between actuations.

NOTE

Accumulation of 1/2 inch of ice can cause a cruise speed reduction of up to 30 knots as well as heavy buffet and a significant stall speed increase. Increase power as required to maintain desired airspeed.

D. After Landing
   1. Electrical Windshield Anti-Ice Switch - OFF.

SECTION 5 - PERFORMANCE

A. When climbing through areas of light to moderate icing conditions, use cruise climb airspeeds and maximum climb power (full power) settings to preclude ice buildup on the fuselage undersurface and lower wing surfaces and minimize the exposure time to icing conditions.
B. During prolonged icing encounters in cruise, increase engine power to 75% or greater to maintain cruise speed as ice accumulates on the unprotected areas and preclude ice buildup on the fuselage under surface and lower wing surfaces.
C. Prestall buffet and stall speeds increase slightly when deice boots are actuated. Maintain extra speed, especially during an approach, before actuating the boots.
D. Maintain extra airspeed on approach to compensate for the increased prestall buffet associated with ice on the unprotected areas and the increased weight. Maintaining extra airspeed on approach will increase the landing distance.
E. Airplane general performance is decreased with ice on the unprotected areas.

FIRE DETECTION AND EXTINGUISHING SYSTEM

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the fire detection and extinguishing system.

Description

The fire detection and extinguishing system consists of three major components: three heat sensitive detectors located in each engine accessory compartment; an annunciator and actuator panel; see Figure 2; and a compressed Freon single-shot gas bottle in each engine accessory compartment

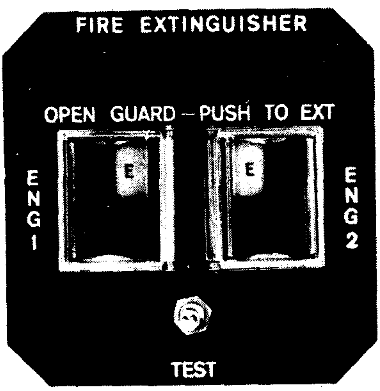
A test function is provided to test the bottle firing cartridge and annunciator lights. When the test switch is pushed, all lights should illuminate; if any light fails to illuminate, replace the bulb. If the green light does not illuminate, check the bottle pressure gages for correct pressure as shown in Figure 1. If the bottle pressure is adequate, replace the firing cartridge in the fire extinguisher. Any other light failure, after replacing bulbs and firing cartridge, indicates a malfunction in the unit or associated wiring.

AMBIENT TEMPERATURE Vs RECOMMENDED PRESSURE

Ambient Temperature-°C	-40.0	-28.9	-17.8	-6.7	+4.4	+15.6	+26.7	+37.8	+48.9
Ambient Temperature-°F	-40	-20	0	+20	+40	+60	+80	+100	+120
Recommended Operating Pressure-PSIG	127 to 155	148 to 180	174 to 212	207 to 251	249 to 299	304 to 354	367 to 417	442 to 492	532 to 582

Figure 1

FIRE DETECTION AND EXTINGUISHING SYSTEM



ANNUNCIATION		
LEGEND	COLOR	CAUSE OF ILLUMINATION
FIRE	RED	FIRE CONDITION EXISTING IN ENGINE COMPARTMENT
E	AMBER	FIRE EXTINGUISHER CONTAINER EMPTY
OK	GREEN	FIRE CARTRIDGE AND ASSOCIATED WIRING IS IN OPERATIONAL CONDITION

Figure 2

If an overheat condition is detected, the appropriate FIRE light will annunciate the engine to be extinguished. To activate the extinguisher, open the guard for the appropriate engine and press the FIRE light. Freon, under pressure, will be discharged to the engine and engine accessory compartments. The amber light E will illuminate after the extinguisher has been discharged and will continue to show empty until a new bottle is installed. The FIRE light will remain illuminated until compartment temperatures cool.

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

If a fire warning light indicates an engine compartment fire and is confirmed or if a fire is observed without a fire warning light:

1. Both Auxiliary Fuel Pumps - OFF.
2. Operative Engine Fuel Selector - MAIN TANK (Feel For Detent).
3. Emergency Crossfeed Shutoff - OFF (Pull Up).
4. Appropriate Engine - SECURE.
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
   d. Fuel Selector - OFF (Feel For Detent).
   e. Cowl Flap - CLOSE.
   f. Open the appropriate guard and push FIRE light.
   g. Magnetos - OFF.
   h. Propeller Synchrophaser - OFF (Optional System).
   i. Alternator - OFF.
5. Cabin Heater - OFF.
6. Land as soon as practical.

NOTE

Best results may be obtained if the airflow through the nacelle is reduced by slowing the airplane (as slow as practical) prior to actuating the extinguisher.

SECTION 4 – NORMAL PROCEDURES

A. Before Takeoff
   1. Test Switch - PRESS. All lights should illuminate.

SECTION 5 – PERFORMANCE

Not Applicable.

FIRE DETECTION AND EXTINGUISHING SYSTEM

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the fire detection and extinguishing system.

Description

The fire detection and extinguishing system consists of three major components: three heat sensitive detectors located in each engine accessory compartment; an annunciator and actuator panel; see Figure 2; and a compressed Freon single-shot gas bottle in each engine accessory compartment.

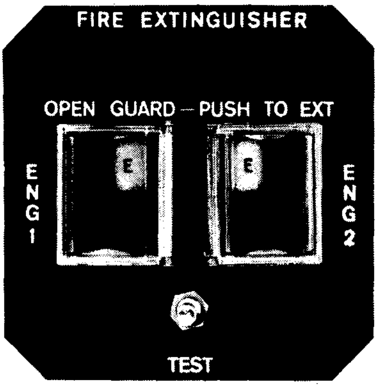
A test function is provided to test the bottle firing cartridge and annunciator lights. When the test switch is pushed, all lights should illuminate; if any light fails to illuminate, replace the bulb. If the green light does not illuminate, check the bottle pressure gages for correct pressure as shown in Figure 1. If the bottle pressure is adequate, replace the firing cartridge in the fire extinguisher. Any other light failure, after replacing bulbs and firing cartridge, indicates a malfunction in the unit or associated wiring.

AMBIENT TEMPERATURE Vs RECOMMENDED PRESSURE

Ambient Temperature-°C	-40.0	-28.9	-17.8	-6.7	+4.4	+15.6	+26.7	+37.8	+48.9
Ambient Temperature-°F	-40	-20	0	+20	+40	+60	+80	+100	+120
Recommended Operating Pressure-PSIG	127 to 155	148 to 180	174 to 212	207 to 251	249 to 299	304 to 354	367 to 417	442 to 492	532 to 582

Figure 1

FIRE DETECTION AND EXTINGUISHING SYSTEM



ANNUNCIATION		
LEGEND	COLOR	CAUSE OF ILLUMINATION
FIRE	RED	FIRE CONDITION EXISTING IN ENGINE COMPARTMENT
E	AMBER	FIRE EXTINGUISHER CONTAINER EMPTY
OK	GREEN	FIRE CARTRIDGE AND ASSOCIATED WIRING IS IN OPERATIONAL CONDITION

Figure 2

If an overheat condition is detected, the appropriate FIRE light will annunciate the engine to be extinguished. To activate the extinguisher, open the guard for the appropriate engine and press the FIRE light. Freon, under pressure, will be discharged to the engine and engine accessory compartments. The amber light E will illuminate after the extinguisher has been discharged and will continue to show empty until a new bottle is installed. The FIRE light will remain illuminated until compartment temperatures cool.

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

If a fire warning light indicates an engine compartment fire and is confirmed or if a fire is observed without a fire warning light:

1. Both Auxiliary Fuel Pumps - OFF.
2. Operative Engine Fuel Selector - MAIN TANK (Feel For Detent).
3. Emergency Crossfeed Shutoff - OFF (Pull Up).
4. Appropriate Engine - SECURE.
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
   d. Fuel Selector - OFF (Feel For Detent).
   e. Magnetos - OFF.
   f. Propeller Synchrophaser - OFF (Optional System).
   g. Alternator - OFF.
   h. Cowl Flap - CLOSE.
5. Cabin Heater - OFF.
6. Open the appropriate guard and push FIRE light.
7. Land as soon as practical.

NOTE

Best results may be obtained if the airflow through the nacelle is reduced by slowing the airplane (as slow as practical) prior to actuating the extinguisher.

SECTION 4 – NORMAL PROCEDURES

A. Before Takeoff
   1. Test Switch - PRESS. All lights should illuminate.

SECTION 5 – PERFORMANCE

Not Applicable.

FUEL FLOW INDICATING SYSTEM

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the electronic fuel flow indicating system.

Description

The electronic fuel flow indicating system consists of a dual needle indicator and a fuel flow transducer for each engine. The flow transducer generates electrical pulses, which represents a measure of fuel flow rate, and transmits these pulses to the indicator as input frequency. The indicator then converts the frequency signals into an analog output which is displayed by the indicator as fuel flow rate in pounds per hour. These gage markings are predicated on the use of 100 grade aviation fuel. Increase fuel flow 2% above markings when 100LL grade aviation fuel is used. In addition, these pulses provide information to a totalizer within the indicator. The totalizer indicates the quantity of fuel remaining or consumed, even if power is removed from the normal power input circuit.

The electronic fuel flow indicator has a digital totalizer, a DIM/CLR knob and a counter switch. The totalizer displays either the fuel remaining or the fuel consumed for both the left and right engines or full tanks. The DIM/CLR knob controls the light intensity of the totalizer and resets the totalizer counter to zero. The counter switch is used to set 10-pound and 100-pound increments of fuel for totalizer use.

NOTE

If the "memory" voltage is interrupted, such as when the airplane battery is removed and reinstalled, the totalizer display will not indicate accurately until the counter has been reset.

SECTION 2 — LIMITATIONS

Same as standard fuel flow gage contained in Section 2 of this manual.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. Preflight Inspection
   1. Counter Switch - ACTUATE until totalizer reads equal to the amount of fuel in the tanks if a fuel remaining reading is desired.
   2. DIM/CLR Switch - CLR if a fuel consumed reading is desired.

NOTE

If fuel is added before a flight, insure that the totalizer is adjusted to reflect the additional fuel.

SECTION 5 — PERFORMANCE

Not Applicable.

MANUALLY ADJUSTABLE SEAT

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the manually adjustable seats.

Description

The manually adjustable pilot and copilot seats are secured to seat pan assemblies which are attached to the forward main spar carry-thru structure. The seats may be adjusted fore and aft, vertically and tilted to any desired position within the limits of the seat by using the controls located on the front of the seat, see Figure 1.

An optional lumbar support is available for the pilot's and copilot's seat backs. The support is designed to provide increased comfort during long flights. The support is basically an air-tight, foam-filled cushion which can be adjusted in size and shape as governed by external forces and the operation of the bleed valve.

MANUALLY ADJUSTABLE SEAT CONTROLS

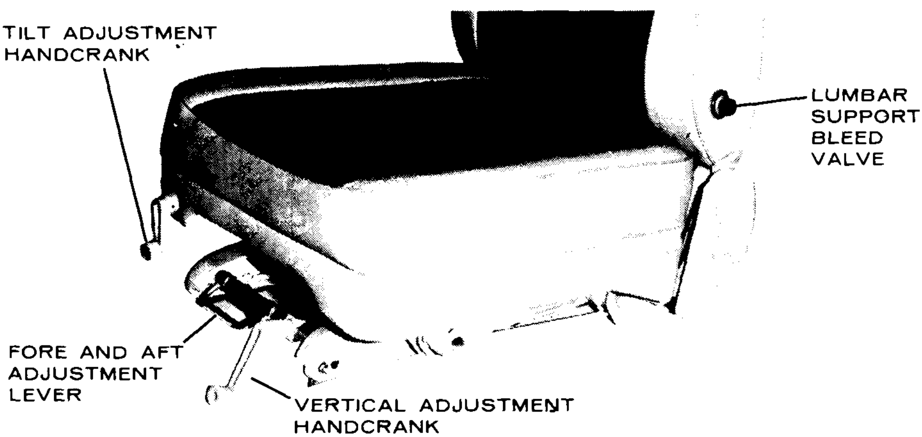


Figure 1

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

A. Loss of Cabin Pressure
1. Lumbar Support Bleed Valve - PRESS as required to decrease inflation.

SECTION 4 – NORMAL PROCEDURES

Controls for the manually adjustable seats, see Figure 1, are located at the forward side of the seat. Rotating the handcrank, located at the forward right corner of the seat, tilts the back. Rotating the handcrank, located at the forward left corner of the seat, raises and lowers the seat. The fore and aft adjustment lever is located at the forward side of the seat near the center. It is recommended that the seat be moved to the aft position prior to making tilt or vertical adjustments, to provide maximum handcrank clearance.

With the optional lumbar support installed and the seat adjusted as desired, lean back in a comfortable position and press the lumbar support bleed valve as required to achieve the desired level of support. During a climb to high altitude, cabin pressure will slowly decrease relative to the air pressure in the lumbar support, thus the support will expand. This can be corrected by bleeding off the excessive expansion by pressing the lumbar support bleed valve as required. During descents, the cabin pressure will slowly increase relative to the air pressure in the lumbar support, thus the support will contract. This can be corrected by unloading the seat back and pressing the bleed valve as required.

SECTION 5 – PERFORMANCE

Not Applicable.

PROPELLER DEICE SYSTEM

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the propeller deice system.

Description

The propeller deice system consists of electrically heated boots on the propeller blades. Each boot consists of an inboard and outboard heating element, which receive their electrical power through a deice timer. To reduce power drain and maintain propeller balance, the timer directs current to the propeller boots in cycles between elements and between propellers.

The timer directs current to the propeller boots in cycles between boot elements and between propellers in the following sequence:

Heating Period No. 1 - Outboard Halves - right engine blades.
Heating Period No. 2 - Inboard Halves - right engine blades.
Heating Period No. 3 - Outboard Halves - left engine blades.
Heating Period No. 4 - Inboard Halves - left engine blades.

Each heating period lasts approximately 20 seconds.

A reading below the green arc on the propeller deice ammeter indicates that the blades of the propeller are not being deiced uniformly.

WARNING

When uneven deicing of the propeller blades is indicated, it is imperative that the deice system be turned OFF. Uneven deicing of the blades can result in propeller unbalance and engine failure.

Abnormal operation of the propeller deice system is indicated by the deice switch breaker tripping to the OFF position. Failure of the switch breaker to stay reset indicates that deicing is impossible for the propellers.

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

A. If uneven deicing of propeller blades is indicated by excessive vibration:
   1. Propellers - EXERCISE to MAX RPM.
   2. Propeller Ammeter - CHECK for proper operation by periodic fluctuations within the green arc. If reading is below the green arc indicating that the propeller blades may not be deiced uniformly:
      a. Propeller Deice Switch - OFF.

CAUTION

Do not operate propeller deice for prolonged periods when propellers are not turning.

SECTION 4 – NORMAL PROCEDURES

A. Preflight Inspection
   1. Propeller Heating Elements - CHECK condition and attachment.

B. Before Takeoff
   1. Propeller Deice Switch - ON momentarily. Check propeller ammeter.

C. Inflight
   1. Propeller Deice Switch - ON before entering visible moisture with outside air temperature below 4.4°C (40°F).

NOTE

Energizing the propeller deice system early in icing conditions will prevent ice build up which will be thrown off and can chip the fuselage paint.

   2. Leave icing conditions as soon as possible if airplane is not equipped for flight in icing conditions.

NOTE

Since propeller deice boots alone do not provide adequate protection for the entire airplane, icing conditions should be avoided whenever possible unless the airplane is equipped for flight in icing conditions. Refer to Ice Protection Equipment (Flight In Icing Conditions) supplement for details. If icing is encountered, close attention should be given to the pitot-static system, propellers, induction systems, wing and stabilizer leading edges and other components subject to icing.

SECTION 5 – PERFORMANCE

Not Applicable.

YAW DAMPER

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the yaw damper system.

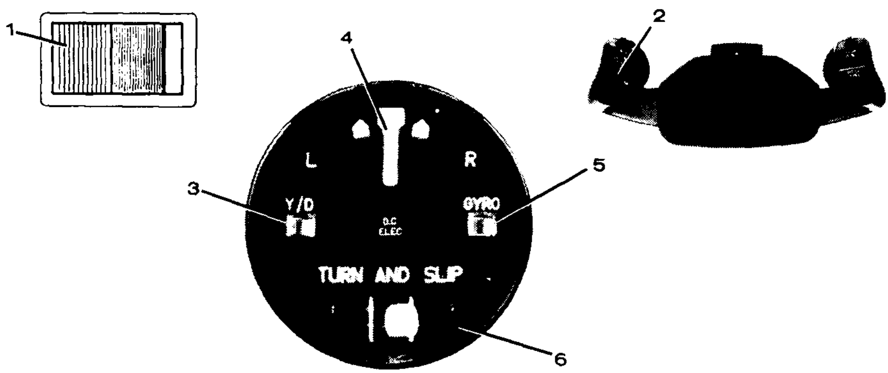
Description

The yaw damper is an independent system that may be engaged at any time regardless of the state of the autopilot or flight director. When engaged, the yaw damper provides yaw axis stabilization. The panel-mounted gyro computer turn-and-slip indicator, see Figure 1, provides yaw rate signals to operate the rudder servo. If an 800B Integrated Flight Control System is installed, the yaw damper is automatically engaged with the basic autopilot engagement and cannot be disengaged with the autopilot ON except by pulling the YAW DAMP circuit breaker.

NOTE

The flags in the turn-and-slip indicator will retract whenever power is applied to this unit.

YAW DAMPER CONTROLS AND INDICATOR



1. YAW DAMPER ON-OFF SWITCH - Turns yaw damper on and holds it on until switch is turned off or control wheel autopilot disengage switch is depressed.
2. CONTROL WHEEL AUTOPILOT/ELECTRIC ELEVATOR TRIM DISENGAGE SWITCH (RED) - When depressed, turns yaw damper off.
3. Y/D FLAG - When yellow flag disappears, indicates power is supplied to the yaw damper computer.
4. RATE-OF-TURN POINTER - Indicates rate and direction of airplane yaw movement.
5. GYRO FLAG - When red flag disappears, indicates power is applied to the gyro.
6. SLIP INDICATOR - Indicates slip or skid when ball is displaced from center.

Figure 1

SECTION 2 — LIMITATIONS

A. Disengage yaw damper if malfunction occurs.
B. Required Placards:
   1. On Circuit Breaker Panel:
      a. "YAW DAMP"
   2. Near Yaw Damper Switch:
      a. "YAW DAMP-ON-OFF"
      b. If yaw damper switch is located on the autopilot control head, change item "a" to "YAW ON."
   3. On Pilot's Control Wheel:
      a. "AUTOPILOT - DISENGAGE" (also disengages yaw damper).

SECTION 3 — EMERGENCY PROCEDURES

A. Hardover Rudder Deflection
   1. Rudder - OVERPOWER. Requires approximately 70 pounds.
   2. Autopilot Disengage Switch - DISENGAGE.
   3. Yaw Damper Circuit Breaker - PULL.
   4. If optional autopilot installed - REENGAGE if desired.
B. Excessive Rudder Forces (Gear Train Jammed)
   1. Rudder pedal forces in excess of normal control forces required to overpower the slip clutch in the event of a jammed servo actuator will not exceed 70 pounds.

SECTION 4 — NORMAL PROCEDURES

A. Engagement
   1. Yaw Damper ON-OFF Switch - ON. With 800B Integrated Flight Control System installed, the yaw damper is automatically engaged with the autopilot.
   2. Gyro and Y/D Flags - VERIFY that both are out of view.
B. Disengagement
   1. Autopilot Disengage Switch - DISENGAGE (Or)
   2. Yaw Damper ON-OFF Switch - OFF. With 800B Integrated Flight Control System installed, the yaw damper is disabled by pulling the YAW DAMP circuit breaker.

SECTION 5 — PERFORMANCE

Not Applicable.

400 ENCODING ALTIMETER (TYPE EA-401A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 400 encoding altimeter.

Description

The Cessna 400 encoding altimeter (Type EA-401A) is an electrically driven instrument that provides the pilot with a visual display of the airplane's altitude. The altimeter also includes an optical encoder which automatically produces a logic code that corresponds to the sensed altitude. This code is supplied to the Air Traffic Control Radar Beacon System transponder in the airplane to generate replies to Mode C (altitude reporting) interrogations from the ground controller.

The 400 encoding altimeter, see Figure 1, is a panel-mounted barometric altimeter with an altitude range of -1000 to +35,000 feet. Altitude is displayed by a dial and a digital readout. The dial is graduated in numerical divisions which represent increments of 100 feet, with subdivision markings for every 20 feet. The dial pointer completes one revolution for every 1000 feet of altitude change. The digital readout displays airplane altitude in increments of hundreds and thousands of feet only. Friction-induced lag and jumping of the display is reduced by the use of a combined aneroid sensor and motor-driven display. Electronic damping circuits in the unit insure that the display follows altitude changes rapidly with no overshoot. When power is removed from the altimeter, a striped warning flag appears across the digital altitude display to indicate a "power-off" condition.

Except for setting pressure, operation of the altimeter is completely automatic. Ambient atmospheric pressure, set into the altimeter with a manually operated baroset knob, is displayed on a four-digit readout, either in inches of mercury or in millibars (as ordered). The pressure setting does not affect the output of the optical encoder, since the encoder is always referenced to standard pressure (sea level; 29.92 inches of mercury or 1013 millibars).

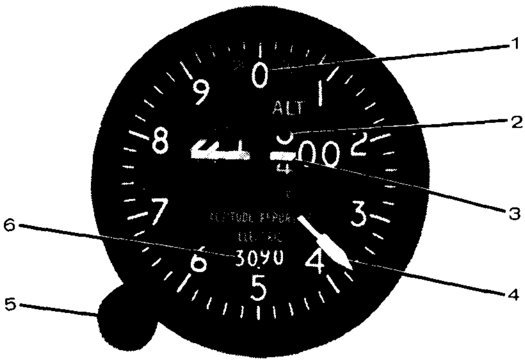
SECTION 2 — LIMITATIONS

A. A standby barometric altimeter is required when the encoding altimeter is installed.

SECTION 3 — EMERGENCY PROCEDURES

A. Encoding Altimeter Failure (Warning Flag Showing)
   1. ALT Circuit Breaker - CHECK IN.
   2. If warning flag is still showing, use the standby barometric altimeter.

400 ENCODING ALTIMETER INDICATOR



1. ZERO-TO-THOUSAND FOOT ALTITUDE DISPLAY DIAL - Calibrated in 10 numerical graduations which represent increments of 100 feet; the subdivisions of each graduation represents increments of 20 feet.
2. ALTITUDE READOUT - Displays altitude above 100 feet on three-section counter in increments of 10,000, 1000 and 100 feet. When altitude is below 10,000 feet, a diagonally striped flag appears in the 10,000-foot window.
3. POWER-OFF WARNING FLAG - Appears across altitude readout when power is removed from altimeter to indicate that readout is not reliable.
4. ZERO-TO-THOUSAND FOOT ALTITUDE DISPLAY POINTER - Directly indicates airplane altitude between 0 and 1000 feet; for altitudes above 1000 feet, indicates the last three digits of altitude (ones, tens and hundreds).
5. BAROSET KNOB - Used to set in atmospheric pressure; clockwise rotation increases pressure setting, counterclockwise rotation decreases pressure setting.
6. ATMOSPHERIC PRESSURE READOUT - Displays atmospheric pressure set into the altimeter with the baroset knob on the four-digit counter.

Figure 1

SECTION 4 — NORMAL PROCEDURES

A. Altimeter Operation

1. Baroset Knob - TURN as necessary to set readout to required pressure.
2. Power Off Warning Flag - VERIFY that flag is not in view.

WARNING

Do not attempt to use altimeter indication for flight information if warning flag is in view. Flag indicates that power has been removed from the altimeter.

3. Altitude Display - Below 1000 feet, read altitude on display pointer and dial. Above 1000 feet, read altitude on altitude readout plus pointer and dial indication for last two digits (for example, for an altitude of 12,630 feet, read 12,600 feet on readout and read 30 feet on pointer and dial).

B. Altitude Encoding Operation.

Operation of the altitude encoding function of the altimeter is completely automatic as soon as power is applied to the altimeter and the warning flag is out of view. However, for transmission of the altitude information to the ground controller, the Mode C (ALT) function must be selected on the transponder.

SECTION 5 — PERFORMANCE

Not Applicable.

800 ALTITUDE ENCODING/ALERTING/PRESELECT (TYPE EA-801A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 800 encoding altimeter.

Description

The Cessna 800 encoding altimeter (Type EA-801A) is an electrically driven instrument that senses airplane altitude and provides the pilot with a visual display of the altitude. It also includes an optical encoder which automatically produces a logic code corresponding to the sensed altitude. This code is supplied to the Air Traffic Control Radar Beacon System transponder in the airplane to generate replies to Mode C (altitude reporting) interrogations from the ground controller. A second altitude information output from the altimeter can be coupled to airplane accessory equipment such as an altitude alerter or an autopilot altitude preselector circuit.

The altitude alerter (Type AA-801A) is an accessory unit used with the 800 encoding altimeter to supply a preselected altitude capture signal to arm the altitude hold function of the Integrated Flight Control System. It also provides visual and aural warnings when the airplane deviates from the selected altitude.

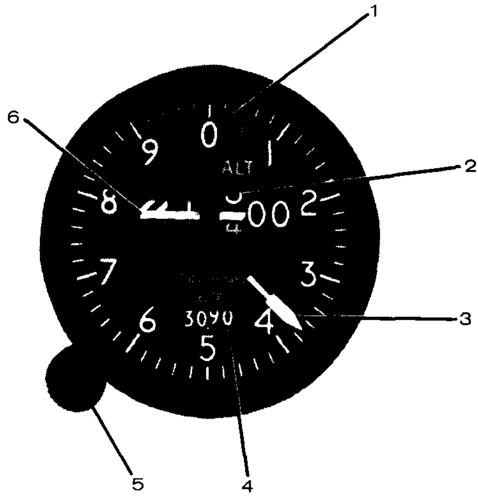
The encoding altimeter is a panel-mounted barometric altimeter with an altitude range of -1000 to +35,000 feet. Altitude is displayed by a dial and a digital readout. The dial is graduated in 10 numerical divisions which represent increments of 100 feet, with subdivision markings for every 20 feet; the dial pointer completes one revolution for every 1000 feet of altitude change. The digital readout displays airplane altitude in increments of hundreds and thousands of feet only. Friction-induced lag and jumping of the display is reduced by the use of a combined aneroid sensor and motor-driven display. Electronic damping circuits in the unit insure that the display follows altitude changes rapidly with no overshoot. When power is removed from the altimeter, a striped warning flag appears across the digital altitude display to indicate a "power-off" condition.

Ambient atmospheric pressure is set into the altimeter with a manually operated baroset knob, and is displayed on a four-digit readout, either in inches of mercury or in millibars (as ordered). The pressure setting does not affect the output of the optical encoder, since the encoder is always referenced to standard pressure (sea level; 29.92 inches of mercury or 1013.2 millibars).

Except for introducing the altimeter setting with the baroset knob, operation of the altimeter is completely automatic. The baroset knob and the display indicators are shown in Figure 1.

The altitude alerter is a panel-mounted unit which includes all of the operating controls and indicators and the preselector logic circuits. Altitude information for use in the altitude alerter is supplied electronically from the encoding altimeter. Three Minilever switches, mounted on the front panel of the unit, are used to select any altitude between 100 and 35,000 feet in 100-foot increments; the selected altitude is displayed on a digital readout. The preselector control and indicators and an ALERT indicator are also included on the front panel of the unit. All controls and indicators for the altitude alerter are shown in Figure 2.

ENCODING ALTIMETER INDICATOR



1. ZERO-TO-THOUSAND FOOT ALTITUDE DISPLAY DIAL - Calibrated in 10 numerical graduations which represent increments of 100 feet; the subdivisions of each graduation represent increments of 20 feet.
2. ALTITUDE READOUT - Displays altitude above 100 feet on three-section counter in increments of 10,000, 1000, and 100 feet. When altitude is below 10,000 feet, a diagonally striped flag appears in 10,000-foot window.
3. ZERO-TO-THOUSAND FOOT ALTITUDE DISPLAY POINTER - Directly indicates airplane altitude between 0 and 1000 feet; for altitudes above 1000 feet, indicates last three digits of altitude (ones, tens, and hundreds).
4. ALTIMETER SETTING READOUT - Displays altimeter setting set into altimeter with baroset knob on a four-digital counter.
5. BAROSET KNOB - Used to set in local altimeter setting; clockwise rotation increases setting, counterclockwise rotation decreases setting.
6. POWER-OFF WARNING FLAG - Appears across altitude readout when power is removed from altimeter to indicate that readout is not reliable.

Figure 1

ALTITUDE ALERTER INDICATOR

1. ALTITUDE SELECTOR AND DISPLAY - Minilever switches (3) select desired altitude between 100 and 35,000 feet in 100-foot increments. Digital readout displays selected altitude.
2. ALTITUDE CAPTURE CONTROL AND INDICATORS - Selector switch and two-lamp indicator which operate as follows:
   a. ARM Pushbutton Switch - Arms altitude capture function of Alerter, provided Integrated Flight Control System is turned on and not already engaged in a vertical mode (Altitude hold or glide slope coupled).
   b. ARMD Amber Lamp - Lights when ARM pushbutton switch is pushed in and altitude capture function is enabled.
   c. CPLD Green Lamp - Lights when airplane reaches selected altitude and Integrated Flight Control System altitude hold mode is automatically engaged.
3. ALTITUDE ALERT INDICATOR - Three-lamp indicator which operates within a preestablished range on either side of the selected altitude, as follows:
   a. ALERT Green Lamp - Lights when airplane altitude is within 300 feet of the selected altitude.
   b. HI ALERT Amber Lamp - Lights when airplane altitude is between 300 and 1000 feet above the selected altitude.
   c. LO ALERT Amber Lamp - Lights when airplane altitude is between 300 and 1000 feet below the selected altitude.
   d. ALT ALERT Amber Lamp - This remotely located lamp illuminates when either the HI ALERT or LO ALERT lamps illuminate.

Figure 2

The altitude capture function is selected by a white pushbutton switch (ARM) which energizes the preselector logic circuits. For altitude capture function operation, the Integrated Flight Control System must be turned on but not already engaged in a vertical mode (altitude hold or glide slope coupled). When the Minilever switches are set to the desired altitude and the white ARM pushbutton is pushed in, an amber ARMD panel lamp lights to indicate that the function is "armed." When the airplane reaches the selected altitude, the amber ARMD lamp turns off, and a green CPLD panel lamp on the alerter and the altitude hold (ALT) lamp on the flight director mode selector lights to indicate that altitude hold mode is operational. If the Minilever switches are repositioned after the preselector has been armed but before altitude hold is engaged, the logic circuits are reset and must be rearmed by again pushing in the ARM switch.

The alert indicator consists of a three-lamp display and a one-second aural tone. The alerting range levels are variable within limits for individual airplane requirements and may be preset for each airplane. As factory installed, a green indicator lamp lights when the airplane altitude is within ±300 feet of the selected altitude. When the airplane enters an altitude band from 300 feet to 1000 feet above or below the selected altitude, an amber HI ALERT or LO ALERT lamp lights and simultaneously, the one-second tone is heard. A remotely mounted amber ALT ALERT lamp illuminates when either the HI ALERT or LO ALERT lamps light. At altitudes above or below the 1000-foot alerting range, the alert function does not operate.

SECTION 2 – LIMITATIONS

A. A standby barometric altimeter is required when the encoding altimeter is installed.

SECTION 3 – EMERGENCY PROCEDURES

A. Encoding Altimeter Failure (Warning Flag Showing)
   1. ENC ALT Circuit Breaker - CHECK IN.
   2. If warning flag is still showing, use the standby barometric altimeter.

SECTION 4 – NORMAL PROCEDURES

A. Altimeter Operation
   1. Baroset Knob - TURN as necessary to set readout to local altimeter setting.
   2. Power-off Warning Flag - VERIFY that flag is not in view.

WARNING

Do not attempt to use altimeter indication for flight information if warning flag is in view. Flag indicates that power has been removed from altimeter.

3. Altitude Display - Below 1000 feet, read altitude on display pointer and dial. Above 1000 feet, read altitude on altitude readout plus pointer and dial indication for last two digits (for example, for an altitude of 12,630 feet, read 12,600 feet on readout; read 30 feet on pointer and dial).

B. Altitude Encoding and Accessory Operation

Operation of the altitude encoding and accessory information functions of the altimeter is completely automatic as soon as power is applied to the altimeter and the warning flag is out of view. However, for transmission of the altitude information to the ground controller, the Mode C (ALT) function must be selected on the transponder.

C. Altitude Alert

NOTE

The altitude alerter must be used with a properly functioning 800 encoding altimeter for all operation.

During flight, altitude alert operation of the altitude alerter is automatic within the preestablished alert range. Operation may be verified on the ground as follows:

1. Apply power to the equipment. Altimeter power-off warning flag should disappear.
2. Set altitude selector switches to slightly more than 1000 feet above the altitude indicated on the encoding altimeter. Altitude is displayed on readout.
3. Begin to turn altimeter baroset knob to set altimeter reading to agree with selected altitude. When altitude reading reaches lower limit of alert range, one-second tone is heard and amber LO ALERT lamp lights.
4. Continue to turn baroset knob for selected altitude. When altitude reading is within altitude tolerance of alerter, the LO ALERT lamp goes out and the green ALERT lamp lights.
5. Turn baroset knob for altitude above altitude tolerance of alerter. Green lamp goes out, one-second tone is heard, and amber HI ALERT lamp lights.
6. Continue to turn baroset knob until altitude reading is above alert range. Just as altitude leaves alert range, the HI ALERT lamp goes out.
7. Turn off power; power-off warning flag appears.
8. Turn baroset knob to reset altimeter as required.

D. Altitude Capture

Altitude capture operation may be verified on the ground as follows:

1. Turn on airplane power. Power-off warning flag on altimeter should disappear.
2. Turn on Integrated Flight Control System and verify that a vertical mode is not selected.
3. Set altitude selector switches to desired altitude; altitude is displayed on readout.
4. Push in ARM pushbutton switch. Amber ARMD lamp lights.
5. Turn altimeter baroset knob to set altimeter reading to displayed alerter altitude. When altimeter is set, ARMD lamp goes out and green CPLD lamp lights. The altitude hold indicator lamp on the flight director mode selector will also light.
6. Turn off power. Power-off warning flag appears and all indicator lamps go out.
7. Turn baroset knob to reset altimeter as required.

E. Altitude Capture Operating Notes

1. If the altitude selector switches are moved to a new position after the ARM pushbutton has been pushed in but before the altitude is captured, the alerter logic is reset and the ARM pushbutton must be pushed again to enable the new altitude.
2. After altitude capture, and altitude hold mode is established; if the airplane leaves the selected altitude, the green CPLD lamp will remain lit. The altitude deviation will be indicated by the altitude ALERT lamps and the discrepancy between the selected altitude displayed on the alerter and the airplane altitude displayed by the altimeter.
3. If the altitude selector switches are set to a different altitude after altitude capture, the Integrated Flight Control System will remain in the altitude hold mode but the green CPLD lamp will go out to indicate that the altitude displayed is not the altitude at which the airplane is being held.
4. If altitude hold is manually selected on the flight director mode selector prior to automatic altitude capture, the ARMD lamp will go out, the CPLD lamp will not light, and the capture logic circuits will have to be reset for the next use. The function may be reset after altitude hold is disengaged.

SECTION 5 – PERFORMANCE

Not Applicable.

400 AREA NAVIGATION SYSTEM (TYPE RN-478A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 400 area navigation system.

Description

The Cessna 400 area navigation system (Type RN-478A) consists of an RN-478A area NAV computer (RNAV), a compatible VHF navigation receiver and course deviation indicator and the Type R-476A distance measuring equipment (DME). The RNAV includes converter circuits which operate with the VHF navigation receiver and produce positional information for display by the course deviation indicator. It also includes computer circuits which combine the bearing information from the navigation set with the distance information from the R-476A DME to establish navigation data for selected waypoints. During RNAV operation, a course scalloping suppressor circuit suppresses the spurious navigation signal phases to provide stable waypoint information which enhances autopilot operation.

The course scalloping suppression (radial straightening), may be used to an advantage while tracking inbound or outbound from the VOR station. These advantages may be obtained by programming a waypoint directly over the associated VOR (000.0°/ 000.0 nautical miles) and using RNAV for course smoothing while enroute.

The 400 RNAV includes storage for 3 waypoints.

A "Frequency Memory" voltage is provided so that the preset waypoints are not lost when the area navigation system is turned off. This voltage is provided directly from the hot battery bus and is present even with the battery switch off. To prevent battery discharge during periods of long term storage, a FREQ MEM circuit breaker is provided on the right side console.

> NOTE
>
> If the "Frequency Memory" voltage is interrupted, all stored information for the RNAV display will be lost. Subsequent operation of the system, with the "Frequency Memory" voltage restored, will require reprogramming of waypoints.

All operating controls and displays which are part of the area navigation system are shown and described in Figure 1. Other controls required for operation of the area navigation system are included on the VHF navigation receiver and on the R-476A DME control; these controls are shown and described in the respective supplements included for this equipment. An indicator light is provided adjacent to or integral to the associated HSI or VOR-LOC indicator to denote RNAV operation.

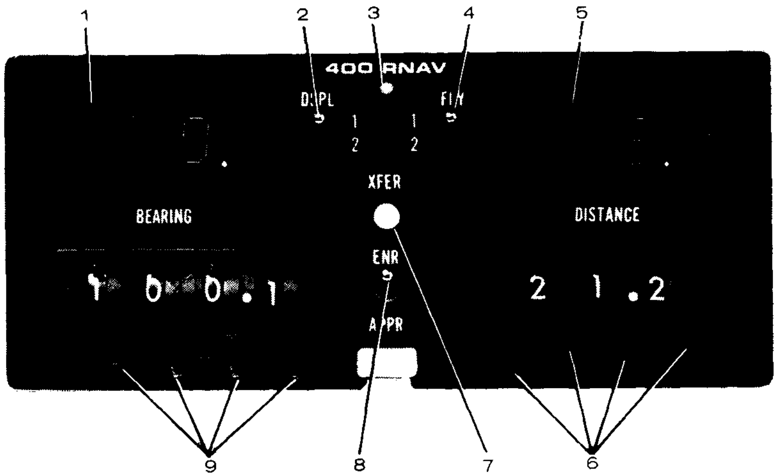
SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

400 AREA NAVIGATION CONTROLS



1. BEARING DISPLAY READOUT - Depending on position of DSPL switch, displays bearing programmed for waypoint 1 or waypoint 2.
2. DISPLAY SWITCH - Determines information shown on DISTANCE and BEARING displays: In position 1, distance and bearing programmed for waypoint 1 are displayed; in position 2, distance and bearing programmed for waypoint 2 are displayed.
3. DISPLAY/FLY ANNUNCIATOR LAMP - Flashes amber when FLY switch and DSPL switch are not set to same number; indicates that waypoint information being displayed is not waypoint information being flown.
4. FLY SWITCH - Determines waypoint being used for navigation. In position 1, waypoint 1 is in use. In position 2, waypoint 2 is in use.
5. DISTANCE DISPLAY READOUT - Depending on position of DSPL switch, displays distance programmed for waypoint 1 or waypoint 2.
6. DISTANCE MINILEVER SWITCHES (4) - Select distance of desired waypoint from VOR/DME station. May be used to store distance of 3rd waypoint.
7. XFER PUSH BUTTON - Transfers waypoint distance and bearing from minilevers into either waypoint 1 or 2 as selected by DSPL switch position.
8. ENR/APPR SWITCH - Controls width of navigation corridor. ENR position provides standard (±5 NM) enroute sensitivity; APPR position provides standard (±1-1/4 NM) approach course sensitivity.
9. BEARING MINILEVER SWITCHES (4) - Select bearing of desired waypoint from VOR/DME station. May be used to store bearing of 3rd waypoint.

Figure 1

SECTION 4 – NORMAL PROCEDURES

A. RNAV Operation

NOTE

Proper RNAV operation requires valid VOR and DME inputs to the RNAV system. In certain areas, the ground station antenna patterns and transmitter power may be inadequate to provide valid signals to the RNAV. For this reason, intermittent RNAV signal loss may be experienced enroute. Prolonged loss of RNAV signal shall require the pilot to revert to other navigational procedures.

1. VHF Navigation Receiver - ON.
2. VHF Navigation Receiver
   Frequency Selector Switches - SET to VOR/DME frequency.
3. DME TEST/ON-OFF Switch - ON.
4. DME Mode Selector Switch - RNAV.
5. DSPL and FLY Switches - SET to selected waypoint.
6. ENR/APP - SET to desired sensitivity.
7. Navigation data is now supplied as distance to the waypoint and left/right steering information with respect to selected course.

B. Waypoint Programming
1. Using Selected VOR/DME Station Data - DETERMINE distance and bearing for desired waypoint(s).
2. DME TEST/ON-OFF Switch - ON.
3. RNAV DSPL Switch - 1.

NOTE

When DSPL and FLY switches are not set to the same waypoint number, the display/fly annunciator slowly blinks on and off as a reminder to the pilot that values displayed are not those being used for navigation. This does not affect operation of the unit.

4. BEARING Minilever Switches - SET to first waypoint bearing.

NOTE

000.0 must be programmed for a north waypoint bearing.

5. DISTANCE Minilever Switches - SET to first waypoint distance.
6. XFER Push Button - PUSH.
   a. First waypoint bearing and distance are placed in memory as waypoint 1.
   b. BEARING Display Readout - DISPLAYS first waypoint bearing as programmed.

c. DISTANCE Display Readout - DISPLAYS first waypoint distance as programmed.

7. RNAV DSPL Switch - SET to 2.
8. BEARING Minilever Switches - SET to second waypoint bearing.
9. DISTANCE Minilever Switches - SET to second waypoint distance.
10. XFER Push Button - PUSH.
    a. Second waypoint bearing and distance are placed in memory as waypoint 2.
    b. BEARING Display Readout - DISPLAYS readout of second waypoint bearing.
    c. DISTANCE Display Readout - DISPLAYS readout of second waypoint distance.
11. BEARING Minilever Switches - SET to standby waypoint bearing.
12. DISTANCE Minilever Switches - SET to standby waypoint distance.

C. Area Navigation Circuits Verification

> NOTE
>
> Proper RNAV verification requires valid VOR and DME signals to the RNAV.

1. VHF Navigation Receiver - ON.
2. VHF Navigation Receiver Frequency Selector Switches - SET to a VOR/DME frequency.
3. DME TEST/ON-OFF Switch - ON.
4. DME Mode Selector Switch - RNAV.
    a. RN Course Indicator Lamp - ILLUMINATED.
5. RNAV Computer - PROGRAMMED to waypoint 1.
6. DSPL and FLY Switches - SET to waypoint to be tested.
    a. BEARING Display - READOUT is waypoint bearing.
    b. DISTANCE Display - READOUT is waypoint distance.
7. Course Indicator OBS - SET to waypoint bearing.
8. VHF Navigation Receiver Test Switch - HOLD in test position.
    a. Course Deviation Indicator - CENTERS.
    b. TO-FROM Course Indicator - Shows TO.
    c. DME Distance-to-Station Display - READOUT is the same as the programmed waypoint DISTANCE readout.

> NOTE
>
> - After releasing the navigation receiver test switch, the return to accurate computed bearing and distance data can take up to 60 seconds depending upon airplane position and waypoint.
>
> - This test does not fulfill the requirements of FAR 91.25.

9. Additionally cross-check RNAV circuits as follows:
    a. RNAV Computer - PROGRAM to waypoint 000.0°/ 000.0 NM (system is operating in RNAV mode).

b. Course Indicator - TURN course selector to center Course Deviation Indicator. Note RNAV distance to waypoint on DME Control Unit.
c. DME Mode Selector Switch - SET to selected VHF Navigation Receiver, NAV 1 or NAV 2 (System is now operating in VOR/DME mode). Verify that DME distance is same as in step b above and that Course Deviation Indicator remains centered.

D. Display Reliability Tests
1. VHF Navigation Receiver - ON.
2. VHF Navigation Receiver
Frequency Selector Switches - SET to VOR/DME frequency.
3. DME TEST ON/OFF Switch - ON.
4. RNAV DSPL and FLY Switches - SET display switch to 1 and fly switch to 2.
    a. Readout - DISPLAYS first waypoint bearing and distance.
    b. Display/Fly Annunciator Lamp - FLASHES.
5. RNAV DSPL and FLY Switches - SET display switch to 2 and fly switch to 1.
    a. Readout - DISPLAYS second waypoint distance and bearing.
    b. Display/Fly Annunciator Lamp - FLASHES.
6. RNAV DSPL and FLY Switches - SET both switches to 1 or 2.
    a. Readout - DISPLAYS waypoint bearing and distance as selected by DSPL switch.
    b. Display/Fly Annunciator Lamp - NOT ILLUMINATED.
7. DME Mode Selector Switch - SET to RNAV.
    a. Both DME RN and NM Annunciator Lights - ILLUMINATED.
    b. RN Course Indicator Lamp - ILLUMINATED.
    c. DME TEST/ON-OFF Switch - HOLD to test.
    d. DME Distance-to-Station Display - READOUT is 888.8.
    e. DME Time-to-Station/
    Ground Speed Display - READOUT is blank.
    - READOUT is 888 on some models which have ground speed/time-to-Station information to the selected VOR (not the waypoint).
    f. RNAV BEARING Display - READOUT is 888.8.
    g. RNAV DISTANCE Display - READOUT is 188.8.
8. VHF Navigation Receiver
Frequency Selector Switches - SET to LOC frequency.
    a. DME Distance-to-Station Display - NOT ILLUMINATED.
    b. Course Indicator Off Flag - IN VIEW.
9. DME Mode Selector Switch - SET to selected NAV.
    a. NM Annunciator Light - ILLUMINATED.
    b. RN Course Indicator Lamp - NOT ILLUMINATED.
    c. TO-FROM Course Indicator - Shows TO if a usable signal is received by selected NAV receiver.

SECTION 5 — PERFORMANCE

Not Applicable.

800 AREA NAVIGATION SYSTEM (TYPE RN-878A)

SECTION 1 - GENERAL

This supplement provides information which must be observed when operating the 800 area navigation system.

Description

The Cessna 800 Area Navigation System (Type RN-878A) consists of an RN-878A area NAV computer (RNAV), a compatible VHF navigation receiver and course deviation indicator and the Type 876A distance measuring equipment (DME). The RNAV includes converter circuits which operate with the VHF navigation receiver and produce positional information for display by the course deviation indicator. It also includes computer circuits which combine the bearing information from the navigation set with the distance information from the 876A DME to establish navigation data for selected waypoints. During RNAV operation, a course scalloping suppressor circuit suppresses the spurious navigation signal phases to provide stable waypoint information which enhances autopilot operation. This feature may be used to advantage during VOR tracking by programming a waypoint directly over the associated VOR (000.0°/000.0 NM) and using RNAV for course smoothing enroute.

The 800 RNAV includes storage for 5 waypoints and provisions for offsetting 2 to 12 nautical miles parallel to a waypoint course.

A "Frequency Memory" voltage is provided so that the preset waypoints are not lost when the area navigation system is turned off. This voltage is provided directly from the hot battery bus and is present even with the battery switch off. To prevent battery discharge during periods of long term storage, a FREQ MEM circuit breaker is provided on the right side console.

NOTE

If the "Frequency Memory" voltage is interrupted, all stored information for the RNAV display will be lost. Subsequent operation of the system, with the "Frequency Memory" voltage restored, will require reprogramming of waypoints

All operating controls and displays which are part of the area navigation system are shown and described in Figure 1. Other controls required for operation of the area navigation system are included on the VHF navigation receiver indicator and on the C-876A DME control; these controls are shown and described in the respective supplements included for this equipment. An indicator light is provided adjacent to or integral to the associated HSI or VOR-LOC indicator to denote RNAV operation.

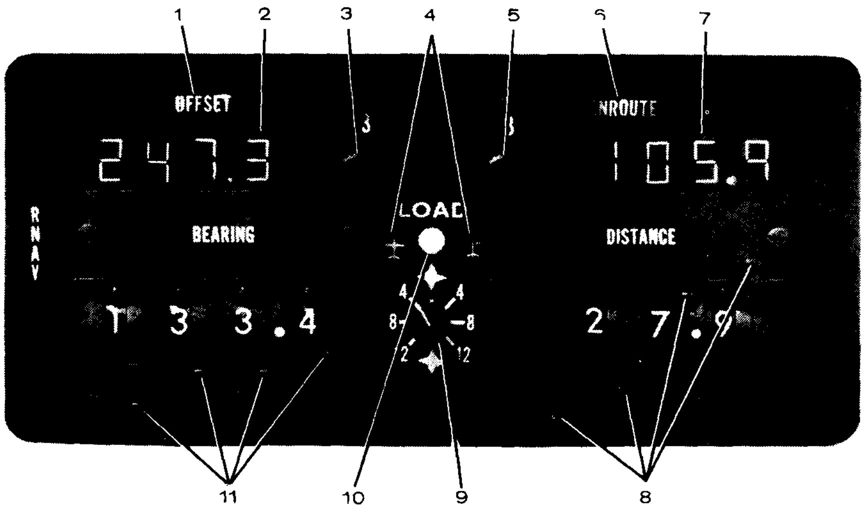
SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

800 AREA NAVIGATION CONTROLS



1. OFFSET ANNUNCIATOR - Lights if offset mode is active. APPROACH/ ENROUTE/OFFSET selector must be ENROUTE (pushed in) and out of center detent.
2. BEARING DISPLAY READOUT - Displays bearing programmed for waypoints 1 through 4 as selected by the DSPL switch. Flashes if the DSPL switch setting does not agree with the FLY switch setting.
3. DSPL SWITCH - Selects waypoint (1 through 4) to be shown on the BEARING and DISTANCE display readout.
4. RIGHT/LEFT OFFSET ANNUNCIATORS - The right airplane symbol is lighted if the right offset is being used (flight path will be to the right of the zero offset course). The left airplane symbol is lighted if the left offset is being used (flight path will be to the left of the zero offset course).
5. FLY SWITCH - Selects waypoint (1 through 4) to be used for actual navigation.
6. APPROACH/ENROUTE ANNUNCIATOR - Lights APPROACH or ENROUTE as selected by the APPROACH/ENROUTE/ OFFSET selector.
7. DISTANCE DISPLAY READOUT - Displays distance programmed for way-points 1 through 4 as selected by the DSPL switch. Flashes if the DSPL switch setting does not agree with the FLY switch setting.

Figure 1 (Sheet 1 of 2)

800 AREA NAVIGATION CONTROLS

8. DISTANCE MINILEVER SWITCHES (4) - Select distance of desired waypoint from VOR/DME station. May be used to store the distance of the 5th waypoint.
9. APPROACH/ENROUTE/OFFSET SELECTOR - Controls enroute and approach indicator sensitivity and also provides offset route selection in the enroute mode.

   PUSHED IN - Selects standard enroute sensitivity (±5 nautical miles full scale) on the course deviation indicator. Selector detents in the center (zero offset) position and may be rotated right or left to command course offsets of up to 12 nautical miles. The airplane symbols depict the relative position of the offset course with respect to the selected waypoint course. The airplane symbols and offset graduations are illuminated only when the selector is moved out of the detent.

   PULLED OUT - Selects the standard approach sensitivity (±1-1/4 nautical miles full scale) on the course deviation indicator. The selector is locked in the center position to prevent course offset. The selector can be pulled out only if the selector is set to the center (zero offset) position.
10. LOAD PUSH BUTTON - Transfers waypoint distance and bearing from minilevers into memory for waypoints 1 through 4 as selected by the waypoint DSPL switch.
11. BEARING MINILEVER SWITCHES (4) - Select bearing of desired waypoint from VOR/DME station. May be used to store the bearing of the 5th waypoint.

Figure 1 (Sheet 2 of 2)

SECTION 4 — NORMAL PROCEDURES

A. RNAV Operation

> NOTE
>
> Proper RNAV operation requires valid VOR and DME inputs to the RNAV system. In certain areas, the ground station antenna patterns and transmitter power may be inadequate to provide valid signals to the RNAV. For this reason, intermittent RNAV signal loss may be experienced enroute. Prolonged loss of RNAV signal shall require the pilot to revert to other navigational procedures.

1. VHF Navigation Receiver - ON.
2. VHF Navigation Receiver Frequency Selector Switches - SET to VOR/DME frequency.
3. DME TEST/ON-OFF Switch - ON.
4. DME Mode Selector Switch - RNAV.
5. DSPL and FLY Switches - SET to selected waypoint.

6. APPROACH/ENROUTE/OFFSET Selector - SET to desired offset and sensitivity.

> **NOTE**
>
> APPROACH/ENROUTE/OFFSET selector cannot be turned to an offset in the approach mode. In the offset mode, distance, ground speed and time-to-station are computed with respect to the original waypoint, not to the offset waypoint.

7. Navigation data is now supplied as the distance to waypoint, ground speed, time-to-waypoint and left and right steering information with respect to the selected course.

> **NOTE**
>
> Ground Speed/Time-To-Waypoint information is blanked in the APPROACH mode. In the ENROUTE mode, Ground Speed/Time-To-Waypoint information will be blanked or unreliable after waypoint passage, any change in waypoint or loss of signal; as it requires five to seven minutes for reliable information to be displayed.

B. Waypoint Programming

1. Using Selected VOR/DME Station Data - DETERMINE distance and bearing for desired waypoint(s).
2. DME TEST/ON-OFF Switch - ON.
3. RNAV DSPL Switch - 1.

> **NOTE**
>
> When DSPL and FLY switches are not set to the same waypoint number, the BEARING and DISTANCE displays slowly blink on and off as a reminder to the pilot that the values being displayed are not those being used for navigation. This does not affect operation of the unit.

4. BEARING Minilever Switches - SET to first waypoint bearing.
5. DISTANCE Minilever Switches - SET to first waypoint distance.
6. LOAD Push Button - PUSH.
   a. First waypoint bearing and distance are placed in memory as waypoint 1.
   b. BEARING Display Readout - DISPLAYS first waypoint bearing as programmed.
   c. DISTANCE Display Readout - DISPLAYS first waypoint distance as programmed.
7. Waypoints 2, 3 and 4 - REPEAT steps 4 through 6 with the DSPL switch set to 2, 3 and 4.
8. BEARING Minilever Switches - SET to standby waypoint bearing.
9. DISTANCE Minilever Switches - SET to standby waypoint distance.
10. DSPL and FLY Switches - SET to selected waypoint.

C. Area Navigation Circuits Verification

> **NOTE**
>
> Proper RNAV verification requires valid VOR and DME signals to the RNAV.

1. VHF Navigation Receiver - ON.

2. VHF Navigation Receiver
   Frequency Selector Switches - SET to a VOR/DME frequency.
3. DME TEST/ON-OFF Switch - ON.
4. DME Mode Selector Switch - RNAV.
   a. RN Course Indicator Lamp - ILLUMINATED.
5. RNAV Computer - PROGRAMMED to any waypoint.
6. DSPL and FLY Switches - SET to waypoint to be tested.
   a. BEARING Display - READOUT is waypoint bearing.
   b. DISTANCE Display - READOUT is waypoint distance.
7. Course Indicator OBS - SET to waypoint bearing.
8. VHF Navigation Receiver Test Switch - HOLD in test position.
   a. Course Deviation Indicator - CENTERS.
   b. TO-FROM Course Indicator - Shows TO.
   c. DME Distance-to-Station Display - READOUT is the same as the programmed waypoint DISTANCE readout.

NOTE

- After releasing the navigation receiver test switch, a return to accurately computed bearing and distance data may take up to 1 minute, depending upon the airplane position and waypoint.
- This test does not fulfill the requirements of FAR 91.25.

9. Additionally crosscheck the RNAV circuits as follows:
   a. RNAV Computer - PROGRAM to waypoint 000.0°/000.0 nautical miles. System is operating in the RNAV mode.
   b. Course Indicator - TURN course selector to center the course deviation indicator. Note the RNAV distance to waypoint on the DME control unit.
   c. DME Mode Selector Switch - SET to selected VHF navigation receiver, NAV 1 or NAV 2. (The system is now operating in the VOR/DME mode.) Verify that the DME distance is the same as in the preceding step 9.b. and that the course deviation indicator remains centered.

D. Display Reliability Tests
1. VHF Navigation Receiver - ON.
2. VHF Navigation Receiver
   Frequency Selector Switches - SET to VOR/DME frequency.
3. DME TEST ON/OFF Switch - ON.
4. RNAV DSPL and FLY Switches - SET FLY and DSPL switches to different waypoints.
   a. Readout - FLASHES and DISPLAYS waypoint bearing and distance selected by the DSPL switch.
5. RNAV DSPL and FLY Switches - SET FLY and DSPL switches to same waypoint.
   a. Readout - DISPLAYS waypoint distance and bearing selected by DSPL switch.
6. APPROACH/ENROUTE/OFFSET Selector - CENTERED and PULLED OUT.
   a. OFFSET Annunciator - NOT ILLUMINATED.
   b. Right/Left Offset Annunciators - NOT ILLUMINATED.
   c. APPROACH/ENROUTE Annunciator - APPROACH is illuminated.
7. APPROACH/ENROUTE/OFFSET Selector - PUSHED IN.
   a. APPROACH/ENROUTE Annunciator - ENROUTE is illuminated.

8. APPROACH/ENROUTE/OFFSET Selector - RIGHT OFFSET.
   a. OFFSET Annunciator - ILLUMINATED.
   b. Right Offset Annunciator - ILLUMINATED.
9. APPROACH/ENROUTE/OFFSET Selector - LEFT OFFSET.
   a. OFFSET Annunciator - ILLUMINATED.
   b. Left Offset Annunciator - ILLUMINATED.
10. DME Mode Selector Switch - SET to RNAV.
    a. Both DME RN and NM Annunciator Lights - ILLUMINATED.
    b. RN Course Indicator Lamp - ILLUMINATED.

NOTE

If the optional horizontal situation indicator (HSI) is installed, the RN course indicator lamp is located adjacent to the HSI.

11. DME TEST/ON-OFF Switch - HOLD to test.
    a. DME Distance-to-Station Display - READOUT is 888.8.
    b. DME Time-to-Station/Ground Speed Display - READOUT is 888.
    c. RNAV BEARING Display - READOUT is 888.8.
    d. RNAV DISTANCE Display - READOUT is 188.8.
12. VHF Navigation Receiver Frequency Selector - SET to LOC frequency.
    a. Course Indicator Off Flag - OUT OF VIEW if a usable signal is received.
    b. TO-FROM Course Indicator - Shows TO if a usable signal is received..
13. DME Mode Selector - SET to selected NAV.
    a. DME Distance-to Station Display - NOT ILLUMINATED.
    b. NM Annunciator Light - ILLUMINATED.
    c. RN Course Indicator Lamp - NOT ILLUMINATED.

SECTION 5 – PERFORMANCE

Not Applicable.

1000 AUDIO CONTROL PANEL (TYPE F-1010B)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 1000 audio control panel, Type F-1010B.

Description

The 1000 audio control panel provides for amplification of the audio signals for the speaker system and allows audio switching for the cockpit and cabin speakers, headsets, intercom and microphones. The audio panel is installed in a single configuration, where pilot and copilot utilize the same panel.

All operating controls and indicators are located on the front of the panel, see Figure 1. The receiver selector switches that are used on the audio control panel are determined by the avionics equipment installed in the airplane. Unused switches are identified with a black boot on the switch handle.

Power to the audio control panel is arranged so that access to a usable communication receiver/ transmitter is maintained. COM 1 is delivered as the designated emergency receiver/transmitter and in the event of a failure of the control panel, communications can be maintained through COM 1 by selecting EMER COM position. When EMER COM is selected, headsets must be used since power is removed from the audio amplifier, disabling the speaker amplifier.

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

In the event that the audio control panel malfunctions such that Com operations cannot be performed on COM 1, COM 2, or COM 3, proceed as follows:

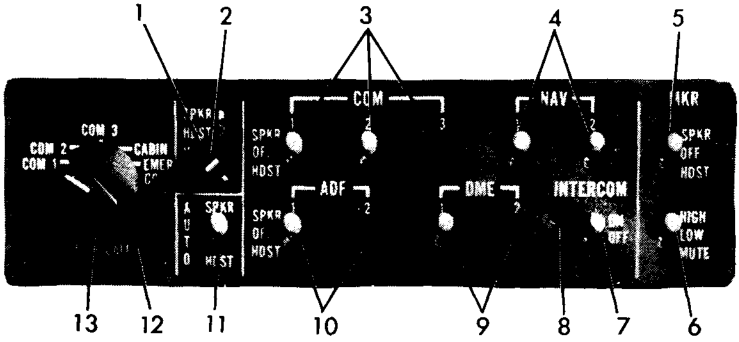
1. Function Selector Switch - EMER COM.

NOTE

Speaker operations will be inoperable in all modes since the EMER COM position turns off all power to the audio control panel.

2. Employ the headsets if not already in use.
3. Set the desired frequency on COM 1 and proceed with communications on that COM only.
4. Select the NAV, MKR, ADF or DME audio to be monitored by setting the appropriate receiver selector switches to HDST. A reduction in normal amplitude will be experienced while operating in the emergency mode.

1000 AUDIO CONTROL PANEL (TYPE F-1010B)



1. VOL HDST CONTROL - Controls volume level for headset audio.
2. VOL SPKR CONTROL - Controls volume level for cockpit speaker.
3. COM 1, 2, 3 SPKR/OFF/HDST RECEIVER SELECTOR SWITCHES - Selects COM receiver audio from COM 1, COM 2 or COM 3 receivers for either speaker or headset. OFF position turns off COM audio.

NOTE

- Although all the COM 1, 2, 3 SPKR/OFF/HDST switches select the individual receiver audio for monitoring, the function selector switch (item 13) automatically selects the appropriate COM receiver audio for monitoring on either speaker or headset as selected by the AUTO SPKR/HDST switch (item 11).
- The audio signals from the COM, NAV, ADF, DME and marker beacon receivers will be muted whenever any microphone key is actuated for COM 1, COM 2 or COM 3 operation.

4. NAV 1, 2 SPKR/OFF/HDST RECEIVER SELECTOR SWITCHES - Selects NAV receiver audio from NAV 1 or Nav 2 receivers for either speaker or headset. OFF position turns off NAV audio.
5. MKR SPKR/OFF/HDST RECEIVER SELECTOR SWITCHES - Selects marker beacon receiver audio for either speaker or headset. OFF position turns off marker beacon audio.

Figure 1 (Sheet 1 of 3)

1000 AUDIO CONTROL PANEL (TYPE F-1010B)

6. HIGH/LOW/MUTE
   SELECTOR SWITCH - Selects marker beacon receiver sensitivity, HIGH or LOW. MUTE is a momentary contact switch position that cuts off the marker beacon audio for approximately 30 seconds. When MUTE position is released, switch returns to LOW.
7. INTERCOM ON/OFF
   SELECTOR SWITCH - Turns on pilot and copilot microphones for intercommunication with each other.

NOTE

Audio feedback may be encountered if AUTO/SPKR is selected during INTERCOM operation.

8. SIDETONE SCREWDRIVER
   ADJUST - Adjusts sidetone level in speaker. Sidetone is obtained when transmitting on COM 1, COM 2 or COM 3.

NOTE

Sidetone adjustment is normally a maintenance function and not part of the normal operating procedure.

9. DME 1, 2, SPKR/OFF/HDST RECEIVER SELECTOR
   SWITCHES - Selects DME receiver audio from DME 1 or DME 2 receivers for either speaker or headset, OFF position turns off DME audio.
10. ADF 1, 2, SPKR/OFF/HDST RECEIVER
    SELECTOR SWITCHES - Selects ADF receiver audio from ADF 1 or ADF 2 receivers for either speaker or headset. OFF position turns off ADF audio.
11. AUTO SPKR/HDST
    SELECTOR SWITCH - Selects either speaker or headset for the associated audio selected via the function selector switch.
12. CABIN CALL - Back-lighted blue indicator that lights when the cabin microphone switch is actuated to signal the cockpit that the cabin wishes to communicate via the cabin microphone and speaker. Cockpit communication with the cabin is made by setting the Function Selector Switch to the CABIN position. The incoming audio selected via the receiver selector switches will not be interrupted when the Function Selector Switch is set to CABIN position.

Figure 1 (Sheet 2 of 3)

1000 AUDIO CONTROL PANEL (TYPE F-1010B)

13. COM 1/COM 2/COM 3/CABIN/EMER COM
    FUNCTION SELECTOR SWITCH - Selects the microphone connection for Com 1, Com 2 or Com 3 transmission, cabin communication or the emergency mode of operation. In COM 1, COM 2, COM 3 and CABIN switch positions, the associated audio is automatically selected for monitoring on either headset or speaker, as selected by the AUTO SPKR/HDST switch (item 11).

Figure 1 (Sheet 3 of 3)

SECTION 4 — NORMAL PROCEDURES

1. VOL HDST/SPKR
   Control - Initial setting of both controls at 2 o'clock position. The VOL HDST outer concentric knob sets the master volume level for the headsets. The VOL SPKR inner concentric knob sets the master volume level of the speaker.

NOTE

Set the individual volume controls of each receiver only after setting the master volume level controls on the audio control panel.

2. INTERCOM ON/OFF
   Selector-Switch - AS REQUIRED. When the switch is set to the ON position it provides communication between pilot and copilot without having to actuate any microphone button. During transmissions, where the pilot or copilot wheel microphone buttons are pressed, the interphone function is muted.

NOTE

- The interphone level is adjustable only through the master HDST or SPKR controls and should be adjusted from the initial 2 o'clock setting to the desired level before the individual receiver controls are set to their final desired level.
- The speaker interphone function should only be used with oxygen mask microphones because the normal lip microphones will cause a feedback squeak in the cockpit.
- Intercommunication between pilot and copilot should not be attempted using the hand-held microphone, since keying the microphone will key the transmitter for whatever COM the function selector switch is set.

3. SPKR/OFF/HDST Receiver
Selector Switches - SELECT any of the receiver audio signals individually or in combination for simultaneous monitoring.

NOTE

Set the individual receiver volume controls at their final desired level only after establishing the interphone level with the master controls. In the event that interphone is not being utilized, set the individual receiver volume controls with the master controls at the 2 o'clock position.

4. Function Selector
Switch - AS REQUIRED. Select COM 1, 2, 3, or CABIN. The transmitter sidetone audio will be heard in the headset or speaker for the appropriately selected transmitter.
5. AUTO SPKR/HDST
Selector Switch - AS REQUIRED. Selects the appropriate receiver audio or transmitter sidetone for reception on the headset or speaker.
6. Marker Beacon
HIGH/LOW/MUTE Switch - AS REQUIRED. LOW position is used during an ILS approach. MUTE position is momentary and mutes the marker beacon audio for approximately 30 seconds.

NOTE

- The marker beacon and DME audio level is adjustable only through the master volume controls, therefore, it is important to keep the master controls within their normal operating range of approximately 2 o'clock ± any individual comfort adjustment to take care of ambient voice level or variations in headset types (muff, single receiver, etc.)
- Do not operate the master volume controls at an extremely low setting while turning up the individual receiver volume controls to an extremely low setting. This could result in distortion of NAV, COM and ADF audio as well as low levels of MKR and DME audio.

7. Cabin Communication - Cockpit communication with the cabin is accomplished by setting the function selector switch to CABIN position and actuating the hand-held microphone or boom or oxygen mask microphone. When the cabin wishes to communicate with the cockpit, actuation of the cabin-mounted microphone key lights the CABIN CALL indicator on the audio control panel to signal the cockpit. When the function selector switch is set to CABIN, communication is established between the cockpit and cabin.

SECTION 5 — PERFORMANCE

Not Applicable.

400 AUTOMATIC DIRECTION FINDER (TYPE R-446A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 400 ADF.

Description

The Cessna 400 ADF (Type R-446A) is an automatic direction finder set which provides continuous, visual bearing indications of the direction from which an RF signal is being received. It can be used for plotting position, for homing, and for aural reception of AM signals between 200 kHz and 1699 kHz. In addition, a crystal-controlled, beat frequency oscillator (BFO) permits coded identifier of stations transmitting keyed CW signals (Morse Code) to be heard.

The 400 ADF consists of an R-446A receiver with dual frequency selectors, fixed loop antenna, indicator(s) and a sense antenna. Depending upon the avionics options installed, the indicator(s) can be IN-346A or IN-346B bearing indicators or IN-13A-1, IN-404 or IN-1004A RMI indicators. The receiver and goniometer-indicator are panel-mounted units. The sense and fixed loop antennas are mounted on the external airplane surfaces. Operating controls, see Figure 1, are mounted on the receiver front panel. The goniometer-indicator presents station bearing in degrees of azimuth. An automatic pointer-stow feature alerts the operator to non-ADF operation by slewing the pointer to the 3 o'clock position when the REC mode is selected. An optional RA-446A, RA-346A or RA-346B receiver accessory may be substituted for the goniometer-indicator to supply the goniometer function for driving a conventional ADF indicator or an RMI.

The frequency range of the 400 ADF is electronically divided into three bands: 200-399 kHz, 400-799 kHz and 800-1699 kHz. Frequency spacing within each band is in 1-kHz increments. The operating frequency and band are selected by a four-section Minilever switch which displays a digital readout of the frequency selected and supplies a binary code to control the logic circuits within the set. A secondary (standby) operating frequency is selected by another four-section minilever switch. Frequency control of the ADF is switched to the primary or the secondary operating frequency by a toggle switch. The operating modes (ADF and REC) are selected by individual pushbutton switches. Additional pushbutton switches are used to select the BFO and to test signal reliability during ADF operation.

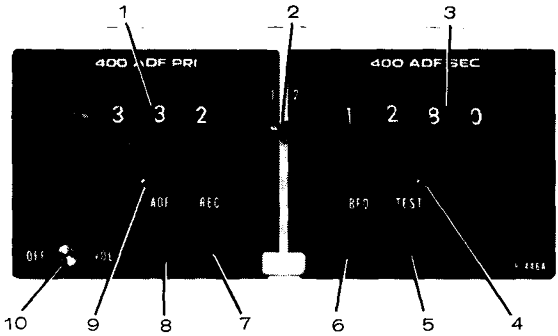
SECTION 2 — LIMITATIONS

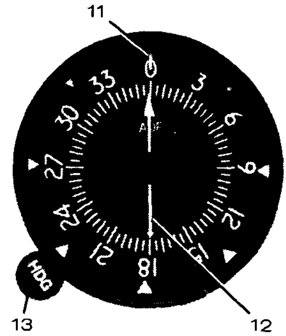
Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

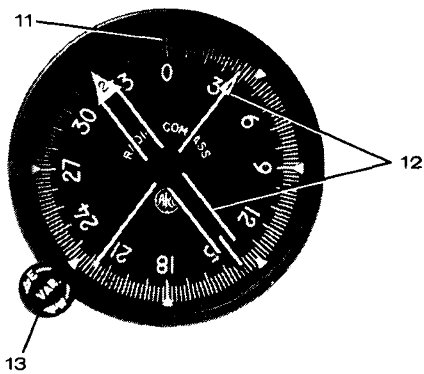
Not Applicable.

400 ADF CONTROLS AND INDICATORS

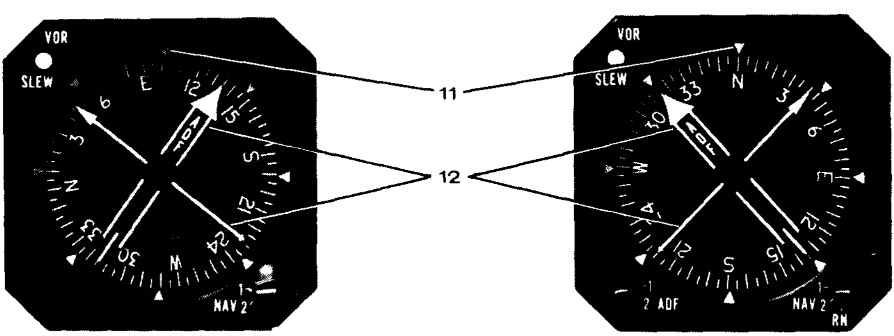




IN-346A or B



IN-13A-1



IN-404A

IN-1004A

Figure 1 (Sheet 1 of 2)

400 ADF CONTROLS AND INDICATORS

1. PRI (PRIMARY FREQUENCY SELECTOR) - Selects and displays "primary" frequency.
2. 1-2 - The "1" position activates "primary" (PRI) frequency. The "2" position activates "secondary" (SEC) frequency.
3. SEC (SECONDARY FREQUENCY SELECTOR) - Selects and displays "secondary" frequency.
4. SECONDARY PRESELECT LAMP - Lamp will flash only when "secondary" (SEC) frequency selection is outside of operating range of the receiver and 1-2 switch is in the "2" position.
5. TEST - Momentary-on switch used only with ADF function to test bearing reliability. When held depressed, slews indicator pointer; when released, if bearing is reliable, pointer returns to original position.
6. BFO - Pushed in: Activates beat frequency oscillator tone to permit coded identifier of stations transmitting keyed CW signals (Morse Code) to be heard.
7. REC - Pushed in: Selects receive mode (set operates as a standard communications receiver using sense antenna only).

NOTE

When the 400 ADF is in the REC function, an automatic pointer stow feature will alert the pilot to non-ADF operation by positioning and retaining the pointer at the 3 o'clock position.

8. ADF - Pushed in: Selects ADF mode (set operates as automatic direction finder using fixed loop and sense antennas).
9. PRIMARY PRESELECT LAMP - Lamp will flash only when "primary" (PRI) frequency selection is outside of operating range of the receiver and 1-2 switch is in the "1" position.
10. OFF-VOL - Turns set on or off and adjusts receiver volume.
11. INDEX - Fixed reference line for dial rotation adjustment.
12. POINTER - When HDG or VAR control is adjusted, indicates either relative, magnetic or true bearings of a radio station.
13. HDG or VAR - Rotates dial to facilitate relative, magnetic or true bearing information.

Figure 1 (Sheet 2 of 2)

SECTION 4 — NORMAL PROCEDURES

A. Communication Receiver
1. OFF/VOL Control - ON.
2. REC Pushbutton - PUSH IN.

NOTE

ADF indicator pointer will point to a 3 o'clock position to alert the pilot to non-ADF operation.

3. PRI Frequency Selectors - SELECT desired operating frequency.
4. SEC Frequency Selectors - SELECT desired operating frequency.

5. 1-2 Selector Switch - 1 position.

> NOTE
> The 1-2 selector switch can be placed in the "2" position for operation on secondary frequency. The reselect lamp will flash only when frequency selection is outside of operating range of the receiver.

6. ADF SPEAKER/PHONE Switch - SELECT speaker or phone position.
7. VOL Control - ADJUST to desired listening level.

B. Automatic Direction Finder
1. OFF/VOL Control - ON.
2. PRI Frequency Selectors - SELECT desired operating frequency.
3. SEC Frequency Selectors - SELECT desired operating frequency.
4. 1-2 Selector Switch - 1 Position.

> NOTE
> The 1-2 selector switch can be placed in the "2" position for operation on secondary frequency. The reselect lamp will flash only when frequency selection is outside of the operating range of the receiver.

5. ADF SPEAKER/PHONE Switch - SELECT speaker or phone position as desired.
6. ADF Pushbutton - PUSH IN and note relative bearing on ADF indicator.
7. HDG Control - SET goniometer-indicator dial so that index indicates magnetic or true heading of airplane. Pointer indicates bearing to station.

> NOTE
> When switching stations, place function pushbutton in the REC position. Then, after station has been selected, place function pushbutton in the ADF position to resume automatic direction finder operation. This practice prevents the bearing indicator from swinging back and forth as frequency dial is rotated.

C. Self-Test
1. ADF Pushbutton - PUSH IN and note bearing on indicator.
2. TEST Pushbutton - PUSH IN and hold until indicator pointer slews off indicated bearing at least 10 to 20 degrees.
3. Indicator Pointer - Observe that pointer returns to the same relative bearing as in step 1.

D. BFO Operation
1. OFF/VOL Control - ON.
2. ADF SPEAKER/PHONE Switch - SELECT speaker or phone position.
3. BFO Pushbutton - PUSH IN.
4. 1-2 Selector Switch - SELECT 1 position to activate PRI frequency or 2 to activate SEC frequency that is transmitting keyed CW signals (Morse Code).
5. VOL Control - ADJUST to desired listening level.

> NOTE
> A 1000-Hz tone is heard in the audio output when CW signal (Morse Code) is tuned in properly.

SECTION 5 — PERFORMANCE

Not Applicable.

1000 AUTOMATIC DIRECTION FINDER (TYPE 1046B)

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the 1000 automatic direction finder.

Description

The 1000 automatic direction finder (ADF) (Type 1046B) provides continuous, visual bearing indications of the direction from which LF or MF signals are being received. It can be used for plotting position, for homing, and for aural reception of AM signals between 200 kHz and 1699 kHz. In addition, a crystal-controlled, beat frequency oscillator (BFO) permits identification of stations transmitting keyed CW signals (Morse Code).

The 1000 ADF permits presetting three frequencies of which two (input and active) are displayed on electronic readouts. As new input frequencies are selected, they may be transferred to active status by means of a pushbutton. The previous active frequency is stored in memory and may be recalled by means of a pushbutton. A control is provided to permit selecting the operating frequency directly from the frequency selector knobs, if desired.

To prevent accidental operation, the frequency related pushbuttons (XFER and RECALL) must be pressed for at least 1/4 second to change frequencies. In addition, a safety circuit is provided which prevents inadvertently entering the same frequency twice and unintentionally erasing the previous memory frequency.

A "Frequency Memory" voltage is provided so that the preset frequencies are not lost when the receiver-transmitter is turned off. This voltage is provided directly from the hot battery bus and is present even with the battery switch off. To prevent battery discharge during periods of long term storage, a FREQ MEM circuit breaker is provided on the right side console.

NOTE

If the "Frequency Memory" voltage is interrupted, all stored frequencies for the ADF will be lost. Subsequent operation of the system, with the "Frequency Memory" voltage restored, will require new frequency inputs.

The 1000 ADF consists of an R-1046B receiver, a C-846A control unit, an IN-346A, B, C or D goniometer-indicator and sense and loop antennas. All operating controls, except the master lamp test switch, are located on the control unit, see Figure 1.

The goniometer-indicator pointer indicates the bearing of the radio station from which the signal is received. An automatic pointer-stow feature alerts the pilot to non-ADF operation by slewing the pointer to the 3 o'clock position when the BFO or REC mode of operation is selected. An optional RA-846A receiver accessory may be substituted for the goniometer-indicator to drive a conventional ADF indicator or dual-pointer RMI.

The frequency range of the 1046B is electronically divided into three bands: 200-399 kHz, 400-799 kHz and 800-1699 kHz. Frequency spacing within each band is in 1-kHz increments. The operating frequency and band are selected by three frequency selector switches, and the frequency selected is displayed digitally. The operating mode (BFO, REC or ADF) is selected by a function switch. A pushbutton switch is used to test signal reliability during ADF operation.

1000 ADF CONTROLS AND INDICATORS

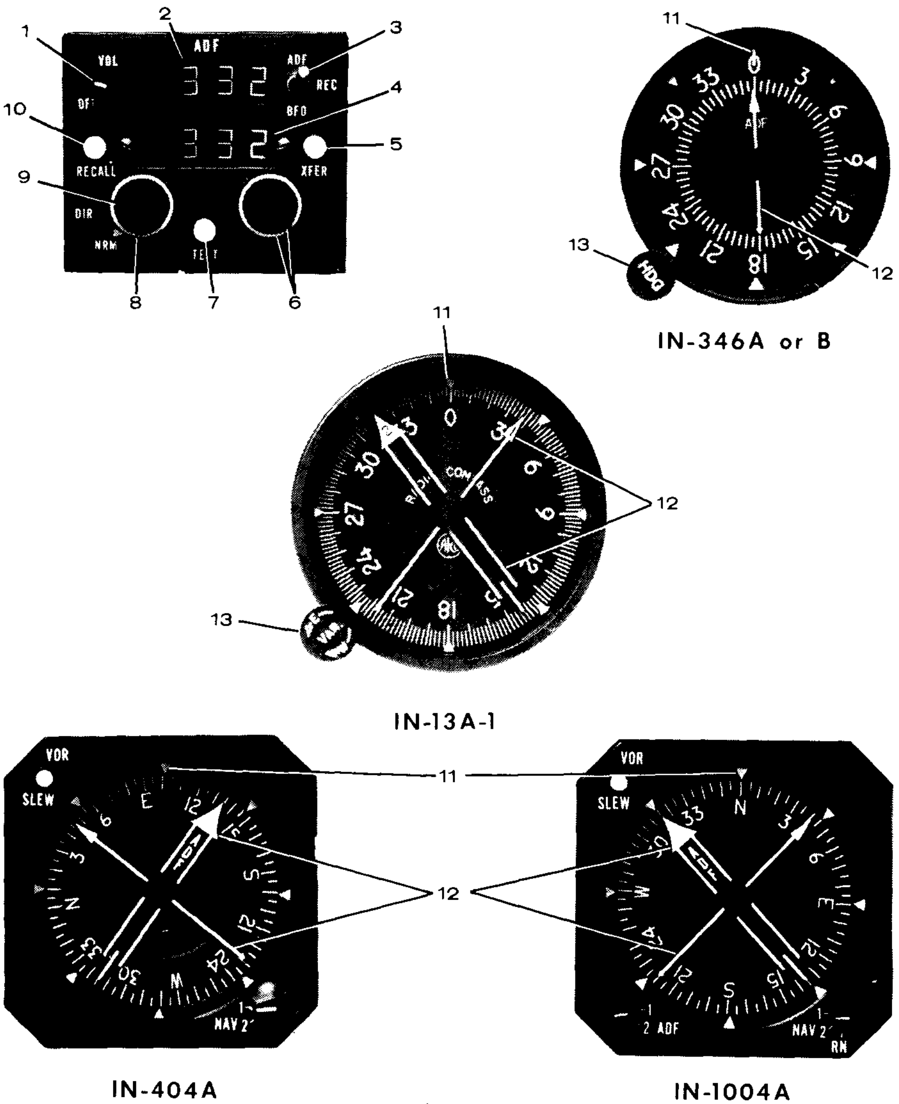


Figure 1 (Sheet 1 of 2)

1000 ADF CONTROLS AND INDICATORS

1. OFF/VOL CONTROL - Clockwise rotation applies power. Further clockwise rotation increases audio level.
2. ACTIVE FREQUENCY READOUT - Displays active frequency which is being received.
3. FUNCTION SWITCH - Selects operating mode:
   ADF - Set operates as automatic direction finder and pointer indicates direction from which signal is being received.
   REC - Set operates as communications receiver and pointer is stowed at 3 o'clock.
   BFO - Set operates as a communication receiver, beat frequency oscillator is activated for identification of keyed CW signals (Morse Code), and pointer is stowed at 3 o'clock.
4. INPUT FREQUENCY READOUT - Displays frequency selected by frequency selectors in NRM mode. Blanked in DIR mode.
5. XFER PUSHBUTTON - Transfers input frequency to active frequency which is being received. The previous active frequency is stored in memory. The previous memory frequency is lost. Pushbutton action delayed by 1/4 second to prevent accidental actuation. Does not function in DIR mode.

NOTE

The XFER pushbutton transfers the same frequency to the active input only once, regardless of how many times the pushbutton is pressed. This prevents accidentally loading the same frequency twice and unintentionally erasing the previous memory frequency.

6. 1 and 10 kHz
   FREQUENCY SELECTORS - Outer knob selects frequency in 1 kHz steps; inner knob selects frequency in 10 kHz steps.
7. TEST PUSHBUTTON - Pushbutton used with ADF function to test bearing reliability. When pushed in, pointer is slewed; when released, if bearing is reliable, pointer returns to its original position. Also tests the active and input frequency readouts. When pushed in, readouts display 1888.
8. DIR/NRM SELECTOR - Selects direct or normal mode:
   DIR - Active frequency selected directly by frequency selectors. Input frequency readout is blanked.
   NRM - Input frequency selected by frequency selectors. Active frequency is controlled with XFER or RECALL pushbuttons.
9. 100 kHz FREQUENCY SELECTOR - Selects frequency in 100 kHz steps.
10. RECALL
    PUSHBUTTON - Recalls frequency stored in memory to active frequency. Previous active frequency is stored in memory. Pushbutton action delayed by 1/4 second to prevent accidental actuation. Does not function in DIR mode.
11. INDEX - When HDG or VAR control is adjusted, pointer indicates relative, magnetic or true bearing to the station.

Figure 1 (Sheet 2 of 2)

12. POINTER - When HDG or VAR control is adjusted, pointer indicates relative, magnetic or true bearing of station from which radio signal is being received. During REC or BFO operation, pointer is automatically stowed at the 3 o'clock position.
13. HDG or VAR - Rotates dial to introduce relative, magnetic or true bearing information.

NOTE

The pointer on the RMI indicates only magnetic bearing to the station. The compass card is not manually adjustable but is slaved to the airplane remote compass system.

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. Frequency Selection in Normal Mode
   1. OFF/VOL Control - CLOCKWISE to turn on ADF and adjust for comfortable audio level.
   2. DIR/NRM Selector - NRM.
   3. Frequency Selectors - AS REQUIRED.
   4. XFER Pushbutton - PRESS. The following occurs:
      a. Input frequency transferred to active frequency readout.
      b. Previous active frequency is stored in memory.
   5. The second frequency may be programmed as in steps 3 and 4 above. The third frequency may be stored in frequency selector and input frequency readout.
   6. To recall frequency stored in memory - PRESS RECALL. The following occurs:
      a. Frequency in memory is transferred to active frequency readout.
      b. Previous active frequency is stored in memory.

B. Frequency Selection in Direct Mode.
   1. OFF/VOL Control - CLOCKWISE to turn on ADF and adjust for comfortable audio level.
   2. DIR/NRM Selector - DIR. The following occurs:
      a. Input frequency readout blanks.
      b. Active frequency readout displays frequency selected by frequency selectors.

NOTE

- XFER and RECALL functions are disabled when operating in direct mode.
- Switching to the direct mode does not affect the memory frequency. The memory frequency may be recalled by switching back to the normal mode and pressing RECALL.

3. Frequency Selectors - AS REQUIRED.

C. Navigation
1. OFF/VOL Control - CLOCKWISE to turn on ADF and adjust for comfortable audio level.
2. Function Switch - REC.
3. Operating Frequency - LOAD as previously described and identify station.

NOTE

If station is transmitting keyed CW signals (Morse Code), set function switch to BFO to identify station.

4. Function Switch - ADF.
5. HDG or VAR Control - SET goniometer-indicator dial so that index indicates relative, magnetic or true heading of airplane. Pointer indicates bearing of station.

D. Self-Test
1. TEST Pushbutton - PUSH IN and hold until pointer slews off of the indicated bearing, then release button. If signal is reliable, pointer will return to original bearing indication.

NOTE

The self-test also tests the input and active frequency readouts.

SECTION 5 – PERFORMANCE

Not Applicable.

400B NAV-O-MATIC AUTOPILOT SYSTEM (TYPE AF-550A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 400B Nav-O-Matic autopilot system.

Description

The 400B Nav-O-Matic autopilot system is a two-axis autopilot system that controls the ailerons and elevators to maintain the airplane in a desired attitude. A horizon gyro and directional gyro are provided to display attitude and heading. An optional HSI, see Figure 3, can be installed in place of the directional gyro.

All controls and indicators necessary to properly operate the autopilot are shown in Figures 1 and 2, except for the autopilot disconnect test button, the autopilot off light, the back course selector switch and the navigation receiver selector switch.

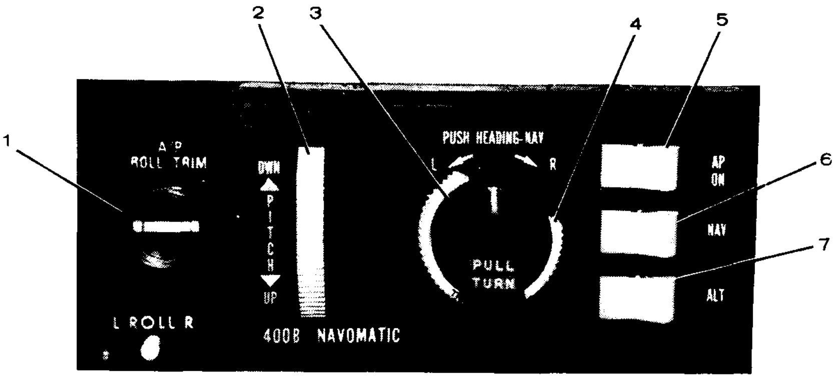
An automatic autopilot disengage function is provided which automatically disengages the autopilot anytime the airplane pitches up or down more than a normal amount from a level flight attitude. The operational capability of the disengage function should be tested before takeoff by pressing the autopilot disconnect test button, located adjacent to the autopilot control head. When the test button is pressed with the autopilot engaged, a test voltage is inserted into the autopilot, causing slight aft control column movement and autopilot disengagement. Do not press this button in flight. Inflight actuation of the test button with the autopilot engaged will cause the airplane to pitch up sharply and disengage the autopilot.

The autopilot off (A/P OFF) light, located adjacent to the horizon gyro, will illuminate when the autopilot is disengaged by any means other than the airplane control wheel disengage switch. Whenever the autopilot is disengaged by any means, the autopilot disengage horn will produce a short tone lasting 1 to 2 seconds with decreasing amplitude. The A/P OFF light will remain on until it is cancelled by pressing the airplane control wheel autopilot disengage switch.

The back course selector switch, located on the left instrument panel, is only used when conducting localizer approaches. With the navigation receiver set to a localizer frequency, positioning the switch to BACK COURSE will reverse the appropriate signals to provide for back course operation for either autopilot or manual flight. Except with an HSI type indicator, selecting BACK COURSE causes reversal of the course deviation indicator indication, whether or not the autopilot is being used.

The navigation receiver selector switch, located on the left instrument panel when dual navigation receivers are installed, allows the autopilot to operate in conjunction with either navigation receiver. If a non-slaved directional gyro is installed, no course datum information is available.

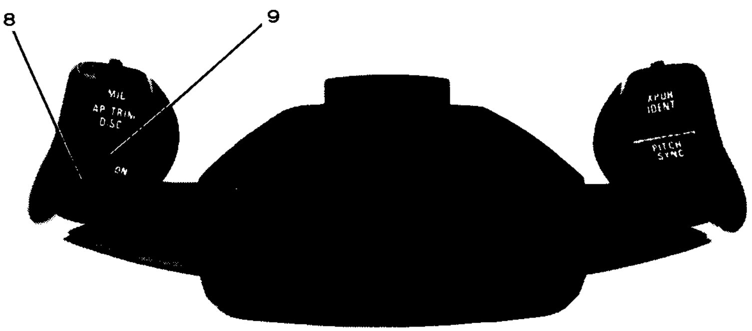
AUTOPILOT CONTROL HEAD AND AIRPLANE CONTROL WHEEL



1. AUTOPILOT PITCH COMMAND WHEEL - Controls pitch attitude of the airplane. Rotating up, commands airplane pitch up proportional to rotation of the wheel. Rotating down, commands airplane pitch down.
2. ROLL TRIM INDICATOR - Indicates direction of autopilot roll effort. Continuous deflection in either direction during steady flight indicates that manual adjustment of the airplane aileron trim is required in the same direction. Indicator is active with autopilot and/or flight director engaged or disengaged.
3. AUTOPILOT TURN COMMAND KNOB - When knob is pulled out in the center detent position, the knob can be rotated left or right which will command a left or right bank. The control knob when pushed in, sets the autopilot in directional gyro heading or navigation mode if either are selected.
4. AUTOPILOT LATERAL TRIM CONTROL - When the autopilot turn command knob is pulled out and centered, with no lateral modes engaged and the airplane manually trimmed for existing flight conditions, the control is used to trim the autopilot for a wings level attitude.
5. AUTOPILOT ON-OFF SWITCH - Controls primary power to autopilot.

Figure 1 (Sheet 1 of 2)

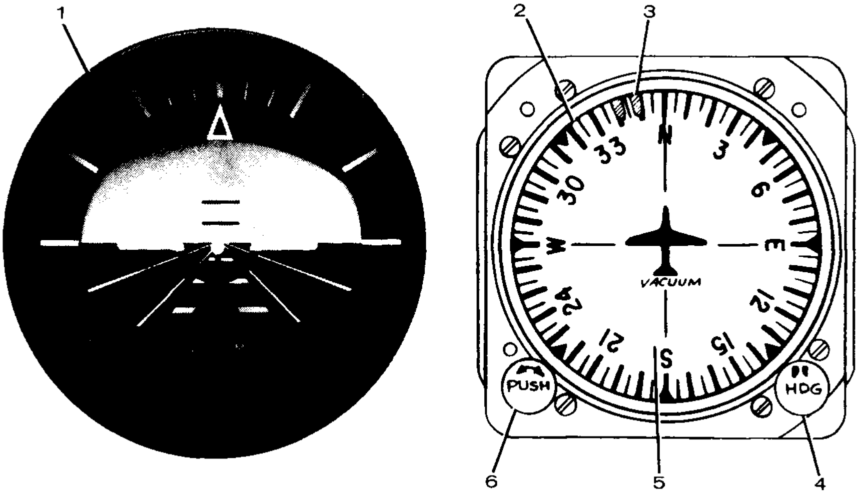
AUTOPILOT CONTROL HEAD AND AIRPLANE CONTROL WHEEL



6. AUTOPILOT NAVIGATION
   ENGAGE SWITCH - Pressing the NAV side of the switch witn the autopilot turn command knob pushed in provides capture and track of VOR (omni) or LOC (localizer) signals, depending upon the selected navigation receiver frequency, and RNAV course, if installed. Pressing the left side of the switch resets the switch and returns autopilot directional control to the directional gyro HDG selector knob (heading bug). The navigation mode can also be disengaged by pulling the autopilot turn command knob.
7. ALTITUDE HOLD ENGAGE SWITCH - Commands the airplane to maintain the pressure altitude existing at the moment of selection. Engagement may be accomplished in climb, descent or level flight. This mode can be used with all lateral command modes. With the autopilot navigation mode engaged, altitude hold will automatically disengage when a glide slope signal is captured.
8. AIRPLANE CONTROL WHEEL
   ELECTRIC TRIM SWITCH - When moved forward to the DN position, the elevator trim tab moves in the nose-down direction; conversely, moving the switch aft to the UP position moves the trim tab in the nose-up direction. The electric trim switch is inoperative when the autopilot is engaged.
9. AUTOPILOT/ELECTRIC ELEVATOR
   TRIM DISENGAGE SWITCH (RED) - Disengages the autopilot and a short (1 to 2 seconds) tone with decreasing amplitude is heard in the cockpit. Disables the electric trim while the switch is depressed.

Figure 1 (Sheet 2 of 2)

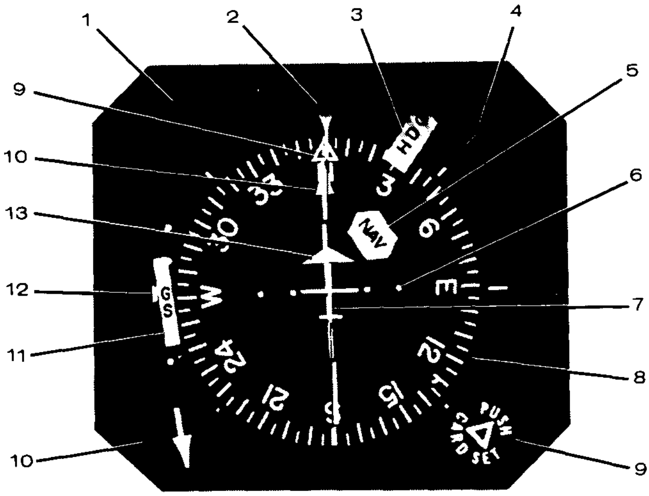
HORIZON AND DIRECTIONAL GYROS



1. HORIZON GYRO - Displays airplane attitude as a conventional attitude gyro. The roll reference scale indicates 0, 10, 20, 30, 60 and 90° of bank.
2. DIRECTIONAL GYRO - The unslaved directional gyro, or optional slaved directional gyro, displays heading of the airplane when properly set to agree with the magnetic compass.
3. HEADING BUG - Displays the selected heading relative to the compass card.
4. HEADING SELECTOR KNOB - The heading bug is positioned by rotating the directional gyro HDG selector knob.
5. COMPASS CARD - Rotates to display airplane heading.
6. COMPASS CARD KNOB - When pushed in, allows manual setting of the compass card to agree with the magnetic compass. The unslaved directional gyro compass card must be reset periodically to compensate for precessional errors in the gyro.

Figure 2

HORIZONTAL SITUATION INDICATOR



1. HORIZONTAL SITUATION INDICATOR (HSI) - Provides a pictorial presentation of the airplane position relative to VOR radials, RNAV course, localizer and glide slope beams. It also gives heading reference with respect to magnetic north and provides selection of desired heading, VOR radials, RNAV course, and LOC runway heading.
2. HSI HEADING REFERENCE - Indicates airplane heading on compass card.
3. HSI HEADING FLAG - Flag in view indicates the heading data is not reliable.
4. HSI GYRO SLAVING INDICATOR - Displays synchronization of compass card with respect to the magnetic flux detector unit. The heading selector knob may be used at any time to accomplish synchronization of the compass card reading with the magnetic heading as indicated by zeroing the slaving indicator. A slaved condition is present when the slaving indicator oscillates about the null point (45^{0} fixed reference line on the HSI).
5. HSI NAV FLAG - Flag in view indicates the NAV receiver signal being received is inadequate.

Figure 3 (Sheet 1 of 2)

HORIZONTAL SITUATION INDICATOR

6. HSI COURSE DEVIATION DOTS - Full scale course deviation bar displacement (2 dots) represents the following deviation from beam center; VOR $\pm 10^{\circ}$, localizer approximately $\pm 2^{\circ}$, RNAV enroute ±5 nautical miles, RNAV approach ±1-1/4 nautical miles.
7. HSI COURSE DEVIATION BAR - Displays displacement from the VOR, RNAV or localizer course center.
8. HSI COMPASS CARD - The compass card displays airplane heading. It is slaved to correct for normal precessional errors. Each graduation represents 5 degrees.
9. HSI HEADING BUG AND HEADING SELECTOR KNOB - Heading bug displays selected heading relative to the compass card. It is positioned by rotating the heading selector knob. The bug rotates with the compass card. Pushing in and rotating the knob sets the compass card.
10. HSI COURSE CURSOR AND COURSE SELECTOR KNOB - Course cursor is positioned on the compass card by rotating the course selector knob; this selects a VOR radial, RNAV course or LOC runway heading. It rotates with the compass card.
11. HSI GLIDE SLOPE FLAG - Flag in view indicates glide slope receiver signal is inadequate.
12. HSI GLIDE SLOPE POINTER, SCALE AND FLAG - Displays deviation of airplane from an ILS glide slope. Flag obscures scale when the signal being received is not adequate. Full scale deflection of the glide slope pointer represents $\pm 0.7^{\circ}$.
13. HSI TO-FROM FLAG - Indicates direction of the VOR station relative to the selected course.

Figure 3 (Sheet 2 of 2)

SECTION 2 — LIMITATIONS

A. Autopilot must be off for takeoff, landing and all operations with wing flaps down more than 15°.
B. Approach VOR radial at an angle of 135° or less prior to engaging navigation mode.
C. Approach localizer at an angle of 90° or less prior to engaging navigation mode.
D. Approach glide slope from below.
E. Disengage autopilot if malfunction occurs.
F. Maximum speed for autopilot operation is 230 KIAS.

G. Required placards:
   1. On Circuit Breaker Panel
      a. "AUTOPILOT" - "COMP" - "ACT" - "WARN" (3 Circuit Breakers).
      b. "ELECT TRIM"
   2. Near Autopilot Control Head
      a. "A/P TEST - BEFORE EACH FLT"
   3. On Instrument Panel
      a. "AUTOPILOT - NAV-1 - NAV-2"
      b. "FRONT - BACK"
   4. On Instrument Panel Near Autopilot Off Light (Near Horizon Gyro)
      a. "A/P OFF"
   5. On Pilot's Control Wheel
      a. "AUTOPILOT - DISENGAGE"
      b. "ELEV TRIM - DISENGAGE"
      c. "UP-DN"

SECTION 3 — EMERGENCY PROCEDURES

A. Autopilot Malfunction
   1. Elevator Or Aileron Control - OVERPOWER as required.
   2. All Airplane Control Wheel Disengage Switches - DISENGAGE.

NOTE

- All airplane control wheel disengage switches should be simultaneously disengaged to prevent having to immediately distinguish between an autopilot or an electric elevator trim malfunction.
- Sustained elevator overpower will result in the autopilot trimming against the overpower force.

B. Engine Failure
   1. Airplane Control Wheel Autopilot Disengage Switch - DISENGAGE.
   2. Operative Engine - ADJUST as required.
   3. Inoperative Engine - SECURE.
   4. Trim Tabs - ADJUST.
   5. Autopilot - REENGAGE if desired.

NOTE

Power, speed and/or configuration changes, such as on the approach to landing, will require manual trim adjustments to insure continued proper autopilot operation.

C. Possible altitude loss if autopilot malfunctions (includes altitude loss prior to pilot recognition):
   1. Cruise Configuration - 600 feet.
   2. Approach Configuration - 200 feet.

D. Airplane control wheel forces required to overpower the autopilot (prior to autopilot elevator trimming against the overpower force) will not exceed:
   1. Elevator - 40 pounds.
   2. Aileron - 20 pounds.

E. Airplane control wheel forces, in excess of normal control forces, required to overpower a slip clutch in the event of a jammed servo actuator will not exceed:
  1. Elevator - 50 pounds.
  2. Aileron - 20 pounds.

SECTION 4 — NORMAL PROCEDURES

I. BEFORE TAKEOFF

A. Autopilot Automatic Disconnect Check (With Engines Running And Gyros Erected)
  1. Autopilot Turn Command Knob - PULL OUT and CENTER.
  2. Autopilot Lateral Trim Control - CENTER.
  3. Autopilot On-Off Switch - ON.

> NOTE
>
> The roll servo will engage immediately. The pitch servo will engage after pitch synchronization as evidenced by the autopilot pitch command wheel coming to rest.

  4. Airplane Control Wheel - HOLD to reduce movement.
  5. Autopilot Disconnect Test Button - PUSH and HOLD.
  6. Verify the following:
     a. Autopilot On-Off Switch - OBSERVE disengage.
     b. Autopilot Off Light - OBSERVE illumination.
     c. Autopilot Disengage Horn - OBSERVE 1 to 2 second aural tone.
  7. Airplane Control Wheel
     Autopilot Disengage Switch - PUSH to turn off the autopilot off light.

II. BASIC AUTOPILOT OPERATION

A. Before Engagement
  1. Airplane Elevator, Aileron And Rudder Trim - ADJUST.

B. Engagement
  1. Autopilot Turn Command Knob - PULL OUT and CENTER.
  2. Autopilot Lateral Trim Control - CENTER.
  3. Autopilot On-Off Switch - ON.
  4. Autopilot Lateral Trim Control - ADJUST.

> NOTE
>
> ● Airplane rudder trim should be adjusted as required to center the turn and bank "ball". Airplane aileron trim may have to be readjusted to compensate for large airspeed changes.
>
> ● If the airplane will not maintain the correct attitude with the autopilot engaged; disengage the autopilot, manually retrim the airplane to obtain wings level with the turn and bank "ball" centered, then reengage the autopilot.

C. Turn Commands
   1. Autopilot Turn Command Knob - PULL OUT and ROTATE as desired.

D. Pitch Commands
   1. Altitude Hold Engage Switch - CHECK OFF.
   2. Autopilot Pitch Command Wheel - ROTATE as desired.

E. Disengagement
   1. Autopilot On-Off Switch - OFF. (Or)
   2. Airplane Control Wheel Autopilot Disengage Switch - DISENGAGE.

NOTE

- If the autopilot is either disengaged with the control head on-off switch or is automatically disengaged due to a system malfunction, the autopilot off light will continuously illuminate and a 1 to 2 second aural tone will occur. The autopilot off light may be extinguished by cycling the airplane control wheel autopilot disengage switch.
- Normal autopilot disengagement should be conducted with the airplane control wheel autopilot disengage switch. The autopilot off light will not illuminate but the 1 to 2 second aural tone will occur.

III. ALTITUDE HOLD COUPLING

A. Engagement
   1. Altitude Hold Engage Switch - ALT.

B. Disengagement (Altitude Hold Coupling)
   1. Altitude Hold Engage Switch - OFF.

CAUTION

Do not operate the autopilot in altitude hold mode when flying in moderate to severe turbulence, mountain lee wave activity and/or moderate to severe icing conditions.

NOTE

- Altitude hold mode should be disengaged before actuating the autopilot pitch command wheel. Autopilot pitch command wheel rotation will not disengage altitude hold mode.
- Altitude hold mode will automatically disengage on a coupled ILS approach when the glide slope is captured.

IV. HEADING SELECT FUNCTION

A. Engagement
   1. Directional Gyro Heading Selector Knob - ROTATE bug to the desired magnetic heading.
   2. Autopilot Turn Command Knob - PUSH to engage.
   3. Directional Gyro Heading Selector Knob - ADJUST for any subsequent desired heading.

B. Disengagement (Heading Select Function)
   1. Autopilot Turn Command Knob - PULL. (Or)
   2. Autopilot Navigation Engage Switch - NAV.

V. ILS/LOCALIZER COUPLING

A. Engagement

1. Instrument Panel Navigation Receiver Selector Switch - NAV 1 or NAV 2 if dual navigation receivers are installed.
2. Course Selector Knob - ADJUST to localizer front course bearing for both front and back course approaches.
3. Instrument Panel Back Course Switch - FRONT or BACK as applicable. Check annunciator light if back course is selected.
4. Wing Flaps - DOWN 15° if all engines operative.
5. Airspeed - 110 to 130 KIAS (120 To 130 KIAS If Engine Inoperative).
6. Directional Gyro Heading Selector Knob - ROTATE bug for radar vectors and/or 30° to 45° localizer intercept angle.
7. Autopilot Turn Command Knob - PUSH to engage heading mode.
8. When course deviation indicator moves off of the peg:
   a. With course datum on selected navigation receiver:
      (1) Autopilot Navigation Engage Switch - NAV.
   b. Without course datum on selected navigation receiver:
      (1) Directional Gyro Heading Selector Knob - ADJUST to coincide with localizer inbound heading.
      (2) Autopilot Navigation Engage Switch - NAV.

NOTE

- Navigation mode is not recommended for tracking outbound on a back course localizer approach due to the possibility of capturing a false glide slope.
- In course datum systems, the navigation course information required by the autopilot is provided automatically from the course setting function on the HSI or CDI.
- In non-course datum systems, the navigation course information required by the autopilot is provided separately from the heading bug on the directional gyro.
- Airplane deviation from the selected localizer course or VOR radial beam is supplied directly to the autopilot from the CDI or HSI.

9. Altitude Hold Engage Switch - CHECK automatic disengagement at glide slope capture.
   - OFF if localizer approach only. Adjust autopilot pitch command wheel for proper descent.

> NOTE
>
> ● Glide slope must be approached from below.
>
> ● Back course mode disables the glide slope couple function.

10. Landing Gear - DOWN at outer marker if all engines operative.
11. Airspeed - 110 to 130 KIAS (120 To 130 KIAS If Engine Inoperative).
12. Landing Gear - DOWN within gliding distance of field, if engine inoperative landing.
13. Wing Flaps - DOWN 45° when landing is assured, if engine inoperative landing.

> NOTE
>
> Autopilot must be off when wing flaps are down more than 15°.

B. Disengagement (ILS/Localizer Coupling)
   1. Autopilot Turn Command Knob - PULL. (Or)
   2. Autopilot Navigation Engage Switch - OFF.

> NOTE
>
> Complete autopilot disengagement should normally be conducted at the appropriate minimums with the airplane control wheel autopilot disengage switch.

VI. VOR COUPLING (Airplane Configurations for VOR Approach - Refer To ILS/Localizer Coupling Procedure)

A. Engagement
   1. Instrument Panel Navigation Receiver Selector Switch - NAV 1 or NAV 2.
   2. Course Selector Knob - ADJUST to desired VOR course.
   3. Directional Gyro Heading Selector Knob - ROTATE bug to obtain airplane heading within 135° of desired VOR course.
   4. Autopilot Turn Command Knob - PUSH to engage heading mode.

5. When the airplane is within 135° of desired VOR course:
   a. With course datum on selected navigation receiver:
      (1) Autopilot Navigation Engage Switch - NAV.
   b. Without course datum on selected navigation receiver:
      (1) Directional Gyro Heading Selector Knob - ADJUST to VOR course heading.
      (2) Autopilot Navigation Engage Switch - NAV.

NOTE

- When the airplane is established on course, the computer will automatically switch into a "track" mode. When course changes greater than 20° are required, disengage the autopilot navigation engage switch, rotate the course selector knob and then reengage the autopilot navigation engage switch.
- In course datum systems, the navigation course information required by the autopilot is provided automatically from the course setting function on the HSI or CDI.
- In non-course datum systems, the navigation course information required by the autopilot is provided separately from the heading bug on the directional gyro.

B. Disengagement (VOR Coupling)
   1. Autopilot Navigation Engage Switch - OFF. (Or)
   2. Autopilot Turn Command Knob - PULL to disengage.

NOTE

Complete autopilot disengagement should normally be conducted on a VOR approach at the appropriate minimums with the airplane control wheel autopilot disengage switch.

SECTION 5 — PERFORMANCE

Not Applicable.

CHECKLIST DISPLAY UNIT CC-2024B

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the CC-2024B Checklist Display Unit.

Description

The Bendix CC-2024B Checklist Display, an option to the RDR-150, RDR-160 and RDR-1100 color radar systems, is operated by a control unit accessible to the pilot and copilot. Power for the unit is provided through the color radar indicator. All controls are located on the front panel of the control unit, see Figure 1. In addition, a telephone type socket on the control unit accepts the plug from the CK-2029A hand held keyboard programmer which is required to program the checklist. Programming is accomplished by manipulating a complete set of alphanumeric keys, plus an assortment of symbols, on the keyboard. No internal batteries are required since power is derived from the checklist control unit.

The system can be programmed to provide 16 pages of checklist informations. Each page contains a maximum of 12 lines with up to 32 alphanumeric characters in each line. Instructions for use are printed on the back of the keyboard. The keyboard remains connected to the checklist control unit only during the initial programming or when updating the program is desired. When not in use, the keyboard may be stored in any convenient place, e.g., the glove compartment.

The checklist may be programmed to operate in either the SIMPLE mode or in the SMART mode which includes an index of checklists. Programming instructions in either of these modes is provided in Bendix Checklist Pilots Manual ASC-853.

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

Not APPLICABLE.

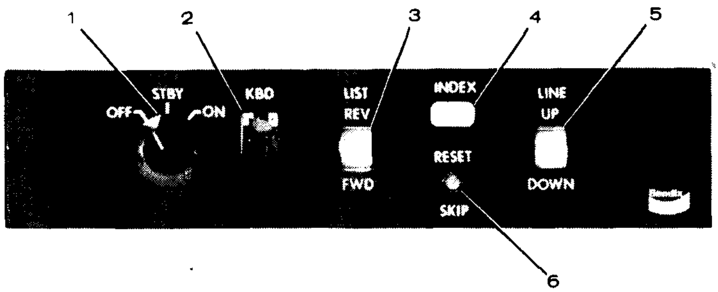
SECTION 4 – NORMAL PROCEDURES

1. Radar Function Switch - AS REQUIRED for normal radar display.
2. Checklist Function Switch - ON. First page of checklist will be displayed and will override any radar display.
3. List Button - AS REQUIRED.
4. Line Button - AS REQUIRED.

SECTION 5 – PERFORMANCE

Not Applicable.

CHECKLIST DISPLAY CONTROLS



1. FUNCTION SWITCH - Turns unit on and off and selects the following functions:
   OFF - Removes primary power from the unit. The radar indicator in the system will operate normally.
   STBY - Applies power to the unit allowing normal radar display but maintains the checklist on alert.
   ON - Applies power to the unit.
   SMART mode displays INDEX page.
   SIMPLE mode displays page 1.
2. KBD - Receptacle for a connecting CK-2029A keyboard for programming.
3. LIST FWD/REV SWITCH - Moves the checklist presentation one page or list forward or backward.
4. INDEX
   SIMPLE Mode - Displays first checklist page with top line highlighted.
   SMART Mode - Displays first index page of checklists with top list highlighted. When the desired list is selected (using the LINE button), pressing the INDEX button again displays the highlighted checklist. Pressing the INDEX button a third time returns the display to the index page with the last checklist used highlighted.

Figure 1 (Sheet 1 of 2)

CHECKLIST DISPLAY CONTROLS

5. LINE UP/DOWN SWITCH - When a page or checklist is selected, the first line is highlighted in white. Pressing the LINE switch downward once, "checks off" an item and moves the highlighter to the next line. Pressing the LINE switch upward reverses the procedure.
   SIMPLE Mode - Highlighted line is white, other lines are blue.
   SMART Mode - Highlighted line is white, unchecked lines are yellow and checked off lines are blue.
6. SKIP/RESET Button
   (SMART Mode only) - Pressing SKIP/RESET button causes the highlighted item to be stored in a "skip list" and the next line is highlighted. As a reminder the letters "SK" will flash in the upper right corner alternating with the page number. Pressing the INDEX button will display the "skip list" in yellow. The items are now checked off using the LINE DOWN switch. As each item on the "skip list" is checked off, it will disappear from the display and remaining items will move up.

Figure 1 (Sheet 2 of 2)

1000 COMMUNICATION SYSTEM (TYPE 1038A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 1000 communication system.

Description

The Cessna 1000 communication system (Type 1038A) is an airborne communication system capable of receiving and transmitting on any one of 720 frequencies. The frequencies are spaced 25 kHz apart and cover a frequency range of 118.000 through 135.975 MHz. The receiver-transmitter frequency is synthesizer-controlled and tuned automatically when the frequency is selected on the control unit. The receiver section is equipped with an automatic squelch circuit which automatically compensates for varying noise levels. The squelch threshold is manually adjustable.

The communication receiver-transmitter provides for three presettable frequencies of which two (input and active) are displayed on electronic readouts. As new input frequencies are selected, they may be transferred to active status by means of a pushbutton. The previous active frequency is stored in memory and may be recalled by means of a pushbutton.

To prevent accidental operation, the frequency related pushbuttons (XFER and RECALL) must be pressed for at least 1/4 second to change frequencies. In addition, a safety circuit is provided which prevents inadvertently entering the same frequency twice.

A "Frequency Memory" voltage is provided so that the preset frequencies are not lost when the receiver-transmitter is turned off. This voltage is provided directly from the hot battery bus and is present even with the battery switch off. To prevent battery discharge during periods of long term storage, a FREQ MEM circuit breaker is provided on the right side console.

NOTE

If the "Frequency Memory" voltage is interrupted, all stored frequencies for the ADF will be lost. Subsequent operation of the system, with the "Frequency Memory" voltage restored, will require new frequency inputs.

The 1000 communication system consists of a panel-mounted module control unit, see Figure 1, a remotely located receiver-transmitter unit, a VHF communication antenna and interconnecting cables. The system utilizes the airplane's microphone, headphone and speaker systems.

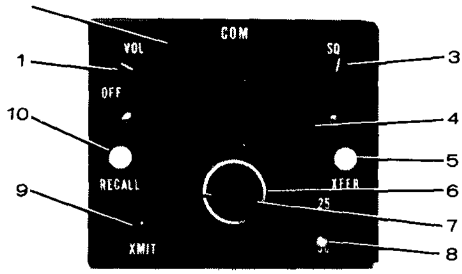
All of the required operating controls are mounted on the front panel of the module control unit except the microphone switch, emergency frequency selector and master lamp test switch.

Nose compartment equipment cooling is provided by a cooling fan which circulates air from the nosewheel well into the avionics bay. The fan is controlled by the EQUIP FAN circuit breaker.

SECTION 2 — LIMITATIONS

Not Applicable.

1000 COMMUNICATION CONTROL PANEL



1. VOL CONTROL SWITCH - Clockwise rotation applies power. Further clockwise rotation increases audio level.
2. ACTIVE FREQUENCY READOUT - Displays active frequency which is being received and transmitted. The last digit (0 or 5 kHz) is not displayed.
3. SQ CONTROL - Controls threshold of automatic squelch circuit. Counterclockwise rotation increases squelch action (silences receiver).
4. INPUT FREQUENCY READOUT - Displays frequency directly selected by frequency selectors. This frequency cannot be used to transmit/receive until it is transferred to active frequency readout. The last digit (0 or 5 kHz) is not displayed.
5. XFER PUSHBUTTON - Transfers input frequency to active frequency which is being received and transmitted. The previous active frequency is stored in memory. The previous memory frequency is lost. The pushbutton action is delayed by 1/4 second to prevent accidental actuation.

NOTE

> The XFER pushbutton transfers the same frequency to the active input only once, regardless of how many times the pushbutton is pressed. This prevents accidentally loading the same frequency twice and unintentionally erasing the previous memory frequency.

6. WHOLE MEGAHERTZ SELECT KNOB - Selects receiver-transmitter input frequency in 1 MHz steps.
7. FRACTIONAL MEGAHERTZ SELECT KNOB - Selects receiver-transmitter input frequency in 50 kHz steps.
8. 25/50 SWITCH - In the 50 position, the input frequency changes in whole 50 kHz steps. In the 25 position, 25 kHz is added to each 50 kHz step to obtain frequencies ending in 25 and 75 kHz.
9. XMIT LIGHT - Lights when microphone is keyed if transmitter operation is proper.

Figure 1

10. RECALL
PUSHBUTTON - Recalls frequency stored in memory to active frequency. Previous active frequency is stored in memory. Pushbutton action delayed by 1/4 second to prevent accidental actuation.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. Programming Frequencies
1. VOL Control - CLOCKWISE to apply power.
2. 25/50 Fractional MHz Switch - AS REQUIRED.
3. Frequency Selector Knobs - AS REQUIRED.
4. XFER Pushbutton - PRESS. The following occurs:
   a. Input frequency transferred to active frequency readout.
   b. Previous active frequency is stored in memory.
5. The second frequency may be programmed as in steps 3 and 4 above. The third frequency may be stored in the frequency selector and input frequency readout.

B. Recalling Frequency from Memory
1. RECALL Pushbutton - PRESS. The following occurs:
   a. Frequency in memory is transferred to active frequency readout.
   b. Previous active frequency is transferred to memory.

C. Com Operation
1. If Avionics Switch Panel Is Installed:
   a. Microphone Selector KNOB - AS REQUIRED.
   b. Speaker/Phone Switch - AS REQUIRED.

NOTE

If dual VHF communications systems are installed, improved communication with the airplane on the ground may be obtained by using the VHF #2 Com antenna mounted on top of fuselage. Airframe masking of the RF signals from the lower fuselage antenna associated with the VHF #1 Com sometimes impairs ground communication.

2. VOL Control - CLOCKWISE to apply power and adjust for comfortable audio level.
3. Microphone Button - PRESS to transmit. Transmitter indicator lamp will light when transmitter is keyed.
4. Microphone Button - RELEASE to receive. Audio signals should be heard.

SECTION 5 — PERFORMANCE

Not Applicable.

400 DME (TYPE R-476A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 400 DME.

Description

The Cessna 400 DME (Type R-476A) is the airborne "interrogator" portion of a navigation system which supplies continuous, accurate, direct-line distance information from a fixed ground station to the airplane in flight.

Except for selection of the operating channel, which is selected by the VHF navigation receiver frequency selector switches, the DME is capable of automatic operation. The equipment consists of a panel-mounted C-476A control unit which contains all of the operating controls and displays, see Figure 1, and a remotely mounted RTA-476A receiver-transmitter. The receiver-transmitter transmits interrogating pulse pairs on 200 channels between 1041 MHz and 1150 MHz; it receives associated ground-to-air replies between 978 MHz and 1213 MHz. The control unit digitally displays distances up to 200 nautical miles and either ground speed or time-to-station information, as selected.

Nose compartment equipment cooling is provided by a cooling fan which circulates air from the nosewheel well into the avionics area. The fan is controlled by the EQUIP FAN circuit breaker.

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

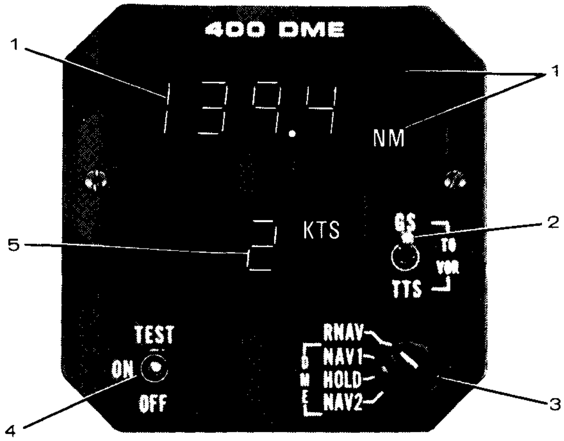
SECTION 4 — NORMAL PROCEDURES

A. DME Operation
1. TEST/ON-OFF Switch - SET to ON.
2. DME Mode Selector Switch - SET to NAV 1 or NAV 2.
3. NAV 1 and NAV 2 VHF Navigation Receivers - ON; SET frequency selector switches to VOR/DME station frequencies, as required.
4. GS/TTS Switch - SET as desired.
5. TEST/ON-OFF Switch - HOLD to TEST:
   a. Distance-to-Station Display readout is 188.8.
   b. Knots/Minutes Display readout is 888.
6. TEST/ON-OFF Switch - RELEASE to ON; display readouts return to normal.

NOTE

In wet weather, it is recommended the EQUIP FAN circuit breaker be pulled during taxi, takeoff and landing to minimize the probability of water ingestion in the nose compartment.

400 DME CONTROLS



1. RN/NM DISTANCE-TO-STATION DISPLAY - In NAV 1, NAV 2, or HOLD mode, displays distance to selected VOR/DME station in nautical miles; only NM (Nautical Miles) designation lights. In RNAV mode, displays distance to selected waypoint in nautical miles; both RN (RNAV) and NM designations light.
2. GS/TTS SELECTOR SWITCH - In NAV 1, NAV 2, or HOLD mode, selects display of ground speed (GS) or time to station (TTS). In RNAV mode, ground speed or time to station to the selected VOR (not the waypoint) may be displayed on some DME units.
3. DME MODE SELECTOR SWITCH - Selects DME operating mode:
   RNAV - Selects area navigation operation; selects display of nautical miles (distance) to selected RNAV waypoint.
   NAV 1 - Selects DME operation with No. 1 VHF navigation set; enables channel selection by NAV 1 frequency selector switches.
   HOLD - Selects DME memory circuit; DME remains channeled to station to which it was channeled when HOLD was selected; display of distance continues to be nautical miles to that station. Both the NAV 1 and NAV 2 sets may be set to new operating frequencies.

NOTE

In the HOLD mode, there is no annunciation of the VOR/DME station frequency. The station being received can be verified by monitoring the coded ID in the speaker or headset.

Figure 1 (Sheet 1 of 2)

400 DME CONTROLS

NAV 2 - Selects DME operation with No. 2 VHF navigation set; enables channel selection by NAV 2 frequency selector switches.

4. TEST/ON-OFF SWITCH - Controls application of power to DME circuits (turns equipment on or off); selects display lamp test for DME and RNAV displays.
5. KTS/MIN DISPLAY - Displays ground speed in knots or time-to-station in minutes:

With GS/TTS Switch set to GS - Displays ground speed to or from station in knots (airplane must be flying directly to or from the VOR/DME station for accurate indication).

With GS/TTS Switch set to TTS - Displays time to VOR/DME station in minutes at the ground speed component indicated.

GS/TTS in RNAV mode - Displays ground speed or time to station to the selected VOR (not the waypoint) on some DME units.

Figure 1 (Sheet 2 of 2)

SECTION 5 — PERFORMANCE

Not Applicable.

800 DME (TYPE RTA-876A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 800 DME.

Description

The Cessna 800 DME (Type RTA-876A) is the airborne "interrogator" portion of a navigation system which supplies continuous, accurate, direct-line distance information from a fixed ground station to the airplane in flight.

Except for selection of the operating channel, which is selected by the VHF navigation receiver (Type 1048A) frequency circuits, the DME is capable of independent operation. The equipment consists of a panel-mounted C-476A control unit which contains all of the operating controls and displays, see Figure 1, and a remotely mounted RTA-876A receiver-transmitter. The receiver-transmitter transmits interrogating pulse pairs on 200 channels between 1041 MHz and 1150 MHz; it receives associated ground-to-air replies between 978 MHz and 1213 MHz. The control unit digitally displays distances up to 200 nautical miles and either ground speed or time-to-station information, as selected. The DME is compatible and must be connected to the optional 800 Area Navigation System (Type RN-878A) in order for the 800 DME to operate in the RNAV mode.

Nose compartment equipment cooling is provided by a cooling fan which circulates air from the nosewheel well into the avionics bay. The fan is controlled by the EQUIP FAN circuit breaker.

SECTION 2 — LIMITATIONS

Not Applicable.

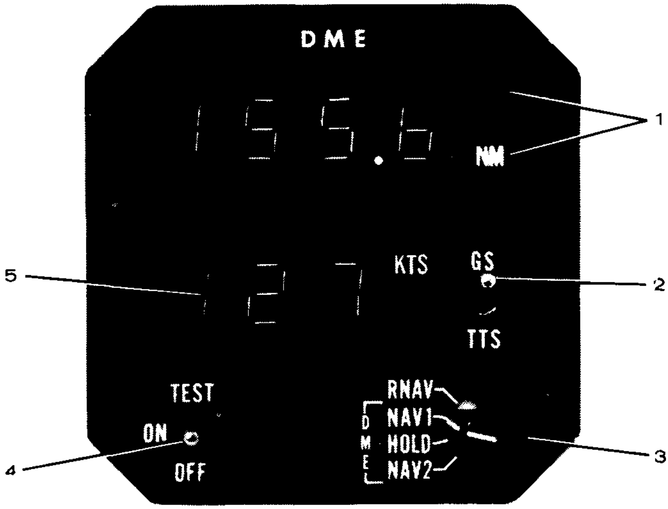
SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. DME Operation
1. TEST/ON-OFF Switch - SET to ON.
2. DME Mode Selector Switch - SET to NAV 1 or NAV 2.
3. NAV 1 and NAV 2 VHF Navigation Receivers - ON; SET frequency selector switches to VOR/DME station frequencies, as required.
4. DME Speaker/Phone Switch - AS REQUIRED.
5. GS/TTS Switch - SET as desired.
6. TEST/ON-OFF Switch - HOLD to TEST:
   a. Distance-to-Station display readout is 188.8.
   b. Knots/Minutes display readout is 888.
7. TEST/ON-OFF Switch - RELEASE to ON; display readouts return to normal.

800 DME CONTROLS



1. RN/NM DISTANCE-TO-STATION DISPLAY - In NAV 1, NAV 2, or HOLD mode, displays distance to selected VOR/DME station in nautical miles; only NM (Nautical Miles) designation lights. In RNAV mode, displays distance to selected waypoint in nautical miles; both RN (RNAV) and NM designations light.
2. GS/TTS SELECTOR SWITCH - In NAV 1, NAV 2, or HOLD mode, selects display of ground speed (GS) or time to station (TTS). In RNAV mode, selects display of ground speed (GS) or time to waypoint (TTS).
3. DME MODE SELECTOR SWITCH - Selects DME operating mode:

   RNAV - Selects area navigation operation using the selected NAV receiver.

   NAV 1 - Selects DME operation with No. 1 VHF navigation set; enables channel selection by NAV 1 frequency selector switches.

   HOLD - Selects DME memory circuit; DME remains channeled to station to which it was channeled when HOLD was selected; display of distance continues to be nautical miles to that station. Both the NAV 1 and NAV 2 sets may be set to new operating frequencies.

NOTE

In the HOLD mode, there is no annunciation of the VOR/DME station frequency. The station being received can be verified by monitoring the coded ID in the speaker or headset.

Figure 1 (Sheet 1 of 2)

800 DME CONTROLS

NAV 2 - Selects DME operation with No. 2 VHF navigation set; enables channel selection by NAV 2 frequency selector switches.

4. TEST/ON-OFF SWITCH - Controls application of power to DME circuits (turns equipment on or off); selects display lamp test for DME and RNAV displays.
5. KTS/MIN DISPLAY - Displays ground speed in knots or time-to-station in minutes:

With GS/TTS Switch set to GS - Displays ground speed to or from station in knots (airplane must be flying directly to or from the VOR/DME station for accurate indication).

With GS/TTS Switch set to TTS - Displays time to VOR/DME station in minutes at the ground speed component indicated.

GS/TTS in RNAV mode - Displays either ground speed or time to waypoint as described above. Airplane track must be directly to or away from the waypoint for accurate indications.

Figure 1 (Sheet 2 of 2)

SECTION 5 — PERFORMANCE

Not Applicable.

400 AND 1000 GLIDE SLOPE (TYPE R-443 AND TYPE R-1043)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the glide slope.

Description

The Cessna glide slope receiver (Type R-443 and Type R-1043) is an airborne navigation equipment which receives and interprets glide slope signals from a ground-based instrument landing system (ILS). It is used with the localizer function of a VHF navigation receiver for making instrument approaches to an airport. The glide slope provides vertical flight path guidance while the localizer provides azimuth guidance.

Operation of the glide slope receiver is controlled by the associated VHF navigation receiver. When the VHF navigation frequency selector switches are set to a localizer frequency, the glide slope receiver is energized and the paired glide slope frequency is automatically selected. Flight guidance is displayed on the VHF NAV course deviation indicator (CDI), see Figure 1, or horizontal situation indicator (HSI).

NOTE

The optional Nav 2 course deviation indicator or copilot's HSI will not present glide slope information unless a second glide slope receiver is installed.

The glide slope receiver accepts frequency selection serial data from the VHF navigation control unit and translates it into standard ARINC "2-out-of-5" channel selection information to control and crystal-switching matrix in the receiver. It covers the frequency range of 329.15 MHz through 335.00 MHz in 40 channels spaced 150 kHz apart. A double-conversion superheterodyne circuit is used to convert the received glide slope signal for display by the glide slope pointer and flag circuits of the CDI or HSI. The receiver also includes a "superflag" circuit which amplifies the flag signal for use in an autopilot or other avionic equipment.

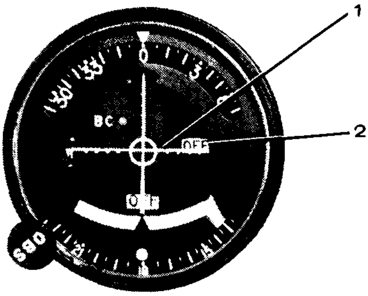
SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

GLIDE SLOPE INDICATOR



1. GLIDE SLOPE DEVIATION INDICATOR - Indicates deviation from normal glide slope.
2. GLIDE SLOPE OFF FLAG - When visible, flag indicates unreliable glide slope signal or improperly operating equipment. The flag disappears when a reliable glide slope signal is being received.

Figure 1

SECTION 4 — NORMAL PROCEDURES

A. Glide Slope Operation
1. Turn on associated VHF navigation set.
2. Select localizer frequency; the paired glide slope frequency will be automatically selected.
3. Identify localizer station and make certain that the glide slope OFF flag is out of sight.

SECTION 5 — PERFORMANCE

Not Applicable.

HF-200 TRANSCEIVER

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the HF-200 transceiver.

Description

The Collins 200 HF transceiver is an airborne, 20-channel, single sideband (SSB) radio with a compatible amplitude modulated (AM) transmitting-receiving system for long-range voice communications in the 2.0 to 22.9999 MHz frequency range. The system consists of a panel-mounted receiver/-exciter (see Figure 1), a remote-mounted power amplifier/power supply, an antenna coupler and an externally mounted, fixed wire, medium/high frequency antenna.

A channel selector knob determines the operating frequency of the transceiver which has a preprogrammed frequency memory circuit board installed to provide the desired operating frequencies. A mode selector control is provided to supply the type of emission for the channel, either sideband; AM; split-channel, reduced-carrier telephone mode; or split-channel, suppressed-carrier telephone mode. A volume knob, clarifier knob and squelch knob are provided to assist in audio operation during the receiver mode.

The system utilizes the airplane microphone, headphone and speaker. Operation and description of audio control panels used in conjunction with this radio are shown and described in Section 9 of this handbook.

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

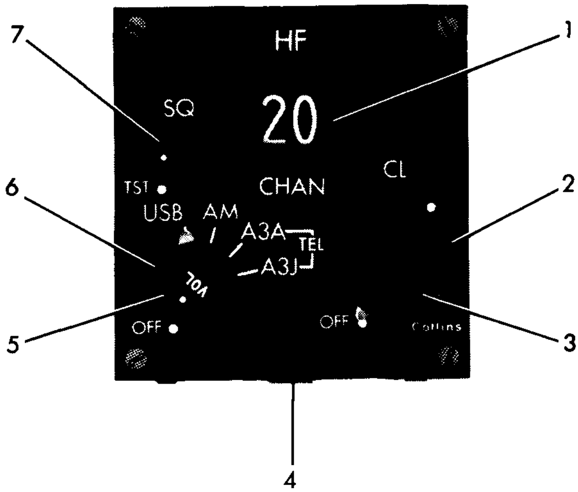
A. To Receive.
1. HF Com Switch - ON.
2. HF Com Audio Switch - SPEAKER or PHONE (On Audio Control Panel).
3. OFF/VOL Control - CLOCKWISE. Allow 15 minutes warmup (time required for frequency standard to stabilize).
4. Channel Selector - SELECT desired frequency. (Use the pullout channel/frequency card to correlate channel number and frequency.)
5. Mode Selector - AS REQUIRED.
6. Squelch Control - ADJUST the audio gain counterclockwise for normal noise output; then, slowly adjust clockwise until the receiver is silent.
7. Clarifier Control - ADJUST when upper single sideband RF signal is being received for maximum clarity.

B. To Transmit.
1. Microphone Selector Switch - HF COMM (On Audio Control Panel).
2. Microphone Switch - Press.

SECTION 5 — PERFORMANCE

Not Applicable.

HF-200 TRANSCEIVER CONTROLS



1. CHANNEL WINDOW - Displays selected operating channel.
2. CLARIFIER CONTROL - Switch portion enables (out of detent) or disables (OFF position) clarifier function. Rotating the control permits tuning the received frequency ±100 Hz (USB or TEL modes only). The clarifier function is automatically disabled during transmit.
3. CHANNEL SELECTOR CONTROL - Selects desired channel.
4. CHANNEL/FREQUENCY CARD - Pulls out to provide an index of transmit and receive frequencies programmed for each of the 20 channels.
5. ON/OFF/VOL CONTROL - Controls application of primary power to the entire system and varies audio gain.
6. MODE CONTROL - Selects system mode of operation.
   AM - Selects compatible AM operation and full AM reception.
   USB - Selects upper sideband operation for long-range voice communications.
   TEL - Used for public correspondence telephone, ship to shore.
7. SQUELCH CONTROL - Squelch position enables (out of detent) or disables (Test Position) squelch function. Rotating the control sets the squelch threshold.

Figure 1

400B INTEGRATED FLIGHT CONTROL SYSTEM (TYPE IF-550A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 400B Integrated Flight Control System.

Description

The Cessna 400B Integrated Flight Control System (IFCS) (Type IF-550A) provides a capability of automatic flight control or manual control with precision flight direction provided by computed command information. The complete presentation for the system is displayed on the flight director indicator (FDI), the mode selector and the horizontal situation indicator (HSI).

Operation of the manual and automatic system is basically the same. The difference is whether the pilot follows the flight director commands manually or allows the autopilot to fly the airplane.

Precision flight direction information for manual control is provided on the FDI, see Figure 4, by means of a symbolic airplane and pitch and roll command bars. The pilot flies the airplane to satisfy the two command bars, thus following the calculated flight path determined by the computer.

A horizontal situation indicator (HSI), see Figure 3, displays a pictorial presentation of the airplane's position relative to VOR radials, localizer and glide slope beams. The HSI also gives heading reference with respect to magnetic north and provides selection of the desired heading, VOR radials, LOC runway heading and RNAV course, if installed. Course datum is available on Nav 1 and Nav 2.

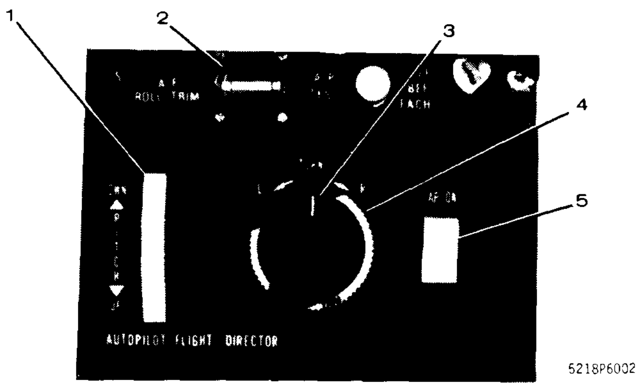
For automatic flight, the autopilot on-off switch on the autopilot control head, see Figure 1, is activated. Pitch and roll manual command controls are also located on this control head. All other normal modes of flight are controlled from the mode selector, see Figure 2.

An automatic autopilot disengage function is provided to automatically disengage the autopilot any time the airplane pitches up or down more than a normal amount from a level flight attitude. The operational capability of the disengage function should be tested before takeoff by pressing the autopilot disconnect test button, located adjacent to the autopilot control head. When the test button is pressed with the autopilot engaged, a test voltage is inserted into the autopilot, causing slight aft control column movement and autopilot disengagement. Do not press this button in flight. Inflight actuation of the test button, with the autopilot engaged, will cause the airplane to pitch up sharply and disengage the autopilot.

The autopilot off (A/P OFF) light, located adjacent to the flight director indicator, will illuminate when the autopilot is disengaged by any means other than the airplane control wheel disengage switch. Whenever the autopilot is disengaged by any means, the autopilot disengage horn will produce a short tone lasting 1 to 2 seconds with decreasing amplitude. The A/P OFF light will remain on until it is cancelled by pressing the airplane control wheel AP/TRIM DISC switch.

The pilot's control wheel, see Figure 1, incorporates four switches for other related autopilot operations. Three of the switches, which are mounted on the left side of the control wheel, provide for operation of electric elevator trim, autopilot disengage and electric elevator trim disengage. The fourth switch, located on the right side of the control wheel, provides for operation of the flight director pitch synchronization. The left throttle control, see Figure 7-1, incorporates the GA switch, which provides for operation in the go-around mode. When pressed, the flight director GA mode is engaged if the FD or AP mode is engaged. The GA annunciator will light, all other modes are cancelled and the autopilot is disengaged. The GA mode provides a preset pitch-up and wings level command. Repressing the GA switch, selecting the HDG mode or reengaging the autopilot will cancel the GA mode.

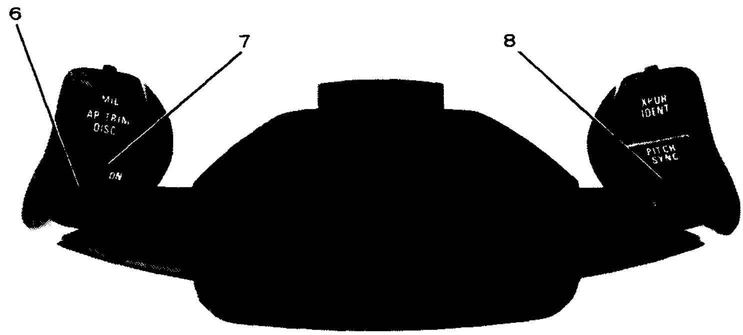
400B IFCS AUTOPILOT CONTROL HEAD AND AIRPLANE CONTROL WHEEL



1. AUTOPILOT PITCH COMMAND WHEEL - Controls pitch attitude of the airplane. Rotating up, commands airplane pitch up proportional to rotation of the wheel. Rotating down, commands airplane pitch down.
2. ROLL TRIM INDICATOR - Indicates direction of autopilot roll effort. Continuous deflection in either direction during steady flight indicates that manual adjustment of the airplane aileron trim is required in the same direction. Indicator is active with autopilot and/or flight director engaged or disengaged.
3. AUTOPILOT TURN COMMAND KNOB - Controls roll attitude of the airplane. When turned left or right, the knob will command a left or right bank accordingly. When moved from the center detent position, it disconnects the heading (HDG) or navigation (NAV) modes if selected on the mode selector.

Figure 1 (Sheet 1 of 2)

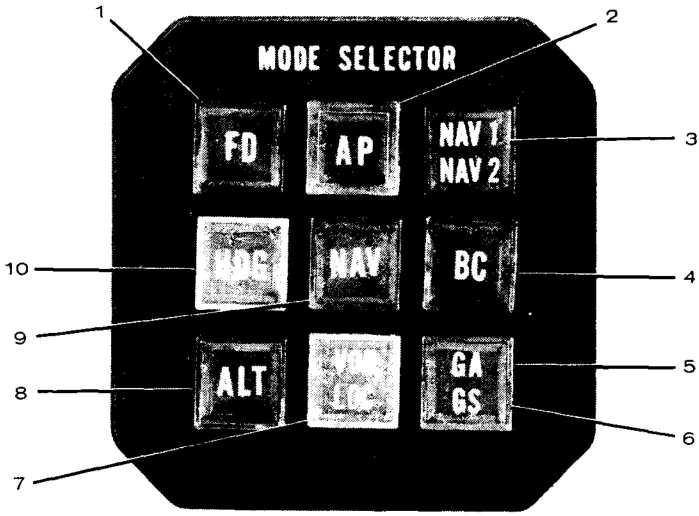
400B IFCS AUTOPILOT CONTROL HEAD AND AIRPLANE CONTROL WHEEL



4. AUTOPILOT LATERAL TRIM CONTROL - When the turn command knob is centered, with no lateral modes engaged and the airplane manually trimmed for existing flight conditions, the control is used to trim the IFCS for a wings level attitude.
5. AUTOPILOT ON-OFF SWITCH - Engages autopilot when in the ON position if all interlocks are valid. The autopilot annunciator on the mode selector will light when the autopilot is engaged.
6. ELECTRIC TRIM SWITCH - When moved forward to the DN position, the elevator trim tab moves in the nose-down direction; conversely, moving the switch aft to the UP position moves the tab in the nose-up direction. The electric trim switch is inoperative when the autopilot is engaged.
7. AUTOPILOT/ELECTRIC ELEVATOR TRIM DISENGAGE SWITCH (RED) - Disengages the autopilot and a short (1 to 2 seconds) tone with decreasing amplitude is heard in the cockpit. Disables the electric trim while the switch is depressed.
8. PITCH SYNCHRONIZATION (PITCH SYNC) BUTTON - When the FD mode is engaged, the pitch command bar will automatically synchronize to the pitch command at the time of engagement. To resynchronize the pitch command bar after a new pitch attitude is established, manually depress, but do not hold, the PITCH SYNC button on the control wheel. Depressing the button also disengages the altitude hold mode.

Figure 1 (Sheet 2 of 2)

400B IFCS MODE SELECTOR



1. FLIGHT DIRECTOR MODE
   SELECTOR BUTTON - Engages or disengages the flight director mode. The FD annunciator will light and command bars on the FDI will appear.
2. AUTOPILOT MODE SELECTOR
   ANNUNCIATOR LIGHT - Lights when the autopilot is engaged.
3. NAV 1 - NAV 2
   MODE SELECTOR BUTTON - Selects the navigation receiver for IFCS operation. The receiver that is connected to the IFCS is annunciated. Pressing the button will transfer the IFCS to the other receiver with appropriate annunciation.
4. BACK COURSE MODE
   SELECTOR BUTTON - Engages or disengages the back course mode and is used with localizer operation only. With the autopilot or flight director off or on and the navigation receiver set to a localizer frequency, the back course mode will reverse the appropriate signals to provide for back course operation for either automatic or manual flight. Except with an HSI type indicator, selecting the back course mode causes reversal of the course deviation indication, whether or not the IFCS is being used. The back course annunciator will light when the back course mode is engaged.
5. GO-AROUND MODE
   SELECTOR ANNUNCIATOR LIGHT - The go-around annunciator will light when the go-around mode is engaged.

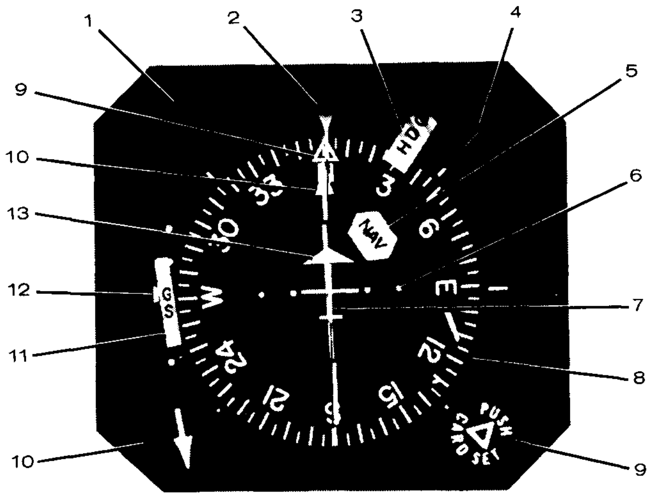
Figure 2 (Sheet 1 of 2)

400B IFCS MODE SELECTOR

6. GLIDE SLOPE MODE SELECTOR ANNUNCIATOR LIGHT - When the NAV/LOC mode is engaged and the glide slope automatically engages, the glide slope annunciator will light.
7. VOR/LOCALIZER MODE SELECTOR ANNUNCIATOR LIGHT - When the AP or FD navigation mode is engaged, either the VOR or LOC annunciator will light to reflect the frequency selected on the navigation receiver. The VOR/LOC light will only illuminate while in the AP or FD navigation mode.
8. ALTITUDE HOLD MODE SELECTOR BUTTON - Engages or disengages the altitude hold mode. The ALT annunciator will light when the mode is engaged. Engagement may be accomplished in either climb, descent or level flight, which commands the airplane to maintain the pressure altitude existing at the moment of selection. This mode can be used with all lateral command modes. In the NAV-LOC mode, altitude hold will automatically disengage when the glide slope engages. The go-around mode, when engaged, will also disengage the altitude hold mode. When the optional 800 encoding altimeter system is installed, altitude hold can be engaged automatically by the optional altitude/preselect system.
9. NAV MODE SELECTOR BUTTON - Engagement provides for capture and track of the VOR (omni) or LOC (localizer), dependent upon the frequency selected on the navigation receiver. During NAV-LOC operation, the glide slope mode will automatically engage only at the beam center and when the beam is approached from below. If the go-around switch on the left throttle control is actuated, the navigation mode will automatically be cancelled and all associated annunciator lights will go out.
10. HEADING MODE SELECTOR BUTTON - Engages the heading mode, which commands the airplane to turn to and maintain a heading selected on the HSI. The HDG annunciator will light when the mode is engaged. A new heading may be selected at any time and will result in a command to turn to the new heading with a bank angle of approximately 25°. The heading mode will cancel the go-around mode.

Figure 2 (Sheet 2 of 2)

400B IFCS HORIZONTAL SITUATION INDICATOR



1. HORIZONTAL SITUATION INDICATOR (HSI) - Provides a pictorial presentation of the airplane position relative to VOR radials, RNAV course, localizer and glide slope beams. It also gives heading reference with respect to magnetic north and provides selection of desired heading, VOR radials, RNAV course and LOC runway heading.
2. HSI HEADING REFERENCE - Indicates airplane heading on compass card.
3. HSI HEADING FLAG - Flag in view indicates the heading data is not reliable.
4. HSI GYRO SLAVING INDICATOR - Displays synchronization of compass card with respect to the magnetic flux detector unit. The heading selector knob may be used at any time to accomplish synchronization of the compass card reading with the magnetic heading as indicated by zeroing the slaving indicator. A slaved condition is present when the slaving indicator oscillates about the null point (45^{o} fixed reference line on the HSI).
5. HSI NAV FLAG - Flag in view indicates the navigation receiver signal being received is inadequate.

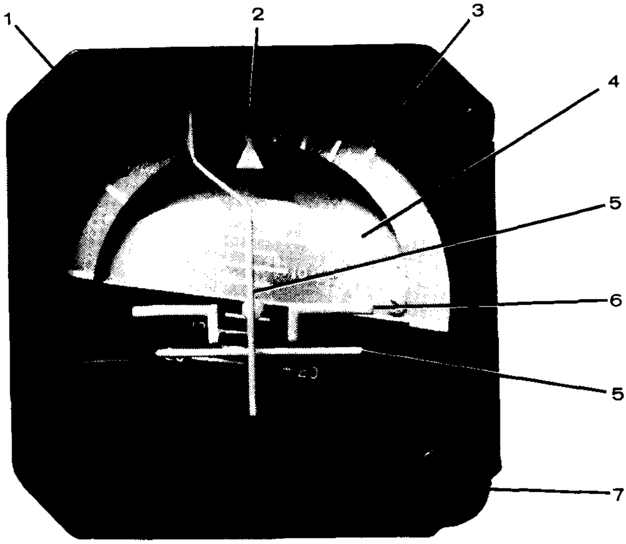
Figure 3 (Sheet 1 of 2)

400B IFCS HORIZONTAL SITUATION INDICATOR

6. HSI COURSE DEVIATION DOTS - Full scale course deviation bar displacement (2 dots) represents the following deviation from beam center; VOR $\pm10^{o}$, localizer approximately $\pm2\text{-}1/2^{o}$, RNAV enroute ±5 nautical miles, RNAV approach ±1-1/4 nautical miles.
7. HSI COURSE DEVIATION BAR - Displays displacement from the VOR, RNAV or localizer course center.
8. HSI COMPASS CARD - The compass card displays airplane heading. It is slaved to correct for normal precessional errors. Each graduation represents 5 degrees.
9. HSI HEADING BUG AND HEADING SELECTOR KNOB - When knob is rotated in the normal (out) position, selects airplane autopilot heading and positions heading bug to indicate selected heading on the compass card.
   - When knob is pushed in and rotated, permits setting of the compass card to agree with the magnetic compass. The course cursor and course deviation bar will rotate with the compass card.
10. HSI COURSE CURSOR AND COURSE SELECTOR KNOB - Course cursor is positioned on the compass card by rotating the course selector knob; this selects a VOR radial, RNAV course or LOC runway heading. It rotates with the compass card.
11. HSI GLIDE SLOPE FLAG - Flag in view indicates the glide slope receiver signal is inadequate.
12. HSI GLIDE SLOPE POINTER, SCALE AND FLAG - Displays deviation of airplane from an ILS glide slope. Flag obscures scale when the signal being received is not adequate. Full scale deflection of the glide slope pointer represents $\pm0.7^{o}$.
13. HSI TO-FROM FLAG - Indicates direction of the VOR station relative to the selected course. Displays TO when a LOC frequency is selected.

Figure 3 (Sheet 2 of 2)

400B IFCS FLIGHT DIRECTOR INDICATOR



1. FLIGHT DIRECTOR INDICATOR (FDI) - Displays airplane attitude as a conventional attitude gyro and displays commands for flight director operation.
2. FDI ROLL ATTITUDE INDEX - Displays airplane roll attitude read against roll attitude scale.
3. FDI ROLL ATTITUDE SCALE - Movable scale marked at 0, ±10, ±20, ±30, ±60 and ±90 degrees.
4. FDI PITCH ATTITUDE SCALE - Moves with respect to the symbolic airplane to display airplane pitch and roll attitude. The scale is graduated at 0, ±5, ±10, ±15 and ±20 degrees.
5. FDI COMMAND BARS - Displays computed steering commands referenced to the dot in the symbolic airplane.
6. FDI SYMBOLIC AIRPLANE - Airplane attitude is displayed by the relationship between the fixed symbolic airplane and the movable background. The symbolic airplane is normally aligned with the horizon line for normal cruise attitude. During flight director operation, the symbolic airplane is flown to align its center dot with the command bars to satisfy the flight director commands.
7. FDI SYMBOLIC AIRPLANE ALIGNMENT KNOB - Provides manual positioning of the symbolic airplane for pitch attitude alignment.

Figure 4

SECTION 2 — LIMITATIONS

A. Autopilot must be off for takeoff, landing and all operations with wing flaps down more than 15°.
B. Approach VOR radial at an angle of 135° or less prior to engaging the navigation mode.
C. Approach localizer at an angle of 90° or less prior to engaging the navigation mode.
D. Approach glide slope from below.
E. Disengage autopilot if malfunction occurs.
F. Maximum speed for autopilot operation is 230 KIAS.
G. Required Placards:
   1. On Circuit Breaker Panel
      a. "AUTOPILOT" - "COMP" - "ACT" - "WARN" (3 Circuit Breakers)
      b. "TRIM POWER"
   2. Near Autopilot Control Head
      a. "A/P TEST - BEFORE EACH FLIGHT"
   3. On Instrument Panel Near Autopilot Off Light (Near Flight Director Indicator)
      a. "A/P OFF"
   4. On Pilot's Control Wheel
      a. "AUTOPILOT-DISENGAGE"
      b. "ELEV TRIM - DISENGAGE"
      c. "PITCH SYNC"
      d. "UP - DN"
   5. On Left Throttle Control
      a. "GA"

SECTION 3 — EMERGENCY PROCEDURES

A. Autopilot Malfunction
   1. Elevator Or Aileron Control - OVERPOWER as required.
   2. All Airplane Control Wheel Disengage Switches - DISENGAGE.

> **NOTE**
>
> - All airplane control wheel disengage switches should be simultaneously disengaged to prevent having to immediately distinguish between an autopilot or an electric elevator trim malfunction.
> - Sustained elevator overpower will result in the autopilot trimming against the overpower source.

B. Engine Failure
   1. Airplane Control Wheel Autopilot Disengage Switch - DISENGAGE.
   2. Operative Engine - ADJUST as required.
   3. Inoperative Engine - SECURE.
   4. Trim Tabs - ADJUST.
   5. Autopilot - REENGAGE if desired.

> **NOTE**
>
> Power, speed and/or configuration changes, such as on the approach to landing, will require manual trim adjustments to insure continued proper autopilot operation.

C. Possible altitude loss if autopilot malfunctions (includes altitude loss prior to pilot recognition):
   1. Cruise Configuration - 600 feet.
   2. Approach Configuration - 200 feet.

D. Airplane control wheel forces required to overpower the autopilot (prior to autopilot elevator trimming against the overpower force) will not exceed:
   1. Elevator - 40 pounds.
   2. Aileron - 20 pounds.

E. Airplane control wheel forces, in excess of normal control forces, required to overpower a slip clutch in the event of a jammed servo actuator will not exceed:
   1. Elevator - 50 pounds.
   2. Aileron - 20 pounds.

SECTION 4 — NORMAL PROCEDURES

I. BEFORE TAKEOFF
   A. Autopilot Automatic Disconnect Check (With Engines Running And Gyros Erected)
      1. Autopilot Turn Command Knob - CENTER.
      2. Autopilot Lateral Trim Control - CENTER.
      3. Autopilot On-Off Switch - ON. Observe annunciation on mode selector.

NOTE

The roll servo will engage immediately. The pitch servo will engage after pitch synchronization as evidenced by the autopilot pitch command wheel coming to rest.

      4. Flight Director Mode Selector Button - ENGAGE. Observe annunciation.
      5. Airplane Control Wheel - HOLD to reduce movement.
      6. Autopilot Disconnect Test Button - PUSH and HOLD.
      7. Verify the following:
         a. Flight Director Indicator - OBSERVE up command.
         b. Autopilot On-Off Switch - OBSERVE disengage.
         c. Autopilot Off Light - OBSERVE illumination.
         d. Autopilot Disengage Horn - OBSERVE 1 to 2 second aural tone.
      8. Airplane Control Wheel
         Autopilot Disengage Switch - PUSH to turn off the autopilot off light.
      9. Flight Director Mode Selector Button - DISENGAGE.

II. BASIC AUTOPILOT OPERATION (FLIGHT DIRECTOR ON OR OFF)
   A. Before Engagement
      1. Airplane Elevator, Aileron and Rudder Trim - ADJUST.
   B. Engagement
      1. Autopilot Turn Command Knob - CENTER DETENT.
      2. Autopilot Lateral Trim Control - CENTER.
      3. Airplane Control Wheel
         Pitch Synchronization Button - MOMENTARILY DEPRESS to synchronize the flight director pitch command bar to the flight attitude if the flight director is engaged.

4. Autopilot On-Off Switch - ON. Observe annunciation.
5. Autopilot Lateral Trim Control - ADJUST.

NOTE

- Airplane rudder trim should be adjusted as required to center the turn and bank "ball". Airplane aileron trim may have to be readjusted to compensate for large airspeed changes.
- If the airplane will not maintain the correct attitude with the autopilot engaged, disengage the autopilot, manually retrim the airplane to obtain wings level with the turn and bank "ball" centered, then reengage the autopilot.

C. Turn Commands:
   1. Autopilot Turn Command Knob - ROTATE as desired.

D. Pitch Commands:
   1. Altitude Hold Mode Selector Button - CHECK DISENGAGED.
   2. Autopilot Pitch Command Wheel - ROTATE as desired.

E. Disengagement:
   1. Autopilot On-Off Switch - OFF. (Or)
   2. Airplane Control Wheel
      Autopilot Disengage Switch - DISENGAGE. (Or)
   3. Left Throttle Control
      Go-Around (GA) Switch - ENGAGE. Refer to Go-Around Operation.

NOTE

- If the autopilot is either disengaged with the control head on-off switch or is automatically disengaged due to a system malfunction, the autopilot off light will continuously illuminate and a 1 to 2 second aural tone will occur. The autopilot off light may be extinguished by cycling the airplane control wheel autopilot disengage switch.
- Normal autopilot disengagement should be conducted with the airplane control wheel autopilot disengage switch. The autopilot off light will not illuminate but the 1 to 2 second aural tone will occur.
- Autopilot disengagement with the left throttle control go-around (GA) switch will not illuminate the autopilot off light but will give a 1 to 2 second aural tone. Refer to Go-Around Operation.

III. BASIC FLIGHT DIRECTOR OPERATION (AUTOPILOT OFF)

A. Engagement

1. Autopilot Turn Command Knob - CENTER DETENT.
2. Flight Director Mode Selector Button - ENGAGE. Observe annunciation and flight director command bars.
3. Flight Director Symbolic Airplane Alignment Knob - ALIGN with flight director pitch command bar.
4. Autopilot Lateral Trim Control - ADJUST as required to center the flight director roll command bar.

B. Basic Pitch Commands:

1. Manually fly the airplane to the desired pitch attitude.
2. Airplane Control Wheel Pitch Synchronization Button - MOMENTARILY DEPRESS to synchronize the pitch command bar to the flight attitude.

NOTE

In a flight director only mode (autopilot off), the flight director pitch command bar will automatically synchronize to the pitch attitude at the time of engagement. If a new pitch attitude is flown, the airplane control wheel pitch synchronization button should be depressed to synchronize the flight director command bar to that attitude.

C. Altitude Hold, Heading Select and Navigation Coupling

NOTE

Altitude hold, heading select and navigation coupling procedures are identical to the procedures that follow for flight director and/or autopilot modes. In a flight director mode, with autopilot off, the pilot must manually satisfy the flight director pitch and roll command bars.

D. Disengagement (Flight Director):

1. Flight Director Mode Selector Button - DISENGAGE.

IV. ALTITUDE HOLD COUPLING (FLIGHT DIRECTOR AND/OR AUTOPILOT MODES)

A. Engagement:

1. With Basic IFCS:
   a. Altitude Hold Mode Selector Button - ENGAGE at desired altitude. Observe annunciation.

2. With Optional Altitude Alert/Preselect System:
   a. Desired Altitude - SELECT.
   b. Altitude Alert/Preselect Arm Button - PUSH. Observe that amber ARMD light illuminates.

CAUTION

Do not operate the autopilot in altitude hold mode when flying in moderate to severe turbulence, mountain lee wave activity and/or moderate to severe icing conditions.

NOTE

The altitude alert/preselect ARMD mode is inoperative when the autopilot is in the altitude hold or glide slope mode.

   c. Autopilot Pitch Command Wheel - UP or DOWN as required to intercept selected altitude.
   d. When selected altitude is captured, observe:
      (1) Altitude alert/preselect amber ARMD light goes off.
      (2) Altitude alert/preselect green CPLD light illuminates.
      (3) IFCS mode selector ALT light illuminates.

NOTE

Once armed, the altitude alert/preselect can be disarmed only by reselecting a different altitude on the altitude preselect presentation, by selecting the altitude hold mode on the mode selector or by glide slope capture.

B. Disengagement (Altitude Hold Coupling):
   1. Altitude Hold Mode Selector Button - DISENGAGE. (Or)
   2. Airplane Control Wheel Pitch Synchronization Button - MOMENTARILY DEPRESS.

WARNING

Do not attempt to use the encoding altimeter indicator for flight information if warning flag is in view. The flag indicates that power has been removed from the encoding altimeter.

NOTE

- The altitude hold mode selector button must be disengaged before actuating the autopilot pitch wheel. Autopilot pitch wheel rotation will not disengage the altitude hold mode.
- Altitude hold mode will automatically disengage in the coupled ILS mode when the glide slope is captured.

V. HEADING SELECT FUNCTION (FLIGHT DIRECTOR AND/OR AUTOPILOT MODES)

A. Engagement:

1. Autopilot Turn Command Knob - CENTER DETENT.
2. Directional Gyro Heading Selector Knob - ROTATE bug to desired magnetic heading.
3. Heading Mode Selector Button - ENGAGE. Observe annunciation.
4. Directional Gyro Heading Selector Knob - ADJUST for any subsequent desired heading.

NOTE

When an optional copilot's horizontal situation indicator or autopilot directional gyro is installed, the pilot's heading bug controls the heading when NAV 1 receiver is selected and the copilot's heading bug controls heading when NAV 2 receiver is selected.

B. Disengagement (Heading Select Function):

1. Heading Mode Selector Button - DISENGAGE. (Or)
2. Autopilot Turn Command Knob - ROTATE. (Or)
3. Navigation Mode Selector Button - ENGAGE.

VI. ILS/LOCALIZER COUPLING (FLIGHT DIRECTOR AND/OR AUTOPILOT MODE)

A. Engagement:

1. NAV 1 - NAV 2 Mode Selector Button - SELECT NAV 1 or NAV 2. Observe proper annunciation on mode selector.
2. Course Selector Knob - ADJUST to localizer front course bearing for both front and back course approaches.
3. Back Course Mode Selector Button - ENGAGE as applicable. Observe BC annunciation on mode selector.
4. Wing Flaps - DOWN 15° if all engines operative.
5. Airspeed - 110 to 130 KIAS (120 to 130 KIAS If Engine Inoperative).
6. Directional Gyro Heading Selector Knob - ROTATE bug for radar vectors and/or 30° to 45° localizer intercept angle.
7. Autopilot Turn Command Knob - CENTER DETENT.
8. Heading Mode Selector Button - ENGAGE. Observe annunciation.

9. When course deviation indicator moves off the peg:
   a. Navigation Mode
      Selector Button - ENGAGE. Observe NAV and LOC annunciation on mode selector; HDG annunciation on mode selector will go out.

NOTE

Navigation mode is not recommended for tracking outbound on a back course localizer approach due to the possibility of capturing a false glide slope.

10. Altitude Hold
    Mode Selector - CHECK automatic disengage at glide slope capture. Observe ALT annunciator on the mode selector goes out and GS annunciator illuminates.
    - OFF if localizer approach only. Adjust autopilot pitch command wheel for proper descent.

NOTE

- Glide slope must be approached from below.
- Back course disables IFCS glide slope couple function.

11. Landing Gear - DOWN at outer marker if all engines operative.
12. Airspeed - Maintain 110 to 130 KIAS (120 to 130 KIAS If Engine Inoperative).
13. Landing Gear - DOWN within gliding distance of field, if engine inoperative landing.
14. Wing Flaps - DOWN when landing is assured, if engine inoperative landing.

NOTE

Autopilot must be off when wing flaps are down more than 15°.

B. Disengagement (ILS/Localizer Coupling):
   1. Navigation Mode Selector Button - DISENGAGE. (Or)
   2. Autopilot Turn Command Knob - ROTATE.

NOTE

Complete autopilot disengagement should normally be conducted at the appropriate minimums with the airplane control wheel disengage switch.

VII. VOR COUPLING (FLIGHT DIRECTOR AND/OR AUTOPILOT MODE) (AIRPLANE CONFIGURATION FOR VOR APPROACH - REFER TO ILS/LOCALIZER COUPLING PROCEDURES)

A. Engagement

1. NAV 1 - NAV 2 Mode Selector Button - SELECT NAV 1 or NAV 2. Observe proper annunciation.
2. Course Selector Knob - ADJUST to desired VOR course.
3. Directional Gyro
   Heading Selector Knob - ROTATE bug to within 135° of desired VOR course.
4. Autopilot Turn Command Knob - CENTER DETENT.
5. Heading Mode Selector Button - ENGAGE. Observe annunciation.
6. When airplane is within 135° of desired VOR course:
   a. Navigation Mode
      Selector Button - ENGAGE. Observe NAV and VOR annunciation on mode selector; HDG annunciation on mode selector will go out.

NOTE

- The autopilot will intercept and track the selected VOR radial compensating for wind correction.
- When the airplane is established on course, the computer will automatically switch into a "track" mode. When course changes greater than 20° are required, disengage the navigation mode selector, rotate the course selector knob and then reengage the navigation mode selector.

B. Disengagement (VOR Coupling):

1. Navigation Mode Selector Button - DISENGAGE. (Or)
2. Autopilot Turn Command Knob - ROTATE.

NOTE

Complete autopilot disengagement should normally be conducted on a VOR approach at the appropriate minimums with the airplane control wheel autopilot disengage switch.

VIII. GO-AROUND OPERATION (FLIGHT DIRECTOR AND/OR AUTOPILOT MODE)

A. Left Throttle Control
   Go-Around Switch - ENGAGE. Observe GA and FD annunciation on mode selector if not already engaged.

NOTE

The go-around mode gives a wings level, pitch up command (4° to 6° nose up) on the flight director indicator pitch command bar only. Actuation of go-around mode disengages the autopilot.

B. Disengagement (Go-Around):
   1. Left Throttle Control Go-Around Switch - CYCLE. (Or)
   2. Heading Mode Selector Button - ENGAGE. (Or)
   3. Autopilot On-Off Switch - ON.

NOTE

The airplane should be manually retrimmed to the flight director attitude before reengaging the autopilot to avoid an abrupt pitch change as the autopilot tries to satisfy the existing pitch command.

SECTION 5 – PERFORMANCE

Not Applicable.

800B INTEGRATED FLIGHT CONTROL SYSTEM (TYPE IF-550A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 800B Integrated Flight Control System.

Description

The Cessna 800B Integrated Flight Control System (IFCS) (Type IF-550A) provides a capability of automatic flight control or manual control with precision flight direction provided by computed command information. In addition, a horizontal situation display is provided to keep the pilot informed of his navigational situation. The complete presentation for the system is displayed on the flight director indicator (FDI), the mode selector and the horizontal situation indicator (HSI).

Operation of the manual and automatic system is basically the same. The difference is whether the pilot follows the flight director commands manually or allows the autopilot to fly the airplane.

Precision flight direction information for manual control is provided on the FDI, see Figure 4, by means of a symbolic airplane and pitch and roll command bars. The pilot flies the airplane to satisfy the two command bars, thus following the calculated flight path determined by the computer.

A horizontal situation indicator (HSI), see Figure 3, displays a pictorial presentation of the airplane's position relative to VOR radials, localizer and glide slope beams. The HSI also gives heading reference with respect to magnetic north and provides selection of the desired heading, VOR radials, LOC runway heading and RNAV course, if installed. Course datum is available on Nav 1 and Nav 2.

For automatic flight, the autopilot on-off switch on the autopilot control head, see Figure 1, is activated. Pitch and roll manual command controls are also located on this control head. All other normal modes of flight are controlled from the mode selector, see Figure 2.

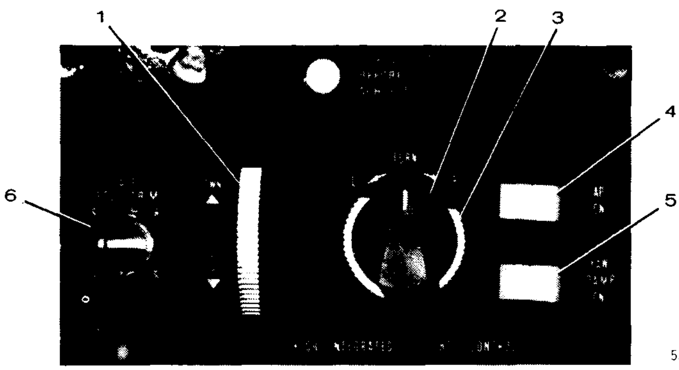
The autopilot on-off switch also energizes the yaw damper system in the airplane. This system functions independently of the IFCS except for turning on and off. An alternate yaw damper switch is also provided on the autopilot control head to enable energizing the yaw damper without turning on the IFCS.

An automatic autopilot disengage function is provided to automatically disengage the autopilot any time the airplane pitches up or down more than a normal amount from a level flight attitude. The operational capability of the disengage function should be tested before takeoff by pressing the autopilot disconnect test button, located adjacent to the autopilot control head. When the test button is pressed with the autopilot engaged, a test voltage is inserted into the autopilot, causing slight aft control column movement and autopilot disengagement. Do not press this button in flight. Inflight actuation of the test button, with the autopilot engaged, will cause the airplane to pitch up sharply and disengage the autopilot.

The autopilot off (A/P OFF) light, located adjacent to the horizon gyro, will illuminate when the autopilot is disengaged by any means other than the airplane control wheel disengage switch. Whenever the autopilot is disengaged by any means, the autopilot disengage horn will produce a short tone lasting 1 to 2 seconds with decreasing amplitude. The A/P OFF light will remain on until it is cancelled by pressing the airplane control wheel autopilot disengage switch.

The pilot's control wheel, see Figure 1, incorporates four switches for other related autopilot operations. Three of the switches, which are mounted on the left side of the control wheel, provide for operation of electric elevator trim, autopilot disengage and electric elevator trim disengage. The fourth switch, located on the right side of the control wheel, provides for operation of the flight director pitch synchronization. The left throttle control, see Figure 7-1, incorporates the GA switch, which provides for operation in the go-around mode. When pressed, the flight director GA mode is engaged if the FD or AP mode is engaged. The GA annunciator will light, all other modes are cancelled and the autopilot is disengaged. The GA mode provides a preset pitch-up and wings level command. Repressing the GA switch, selecting the HDG mode or reengaging the autopilot will cancel the GA mode.

800B IFCS AUTOPILOT CONTROL HEAD AND AIRPLANE CONTROL WHEEL

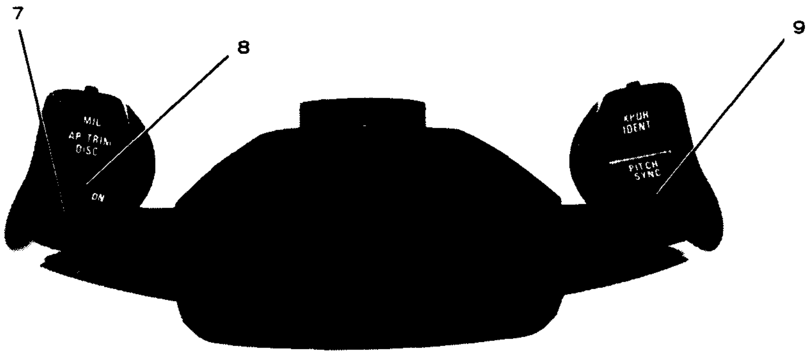


5218P6001

1. AUTOPILOT PITCH COMMAND WHEEL - Controls pitch attitude of the airplane. Rotating up, commands airplane pitch up proportional to rotation of the wheel. Rotating down, commands airplane pitch down.
2. AUTOPILOT TURN COMMAND KNOB - Controls roll attitude of the airplane. When turned left or right, the knob will command a left or right bank accordingly. When moved from the center detent position, it disconnects the heading (HDG) or navigation (NAV) modes if selected on the mode selector.
3. AUTOPILOT LATERAL TRIM CONTROL - When the autopilot turn command knob is centered, with no lateral modes engaged and the airplane manually trimmed for existing flight conditions, the control is used to trim the IFCS for a wings level attitude.

Figure 1 (Sheet 1 of 2)

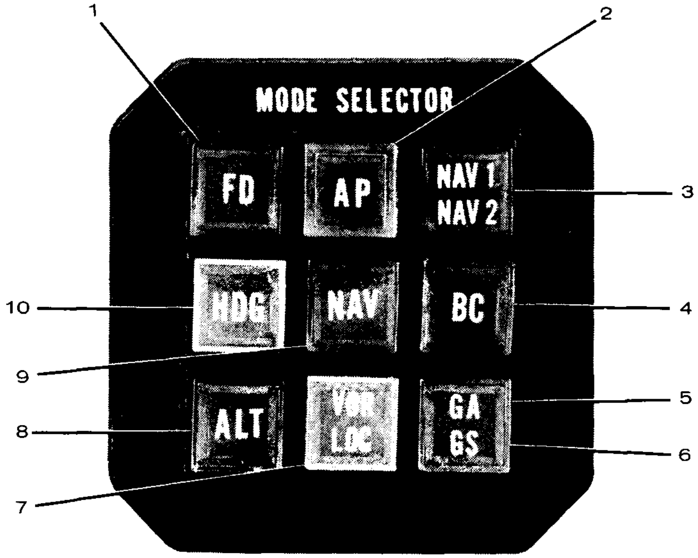
800B IFCS AUTOPILOT CONTROL HEAD AND AIRPLANE CONTROL WHEEL



4. AUTOPILOT ON-OFF SWITCH - Controls primary power to the yaw damper and engages the autopilot when in the on position if interlocks are valid. The autopilot annunciator on the mode selector will light when autopilot is engaged.
5. AUTOPILOT YAW DAMPER ON SWITCH - Turns on yaw damper system only.
6. ROLL TRIM INDICATOR - Indicates direction of autopilot roll effort. deflection in either direction during steady flight indicates that manual adjustment of the airplane aileron trim is required in the same direction. Indicator is active with autopilot and/or flight director engaged or disengaged.
7. ELECTRIC TRIM SWITCH - When moved forward to the DN position, the elevator trim tab moves in the nose-down direction; conversely, moving the switch aft to the UP position moves the tab in the nose-up direction. The electric trim switch is inoperative when the autopilot is engaged.
8. AUTOPILOT/ELECTRIC ELEVATOR TRIM DISENGAGE SWITCH (RED) - Disengages the autopilot and a short (1 to 2 seconds) tone with decreasing amplitude is heard in the cockpit. Disables the electric trim while the switch is depressed.
9. PITCH SYNCHRONIZATION (PITCH SYNC) BUTTON - When the FD mode is engaged, the pitch command bar will automatically synchronize to the pitch command at the time of engagement. To resynchronize the pitch command bar after a new pitch attitude is established, manually depress, but do not hold, the PITCH SYNC button on the control wheel. Depressing the button also disengages the altitude hold mode.

Figure 1 (Sheet 2 of 2)

800B IFCS MODE SELECTOR



1. FLIGHT DIRECTOR MODE
   SELECTOR BUTTON - Engages or disengages the flight director mode. The FD annunciator will light and command bars on the FDI will appear.
2. AUTOPILOT MODE SELECTOR
   ANNUNCIATOR LIGHT - Lights when the autopilot is engaged.
3. NAV 1 - NAV 2
   MODE SELECTOR BUTTON - Selects the navigation receiver for IFCS operation. The receiver that is connected to the IFCS is annunciated. Pressing the button will transfer the IFCS to the other receiver with appropriate annunciation.
4. BACK COURSE MODE
   SELECTOR BUTTON - Engages or disengages the back course mode and is used with localizer operation only. With the autopilot or flight director off or on and the navigation receiver set to a localizer frequency, the back course mode will reverse the appropriate signals to provide for back course operation for either automatic or manual flight. The back course annunciator will light when the back course mode is engaged. Except with an HSI-type indicator, selecting the back course mode causes reversal of the course deviation indication, whether or not the IFCS is being used.

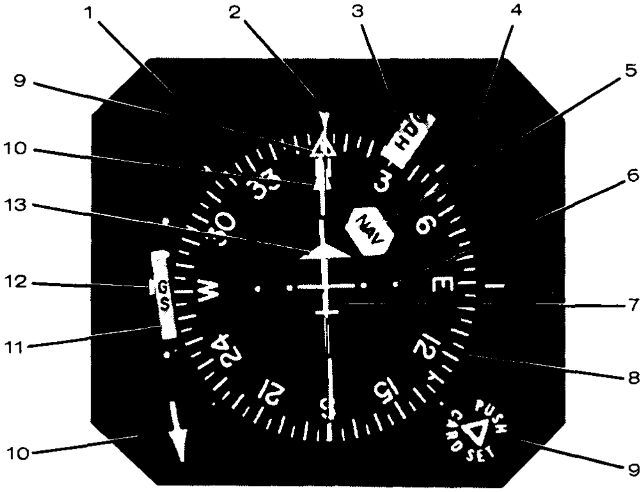
Figure 2 (Sheet 1 of 2)

800B IFCS MODE SELECTOR

5. GO-AROUND MODE
   SELECTOR ANNUNCIATOR LIGHT - The go-around annunciator will light when the go-around mode is engaged.
6. GLIDE SLOPE MODE
   SELECTOR ANNUNCIATOR LIGHT - When the NAV/LOC mode is engaged and the glide slope automatically engages, the glide slope annunciator will light.
7. VOR/LOCALIZER MODE
   SELECTOR ANNUNCIATOR LIGHT - When the AP or FD navigation mode is engaged, either the VOR or LOC annunciator will light to reflect the frequency selected on the navigation receiver. The VOR/LOC light will only illuminate while in the FD or AP navigation mode.
8. ALTITUDE HOLD
   MODE SELECTOR BUTTON - Engages or disengages the attitude hold mode. The ALT annunciator will light when the mode is engaged. Engagement may be accomplished in either climb, descent or level flight, which commands the airplane to maintain the pressure altitude existing at the moment of selection. This mode can be used with all lateral command modes. In the NAV-LOC mode, altitude hold will automatically disengage when the glide slope engages. The go-around mode, when engaged, will also disengage the altitude hold mode. When the optional 800 encoding altimeter system is installed, altitude hold can be engaged automatically by the optional altitude/preselect system.
9. NAV MODE SELECTOR
   BUTTON - Engagement provides for capture and track of the RNAV course and VOR (omni) or LOC (localizer), dependent upon the frequency selected on the navigation receiver. During NAV-LOC operation, the glide slope mode will automatically engage only at the beam center and when the beam is approached from below. If the go-around switch on the left throttle control is actuated, the navigation mode will automatically be cancelled and all associated annunciator lights will go out.
10. HEADING MODE SELECTOR
    BUTTON - Engages the heading mode, which commands the airplane to turn to and maintain a heading selected on the HSI. The HDG annunciator will light when the mode is engaged. A new heading may be selected at any time and will result in a command to turn to the new heading with a bank angle of approximately 25°. The heading mode will cancel the go-around mode.

Figure 2 (Sheet 2 of 2)

800B IFCS HORIZONTAL SITUATION INDICATOR



1. HORIZONTAL SITUATION INDICATOR (HSI) - Provides a pictorial presentation of the airplane position relative to VOR radials, RNAV course, localizer and glide slope beams. It also gives heading reference with respect to magnetic north and provides selection of desired heading, VOR radials, RNAV course, and LOC runway heading.
2. HSI HEADING REFERENCE - Indicates airplane heading on compass card.
3. HSI HEADING FLAG - Flag in view indicates the heading data is not reliable.
4. HSI GYRO SLAVING INDICATOR - Displays synchronization of compass card with respect to the magnetic flux detector unit. The heading selector knob may be used at any time to accomplish synchronization of the compass card reading with the magnetic heading as indicated by zeroing the slaving indicator. A slaved condition is present when the slaving indicator oscillates about the null point (45° fixed reference line on the HSI).
5. HSI NAV FLAG - Flag in view indicates the NAV receiver signal being received is inadequate.

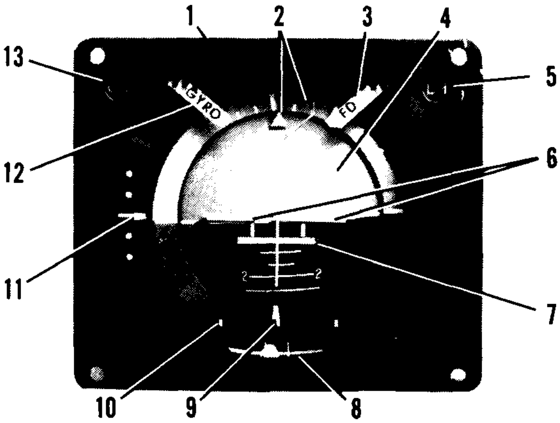
Figure 3 (Sheet 1 of 2)

800B IFCS HORIZONTAL SITUATION INDICATOR

6. HSI COURSE DEVIATION DOTS - Full scale course deviation bar displacement (2 dots) represents the following deviation from beam center; VOR ±10°, localizer approximately ±2-1/2°, RNAV enroute ±5 nautical miles, RNAV approach ±1-1/4 nautical miles.
7. HSI COURSE DEVIATION BAR - Displays displacement from the VOR, RNAV or localizer course center.
8. HSI COMPASS CARD - The compass card displays airplane heading. It is slaved to correct for normal precessional errors. Each graduation represents 5 degrees.
9. HSI HEADING BUG AND HEADING SELECTOR KNOB - When knob is rotated in the normal (out) position, selects airplane autopilot heading and positions heading bug to indicate selected heading on the compass card.
   - When knob is pushed in and rotated, permits setting of the compass card to agree with the magnetic compass. The course cursor and course deviation bar will rotate with the compass card.
10. HSI COURSE CURSOR AND COURSE SELECTOR KNOB - Course cursor is positioned on the compass card by rotating the course selector knob; this selects a VOR radial, RNAV course or LOC runway heading. It rotates with the compass card.
11. HSI GLIDE SLOPE FLAG - Flag in view indicates glide slope receiver signal is inadequate.
12. HSI GLIDE SLOPE POINTER, SCALE AND FLAG - Displays deviation of airplane from an ILS glide slope. Flag obscures scale when the signal being received is not adequate. Full scale deflection of the glide slope pointer represents ±0.7°.
13. HSI TO-FROM FLAG - Indicates direction of the VOR station relative to the selected course. Displays TO when a LOC frequency is selected.

Figure 3 (Sheet 2 of 2)

800B IFCS FLIGHT DIRECTOR INDICATOR



1. FLIGHT DIRECTOR INDICATOR (FDI) - Displays airplane attitude as a conventional attitude gyro and displays commands for flight director operation.
2. FDI ROLL ATTITUDE INDEX - Displays airplane roll attitude through a movable scale and fixed reference marks on the scale at 0 ±10, ±20, ±30, ±45, ±60 and ±90 degrees.
3. FDI FD WARNING FLAG - Flag in view indicates 28 volts DC is not available to the FDI.
4. FDI ATTITUDE BACKGROUND - Moves with respect to symbolic airplane to display airplane pitch and roll attitude.
5. FDI DECISION HEIGHT (DH) ANNUNCIATOR - Indicates airplane has reached preset decision height selected on the optional radio altimeter.
6. FDI COMMAND BARS - Displays computed steering commands referenced to the dot on the symbolic airplane to intercept and maintain a desired flight path.
7. FDI RISING RUNWAY - (Applicable only with optional radio altimeter.) Bar comes into view at approximately 200 feet altitude and rises with descending altitude.
8. FDI INCLINOMETER - Indicates slip to the left or right by displacement of the ball.
9. FDI EXPANDED LOCALIZER INDICATOR - Indicates deviation from localizer or optional RNAV approach mode course center line.
10. FDI EXPANDED LOCALIZER SCALE - Scale consists of 3 vertical marks: The center mark represents the localizer course centerline. The right and left marks indicate 0.3 degree either side of the localizer centerline.
11. HSI GLIDE SLOPE POINTER AND SCALE - Displays deviation of airplane from a NAV 2 ILS glide slope if 1000 series NAVs are installed. With 400 series NAVs or if the glide slope data is unreliable, the pointer will be retracted out of view.

Figure 4 (Sheet 1 of 2)

800B IFCS FLIGHT DIRECTOR INDICATOR

12. FDI GYRO WARNING FLAG - Flag in view indicates adequate vacuum is not available, therefore, the heading data is not reliable.
13. FDI GO-AROUND (GA) ANNUNCIATOR - Indicates Go-Around mode has been selected by the pilot.

Figure 4 (Sheet 2 of 2)

SECTION 2 — LIMITATIONS

A. Autopilot must be off for takeoff, landing and all operations with wing flaps down more than 15°.
B. Approach VOR radial at an angle of 135° or less prior to engaging the navigation mode.
C. Approach localizer at an angle of 90° or less prior to engaging the navigation mode.
D. Approach glide slope from below.
E. Disengage autopilot if malfunction occurs.
F. Maximum speed for autopilot operation is 230 KIAS.
G. Required Placards:
   1. On Circuit Breaker Panel
      a. "AUTOPILOT" - "COMP" - "ACT" - "WARN" (3 Circuit Breakers)
      b. "TRIM POWER"
      c. "YAW DAMPER"
   2. Near Autopilot Control Head
      a. "A/P TEST - BEFORE EACH FLT"
   3. On Instrument Panel Near Autopilot Off Light (Near Flight Director Indicator)
      a. "A/P OFF"
   4. On Pilot's Control Wheel
      a. "AUTOPILOT-DISENGAGE"
      b. "ELEV TRIM - DISENGAGE"
      c. "PITCH SYNC"
      d. "UP - DN"
   5. On Left Throttle Control
      a. "GA"

SECTION 3 — EMERGENCY PROCEDURES

A. Autopilot Malfunction
   1. Elevator Or Aileron Control - OVERPOWER as required.
   2. All Airplane Control Wheel Disengage Switches - DISENGAGE.

NOTE

- All airplane control wheel disengage switches should be simultaneously disengaged to prevent having to immediately distinguish between an autopilot or an electric elevator trim malfunction.
- Sustained elevator overpower will result in the autopilot trimming against the overpower source.

B. Engine Failure
1. Airplane Control Wheel Autopilot Disengage Switch - DISENGAGE.
2. Operative Engine - ADJUST as required.
3. Inoperative Engine - SECURE.
4. Trim Tabs - ADJUST.
5. Autopilot - REENGAGE if desired.

NOTE

Power, speed and/or configuration changes, such as on the approach to landing, will require manual trim adjustments to insure continued proper autopilot operation.

C. Possible altitude loss if autopilot malfunctions (includes altitude loss prior to pilot recognition):
1. Cruise Configuration - 600 feet.
2. Approach Configuration - 200 feet.

D. Airplane control wheel forces required to overpower the autopilot (prior to autopilot elevator trimming against the overpower force) will not exceed:
1. Elevator - 40 pounds.
2. Aileron - 20 pounds.

E. Airplane control wheel forces, in excess of normal control forces, required to overpower a slip clutch in the event of a jammed servo actuator will not exceed:
1. Elevator - 50 pounds.
2. Aileron - 20 pounds.

SECTION 4 — NORMAL PROCEDURES

I. BEFORE TAKEOFF

A. Autopilot Automatic Disconnect Check (With Engines Running And Gyros Erected)
1. Autopilot Turn Command Knob - CENTER.
2. Autopilot Lateral Trim Control - CENTER.
3. Autopilot On-Off Switch - ON. Observe annunciation on mode selector and that the turn and bank yaw damper flag is retracted.

NOTE

The roll servo will engage immediately. The pitch servo will engage after pitch synchronization as evidenced by the autopilot pitch command wheel coming to rest.

4. Flight Director Mode Selector Button - ENGAGE. Observe annunciation.
5. Airplane Control Wheel - HOLD to reduce movement.
6. Autopilot Disconnect Test Button - PUSH and HOLD.
7. Verify the following:
   a. Flight Director Indicator - OBSERVE up command.
   b. Autopilot On-Off Switch - OBSERVE disengage.
   c. Autopilot Off Light - OBSERVE illumination.
   d. Autopilot Disengage Horn - OBSERVE 1 to 2 second aural tone.

8. Airplane Control Wheel
   Autopilot Disengage Switch - PUSH to turn off the autopilot off light.
9. Flight Director Mode Selector Button - DISENGAGE.

II. BASIC AUTOPILOT OPERATION (FLIGHT DIRECTOR ON OR OFF)

A. Before Engagement
   1. Airplane Elevator, Aileron and Rudder Trim - ADJUST.

B. Engagement
   1. Autopilot Turn Command Knob - CENTER DETENT.
   2. Autopilot Lateral Trim Control - CENTER.
   3. Airplane Control Wheel
      Pitch Synchronization Button - MOMENTARILY DEPRESS to synchronize the flight director pitch command bar to the flight attitude if the flight director is engaged.
   4. Autopilot On-Off Switch - ON. Observe annunciation.
   5. Autopilot Lateral Trim Control - ADJUST.

NOTE

- Airplane rudder trim should be adjusted as required to center the turn and bank "ball". Airplane aileron trim may have to be readjusted to compensate for large airspeed changes.

- If the airplane will not maintain the correct attitude with the autopilot engaged, disengage the autopilot, manually retrim the airplane to obtain wings level with the turn and bank "ball" centered, then reengage the autopilot.

C. Turn Commands
   1. Autopilot Turn Command Knob - ROTATE as desired.

D. Pitch Commands
   1. Altitude Hold Mode Selector Button - CHECK DISENGAGED.
   2. Autopilot Pitch Command Wheel - ROTATE as desired.

E. Disengagement
   1. Autopilot On-Off Switch - OFF. (Or)
   2. Airplane Control Wheel
      Autopilot Disengage Switch - DISENGAGE (Or)
   3. Left Throttle Control
      Go-Around (GA) Switch - ENGAGE. Refer to Go-Around Operation.

NOTE

If the autopilot is either disengaged with the control head on-off switch or is automatically disengaged due to a system malfunction, the autopilot off light will continuously illuminate and a 1 to 2 second aural tone will occur. The autopilot off light may be extinguished by cycling the airplane control wheel autopilot disengage switch.

NOTE

- Normal autopilot disengagement should be conducted with the airplane control wheel autopilot disengage switch. The autopilot off light will not illuminate but the 1 to 2 second aural tone will occur.
- Autopilot disengagement with the left throttle control go-around (GA) switch will not illuminate the autopilot off light but will give a 1 to 2 second aural tone. Refer to Go-Around Operation.

III. BASIC FLIGHT DIRECTOR OPERATION (AUTOPILOT OFF)

A. Engagement

1. Autopilot Turn Command Knob - CENTER DETENT.
2. Flight Director Mode Selector Button - ENGAGE. Observe annunciation and flight director command bars.
3. Autopilot Lateral Trim Control - ADJUST as required to center the flight director roll command bar.

B. Basic Pitch Commands

1. Manually fly the airplane to the desired pitch attitude.
2. Airplane Control Wheel Pitch Synchronization Button - MOMENTARILY DEPRESS to synchronize the pitch command bar to the flight attitude.

NOTE

In a flight director only mode (autopilot off), the flight director pitch command bar will automatically synchronize to the pitch attitude at the time of engagement. If a new pitch attitude is flown, the airplane control wheel pitch synchronization button should be depressed to synchronize the flight director command bar to that attitude.

C. Altitude Hold, Heading Select and Navigation Coupling

NOTE

Altitude hold heading select and navigation coupling procedures are identical to the procedures that follow for flight director and/or autopilot modes. In a flight director mode, with autopilot off, the pilot must manually satisfy the flight director pitch and roll command bars.

D. Disengagement (Flight Director)

1. Flight Director Mode Selector Button - DISENGAGE.

IV. ALTITUDE HOLD COUPLING (FLIGHT DIRECTOR AND/OR AUTOPILOT MODES)

A. Engagement

1. With Basic IFCS:
   a. Altitude Hold Mode Selector Button - ENGAGE at desired altitude. Observe annunciation.

2. With Optional Altitude Alert/Preselect System:
   a. Desired Altitude - SELECT.
   b. Altitude Alert/Preselect Arm Button - PUSH. Observe that amber ARMD light illuminates.

CAUTION

Do not operate the autopilot in altitude hold mode when flying in moderate to severe turbulence, mountain lee wave activity and/or moderate to severe icing conditions.

NOTE

The altitude alert/preselect ARMD mode is inoperative when the autopilot is in the altitude hold or glide slope mode.

   c. Autopilot Pitch Command Wheel - UP or DOWN as required to intercept selected altitude.
   d. When selected altitude is captured, observe:
      (1) Altitude alert/preselect amber ARMD light goes off.
      (2) Altitude alert/preselect green CPLD light illuminates.
      (3) IFCS mode selector ALT light illuminates.

NOTE

Once armed, the altitude alert/preselect can be disarmed only by reselecting a different altitude on the altitude preselect presentation, by selecting the altitude hold mode on the mode selector or by glide slope capture.

B. Disengagement (Altitude Hold Coupling)
   1. Altitude Hold Mode Selector Button - DISENGAGE. (Or)
   2. Airplane Control Wheel
      Pitch Synchronization Button - MOMENTARILY DEPRESS.

WARNING

Do not attempt to use the encoding altimeter indicator for flight information if warning flag is in view. The flag indicates that power has been removed from the encoding altimeter.

NOTE

- The altitude hold mode selector button must be disengaged before actuating the autopilot pitch wheel. Autopilot pitch wheel rotation will not disengage the altitude hold mode.
- Altitude hold mode will automatically disengage in the coupled ILS mode when the glide slope is captured.

V. HEADING SELECT FUNCTION (FLIGHT DIRECTOR AND/OR AUTOPILOT MODES)

A. Engagement

1. Autopilot Turn Command Knob - CENTER DETENT.
2. Directional Gyro Heading Selector Knob - ROTATE bug to desired magnetic heading.
3. Heading Mode Selector Button - ENGAGE. Observe annunciation.
4. Directional Gyro Heading Selector Knob - ADJUST for any subsequent desired heading.

NOTE

When an optional copilot's horizontal situation indicator or autopilot directional gyro is installed, the pilot's heading bug controls the heading when NAV 1 receiver is selected and the copilot's heading bug controls heading when NAV 2 receiver is selected.

B. Disengagement (Heading Select Function)

1. Heading Mode Selector Button - DISENGAGE. (Or)
2. Autopilot Turn Command Knob - ROTATE. (Or)
3. Navigation Mode Selector Button - ENGAGE.

VI. ILS/LOCALIZER COUPLING (FLIGHT DIRECTOR AND/OR AUTOPILOT MODE)

A. Engagement

1. NAV 1 - NAV 2 Mode Selector Button - SELECT NAV 1 or NAV 2. Observe proper annunciation on mode selector.
2. Course Selector Knob - ADJUST to localizer front course bearing for both front and back course approaches.
3. Back Course Mode Selector Button - ENGAGE as applicable. Observe BC annunciation on mode selector.
4. Wing Flaps - DOWN 15° if all engines operative.
5. Airspeed - 110 to 130 KIAS (120 to 130 KIAS If Engine Inoperative).
6. Directional Gyro Heading Selector Knob - ROTATE bug for radar vectors and/or 30° to 45° localizer intercept angle.
7. Autopilot Turn Command Knob - CENTER DETENT.
8. Heading Mode Selector Button - ENGAGE. Observe annunciation.
9. When course deviation indicator moves off the peg:
   a. Navigation Mode Selector Button - ENGAGE. Observe NAV and LOC annunciation on mode selector; HDG annunciation on mode selector will go out.

NOTE

Navigation mode is not recommended for tracking outbound on a back course localizer approach due to the possibility of capturing a false glide slope.

10. Altitude Hold Mode Selector - CHECK automatic disengage at glide slope capture. Observe ALT annunciator on the mode selector goes out and GS annunciator illuminates.
    - OFF if localizer approach only. Adjust autopilot pitch command wheel for proper descent.

NOTE

- Glide slope must be approached from below.
- Back course disables IFCS glide slope couple function.

11. Landing Gear - DOWN at outer marker if all engines operative.
12. Airspeed - Maintain 110 to 130 KIAS (120 to 130 KIAS If Engine Inoperative).
13. Landing Gear - DOWN within gliding distance of field, if engine inoperative landing.
14. Wing Flaps - 45° DOWN when landing is assured, if engine inoperative landing.

NOTE

Autopilot must be off when wing flaps are down more than 15°.

B. Disengagement (ILS/Localizer Coupling)
   1. Navigation Mode Selector Button - DISENGAGE. (Or)
   2. Autopilot Turn Command Knob - ROTATE.

NOTE

Complete autopilot disengagement should normally be conducted at the appropriate minimums with the airplane control wheel disengage switch.

VII. VOR COUPLING (FLIGHT DIRECTOR AND/OR AUTOPILOT MODE) (AIRPLANE CONFIGURATION FOR VOR APPROACH - REFER TO ILS/LOCALIZER COUPLING PROCEDURES)

A. Engagement
   1. NAV 1 - NAV 2 Mode Selector Button - SELECT NAV 1 or NAV 2. Observe proper annunciation.
   2. Course Selector Knob - ADJUST to desired VOR course.
   3. Directional Gyro Heading Selector Knob - ROTATE bug to within 135° of desired VOR course.
   4. Autopilot Turn Command Knob - CENTER DETENT.
   5. Heading Mode Selector Button - ENGAGE. Observe annunciation.

6. When airplane is within 135° of desired VOR course:
   a. Navigation Mode Selector Button - ENGAGE. Observe NAV and VOR annunciation on mode selector; HDG annunciation on mode selector will go out.

NOTE

- The autopilot will intercept and track the selected VOR radial compensating for wind correction.
- When the airplane is established on course, the computer will automatically switch into a "track" mode. When course changes greater than 20° are required, disengage the navigation mode selector, rotate the course selector knob and then reengage the navigation mode selector.

B. Disengagement (VOR Coupling)
   1. Navigation Mode Selector Button - DISENGAGE. (Or)
   2. Autopilot Turn Command Knob - ROTATE.

NOTE

Complete autopilot disengagement should normally be conducted on a VOR approach at the appropriate minimums with the airplane control wheel autopilot disengage switch.

VIII. GO-AROUND OPERATION (FLIGHT DIRECTOR AND/OR AUTOPILOT MODE)

A. Left Throttle Control Go-Around Switch - ENGAGE. Observe GA and FD annunciation on mode selector if not already engaged.

NOTE

The go-around mode gives a wings level, pitch up command (4° to 6° nose up) on the flight director indicator pitch command bar only. Actuation of go-around mode disengages the autopilot.

B. Disengagement (Go-Around)
   1. Left Throttle Control Go-Around Switch - CYCLE. (Or)
   2. Heading Mode Selector Button - ENGAGE. (Or)
   3. Autopilot On-Off Switch - ON.

NOTE

The airplane should be manually retrimmed to the flight director attitude before reengaging the autopilot to avoid an abrupt pitch change as the autopilot tries to satisfy the existing pitch command.

SECTION 5 – PERFORMANCE

Not Applicable.

LOCATOR BEACON (DMELT-6 AND -6C)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the DMELT-6 and -6C (Canada) locator beacon.

Description

The locator beacon system is a battery-operated, sweep tone emergency radio transmitter incorporating an externally mounted whip antenna and a transmitter with an integral 3-position switch, all located on the left side of the fuselage tail cone. The switch can be reached by removing the plug button located adjacent to the locator beacon placard. Normally, the switch is in the ARM (AUTOMATIC "G" OPERATION) position; this position allows the transmitter to be activated automatically by the "G" switch. The ON (EMERGENCY & TEST) position should be used only to test the equipment or whenever a rescue is desired. The OFF (AFTER RESCUE) position should be used only after the rescue as this position will disable all emergency transmissions.

The locator beacon transmits on both 243.0 MHz (UHF) and 121.5 MHz (VHF) emergency frequencies simultaneously. The DMELT-6C locator beacon, provided for operation in Canada, transmits only on the VHF emergency frequency.

Transmitter power is provided by an alkaline battery pack inside the transmitter case.

NOTE

The battery pack must be changed no later than the date specified on the outside of the locator beacon case and on each battery case.

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

A. Before Landing
   1. If time permits, use airplane radio (121.5 MHz) to transmit distress call; include airplane position if possible.

B. After Landing
   1. Plug Button - REMOVE (Located On Left Side Of Tail Cone).
   2. Locator Beacon Switch - ON.

C. After Rescue
   1. Locator Beacon Switch - OFF.

SECTION 4 — NORMAL PROCEDURES

Not Applicable.

SECTION 5 — PERFORMANCE

Not Applicable.

400 MARKER BEACON (TYPE R-402A)

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the 400 Marker Beacon.

Description

The Cessna 400 Marker Beacon (Type R-402) consists of a 75 MHz marker beacon receiver, antenna and three instrument panel mounted lights, see Figure 2. Marker beacon audio is controlled by a speaker phone switch on the audio control panel. Volume level of the marker beacon audio is fixed but can be ground adjusted by avionic technicians. Sensitivity of the marker beacon is controlled by a HI LOW switch on the audio control panel. Illumination capability of the marker beacon lights can be checked by actuation of the marker beacon test switch. When this switch is actuated, all three marker beacon lights should illuminate.

An optional marker beacon audio mute capability is available to greatly reduce the marker beacon audio level. The audio mute is controlled by a switch on the 1000 audio control panel, if installed. If the 800 audio control panel is installed, audio mute is controlled by a three-position center off switch located adjacent to the marker beacon lights. Momentary actuation of either audio mute switch will greatly suppress marker beacon audio of approximately 30 seconds.

The marker beacon provides visual and aural indications of the 75 MHz ILS marker beacon signals as each marker is passed. The three most currently used marker facilities and their characteristics are listed in Figure 1.

MARKER FACILITIES

MARKER	IDENTIFYING TONE	LIGHT*
INNER	CONTINUOUS 6 DOTS PER SEC (3000 HZ)	WHITE
MIDDLE	ALTERNATE DOTS AND DASHES (1300 HZ)	AMBER
OUTER	2 DASHES PER SEC (400 HZ)	BLUE
*WHEN THE IDENTIFYING TONE IS RECEIVED, THE RESPECTIVE INDICATING LIGHT WILL BLINK ACCORDINGLY.		

Figure 1

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

Not Applicable.

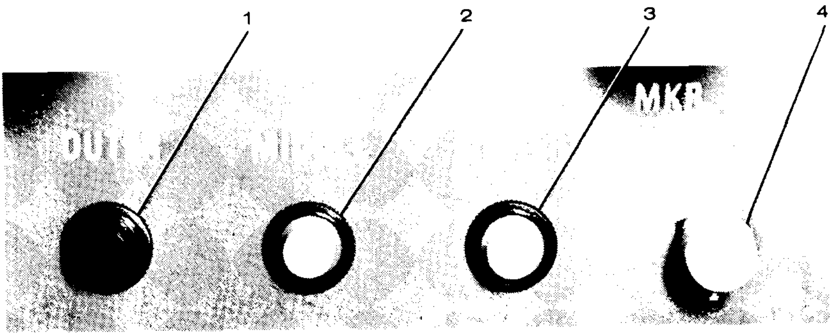
SECTION 4 – NORMAL PROCEDURES

1. LO/HI MKR Switch - SELECT HI position for airway flying or LO position for ILS approaches.
2. SPEAKER/PHONE MKR Switch - SELECT speaker or phone audio.
3. Marker Beacon Test Switch - ACTUATE to insure that marker beacon indicator lights are operative.

SECTION 5 – PERFORMANCE

Not Applicable.

400 MARKER BEACON INDICATOR LIGHTS



1. OUTER MARKER BEACON INDICATOR LIGHT - Indicates passage of outer marker beacon. The OUTER light is blue.
2. MIDDLE MARKER BEACON INDICATOR LIGHT - Indicates passage of middle marker beacon. The MIDDLE light is amber.
3. INNER MARKER BEACON INDICATOR LIGHT - Indicates passage of inner marker beacon. The INNER light is white.
4. MARKER BEACON TEST SWITCH - Switch actuation suppresses marker beacon audio for approximately 30 seconds. The button shown above is used when the 1000 audio control panel is installed. If the 800 audio control panel is installed, a three-position, center off switch is provided to control the test and mute functions.

Figure 2

1000 NAVIGATION SYSTEM (TYPE 1048A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 1000 navigation system.

Description

The Cessna 1000 navigation system (Type 1048A) is a synthesizer-controlled, 200 channel VHF navigation receiver. The system receives and interprets VHF omnidirectional range (VOR) and localizer signals between the frequencies of 108.00 and 117.95 MHz.

The 1000 navigation system consists of a panel-mounted module control unit, a remotely located receiver, converter, VOR/ILS indicator, (VHF) omni antenna and interconnecting cables. The system utilizes the airplane microphone, headphone and speaker systems for the audio circuits.

The navigation receiver provides for three presettable frequencies of which two (input and active) are displayed on electronic readouts. As new input frequencies are selected, they may be transferred to active status by means of a pushbutton. The previous active frequency is stored in memory and may be recalled by means of a pushbutton.

To prevent accidental operation, the frequency related pushbuttons (XFER and RECALL) must be pressed for at least 1/4 second to change frequencies. In addition, a safety circuit is provided which prevents inadvertently entering the same frequency twice.

A "Frequency Memory" voltage is provided so that the preset frequencies are not lost when the receiver is turned off. This voltage is provided directly from the hot battery bus and is present even with the battery switch off. To prevent battery discharge during periods of long term storage, a FREQ MEM circuit breaker is provided on the right side console.

NOTE

If the "Frequency Memory" voltage is interrupted, all stored frequencies for the ADF will be lost. Subsequent operation of the system, with the "Frequency Memory" voltage restored, will require new frequency inputs.

All operating controls, see Figure 1, for the 1000 navigation system are located on the front panel of the module control unit except the course selector, which is located on the VOR/ILS indicator, and the master lamp test switch. In addition, a speaker-phone selector switch is provided on the audio control panel. The airplane microphone transmitter switch button cuts out the NAV receiver audio circuit when the button is depressed for transmitting on another system.

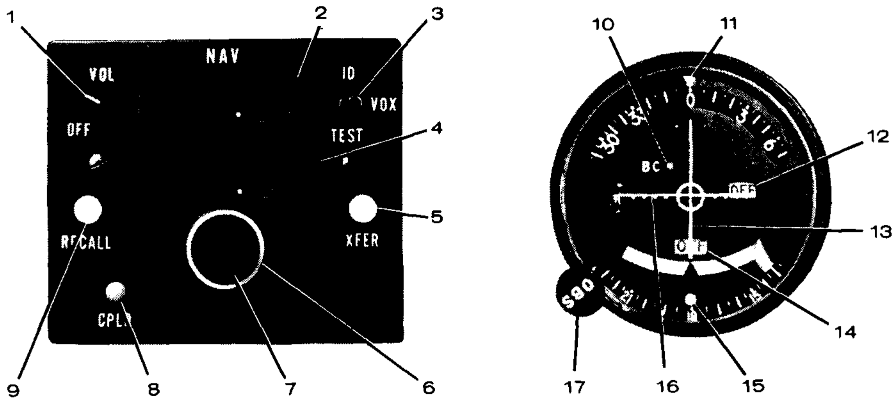
SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

1000 NAVIGATION CONTROL PANEL AND INDICATOR



1. OFF/VOL CONTROL - Primary power and volume control. Clockwise rotation applies power. Further clockwise rotation increases audio level.
2. ACTIVE FREQUENCY READOUT - Displays active frequency which is being received.
3. ID/VOX/TEST SWITCH - Selects mode as follows:
   ID - Provides audio Morse Code station identification.
   VOX - Provides audio voice station identification or other voice transmissions.
   TEST - Provides self-test for VOR navigation circuits, the readouts and CPLD lamp.
4. INPUT FREQUENCY READOUT - Displays frequency directly selected by frequency selectors. This frequency cannot be used to receive until it is transferred to active frequency readout.
5. XFER PUSHBUTTON - Transfers input frequency to active frequency which is being received. The previous active frequency is stored in memory. The previous memory frequency is lost. Pushbutton action is delayed by 1/4 second to prevent accidental actuation.

> **NOTE**
>
> The XFER pushbutton transfers the same frequency to the active input only once, regardless of how many times the pushbutton is pressed. This prevents accidentally loading the same frequency twice and unintentionally erasing the previous memory frequency.

Figure 1 (Sheet 1 of 2)

1000 NAVIGATION CONTROL PANEL AND INDICATOR

6. MEGAHERTZ SELECTOR - Selects navigation input frequency in 1 MHz steps.
7. FRACTIONAL MEGAHERTZ SELECTOR - Selects navigation receiver input frequency in .05 MHz steps.
8. CPLD LAMP - Lights when the receiver is coupled to the autopilot.
9. RECALL PUSHBUTTON - Recalls frequency stored in memory to active frequency. Previous active frequency is stored in memory. Pushbutton action is delayed by 1/4 second to prevent accidental actuation.
10. BC LAMP - Amber light illuminates when the autopilot or reverse sense option is installed and the reverse sense switch or the autopilot's back-course button is engaged; indicates CDI needle is reversed on selected receiver when tuned to a localizer frequency.
11. COURSE INDEX - Indicates selected VOR course (bearing).
12. GLIDE SLOPE "OFF" FLAG - When visible, indicates unreliable glide slope signal or improperly operating equipment. The flag disappears when a reliable glide slope signal is being received.
13. COURSE DEVIATION POINTER - Indicates course deviation from selected omni bearing or localizer centerline.
14. OFF/TO-FROM INDICATOR - Operates only with a VOR or localizer signal. OFF position (Flag) indicates unusable signal. With usable VOR signal, when OFF position disappears, indicates whether selected course is TO or FROM station. With a usable localizer signal, shows TO.
15. RECIPROCAL COURSE INDEX - Indicates reciprocal of selected VOR course.
16. GLIDE SLOPE DEVIATION POINTER - Indicates deviation from normal glide slope.
17. OMNI BEARING SELECTOR (OBS) - Selects bearing to or from VOR station.

NOTE

An HSI may be used in place of the navigation course indicator.

Figure 1 (Sheet 2 of 2)

SECTION 4 — NORMAL PROCEDURES

A. Programming Frequencies
1. VOL Control - CLOCKWISE to apply power.
2. Frequency Selector Knobs - AS REQUIRED.
3. XFER Pushbutton - PRESS. The following occurs:
   a. Input frequency transferred to active frequency readout.
   b. Previous active frequency is stored in memory.
4. The second frequency may be programmed as in steps 2 and 3 above. The third frequency may be stored in the frequency selector and input frequency readout.

B. Recalling Frequency From Memory
1. RECALL Pushbutton - PRESS. The following occurs:
   a. Frequency in memory is transferred to active frequency readout.
   b. Previous active frequency is transferred to memory.

C. NAV Operation
   1. Speaker/Phone Select Switch - AS REQUIRED.
   2. VOL Control - CLOCKWISE to apply power and adjust for comfortable audio level.
   3. Active Frequency - AS REQUIRED.
   4. ID/VOX/TEST Switch - ID position to identify the navigation station. Return identifier signal to the VOX position to filter the navigation station identifier signal from the receiver audio.
   5. TO-FROM INDICATOR - CHECK that it reads TO or FROM with the usable VOR navigation signal.

D. VOR Self-Test Operation
   1. Turn on navigation set and tune to usable VOR signal (from either a VOR station or a test signal).
   2. Using OBS knob, set course deviation indicator to 0. Press ID/VOX/TEST Switch to TEST. Course deviation indicator should center and TO-FROM indicator should show FROM.
   3. With switch pressed to TEST, displace course selector approximately 10 degrees to either side of 0. Course deviation indicator should deflect full scale in direction corresponding to the course selector displacement.
   4. Release switch from TEST for normal VOR operation.

NOTE

The VOR self-test also tests the readouts and CPLD lamp.

SECTION 5 — PERFORMANCE

Not Applicable.

400 NAV/COM (TYPE RT-485A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 400 Nav/Com.

Description

The Cessna 400 Nav/Com (Type RT-485A) consists of a panel-mounted receiver-transmitter and a single or dual pointer remote course deviation indicator.

The set includes a 720-channel VHF communications receiver-transmitter and a 200-channel VHF navigation receiver, both of which may be operated simultaneously. The communications receiver-transmitter receives and transmits signals between 118.000 and 135.975 MHz in 25-kHz steps. The navigation receiver receives omni and localizer signals between 108.00 and 117.95 MHz in 50 kHz steps. The circuits required to interpret the omni and localizer signals are located in the course deviation indicator. Microprocessor frequency management provides storage for 3 pretuned navigation and 3 pretuned communication frequencies in memory.

A "Frequency Memory" voltage is provided so that the preset frequencies are not lost when the receiver is turned off. This voltage is provided directly from the hot battery bus and is present even with the battery switch off. To prevent battery discharge during periods of long term storage, a FREQ MEM circuit breaker is provided on the right side console.

NOTE

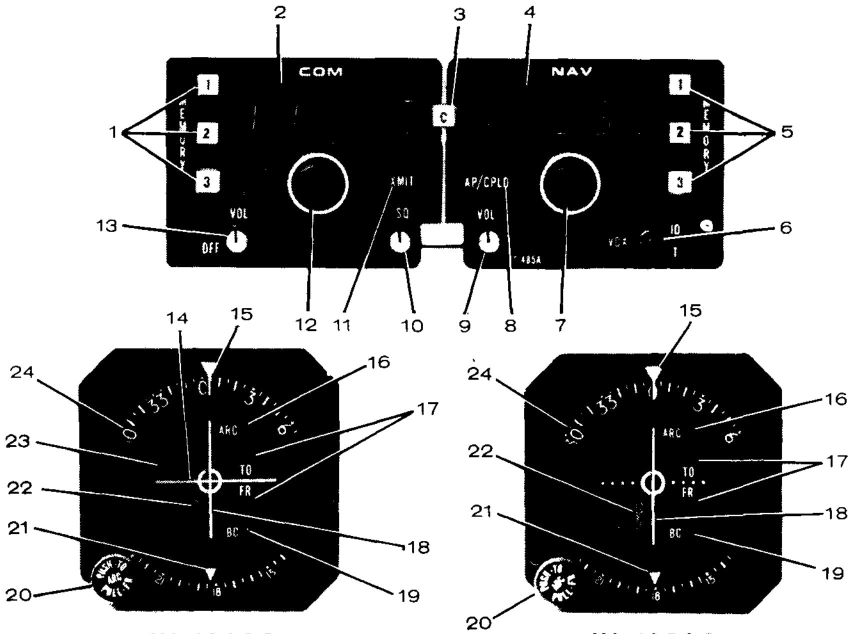
If the "Frequency Memory" voltage is interrupted, all stored frequencies for the ADF will be lost. Subsequent operation of the system, with the "Frequency Memory" voltage restored, will require new frequency inputs.

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

The course deviation indicator includes either a single-pointer and related NAV flag for VOR/LOC indication only, or dual pointers and related NAV and GS flags for both VOR/LOC and glide slope indications. Both types of indicators incorporate a back-course lamp (BC) which lights when optional back course (reversed sense) operation is selected. Both types may be provided with Automatic Radial Centering which, when selected, automatically indicates the radial (bearing) to or from the VOR station.

All controls for the nav/com, except the omni bearing selector (OBS) knob, which is located on the course deviation indicator, are mounted on the front panel of the receiver-transmitter, see Figure 1. In addition, when two or more radios are installed, airplane mounted transmitter selector and speaker/phone switches are provided.

400 NAV/COM CONTROLS PANEL AND INDICATORS



1. COM MEM 1, 2, 3 BUTTONS - Selects frequency in com memory for tuning and use. Each button lights when pressed, and light goes out on button previously pressed. Three pretuned frequencies are available by pressing appropriate com memory button. Upon turn-on, com memory 1 is automatically selected.
2. COMMUNICATION OPERATING FREQUENCY READOUT - Indicates com frequency in use. Third decimal place not shown.
3. CYCLE (C) BUTTON - Selects last decimal place on com frequency in use. If last decimal place is 2 or 7, pressing button changes number to 5 or 0, respectively. If last decimal place is 5 or 0, pressing button changes number to 7 or 2, respectively. Also provides test function by holding button pressed for more than 1.7 seconds. This lights each com and nav MEM button in turn, and displays the corresponding pretuned frequency in memory.
4. NAVIGATION OPERATING FREQUENCY READOUT - Indicates nav frequency in use.

Figure 1 (Sheet 1 of 3)

400 NAV/COM CONTROL PANEL AND INDICATOR

5. NAV MEM 1, 2, 3 BUTTONS - Selects frequency in nav memory for tuning and use. Each button lights when pressed, and light goes out on button previously pressed. Three pretuned frequencies are available by pressing appropriate nav memory button. Upon turn-on, nav memory 1 is automatically selected.
6. ID-VOX-T SWITCH - In ID position, station identifier signal is audible; in VOX position, identifier signal is suppressed; in T (Momentary On) position, the self-test function is selected, and the AP/CPLD and XMIT annunciators are lighted.
7. NAVIGATION RECEIVER FREQUENCY SELECTORS - Outer knob changes nav frequency in 1-MHz steps between 108 and 117 MHz; inner knob changes nav frequency in .05-MHz steps between .00 and .95 MHz; simultaneously selects paired glide slope frequency and DME channel.
8. AP/CPLD ANNUNCIATOR - Lights when autopilot is coupled to nav VOR/LOC converter output.
9. NAV VOL CONTROL - Adjusts volume of navigation receiver audio.
10. SQUELCH CONTROL - Adjust signal threshold necessary to activate com receiver audio. Clockwise rotation increases background noise (decreases squelch action); counterclockwise rotation decreases background noise.
11. XMIT ANNUNCIATOR - Lights when transmitter output is normal.
12. COMMUNICATION RECEIVER FREQUENCY SELECTORS - Outer knob changes com frequency in 1-MHz steps between 118 and 136 MHz; inner knob changes com frequency in .05 MHz steps between .025 and .975 MHz or between .000 and .950 MHz depending on setting of C button.
13. COM OFF-VOL CONTROL - Combination on/off switch and volume control; turns on nav/com set and controls volume of com receiver audio.
14. GLIDE SLOPE DEVIATION POINTER - Indicates deviation from ILS glide slope.
15. COURSE INDEX - Indicates selected VOR course.
16. AUTOMATIC RADIAL CENTERING (ARC) INDICATOR - Amber light illuminates when Automatic Radial Centering is in use.
17. NAV/TO-FROM INDICATOR - Operates only with a VOR or localizer signal. Red NAV position (flag) indicates unusable signal. With usable VOR signal, indicates whether selected VOR course is TO or FROM station. With usable localizer signal, shows TO.
18. COURSE DEVIATION POINTER - Indicates course deviation from selected omni course or localizer centerline.
19. BC LAMP - Amber light illuminates when autopilot or reverse sense option is installed and the reverse sense switch or autopilot's back-course button is engaged; indicates course deviation pointer is reversed on selected receiver when tuned to a localizer frequency.

Figure 1 (Sheet 2 of 3)

400 NAV/COM CONTROL PANEL AND INDICATORS

20. AUTOMATIC RADIAL CENTERING (ARC) PUSH-TO/PULL-FROM SELECTOR - In center detent functions as conventional OBS. Pushed to inner (Momentary On) position, slews OBS course card to center course deviation indicator with a TO flag, then returns to conventional OBS selection. Pulled to outer detent, continuously slews OBS course card to indicate bearing from VOR station, keeping course deviation pointer centered, with a FROM flag.
21. RECEPROCAL COURSE INDEX - Indicates reciprocal of selected VOR course.
22. NAVIGATION (NAV) FLAG - When visible, indicates unreliable navigation information. Flag disappears when reliable navigation information is being received.
23. GLIDE SLOPE (GSH) FLAG - When visible, idicates unreliable glide slope signal or improperly operating equipment. Flag disappears when a reliable glide slope signal is being received.
24. COURSE CARD - Indicates selected VOR course under course index.

Figure 1 (Sheet 3 of 3)

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. Pretuning Nav/Com Frequencies
   1. MEM 1, 2, 3 Buttons - PRESS desired nav or com button for at least 1/4 second.
   2. Frequency Selectors - ROTATE corresponding nav or com selector (press C button as required in com) until the desired frequency is shown on the operating frequency readout.
   3. MEM 1, 2, 3 Buttons - PRESS next nav or com button as desired. The previous pretuned frequency will be stored in memory. Repeat steps 2 and 3 for up to 3 nav and 3 com frequencies.

B. Communication Receiver-Transmitter Operation

1. COM OFF/VOL Control - TURN ON; adjust to desired audio level.
2. Avionic Switch Panel (If Installed):
   a. XMTR SEL Switch - SELECT receiver-transmitter.
   b. SPEAKER/PHONE Switch - AS REQUIRED.
3. Frequency Selection - SELECT desired operating frequency by either pressing a com MEM button to recall a pretuned frequency, or by using com frequency selectors and C button.

NOTE

If dual VHF communications systems are installed, improved communication with the airplane on the ground may be obtained by using the VHF #2 Com which is connected to the vertical fin antenna. Airframe masking of the RF signals from the lower fuselage antenna associated with the VHF #1 Com sometimes impairs ground communication.

4. SQ Control - ROTATE counterclockwise to decrease background noise as required.
5. Microphone Button:
   a. To Transmit - PRESS; speak into microphone.
   b. To Receive - RELEASE.

NOTE

In wet weather, it is recommended the EQUIP FAN circuit breaker be pulled during taxi, takeoff and landing to minimize the probability of water ingestion in the nose compartment.

C. Navigation Operation

1. SPEAKER/PHONE Switch - AS REQUIRED.
2. COM OFF/VOL Control - TURN ON.
3. Frequency Selection - SELECT desired operating frequency by either pressing a nav MEM button to recall a pretuned frequency, or by using nav frequency selectors.
4. ID-VOX-T Switch:
   a. To Identify Station - SET to ID to hear navigation station identifier signal.
   b. To Filter Out Station Identifier Signal - Set to VOX to include filter in audio circuit.
5. ARC PUSH-TO/PULL-FROM (If applicable):
   a. To use as conventional OBS - PLACE in center detent.
   b. To obtain one-time bearing to VOR station - PUSH to inner (momentary on) position.
   c. To obtain continuous bearing from VOR station - PULL to outer detent.

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

E. Memory Test Operation
1. C Button - PUSH for at least 1.7 seconds. Each com and nav MEM button lights in turn, and corresponding pretuned frequency is displayed.

SECTION 5 — PERFORMANCE

Not Applicable.

AA-100 RADIO ALTIMETER

SECTION 1 — GENERAL

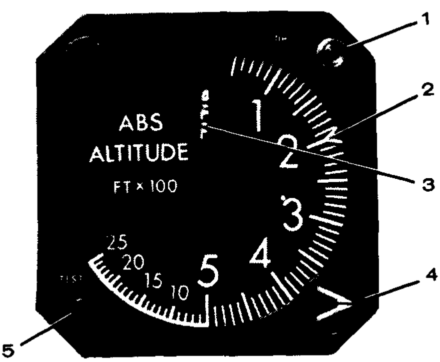
This supplement provides information which must be observed when operating the AA-100 radio altimeter.

Description

The AA-100 radio altimeter, see Figure 1, gives an absolute altitude indication from 2500 feet AGL to 40 feet AGL. The radio altimeter incorporates a warning flag to alert the pilot to a radio altimeter failure. A DH SET knob is provided to position an indexer which will trigger a visual warning when the selected altitude is reached. A self-test is included for system checkout. Pressing the TEST button causes the indicator to read 100 feet, illuminates the DH (decision height) light when decision height indexer is set above 100 feet, and brings the warning flag into view. The system receives its power from the airplane's 28-volt system.

As the airplane descends below 2500 feet AGL, the pointer will indicate the airplane's absolute altitude. When the airplane reaches the preselected warning altitude, a warning light and tone burst comes on. Climbing through the selected altitude extinguishes the lights.

RADIO ALTIMETER INDICATOR



1. DECISION HEIGHT LIGHT - Alerts that the absolute altitude of the airplane is at or below the set altitude.
2. DECISION HEIGHT INDEXER - Triggers a visual warning when the selected altitude is reached.
3. POINTER - Indicates the airplane's absolute altitude.
4. DECISION HEIGHT SET KNOB - Positions indexer around the periphery of the dial.
5. TEST BUTTON - Tests the altimeter for proper operation.

Figure 1

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 – NORMAL PROCEDURES

A. Normal Operation
1. Radio Altimeter Switch - ON.
2. Pointer - STOWED behind mask if on ground.
   - 2500 FEET if in flight.
3. DH Set Knob - AS REQUIRED.

NOTE

During ground operation, DH function and annunciator are deactivated by the landing gear squat switch. The pointer will be stowed behind the mask. Self-test will function on the ground.

B. Ground Self-Test
1. DH Set Knob - 200 FEET.
2. Test Button - PRESS and hold. Altitude pointer will indicate 100 ±20 feet and the DH annunciator will illuminate.
3. Test Button - RELEASE. After 3 seconds the pointer will stow behind the mask and the DH annunciator will extinguish.

C. In Flight Self-Test
1. Pointer - STOWED behind mask above 2500 feet AGL.
2. DH Set Knob - 200 FEET.
3. Test Button - PRESS and hold. Altitude pointer will indicate 100 ±20 feetand the DH annunciator will illuminate.
4. Test Button - RELEASE. After 3 seconds the pointer will stow behind the mask and the DH annunciator will extinguish.

NOTE

Altitude pointer will stow behind mask below 2500 feet AGL if the ground return signal is lost or when the airplane is in a bank in excess of 45°.

SECTION 5 – PERFORMANCE

Not Applicable.

AA-215 RADIO ALTIMETER

SECTION 1 – GENERAL

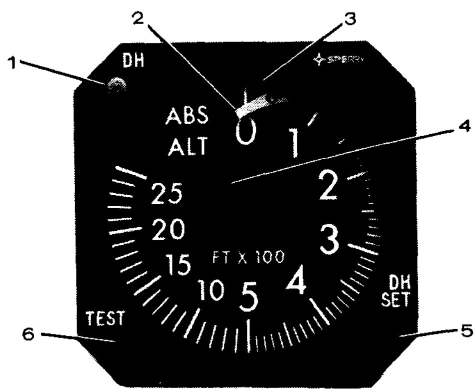
This supplement provides information which must be observed when operating the AA-215 radio altimeters.

Description

The AA-215 radio altimeter, see Figure 1, gives an absolute altitude indication from 2500 feet AGL to ground level. The radio altimeter incorporates a warning flag to alert the pilot to a radio altimeter failure. A DH SET knob is provided to position an indexer which will trigger a visual warning when the selected altitude is reached. A self-test is included for system checkout. Pressing the TEST button causes the indicator to read 100 feet, illuminates the DH (decision height) light when decision height indexer is set above 100 feet, and brings the warning flag into view. The system receives its power from the airplane's 28-volt system.

As the airplane descends below 2500 feet AGL, the pointer will indicate the airplane's absolute altitude. When the airplane reaches the preselected warning altitude, a warning light and tone burst comes on. Climbing through the selected altitude extinguishes the lights.

RADIO ALTIMETER INDICATOR



1. DECISION HEIGHT LIGHT - Alerts that the absolute altitude of the airplane is at or below the set altitude.
2. FAILURE WARNING FLAG - Indicates signal or system malfunction.
3. DECISION HEIGHT INDEXER - Triggers a visual warning when the selected altitude is reached.
4. POINTER - Indicates the airplane's absolute altitude.
5. DECISION HEIGHT SET KNOB - Positions indexer around the periphery of the dial.
6. TEST BUTTON - Tests the altimeter for proper operation.

Figure 1

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. Normal Operation
1. Radio Altimeter Switch - ON.
2. Off Flag - RETRACTED after 35 seconds warmup.
3. DH Set Knob - AS REQUIRED.

> NOTE
>
> During ground operation, DH function and annunciator can be deactivated by setting DH bug below 0 feet.

B. Ground Self-Test
1. DH Set Knob - 50 FEET.
2. Off Flag - RETRACTED after 35 seconds warm up. DH annunciator will illuminate and altitude pointer will indicate 0 ±5 feet.
3. Test Button - PRESS and hold. Altitude pointer will indicate 100 ±20 feet, DH annunciator will extinguish and the OFF flag will appear.
4. Test Button - RELEASE. Altitude pointer will indicate 0 ±5 feet, DH annunciator will light and OFF flag will retract.

C. In Flight Self-Test
1. Off Flag - RETRACTED.
2. Altitude Pointer - STOWED behind mask above 2500 feet AGL.

> NOTE
>
> Altitude pointer will stow behind mask below 2500 feet AGL if the ground return signal is lost or when airplane is in a bank in excess of 45°.

3. DH Set Knob - 200 FEET.
4. Test Button - PRESS and hold. Altitude pointer will indicate 100 ±20 feet, DH annunciator will illuminate and OFF flag will appear.
5. Test Button - RELEASE. Altitude pointer will return to previous indication, DH annunciator will extinguish and OFF flag should retract.

SECTION 5 — PERFORMANCE

Not Applicable.

400 RADIO MAGNETIC INDICATOR (TYPE IN-404A)

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the 400 radio magnetic indicator.

Description

The Cessna 400 Radio Magnetic Indicator (RMI) is used in conjunction with other airborne navigation equipment to aid the pilot in navigating the airplane. The RMI eliminates the need for many of the numerical and graphical computations necessary for determining airplane position.

The RMI, see Figure 1, is a panel-mounted navigation instrument that combines the display of VOR and ADF bearing information with the airplane heading on a single instrument. The VOR and ADF bearings are displayed by individual rotating pointers against the background of a rotating azimuth card. The azimuth card is driven by the slaved magnetic compass system in the airplane and continuously indicates airplane heading.

Each pointer in the Type IN-404A RMI is dedicated to its associated receiver for indicating bearings. A single-bar pointer indicates VOR bearings and a double-bar pointer indicates ADF bearings. Two NAV receivers supply VOR signals to the RMI for selection. A two-position selector switch (NAV 1/NAV 2) on the lower right of the RMI selects the desired VOR signal for display of bearing information.

The RMI contains a VOR test feature to verify the reliability of the VOR signal and the operational status of the RMI circuitry and mechanism that drives the VOR pointer. This test feature is a pushbutton switch (VOR SLEW) on the upper left of the RMI. (A similar ADF test feature for verifying the ADF received signal and pointer mechanism is provided on the 400 ADF receiver.)

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 – NORMAL PROCEDURES

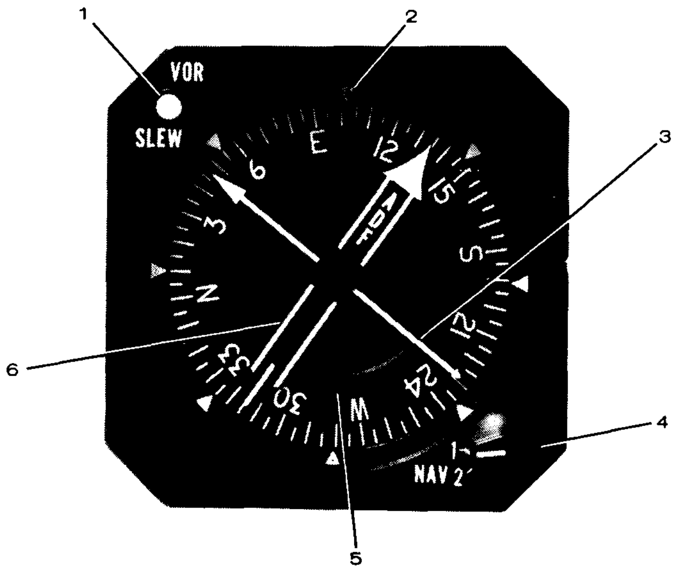
A. Normal Operation

NOTE

Operation of the RMI is dependent upon input information from the compass system (slaved directional gyro), the associated VHF navigation and ADF receivers. Refer to the appropriate supplements in this section for operation of this equipment.

1. Compass Cards
   (On RMI and Directional Gyro) - HEADING READINGS indicated on RMI and directional gyro will be the same.

400 RADIO MAGNETIC INDICATOR



1. VOR SLEW PUSHBUTTON SWITCH - Momentary switch used to verify the displayed VOR bearing. When the switch is pressed, the single bar pointer slews away from the station bearing. When the switch is released, if equipment operation and signal strength is normal, the pointer will return to the bearing.
2. HEADING INDEX - Indicates the airplane magnetic heading on the azimuth card.
3. SINGLE-BAR POINTER - Indicates the magnetic bearing of the VOR station.
4. NAV 1/NAV 2 FUNCTION SWITCH - Selects either NAV 1 or NAV 2 VOR signal for display by the single-bar pointer.
5. ROTATING AZIMUTH (COMPASS) CARD - Rotates as the airplane turns so that the airplane magnetic heading is continuously displayed at the heading index.
6. DOUBLE-BAR POINTER - Indicates the magnetic bearing of the station to which the ADF is tuned.

Figure 1

2. ADF Receiver - SELECT STATION on receiver. The double-bar pointer will indicate the bearing of the station.

NOTE

If the ADF receiver is turned to BFO, REC, or to ADF with an unusable signal being received, the double bar pointer will be in the stowed position. (Fixed at the 3 o'clock position.) If the ADF receiver is in ADF mode and then turned OFF, the double bar pointer will stow at a random position.

3. NAV 1-2 Selector Switch (On RMI) - SET to NAV 2 and select VOR station on the associated NAV receiver. The single-bar pointer will indicate the station bearing.

B. RMI Test

1. ADF TEST Pushbutton (On 400 ADF Receiver Only) - PUSH in and hold TEST button until the double-bar pointer (on RMI) slews off away from the station bearing at least 10-20 degrees.
2. ADF TEST Pushbutton (On 400 ADF Receiver Only) - RELEASE and OBSERVE that double-bar pointer (on RMI) returns to the same station bearing as in step 1 to indicate a normal operation.

NOTE

If the ADF receiver is turned to BFO, REC, or to ADF with an unusable signal being received, the double bar pointer will be in the stowed position. (Fixed at the 3 o'clock position.) If the ADF receiver is in ADF mode and then turned OFF, the double bar pointer will stow at a random position.

3. VOR SLEW Test Pushbutton (On RMI) - PUSH in and hold VOR SLEW pushbutton until the single-bar pointer slews away from the station bearing.
4. VOR SLEW Test Pushbutton (On RMI) - RELEASE and OBSERVE that single-bar pointer (on RMI) returns to the same station bearing as in step 3 to indicate a normal operation.

NOTE

When optional RNAV equipment is installed, and RNAV is selected, RMI will point to the VOR station used and not to the waypoint.

SECTION 5 — PERFORMANCE

Not Applicable.

1000 RADIO MAGNETIC INDICATOR (TYPE IN-1004A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 1000 radio magnetic indicator.

Description

The Cessna 1000 radio magnetic indicator (RMI) (Type IN-1004A) is a panel-mounted unit that includes both a radio magnetic indicator assembly and a VHF radio magnetic indicator converter circuit. The RMI is used in conjunction with other airborne navigation sets to aid the pilot in navigating and maintaining direction of the airplane. Use of the RMI eliminates the need for many of the numerical and graphical computations normally associated with air navigation.

The RMI converter circuit interprets the navigation signal from either of two VHF navigation receivers, as selected, and combines it with magnetic heading information from a stabilized heading source to provide continuous airplane-to-omnirange bearing.

The RMI display consists of a rotating azimuth card, a fixed heading index, a double-bar pointer and a single-bar pointer, see Figure 1. The azimuth card is slaved to the magnetic heading signal and rotates as the airplane turns so that the magnetic heading of the airplane is continuously displayed at the heading index. A two-position switch on the lower left corner of the RMI selects input signals from one of two ADF receivers to be applied to the double-bar pointer of the display. A three-position switch on the lower right corner selects operation of the single-bar pointer by information from either of two VHF navigation receivers or from the RNAV computer. When the switch is set to either NAV 1 or NAV 2, the navigation signals from the selected receiver are applied to the RMI converter circuits for interpretation and are then displayed by the single-bar pointer. When the switch is set to RN, signals from the RNAV computer are coupled to the single-bar pointer for display, and a green annunciator light (RN) on the RMI illuminates. If the switch is set to RN and RNAV operation has not been selected on the DME control, the lamp will flash. The two RMI pointers display the magnetic bearing to the selected ADF and VOR stations or RNAV waypoint. Either of the pointers can be temporarily displaced by external test switches to verify the displayed information.

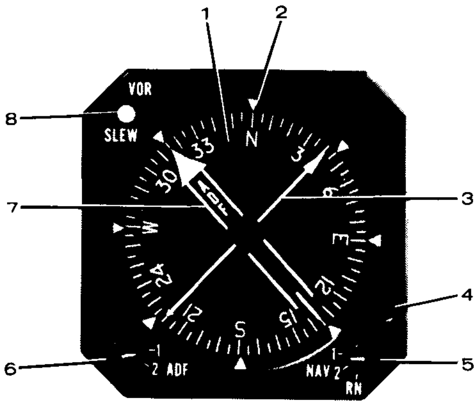
SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

1000 RADIO MAGNETIC INDICATOR



1. ROTATING AZIMUTH CARD - Slaved to remote stabilized heading source; rotates as the airplane turns so that the airplane magnetic heading is continuously displayed at the heading index.
2. HEADING INDEX - Indicates the airplane magnetic heading on the azimuth card.
3. SINGLE-BAR POINTER - Indicates the magnetic bearing to the VOR station or RNAV waypoint, as selected by the function switch.
4. RN ANNUNCIATOR - Green lamp illuminates when the function switch is set to RN to indicate that the single-bar pointer is displaying a waypoint bearing. If the function switch is set to RN but the DME switch is not set to RNAV, the lamp will flash to indicate that the displayed bearing is not reliable.
5. NAV 1/NAV 2/RN FUNCTION SWITCH - Selects signals from NAV 1 or NAV 2 VHF navigation receiver or RNAV computer for display by the single-bar pointer.
6. ADF FUNCTION SWITCH - Selects signals from ADF 1 or ADF 2 for display by the double-bar pointer.
7. DOUBLE-BAR POINTER - Indicates bearing of selected ADF station.
8. VOR SLEW SWITCH - Momentary contact switch used to verify the displayed VOR or RNAV station bearing. When the switch is pressed, the single-bar pointer slews away from the station bearing; when the switch is released, if equipment operation is normal, the pointer will return to the station bearing.

Figure 1

SECTION 4 — NORMAL PROCEDURES

NOTE

Operation of the RMI is dependent upon input information from the stabilized heading source (slaved directional gyro), the associated VHF navigation and ADF sets, and the RNAV system. Refer to the appropriate supplements for operation of this equipment.

A. Normal Operation
   1. Directional Gyro - TURN ON and allow gyro to stabilize. The azimuth card on the RMI should rotate to bring the airplane magnetic heading to the heading index. Check that the heading on the gyro and RMI agree.
   2. ADF Function Switch - SET to either ADF 1 or ADF 2 and select station on the associated ADF set. The double-bar pointer will indicate the station bearing.
   3. Function Switch - SET to NAV 1 or NAV 2 and select OMNI station on the associated VHF navigation set. The single-bar pointer will indicate the station bearing.
   4. Waypoint - SELECT on area navigation system.
   5. Function Switch - RN. RN annunciator light will illuminate and the single-bar pointer will indicate the waypoint bearing.

B. RMI Test
   1. ADF Test Switch - PRESS. Double-bar pointer will slew away from the station bearing. Release test switch and the double-bar pointer will return to the station bearing.
   2. VOR SLEW Switch - PRESS. Single-bar pointer will slew away from the station or waypoint bearing. Release test switch and the single-bar pointer will return to the station or waypoint bearing.

SECTION 5 — PERFORMANCE

Not Applicable.

RADIO MAGNETIC INDICATOR (7100 RMI)

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the 7100 Radio Magnetic Indicator.

Description

The Radio Magnetic Indicator (7100 RMI) is used in conjunction with other airborne navigation equipment to aid the pilot in navigating the airplane. The RMI eliminates the need for many of the numerical and graphical computations necessary for determining airplane position.

The RMI, see Figure 1, is a panel-mounted navigation instrument that combines the display of VOR and ADF bearing information with the airplane heading on a single instrument. The VOR and ADF bearings are displayed by individual rotating pointers against the background of a rotating azimuth card. The azimuth card is driven by the slaved magnetic compass system in the airplane and continuously indicates airplane heading.

The RMI display consists of a rotating azimuth card, a fixed heading index, a double-bar pointer and a single-bar pointer, see Figure 1. The azimuth card is slaved to the magnetic heading signal and rotates as the airplane turns so that the magnetic heading of the airplane is continuously displayed at the heading index.

Each pointer serves to indicate ADF or VOR bearings according to the position of its selector switch. The selector switches, one at each lower corner of the RMI, have ADF and VOR positions. The knobs are identified with a single or double line to relate to the single and double-bar pointers.

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 – NORMAL PROCEDURES

A. Normal Operation

NOTE

Operation of the RMI is dependent upon input information from the compass system (slaved directional gyro), the associated VHF navigation and ADF receivers. Refer to the appropriate supplements in this section for operation of this equipment.

1. Compass Cards
   (On RMI and Directional Gyro or HSI) - HEADING READINGS indicated on RMI and directional gyro or HSI will be the same.

2. ADF Receiver - SELECT STATION on receiver.
3. ADF/VOR SELECTOR SWITCH-SINGLE BAR - ADF The single bar pointer will indicate the bearing of the station.

NOTE

If a second ADF receiver is installed, repeat steps 2 and 3 using ADF 2 and the double-bar switch and pointer.

4. NAV 1 Receiver - SELECT VOR STATION on number one NAV receiver.
5. ADF/VOR SELECTOR SWITCH-SINGLE BAR - VOR The single bar pointer will indicate the bearing of the station.
6. NAV 2 Receiver - SELECT VOR STATION on number two NAV receiver.
7. ADF/VOR SELECTOR SWITCH-DOUBLE BAR - VOR The double bar pointer will indicate the bearing of the station.

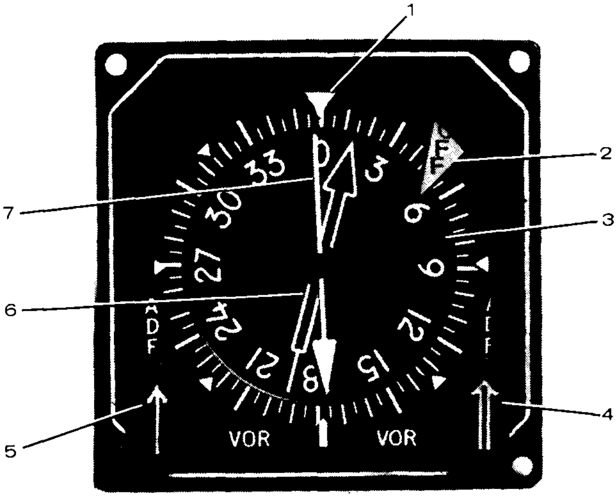
NOTE

Absence of a valid VOR signal, switching to the ILS mode or switching the ADF receiver to ANT will cause the pointers to stow in the 3 o'clock positions.

SECTION 5 — PERFORMANCE

Not Applicable.

RADIO MAGNETIC INDICATOR



1. HEADING INDEX - Indicates the airplane magnetic heading on the azimuth card.

2. OFF WARNING FLAG - Indicates loss of instrument power or servo error.

3. ROTATING AZIMUTH (COMPASS) CARD - Rotates as the airplane turns so that the airplane magnetic heading is continuously displayed at the heading index.

4. ADF/VOR SELECTOR SWITCH-DOUBLE BAR - Selects ADF or VOR operation of double-bar pointer.

5. ADF/VOR SELECTOR SWITCH-SINGLE BAR - Selects ADF or VOR operation of single-bar pointer.

6. DOUBLE-BAR POINTER - Indicates the magnetic bearing of the selected ADF 2 or VOR 2 Station.

7. SINGLE-BAR POINTER - Indicates the magnetic bearing of the selected ADF 1 or VOR 1 Station.

Figure 1

FLITEFONE III RADIO TELEPHONE

SECTION 1 – GENERAL

This supplement provides information which must be observed when operating the Flitefone III radio telephone.

Description

The Flitefone III airborne radiotelephone, see Figure 1, provides air-to-ground and ground-to-air communications. The system consists of a transmitter-receiver, an antenna and a control unit. Power for the system is provided by the airplane's 28-volt system. Channel buttons on the control unit, which light up when a call is placed or received, indicate visually which channel is in use.

FLITEFONE III RADIO TELEPHONE

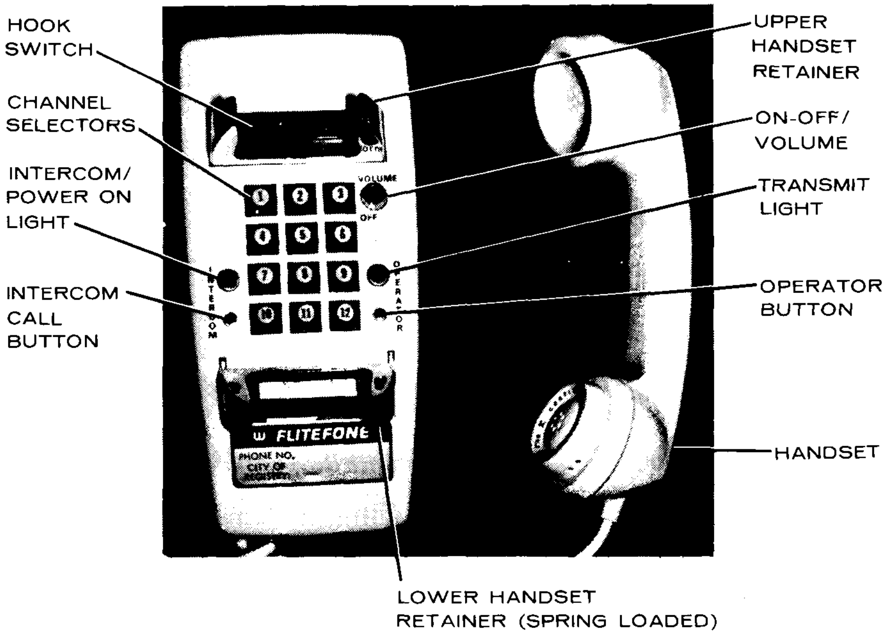


Figure 1

SECTION 2 – LIMITATIONS

Not Applicable.

SECTION 3 – EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 – NORMAL PROCEDURES

A. To Initiate A Call
   1. OFF/VOL Switch - CLOCKWISE. Intercom light should illuminate.
   2. Handset - REMOVE from cradle.
   3. Appropriate Channel Button - PRESS. Intercom light should extinguish and channel button should illuminate.
   4. After Receiving Dial Tone:
      a. Operator Button - PRESS.
      b. Green Transmit Light - Check ON.
   5. After Receiving Operator:
      a. Provide requested information to operator.
      b. Pressing the intercom button will alert other control units without interrupting telephone call in progress.
   6. After Completing Call:
      a. All Handsets - HANG UP.
      b. Check Operator Light - OFF; Intercom light - ON.

B. To Receive A Call:
   1. OFF/VOL Switch - CLOCKWISE. Intercom light should illuminate.
   2. Radio Telephone is now ready to receive calls. An incoming call is indicated by an alternating flashing of the intercom light and the calling channel light and the bell ringing.
   3. Handset - REMOVE from cradle. Answer in a normal fashion. The channel is automatically selected.
   4. After Completing Call:
      a. All Handsets - HANG UP.
      b. Check Operator Light - OFF; Intercom Light - ON.

C. To Use As An Intercom:
   1. OFF/VOL Switch - CLOCKWISE. Intercom light should illuminate.
   2. Handset - REMOVE from cradle.
   3. Intercom Button - PRESS. Pressing the intercom button causes the bell to ring in other handsets.
   4. After Completing Call:
      a. All Handsets - HANG UP.
      b. Check Operator Light - OFF; Intercom Light - ON.

SECTION 5 – PERFORMANCE

Not Applicable.

400 TRANSPONDER (TYPE 459A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 400 transponder.

Description

The Cessna 400 transponder (Type 459A) is the airborne component of an Air Traffic Control Radar Beacon System (ATCRBS). The transponder enables the ATC ground controller to "see" and identify the airplane, while in flight, at distances beyond the primary radar range.

The 400 transponder consists of a panel-mounted unit and an externally mounted antenna. The transponder receives interrogating pulse signals on 1030 MHz and transmits coded pulse-train reply signals on 1090 MHz. It is capable of replying to Mode A (airplane position identification) and Mode C (altitude information) interrogations on a selective reply basis on any of 4096 information code selections. When an optional panel-mounted EA-401A altitude encoder (not part of the 400 transponder system) is included in the avionics configuration, the transponder can provide altitude reporting in 100-foot increments between -1000 and +35,000 feet.

All 400 transponder operating controls, see Figure 1, are located on the front panel of the unit. The optional altitude encoder's barometric pressure set knob is located on the face of the encoding altimeter.

SECTION 2 — LIMITATIONS

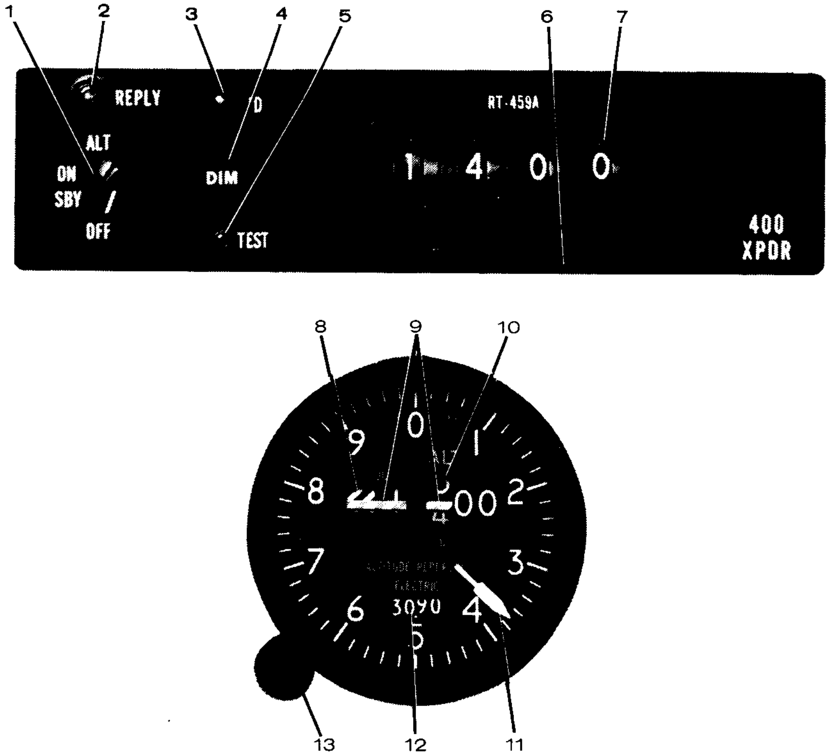
Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

A. To Transmit An Emergency Signal
1. Function Switch - ON.
2. Reply-Code Selector Switches - SELECT 7700 operating code.
3. ID Switch - PRESS to effect immediate identification of airplane on ground controller's displays.
4. DIM Control - ADJUST light brilliance of reply lamp.

B. To Transmit A Signal Representing Loss Of All Communications
1. Function Switch - ON.
2. Reply-Code Selector Switches - SELECT 7700 operating code for 1 minute, then select 7600 operating code for 15 minutes and then repeat this procedure for the remainder of the flight.
3. ID Switch - PRESS to effect immediate identification of airplane on the ground controller's display.
4. DIM Control - ADJUST light brilliance of reply lamp.

400 TRANSPONDER CONTROL PANEL AND ALTIMETER INDICATOR



1. FUNCTION SWITCH - Controls application of power and selects transponder operating mode, as follows:
   OFF - Removes power from transponder (turns set off).
   SBY - Applies power for equipment warm-up.
   ON - Applies operating power and enables transponder to transmit Mode A reply pulses.
   ALT - Applies operating power and enables transponder to transmit either Mode A reply pulses or Mode C altitude information pulses selected automatically by the interrogating signal.
2. REPLY LAMP - Provides visual indication of transponder replies. During normal operation, lamp flashes when reply pulses are transmitted; when special pulse identifier is selected, lamp glows steadily for duration of IDENT pulse transmission. (Reply lamp will also glow steadily during initial warm-up period.)

Figure 1 (Sheet 1 of 2)

400 TRANSPONDER CONTROL PANEL AND ALTIMETER INDICATOR

3. IDENT SWITCH - When pressed, selects special pulse identifier to be transmitted with transponder reply to effect immediate identification of airplane on ground controller's display. (Reply lamp will glow steadily during duration of IDENT pulse transmission.)
4. DIMMER CONTROL - Allows pilot to control brilliance of reply lamp.
5. SELF-TEST SWITCH - When depressed, causes transponder to generate a self-interrogating signal to provide a check of transponder operation. (Reply lamp will illuminate to verify self-test operation.)
6. REPLY-CODE SELECTOR SWITCHES (4) - Select assigned Mode A (or Mode C) reply code.
7. REPLY-CODE INDICATORS (4) - Display selected Mode A (or Mode C) reply code.
8. 1000-FOOT DRUM-TYPE INDICATOR - Provides digital altitude readout in 1000-foot increments between -1000 feet and +35,000 feet.
9. OFF INDICATOR WARNING FLAG - Flag appears when power is removed from the system.
10. 100-FOOT DRUM-TYPE INDICATOR - Provides digital altitude readout in 100-foot increments between 0 feet and 1000 feet.
11. 20-FOOT INDICATOR NEEDLE - Indicates altitude in 20-foot increments between 0 feet and 1000 feet.
12. BAROMETRIC PRESSURE SET INDICATOR - DRUM-TYPE - Indicates selected barometric pressure in the range of 27.9 to 31.0 inches of mercury.
13. BAROMETRIC PRESSURE SET KNOB - Dials in desired barometric pressure setting in the range of 27.9 to 31.0 inches of mercury.

Figure 1 (Sheet 2 of 2)

SECTION 4 — NORMAL PROCEDURES

A. Before Takeoff
   1. Function Switch - SBY. Allow 30 Seconds Warmup.

B. To Transmit Mode A (Airplane Position Identification) Codes In Flight
   1. Reply-Code Selector Switches - SELECT assigned code.
   2. Function Switch - ON.
   3. DIM Control - ADJUST light brilliance of reply lamp.

> NOTE
>
> During normal operation, with the function switch in the ON position, the REPLY lamp will flash which indicates transponder is replying to interrogations.

   4. ID Button - PRESS momentarily when instructed by ground controller to "squawk IDENT." REPLY lamp will glow steadily, indicating IDENT operation.

C. To Transmit Mode C (Altitude Information) Codes In Flight

1. Barometric Pressure Set Knob - DIAL assigned barometric pressure.
2. Reply-Code Selector Switches - SELECT assigned code.
3. Function Switch - ALT.

NOTE

- When directed by ground controller to "stop altitude squawk," turn function switch to ON for Mode A operation only.
- Pressure altitude is transmitted, and conversion to indicated altitude is done in ATC computers. Altitude squawk will agree with indicated altitude when altimeter setting in use by the ground controller is set in the altitude encoder.

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

D. Self-Test

1. Function Switch - SBY and wait 30 seconds for equipment to warm up.
2. Function Switch - ON.
3. TST Button - PRESS. Reply lamp should light brightly regardless of DIM control setting.

SECTION 5 — PERFORMANCE

Not Applicable.

800 TRANSPONDER (TYPE 859A)

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the 800 ATC Transponder.

Description

The Cessna 800 ATC Transponder (Type 859A) is the airborne component of an Air Traffic Control Radar Beacon System (ATCRBS). The transponder enables the ATC ground controller to "see" and identify the airplane, while in flight, on the control center radar scope.

The 800 Transponder consists of a panel-mounted receiver-transmitter and an externally mounted antenna. The transponder receives interrogating pulse signals on 1030 MHz and transmits coded reply signals on 1090 MHz. It is capable of replying to Mode A (airplane identification) and Mode C (altitude reporting) interrogations on a selective reply basis on any of 4096 information code selections. When an optional EA-401A or EA-801A Encoding Altimeter (refer to appropriate supplement) is included in the avionics configuration, the transponder can provide altitude reporting in 100-foot increments between -1000 feet and +35,000 feet.

All 800 Transponder operating controls, see Figure 1, are located on the front panel of the receiver-transmitter. Except for the selection of the Mode A reply code and the IDENT pulse on command, operation of the transponder is automatic as soon as the equipment is turned on.

SECTION 2 — LIMITATIONS

Not Applicable.

SECTION 3 — EMERGENCY PROCEDURES

EMERGENCY SIGNAL TRANSMISSION

1. ON Pushbutton Switch - PUSH IN.
2. Reply-Code Selector Switches - SELECT Code 7700.

LOSS-OF-COMMUNICATIONS SIGNAL TRANSMISSION

1. ON Pushbutton Switch - PUSH IN.
2. Reply-Code Selector Switches - SELECT Code 7700; WAIT 1 minute, THEN SELECT Code 7600; WAIT 15 minutes. REPEAT procedures at same intervals for remainder of flight.

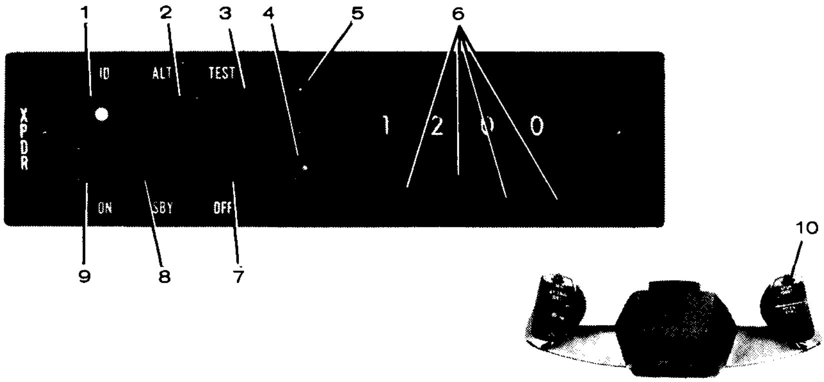
SECTION 4 — NORMAL PROCEDURES

A. Before Takeoff and After Landing - SBY Pushbutton Switch - PUSH IN.

NOTE

OFF, SBY and ON Pushbutton Switches are interlocked. Button must be fully depressed to activate desired function; partial depression will release all buttons and automatically place the transponder in standby.

800 TRANSPONDER CONTROL PANEL



1. ID (IDENT) PUSHBUTTON SWITCH - (Momentary) When pressed, selects transmission of special identifier pulse with regular reply pulses to effect immediate airplane identification on controller's display.
2. ALT PUSHBUTTON SWITCH - Enables Mode C operation.
3. TEST PUSHBUTTON SWITCH - (Momentary) When pressed, selects internally generated interrogation signal to self-test equipment. Steady glow of reply lamp indicates satisfactory operation.
4. LIGHT SENSOR - Senses ambient cockpit light to control intensity of reply lamp brilliance.
5. REPLY LAMP - Flashes to indicate transmission of reply pulses; glows steadily to indicate transmission of ident pulse; glows steadily with maximum brilliance during satisfactory self-test operation. (Also glows steadily during initial warmup.)
6. MODE A REPLY-CODE SELECTOR SWITCHES AND INDICATORS (4) - Select and display airplane identification code.
7. OFF PUSHBUTTON SWITCH - Turns set off.
8. SBY PUSHBUTTON SWITCH - Applies warmup or standby power.
9. ON PUSHBUTTON SWITCH - Turns set on; enables Mode A operation.
10. REMOTE ID SWITCH - Same as panel-mounted ID pushbutton switch.

Figure 1

B. At Takeoff - ON Pushbutton Switch - PUSH IN.

C. Airplane Identification (Mode A) Operation
   1. Reply-Code Selector Switches - SELECT assigned code.
   2. ON Pushbutton Switch - PUSH IN.
   3. ID Pushbutton Switch - PRESS THEN RELEASE when instructed by ground controller to "Squawk IDENT."
   4. REPLY Lamp - Lamp flashes when transponder is replying to interrogation; glows steadily for duration of IDENT transmission.

D. Airplane Identification (Mode A)/Altitude Reporting (Mode C) Operation
   1. Reply-Code Selector Switches - SELECT assigned Mode A code.
   2. Encoding Altimeter:
      a. Power Warning Flag - VERIFY that flag is out of view.
      b. Baroset Knob - SET IN local altimeter setting.
   3. ON Pushbutton Switch - PUSH IN.

NOTE

Altitude information transmitted by transponder for altitude squawk is pressure altitude; compensation for local altimeter setting is made by ground computer before display on radar scope. For agreement between cockpit altimeter readout and ground display, local altimeter setting must be introduced into the encoding altimeter with the Baroset Knob.

   4. ALT Pushbutton Switch - PUSH IN.
   5. ID Pushbutton Switch - PRESS THEN RELEASE when instructed by controller to "Squawk IDENT."
   6. REPLY Lamp - Lamp flashes when transponder is replying to interrogation; glows steadily for duration of IDENT transmission.
   7. ALT/ON Switches - When instructed by controller to "Stop altitude squawk," push in ON pushbutton switch to turn off Mode C operation.

E. Self-Test Operation
   1. ON or ALT pushbutton Switch - PUSH IN.
   2. TEST Pushbutton Switch - Push in and hold; REPLY lamp lights with full brilliance.
   3. TEST Pushbutton Switch - Release for normal operation.

SECTION 5 — PERFORMANCE

Not Applicable.

RDR-150 AND RDR-160 WEATHER RADAR

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the RDR-150 and RDR-160 weather radar.

Description

The RDR-150 and RDR-160 weather radar are used to detect significant enroute weather formations within a range of 160 nautical miles to preclude undesirable penetration of heavy weather and its usually associated turbulence. The RDR-150 system consists of an indicator mounted in the center of the instrument panel, a transceiver located in the nose section and a flat-plate antenna inside the nose radome. The RDR-160 system consists of an indicator and a combination transceiver/parabolic-dish antenna located in the nose radome. Power for the system is provided by the airplane's 28-volt system. All controls for the system, see Figure 1, are located on the lower section of the front panel. Internally generated range marks appear as evenly spaced concentric circles on the display to assist in determining range to the weather target. Reference marks on each side of the zero heading assist in determining weather azimuth bearing targets. A secondary objective of the weather radar system is gathering and presentation of terrain data.

SECTION 2 — LIMITATIONS

A. Do not operate radar within 15 feet of ground personnel or containers holding flammable or explosive material.
B. Do not operate radar during fueling operations.

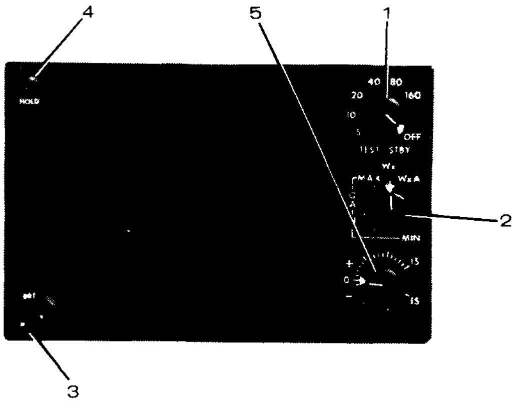
SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. Preflight Test
   1. Function Switch - TEST. Allow 2 minutes warmup.
   2. Wx Gain Switch - Wx.
   3. Hold/Scan Switch - SCAN.
   4. Tilt Switch - +4°.
   5. Brt Switch - AS REQUIRED.
   6. Self-Test - CHECK. Four equally spaced range marks should appear, no displayed "noise" and two distinct brightness levels should appear. Strobe line should smoothly sweep full 90°.
      a. Hold/Scan Switch - HOLD. Strobe line should disappear and test pattern should "freeze" on indicator.
      b. Wx Gain Switch - Wx A. Test pattern should pulse on indicator.
      c. Hold/Scan Switch - SCAN.
      d. Function Switch - 10 or 20. Transmitter on.
      e. Tilt Switch - VARY between 0° and 15°. Close in ground clutter appears at lower tilt settings and any local moisture laden weather appears at higher tilt settings.

WEATHER RADAR CONTROLS



1. FUNCTION SWITCH - Controls application of power and selects weather radar operating ranges as follows:
   - OFF - Removes power from the weather radar (turns equipment off).
   - STBY - Applies power to system for warmup (warmup time is approximately 2 minutes) and when system is not in use.
   - TEST - Applies drive to antenna and activates test circuit and indicator display to determine operability of system.
   - 5, 10, 20, 40, 80, 160 - Energizes system and selects respective nautical mile maximum range.

> **NOTE**
>
> Each time the function switch position is changed, the indicator presentation is automatically erased so that information on the newly selected function may be presented without confusion.

2. Wx-GAIN/Wx-A SWITCH - Selects weather radar mode of operation.
   - Wx - Places indicator in automatic contour mode. Contoured storm cells will be outlined by lighter shades automatically.
   - GAIN - Places indicator in MAP mode (disables contour feature) and activates manual gain control. All targets will be presented on the indicator in up to 3 different shades, dependent on the radar echo strength and the particular click-gain setting used.

Figure 1 (Sheet 1 of 2)

WEATHER RADAR CONTROLS

Wx-A - When the mode selector is in the Wx A position, the display on the indicator will cycle to verify if a dark hole is a contour or a storm cell. Its presentation will alternate from darkest shade to brightest shade approximately 4 times per scan. If a dark hole remains the same intensity while in the Wx A mode, then this area of the display does not represent a contour or storm cell.

3. BRT CONTROL - Controls the brightness of the indicator display.
4. HOLD/SCAN SELECTOR - Provides antenna hold/scan selection. The selector is a push-push button. Pushing the button in puts the image in the hold mode; pushing the button in again puts the image in the scan mode.

HOLD - Weather or ground mapping image last presented is retained (frozen) on the indicator display in order to evaluate the significance of storm cell movement. Switching back to scan from hold mode reveals direction and distance of target movement during hold period. During HOLD mode, the antenna continues to scan and the display will continue to be presented as long as power is supplied to the system and the range is not changed.

SCAN - The SCAN position places the antenna in a 90° scan mode ±45° to each side of the airplane's longitudinal axis.

5. TILT CONTROL - Electrically adjusts the antenna parabola to move the radar beam to 15° up or down from horizontal ("0" position).

Figure 2 (Sheet 2 of 2)

B. Normal Operation
1. Function Switch - STBY. Allow 2 minutes warmup.
2. Wx Gain Switch - GAIN. Adjust manual gain as required.
   - Wx. For contour mode of operation.
3. Function Switch - AS REQUIRED.
4. Brt Switch - AS REQUIRED.
5. Wx A Switch - AS REQUIRED.
6. Hold/Scan Switch - AS REQUIRED.
7. Tilt Control - AS REQUIRED.

SECTION 5 — PERFORMANCE

Not Applicable.

RDR-150 WEATHER RADAR - COLOR DISPLAY

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the RDR-150 color display radar.

Description

The Bendix RDR-150 color display radar, which is mounted in the center of the instrument panel, is used to detect significant enroute weather formations within a range of 160 nautical miles to preclude undesirable penetration of heavy weather and its usually associated turbulence. The radar system consists of a receiver-transmitter, an indicator and an antenna. Power is provided by the airplane's 28-volt system. All controls for the system are located on the front panel of the indicator, see Figure 1. The weather radar portion of the display consists of light, medium and heavy rainfall areas shown in green, yellow and red respectively. Internally generated range marks appear as evenly spaced concentric arcs on the display to assist in determining range to the weather target or terrain feature under observation. Azimuth reference marks are also provided as an aid in determining the relative bearing to the target. System function in use as well as the range and range marks in use are digitally displayed on the screen in the upper corners. The radar's hold mode permits the display to be frozen on the screen for extended periods in order to evaluate the significance of storm movement. Switching back to scan instantly reveals the direction and distance the target has moved during the hold period. In the weather alert mode, the display flashes a warning to the pilot of any heavy rainfall areas exceeding .47 inch (12 millimeters) per hour within the display range by alternately switching the contour/normal display modes approximately 4 times per antenna scan. The pilot then sees the red portion of any storm cell as a flashing on/off display. Each time the operational mode of the system is changed, a momentary digital display is presented on the indicator which shows available and active mode data such as range/range marks and rainfall intensity color key.

In addition to its primary function of weather detection, the radar also enables mapping of prominent terrain features such as lakes, bays, rivers, inlets, shorelines, channel markers and offshore oil rigs.

SECTION 2 — LIMITATIONS

A. Do not operate the radar system within 15 feet of ground personnel or containers holding flammable or explosive material.
B. Do not operate the radar system during fueling operations.
C. When preflighting the radar system, insure that the airplane is facing away from buildings or large metal structures that are likely to reflect significant amounts of radar energy back into the system.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

SECTION 4 — NORMAL PROCEDURES

A. Preflight Test
  1. Function Switch - TEST. Allow 2-minute warmup.
  2. TILT Control - 0°.
  3. BRT Control - Mid-range position.
  4. Self-Test - CHECK:
     a. Test pattern should display five colored bands; starting with the closest band at the bottom of the screen, the bands will be green, yellow, red, yellow and green. The red band represents the most intense level. All range marks will be visible and displayed in blue letters.

> NOTE
>
> Width of test pattern bands and position of bands relative to the range marks is not critical.

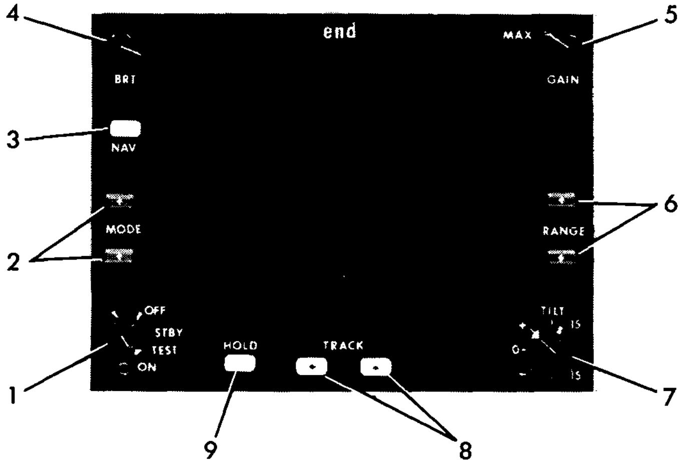
     b. MODE Buttons - Sequence to WxA mode. The red test band should alternate from red to black approximately once per second. Return the mode to Wx.
     c. HOLD Button - PRESS. The word HOLD should flash in the upper LH corner.
  5. Function Switch - STBY. Insure area ahead of airplane is clear as stated in Section 2 - Limitations of this supplement.
  6. Function Switch - ON. The indicator will automatically switch to the Wx mode.
  7. HOLD Button - Check OFF.
  8. RANGE Buttons - 40-mile range.
  9. TILT Control - Move UP in small increments until a clear picture of any local weather appears. Close-in ground targets may also appear in the display.
  10. RANGE Buttons - Select remaining ranges and repeat TILT control check.
  11. FUNCTION Switch - STBY prior to taxi.
  12. Checklist Display - If optional checklist display system is installed, refer to Checklist Supplement 38B for preflight test procedures.

B. Normal Operations
  1. Function Switch - STBY. Allow 2 minutes warmup.
  2. MODE Buttons - AS REQUIRED.
     a. Wx - For normal weather display.
     b. WxA - For weather alert (flashing red area).
     c. MAP - For terrain mapping.
  3. Function Switch - AS REQUIRED.
  4. BRT Control - AS REQUIRED.
  5. GAIN Control - AS REQUIRED (For Terrain Mapping Only).
  6. RANGE Buttons - AS REQUIRED.
  7. TRACK Button - AS REQUIRED.
  8. TILT Control - AS REQUIRED.

SECTION 5 — PERFORMANCE

Not Applicable.

RDR-150 WEATHER RADAR CONTROLS



1. FUNCTION SWITCH - Turns unit on and off and selects the following functions:
   - OFF - Removes power from the weather radar (turns equipment off).
   - STBY - (Standby) Applies power to system for warm up (warm-up time approximately 2 minutes) and maintains unit in a ready status to allow immediate use when desired.
   - TEST - Applies drive to antenna, activates test circuitry and provides a display test pattern for checking proper operation of the system. No radar energy is transmitted in the test mode. Checklist function remains operable when unit is in the test mode.
   - ON - Normal operating position. Radar energy is transmitted and display picture is received.
2. MODE BUTTONS - Select weather, weather alert or terrain mapping modes. The symbol for the mode selected appears in the lower LH corner of the display screen.
   - Wx - (Weather) Displays normal weather picture in three colors of weather intensity (green-light, yellow-medium, red-heavy).
   - WxA - (Weather Alert) Displays the same picture as Wx mode except the high intensity red area flashes on and off as a warning to the pilot.
   - MAP - (Terrain Mapping) Places system in terrain mapping mode. In this mode, prominent ground features are presented in three colors of intensity, depending on the strength of target return (green-light return, yellow-medium return, red-heavy return).

Pressing either mode button momentarily displays an "information list" of pertinent operational data including available modes range/range marks and applicable color/signal level reference. Pressing either button again advances the display to the next adjacent mode on the information list, above or below the displayed mode, depending upon the button depressed.

Figure 1 (Sheet 1 of 2)

RDR-150 WEATHER RADAR CONTROLS

When either the top or bottom mode is reached, the opposite button must be depressed in order to further change the operational mode. The active mode is displayed in blue while the remaining modes are yellow.

3. NAV BUTTON - Non-functional. Pressing the NAV button displays the words NO NAV in the lower left corner of the screen below the active mode.
4. BRT CONTROL - Adjusts brightness of the display to accommodate variation in cockpit lighting.
5. GAIN CONTROL - Permits adjusting the radar receiver gain in the terrain MPA mode only.

> NOTE
>
> In the TEST function as well as in all weather modes, the receiver gain is preset; thus, no adjustment is required.

6. RANGE BUTTONS - Clears the screen and advances the display to the next higher range, each time the button is depressed, until the maximum range is reached. Subsequently, the RANGE button with the downward-pointing arrow must be depressed in order to select a lower range.

A selected range or 20, 40, 80 or 160 nautical miles is displayed in blue in the upper right corner of the screen adjacent to the top range mark. The distance from the apex of the display to each of the other range marks is also annunciated at the right end of each mark.

7. TILT CONTROL - Permits positioning the antenna beam up or down within the maximum limits of +15° to -15° from the horizontal of 0°.
8. TRACK BUTTONS - When pressed, a yellow track line extending from the apex of the display through the top range mark appears and moves either right or left to a maximum of 30° from center, depending upon the button depressed. The differential bearing is indicated in yellow numerals in the upper left corner of the screen. The track line and relative bearing display disappears approximately 15 seconds after the TRACK button is released.
9. HOLD BUTTON - Inhibits normal display update of weather, terrain or mapping data. The last image presented before pressing the HOLD button is retained until the button is pressed again. In this mode, the word HOLD flashes on and off in the upper left corner of the screen as a reminder that no new data is being presented. However, the antenna continues to scan in order that an accurate and instant update can occur the moment HOLD is deactivated. The static display during HOLD will continue until the HOLD button is pressed a second time or until power is removed from the system. A change in range selection during HOLD results in a blank screen.

Figure 1 (Sheet 2 of 2)

WEATHER RADAR-COLOR DISPLAY PRIMUS-200

SECTION 1 — GENERAL

This supplement provides information which must be observed when operating the Primus - 200 Weather Radar Color Display.

Description

The Primus - 200 Color Radar, which is mounted in the center of the instrument panel, is used to detect significant enroute weather formations within a range of 200 nautical miles to preclude undersirable penetration of heavy weather and its usually associated turbulence. The radar system consists of a receiver-transmitter, an indicator and an antenna. Power is provided by the airplane's 28-volt system. All controls for the system are located on the front panel of the indicator, see Figure 1. The weather radar portion of the display consists of light, medium and heavy rainfall areas shown in green, yellow and red respectively. Internally generated range marks appear as evenly spaced concentric arcs on the display to assist in determining range to the weather target or terrain feature under observation. Azimuth reference marks are also available as an aid in determining the relative bearing to the target. System function selected as well as range and azimuth marks and range values are displayed on the screen in blue. The radar's freeze mode permits the display to be frozen on the screen for extended periods in order to evaluate the significance of storm movement. Releasing freeze mode switches radar back to scan and instantly reveals the direction and distance the target has moved during the freeze period. In the WX/C mode, the display flashes a warning to the pilot of any heavy rainfall areas within the display range. This is accomplished by alternately switching the contour/normal display modes at approximately two cycles per second. The pilot then sees the red portion of any storm cell as a flashing on/off display. Each time the operational mode of the system is changed, a digital display is presented on the indicator which annunciates the active mode.

In addition to its primary function of weather detection, the radar also enables mapping of prominent terrain features such as lakes, bays, rivers, inlets, shorelines, channel markers and offshore oil rigs. When in mapping mode the color display is presented as blue, yellow and magenta (purple) for weak, medium and strong returns respectively. Range and azimuth marks, as well as annunciated words are displayed in green when in mapping mode.

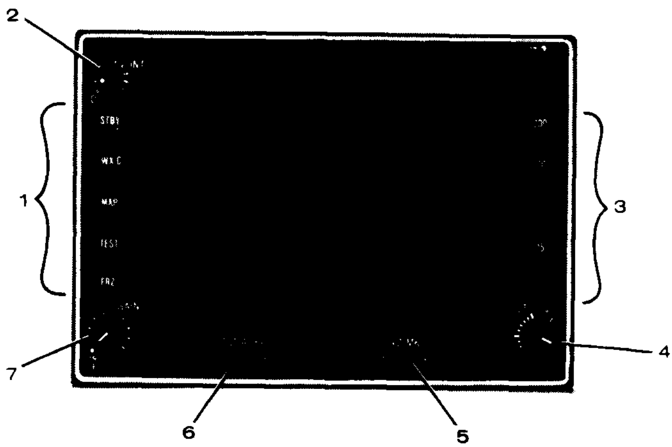
SECTION 2 — LIMITATIONS

A. Do not operate the radar system within 15 feet of ground personnel or containers holding flammable or explosive material.
B. Do not operate the radar system during fueling operations.
C. When preflighting the radar system, ensure that the airplane is facing away from buildings or large metal structures that are likely to reflect significant amounts of radar energy back into the system.

SECTION 3 — EMERGENCY PROCEDURES

Not Applicable.

WEATHER RADAR CONTROLS



1. MODE SELECTION PUSHBUTTONS - Turn unit on and off and select the following functions.

STBY - Places the system in standby condition for warmup (warmup time approximately 30-seconds) and maintains unit in a ready status to allow immediate use when desired. In standby the antenna does not scan and no signal is being transmitted. STBY will be annunciated and range marks will be displayed. Azimuth marks will also be present if AZ switch is on.

WX/C - Alternate-action pushbutton switch used to select weather mode or cyclic contour mode.
If selected at turn-on, system will come up in weather mode; second depression of switch will select contour mode. If selected when system is already operating in another mode, system will come on in weather mode; second switch depression will select contour mode.
In cyclic contour mode, 3-level (red) display will flash on and off at 1/2-second intervals; gain is automatically set to preset level.

MAP - Ground mapping mode displays prominent topographical features with the strongest targets in magenta (purple), the next level in yellow and the weakest targets in blue. Azimuth lines, range marks and annunciated MAP appear in green.

Figure 1 (Sheet 1 of 2)

WEATHER RADAR CONTROLS

TEST - Adds test pattern to display and annunciates TEST. Antenna is allowed to scan but no signal is being transmitted. Manual antenna tilt control can be checked while in test mode. Range is automatically 100MM and gain is set at a preset level.

FRZ - Freezes the last display as a warning to the pilot that display is not being updated, FRZ annunciation will flash at 1/2 second intervals.

2. INT/OFF - Rotary knob used regulate brightness (intensity) of display. On/Off function: Full CCW rotation of intensity control places system in OFF condition. CW rotation from OFF setting turns system on. STBY is displayed until WX/C, MAP, or TEST is selected.
   If WX/C or MAP is selected immediately, WAIT will be displayed until RT warms up (approximately 30 seconds).
   If TEST is selected immediately, WAIT will be dsiplayed until Antenna is synchronized (less than 4 seconds) and then test pattern will appear.
   WAIT will also be displayed if WX/C or MAP is selected prior to end of warm-up period.
3. RANGE SELECTION PUSHBUTTONS
   200, 100, 50, 25, 10 — When a range button is pushed, the maximum range in nautical miles, as indicated on the button, will annunciate at the top arc and the lower arcs will show 20% shorter increments, e.g. 100, 80, 60, 40, 20.
4. TILT - Rotary knob that enables pilot to select angles of antenna beam tilt with relation to airframe. Rotating control CW tilts beam upward; CCW rotation tilts beam downward.
5. AZ MK - Slide switch used to display azimuth markers at 30-degree intervals.
6. TGT ALERT - Target alert ON-OFF switch. ON causes TGT annunciation to flash whenever a strong (red level) signal is detected within 60 to 160 nautical miles and ±7.5 degrees of dead ahead, regardless of range selected. When no such signal is detected, the annunciation will be a steady T. Target alert is disabled by switching to MAP mode or switching gain control out of PRESET position.
7. GAIN/PRESET - Rotary knob with one fixed-gain detented position, PRESET. Used to adjust sensitivity of receiver, primarily to resolve nearby stong target signals, usually while ground-mapping. Full CCW rotation sets gain at preset level. When control is not in detented preset position, VAR is displayed.

Figure 1 (Sheet 2 of 2)

SECTION 4 — NORMAL PROCEDURES

A. Preflight Test
   1. Mode Selections - TEST
   2. TILT Control - +10 (degrees)
   3. AZ MK Switch - ON. Range and azimuth marks will appear and TEST will be annunciated. Range values of 20, 40, 60, 80 and 100 (nautical miles) will be displayed at range marks.

In approximately 30 seconds a test pattern is added to the presentation and should display five distinct color bands (excluding the range marks). Starting with the closest band at the bottom of the screen, the first band is green, the second band is yellow, the third is the cyclic contour band and cycles from red to black, the fourth band is yellow and the fifth band is green.

4. AZ MK Switch - OFF.
5. STBY Button - PRESS.
6. TGT ALERT Switch - ON.
7. TEST Button - PRESS. Verify that a T is displayed until the sweep enters the dead ahead area and then TGT is displayed.
8. WX/C Button - PRESS.
9. GAIN/PRESET Knob - ROTATE out of PRESET detent. Verify that 1 2 3 display is replaced by VAR display.
10. FRZ Button - PRESS. VAR is replaced by flashing FRZ display.
11. FRZ Button - PRESS. VAR display reappears.
12. WX/C Button - PRESS. CYC is displayed.
13. MAP Button - PRESS. MAP is displayed and range marks color changes to green.
14. GAIN/PRESET Knob - ROTATE to PRESET. VAR display is replaced by 1 2 3.
15. WX/C Button - PRESS.
16. Range Selection Button - PRESS each in turn and varify that numerics change appropriately.

B. Normal Operations
1. INT/OFF Knob - MID RANGE.
2. WX/C Button - PRESS after warmup period.
3. INT/OFF Knob - ROTATE to desired brightness.
4. Range Selection - AS REQUIRED.
5. TILT Control - AS REQUIRED.
6. AZ MK Switch - AS REQUIRED.
7. TGT ALERT Switch - AS REQUIRED.
8. GAIN/PRESET Control - AS REQUIRED.

SECTION 5 — PERFORMANCE

Not Applicable.

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ALPHABETICAL INDEX

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Cessna
A Textron Company

Pilot Safety and Warning Supplements

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

Member of GAMA

D5139-13

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Reissue - 1 June 1998

CONTENTS

SUPPLEMENT

INTRODUCTION

FLIGHT CONSIDERATIONS

SYSTEM OPERATIONAL CONSIDERATIONS

MAINTENANCE CONSIDERATIONS

INTRODUCTION

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

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

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

WARNING

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

- **PILOT PHYSICAL CONDITION AND PROFICIENCY**
- **AIRPLANE AIRWORTHINESS**
- **AIRPLANE EQUIPMENT APPROPRIATE FOR THE FLIGHT**
- **AIRPLANE LOADING AND WEIGHT AND BALANCE**
- **ROUTE OF THE FLIGHT**
- **WEATHER DURING THE FLIGHT**
- **FUEL QUANTITY REQUIRED FOR THE FLIGHT, INCLUDING ADEQUATE RESERVES**
- **AIR TRAFFIC CONTROL AND ENROUTE NAVIGATION FACILITIES**
- **FACILITIES AT AIRPORTS OF INTENDED USE**

(Continued Next Page)

WARNING (Continued)

- **ADEQUACY OF AIRPORT (RUNWAY LENGTH, SLOPE, CONDITION, ETC.)**
- **LOCAL NOTICES, AND PUBLISHED NOTAMS**

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

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

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

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

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

Airplanes require maintenance on a regular basis. As a result, it is essential that the airplane be regularly inspected and repaired when parts are worn or damaged in order to maintain flight safety. Information for the proper maintenance of the airplane is found in the airplane Service/Maintenance Manual, Illustrated Parts Catalog, and in company-issued Service Information

Letters or Service Bulletins, etc. Pilots should assure themselves that all recommendations for product changes or modifications called for by Service Bulletins, etc., are accomplished and that the airplane receives repetitive and required inspections.

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

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

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

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

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

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

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

PHYSIOLOGICAL

FATIGUE

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

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

STRESS

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

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

EMOTION

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

ILLNESS

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

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

MEDICATION

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

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

ALCOHOL

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

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

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

DRINKING THE RIGHT FLUIDS

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

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

Beginning a flight in a rested, healthy condition is of prime importance. Proper water balance through frequent fluid intake relieves the adverse effects produced by insensible water loss in an atmosphere of lowered humidity. Typical dehydration conditions are: dryness of the tissues and resulting irritation of the eyes, nose, and throat as well as other conditions previously mentioned plus the associated fatigue relating to the state of acidosis (reduced alkalinity of the blood and the body tissues). A person reporting for a flight in a dehydrated state will more readily notice these symptoms until fluids are adequately replaced.

Consumption of coffee, tea, cola, and cocoa should be minimized since these drinks contain caffeine. In addition, tea contains a related drug, theophylline, while cocoa (and chocolate) contain theobromine, of the same drug group. These drugs, besides having a diuretic effect, have a marked stimulating effect and can cause an increase in pulse rate, elevation of blood pressure, stimulation of digestive fluid formation, and irritability of the gastrointestinal tract.

HYPOXIA

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

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

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

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

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

NOTE

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

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

SMOKING

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

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

WARNING

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

HYPERVENTILATION

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

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

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

EAR BLOCK

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

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

SINUS BLOCK

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

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

VISION IN FLIGHT

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

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

SCUBA DIVING

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

AEROBATIC FLIGHT

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

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

CHECKLISTS

CONSISTENT USE

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

NOTE

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

CONTRIBUTIONS TO SAFETY

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

CHECKLIST ARRANGEMENT (ORGANIZATION OF ITEMS)

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

EMERGENCY CHECKLISTS

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

AIRPLANE LOADING

AIRPLANE CENTER-OF-GRAVITY RANGE

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

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

LOCATING THE LOAD

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

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

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

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

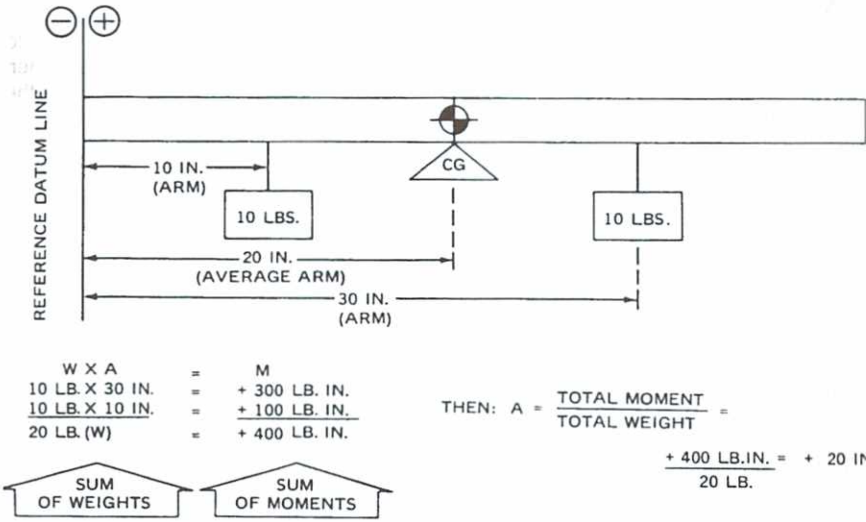
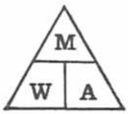


Figure 1. Computing the Center-of-Gravity

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



$$\text{weight} \times \text{arm} = \text{moment}$$
$$\text{moment} \div \text{weight} = \text{arm}$$
$$\text{moment} \div \text{arm} = \text{weight}$$

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

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

LOAD SECURITY

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

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

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

EFFECTS OF LOADING ON THE FLIGHT

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

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

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

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

LOAD AND LATERAL TRIM

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

WEIGHT AND BALANCE TERMINOLOGY

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

Arm	The horizontal distance from the reference datum to the center-of-gravity (C.G.) of an item.
Basic Empty Weight	The standard empty weight plus the weight of installed optional equipment.

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

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

SINGLE ENGINE FLIGHT INFORMATION (MULTI-ENGINE AIRPLANES)

INTRODUCTION

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

SINGLE ENGINE TAKEOFF AND CLIMB

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

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

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

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

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

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

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

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

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

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

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

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

SINGLE ENGINE CRUISE

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

SINGLE ENGINE APPROACH AND LANDING OR GO-AROUND

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

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

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

PILOT PROFICIENCY

AIRSPEED CONTROL

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

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

TRAFFIC PATTERN MANEUVERS

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

USE OF LIGHTS

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

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

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

PARTIAL PANEL FLYING

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

If a second vacuum system is not installed and a complete vacuum system failure occurs during flight, the vacuum-driven directional indicator and attitude indicator will be disabled, and the pilot will have to rely on the turn coordinator or the turn and bank indicator if he or she flies into instrument meteorological conditions. If an autopilot is installed, it too will be affected, and should not be used. The following instructions assume that only the electrically-powered turn coordinator is operative, and that the pilot is not completely proficient in instrument flying.

EXECUTING A 180° TURN IN CLOUDS

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

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

EMERGENCY DESCENT THROUGH CLOUDS

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

1. Extend the landing gear (if applicable).

2. Reduce power to set up a 500 to 800 ft/min rate of descent.
3. Adjust mixture(s) as required for smooth engine operation.
4. Adjust elevator or stabilizer, rudder and aileron trim controls for a stabilized descent.
5. Keep hands off the control wheel. Monitor turn and bank or turn coordinator and make corrections by rudder alone.
6. Check trend of compass card movement and make cautious corrections with rudder inputs to stop turn.
7. Upon breaking out of the clouds, resume normal cruising flight.

RECOVERY FROM A SPIRAL DIVE

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

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

USE OF LANDING GEAR AND FLAPS

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

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

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

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

ILLUSIONS IN FLIGHT

Many different illusions can be experienced in flight. Some can lead to spatial disorientation. Others can lead to landing errors. Illusions rank among the most common factors cited as contributing to fatal airplane accidents. Various complex motions and forces and certain visual scenes encountered in flight can create illusions of motion and position. Spatial disorientation from these illusions can be prevented only by visual reference to reliable, fixed points on the ground, or to flight instruments.

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

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

8. **Autokinesis** - In the dark, a static light will appear to move about when stared at for many seconds. The disoriented pilot will lose control of the airplane in attempting to align it with the light.

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

1. **Runway width illusion** - A narrower than usual runway can create the illusion that the airplane is at a higher altitude than it actually is. The pilot who does not recognize this illusion will tend to fly a lower approach, with the risk of striking objects along the approach path, or land short. A wider than usual runway can have the opposite effect, with the risk of flaring high and landing hard or overshooting the runway.
2. **Runway and terrain slopes illusion** - An up sloping runway, up sloping terrain, or both, can create the illusion that the airplane is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach. A down sloping runway, down sloping approach terrain, or both, can have the opposite effect.
3. **Featureless terrain illusion** - An absence of ground features, as when landing over water, darkened areas and terrain made featureless by snow, can create the illusion that the airplane is at a higher altitude than it actually is. The pilot who does not recognize this illusion will tend to fly a lower approach.
4. **Atmospheric illusion** - Rain on the windshield can create an illusion of greater height, and a greater distance from the runway. The pilot who does not recognize this illusion will tend to fly a lower approach. Penetration of fog can create the illusion of pitching up. The pilot who does not recognize this illusion will steepen the approach, often quite abruptly.
5. **Ground lighting illusions** - Lights along a straight path, such as a road, and even lights on trains, can be mistaken for runway and approach lights. Bright runway and approach lighting systems, especially where few lights illuminate the surrounding terrain, may create the illusion of less distance to the runway. The pilot who does not recognize this illusion will tend to fly a higher approach. Conversely, the pilot overflying terrain which has few lights to provide height cues may make a lower than normal approach.

SPATIAL DISORIENTATION

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

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

When flying by reference to the natural horizon, the attitude of the airplane can be determined visually at all times. During instrument flight, when the natural horizon is not visible, the attitude of the airplane must be determined from the gyro horizon and other flight instruments. Sight, supported by other senses, maintains orientation in either case.

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

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

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

1. Obtain training and maintain proficiency in the control of an airplane by reference to instruments before flying in visibility of less than three miles.
2. Refer to the attitude instruments frequently when flying at night or in reduced visibility conditions.

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

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

MOUNTAIN FLYING

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

1. For pilots with little or no mountain flying experience, always get dual instruction from a qualified flight instructor to become familiar with conditions which may be encountered before flying in mountainous terrain.
2. Plan your route to avoid topography which would prevent a safe forced landing. The route should be near populated areas and well known mountain passes. Sufficient altitude should be maintained to permit gliding to a safe landing in the event of engine failure.
3. Always file a flight plan.

4. Don't fly a light airplane when the winds aloft, at your proposed altitude, exceed 35 miles per hour. Expect the winds to be of much greater velocity over mountain passes than reported a few miles from them. Approach mountain passes with as much altitude as possible. Downdrafts of from 1500 to 2000 feet per minute are not uncommon on the leeward (downwind) side.
5. Severe turbulence can be expected near or above changes in terrain, especially in high wind conditions.
6. Some canyons run into a dead end. Don't fly so far into a canyon that you get trapped. Always be able to make a 180-degree turn, or if canyon flying is necessary, fly down the canyon (toward lower terrain), not up the canyon (toward higher terrain).
7. Plan the trip for the early morning hours. As a rule, the air starts to get turbulent at about 10 a.m., and grows steadily worse until around 4 p.m., then gradually improves until dark.
8. When landing at a high altitude airfield, the same indicated airspeed should be used as at low elevation fields. Due to the less dense air at altitude, this same indicated airspeed actually results in a higher true airspeed, a faster landing speed, and a longer landing distance. During gusty wind conditions, which often prevail at high altitude fields, a "power approach" is recommended. Additionally, due to the faster ground speed and reduced engine performance at altitude, the takeoff distance will increase considerably over that required at lower altitudes.

OBSTRUCTIONS TO FLIGHT

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

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

FUEL MANAGEMENT

POOR TECHNIQUES

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

FUELING THE AIRCRAFT

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

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

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

UNUSABLE FUEL

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

FUEL PLANNING WITH MINIMUM RESERVES

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

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

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

FLIGHT COORDINATION VS. FUEL FLOW

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

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

FUEL SELECTION FOR APPROACH/LANDING

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

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

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

AIRFRAME ICING

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

FLIGHT INTO KNOWN ICING

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

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

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

AIRPLANES CERTIFIED FOR FLIGHT INTO KNOWN ICING

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

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

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

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

KINDS OF ICING

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

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

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

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

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

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

RESULTS OF ICING

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

INADVERTENT ICING ENCOUNTER

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

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

WEATHER

ALERTNESS

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

VFR JUDGMENT

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

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

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

IFR JUDGMENT

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

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

at least one VHF communications radio, or a hand-held communications radio.

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

WIND

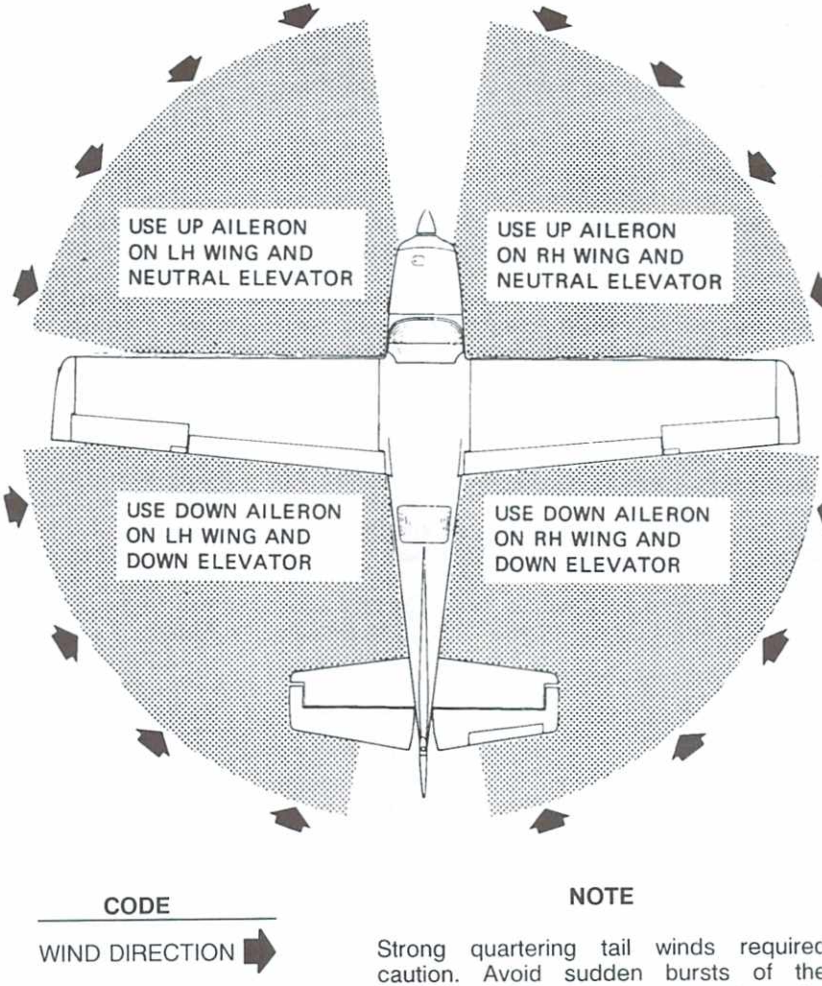
The keys to successfully counteracting the effects of wind are proficiency, understanding the wind response characteristics of the airplane, and a thoughtful approach to the operation. Some operating handbooks indicate a maximum demonstrated crosswind velocity, but this value is not considered to be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

CROSSWIND

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

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

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



NOTE

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

Figure 1. Crosswind Taxi Diagram

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

LOW LEVEL WIND SHEAR

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

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

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

TYPES OF WIND SHEAR CONDITIONS

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

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

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

INDICATIONS OF WIND SHEAR

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

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

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

COPING WITH WIND SHEAR

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

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

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

THUNDERSTORM AVOIDANCE

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

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

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

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

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

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

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

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

FROM WARM WEATHER TO COLD WEATHER

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

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

ICE, SNOW, FROST, Etc.

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

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

WAKE TURBULENCE

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

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

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

RESTRAINT SYSTEMS

SEAT RESTRAINTS

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

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

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

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

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

SEAT STOPS/LATCHES

The pilot should visually check the seat for security on the seat tracks and assure that the seat is locked in position. This can be accomplished by visually ascertaining pin engagement and physically attempting to move the seat fore and aft to verify the seat is secured in position. Failure to ensure that the seat is locked in position could result in the seat sliding aft during a critical phase of flight, such as initial climb. Mandatory Service Bulletin SEB89-32 installs secondary seat stops and is available from Cessna.

The pilot's seat should be adjusted and locked in a position to allow full rudder deflection and brake application without having to shift position in the seat. For takeoff and landing, passenger seat backs should be adjusted to the most upright position.

SECURITY IN AFT-FACING SEATS

Some aft-facing seats are adjustable fore and aft, within the limits of the seat stops. Ensure the seat stop pins are engaged with the holes in the seat tracks before takeoff and landing. The restraint system should be worn anytime the seat is occupied. Assure that the seats are installed in the correct positions. Approved seat designs differ between forward-facing and rear-facing seats and proper occupant protection is dependent upon proper seat installation.

FUEL SYSTEM CONTAMINATION

ADEQUATE PREFLIGHT OF THE FUEL SYSTEM

A full preflight inspection is recommended before each flight for general aviation airplanes. Inspection procedures for the fuel system must include checking the quantity of fuel with the airplane on level ground, checking the security of fuel filler caps and draining the fuel tank sumps, fuel reservoir(s), fuel line drain(s), fuel selector drains, and fuel strainer(s). To ensure that no unsampled fuel remains in the airplane, an adequate sample of fuel from the fuel strainer must be taken with the fuel selector valve placed in each of its positions (BOTH, LEFT, RIGHT, etc.). Some Cessna airplanes are equipped with a fuel reservoir(s). If so equipped, the pilot should be aware of the location of the fuel reservoir(s) and its drain plug or quick-drain. The fuel reservoir(s) on most single-engine airplanes is located near the fuel system low point where water will accumulate. Therefore, the fuel reservoir(s) must be drained routinely during each preflight inspection. Periodically check the condition of the fuel filler cap seals, pawls, and springs for evidence of wear and/or deterioration which indicates a need for replacement. Check fuel cap adapters and seals to insure that the sealing surfaces are clean and not rusted or pitted. Deformed pawls may affect the sealing capabilities of the seals and/or cause it to be exposed to detrimental weather elements. Precautions should be taken to prevent water entry into fuel tanks, due to damaged filler caps and every effort made to check and remove all water throughout the fuel system. Umbrella caps will assist in preventing water entry into the fuel tank through the fuel filler.

It is the pilot's responsibility to ensure that the airplane is properly serviced before each flight with the correct type of fuel. The pilot must take the time to inspect the airplane thoroughly, making sure all of the fuel filler caps are installed and secured properly after visually checking the fuel quantity with the airplane on level ground. During the check of the fuel tanks, observe the color and odor of the fuel while draining a generous sample from each sump and drain point into a transparent container. Check for the presence of water, dirt, rust, or other contaminants. Never save the fuel sample and risk the possibility of contaminating the system. Also, ensure that each fuel tank vent is clear of restrictions (i.e., dirt, insect nests, ice, snow, bent or pinched tubes, etc.). Refer to the airplanes Maintenance Manual for for fuel tank vent removal and inspection if needed.

PROPER SAMPLING FROM QUICK DRAINS

The fuel system sumps and drains should always be drained and checked for contaminants after each refueling and during each preflight inspection. Drain at least a cupful of fuel into a clear container to check for solid and/or liquid contaminants, and proper fuel grade. If contamination is observed, take further samples at all fuel drain points until fuel is clear of contaminants; then, gently rock wings and, if possible, lower the tail to move any additional contaminants to the sampling points. Take repeated samples from all fuel drain points until all contamination has been removed. If excessive sampling is required, completely defuel, drain and clean the airplane fuel system, and attempt to discover where or how the contamination originated before the airplane flies again. Do not fly the airplane with contaminated or unapproved fuel. If an improper fuel type is detected, the mandatory procedure is to completely defuel and drain the fuel system.

Extra effort is needed for a proper preflight of all fuel drains on a float plane. If water is detected after rocking the wings and lowering the tail, the aircraft should not be flown until after the fuel system is completely drained and cleaned.

80 versus 100 OCTANE FUEL

When 80 octane (red) fuel began to be replaced by 100LL (blue) there was concern about the service life expectancy of low compression engines. It was claimed that some engines experienced accelerated exhaust valve erosion and valve guide wear from the use of highly leaded 100/130 (green) avgas in engines that were rated to use a minimum grade of 80 octane fuel. Engine manufacturers have provided amended operating procedures and maintenance schedules to minimize problems resulting from the use of high lead 100/130 avgas. Experience has now proven that low-compression aircraft engines can be operated safely on 100LL avgas providing they are regularly operated and serviced in accordance with the operating handbook or other officially approved document.

AVGAS versus JET FUEL

Occasionally, airplanes are inadvertently serviced with the wrong type of fuel. Piston engines may run briefly on jet fuel, but detonation and overheating will soon cause power failure. All piston-engine airplanes should have fuel filler restrictors installed to prevent jet fuel from being pumped into the fuel tanks. An engine failure caused by running a turbine engine on the wrong fuel may not be as sudden, but prolonged operation on avgas will severely damage the engine because of the lead content and differing combustion temperature of the fuel. Time limitations for use of avgas in turbine engines are listed in the operating handbook.

AUTOMOTIVE GASOLINE/FUEL

Never use automotive gasoline in an airplane unless the engine and airplane fuel system are specifically certified and approved for automotive gasoline use. The additives used in the production of automotive gasoline vary widely throughout the petroleum industry and may have deteriorating effects on airplane fuel system components. The qualities of automotive gasoline can induce vapor lock, increase the probability of carburetor icing, and can cause internal engine problems.

FUEL CAP SECURITY

The consequence of a missing or incorrectly installed fuel filler cap is inflight fuel siphoning. Inflight siphoning may distort the fuel cell on some airplanes with bladder-type fuel cells. This distortion will change the fuel cell capacity, and may interfere with the operation of the fuel quantity indicator sensing mechanism inside the cell. This condition will generally cause an erroneous and misleading fuel quantity reading and may result in incomplete filling for the next flight.

CONTAMINATION

Solid contamination may consist of rust, sand, pebbles, dirt, microbes or bacterial growth. If any solid contaminants are found in any part of the fuel system, drain and clean the airplane fuel system. Do not fly the airplane with fuel contaminated with solid material.

Liquid contamination is usually water, improper fuel type, fuel grade, or additives that are not compatible with the fuel or fuel system components. Liquid contamination should be addressed as set forth in the section entitled "Proper Sampling from Quick Drains", and as prescribed in the airplane's approved flight manual.

FUEL PUMP OPERATION

AUXILIARY FUEL PUMP OPERATION - GENERAL

The engine-driven fuel pump is designed to supply an engine with a steady, uninterrupted flow of fuel. Temperature changes, pressure changes, agitation in the fuel lines, fuel quality, and other factors can cause a release of vapor in the fuel system. Some airplanes (single and multi-engine) incorporate an auxiliary fuel pump to reduce excess fuel vapor in the fuel supply for each engine. This pump is also used to ensure that a positive supply of fuel is available in the event the engine driven fuel pump should fail.

FUEL VAPOR

Under hot, high altitude conditions, or in situations during a climb that are conducive to fuel vapor formation, it may be necessary to utilize the auxiliary fuel pump(s) to attain or stabilize the fuel flow required for proper engine operation. Use the auxiliary fuel pump(s) in all conditions where there is any possibility of excessive fuel vapor formation or temporary disruption of fuel flow in accordance with operating handbook procedures.

SINGLE ENGINE FUEL PUMP OPERATION (CARBURETED ENGINE)

On some carbureted, high wing, single engine airplanes, the auxiliary fuel pump should be turned on anytime the indicated fuel pressure falls below the minimum. Typically this would only occur in an extreme climb attitude following failure of the engine driven fuel pump. Consult the operating handbook of the affected model for a detailed description of the procedure.

SINGLE ENGINE FUEL PUMP OPERATION (PRECISION/BENDIX FUEL INJECTED ENGINE)

The auxiliary fuel pump is used primarily for priming the engine before starting. Priming is accomplished through the regular injection system. If the auxiliary fuel pump switch is placed in the ON position for prolonged periods with the master switch turned on, the mixture rich, and the engine stopped, the intake manifolds will become flooded.

The auxiliary fuel pump is also used for vapor suppression in hot weather. Normally, momentary use will be sufficient for vapor suppression. Turning on the auxiliary fuel pump with a normally operating engine pump will result in enrichment of the mixture. The auxiliary fuel pump should not be operated during takeoff and landing, since gravity and the engine driven fuel pump will supply adequate fuel flow to the fuel injector unit. In the event of failure of the engine driven fuel pump, use of the auxiliary fuel pump will provide sufficient fuel to maintain flight at maximum continuous power.

To ensure a prompt engine restart after running a fuel tank dry, switch the fuel selector to the opposite tank at the first indication of fuel flow fluctuation or power loss. Turn on the auxiliary fuel pump and advance the mixture control to full rich. After power and steady fuel flow are restored, turn off the auxiliary fuel pump and lean the mixture as necessary.

SINGLE ENGINE FUEL PUMP OPERATION (TCM FUEL INJECTED ENGINE)

The auxiliary fuel pump on single engine airplanes is controlled by a split rocker type switch labeled AUX PUMP. One side of the switch is red and is labeled HI; the other side is yellow and is labeled LO.

The LO side operates the pump at low speed, and, if desired, can be used for starting or vapor suppression. The HI side operates the pump at high speed, supplying sufficient fuel flow to maintain adequate power in the event of an engine driven fuel pump failure. In addition, the HI side may be used for normal engine starts, vapor elimination in flight, and inflight engine starts.

When the engine driven fuel pump is functioning and the auxiliary fuel pump is placed in the HI position, a fuel/air ratio considerably richer than best power is produced unless the mixture is leaned. Therefore, the auxiliary fuel pump must be turned off during takeoff or landing, and during all other normal flight conditions. With the engine stopped and the battery switch on, the cylinder intake ports can become flooded if the HI or LO side of the auxiliary fuel pump switch is turned on.

In hot, high altitude conditions, or climb conditions that are conducive to fuel vapor formation, it may be necessary to utilize the auxiliary fuel pump to attain or stabilize the fuel flow required for the type of climb being performed. Select either the HI or LO position of the switch as required, and adjust the mixture to the desired fuel flow. If fluctuating fuel flow (greater than 5 lbs/hr) is observed, place the auxiliary fuel pump switch in the HI or LO position as required to clear the fuel system of vapor. The auxiliary fuel pump may be operated continuously in cruise, if necessary, but should be turned off prior to descent. Each time the auxiliary fuel pump switch is turned on or off, the mixture should be readjusted.

MULTI-ENGINE FUEL PUMP OPERATION

Cessna multi-engine, low wing airplanes utilize engine driven fuel pumps to assist the continuous flow of fuel to the engine. As a general rule, the auxiliary fuel pumps should be utilized under the following conditions:

1. Every takeoff.
2. Initial climb after takeoff (unless the operating handbook indicates that it is not necessary).
3. When switching the fuel selector(s) from one tank to another.
4. Every approach and landing.
5. Anytime the fuel pressure is fluctuating and the engine is affected by the fluctuation.
6. During hot weather, such as hot engine ground operation where fuel vapor problems cause erratic engine operation.
7. High altitude. (For auxiliary fuel pump operation at high altitude consult the operating handbook.)
8. If the engine driven fuel pump should fail.
9. On some twins when using the auxiliary fuel tanks.

If the auxiliary fuel pump is used during ground operations, such as hot day engine starts or purging fuel vapor, pilots should check the condition of the engine driven fuel pump before takeoff by turning the auxiliary fuel pump OFF briefly, and then back ON for takeoff. If the engine driven fuel pump has failed, the engine will not continue to operate.

If the battery or master switch is on while an engine is stopped on the ground or in flight, the cylinder intake ports can become flooded if the auxiliary fuel pump is turned on. If this situation occurs in excess of 60 seconds, the cylinders must be purged as follows:

1. With the auxiliary fuel pump OFF, allow the induction manifold to drain at least five minutes or until fuel ceases to flow from the drains on the bottom of the engine.
2. If natural draining has occurred, ensure that the auxiliary fuel pump is OFF, the magnetos or ignition switch is OFF, the mixture is in IDLE CUT-OFF, and the throttle is FULL OPEN, then turn the engine with the starter .
3. If natural draining has not occurred, perform maintenance as required.

A mandatory service bulletin (MEB88-3) was issued to replace the automatic fuel pressure sensing and the cockpit auxiliary fuel pump switches for each engine with three-position lever lock type toggle switches. These modifications provide direct pilot activation of the auxiliary fuel pumps.

On low wing multi-engine airplanes (except model 310, 310A, and 310B, which are not affected by this change), the switches are labeled AUX PUMP, L (left engine) and R (right engine) and switch positions are labeled LOW, OFF, and HIGH. The LOW position operates the auxiliary fuel pumps at low pressure and can be used, when required, to provide supplementary fuel pressure for all normal operations. The switches are OFF in the middle position. The HIGH position is reserved for emergency operation, and operates the pumps at high pressure. The switches are locked out of the HIGH position and the switch toggle must be pulled to clear the lock before it can be moved to the HIGH setting. The toggle need not be pulled to return the switch to OFF.

The LOW position of the auxiliary fuel pump switches should be used whenever an original manual/handbook or checklist procedure specifies either LOW (PRIME, in 310C, 310D, 310F, 310G, 310H, 320, and 320A.) or ON. The LOW position is also used anytime there are indications of vapor, as evidenced by fluctuating fuel flow. Auxiliary fuel pumps, if needed, are to be operated on LOW in all conditions except when an engine driven fuel pump fails.

The HIGH position supplies sufficient fuel flow to sustain partial engine power and should be used solely to sustain the operation of an engine in the event its engine driven fuel pump fails. Failure of an engine driven fuel pump will be evidenced by a sudden reduction in the fuel flow indication immediately prior to a loss of power while operating from a fuel tank containing adequate fuel. In an emergency, where loss of an engine driven fuel pump is involved, pull the applicable auxiliary fuel pump switch to clear the lock and select the HIGH position. Then adjust the throttle and mixture controls to obtain satisfactory operation. At high manifold pressure and RPM, auxiliary fuel pump output may not be sufficient for normal engine operation. In this case, reduce manifold pressure to a level compatible with the indicated fuel flow. At low power settings, the mixture may have to be leaned for smooth engine operation. If HIGH auxiliary pump output does not restore adequate fuel flow, a fuel leak may exist. The auxiliary pump should be shut off and the engine secured.

If the auxiliary fuel pump switches are placed in the HIGH position with the engine-driven fuel pump(s) operating normally, total loss of engine power may occur due to flooding.

When performing single engine operations, the auxiliary fuel pump of the engine to be shutdown should be turned OFF prior to any intentional engine shutdown, to preclude fuel accumulation in the engine intake system.

In models 310, 310A, and 310B, which are equipped with pressure type carburetors, the electric fuel boost pumps in the tanks provide a positive fuel flow as emergency pumps in the event of failure of the engine driven fuel pumps. They also provide fuel pressure for priming and starting. The boost pumps are operated by two electric switches, and the up position is ON. Always take off and land with these pumps turned ON. Anytime the boost pumps are turned on without the engines running, mixture controls must be in the idle cut-off position to prevent flooding the intake manifolds.

CENTERLINE THRUST TWINS (FUEL PUMP OPERATION)

The auxiliary fuel pumps on the centerline thrust models (336 and 337 Skymaster) are controlled by two split rocker type switches. The switches are labeled AUX PUMPS and F ENGINE R. One side of each switch is red and is labeled HI. The other side is yellow and is labeled LO. The LO side operates the pumps at low speed, and if desired, can be used for starting or vapor suppression. The HI side operates the pumps at high speed, supplying sufficient fuel flow to maintain adequate power in the event of an engine driven fuel pump failure. In addition, the HI side may be used for normal engine starts, vapor elimination in flight, and inflight engine starts.

When the engine driven fuel pump is functioning and the auxiliary fuel pump is placed in the HI position, a fuel/air ratio considerably richer than best power is produced unless the mixture is leaned. Therefore, these switches must be turned OFF during takeoff or landing, and during all other normal flight conditions. With the engine stopped and the battery switch ON, the cylinder intake ports can become flooded if the HI or LO side of the auxiliary fuel pump switch is turned on.

In hot, high altitude conditions, or climb conditions that are conducive to fuel vapor formation, it may be necessary to utilize the auxiliary fuel pumps to attain or stabilize the fuel flow required for the type of climb being performed. Select either the HI or LO position of the switches as required, and adjust the mixtures to the desired fuel flow. If fluctuating fuel flow (greater than 5 lbs/hr) is observed, place the appropriate auxiliary fuel pump switch in the HI or LO position as required to clear the fuel system of vapor. The auxiliary fuel pump may be operated continuously in cruise, if necessary, but should be turned off prior to descent. Each time the auxiliary fuel pump switches are turned on or off, the mixtures should be readjusted.

AUXILIARY FUEL TANKS

Many twin engine Cessna airplanes incorporate auxiliary fuel tanks to increase range and endurance. These tanks are usually bladder type cells located symmetrically in the outboard wing areas and contain no internal fuel pumps. When selected, the fuel from these tanks is routed to the engine driven fuel pump.

If the auxiliary fuel tanks are to be used, the pilot must first select main tank (tip tank) fuel for at least 60 minutes of flight (with use of 40-gallon auxiliary fuel tanks) or 90 minutes of flight (with use of 63-gallon auxiliary fuel tanks). This is necessary to provide space in the main fuel tanks for vapor and fuel returned from the engine driven fuel pumps when operating on the auxiliary fuel tanks. If sufficient space is not available in the main tanks for this returned fuel, the tanks can overflow through the overboard fuel vents. Since part of the fuel from the auxiliary fuel tanks is diverted back to the main tanks instead of being consumed by the engines, the auxiliary tanks will empty sooner than may be anticipated. However, the main tank volume or quantity will be increased by the returned fuel.

The fuel supply in the auxiliary fuel tanks is intended for use during cruise flight only. The shape of the auxiliary fuel tanks is such that during certain flight maneuvers, the fuel will move away from the fuel tank outlet. If the outlet is uncovered while feeding the engine, fuel flow to the engine will be interrupted and a temporary loss of power may result. Because of this, operation from the auxiliary fuel tanks is not recommended below 1000 feet AGL.

An optional auxiliary fuel tank may be installed on some centerline thrust twins (336 and 337 Skymaster). The system consists of two tanks, each containing 18 gallons (108 pounds) usable, one located in each inboard wing panel. The tanks feed directly to the fuel selector valves. The left auxiliary tank provides fuel to the front engine only and the right auxiliary tank provides fuel to the rear engine only. Fuel quantity for the auxiliary tanks is read on the same fuel quantity indicators used for the main fuel tanks. This is accomplished when the fuel selector valve handles are turned to the AUXILIARY position. As each selector valve handle is turned to this position, it depresses a gaging button, labeled PUSH TO GAGE, located in the AUXILIARY quadrant of the fuel selector valve placard. The depressed button actuates a microswitch and electrically senses auxiliary fuel rather than main fuel quantity. Auxiliary fuel quantity can be checked without changing the selector valve handle, by depressing the PUSH TO GAGE button manually. Depressing the gaging button, either manually or by rotating the selector valve handle to the AUXILIARY position, will illuminate the amber AUX FUEL ON indicator lights mounted above the engine instrument cluster. When fuel is being used from the auxiliary fuel tanks, any excess fuel and vapor from the engine driven pumps is returned to fuel line manifolds. The returned vapor passes through the fuel line manifolds to the vent lines and is routed overboard. The excess fuel passes into the fuel line manifold and is returned to the engine driven pumps.

On some early model Skymasters, fuel vapor from the engine driven fuel pumps is returned to the main fuel tanks. When the selector valve handles are in the AUXILIARY position, the left auxiliary tank feeds only the front engine and the right auxiliary tank feeds only the rear engine. If the auxiliary tanks are to be used, select fuel from the main tanks for 60 minutes prior to switching to auxiliary tanks. This is necessary to provide space in the main tanks for vapor and fuel returned from the engine driven fuel pumps when operating on auxiliary tanks. On some models, auxiliary fuel boost pumps are not provided for the auxiliary fuel tank. Therefore it is recommended to use the auxiliary fuel tanks only in straight and level flight. When unsure of the type of auxiliary tank installation, consult the operating handbook for the respective airplane.

A few single-engine airplanes contain an auxiliary fuel tank. The system's main components include a fuel tank installed on the baggage compartment floor and an electric fuel transfer pump. The auxiliary fuel system is plumbed into the right main fuel tank.

To use the auxiliary fuel system, select the right wing fuel tank in cruise and operate on that tank until the fuel tank has adequate room for the transfer of auxiliary fuel. After selecting the left main tank, turn on the auxiliary fuel transfer pump to refill the right main fuel tank from the auxiliary tank. Transfer will take from 45 minutes to 1 hour. Prior to transfer, ensure that adequate fuel is available in the left tank to allow time for the auxiliary tank to transfer.

Do not operate the transfer pump with the fuel selector valve turned to either the BOTH or RIGHT positions. Total or partial engine stoppage will result from air being pumped into fuel lines after fuel transfer has been completed. If this should occur the engine will restart in 3 to 5 seconds after turning off the transfer pump, as the air in the fuel line will be evacuated rapidly.

After transfer is complete and the pump has been turned off, the selector may be returned to BOTH or RIGHT. Takeoff, climb, and landing should always be conducted with the selector in the BOTH position for maximum safety.

WING LOCKER FUEL TANK USAGE

Some twins may have wing locker fuel tanks installed in the forward portion of each wing locker baggage area. These tanks are bladder type cells for storage of extra fuel to supplement the main tank fuel quantity. The fuel in these tanks cannot be fed directly to the engines. Instead, it has to be transferred to the main tanks by wing locker fuel transfer pumps. Fuel transfer should begin as soon as adequate volume is available in the main fuel tanks to hold the wing locker fuel. Waiting until the main tanks are low before transferring wing locker fuel does not allow early recognition of possible failure to transfer.

If wing locker fuel is to be used, consult the operating handbook for the quantity of main tank fuel which must first be used in the respective main tank for the transferred wing locker fuel. This will prevent overflowing of the main tank(s) when transferring the wing locker fuel.

Wing locker fuel transfer pump switches are provided to manually control the transfer of the wing locker fuel to the main tanks. These switches should be turned ON only to transfer fuel and turned OFF when indicator lights illuminate to show that fuel has been transferred. The transfer pumps use the fuel in the wing locker tank for lubrication and cooling. Therefore, transfer pump operation after fuel transfer is complete will shorten the life of the pump. Fuel should be cross fed, as required, to maintain fuel balance.

INSTRUMENT POWER

VACUUM POWER FAILURES

Many airplanes may be equipped with some type of back-up vacuum system for operation in the event the primary vacuum system becomes inoperative in flight. The backup system may be in the form of another engine-driven vacuum pump, in parallel with the primary pump, or an electric standby vacuum pump, also in parallel with the primary pump, or both. If a back-up system is not available and the attitude and directional indicators are disabled, the pilot must rely on partial instrument panel operation. This may include using the electrically-powered turn coordinator or turn and bank indicator and the magnetic compass, altimeter, airspeed indicator, and rate of climb indicator.

A suction gage, and in some airplanes a low-vacuum warning light, provides a means of monitoring the vacuum system for proper operation in flight. Operating handbooks reflect a desired suction range during normal operation of the airplane. A suction reading outside of this range may indicate a system malfunction, and in this case, the vacuum driven instruments should not be considered reliable. Whenever operation of the airplane's vacuum system is in doubt, land when practical for repairs.

In the event of a directional indicator and attitude indicator failure due to vacuum failure, the pilot must rely on partial instrument panel operation using the remaining instruments. VFR operations can generally be conducted satisfactorily without the vacuum instruments. However, instrument meteorological conditions (IMC) can be considerably more challenging. An instrument rated pilot should stay current on partial panel flying skills but both VFR and IFR pilots should maintain VFR conditions if a vacuum failure occurs while clear of clouds. All pilots should become familiar with the following procedure for executing a 180° turn in clouds with the aid of either the turn coordinator or the turn and bank indicator.

Upon inadvertently entering clouds, maintain control of the aircraft. If it is desired to turn back out of the clouds, the following action should be employed:

1. Note the compass heading.
2. Note the time in both minutes and seconds.
3. When the seconds indicate the nearest half minute, initiate a standard rate left turn, holding the turn coordinator or turn and bank indicator (if installed) symbolic airplane wing opposite the lower left index mark for 60 seconds. Then roll back to level flight by leveling the miniature airplane.
4. Check accuracy of turn by observing the compass heading which should be the reciprocal of the original heading.

5. If necessary, adjust heading primarily with skidding motions rather than rolling motions so that the compass will read more accurately.
6. Maintain altitude and airspeed by cautious application of elevator control. Avoid over controlling by keeping the hands off the control wheel as much as possible and steering only with the rudder.

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

1. Extend landing gear (if applicable).
2. Enrichen the fuel mixture.
3. Use full carburetor heat (if applicable).
4. Reduce power to set up a 500 to 800 ft/min rate of descent.
5. Adjust the elevator trim and rudder trim (if installed) for a stabilized descent at 5 to 20 knots above the best glide speed for the airplane.
6. Keep hands off the control wheel.
7. Monitor turn coordinator and make corrections by rudder alone.
8. Check trend of compass card movement and make cautious corrections with rudder to stop the turn.
9. Upon breaking out of clouds, resume normal cruise flight.

ELECTRICAL POWER FAILURES

Many operating handbooks have emergency procedures for partial or total loss of electrical power in flight. These procedures should be reviewed periodically to remain knowledgeable of what to do in the event of an electrical problem. The pilot should maintain control of the airplane and land when practical if an electrical power loss is evident.

Early detection of an electrical power supply system malfunction can be accomplished by periodically monitoring the ammeter and, if equipped, low-voltage warning light. The cause of these malfunctions is difficult to determine in flight. Common causes of alternator or generator failure are a broken drive belt, alternator or generator drive, a defective alternator control unit or voltage regulator or wiring. Problems of this nature constitute an electrical emergency and should be addressed immediately.

If alternator power cannot be restored, and a second or back up alternator is not available, the pilot must rely on the limited power of the battery only. Every effort should be made to conserve electrical power for use with the most essential equipment, such as communication and navigation radios, by turning off or not using any non-essential equipment. Electric or electro-hydraulic landing gear systems should be extended manually and flaps (if electrically operated) should remain retracted during approach and landing to conserve battery power, especially in instrument conditions.

If an electrical power loss is experienced, continued flight is possible but should be terminated as soon as practical. Such things as fuel quantity and engine temperature indicators and panel lights may no longer work. Hand-held nav/comm radios and other such products are widely available and marketed for just such a scenario; otherwise navigation by pilotage and appropriate loss of communication procedures for the airspace involved should be conducted. The pilot should always have a flashlight available for night flights.

LOSS OF PITOT/STATIC SOURCES

A thorough preflight inspection should reveal any blockage of the pitot tube, drain hole, or static port on the ground to allow corrective action to be taken prior to flight. Pilots should understand the various conditions and remedies associated with a loss of pitot-static sources.

Pitot heat should be used whenever flying in visible moisture and the temperature is near freezing. If airspeed is suspected to be in error while flying in possible icing conditions with the pitot heat on, the pitot heat switch should be cycled and the circuit breaker should be checked. If proper operation cannot be restored, the airspeed indicator must be considered unreliable.

If the pitot tube ram air inlet becomes blocked, the airspeed will drop to zero. If this blockage cannot be removed in flight, the pilot must rely on pitch attitude and power settings to maintain a safe airspeed. A slightly higher than normal power setting should be used to maintain a reasonable margin of extra airspeed on final.

When flying in clear ice conditions and pitot heat is unavailable, both the ram air inlet and the pitot drain hole could become blocked. This will cause the airspeed indicator to react like an altimeter, indicating a higher airspeed at higher altitudes and a lower airspeed at lower altitudes. The airspeed indicator must be ignored. A higher power setting appropriate to the overall icing problem should be used during the landing phase.

Many light single engine airplanes equipped with pitot heat may not be equipped with static source heat. If the static source becomes blocked, the airspeed indicator will still function, but will give erroneous indications. If the airplane climbs after the blockage occurs, the airspeed indicator will indicate lower than normal. If the airplane descends after the blockage occurs, the airspeed will indicate higher than actual. During the landing phase, this condition could deceive the pilot into thinking the airspeed is too high. The altimeter and vertical speed indicator will also be affected by a static source blockage. The altimeter will not indicate a change of altitude and the vertical speed indicator will indicate zero airspeed. Neither instrument will reflect any altitude changes.

Many airplanes are equipped with an alternate static air source vented within the cabin area. If static port blockage is suspected, the alternate static source should be selected. The cabin pressure will be slightly lower than ambient air, but will provide a reasonable level of accuracy to the pitot static system. With slightly less dense air in the cabin, the airspeed indicator and altimeter will both show slightly higher than normal indications.

If the airplane is not equipped with an alternate static source, and pitot/static instruments are essential for continued flight, the glass on the vertical speed indicator may be broken to provide cabin air to the static system lines. The vertical speed indicator will no longer be reliable, but the airspeed indicator and altimeter will be functional again, with slightly higher than normal indications.

GYRO SPIN UP AND SPIN DOWN

Gyro instruments, such as attitude and directional indicators, contain a high-speed rotor assembly driven by either electric or vacuum power. These instruments normally operate at very high RPM and can take up to 10 minutes or more to spin down after power is removed. Although some gyro instruments have a "quick erect" mechanism to permit manual erection of the rotor, which effectively minimizes time required before use, some gyro instruments still require up to 5 minutes or more to spin up and stabilize after power is applied. During this spin up or spin down time, the gyro instruments should not be considered reliable. A failed gyro can be detected by first checking the suction gage and, if available, low-voltage or low-vacuum lights as applicable and, second, checking for slow or erratic indications of the gyro instruments by cross-referencing with other flight instruments for contradictory indications.

FAILED GYRO EFFECT ON AUTOPILOT

Some autopilot systems receive roll and/or yaw rate inputs from the electrically-driven turn coordinator or turn and bank indicator. Other autopilot systems depend on vacuum-driven attitude and directional indicators for horizontal and azimuth reference. If a failure should occur in any of these instruments, the autopilot should be turned off. Random signals generated by a malfunctioning gyro could cause the autopilot to position the airplane in an unusual attitude. Use of the autopilot after a gyro failure may result in an out of trim condition. Be prepared to correct for this when turning off the autopilot.

ALTERNATE AIR SYSTEM

An alternate source of air is provided to ensure satisfactory engine operation in the event the normal induction air filter or air inlet becomes obstructed. Although alternate air controls vary from one airplane to another, the types are: carburetor heat, direct manual control, automatic control, or a combination of automatic and manual controls. In most cases, the alternate air is extracted from inside the engine cowling and is, therefore, unfiltered and hotter than normal induction air. A loss of power will be caused by the hotter air. The richer mixture may require adjustment of the mixture control. Consult the applicable airplane operating handbook for details concerning the use of the alternate air system.

CARBURETOR HEAT AND INDUCTION ICING

Carburetor heat and manually operated alternate air valve(s) are controlled by the pilot. The carburetor heat system uses unfiltered air from inside the engine cowling. This air is drawn into a shroud around an exhaust riser or muffler and then ducted to the carburetor heat valve in the induction air manifold. The carburetor heat valve is controlled by the pilot and should be used during suspected or known carburetor icing conditions. Carburetor heat may also be used as an alternate air source should the induction air inlet or induction air filter become blocked for any reason.

The use of full carburetor heat at full throttle usually results in a 1 to 2 inch loss of manifold pressure or a loss of approximately 150 RPM, depending upon the airplane model. Application or removal of carburetor heat at higher power settings may require adjustment of the fuel mixture. It may be impractical to lean the mixture under low engine power conditions.

When a go-around or balked landing is initiated after use of carburetor heat during the landing approach, the pilot should usually advance the throttle first, then move the carburetor heat to off or cold. The throttle application must be smooth and positive. Rapid throttle advancement in some icing conditions could result in the engine failing to respond and the loss of power could become critical because of the low altitude and low airspeed.

When the relative humidity is more than 50 percent and the ambient air temperature is between 20°F to 90°F, it is possible for ice to form inside the carburetor, since the temperature of the air passing through the venturi may drop as much as 60°F below the ambient air temperature. If not corrected, ice accumulation may cause complete engine stoppage.

A drop in engine RPM on fixed pitch propeller airplanes and a drop in engine manifold pressure on constant speed propeller airplanes are indications of carburetor ice. If the airplane is equipped with a carburetor air temperature gage, the possibility of carburetor ice may be anticipated and prevented by maintaining the recommended amount of heat during cruise and letdown. Without the indications of a carburetor air temperature gage for reference, a pilot should use only the full heat or full cold position. An unknown amount of partial heat can cause carburetor ice. This can occur when ice that would ordinarily pass through the induction system is melted by partial carburetor heat and the water droplets then refreeze upon contact with the cold metal of the throttle plate. A carburetor air temperature gage may allow partial carburetor heat use, resulting in less power loss.

ALTERNATE AIR FOR FUEL INJECTED ENGINE ICING

Either an automatic alternate air system, a manually controlled alternate air system, or a combination automatic and manual system are incorporated on most fuel injected engines to address the potential of a blocked air induction system.

On engines equipped with automatic alternate air, ram air from the engine cowling inlet enters an air filter, which removes dust and other foreign matter that would be harmful to the engine. If the air inlet or the induction air filter should become blocked, suction created by the engine will open an alternate air door, allowing air to be admitted from either inside or outside the cowling, depending upon the airplane model. This air bypasses the filter and will result in a slight decrease in full throttle manifold pressure on non-turbocharged engines, and a notable decrease in manifold pressure from the selected cruise power setting on turbocharged engines. This manifold pressure may be recoverable, up to a particular altitude, with throttle and/or RPM adjustment. The alternate air doors should be kept closed on the ground to prevent engine damage caused by ingesting debris through the unfiltered air ducts. For details concerning a specific model, consult the airplane operating handbook.

Most twin engine airplanes have a manually controlled alternate air door in each engine induction air system. If a decrease in manifold pressure is experienced when flying in icing conditions, the alternate air doors should be manually opened. On most twins, this manual control has two positions. When fully in, normal filtered ram air is provided; when fully out, warm unfiltered air from inside the cowling is provided. Other twins have alternate air controls with an additional intermediate or center detent to provide cool, unfiltered ram air to the induction system in the event the induction air filter is blocked by matter other than ice.

Since the higher intake air temperature of the alternate air results in a decrease in engine power and turbocharger capability, it is recommended that the alternate induction air not be utilized until indications of induction air blockage (decreased manifold pressure) are actually observed.

If additional power is required, the pilot should increase RPM as required, move the throttles forward to maintain desired manifold pressure and readjust the fuel mixture controls as required. These recommendations do not replace the procedure in the airplane operating handbook.

Although most pilots are aware of the potential of carburetor to icing, many may think that a fuel injected engine is not subject to induction icing. Although a fuel injected engine will not form carburetor ice, other parts of the induction system such as bends in the system or the air filter can gather ice. Slush and/or snow can block the induction air filter. Induction air blockage can cause loss of manifold pressure or engine stoppage.

CARBON MONOXIDE

Carbon monoxide is a colorless, odorless, tasteless product of an internal combustion engine and is always present in exhaust fumes. Even minute quantities of carbon monoxide breathed over a long period of time may lead to dire consequences. Carbon monoxide has a greater ability to combine with the blood than oxygen. Once carbon monoxide is absorbed in the blood, it prevents the oxygen from being absorbed.

The symptoms of carbon monoxide poisoning are difficult to detect by the person afflicted and may include blurred thinking, a feeling of uneasiness, dizziness, headache, and loss of consciousness. If any of these symptoms occur, immediately open all cabin vents and turn the cabin heater off. Land as soon as possible at the nearest airport and seek medical attention if needed.

HEATER OPERATION

Many cabin heaters in general aviation airplanes operate by allowing ambient air to flow through an exhaust shroud where it is heated before being ducted into the cabin. Therefore, if anyone in the cabin smells exhaust fumes when using the cabin heater, immediately turn off the cabin heater and open all cabin vents. Land as soon as possible at the nearest airport and seek medical attention if needed.

WINDOW VENTILATION

If carbon monoxide is suspected in the cabin at any time, it is imperative that immediate ventilation be initiated, including the opening of cabin windows. Observe the maximum speed for window opening in flight. Opening a cabin window is probably the best means of ventilating the cabin while on the ground. However, care should be taken when parked with engine(s) operating or when in the vicinity of other airplanes that have their engines running. The exhaust gases from your airplane or the other airplane could enter the cabin through the open window. Also, engine exhaust could be forced into the cabin area during taxi operations or when taxiing downwind.

PRESSURIZED AIRPLANES

Refer to the operating handbook and/or approved flight manual for appropriate ventilation procedures.

TURBOCHARGER

When operating turbocharged engines, any power increases should be accomplished by increasing the propeller RPM first, then increasing the manifold pressure. Power reductions should be accomplished by reducing the manifold pressure first, then the RPM.

During cold weather operation, care should be exercised to insure that overboost does not occur during takeoff as a result of congealed oil in the waste gate actuating system. Before takeoff engine checks should not be accomplished until oil temperature is at least 75°F (minimum approved operating limit). Takeoff should not be started until oil temperature is above 100°F and oil pressure below 100 psi to assure proper oil flow to the turbocharger and its actuating system. Monitor manifold pressure during takeoff so as not to exceed specified takeoff limits. Advance the throttle slowly, pausing momentarily at approximately 30" MP to permit turbine speed to stabilize, then gradually open the throttle to obtain takeoff manifold pressure.

Prior to engine shut down, operate the engine at idle RPM for approximately 5 minutes to allow the turbocharger to cool and slow down. This reduces the possibility of turbine bearing coking caused by oil breakdown. This 5 minutes may be calculated from landing touchdown.

During pilot training, simulated engine out operation requiring the engine be shut down by closing the mixture should be held to an absolute minimum.

TURBOCHARGER FAILURE

The turbocharger system's purpose is to elevate manifold pressure and thus engine power to a level higher than can be obtained without it. A failure of the system will cause either an overboost condition or some degree of power loss. An overboost can be determined on the manifold pressure instrument and can be controlled by a throttle reduction.

If turbocharger failure results in power loss, it may be further complicated by an overly rich mixture. This rich mixture condition may be so severe as to cause a total power failure. Leaning the mixture may restore partial power. Partial or total power loss may also be caused by an exhaust system leak. A landing should be made as soon as practical for either an overboost or partial/total power loss.

IN-FLIGHT FIRES

FIRES IN FLIGHT

A preflight checklist is provided to aid the pilot in detecting conditions which could contribute to an airplane fire. Flight should not be attempted with known fuel, oil, or exhaust leaks, since they can lead to a fire. The presence of fuel or unusual oil or exhaust stains may be an indication of system leaks and should be corrected prior to flight.

Fires in flight must be controlled as quickly as possible by identifying and shutting down the affected system(s), then extinguishing the fire. Until this process is complete, the pilot should assume the worst and initiate action for an immediate landing. A pilot must not become distracted by the fire to the point that control of the airplane is lost. The pilot must be able to complete a deductive analysis of the situation to determine the source of the fire. Complete familiarity with the airplane and its systems will prove invaluable should a fire occur.

ENGINE COMPARTMENT FIRES

An engine compartment fire is usually caused by fuel contacting a hot surface, an electrical short, bleed air leak, or exhaust leak. If an engine compartment fire occurs on a single engine airplane, the first step should be to shut off the fuel supply to the engine by placing the mixture to idle cut off and the fuel selector/shutoff valve to the OFF position. The ignition switch should be left ON in order for the engine to use up the fuel which remains in the fuel lines and components between the fuel selector/shutoff valve and the engine. The airplane should be put into a sideslip, which will tend to keep the flames away from the occupants and the fuel tanks. If this procedure is ineffective, the pilot must make the most rapid emergency descent possible and an immediate landing.

In multi-engine airplanes, **both** auxiliary fuel pumps should be turned off to reduce pressure in the total fuel system (each auxiliary fuel pump pressurizes a crossfeed line to the opposite fuel selector). If equipped, the emergency crossfeed shutoff should also be activated. The engine on the wing in which the fire exists should be shut down and its fuel selector positioned to OFF even though the fire may not have originated in the fuel system. The cabin heater draws fuel from the crossfeed system on some airplanes, and should be turned off as well. The engine compartment fire extinguisher should be discharged if the airplane is so equipped.

An open foul weather window or emergency exit may produce a low pressure in the cabin. To avoid drawing the fire into the cabin area, the foul weather window, emergency exits, or any openable windows should be kept closed. This condition is aggravated on some models, with the landing gear and wing flaps extended. Therefore, it is recommended to lower the landing gear as late in the landing approach as possible. A no flap landing should also be attempted, if practical.

ELECTRICAL FIRES

The initial indication of an electrical fire is usually the distinct odor of burning insulation. Once an electrical fire is detected, the pilot should attempt to identify the effected circuit by checking circuit breakers, instruments, avionics, etc. If the affected circuit cannot be readily detected and flight conditions permit, the battery/master switch and alternator switch(es) should be turned OFF to remove the possible sources of the fire. If at night, ensure the availability of a flashlight before turning off electrical power. Then, close off ventilating air as much as practical to reduce the chances of a sustained fire. If an oxygen system is available in the airplane and no visible signs of flame are evident, occupants should use oxygen until smoke clears.

If electrical power is essential for the flight, an attempt may be made to identify and isolate the effected circuit by turning the Master Switch and other electrical (except magneto) switches off and checking the condition of the circuit breakers to identify the affected circuit. If the circuit can be readily identified, leave it deactivated and restore power to the other circuits. If the circuit cannot be readily identified, turn the Master Switch on, and select switches that were on before the fire indication, one at a time, permitting some time to elapse after each switch is turned on, until the short circuit is identified. Make sure the fire is completely extinguished before opening vents. Land as soon as possible for repairs.

CABIN FIRES

Fire or smoke in the cabin should be controlled by identifying and shutting down the affected system, which is most likely to be electrical in nature, and landing as soon as possible. Smoke may be removed by opening the cabin air controls. However, if the smoke increases in intensity when the air controls are opened, they should be closed as this indicates a possible fire in the heating system, nose compartment baggage area, or that the increase in airflow is aggravating this condition.

In pressurized airplanes, the pressurization air system will remove smoke from the cabin. However, if the smoke is intense, it may be necessary to either depressurize at altitude, if oxygen is available for all occupants, or execute an emergency descent to 10,000 feet, terrain permitting. "Ram Air Dump" handle may be pulled to aid the clearing of smoke from the cabin.

The pilot may choose to expel the smoke through the foul weather window(s). The foul weather window(s) should be closed immediately if the fire becomes more intense when the window(s) are opened. If smoke is severe, and there are no visible signs of flame, use oxygen masks (if installed) and begin an immediate descent.

If a fire extinguisher is used, ventilate the cabin promptly after extinguishing the fire to reduce the gases produced by thermal decomposition. If the fire cannot be extinguished immediately, land as soon as possible.

IN-FLIGHT OPENING OF DOORS

The occurrence of an inadvertent door opening is not as great of a concern to the safety of the flight, as the pilot's reaction to the opening. If the pilot is overly distracted, loss of airplane control may result even though disruption of airflow by the door is minimal. While the shock of a sudden loud noise and increase in sustained noise level may be surprising, mental preparation for this event and a plan of action can eliminate inappropriate pilot reaction.

INADVERTENT OPENING OF BAGGAGE/CARGO DOORS

The flight characteristics of an airplane will not normally be affected by an open baggage or cargo door. The aerodynamic effects on an open door can vary, depending on the location of the door on the airplane and the method used to hinge the door in relation to the slipstream. Baggage/cargo doors mounted on the side of the aft fuselage and hinged at the front will tend to stay in a nearly closed position at most airspeeds and pose no special problems as long as the airplane is not in uncoordinated flight in a direction which would permit unsecured baggage to fall out of the airplane. Because of the door location and the presence of baggage in the immediate area, the door may not be accessible for closing in flight. Passengers, especially children, should never be allowed to occupy the baggage portion of the cabin for the purpose of closing the door in flight. The pilot should slow the airplane to minimize buffeting of the door and land as soon as practical.

Top hinged baggage/cargo doors will react differently than front hinged doors if improperly latched before takeoff. Doors of this type, may pop open at rotation because of the increase in angle of attack and the slipstream pushing underneath the edge of the unsecured door. After the initial opening, a baggage door will generally tend to stay open and then may gently close as speed is reduced and the aircraft is configured for landing (the doors will probably tend to open again during flair). A top hinged door on the side of the aft fuselage of a high wing airplane can sometimes be moved to a nearly closed position by lowering the wing flaps full down (within approved airspeed limitations) so that wing downwash will act upon the door. Unlatched nose baggage doors and large cargo doors on the side of the aft fuselage cannot be closed in flight and a landing should be made as soon as practical. The pilot should avoid any abrupt airplane maneuvers in multi-engine airplanes with an open nose baggage door, as this could throw loose objects out of the baggage compartment and into the propeller.

Front hinged wing locker doors in the aft part of the engine nacelle of multi-engine airplanes will likely trail open a few inches if they become unlatched. Near stall speed just prior to landing, an unlatched door may momentarily float to a full open position.

If a door comes open on takeoff and sufficient runway remains for a safe abort, the airplane should be stopped. If the decision is made to continue the takeoff, maintain required airspeed and return for landing as soon as practical.

INADVERTENT OPENING OF CABIN/EMERGENCY EXIT DOORS (UNPRESSURIZED)

If a cabin or emergency exit door should inadvertently open during unpressurized flight, the primary concern should be directed toward maintaining control of the airplane. Then, if a determination is made to close the door in flight, establish a safe altitude, trim the airplane at a reduced airspeed, and attempt to close the door. To facilitate closing the door, slide the adjacent seat aft slightly to obtain a better grasp of the door handle. The door handle must be in the close position prior to pulling the door closed, followed by rotating the handle to the locked position. Under no circumstances should the pilot leave his/her seat, or unfasten the restraint system to secure a door.

If a cabin door reopens when latched closed, the flight should be terminated as soon as practical and repairs made.

INADVERTENT OPENING OF CABIN/EMERGENCY EXIT DOORS (PRESSURIZED)

An inadvertent opening of a cabin/emergency exit door while the cabin is pressurized and the aircraft is above 12,500 feet, will require the use of supplemental oxygen or an emergency descent to an altitude below 12,500 feet. The pilot may attempt to close the door after ensuring that all occupants are using supplemental oxygen or the cabin altitude is below 10,000 feet. However, the primary concern should be maintaining control of the airplane. The flight should be terminated as soon as practical and the cause of the door opening determined before pressurized flight is continued. Under no circumstances should the pilot leave his/her seat, or unfasten the restraint system to secure a door.

MAINTENANCE

Airplanes require inspection and maintenance on a regular basis as outlined in the operating handbook, service/maintenance manuals, other servicing publications, and in Federal Aviation Regulations. A good visual inspection is a continuing maintenance procedure and should be performed by anyone who is involved with an airplane. This includes pilots, line personnel, and the maintenance department. When worn or damaged parts are discovered, it is essential that the defective parts be repaired or replaced to assure all systems remain operational. The source of information for proper maintenance is the airplane Service/Maintenance Manual and Service Letters or Service Bulletins. Cessna's Service/Maintenance Manuals are occasionally revised. Maintenance personnel should follow the recommendations in the latest revision. The owner/operator must ensure that all unacceptable conditions are corrected and the airplane receives repetitive and required inspections.

UNAUTHORIZED REPAIRS/MODIFICATIONS

All repair facilities and personnel should follow established repair procedures. Cessna does not support modifications to Cessna airplanes, whether by Supplemental Type Certificate or otherwise, unless those modifications are approved by Cessna. Such modifications may void any and all warranties on the airplane, since Cessna may not know the full effects on the overall airplane. Cessna has not tested and approved all such modifications by other companies. Operating procedures and performance data specified in the operating handbook and maintenance procedures specified in the service/Maintenance Manual may no longer be accurate for the modified airplane. Operating procedures, maintenance procedures and performance data that are effected by modifications not approved by Cessna should be obtained from the STC owner.

AIRWORTHINESS OF OLDER AIRPLANES

For an airplane to remain airworthy and safe to operate, it should be operated in accordance with Cessna recommendations and cared for with sound inspection and maintenance practices.

An aging airplane needs more care and attention during maintenance processes and may require more frequent inspection of structural components for damage due to the effects of wear, deterioration, fatigue, environmental exposure, and accidental damage. Typical areas requiring more frequent inspection are:

1. Wing attach points and fuselage carry-through structure.
2. Wing spar capstrips, especially the lower ones.
3. Horizontal and vertical stabilizer attach points and spar structure.
4. Control surface structure and attach points.
5. Engine mounts, beams, and cowlings.
6. Landing gear structure and attach points.
7. Structural and flooring integrity of seat and equipment attachments.
8. Pressurized structures, especially around all doors, windows, windshields and other cutouts on pressurized airplanes.
9. Exhaust and cabin heater systems.

The final responsibility for airplane care rests with the owner/operator. All airplane owners/operators should use the following steps as a minimum guideline to ensure continued airworthiness of their airplanes:

1. Always follow recommended maintenance and inspection procedures.
2. Recognize that corrosion, overloading, or damage to structure can drastically shorten fatigue life.
3. Comply with all applicable Service Bulletins, Service Letters, and FAA Airworthiness Directives.
4. Use one of Cessna's Progressive Care Inspection and maintenance programs to get the maximum utilization of your airplane at a minimum cost and downtime.

CORROSION

Corrosion can cause structural failure if left unchecked. The appearance of the corrosion varies with the metal. On aluminum and magnesium, it appears as surface pitting and etching, often combined with a grey or white powdery deposit. On copper and copper alloys the corrosion forms a greenish oxide and on steel, a reddish rust. When grey, white, green or red deposits are removed, each of the surfaces may appear etched and pitted, depending upon the length of exposure and severity of the attack. If the damage is not too deep, it may not significantly alter the strength of the metal. However, the pits may become sites for crack development. Some types of corrosion can travel beneath surface coatings and spread until the part fails.

Remove corrosion as soon as possible because it attacks and holds moisture in contact with the metal, which causes more corrosion to form. Every visible trace must be removed by some mechanical or chemical means. The surface must then be chemically treated to form a film which prevents oxygen or moisture from contacting the surface. Then, the protective surface (paint) must be restored.

There are several different types of corrosion and different ways of detecting it in its early stages. Uniform surface corrosion is the most common type of corrosion. When an area of unprotected metal is exposed to the atmosphere, there will be a uniform attack over the entire unprotected area. On a polished surface, this type of corrosion is first seen as a general dulling of the surface. If the corrosion is allowed to continue, the surface becomes rough and possibly frosted in appearance.

If surface corrosion is allowed to go untreated, it can progress into the next type of corrosion, called pitting. Pits form in localized areas and appear as white or grey powdery deposits. Metal is converted to salts, and when deposits are cleaned away, tiny pits or holes can be seen on the surface. If allowed to continue, pitting can progress completely through the metal in extreme cases.

Stress corrosion cracking is caused by the simultaneous effects of tensile stress and corrosion. Stress may be either internal or applied. Residual stress from the processes of heat treatment and forming, or sustained operating or static loads, can lead to stress corrosion.

Fretting corrosion is corrosion damage between close fitting parts which are allowed to rub together. It is the corrosive attack on one or both metals because of chafing under a load. The results of fretting are removal or pitting of the metal in the area of contact, galling, seizing, cracking or fatigue of the metal, loss of tolerance in accurately fitted parts, and loosening of bolted or clamped surfaces.

Corrosion is a universal problem that costs considerable amounts of time and money. It is essential that each airplane owner maintain his or her airplane based on the operating conditions, environment, and service experience. Corrosion can be effectively prevented and/or controlled if appropriate action is taken early.

SEAT AND RESTRAINT SYSTEMS

ADJUSTABLE SEAT ASSEMBLIES

Most Cessna manually-adjustable seats are suspended on two parallel, cabin floor mounted seat tracks by roller assemblies which allow the seat to move forward and rearward along the tracks. A series of holes are provided, usually in the forward end of either or both seat tracks, to accommodate a mechanical locking pin(s) which allows intermediate positioning and locking of the seat. To prevent the seat from disengaging from the seat tracks when reaching the ends, a mechanical seat stop is installed near both ends of the track(s).

Incidents of manually-adjustable seats slipping rearward or forward during acceleration or deceleration of the airplane have been reported. The investigations following these incidents have revealed discrepancies such as gouged lockpin holes, bent lockpins, excessive clearance between seat rollers and tracks, and missing seat stops, to name a few. Also, dust, dirt, and debris accumulations on seat tracks and in the intermediate adjustment holes have been found to contribute to the problem. A close check of each seat during daily preflight, improved cabin cleanliness, and replacement of parts when necessary will help prevent accidents involving seats. Visual checks of the airplane should always include the cabin interior.

When inspections are made, examination of the following items is recommended:

1. Check the seat assembly for structural integrity.
2. Inspect the roller assemblies for separation and wear.
3. Check the locking mechanism (actuating arm, linkage, locking pin or pins) for wear.
4. Check all seat track stops for security and proper installation.
5. Inspect seat tracks for condition and security, and the locking pin holes for wear, and dirt or debris accumulation.
6. Determine that the floor structure in the vicinity of the seat tracks is not cracked or distorted.
7. Ensure that the secondary seat stop addressed in mandatory Service Bulletin SEB89-32 is installed.

Damaged or worn parts are a potential hazard which should be immediately repaired or replaced. Cessna recommends repair and/or replacement of damaged components in accordance with the airplane's service or maintenance publications and Service Bulletins.

RESTRAINT SYSTEMS

While performing the cabin portion of the daily preflight, it is recommended that pilots check each restraint system installed in the airplane. This should include a functional check of the restraint belt locking and releasing mechanism. If new passengers or students are to be carried, it is a good practice to insist that they operate the restraint system to become familiar with the procedures.

During inspections, maintenance personnel should check each restraint system installation for serviceability in accordance with current publications applicable to the airplane. Special attention should be given to restraint attachment points and to the nylon bushing on the belt at the point where the shoulder restraint harness attaches. Undetected cracks or broken connections could cause a serious situation to develop when it is least expected. The restraint system webbing should be inspected for degradation. Repair or replace the restraint system per Cessna instructions if damage is detected.

EXHAUST AND FUEL SYSTEMS

THE ENGINE EXHAUST SYSTEM

The primary function of an engine exhaust system is to route exhaust gases safely overboard. Other functions of the exhaust system may include use as the driving source for a turbocharger turbine and/or use as a heat source for carburetor and/or cabin heat requirements.

Heat and carbon monoxide are the unavoidable byproducts of all reciprocating engine operations. The temperatures within the exhaust system of an engine can exceed 1750°F. Consequently, if an exhaust leak should occur, heat damage can occur to the engine mounting structure, and accessories such as hoses, belts, wire bundles, etc. In some cases, the position of the leak could lead to engine stoppage and/or an engine compartment fire.

An exhaust system leak can also lead to carbon monoxide poisoning. This colorless, odorless, tasteless combustion byproduct is always present in exhaust fumes. For this reason, special seals are provided wherever cables, hoses, wire bundles, etc. pass through the engine firewall. For even greater protection from carbon monoxide, special window, door, and fuselage seals are installed. No leakage of exhaust into the cabin should be tolerated.

Exhaust systems should be checked for stains indicative of exhaust leaks at cylinder heads or cracks in the exhaust or tailpipe. The condition and security of the exhaust system in the area of the exhaust muffler shroud should be checked. Any cracks or leaks in this area could be a source for exhaust to enter the cabin.

ENGINE COMPARTMENT TEMPERATURES

High engine compartment temperatures can degrade the operational efficiency of the engine and also accelerate the deterioration of engine components. Several conditions could cause or contribute to a higher than normal engine compartment temperature; however, improper operating techniques are found to be the most common cause. Avoid excessive operation of an engine on the ground. Prolonged ground operations should be done into the wind at rich mixture settings. If the cowling has been removed for maintenance, cooling airflow is poor and cylinder head temperature and oil temperature gages must be monitored during engine runups.

On virtually all air-cooled reciprocating engines, the engine and engine compartment are cooled by utilizing a pressure cooling baffle system with airflow as the cooling medium. The condition of these baffles and their seals is important.

Baffles should be secure and baffle seals should be positioned in a direction which would seal airflow around the engine baffles. Even a slight reduction in cooling efficiency can cause the engine to operate hotter than normal, thus increasing the potential for heat damaged components.

An inspection of the engine compartment, plus careful observation of the engine temperatures during normal flight, can be of great assistance in verifying the condition of the engine. If the pilot takes the time to record engine temperatures on a regular basis, trends within the engine can be detected early and corrected before a serious condition occurs.

HOSES AND WIRE HARNESS INTEGRITY

All fuel, oil, and hydraulic components should be checked for condition, security and any evidence of leakage. All leaks should be repaired before starting the engine.

As airplanes and engines age, there is a need to re-emphasize the inspection or replacement requirements of engine hoses or lines that carry fuel, oil, or hydraulic fluid. For newer Cessnas, a replacement requirement for hoses in the engine compartment (except teflon lined) has been established at each 5 years or at engine overhaul, whichever occurs first. This is considered to include “shelf” life. All hose manufactured for airplane use is marked indicating the quarter-year in which they were manufactured. For instance, a listing of “4Q85” means the hose was manufactured in the fourth quarter of 1985. Maintenance personnel should not use hoses with a high “shelf” life age.

Like time, heat is always a detriment to hoses. The prudent pilot realizes during the daily preflight, that an engine hose might look good, but if it is wiggled, a telltale “crackle” may be heard. This means that the hose is brittle and should be replaced. Also if he slides his hand over the back side of the hose, he may find an abrasion or wear not visible from the front side.

Ignition leads/wire harnesses and spark plugs are also affected by excessive heating in the engine compartment. Overheating of the spark plug barrels, sometimes caused by damaged cylinder baffles or missing cooling air blast tubes, may seriously deteriorate the ignition leads. Any overheating of a spark plug by a defective baffle or exhaust gas leak at the exhaust pipe mounting flange can generate temperatures sufficient to cause pre-ignition and piston distress.

RETRACTABLE LANDING GEAR

The adjustment and rigging of a retractable landing gear system should be done by trained maintenance personnel. Continued reliability of the landing gear system is only possible if it is properly maintained in the prescribed published manner. The rigging process must be performed exactly as published in the Cessna Service/Maintenance Manual and Service Bulletins. For complete emergency procedures concerning landing gear extension, refer to the airplane operating handbook.

PRESSURIZED AIRPLANES

DOOR SECURITY

The conventional and air-stair doors on pressurized airplanes have a series of pins, actuated by an overcenter locking handle, to maintain the door seal during the pressurization cycle. Some air-stair doors are sealed by pressurization air pressing against the cabin door windlace which covers the door gap. Door security can be verified by visually checking the locking indicator for the door handle safety lock, in the case of single-engine airplanes, and checking for correct locking indications provided in the door of multi-engine airplanes. It is recommended that pilots check the locking pins and door seals for cracks or damage during each preflight. Any damaged parts should be repaired prior to pressurized flight.

WINDOWS AND WINDSHIELDS

The windows in pressurized airplanes are exposed to a fatigue cycle each time the airplane is pressurized. These cycles could lead to fatigue cracks in and around the windows. Windows should be inspected frequently for condition and serviceability. Windows or windshields having replacement life limits should be replaced prior to intervals defined in applicable service/maintenance manuals.

The windows and windshields on pressurized airplanes are particularly sensitive to crazing and scratches. Any crazing, cracks, or deep scratches cannot be tolerated for pressurized flight. Consult the airplane's operating manual when in doubt about the severity of the damage. Repairs should be completed prior to pressurized flight.

THE PRESSURE VESSEL

There are significant structural differences between the fuselage of a non-pressurized airplane and one which is pressurized. The pressure vessel is the portion of the cabin area to be pressurized. Pressure differential is the difference between the atmospheric pressure at the altitude at which the airplane is flying and the pressure inside the cabin.

Any seam, joint, or hole where wire bundles or tubing pass through the pressure vessel must be sealed to maintain the selected pressurization. If any of these seals are deteriorated or missing, the normal cabin pressure differential may be impossible to attain. Maintenance personnel should inspect the pressure seals for serviceability. Any cracks in the skin of the pressure vessel could lead to sudden depressurization. Maintenance personnel should carefully inspect the pressure vessel for cracks, corrosion, and deterioration. Any damage should be corrected before pressurized flight.

If the airplane cabin is pressurized and it becomes necessary to use the heated alternate induction air on both engines, the pressurization controls must be selected OFF to preventing nacelle fumes from entering the cabin. The cabin should be depressurized and maximum ventilation provided. Therefore, if the flight altitude is above 10,000 feet, all occupants should use oxygen, if available, or descent should be initiated.

POTENTIAL HAZARDS

PROPELLERS

WARNING

ALWAYS STAND CLEAR OF PROPELLER BLADE PATHS, ESPECIALLY WHEN MOVING THE PROPELLER. PARTICULAR CAUTION SHOULD BE PRACTICED AROUND WARM ENGINES.

Review of propeller accidents indicates that most were preventable. A propeller under power, even at slow idling speed, has sufficient force to inflict fatal injuries. Pilots can be most effective in ensuring that passengers arrive and depart the vicinity of the airplane safely by stopping the engine(s) during loading and unloading.

Cessna airplanes are delivered with propellers using paint schemes to increase visibility of the blades. Owners should maintain the original paint scheme.

Pilots and Service personnel should develop the following safety habits:

1. Before moving a propeller or connecting an external power source to an airplane, be sure that the airplane is chocked, ignition switches are in the OFF position, throttle is closed, mixture is in IDLE CUT-OFF position, and all equipment and personnel are clear of the propeller. Failed diodes in airplane electrical systems have caused starters to engage when external power was applied regardless of the switch position.
2. When removing an external power source from an airplane, keep the equipment and yourself clear of the propeller.
3. Pilots should make certain that all personnel are clear of the propeller, prior to engine start.
4. Attach pull ropes to wheel chocks located close to a rotating propeller(s).
5. Before removing the wheel chocks, the pilot should hold brakes or apply the parking brake.
6. Be absolutely sure that all equipment and personnel are clear of the airplane before releasing the brakes.
7. Ground personnel should be given recurrent propeller safety training to keep them alert to the dangers of working around airplanes.

The pilot should carefully inspect the propeller during each preflight inspection. Some constant speed propellers manufactured by McCauley are subject to a requirement that they be filled with a red-dyed oil. This oil helps lubricate and prevent corrosion of internal propeller parts and may assist in detection of cracks. If a crack is detected, the airplane should not be flown until the propeller is replaced.

AIR CONDITIONING FREON

The refrigerant R- 12 (FREON) is relatively safe to handle when using proper protective safety equipment. Since at sea level the boiling point of R- 12 is -21.6°F, any contact with bare skin will immediately burn (freeze) the area. If R-12 should contact your eye, it will burn and can cause permanent blindness. Treat spills or splashes on your body by washing with clean, cool, water, and seek immediate medical attention. R-12, when heated to a high temperature such as with an open flame or spillage on a hot manifold, generates phosgene gas (a colorless gas with an unpleasant odor). This gas is a severe respiratory irritant and should be considered as a DEADLY POISON.

USED ENGINE OIL

Pilots and maintenance personnel who handle engine oil are advised to minimize skin contact with used oil, and promptly remove any used engine oil from their skin.

The following are some do's and don'ts concerning used engine oil:

1. Do follow work practices that minimize the amount of skin exposed, and the length of time used oil stays on the skin.
2. Do thoroughly wash used oil off skin as soon as possible.
3. Do wash oil-soaked clothing before wearing them again. Discard oil-soaked shoes.
4. Do use gloves made from material that oil cannot penetrate.
5. Don't use kerosene, gasoline, thinners, or solvents to remove used engine oil. These products can cause serious toxic effects.
7. Don't put oily rags in pockets, or tuck them under a belt. This can cause continuous skin contact.
8. Don't pour used engine oil on the ground, or down drains and sewers. This is a violation of Federal Law. The Environmental Protection Agency (EPA) encourages collection of used engine oil at collection points in compliance with appropriate state and local ordinances.

AVIATION FUEL ADDITIVE

Ethylene glycol monomethyl ether (EGME), which is a primary ingredient in aviation fuel additives, is toxic. It creates a dangerous health hazard when breathed or absorbed into the skin. When inhaled, EGME is primarily a central nervous system depressant, and acute inhalation overexposure may cause kidney injury. The primary symptoms of inhalation overexposure include headache, drowsiness, blurred vision, weakness, lack of coordination, tremor, unconsciousness, and even death. EGME is irritating to the eyes and skin and can be readily absorbed through the skin in toxic amounts. Symptoms of overexposure due to skin absorption are essentially the same as those outlined for inhalation.

When servicing fuel with an anti-ice additive containing EGME, follow the manufacturers instructions and use appropriate personal protective equipment. These items would include chemical safety goggles or shield, respirator with organic vapor cartridges, nonabsorbing neoprene rubber gloves and an apron and long-sleeved shirt as additional skin protection from spraying or splashing anti-ice additive.

In the event EGME contact is experienced, the following emergency and first aid procedures should be used.

1. If EGME is inhaled, remove person to fresh air. If breathing is difficult, administer oxygen. If the person is not breathing give artificial respiration. Always call a physician.
2. If eye or skin contact is experienced, flush with plenty of water (use soap and water for skin) for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Thoroughly wash contaminated clothing and shoes before reuse.
3. If ingested, drink large quantities of water and induce vomiting by placing a finger far back in throat. Contact a physician immediately. If vomiting cannot be induced, or if victim is unconscious or in convulsions, take immediately to a hospital or physician. Do not induce vomiting or give anything by mouth to an unconscious person.

Diethylene glycol monomethyl ether (DIEGME), a fuel anti-icing additive approved for use in some airplanes, is slightly toxic if swallowed and may cause eye redness, swelling and irritation. DIEGME also is combustible. Before using DIEGME, refer to all safety information on the container.

BIRDS, INSECTS, AND RODENTS

Bird, insect, and mouse nests in airplanes are both hazardous and costly. They seem to find even the smallest opening on an airplane to make their nests. Evidence of nest building activities may include the following:

1. Any mud smears or droplets at pitot/static masts, fuel tank vents, crankcase breathers, stall warning vanes, cabin air vents, and any fluid drain holes are indications of mud dauber wasp activities.
2. Straw, string, or blades of grass extending from cowling openings, carburetor air intakes, blast tubes, or exhaust stacks are signs of birds at work.
3. Cotton batting, shreds of fabric, and/or paper at wheel wells and empennage openings are frequently indicators that rodents such as

mice have been or may still be on board. They may gnaw on any material in the airplane including wire bundles and rubber or plastic tubing.

If nests or building materials are found on the airplane, they must be removed before flight. It is strongly recommended that a qualified mechanic thoroughly inspect components such as pitot/static systems for remains of any nesting material after its removal and before flight to ensure complete removal. Even small amounts of foreign material can result in significant problems in flight.

Some precautions can be taken to prevent problems. Always use the pitot tube cover and any other external covers when the airplane is being stored. If the airplane is hangared, make sure the hangar is kept clean and neat to prevent insects and mice from lodging in the hanger in the first place. If need be, set traps for rodents and/or spray the area for insects. Models of predators that appear life-like such as owls or snakes may also be effective at preventing some birds from lodging in a hangar.

Removal of the nest of an insect, bird, or rodent does not prevent reconstruction elsewhere on the airplane or even in the same location again. Some creatures are not easily discouraged and may return to cause problems within a very short time period. Regardless of precautions used to prevent such problems, the pilot should be alert to the evidence of small animal activities during every preflight inspection.

FIRE EXTINGUISHER AGENTS

Halon, Bromochloromethane (CB), Carbon Dioxide (CO2), and dry chemical extinguishing agents are four of the most common types of fire extinguishing agents found in and around airplanes. Prolonged exposure (5 minutes or more) to any of these agents in a confined area could cause serious injury or even death. Pilots and ground personnel should become familiar with the precautions associated with each particular agent. Adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

The discharge of large amounts of carbon dioxide to extinguish a fire may create hazards to personnel such as oxygen deficiency and reduced visibility. The dilution of the oxygen in the air, by the carbon dioxide concentrations that will extinguish a fire, may create an atmosphere that will not sustain life. Personnel rendered unconscious under these conditions can usually be revived without any permanent ill effects when promptly removed from the adverse condition.

The discharge of large amounts of dry chemical agents may create hazards to personnel such as reduced visibility and temporary breathing difficulty. Where there is a possibility that personnel may be exposed to dry chemical agents, suitable safeguards should be provided to ensure prompt evacuation.

OXYGEN

Before servicing any airplane with oxygen, consult the specific airplane service/maintenance manual to determine the proper type of servicing equipment to be used. Airplanes should not be serviced with oxygen during refueling, defueling, or other maintenance work which could provide fuel and a source of ignition. Also, oxygen servicing of an airplane should be accomplished outside, not in hangars.

Oxygen is a very reactive material, combining with most of the chemical elements. The union of oxygen with another substance is known as oxidation. Extremely rapid or spontaneous oxidation is known as combustion. While oxygen is non-combustible in itself, it strongly and rapidly accelerates the combustion of all flammable materials; some to an explosive degree.

The following are some do's and don'ts when handling or using oxygen:

1. Do check that only "aviators breathing oxygen" is going into the airplane system.
2. Don't confuse aviators breathing oxygen with "hospital/medical" oxygen. (The latter is pure enough for breathing, but the moisture content is usually higher which could freeze and plug the lines and valves of an airplane oxygen system.)
3. Do reject any oxygen that has an abnormal odor (good oxygen is odorless).
4. Do follow the published applicable instructions regarding charging, purging, and maintenance of airplane oxygen systems.
5. Don't use oil or grease (including certain lipsticks and lip balms) around oxygen systems.
6. Don't expose oxygen containers to high temperatures.

COMPRESSED AIR

Compressed air is a mechanic's tool as versatile as electricity, and can be as deadly. The use of compressed air to blow dust or dirt from parts of the body or clothing is a dangerous practice. As little as 12 psi can dislocate an eyeball. Air can enter the navel through a layer of clothing and inflate and rupture the intestines. Compressed air has been known to strike a small wound on a person's hand and inflate the arm.

Never look into or point any compressed air apparatus toward any part of the body. Always wear prescribed personal protective equipment. Also, continuously check the condition of air tools and air hoses to make sure they do not show signs of damage or looseness. A loose hose carrying pressure is like a bullwhip and can cause serious injury to personnel and/or cause damage to surrounding equipment. If a situation such as this should occur, do not attempt to catch the hose end; shut off the air source first.

STATIC ELECTRICITY

Static electricity, by definition, is a negative or positive charge of electricity that an object accumulates, and creates a spark when the object comes near another object. Static electricity may accumulate on an airplane during flight or while it is on the ground, as long as air is flowing over its surfaces. Unless static electricity is carried away by ground wires, an explosion may be caused during any fueling operations.

Grounding an airplane is a good safety precaution because static electricity cannot be seen until it's too late. To properly ground an airplane, attach one end of a static ground wire to an unpainted point on the airplane and the other end to an approved grounding stake. Attaching the ground wire to the airplane first will ensure that any spark of static electricity will occur at the grounding stake and not at the airplane. Do not attach a ground wire to any antenna. Antennas are poor grounding attachment points because they are insulated from the airplane structure.

On some airplanes, wick-type static dischargers are installed to improve radio communications during flight through dust or various forms of precipitation (rain, snow or ice crystals). Under these conditions, the build-up and discharge of static electricity from the trailing edges of wings, rudder, elevator, and propeller tips can result in loss of usable radio signals on all communications and navigation radio equipment. Usually the ADF is first to be affected and VHF communication equipment is the last to be affected. Installation of static dischargers reduces interference from precipitation static, but it is possible to encounter severe precipitation static conditions which might cause the loss of radio signals, even with static dischargers installed.

Static dischargers lose their effectiveness with age, and therefore should be checked at every scheduled inspection by a qualified technician. If testing equipment is not available, it is recommended that the wicks be replaced every two years, especially if the airplane is operated frequently in IFR conditions.

ELT BATTERY AND GAS SPRING/DAMPER DISPOSAL

To prevent bodily injury, do not compact (compress) or incinerate an ELT battery-pack or gas spring/damper. The ELT battery pack should be discarded in accordance with local EPA standards.

A gas spring or gas damper contains an inert gas and oil under pressure, and reacts much like an aerosol can when compressed or heated; it may explode. Therefore, all unserviceable gas springs or dampers should be depressurized, using the maintenance manual instructions.

HEARING LOSS

Hearing loss due to overexposure to loud noise levels is a real possibility while working near operating airplane engines. Continuous exposure to excessive noise diminishes hearing acuity, with high frequency response failing first. If the overexposure continues, the middle frequencies, most important in conversation, are also lost. Earmuffs, some headset types, and earplugs are very useful to avoid hearing loss. By far, the earplug has proven to be the best protection overall. Limits have been established which relate sound level (dB) to exposure time. These limits are based on daily exposures for long intervals.

Sound Level (dB)	115	110	105	100
Maximum Time (min.)	15	30	60	120

WEATHER RADAR EXPOSURE

The dangers of exposure to airborne weather radar operated on the ground include the possibility of damage to low tolerance parts of the human body and ignition of combustible materials by radiated energy. Low tolerance parts of the body include the eyes and testes. Airborne weather radar should be operated on the ground only by qualified personnel. The radar should not be operated while the airplane is in a hangar or other enclosure unless the radar transmitter is disconnected, or the energy is directed toward an absorption shield which dissipates the radio frequency (RF) energy.

Personnel should never stand near or directly in front of a radar antenna which is transmitting. When the antenna is transmitting and scanning, personnel should not be allowed within 15 feet of the area being scanned by the antenna.

Personnel should not be allowed at the end of an open waveguide (hollow duct work through which electromagnetic waves are conducted to and from the antenna) unless the radar is off and will remain off. Radar should not be operated with an open waveguide unless a "dummy load" is connected to the portion which is connected to the transmitter. Personnel should not look into a waveguide, or the open end of a coaxial connector or line connected to a radar transmitter.

Weather radar installed on any airplane should not be operated while that airplane, or an adjacent airplane is being refueled or defueled.

NOTES